City of Richmond

Report to Committee

To:	Finance Committee	**Date:**	April 20, 2018
From:	Serena Lusk General Manager, Community Services	**File:**	06-2345-20-GCIT1/Vol 01
Re:	**Garden City Lands Project Importation Fees Revenues - Update**		

Staff Recommendation

1. That the Chief Administrative Officer and General Manager, Community Services be authorized to enter into soil deposit agreements with private contractors for placement of soil on the Garden City Lands (the "Lands") required for the development of the Lands, as detailed in the staff report (the "Report") titled "Garden City Lands Project Importation Fees Revenues - Update," dated April 20, 2018;

2. That all net revenues generated through tipping fees on the Lands be reinvested into the Lands to offset any future project related costs, as detailed in the Report; and

3. That staff be directed to continue implementing the soil enhancement plan, developed in consultation with the Agricultural Land Commission, for the imported soil establishing the farm at the Lands, as detailed in the Report.

Serena Lusk
General Manager, Community Services
(604-233-3344)

Att. 19

REPORT CONCURRENCE		
ROUTED TO:	**CONCURRENCE**	**CONCURRENCE OF GENERAL MANAGER**
Finance Department	☑	
Law	☑	
Community Bylaws	☑	
REVIEWED BY STAFF REPORT / AGENDA REVIEW SUBCOMMITTEE	**INITIALS:** DW	**APPROVED BY CAO**

Staff Report

Origin

At the July 18, 2016, General Purposes Committee meeting, Council received the staff report titled "Garden City Lands Park Development Plan," providing Council an update of future construction and development activities on the Garden City Lands ("Lands"). Since then, the first phases of the Park Development Plan have been implemented.

To fully realize the Park Development Plan and proceed with the proposed agricultural activities, soil of the appropriate environmental quality and physical characteristics is required to be imported onto the site. The Agricultural Land Commission (ALC) has approved the placement of fill on the site, and City soil deposit permits are in place. Significant quantities of soil were sourced from providers in Richmond. This activity has represented a significant revenue stream for the City.

In 2017, approximately 21,100 cubic metres (m^3) of soil was imported to create the 2.6 hectare first phase of the Farm which is leased to Kwantlen Polytechnic University (KPU), and approximately 9,900 m^3 was also imported to amend the existing soil on The Rise (the elevated landscape feature at the northwest corner of the Lands). Additionally, approximately 3,800 m^3 of peat was imported to enhance existing soils (Attachment 1).

In 2018, it is expected that approximately 26,000m^3 of soil will be imported to complete the Farm area. Beyond 2018, subject to ALC approval and the sourcing of appropriate material, additional soil will be required to facilitate future agricultural activities on the site. It is expected that revenue will be generated by these activities.

At the March 5, 2018, Finance Committee meeting, the "Garden City Lands Project Tipping Fees Revenues" Report was discussed. As a result, staff received the following referrals:

That the report be referred back to staff for more information on:

(1) the remediation program and soil program going forward; and

(2) the appropriate consultant to be used.

The purpose of this report is in response to the above referrals and provide additional background information.

This report supports Council's 2014-2018 Term Goal #3 A Well-Planned Community:

> *Adhere to effective planning and growth management practices to maintain and enhance the livability, sustainability and desirability of our City and its neighbourhoods, and to ensure the results match the intentions of our policies and bylaws.*
>
> *3.1. Growth and development that reflects the OCP, and related policies and bylaws.*

This report supports Council's 2014-2018 Term Goal #7 Strong Financial Stewardship:

> *Maintain the City's strong financial position through effective budget processes, the efficient and effective use of financial resources, and the prudent leveraging of economic and financial opportunities to increase current and long-term financial sustainability.*
>
> *7.2. Well-informed and sustainable financial decision making.*
>
> *7.4. Strategic financial opportunities are optimized.*

Analysis

Soil Importation

Rationale and Regulatory Framework

The Park Development Plan envisions the western half of the Lands for intensive agricultural production. The following two principle reasons for placing fill on the Lands are:

1. To mitigate the effects of the low level soil contamination found in the pre-existing soils. The project Qualified Environmental Professional (QEP), (Hemmera) has recommended placing additional soil to permit agricultural production on the site. The placement of 30 cm to 60 cm of uncontaminated soil will provide the recommended rooting volume for anticipated field crops to be grown; and

2. There is currently a layer of predominantly peat-based soils on the ground level on the Lands. Current best management practices in sustainable farming indicate farming peat soils is not recommended. KPU's agrologists have advised that actively farming the peat layer will accelerate the decomposition of the peat releasing the carbon currently sequestered by the peat. With the placement of soil over existing peat, the peat's decomposition process will be greatly diminished. This capping soil material will prevent the release of the peat's carbon.

Placing soil material over the existing soils on the Lands proceeded for the aforementioned reasons. Imported material placed on the Lands in 2017 was either:

1. Soil to establish the Farm as per ALC Decision 56199 (Attachment 2) or amend the soil in place on The Rise; or

2. Peat as a soil amendment (an ALC permitted agriculture-related activity; no ALC approval required).

Soil Placement Inspection

At the March 5, 2018 General Purposes Committee Meeting City staff stated that McTavish Resource and Management Consultants (McTavish) were engaged from the beginning of the soil placement activities on the Garden City Lands. In fact, soil was placed on The Rise in May and in June of 2017 and placement of the soil for the Farm commenced on June 26, 2017. McTavish

was not engaged until early July 2017 to provide soil management oversight; their first site visit to the Farm was on July 5, 2017.

McTavish has a longstanding working relationship with the City of Richmond, providing soil and agricultural technical support for all Non-Farm Use fill applications made to the City of Richmond since 2015. McTavish has been involved in the development of agricultural and drainage plans for high-profile projects such as the Mylora Lands and the Ling Yen Mountain Temple. As professional agrologists and soil scientists, McTavish is qualified to support the City's agricultural plans and activities and has an excellent reputation in the industry and extensive experience. McTavish has also been retained by the ALC to provide senior agrologist support on contentious projects and legal issues.

To ensure impartiality and quality of work, the City has requested that McTavish has a qualified, third party professional review their work prior to key submissions to the ALC.

Staff has confidence McTavish is able to provide professional, impartial and scientifically sound consulting services, appropriate for this complex project.

Soil Management

The soil imported to the Lands in 2017 was sourced from Richmond locations only. Soil placed at the Farm and The Rise was sourced from Sea Island (YVR- Vancouver Airport Authority projects) and peat imported for soil amendment was provided by a local contractor working on several properties located in the ALR. A process which included documentation and testing was undertaken prior to soil importation. However, soil quality concerns were raised by the ALC shortly after placement. Subsequent communication and discussions resulted in a soil amendment plan which has been approved by the ALC and will be implemented this spring.

Moving forward, soil conforming to the specifications and protocols documented in the Source Soil Management letter, dated December 17, 2017 (Attachment 3), will be placed on the Lands. Soil for the Lands would be sourced from approved development projects, including single- and multi-family residential properties. Viable source sites would be primarily located in Richmond but may also include the UBC Endowment Lands, Delta, and Surrey.

Owners or contractors of the source soil will be required to provide documentation, including a Phase 1 Environmental Assessment to evaluate soil suitability. Prior to the soil being imported, there will also be further analytical testing of imported soils to ensure that the ALC Guidelines for soil and the BC Contaminated Sites Regulation (BC CSR) – Schedule 3.1, Column 4 standards for Agricultural Lands are met and soil source site(s) will be inspected to confirm the absence of invasive species prior to importation of soil onto the Lands.

Attachment 4 includes a timeline and supporting documentation, outlining key milestones during the process of importing soil to the Lands to establish the Farm.

Soil Amendment Plan

In spring, 2018, the City will amend the current imported soil at the Farm site. This plan was developed in consultation with McTavish and approved by the ALC (Attachment 17). The materials to be imported are:

- Premium Class A Compost;
- Imported Peat (screened on site); and
- Chicken Manure from a Certified Organic source.

Once placed onto the soil, these enhancements will be tilled into the soil. The result will be a positive impact on the soil's organic matter content and nutrient composition. Once completed, the soil will be tested and the results will be shared with the ALC.

A soil percolation test was conducted on the existing Farm soil on March 20, 2018 (Attachment 19). The soil's infiltration rate was characterized as "moderately-rapid". This result is consistent with rates for sandy-loam soil types which is the predominant soil type on the Farm site. The infiltration rate is expected to improve with the addition of the aforementioned soil amendments.

The City is confident that with the implementation of the Soil Amendment Plan, the amended soil placed on the Farm site will fully meet the standard for "good" soil (Attachment 10 and 18). The approximate cost to implement the Soil Amendment Plan is $75,000.

KPU will begin farming the soil upon receiving the lab results for the soil's improved qualities. The soil's improved quality will be maintained by KPU's sustainable farming best management practices, including the ongoing addition of compost, manure, and planting cover crops.

Soil Revenue

Locations for the placement of soil (or 'fill sites') are in demand within the region by the construction and development industry. A typical fill site operator charges a tipping fee (charged on a per dump truck or cubic metre basis) to deposit soil at a site. The Lands are a desirable soil deposit site. Suppliers are required to meet the City's specific technical requirements, the conditions of the ALC approval to place soil, and to pay the proposed rates. Additionally, these best management practices will be followed:

- The City charges a tipping fee to ensure compliance with the Community Charter's provisions on not providing assistance to a business; and
- City staff consults with industry representatives to ensure the fees reflect current market rates and are within an acceptable range.

Rates are reviewed every six (6) months. The City charged the following rates in 2017 on a per load basis:

1. Soil:
    - $100 per Tandem Dump Truck (approx. vol.: 7 cubic metre); and
    - $125 per Tri-Tandem Dump Truck (approx. vol.: 12 cubic metres).
2. Peat:
    - $85 per Tandem Dump Truck.

The tipping fees collected by the City in 2017 were determined by assessing the current market rates at that time through discussions with contractors who specialize in fill deposit projects. Tipping fees may fluctuate year-to-year, and as such, City staff will consult with industry representatives throughout the Lower Mainland and Fraser Valley to ensure the fees collected reflect current market rates, within an acceptable range.

Rates were last reviewed in February 2018. Based on this review, tipping fees rates are anticipated to increase. Staff will ensure contracts include a provision, allowing for an annual adjustment, if required.

Next Steps

To fully realize the site's entire agricultural capacity and address the recommendations of the QEP, significant volumes of soil will need to be imported onto the Lands (Attachment 1). The remaining areas requiring soil are:

1. The Farm: 5.4 hectares; and
2. The "South Farm": 9.5 hectares.

As a soil deposit site, the Lands project generated in excess of $450,000 in revenues from the importation of soil in 2017. Anticipated revenues from the proposed 2018 fill activities on the Farm site could be in the range of $350,000 to $450,000. The potential gross revenues from the proposed activity on the southern half of the Lands could be in the range of $900,000 to $1,200,000. Soil placement for the southern portion of the Lands would only be able to proceed once ALC approval is secured.

Future revenue could be utilized to offset future project-related costs not eligible under the Development Cost Charge (DCC) program. With Council's direction, staff request that all net revenue generated through activities at the Lands be reinvested back into the Garden City Lands project to fund non-DCC eligible works including parking lots and farm-related structures such as a barn.

If required, revenue could also be utilized to purchase the top soil and soil amendments for the Farm fields. The estimated cost to purchase top soil to establish the remaining 5.4 hectare Farm from commercial soil operators is approximately between $650,000 to $970,000.

Financial Impact

Net revenue generated at the Lands will be used to support future Lands capital projects which will be included in the annual budget process.

Conclusion

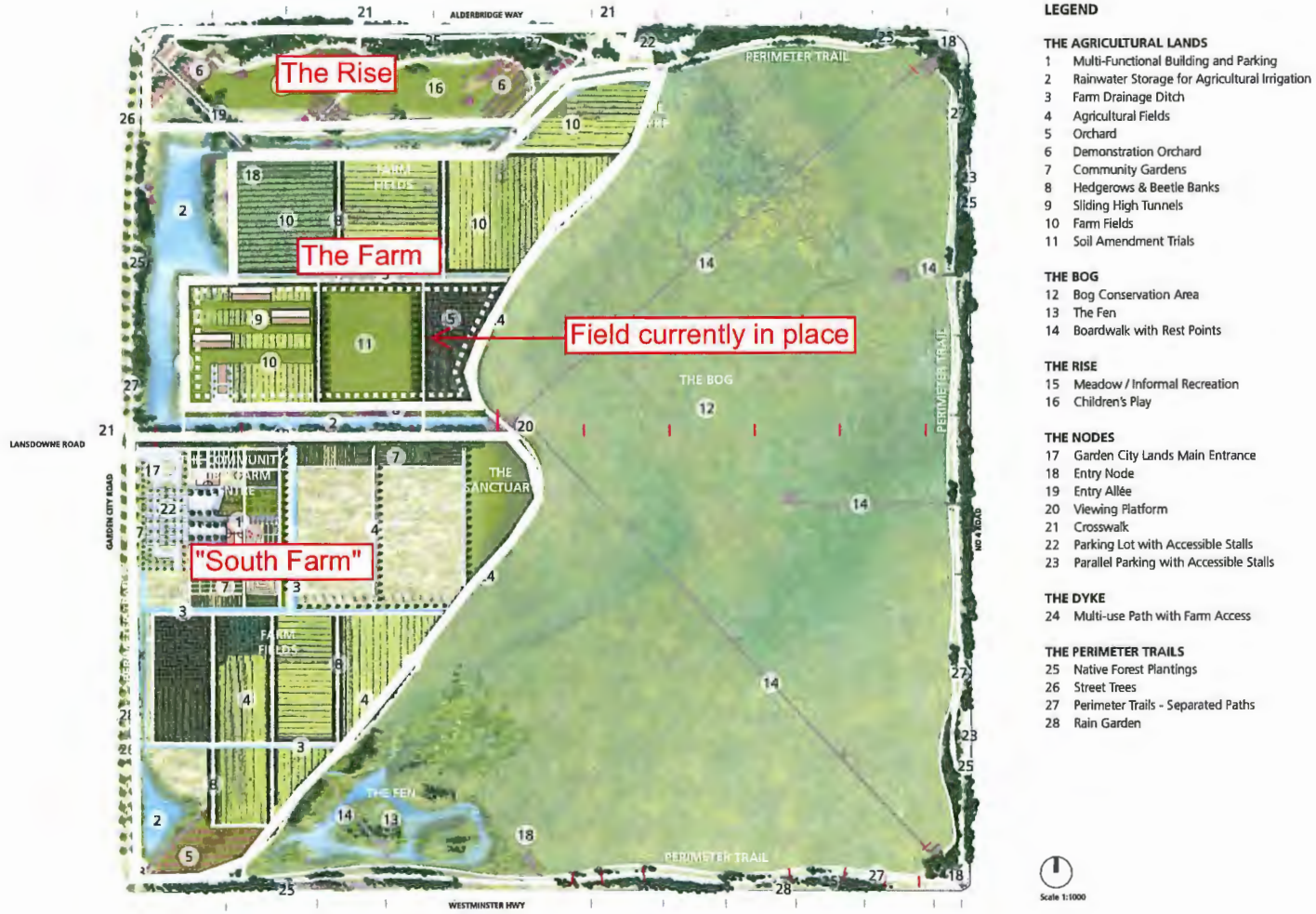
With the importation of soil, the Lands will generate significant alternative revenues for the City. Revenues could be utilized to offset non-DCC eligible works, as well as the importation of top soil and other soil amendments for the Farm. With Council's direction, staff will contract suppliers to facilitate the supply of soil to establish areas for future agriculture production. Whenever possible, staff will endeavor to source Richmond soil for use on the Lands.

Alexander Kurnicki
Research Planner 2
(604-276-4099)

Att. 1: Garden City Lands Soil Fill Areas Plan
Att. 2: ALC Letter re: Application to Conduct a Non-Farm Use in the Agricultural Land Reserve (ALR), dated June 12, 2017
Att. 3: McTavish Letter re: Source Soil Management, dated December 19, 2017
Att. 4: Timeline of Key Milestone for Soil Placement Activities on the Garden City Lands
Att. 5: Report to Parks, Recreation & Cultural Services Committee: Garden City Lands April 2017 Update
Att. 6: McTavish Report re: Fill Site Inspections for ALC Approval 56199 - Garden City Lands, dated July 12, 2017
Att. 7: McTavish Report re: Phase 1 Closure Report ALC Approval 56199 – GCL Richmond, dated July 18, 2017
Att. 8: ALC Letter re: Authorization to Proceed To Phase 2, dated July 20, 2017
Att. 9: McTavish Report re: Fill Site Inspections for ALC Approval 56199 – Garden City Lands, Phase 2, dated August 10, 2017
Att. 10: ACL Email Correspondence with City of Richmond re: ALC File 56199: Garden City Lands Inspection August 9, dated August 29, 2017
Att. 11: McTavish Report re: Soil Quality Investigation Garden City Lands, Richmond BC ALC Approval #56199, dated September 15, 2017
Att. 12: McTavish Letter re: Organic Matter Volume Calculations for Garden City, dated September 19, 2017
Att. 13: KPU Report re: Potential to Reduce Greenhouse Gas Emissions Associated with Conversion of Garden City Lands Peatland to Farmland
Att. 14: KPU Letter re: Garden City Lands Soil, to City of Richmond Parks, Recreation and Cultural Services Committee, dated September 27, 2017

Att. 15: McTavish Letter re: Garden City Lands Fill Project ALC Request, dated October 11, 2017
Att. 16: ALC Email Correspondence with City of Richmond re: 56199 Garden City Lands Fill Project - Moving Forward, dated October 12, 2017
Att. 17: McTavish Memo Re: Source Soil Management, dated March 12, 2018
Att. 18: McTavish Letter re: Garden City Lands Spring Soil Management Plan, dated December 19, 2017
Att. 19: McTavish Report re: Percolation Testing Garden City Farm Development Richmond BC, dated March 25, 2018

Garden City Lands Soil Fill Areas Plan



Garden City Lands: Park Development Plan

Agricultural Land Commission
133 – 4940 Canada Way
Burnaby, British Columbia V5G 4K6
Tel: 604 660-7000
Fax: 604 660-7033
www.alc.gov.bc.ca

June 12, 2017

ALC File: 56199
Your File: 06-2345-20-GCITI/Vol 01

City of Richmond
5599 Lynas Lane
Richmond, BC V7C 5B2

Attn: Alex Kurnicki

Re: Application to Conduct a Non-Farm Use in the Agricultural Land Reserve (ALR)

Please find attached the Reasons for Decision of the South Coast Panel (Resolution #158/2017) as it relates to the above noted application. A sketch plan depicting the decision is also attached. As agent, it is your responsibility to notify the applicant accordingly.

Reconsideration of a Decision as Directed by the ALC Chair

Please note that pursuant to s. 33.1 of the *Agricultural Land Commission Act*, the Chair may direct the Executive Committee to reconsider any panel decision if, within 60 days from the date of this decision, he considers that the decision may not fulfill the purposes of the commission as set out in s. 6, or does not adequately take into consideration s. 4.3.

You will be notified in writing if the Executive Committee is directed to reconsider your decision. The Commission advises you to take this 60 day period into consideration prior to proceeding with any actions upon this decision.

Reconsideration of a Decision by an Affected Person

We draw your attention to s. 33(1) of the *Agricultural Land Commission Act* which provides a person affected the opportunity to submit a request for reconsideration.

33(1) On the written request of a person affected or on the commission's own initiative, the commission may reconsider a decision of the commission under this Act and may confirm, reverse or vary it if the commission determines that:

(a) evidence not available at the time of the original decision has become available,
(b) all or part of the original decision was based on evidence that was in error or was false.

For further clarity, s. 33.1and s. 33(1) are separate and independent sections of the *Agricultural Land Commission Act*.

Further correspondence with respect to this application is to be directed to Shawna Wilson at (Shawna.Mary.Wilson@gov.bc.ca).

Yours truly,

PROVINCIAL AGRICULTURAL LAND COMMISSION

Shawna Wilson

Shawna Wilson, Land Use Planner

Enclosures: Reasons for Decision (Resolution #158/2017)
Sketch Plan
Schedule A - Quality Control Procedure for Garden City Lands Soil Import

56199d1

AGRICULTURAL LAND COMMISSION FILE 56199

REASONS FOR DECISION OF THE SOUTH COAST PANEL

Application submitted pursuant to s. 20(3) of the *Agricultural Land Commission Act*

Applicant:	**City of Richmond** **(the "Applicant")**
Agent:	**Alex Kurnicki** **(the "Agent")**
Application before the South Coast Regional Panel:	**William Zylmans, Panel Chair** **Sam Wind** **Satwinder Bains**

THE APPLICATION

[1] The legal description of the properties involved in the application are:

Property 1
Parcel Identifier: 024-741-418
Section 3 Block 4 North Range 6 West New Westminster District Except: Firstly: Plan with Fee 5758F, Secondly: Plan with Fee 5759F, Thirdly: Part Subdivided by Plan 24067, Fourthly: Parcel D (Bylaw Plan 50488), Fifthly: Part Dedicated Road on Plan LMP43167, Sixthly: 1.84 Acres Filing 16918, Seventhly: Parcel F (Bylaw Plan LMP24326), Eighthly: Parcel C (Bylaw Plan 73626)
Area: 55.2 ha
Civic Address: 5555 No. 4 Road, Richmond, BC

Property 2
Parcel Identifier: 009-299-564
Lot 1 Section 3 Block 4 North Range 6 West New Westminster District Plan 24067
Area: 3.3 ha in area (1.3 ha in the ALR)
Civic Address: 5040 Garden City Road, Richmond, BC

Property 3
Parcel Identifier: 003-682-285
Parcel "D" (Bylaw Plan 50488) Section 3 Block 4 North Range 6 West New Westminster District
Area: 0.9 ha
Civic Address: 9111 Westminster Hwy, Richmond, BC

(collectively the "Properties")

[2] The Properties are located within a designated agricultural land reserve ("ALR") as defined in s. 1 of the *Agricultural Land Commission Act* (the "*ALCA*").

[3] The Properties are located within Zone 1 as defined in s. 4.2 of the *ALCA*.

[4] Pursuant to s. 20(3) of the *ALCA*, the Applicants are applying to place 48,000 m^3 of fill over an 8 ha portion of the Properties for the purpose of establishing a farm to be operated by the Kwantlen Polytechnic University Sustainable Food Systems program (the "Proposal"). The Proposal along with supporting documentation is collectively the application (the "Application").

RELEVANT STATUTORY PROVISIONS

[5] The Application was made pursuant to s. 20(3) of the *ALCA*:

> 20(3) An owner of agricultural land or a person with a right of entry to agricultural land granted by any of the following may apply to the commission for permission for a non-farm use of agricultural land.

[6] The Panel considered the Application within the context of s. 6 of the *ALCA*. The purposes of the Agricultural Land Commission (the "Commission") set out in s. 6 are as follows:

> 6 The following are the purposes of the commission:
>
> (a) to preserve agricultural land;
> (b) to encourage farming on agricultural land in collaboration with other communities of interest; and
> (c) to encourage local governments, first nations, the government and its agents to enable and accommodate farm use of agricultural land and uses compatible with agriculture in their plans, bylaws and policies.

EVIDENTIARY RECORD BEFORE THE PANEL

[7] The Panel considered the following evidence:

1. The Application
2. Local government documents
3. Previous application history
4. ALR context map and satellite imagery
5. City of Richmond Garden City Lands Biophysical Inventory and Analysis report, prepared by Diamond Head Consulting Ltd, dated July 24, 2013 (the "Diamond Head Report")
6. Human Health and Ecological Risk Assessment, prepared by Hemmera Envirochem Inc., dated January 2017 (the "Hemmera Report").

All documentation noted above was disclosed to the Agent in advance of this decision.

[8] At its meeting of June 9, 2014, the City of Richmond resolved that the Garden City Lands Legacy Landscape Plan and staff report titled "Garden City Lands Legacy Landscape Plan," dated May 5, 2014, be endorsed.

[9] The Panel reviewed 6 previous applications involving the Properties:

Application ID: 22195 Legacy File: 15279 (Progressive Contracting, 1982)	To deposit 22,000 m3 of subsoil over portions of the Properties to construct a road. The Commission noted that deposition of any fill material would substantially reduce the agricultural potential of the property. The application was refused by Resolution #1616/1982.
Application ID: 35442 Legacy File: 14777 (Township of Richmond, 1982)	To develop a fill site on portions of the Properties. The Commission noted that deposition of fill on this area would substantially reduce its agricultural potential. The application was refused by Resolution #1336/1982.
Application ID: 40357 Legacy File: 19261 (Township of Richmond, 1985)	To establish and construct a road along the northern boundary of Property 1 and 2 to form a municipal connector road for the Annacis Island crossing. The

application was approved by ALC Resolution #756/1985.

Application ID: 21907
Legacy File: 22303
(F.W. Scales Trucking Ltd., 1988)

To deposit soil for the purposes of constructing a 2 m high berm along Alderbridge Road between Garden City Road and No. 4 Road on Property 2. The application was approved by ALC Resolution #570/1988.

Application ID: 42622
Legacy File: 36435
(Canada Lands Company, 2006)

To exclude Property 1 (55.2 ha) from the ALR to facilitate development of a trade and exhibition centre, urban residential and mixed-use development, and major City of Richmond park facilities. The Commission found that the proposal was inconsistent with the preservation of agricultural land and that a convincing community need argument had not been made that would justify the Commission considering the exclusion of prime agricultural land from the ALR. The application was refused by Resolution #431/2006.

Application ID: 44962
Legacy File: 38099
(City of Richmond, 2009)

To exclude Property 1 (55.2 ha) from the ALR. The Commission concluded that the property is comprised of lands with agricultural potential, that the property is suitable for agricultural use, and that the proposal was inconsistent with the objective of the *ALCA* to preserve agricultural land. The application was refused by Resolution #19/2009.

Application ID: 55588
(City of Richmond, 2017)

To construct and operate a non-farm use on the Properties comprising 1.9 ha of recreational trails for pedestrians and cyclists. The application was approved by Resolution #1/2017.

FINDINGS

[10] The Properties were not classified by the Canada Land Inventory or British Columbia Land Inventory; however, the Panel reviewed the Diamond Head Report which states the following with respect to agricultural capability:

> *Although the site was not previously included in the provincial agricultural capability mapping, interpolating these ratings is possible based on results from adjacent sites and previous assessments by the Agricultural Land Commission.*
>
> *Soils on site were assessed to be Organic Class 3 (O2 improved) and Organic Class 4 (O3 improved) based on limitations relating to acidity, drainage, and the presence of deep layers of organic matter. These ratings are in alignment with assessed ratings provided by the Agricultural Land Commission in 2009 [(reference Agricultural Land Commission, 2009. Exclusion application – Garden City Lands, ALC File #O-38099. Decision, February 12, 2009)].*

The Diamond Head Report reaffirms previous agricultural capability assessments by the ALC. The Panel finds that the Properties have prime agricultural capability and that they are appropriately designated within the ALR.

[11] The Application states that the 48,000 m^3 of proposed fill will be placed over 8 ha of the Properties to a maximum depth of 0.6 m. The estimated duration of the Proposal is 18 months and the Applicant intends to phase the placement of fill, starting with a 2 ha area which will be developed into a market garden. The Applicant submits that the Proposal will *"manage existing low-level contaminated sub-surface soils currently in place"* and that the proposed fill *"will establish a safe growing medium appropriate for food production"* as per the Hemmera Report. The Panel reviewed the Hemmera Report and finds that the establishment of a safe growing medium would assist with bringing the Properties into agricultural production.

[12] The Application outlines a Quality Control Procedure for the Proposal area that specifies monitoring and processing of the proposed fill, requirements as to sourcing, and soil texture requirements based on the hydrological characteristics of the Proposal site. The Panel finds that implementation of the Applicant's Quality Control Procedure as outlined would ensure that the proposed fill would not decrease the agricultural capability of the Properties, nor negatively impact the site's drainage. As such, the Panel is amenable to the Proposal, provided that the implementation is staged in order to allow for appropriate monitoring and oversight by the Commission.

DECISION

[13] For the reasons given above, the Panel approves the Proposal to place 48,000 m^3 of fill over an 8 ha portion of the Properties for the purpose of establishing a farm to be operated by the Kwantlen Polytechnic University Sustainable Food Systems program.

[14] The Proposal is approved subject to the following conditions:

Fill Placement and Fill Material

a) All fill placement activities must be conducted in substantial compliance with the information submitted with the Application, the Applicant's Quality Control Procedure (Schedule A), and the conditions set out in this decision;

b) fill placement activities are restricted to the 8 ha area shown in the Sketch Plan attached to this decision. The total volume of material is limited to 48,000 m^3;

c) the qualified registered professional is responsible for conducting regular site visits to ensure that fill related activities are in substantial compliance with the decision;

d) the qualified registered professional is responsible for reviewing all fill source locations to ensure that the fill is of suitable quality and meets the standards set out in the

Contaminate Sites Regulation Schedule 7 for soil relocation to agricultural land (Column III);

e) A designated environmental monitor must be onsite at all times when fill is brought onto the Properties to inspect and approve each truck load and to reject any fill material containing construction and demolition debris, contaminants, heavy clay and boulders (>25cm in diameter);

f) The designated environmental monitor is responsible for maintaining trucking records for each load of fill brought onto the Properties. The trucking records must indicate the truck operator (name and business license), date and time of fill, volume of fill, description of fill, and the source location. These records must be provided to the qualified registered professional for inclusion into their status reports to the Commission;

g) approval to place fill is granted for the sole benefit of the Applicant and is non-transferable without the written approval of the Commission;

h) unauthorized fill material must not be placed on the Properties, this includes fill containing construction and demolition debris (including concrete and wood waste), contaminants, clay, and boulders (>25 cm diameter);

Invasive Plant Species Control

i) appropriate invasive plant species control measures must be practiced on all disturbed areas;

Irrevocable Letter of Credit (ILOC)

j) to ensure the successful implementation of the Proposal, a financial security in the form of an ILOC in the amount of $160,000 must be made payable to the Minister of Finance c/o the Agricultural Land Commission. The ILOC is to ensure the Proposal is conducted in accordance with the information submitted with the Application and the conditions of this decision. For greater clarity, some or all of the ILOC will be accessible to, and used

by, the Commission upon the failure of the operator to comply with any or all aspects of the conditions of approval contained herein;

Qualified Registered Professional

k) the project must be overseen by a qualified registered professional, with specific knowledge of soils and drainage;

l) the qualified registered professional is responsible for ensuring that all required reports and documentation are provided to the Commission;

m) if the required reports are not provided to the Commission in a timely manner and as per the schedules indicated in conditions "q" and "t", the qualified registered professional must immediately notify the Commission indicating why. If the qualified registered professional fails to notify the Commission in a timely manner, a stop work order will be issued;

Decision Term

n) the fill project must be implemented in a phased approach, consisting of two (2) distinct phases as per the attached Sketch Plan;

o) the fill project must be completed within three (3) years from the date of release of this decision. This approval expires on June 12, 2020;

p) should an extension of time beyond June 12, 2020 be required to complete the project, a request must be submitted to the Commission in writing prior to April 13, 2020. Any such request must include a status report that includes details of the project, the reason for the extension request, and photos of the site. Failure to submit a request by April 13, 2020 may require the submission of a new application to the Commission;

Decision Term - Phase 1

q) within 60 calendar days from release of this decision or prior to the implementation of Phase 1 (whichever occurs first), the qualified registered professional must submit for the Commission's review and approval:

   i. a Project Schedule outlining the projected implementation start and end dates of Phase 1;

   ii. a schedule for quarterly Monitoring Reports that is in alignment with the Project Schedule as per condition "q(i)" above. The Monitoring Reports must update the Commission on the progress of the fill project. The first Monitoring Report is due three weeks after filling for Phase 1 commences; The Monitoring Reports must include the following:

      i. confirmation that operations are in compliance with the Reclamation Plan and terms and conditions set by the Commission;
      ii. evidence that fill quality meets the conditions outlined herein (supported by photographs, site and soils field data);
      iii. a record of fill volume and fill source locations;
      iv. confirmation that no contaminated materials have been brought onto the site (i.e. Phase 1 Environmental Site Assessment reports from fill source locations). The Commission may request soil samples be sent to laboratories for analysis or may collect samples for analysis. A monitoring fee will be charged to the Applicant as per the fee outlined in the Regulation, Section 33.1 (1);
      v. any additional information requested by the Commission;

r) upon completion of Phase 1, the Commission will conduct a site inspection of the Property. Phase 1 must be completed to the satisfaction of the Commission prior to the implementation of Phase 2;

Decision Term - Phase 2

s) Phase 2 shall not be implemented without written authorization confirming that Phase 1 has been completed to the satisfaction of the Commission;

t) within 30 calendar days from receipt of written authorization confirming that Phase 1 has been completed to the satisfaction of the Commission, the qualified registered professional must submit for the Commission's review and approval:

   i. a Project Schedule outlining the projected implementation start and end dates of Phase 2;

   ii. a schedule for quarterly Monitoring Reports that is in alignment with the Project Schedule as per condition "t(i)" above.

Closure Report

u) no later than 3 months following the completion of fill activities, the qualified registered professional must submit a Closure Report for the Commission's review and approval:

   i. evidence that the entire fill placement project has been completed in accordance with the conditions outlined herein;
   ii. confirmation of the post-fill agricultural capability and evidence that the filling activities have improved the agricultural capability/suitability of the site to Class 2 or better. This should be supported by detailed soil test pits, site information, and photographs;
   iii. a soil fertility analysis of the upper 30 cm of the soil profile;
   iv. an overview of post-fill site drainage including any new drainage infrastructure. A site visit to assess drainage should be conducted after a heavy, sustained rainfall event;
   v. final cross section profiles of the fill project area showing final contours, and depth and volumes of imported fill; and,
   vi. outstanding issues and recommended remedial actions.

[15] This decision does not relieve the owner or occupier of the responsibility to comply with applicable Acts, regulations, bylaws of the local government, and decisions and orders of any person or body having jurisdiction over the land under an enactment.

[16] These are the unanimous reasons of the South Coast Panel of the Agricultural Land Commission.

[17] A decision of the Panel is a decision of the Commission pursuant to s. 11.1(5) of the *Agricultural Land Commission Act*.

[18] This decision is recorded as Resolution #158/2017 and is released on June 12, 2017.

CERTIFICATION OF DECISION

William Zylmans, Panel Chair, on behalf of the South Coast Panel

LEGEND

THE AGRICULTURAL LANDS

1 Multi-Functional Building and Parking
2 Rainwater Storage for Agricultural Irrigation
3 Farm Drainage Ditch
4 Agricultural Event Field
5 Agricultural Fields
6 Orchard
7 Demonstration Orchard
8 Community Gardens
9 Hedgerows & Beetle Banks
10 Sliding High Tunnels
11 Farm Fields
12 Soil Amendment Trials

THE BOG

13 Bog Conservation Area
14 The Fen
15 Boardwalk with Rest Points

THE RISE

16 Meadow / Informal Recreation
17 Children's Play

THE NODES

18 Garden City Lands Main Entrance
19 Entry Nodes
20 Entry Alley
21 Viewing Platform
22 Crosswalk
23 Parking Lot with Accessible Stalls
24 Parallel Parking with Accessible Stalls

THE DYKE

25 Multi-use Path with Farm Access

THE PERIMETER TRAILS

26 Native Forest Plantings
27 Street Trees
28 Perimeter Trails - Separated Paths
29 Rain Garden

Scale 1:1000

GARDEN CITY LANDS Park Development Plan

CITY OF RICHMOND | PWL PARTNERSHIP

garden city lands

AGRICULTURAL LAND COMMISSION FILE 56199

SCHEDULE A

Documentation as provided by the Applicant

Quality Control Procedure for Garden City Lands Soil Import

1. Potential sites will be identified and the above information will be requested from the site owner by the project coordinator.
2. The project coordinator will provide the City of Richmond and KPU with environmental reports and soil characteristics for the potential source site.
3. The City of Richmond and KPU will review the information and determine if further information and/or a site visit is required.
4. Potential site will be accepted or rejected by KPU and City of Richmond and this will be communicated to the project coordinator.
5. If the site is accepted, the soil will be delivered to the Garden City Lands (GCL).
6. On-site processing:
    a. Any delivery will be inspected by the on-site manager to ensure that it meets criteria agreed upon. Loads not meeting criteria will be turned away.
    b. Accepted loads will be directed to the appropriate location and deposited on site
    c. The source and location on site that the load was dumped will be recorded.
    d. If necessary, the soil will be mixed with organic material on site either through a mixing process or through tillage in the field.
    e. If necessary, the soil may need to be 'raked' in the field to remove any larger stumps or wood material that will not be tolerated by the agricultural equipment.
    f. Soil will be spread and leveled in the field.

Soil Criteria

Source Site Requirements

1. All soils must meet the environmental standards articulated in the Canadian Council of Ministers of the Environment Soil Quality Standard for agricultural use.
2. As much as possible, the soil should be free from noxious weeds.
3. Material should not contain stones larger than 12" or large woody material (ie. roots or stumps larger than 4" in diameter and/or 4' in length)
4. Potential source sites must provide:
    a. Environmental report articulating the site history, including all previous uses;
    b. Texture analysis of the soil to be used;
    c. If applicable, testing for potential contaminants. (Sites that have not had any previous use that would suggest contamination may not require testing for contaminants).

Soil Texture Requirements

Soil texture criteria have been defined to ensure that the imported soil will be well suited to the production of agricultural crops. These criteria have also taken into account the attributes of the Garden City Lands site.

Required soil characteristics:

- Soil will be place on top of a predominantly organic soil and consideration must be given to the transition between the soil cap and native soil.
- Hydrological characteristics of the site will require well-draining soil
- Criteria are flexible to accommodate the need for multiple source sites due to the large volume of soil required.

Soil Texture Criteria required to meet the above characteristics:

- Organic content: 2- 20%
- clay content of the soil: below 20 %
- Sand content: above 20% (This rules out soils that will cause mixing problem ie. 20% clay and 80% silt)

Figure 1 is a diagram of a typical soil texture triangle with the shaded area indicating the soil KPU desires to place at the Garden City Lands based on the above Soil Texture Criteria and the % combinations of soil separates that is acceptable (not including organic matter).

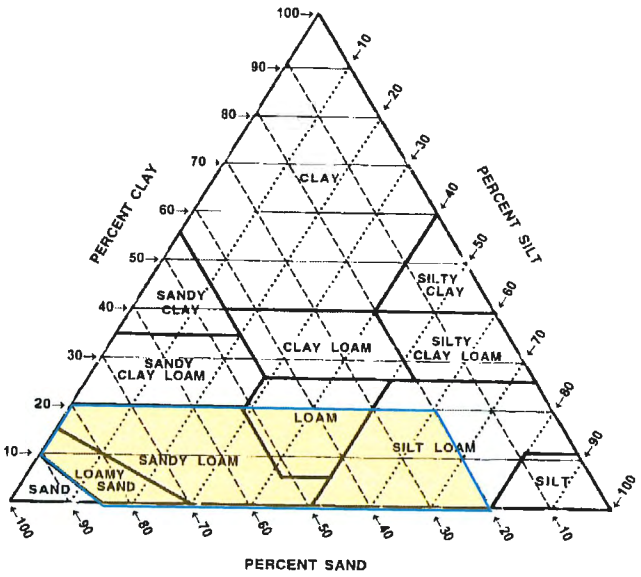


Figure 1. Soil textures acceptable for placement at the Garden City Lands highlighted in yellow

City of Richmond

Memorandum
Community Services Division

To:	Mayor and Councillors	**Date:**	April 24, 2018
From:	Ted G. deCrom Manager, Parks Operations	**File:**	11-7200-01/2018-Vol 01
Re:	**Mitchell Island Park Closure for Pier Repair**		

The purpose of this memo is to inform Mayor and Councillors of the temporary closure of the Mitchell Island Park to allow for required pier repairs within the Park.

The City-owned pier, a wooden structure located within Mitchell Island Park, has a Hydro tower on it which is owned by Richmond Steel Recyclers and has a right-of-way agreement with BC Hydro for the BC Hydro overhead high voltage transmission lines. The hydro lines cross the Fraser River from Vancouver and run from the pier tower over the Mitchell Island Park and towards Richmond Steel Recyclers exclusively.

The pier requires one of its four hinged bearing rocker-s (pier legs) to be realigned back to plumb to assure structural stability. Richmond Steel Recyclers through an agreement with the City has contracted Hymac Industries Ltd. to make the interim repairs. This work will bring -the rocker bearings back into plumb condition to facilitate thermal movement of the pier and reduce the horizontal thrust being placed on the pier. The planned date for this work is May 4 and~~&~~ 5, 2018, weather permitting. As a precautionary measure, the park will be fenced off and closed to the public during this time.

If you have any questions or require further information, please feel free to contact me directly at 604-244-1210.

Ted G. deCrom
Manager, Parks Operations

pc: SMT
Ted Townsend, Director, Corporate Communications and Marketing

McTAVISH
RESOURCE & MANAGEMENT
CONSULTANTS LTD.

#300 – 15300 Croydon Drive
Surrey BC
V3S 0Z5

Date: December 19, 2017

Attn: Alex Kurnicki

From: Bruce McTavish

Re: Source Soil Management

This memo outlines the steps to takeplace when soil is sourced for transport and deposit at the Garden City project.

The soil for the Garden City must adhere to the ALC guidelines for soil and the BC Contaminated Site Regulations (BCCSR) – Schedule 4 for Agricultural Lands.

The owner or contractor of the source soil will need to provide a Phase 1 Environmental Assessment.

When a source of soil has been identified, the following steps will be taken:

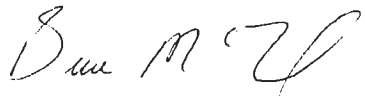
1) On behalf of the City of Richmond, an Agrologist with expertise in soil science and soil handling will review available documentation including a Phase I Site Investigation (environmental assessment) report for the site from which the soil originates.

2) The Agrologist must visit the source site and evaluate the soil for suitability as fill on the Garden City lands, and report on whether and how conditions of the ALC for soil will be met. This evaluation starts with on site visual observations of the site and the soil. Based on the observations and review the Agrologist can:
    a. Reject the soil
    b. Approve the soil and then
    c. Proceed with a soil investigation program, including sampling and sample analysis.
    d. Ensure that soil meets the KPU specification attached to ALC decision 56119

3) The Agrologist must prepare a protocol for the soil handling before transportation of the soil to the Garden City Lands. The protocol will be site specific and include:
    a. Supervision of soil handling
    b. Separation and set aside of topsoil
    c. Separate transport of topsoil and other soil to the Garden City property
    d. Placement of soil and topsoil to mimic the original profile, and
    e. Monitoring of stoniness
    f. Monitoring of non-soil inclusions such as asphalt and concrete and procedures for removal of such items.

#300 – 15300 Croydon Drive
Surrey BC
V3S 0Z5

The Agrologist may recommend that screening of the soil to remove inclusions takes place before transport of the soil to the Garden City property.



Bruce McTavish MSc MBA PAg RPBio
Senior Agrologist

Timeline of Key Milestones for Soil Placement Activities on the Garden City Lands

Date	Subject	Activity	Att.#
April 25, 2017	Staff Report	Staff report providing project update and notification of intent to import soil to the Farm site.	5
May-June, 2017	Soil Placement	Soil amendment placed on The Rise (ALC approval not required).	n/a
June 12, 2017	ALC Decision 56199	ALC Decision permitting the placement of 48,000m^3 of imported soil to the Farm site	2
June 26, 2017	Soil Placement	Soil importation began on the Farm site. City of Richmond Soil Deposit Permit No. 61974 was issued for the placement of soil on The Rise and the Farm and the importation of peat as soil amendment.	n/a
Early July, 2017	QEP engaged	McTavish provided oversight of soil activities.	n/a
July 12, 2017	Technical Report	Soil Inspection Report submitted to ALC.	6
July 18, 2017	Soil Report	Phase 1 Soil Closure Report submitted to ALC.	7
July 20, 2017	ALC Correspondence	ALC directed City to proceed with Phase 2 soil placement on Farm Fields.	8
August 9, 2017	South Coast Panel Site Visit	South Coast Panel inspected Farm Field with ALC, City staff, and McTavish.	n/a
August 10, 2017	Technical Report	Soil Inspection Report submitted to ALC.	9
August 29, 2017	ALC Correspondence	Follow up to South Coast Panel site visit: ALC directed City to address soil quality concerns.	10
September 15, 2017	Soil Report	Soil was tested; results summarized in Soil Quality Report submitted to ALC for review.	11
September 19, 2017	Technical Letter	Letter by McTavish for volume of organic matter required to amend Farm soil sent to ALC	12
September 2017	KPU Report	Greenhouse gas sequestration report supporting placement of soil over peat-based subgrade.	13
September 27, 2017	KPU Letter	KPU letter to City of Richmond Parks, Recreation and Cultural Services Committee, dated September 27, 2017, supporting soil placed for Farm.	14

Date	Subject	Activity	Att.#
October 5, 2017	Meeting with ALC	City met with South Coast Panel and ALC staff to discuss soil quality concerns, and discuss implementation of Soil Amendment Plan.	n/a
October 11, 2017	Technical Letter	Interim Farm Soil Amendment Plan to ALC.	15
October 12, 2017	ALC Correspondence	ALC Approved Farm interim Soil Amendment Plan.	16
Mid October, 2017	Farm Field Amendments	Cover crop seeded and peat stockpiled on Farm as first phase of Soil Amendment Plan.	n/a
December 19, 2017	Soil Amendment and Importation Plans	Final Farm Soil Importation plan and Soil Improvement Plan was sent to ALC.	17, 18
March 25, 2018	Soil Percolation Test Conducted	Farm soil classified with drainage characteristics consistent with a sandy-loam soil (moderately-high).	19

City of Richmond

Report to Committee

To:	Parks, Recreation and Cultural Services Committee	**Date:**	April 5, 2017
From:	Mike Redpath Senior Manager, Parks	**File:**	06-2345-20-GCIT1/Vol 01
Re:	**Garden City Lands April 2017 Update**		

Staff Recommendation

1. That the staff report titled "Garden City Lands April 2017 Update," dated April 5, 2017, from the Senior Manager, Parks be received for information; and

2. That a copy of this report be forwarded to Kwantlen Polytechnic University, stakeholder groups and be posted on the City's website.

for
Mike Redpath
Senior Manager, Parks
(604-247-4942)

Att. 3

REPORT CONCURRENCE	
CONCURRENCE OF GENERAL MANAGER	
REVIEWED BY STAFF REPORT / AGENDA REVIEW SUBCOMMITTEE	INITIALS:
APPROVED BY CAO	

Staff Report

Origin

In July 2016, Council was provided a staff report titled "Garden City Lands Park Development Plan," dated June 30, 2016, detailing future construction and development of the Garden City Lands. The purpose of this report is to provide information on the ongoing implementation of the Garden City Lands Park Development Plan (Attachment 1) and recent construction associated with the first phase of the Garden City Lands.

This report supports Council's 2014-2018 Term Goal 2: A Vibrant, Active and Connected City:

> *Continue the development and implementation of an excellent and accessible system of programs, services, and public spaces that reflect Richmond's demographics, rich heritage, diverse needs, and unique opportunities, and that facilitate active, caring, and connected communities.*
>
> *2.3. Outstanding places, programs and services that support active living, wellness and a sense of belonging.*

Findings of Fact

The City-owned Garden City Lands are approximately 55.2 hectares (136.5 acres), located on the eastern edge of Richmond City Centre. The Garden City Lands is one of Richmond's newest parks and has a unique combination of agricultural and ecological functions resulting in what will be a singular park in Metro Vancouver. While the Garden City Lands is designated a city-wide park, because it is inherently embedded in a high-density neighbourhood, it will serve as an important recreational destination to the local community. Several existing and planned greenway and pedestrian connections will also make this park a destination for many visitors city-wide and throughout Metro Vancouver.

In 2014, Council approved the Garden City Lands Legacy Landscape Plan as a framework for the future detailed planning and development of the Garden City Lands. In July, 2016, the Garden City Water and Ecological Resource Management Strategy and the Garden City Lands Park Development Plan were presented to Council.

The Water and Ecological Resource Management Strategy provides a number of ecological and hydrological management considerations to guide the implementation of the Park Development Plan. The Park Development Plan is a synthesis of the Legacy Landscape Plan, the science-based recommendations from the Water and Ecological Resource Management Strategy and feedback from Richmond residents. The Park Development Plan provides the subject-matter expert analysis and direction for the implementation and construction methodology of the Garden City Lands project.

Project Update

Implementation of the first phases of the Park Development Plan has entailed the preparation of detailed designs and development of construction drawings and specifications. These first phases include site survey layout of the proposed works, procurement of specified materials, applications for approval to the Agricultural Land Commission and actual on-site construction.

In December 2015, Council awarded a consulting contract for professional services for landscape architecture, engineering and bog ecology to assist staff in developing an implementation and construction strategy. Staff take under consideration the consultant team's recommendations to develop the appropriate construction methodology for the particular conditions of the site and types of features being constructed. All work is conforming with applicable best management practices for this type of construction and follows all applicable Agricultural Land Commission and City Bylaw policies and regulations. The City policies and regulations include traffic management, construction noise management, soil deposition, placement of silt fencing and hours of work. In addition to these municipal regulations, all imported soil materials are tested prior to placement on site once approvals are in place.

Staff have reported to Council and Committees and to date, Council has approved the following milestones for this project:

- June 9, 2014: Garden City Lands Legacy Landscape Plan: Report to Council adopted on consent;
- February 10, 2015: Five Year Financial Plan: Approval of the $2.1M capital submission for construction of perimeter trails;
- June 8, 2015: Kwantlen Polytechnic University Sustainable Agriculture Research and Education Farm: Report to Closed Council;
- December 14, 2015: Award of RFP 5540P for Design and Construction Services: Report to Closed Council;
- December 14, 2015: Five Year Financial Plan: Approval of the $3.1M capital submission for construction of water management infrastructure; and
- December 12, 2016: Five Year Financial Plan: Approval of the $1.2M capital submission for continuation of construction of water management infrastructure and improvements to enable agricultural uses.

Park Development Plan Implementation

The work commenced in the summer of 2016 and will continue through 2017. Work completed in 2016 includes approximately 100 metres of the seepage barrier and approximately 1,680 metres of the central berm (dike) and sections of farm service roads.

These initial phases of construction will lay the sub-surface infrastructural foundation for the future park which can only be done at the beginning of a project. The phasing and sequencing of this initial phase of work is complicated by the saturated site conditions. Work is limited within most of the site for all but several months in the summer, leaving only the edges, adjacent to

roadways, accessible for construction throughout the year. Construction is currently occurring along this less saturated perimeter zone.

Planned activities for the 2017 season include:

- Perimeter pedestrian and bicycle trails (underway since March, 2017);
- Completion of the seepage barrier along the central dike and along Westminster Highway;
- Installation of site infrastructure (drainage ditches, storm sewer connections and weir structures, and preparation for electrical and water connections);
- Placement of soil for the initial phase of farm development (subject to approval by the Agricultural Land Commission);
- Hydroseeding of exposed peat soils along trails;
- Fall/winter tree planting along the perimeter;
- Community engagement;
- Partnering with Kwantlen Polytechnic University on the Research and Education Farm;
- Agricultural Land Commission approvals; and
- Hosting the City's Harvest Fair proposed for the Garden City Lands in September.

See Attachment 2 for a summary of the planned construction and project related activities anticipated to be completed in 2017.

Perimeter Pedestrian and Bicycle Trails

In March, construction began on the network of twinned trails which will ultimately form a 2.9 kilometre multi-modal recreational experience, accommodating pedestrians on a 2.5 metre wide path and cyclists on a 3.5 metre wide path. The trails will form a complete loop around the site and will be the park's primary interface with the surrounding community and roadways. They will also serve as the physical connections to existing and future greenways which includes the future greenway along May Drive (north of Alderbridge) and Lansdowne Linear Park to the west. The City has received approval from the Agricultural Land Commission to build the perimeter trails. Additionally, a City Soil Deposit Permit has been issued for this scope of work.

Both trails are bi-directional and the surface will be suitable for all pedestrians as well as wheeled devices, including mobility aids. The path is constructed of several grades of gravels and crushed stone laid over geotextile fabrics set on the existing ground (Attachment 3). This method of construction achieves a stable, permeable and durable path. Existing soils excavated to establish path design grades are stockpiled on-site for later reuse. Invasive plant material and excavated debris are being appropriately disposed of.

The phased construction is dictated by the water levels on the site. Construction along the edges of the site, that is, along the adjacent roadways, is not affected by the currently saturated soils within the site. In mid-March, construction began along No. 4 Road. Construction along Alderbridge Way will then begin followed by work along Garden City Road with anticipated completion by mid-summer. The frontage along Westminster Highway will begin when the

water table subsides enough to permit the effective installation of storm water infrastructure and the clay seepage barrier (see below for more information).

As each phase is completed and the site is secured to ensure the public's safety, staff will consider opening the trails for limited public use, that is, access will be restricted to the trails only. Openings will be subject to ensuring the public's safety during on-going construction. Public access to the site will remain substantially restricted to designated areas because the site is a conservation area and/or a construction zone. Wayfinding signage and safety barriers will be placed to ensure the public is well informed and their safety maintained. Openings will be announced to the public thru the City's web site and on-site signage and social media.

Seepage Barrier

As per hydrologist and engineering consultant recommendations, a clay seepage barrier is being installed along two edges of the bog. The purpose of the barrier is twofold:

1. Retain water in the bog to maintain high water levels throughout the season; and
2. Prevent infiltration of water from the farm into the bog area.

Healthy bogs require a high water, high acidity and low nutrients levels. As per the project's consulting engineer's recommendation, imported clay material is placed to a depth of approximately 1 metre below grade, that is, from the surface to the underlying, impermeable clay and silt layer. The existing peat is excavated, stockpiled on-site for later re-use. The imported clay will be placed along the entire eastern frontage of the dike and along the northern edge of the soon-to-be built perimeter path along Westminster Highway. As the clay barrier is installed, the previously excavated temporarily stockpiled peat is placed over the newly installed seepage barrier and re-graded to create a smooth transition from the raised edge of the path down to the adjacent bog surface. This sloped area will be initially hydroseeded with native grasses to prevent the establishment of invasive weeds. In later phases, it will be planted with native shrubs and plant material.

The clay material is sourced from Metro Vancouver development sites. All imported clay material brought on site is tested to confirm they are free of significant debris, containments and physical composition prior to delivery to site. Staff will monitor the water levels, chemical profile and acidity of the water in the bog for the next three years after the barrier's installation.

Infrastructure Support System

Municipal infrastructure will be installed simultaneously with the installation of the trails and seepage barrier. A majority of these improvements are located underground and will not be visible at the surface once installed. Planned improvements include drainage ditches and swales, drain pipes, storm sewer and water connections to the City's network, weir structures to regulate water levels in the bog and electrical supply (installed in coordination with BC Hydro). These items are being installed at this time to minimize excavating previously installed site improvements at some future date.

Soil Placement for the Initial Phase of Farm Development

In February 2017, the City of Richmond submitted an application to the Agricultural Land Commission to place fill at the Garden City Lands. This fill will establish the initial 2 hectare (5 acre) area of the Kwantlen Polytechnic University (KPU) Sustainable Agriculture Research and Education Farm. The Agricultural Land Commission's approval is expected in April.

Approximately 800 dump trucks of fill are required to establish the initial phase of the ultimate 8 hectare (20 acre) research and education farm. KPU staff have provided the City a soil specification indicating the soil type and composition they require. The soil required needs to meet strict environmental guidelines for soil suitable for agricultural purposes. A comprehensive soil testing protocol will include:

1. Chain of custody documentation identifying the source;
2. Soil sample testing by certified laboratories; and
3. Assessment of soil structure, composition and level of contamination.

Soil will come from a number of sources, possibly including the City's Sidaway soil dump and development sites throughout Metro Vancouver. Fill placement will not proceed until Agricultural Land Commission approval and a City of Richmond Soil Deposit Permit are received and the site is dry enough (expected to be mid-to-late summer though subject to weather). Soils not suitable for agricultural purposes will not be placed in areas designated for food production.

City staff will be managing the soil placement operation which may include the use of heavy equipment such as bulldozers to place soil manufactured by an on-site industrial soil shredder (to mix soil provided to meet KPU's specifications). Dump trucks accessing the site will be routed along existing farm service roads and the dike trail.

Hydroseeding

Commencing this spring, exposed portions of previously disturbed soil are and will be hydroseeded with native grass seeds (Attachment 3). Hydroseeding is a highly efficient method of applying grass seed. It involves a truck applying a water based mixture of mulch and seeds over a large area with a water cannon. The mixture of seed, mulch and other additives has been specially formulated in coordination with a bog ecologist to ensure the seeds used are native and the chemical composition of the slurry is appropriate for use in bogs. To date, a 1.2 hectare area has been hydroseeded.

Fall and Winter Tree Planting

Beginning this fall, City of Richmond staff will commence tree planting on site. Native trees will be planted next to the pedestrian and cycling trails along the entire perimeter of the Garden City Lands. Once completed, this phase of work will see over 1,300 trees planted, comprised of predominantly native conifer and deciduous trees and selected cultivated fruit bearing trees slated for the proposed orchard on the Rise (northwestern corner of the site, along Alderbridge

Way at Garden City Road). If tree planting cannot be completed over the 2017/2018 winter season, tree planting will resume in fall, 2018.

Community Engagement and Stakeholder Involvement

In May 2015, staff provided Council a proposed Garden City Lands communications strategy. In this strategy updates to Committee and Council, outreach via social media, project website, on-site signage, stakeholder engagement and public events. The following provides a synopsis of staff's project related community engagement efforts to date.

The Garden City Lands web page (http://www.richmond.ca/parks/about/design-construction/gardencitylands.htm) is regularly updated to provide the public information on activities planned for 2017. Aerial perspectives and a drone, fly-over video of the site from this past winter are also posted. The webpage will be updated with new images portraying the steady transformation of the Garden City Lands.

Previously available materials such as links to the Garden City Lands Legacy Landscape Plan, Council, Committee and consultant reports and studies are available on the website at: http://www.richmond.ca/parks/about/design-construction/gardencitylands/archive.htm.

Ongoing updates and information will be provided to the public via the project's web page, http://www.letstalkrichmond.ca/lets-talk-richmond, and with updated on-site signage, currently located at key locations at Garden City Lands. Two signs have been installed on site since February 2017.

With the completion of the perimeter trail and initial work on the KPU farm area anticipated to begin in 2017, the Garden City Lands will be ready for program development in 2018. Additional staff resources will be included as part of the 2018 capital submission in order to advance programming at Garden City Lands.

There are many key stakeholders who have been engaged in early program visioning for the site, and who will be engaged in programming the site moving forward. These stakeholders include:

- KPU Department of Sustainable Agriculture and Food Systems;
- Richmond Food Security Society;
- Richmond Nature Park Society;
- Richmond Fitness and Wellness Association;
- Garden City Lands Conservation Society;
- City Centre Community Centre; and
- School District 38.

Early program opportunities at the site include:

- Site interpretation, including signage plan;
- Community gardening and learn to garden programs;
- Workshops and seminars related to food production (ie: fruit tree pruning, etc.);

- Fitness and wellness programs (walking clubs, tai chi, yoga, etc.);
- Nature-based education programs with a focus on bog conservation and agro-ecology (ie: guided walks and tours, school programs);
- Special events, including the Richmond Harvest Festival; and
- The establishment of a stewardship group under the Partners for Beautification Program that would create opportunities for volunteer involvement at many levels.

As the park infrastructure continues to develop, programming will expand and grow along with it. Engagement with key stakeholders is as an important step in the process to develop a vibrant and active public space. Their involvement will give the park the grassroots support and momentum to make the Garden City Lands an engaging place in the City. A copy of this report will be provided to these key stakeholders to give them an update on the project's progress.

As portions of the perimeter trails are deemed safe for public use, staff will publicly announce, via on-site signage, the City's web site and social media, that the trails are available for recreational use. Staff see these limited openings as opportunities to introduce the public to using the Garden City Lands as recreational destination in their own community.

To date, Council and Committees have considered 10 formal reports as progress reports and/or requests for approval at key project milestones. In addition to the aforementioned reports, the Parks, Recreation and Cultural Services Committee has a standing agenda item to have staff provide the Committee monthly verbal progress reports and have been provided memos providing additional information. Since January 2016, 13 verbal reports have been provided to the Committee. The minutes from these meetings are posted on the City's website.

The Harvest Festival

The Harvest Festival, part of the Richmond's Canada 150 celebrations, is planned to occur at the Garden City Lands, just off Garden City Road near Lansdowne, on Saturday, September 30, 2017. The Harvest Festival will be a first annual event celebrating the City's agricultural heritage featuring a farmers market, farming equipment, farm animals, live busking entertainment, food trucks and agricultural displays. The event is expected to attract an estimated 10,000 people. The Harvest Festival attendees will learn about agriculture and its importance to the City's past, present and future. The event will also help in establishing the park as recreational and educational destination in Richmond's City Center area. This event is subject to ALC approval.

The Proposed Kwantlen Polytechnic University Farm

The City of Richmond is working with KPU to plan a future Sustainable Agriculture Research and Education Farm. Soil placed by the City will establish the first phase of this farm. When the farm is fully implemented, it will be managed by KPU as part of the University's Sustainable Agriculture program.

A number of improvements will be installed on the site as the soil is placed. Water services will be provided off of both Alderbridge Way and Garden City Road for irrigation purposes. A drainage system will be designed by the project's engineering consultants and installed by City staff. While some of the farm's drainage will be diverted to ditches and ponds (construction

slated for future phases), the City will provide the farm with a storm water connection to the City's system. These infrastructural components will be installed in phases as the farm evolves and their requirements increase accordingly.

KPU is planning to place mobile and lightweight agriculture-grade greenhouse structures called 'hoop houses' to increase agricultural production on the site and extend the growing season for certain crops. KPU would also like to place two re-purposed shipping containers to provide secure, on-site equipment storage space for the farmers. The City will work with KPU to appropriately locate these structures and create a strong graphic identity to profile KPU's involvement at the Garden City Lands and mitigate graffiti vandalism. City staff will work with the appropriate City departments to gain any required permits and approvals for the above noted site improvements.

Staff will provide KPU a copy of this report and ongoing updates as the Park Development Plan is implemented.

Agricultural Land Commission

In January 2017, City staff presented the Garden City Lands Park Development Plan to Agricultural Land Commission staff and discussed the proposed Phase 1 scope of work within the Park Development Plan to determine what applications the City would be required to make to the Agricultural Land Commission to gain approval to proceed. Since that presentation to Agricultural Land Commission, the City of Richmond has submitted three applications to the Agricultural Land Commission for review and approval by the Board, they are:

- Transportation, Utility, or Recreational Trail Uses within the ALR (for permission to build the perimeter trails);
- Application to Place Fill and/or Remove Soil (for permission to place fill to create the KPU Farm); and
- Non-Farm Use Application (for permission to hold the inaugural annual Harvest Festival).

To date, the City of Richmond has received permission for the construction of the perimeter recreational trails. Construction of these trails is currently proceeding on site. As a condition of approval and as per Agricultural Land Commission policy, the City is required to install an agricultural fence around the Garden City Lands adjacent to this publicly accessible path; staff is proceeding with implementing this required site improvement. Approvals for the placement of fill for the initial 2 hectare (5 acre) phase of the KPU farm is expected in mid-to-late April and in May or June for the Harvest Festival.

Agricultural Land Commission staff have advised the City that it would be preferable to make a single application for the remaining improvements identified in the Park Development Plan requiring Agricultural Land Commission approval. Further detail will be required in order to accurately describe the scope of elements such as the Community Hub and Farm Centre, washroom facilities and other park elements prior to an application being submitted to the

Agricultural Land Commission. Staff will begin a more detailed design and programming study later in 2017 in order to make a Non-farm Use Application in the future.

Budget Update

In 2014, 2015, and 2016, Council approved capital projects to fund the phased implementation of the Park Development Plan for a total of $6.4M. To date expenditures are $1.7M. It is anticipated that the remaining amount ($4.2M) will be spent by the end of the year, weather permitting and $.5M in early 2018, again weather permitting.

Next Steps

Staff will be preparing capital budget submissions as part of the 2018 budget process. Requests for additional funding of park elements identified in the Park Development Plan will be submitted for Council's consideration, particularly planning for the Community Hub and Farm Centre. Planning and programing of this facility needs to be started prior to formal design and construction begins. In support of this major park element, staff will be exploring potential grant and partnership opportunities as well as approval for siting and construction from the Agricultural Land Commission.

Planned construction activities for the remainder of the 2017 construction season at Garden City Lands will be focused on completing the landscape works associated around the perimeter trails, further implementation of the Kwantlen Polytechnic Farm and implementation of a signage and wayfinding strategy.

As work proceeds, staff will continue with public outreach and engagement efforts. Staff will also provide Council another project update in fall 2017 reviewing progress on construction to date as well as a summary of project related issues such as the City's partnership with Kwantlen Polytechnic University and the Agricultural Land Commission.

Financial Impact

None.

Conclusion

Steady progress has been made toward implementation of the Garden City Lands Park Development Plan, with construction well underway. The work is proceeding according to all applicable regulations, best practices and the recommendations of a range of expertise specific to this site and the unique combination of uses being developed for it.

Throughout the planning and design process, Council and the public have expressed their support for this unique park in the City Centre area. As a result of the comprehensive planning and design that has occurred in the last five years, there is broad public interest and support to use the Garden City Lands for both agriculture and recreation. The completion of the perimeter trail around the Garden City Lands will provide the community an accessible 2.9 kilometre path, welcoming City residents and visitors to Richmond to the Garden City Lands.

Staff are confident that the planned 2017 construction season work program is achievable within the parameters of currently available funding. Successful completion of the initial phases will bring to reality the City's vision as set out in the Garden City Lands Park Development Plan.

Jamie Esko
Manager, Parks Planning & Design
(604-233-3341)

Alex Kurnicki
Research Planner II
(604-276-4099)

Att. 1: 2016 Garden City Lands Park Development Plan
2: 2017 Scope of Works Schedule
3: Spring, 2017 Construction Activity Site Photos

McTAVISH
RESOURCE & MANAGEMENT
CONSULTANTS LTD.

Fill site inspections for
ALC Approval 56199- Garden City Lands
Richmond, BC

Prepared by:

Bruce McTavish, MSc MBA PAg RPBio

Justin McTavish, BSc AAg

McTavish Resource & Management Consultants Ltd.
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July 12, 2017

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List of Figures

1.0 Introduction

McTavish Resource Management Consultants (McTavish) has been retained by the City of Richmond to carry out weekly inspections for Phase 1 of the Garden City lands fill project in Richmond BC (Figure 1). This report summarizes fill observations for June 28, July 6 and July 11, 2017.

Figure 1 Site location

2.0 Methodology

Observations were carried out June 28, July 6 and July 11, 2017.

For each inspection, the quality of fill and topsoil was based on visual observations.

On July 6, an aggregate soil sample was gathered from the fill/topsoil on the property and delivered to Exova Laboratory Inc. in Surrey BC for analysis. Soils were tested for macro and micronutrients, electrical conductivity (EC), organic matter (OM), pH and particle size analysis.

3.0 Observations

3.1 June 28, 2017

Site observations were completed by Bruce McTavish, PAg RPBio. No debris was observed from previously deposited soil or soils that were being hauled in and deposited during the time of inspection. Soil was hand texted as a sandy loam.

3.2 July 6, 2017

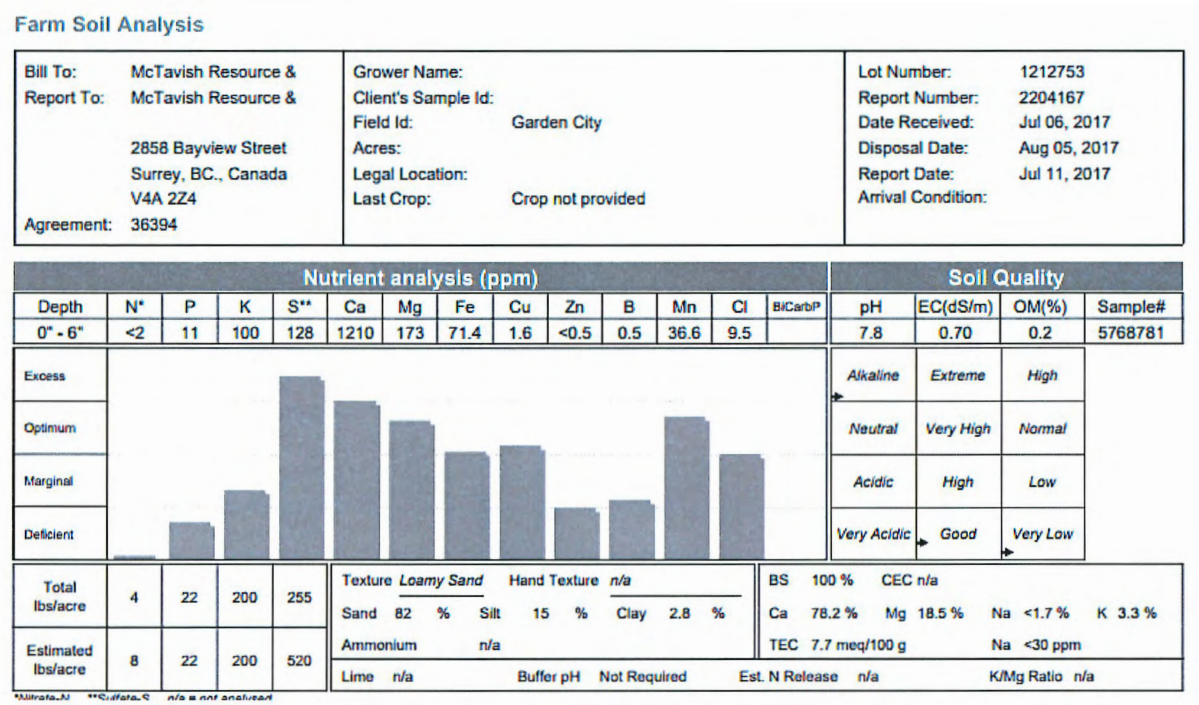
Site observations were completed by Justin McTavish, AAg. No debris was observed from previously deposited soil or soils that were being hauled in and deposited during the time of inspection. Occasional clumps of clay were also observed. Soil textures ranged from a sandy material to a sandy loam. An aggregate soil sample was taken from recently deposited stockpiled soil. Results are described in section 4.0.

3.3 July 11, 2017

Site observations completed by Justin McTavish, AAg and Taisha Mitchell, AAg, BIT. Some small debris such as plastic pipe was observed during the inspection but fill was otherwise free of debris. Debris was being separated from fill when found. The soil being deposited was consistent with previous site inspections and was hand textured as a sandy loam.

4.0 Soil test results

Nitrogen and phosphorus are both considered deficient and potassium is marginal. Sulphur is slightly excessive which is unusual given the low amount of organic matter in the sample (0.2%). The high sulphur may be related to the proximity to YVR which could account for higher amounts of atmospheric sulphur due to plane exhaust. All micronutrients are considered optimum except for boron and zinc. Soil pH is 7.8 or slightly alkaline. EC is 0.70 indicating no issues with salinity. OM is 0.2% which is considered low.



Farm Soil Analysis

Bill To:	McTavish Resource &	Grower Name:		Lot Number:	1212753
Report To:	McTavish Resource &	Client's Sample Id:		Report Number:	2204167
		Field Id:	Garden City	Date Received:	Jul 06, 2017
	2858 Bayview Street	Acres:		Disposal Date:	Aug 05, 2017
	Surrey, BC., Canada	Legal Location:		Report Date:	Jul 11, 2017
	V4A 2Z4	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	36394				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	<2	11	100	128	1210	173	71.4	1.6	<0.5	0.5	36.6	9.5	

Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
7.8	0.70	0.2	5768781

Alkaline	Extreme	High		
Neutral	Very High	Normal		
Acidic	High	Low		
Very Acidic	Good	Very Low		

Total lbs/acre	4	22	200	255
Estimated lbs/acre	8	22	200	520

Texture *Loamy Sand* Hand Texture *n/a*
Sand 82 % Silt 15 % Clay 2.8 %
Ammonium n/a
Lime n/a Buffer pH Not Required Est. N Release n/a K/Mg Ratio n/a

BS 100 % CEC n/a
Ca 78.2 % Mg 18.5 % Na <1.7 % K 3.3 %
TEC 7.7 meq/100 g Na <30 ppm

Figure 2 Soil test results

5.0 Fill Volume

As of July 12, 2017, the following truck volume has occurred:

- 1,488 tandem trucks
- 150 tri-tandem trucks

Assuming ~8 m^3 per load for tandem trucks and ~12 m^3 per load for tri-tandem trucks, the calculated amount of fill on the property as of July 12, 2017 is 13,704 m^3.

6.0 Summary

Soils being deposited on the Garden City lands have been consistent with textures ranging from loam to sandy loam. Only minor debris such as plastic pipe have been observed and have been removed by fill-site staff. McTavish will continue to perform weekly site visits to make observations on soil quality and soil volume. Two more aggregate soil tests will be taken for lab analysis—one during the third week of July and another upon project completion.

McTavish did not test for soil contamination (metals and hydrocarbons) as the source site was the subject of an environmental investigation by Hemmera Envirochem Inc.

Appendix I Site photographs

Figure 3 Soil being deposited June 28, 2017

Figure 4 Soil being graded with dozer June 28, 2017

Figure 5 Extent of fill July 6, 2017

Figure 6 Fill being deposited July 6, 2017

Phase 1 Closure Report
ALC Approval 56199- Garden City Lands
Richmond, BC

Prepared by:

Bruce McTavish, MSc MBA PAg RPBio

Justin McTavish, BSc AAg

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July 18, 2017

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List of Figures

1.0 Introduction

McTavish Resource Management Consultants (McTavish) has been retained by the City of Richmond to carry out weekly inspections for Phase 1 of the Garden City lands fill project in Richmond BC (Figure 1). A final site inspection was conducted by McTavish on July 14th.

Figure 1 Site location

2.0 Methodology

Observations were carried out June 28, July 6, July 11, and a final inspection on July 14, 2017.

For each inspection, the quality of fill and topsoil was based on visual observations and soil lab analysis.

On July 14, an aggregate soil sample was gathered from the fill/topsoil on the property and delivered to Exova Laboratory Inc. in Surrey BC for analysis. Soils were tested for macro and micronutrients, electrical conductivity (EC), organic matter (OM), pH and particle size analysis. A total of 11 soil pits were installed and located with a handheld GPS device (Figure 2).

The total area of fill placement is based on walking the perimeter of the fill site and calculated with a handheld GPS device. Fill volume is calculated from up to date truck load counts.

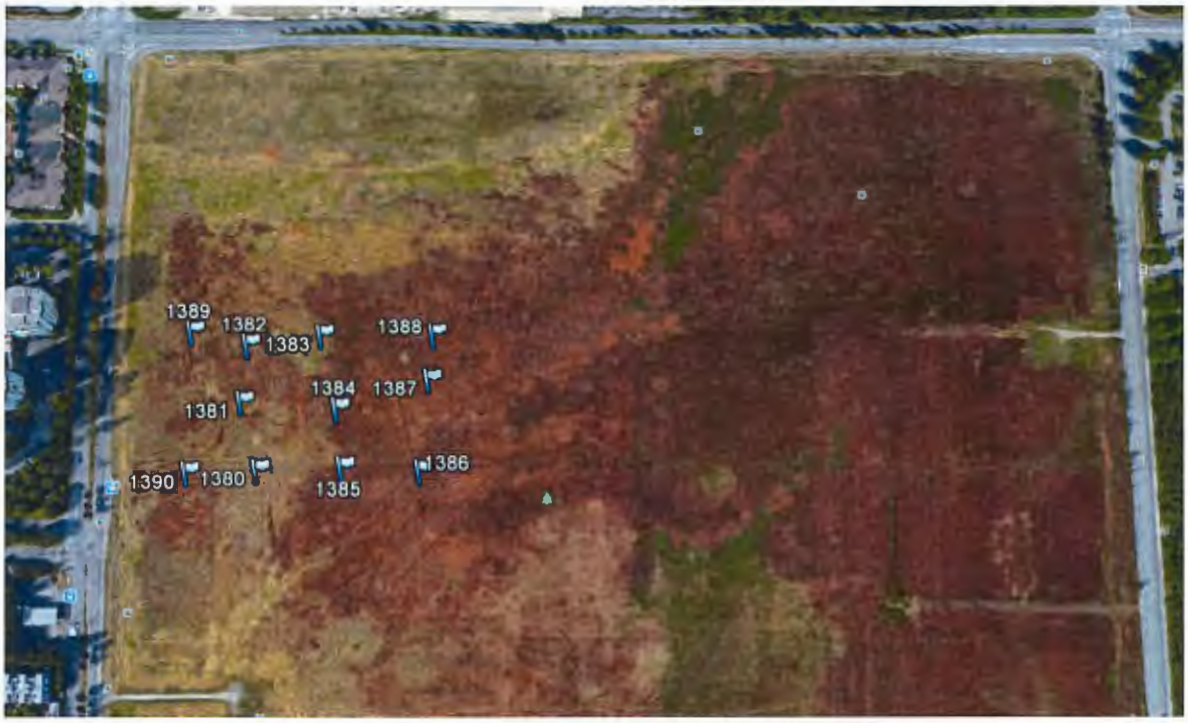

Figure 2 Soil pit locations

3.0 Observation Summary

Soil quality observed during Phase 1 of the fill project was consistent during all McTavish site-inspections. Soil textures were generally a sandy loam with some minor deposits of organic material and clay. Only minor debris, such as old drainage pipe and hose, were observed and were separated from fill during site inspections.

4.0 Agricultural land capability

4.1 Existing agricultural land capability

There are no existing agricultural land capability ratings for the Garden City lands. Properties with similar characteristics and within close proximity to the subject property are classed as 7:05WF-3:04W improvable to 7:03WF-3:O2W (Figure 3). Based on site observations, this report proposes that existing agricultural land capability of the subject property (pre-fill) should be similar to the classified properties in close proximity.

The following are descriptions of existing agricultural land capability classifications:

Class 4

Land may only be suitable for a few crops, or a wide range of crops with low yield. Risk of crop failure is high. Soil conditions are such that special development and management practices are required. Limitations may restrict choice of crop, timing and ease of tillage, planting and harvesting, and methods of soil conservation.

Class 4W

On class 4W land, frequent or continuous occurrence of excess water during the growing period may cause moderate crop damage and occasional crop loss. Water level is at the surface most of the winter and/or until mid-spring forcing lade seeding, or the soil is poorly drained.

Class 5

Land has limitations that make it suitable for perennial forage or other specially adapted crops. Crops such as cranberries may be appropriate, or fruit trees or grapes if area is climatically suitable (stoniness and/or topography are not significant limitations to these crops). Productivity of these suited crops may be high. Class 5 lands may be used to cultivate field crops, provided intensive management is employed. If adverse climate is the main limitation, cultivated crops may be grown, however crop failure is expected under average conditions.

Class 5F

Land in class 5F includes soils with very severe nutrient imbalances, extreme acidity or alkalinity, and/or extreme carbohydrates levels in the upper 50 cm. Fertility status restricts the range of crops to perennial forages or other specially adapted crops such as cranberries.

Class 5W

On class 5W land, frequent or continuous occurrence of excess water during the growing period making land suitable for only perennial forage crops, and/or improved pasture. Water level is at the surface until early summer, or the maximum period of water level is less than 20 cm below the soil surface for 6 weeks during the growing period, or the soil is very poorly drained, commonly with shallow organic layers. Effective grazing is longer than 10 weeks.

Figure 3 Existing agricultural land capability classifications

4.2 Current agricultural land capability

Based on site observations and soil test analysis, the current agricultural land capability has improved from 7:05WF-3:04W to 2WF. Minor limitations to agriculture are likely due to wetness (W) and soil fertility (F). Soil wetness restrictions can be improved by drainage. Soil fertility can be improved through the incorporation of organic matter or fertilizers.

The improved agricultural land capability is as follows:

Class 2

Land has minor limitations that either require good ongoing management practices or may restrict the range of crops (or both). Soils are deep, hold moisture well, and can be managed with little difficulty.

Class 2F

Land in class 2F includes soils with minor nutrient imbalances, inadequate exchange capacity, nutrient holding ability, in the upper 50 cm, and/or moderate to severe fertility problems below the 50-cm depth. Fertility status does not restrict the range of crops.

Class 2W

On class 2W land, occasional occurrence of excess water during the growing period may cause slight crop damage, or the occurrence of excess water during the winter months may cause adversely affect deep-rooted perennial crops. Water level is rarely, if ever, at the surface and excess water is within the upper 50 cm for only short periods (<2 weeks) during the year.

5.0 Soil test results

Soil test results for the closure report should be available by July 21, 2017. McTavish does not anticipate any variation from soil tests taken from July 6, 2017.

6.0 Fill Volume

As of July 14 2017, the following truck volume has occurred:

- 1,655 tandem trucks (assumed average load of ~8m^3 per load)
- 177 tri-tandem trucks (assumed average load of ~12m^3 per load)

Based on the assumed average per tandem and tri-tandem truck loads, the amount of fill on the property as of July 14, 2017 is 15,364m^3. This will be used as the volume calculation for phase 1.

6.1 Fill Area

Based on measurements from a handheld GPS device, the total area filled for phase 1 is 4.52 acers (figure 4).

Figure 4 Phase 1 fill area

7.0 Summary

Soils being deposited on the Garden City lands have been consistent with textures ranging from loam to sandy loam. Only minor debris such as plastic pipe have been observed and have been removed by fill-site staff. Monitoring of Phase 1 indicates that the fill site has met the expectations of the requirements set by the ALC. Fill located on the property has improved the agricultural land capability and is suitable for agricultural purposes.

Appendix I Site photographs

Phase 1 Fill deposition completion, southwest corner

Phase 1 Overview looking east

Typical soil profile on fill site 0-20cm

Agricultural Land Commission
133 – 4940 Canada Way
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July 20, 2017

Reply to the attention of Shawna Wilson
ALC File: 56199

Alex Kurnicki
City of Richmond
5599 Lynas Lane
Richmond, BC V7C 5B2

Alex Kurnicki:

Re: Authorization to Proceed to Phase 2

Resolution #191/2017 requires the City of Richmond to submit a Closure Report to the Agricultural Land Commission (the "Commission") upon completion of Phase 1 as per condition "q ii". The Commission is in receipt of the fill site inspection report dated July 12, 2017 and the Closure Report dated July 18, 2017 relating to the above noted application.

Upon review of the above mentioned reports, the Commission has identified the following pieces of outstanding information:

1. Soil sample results from samples taken July 14, 2017
2. Information from trucking records (as per condition "f" of Resolution #158/2017 and Resolution #191/2017)

The City of Richmond is required to submit the outstanding information prior to July 28, 2017.

Condition "r" of Resolution #158/2017 and Resolution #191/2017 states the following: *upon completion of Phase 1, the Commission will conduct a site inspection of the Property. Phase 1 must be completed to the satisfaction of the Commission prior to the implementation of Phase 2.* A site inspection was completed by the Commission on July 11, 2017.

Condition "s" of Resolution #158/2017 and Resolution #191/2017 states that *Phase 2 shall not be implemented without written authorization confirming that Phase 1 has been completed to the satisfaction of the Commission.* Based on the site inspection carried out by the Commission and the reports submitted by the City of Richmond, it has been

determined that Phase 1 has been completed to the satisfaction of the Commission. Authorization is therefore provided to proceed to Phase 2.

Further correspondence with respect to this application is to be directed to Shawna Wilson (Shawna.Mary.Wilson@gov.bc.ca).

Yours truly,

PROVINCIAL AGRICULTURAL LAND COMMISSION

Per: Shawna Wilson

Kim Grout, Chief Executive Officer

56199m3

Fill site inspections for
ALC Approval #56199 - Garden City Lands, Phase 2
Richmond, BC

Prepared by:

Bruce McTavish, MSc MBA PAg RPBio

Justin McTavish, BSc AAg

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15300 Croydon Drive, Suite #300, Surrey BC V3Z 0Z5
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August 10, 2017

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List of Figures

1.0 Introduction

McTavish Resource & Management Consultants Ltd. (McTavish) was retained by the City of Richmond to carry out weekly inspections for Phase 2 of the Garden City Lands fill project in Richmond BC (Figure 1). This report summarizes fill observations for July 27, 2017 and August 2, 2017.

This report also provides the aggregate soil sample test results for the completion of Phase 1.

Figure 1 Site location

2.0 Methodology

Observations were carried out on July 27, 2017 and August 02, 2017.

The quality of fill and topsoil was based on visual observations during each inspection.

On July 27, 2017 an aggregate soil sample was obtained from the fill/topsoil on the property and delivered to Exova Laboratory Inc. for analysis. Soils were tested for macro and micronutrients, electrical conductivity (EC), organic matter (OM), pH and particle size.

3.0 Observations

The following section provides site observations from inspections on July 27, 2017 and August 2, 2017.

3.1 July 27, 2017

Site observations were completed by Justin McTavish, AAg. No debris was observed in previously deposited soil. Soil being deposited during the time of inspection was free of debris. Soil was hand textured as a sandy loam. An aggregate soil sample was taken from recently deposited soil.

3.2 August 02, 2017

Site observations were completed by Justin McTavish, AAg. Some small pieces of plastic were observed in the topsoil and it was recommended that when surface debris is seen, it be removed. The soil being deposited was consistent with soil observations during previous site visits. The soil being deposited was hand textured as a sandy loam.

4.0 Soil test results

The following section provides soil test results from Phase 1 and Phase 2 of the project.

4.1 Phase 1 final soil test results

Nitrogen and phosphorus are both considered deficient, and potassium is marginal. Sulphur is slightly excessive. All micronutrients are considered optimum except for boron which is marginal. Soil pH is 7.4 or slightly alkaline. EC is 0.59, indicating no issues with salinity. Organic matter (OM) is 1.2%, which is considered low. Soil texture is classified as a sandy loam. Figure 2 provides the laboratory results from the Phase 1 soil testing.

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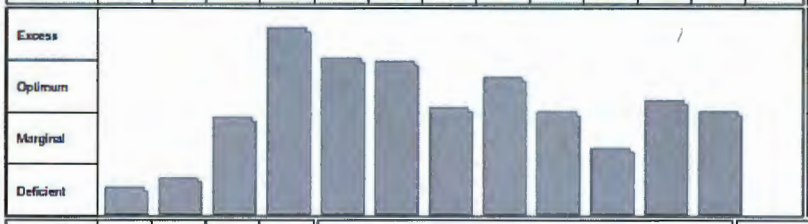
Exova

Farm Soil Analysis

Bill To:	McTavish Resource &	Grower Name:		Lot Number:	1215129
Report To:	McTavish Resource &	Client's Sample Id:		Report Number:	2207266
		Field Id:	Garden City Lands	Date Received:	Jul 18, 2017
	2858 Bayview Street	Acres:		Disposal Date:	Aug 17, 2017
	Surrey, BC., Canada	Legal Location:		Report Date:	Jul 21, 2017
	V4A 2Z4	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	36394				

Nutrient analysis (ppm)														Soil Quality			
Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP	pH	EC(dS/m)	OM(%)	Sample#
0" - 6"	12	11	145	167	1600	276	129	3.8	2	0.5	14.6	12		7.4	0.59	1.2	5781728



Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

Total lbs/acre	23	23	289	333
Estimated lbs/acre	47	23	289	678

Texture *Sandy Loam* Hand Texture *n/a*
Sand 58.4 % Silt 32.0 % Clay 9.9 %
Ammonium n/a
Lime 0 T/ac Buffer pH Not Required Est. N Release n/a K/Mg Ratio n/a

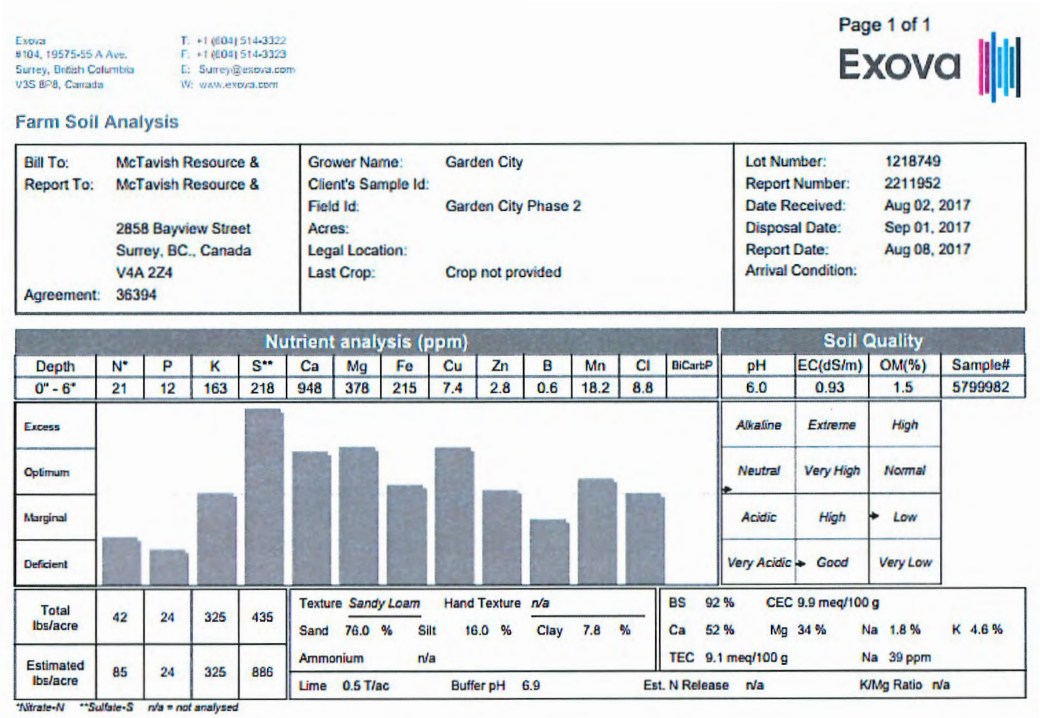
BS 100.0 % CEC 10.8 meq/100 g
Ca 73.9 % Mg 21.0 % Na 1.6 % K 3.4 %
TEC 10.8 meq/100 g Na 40 ppm

*Nitrate-N **Sulfate-S n/a = not analysed

Figure 2 Soil test results end of Phase 1

4.2 Phase 2 soil test results

Nitrogen and phosphorus are both considered deficient, and potassium is marginal. Sulphur is slightly excessive. All micronutrients are considered optimum except for boron, which is marginal. Soil pH is 6.0 or slightly acidic. EC is 0.93 indicating no issues with salinity. Organic matter (OM) is 1.5% which is considered low. Soil texture is classified as a sandy loam. Figure 3 provides the laboratory results from the Phase 2 soil testing.



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Exova

Farm Soil Analysis

Bill To:	McTavish Resource &	Grower Name:	Garden City	Lot Number:	1218749
Report To:	McTavish Resource &	Client's Sample Id:		Report Number:	2211952
		Field Id:	Garden City Phase 2	Date Received:	Aug 02, 2017
	2858 Bayview Street	Acres:		Disposal Date:	Sep 01, 2017
	Surrey, BC., Canada	Legal Location:		Report Date:	Aug 08, 2017
	V4A 2Z4	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	36394				

Nutrient analysis (ppm)														Soil Quality			
Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP	pH	EC(dS/m)	OM(%)	Sample#
0" - 6"	21	12	163	218	948	378	215	7.4	2.8	0.6	18.2	8.8		6.0	0.93	1.5	5799982

Excess		Alkaline	Extreme	High
Optimum		Neutral	Very High	Normal
Marginal		Acidic	High	Low
Deficient		Very Acidic	Good	Very Low

Total lbs/acre	42	24	325	435
Estimated lbs/acre	85	24	325	886

Texture *Sandy Loam* Hand Texture *n/a*
Sand 76.0 % Silt 16.0 % Clay 7.8 %
Ammonium n/a
Lime 0.5 T/ac Buffer pH 6.9

BS 92 % CEC 9.9 meq/100 g
Ca 52 % Mg 34 % Na 1.8 % K 4.6 %
TEC 9.1 meq/100 g Na 39 ppm
Est. N Release n/a K/Mg Ratio n/a

*Nitrate-N **Sulfate-S n/a = not analysed

Figure 3 soil test results phase 2

5.0 Fill Volume

The current truck counts for Phase 2 are:

- 839 tandem trucks
- 126 tri-tandem trucks

Assuming about 8 m^3 per load for tandem trucks and about 12 m^3 per load for tri-tandem trucks, the calculated amount of fill on the property as of July 27, 2017 was 8,224 m^3.

6.0 Summary

Soil being deposited on Phase 2 was similar to Phase 1 with slight variations in soil texture. Phase 2 soils contained more organic matter, and slightly more sand. Some minor plastic debris was observed in the fill and it was advised that it should be removed.

Appendix I Site photographs

Figure 4 Soil being deposited July 27,2017

Figure 5 Topsoil stockpile July 27, 2017

Figure 6 Soil profile July 27, 2017

Figure 7 Phase 2 extent of fill August 2, 2017

Figure 8 Phase 2 extent of fill August 2, 2017

From: Wilson, Shawna Mary ALC:EX <Shawna.Mary.Wilson@gov.bc.ca>
Sent: Tuesday, 29 August 2017 08:54
To: Kurnicki,Alexander
Cc: Glavas, Katarina ALC:EX; Morin,Mike
Subject: ALC File 56199: Garden City Lands Inspection August 9

Good morning Alex,

South Coast Panel Vice Chair Bill Zylmans and South Coast Commissioner Sam Wind carried out a site inspection of ALC file 56199 – Garden City Lands on August 9, 2017. The general concerns identified during the inspection were as follows:

- the size and amount of stones
- the fertility and composition of the soil; specifically that the soil did not appear to be from Sea Island and contained a minimal amount of organic matter and a high amount of sand
- an increase in height from the current elevation

The general points of discussion were as follows:

- progress from Phase I to Phase II should be paused until Phase I fill area is proven to be productive
- compost and a cover crop should be used on the existing fill area and worked into the fill in order to make it productive
- caution should be used to ensure that soil and topography accommodate a wide variety of crops
- site should be crowned for drainage purposes
- quality controls must be implemented for future fill coming to the site

Based on the site visit conducted on August 9, 2017 and laboratory results provided on August 11, 2017, the Agricultural Land Commission (ALC) finds that the City of Richmond is not meeting condition "a" of Resolution #158/2017 that indicates that topsoil must have an organic content of greater than 2% up to 20%. In order to comply with the Resolution, the ALC requires that the City of Richmond complete the following:

- Scrape back approximately 30 cm of the existing fill
- Import 30 cm of undisturbed topsoils sourced from Richmond and place this material on top of the remaining fill

The fill removed from Phase I may be spread onto Phase II lands; however, please note that any fill material placed on Phase II lands that does not adhere to the soil quality guidelines outlined in Resolution #158/2017 will also require the placement of additional topsoil. The ALC will require the City of Richmond to provide information regarding the quality of locally sourced topsoil (photographs, soil test pit information, laboratory data, etc.) **prior to being placed over the existing fill**.

In addition to the soil criteria provided with the application, we also attach topsoil quality criteria for your reference which provides additional quality criteria. Please note that as mentioned in an e-mail dated August 21, 2017 the ALC generally recommends that topsoil should have a texture no coarser than sandy loam or finer than silt loam and contain no coarse fragments.

Rating/Property	Good (G)	Fair (F)	Poor (P)
Reaction (pH)	>5.0 to 7.5	4.0 to 5.0 & 7.6 to 8.4	3.5 to 4.0 & 8.5 to 9.0
Salinity (EC) (dSM)	<2	2 to 4	4 to 8
Sodicity (SAR)	<4	4 to 8	8 to 12
Saturation (%)	30 to 60	20 to 30, 60 to 80	15 to 20, 80 to 120
Stoniness	Class 1, 2	Class 3,4	Class 5,6
Total coarse fragments (% volume	<10%	11 to 40%	41 to 90%

2 mm to 75 mm diameter)			
Cobbles and Stones (% volume > 75 mm diameter)	<1%	2 to 15%	16 to 80%
Texture	Fine Sandy Loam, Loam, Sandy Loam, Silt Loam	Clay Loam, Sandy Clay Loam, Silt Clay Loam	Sand, Loamy Sand, Sandy Clay, Silt Clay, Clay, Heavy Clay
Moist Consistency	very friable, friable	loose	firm, very firm
Organic Carbon %	2 to 17	1 to 2	<1
Equivalent Organic Matter %	3.4 to 30	1.7 to 3.4	<1.7

If you have any questions or require clarification, please contact the ALC.

Thank you,

Shawna Wilson, MSc
Land Use Planner - South Coast Region
Agricultural Land Commission
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McTAVISH
RESOURCE & MANAGEMENT
CONSULTANTS LTD.

Soil quality investigation
Garden City Lands, Richmond BC
ALC Approval #56199

Prepared by:

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Executive summary

The following report has been prepared for the City of Richmond's Garden City Lands due to concerns expressed by the Agricultural Land Commission (ALC) with respect to soil texture and coarse fragments (stones) in the soil. McTavish Resource & Management Consultants (McTavish) installed 28 soil pits which were aggregated into 9 samples for lab testing. Each aggregate sample was sieved to determine coarse fragment content % by volume. Soil test results have been compared to the ALC soil quality guideline as outlined in Resolution 158/2017 as well as Kwantlen Polytechnic University's (KPU) Soil Quality Guidelines.

Executive summary Table 1 summarizes aggregate soil test results and compares them to the ALC and KPU's Guidelines for Topsoil Quality. The Garden City Lands soils meet the good to fair criteria for all parameters except organic matter and electrical conductivity (EC). The soils can be amended to meet the "good" criteria for each parameter of topsoil quality through the incorporation of peat or other organic matter into the soil profile. McTavish recommends well-decomposed peat (H5-H8 on the Van Post Scale for humification) to increase the organic matter of the soils to at least 3.5%.

Coarse fragment % meets the criteria for "good" and there will not be issues with crop establishment or cultivation due to rocks in the soil.

Executive Summary Table 1
Comparison of soil test quality criteria for total aggregate sample with BC Agriculture Land Commission Guidelines and Kwantlen Guidelines.

Soil test parameters	Total aggregate results	ALC Guideline ("good")	Kwantlen Guideline	Quality
Reaction (pH)	7	>5.0 to 7.5	-	Good
Salinity measured by EC (dS/m)	2	<2	-	Fair
Sodicity (SAR)	1.36	<4	-	Good
Organic matter (%)	1*	3.4-30	2-20	**Poor**
Coarse fragments (%)	7*	<10	-	Good
Cobbles and stones (%)	<1		-	Good
Soil texture	Sandy loam	fine sandy loam, loam, sandy loam, silt loam	clay content: <20% sand content: >20%	Good

*Results for total coarse fragments, cobbles, and stones given as the average value from transects Q1-Q9.

1.0 Introduction

McTavish Resource Management Consultants (McTavish) has been retained by the City of Richmond (Figure 1) to carry out weekly inspections for Phase 1 and Phase 2 of the Garden City Lands fill project in Richmond BC (see Figure 1 for site location). This report has been prepared in response to concerns raised by the ALC with respect to soil quality deposited on the property. To address the ALC concerns, McTavish Resource & Management Consultants (McTavish) sampled 28 soil pits which were aggregated into 9 samples for lab testing. Each aggregate sample was sieved to determine coarse fragment content % by volume. Soil test results have been compared to the ALC soil quality guideline outlined in Resolution 158/2017 as well as Kwantlen Polytechnic University (KPU) Soil Quality Guidelines.

Figure 1 Site location

2.0 Methodology

Soil sampling from the Garden City fill project was carried out on August 31, 2017. The strategy developed by McTavish established nine transect sampling regions (Q1-Q9) from north to south across the landscape (Figure 2). Within each transect three soil pits were installed, and soils from each

individual transect were aggregated into nine composite samples (Q1-Q9) for lab analysis. An additional composite sample was prepared by incorporating material from all nine transects and were reported as *total aggregate* (TA).

Aggregate samples taken from each transect were mixed in a pail and sieved to determine % coarse fragments by volume. Soil was then poured into a 400ml beaker and sieved through a size 2 sieve (3.24 mm) followed by a size 12 sieve (1.68 mm). Coarse fragments from each sieve were then measured on a volumetric basis.

Soil analysis for all samples were performed by Exova Laboratories in Surrey BC. For each sample, nutrient analysis was carried out for nitrogen (N), phosphorus (P), potassium (K), and sulfur (S) content. The TA sample was also tested for sodium (Na), calcium (Ca), magnesium (Mg), iron (Fe), copper (Cu), zinc (Zn), boron (B), manganese (Mn), and chloride (Cl) content. Soil chemical and physical properties were tested for all soils, and included pH, electrical conductivity (EC), organic matter (OM) content, and soil texture.

Soil test results were compared to the ALC topsoil criteria[1] (Table 1), as well as to KPU's topsoil criteria.

2.1 KPU topsoil guidelines

Soil texture requirements

Soil texture criteria were defined to ensure that the imported soil will be well suited to the production of agricultural crops. These criteria have also taken into account the attributes of the Garden City Lands site.

Required soil characteristics:

- Soil will be placed over a predominantly organic soil and consideration must be given to the transition between the soil cap and native soil.
- Hydrological characteristics of the site will require well-draining soil
- Due to the large volume of soil required KPU topsoil criteria are flexible to accommodate the need to source material from multiple sites .

Soil texture criteria required to meet the above characteristics:

- Organic content: 2- 20%
- Clay content of the soil: <20 %
- Sand content: >20% (This rules out soils that will cause a mixing problem, eg 20% clay and 80% silt

[1] Email correspondence from Shawna Wilson, Land Use Planner - South Coast Region, August 29, 2017.

Table 1 Parameters and ratings for topsoil quality criteria per BC Agricultural Land Commission Criteria

Rating/property	Good (G)	Fair (F)	Poor (P)	Unsuitable (U)
Reaction (pH)	5.0 - 7.5	4.0 - 5.0; 7.6 - 8.4	3.5 - 4.0; 8.5 to 9.0	<3.5; >9.0
Salinity[a] (dS/m)	<2	2 - 4	4 - 8	>8
Sodicity[b] (SAR)	<4	4 - 8	8 - 12	>12
Saturation (%)	30 - 60	20 – 30; 60 - 80	15 – 20; 80 - 120	<15; >120
Stoniness	Class 1, 2	Class 3,4	Class 5,6	Class 7
Coarse fragments[c] (%)	<10	11 - 40	41 - 90	>90
Cobbles and stones[d] (%)	<1	2 - 15	16 - 80	>80
Texture	fine sandy loam loam sandy loam silt loam	clay loam sandy clay loam silt clay loam	sand loamy sand sandy clay silt clay clay heavy clay	
Moist consistency	friable/ very friable	loose	firm/ very firm	extremely firm
Organic matter (%)	3.4 - 30	1.7 - 3.4	<1.7	

[a]Measured as electrical conductivity (EC).
[b]Measured as sodium adsorption ratio (SAR) and defined as SAR = $[Na^+]/([Ca^{2+}] + [Mg^{2+}])^{1/2}$.
[c]Total coarse fragments reported as % volume of material with diameter measuring 2 - 75 mm.
[d]Cobbles and stones reported as % volume of material with diameter measuring >75 mm.

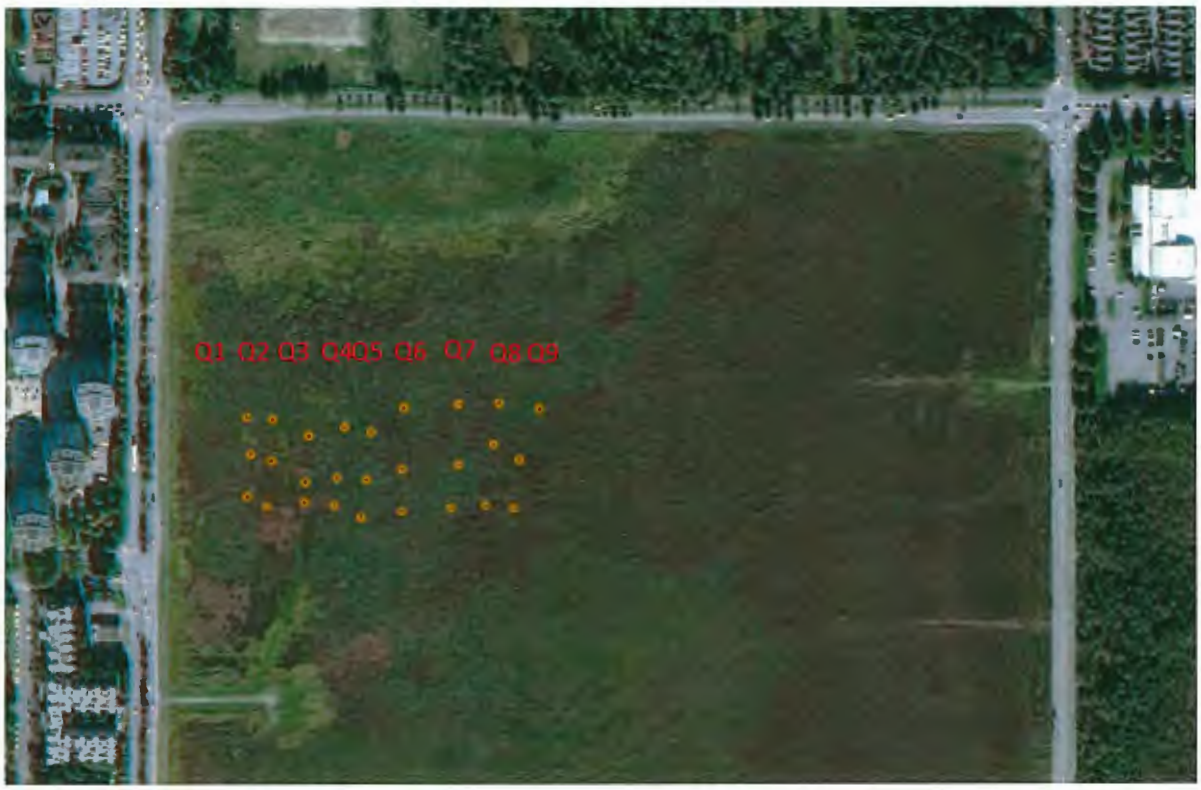


Figure 2 Soil pit locations

3.0 Soil test results

Soil test results for each transect (Q1-Q9) and the total aggregate composite (TA) are summarized in Table 2. Individual soil quality parameters as outlined by the ALC and KPU topsoil quality criteria guidelines are discussed in this section. The results of nutrient analyses are provided in Table 2. The test results compared to the ALC and KPU Soil Quality Guidelines are provided in Table 3.

Table 2 Soil chemical and physical properties for Garden City fill project

	Sample ID									
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	TA
Soil Quality Criteria										
Reaction (pH)	7.4	7.4	7.6	7.5	7.1	7.2	6.8	6.8	6.0	7.0
Salinity (dS/m)	2.63	1.90	3.07	2.99	2.92	2.37	1.20	0.63	2.10	2.00
Sodicity (SAR)	–	–	–	–	–	–	–	–	–	1.36
Organic matter (%)	0.3	0.3	0.5	0.3	1.1	1.4	1.5	1.6	1.7	0.9
Coarse fragments (%)	<1	7	7	7	7	7	3	14	4	
Cobbles and stones (%)	>1	>1	>1	>1	>1	>1	>1	>1	>1	>1
Texture										
Sand (%)	72.4	79.4	70.4	80.0	64.0	59.4	54.4	55.4	50.4	66.4
Silt (%)	23.0	16.0	25.0	17.0	29.0	33.0	36.0	35.0	38.0	28.0
Clay (%)	4.7	4.7	4.7	3.0	7.3	8.2	10.3	9.9	11.7	6.4
Soil Class	Sandy loam	Loamy sand	Sandy loam	Loamy sand	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Loam	Sandy loam
Nutrient Analyses										
N (ppm)	12	10	19	11	25	26	25	33	26	21
P (ppm)	9	7	9	7	11	10	7	8	8	8
K (ppm)	128	112	139	117	166	167	153	171	166	152
S (ppm)	820	731	918	>1000	770	546	276	160	486	710
Na(ppm)	–	–	–	–	–	–	–	–	–	62
Ca (ppm)	–	–	–	–	–	–	–	–	–	1710
Mg (ppm)	–	–	–	–	–	–	–	–	–	357
Fe (ppm)	–	–	–	–	–	–	–	–	–	84
Cu (ppm)	–	–	–	–	–	–	–	–	–	4
Zn (ppm)	–	–	–	–	–	–	–	–	–	2
B (ppm)	–	–	–	–	–	–	–	–	–	0.6
Mn (ppm)	–	–	–	–	–	–	–	–	–	11
Cl (ppm)	–	–	–	–	–	–	–	–	–	29

Table 3 Soil quality results compared to ALC and KPU guidelines

Soil test parameter	Total Aggregate Result	ALC Guideline (Good)	Kwantlen Guideline	Quality
Reaction (pH)	7	>5.0 to 7.5	-	Good
Electrical Conductivity (dS/m)	2	<2	-	Fair
Sodicity (SAR)	1.36	<4	-	Good
Organic matter (%)	1*	3.4-30	2-20	**Poor**
Coarse fragments (%)	7*	<10	-	Good
Cobbles and stones (%)	<1		-	Good
Soil texture	sandy loam	fine sandy loam, loam, sandy loam, silt loam	clay content: <20% sand content: >20%	Good

*Results for total coarse fragments, cobbles, and stones given as the average value from transects Q1-Q9.

3.1 Soil pH

Soil pH was relatively stable across the transects, and ranged from 6.0 to 7.6 (Table 2 & Figure 3). These pH ranges are suitable for a wide range of crop production. All samples had pH values within ALC quality guidelines for good soils except that of Q3, where slightly elevated pH reduced the rating to fair. Depending on crop choice, soil pH should be adjusted to meet crop requirements. This can be achieved using applications of lime or elemental sulfur.

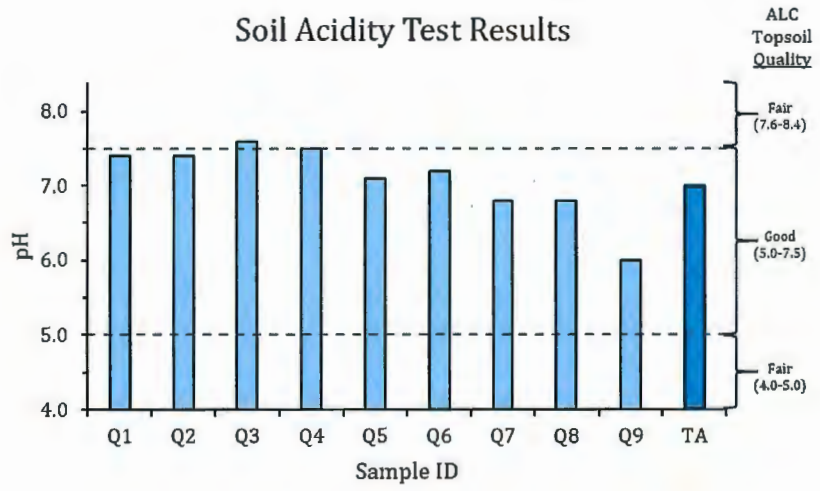


Figure 3 Soil acidity comparison

3.2 Electrical conductivity (EC)

Soil EC is a measure of the amount of solubilized salts in soil (salinity). EC measured on the Garden City Project ranges from 0.63 to 3.07 dS/m (Table 2 & Figure 4). These results are rated as fair to good soil quality based on the ALC Soil Guidelines (Table 2).

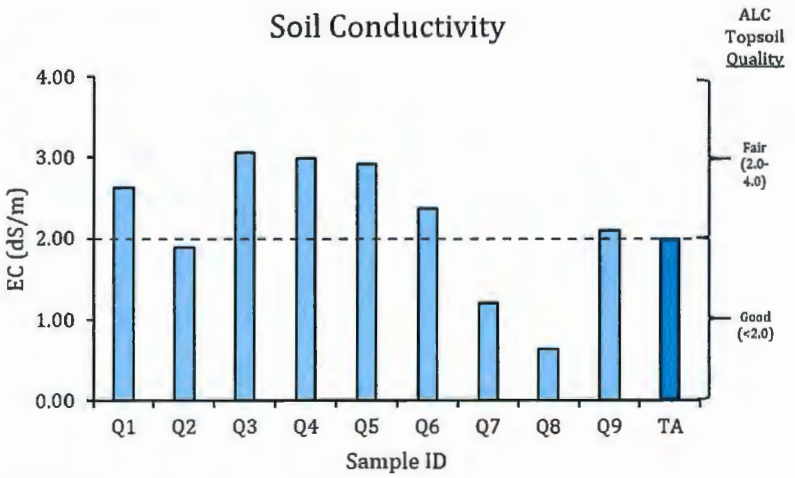


Figure 4 Soil conductivity comparison

3.3 Sodicity

Soil sodicity is a proxy which evaluates the status of sodium in solution and within exchangeable phases on soil material. This parameter is measured through the comparison of sodium, calcium, and magnesium concentrations. These cations were measured as the sodium adsorption ratio (SAR) only for the total aggregate sample (TA). The Garden City fill site total aggregate sample has a SAR of 1.36 (Table 2), well within the ALC soil guidelines considered for good soil (<4; Table 2).

3.4 Organic matter (OM)

Organic matter content ranges from 0.3 to 1.7% (Table 2 & Figure 5). Apart from Q9, which is rated as fair quality, the soils across the fill site have poor organic matter content. Low organic matter content in soils can be remediated by the additional of organic matter via organic soil amendments/conditioners such as compost, manure, organic enriched soil (peat) or incorporation of cover crops.

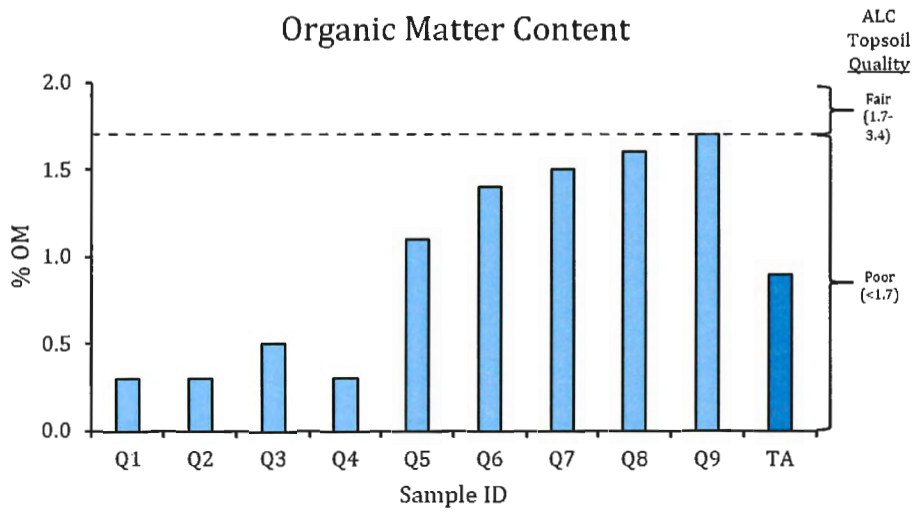


Figure 5 Organic matter content comparison

3.5 Coarse fragments, cobbles, and stones

Cobbles and stones (reported as % volume of material with diameter measuring >75mm) for all samples were found at <1% (Table 2) and are within ALC topsoil criteria for good soils. Total coarse fragments (reported as % volume of material with diameter measuring 2-75 mm) are at or below 7% throughout the fill site, except for transect Q8 with coarse fragment content of 14% (Table 2). The coarse fragment content for these soils meet the ALC topsoil criteria for good soils (<10% coarse fragments) except for transect Q8 which was considered fair (11-40% coarse fragments).

3.6 Soil texture

Soil texture is predominantly sandy loam to loam which falls within the ALC quality guideline for good soils (Table 2). However, toward the western region of the fill site two transects (Q2 and Q4) have loamy sand soil texture which is considered poor by ALC guidelines. Poor soil texture as defined by the ALC soil quality guideline can cause issues with water holding capacity, cation exchange capacity and soil fertility. These factors can be remediated by incorporating organic material into the soil profile and through crop irrigation.

3.7 Nutrient analysis

Soil nutrients analyzed for each soil included nitrogen, phosphorus, potassium, and sulfur, and are summarized in Table 2. Additional tests for sodium (Na), calcium (Ca), magnesium (Mg), iron (Fe), copper (Cu), zinc (Zn), boron (B), manganese (Mn), and chloride (Cl) content were performed for the TA sample. Primary soil nutrient content (N, P, and K) was found to be marginal to deficient for all soils ranging from 10 to 33 ppm, 7 to 11 ppm, and 112 to 171 ppm for N, P, and K respectively. Sulfur content within all soils was found to be in excess ranging from 153 to >1000 ppm. The additional analyses performed for the total aggregate sample revealed relatively optimal levels for most of the nutrients tested (Table 2). However, Ca and Mg content were found to approach excess levels (1710 and 357 ppm respectively) while sodium content was found to be relatively low (62 ppm).

3.8 Statistical analysis

The TA composite sample was tested for any significant differences using a one-sample t-test to compare analysis parameters against their respective mean values from the transect samples (Q1-Q9). A level of significance $\alpha = 0.05$ was used to confirm the hypothesis that no significant difference in soil quality criteria existed between the transects and the TA. Thus the TA sample was considered representative of the whole landscape with respect to soil quality and content.

4.0 Summary and Recommendations

Soils located on the Garden City property meet the ALC guidelines for topsoil, with the exception of organic matter which is classified as poor. This topsoil parameter can easily be remediated by incorporating organic-rich material into the soil profile. McTavish recommends that well decomposed peat (H5-H8 on the Van Post scale for humification[2]) be deposited on the site to increase the organic matter % to at least 3.5%. McTavish understands that Richmond has a source of peat which meets this criterion.

Appendix III provides recommended importation volumes of organic soils to achieve the guideline % of organic matter for the Garden City project.

Electrical conductivity in some of the samples was considered fair. Salinity issues are rarely a problem in the lower mainland due to significant amounts of precipitation throughout the year. The combination of

[2] http://www.d.umn.edu/~pfarrell/Soils/THE%20VON%20POST%20SCALE%20OF%20HUMIFICATION.pdf

coarse textured soils, irrigation and precipitation will flush any excess salts from the soils located on Garden City and is not a concern.

Nutrient analysis for all soils revealed marginal to deficient levels for primary nutrients N, P, and K. However, with organic matter additions these levels are expected to increase. Amendments suited to crop choice will be required upon completion of the project. The anomalously high levels of sulfur observed for each sample will likely require little intervention because excess amounts of this nutrient do not pose a danger to crops, and will decrease naturally over time via leaching and volatilization. However, high levels of sulfur may affect the flavour of certain crops, so cover crops such as alfalfa with high uptake affinity for sulphur should be considered.

Coarse fragment content in the soils of Garden City meets the criteria for good, and will not pose a problem for crop establishment or cultivation. If required, Richmond can use a rock picker attachment on a skid steer or tractor to further reduce the coarse fragments in the soil profile.

Appendix I Site photographs

Number 12 sieve Q1

Number 2 sieve Q1

Number 2 sieve Q2

Number 12 sieve Q2

Number 2 sieve Q3

Number 12 sieve Q3

Number 2 sieve Q4

Number 12 sieve Q4

Number 2 sieve Q5

Number 12 sieve Q5

Number 3 sieve Q6

Number 12 sieve Q6

Number 2 sieve Q7

Number 12 sieve Q7

Number 2 sieve Q9

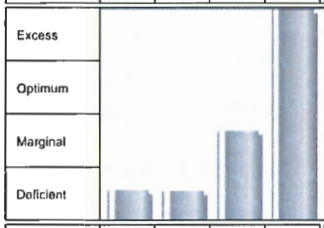
Number 12 sieve Q9

Appendix II Soil test results

Bill To:	McTavish Resource &	Grower Name:		Lot Number:	1223854
Report To:	McTavish Resource &	Client's Sample Id:	Q1 Richmond	Report Number:	2218667
		Field Id:		Date Received:	Aug 31, 2017
	2858 Bayview Street	Acres:		Disposal Date:	Sep 30, 2017
	Surrey, BC., Canada	Legal Location:		Report Date:	Sep 06, 2017
	V4A 2Z4	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	36394				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	12	9	128	820									
Total lbs/acre	23	17	256	1639									
Estimated lbs/acre	47	17	256	3338									



Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
7.4	2.63	0.3	5824602

Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

Texture *Sandy Loam* Hand Texture *n/a*
Sand 72.4 % Silt 23.0 % Clay 4.7 %
Ammonium n/a

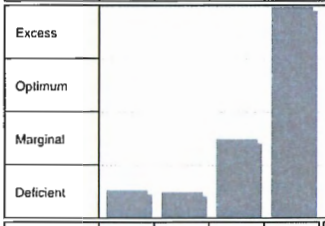
BS n/a CEC n/a
Ca n/a Mg n/a Na n/a K n/a
TEC n/a Na n/a

Lime n/a Buffer pH n/a Est. N Release n/a K/Mg Ratio n/a

Bill To:	McTavish Resource &	Grower Name:		Lot Number:	1223854
Report To:	McTavish Resource &	Client's Sample Id:	Q2 Richmond	Report Number:	2218668
		Field Id:		Date Received:	Aug 31, 2017
	2858 Bayview Street	Acres:		Disposal Date:	Sep 30, 2017
	Surrey, BC., Canada	Legal Location:		Report Date:	Sep 06, 2017
	V4A 2Z4	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	36394				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	10	7	112	731									
Total lbs/acre	21	15	225	1461									
Estimated lbs/acre	43	15	225	2976									



Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
7.4	1.9	0.3	5824612

Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

Texture *Loamy Sand* Hand Texture *n/a*
Sand 79.4 % Silt 16.0 % Clay 4.7 %
Ammonium n/a

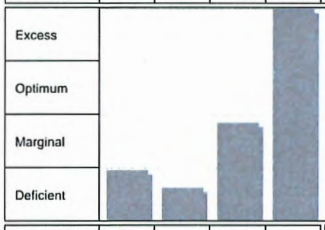
BS n/a CEC n/a
Ca n/a Mg n/a Na n/a K n/a
TEC n/a Na n/a

Lime n/a Buffer pH n/a Est. N Release n/a K/Mg Ratio n/a

Bill To:	McTavish Resource &	Grower Name:		Lot Number:	1223854
Report To:	McTavish Resource &	Client's Sample Id:	Q3 Richmond	Report Number:	2218669
		Field Id:		Date Received:	Aug 31, 2017
	2858 Bayview Street	Acres:		Disposal Date:	Sep 30, 2017
	Surrey, BC., Canada	Legal Location:		Report Date:	Sep 06, 2017
	V4A 2Z4	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	36394				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	19	9	139	918									
Total lbs/acre	38	19	279	1836									
Estimated lbs/acre	77	19	279	3738									



Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
7.6	3.07	0.5	5824613

Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

Texture *Sandy Loam* Hand Texture *n/a*
Sand 70.4 % Silt 25.0 % Clay 4.7 %
Ammonium n/a
Lime n/a Buffer pH n/a

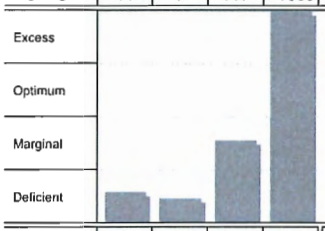
BS n/a CEC n/a
Ca n/a Mg n/a Na n/a K n/a
TEC n/a Na n/a
Est. N Release n/a K/Mg Ratio n/a

*Nitrate-N **Sulfate-S n/a = not analysed

Bill To:	McTavish Resource &	Grower Name:		Lot Number:	1223854
Report To:	McTavish Resource &	Client's Sample Id:	Q4 Richmond	Report Number:	2218670
		Field Id:		Date Received:	Aug 31, 2017
	2858 Bayview Street	Acres:		Disposal Date:	Sep 30, 2017
	Surrey, BC., Canada	Legal Location:		Report Date:	Sep 06, 2017
	V4A 2Z4	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	36394				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	11	7	117	>1000									
Total lbs/acre	23	14	234	2000									
Estimated lbs/acre	47	14	234	4073									



Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
7.5	2.99	0.3	5824614

Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

Texture *Loamy Sand* Hand Texture *n/a*
Sand 80 % Silt 17 % Clay 3.0 %
Ammonium n/a
Lime n/a Buffer pH n/a

BS n/a CEC n/a
Ca n/a Mg n/a Na n/a K n/a
TEC n/a Na n/a
Est. N Release n/a K/Mg Ratio n/a

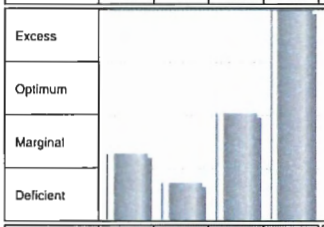
Bill To:	McTavish Resource &	Grower Name:		Lot Number:	1223854
Report To:	McTavish Resource &	Client's Sample Id:	Q5 Richmond	Report Number:	2218671
		Field Id:		Date Received:	Aug 31, 2017
	2858 Bayview Street	Acres:		Disposal Date:	Sep 30, 2017
	Surrey, BC., Canada	Legal Location:		Report Date:	Sep 06, 2017
	V4A 2Z4	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	36394				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	25	11	166	770									
Total lbs/acre	49	22	332	1540									
Estimated lbs/acre	100	22	332	3137									

Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
7.1	2.92	1.1	5824615



Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

Texture *Sandy Loam* Hand Texture *n/a*
Sand 64.0 % Silt 29.0 % Clay 7.3 %
Ammonium n/a

BS n/a CEC n/a
Ca n/a Mg n/a Na n/a K n/a
TEC n/a Na n/a

Lime n/a Buffer pH n/a Est. N Release n/a K/Mg Ratio n/a

*Nitrate-N **Sulfate-S n/a = not analysed

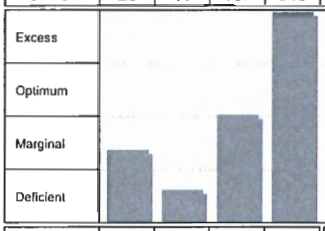
Bill To:	McTavish Resource &	Grower Name:		Lot Number:	1223854
Report To:	McTavish Resource &	Client's Sample Id:	Q6 Richmond	Report Number:	2218672
		Field Id:		Date Received:	Aug 31, 2017
	2858 Bayview Street	Acres:		Disposal Date:	Sep 30, 2017
	Surrey, BC., Canada	Legal Location:		Report Date:	Sep 06, 2017
	V4A 2Z4	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	36394				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	26	10	167	546									
Total lbs/acre	53	19	333	1092									
Estimated lbs/acre	107	19	333	2224									

Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
7.2	2.37	1.4	5824616



Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

Texture *Sandy Loam* Hand Texture *n/a*
Sand 59.4 % Silt 33.0 % Clay 8.2 %
Ammonium n/a

BS n/a CEC n/a
Ca n/a Mg n/a Na n/a K n/a
TEC n/a Na n/a

Lime n/a Buffer pH n/a Est. N Release n/a K/Mg Ratio n/a

*Nitrate-N **Sulfate-S n/a = not analysed

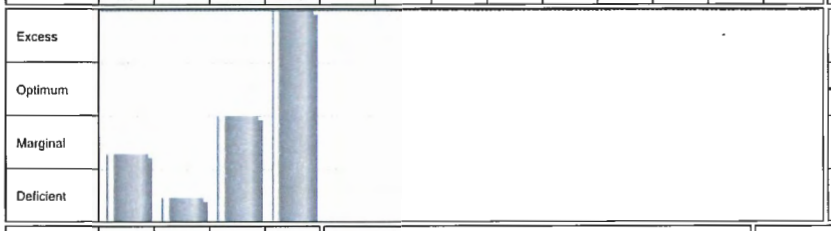
Bill To:	McTavish Resource &	Grower Name:		Lot Number:	1223854
Report To:	McTavish Resource &	Client's Sample Id:	Q7 Richmond	Report Number:	2218673
		Field Id:		Date Received:	Aug 31, 2017
	2858 Bayview Street	Acres:		Disposal Date:	Sep 30, 2017
	Surrey, BC., Canada	Legal Location:		Report Date:	Sep 06, 2017
	V4A 2Z4	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	36394				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	25	7	153	276									

Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
6.8	1.2	1.5	5824617



Alkaline	*Extreme*	*High*		
→ *Neutral*	*Very High*	*Normal*		
Acidic	*High*	→ *Low*		
Very Acidic	→ *Good*	*Very Low*		

Total lbs/acre	49	14	307	552
Estimated lbs/acre	101	14	307	1124

Texture *Sandy Loam* Hand Texture *n/a*
Sand 54.4 % Silt 36.0 % Clay 10.3 %
Ammonium n/a

BS n/a CEC n/a
Ca n/a Mg n/a Na n/a K n/a
TEC n/a Na n/a

Lime n/a Buffer pH n/a Est. N Release n/a K/Mg Ratio n/a

*Nitrate-N **Sulfate-S n/a = not analysed

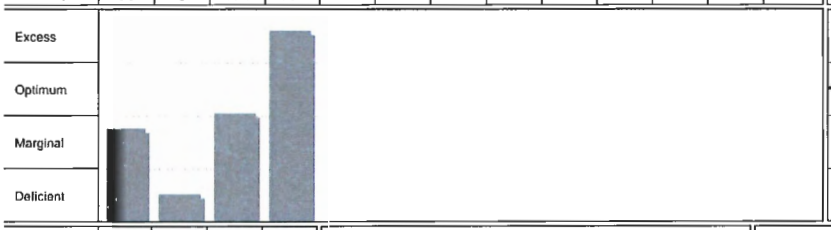
Bill To:	McTavish Resource &	Grower Name:		Lot Number:	1223854
Report To:	McTavish Resource &	Client's Sample Id:	Q8 Richmond	Report Number:	2218674
		Field Id:		Date Received:	Aug 31, 2017
	2858 Bayview Street	Acres:		Disposal Date:	Sep 30, 2017
	Surrey, BC., Canada	Legal Location:		Report Date:	Sep 06, 2017
	V4A 2Z4	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	36394				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	33	8	171	160									

Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
6.8	0.63	1.6	5824618



Alkaline	*Extreme*	*High*		
→ *Neutral*	*Very High*	*Normal*		
Acidic	*High*	→ *Low*		
Very Acidic	→ *Good*	*Very Low*		

Total lbs/acre	66	16	343	320
Estimated lbs/acre	134	16	343	652

Texture *Sandy Loam* Hand Texture *n/a*
Sand 55.4 % Silt 35.0 % Clay 9.9 %
Ammonium n/a

BS n/a CEC n/a
Ca n/a Mg n/a Na n/a K n/a
TEC n/a Na n/a

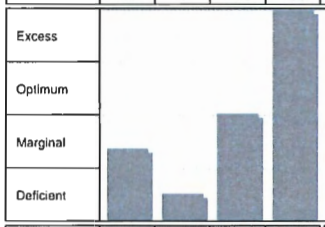
Lime n/a Buffer pH n/a Est. N Release n/a K/Mg Ratio n/a

*Nitrate-N **Sulfate-S n/a = not analysed

Bill To:	McTavish Resource &	Grower Name:		Lot Number:	1223854
Report To:	McTavish Resource &	Client's Sample Id:	Q9 Richmond	Report Number:	2218675
		Field Id:		Date Received:	Aug 31, 2017
	2858 Bayview Street	Acres:		Disposal Date:	Sep 30, 2017
	Surrey, BC., Canada	Legal Location:		Report Date:	Sep 06, 2017
	V4A 2Z4	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	36394				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	26	8	166	486									
Total lbs/acre	53	16	332	972									
Estimated lbs/acre	107	16	332	1980									



Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
6.0	2.10	1.7	5824619

Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

Texture *Loam* Hand Texture *n/a*
Sand 50.4 % Silt 38.0 % Clay 11.7 %
Ammonium n/a

BS n/a CEC n/a
Ca n/a Mg n/a Na n/a K n/a
TEC n/a Na n/a

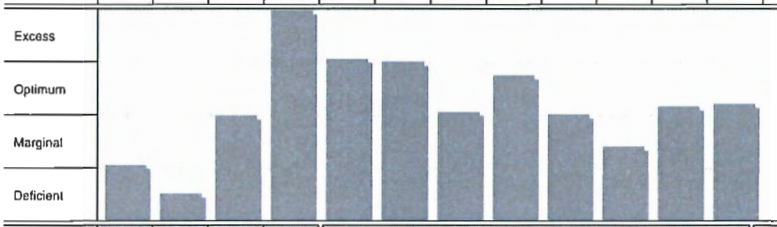
Lime n/a Buffer pH n/a Est. N Release n/a K/Mg Ratio n/a

*Nitrate-N **Sulfate-S n/a = not analysed

Bill To:	McTavish Resource &	Grower Name:		Lot Number:	1223854
Report To:	McTavish Resource &	Client's Sample Id:	Total Aggregate Richmond	Report Number:	2218676
		Field Id:		Date Received:	Aug 31, 2017
	2858 Bayview Street	Acres:		Disposal Date:	Sep 30, 2017
	Surrey, BC., Canada	Legal Location:		Report Date:	Sep 06, 2017
	V4A 2Z4	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	36394				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	21	8	152	710	1710	357	84.3	4.0	2	0.6	10.7	29	
Total lbs/acre	42	16	305	1420									
Estimated lbs/acre	85	16	305	2891									



Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
7.0	2.0	0.9	5824620

Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

Texture *Sandy Loam* Hand Texture *n/a*
Sand 66.4 % Silt 29.0 % Clay 6.4 %
Ammonium n/a

BS 100.0 % CEC 12.1 meq/100 g
Ca 70.3 % Mg 24.2 % Na 2.2 % K 3.2 %
TEC 12.1 meq/100 g Na 62 ppm

Lime 0 T/ac Buffer pH Not Required Est. N Release n/a K/Mg Ratio n/a

*Nitrate-N **Sulfate-S n/a = not analysed

Appendix III Organic matter volume recommendations

The addition of peat as an amendment to low organic matter content in the Garden City fill project soils must take into consideration the bulk density of the soil and the peat additions as well as the organic matter content of both. A simple metric to determine the proper mixing ratio is given below:

$$OM_{final} = \frac{(BD_{soil} \times OM_{soil} \times r) + (BD_{peat} \times OM_{peat} \times (1 - r))}{(BD_{soil} \times r) + (BD_{peat} \times (1 - r))}$$

where, $\mathbf{OM_x}$ is the organic matter content by weight of the soil, peat, and final consolidated mixture respectively

$\mathbf{BD_x}$ is the bulk density of the soil or peat, respectively

and **r** is the mixing ratio of soil-to-peat by volume chosen for the fill site.

The bulk density of sandy loam soils, such as those used for the Garden City fill site, have been estimated based on laboratory data by the US Department of Agriculture to typically range between 1.5-1.6 g/cm^3. Various types of peats can exhibit a range of bulk densities with typical Canadian sphagnum peats possessing a bulk density of 0.13. Other forms of peat may exhibit higher bulk densities and the example for reed-sedge derived peat has been considered here as well with both recommendations calculated below (Table 1). Volume of peat additions are calculated based on incorporation to a depth of 30 cm within the fill site soils. It is recommended that the material be incorporated with a disk or plough within the top 30cm of the soil profile

Table 1
Mixing ratios and calculated peat additions (m^3/acre) based on typical sandy loam and peat bulk densities with measured organic matter content for the Garden City fill site and Richmond peat samples.

	Soil Properties		Peat Properties				Final Mix	
Mixing Ratio (soil:peat)	BD_{soil} (g/cm^3)	OM_{soil} (%)	Class	BD_{peat} (g/cm^3)	OM_{peat} (%)	Volume Added (m^3/acre)	OM_{final} (%)	Increased Depth (cm)
Richmond Peat Sample 1								
75:25	1.55	0.9	sphagnum	0.13	77.8	304	3.0	7.5
70:30	1.55	0.9	sphagnum	0.13	77.8	364	3.6	9.0
85:15	1.55	0.9	reed-sedge	0.23	77.8	182	2.9	4.5
80:20	1.55	0.9	reed-sedge	0.23	77.8	243	3.7	6.0
Richmond Peat Sample 2								
75:25	1.55	0.9	sphagnum	0.13	85.5	304	3.2	7.5
70:30	1.55	0.9	sphagnum	0.13	85.5	364	3.8	9.0
85:15	1.55	0.9	reed-sedge	0.23	85.5	182	3.1	4.5
80:20	1.55	0.9	reed-sedge	0.23	85.5	243	3.9	6.0

Richmond Peat Sample 3								
75:25	1.55	0.9	sphagnum	0.13	85.9	304	3.2	7.5
70:30	1.55	0.9	sphagnum	0.13	85.9	364	3.8	9.0
85:15	1.55	0.9	reed-sedge	0.23	85.9	182	3.1	4.5
80:20	1.55	0.9	reed-sedge	0.23	85.9	243	3.9	6.0

The final bulk density of the fill soil will depend on the weighted average of the existing soil and the peat additions, likely settling between 1.1 to 1.4 g/m^3. Settlement and compaction over time may increase this metric which will be dependent on several factors including soil porosity, water table depth, and the existing bulk density of previous surface material from the fill site prior to excavation. Additionally, it is recommended that peat addition be applied moist to mitigate initial compaction due to water retention of dry material. The expected increase in depth (Table 1) suggests the final fill height following peat addition will increase by 4.5 to 9.0 cm. However, incorporation of the peat-derived organic matter into the existing fill material over time will reduce this overburden significantly though comprehensive settlement analysis may be necessary to determine the magnitude and rate of settling.

Management practices such as over tilling and equipment travel can alter bulk density as well which may lead to changes in soil structure, cover, organic matter content, compaction, and porosity. The disturbance of soil aggregates may then result in reduced OM content, soil structure, and water capacity making soils susceptible to erosion and increased compaction. Recommended measures to mitigate compaction, improve bulk density, and increase organic matter retention should be considered and include:

- organic matter retention practices such as no-till farming, solid manure/compost application, cover crop and crop rotation with perennial legumes or grasses in rotation which produce high residue detritus feedstock;
- use of diverse crop rotations with varying root depths to help mitigate compaction at differing soil layers;
- minimal disturbance of soils via operating equipment and operating equipment only on dry soil;
- use of designated rows for operating equipment and reduced trips across landscape.

McTAVISH
RESOURCE & MANAGEMENT
CONSULTANTS LTD.

September 19, 2017

To: Alex Kurnicki

From: Bruce McTavish MSc MBA PAg RPBio & Dr. David Grewer

Re: Organic matter volume calculations for Garden City

The addition of peat as an amendment to low organic matter content in the Garden City fill project soils must take into consideration the bulk density of the soil and the peat additions as well as the organic matter content of both. A simple metric to determine the proper mixing ratio is given below:

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where, $\mathbf{OM_x}$ is the organic matter content by weight of the soil, peat, and final consolidated mixture respectively

$\mathbf{BD_x}$ is the bulk density of the soil or peat, respectively

and r is the mixing ratio of soil-to-peat by volume chosen for the fill site.

The bulk density of sandy loam soils, such as those used for the Garden City fill site, have been estimated based on laboratory data by the US Department of Agriculture to typically range between 1.5-1.6 g/cm^3. Various types of peats can exhibit a range of bulk densities with typical Canadian sphagnum peats possessing a bulk density of 0.13. Other forms of peat may exhibit higher bulk densities and the example for reed-sedge derived peat has been considered here as well with both recommendations calculated below (Table 1). Volume of peat additions are calculated based on incorporation to a depth of 30 cm within the fill site soils. It is recommended that the material be incorporated with a disk or plough within the top 30cm of the soil profile

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- use of diverse crop rotations with varying root depths to help mitigate compaction at differing soil layers;
- minimal disturbance of soils via operating equipment and operating equipment only on dry soil;
- use of designated rows for operating equipment and reduced trips across landscape.

Bruce McTavish PAg
President

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Potential to reduce greenhouse gas emissions associated with conversion of Garden City Lands peatland to farmland

Michael Bomford, PhD, Kwantlen Polytechnic University
Department of Sustainable Agriculture

Peat is an accumulation of partially-decomposed plant material that builds gradually in certain low oxygen, water-saturated environments. Because it consists almost entirely of organic material, peat represents a concentrated form of carbon. Under extended periods of heat and pressure, peat becomes coal.

Almost a third of terrestrial carbon stores are in peat. Peatlands cover just three percent of the earth's surface, but are estimated to hold some 550 billion metric tons of carbon – about twice as much as the planet's trees.[1,2] Each year, peatland formation sequesters another 100 million metric tons of carbon, counteracting the carbon dioxide emissions of about 80 million cars.

Peatland conservation is a crucial component of efforts to prevent climate change, and peatland degradation has substantial potential to amplify climate change.

Canada has more peat than any other nation, with 1.1 million square kilometers of peatland covering a broad swath between the northwestern region of the Northwest Territories and western Quebec (Figure 1). British Columbia's peatland is concentrated in the northeastern region of the province, and along its west coast. Although most of Canada's peatland remains intact, peatland in populated regions, like the Fraser Valley, is largely degraded.

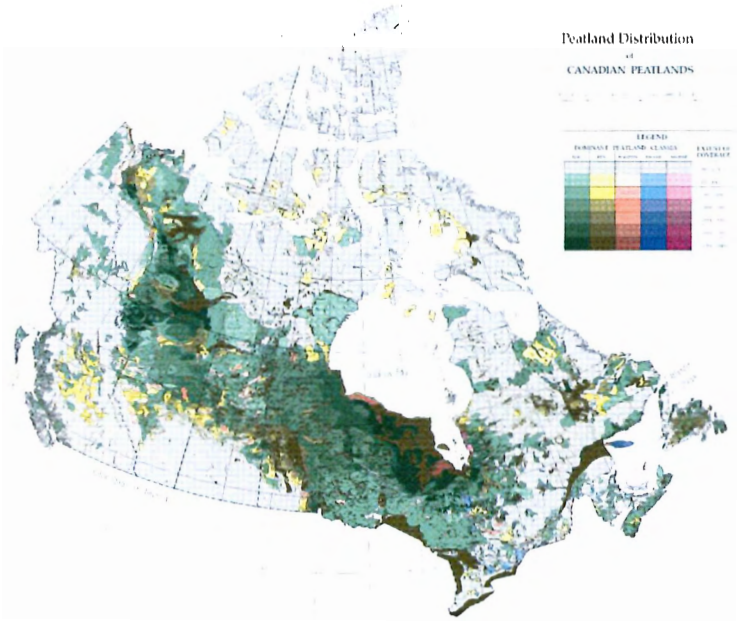

Figure 1. Distribution of Canadian peatlands.[3]

Substantial peat bogs once covered most of East Richmond and East Delta (Figure 2). Smaller bogs existed west of Burnaby Lake, in South Burnaby, North Surrey, and Cloverdale. Except for Burns Bog, in East Delta, only a few fragments of these original bogs remain. Most have been drained to enable agriculture and urban development. Draining peat allows oxygen to penetrate, rapidly reversing the process of peat accumulation, and converting peatland from carbon sink to carbon source.

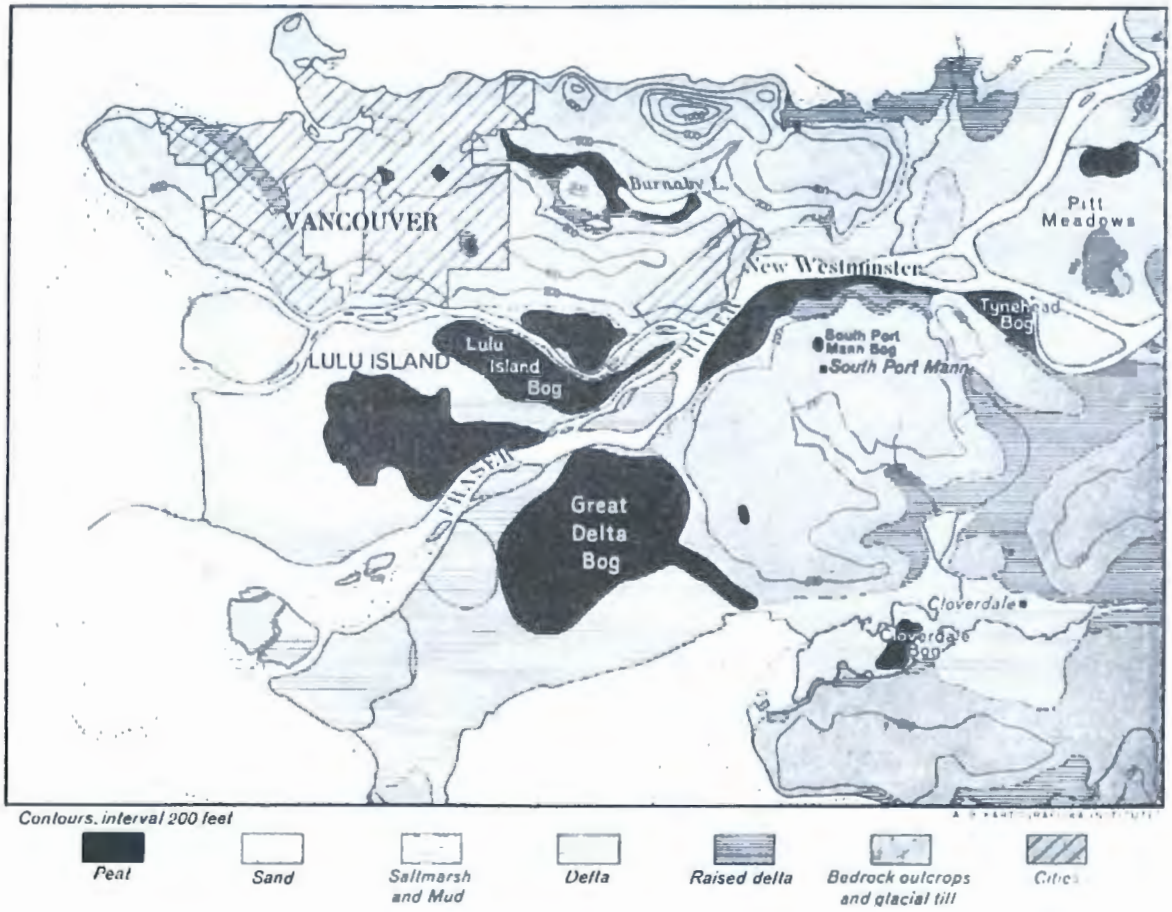

Figure 2. Peat bog extent in the Fraser Valley in 1927.[4] The Garden City Lands are situated at the northeast edge of the former Lulu Island Bog.

Even after drainage, peatlands make poor soil for most types of agriculture, due to their characteristic acidity and low nutrient availability. A few acid-tolerant crops, like cranberry and blueberry, can grow in unamended peat. Most other crops require substantial lime and fertilizer amendments to improve peat fertility.

With suitable amendment, peat makes excellent soil for growing a wide range of crops. Its high organic matter content contributes to exceptional nutrient and water holding capacity. Decomposing peat releases (mineralizes) nitrogen, which promotes crop growth. Compared to mineral soils, peat soils have a much lower bulk density, resist compaction, and have a loose, friable nature that makes them the soil of choice for potting media, and very well-suited to root crop production.

The BC Land Inventory classification system notes that Richmond's peat soils have a limited capacity for crop production due to excessive wetness and acidity, but also that these soils can be suitable for a wide range of crops "with water management, liming, and fertilization."[5]

Unfortunately, water management (drainage), liming, and fertilization of peat all contribute to greenhouse gas emissions. Drainage and cultivation introduce oxygen to the soil, promoting microbial respiration and peat decomposition. The carbon that was stored in the peat over millennia is rapidly released into the atmosphere as carbon dioxide. Adding lime to increase soil pH (i.e. reduce soil acidity) hastens peat decomposition and carbon dioxide release, and can also promote methane release.[6] Drainage and nitrogen fertilization of peat both promote production of nitrous oxide, another potent greenhouse gas.[7]

Greenhouse gas emissions associated with farming peat soil can be 100 times the emissions associated with farming mineral soil.[8] Consequently, some agricultural scientists discourage conversion of peatlands to agricultural production, and recommend policies to remove peatland from agricultural production.[9] Such a policy would compromise regional food security in a region like Richmond, where much of agriculture occurs on peatland. Different models are needed.

In order to fulfil its mandate as a model for sustainable agriculture, the Garden City Lands farm must address greenhouse gas emissions associated with converting peatland to agriculture. It cannot replicate commonly-used systems that are recently-recognized contributors to climate change. Other models exist:

- Paludiculture is the cultivation of crops on undrained or rewetted peatlands, which slows or reverses peat decomposition and reduces greenhouse gas emissions. It has a long history of use in Mexico and Central America, and is more recently being tested and adopted by Asian and European farmers. Cultivation typically takes place on raised beds, just above the water table, with standing water maintained between beds. Carbon dioxide emissions tend to be lower in paludiculture than in farming conducted on drained peatlands (Figure 3). Methane emissions tend to increase when the fields flood, but overall global warming potential of the systems remains lower than in drainage-based systems. Retaining a sufficiently high water table for paludiculture requires wet conditions year-round, which could be difficult to achieve in the typically dry summers of south-western BC.

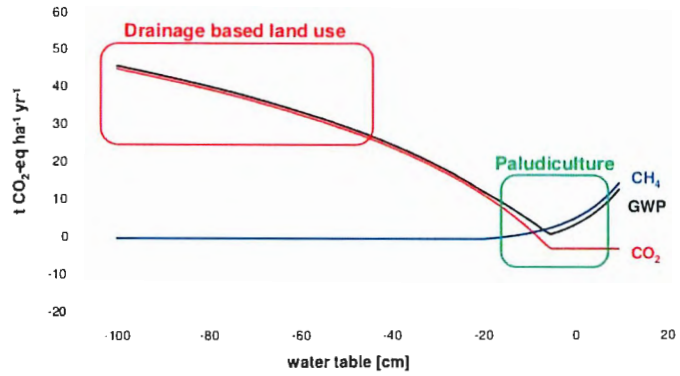

Figure 3. Global Warming Potential (GWP) of agricultural peatlands as a function of water table depth. Total GWP in this figure is the sum of GWP from methane (CH_4) and carbon dioxide (CO_2).[10]

- A recent study conducted in western Norway tested inversion of the peat and clay layers in a shallow peatland. Placing 50-70 cm of mineral soil on top of the peat soil allowed crop production with much lower greenhouse gas emissions (Figure 4).[11]

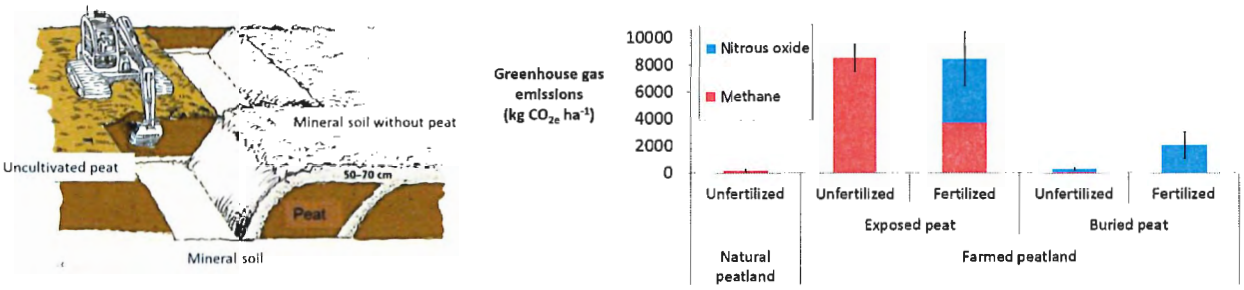

Figure 4. Mineral soil beneath peatlands in western Norway was excavated and placed in a 50-70 cm layer over the peat (left). Nitrous oxide and methane emissions associated with conversion to agriculture were lower from the buried peat than from exposed peat at the same site (right).[12]

Heavy metal contamination has been detected deep in the native peat soils at the Garden City Lands, likely due to the site's use as a firing range early in the 20th century. Independent consultants have indicated that a 30-60 cm layer of clean soil must be added to the site, to avoid potential contamination of food crops. Sixty centimeters of mineral soil from a runway expansion project at the Vancouver International Airport, on Sea Island, was transported seven kilometers east, to the Garden City Lands, for this purpose.

The 60 cm layer of locally-sourced mineral soil added above the native peat on a section of the Garden City Lands mimics the inversion of peat and mineral layers found to dramatically reduce greenhouse gas emissions in western Norway. It will allow testing and demonstration of an innovative approach to greenhouse gas mitigation associated with peatland conversion to agriculture. Agricultural management will be restricted to the mineral layer, and drainage will not penetrate the peat layer, allowing maintenance of a high water table and acidic conditions in the peat layer, to preserve the peat and reduce carbon dioxide emissions (Figure 5). Nitrous oxide emissions associated with nitrogen fertilization of the mineral soil are expected to be much lower than direct fertilization of the peat.[13] The mineral soil layer above the peat will provide an environment for methane-consuming bacteria that thrive in aerobic environments, potentially reducing methane emissions from the buried, anaerobic peat layer. Management of the mineral soil will emphasize organic matter addition through incorporation of cover crops, composts, manures, and other carbon-rich amendments. The management goal will be to increase the organic matter content of the mineral soil, sequestering carbon, while maintaining the high organic matter content in the buried peat. This approach has potential to demonstrate carbon-negative farming in an ecosystem that would normally result in substantial greenhouse gas emissions following conversion to agriculture.

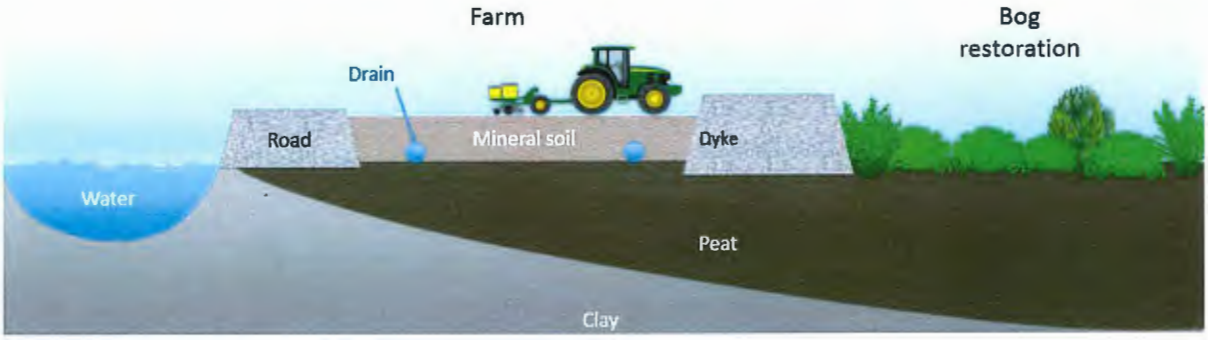

Figure 5. Cross-section of farm and bog restoration portions of the Garden City Lands, showing a 60 cm layer of mineral soil above native peat. Agricultural drainage will not penetrate the underlying peat, allowing it to remain saturated and acidic to prevent greenhouse gas emissions associated with drainage, fertilization, liming, and cultivation, all of which contribute to peat degradation. Mineral soil above the peat will be managed to increase organic matter content and sequester carbon.

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[1] Strack, Maria. 2008. Peatlands and Climate Change: Executive Summary for Policymakers. International Peat Society, Finland. Link.

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[3] Tarnocai, C, I.M. Kettles & B. Lacelle. 2011. Peatlands of Canada. Geological Survey of Canada. https://doi.org/10.4095/205270.

[4] Osvald, Hugo. 1933. Vegetation of the Pacific Coast Bogs of North America. Acta Phytogeographica Suecica. 38 p. Link.

[5] Agriculture and Agri-Food Canada, 2000. "Land Systems Report for the City of Richmond, British Columbia" Prepared by Liz Kenney, Research Branch, Western Land Resource Group, Agassiz, British Columbia.

[6] Murakami, Mio, Yuichiro Furukawa & Kazuyuki Inubushi. 2005. Methane production after liming to tropical acid peat soil. Soil Science and Plant Nutrition 51: 697-699. Link.

[7] Oleszezuk, R., K. Regina, L. Szajdak, H. Hoper & V. Maryganova. 2008. Impacts of agricultural utilization of peat soils on the greenhouse gas balance. Pp. 70-96 in Stack, Maria [ed.], Peatlands and Climate Change. International Peat Society, 2008. 223 p. Link.

[8] Aarhus University. December 17, 2015. Growing crops on organic soils increases greenhouse gas emissions, say scientists. ScienceDaily. Retrieved August 24, 2017. Link.

[9] Ibid

[10] Image adapted from Peters, Jan. 2012. Paludiculture: Business opportunities for rewetted peatlands. Michael Succow Foundation, Greifswald / Germany. Link.

[11] Hansen, S, S. Rivedal, S. Øpstad, S. Heggset, J. Deelstra & P. Dörsch. 2017. GHG emissions and agronomic feasibility for forage production on inverted peat soil. Norwegian Centre for Organic Agriculture. Link.

[12] Figure adapted from Hansen et al., 2017. (Ibid).

[13] The site will be certified to national organic standards, so no synthetic nitrogen fertilizer will be used. Nitrogen enrichment from nitrogen-fixing crops, composts, manures, and other organic fertilizers can still contribute to nitrous oxide emissions in high organic matter soils.

KPU | KWANTLEN POLYTECHNIC UNIVERSITY
Department of Sustasinable Agriculture and Food Systems

September 27, 2017

To: City of Richmond Parks, Recreation and Cultural Services Committee

Re: Garden City Lands Soil

Dear Committee Members,

I am writing this letter in response to the committee's request for feedback on the soil that has been placed on the land KPU is leasing for our Teaching and Research farm on the Garden City Lands.

Throughout the process of soil placement, the City of Richmond staff have been in regular communication with KPU. We were provided with a copy of the Hemmera report and were given the opportunity to provide city staff with specficiations for the soil characteristics that would be acceptable to place on the farm site. These specifications were included in the application that was approved by the ALC. Based on the evidence presented, drainage challenges on the site and our understanding of sustainable management of peat soils we believe the approach of capping the peat with mineral soil is the most ecologically sound approach to bring the site into agricultural production.

The soil that was placed on site has met all of KPU's specification with the exception of organic matter content. When it was brought to our attention that the organic matter content was low and as a result, the nutrient content was also low, we had discussions with the city staff to develop a strategy to amend the soil to meet the specification which involved the incorporation of peat, compost and manure. We are satisfied with this approach.

The addition of the mineral soil on top of the peat is also very beneficial from the stand point of climate change. The cultivation of peat soils results in the relase of highly potent greenhouse gasses and recent research has demonstrated that the release of the greenhouse gasses can be strongly mitigated by capping the peat with at least 50cm of mineral soil. This would allow the carbon stored in the peat on garden city lands to remain sequestered. For this reason, we are hoping to retain as much of the mineral soil that has already been placed as possible.

It is critical to KPU that the establishment and management of this farm is conducted in a way that is consistent with our deep commitment to sustainability and our desire to provide opporutnities for our students, industry partners and the community to engage with agriculture in a very tangible way. To that end, we remain enthusiastic and greatful for the opportunity to collaborate with the City of Richmond on this awesome project and are very eager to get on the site to begin farming!

KPU | KWANTLEN POLYTECHNIC UNIVERSITY
Department of Sustasinable Agriculture and Food Systems

Please do not hestitate to contact me if you have any concerens, questions or would like to have further discussion about the establishment and management of the farm.

Sincerely,

Dr. Rebecca Harbut
Chair, Department of Sustainable Agriculture and Food Systems
Kwantlen Polytechnic University

t: 604-599-2568
e: rebecca.harbut@kpu.ca

McTAVISH
RESOURCE & MANAGEMENT
CONSULTANTS LTD.

#300 – 15300 Croydon Drive
Surrey BC
V3S 0Z5

Date: 11 October 2017

Attn: Alex Kurnicki

From: Bruce McTavish

Re: Garden City Lands Fill Project ALC Request

This memo by McTavish Resource and Management Consultants Ltd. (McTavish) to the ALC on behalf of the City of Richmond is related to the mitigation of the Garden City Lands in Richmond BC. This memo addresses two topics:

1) Establishing of a cover crop, and
2) Future built-up of soils

The ALC allowed the placement of fill on 8 ha of the Garden City Lands. Fill has been placed on about 2.5 ha. The filling process was monitored by McTavish. Concerns regarding the filling process and reclamation were voiced by the ALC and were discussed at a meeting on October 5th, 2017. The meeting included a discussion on reclamation of the filled area and resulted in the allowance of tilling of the site and the expression of the need for organic matter. The allowance for tillage was later expressed in an e-mail from ALC.

This section of the memo will describe the steps to be taken in the reclamation. It includes the short-term actions and any action to be taken in the spring of 2018.

The changes from the previous plan are based on:

a) The comments from the ALC made on October 5th
b) The need to cover the site with a cover crop to protect the soil
c) The limited time to seed a cover crop before the weather restricts growth
d) The current low availability of animal/steer manure
e) The objections by the ALC to use compost
f) The peat brought on-site is wet, restricting spreading and travel on spread peat
g) Spreading peat on top of tilled soil is counter productive
h) The need for a blanket approach for the tilled soil, rather than small test plots
i) The opportunity for Kwantlen Polytechnic University (KPU) to commence farming practices on a small scale in the Spring of 2018.
j) The requirements for an extensive reclamation plan to be submitted to the ALC for approval

The current outline of the plan is indicated in the table below. The objective of the reclamation is to establish a cover crop of rye under-seeded with Crimson Clover to quickly protect the site.

#	Action	Timing	Remarks
1	Tillage and cross ripping	Completed October 9th	The site was ripped and cross ripped to mitigate compaction
2	Seeding and cultivation	To be completed Week of October 10th	The seed mix will be supplemented with required fertilizer to bring quick greening of the site. Germination of the rye will take up to a week, the under-seeded clover will take a bit longer.
3	Establishing field plots	Spring of 2018	Small scale plots will be established by KPU to establish farm units. A mixture of steer manure, peat, poultry manure and other ingredients allowed by ALC will be used.
4	Production	Summer of 2018	The rye crop - if it survives any frost – will be removed and the clover will be allowed to mature.
5	Clover phase	Fall 2019 – to 2020	Clover will be hayed and sold for livestock feed. Small parcels will be removed for test plots and for production according to the KPU farm development strategy.

After the site has been seeded, a team comprised of members from the City of Richmond, McTavish, and KPU will develop the mitigation plan and prepare a detailed outline to include all facets of soil handling, organic matter management, nutrient management, and cropping practices. This plan will be provided to the ALC prior to implementation.

The ALC approved the application of fill to 8ha of the Garden City Site. As sandy soil has been applied to about 2.5 ha, opportunity exist to expand the application of soil to the remainder 5.5 ha. McTavish currently works with the City of Richmond to fine tune the screening and accepting of soil process. As discussed at the October 5th meeting, more steps will be taken to screen the soil. These steps will include:

1) Agrologist review of Phase 1 reports from the site the soil originates from, with an emphasis the soil quality meets the standards set by the ALC for topsoil and that soil meets the criteria as listed in the Schedules of the CSR that are applicable to agricultural soil. Agrologist to be appointed by City of Richmond.
2) Agrologist review of the site the soil originates from to assess the agricultural characteristics of the soil, including topsoil and subsoil. Agrologist to be appointed by City of Richmond.
3) Agrologist to review practices to remove the soil from the site of origin; practice to include separation and set-aside of topsoil, potentially screening of soil to remove coarse fragments, and assessing of texture classes. Agrologist to be appointed by City of Richmond.
4) Supervise the loading of soil and monitor its quality. Topsoil is to be kept separately.
5) Supervise the placement of the soil. Topsoil to be kept separately and placed as a final layer.
6) Supervise the management, tillage and seeding of the soil.

We trust that this meets your needs,

Sincerely,

Bruce McTavish, MSc MBA PAg RPBio
President
McTavish Resource & Management Consultants Ltd.

From: Wilson, Shawna Mary ALC:EX <Shawna.Mary.Wilson@gov.bc.ca>
Sent: Thursday, 12 October 2017 15:53
To: Kurnicki,Alexander
Cc: Esko,Jamie; Lusk,Serena; Morin,Mike; Glavas, Katarina ALC:EX; Grout, Kim ALC:EX
Subject: RE: 56199 Garden City Lands Fill Project - Moving Forward

Good afternoon,

Thank you for submitting the document titled "Memo to ALC_11Octoberfinal" on October 11, 2017. The document outlined the proposed interim plan for amending the soil at Garden City Lands while a more detailed plan is being drafted. The memo outlined that the immediate plan is to establish a cover crop of rye under-seeded with crimson clover and supplemented with commercial fertilizer to establish a winter cover crop.

Given the time of the year and recent weather, the ALC agrees with the immediate plan for the site; however, it is highly recommended that a barley crop is used rather than fall rye given the late planting of the cover crop.

Please note that this interim plan does not absolve the City of Richmond from submitting a more detailed plan for soil reclamation at the site. As discussed at our meeting of October 5, 2017 the plan should include, but not be limited to, the following components:

- Rock picking
- Subsoiling
- Incorporation of well decomposed peat; the project Agrologist should assess the quality of peat from all source sites (i.e., Von Post scale of humification identifying any separation of the fibric and mesic layers) and guide equipment operators in all salvaging activities.
- Incorporation of manure – steer manure is preferred
- Annual cover cropping
- Details of KPU plots – additional information regarding size of test plots

Please continue to keep the ALC updated as to the progress on the site.

Thank you,

Shawna Wilson, MSc
Land Use Planner - South Coast Region
Agricultural Land Commission
133- 4940 Canada Way, Burnaby BC V5G 4K6
P 604.660.7008 | **F** 604.660.7033
Shawna.Mary.Wilson@gov.bc.ca | www.alc.gov.bc.ca

From: Kurnicki,Alexander [mailto:AKurnicki@richmond.ca]
Sent: Wednesday, October 11, 2017 3:23 PM
To: Wilson, Shawna Mary ALC:EX
Cc: Esko,Jamie; Lusk,Serena; Morin,Mike; Glavas, Katarina ALC:EX; Grout, Kim ALC:EX
Subject: RE: 56199 Garden City Lands Fill Project - Moving Forward

Hello Shawna and Katarina:

Further to our meeting with you last week on Thursday, October 5th, please find attached a memo outlining the City of Richmond's plan for amending the soil recently placed at the site. I understand that you have already been in touch with Hubert Timmenga to review the memo.

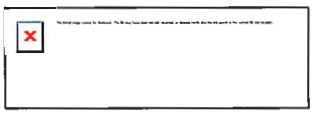
We would appreciate your direction to proceed with seeding the cover crop (as outlined in the memo) at your earliest convenience. We are prepared to seed this week.

Please don't hesitate to contact me if you have any questions or concerns.

Regards,

Alex Kurnicki |MBCSLA
Research Planner II | Parks Planning, Design & Construction
Community Services | City of Richmond
5599 Lynas Lane
Richmond BC V7C 5B2

P|604-276-4099
C|778-554-7839
E| akurnicki@richmond.ca



From: Wilson, Shawna Mary ALC:EX [mailto:Shawna.Mary.Wilson@gov.bc.ca]
Sent: Thursday, 5 October 2017 16:03
To: Kurnicki,Alexander
Cc: Esko,Jamie; Lusk,Serena; Morin,Mike; Glavas, Katarina ALC:EX; Grout, Kim ALC:EX
Subject: 56199 Garden City Lands Fill Project - Moving Forward

Good afternoon,

Thank you all for coming to meet with the ALC this afternoon regarding moving forward at Garden City Lands (ALC File 56199). As discussed, the ALC anticipates the City of Richmond will provide a detailed plan with respect to the peat, manure, and cover crops proposed for Garden City as an alternative to the requirement identified in my August 29, 2017 e-mail. In the meantime, the ALC has no concerns with the City of Richmond carrying out ripping and stone picking activities on site.

We look forward to receiving the above noted information.

Thank you,

Shawna Wilson, MSc
Land Use Planner - South Coast Region
Agricultural Land Commission
133- 4940 Canada Way, Burnaby BC V5G 4K6
P 604.660.7008 | **F** 604.660.7033
Shawna.Mary.Wilson@gov.bc.ca | www.alc.gov.bc.ca

McTAVISH
RESOURCE & MANAGEMENT CONSULTANTS LTD

#300 – 15300 Croydon Drive
Surrey BC
V3S 0Z5

Date: March 12, 2018 (Revision 1)

Attn: Alex Kurnicki

From: Bruce McTavish

Re: Source Soil Management

This memo outlines the steps to takeplace when soil is sourced for transport and deposit at the Garden City project.

The soil for the Garden City must adhere to the ALC guidelines for soil quality deposited on the Garden City lands and the applicable matrix standards from the BC Contaminated Site Regulations (BCCSR) – Schedule 3.1, Column 4 for Agricultural Lands[1].

The owner or contractor of the source soil will need to provide a Phase 1 Environmental Assessment.

When a source of soil has been identified, the following steps will be taken:

1) On behalf of the City of Richmond, an Agrologist with expertise in soil science and soil handling will review available documentation including a Phase I Site Investigation (environmental assessment) report for the site from which the soil originates.

2) The Agrologist must visit the source site and evaluate the soil for suitability as fill on the Garden City lands, and report on whether and how conditions of the ALC for soil will be met. This evaluation starts with on site visual observations of the site and the soil. Based on the observations and review the Agrologist can:
    a. Reject the soil
    b. Approve the soil and then
    c. Proceed with a soil investigation program, including sampling and sample analysis.
    d. Ensure that soil meets the KPU specification attached to ALC decision 56119

3) The Agrologist must prepare a protocol for the soil handling before transportation of the soil to the Garden City Lands. The protocol will be site specific and include:
    a. Supervision of soil handling
    b. Separation and set aside of topsoil
    c. Separate transport of topsoil and other soil to the Garden City property
    d. Placement of soil and topsoil to mimic the original profile, and
    e. Monitoring of stoniness
    f. Monitoring of non-soil inclusions such as asphalt and concrete and procedures for removal of such items.

[1] http://www.bclaws.ca/civix/document/id/lc/statreg/375_96_07

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The Agrologist may recommend that screening of the soil to remove inclusions takes place before transport of the soil to the Garden City property.

Bruce McTavish MSc MBA PAg RPBio
Senior Agrologist/Senior Biologist
President

Cc: Warren Mills Environmental Coordinator

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RESOURCE & MANAGEMENT
CONSULTANTS LTD.

#300 – 15300 Croydon Drive
Surrey BC
V3S 0Z5

Date: December 19, 2017

Attn: Alex Kurnicki

From: Bruce McTavish PAg

Re: Garden City Lands Spring Soil Management Plan

The following document is based on discussions between the City of Richmond (CoR), Kwantlen Polytechnic University (KPU) and McTavish Resource & Management Consultants Ltd. (McTavish). The purpose of the memo is to document the planned spring activities on the filled area at the Garden City Lands.

The site was filled during the summer and fall of 2017 with soil that is predominantly sandy loam to loam. McTavish sampling and testing in 2017 indicated that: "The Garden City Lands soils meet the good to fair criteria for all parameters except organic matter and electrical conductivity (EC). The soils can be amended to meet the "good" criteria for each parameter of topsoil quality through the incorporation of peat or other organic matter into the soil profile. McTavish recommends well-decomposed peat (H5-H8 on the Van Post Scale for humification) to increase the organic matter of the soils to at least 3.5%."

In the late fall of 2017 a cover crop of fall rye and clover was seeded. The fall rye has germinated and established prior to winter. The following steps will take place in the Spring of 2018:

- Till in the cover crop.
    - Incorporation of the cover crop will increase the organic matter of the coarse textured (sandy soil).
- Screen the peaty/organic soil that is on the site per McTavish memo of December 18, 2017.
    - Screening of the peat will remove all coarse debris (wood pieces) and the clumps of clay/silt mineral soil that are in the stockpiled peat. This will improve its attributes as a soil conditioner.
- Spread peat on the existing fill over the surface at ~300 m^3 per acre which will increase the organic matter in the existing fill to ~3.5% (McTavish memo September 19, 2017).
- Once the peat has been spread incorporate (cultivate) it into the existing mineral soil.
- Incorporate other organic soil conditioners such as manure and/or compost if available and incorporate into the existing fill.
- Test the site for soil fertility to determine fertilizer requirements.
- Plant forage grass/legume crop and grow for one season to increase organic matter and establish soil macropores.

McTavish will monitor the soil and report on its quality and make recommendations if further amendments are required.

On a small section of the property ~20% KPU will establish small scale plots as small individual farm units. On these areas a mixture of manure, peat, and other soil amendments/conditioner allowed by ALC will be incorporated into the fill to increase the organic matter content and improve the soil.

Percolation testing
Garden City Farm Development Richmond BC

Prepared for:

City of Richmond

Prepared by:

Bruce McTavish PAg, MBA, RPBio
David Grewer, PhD
Justin McTavish, BSc AAg
Taisha Mitchell, BSc AAg BIT

McTavish Resource & Management Consultants Ltd.
15300 Croydon Drive, Suite 300, Surrey BC V3Z 0Z5
www.mctavishconsultants.ca

March 25, 2018

Table of Contents

1.0 Introduction

McTavish Resource and Management Consultants Ltd. (McTavish) performed soil percolation tests at the Garden City Lands at the request of the City of Richmond (CoR). A soil percolation test determines the water absorption or infiltration rate of soil and is often performed prior to building septic drain fields or infiltration basins. This test examines how quickly a known volume of water infiltrates into the subsoil of a drilled hole of a known surface area. The soil percolation test for the Garden City Lands was performed on March 20, 2018 after fill placement, and prior to peat and manure placement.

Soil texture and composition influence soil hydrology and percolation. Coarse soil textures with larger pore spaces, such as sand, will allow water to flow through the soil profile more readily than fine soil textures, such as clay. The imported soil on the Garden City Lands has a texture ranging from sandy loam to loamy sand, which will have relatively rapid infiltration rates.

Figure 1 Site location and percolation test locations

2.0 Methodology

2.1 Soil percolation field test

To evaluate the water infiltration rates of the imported soil at the Garden City fill site, eight test holes were installed throughout the field. Percolation test locations were randomly sampled within each soil textural class observed across the fill site based on the McTavish report titled "Garden City Soil Report September 20 2017 Final McTavish." Test holes were dug at each site at a depth of approximately 20 cm. Any smeared soil at the base of the test hole was carefully removed to expose an undisturbed interface for water infiltration.

PVC piping approximately 50 cm in length and 10 cm in diameter was then installed above the level surface at the base of the test hole. Excavated soil was replaced around the percolation column to stabilize the PVC piping in the ground (Figure 2). Pre-soaking of each test hole was performed to saturate the underlying soil with water until steady state emerged and more accurate results could be collected. At the time of sampling, prior rainfall helped establish semi-saturated soils within the test area and little pre-soaking was required to reach steady state conditions.

Once the soil was saturated, water was slowly added to a predetermined depth and allowed to infiltrate over time. The depth of water infiltration was measured again at regular intervals and the resulting rate of infiltration was calculated as the volume absorbed (mL) over time (min), based on the area displaced within the percolation test column.

The mean rate observed at each test hole was calculated from replicate trials for each site. Assuming a constant flow rate, standard error analysis of the infiltration rate was determined from the standard deviation of replicate sampling trials at each test hole. Typical infiltration rates based on soil texture classification is presented in Table 1 for reference.

Figure 2 Percolation test hole

Table 1 Typical infiltration rates based on soil texture[1]

Soil Texture	Infiltration Speed	Infiltration Rate (mL/min)		
		Low	Average	High
Sand, gravel	Very rapid	26.18	78.54	130.90
Loamy sand, fine sand	Rapid	7.85	17.02	26.18
Loamy fine sand, fine sandy loam, sandy loam	Moderately rapid	2.62	5.24	7.85
Sandy clay loam, loam, silty loam, very fine sandy loam	Moderate	0.79	1.70	2.62
Clay loam, silty clay loam, silt, silty clay, sandy clay	Moderately slow	0.26	0.52	0.79
Clay, silty clay	Slow	0.08	0.17	0.26
Clay w/ >60% clay	Very slow	0.0020	0.0403	0.0785
	Impermeable	0	0.0010	0.0020

3.0 Results

The results of the soil percolation field tests are summarized in Table 2 and Figure 3. Results show that the slowest percolation rate (2.21 ±0.70 mL/min) falls within typical ranges for a loam indicating moderate infiltration (Table 1). Except for site P4, where infiltration was very rapid, the rate observed at the remaining test holes fell within expected ranges (Table 1), indicative of moderately rapid (2.62 to 7.85 mL/min) to rapid (7.85 to 26.18 mL/min) infiltration.

[1] Infiltration rates based on soil textures adapted from the United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS) Guides on Soil Potential Ratings and Soil Infiltration

Table 2 Water infiltration rates Garden City Project Fill Site

Sample Site	Soil Texture (Lab Textured)	Mean Infiltration Rate (mL/min)
P1	Sandy Loam	2.21 ±0.70
P2	Loamy Sand	5.41 ±0.88
P3	Sandy Loam	18.00 ±14.98
P4	Loamy Sand	48.22 ±13.95
P5	Sandy Loam	9.53 ±1.05
P6	Sandy Loam	7.62 ±3.84
P7	Sandy Loam	20.92 ±1.28
P8	Sandy Loam	5.68 ±1.15

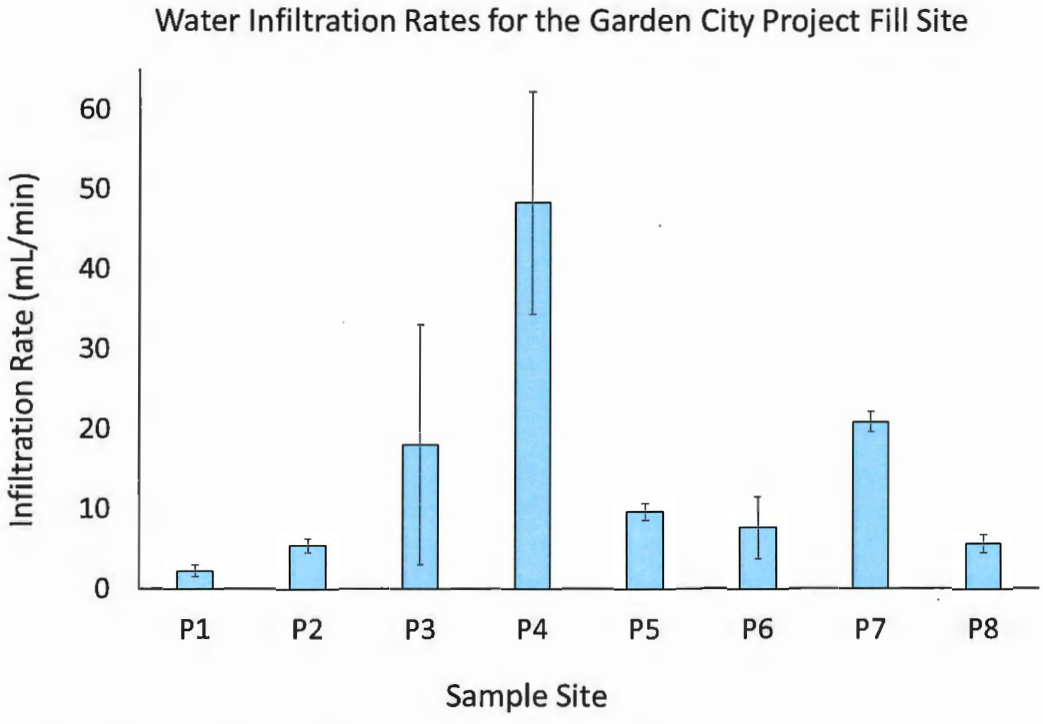

Figure 3 Water infiltration rates for soil percolation test holes

4.0 Discussion

Perolcation test results for the Garden City Lands are consistant with existing literature on perolcation rates for various soil texture types. The predominant soil texture on Garden City Lands is a sandy loam with percolation rates varing from 2.21-9.53 (ml/min). Three percolation test areas installed on soils with a high concentration of sand exhibited perolation rates that are considered rapid to very rapid draining, which is consistent with existing literature on these soil textural types.

Appendix I. Soil lab results (McTavish September 20 2017)

	Sample ID									
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	TA
Soil Quality Criteria										
Reaction (pH)	7.4	7.4	7.6	7.5	7.1	7.2	6.8	6.8	6.0	7.0
Salinity (dS/m)	2.63	1.90	3.07	2.99	2.92	2.37	1.20	0.63	2.10	2.00
Sodicity (SAR)	–	–	–	–	–	–	–	–	–	1.36
Organic matter (%)	0.3	0.3	0.5	0.3	1.1	1.4	1.5	1.6	1.7	0.9
Coarse fragments (%)	<1	7	7	7	7	7	3	14	4	
Cobbles and stones (%)	>1	>1	>1	>1	>1	>1	>1	>1	>1	>1
Texture										
Sand (%)	72.4	79.4	70.4	80.0	64.0	59.4	54.4	55.4	50.4	66.4
Silt (%)	23.0	16.0	25.0	17.0	29.0	33.0	36.0	35.0	38.0	28.0
Clay (%)	4.7	4.7	4.7	3.0	7.3	8.2	10.3	9.9	11.7	6.4
Soil Class	Sandy loam	Loamy sand	Sandy loam	Loamy sand	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Loam	Sandy loam
Nutrient Analyses										
N (ppm)	12	10	19	11	25	26	25	33	26	21
P (ppm)	9	7	9	7	11	10	7	8	8	8

K (ppm)	128	112	139	117	166	167	153	171	166	152
S (ppm)	820	731	918	>1000	770	546	276	160	486	710
Na(ppm)	–	–	–	–	–	–	–	–	–	62
Ca (ppm)	–	–	–	–	–	–	–	–	–	1710
Mg (ppm)	–	–	–	–	–	–	–	–	–	357
Fe (ppm)	–	–	–	–	–	–	–	–	–	84
Cu (ppm)	–	–	–	–	–	–	–	–	–	4
Zn (ppm)	–	–	–	–	–	–	–	–	–	2
B (ppm)	–	–	–	–	–	–	–	–	–	0.6
Mn (ppm)	–	–	–	–	–	–	–	–	–	11
Cl (ppm)	–	–	–	–	–	–	–	–	–	29