City of Richmond

Report to Committee

To:	General Purposes Committee	**Date:**	March 1, 2017
From:	John McGowan Acting General Manager, Law and Community Safety	**File:**	12-8060-02/01-Vol01
Re:	**Non-Farm Use Fill Application for the Property Located at the Eastern Terminus of Francis Road (PID: 023-860-481) – Cranberry Meadows Farms Ltd.**		

Staff Recommendation

1. That the application and corresponding report titled "Non-Farm Use Fill Application for the Property Located at the Eastern Terminus of Francis Road" (PID 023-860-481) – Cranberry Meadows Farms Ltd.", dated March 1, 2017, by the Acting General Manager; Law and Community Safety be referred to the Agricultural Land Commission (ALC); and

2. Should the ALC grant approval, the applicant must satisfy all City and ALC requirements and obtain a soil deposit permit from the City prior to any soil being deposited on the property.

John McGowan
Acting General Manager, Law and Community Safety
(604-276-4104)
Att. 4

REPORT CONCURRENCE			
ROUTED TO:	**CONCURRENCE**	**REVIEWED BY STAFF REPORT / AGENDA REVIEW SUBCOMMITTEE**	**INITIALS:**
Finance Department	☑		
Engineering	☐		
Roads & Construction	☑		
Sustainability	☑		
Law	☑		
Policy Planning	☑		
Transportation	☑	**APPROVED BY CAO**	

Staff Report

Origin

The City of Richmond is in receipt of a soil deposit application, deemed to be non-farm use (the "Application") by the ALC, submitted by Cranberry Meadows Farms Ltd. for PID 023-860-481 (the "Property"). The intent of the application is to place fill on the property located at the Eastern Terminus of Francis Road to improve the property's agricultural capability for the purpose of grape and raspberry farming.

The property is situated within the Agricultural Land Reserve (ALR) and is subject to provisions of the *ALC Act*, *Agricultural Land Reserve Use, Subdivision, and Procedure Regulation*, and the City's current Soil Removal and Fill Deposit Regulation Bylaw 8094 (the "Bylaw").

Pursuant to applicable provincial regulations, non-farm use applications for land that is zoned by bylaw to permit agricultural or farm use require Council authorization to be referred to the ALC. Should the application receive Council resolution to be referred to the ALC and should it subsequently be approved by the ALC, the applicant would be required to satisfy the requirements of the Bylaw before a soil deposit permit would be issued.

Analysis

The property is located at the Eastern Terminus of Francis Road and is zoned AG1 (Agriculture). The current zoning permits a wide range of farming and compatible uses consistent with the provisions of the *ALC Act* and *Regulation* and the City's Official Community Plan (OCP) and Zoning Bylaw.

The applicant has been operating a cranberry farm for the past eleven years. The *Fill Deposition Plan* (the "Plan") prepared by Pottinger Gaherty Environmental Consultants Ltd. (the "Consultant) indicates that the location of the property, near the mouth of the Fraser River, experiences high saline levels in the sourced water used for frost protection in the fall (Attachment 1). The plan notes that the increased salinity levels have negatively impacted the property's agricultural capability for cranberry production resulting in decreased harvest volume.

City staff notes that the drainage/irrigation network that serves the subject property is protected from high levels of salt in irrigation water by an automated valve at the system intake at the No. 6 Road South pump station. The automated valve closes when Fraser River salinity levels are above the levels appropriate for farming. City staff have not been provided evidence indicating that high levels of salt are present in the irrigation water at the subject property or the surrounding area.

Uses on Adjacent Lots

- To the North: Golf Course
- To the East: Industrial
- To the South: ALR – Land is not in production
- To the West: ALR – Land is not in production

Item	Existing	Proposed
Owner (PID 023-860-481)	Cranberry Meadows Farms Ltd. No. BC0729542	No change
Applicant	Cranberry Meadows Farms Ltd. No. BC0729542	No change
Authorized Agent	PGL Environmental Consultants	No change
Lot Size	8.05 hectares (19.89 acres)	No change
Land Uses	Cranberry production	Raspberry and grape production
OCP Designation	Agriculture	No change
ALR Designation	Property is within the ALR	No change
Zoning	AG1	No change
Riparian Management Area (RMA)	5.0 meters RMA	No change

Project Overview

The applicant proposes to raise the property and improve the agricultural capability in order to produce grapes and raspberries.

The total project area of the property is approximately 8.05 hectares (19 acres). The property is presently in agricultural production of cranberries and is comprised of Richmond and Lulu series soils. Lulu soils are suitable for the production of annual legumes, blueberries, cereals, cole crops, corn, perennial forage crops, root crops, and shallow-rooted annual vegetables.

As noted in the consultant's report, grape vines are deep-rooted plants that require an adequate soil depth. The applicant is proposing to import and deposit 362,000 cubic metres of fill (approximately 51,700 truckloads), to improve the property's drainage, slope, aspect, and rooting depth for the production of grapes and raspberries. The property will be raised by approximately 6m to 8m deep at the north section and approximately 2m deep at the south side of the property.

Lulu and Richmond soils have very poor drainage due to a high water table that is present for most of the year. The applicant intends to improve the drainage through the deposition of suitable fill and the establishment of a shallow slope. It is proposed that the site grading will maintain well-drained conditions and restrict surface ponding.

Existing drainage on the perimeter of the property will be retained to manage seasons of high rainfall; however, ditches separating the existing cranberry fields will be filled as part of the fill deposit activities. The conversion to grape and raspberry production will negate the need to induce a harvest flood as the new crops will utilize drip irrigation.

The proposed fill will be sourced from multiple locations within the Lower Mainland. The material will be coarse-textured (sandy) soil with a small percentage of fines, which will improve

site drainage and crop selection. While the target fill material is sandy soil, any stony material which may make up the fill, will be segregated onsite, screened and placed at depth to ensure that it does not hinder cultivation of site soils. Soil screening to remove material over 2.5cm in diameter will be conducted onsite.

The proposal includes blending salvaged organic soil from the property with loamy material to provide a highly suitable growth medium. The plan states that the Lulu and Richmond soils range from 0.4m to 1.6m in depth. The applicant intends to salvage the top 0.25m of organic soil material and utilize the organic soil for mixing with mineral soil to prepare a suitable growing medium for grapes and raspberries, as per the Fill Deposition Plan.

The applicant has advised that the proposed duration of the project will be three years. This includes topsoil preparation and crop transitioning from cranberries to grape and raspberry production. Fourteen acres of the property will be dedicated to grape vines that favor the cooler Metro Vancouver temperatures; while the remaining four acres will be used to produce raspberries to support the Richmond Country Farm market.

The Consultant concludes:

> *"The Fill Deposition Plan is expected to improve the Site's historically mapped agricultural improved capability from O3LW (with limitations of degree of decomposition-permeability and excess water) to an agricultural capability of Class 1 or 2A, with significantly improved agricultural productivity and increased crop selection."*

Richmond Agricultural Advisory Committee Consultation

The Agricultural Advisory Committee (AAC) discussed the proposal on April 26, 2016. It should be noted the committee did not have quorum; however, the members did provide the following comment:

> *"The Committee noted that it understands the issue related to the quality of water and rationale behind the proposed soil fill. Committee agreed that raising the profile of the site will enhance the agricultural viability of the site and enable the owners to pursue a positive venture."*

The AAC introduced the following motion:

> *"That the ALR soil fill application for the site (PID: 023-860-481) be supported as presented."*

Please refer to Attachment 2 for a copy of the AAC meeting discussion notes.

Staff Comments

City staff have prepared a comprehensive soil deposit permit (the "Permit") that addresses a number of key issues, including but not limited to, protection of the surrounding Riparian

Management Areas (RMA), public safety, drainage, eliminating impacts to neighbouring properties and City infrastructure, security deposits, and the permitted hours/days of operation (Attachment 3).

The open watercourse adjacent to the Francis Road right-of-way is a protected RMA. As this work is farm activity it is not subject to Riparian Area Regulation requirements. While it is an accepted best practice to maintain riparian setbacks to support effective agricultural drainage, the City has no authority to require protection and management of the 5m RMA setback in this application.

The applicant will be required to take all necessary precautions to prevent sedimentation of any stream, creek, waterway, watercourse, ditch, drain, catch basin, culvert, or manhole either on or adjacent to the property. Sediment control and erosion measures will be installed/constructed and inspected by the consultant. City staff will inspect to ensure compliance prior to the importation of any soil onto the property. This will be a separate condition within the permit that requires that the applicant meet the City's current Watercourse Protection and Crossing Bylaw and the current Pollution Prevention and Clean-Up Bylaw.

The City will require a comfort letter from a professional engineer confirming that, should the proposal receive approval, the soil will have no impact to surrounding properties including, but not limited to, impacts on the neighbouring properties' groundwater table, open or closed drainage infrastructure connecting to the City's storm drainage infrastructure.

Should the project receive approval, the applicant may be required to install a wheel wash prior to the importation of any soil onto the property.

The permit holder will be required to maintain an accurate daily log of trucks depositing soil on the property. This log will be made available for inspection by City staff when requested. At the sole discretion of the City, alternate measures may be used (i.e. survey, etc.) in order to establish the volume of soil deposited on the property.

Staff are recommending to the ALC as a condition of approval, that the applicant be required to post a substantial performance bond in a form and amount deemed acceptable by the ALC. The performance bond should be of a sufficient amount to ensure that all required mitigation and monitoring measures are completed as proposed and to ensure the rehabilitation of the property in the event the project is not completed. The performance bond will be held by the ALC.

Staff are also recommending to the ALC that the project be monitored by a professional agrologist. Furthermore, that the agrologist provides quarterly inspection reports to the City and ALC. This will be a separate condition within the permit that may include the provision that a report may be required upon request by the City.

Prior to permit issuance, the City will require that the applicant provide a security deposit. The deposit will not be returned until all of the conditions as stated in the permit and the ALC approval, should one be granted, are satisfied in their entirety to the satisfaction of the City. City staff will also require confirmation in writing from the applicant's consultant and the ALC, that

the project is completed as per the initial approval. City staff will conduct a final inspection prior to closing the file.

City staff will monitor the property to regularly ensure compliance with the conditions of the permit and ALC approval, should approval be granted.

Geotechnical & Drainage Considerations

The applicant has contracted Geo Pacific Consultants Ltd. to conduct a geotechnical investigation to determine impacts to surrounding properties and drainage should the project be approved. Please refer to Attachment 4 for a copy of the Geotechnical Investigation Report. It is the opinion of the report's author(s):

> *"The proposed fill program is feasible without adversely impacting drainage or groundwater levels beyond the site."*

As per the investigation and assessment, the report indicates the probability of considerable settlement of up to 6m to 8m beyond the fill area. The report further indicates the likelihood that maintenance may be required to "ensure [...] level access roads and positively flowing ditches." Staff are recommending that the approved fill area be setback a minimum of 8m from property lines in order to mitigate any future impact to neighbouring properties due to potential settlement related issues.

In addition, the planned Vancouver Airport fuel delivery pipeline is projected to be placed within the Francis Road corridor next to the proposed soil deposit project. Geo Pacific has provided an additional geotechnical investigation report assessing potential impacts on the proposed pipeline should the soil deposit project be approved. The report concludes that the pipeline will be setback 12 to 14m from the soil deposit project. Furthermore, the report states:

> *"While measurable movements of the pipeline are likely, they are expected to be low differentially at less than 1mm/metre and should not impact the jet fuel line."*

Geo Pacific has identified and City staff are recommending that a pipeline monitoring plan be implemented for the duration of the fill project. Any cost for monitoring would be assumed by the applicant.

Staff will require a topographic survey identifying pre and proposed post-fill elevations prior to the project commencing.

Environmental Considerations

The applicant will be required to ensure that there is no damage to adjacent watercourses. Conditions of the permit will require that the applicant install adequate erosion/sediment control measures prior to the importation of soil.

The proposed fill site borders Freshwater Wetland Environmentally Sensitive Area (ESA) on its western property boundary and also on the south across the road. Erosion and sediment control will be required to prevent impacts to the ESA.

Any trees of 20cm caliper located on the property and trees located on neighbouring properties within 2m of any property line are to be protected as per the City's information bulletin Tree-03 "Protection of Existing Trees during Demolition and Construction".

As per Fisheries & Oceans Canada, it is recommended that residents self-assess any proposed works to ensure that a project avoids causing serious harm to fish. This applies to work being conducted in or near water bodies that support fish that are part of or that support a commercial, recreational, or Aboriginal fishery.

Agricultural Considerations

The applicant retained the consultant in order to provide the agricultural land capability assessment and any site mitigation recommendations for the proposed soil deposit project.

The owner has identified a number of agricultural considerations with respect to the property. They include, but are not limited to, the following:

- High salt levels recorded in the farm's water source (south arm of the Fraser River) has been detrimental to crop yields and farming operations.
- During the past seven years the crop has averaged a yield of 180,800lbs, while the previous seven years averaged 277,900lbs. This represents a 35% reduction of production per year on average;
- Reductions in cranberry production over the last two years have resulted in Cranberry Meadows being ranked in the bottom 27% of all Ocean Spray growers;
- Farm harvest occurs in the fall and was often delayed due to the quality and quantity of the water from the Fraser River;
- The farm was required in 2010 to use a 3 inch-metered water main from the adjacent golf course to help dilute excess salt water from the Fraser River during harvest flood.

As per the City's report (re: Salinity Intrusion in the Fraser River) identified within the consultant's assessment, City staff identified the potential for the salt wedge to advance beyond the No. 6 Road irrigation water intake during tidal cycles. As noted in the report:

> *"[T]he City installed a salinity meter at the [No. 6 Rd. South] pump station that shuts off flow from the Fraser River when salt content becomes too high."*

The salinity meter and automated valve protect the irrigation system from high levels of salinity. The salinity meter and automated valve are in working order and there are no instances where fault or failure have allowed water with high salt content into the system. While the Fraser River source water does experience high salt concentrations on a regular basis, the irrigation system is maintained at a salinity level appropriate for Richmond farming. There are many farms in the

vicinity of the subject farm that utilize provided irrigation water and maintain successful farming operations.

As indicated, Lulu soils are typically suited for production of annual legumes, blueberries, cereals, cole crops, corn, perennial forage crops, root crops and shallow-rooted vegetables. Production of other crops including grapes and raspberries, which are proposed for the site, are limited by inadequate drainage of these soils causing winter injury due to a high water table.

Consideration should be given to the desirability of man-made transformation of Lulu soils that have traditionally been successfully used for a wide range of agriculture crops throughout Richmond to the specific use of grapes and raspberries.

Should the proposal achieve final approval, the City will require that the consultant be retained to monitor the project and provide regular reporting. Should the consultant not be retained or cease providing regular oversight and reporting, the City would reserve the right as per the permit, to suspend and/or void the permit until such time as a new qualified agrologist, agreeable to the City and ALC, is retained to monitor the project and provide regular reporting.

Road & Traffic Considerations

A traffic management plan has been provided to ensure public safety. Truck contractors accessing the site will be required to adhere to speed and weight limit conditions and must only access No. 6 Road from Steveston Highway. Due to truck weight limit and speed limit considerations, no access will be permitted on No. 6 Road from Williams Road to Westminster Highway. The City will reserve the right, as per the permit conditions, to request modifications to the traffic management plan should it be deemed necessary by staff.

The proponent must ensure that measures for dust and noise control are in place to ensure there is no damage from dust to the cranberry crop on the adjacent cranberry farm or noise disturbance to poultry for the adjacent turkey operation.

Should the soil deposit proposal receive approval, it will be the responsibility of the applicant and his contractor(s) to contact officials with the Vancouver Airport Fuel Facilities Corporation to ensure soil deposit operations (i.e. truck traffic) and pipeline construction do not conflict.

Security Bonds

Should the soil deposit project receive approval, the City will require that the applicant provide the following security bonds:

- $5,000 pursuant to section 8(d) of the current Boulevard and Roadway Protection Regulation Bylaw 6366 to ensure that roadways and drainage systems are kept free and clear of materials, debris, dirt, or mud resulting from the soil deposit activity; and

- $10,000 pursuant to section 4.2.1 of the current Soil Removal and Fill Deposit Regulation Bylaw 8094 to ensure the full and proper compliance with the provisions of this Bylaw and all other terms and conditions of the permit.

The security bonds are required prior to issuance of the permit.

Financial Impact

While there is no incremental financial impact to the City, there are costs associated with City staff monitoring the fill site throughout the duration of the project, as ALC staff do not actively monitor fill projects. In addition, an external consultant's review may be requested should staff deem such a review necessary. Funding is set aside within the existing budget to pay for costs associated with a review.

As per the bylaw, the applicant has provided the City's non-refundable application fee in the amount of $600. In addition, the applicant has submitted the ALC application fee in the amount of $600.

Conclusion

Staff recommends that Council refer the non-farm use fill application for the property located at the Eastern Terminus of Francis Road (PID 023-860-481) to the ALC for their review and consideration.

Ron Graham
Acting Manager, Community Bylaws
(604-247-4601)

RG:mm

Att. 1: Copy of the Fill Deposition Plan (PGL Environmental Consultants) dated October 2016
2: Copy of the AAC meeting discussion notes dated April 26, 2016.
3: Draft copy of the proposed City of Richmond Soil Deposit Permit
4: Copy of the Geotechnical Investigation Report (Geo Pacific Consultants Ltd.) dated January 11, 2017

Eastern Terminus of Francis Road
Richmond, BC

Fill Deposition Plan

PREPARED FOR:
Cranberry Meadows Farm Ltd.
11450 92A Avenue
Delta, BC V4C 3M5

PREPARED BY:
PGL Environmental Consultants
#1200 – 1185 West Georgia Street
Vancouver, BC V6E 4E6

PGL File: 4402-01.01

October 2016

PGL ENVIRONMENTAL CONSULTANTS

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PGL ENVIRONMENTAL CONSULTANTS

1.0 INTRODUCTION

PGL Environmental Consultants (PGL) has been retained by Cranberry Meadows Farm Ltd. (Cranberry Meadows) to develop a fill deposition plan to improve agricultural capability for grape and raspberry production at the eastern terminus of Francis Road (C Sec 21 BLK4N RG5W PL LMP 3438 [BL299792]), in Richmond, BC (the Site; Figure 1). The property owner would like to use appropriate fill materials to raise the majority of the 8.05ha property so that it is at the same elevation as the surrounding properties in the southern portion, and suitably high enough in the northern portion to permit grape production.

2.0 BACKGROUND

The site of an old mined-out peat farm, Cranberry Meadows has been operating a pre-existing cranberry farm for the past eleven years. During that time, crop production has been impacted by the agricultural capability of the property given its current limitations. These limitations are largely due to the quantity and quality of water that is sourced from the South Arm of the Fraser River.

Water required by Cranberry Meadows in the fall for frost protection and harvest flooding is sourced from the Fraser River through the No. 6 South Road Pump Station. Agricultural activities at the site have been increasingly impacted over the years due to high salinity which adversely impacts agricultural production. The location of this property is unique as it requires Cranberry Meadows to source its water closer to the mouth of the Fraser River than other cranberry operations. Most farms in Richmond source their water from further upstream on the North Arm of the Fraser River, which is less saline. In his staff report on salt intrusion into the Fraser River dated July 5, 2010, Richmond's engineering director, John Irving, noted that evidence suggests that the No. 6 Road South Pump Station is impacted by higher saline conditions owing to saltwater intrusion during periods of low flow and high tides. These conditions are associated with periods of the year in which Cranberry Meadows requires water for frost protection and harvest. John Irving further indicated that water quality at the No. 7 North and No. 8 North Pump Stations, which provide water for most agricultural operators in Richmond, are not impacted by saltwater intrusion and associated saline conditions. Consequently, high salinity concentrations have not been a significant impediment for these operations. The property owner has indicated that these concerns have been previously documented by the City of Richmond (the City) staff resulting in a meeting with the City's engineering department. While the City has attempted to address the high salinity issues, a suitable solution has not been identified.

Cranberry Meadows would like to continue using the property for agricultural production but would like to change the crop production from cranberries to grapes and raspberries. This will eliminate the need for spring/fall frost protection and harvest flood, which will provide a significant advantage as it will eliminate the farm's reliance on the Fraser River. The owners of Cranberry Meadows already have a portion of their Richmond Country Farms in grape production. The proposed grape production for the Site will supplement their current grape and wine production. Grape production however, will require improvements to the Site soils and the addition of slopes to facilitate drainage, both of which can be achieved through the proposed fill deposition plan.

The property owner/operator of Cranberry Meadows Farms is a four-generation farming family in Richmond, and they have identified the following specific agricultural considerations:

- High salt levels recorded in the farm's water source (south arm of Fraser River) has been detrimental to crop yields and farming operations;

- During the past seven years the crop has averaged a yield of 180,800lbs, while the previous seven years averaged 277,900lbs. This represents a 35% reduction of production per year on average;
- Reductions in cranberry production over the last two years have resulted in Cranberry Meadows being ranked in the bottom 27% of all Ocean Spray growers;
- Farm harvest occurs in the fall and was often delayed due to the quality and quantity of the water from the Fraser River;
- In 2013, a pre-harvest screening showed unacceptable levels of malathion residue. Malathion is known to be used extensively on blueberry farms in the area but not in Cranberry Meadows operations. Harvest was delayed for two weeks while the residue dissipated;
- Farm operations are impacting area residents as the farm requires water levels in ditches to be raised resulting in localized flooding;
- By introducing new crops, the farm will convert to drip irrigation and drastically reduce the need for large volumes of water from the Fraser River. Irrigation will only be required for the first two years following grape planting, after which irrigation will not be required;
- The farm was required in 2010 to use a 3"-metered water main from the adjacent golf course to help dilute excess salt water from the Fraser River during harvest flood;
- By raising the profile of the property and introducing new crops the farm will convert to drip irrigation, which will be the most efficient form of irrigation and reduce the need for spring/fall frost protection and harvest flood; and
- A temperature difference exists between the surface of the recessed cranberry bog and the elevated properties surrounding the farm, resulting in a temperature differential of approximately 6°C (as observed by the land owner) due to radiative frost conditions (frost pockets) where cold air collects, which reduces the growing season in some years.

2.1 Fill Requirement to Support Existing Wine Production

Richmond Country Farms Ltd. which has a winery division under the name Country Vines will be using the proposed grape production primarily for their white wine production. However, they would like to grow some red varietals under hay grove tunnels as well. Currently Country Vines has approximately 4 acres of white varietals under cultivation, which produces roughly 10 tonnes of grapes. The Agriculture Land Commission (ALC) permits land-based wineries on Agricultural Land Reserve (ALR) land to buy a certain amount of grapes or grape juice from other farms/vineyards in BC, but not all of it.

They state:

"The ALC regulation permits licensed wineries on a parcel in the ALR, provided at least 50% of the farm products (fruit) used to make the wine is produced on the farm on which the winery is located. The farm may be comprised of one or several parcels of land owned or operated by a farmer of farm business. Alternatively, the use is permitted if the farm that grows the fruit to make the wine is 2 ha or larger and at least 50% of the fruit us to make the wine comes from a BC farm under a minimum 3 year contract to provide fruit to the winery. The 50% threshold is measured by the quantity of farm product processed on an annual basis."

The Liquor Distribution Branch (LDB) also put a restriction on the amount a land-based winery can buy from other farms.

They state:

"at least 25% of the grapes that a winery uses must come from land owned or leased by the winery."

In recent discussions, the LDB has indicated that they may increase this percentage in the coming years to prevent land-based wineries from turning into satellite liquor stores.

Successful wineries such as Chaberton Estate winery in the Fraser Valley grow over 50 acres of their own grapes and produce over 50 thousand cases a year. Their most popular seller is a white varietal named Bacchus from Germany. It is a cool-season, early white that is grown primarily in the Fraser Valley where it thrives on a lower temperature and growing degree-days. In order to be successful making wine, a winery needs control of its own grapes. Grapes for wine are grown for quality not quantity. When a Fraser Velley winery is buying from vineyards in the interior, it is hard for them to crop thin to the tonnage per acre that makes the best quality grape that a winemaker wants. Country Vines would like to grow into a 5000+ case winery, as well as produce high-quality estate wines. More local acreage will be required to legally operate under a land-based winery license.

2.2 Soil Requirements for Grape Production

Vine health and productivity depends on a healthy root system. Roots operate most effectively in neutral, deep, well-drained, and well-aerated soil with good organic matter and an adequate supply of nutrients. Grape vines are deep-rooted plants requiring adequate soil depth, and they are not suited to shallow soils.

Grapes are grown on a variety of soil types, such as course-textured sands, fine gravels, and imperfectly drained clay soils, but they grow best on well-drained soils in Canada[1]. Most expert sources suggest sandy loam as the best soil type for growing grapes. This type of soil offers the best blend of characteristics. It drains well but contains a moderate amount of organic matter to retain nutrients and generally lies within the preferred pH range. Silt loam and clay loam soils will also support the healthy growth of grapes as long as they drain well. In most cases, the latter types will benefit from moisture balancing amendments. Grapes will tolerate heavier clay-type soils but this will delay the maturity of crops and vines.

Soils most suitable for commercial grape production have the following characteristics[2]:

- Well drained;
- Water table > 2m of the surface;
- No restriction to root development;
- pH of 6 to 7.5 in the top 40cm;
- Nil to slightly calcarious in the top 40cm, and slight to moderately calcarious beyond 40cm;
- Non saline;
- Preferably medium to high cation exchange capacity;
- Medium to warm soil temperature;
- A gradual slope (3 to 4%) to the south or southwest; and
- Mineral soils with a minimum of 1% organic matter or more for BC interior soils, and 4% or more organic matter in BC coastal soils.

[1] Crop Profile for Grape in Canada. Agriculture and Agri-Food Canada. 2006
[2] BC Ministry of Agriculture and Lands. (2010). Best Practices Guide for Grapes for BC Growers, 2010. pp:200.

Few native soils have these characteristics. Most soils need to be modified before planting, and need to be managed to maintain these characteristics. Cranberry Meadows has the opportunity to produce these conditions through their screening and fill plan.

3.0 MUNICIPAL FILL DEPOSITION REQUIREMENTS

Deposition of fill requires a Fill Deposit Permit under the City of Richmond's Soil Removal and Fill Deposit Regulation (Bylaw No. 8094) and approval for a Non-farm Use to Place Fill or Remove Soil under the *Agricultural Land Commission Act*.

Application to the City for fill deposit as detailed in Bylaw No. 8094 requires completion of a fill deposition plan. The scope of the plan meets the City's requirements and includes:

- Description of the composition and volume of fill to be deposited;
- Completion of a plan diagram showing the location of proposed fill deposit and all pertinent topographic features, including existing buildings, structures, watercourses, and tree cover;
- Depths and proposed slopes, which will be maintained upon completion;
- Proposed methods to control the erosion of the banks of deposited fill;
- Proposed methods to control drainage for the Site during and after deposition of fill;
- Proposed methods to access the deposit area during operation, including a scale map of proposed routing, and scheduling of truck and vehicular traffic;
- The location and size of any buffer zones necessary to provide a visual and sound barrier between the permit area and adjacent lands; and
- Proposed methods to control noise and dust during fill deposition.

4.0 SITE DESCRIPTION

The Site is located on the eastern Terminus of Francis Road, east of No. 6 Road in Richmond, BC (Figure 1). The surrounding area is illustrated in Figure 3 and is characterized by:

- North: A golf course (Country Meadows Golf Course);
- West: Holding property (agricultural-zoned land);
- South: Holding property (agricultural-zoned land owned by Richmond Landfill); and
- East: Industrial land (Richmond Landfill)

4.1 Legal Description

The Site is comprised of one parcel. The legal description of the parcel is:

- C Sec 21 BLK4N RG5W PL LMP 3438 [BL299792]
  The Parcel Identification Number is 023-860-481.

4.2 Zoning and Current Land Use

The Site is zoned by the City as AG1 (traditional sites zoned for agriculture), and lies within the Agricultural Land Reserve. The Site is also designated as an Environmentally Sensitive Area within the City of Richmond Official Community Plan. The Environmentally Sensitive Area designation is Freshwater Wetlands. The Official Community Plan has also identified the property as Agriculture.

The City considers Freshwater Wetlands to be areas with vegetation and soils influenced by the presence of freshwater in the rooting zone for plants. This includes open, forested, and shrub bogs, swamps, marshes, wet meadows, seasonally flooded fields, and shallow (<2m or 6.56ft. depth) ponds and ditches.

The 8.05ha subject property is currently used for cranberry production. The Site is entirely cleared and has been improved with four cranberry fields, a ditch and access road network surrounding the cranberry fields, as well as several outbuildings located on the southwestern portion of the Site.

4.3 Soils

4.3.1 BC Ministry of Environment Mapping

The 1:25,000 scale published soils mapping in the RAB Bulletin 18: Soils of the Langley-Vancouver Map Area indicate the Site has Richmond and Lulu soil series. Richmond soil series consist of 0.4m to 1.6m of well-decomposed organic matter overlying fine-textured deltaic deposits. Lulu soil series consist of 0.4m to 1.6 m of partially-decomposed organic matter over lying moderately fine-textured deltaic deposits. Richmond and Lulu soil series are very poorly drained and acidic in nature.

Historical surveys indicate the main agricultural limitation of the soils in the area is excess water and the degree of decomposition – permeability. The existing, less-detailed historical survey had mapped the Site with an improved agricultural capability classification of 100% Ø3LW (Agricultural Capability Map 92G.3h) throughout the property.

4.3.2 Current Onsite Inspection

The subject property indicated evidence of surficial disturbance to enable trafficability and access to the Site. The western portion had areas of gravel fill, including a driveway along the north property line and a footprint of a former structure near the south property line. A raised portion of the north side of the property has been covered in sawdust or hog fuel.

Peat mining appears to have previously occurred onsite. Test holes advanced on the access roads as part of the geotechnical investigation found that peat occurred in all investigation locations and varied in thickness between 0.4 and 1m[3]. Peat within the farmed portion of the Site may be thicker as it has not been compressed with fill associated with road construction.

Beneath the peat, an overbank sequence between 2m and 4m thick of clayey silt to silty clay deposits overlays a fine sandy silt to silty sand transitional sequence. River channel deposited sands occur beneath the transitional sequence, which extend to a depth of about 25–27m.

The static groundwater level is expected to be in close proximity to the existing elevation of the farm field, and is expected to vary seasonally with generally higher levels during the wetter winter and spring months.

[3] Geotechncial Investigation Report – Proposed Fill Site Terminus of Francis Road – East of No. 6 Road, Richmond, BC. GeoPacific. 2016

5.0 PROPOSED FILL PLAN

The Site's agricultural capability is primarily limited by poorly-drained, naturally infertile and acidic soil. The salinity of water extracted from the irrigation ditch also limits the Site's agricultural production potential. Improvement of the agricultural capability requires improved drainage for the predominantly organic soils to increase crop selection, lengthen the growing season, and increase trafficability.

Lulu soils are typically suited for production of annual legumes, blueberries, cereals, cole crops, corn, perennial forage crops, root crops, and shallow-rooted annual vegetables. Production of other crops including grapes and raspberries, which are proposed for the Site, are limited by inadequate drainage of these soils causing winter injury due to a high water table. This results from their low-lying position and resulting high organic composition which impedes drainage. Filling will improve drainage, which is required for grape production.

Material which will be used for fill will be coarse-textured (sandy loam) soil with a small percentage of fines, which will improve Site drainage and crop selection. While the target fill material is sandy soil, any stoney material which may make up the fill will be segregated onsite, screened, and placed at depth to ensure that it does not hinder cultivation of Site soils. Soil screening to remove material over 2.5cm in diameter will be conducted onsite with an instrument identical to the screen used by the City of Richmond at the Sidaway Road soil depot. The Fill Deposition Plan also involves blending salvaged organic soil from the Site with loamy material to provide a highly suitable growth medium.

The Fill Deposition Plan is expected to improve the Site's historically mapped agricultural improved capability from O3LW (with limitations of degree of decomposition-permeability and excess water) to an agricultural capability of Class 1 or 2A, with significantly improved agricultural productivity and increased crop selection.

5.1 Soil Conservation and Management

5.1.1 Fill Plan

The fill plan has been developed to minimize the impacts to agriculture and surrounding land use, and produce a significant improvement to the Site's agricultural capability. Improvements to agricultural capability will result from reducing the excess water conditions currently experienced onsite, thereby permitting production of a greater variety of agricultural products.

In addition, the fill plan has been developed to allow agriculture to continue on portions of the Site during fill deposition and transition from a cranberry crop to grape/raspberry production.

As the existing soils are organic and not mineral, soil-salvage measures will be completed to salvage portion of the organic soil which will be mixed in with the top soil. Fill will be deposited onto the existing soil surface with coarse material at depth to ensure adequate drainage is maintained.

The fill deposition has been designed to occur over a three-year period. The filling procedures are summarized below. Additional details pertaining to soil composition, slopes and erosion, drainage, buffer, and noise and dust mitigation are provided in the following sections.

Soil will be segregated prior to final placement at the Site to ensure that the maximum improvement to agricultural capability is realized. This will include ensuring that any texture or stoniness limitations associated with the material is managed appropriately.

Fill will be sourced from multiple locations within the Lower Mainland. To maximize improvements to agriculture, fill material will be segregated onsite. The proposed fill placement plan includes:

- Stripping and salvaging the top 0.25m of surface organic soils and stockpiling until final elevations are almost achieved. Organics will be blended with topsoil to achieve the final elevation;
- Screening all soils brought to the Site with an onsite screen plant to produce a sandy loam fill, and placing fill to reach required elevation, while providing adequate drainage for crop production. Screening will be completed using the property owner's Terex Finaly 883 Soil Reclaimer, which has the ability to process up to 600 tons of material per hour;
- Top-dressing the filled area with the previously stripped organic material, sand, and other suitable loam material to achieve an appropriate growth medium required for grapes and raspberries; and
- Should any stony or high-clay-content soil make up a portion of the fill, placing it at depth to ensure that those soil types do not adversely affect drainage of the upper soils and any stony material will not hinder cultivation.

Staging will progress from the eastern portion of the Site towards the western portion of the Site, enabling the farm to phase out the cranberry operations gradually over the course of the fill operation. This staging process will aid the drainage and silt erosion control measures being implemented at the Site prior to releasing the treated water back into the City of Richmond's ditch network at the southwest corner of the Site.

5.1.2 Fill Monitoring Plan

In addition to retaining a geotechnical engineer to oversee fill placement, all material brought to the Site will be monitored by accompanying documentation from its place of origin to ensure that no potential environmental risks are associated with the material. This typically requires completion of a Phase 1 Environmental Site Investigation which assesses current and historic land uses on the site and surrounding properties and identified any potential activities of environmental concern.

To ensure that the soil meets the intended purpose of improving the Site's agricultural capability, a Professional Agrologist will conduct regular Site visits following the start of the project to confirm that fill has been placed as described in the information submitted with the application.

A final report will be submitted to the City of Richmond upon completion of the project. The final report will include, but is not limited to:

- A written description of the project;
- Evidence that the fill placement project has been completed as described in the application;
- Final cross-section profiles of the fill project area showing final contours;
- Clear and accurate measurements of the fill project area, depths, and volumes of imported fill;
- Photographs of the project area accompanied by a scale drawing; and
- A hydrological overview with respect to drainage of the project area.

5.1.3 Soil Composition

Soils are currently mapped as a mixture of Lulu and Richmond soils. Richmond soil series consist of 0.4m to 1.6m of well-decomposed organic matter overlying fine-textured deltaic deposits. Lulu soil series consist of 0.4m to 1.6 m of partially-decomposed organic matter overlying moderately fine-textured deltaic deposits. Richmond and Lulu soil series are very poorly drained and acidic in nature.

The fill deposition plan includes leaving the existing soils in place to prevent an adverse impact to drainage in an area which currently is subject to a shallow groundwater table.

Fill will be sourced from non-contaminated residential development sites in the western portion of Vancouver. Soils in this part of Vancouver have not been historically mapped for agricultural purposes but surficial geology maps have characterized the soils as developing from Vashon Drift and Capilano Sediments[4].

Based on historic mapping and the property owner's previous experience, excavated soil will primarily be characterized by glaciomarine and marine deposits. Additional excavated materials may include the underling glacial drift which includes lodgment and minor flow till, lenses and interbeds of substratified glacial river sand, to gravel and lenses and interbeds of glacial lake laminated stony silt.

Suitable fill material will be free of any large, woody organic material or construction waste.

5.1.4 Fill Volume and Slopes

To create suitable growing conditions, Cranberry Meadows proposes to fill the Site to 1m above surrounding grade (Francis Road) to improve rooting conditions. Class 1 agricultural capability soils include slopes between 0–5%. Additional fill will be placed onsite to create a 3% grade, increasing from the southern edge of the Site towards the north. A 3% grade will create the required aspect to maximize heat accumulation and will provide good cold-air drainage to reduce potential of frost pockets and produce suitable grape producing conditions, as well as permitting production for the full range of climatically suitable soil-based crops in the future. Sites with a slight slope (3 to 4%) to the south or southwest are required to produce the most suitable conditions for commercial grape production.

In order to maximize the area of land that would be available for agricultural production, all side slopes will be established at a slope of 1:2. The north-facing slope will be planted with suitable tree or shrub species to create additional buffering to reduce any potential visual impact to the adjacent property.

To achieve the proposed slopes, deposition of 362,000m^3 of soil will be required. The top elevation of the fill will vary on the western side of the Site as Cranberry Farms intends to maintain the infrastructure located in the southwest corner of the property. Land north of the developed Site (northwest corner) will be filled to the same slope angle as the remainder of Site, but due to the shallower width of the developed southwest corner, the resulting top elevation will be lower than the remainder of the Site. Expected elevations along the north end of the fill are summarized in Table A.

[4] Surficial Geology of Vancouver, Map 1486A, Geological Survey of Canada, 1974 Geological Survey of Canada, 1976 and 1977

Table A: Fill Deposition Summary

Slope	Soil Volume (m3)	Top elevation (above grade*)	Top elevation northwest corner (above grade)
3%	362,000m^3	6.1m	4.4m

Note: *For planning purposes, grade is the current grade of Francis Road.

5.1.5 Erosion Control

Erosion control measures will be required during fill deposition, as well as during agricultural operation. Erosion control measures are summarized below.

The main objective of the erosion and sediment control (ESC) measures during fill deposition will be to prevent sediment discharges to all Site watercourses/drainage ditches, thereby ensuring that runoff does not exceed applicable suspended solid levels. The ESC measures will be in place before commencement of work at the Site.

The basic ESC measures for the Site may include:

- A wheel wash for trucks leaving the Site;
- Silt sacks on catch basins on and off the Site (if required);
- Meeting regulatory requirements for total suspended solids of discharge water;
- Street sweeping (if required);
- Installing silt fencing along the edges of all watercourses/ditches;
- Installing silt fencing along the bases of all fill slopes;
- Covering fill slopes with polyethylene sheeting or mulch, or having them hydroseeded if they are present for the long term; and
- Having the ESC measures inspected on a regular basis and before/after significant rainfall events.

A truck wheel wash facility will be installed at the exit from the Site on the west side of the property. The location of the truck wheel wash and schematic is provided in the attached Erosion Control Plan figure. Cranberry Meadow confirms their obligation to keep City of Richmond roads/highways clean by sweeping and/or flushing soil that may originate from their filling activities on a regular basis as stated in the attached letter.

During fill deposition, Cranberry Meadows will modify and/or halt activity during periods of excessively heavy precipitation when the potential for erosion is unacceptably high.

Once the fill deposition has been completed and slopes have been established, the following general soil management strategies will be implemented to control water erosion:

- Runoff water will be controlled to prevent erosion of surface soils. This will include retention of existing perimeter ditches;
- Vegetation cover will be maintained to prevent mobilization of surface soil and to allow better infiltration of water; and
- Soil structure with good internal drainage will be maintained to permit infiltration.

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5.1.6 Drainage Control

Site soils have been historically mapped as Lulu and Richmond soils which have very poor drainage due to the high water table which is present for most of the year. The high water table restricts the agricultural capability of the land by limiting the range of crops that can be grown and the trafficability of the soils. Cranberry Meadows intends to improve the drainage through the deposition of suitable sandy loam fill. A shallow slope (3%) will be established to provide ideal growing conditions.

Some of the proposed fills, including the marine, glaciomarine, glaciolacustrine and glacial till deposits, would have a relatively low permeability once placed and compacted if placed as-is. However, Cranberry Meadows intends to screen all imported fill with a screening unit and blend soil to produce a sandy loam which will not have the same permeability issues and will not adversely impact drainage.

No subsurface drainage is required. Soils will be coarse-grained with some fines, which will provide good infiltration and internal drainage during high-rainfall periods. Water will flow due to Site grading via both overland and internal flow to the existing ditches. Existing drainage works, including the perimeter drainage ditch, will be retained to manage high rainfall inputs during the fall, winter and spring. Ditches separating the existing cranberry fields will be filled as part of the deposition activities, but the Site grading will maintain well-drained conditions.

The proposed fill plan does not include any additional open or closed drainage infrastructure which may connect to the City of Richmond infrastructure. Drainage will be through infiltration and overland flow to the existing ditch network. As detailed in the attached GeoPacific Geotechnical Investigation Report, it is their opinion that the proposed fill plan is feasible without impacting drainage beyond the Site. GeoPacific's report also assesses whether geotechnical information on the potential impact on surrounding properties or drainage based on the weight of fill and its long-term compacting effects on the subsoil and on local and regional drainage characteristics.

Surface ponding will be further restricted by establishing a 3% grade following the completion of fill deposition. This will also result in a low erosion hazard (Bertrand et al. 1991).

5.1.7 Site Access

Cranberry Meadows intends to undertake fill deposition on the Site over a three-year period. To complete the required filling, approximately 630 truck trips will be completed per month over the proposed three-year period.

Truck traffic will be routed to the Site from Steveston Highway to the south to No. 6 Road prior to accessing Francis Road. The Site is located at the terminus of Francis Road which only services one other agricultural property.

Robert Gilchrist, Supervisor of Traffic Operations at City of Richmond, has stated that the City of Richmond does not require an assessment of associated traffic impacts, but instead requires a Traffic Control/Management Plan for the period that fill we be delivered to the site. The Traffic Control/Management Plan (attached) identifies correct signage and placement as per the Traffic Control Manual for Work on Roadways as published by the Highways Engineering Branch, Ministry of Transportation and Highways and Richmond Traffic Bylaw Pt.V. Sect 18.4.

5.1.8 Buffer

The Site is located at the terminus of Francis Road within an agricultural zoned area of Richmond. Site fill deposition activities have the potential to impact adjacent properties through changes in visual quality, as well as noise and dust generation during fill and re-contouring activities. However, existing natural buffering, as well as management programs detailed in the following sections, are expected to minimize or offset any residual impacts. Existing buffers include:

- North: Treed buffer separating the Country Meadows Golf Course from the Site. Furthermore, both the golf course and Cranberry Meadows are operated by the same individuals;
- West: Recently logged and cleared parcel which separates the Site form the nearest residence located 400m to the west;
- South: Forested parcel with the nearest residence located over 750m south of the Site; and
- East: Constructed earthen berm separating the Site form the Richmond Landfill.

5.1.9 Noise Control

Heavy equipment, including earth moving equipment and trucks, will be required to accomplish the proposed fill deposition activities. While activities will produce noise, the expected impact of noise is considered to be minimal given the location of the Site and surrounding land use. The Site is located at the terminus of Francis Road within a larger area of agricultural land use with no significant residential use. The closest residence is located approximately 400m to the west of the Site.

While a golf course is located immediately north of the Site, a treed barrier currently exists between the properties which will assist with buffering the noise associated with the fill deposition program. The golf course is currently owned by individuals related to those who operate Cranberry Meadows. The remaining surrounding properties are either treed or used for landfill purposes.

Although no sensitive receptors exist adjacent to or immediately near the Site, Cranberry Meadows intends to incorporate mitigation options and a noise management program to minimize noise effects:

- Operating hours will be in accordance with the City's requirements;
- There will be regular maintenance of acoustic seals, mufflers, anti-vibration mounts and other noise-reducing features on vehicles and equipment; and
- Equipment will be turned off when not in use and unnecessary idling will be avoided when practical.

5.1.10 Dust Control

Fill deposition activities have the potential to generate fugitive dust emissions that could impact adjacent blueberry operations. To minimize impacts, additional precautions will be taken to minimize dust generation, including dust suppression and soil/stockpile management. Measures to minimize fugitive dust from exposed or un-vegetated cover soils will also be implemented.

Identification of Potential Sources of Fugitive Dust Emissions

The potential sources of fugitive dust at the Site are summarized in Table B. For each potential source of fugitive dust emissions, the potential causes of dust emission and parameters that may

impact dust emissions are identified in the table. A key step in controlling fugitive dust emissions is to evaluate each of these parameters and determine how they can be controlled.

Table B: Summary of Potential Sources of Fugitive Dust Emissions

Potential Sources of Fugitive Dust Emissions		Potential Causes of Dust Emissions	Parameters that May Impact Fugitive Dust Emissions
A	Unpaved Roads/Areas: • Unpaved roads • Haul trucks • Excavators	• Suspension (by traffic movement or wind) of fines generated from heavy traffic/equipment movement • Traffic movement onsite	• Moisture content • Surface silt loading • Vehicle speed • Distance travelled
B	Material Stockpiles	• Low moisture content • Disturbing the storage pile • Wind erosion of the storage piles	• Moisture content • Fines content • Wind erosion • Stockpile height

Fugitive Dust Control Methodology

Control measures and inspection observation criteria for fugitive dust emissions from Unpaved Roads/Areas and Material Stockpiles is summarized in Tables C and D.

Table C: Source of Fugitive Dust Emissions: Unpaved Roads/Areas

Potential Cause(s) of Fugitive Dust	Control Methodology and Frequency	Inspection Observation Criteria
Suspension by traffic	• Apply water as a dust suppressant (e.g., access roads)	• Check that mobile equipment when driving the speed limit has no observable dust being kicked up by the tires • Check that road surfaces have no observable tracking of dust and dirt • Check that road surfaces have a visible crust or hard surface
Traffic movement onsite	• Speed limit maximum of 20km/hr. • Clean trucks prior to leaving the Site during inclement weather to reduce mud tracking	• Check if drivers are travelling the speed limit • Check trucks are clean when they leave the Site and are not tracking dirt offsite

Table D: Source of Fugitive Dust Emissions: Material Stockpiles

Potential Cause(s) of Fugitive Dust	Control Methodology and Frequency	Inspection Observation Criteria
Low moisture content	• Moisture level of material must be high enough to prevent silt/dust from leaving the pile	• Check that no observable plume or dust leaves the stockpile.
Disturbing the stockpile	• Excavation operators must limit the disturbed area of the stockpile during shipping	
High stockpile height	• Minimize the height of stockpiles	
Wind erosion	• Cover piles or ensure pile surface has a hard surface (i.e., dust suppressant) on the windward side • Work from one side of the pile if possible to minimize the disturbance of material	

Stockpiled materials will be placed within the designated, temporary stockpile storage areas, and graded by the contractor to shed water. If dust suppression becomes necessary during the soil stockpiling, at the discretion of the environmental consultant, exposed soils will be wetted by the contractor.

5.1.11 Riparian Area Management

The Riparian Management Area (RMA) associated with the ditch running along the north side of Francis Road has been set at 15m by the City of Richmond. However, this overlaps with non-valuable habitat features associated with the existing land use (Francis Road) as well as agricultural land use. As such, the current available riparian habitat is less than the 15m RMA. Nevertheless, the proposed filling will encroach on the vegetated portion of the RMA currently used for agricultural production.

To facilitate the erosion control plan while maximizing available land for agricultural production, a 1m-wide horizontal strip between the toe of the proposed fill slopes and the top-of-bank of the perimeter ditches will be provided to further reduce the encroachment into the RMA.

Encroachment into the already disturbed RMA is unavoidable if agricultural productivity on the Site is to be maximized. If encroachment can be permitted, a detailed Riparian Areas Regulation (RAR) assessment may be completed to a) determine the RAR applicable streamside protection and enhancement area (SPEA), b) quantify the proposed encroachment area within the SPEA, and c) initiate a variance approval process under the RAR system. If a variance cannot be provided, the toe of the slope may need to be adjusted to prevent encroachment, resulting in a loss of farmable area.

Cranberry Meadows confirms that no fill activities will impact the City of Richmond-owned RMA without an RMA protection plan from a Qualified Environmental Professional and the written review

and approval of the City of Richmond. Cranberry Meadows also confirms that no new watercourse crossing within the RMA, or improvement of the existing watercourse crossings that includes an increased width of the crossing, are permitted without an RMA protection plan completed by a Qualified Environmental Professional and the written review and approval of the City of Richmond.

5.2 Potential Impacts on Nearby Agricultural Operations

Onsite activities, including trucking, are not expected to affect the existing cranberry and turkey farm located southwest of the Site. Management of potential impacts including noise, dust, and traffic controls are detailed in Sections 5.1.6, 5.1.8, and 5.1.9 of the 2014 Fill Deposition Plan. Proposed controls have been developed to address the City of Richmond's requirements for all land uses located along the trucking route or adjacent to the Site, including agricultural uses. Filling to improve agricultural capability and its associated activities, including trucking and earth moving is a permitted activity within the City of Richmond and the ALR when approved. Cranberry Meadows intends to follow best management practices as detailed in the Fill Deposition Plan to minimize any impacts during the filling period. Following completion of the filling, no potential noise, dust, or vibration sources will be associated with the farm once in operation.

In addition to the proposed controls, Cranberry Meadows does not expect any significant impacts to the turkey operation, as the turkey operation activities occur within enclosed structures located 250m east of the Site. While trucks will pass by the turkey farm, their impacts will be minimized by the controls detailed in the Fill Deposition Plan. Furthermore, the Site is located in an area with surrounding agricultural and industrial use where use of heavy machinery is typical and permitted.

Vibration impacts are typically associated with significant sources, including rail traffic and blasting activities. No potential project-related sources of vibration were identified for the proposed filling program. Using information provided by the Cranberry Meadows operators and a review of conventional trucking and filling methods information, PGL has ascertained that no vibration impacts will occur.

6.0 PROPOSED PLANTING PLAN

Due to the Site's limitations to adequate produce cranberries, Cranberry Meadows proposes to shift its crop production from cranberries to grapes to supply its winery business. The owners currently have seven acres of wine grapes under cultivation on their Richmond Country Farms property on the Steveston Highway. Six tonnes of grapes were produced at the Steveston Highway property in 2013, the second year of production. It is estimated that the four-acre crop of white wine grapes will eventually produce upwards of four to five tons per acre. The required increase in grape production needed for the winery can be accomplished by converting 14 acres of the Francis Road site to grape production. The remaining four acres will be dedicated to raspberry production to support their Richmond Country Farm market.

The planting plan developed for the Francis Road site will favour the cool season white wine varieties including Reisling and Gewurztraminer. White wine grapes will be grown over 10 acres while popular red wine varietals such as Cabernet Sauvignon, Cabernet Franc and Merlot will be grown across four acres. To meet the higher temperature requirements needed for red wine grapes, Cranberry Meadows will use Haygrove Tunnels, a greenhouse growing system that will support red wine grape production and harvest.

All grape vines will be from grafted root stock suited for the Lower Mainland climate. Rows will be spaced 8' apart with plantings spaced at 4' intervals, resulting in approximately 1360 plants per acre (Figure 6). Drip tape will be used to provide adequate irrigation.

Raspberries will be planted over four acres and will include a combination of early variety Malahat raspberries and late season Tulameen raspberries. As with the grapes, raspberry rows will be spaced 8' apart, while individual plants will be spaced at 3' intervals. Drip irrigation will also be used for raspberry production.

7.0 SUMMARY AND CONCLUSIONS

PGL has been retained by Cranberry Meadows to develop a fill deposition plan to improve agricultural capability for grape and raspberry production at the Site. Deposition of fill requires a Fill Deposit Permit under the City of Richmond's Soil Removal and Fill Deposit Regulation (Bylaw No. 8094) and approval for a Non-farm Use to Place Fill or Remove Soil under the *Agricultural Land Commission Act*. This fill deposition plan was developed to meet the requirements set out in the City of Richmond's Bylaw No. 8094.

The Site's agricultural capability is primarily limited by poorly-drained, naturally infertile and acidic soil, and it has previously experienced peat removal resulting in a farming surface below surrounding grade. The salinity of water extracted from the irrigation ditch also limits the Site's agricultural production potential.

Improvement of the agricultural capability requires improved drainage for the predominantly organic soils to increase crop selection, lengthen the growing season, and increase trafficability. Cranberry Meadows proposed filling the Site with suitable soil to establish a 3% grade across the Site, which will create the required aspect to produce suitable grape-producing conditions while maintaining a desirable slope that will provide surface drainage and not restrict any potential for the full range of climatically suitable crops in the future.

Filling would be completed through deposition of fill sourced from the western portion of Vancouver over a three-year period. All fill will be sorted and blended to produce a sandy loam soil ideal for grape and raspberry production, as well as a wide range of suited and well-suited crops. The fill deposition plan has been developed to permit the operation of agricultural activities during the filling period as the Site transitions from cranberry production to grape and raspberry production. The proposed grape production for the Site will supplement the property owners current grape and wine production.

The proposed fill deposition plan will dramatically improve the agricultural capability from Class 3 soils with significant limitations (salinity, excess water) and will result in an improved agricultural capability to Class 1 or 2, while minimizing any potential impacts to agriculture, the environment, or adjacent property and land uses.

Respectfully submitted,

PGL ENVIRONMENTAL CONSULTANTS
Per:

Stewart Brown, M.Sc. P.Ag., R.P.Bio.
Lead Consultant

E.L. (Ned) Pottinger, M.Sc., P.Geo., P.Ag.
Chairman

CSB/ELP/mtl/slr/mtl
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Figures

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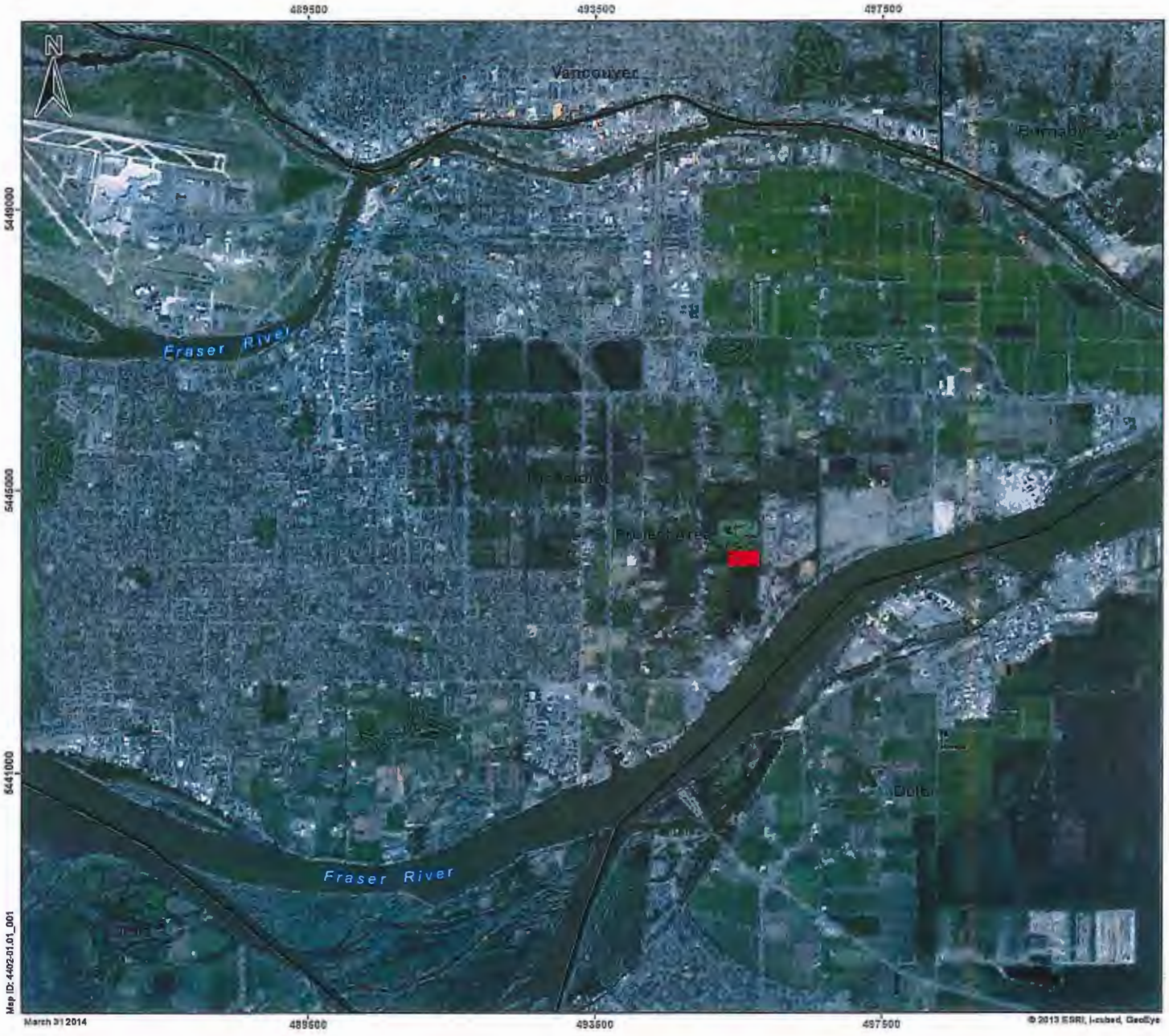

Site Location

Project Location

1:75,000
0 1,000 2,000
Metres
Coordinate System: NAD 1983 UTM Zone 10N

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Figure 1

Site Plan

Project Location

C
Figure 4
Cross Section ID
Figure No.

1:5,000
0
250
Metres

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Figure 2

Surrounding Land Use

- Project Location
- Zoning Boundary
- Agriculture Land Reserve (ALR)

AG1	Agriculture
I	Industrial
GC	Golf Course

1:5,000
0 250
Metres

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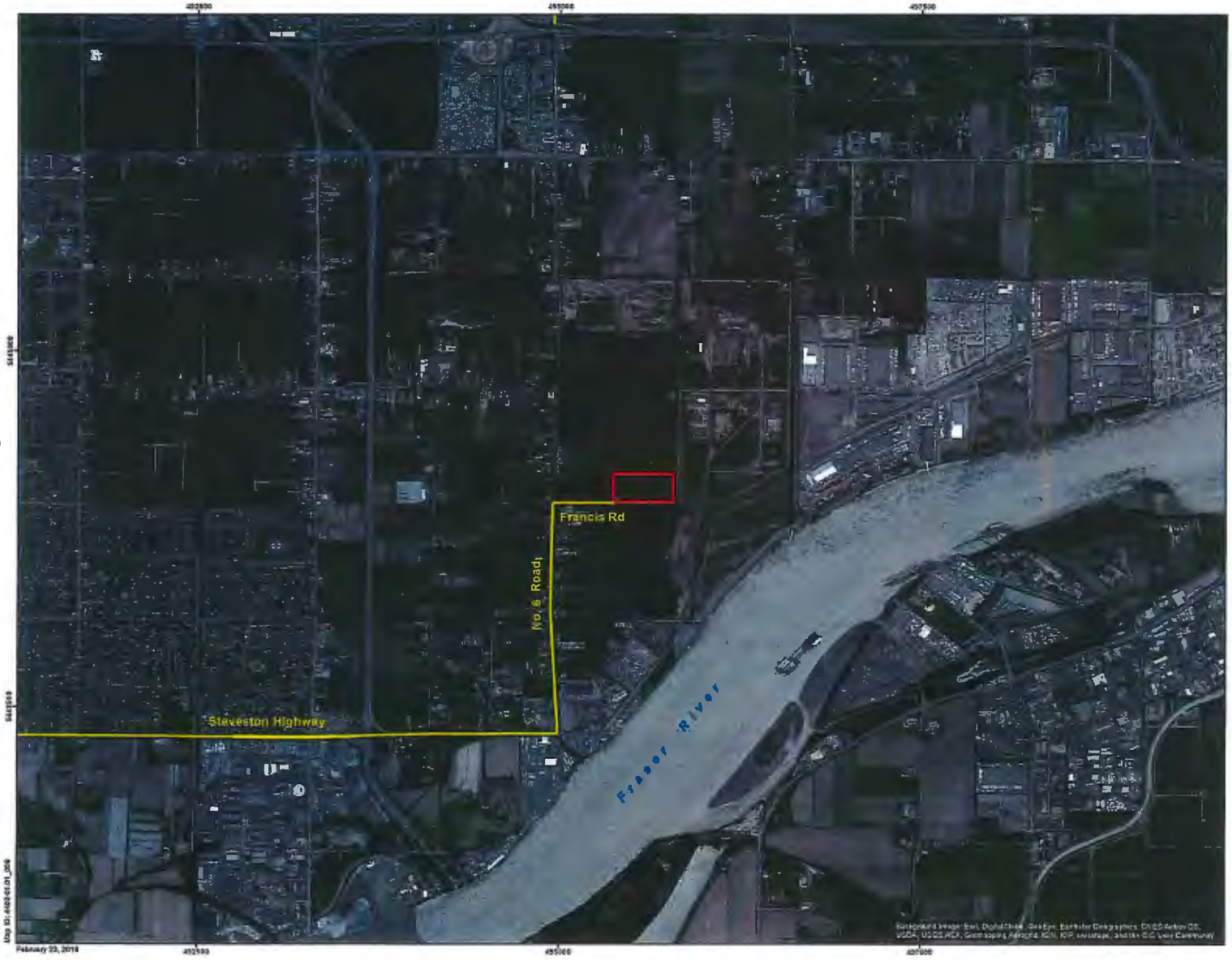
Figure 3



Truck Routing

Proposed Route

Project Location

1:25,000

500 0 500

Metres

Coordinate System: NAD 1983 UTM Zone 10N

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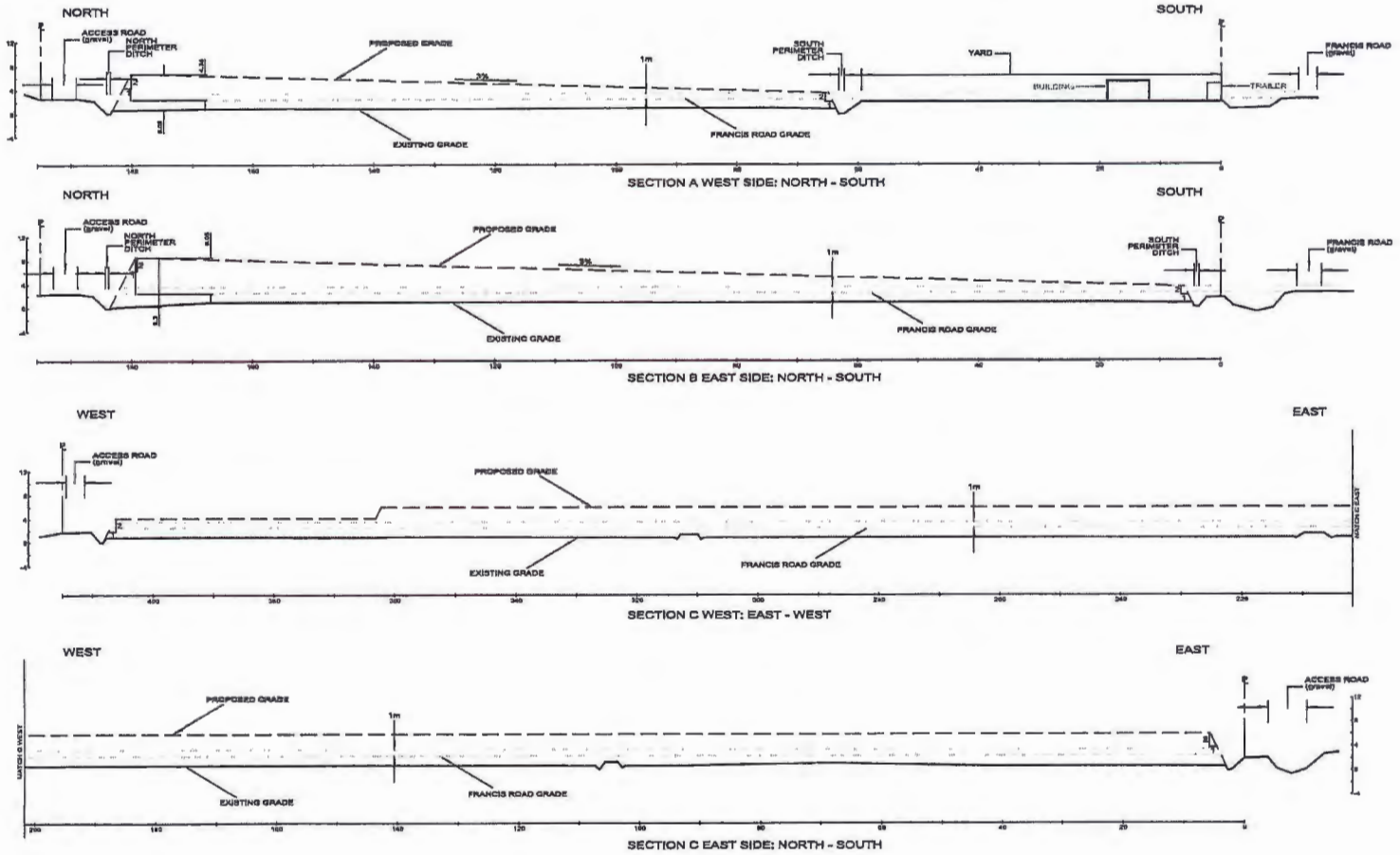
Figure 4



Fill Plan

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Map ID: 4429-01.01_005

JUNE 25, 2014

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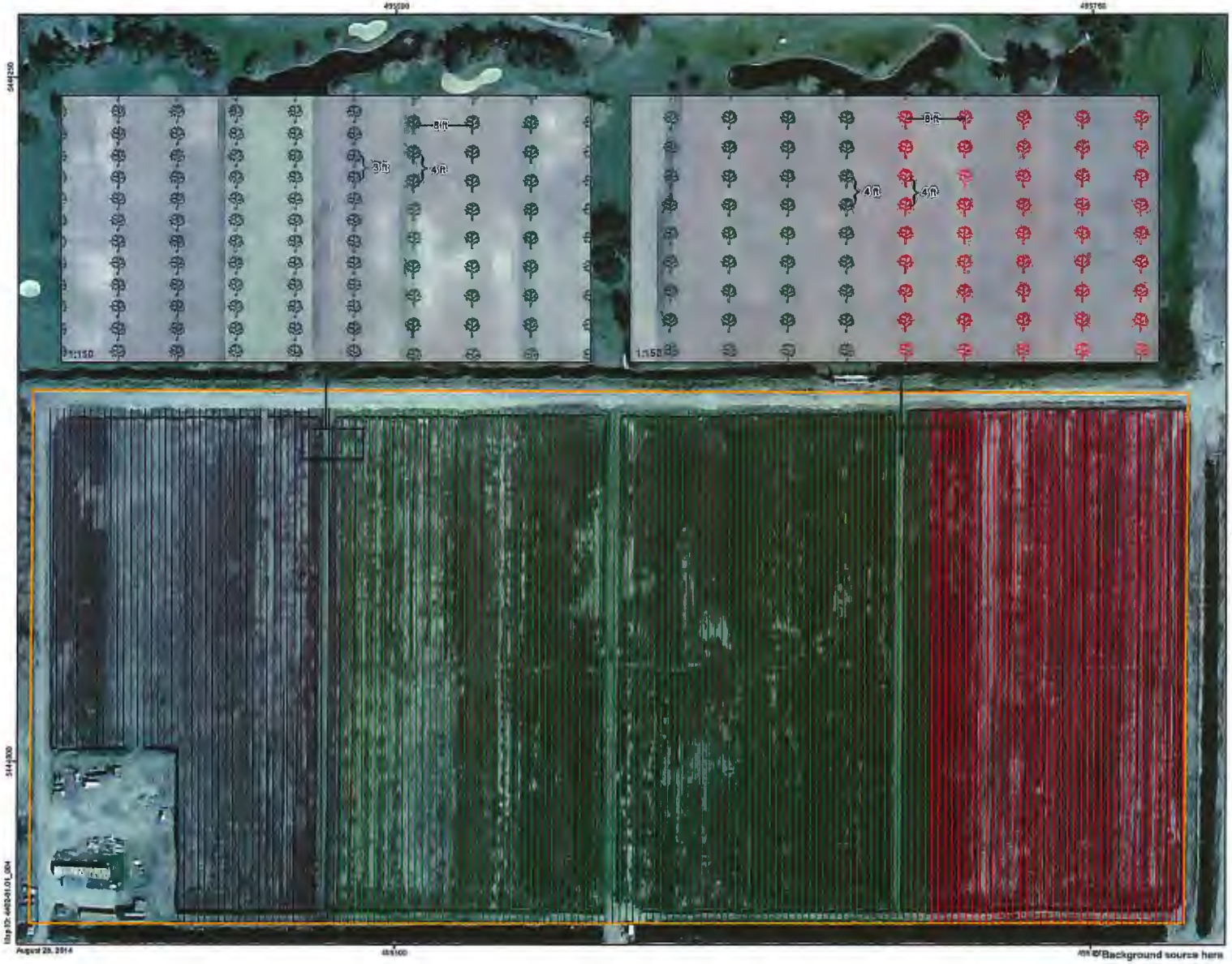
Figure 5



Planting Plan

- Raspberry Plant
- Green Grape Plant
- Red Grape Plant
- Raspberries
- White Grapes
- Red Grapes
- Project Location

1:1,300

0 40 80

Metres

Coordinate System: NAD 1983 UTM Zone 10N

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Figure 6

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Appendix 1

Site Photographs

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Photograph 1:

Looking north from the centre of the Site towards Country Meadows Golf Course

Photograph 2:

Looking west from the centre of the Site

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Photograph 3:

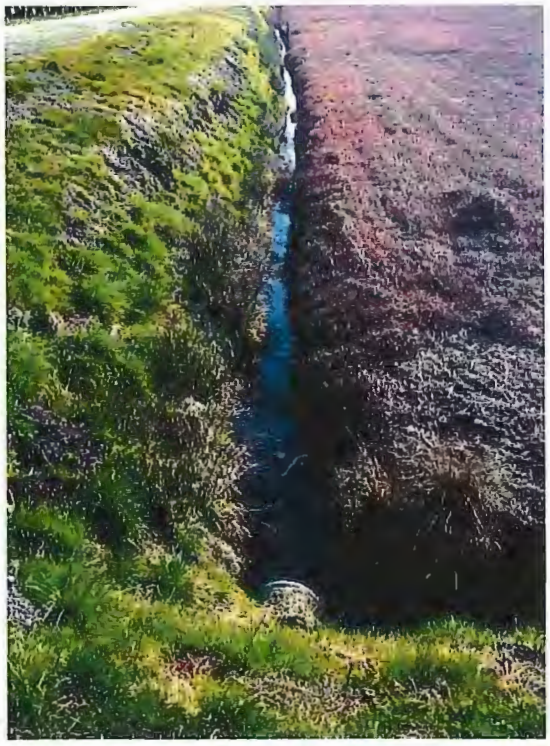
Looking east from the centre of the Site towards Richmond Landfill. Note the steep raised slope of the adjacent property.

Photograph 4:

Looking south from the centre of the Site towards lands owned by the Richmond Landfill

Photograph 5:

Access path between the centre two cranberry bogs, looking north



Photograph 6:

Ditch along north perimeter access road and cranberry bog, looking east

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Photograph 7:

Canal along the east perimeter access road and east access path, looking north

Photograph 8:

Pump station on the south canal located at the centre of the Site, looking west

Photograph 9:

Organic soils overlying fine-textured mineral soil in Test Pit 01 on the northeast side of the Site

Photograph 10:

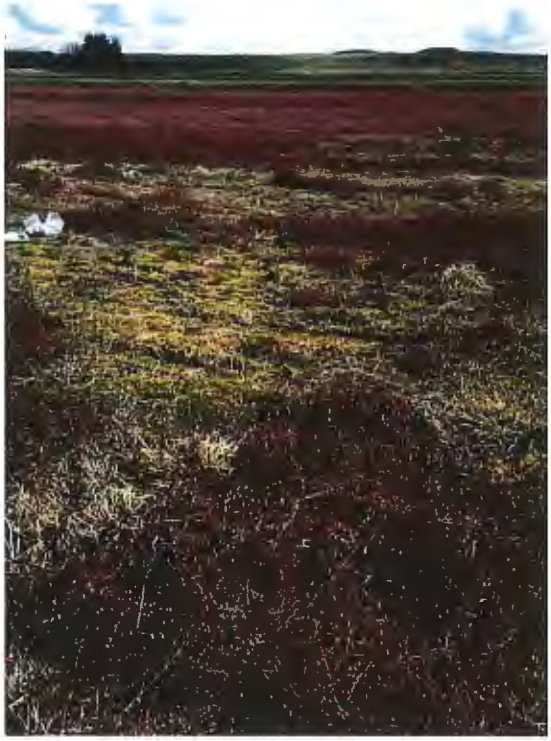
Organic soils overlying fine-textured mineral soil in Test Pit 02 on the southeast side of the Site

Photograph 11:

Organic soils overlying fine-textured mineral soil in Test Pit 05 on the west side of the Site

Photograph 12:

Sand lense between 0.2m and 0.6m in TP06 on the northwest side of the Site



Photograph 13:

Signs of crop damage on the south side of the Site

Photograph 14:

East side of Site, with raised Ecowaste Landfill adjacent to Site

Photograph 15:

Site, looking south with crop damage

Photograph 16:

Soil reclaimer intended for use to screen soil and produce sand loam for filling purposes

PGL ENVIRONMENTAL CONSULTANTS

Photograph 17:

Soil reclaimer and associated screened material

Appendix 2

Erosion Control Plan Figure

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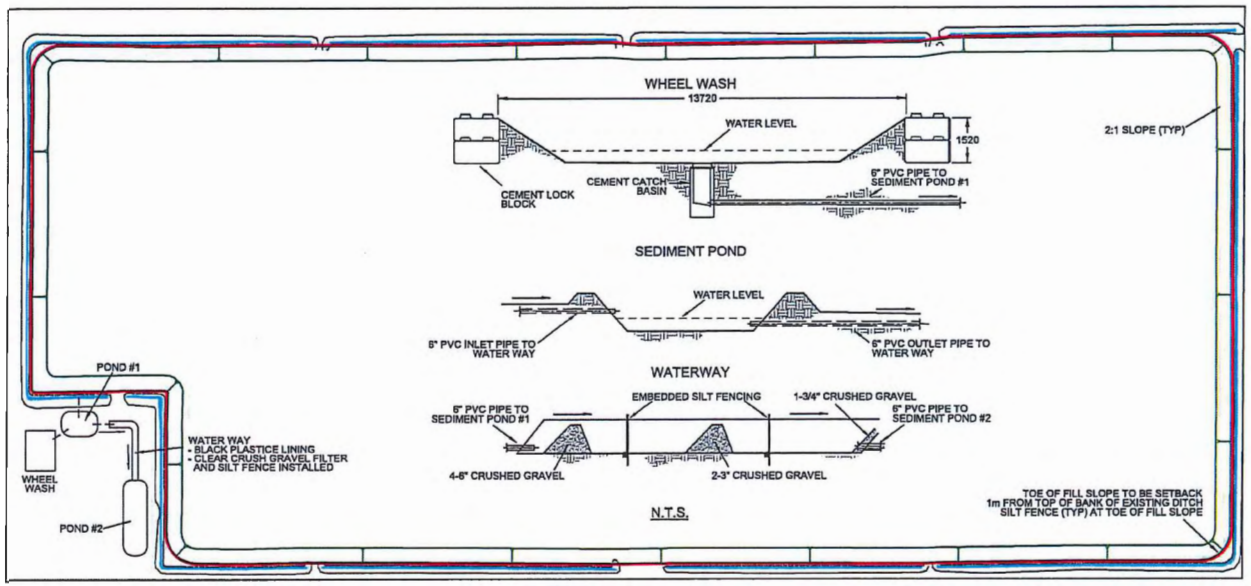
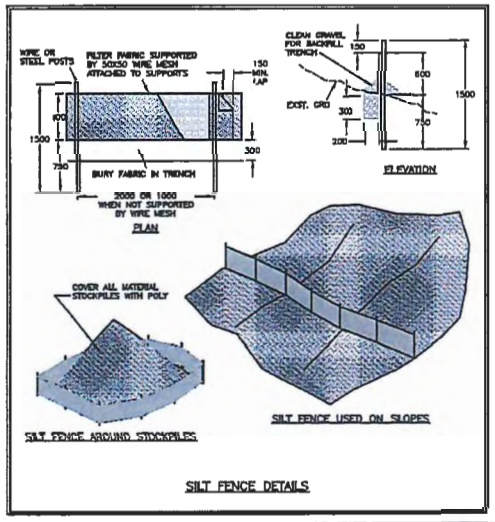




Sediment Control Notes

The owner shall be responsible for installing and maintaining the Erosion and Sediment Control (ESC) system as shown on this drawing.

The owner shall take all steps to ensure that sediment is not discharged to the City of Richmond (City) storm drainage system, roadways or perimeter ditches.

The owner shall inspect the ESC works before and during significant rainfall events and undertake remedial works as required.

Construction and maintenance of the ESC system shall be in accordance with the latest edition of the Federal Land Development Guidelines for the Protection of Aquatic Habitat. 2003.

Owner and/or site owner shall ensure the effective maintenance and operation of the erosion and sediment control measures on site including all roads and ESC facilities. All ESC facilities and works described in the plan must be installed, constructed, and operational in accordance with the approved ESC drawings before any fill works begin. Preliminary inspection and sign off by the Environmental Monitor (EM) will be required to ensure that owner has successfully installed the ESC facilities and controls in accordance with the ESC plan drawings.

The designated EM shall provide a letter to the City confirming that the proposed ESC facilities have been properly installed, inspected and that they are operational in accordance with the approved ESC Plan.

A final inspection of the site and a signed letter is required by the designated EM to ensure that owner has successfully completed the ESC plan requirements (which includes the construction of gravel access pads for each building lot, decommissioning of temporary ESC facilities, proper disposal of any waste materials, and stabilization of any exposed soils).

Owner shall retain an EM to sample and analyze any water leaving the site to ensure that it does not contain Total Suspended Solids (TSS) levels greater than 75mg/L during wet weather and 25mg/L during dry weather. Where there is an exceedance of the allowable TSS/turbidity levels, corrective measures are to be implemented immediately.

EMs will be required on site to inspect at least once a week during construction in rainy periods (October 15 May 15), at least once a day during or after a significant rainfall event (>25mm rainfall per day or 10mm rainfall per hour), and once every two weeks during dry periods to carry out inspections and alterations if necessary. A record of site inspections must be submitted to the City bi-monthly during the rainy period and monthly during dry period (May 16- October 14).

Silt fencing is to be installed in the 1m wide area between the toe of the fill slope and the top of bank of the perimeter ditches.

Construction activities shall be staged to minimize exposed areas.

A gravel access pad (4.5 m wide and comprised of a minimum of 6 inches depth and 100 mm diameter angular rock) shall be installed at the point of entry onto the site from the roadway. It shall be constructed and maintained to minimize the migration of sediment onto the roadways.

A truck wheel wash facility shall be installed at the point of exit from the site.

Install and maintain filter fabric bags inside all road frontage catch basins potentially collecting runoff from the site.

Vehicle/machinery access to and from the site shall be limited to the access pad, staging area, or prepared working road to minimize soil disturbance.

Roadways (fronting the site) are to be swept free and cleaned on a regular basis as required (once a day or more frequently during rain events). Flushing of the roadway is prohibited.

Excavated/imported soils are not to be stockpiled/unloaded on road allowances or curbs, and if soils are stockpiled within the boundary of the site, then the stockpiles shall be covered with polyethylene sheeting and weighted down. Breaks in the cover should be repaired immediately.

Temporary graded areas must be protected from erosion through the use of straw, mulch and/or polyethylene tarps in non-traffic areas and a gravel cap in zones of construction traffic. Final graded or landscaped areas must have the appropriate permanent surface protection or landscaping in place as soon as possible.

Where slopes exceed three metres in height and are steeper than five percent, or where soil types consist predominantly of clays or fines, immediate surface protection using polyethylene sheeting or tarps must be used from October 15th to May 15th or when rain events are expected. Surface protection should be well anchored to resist wind and prevent major leakage. Breaks in the cover should be repaired immediately.

All bare and exposed areas that will be left dormant for longer than 30 days are to be seeded and stabilized with native vegetative species prior to October 15th where possible.

A waterproof copy of the ESC plan, emergency contact information for the site owner and the designated EM for the site must be kept in a location visible from outside the site, for the duration of the project.

The owner shall provide on-site disposal facilities at all times. These disposal facilities shall be removed and disposed on a regular basis and at authorized disposal areas.

PGL ENVIRONMENTAL CONSULTANTS

EROSION CONTROL PLAN
CRANBERRY MEADOWS

Appendix 3

GeoPacific Geotechnical Investigation Report

GEOPACIFIC
VANCOUVER KAMLOOPS CALGARY

P (604) 439 0922
F (604) 439 9189
www.geopacific.ca
#215-1200 West 73rd Ave.
Vancouver, B.C. Canada V6P 6G5

Cranberry Meadows Farms Ltd.
11450 92A Avenue
Delta, BC
V4C 3M5

January 20, 2016
File: 13570

Attention: Gord Maichin

Re: Geotechnical Investigation Report - Proposed Fill Site
Terminus of Francis Road - East of No. 6 Road, Richmond, B.C.

1.0 INTRODUCTION

We understand that you propose to fill the above referenced 8.05 hectare parcel of farm land to elevations varying between 4.4 and 6 m geodetic to permit the farming of grapes and raspberries. We further understand that the City of Richmond requires a geotechnical assessment of the site to determine impacts to surrounding properties and drainage due to the contemplated filling program.

This report presents the results of a geotechnical investigation of the soil and groundwater conditions at the site and presents our assessment of the potential drainage and off-site impacts of the development.

This report has been prepared exclusively for Cranberry Meadows Farms Ltd, for their use, the use of others on their design team, and the City of Richmond for use in the development and permitting process.

2.0 SITE DESCRIPTION

The fill site is located in east Richmond, east of No. 6 Road, and directly north of Francis Road. The site is rectangular with east-west dimension of approximately 410 m and north-south dimension of about 194 m. The site is presently employed as a cranberry farm with equipment lay down and storage area located at the southwest corner of the property. Existing elevations vary from 0 to 1 m geodetic in the farm field with surrounding ditches at lower elevations. Francis Road and gravel access roads surrounding the site are at elevations of about 1 to 2 m geodetic. The site is essentially flat.

The location of the site relative to surrounding properties and roads is shown on our site plan, Drawing 13570-01, attached to this report.

3.0 FIELD INVESTIGATION

GeoPacific completed an investigation of the site on January 6, 2016. The investigation included a total of 4 auger test holes, to depths of 6 m below current site grade and 4 Cone Penetration Test (CPT) soundings, advanced to depths of 22.6 to 30 m below grade. The test holes and CPT soundings were completed using a subcontracted, track mounted auger drill rig operated by On Track Drilling Inc. of Coquitlam, B.C. All test holes were logged in the field by a technician from our office and backfilled immediately upon completion of testing and logging.

As the cone penetrometer is advanced into the ground, it records cone tip resistance, sleeve friction, pore water pressure, temperature and inclination every 50 mm to a purpose built data acquisition system. Analysis of the CPT sounding data allows an estimation of geotechnical design parameters and inference of the sub-surface stratigraphy from soil-type behaviour characteristics. The stratigraphic interpretation was verified with the augured test holes as described above. The CPT sounding results are presented in Appendix B of this report. Geotechnical parameters interpreted from the CPT soundings, such as undrained shear strength and standard penetration $N_{1(60)}$ values, are presented in Appendix C of this report while Liquefaction Analyses are presented in Appendix D.

Test holes were completed on the access roads surrounding the farm land and equipment storage area as the farm land itself is not capable of supporting a heavy drill rig.

The approximate location of the auger test holes and CPT soundings with respect to the property are shown on our Drawing No. 13750-01.

4.0 SUBSURFACE CONDITIONS

4.1 Soil Conditions

The existing soil profile at the site, from the surface downwards, generally consists of 0.6 and 1.4 m of fill around the site perimeter, and then natural soils of PEAT followed by low plastic clayey SILT to silty CLAY over interbedded silty fine SAND to fine sandy SILT over silty to clean SAND. The sand is underlain by a thick sequence of marine clay silt interbedded with fine sands below depths of 25 to 27 m. Based on our general knowledge of the area, and published geology, we anticipate the marine clay silt extends to a depth of about 60 metres where it is underlain by dense glacially consolidated deposits.

A detailed description of the soils encountered is given below.

Fill

Fill was encountered at each test hole and varied from pavement structure related sand and gravel to wood chips to organic rich silty sand (topsoil). These materials were also encountered on the access roads and lay down area surrounding the farm field. We do not expect much, if any, mineral based fill in the farm field itself.

Peat

Peat was present at all test hole locations and varied in thickness between 0.4 and 1 m with moisture contents between 167% and 274%. These moisture content values are relatively low for peat and are expected to be a function of the consolidation induced by the presence of the above referenced fills. We anticipate that the peat will likely be thicker with higher moisture content within the farm land, and therefore more susceptible to larger settlements induced by filling.

Peat is highly compressible when loaded in excess of it's current insitu stress. Conventional site preparation measures to limit post construction settlements also have a limited benefit on peat. Long term settlements of peat are caused by the gradual decay of the organic constituent that makes up the majority of the peat. These settlements are unavoidable.

Clayey Silt to silty Clay (Overbank Sequence)

The peat is underlain by between 2 and 4 m of silt to clay. The silt is typically firm with some organic content and brown in the upper 200 to 500 mm, below this becoming firm to soft and grey in colour. Laboratory testing yielded moisture contents ranging from 50 to 123%. Shear strength in the soft portion of the clayey silt profile is interpreted at between 15 and 50 kPa below the upper desiccated zone as shown in Appendix C. The desiccated zone is typically about 300 mm thick and has a shear strength of between 75 and 120 kPa. The soft portion of the clayey silt zone is significantly compressible under the contemplated fill loads.

Fine Sandy Silt to Silty Sand (Transitional Sequence)

Underlying the clay silt is about 2 m of a transitional sequence comprised of loose to compact silty fine SAND to fine sandy SILT. The sequence is non plastic and therefore somewhat compressible under moderate to heavy loading only.

Clean Sand to Silty Sand (Channel Sequence)

The silt and interbedded sand and silt described above is underlain by a sequence of river channel deposited sands. The slight variations in the in-situ density, compressibility, mineralogy and grain size are reflected in the shape of the tip resistance curves shown on the CPT plots in Appendix B. In general the Fraser River channel sands are well graded, medium grained, predominantly quartz, highly stratified and loose to medium dense. These deposits extend to about 25 to 27 m depth at our CPT soundings,.

Occasional zones of clayey silts are interbedded in the predominantly sand, channel sequence, as shown on the soil behaviour type plots given in Appendices B and C.

Deep Marine Clay Silt

The sand is underlain by a thick sequence of deep marine clay silt below 25 to 27 m. This zone is expected to extend down to the glacial deposits, inferred to extend to about 60 m below local site grades. This zone is considered compressible given the height and extent of the contemplated filling. Due to the thickness of this zone and it's low permeability, post filling settlements will continue for many years after the completion of the site preparation work. This long term settlement behaviour is not uncommon in Richmond with long term post construction settlements occurring as a result of mid-rise tower development, for example.

For a more detailed description of the subsurface soil conditions refer to the Test Hole Logs and CPT Sounding Logs in Appendices A and B, following the text of this report.

4.2 Groundwater Conditions

The static groundwater level is expected to be in close proximity to the existing elevation of the farm field. Groundwater levels are expected to vary seasonally with generally higher levels during the wetter winter and spring months. It has been our experience that near surface groundwater levels are often controlled by surface water levels in local ditches and thus levels can rise to near ambient ground level during periods of

heavy and prolonged rainfall.

5.0 DISCUSSION

5.1 Fill Program

We understand that the filling program is proposed to occur over a period of 3 years with a total of 362,000 m^3 of material imported to the site. The site will be sloped at approximately 3% with finished site elevations varying from 4.4 to 6 m geodetic. The margins of the fill site will be sloped at 2H:1V. The existing soils will be left in place with new fill derived from sites in western Vancouver varying from Vashon Drift to Capilano sediments. These soils vary in composition and may include glacial till (well graded sand, silt, and gravel), glaciofluvial sand to gravel, glaciolacustrine silts, marine and glaciomarine silts, and beach deposited sands.

5.2 Drainage

The natural soil profile consists of relatively low permeability peat and overbank deposited silts which grade into channel deposited sands at depth. The proposed fill operation will result in significant consolidation of the peat and silt. While the permeability of these upper will reduce, the main aquifer of sand below 6 m depth will not be affected. We would expect normal flows in these Fraser River sands to control the surrounding property groundwater levels.

The current conditions allow for natural infiltration of rainwater into the topsoil of the farm field. Some of the proposed fills including the marine, glaciomarine, glaciolacustrine, and glacial till deposits will have a relatively low permeability once placed and compacted. Negligible infiltration into these materials will occur. We expect that some rainwater will be retained in the topsoil of the future grape and raspberry fields, but some will also flow to the perimeter of the site. We anticipate that a cleaner granular soil will be placed below the upper topsoil to facilitate drainage as required. Regardless, the surface runoff would be directed to perimeter site drainage to ensure no mounding of groundwater levels at adjacent properties. Any potential groundwater impact in this regard can be mitigated substantially with the incorporation of an efficient ditch and drainage system around the periphery of the site which conveys surface run off to the surrounding City storm system.

In summary, it is our geotechnical opinion that the proposed fill program is feasible without adversely impacting drainage or groundwater levels beyond the site. Some maintenance of the drainage system during the filling process as well as in the future due to the predicted long term settlements, described in Section 5.3, should be expected.

5.3 Settlement

Due to the large extent of the fill area, significant consolidation of the upper compressible peat and silt deposits will occur along with the deep marine deposits. Due to the thickness and low permeability of the marine deposits, consolidation of this stratum will continue to occur for several years after placement of the fill. Our analysis indicates that total settlements on the order of 1.2 to 1.8 m should be anticipated at the mid point of the fill site. Settlements are predicted to decrease to about 600 mm to 900 mm at the margin of the fill area. We anticipate that approximately 60 to 70% of this settlement will occur during fill placement with the remainder accumulating over about 20 to 25 years.

The majority of the settlement is derived from the surficial peat and silt, which accounts for approximately

60% of the total settlements. The primary consolidation of these two stratums should occur relatively quickly within a few months of completion of the fill program. Significant secondary consolidation will be as a result of gradual consolidation of the marine deposits at depth. Some limited settlement will be realized from gradual decay of the peat as well, but this is anticipated to be small in relation to the predicted total.

Significant differential settlements should be anticipated within 6 to 8 m of the fill area. These settlements will likely require some maintenance of the surrounding area to ensure, for example, level access roads and positively flowing ditches.

Settlements will be measurable off-site. We estimate settlements at about 8 m beyond the fill area to range from 50 to 150 mm. These settlements are derived from the marine deposits located below about 26 m depth. Therefore, the surface projection of these deep settlements typically result in small differentials of less than 2 mm/metre and are generally not damaging to surface infrastructure. However, the long term impacts on gravity based services surrounding the site should be reviewed. Similar behaviour occurs beyond mid-rise towers in Richmond.

6.0 CLOSURE

The preceding comments and calculations are based on theoretical consolidation approaches and stress distribution procedures. Some variation between theoretical and actual settlements is likely. Any changes to the fill plan should be provided to GeoPacific for review and update our settlement estimates.

Please do not hesitate to call the undersigned if you should require any clarification or additional details.

For:
GeoPacific Consultants Ltd.

Reviewed by:

JAN 2 0 2016

John Carter, M.Eng., P.Eng.
Principal Engineer

Keith Robinson, M.Eng., P.Eng.
Principal Consultant

LEGEND:

CPT##-# – CONE PENETRATION TEST (CPT) LOCATION

TH##-# – TEST HOLE (TH) LOCATION

SITE PLAN

*TEST LOCATIONS ARE APPROXIMATE

REFERENCE:

GEOPACIFIC
VANCOUVER KAMLOOPS CALGARY

DATE: 2016-Jan-1

DRAWN BY:	APPROVED BY:	REVIEWED BY:
ED	JC	JC

SCALE: AS SHOWN

CRANBERRY MEADOWS
TERMINUS OF FRANCES ROAD (EAST OF NO. 6 ROAD), RICHMOND, BC
TEST HOLE SITE PLAN

FILE NO.: 13570

DWG. NO.: 13570-01

REVISIONS:
A.
B.
C.

APPENDIX A - TEST HOLE LOGS

Test Hole Log: TH16-01 (CPT16-01)

File: 13570
Project: CRANBERRY MEADOWS
Client: CRANBERRY MEADOWS FARMS LTD
Site Location: TERMINUS OF FRANCES ROAD (EAST OF NO. 6 ROAD),

GEOPACIFIC CONSULTANTS
215 - 1200 West 73rd Avenue, Vancouver, BC, V6P 6G5
Tel: 604-439-0922 Fax:604-439-9189

Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth (m)/Elev (m)	Moisture Content (%)	DCPT (blows per foot) 10 20 30 40	Groundwater / Well	Remarks
0 / 0		Ground Surface					
		Sand and gravel compact SAND and GRAVEL fill, brown, slightly moist	0.0				
3 / 1		moist after 1.1m					
		Peat firm to soft PEAT, red-brown, moist to wet	1.4	186.1		▼	1.7m estimated water table depth based on CPT pore pressure data
		Silt soft SILT, trace organics, grey, wet	1.8				
10 / 3				123.3			
		sand lens at 3.2m					
13 / 4				49.6			
		Silt firm sandy SILT, grey, wet	4.3				
17 / 5		sandy SILT to silty SAND after 5.3m		36.9			
20 / 6		End of Borehole	6.1				
23 / 7							
26							

Logged: ED
Method: Sollid stem auger/CPT
Date: 2016-Jan-6

Datum: Ground elevation
Figure Number: A.01
Page: 1 of 1

Test Hole Log: TH16-02 (CPT16-02)

File: 13570
Project: CRANBERRY MEADOWS
Client: CRANBERRY MEADOWS FARMS LTD
Site Location: TERMINUS OF FRANCES ROAD (EAST OF NO. 6 ROAD),

GEOPACIFIC CONSULTANTS
215 - 1200 West 73rd Avenue, Vancouver, BC, V6P 6G5
Tel: 604-439-0922 Fax:604-439-9189

Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth (m)/Elev (m)	Moisture Content (%)	DCPT (blows per foot) 10 20 30 40	Groundwater / Well	Remarks
0 / 0		Ground Surface					
		Sand and gravel compact SAND and fine grained GRAVEL fill, grey, slightly moist	0.0 0.3				
1 / 1		***Fill*** compact wood chip fill, brown, moist wet at 0.8m	0.8	189.2			
2 / 2		***Peat*** firm to soft PEAT, red-brown, moist wet after 1.2m		273.8			
		Silt soft organics rich SILT, brown, wet	1.8				
3 / 4		***Silt*** soft SILT, trace organics, grey, wet no organics after 3.2m trace to some fine grained sand after 4.0m	2.3	101.7 62.0		▼	3.2m estimated water table depth based on CPT pore pressure data
5 / 6		***Silt*** firm sandy SILT, grey, wet	4.6	33.4			
		End of Borehole	6.1				
7 / 26							

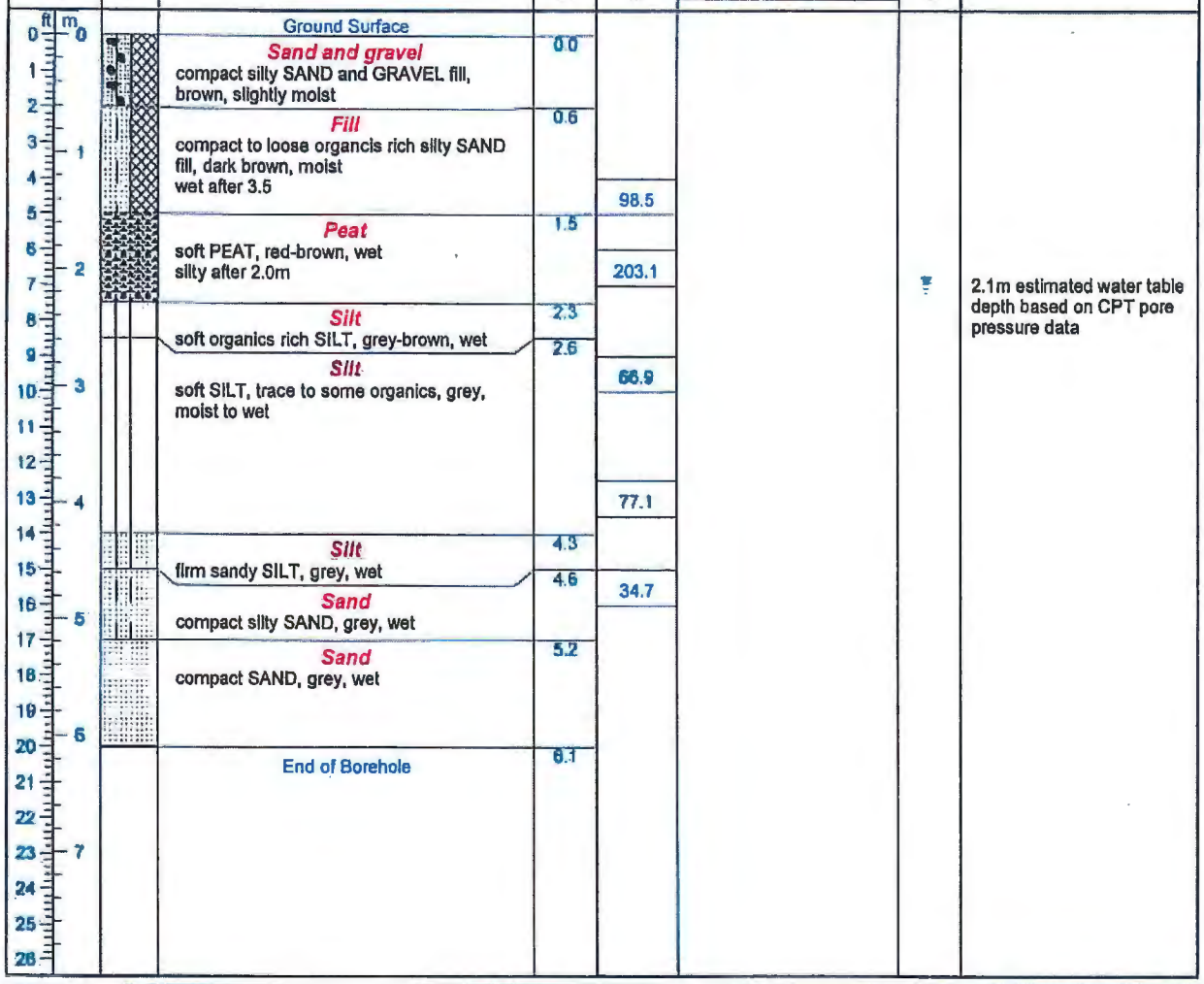
Logged: ED
Method: Sollid stem auger/CPT
Date: 2016-Jan-6

Datum: Ground elevation
Figure Number: A.02
Page: 1 of 1

Test Hole Log: TH16-03 (CPT16-03)

File: 13570
Project: CRANBERRY MEADOWS
Client: CRANBERRY MEADOWS FARMS LTD
Site Location: TERMINUS OF FRANCES ROAD (EAST OF NO. 6 ROAD),

GEOPACIFIC CONSULTANTS
#215 - 1200 West 73rd Avenue, Vancouver, BC, V6P 6G5
Tel: 604-439-0922 Fax:604-439-9189



Logged: ED
Method: Sollid stem auger/CPT
Date: 2016-Jan-6

Datum: Ground elevation
Figure Number: A.03
Page: 1 of 1

Test Hole Log: TH16-04 (CPT16-04)

File: 13570
Project: CRANBERRY MEADOWS
Client: CRANBERRY MEADOWS FARMS LTD
Site Location: TERMINUS OF FRANCES ROAD (EAST OF NO. 6 ROAD),

GEOPACIFIC CONSULTANTS
215 - 1200 West 73rd Avenue, Vancouver, BC, V6P 6G5
Tel: 604-439-0922 Fax:604-439-9189

Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth (m)/Elev (m)	Moisture Content (%)	DCPT (blows per foot) 10 20 30 40	Groundwater / Well	Remarks
0 / 0		Ground Surface					
		Sand and gravel compact to dense silty SAND and GRAVEL fill, grey, slightly moist	0.0				
4 / 1		***Peat*** firm to soft PEAT, red-brown, moist	1.2	166.5			
7 / 2		***Silt*** soft organics rich SILT, peat like organics, brown, wet	2.1	259.9		▼	1.9m estimated water table depth based on CPT pore pressure data
			2.4				
10 / 3		***Silt*** soft SILT, some organics, grey-brown, wet trace organics after 2.7m		51.2			
13 / 4				78.5			
		trace fine grained SAND after 4.6m					
18 / 5				46.4			
20 / 6		End of Borehole	6.1				
23 / 7							
26							

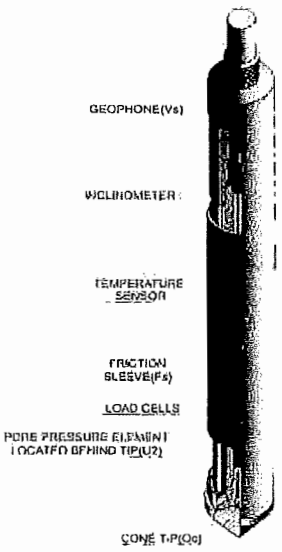
Logged: ED
Method: Sollid stem auger/CPT
Date: 2016-Jan-6

Datum: Ground elevation
Figure Number: A.04
Page: 1 of 1

APPENDIX B - ELECTRONIC CONE PENETRATION RESULTS

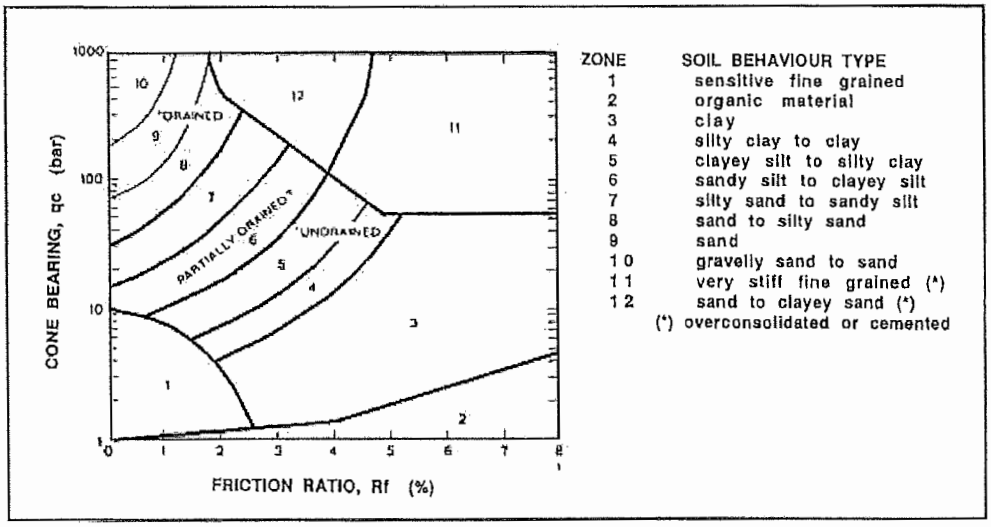
The system used is owned and operated by GeoPacific and employs a 35.7 mm diameter cone that records tip resistance, sleeve friction, dynamic pore pressure, inclination and temperature at 5 cm intervals on a digital computer system. The system is a Hogentogler electronic cone system and the cone used was a 10 ton cone with pore pressure element located behind the tip and in front of the sleeve as shown on the adjacent figure.

Electronic Cone Penetrometer



In addition to the capabilities described above, the cone can be stopped at specified depths and dissipation tests carried out. These dissipation tests can be used to determine the groundwater pressures at the specified depth. This is very useful for identifying artesian pressures within specific layers below the ground surface.

Interpretation of the cone penetration test results are carried out by computer using the interpretation chart presented below by Robertson[1]. Raw data collected by the field computer includes tip resistance, sleeve friction and pore pressure. The tip resistance is corrected for water pressure and the friction ratio is calculated as the ratio of the sleeve friction on the side of the cone to the corrected tip resistance expressed as a percent. These two parameters are used to determine the soil behaviour type as shown in the chart below. The interpreted soil type may be different from other classification systems such as the Unified Soil Classification that is based upon grain size and plasticity.

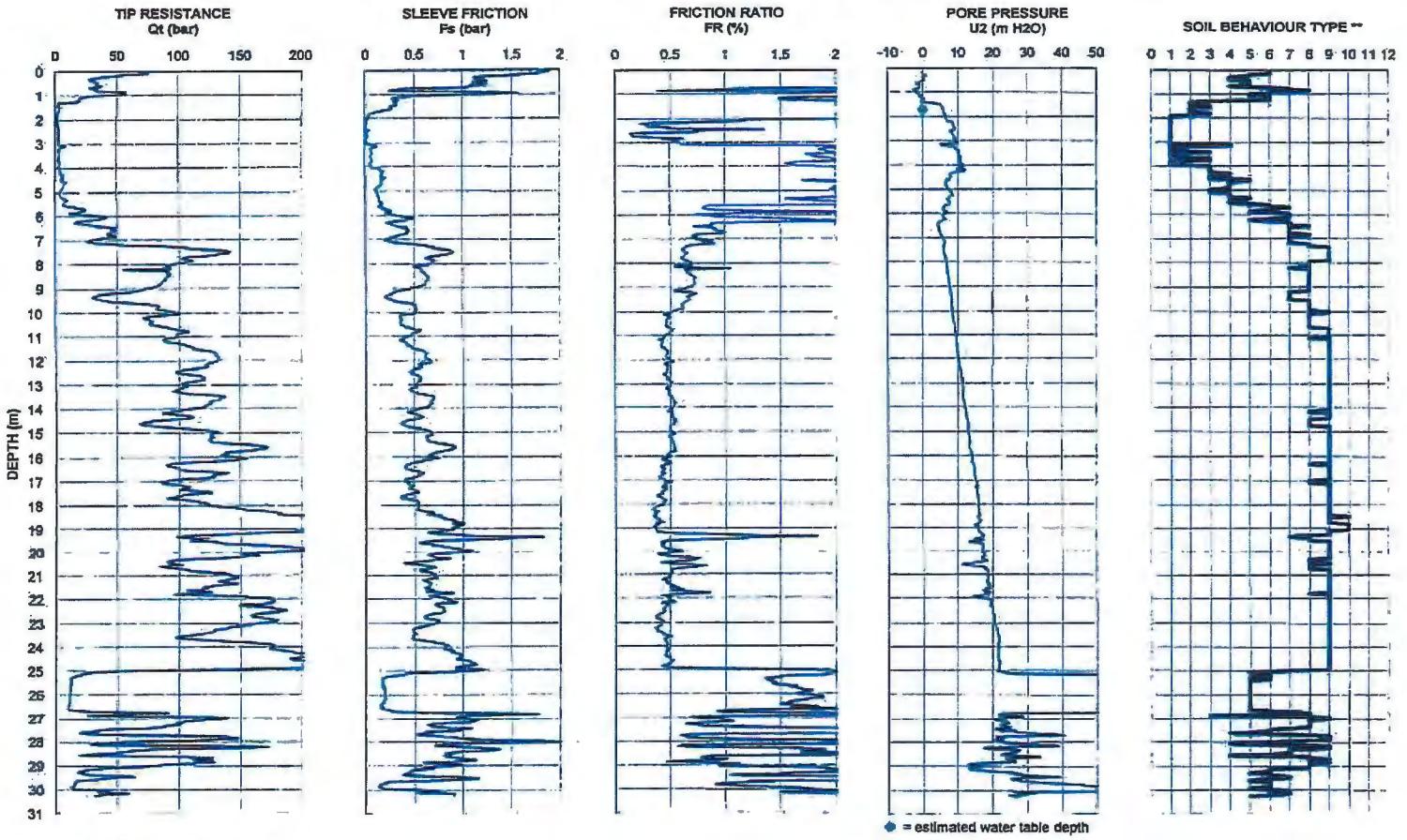


ZONE	SOIL BEHAVIOUR TYPE
1	sensitive fine grained
2	organic material
3	clay
4	silty clay to clay
5	clayey silt to silty clay
6	sandy silt to clayey silt
7	silty sand to sandy silt
8	sand to silty sand
9	sand
10	gravelly sand to sand
11	very stiff fine grained (*)
12	sand to clayey sand (*)

(*) overconsolidated or cemented

[1] Robertson, P.K., 1990, "Soil Classification using the cone penetration test", 1990 Canadian Geotechnical Colloquium, Canadian Geotechnical Journal, Vol. 27, No. 1, 1990

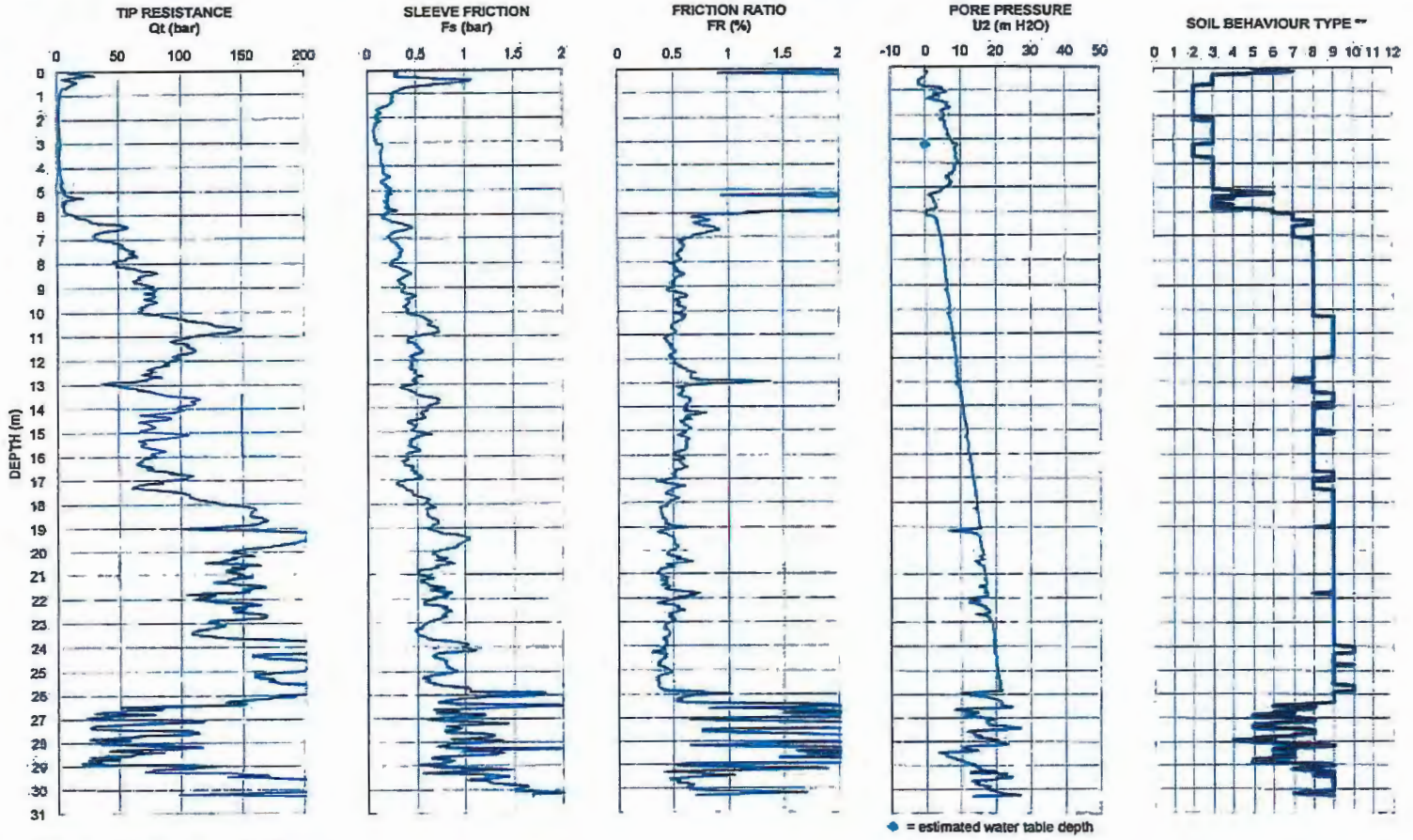
GEOPACIFIC CONSULTANTS	2016-Jan-6	CRANBERRY MEADOWS FARMS LTD	GeoPacific Project #: 13570
	Sounding: CPT16-01	TERMINUS OF FRANCIS ROAD (EAST OF NO. 6 ROAD), RICHMOND	Figure: B.01



** Based on Robertson et. al 1986

1 Sensitive Fine Grained
2 Organic Material
3 Clay
4 Silty Clay to Clay
5 Clayey Silt to Silty Clay
6 Sandy Silt to Clayey Silt
7 Silty Sand to Sandy Silt
8 Sand to Silty Sand
9 Sand
10 Gravelly Sand to Sand
11 Very Stiff Fine Grained
12 Sand to Clayey Sand

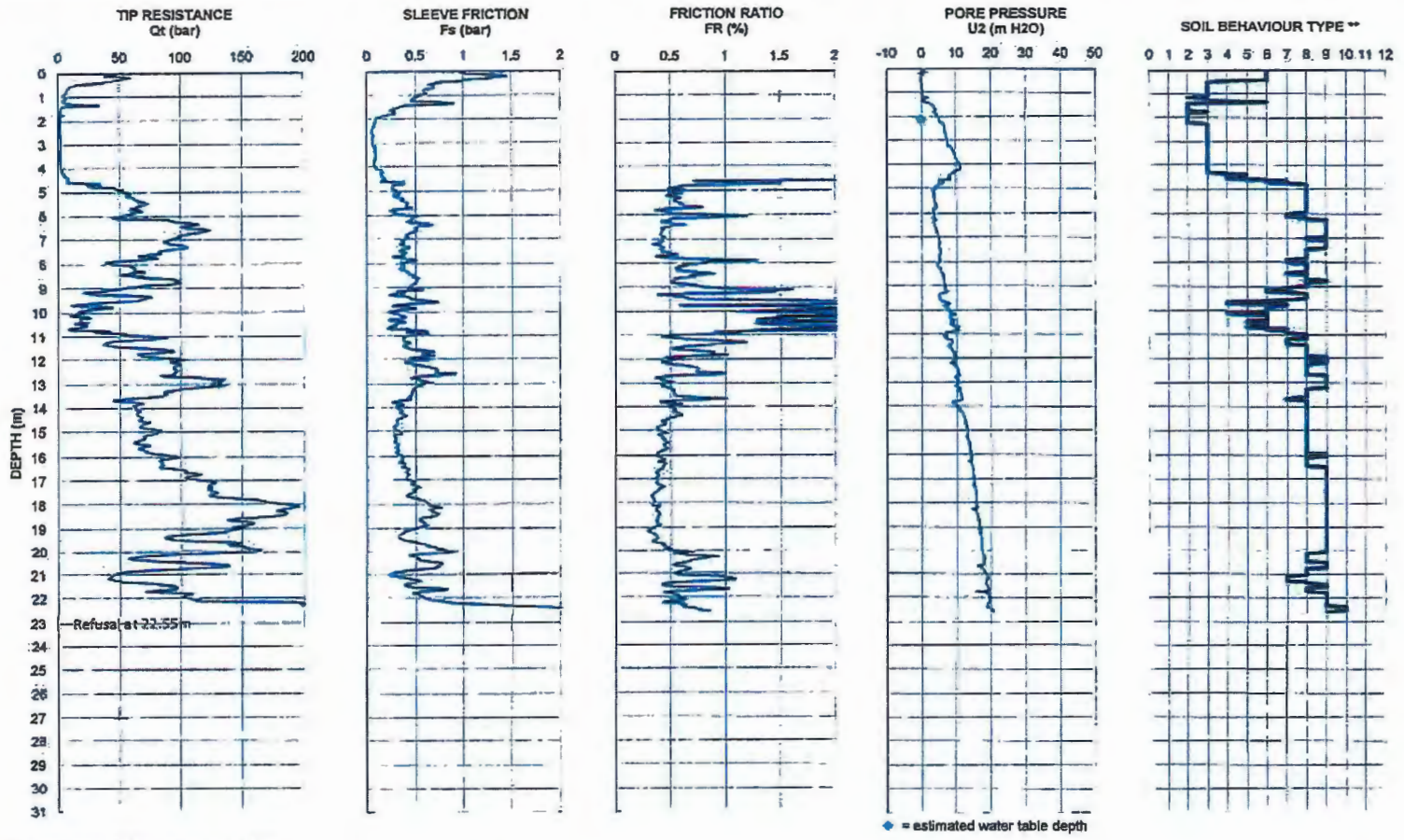
GEOPACIFIC CONSULTANTS	2016-Jan-6	CRANBERRY MEADOWS FARMS LTD	GeoPacific Project #: 13570
	Sounding: CPT16-02	TERMINUS OF FRANCIS ROAD (EAST OF NO. 6 ROAD), RICHMOND	Figure: B.02



** Based on Robertson et. al 1986

1 Sensitive Fine Grained
2 Organic Material
3 Clay
4 Silty Clay to Clay
5 Clayey Silt to Silty Clay
6 Sandy Silt to Clayey Silt
7 Silty Sand to Sandy Silt
8 Sand to Silty Sand
9 Sand
10 Gravelly Sand to Sand
11 Very Stiff Fine Grained
12 Sand to Clayey Sand

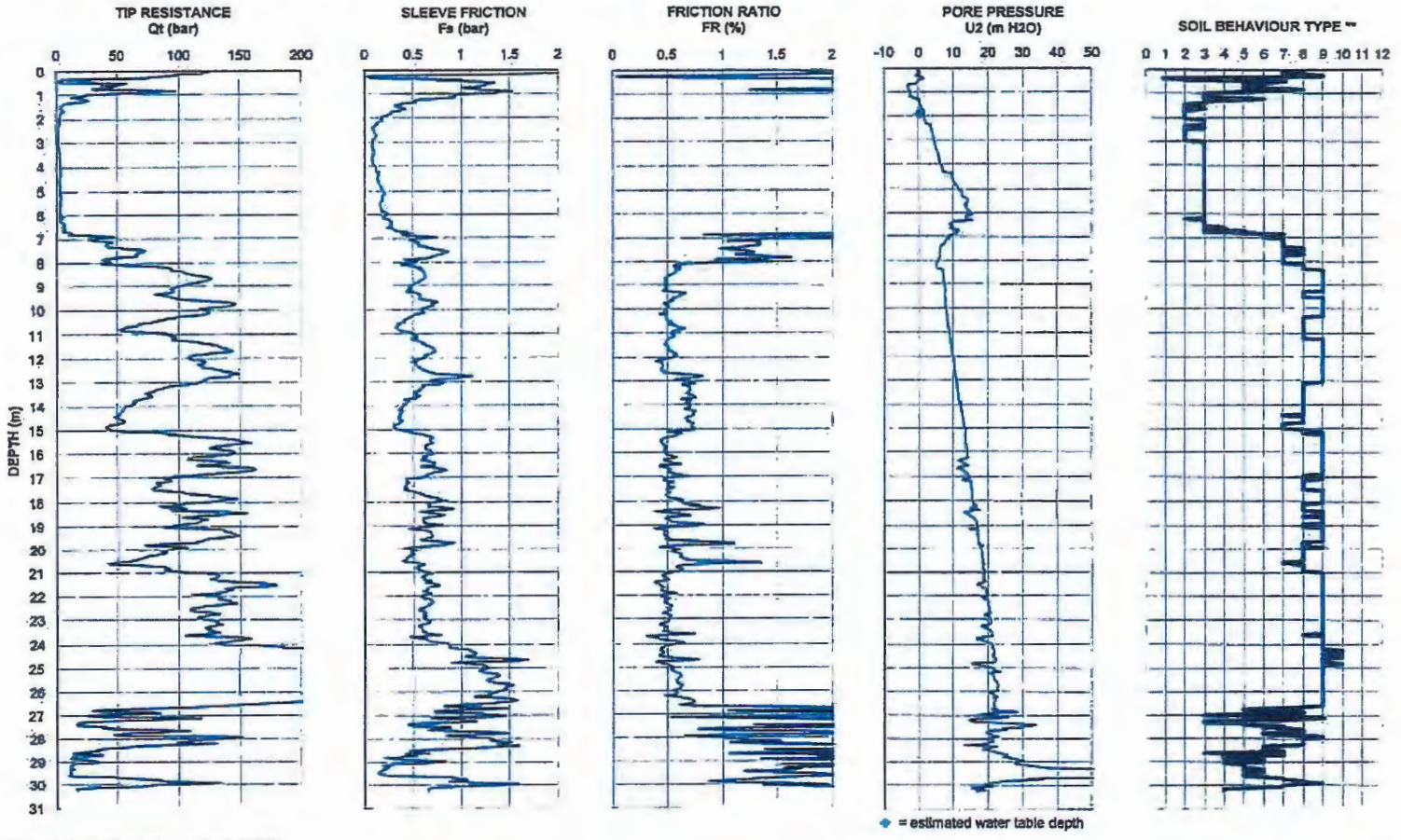
GEOPACIFIC CONSULTANTS	2016-Jan-6	CRANBERRY MEADOWS FARMS LTD	GeoPacific Project #: 13570
	Sounding: CPT16-03	TERMINUS OF FRANCIS ROAD (EAST OF NO. 6 ROAD), RICHMOND	Figure: B.03



** Based on Robertson et. al 1986

1 Sensitive Fine Grained
2 Organic Material
3 Clay
4 Silty Clay to Clay
5 Clayey Silt to Silty Clay
6 Sandy Silt to Clayey Silt
7 Silty Sand to Sandy Silt
8 Sand to Silty Sand
9 Sand
10 Gravelly Sand to Sand
11 Very Stiff Fine Grained
12 Sand to Clayey Sand

GEOPACIFIC CONSULTANTS	2016-Jan-6	CRANBERRY MEADOWS FARMS LTD	GeoPacific Project #: 13570
	Sounding: CPT16-04	TERMINUS OF FRANCIS ROAD (EAST OF NO. 6 ROAD), RICHMOND	Figure: B.04



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APPENDIX C - INTERPRETED PARAMETERS

The following charts plot the Standard Penetration Test (SPT) values and the undrained strength of fine grained soils based upon generally accepted correlations. The methods of correlation are presented below.

STANDARD PENETRATION TEST CORRELATION

The Standard Penetration Test $N_{1(60)}$ value is related to the cone tip resistance through a Qc/N ratio that depends upon the mean grain size of the soil particles. The soil type is determined from the interpretation described in Appendix B and the data of Table C.1 below is used to calculate the value of $N_{(60)}$.

Table C.1. Tablulated $Qc/N_{1(60)}$ Ratios for Interpreted Soil Types

Soil Type	Qc/N Ratio
Organic soil - Peat	1.0
Sensitive Fine Grained	2.0
Clay	1.0
Silty Clay to Clay	1.5
Clayey Silt to Silty Clay	2.0
Silt	2.5
Silty Sand to Sandy Silt	3.0
Clean Sand to Silty Sand	4.0
Clean Sand	5.0
Gravelly Sand to Sand	6.0
Very Stiff Fine Grained	1.0
Sand to Clayey Sand	2.0

The $Qc/N_{1(60)}$ ratio is based upon the published work of Robertson (1985)[2]. The values of N are corrected for overburden pressure in accordance with the correction suggested by Liao and Whitman using a factor of 0.5. Where the correction is of the form:

$$N_1 = \sigma^{0.5} * N$$

All calculations are carried out by computer using the software program CPTint.exe developed by UBC Civil Engineering Department. The results of the interpretation are presented on the following Figures.

UNDRAINED SHEAR STRENGTH CORRELATION

It is generally accepted that there is a correlation between undrained shear strength of clay and the tip resistance as determined from the cone penetration testing. Generally the correlation is of the form:

$$S_u = \frac{(q_c - \sigma_v)}{N_k}$$

where q_c = cone tip resistance, σ = in situ total stress, N_k = cone constant

The undrained shear strength of the clay has been calculated using the cone tip resistance and an N_k factor of 12.5. All calculations have been carried out automatically using the program CPTint.exe. The results are presented on the Figures following.

---

2 Robertson, P.K., 1985, "In-Situ Testing and Its Application to Foundation Engineering", 1985 Canadian Geotechnical Colloquium, Canadian Geotechnical Journal, Vol. 23, No. 23, 1986

APPENDIX C - OVER CONSOLIDATION RATIO ANALYSIS

The over consolidation ratio (OCR) is defined as the ratio between the maximum past vertical pressure on the soil versus the current in-situ vertical pressure. The maximum past vertical pressure is typically caused by the presence of excess overburden which is removed by either natural or man-made reasons. Soil ageing and other chemical precipitation affects can also cause a soil to behave as if it has a higher maximum past pressure, which is sometimes described as pseudo-overconsolidation.

Research by Schmertmann (1974) showed the following equation reasonably approximates the OCR of medium plastic to clayey soils:

$$OCR = \left(\frac{\left(\frac{Su / p'oc}{Su / p'nc} \right)^{5/3} + 0.82}{1.82} \right)$$

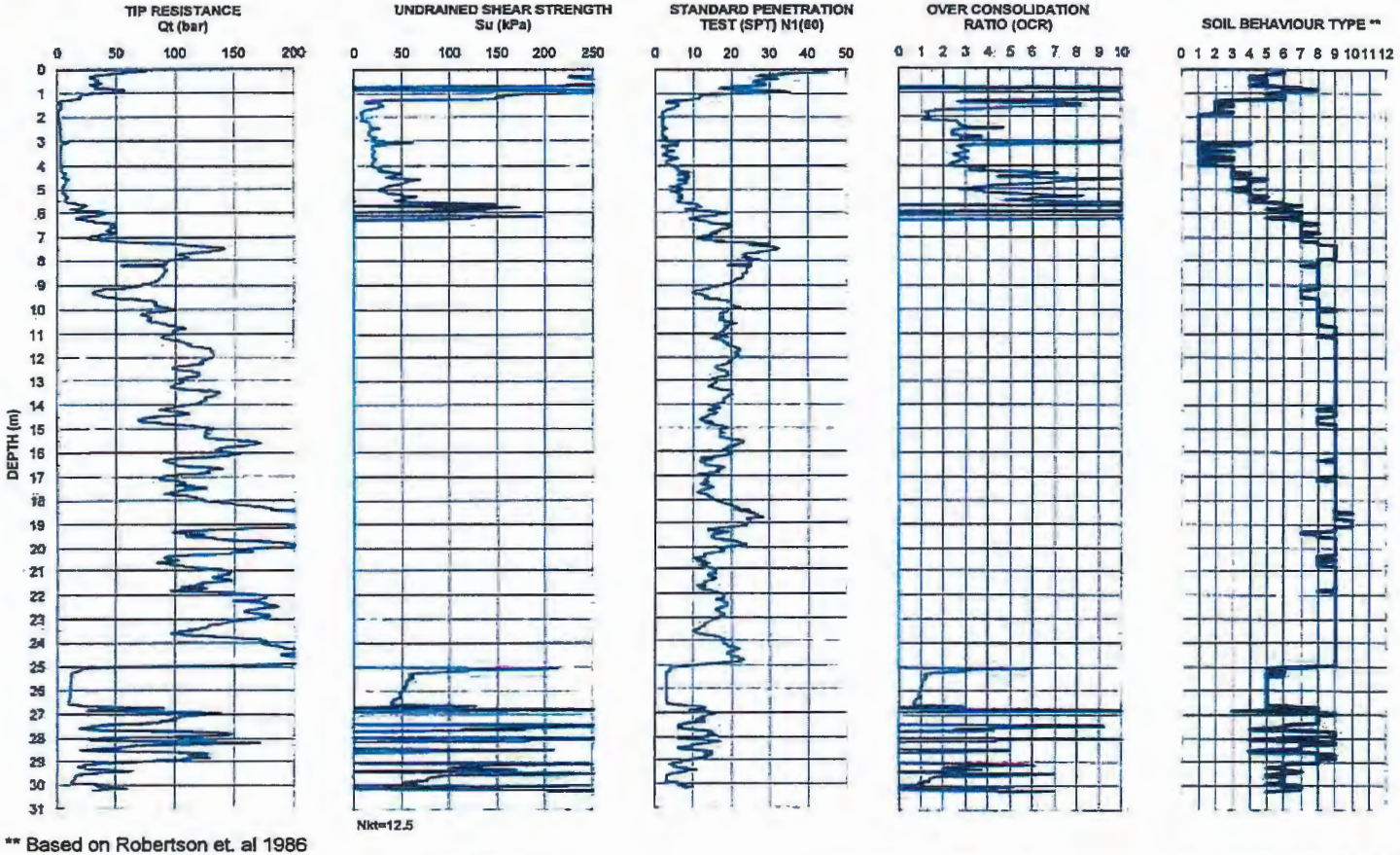
Su/p'oc = The undrained shear strength to effective stress ratio of the over consolidated soil

Su/p'nc = The undrained shear strength to effective stress ratio of a normally consolidated soil (OCR = 1). Typically = ~0.2

Soils which are subject to loads less than the maximum past pressure of the soil are typically subject to relatively small elastic settlements. Loads which exceed the maximum past pressure on the soil typically cause consolidation which is the gradual settlement of the ground as a result of expulsion of water from the pores of the soil. The rate of settlement and the time to complete consolidation is a function of the permeability of the soil.

The Schmertman equation has been employed to estimate the OCR of the soils with depth employing the CPT data provided in Appendix B and C.

GEOPACIFIC CONSULTANTS	2016-Jan-6	CRANBERRY MEADOWS FARMS LTD	GeoPacific Project #: 13570
	Sounding: CPT16-01	TERMINUS OF FRANCIS ROAD (EAST OF NO. 6 ROAD), RICHMOND	Figure: C.01



** Based on Robertson et. al 1986

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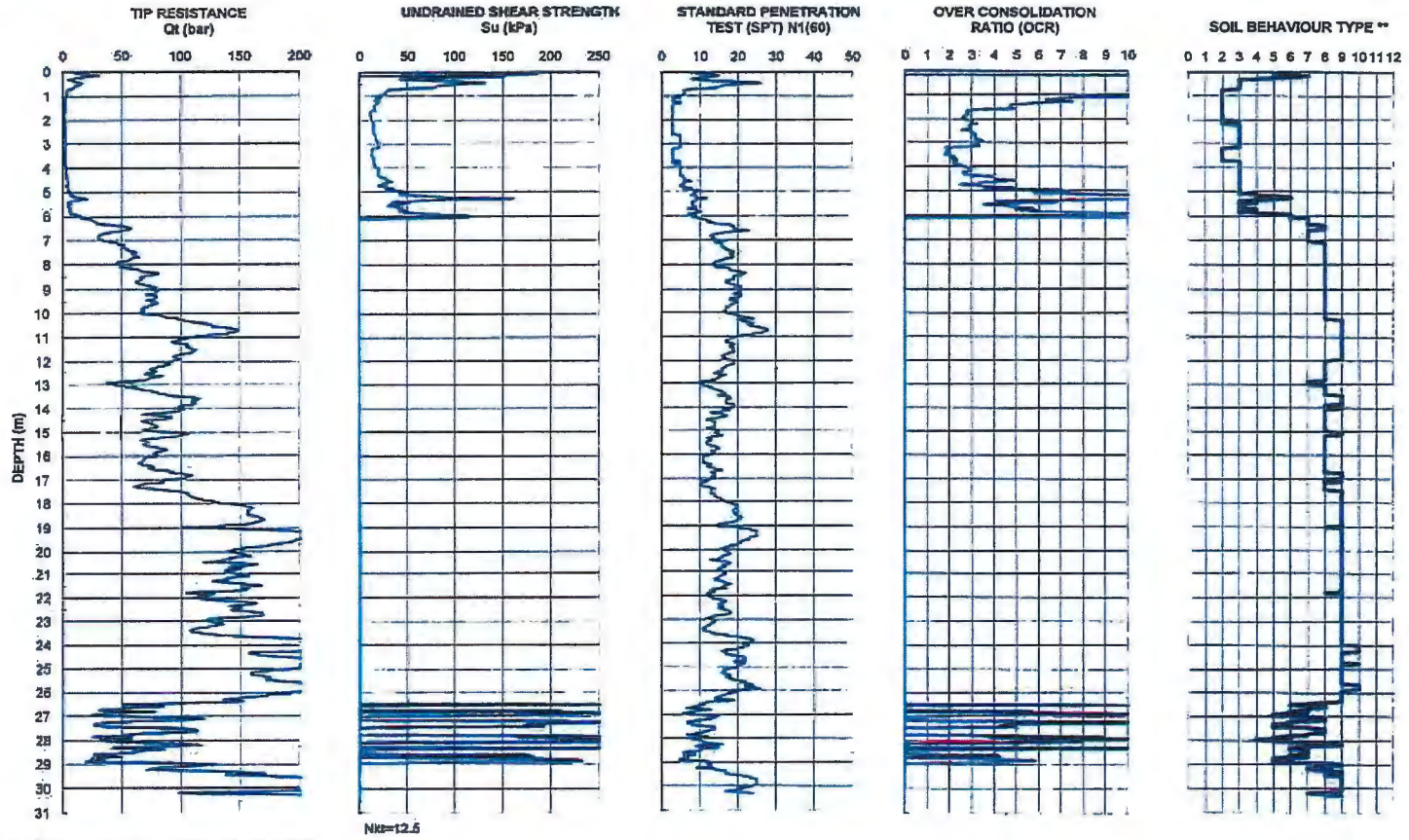
GEOPACIFIC CONSULTANTS	2016-Jan-6	CRANBERRY MEADOWS FARMS LTD	GeoPacific Project #: 13570
	Sounding: CPT16-02	TERMINUS OF FRANCIS ROAD (EAST OF NO. 6 ROAD), RICHMOND	Figure: C.02



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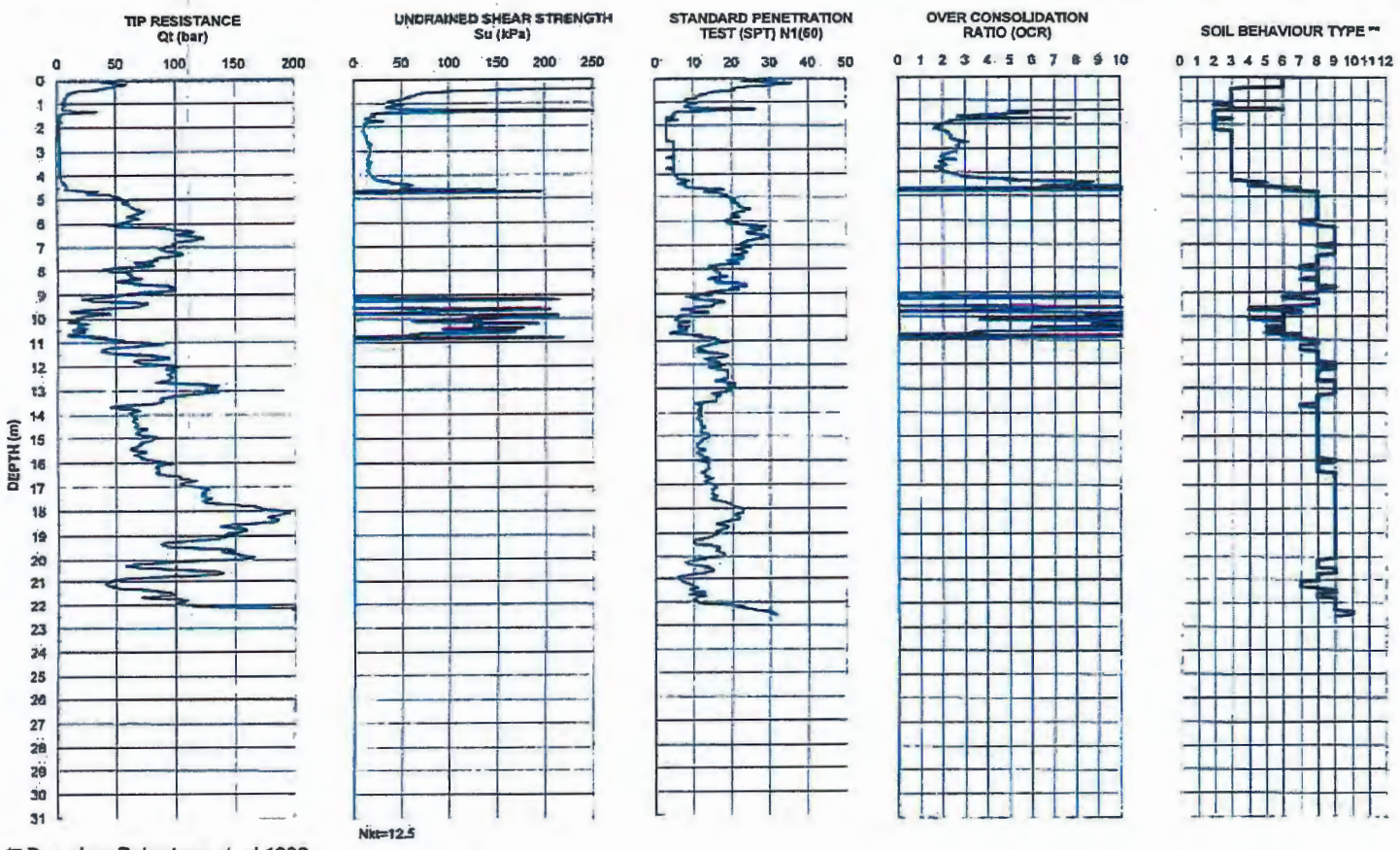
GEOPACIFIC CONSULTANTS	2016-Jan-6	CRANBERRY MEADOWS FARMS LTD	GeoPacific Project #: 13570
	Sounding: CPT16-03	TERMINUS OF FRANCIS ROAD (EAST OF NO. 6 ROAD), RICHMOND	Figure: C.03



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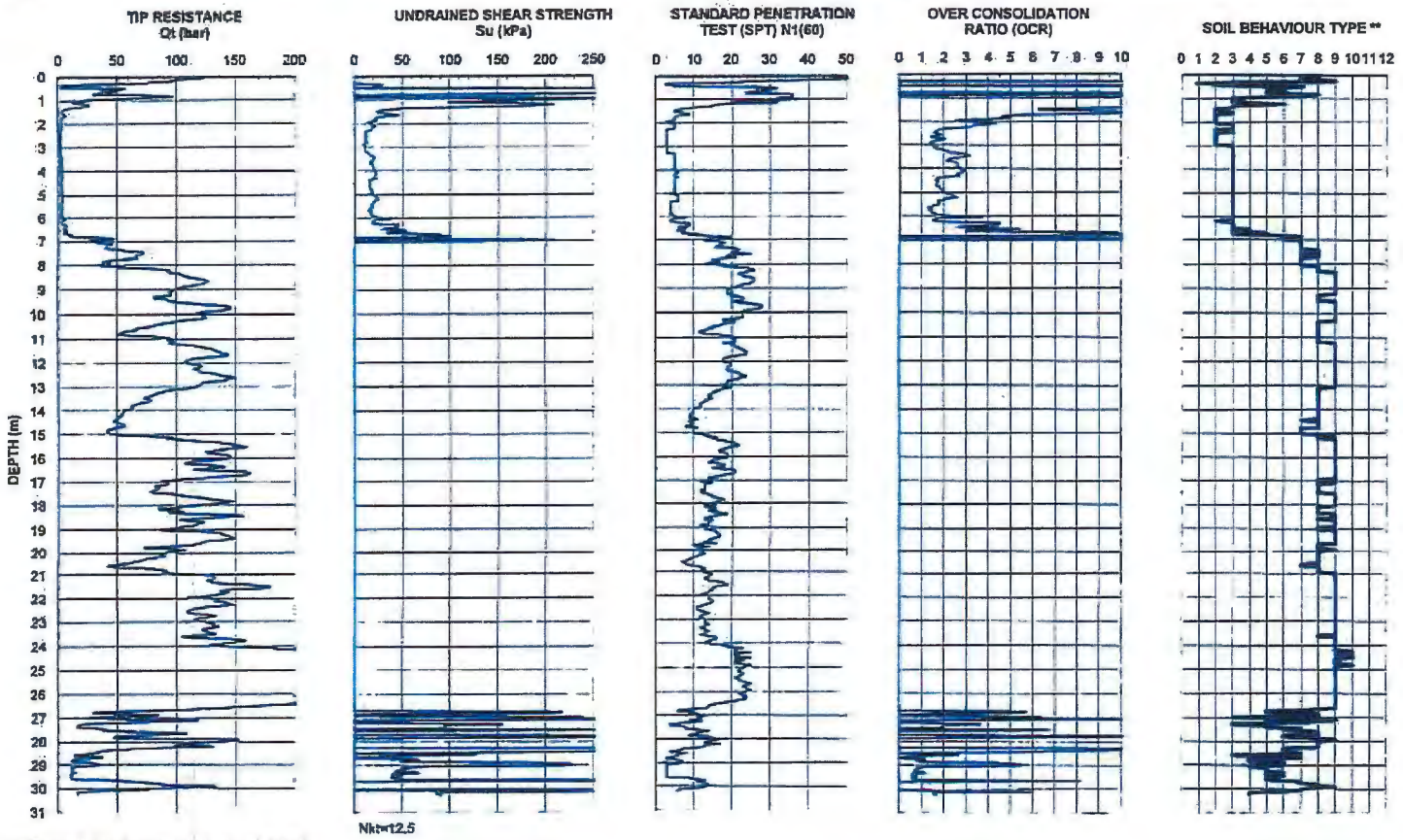
GEOPACIFIC CONSULTANTS	2016-Jan-6	CRANBERRY MEADOWS FARMS LTD	GeoPacific Project #: 13570
	Sounding: CPT16-04	TERMINUS OF FRANCIS ROAD (EAST OF NO. 6 ROAD), RICHMOND	Figure: C.04



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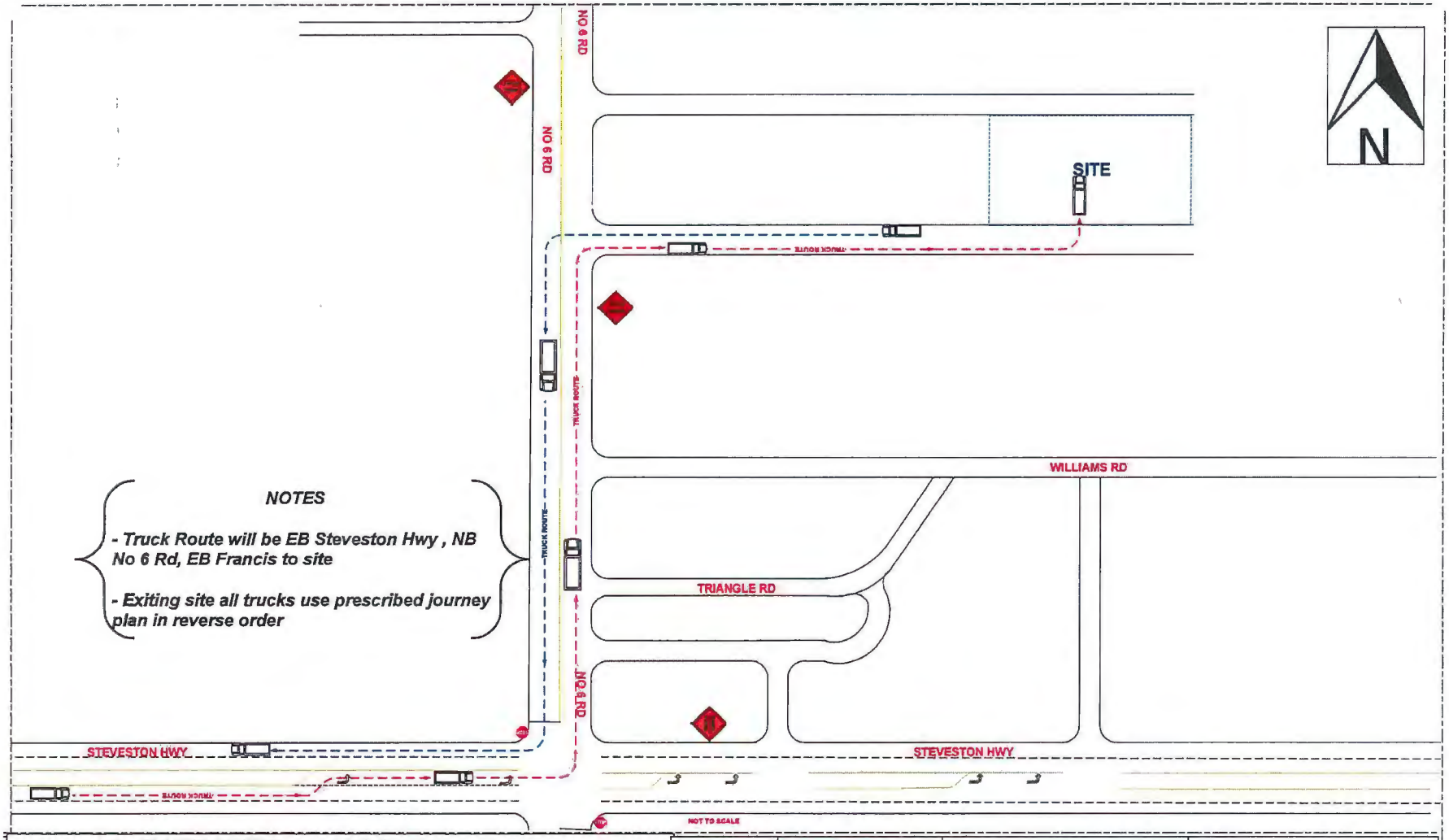
Appendix 4

Traffic Control/Management Plan

PGL
ENVIRONMENTAL CONSULTANTS



PREPARED BY: onestop TRAFFIC CONTROL, email info@ostc.ca
Tel 604- 889-5700

DRAWN BY: BH | DATE: JAN 29TH, 2016 | NOTES:

LOCATION: NO 6 RD & FRANCIS, RICHMOND

SITE CONTACT STEWART BROWN 604-582-3707

Approved by Lance Robertson

TUBULAR MARKERS – D TYPE | FLASHING ARROW BOARD | BUFFER VEHICLE | TRUCK ROUTE

PGL ENVIRONMENTAL CONSULTANTS | onestop TRAFFIC CONTROL

•TRAFFIC CONTROL PERSONNEL WILL ASSIST PEDESTRIANS, CYCLISTS & VEHICLES WHEN & WHERE NECESSARY
•ADVANCE WARNING SIGNS WILL BE LOCATED UPSTREAM OF WHAT IS INDICATED
•PLEASE REFER TO THE M.O.T. MANUAL FOR ALL TERMS AND DISTANCES RELATED TO TRAFFIC CONTROL
•SUGGESTED PRINT SIZE 11" X 17"

City of Richmond

Discussion Notes
(no quorum meeting)

AGRICULTURAL ADVISORY COMMITTEE (AAC)

Held Thursday, April 26, 2016 (7:00 pm)
M.2.002
Richmond City Hall

In Attendance:

Steve Easterbrook (Co-Chair); Krishna Sharma; Doug Wright; Scott May; Robert Savage; Minhee Park (Policy Planning); Terry Crowe (Policy Planning); John Hopkins (Policy Planning), Michelle Orsetti (Community Bylaw); Kevin Connery (Parks); Dieter Geesing (Ministry of Agriculture); Tony Pellett (Agricultural Land Commission)

Regrets:

Councillor Harold Steves; Todd May (Co-Chair); Janet Langelaan; Kyle May; Teresa Murphy; Colin Dring

Guests:

Theresa Duynstee (Metro Vancouver)

1. Adoption of the Agenda

Since there was no quorum, the Committee could not formally adopt the agenda.

2. AAC Communication Process

Terry Crowe clarified the role of the AAC and draft communication process to be used when the AAC comments on development applications related to agriculture. He noted that the AAC comments are advisory only, and the applicants are not automatically required to address the comments. After the AAC meeting, staff will discuss the AAC's recommendation and comments with the applicant who may choose either to act on the AAC's recommendation or not act on it. If the applicant chooses not to act on it, staff may either request that the applicant do so to provide a complete report to Council or recommend that the applicant not do so and let the Planning Committee decide. The final decision will be made by the Planning Committee and Council.

Mr. Crowe requested feedback from the Committee. The Committee did not have specific comments or concerns.

3. Development Proposal – Non-farm Use Application (Soil fill) 14791 Westminster Highway

Community Bylaw Staff (Michelle Orsetti) provided an overview of the Agricultural Land Reserve (ALR) soil fill application to establish a tree nursery at 14791 Westminster

Highway. The application was initially considered by the Committee on September 24, 2015. Staff noted that the applicant had provided all the information previously requested by the Committee. The Chair invited the applicant and the project agrologist to the table.

The Committee had the following questions and comments:

- Committee asked about the source of subsoil. The applicant noted that it will be sourced from a single local provider.

- Committee asked whether the owner plans to grow only local trees. The applicant noted that, unless there is a request for exotic trees, they will grow mostly local trees.

- Discussion ensued regarding suitability of the site for the proposed use and proposed improvement. The agrologist noted that the site can be used for a tree nursery with some improvement.

- Committee noted that it wants to see a long term business plan when reviewing a development application in the ALR to ensure that the proposed proposal makes sense. Committee also would like to see a long term commitment from the applicant and ensure the site will still be agriculturally productive after fill activities are completed in case the nursery operation ceases in the future.

- The soil contractor from Hexcel Construction Ltd. was invited to the table and provided details of the operation and soil quality. He noted that soil will be tested and certified, and it will mostly be from Richmond.

- A Committee member noted that the site has been fallow for 40-50 years, and there must be a reason for it. Another member also noted that the plan makes sense, and Committee's role is to provide comments on the plan, not to enforce it.

- The chair introduced the following motion:

  That the ALR non-farm use application for soil fill at 14791 Westminster Highway be supported subject to the following conditions:
  1. *The applicant ensures that there is no drainage impact on neighbouring properties.*
  2. *The applicant commits to using only non-contaminated soil supported by a Phase 1 Environmental Site Assessment report and not to bring in construction materials and/or non-excavated soil.*
  3. *No soil sub-contractor, other than the designated soil provider, to be used to ensure the soil quality.*
  4. *A performance bond to be provided*
  5. *The property must be left to a condition that it can still be viable for agriculture once the tree nursery operation ceases.*

Due to the absence of quorum, the motion could not be considered.

4. Development Proposal – Non-farm Use Application (Soil Fill) PID: 023-860-481 (no civic address)

Staff provided a brief overview of the non-farm use application. The Chair invited the applicants to the table. The applicant explained the current limitations of the site due to the high salinity of water that is sourced from the South Arm of the Fraser River. The proponent would like to change the crop production from cranberries to grapes and raspberries. The grape production on the site will supplement their current grape and wine production on another site in Richmond.

The Committee had the following questions and comments:

- In response to Committee's query, the proponent provided further information about the current winery operation. The proponent noted that more than 50% of the products used to manufacture wine will be produced on the farm but they will also continue to purchase grapes from Okanagan.

- The Committee asked how much raspberry production is planned on the site. The proposed raspberry production will be roughly around 5 acres and will use drip irrigation.

- The Committee noted that it understands the issue related to the quality of water and rationale behind the proposed soil fill. Committee agreed that raising the profile of the site will enhance the agricultural viability of the site and enable the owners to pursue a positive venture.

As a result of discussion, the Committee introduced the following motion:

That the ALR soil fill application for the site (PID: 023-860-481) be supported as presented.

Carried Unanimously

5. Verbal Update – Soil Fill at 12871 Steveston Highway

Ms. Orsetti provided an update on the soil fill activity at 12871 Steveston Highway. She noted the conditions of the ALC approval.

The ALC, Community Bylaw, and the City's Agrologist have been monitoring the site to ensure these conditions are met. The City conducted a joint inspection with the ALC staff on October 23, 2015. They noted that the surface of the site was clean and there was large asphalt for access road base. The departing trucks were also clean.

In January 2016, the City and the ALC conducted another joint inspection. Since it was not clear adequate amount of soil and top soil had been placed, a survey was requested to verify the volume of fill. The survey was provided and it was confirmed that the amount of soil brought to the site was in accordance with the approved plans. However, the amount of top soil is inadequate so the applicant is working to correct the issue.

Another inspection is scheduled for early May, 2016. The ALC will take further action if the top soil issue does not get corrected.

The Committee requested staff to send the conditions of the ALC approval to the members by email.

6. Agriculture Impact Assessment Guidelines

Theresa Duynstee, Regional Planner from Metro Vancouver, provided highlights of the Agricultural Impact Assessment Guidelines. The AIA process can be used to better understand the effects of non-farm use developments. She noted the table "Screening Significance Indicator" on page 7 of the guidelines can be used in reviewing development applications. Committee noted that the guidelines would be useful and the City should consider using the guidelines in reviewing development applications. Staff noted that staff will review how the AIA guidelines could be integrated into the 2041 Official Community Plan and Agricultural Viability Strategy.

7. Garden City Lands Update

Parks staff (Kevin Connery) noted that, since the Garden City Lands Legacy Landscape Plan was adopted by Council in 2014, staff had continued with developing a more detailed design. The presentation was to share the findings of the hydrogeological assessments with the AAC and discuss the implications on the Legacy Landscape Plan.

The Committee had the following questions and comments:

- In response to the Committee' query regarding the source of water, Mr. Connery answered that it is precipitation only, and there is no other source on the site. He also noted that there is a concern regarding the long-term viability of the bog and ideas to keep the bog viable are being discussed.
- In response to the Committee's query about the current status, Mr. Connery noted that 5.2 million has been approved by Council to develop the perimeter trail, mid dyke, farm road and water management system and implement the farm plan.
- Committee requested further information about the proposed land uses and farming. Mr. Connery noted that ultimately approximately 20 acres will be used for farming with partnership with Kwantlen Polytechnic University. Mr. Connery said that farm plan is currently being developed and would likely be ready in June.
- Farming will be based on sustainable agriculture practices; it will focus more on research and investigation, not production.
- Committee asked if there is any water feature.
- It was suggested that GCL should showcase ethnic diversity through farming (ethnic crops and practices.)
- In response to the Committee's query regarding the next steps, Mr. Connery noted that an open house is planned for early June, and the City will prepare an application to the ALC for non-farm use.

8. Meeting Minutes and Business Arising from February 4, 2016 Meeting.

Since there was no quorum, the said minutes will be formally approved by the Panel in its next meeting.

9. Action Item Table – Review and Update

No update.

10. Updates

No update.

11. New Business/Information and Update Items

None.

12. Next Meeting date – May 26, 2016 (Tentative)

13. Adjournment

SOIL DEPOSIT PERMIT 42047

Property Location:	PID: 023-860-481 (the "Lands")	
Name of Owner(s):	Cranberry Meadow Farms Ltd.	**Phone:** 604.802.4775
Name of Agent:	NA	**Phone:** NA
A.L.C. Approval Date:	Date?	
A.L.C. Expiration Date:	Date?	
Permit Issuance Date:	Date?	
Permit Expiry Date:	**Date?**	
Permitted Volume of Soil or Fill:	volume of soil or fill m3	

This permit is issued pursuant to section 4.3 of the City of Richmond's current *Soil Removal & Fill Deposit Regulation Bylaw No. 8094*, as may be amended, updated, or replaced.

Deposition and removal of soil or fill must be done in compliance with all requirements of the City of Richmond's *Soil Removal & Fill Deposit Regulation Bylaw No. 8094,* as may be amended, updated, or replaced. This permit is also issued subject to compliance with all of the following conditions:

GENERAL CONDITIONS OF THE PERMIT

1) This permit is issued subject to full and continual compliance with all conditions for the deposition and/or removal of soil or fill as contained in the City of Richmond's *Soil Removal & Fill Deposit Regulation Bylaw No. 8094* (the "Bylaw") and the current *Agricultural Land Commission (ALC) Act*, as may be amended, updated, or replaced.

2) The permit holder will comply with all other applicable Acts, regulations, and decisions and orders of any person or body having jurisdiction over the Lands.

3) The owner of the Lands, as well as the permit holder, will both indemnify and save harmless the City of Richmond (the "City') from any and all claims, proceedings, liabilities, obligations, damages, costs and expenses whatsoever arising from, or in connection with the soil or fill project (the "Project") which is authorized by this permit, including but not limited to, claims in relation to the subject Lands or neighbouring properties.

4) Prior to commencement of the project; the permit holder may be required, at the Manager of Community Bylaw's (the "Manager") sole discretion, to arrange for the perimeter of the approved project area(s) to be staked out so as to make the area(s) clearly visible. The project may not be permitted to commence until the staked area has been inspected and approved by City staff.

5) Prior to the depositing of any soil or fill, all existing trees that measure 20cm calliper or greater located on the site require tree protection fencing to be installed around the drip line (and inspected by City staff) as per Tree Protection Bulletin Tree-03, as may be amended, updated, or replaced.

6) The deposition of soil or fill will not be permitted on weekends or statutory holidays or between the hours of **7:00 p.m. and 8:00 a.m.**, unless identified within the *Special Conditions* or unless exempted by the Manager.

7) The City must be advised **forty-eight (48) hours** prior to the project proceeding unless exempted by the Manager.

8) No soil or fill will be placed within **three (3) metres** of any property line unless exempted by the Manager.

9) The permit placard issued by the City for this permit will be placed in a visible location at the front of the Lands for the duration of the project authorized by this permit.

10) The placement of cedar hog fuel and any other forms of wood waste within the area designated for soil or fill is strictly prohibited. In addition, no concrete, asphalt, construction debris, petroleum products, toxic wastes, contaminated materials, or any other non-soil material (the "Other Material") will be deposited on the Lands.

11) The deposition of concrete and asphalt waste material is not permitted for driveway and road base on the Lands, unless exempted by the Manager, ALC staff, or the *ALC Act* or *Regulations*.

12) The Lands are to be secured at all times to prevent unauthorized deposition of soil, fill, or other material. The owner of the Lands, as well as the permit holder, will both remain responsible for the removal of, or placement of unauthorized soil, fill, or other material on the Lands.

13) Caution will be exercised with the storage and handling of fuels and lubricants on-site. Soil or fill contaminated by spills will be removed immediately and disposed of at a permitted facility in accordance with the requirements of the current *BC Environmental Management Act*, as may be amended, updated, or replaced.

14) The deposition of soil or fill will not, in any way, interfere with the above or below ground drainage pattern of any adjoining properties to the Lands, and will not cause the groundwater table to rise on adjoining properties to the Lands, so as to cause flooding or malfunctioning of any sewage disposal system.

15) Groundwater and surface run off is not to drain into or onto adjoining properties to the Lands at greater rates after commencement than prior to the commencement of the project authorized by this permit.

16) The owner of the Lands, as well as the permit holder, will both remain responsible for any adverse effects, including drainage, caused by the placement of the soil or fill and will ensure any adverse effects are corrected upon written request by the City.

17) All necessary precautions must be taken to prevent sedimentation of any stream, creek, waterway, watercourse, ditch, drain, catch basin, culvert, or manhole either on or adjacent to the Lands. Sediment control and erosion measures will be installed/constructed and inspected by the Manager, if required by the Manager, at his/her sole discretion.

18) The permit holder is responsible for any contamination of ground/surface water which is attributable to the project authorized by this permit.

19) The permit holder will ensure that all dirt, mud, and debris resulting from the project authorized by this permit is removed from all public roads, as many times per day that is required to keep the road safe for both pedestrian and vehicular traffic, or as directed by the Manager, at his/her sole discretion. Should the permit holder fail to perform the necessary cleaning work, the City may undertake the cleaning work and recover the costs of such work by drawing on the security deposit, as well as pursue the owner and permit holder for repayment for any such costs incurred by the City.

20) Dust control measures are to be implemented, if required by the Manager, at his/her sole discretion.

21) The soil or fill to be deposited pursuant to this permit will consist of good quality soil or fill, substantially free of stones and other material, and which is suitable for the intended development use.

22) Any soil or other material deposited under this permit must be free and clear of any invasive species, including plant fragments or seeds, as identified in the provincial *Weed Control Act*, as may be amended, updated, or replaced, and any related regulations. If invasive species, including any plant fragments or seeds, are identified in the subject soil or other material, the Manager, at his/her sole discretion, may suspend the permit. In addition, a report must be prepared by a Qualified Environmental Professional (QEP), including proposed remediation steps and an implementation plan. This report must include best management practices for either chemical or mechanical treatment, and must be submitted within thirty (30) days and approved by the City's Environmental Coordinator. The QEP must supervise the agreed upon remediation efforts contained in the report, including monitoring the site for three (3) years for any emerging invasive plants post-treatment, unless determined otherwise by the QEP, and agreed to by the City. The QEP must also supervise any required follow-up treatments. The QEP must deliver a final report to the City confirming that the deposited soil or other material is free and clear of any invasive species, including plant fragments or seeds, as identified in the provincial *Weed Control Act*, as may be amended, updated, or replaced, and any related regulations, prior to the City returning the security deposit and closing its soil deposit file for this property.

23) The approved project area(s) will be seeded as soon as possible following completion of the project authorized by this permit, as required by the Manager, at his/her sole discretion.

24) The permit holder will, upon request of the City, provide a detailed traffic management plan, in form and substance acceptable to the Manager. The Manager may request modification of the plan prior to or at any time throughout the soil deposit project.

25) Trucks will access the approved project site from designated truck routes in accordance with the City's current *Traffic Control & Regulation Bylaw*, as may be amended, updated, or replaced. Where soil or fill is transported to the Lands over any road which is a non-designated truck route, the permit holder will be responsible for any damage occurring to that road as a result of the transportation of the soil or fill.

26) No truck traffic is permitted to be parked or staged on any Municipal roadway/allowance.

27) The permit holder will maintain an accurate daily log of trucks depositing soil or fill on the site. This log will be made available for inspection by the Manager when requested. At the sole discretion of the Manager, alternate measures may be used (i.e. survey, etc) in order to determine the volume of soil or fill deposited on or removed from the Lands.

28) Subject to any requirements of a Provincial enactment, the Manager is hereby authorized at all reasonable times to enter upon and inspect the Lands to determine whether the requirements, restrictions, regulations, terms, conditions, and directions of this this permit, the Bylaw, and *ALC Act* are being followed.

29) Non-compliance with any of the terms and conditions contained in this permit may render this permit suspended or void. If suspended, the Manager may order that the deposition of soil or fill cease until such a time as the permit holder has rectified the issue of non-compliance within the timeframe required by the Manager, to the Manager's satisfaction.

30) This permit may be voided by the Manager, at his/her sole discretion, if non-compliant issues are not rectified to the Manager's satisfaction. The Manager, at his/her sole discretion, may void the permit without suspension.

31) Should the applicant be non-compliant with any conditions of this permit, the Manager, at his/her sole discretion, may draw a partial or full amount of the security deposit and cancel or suspend the permit until a new amount for the security deposit is provided to the City, to the Manager's satisfaction.

32) Prior to the security deposit being returned, the permit holder will provide the Manager with any reports or information that may be required by the Manager in order to confirm that the deposit or removal which is the subject matter of this permit is in compliance with the permit conditions, bylaws, Acts, enactments, applicable legislation, or other requirements of any person or body having any jurisdiction over the Lands.

33) Prior to the security deposit being returned, all conditions as stated in this permit and ALC approval, will be satisfied in their entirety, to the satisfaction of the Manager, and only after the City has carried out a final site inspection and confirmed, in writing, that the site is in a condition satisfactory to the Manager.

34) The security deposit may be used by the City to pay for or recover costs incurred by the City or to pay outstanding fees to the City.

35) Should a permit extension be required, the permit holder will provide reasonable advance notice to the City, and if applicable, to the ALC, prior to the expiration of this permit.

SPECIAL CONDITIONS OF THE PERMIT

36) The permit holder will arrange for a site meeting with City staff prior to work commencing to ensure all pre-fill requirements have been satisfied.

37) All soil or fill shall be deposited as per the *Fill Deposition Plan* prepared by Pottinger Gaherty Environmental Consultants Ltd. dated October 2016.

38) All soil or fill shall be deposited in full compliance with the conditions as stipulated in the decision from the *Agricultural Land Commission (ALC)* dated «adddate». The project may not commence until such time as all ALC approval conditions have been satisfied.

39) Upon completion of the soil deposit project, a final topographic survey will be provided that identifies the finished elevations and the total volume of soil deposited on the Lands.

40) If additional soil or fill is required beyond the permitted volume, the permit holder may be required to complete a new *Soil Removal / Fill Deposit* form as per the City's current *Soil Removal & Fill Deposit Regulation Bylaw*, at the Manager's sole discretion.

42047

If the permit holder fails to satisfy or comply with any condition of this permit, the owner of the Lands agrees to immediately satisfy or comply with the applicable condition, upon request by the City. Further, the issuance of this permit does not, in any way, relieve the owner of the Lands, any occupier of the Lands, or the permit holder, from having to comply with any and all applicable legislation; including but not limited to, all applicable zoning, subdivision, and other land use bylaws of the City, as well as all other applicable Acts or regulations, and any and all decisions of responsible authorities which may apply to the Lands.

Enter Your Name
SOIL BYLAW OFFICER

Date

Enter Name
Owner/Agent

Date

GEOPACIFIC
VANCOUVER KAMLOOPS CALGARY

P 604.439.0922
F 604.429.9189
geopacific.ca
1779 W 75th Ave.
Vancouver, B.C. Canada V6P 6P2

Cranberry Meadows Farms Ltd.
11450 92A Avenue
Delta, BC
V4C 3M5

January 11, 2017
File: 13570

Attention: Gord Maichin

Re: Geotechnical Investigation Report - Proposed Fill Site
Terminus of Francis Road - East of No. 6 Road, Richmond, B.C.

1.0 INTRODUCTION

We understand that you propose to fill the above referenced 8.05 hectare parcel of farm land to elevations varying between 4.4 and 6 m geodetic to permit the farming of grapes and raspberries. We further understand that the City of Richmond requires a geotechnical assessment of the site to determine impacts to surrounding properties and drainage due to the contemplated filling program. We also note that it is intended to install a new jet fuel pipeline to service Vancouver International Airport, which will be installed within the Francis Road right-of-way adjacent to the proposed fill site.

This report presents the results of a geotechnical investigation of the soil and groundwater conditions at the site and presents our assessment of the potential drainage and off-site impacts of the development.

This report has been prepared exclusively for Cranberry Meadows Farms Ltd, for their use, the use of others on their design team, and the City of Richmond for use in the development and permitting process.

2.0 SITE DESCRIPTION

The fill site is located in east Richmond, east of No. 6 Road, and directly north of Francis Road. The site is rectangular with east-west dimension of approximately 410 m and north-south dimension of about 194 m. The site is presently employed as a cranberry farm with equipment lay down and storage area located at the southwest corner of the property. Existing elevations vary from 0 to 1 m geodetic in the farm field with surrounding ditches at lower elevations. Francis Road and gravel access roads surrounding the site are at elevations of about 1 to 2 m geodetic. The site is essentially flat.

The location of the site relative to surrounding properties and roads is shown on our site plan, Drawing 13570-01, attached to this report.

3.0 FIELD INVESTIGATION

GeoPacific completed an investigation of the site on January 6, 2016. The investigation included a total of 4 auger test holes, to depths of 6 m below current site grade and 4 Cone Penetration Test (CPT) soundings, advanced to depths of 22.6 to 30 m below grade. The test holes and CPT soundings were completed using

a subcontracted, track mounted auger drill rig operated by On Track Drilling Inc. of Coquitlam, B.C. All test holes were logged in the field by a technician from our office and backfilled immediately upon completion of testing and logging.

As the cone penetrometer is advanced into the ground, it records cone tip resistance, sleeve friction, pore water pressure, temperature and inclination every 50 mm to a purpose built data acquisition system. Analysis of the CPT sounding data allows an estimation of geotechnical design parameters and inference of the sub-surface stratigraphy from soil-type behaviour characteristics. The stratigraphic interpretation was verified with the augured test holes as described above. The CPT sounding results are presented in Appendix B of this report. Geotechnical parameters interpreted from the CPT soundings, such as undrained shear strength and standard penetration $N_{1(60)}$ values, are presented in Appendix C of this report while Liquefaction Analyses are presented in Appendix D.

Test holes were completed on the access roads surrounding the farm land and equipment storage area as the farm land itself is not capable of supporting a heavy drill rig.

The approximate location of the auger test holes and CPT soundings with respect to the property are shown on our Drawing No. 13750-01.

4.0 SUBSURFACE CONDITIONS

4.1 Soil Conditions

The existing soil profile at the site, from the surface downwards, generally consists of 0.6 and 1.4 m of fill around the site perimeter, and then natural soils of PEAT followed by low plastic clayey SILT to silty CLAY over interbedded silty fine SAND to fine sandy SILT over silty to clean SAND. The sand is underlain by a thick sequence of marine clay silt interbedded with fine sands below depths of 25 to 27 m. Based on our general knowledge of the area, and published geology, we anticipate the marine clay silt extends to a depth of about 60 metres where it is underlain by dense glacially consolidated deposits.

A detailed description of the soils encountered is given below.

Fill

Fill was encountered at each test hole and varied from pavement structure related sand and gravel to wood chips to organic rich silty sand (topsoil). These materials were also encountered on the access roads and lay down area surrounding the farm field. We do not expect much, if any, mineral based fill in the farm field itself.

Peat

Peat was present at all test hole locations and varied in thickness between 0.4 and 1 m with moisture contents between 167% and 274%. These moisture content values are relatively low for peat and are expected to be a function of the consolidation induced by the presence of the above referenced fills. We anticipate that the peat will likely be thicker with higher moisture content within the farm land, and therefore more susceptible to larger settlements induced by filling.

Peat is highly compressible when loaded in excess of it's current insitu stress. Conventional site

preparation measures to limit post construction settlements also have a limited benefit on peat. Long term settlements of peat are caused by the gradual decay of the organic constituent that makes up the majority of the peat. These settlements are unavoidable.

Clayey Silt to silty Clay (Overbank Sequence)

The peat is underlain by between 2 and 4 m of silt to clay. The silt is typically firm with some organic content and brown in the upper 200 to 500 mm, below this becoming firm to soft and grey in colour. Laboratory testing yielded moisture contents ranging from 50 to 123%. Shear strength in the soft portion of the clayey silt profile is interpreted at between 15 and 50 kPa below the upper desiccated zone as shown in Appendix C. The desiccated zone is typically about 300 mm thick and has a shear strength of between 75 and 120 kPa. The soft portion of the clayey silt zone is significantly compressible under the contemplated fill loads.

Fine Sandy Silt to Silty Sand (Transitional Sequence)

Underlying the clay silt is about 2 m of a transitional sequence comprised of loose to compact silty fine SAND to fine sandy SILT. The sequence is non plastic and therefore somewhat compressible under moderate to heavy loading only.

Clean Sand to Silty Sand (Channel Sequence)

The silt and interbedded sand and silt described above is underlain by a sequence of river channel deposited sands. The slight variations in the in-situ density, compressibility, mineralogy and grain size are reflected in the shape of the tip resistance curves shown on the CPT plots in Appendix B. In general the Fraser River channel sands are well graded, medium grained, predominantly quartz, highly stratified and loose to medium dense. These deposits extend to about 25 to 27 m depth at our CPT soundings,.

Occasional zones of clayey silts are interbedded in the predominantly sand, channel sequence, as shown on the soil behaviour type plots given in Appendices B and C.

Deep Marine Clay Silt

The sand is underlain by a thick sequence of deep marine clay silt below 25 to 27 m. This zone is expected to extend down to the glacial deposits, inferred to extend to about 60 m below local site grades. This zone is considered compressible given the height and extent of the contemplated filling. Due to the thickness of this zone and it's low permeability, post filling settlements will continue for many years after the completion of the site preparation work. This long term settlement behaviour is not uncommon in Richmond with long term post construction settlements occurring as a result of mid-rise tower development, for example.

For a more detailed description of the subsurface soil conditions refer to the Test Hole Logs and CPT Sounding Logs in Appendices A and B, following the text of this report.

4.2 Groundwater Conditions

The static groundwater level is expected to be in close proximity to the existing elevation of the farm field.

Groundwater levels are expected to vary seasonally with generally higher levels during the wetter winter and spring months. It has been our experience that near surface groundwater levels are often controlled by surface water levels in local ditches and thus levels can rise to near ambient ground level during periods of heavy and prolonged rainfall.

5.0 DISCUSSION

5.1 Fill Program

We understand that the filling program is proposed to occur over a period of 3 years with a total of 362,000 m^3 of material imported to the site. The site will be sloped at approximately 3% with finished site elevations varying from 4.4 to 6 m geodetic. The margins of the fill site will be sloped at 2H:1V. The existing soils will be left in place with new fill derived from sites in western Vancouver varying from Vashon Drift to Capilano sediments. These soils vary in composition and may include glacial till (well graded sand, silt, and gravel), glaciofluvial sand to gravel, glaciolacustrine silts, marine and glaciomarine silts, and beach deposited sands.

5.2 Drainage

The natural soil profile consists of relatively low permeability peat and overbank deposited silts which grade into channel deposited sands at depth. The proposed fill operation will result in significant consolidation of the peat and silt. While the permeability of these upper soils will reduce, the main aquifer of sand below 6 m depth will not be affected. We would expect normal flows in these Fraser River sands to control the surrounding property groundwater levels.

The current conditions allow for natural infiltration of rainwater into the topsoil of the farm field. Some of the proposed fills including the marine, glaciomarine, glaciolacustrine, and glacial till deposits will have a relatively low permeability once placed and compacted. Negligible infiltration into these materials will occur. We expect that some rainwater will be retained in the topsoil of the future grape and raspberry fields, but some will also flow to the perimeter of the site. We anticipate that a cleaner granular soil will be placed below the upper topsoil to facilitate drainage, as required. Regardless, the surface runoff would be directed to perimeter site drainage to ensure no mounding of groundwater levels at adjacent properties. Any potential groundwater impact can be mitigated substantially with the incorporation of an efficient ditch and drainage system around the periphery of the site which conveys surface run off to the surrounding City storm system.

In summary, it is our geotechnical opinion that the proposed fill program is feasible without adversely impacting drainage or groundwater levels beyond the site. Some maintenance of the drainage system during the filling process as well as in the future, due to the predicted long term settlements described in Section 5.3, should be expected.

5.3 Settlement

Due to the large extent of the fill area, significant consolidation of the upper compressible peat and silt deposits will occur along with the deep marine deposits. Due to the thickness and low permeability of the marine deposits, consolidation of this stratum will continue to occur for several years after placement of the fill. Our analysis indicates that total settlements on the order of 1.2 to 1.8 m should be anticipated at the mid point of the fill site. Settlements are predicted to decrease to about 600 mm to 900 mm at the margin of the fill area. We anticipate that approximately 60 to 70% of this settlement will occur during fill placement with the remainder accumulating over about 20 to 25 years.

The majority of the settlement is derived from the surficial peat and silt, which accounts for approximately 60% of the total settlements. The primary consolidation of these two stratums should occur relatively quickly within a few months of completion of the fill program. Significant secondary consolidation will be as a result of gradual consolidation of the marine deposits at depth. Some limited settlement will be realized from gradual decay of the peat as well, but this is anticipated to be small in relation to the predicted total.

Significant differential settlements should be anticipated within 6 to 8 m of the fill area. These settlements will likely require some maintenance of the surrounding area to ensure, for example, level access roads and positively flowing ditches.

Settlements will be measurable off-site. We estimate settlements at about 8 m beyond the fill area to range from 50 to 150 mm. These settlements are derived from the marine deposits located below about 26 m depth. Therefore, the surface projection of these deep settlements typically result in small differentials of less than 2 mm/metre and are generally not damaging to surface infrastructure. However, the long term impacts on gravity based services surrounding the site should be reviewed. Similar behaviour occurs beyond mid-rise towers elsewhere in Richmond.

5.4 Francis Road - Jet Fuel Pipe Line

We understand that it is proposed to install a new pipe line within the Francis Road right-of-way fronting the site which will supply jet fuel to Vancouver International Airport. Details of the pipeline are shown on the Construction Plan (DWG 1452-AL-A04, dated November 30, 2016) prepared by CCI.

The contemplated fill plan includes a fill setback from Francis Road of 10 to 12 m. The above referenced jet fuel plan indicates that the pipe line will be installed at about the mid point of the existing road, which would result in a pipeline to fill setback of approximately 12 to 14 m. The jet fuel line is to be installed by horizontal directional drilling with entry and exit pits located within Francis Road at the approximate easterly and westerly ends of the development property. At the pit locations the pipe depth will be 1.5 to 4 m. The pipe will be deepest at the midpoint of the property at a depth of approximately 15 m.

While measurable movements of the pipeline are likely, they are expected to be low differentially at less than 1 mm/metre and should not impact the jet fuel line. We also assume that the pipeline designers have considered that properties along the alignment are likely to develop over time and considerations for settlements have been incorporated into their pipe design

Filling much closer to, and at greater heights than this project has been completed successfully by GeoPacific adjacent to the existing jet fuel pipeline on Bridgeport Road, directly east of Sea Island. This work included placement of a preload up to 12 m in height within 2 m of the jet fuel pipe line. That pipe was monitored by Kinder Morgan's geotechnical engineer during the site preparation work with no damage reported, and no remedial repairs required. We expect that a similar monitoring program will have to be developed with the geotechnical engineer for the new pipeline prior to filling.

6.0 CLOSURE

The preceding comments and calculations are based on theoretical consolidation approaches and stress distribution procedures. Some variation between theoretical and actual settlements is likely. Any changes to the fill plan should be provided to GeoPacific for review and update our settlement estimates.

Please do not hesitate to call the undersigned if you should require any clarification or additional details.

For:
GeoPacific Consultants Ltd.

Reviewed by:

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
J. G. CARTER
29777

JAN 1 1 2017

John Carter, M.Eng., P.Eng.
Principal Engineer

Keith Robinson, M.Eng., P.Eng.
Principal Consultant

LEGEND:

- CPT##-# – CONE PENETRATION TEST (CPT) LOCATION
- TH##-# – TEST HOLE (TH) LOCATION

SITE PLAN

*TEST LOCATIONS ARE APPROXIMATE

REFERENCE:

GEOPACIFIC
VANCOUVER KAMLOOPS CALGARY
#215-1200 West 73rd Ave.
Vancouver, B.C. V6P 6G5
P 604.439.0922
F 604.439.9189

DATE:	2016-Jan-1	
DRAWN BY: ED	APPROVED BY: JC	REVIEWED BY: JC
SCALE: AS SHOWN		

CRANBERRY MEADOWS

TERMINUS OF FRANCES ROAD (EAST OF NO. 6 ROAD), RICHMOND, BC

TEST HOLE SITE PLAN

FILE NO.: 13570

DWG. NO.: 13570-01

REVISIONS:
A.
B.
C.

ORIGINAL PAPER SIZE 8.5"x11"

APPENDIX A - TEST HOLE LOGS

Test Hole Log: TH16-01 (CPT16-01)

File: 13570
Project: CRANBERRY MEADOWS
Client: CRANBERRY MEADOWS FARMS LTD
Site Location: TERMINUS OF FRANCES ROAD (EAST OF NO. 6 ROAD),

GEOPACIFIC CONSULTANTS
215 - 1200 West 73rd Avenue, Vancouver, BC, V6P 6G5
Tel: 604-439-0922 Fax:604-439-9189

Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth (m)/Elev (m)	Moisture Content (%)	DCPT (blows per foot) 10 20 30 40	Groundwater / Well	Remarks
0 / 0		Ground Surface					
		Sand and gravel compact SAND and GRAVEL fill, brown, slightly moist	0.0				
1 /		moist after 1.1m					
		Peat firm to soft PEAT, red-brown, moist to wet	1.4	186.1		▽	1.7m estimated water table depth based on CPT pore pressure data
2 /		***Silt*** soft SILT, trace organics, grey, wet	1.8				
				123.3			
3 /		sand lens at 3.2m					
				49.6			
4 /		***Silt*** firm sandy SILT, grey, wet	4.3				
5 /		sandy SILT to silty SAND after 5.3m		36.9			
6 /		End of Borehole	6.1				
7 /							

Logged: ED
Method: Sollid stem auger/CPT
Date: 2016-Jan-6

Datum: Ground elevation
Figure Number: A.01
Page: 1 of 1

Test Hole Log: TH16-02 (CPT16-02)

File: 13570
Project: CRANBERRY MEADOWS
Client: CRANBERRY MEADOWS FARMS LTD
Site Location: TERMINUS OF FRANCES ROAD (EAST OF NO. 6 ROAD),

GEOPACIFIC CONSULTANTS
215 - 1200 West 73rd Avenue, Vancouver, BC, V6P 6G5
Tel: 604-439-0922 Fax:604-439-9189

INFERRED PROFILE

Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth (m)/Elev (m)	Moisture Content (%)	DCPT (blows per foot) 10 20 30 40	Groundwater / Well	Remarks
0 / 0		Ground Surface					
		Sand and gravel compact SAND and fine grained GRAVEL fill, grey, slightly moist	0.0 – 0.3				
3 / 1		***Fill*** compact wood chip fill, brown, moist wet at 0.8m	0.8	189.2			
5 / 2		***Peat*** firm to soft PEAT, red-brown, moist wet after 1.2m		273.8			
7 / 2		***Silt*** soft organics rich SILT, brown, wet	1.8				
8 / 3		***Silt*** soft SILT, trace organics, grey, wet	2.3	101.7			
10 / 3		no organics after 3.2m				▼	3.2m estimated water table depth based on CPT pore pressure data
13 / 4		trace to some fine grained sand after 4.0m		62.0			
15 / 5		***Silt*** firm sandy SILT, grey, wet	4.6	33.4			
20 / 6		End of Borehole	6.1				
23 / 7							
26							

Logged: ED
Method: Sollid stem auger/CPT
Date: 2016-Jan-6

Datum: Ground elevation
Figure Number: A.02
Page: 1 of 1

Test Hole Log: TH16-03 (CPT16-03)

File: 13570
Project: CRANBERRY MEADOWS
Client: CRANBERRY MEADOWS FARMS LTD
Site Location: TERMINUS OF FRANCES ROAD (EAST OF NO. 6 ROAD),

GEOPACIFIC CONSULTANTS
215 - 1200 West 73rd Avenue, Vancouver, BC, V6P 6G5
Tel: 604-439-0922 Fax:604-439-9189

Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth (m)/Elev (m)	Moisture Content (%)	DCPT (blows per foot) 10 20 30 40	Groundwater / Well	Remarks
0 / 0		Ground Surface					
		Sand and gravel compact silty SAND and GRAVEL fill, brown, slightly moist	0.0				
1		***Fill*** compact to loose organcis rich silty SAND fill, dark brown, moist wet after 3.5	0.6	98.5			
2 / 1		***Peat*** soft PEAT, red-brown, wet silty after 2.0m	1.5	203.1		▼	2.1m estimated water table depth based on CPT pore pressure data
3		***Silt*** soft organics rich SILT, grey-brown, wet	2.3				
4		***Silt*** soft SILT, trace to some organics, grey, moist to wet	2.6	66.9			
5 / 2							
6				77.1			
7		***Silt*** firm sandy SILT, grey, wet	4.3				
8		***Sand*** compact silty SAND, grey, wet	4.6	34.7			
9 / 3		***Sand*** compact SAND, grey, wet	5.2				
10		End of Borehole	6.1				
11 / 4							
12							
13							
14 / 5							
15							
16							
17 / 6							
18							
19							
20 / 7							
21							
22							
23							
24							
25							
26							

Logged: ED
Method: Sollid stem auger/CPT
Date: 2016-Jan-6

Datum: Ground elevation
Figure Number: A.03
Page: 1 of 1

Test Hole Log: TH16-04 (CPT16-04)

File: 13570
Project: CRANBERRY MEADOWS
Client: CRANBERRY MEADOWS FARMS LTD
Site Location: TERMINUS OF FRANCES ROAD (EAST OF NO. 6 ROAD),

GEOPACIFIC CONSULTANTS
215 - 1200 West 73rd Avenue, Vancouver, BC, V6P 6G5
Tel: 604-439-0922 Fax:604-439-9189

INFERRED PROFILE

Depth (ft / m)	Symbol	SOIL DESCRIPTION	Depth (m)/Elev (m)	Moisture Content (%)	DCPT (blows per foot) 10 20 30 40	Groundwater / Well	Remarks
0 / 0		Ground Surface					
		Sand and gravel compact to dense silty SAND and GRAVEL fill, grey, slightly moist	0.0				
4 / 1		***Peat*** firm to soft PEAT, red-brown, moist	1.2	166.5			
7 / 2		***Silt*** soft organics rich SILT, peat like organics, brown, wet	2.1	259.9		▼	1.9m estimated water table depth based on CPT pore pressure data
			2.4				
10 / 3		***Silt*** soft SILT, some organics, grey-brown, wet trace organics after 2.7m		51.2			
13 / 4				78.5			
		trace fine grained SAND after 4.6m					
18 / 5				46.4			
20 / 6		End of Borehole	6.1				
23 / 7							
26							

Logged: ED
Method: Sollid stem auger/CPT
Date: 2016-Jan-6

Datum: Ground elevation
Figure Number: A.04
Page: 1 of 1

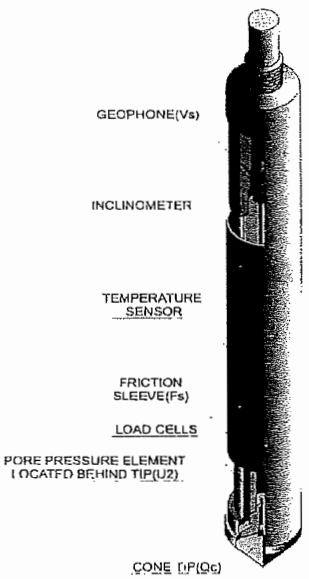
APPENDIX B - ELECTRONIC CONE PENETRATION RESULTS

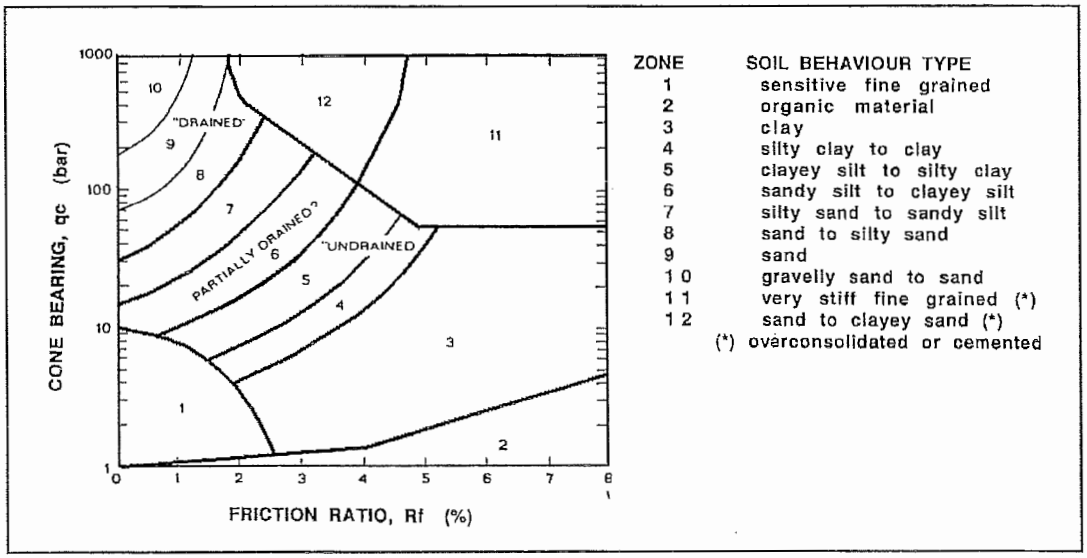
The system used is owned and operated by GeoPacific and employs a 35.7 mm diameter cone that records tip resistance, sleeve friction, dynamic pore pressure, inclination and temperature at 5 cm intervals on a digital computer system. The system is a Hogentogler electronic cone system and the cone used was a 10 ton cone with pore pressure element located behind the tip and in front of the sleeve as shown on the adjacent figure.

In addition to the capabilities described above, the cone can be stopped at specified depths and dissipation tests carried out. These dissipation tests can be used to determine the groundwater pressures at the specified depth. This is very useful for identifying artesian pressures within specific layers below the ground surface.

Interpretation of the cone penetration test results are carried out by computer using the interpretation chart presented below by Robertson[1]. Raw data collected by the field computer includes tip resistance, sleeve friction and pore pressure. The tip resistance is corrected for water pressure and the friction ratio is calculated as the ratio of the sleeve friction on the side of the cone to the corrected tip resistance expressed as a percent. These two parameters are used to determine the soil behaviour type as shown in the chart below. The interpreted soil type may be different from other classification systems such as the Unified Soil Classification that is based upon grain size and plasticity.

Electronic Cone Penetrometer



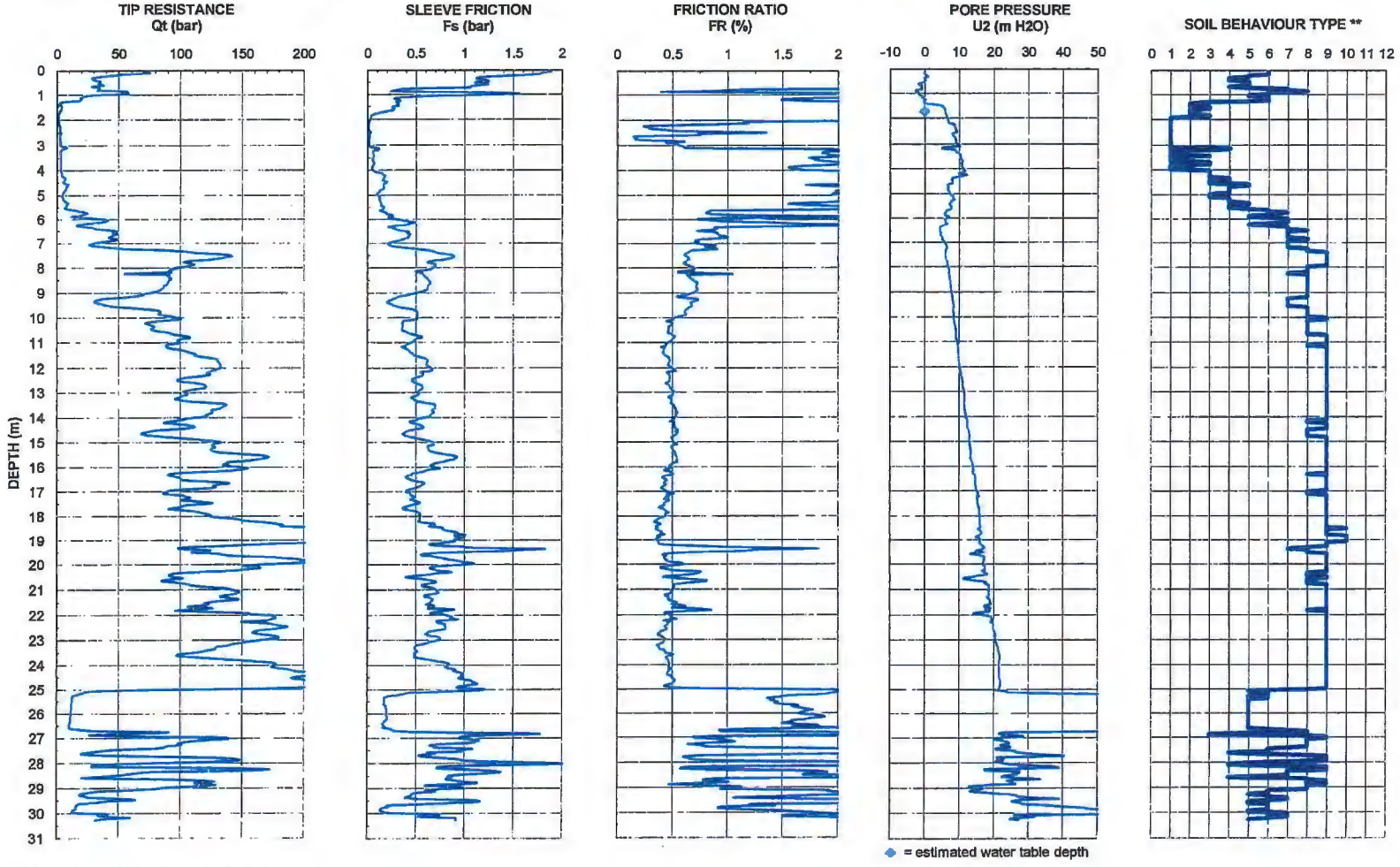


ZONE	SOIL BEHAVIOUR TYPE
1	sensitive fine grained
2	organic material
3	clay
4	silty clay to clay
5	clayey silt to silty clay
6	sandy silt to clayey silt
7	silty sand to sandy silt
8	sand to silty sand
9	sand
10	gravelly sand to sand
11	very stiff fine grained (*)
12	sand to clayey sand (*)

(*) overconsolidated or cemented

1 Robertson, P.K., 1990, "Soil Classification using the cone penetration test", 1990 Canadian Geotechnical Colloquium, Canadian Geotechnical Journal, Vol. 27, No. 1, 1990

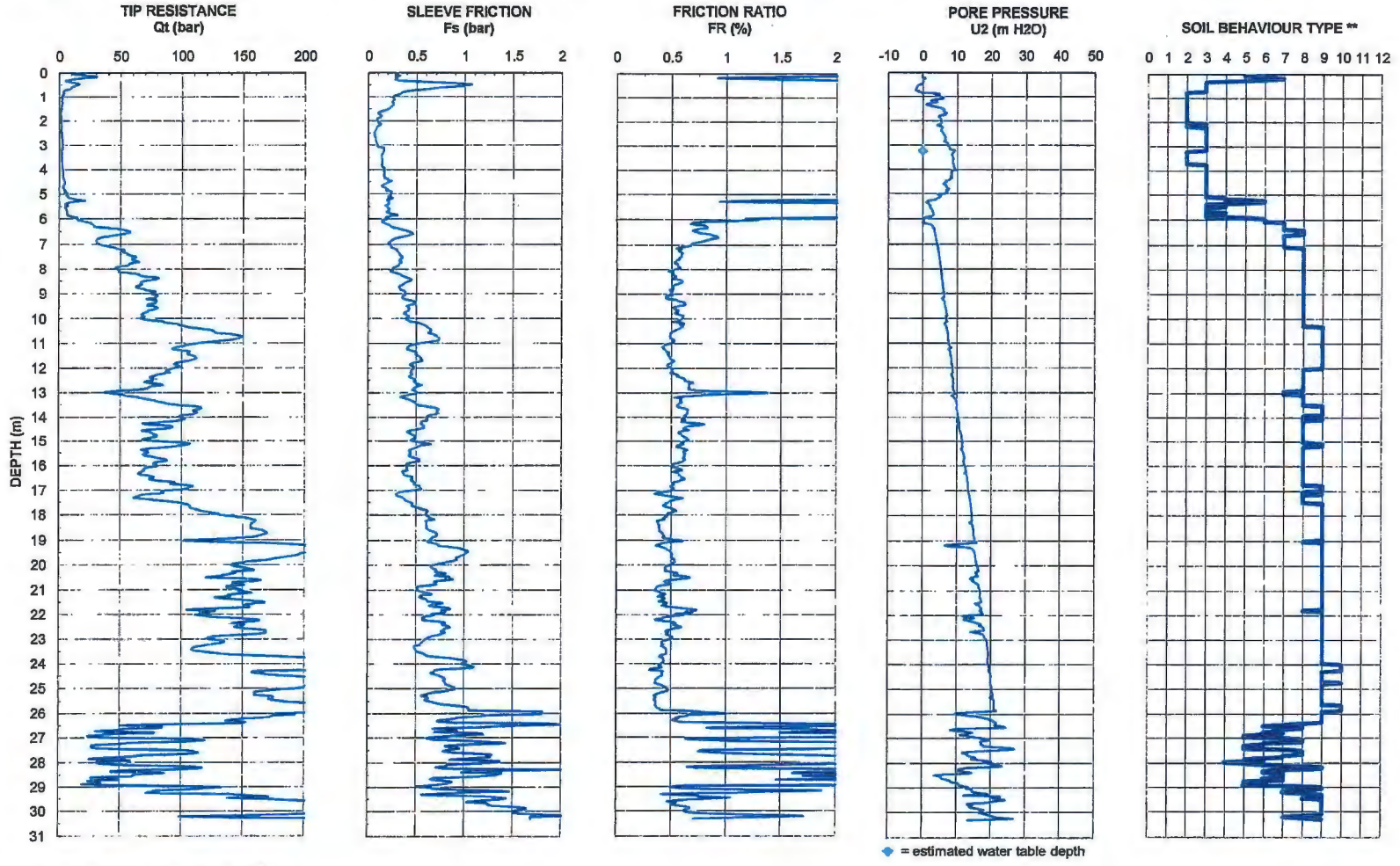
GEOPACIFIC CONSULTANTS	2016-Jan-6	CRANBERRY MEADOWS FARMS LTD	GeoPacific Project #: 13570
	Sounding: CPT16-01	TERMINUS OF FRANCIS ROAD (EAST OF NO. 6 ROAD), RICHMOND	Figure: B.01



** Based on Robertson et. al 1986

1 Sensitive Fine Grained
2 Organic Material
3 Clay
4 Silty Clay to Clay
5 Clayey Silt to Silty Clay
6 Sandy Silt to Clayey Silt
7 Silty Sand to Sandy Silt
8 Sand to Silty Sand
9 Sand
10 Gravelly Sand to Sand
11 Very Stiff Fine Grained
12 Sand to Clayey Sand

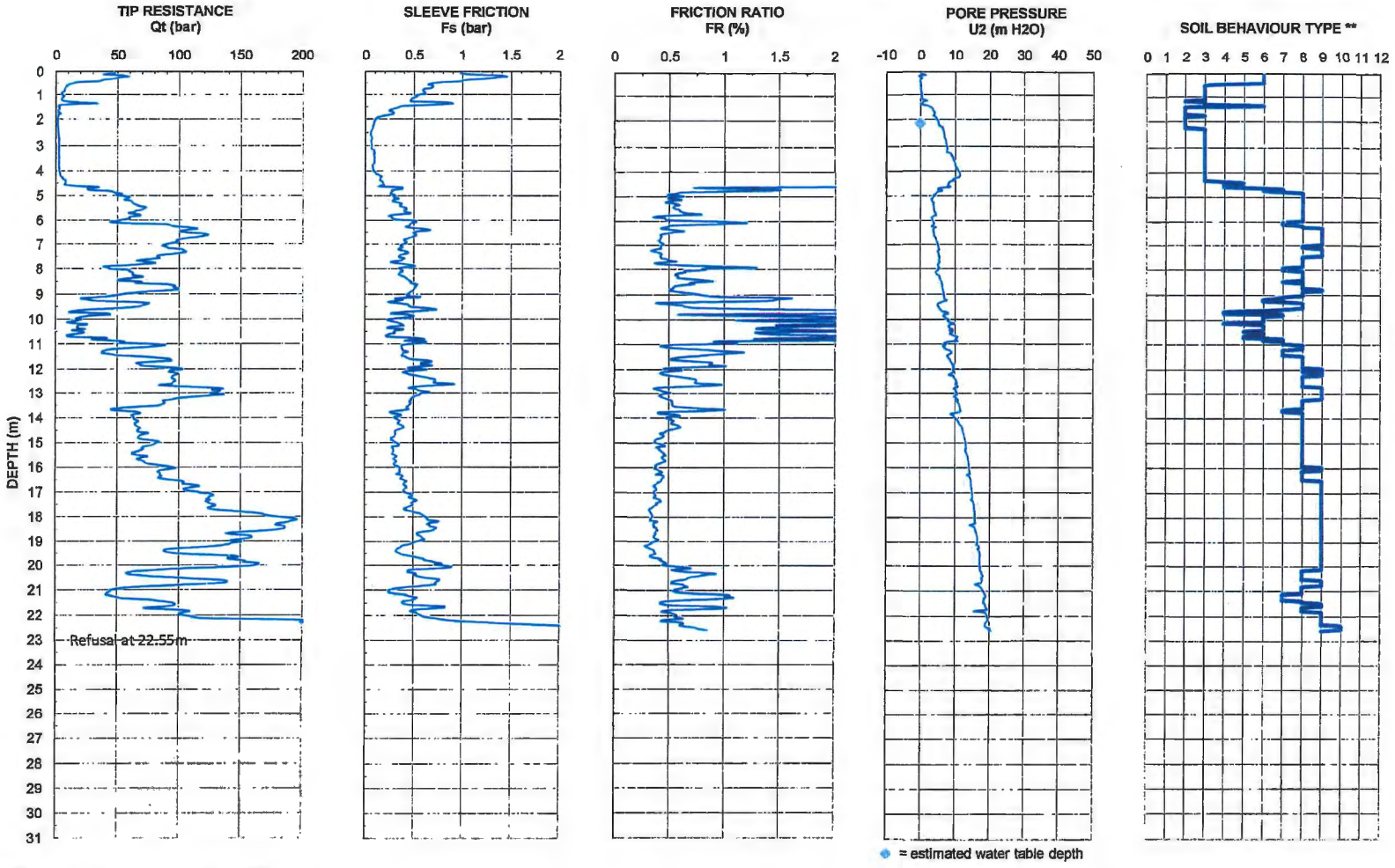
GEOPACIFIC CONSULTANTS	2016-Jan-6	CRANBERRY MEADOWS FARMS LTD	GeoPacific Project #: 13570
	Sounding: CPT16-02	TERMINUS OF FRANCIS ROAD (EAST OF NO. 6 ROAD), RICHMOND	Figure: B.02



** Based on Robertson et. al 1986

1 Sensitive Fine Grained
2 Organic Material
3 Clay
4 Silty Clay to Clay
5 Clayey Silt to Silty Clay
6 Sandy Silt to Clayey Silt
7 Silty Sand to Sandy Silt
8 Sand to Silty Sand
9 Sand
10 Gravelly Sand to Sand
11 Very Stiff Fine Grained
12 Sand to Clayey Sand

GEOPACIFIC CONSULTANTS	2016-Jan-6	CRANBERRY MEADOWS FARMS LTD	GeoPacific Project #: 13570
	Sounding: CPT16-03	TERMINUS OF FRANCIS ROAD (EAST OF NO. 6 ROAD), RICHMOND	Figure: B.03

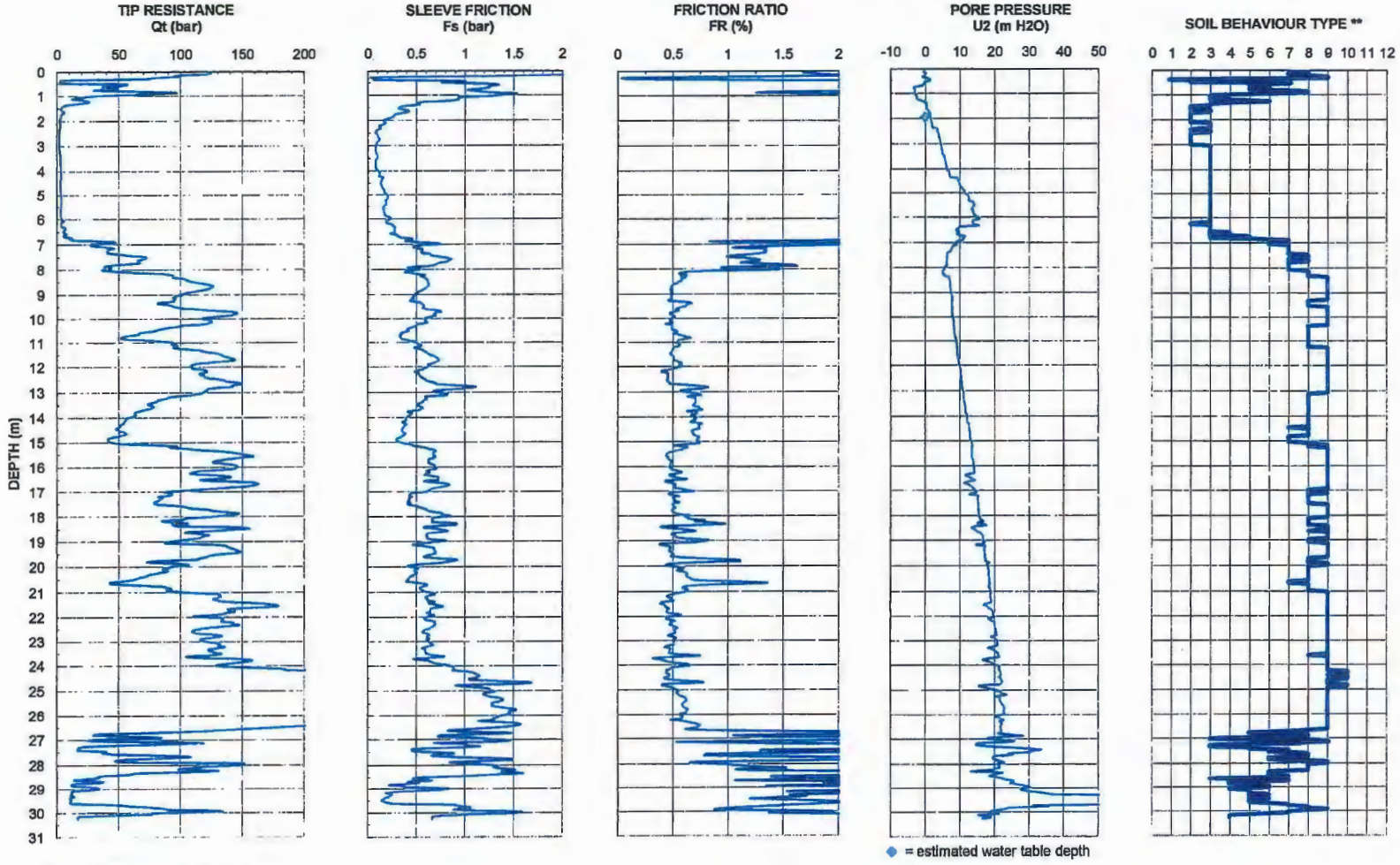


** Based on Robertson et. al 1986

1 Sensitive Fine Grained
2 Organic Material
3 Clay
4 Silty Clay to Clay
5 Clayey Silt to Silty Clay
6 Sandy Silt to Clayey Silt
7 Silty Sand to Sandy Silt
8 Sand to Silty Sand
9 Sand
10 Gravelly Sand to Sand
11 Very Stiff Fine Grained
12 Sand to Clayey Sand

GP - 107

GEOPACIFIC CONSULTANTS	2016-Jan-6	CRANBERRY MEADOWS FARMS LTD	GeoPacific Project #: 13570
	Sounding: CPT16-04	TERMINUS OF FRANCIS ROAD (EAST OF NO. 6 ROAD), RICHMOND	Figure: B.04



** Based on Robertson et. al 1986

1 Sensitive Fine Grained
2 Organic Material
3 Clay
4 Silty Clay to Clay
5 Clayey Silt to Silty Clay
6 Sandy Silt to Clayey Silt
7 Silty Sand to Sandy Silt
8 Sand to Silty Sand
9 Sand
10 Gravelly Sand to Sand
11 Very Stiff Fine Grained
12 Sand to Clayey Sand

APPENDIX C - INTERPRETED PARAMETERS

The following charts plot the Standard Penetration Test (SPT) values and the undrained strength of fine grained soils based upon generally accepted correlations. The methods of correlation are presented below.

STANDARD PENETRATION TEST CORRELATION

The Standard Penetration Test $N_{1(60)}$ value is related to the cone tip resistance through a Qc/N ratio that depends upon the mean grain size of the soil particles. The soil type is determined from the interpretation described in Appendix B and the data of Table C.1 below is used to calculate the value of $N_{(60)}$.

Table C.1. Tablulated $Qc/N_{1(60)}$ Ratios for Interpreted Soil Types

Soil Type	Qc/N Ratio
Organic soil - Peat	1.0
Sensitive Fine Grained	2.0
Clay	1.0
Silty Clay to Clay	1.5
Clayey Silt to Silty Clay	2.0
Silt	2.5
Silty Sand to Sandy Silt	3.0
Clean Sand to Silty Sand	4.0
Clean Sand	5.0
Gravelly Sand to Sand	6.0
Very Stiff Fine Grained	1.0
Sand to Clayey Sand	2.0

The $Qc/N_{1(60)}$ ratio is based upon the published work of Robertson (1985)[2]. The values of N are corrected for overburden pressure in accordance with the correction suggested by Liao and Whitman using a factor of 0.5. Where the correction is of the form:

$$N_1 = \sigma^{0.5} * N$$

All calculations are carried out by computer using the software program CPTint.exe developed by UBC Civil Engineering Department. The results of the interpretation are presented on the following Figures.

UNDRAINED SHEAR STRENGTH CORRELATION

It is generally accepted that there is a correlation between undrained shear strength of clay and the tip resistance as determined from the cone penetration testing. Generally the correlation is of the form:

$$S_u = \frac{(q_c - \sigma_v)}{N_k}$$

where q_c = cone tip resistance, σ = in situ total stress, N_k = cone constant

The undrained shear strength of the clay has been calculated using the cone tip resistance and an N_k factor of 12.5. All calculations have been carried out automatically using the program CPTint.exe. The results are presented on the Figures following.

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2 Robertson, P.K., 1985, "In-Situ Testing and Its Application to Foundation Engineering", 1985 Canadian Geotechnical Colloquium, Canadian Geotechnical Journal, Vol. 23, No. 23, 1986

APPENDIX C - OVER CONSOLIDATION RATIO ANALYSIS

The over consolidation ratio (OCR) is defined as the ratio between the maximum past vertical pressure on the soil versus the current in-situ vertical pressure. The maximum past vertical pressure is typically caused by the presence of excess overburden which is removed by either natural or man-made reasons. Soil ageing and other chemical precipitation affects can also cause a soil to behave as if it has a higher maximum past pressure, which is sometimes described as pseudo-overconsolidation.

Research by Schmertmann (1974) showed the following equation reasonably approximates the OCR of medium plastic to clayey soils:

$$OCR = \left(\frac{\left(\frac{Su / p'oc}{Su / p'nc} \right)^{5/3} + 0.82}{1.82} \right)$$

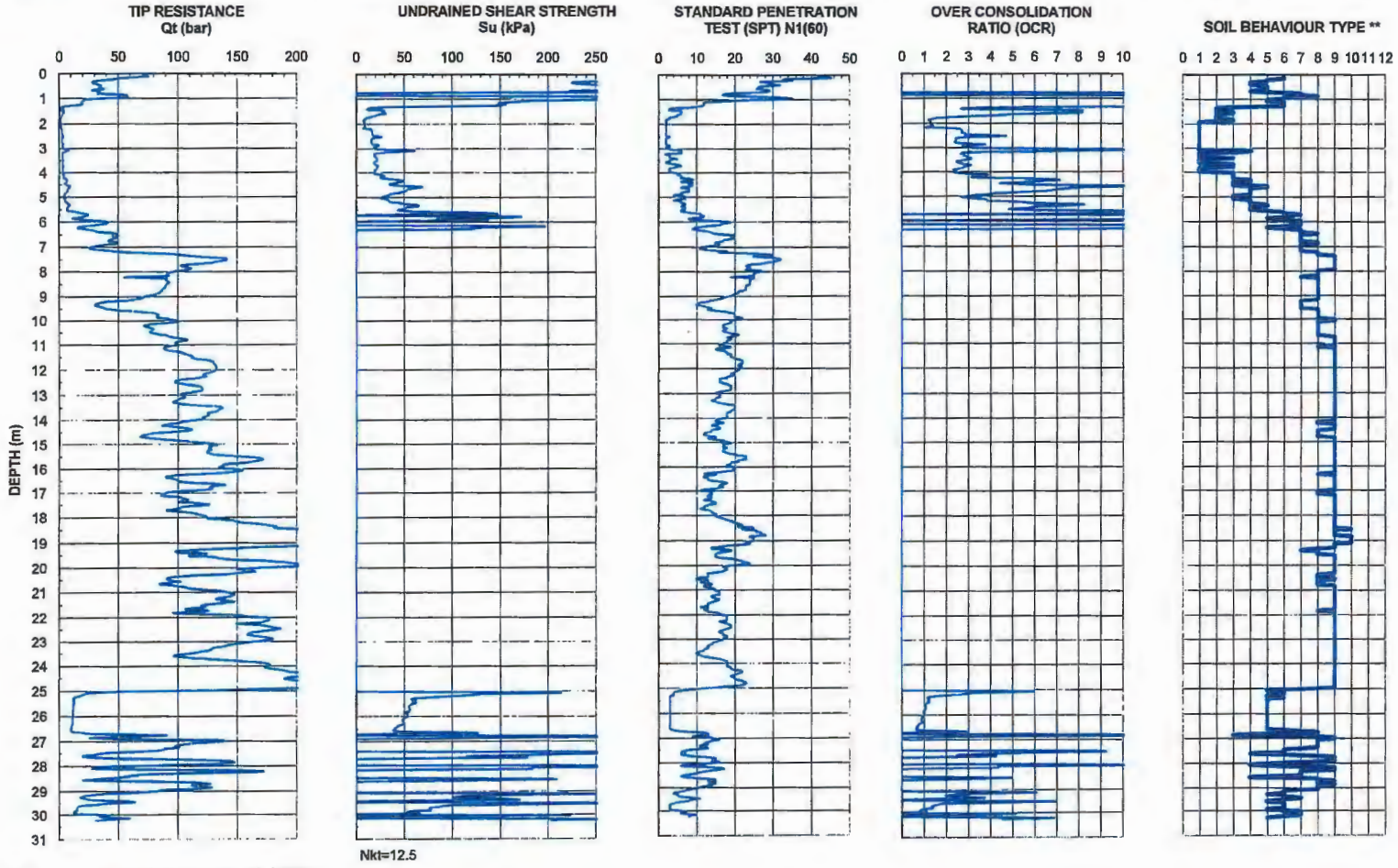
Su/p'oc = The undrained shear strength to effective stress ratio of the over consolidated soil

Su/p'nc = The undrained shear strength to effective stress ratio of a normally consolidated soil (OCR = 1). Typically = ~0.2

Soils which are subject to loads less than the maximum past pressure of the soil are typically subject to relatively small elastic settlements. Loads which exceed the maximum past pressure on the soil typically cause consolidation which is the gradual settlement of the ground as a result of expulsion of water from the pores of the soil. The rate of settlement and the time to complete consolidation is a function of the permeability of the soil.

The Schmertman equation has been employed to estimate the OCR of the soils with depth employing the CPT data provided in Appendix B and C.

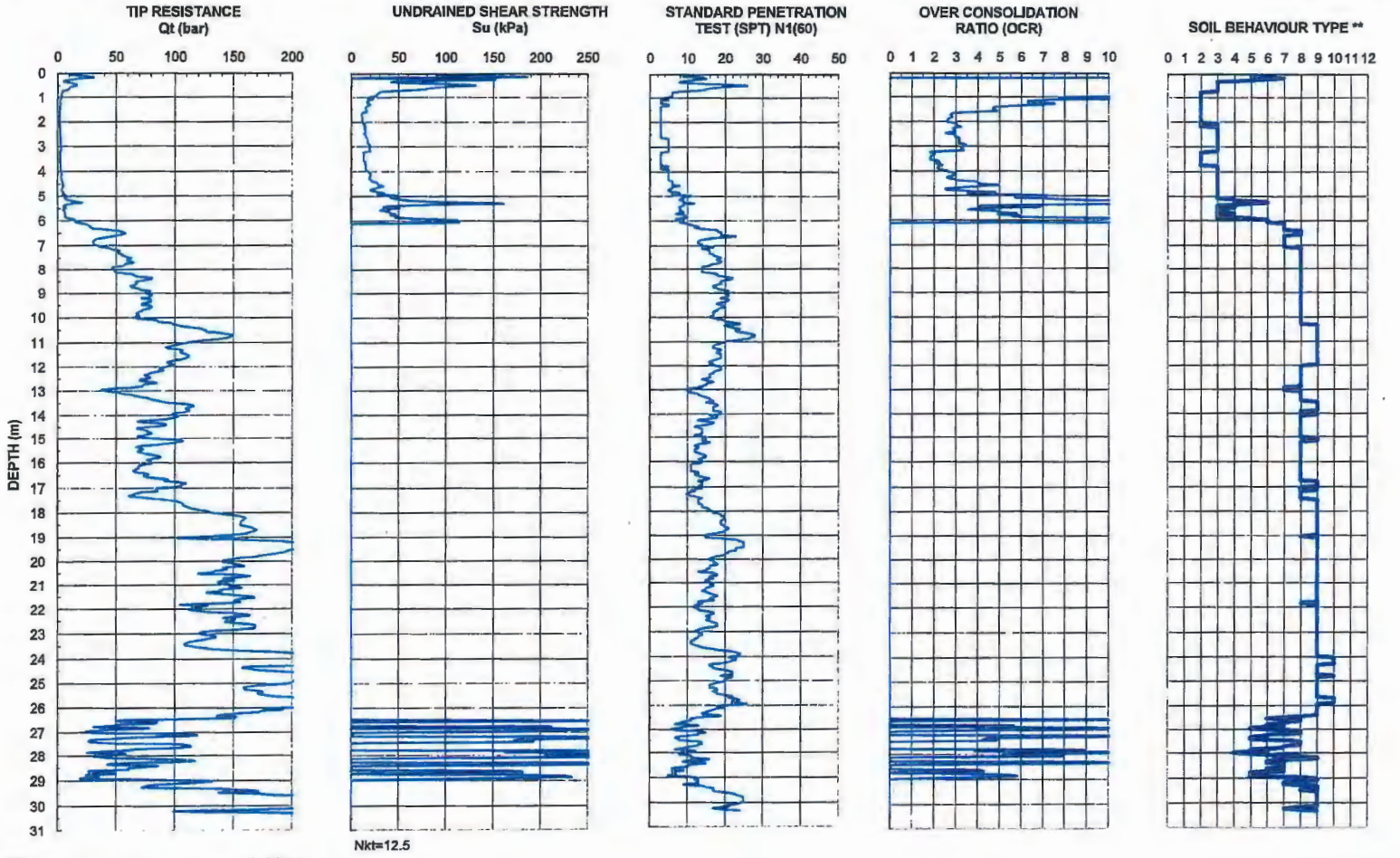
GEOPACIFIC CONSULTANTS	2016-Jan-6	CRANBERRY MEADOWS FARMS LTD	GeoPacific Project #: 13570
	Sounding: CPT16-01	TERMINUS OF FRANCIS ROAD (EAST OF NO. 6 ROAD), RICHMOND	Figure: C.01



** Based on Robertson et. al 1986

1 Sensitive Fine Grained
2 Organic Material
3 Clay
4 Silty Clay to Clay
5 Clayey Silt to Silty Clay
6 Sandy Silt to Clayey Silt
7 Silty Sand to Sandy Silt
8 Sand to Silty Sand
9 Sand
10 Gravelly Sand to Sand
11 Very Stiff Fine Grained
12 Sand to Clayey Sand

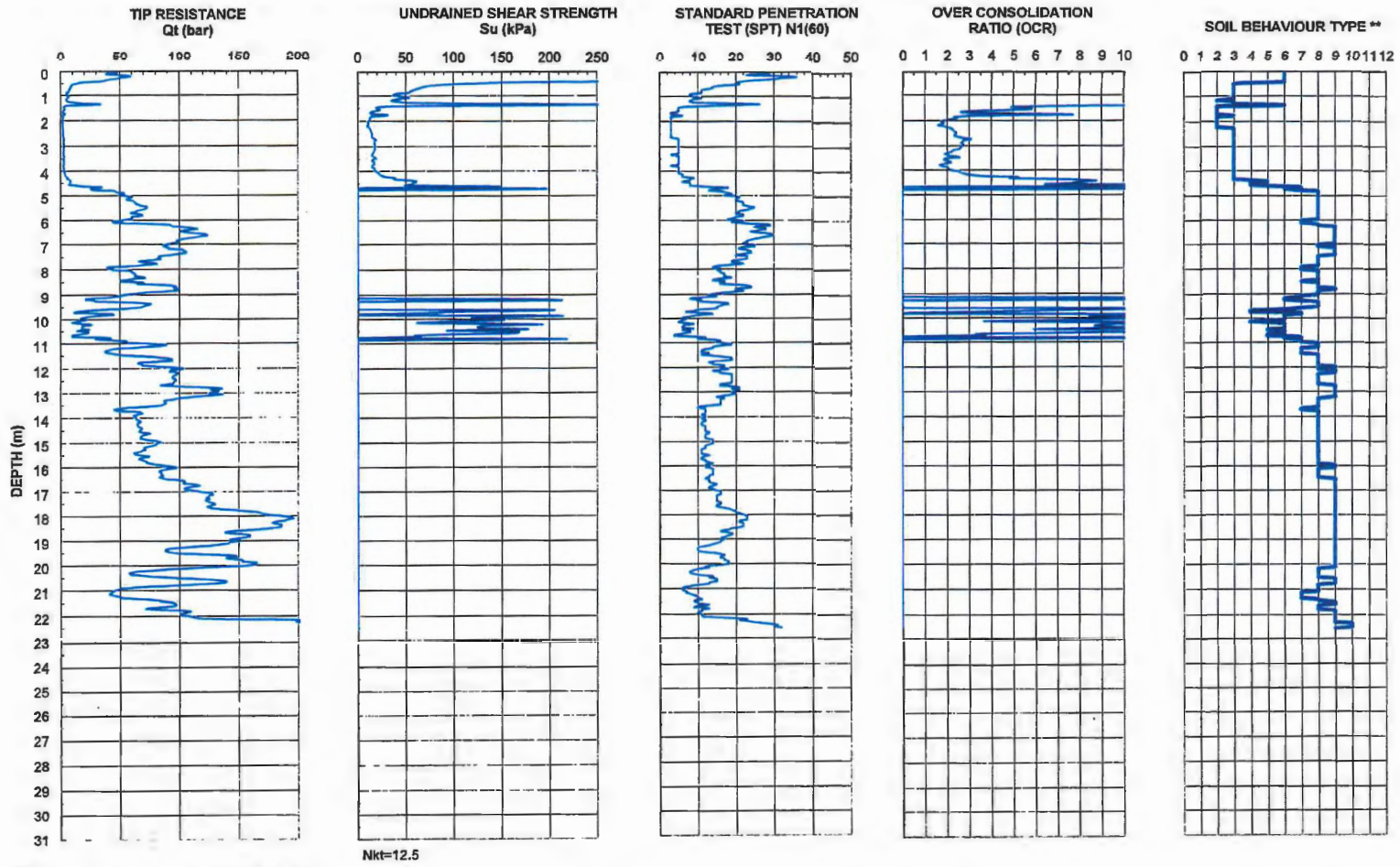
GEOPACIFIC CONSULTANTS	2016-Jan-6	CRANBERRY MEADOWS FARMS LTD	GeoPacific Project #: 13570
	Sounding: CPT16-02	TERMINUS OF FRANCIS ROAD (EAST OF NO. 6 ROAD), RICHMOND	Figure: C.02



** Based on Robertson et. al 1986

1 Sensitive Fine Grained
2 Organic Material
3 Clay
4 Silty Clay to Clay
5 Clayey Silt to Silty Clay
6 Sandy Silt to Clayey Silt
7 Silty Sand to Sandy Silt
8 Sand to Silty Sand
9 Sand
10 Gravelly Sand to Sand
11 Very Stiff Fine Grained
12 Sand to Clayey Sand

GEOPACIFIC CONSULTANTS	2016-Jan-6	CRANBERRY MEADOWS FARMS LTD	GeoPacific Project #: 13570
	Sounding: CPT16-03	TERMINUS OF FRANCIS ROAD (EAST OF NO. 6 ROAD), RICHMOND	Figure: C.03



** Based on Robertson et. al 1986

1 Sensitive Fine Grained
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6 Sandy Silt to Clayey Silt
7 Silty Sand to Sandy Silt
8 Sand to Silty Sand
9 Sand
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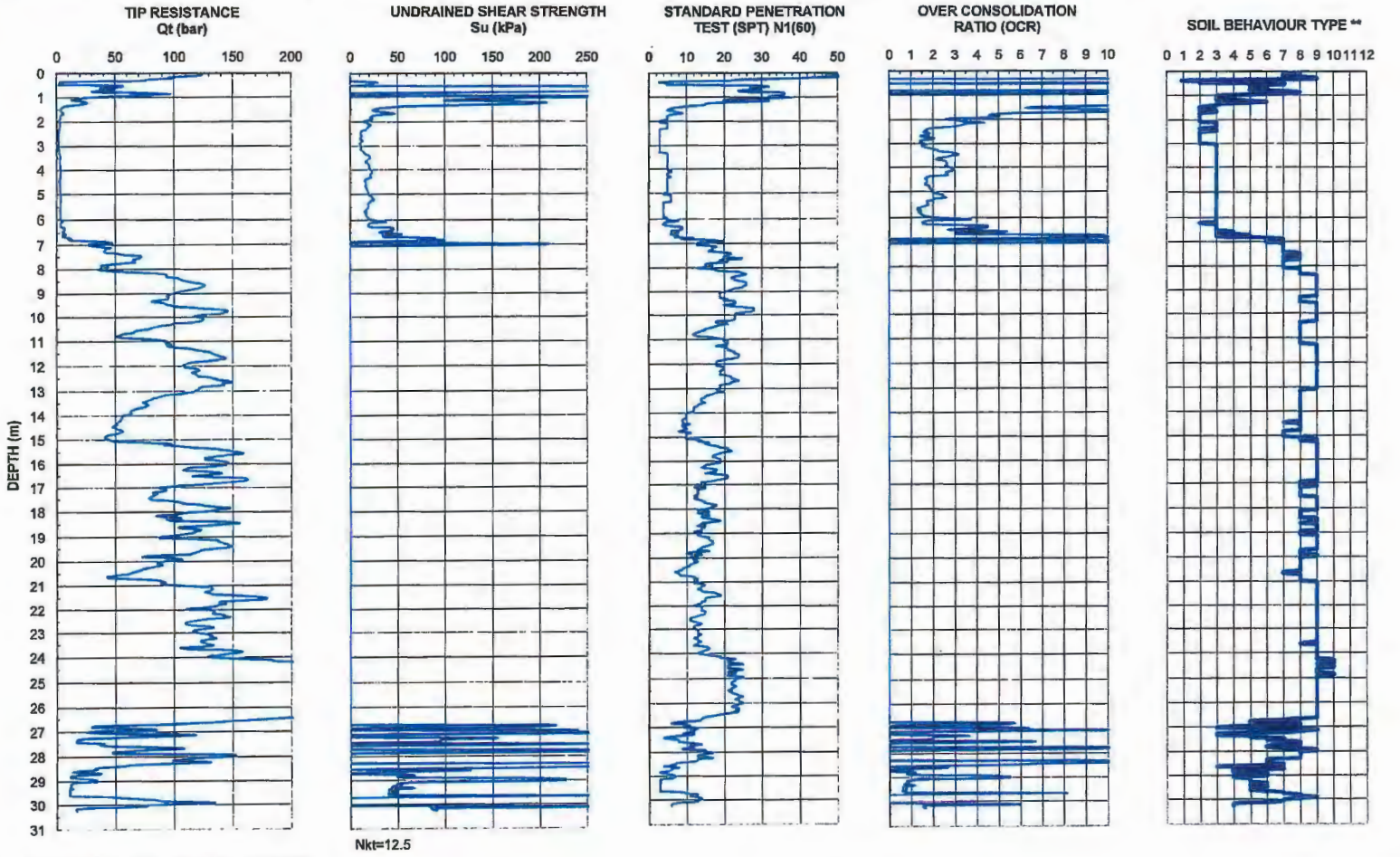
11 Very Stiff Fine Grained
12 Sand to Clayey Sand

GEOPACIFIC CONSULTANTS	2016-Jan-6	CRANBERRY MEADOWS FARMS LTD	GeoPacific Project #: 13570
	Sounding: CPT16-04	TERMINUS OF FRANCIS ROAD (EAST OF NO. 6 ROAD), RICHMOND	Figure: C.04



** Based on Robertson et. al 1986

1 Sensitive Fine Grained
2 Organic Material
3 Clay
4 Silty Clay to Clay
5 Clayey Silt to Silty Clay
6 Sandy Silt to Clayey Silt
7 Silty Sand to Sandy Silt
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12 Sand to Clayey Sand