City of Richmond

# Report to Committee

| | | | |
|---|---|---|---|
| **To:** | Planning Committee | **Date:** | December 3, 2019 |
| **From:** | Barry Konkin<br>Director, Policy Planning | **File:** | AG 19-855723<br>AG 19-855800<br>AG 19-855911 |

**Re:** **Agricultural Land Reserve Exclusion Application by JNA Holdings Inc. at 14540 Burrows Road;**
**Agricultural Land Reserve Exclusion Application by Karl, Lydia & Ulrich Wacker at 14680 Burrows Road; and**
**Agricultural Land Reserve Exclusion Application by Shorewood Developments Ltd. at 14920 Burrows Road**

## Staff Recommendation

1. That authorization for JNA Holdings Inc. to forward an Exclusion Application to the Agricultural Land Commission for exclusion of 14540 Burrows Road from the Agricultural Land Reserve be denied.

2. That authorization for Karl, Lydia & Ulrich Wacker to forward an Exclusion Application to the Agricultural Land Commission for exclusion of 14680 Burrows Road from the Agricultural Land Reserve be denied.

3. That authorization for Shorewood Developments Ltd. to forward an Exclusion Application to the Agricultural Land Commission for exclusion of 14920 Burrows Road from the Agricultural Land Reserve be denied.

Barry Konkin
Director, Policy Planning

BK:sds
Att. 5

| REPORT CONCURRENCE | | |
|---|---|---|
| ROUTED TO: | CONCURRENCE | CONCURRENCE OF GENERAL MANAGER |
| Development Applications | ☑ | |

## Staff Report

### Origin

JNA Holdings Inc., Karl, Lydia & Ulrich Wacker, & Shorewood Developments Ltd. have applied to exclude three properties located at 14540, 14680 & 14920 Burrows Road from the Agricultural Land Reserve (ALR). A location map and aerial photograph are provided in Attachment 1. The properties are located in the ALR, zoned "Agriculture (AG1)", designated "Agriculture (AGR)" in the Official Community Plan (OCP) and all three properties contain Environmentally Sensitive Area (ESA). The applicants have submitted individual applications for each property and are not proposing an end use at this time. 14540 and 14920 Burrows Road are currently vacant and 14680 Burrows Road is currently occupied by a single-family dwelling. There are currently no active agricultural uses on any of the three subject properties.

In 1986, the south side of Burrows Road was considered by Council and the Agricultural Land Commission (ALC) for ALR exclusion as part of a block exclusion application by the City. However, exclusion of the south side of Burrows Road from the ALR was denied by the ALC. Council subsequently changed the area's OCP designation to Agriculture. Since then, the City has repeatedly not supported the property owners' request to exclude the properties from the ALR, as it is contrary to the City's OCP's agricultural designation and related policies. More information regarding historical proposals on the subject properties is provided in the "Background" section of this report.

### Findings of Fact

A Development Application Data Sheet providing details about the development proposal is attached (Attachment 2).

### Surrounding Development

To the North: Across Burrows Road, light industrial buildings with surface parking and loading on properties zoned "Light Industrial (IL)".

To the South: An agricultural operation on an approximately 40 acre (16 ha) lot zoned "Agriculture (AG1)".

To the East: Across Savage Road unopened road allowance, agriculture operations on lots zoned "Agriculture (AG1)".

To the West: Single-family dwelling on a lot zoned "Agriculture (AG1)", fronting Burrows Road.

**Related Policies & Studies**

Official Community Plan

The Official Community Plan (OCP) land use designation for the subject is "Agriculture (AGR)", which comprises of those areas of the City where the principal use is agriculture and food production, but may include other land uses as permitted under the *Agricultural Land Commission Act* (ALCA) (i.e. farm uses).

The proposed exclusion applications are inconsistent with the land use designation and are inconsistent with applicable policies in the OCP:

| OCP Policy (Section 7.0) | Subject Applications |
|---|---|
| Maintain the existing ALR boundary and do not support a loss of ALR land unless there is a substantial net benefit to agriculture and the agricultural community is consulted. | • The proposal is to remove the subject properties from the ALR.<br>• Removal of the subject properties from the ALR would result in a net loss of total ALR land.<br>• No agriculture is proposed and there is no net benefit to agriculture as part of this proposal. |
| Support the 2040 Metro Vancouver Regional Growth Strategy which includes agricultural designations and policies for protection of agricultural land. | • The subject properties are designated "Agricultural" in the 2040 Metro Vancouver Regional Growth Strategy.<br>• The proposal is not consistent with the regional land use designation and does not support agricultural viability.<br>• Exclusion from the ALR for urban (non-agricultural) uses would require an amendment to the land use designation. |
| Continue to encourage the use of ALR land for farming and discourage non-farm uses. | • The purpose of the application is to remove the properties from the ALR in order to pursue land uses other than agriculture (i.e. non-farm uses). |

Agricultural Viability Strategy

The Agricultural Viability Strategy (AVS), adopted by Council in 2003, establishes a long-range strategy for improving viability of farmland within the City. The objectives of the AVS include supporting and maintaining the stability and integrity of the ALR boundary, and not supporting a change to the ALR boundary or a loss of ALR land unless there is a substantial net benefit to agriculture. The AVS is currently in the process of being updated, but the principle of maintaining the ALR boundary is a long-standing City policy. Staff note that there are no apparent benefits to agriculture as a result of these applications.

Food Security and Agricultural Advisory Committee

The proposal was reviewed by the Food Security and Agricultural Advisory Committee (FSAAC) at the meeting on October 24, 2019. The Committee acknowledged the existing

condition of the properties presents challenges for an agricultural operation (specifically drainage issues); however, the subject exclusion applications may set a precedent for other small parcels in the ALR. A motion to support the application to proceed to Council was made, but it was defeated. No formal resolution was provided from FSAAC. An excerpt from the October 24, 2019 FSAAC meeting minutes is provided in Attachment 3.

Bill 15 – Agricultural Land Commission Amendment Act

Currently, the *Agricultural Land Commission Act* (ALCA) allows a property owner to make an exclusion application directly to the ALC and City. As per Bill 15, which received Royal Assent on May 30, 2019, individual landowners will no longer be able to submit exclusion applications to the ALC. The changes as per Bill 15 do not have force and effect until the enabling ALR Regulations are adopted (Provincial Government is currently working on these regulations). However, it is anticipated that the changes will include grandfathering provisions for in-stream applications.

### Public Consultation

As per the ALR General Regulation, the applicants were required to complete the following in association with the submission of the exclusion applications to the Agricultural Land Commission (ALC):

- Advertise the application on two separate occasions in a newspaper in general circulation in the municipality where the property under application is located;
- Serve a signed copy of notice to all registered owners of land in the ALR that share a common boundary with the property, including owners of ALR property separated by a public road; and
- Installation of exclusion application signage.

The applicant has satisfied these requirements as per the ALR General Regulation.

Staff have received one piece of public correspondence in objection to the proposal and with the following concerns (Attachment 4):

- Removal of the lands from the ALR will impact the market for industrial land;
- The proposal could set a precedent for other properties in the ALR to apply for exclusion; and
- Land in Richmond is well-suited for agriculture.

### Background

In 1986, a block exclusion application was made to the ALC by the City to remove seven separate areas from the ALR, including all lots on the south side of Burrows Road, as part of Richmond's first OCP. Five out of the seven areas for ALR exclusion were approved and two areas were denied (south side of Burrows Road and northwest corner of No. 6 Road & Steveston Highway). The northwest corner of No. 6 Road & Steveston Highway was later approved for ALR exclusion in 1988. The City subsequently changed the OCP designation of the Burrows

Road area from "Non-Residential" to "Agriculture". Since then, the City has repeatedly not supported the request for exclusion of the properties from the ALR, as it is contrary to the City's OCP's agricultural designation and related policies.

The property owners on the south side of Burrows Road submitted an exclusion application in 1988 and again in 1997. The 1988 application (LCA 88-000438) was withdrawn by the applicants prior to moving forward to Council for consideration. The 1997 application (AG 97-117852) was to exclude the properties from the ALR in order to pursue industrial uses, which was denied by Council on October 27, 1997, as the proposal was not consistent with the OCP's agricultural objectives and related policies. Both applications did not proceed to the ALC for consideration.

Since 2010, the property owner of 14680 Burrows Road has claimed drainage issues resulting in the settling of and damage to the house on the subject property, with the construction and operation of the private cranberry berms that were built for an adjacent cranberry farm at 2580 No. 6 Road. The City does not issue any permits relating to private berms, provided no additional soil is brought onto the property. In 2017, the property owner of 14680 Burrows Road also claimed the damage was a result of the City's negligence via a letter to Mayor and Council, dated October 23, 2017. Staff from the City's Law, Engineering, Policy Planning, Transportation and Community Bylaws Departments reviewed all available information and collectively concluded that the City is not responsible for the drainage issues identified in the letter.

## Analysis

### Subject Applications

The purpose of the current subject applications is to exclude 14540, 14680 & 14920 Burrows Road from the ALR. The proposal does not include the other four lots on the south side of Burrows Road (14400, 14300 Burrows Road and 2200 & 2280 No. 6 Road), located to the west of the subject properties. The subject properties are approximately 4.5 acres (1.8 hectares) each, for a total area of approximately 13.76 acres (5.57 hectares). The properties are zoned "Agriculture (AG1)" and designated "Agriculture (AGR)" in the OCP. The difference between the subject exclusion application and previous exclusion applications by the property owners is that this proposal does not specifically request an intended use; however, the intention is to eventually pursue urban uses (non-farm uses).

### Technical Reports

The three applications include a number of technical reports (summarized below and provided in Attachment 5) regarding the subject properties:

- Soil and land capability assessment, dated October 31, 2016, provides a review of all existing soil, agricultural capability mapping and detailed site observations, including the following information:
    - Soils are poorly to very poorly drained with water tables at or near the surface for most of the winter and into early spring;

- The unimproved agricultural capability for the majority of the area is Class 4W to 4WD (Class 1 is the highest class and Class 7 is the lowest). The subclass letters attached to the class indicate restrictions, in this case excess water (W) and undesirable soil structure (D);
- If the land was properly drained, the land capability could be improved to Class 3;
- Potential options to improve agricultural capability include (a) improved drainage using a pumping station and drainage ditch, (b) stripping existing topsoil and filling the site with approximately 1.5 m of fill and re-spreading the topsoil, and (c) fill the site enough to build a greenhouse facility constructed above the winter water table (staff note that a greenhouse with concrete is not permitted without a rezoning application);
- Properties are still permitted to construct a single-family dwelling as per Zoning Bylaw 8500 and ALR Regulation, which allows filling the site (maximum 0.1 hectare area) to meet the flood construction level (3.0 m GSC).

- Assessment of environmentally sensitive areas, dated October 11, 2016 provides information on existing ecosystem conditions through a vegetation survey, wildlife habitat survey, and review of endangered species, including the following information:
  - The subject properties are designated Environmentally Sensitive Area (ESA) as ESA type OLSH (old fields and shrublands);
  - Three vegetative communities exist on the subject properties, including old field habitat/mixed grass, old orchard (with Himalayan blackberries) and hedgerow;
  - The subject properties are dominated by reed canary grass;
  - Old field habitats are known to provided unique and valuable foraging and nesting habitats to a variety of species, including raccoons, coyotes, eastern cotton tail, songbirds and raptors;
  - No species on the federally or provincially listed wildlife species were observed;
  - Staff note that agricultural activities are exempt from ESA regulations (with the submission of an acceptable farm plan). The ESA would need to be addressed as part of any non-agricultural development (i.e. ESA Development Permit).
- Preliminary Hydrology Assessment, dated November 24, 2016 evaluates the hydrogeology and the drainage characteristics of the site, including the following information:
  - The ground surface elevation at the site occurs generally between 0.8 and 1.0 m geodetic. Overall the ground surface is generally flat with no discernible slope;
  - A drainage ditch is present to the immediate north of the site, along the south side of Burrows Road;
  - There are also dikes to the east and south of the site. The dike to the south (on the private cranberry farm) varies between 1.9 and 2.7 m geodetic, and the crest of

the raised dike located immediately east of the site varies between 2.99 and 1.74 m geodetic and is also used for cranberry production;

- The site is poorly drained and is inundated with water during portions of the year, surface water and groundwater cannot flow effectively to surrounding drainages;
- Subsoil drains and a pump station would be required to effectively drain the area if the current ground surface elevations were maintained to direct flow from the site to the Burrows Road ditch or the drainage canal to the east. On-site drainage may also be improved by soil filling at least 1.5 m and providing an approximate 2% slope to the north to allow for gravity drainage (no pumping required) to the Burrows Road ditch.

- Preliminary Geotechnical Investigation, dated July 27, 2016 evaluates soil conditions, including the following information:
  - Surficial layer of topsoil and root mat is underlain by approximately 1.5-2.1 m thick layer of silt and clay. Medium to fine grained sand was encountered below silt and clay.

Staff Assessment

Based on the technical reports provided, there are existing drainage issues which would need to be addressed for soil-based farming on the subject properties. The report notes that with improvements to drainage (i.e. drainage ditches, pumping stations or fill) the agricultural capability could be improved to Class 3 (from Class 4W and 4WD). Alternatively, other types of agricultural activities are permitted, such as greenhouses, nurseries or other non-soil bound agriculture (staff note that a greenhouse with concrete is not permitted without a rezoning application). The property owners have not fully attempted to improve the site for active agricultural production due to costs.

Staff do not support the proposal for the following reasons:

- **Land is designated for farming:** the subject properties are located within the ALR and are designated "Agriculture" in the Metro Vancouver Regional Growth Strategy (RGS) and the City's OCP. Also, the subject properties are located outside the urban containment boundary, which is identified in the RGS and OCP. Prior to urban uses being considered, an application to Metro Vancouver to change the designation would be required. Removing the properties from the ALR is contrary to the objectives of the RGS and OCP to protect these areas from urban development.

- **No benefit to agriculture:** as per the OCP, existing policies include maintaining the ALR boundary to strengthen the viability of farming operations. The City's Agricultural Viability Strategy (AVS) includes objectives to protect the ALR boundary and not support a change or loss of ALR land unless there is a substantial net benefit to agriculture. No agriculture is being conducted currently and the purpose of these applications is to eventually pursue non-agricultural uses.

- **Protection of farmland is a high priority:** as per the *Agricultural Land Commission Act* (ALCA), the purpose of the ALC is (a) to preserve the ALR, (b) to encourage farming of land within the ALR, and (c) to encourage local governments to enable and accommodate farm use of land within the ALR. This includes ALR land currently used for agriculture, as well as currently unused for farming, but which can be farmed. When considering applications, the ALC considers the agricultural capability of the land with and without improvements, and if an effort to improve the land has been attempted. The subject properties have the potential to be actively farmed with improvements to the land.

Although the subject proposal does not specifically identify an end use, previous exclusion applications on the south side of Burrows Road proposed an industrial end use, due to the industrial adjacency to the north, across Burrows Road. Adding additional industrial land may be potentially contrary the City's Industrial Land Intensification Initiative (ILII), currently under staff review, which aims to strengthen and intensify existing industrial land, rather than expanding into non-industrial areas (specifically agricultural).

The proposal to exclude the properties from the ALR also has the potential to be precedent setting for other parcels in the ALR.

### Financial Impact

None.

### Conclusion

JNA Holdings Inc., Karl, Lydia & Ulrich Wacker, & Shorewood Developments Ltd. have applied to exclude 14540, 14680 & 14920 Burrows Road from the Agricultural Land Reserve (ALR).

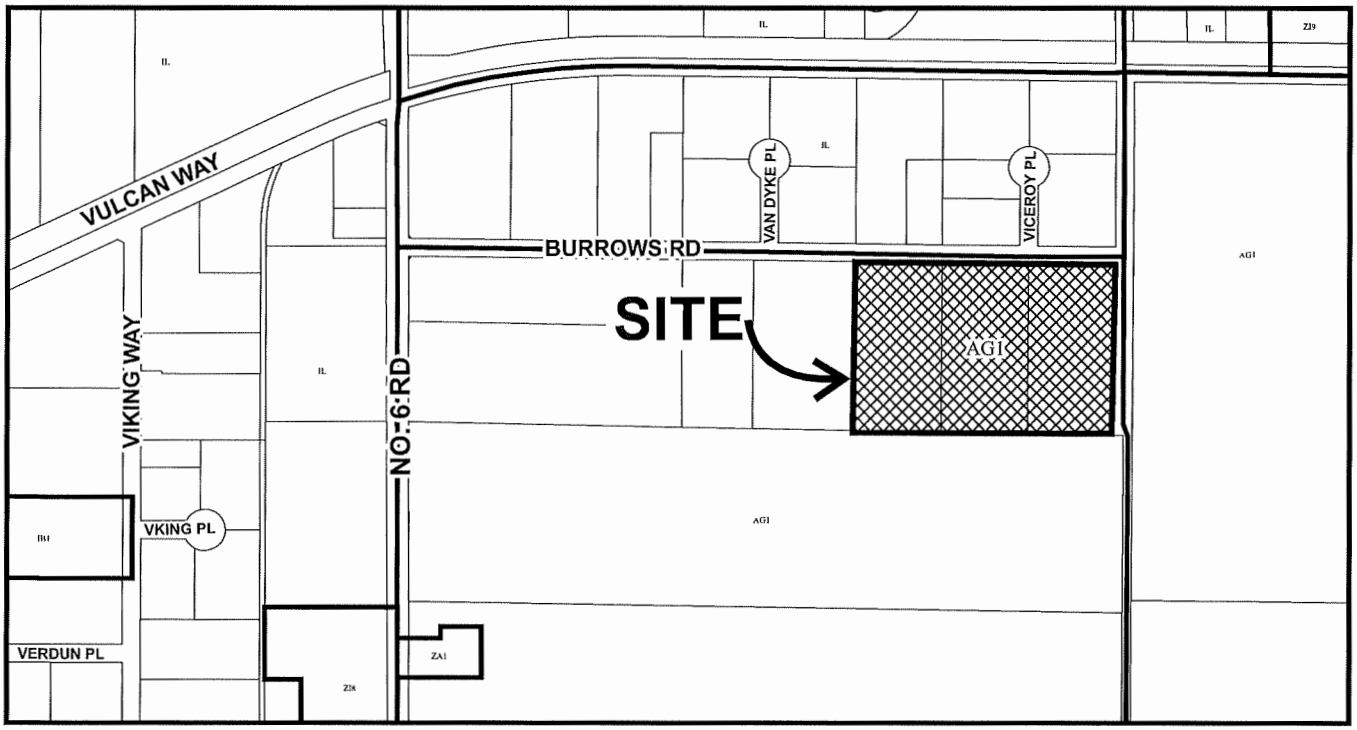
The proposal does not comply with the land use designation or applicable policies contained within the OCP. On this basis, it is recommended that the applications be denied.

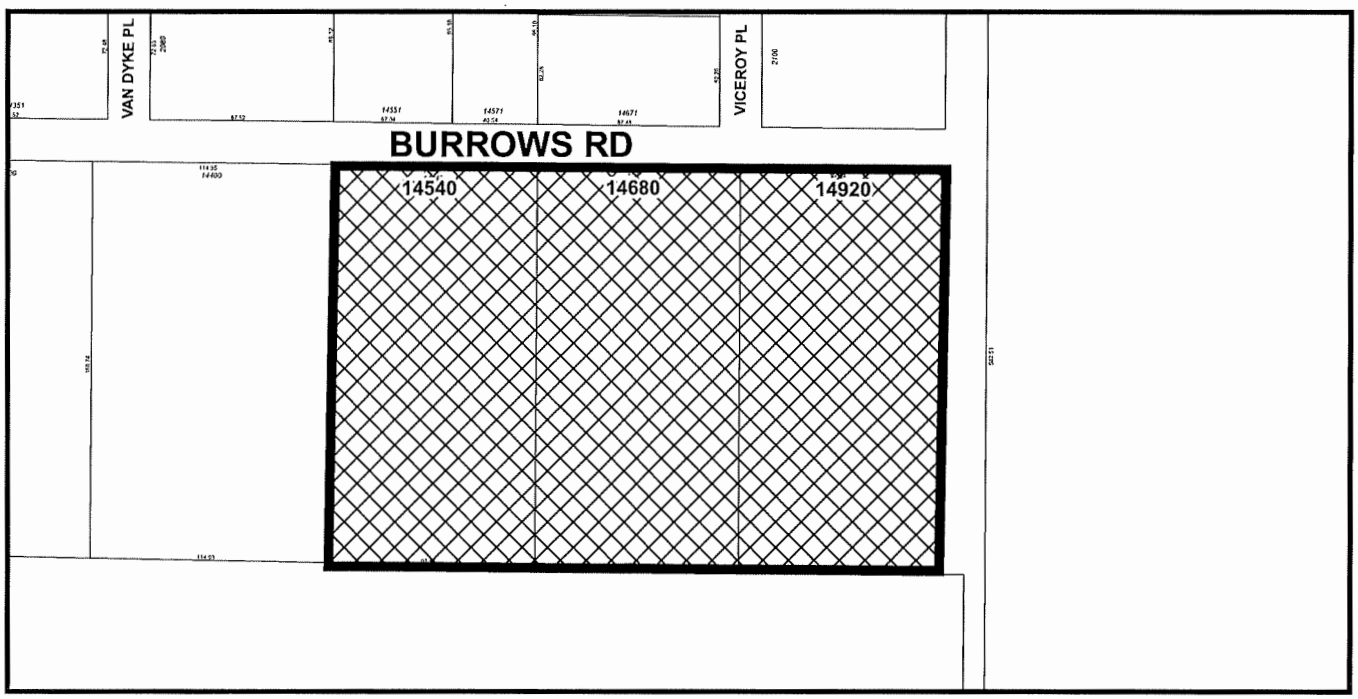
Steven De Sousa
Planner 1

SDS:cas

Attachment 1: Location Map and Aerial Photo
Attachment 2: Development Application Data Sheet
Attachment 3: Excerpt from the October 24, 2019 FSAAC Meeting Minutes
Attachment 4: Public Correspondence
Attachment 5: Technical Reports

City of Richmond




AG 19-855723
AG 19-855800
AG 19-855911

Original Date: 09/19/19

Revision Date:

Note: Dimensions are in METRES

City of
Richmond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City of Richmond

# Development Application Data Sheet

Development Applications Department

**AG 19-855723, AG 19-855800 & AG 19-855911** **Attachment 2**

Address: 14540, 14680 & 14920 Burrows Road

Applicant: JNA Holdings Inc., Karl, Lydia & Ulrich Wacker, & Shorewood Developments Ltd.

Planning Area(s): East Richmond

| | Existing | Proposed |
|---|---|---|
| **Owner:** | 14540: JNA Holdings Inc.<br>14680: Karl, Lydia & Ulrich Wacker<br>14920: Shorewood Developments Ltd. | No change |
| **Site Size:** | 14540: 4.57 acres (1.85 hectares)<br>14680: 4.59 acres (1.86 hectares)<br>14920: 4.6 acres (1.86 hectares) | No change |
| **Land Uses:** | 14540: Vacant<br>14680: Single-family residential<br>14920: Vacant | Non-agriculture |
| **OCP Designation:** | Agriculture | Non-agriculture |
| **Zoning:** | "Agriculture (AG1)" | Non-agriculture |
| **Other Designations:** | Agricultural Land Reserve (ALR) | Exclusion from the ALR |

City of Richmond

# Development Application Data Sheet

Development Applications Department

**AG 19-855723, AG 19-855800 & AG 19-855911** **Attachment 2**

Address: 14540, 14680 & 14920 Burrows Road

Applicant: JNA Holdings Inc., Karl, Lydia & Ulrich Wacker, & Shorewood Developments Ltd.

Planning Area(s): East Richmond

| | Existing | Proposed |
|---|---|---|
| **Owner:** | 14540: JNA Holdings Inc.<br>14680: Karl, Lydia & Ulrich Wacker<br>14920: Shorewood Developments Ltd. | No change |
| **Site Size:** | 14540: 4.57 acres (1.85 hectares)<br>14680: 4.59 acres (1.86 hectares)<br>14920: 4.6 acres (1.86 hectares) | No change |
| **Land Uses:** | 14540: Vacant<br>14680: Single-family residential<br>14920: Vacant | Non-agriculture |
| **OCP Designation:** | Agriculture | Non-agriculture |
| **Zoning:** | "Agriculture (AG1)" | Non-agriculture |
| **Other Designations:** | Agricultural Land Reserve (ALR) | Exclusion from the ALR |

| | Bylaw Requirement (AG1) | Proposed | Variance |
|---|---|---|---|
| Buildable Floor Area: | Max. 400 $m^2$ (4,305 $ft^2$) | Residential development is not proposed at this time. | None permitted |
| Farm Home Plate Area: | Max. 1,000 $m^2$ (10,764 $ft^2$) | | None |
| Single Detached Building – Setback: | Max. 50.0 m | | None |
| Front Yard – Setback: | Min. 6.0 m | | None |
| Interior Side Yard – Setback | Min. 1.2 m on one side and 6.0 m on the other side | | None |
| Rear Yard – Setback | Min. 10.0 m | | None |
| Height | Max. 2 storeys (9.0 m) | | None |

## Excerpt from the Meeting Minutes of the

# Food Security and Agricultural Advisory Committee (FSAAC)

**Thursday, October 24, 2019 – 7:00 p.m.**
**Rm. M.2.002**
**Richmond City Hall**

### Agricultural Land Reserve Exclusion Applications at 14540, 14680 & 14920 Burrows Road

Steven De Sousa, Planner 1, introduced the proposed exclusion applications at 14540, 14680 & 14920 Burrows Road and provided the following comments:

- The subject properties are located in the Agricultural Land Reserve (ALR) and zoned "Agriculture (AG1)". The properties are also designated Environmentally Sensitive Area (ESA);
- The purpose of the application is to remove the three subject properties from the ALR;
- In the mid-1980s, the City once considered the area as part of a block exclusion application, however this was denied. Since then, the City has not supported the proposed exclusion from the ALR as it is contrary to the OCP's agricultural designation and related policies;
- OCP policies include maintaining the existing ALR boundary and not supporting a loss of ALR land, unless there is a substantial net benefit to agriculture and the agricultural community is consulted; and
- The applicant has provided a series of technical reports regarding the agricultural capability of the properties.

Colin Fry, Applicants' Agent, provided the following additional comments regarding the proposal:

- The purpose of the application is to allow the Agricultural Land Commission (ALC) to re-assess the agricultural land status of the subject properties;
- The proposal does not include an end use at this time;
- There are significant costs associated with improving the existing condition to be productive agricultural land;
- The City once considered the properties for ALR exclusion through a block exclusion application, however the Burrows Road area was denied by the ALC;
- The current zoning of the properties is "Agriculture (AG1)", which is a reflection of the ALR designation; and
- The request is that the application be forwarded to the ALC in order to assess the agricultural suitability of the subject properties and determine if the designation as agricultural land is still appropriate.

Rod Ast, Property Owner, provided the following additional comments:

- The single-family dwelling on his property built in 1973 has significant damage to the foundation due to the adjacent cranberry bog;
- The adjacent industrial uses have caused safety concerns; and
- The property produced hay until 2010, before losing farm status, due to changing site conditions.

Discussion ensued regarding the adjacent farming operation to the south, tenure and ownership, and the purpose of excluding the properties from the ALR if no end uses are proposed.

As a result of the discussion, the Committee made the following comments:

- The existing condition of the properties presents challenges for an agricultural operation and the costs for improvement are significant;
- The projected financials in the technical reports may not reflect current market conditions; and
- The subject ALR exclusion applications may set a precedent for other small parcels in the ALR.

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

*That the Food Security and Agricultural Advisory Committee recommend the Agricultural Land Reserve Exclusion Applications at 14540, 14680 & 14920 Burrows Road proceed to Council for consideration of the application to move forward to the Agricultural Land Commission.*

*Defeated*
*Opposed: Sarah Drewery, Laura Gillanders, Teresa Murphy*
*Abstained: Steve Easterbrook*

COMMERCIAL REAL ESTATE SERVICES

CBRE

1021 West Hastings Street, Suite 2500
Vancouver, BC V6E 0C3

April 18, 2019

City of Richmond
6911 No. 3 Road
Richmond, BC V6Y 2C1
Canada

ATTN: Agricultural Planning Department – ALR Exclusion Application 14540 & 14680 Burrows Road

Dear City of Richmond,

There is no need for this land to be removed from the agricultural land reserve. The price of industrial land is based on the existing supply and is trading at record high values. For example, the Versacold property at 3231 No. 6 Road recently sold for $4.5 million an acre due to the low supply of industrial land in the municipality. If the land on Burrows is removed from the agricultural land reserve, it is not fair to the existing industrial land owners since it will devalue their property while setting precedent for future application for removal from the ALR. An additional example, I recently sold 14291 Burrows Road which transacted for $8 million (20,000 SF building on 1.1 acres) because there was no alternative supply of available properties.

The argument that the land should be removed because it is not fit for farming is NOT TRUE. Farm land in Richmond is some of the best in BC because the there are very few low temperature days, a consistent supply of water, and the slope allows for good farming as it is on a relatively level grade.

I do not support this land being removed from the agricultural land reserve because it will set a bad precedent and will set an example for future ALR exclusion applications.

Sincerely,

Bruce Richardson
Vice President
Industrial Properties Group
Direct Line (604) 662-5127
bruce.richarson@cbre.com

# Soil and land capability assessment for the property located at 14540 Burrows Road, Richmond, BC

Prepared by:

Bruce McTavish, MSc, MBA, PAg, RPBio,

&

Elizabeth Kenney MSc, PAg

McTavish Resource & Management Consultants Ltd.

2858 Bayview Street, Surrey, BC, V4A 2Z4

September 28, 2016

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## 1.0 Introduction

McTavish Resource & Management Consultants Ltd. was requested by the property owners to conduct a soils and landscape assessment for property located at 14540 Burrows Road, Richmond BC. A field visit was made on May 5, 2016. The objective of the fieldwork was to assess the agricultural capability of the land, determine the soil series and determine agricultural limitations on the property.

## 2.0 Methodology

Three field investigations were conducted at GPS locations 548, 549 & 550 as seen in Figure 1. At each site an excavator was used to dig the soil to depths of 120-190 cm. For each site the soils were described in terms of profile morphology including horizonation, depths, soil textures, coarse fragments, mottles, and depth to water table. The site landscapes were described in terms of landform, surficial materials, surface stoniness, slope, and soil drainage. The soils observed were identified to soil series and were then compared to the existing soil mapping for the subject property (Figure 2).

The soils were also compared to the existing agricultural capability mapping for the subject property (Figure 3). Two soil samples were collected for chemical analysis. The three surface horizons were composited into one sample for analysis to represent the surface Op. The second soil sample consisted of a composite sample from the underlying subsurface B horizons from the three sample points.


Figure 1 Soil sampling sites

## 3.0 Summary of the soil observations

The May 5, 2016 soil sampling verified the existing soil mapping to varying degrees. The existing mapping which was done at 1:25,000 scale recognized 2 different soils occurring within the subject area (Figure 2). The existing mapping reports the landscape as gently undulating with slopes between 0.5 and 2%. The surface stoniness class was mapped as S0 Non Stony land. These mapped soils are shallow organic accumulations (15-40 cm thick) overlaying moderately fine to fine textured fluvial and deltaic deposits: Annis (AN) – Peaty Gleysols and soils that have developed from 40-160 cm of mainly well decomposed organic materials which overly moderately fine to fine textured deltaic deposits: Richmond (RC) – Terric Humisols.

All three sample sites fell within the existing soil mapping polygon AN60% -RC 40%/b, S0 and were classified as belonging to the Annis soil series (Table 1). No obvious Richmond soil was observed on the subject property although GPS Sites 548 and 549 had surface organic layers that were 40 cm thick in places and could be called Richmond soil series.

Annis soils differ from the Richmond soils in the thickness of the overlying organic materials. None of the three sample sites on the subject property had organic surfaces >40 cm. While GPS Sites 548 and 549 had surface organic layers that were 40 cm thick in places the thickness was not consistently 40 cm or more, but varied to less than 40 cm in places. Therefore soils from Sites 548 & 549 are better classified as Peaty Gleysols belonging to the Annis soil series.

All soils on the property have poor to very poor drainage characteristics that are a function of soil texture, subsoil compaction and location in the regional topography (Table 2).

Table 1 Soil series observed on the property

| **Soil observation GPS numbers** | **Soil polygon map unit name** | **Soil series occurring at the soil observation site** |
|---|---|---|
| 548 | AN60%-RC 40%/b,S0 | AN/b, S0 Annis borderline with Richmond RC/b,S0 |
| 549 | AN60% -RC 40%/b,S0 | AN/b, S0 Annis borderline with Richmond RC/b,S0 |
| 550 | AN60% -RC 40%/b,S0 | AN/b, S0 Annis |

Table 2 Soil properties and drainage characteristics

| Soil symbol | Soil name | Soil texture and parent material | Soil drainage |
|---|---|---|---|
| AN | Annis | Shallow organic matter accumulations (15-40 cm) that overlie moderately fine to fine textured Fraser River floodplain and deltaic deposits. Surfaces are generally well decomposed humic organic materials. Subsurface and subsoils are silty clay loam or silty clay. At depths below 1 metre medium or fine sand may occur. These deeper materials maybe saline in the deltaic deposits. | Poorly to very poorly drained |
| RC | Richmond | 40-160 cm of mainly well decomposed organic materials overlying moderately fine and fine deltaic materials. Surfaces vary from moderately to well decomposed depending on length of time under cultivation. Subsurface organic materials are well decomposed humic materials. The underlying mineral soil is silt loam to silty clay loam. The mineral soil is often massive and contains the remains of old plant roots and stems. The mineral soil maybe saline. | Very poorly drained Water tables at or near surface during most of the winter early spring but recede somewhat during the growing season |

From Luttmerding 1981


Figure 2 Existing soil map

Luttmerding 1980 Scale 1:25,000
http://www.env.gov.bc.ca/esd/distdata/ecosystems/Soil_Data/SIFT/Soil__AgCap_KML_Files/.

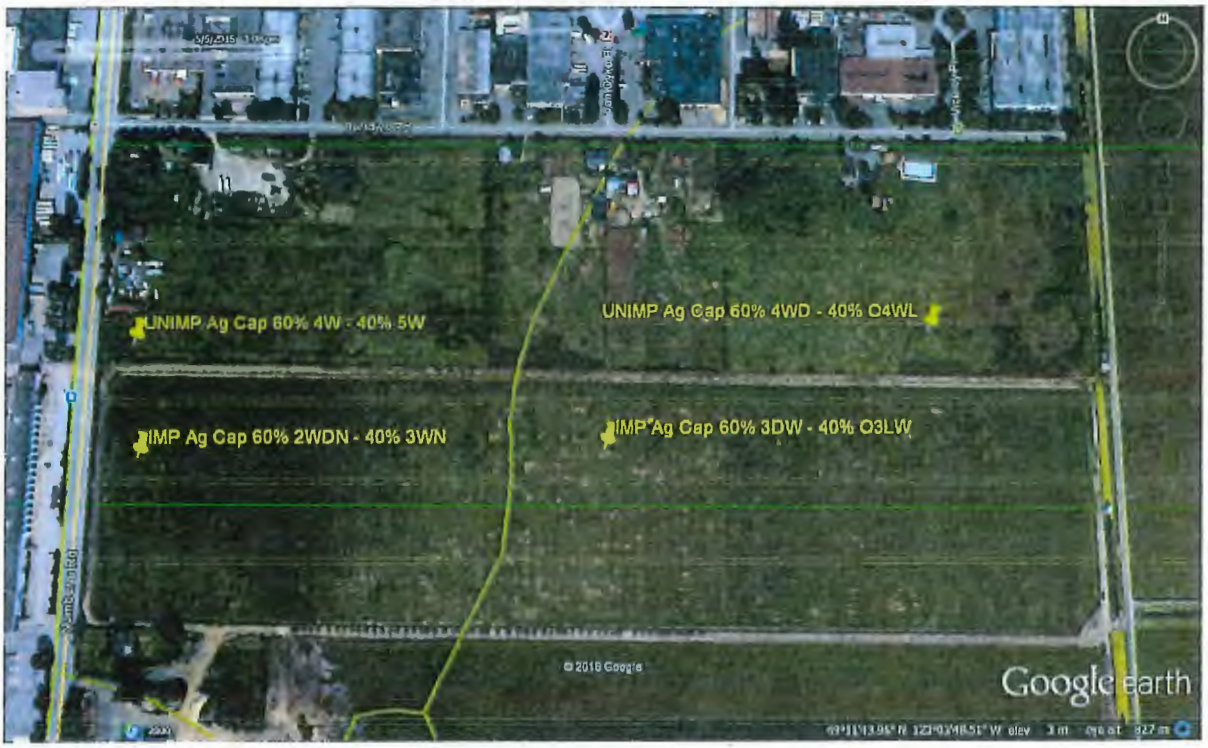

Figure 3 Historical agricultural capability

http://www.env.gov.bc.ca/esd/distdata/ecosystems/Soil_Data/SIFT/Soil__AgCap_KML_Files/

## 4.0 Agricultural capability

The historic mapping of this property indicates that the unimproved agricultural capability is 60% 4WD – 40% O4WL improvable with drainage to 60% 3DW – 40% O3LW (Table 3)

Table 3 Agricultural capability from historic mapping

| Unimproved agricultural capability | Improved agricultural capability |
|---|---|
| 60% 4WD – 40% O4WL | 60% 3DW – 40% O3LW |

W = Excess water
D = Undesirable soil structure and/or low perviousness
L = Degree of decomposition – permeability for organic soils (O)

Based on the site visit of May 5, 2016 the agricultural capability of the subject property is unimproved 4WD improvable to 3DW by improving drainage (Table 4). The landscape topography is not limiting and there are no limitations due to coarse fragments. At the time of sampling (May 5 – late spring) the water table was at or below 1 metre. The presence of an organic surface layer and mottling in the surface mineral soils indicate that the soils are experiencing water levels at or near the surface during the winter months. The lack of mottles in the lower C horizon (depths ~ 100 cm+) at Site 549 indicates that the soil at depth remains wet or saturated and remains in a reduced state.

The mineral soils underlying the organic surface horizon are silty clay in texture and are sticky when wet. The deeper C horizons are also more massive in terms of soil structure. The texture and structure of the subsurface and subsoils are consistent with a 3D limitation for undesirable soil structure and/or low perviousness.

Based on interviews with the owner and a review of the Hydrologist's report it is evident that the property has water at the surface and/or the soil is in a saturated condition for the winter and early spring with at least 4 months of the year that the land is not accessible. This corresponds with the soil observations and confirms the unimproved class 4W capability classification for the majority of the site.

"The ground surface is flat with no discernible grades to surface water drainage on any side of the Site. Evidence indicates surface water cannot flow to drainages located on the north and east sides of the Site. There are dykes located up to 2.4 higher than the property on the south and east sides which prevent runoff in these directions."[1]

Table 4 Agricultural capability based on site observations

| Soil observation GPS numbers | Soil | Unimproved | Improved |
|---|---|---|---|
| 548 | Annis | 4WD | 3DW |
| 549 | Annis | 4WD | 3DW |
| 550 | Annis | 4WD | 3DW |

## 5.0 Soil Management

The soil management considerations and crop suitability are provided in Table 5 based on the observed soil mapping. The soil management groupings of the Fraser Valley Soils and the crop suitability for each management group has been well documented in two reports (Luttmerding, 1984 and Bertrand et Al, 1991). Table 5 draws on these two publications for management and crop suitability as well as on Luttmerding 1981.

[1] Active Earth Engineering August 29, 2016. Preliminary Hydrology Assessment 14920, 14680, 14540, 14400, and 14300 Burrows Road, Richmond BC

Table 5 Soil management and crop suitability

| Soil name | Soil management considerations from Bertrand et Al 1991 and Luttmerding 1984 | Crop suitability from Bertrand et Al 1991 and Luttmerding 1984 |
|---|---|---|
| Annis | Poor drainage is the main agricultural limitation<br>Underdrains need to be closely spaced due to the moderately to slow perviousness nature of the subsoils<br>Periodic subsoiling to loosen the silty clay subsoils is required to maintain the underdrains efficiency as well as to improve aeration and root distribution<br>Management required to minimize loss of the organic surface layer<br>Liming will generally be required to improve crop production<br>High water tables and variable bearing strengths also make road and building construction difficult and basements impractical | Suited crops include pasture and forage crops, blueberries, and annual field crops including: annual legumes, cereals, cole crops, corn, root crops excluding carrots, and shallow rooted annual vegetables<br><br>Unsuited crops include nursery and Christmas trees, raspberries, strawberries and tree fruits because even with artificial drainage the soils will still have excessive water for the production of these crops |
| Richmond | Poor drainage and high water tables especially during the winter are the main agricultural limitations<br>Drainage controls require close spacing<br>Soils tend to be very acidic and require liming<br>Management required to minimize loss of the organic surface layer<br>Exposed soil surfaces are prone to wind and water erosion<br>High watertables and variable bearing strengths also make road and building construction difficult and basements impractical | Suited crops include pasture and forage crops, blueberries, and annual field crops including annual legumes, cereals, cole crops, corn, root crops, and shallow rooted annual vegetables<br>These soils can be productive for intensive vegetable production with adequate water table control<br><br>Unsuited crops include nursery and Christmas trees, raspberries, strawberries and tree fruits because even with artificial drainage the soils will still have excessive water to allow for the production of these crops |

## 5.1 Site improvement for agriculture

For field agriculture production (other than pasture) to be viable on this property drainage must be improved. This requires the installation of subsurface drainage and having a drainage ditch of adequate depth for the subsurface drains to discharge. At the present time no ditches are available for gravity discharge and the only potential outlet would be to install a pumping station to discharge water into the large drainage channel to the east of the adjacent property. This would require a jointly owned/operated pumping infrastructure and an easement through the two adjacent properties.

A second option is the fill the site; raising the elevation high enough above the water table to improve drainage for production of annual vegetable, forage and/or small berry crops.

# References

Bertrand, RA, GA Hughes-Games, DC Nikkel 1991. Soil Management Handbook for the Lower Fraser Valley, 2nd edition. BC Ministry of Agriculture, Fisheries and Food, Abbotsford, BC, 115 pp.

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Soil Classification Working Group. 1998. The Canadian System of Soil Classification, 3rd Ed. Agriculture and Agri-Food Canada Publication 1646, 187 pp. ISBN 0-660-17404-9.

# Appendix I Soil observations

The following discussion summarizes the observations made at each of the soil sample sites in terms of soil and landscape properties.

## Sample Site 548

SOIL SERIES: Annis (Borderline Richmond)

SOIL CLASSIFICATION: Orthic Gleysol peaty phase (Borderline Terric Humisol)

PARENT MATERIAL: Shallow organic accumulations overlaying moderately fine too fine textured fluvial and deltaic deposits.

DRAINAGE: Poor to very poor

WATERTABLE at TIME of SAMPLING: 100 cm

SURFACE STONINESS: Non Stony

ROOT RESTRICTING LAYER: None.

TOPOGRAPHY: Gently undulating (0.5-2% slopes)

VEGETATION & LAND USE: Reed canary grass

| Horizon | Depth (cm) | Coarse Fragments (% by volume) | Texture | Moisture | Comments |
|---|---|---|---|---|---|
| Op | 0-40 | 0 | Humic | moist | Well decomposed organic matter thickness varies from 34-40 cm Borderline with the Richmond soil series: calling Annis as the thickness varies to less than 40 cm |
| Bg | 40-70 | 0 | SiC | moist | Common, fine mottles, some structure, contains plentiful roots |
| Cg | 70-110 | 0 | SiC-SiCL | wet | Common medium prominent mottles, contains plentiful roots |

Soil at Site 548

## Sample site 549

SOIL SERIES: Annis (borderline Richmond)

SOIL CLASSIFICATION: Orthic Gleysol peaty phase (borderline Terric Humisol)

PARENT MATERIAL: Shallow organic accumulations overlaying moderately fine too fine textured fluvial and deltaic deposits.

DRAINAGE: Poor

WATERTABLE at TIME of SAMPLING: 120 cm

SURFACE STONINESS: Non Stony

ROOT RESTRICTING LAYER: None

TOPOGRAPHY: Gently undulating (0.5-2% slopes)

VEGETATION & LAND USE: Reed canary grass

Profile description Site 549

| Horizon | Depth (cm) | Coarse Fragments (% by volume) | Texture | Moisture | Comments |
|---|---|---|---|---|---|
| Op | 0-40 | 0 | Humic | moist | Well decomposed organic matter Borderline with the Richmond soil series: calling this soil Annis as the thickness is 40 cm and in places it is less than 40 cm |
| Bg | 40-93 | 0 | SiC | moist | Common, medium mottles, some structure, contains plentiful roots, contains sand pockets |
| Cg | 93-150 | 0 | SiC | wet | No mottles, contains plentiful roots |

Soil at Site 549

## Sample Site 550

SOIL SERIES: Annis

SOIL CLASSIFICATION: Orthic Gleysol peaty phase

PARENT MATERIAL: Shallow organic accumulations overlaying moderately fine to fine textured fluvial and deltaic deposits.

DRAINAGE: Poor

WATERTABLE at TIME of SAMPLING: 120 cm

SURFACE STONINESS: Non Stony

ROOT RESTRICTING LAYER: None.

TOPOGRAPHY: Gently undulating (0.5-2% slopes)

VEGETATION & LAND USE: Reed canary grass and horsetail

| Horizon | Depth (cm) | Coarse Fragments (% by volume) | Texture | Moisture | Comments |
|---|---|---|---|---|---|
| Op | 32-0 | 0 | Humic | moist | Well decomposed organic matter |
| Bg | 0-60 | 0 | SiC | moist | Common, medium-fine mottles, contains plentiful roots |
| Cg | 60-120 | 0 | SiC | moist | Few fine-medium distinct mottles, contains roots |

# Appendix II Soil laboratory analysis

Chemical analysis – Soil quality laboratory results from selected soil horizons for the composited sample of the three GPS locations

| GPS Site # | Horizon | pH 1:2 water extract | EC (dS/m) saturated paste 1:2 | OM % loss on ignition |
|---|---|---|---|---|
| 548<br>549<br>550 | Op<br>Surface horizon | 5.4<br>Acidic * | 0.17<br>Non saline | 30.4<br>High |
| 548<br>549<br>550 | B<br>Subsurface Horizon | 5.6<br>Acidic * | 0.20<br>Non saline | Not determined |

* Soil Reaction Class: The Canadian System of Soil Classification 3rd edition.1998. Soil Classification Working Group. Research Branch, Agriculture and Agri-Food Canada Publication 1646. National research Council, Ottawa, Canada. 187 pages.

Chemical analysis – Nutrient analysis laboratory results from selected soil horizons for the composited sample of the three GPS locations

| | | Nutrient analysis (ppm) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GPS Site # | Horizon | N* | P | K | S** | Ca | Mg | Fe | Cu | Zn | B | Mn | Cl |
| 548<br>549<br>550 | Op | <2<br>D[1] | 20<br>M[2] | 51<br>D[1] | 11<br>O[3] | 1520<br>O[3] | 142<br>O[3] | 250<br>O[3] | 0.8<br>M[2] | 2.1<br>O[3] | 0.2<br>D[1] | 0.8<br>D[1] | 4<br>D[1] |
| 548<br>549<br>550 | B | <2<br>D[1] | | | 23<br>O[3] | | | | | | | | |

N* nitrate-N

S** sulphate-S

D[1] deficient nutrient status

M[2] marginal nutrient status

O[3] optimum nutrient status

$E^4$ excess nutrient status

The chemical data indicate that the soils in the subject property are non saline, are acidic in terms of soil acidity, and are deficient in nitrogen, potassium, boron, manganese, and chlorine. The nutrient levels of phosphorus and copper are marginal, whereas the levels for the other nutrients measured are optimal status.

# Soil and land capability assessment for the property located at 14680 Burrows Road, Richmond BC

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# 1.0 Introduction

McTavish Resource & Management Consultants Ltd. was requested by the property owners to conduct a soils and agricultural capability assessment for property located at 14680 Burrows Road, Richmond BC. A field visit was made on May 5, 2016. The objective of the fieldwork was to assess the agricultural capability of the land, determine the soil series and determine agricultural limitations on the property.

# 2.0 Methodology

Three field investigations were conducted at GPS locations 542, 543 and 544 as seen in Figure 1. At each site an excavator was used to dig the soil to depths of 120-150 cm. For each site the soils were described in terms of profile morphology including horizonation, depths, soil textures, coarse fragments, mottles, and depth to water table. The site landscapes were described in terms of landform, surficial materials, surface stoniness, slope, and soil drainage.

The soils observed were identified to soil series and then compared to the existing soil mapping for the subject property (Figure 2). The soils were also compared to the existing agricultural capability mapping for the subject property (Figure 3).

Two soil samples were collected for chemical analysis. The three surface horizons were composited into one sample for analysis to represent the surface Op. The second soil sample consisted of a composite sample of the underlying subsurface B horizons from the three sample points.


Figure 1 Soil sampling sites

## 3.0 Summary of soil observations

The May 5, 2016 soil sampling confirmed the existing soil mapping. The existing mapping, which was done at 1: 25,000 scale, recognized 2 different soils occurring within the subject area (Figure 2). The existing mapping reports the landscape as gently undulating with slopes between 0.5 and 2%. The surface stoniness class was mapped as S0 Non Stony land. These mapped soils are shallow organic accumulations (15-40 cm thick) overlying moderately fine to fine textured fluvial and deltaic deposits: Annis (AN) – Peaty Gleysols, and soils that have developed from 40-160 cm of mainly well decomposed organic materials which overlie moderately fine to fine textured deltaic deposits: Richmond (RC) – Terric Humisols.

All three sample sites fell within the existing soil mapping polygon AN 60%-RC 40%/b,S0. GPS Sites 543 and 544 were classified as belonging to the Annis soil series, and GPS Site 542 was classified as belonging to the Richmond soil series. Annis soils differ from Richmond soils in the thickness of the overlying organic materials. One of the three sample sites on the subject property, GPS 542, had organic surfaces >40 cm. The Richmond soil sampled trended towards the Annis soil as the thickness of the organic surface layer was only 45 cm.

Table 1 indicates which landscape unit number and soil polygon the observations occurred in, and Table 2 summarizes soil properties and drainage characteristics.

Table 1 Soil series observed on the property

| **Soil observation GPS numbers** | **Soil polygon map unit name** | **Soil series occurring at the soil observation site** |
|---|---|---|
| 542 | AN60% -RC 40%/b, S0 | RC/b, S0 Richmond |
| 543 | AN60% -RC 40%/b, S0 | AN/b, S0 Annis |
| 544 | AN60% -RC 40%/b, S0 | AN/b, S0 Annis |

Table 2 Soil properties from existing mapping

| Soil symbol | Soil name | Soil texture and parent material | Soil drainage |
|---|---|---|---|
| AN | Annis | Shallow organic matter accumulations (15-40 cm) overlying moderately fine to fine textured Fraser River floodplain and deltaic deposits. Surfaces are generally well decomposed humic organic materials. Subsurface and subsoils are silty clay loam or silty clay. At depths below 1 metre medium or fine sand may occur. These deeper materials maybe saline in the deltaic deposits. | Poorly to very poorly drained |
| RC | Richmond | 40-160 cm of mainly well decomposed organic materials overlying moderately fine and fine deltaic materials. Surfaces vary from moderately to well decomposed, depending on length of time under cultivation. Subsurface organic materials are well decomposed humic materials. The underlying mineral soil is silt loam to silty clay loam. The mineral soil is often massive and contains the remains of old plant roots and stems. The mineral soil may be saline. | Very poorly drained. Water tables at or near surface during most of the winter and early spring, receding somewhat during the growing season |

From Luttmerding 1981


Figure 2 Existing soil mapping (Luttmerding 1980 Scale 1:25,000)

http://www.env.gov.bc.ca/esd/distdata/ecosystems/Soil_Data/SIFT/Soil_AgCap_KML_Files/)

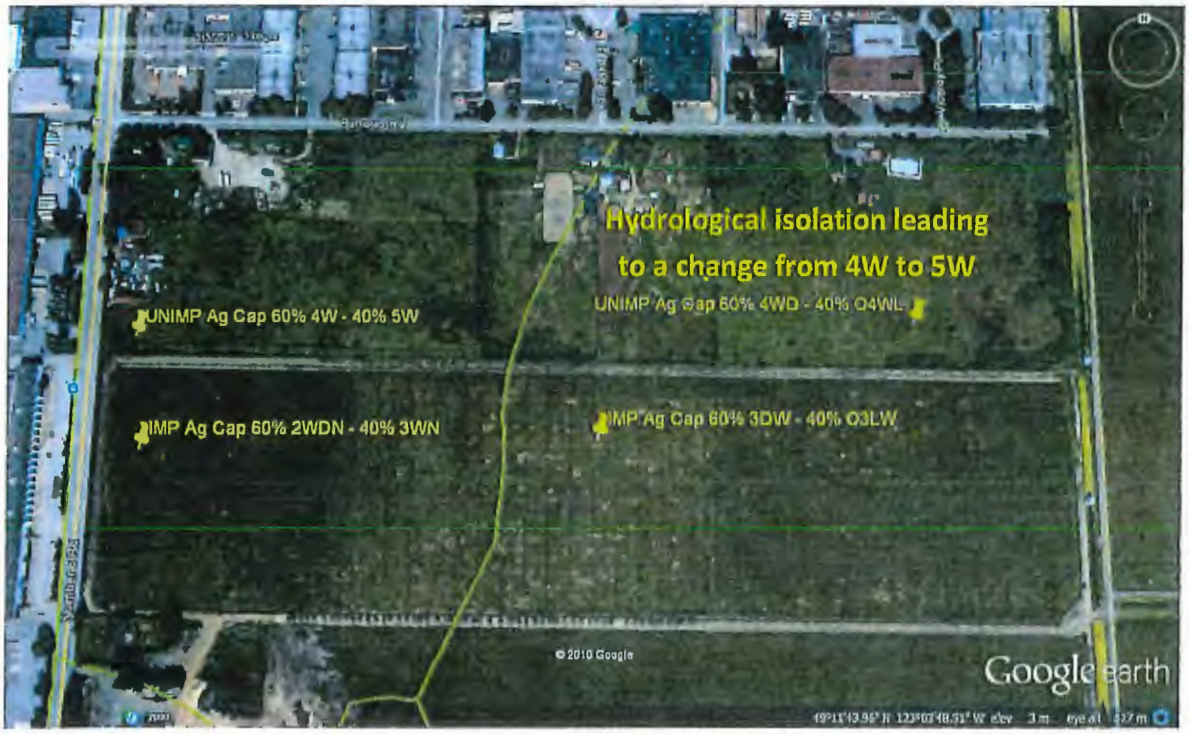

Figure 3 Existing agricultural capability

(http://www.env.gov.bc.ca/esd/distdata/ecosystems/Soil_Data/SIFT/Soil__AgCap_KML_Files/)

## 4.0 Agricultural capability

The mapped agricultural capability indicates that the unimproved agricultural capability is 60% 4WD and 40% O4W (Figure 3 and Table 3).

Table 3 Agricultural capability from historic mapping

| Unimproved agricultural capability | Improved agricultural capability |
|---|---|
| 60% 4WD – 40% O4WL | 60% 3DW – 40% O3LW |

W = Excess water
D = Undesirable soil structure and/or low perviousness
L = Degree of decomposition - permeability for organic soils (O)

Based on the site visit of May 5, 2016 the agricultural capability of the subject property is unimproved 4WD improvable to 3DW by improving drainage for the Annis soils (GPS Sites 543 and 544). The agricultural capability of the southern half of the subject property is unimproved O4WL to O5W, improvable to O3LWD by improving drainage.

Based on interviews with the owner, review of the Hydrologist's report for this property and soil observations it is evident that the property has water at the surface and/or the soil is in a saturated condition from the early winter until late spring with up to 7 months of the year that the land is not accessible by farm equipment due to saturated soil conditions.

"The ground surface is flat with no discernible grades to surface water drainage on any side of the Site. Evidence indicates surface water cannot flow to drainages located on the north and east sides of the Site. There are dykes located up to 2.4 higher than the property on the south and east sides which prevent runoff in these directions."[1]

Based on an interview with the landowner of 14680 Burrows Road, there has been a significant deterioration in the agricultural capability of the land since the construction of the cranberry bog to the south of the property. The land owner claims that the land has become increasingly wet for longer periods of time. This is verified by the fact that the land had been in continuous cultivation for 40 years and had farm status until 2011[2]. Farm tax status was lost in 2011 due to the constant wet soil conditions resulting in the inability to grow or harvest hay on the property.

The hydrological isolation of the property to the south and east combined with the culvert invert elevations and shallow slope of the Burrow Road ditch results in long term water retention on the subject property. A soil wetness (poor drainage) transition has been observed on this property resulting in the land capability for agricultural classification deteriorating on much of the property from 4W to 5W.

The landscape topography is not limiting and there are no limitations due to coarse fragments. At the time of sampling (May 5 – late spring) the water table was at or below 1 metre. The presence of an organic surface layer and mottling in the surface mineral soils indicate that the soils experience water levels at or near the surface during the winter months.

At Sites 542 and 543 the mineral soils underlying the organic surface horizon are clay in texture and are sticky when wet. The mineral soil at Site 544 was not as fine textured and was silty clay loam. The deeper C horizons are also more massive in terms of soil structure. The texture and structure of the subsurface and subsoils are consistent with a 3D limitation for undesirable soil structure and/or low perviousness.

Table 4 Agricultural capability based on site observations

| Soil observation GPS numbers | Soil | Unimproved | Improved |
|---|---|---|---|
| 542 | Richmond | O4WL – O5W | O3LWD |
| 543 | Annis | 4WD – 5WD | 3DW |
| 544 | Annis | 4WD – 5WD | 3WD |

[1] Active Earth Engineering August 29, 2016. Preliminary Hydrology Assessment 14920, 14680, 14540, 14400, and 14300 Burrows Road, Richmond BC

[2] Review of BC Assessment documents 2010, 2011 and 2012.

# 5.0 Soil Management

The soil management considerations and crop suitability is provided in Table 5 based on the observed soil mapping. The soil management groupings of the Fraser Valley soils and the crop suitability for each management group has been well documented in two reports (Luttmerding, 1984 and Bertrand et Al, 1991). Table 5 draws on these two publications for management and crop suitability as well as on Luttmerding, 1981.

Table 5 Soil management and crop suitability

| **Soil name** | **Soil management considerations from Bertrand et Al 1991 and Luttmerding 1984** | **Crop suitability from Bertrand et Al 1991 and Luttmerding 1984** |
|---|---|---|
| Annis | Poor drainage is the main agricultural limitation<br>Underdrains need to be closely spaced due to the moderately to slow perviousness nature of the subsoils<br>Periodic subsoiling to loosen the silty clay subsoils is required to maintain the underdrains efficiency as well as to improve aeration and root distribution<br>Management required to minimize loss of the organic surface layer<br>Liming will generally be required to improve crop production<br>High water tables and variable bearing strengths also make road and building construction difficult and basements impractical | Suited crops include pasture and forage crops, blueberries, and annual field crops including: annual legumes, cereals, cole crops, corn, root crops excluding carrots, and shallow rooted annual vegetables<br><br>Unsuited crops include nursery and Christmas trees, raspberries, strawberries and tree fruits because even with artificial drainage the soils will still have excessive water for the production of these crops |
| Richmond | Poor drainage and high water tables especially during the winter are the main agricultural limitations<br>Drainage controls require close spacing<br>Soils tend to be very acidic and require liming<br>Management required to minimize loss of the organic surface layer<br>Exposed soil surfaces are prone to wind and water erosion<br>High water tables and variable bearing strengths also make road and building construction difficult and basements impractical | Suited crops include pasture and forage crops, blueberries, and annual field crops including annual legumes, cereals, cole crops, corn, root crops, and shallow rooted annual vegetables<br>These soils can be productive for intensive vegetable production with adequate water table control<br><br>Unsuited crops include nursery and Christmas trees, raspberries, strawberries and tree fruits because even with artificial drainage the soils will still have excessive water to allow for the production of these crops |

## 5.1 Site improvement for agriculture

For field agriculture production, other than pasture to be viable on this property drainage must be improved. This requires the installation of subsurface drainage and having a drainage ditch of adequate depth for the subsurface drains to discharge. The city ditch on Burrows Road has a slope of approximately 0.05% available for gravity discharge which can not remove water at an adequate rate therefore the only potential drainage solution is to install a pumping station to discharge water into the large drainage channel east of the adjacent property. This would require a jointly owned/operated pumping infrastructure and an easement through the adjacent property.

A second option is the fill the site; raising the elevation high enough above the water table to improve drainage for production of annual vegetable, forage and/or small berry crops.

# References


Bertrand, RA, GA Hughes-Games, DC Nikkel, 1991. Soil Management Handbook for the Lower Fraser Valley, 2nd edition. BC Ministry of Agriculture, Fisheries and Food, Abbotsford, BC, 115 pp.

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# Appendix I Soil observations

The following discussion summarizes the observations made at each of the soil sample sites in terms of soil and landscape properties.

## Sample Site 542

SOIL SERIES: Richmond

SOIL CLASSIFICATION: Terric Humisol

PARENT MATERIAL: Well decomposed organic accumulations (40-160 cm thick) overlaying moderately fine to fine textured deltaic deposits.

DRAINAGE: Poor to very poor

WATERTABLE at TIME of SAMPLING: 100 cm

SURFACE STONINESS: Non Stony

ROOT RESTRICTING LAYER: 55 cm massive subsoil

TOPOGRAPHY: Gently undulating (0.5-2% slopes)

VEGETATION & LAND USE: Reed canary grass

| Horizon | Depth (cm) | Coarse Fragments (% by volume) | Texture | Comments |
|---|---|---|---|---|
| Op | 45-0 | 0 | Humic | Well decomposed organic matter containing pockets of sand |
| Cg1 | 45-55 | 0 | SiCL | Faint mottles |
| Cg2 | 55-155 | 0 | C | Massive: no structure, grey with common mottles water piping in at 100 cm |

## Sample site 543

SOIL SERIES: Annis

SOIL CLASSIFICATION: Rego Gleysol peaty phase

PARENT MATERIAL: Shallow organic accumulations overlaying moderately fine to fine textured fluvial and deltaic deposits

DRAINAGE: Poor to very poor

WATERTABLE at TIME of SAMPLING: 100 cm

SURFACE STONINESS: Non Stony

ROOT RESTRICTING LAYER: 25 cm massive subsoil

TOPOGRAPHY: Gently undulating (0.5-2% slopes)

VEGETATION & LAND USE: Reed canary grass

| Horizon | Depth (cm) | Coarse Fragments (% by volume) | Texture | Comments |
|---|---|---|---|---|
| Op | 25-0 | 0 | Humic | Well decomposed organic matter |
| Cg | 0-110 | 0 | C | Massive: no structure, grey with common mottles water piping in at 100 cm |

## Sample Site 544

SOIL SERIES: Annis

SOIL CLASSIFICATION: Orthic Gleysol peaty phase

PARENT MATERIAL: Shallow organic accumulations overlaying moderately fine to fine textured fluvial and deltaic deposits.

DRAINAGE: Poor

WATERTABLE at TIME of SAMPLING: 136 cm

SURFACE STONINESS: Non Stony

ROOT RESTRICTING LAYER: None

TOPOGRAPHY: Gently undulating (0.5-2% slopes)

VEGETATION & LAND USE: Reed canary grass

| Horizon | Depth (cm) | Coarse Fragments (% by volume) | Texture | Moisture | Comments |
|---|---|---|---|---|---|
| Op | 17-0 | 0 | Humic | moist | Well decomposed organic matter |
| Bgj | 0-36 | 0 | Medium S | moist | Few, fine faint mottles, medium sand |
| BCg | 36-120 | 0 | SiCL | moist | Common, fine-medium prominent mottles, well-structured: prismatic structure, contains sand pockets, clay skins, roots, earthworm present at 75 cm |
| Cg1 | 120-130 | 0 | SiCL | moist | |
| Cg2 | 130-155 | 0 | SiCL | wet | Water at 136 cm |


Figure 4 Vegetation and soil at Site 544

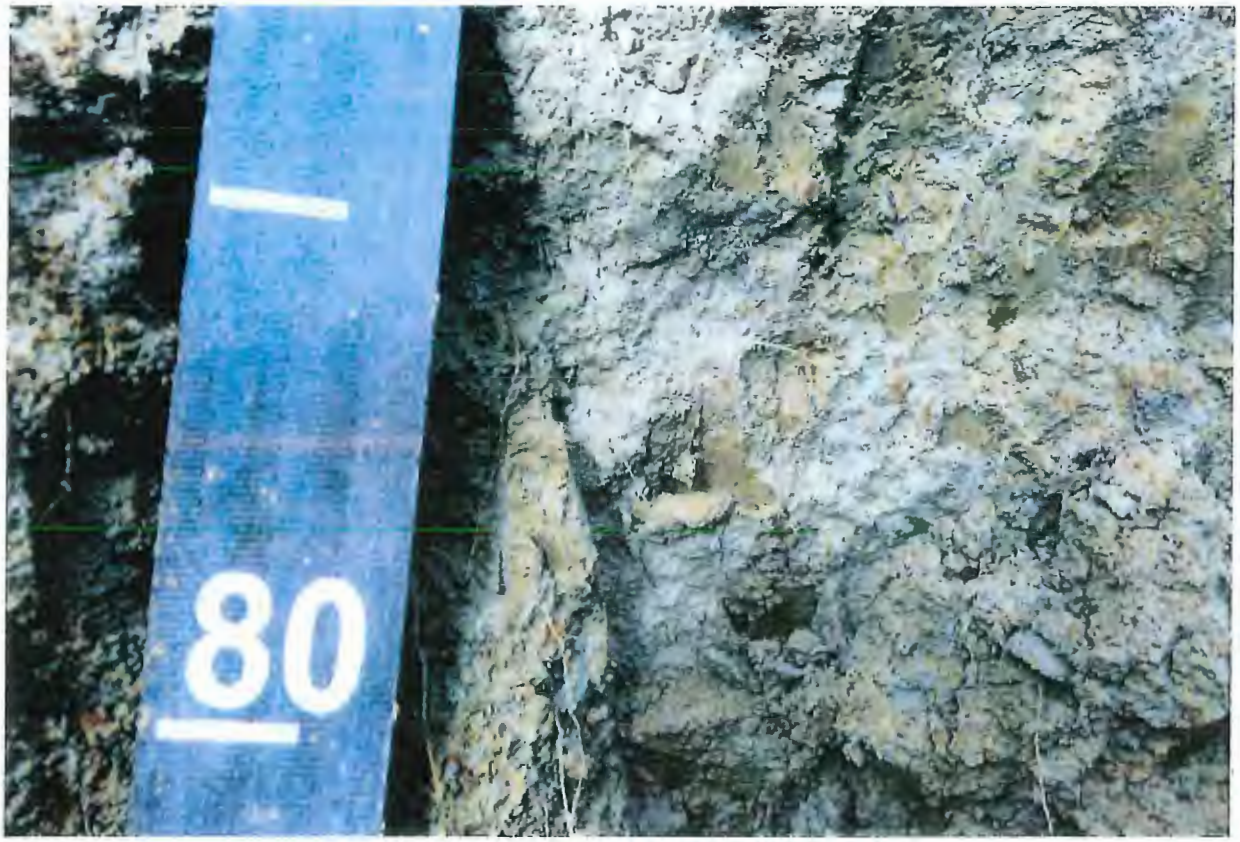


Figure 5 Mottles and roots at 80 cm found at Site 544

# Appendix II Soil chemical analysis

Chemical analysis – Soil Quality laboratory results from selected soil horizons for the composited sample of the three GPS locations

| GPS Site # | Horizon | pH 1:2 water extract | EC (dS/m) Saturated paste 1:2 | OM % Loss on ignition |
|---|---|---|---|---|
| 542<br>543<br>544 | Op<br>Surface<br>horizon | 5.3<br>Acidic * | 0.15<br>Non saline | 33.6<br>High |
| 542<br>543<br>544 | B<br>Subsurface<br>horizon | 6.2<br>Neutral * | 0.08<br>Non saline | Not<br>determined |

* Soil Reaction Class: The Canadian System of Soil Classification 3rd edition.1998. Soil Classification Working Group. Research Branch, Agriculture and Agri-Food Canada Publication 1646. National Research Council, Ottawa, Canada. 187 pages.

Chemical analysis – Nutrient analysis laboratory results from selected soil horizons for the composited sample of the three GPS locations

| | | Nutrient analysis (ppm) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GPS Site # | Horizon | N* | P | K | S** | Ca | Mg | Fe | Cu | Zn | B | Mn | Cl |
| 542<br>543<br>544 | Op | <2<br>$D^1$ | 7<br>$D^1$ | 39<br>$D^1$ | 5<br>$M^2$ | 1860<br>$E^4$ | 67<br>$O^3$ | 194<br>$O^3$ | 0.8<br>$M^2$ | 4.9<br>$O^3$ | 0.2<br>$D^1$ | 1.0<br>$M^2$ | 5.8<br>$M^2$ |
| 542<br>543<br>544 | B | <2<br>$D^1$ | | | 3<br>$M^2$ | | | | | | | | |

N* nitrate-N

S** sulphate-S

$D^1$ deficient nutrient status

$M^2$ marginal nutrient status

$O^3$ optimum nutrient status

$E^4$ excess nutrient status

The chemical data indicate that the soils in the subject property are non-saline, are acidic in the surface layer and neutral in the subsurface in terms of soil acidity, and are deficient in nitrogen, phosphorus, potassium and boron. The nutrient levels of sulphur, copper, manganese, and chlorine are marginal, and there is an excess of calcium, whereas the levels for the other nutrients measured are optimal status.

# Soil and land capability assessment for the property located at 14920 Burrows Road, Richmond BC

Prepared by:

Bruce McTavish, MSc, MBA, PAg, RPBio

&

Elizabeth Kenney MSc, PAg

McTavish Resource & Management Consultants Ltd.
2858 Bayview Street, Surrey BC V4A 2Z4

September 28, 2016

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## 1.0 Introduction

McTavish Resource & Management Consultants Ltd. was requested by the property owners of 14920 Burrows Road, Richmond BC to conduct a soils and agricultural capability assessment for their property. A field visit took place on May 5, 2016. The objective of the field work was to assess the agricultural capability of the land, determine the soil series and determine agricultural limitations on the property.

## 2.0 Methodology

Three detailed field investigations were conducted at GPS locations 545, 546 and 547 as seen in Figure 1. At each site an excavator was used to dig the soil to depths of 120-190 cm. For each site the soils were described in terms of profile morphology including: horizonation, depths, soil textures, coarse fragments, mottles, and depth to water table. The site landscapes were described in terms of landform, surficial materials, surface stoniness, slope, and soil drainage. The soils observed were identified to soil series and were then compared to the existing soil mapping for the subject property (See Figure 2).

The soils were also compared to the existing agricultural capability mapping for the subject property (Figure 3). Two soil samples were collected for chemical analysis. The three surface horizons were composited into one sample for analysis to represent the surface Op. The second soil sample consisted of a composite sample from the underlying subsurface B horizons from the three sample points.


Figure 1 Soil sampling sites

## 3.0 Summary of soil observations

The May 5, 2016 soil sampling verified the existing soil mapping to varying degrees. The existing mapping, which was done at 1:25,000 scale, recognized 2 different soils occurring within the subject area (Figure 3). The existing mapping reports the landscape as gently undulating with slopes between 0.5 and 2%. The surface stoniness class was mapped as S0 (non-stony) land. These mapped soils are shallow organic accumulations (15-40 cm thick) overlaying moderately fine to fine textured fluvial and deltaic deposits: AN (Annis) – Peaty Gleysols, and soils that have developed from 40-160 cm of mainly well decomposed organic materials which overlie moderately fine to fine textured deltaic deposits: Richmond (RC) – Terric Humisols.

All three sample sites fell within the existing soil mapping polygon AN 60%, RC 40%/b, S0 and were classified as belonging to the Annis soil series (Table 1). No Richmond soil was observed on the subject property.

All soils on the property have poor to very poor drainage characteristics that are a function of soil texture, subsoil compaction, location in the regional topography and dykes up to 2.4 m high on the south and east of the property which prevent surface drainage (Table 2).

Detailed soil logs are provided in Appendix I and soil laboratory results in Appendix II.


Figure 2 Existing soil mapping

Luttmerding 1980 Scale 1:25,000
http://www.env.gov.bc.ca/esd/distdata/ecosystems/Soil_Data/SIFT/Soil__AgCap_KML_Files/

Table 1 Soil series observed on the subject property

| Soil observation GPS numbers | Soil polygon map unit name | Soil series occurring at the soil observation site |
|---|---|---|
| 545 | AN60% - RC 40%/b, S0 | AN/b, S0 Annis |
| 546 | AN60% - RC 40%/b, S0 | AN/b, S0 Annis |
| 547 | AN60% - RC 40%/b, S0 | AN/b, S0 Annis |

Table 2 Soil properties and drainage characteristics

| Soil symbol | Soil name | Soil texture and parent material | Soil drainage |
|---|---|---|---|
| AN | Annis | Shallow organic matter accumulations (15-40 cm) which overlie moderately fine to fine textured Fraser River floodplain and deltaic deposits. Surfaces are generally well decomposed humic organic materials. Subsurface and subsoils are silty clay loam or silty clay. At depths below 1 metre medium or fine sand may occur. These deeper materials may be saline in the deltaic deposits. | Poorly to very poorly drained |
| RC | Richmond | 40-160 cm of mainly well decomposed organic materials overlying moderately fine and fine textured deltaic materials. Surfaces vary from moderately to well decomposed depending on length of time under cultivation. Subsurface organic materials are well decomposed humic materials. The underlying mineral soil is silt loam to silty clay loam. The mineral soil is often massive and contains the remains of old plant roots and stems. The mineral soil may be saline. | Very poorly drained Water tables at or near surface during most of the winter early spring but recede somewhat during the growing season |

From Luttmerding 1981

Annis soils differ from the Richmond soils in the thickness of the overlying organic materials. None of the three sample sites on the subject property had organic surfaces >40 cm.

## 4.0 Agricultural capability

The original agricultural capability mapping indicates that the unimproved agricultural capability rating is 60% 4WD and 40% O4WL as shown in Figure 3 and Table 3.

Based on the site investigations and analysis of results, the agricultural capability of the subject property is unimproved 4WD improvable to 3DW by improving drainage (Table 4).

The landscape topography is not limiting and there are no limitations due to coarse fragments. At the time of sampling (May 5 – late spring) the water table was below 1 metre. The presence of an organic surface layer and mottling in the surface mineral soils indicate that the soils are experiencing water levels at or near the surface during the winter months. The lack of mottles in the lower C horizons

(depths ~ 100 cm+) indicates that the soil at depth remains wet or saturated and remains in a reduced state.

The mineral soils underlying the organic surface horizon are silty clay in texture and are sticky when wet. The deeper C horizons are also more massive in terms of soil structure. The texture and structure of the subsurface and subsoils are consistent with a 3D limitation for undesirable soil structure and/or low perviousness.

Based on interviews with the owner and a review of the Hydrologist's report for this property it is evident that the property has water at the surface and/or the soil is in a saturated condition for the winter and early spring with at least 4 months of the year that the land is not accessible.

"The ground surface is flat with no discernible grades to surface water drainage on any side of the Site. Evidence indicates surface water cannot flow to drainages located on the north and east sides of the Site. There are dykes located up to 2.4 higher than the property on the south and ease sides which prevent runoff in these directions."[1]

The interview with the landowner and review of the Hydrologist's report correspond with the soil observations and confirm the unimproved 4W capability classification.

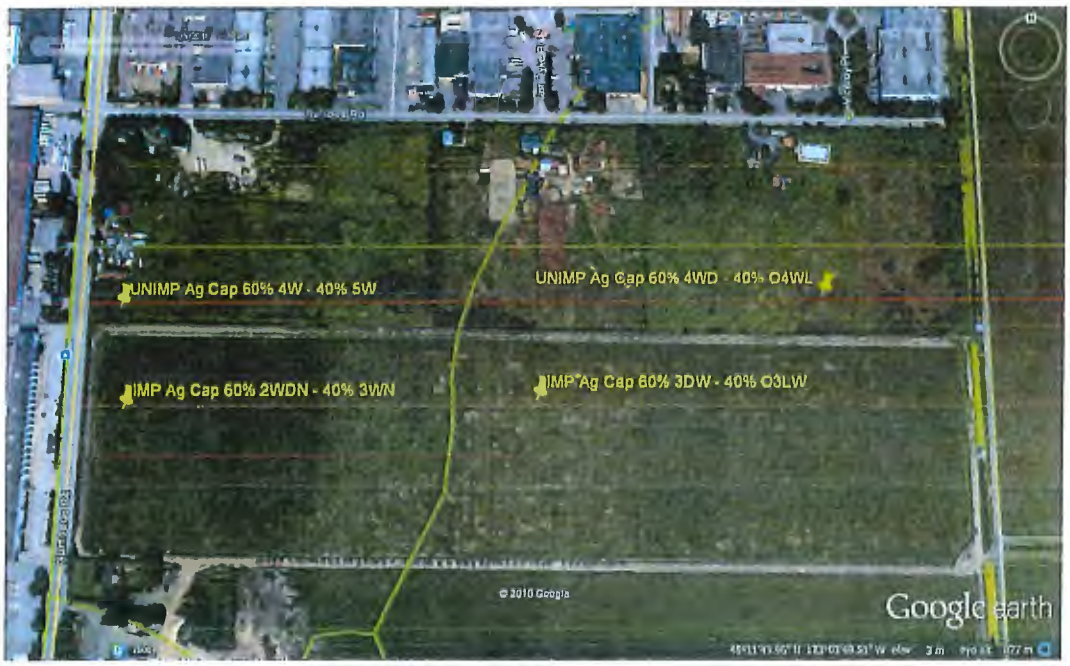


Figure 3 Historical agricultural capability mapping

http://www.env.gov.bc.ca/esd/distdata/ecosystems/Soil_Data/SIFT/Soil__AgCap_KML_Files/

[1] Active Earth Engineering August 29, 2016. Preliminary Hydrology Assessment 14920, 14680, 14540, 14400, and 14300 Burrows Road, Richmond BC

Table 3 Agricultural capability from historic mapping

| Unimproved agricultural capability | Improved agricultural capability |
|---|---|
| 60% 4WD – 40% O4WL | 60% 3DW – 40% O3LW |

W = Excess water
D = Undesirable soil structure and/or low perviousness
L = Degree of decomposition - permeability for organic soils (O)

Table 4 Agricultural capability based on site observations

| Soil observation GPS numbers | Soil | Unimproved | Improved |
|---|---|---|---|
| 545 | Annis | 4WD | 3DW |
| 546 | Annis | 4WD | 3DW |
| 547 | Annis | 4WD | 3DW |

## 5.0 Soil management

Table 8 shows the soil management considerations and crop suitability based on site observations and observed soil mapping. The soil management groupings of the Fraser Valley soils and the crop suitability for each management group have been well documented in two reports (Luttmerding, 1984 and Bertrand et Al, 1991). Table 5 draws on these two publications for management and crop suitability as well as on Luttmerding 1981.

Table 5 Soil management and crop suitability

| Soil name | Soil management considerations from Bertrand et Al 1991 and Luttmerding 1984 | Crop suitability from Bertrand et Al 1991 and Luttmerding 1984 |
|---|---|---|
| Annis | Poor drainage is the main agricultural limitation<br>Underdrains need to be closely spaced due to the moderately to slow perviousness nature of the subsoils<br>Periodic subsoiling to loosen the silty clay subsoils is required to maintain the underdrains efficiency as well as to improve aeration and root distribution<br>Management required to minimize loss of the organic surface layer<br>Liming will generally be required to improve crop production<br>High water tables and variable bearing strengths also make road and building construction difficult and basements impractical | Suited crops include pasture and forage crops, blueberries, and annual field crops including: annual legumes, cereals, cole crops, corn, root crops excluding carrots, and shallow rooted annual vegetables<br><br>Unsuited crops include nursery and Christmas trees, raspberries, strawberries and tree fruits because even with artificial drainage the soils will still have excessive water for the production of these crops |

## 5.1 Site improvement for agriculture

For field agriculture production (other than pasture) to be viable on this property drainage must be improved. This requires the installation of subsurface drainage and having a drainage ditch of adequate depth for the subsurface drains to discharge. At the present time there are no ditches available for gravity discharge and the only potential outlet option would be to install a pumping station to discharge water into the large drainage channel directly to the east of the property.

A second option is the fill the site; raising the elevation high enough above the water table to improve drainage for production of annual vegetable, forage and/or small berry crops.


Figure 4 Drainage channel directly east of the property

# References

Bertrand, RA, GA Hughes-Games, DC Nikkel, 1991. Soil Management Handbook for the Lower Fraser Valley, 2nd Edition. BC Ministry of Agriculture, Fisheries and Food, Abbotsford, BC, 115 pp.

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Kenk, E 1983.Land Capability Classification for Agriculture in British Columbia, MOE Manual 1. BC Ministry of Environment and BC Ministry of Agriculture, Kelowna, BC, 62 pp.

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# Appendix I Detailed soil observations

## Sample Site 545

SOIL SERIES: Annis

SOIL CLASSIFICATION: Orthic Gleysol peaty phase

PARENT MATERIAL: Shallow organic accumulations overlaying moderately fine to fine textured fluvial and deltaic deposits.

DRAINAGE: Poor

WATERTABLE at TIME of SAMPLING: 150 cm

SURFACE STONINESS: Non stony

ROOT RESTRICTING LAYER: None.

TOPOGRAPHY: Gently undulating (0.5-2% slopes)

VEGETATION & LAND USE: Reed canary grass

Table 6 Profile description Site 545

| Horizon | Depth (cm) | Coarse fragments (% by volume) | Texture | Moisture | Comments |
|---|---|---|---|---|---|
| Op | 30-0 | 0 | Humic | moist | Well decomposed organic matter |
| Bgj | 0-9 | 0 | SiCL | moist | Yellow brown colour, few, fine faint mottles, well structured, contains roots |
| BCg | 9-77 | 0 | SiC | moist | Many, fine-medium prominent mottles, well structured, contains roots |
| Cg1 | 77-110 | 0 | SiC | moist | Common, medium, prominent mottles, more massive, contains roots |
| Cg2 | 110-156 | 0 | SiCL-SiC | wet | No mottles, more massive, contains roots, contains sand lenses along crack faces, water table at 150 cm |
| Cg3 | 156-160+ | 0 | SCL | wet | No mottles, more massive, contains few roots |

Vegetation and soil at Site 545

## Sample Site 546

SOIL SERIES: Annis

SOIL CLASSIFICATION: Orthic Gleysol peaty phase

PARENT MATERIAL: Shallow organic accumulations overlaying moderately fine to fine textured fluvial and deltaic deposits.

DRAINAGE: Poor

WATERTABLE at TIME of SAMPLING: 182 cm

SURFACE STONINESS: Non stony

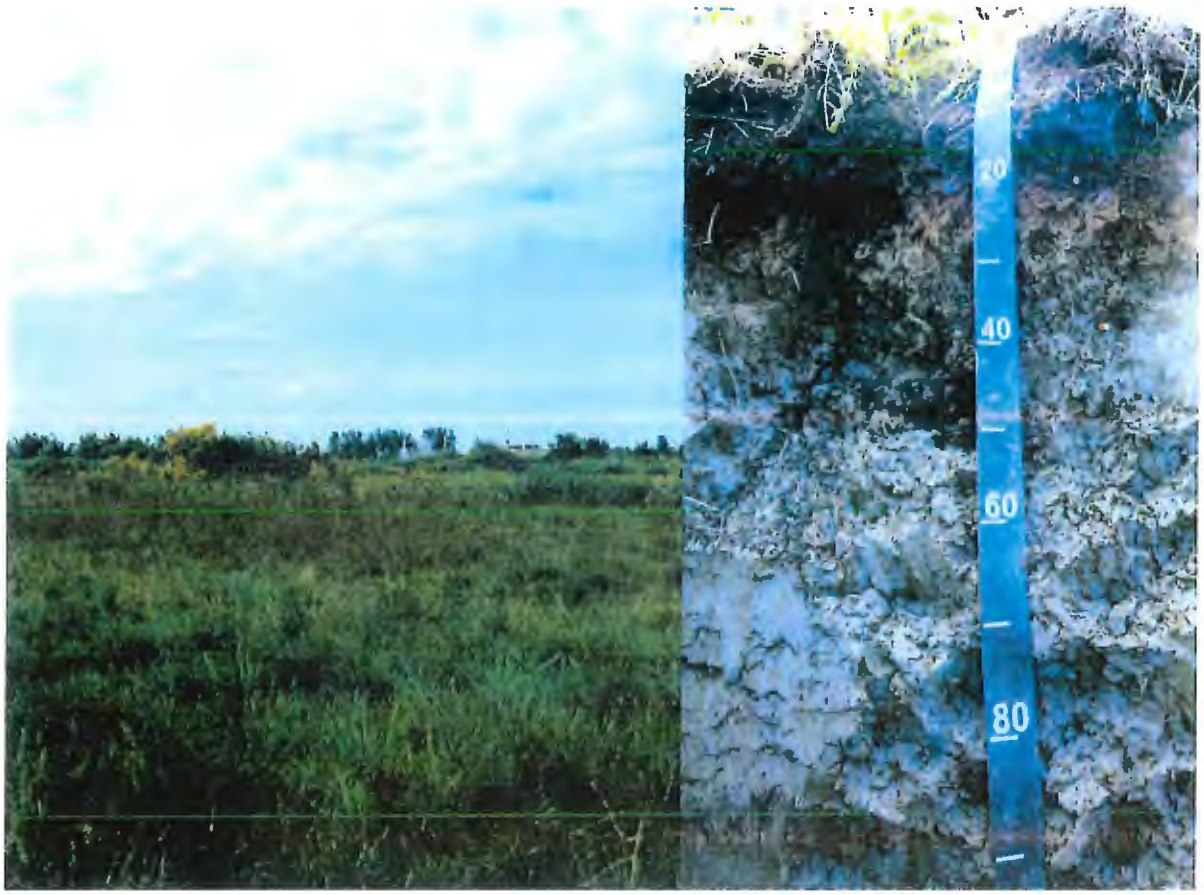
ROOT RESTRICTING LAYER: None.

TOPOGRAPHY: Gently undulating (0.5-2% slopes)

VEGETATION & LAND USE: Reed canary grass

Profile description Site 546

| Horizon | Depth (cm) | Coarse fragments (% by volume) | Texture | Moisture | Comments |
|---|---|---|---|---|---|
| Op | 22-0 | 0 | Humic | moist | Well decomposed organic matter |
| Bgj | 0-9 | 0 | SL | moist | Yellow brown colour, few, fine faint mottles, contains roots |
| II Bgj | 9-27 | 0 | SiC | moist | few, fine faint mottles, well structured, sticky, contains plentiful roots, contains organic materials |
| II BCg | 27-54 | 0 | SiC | moist | Common, medium, prominent mottles, contains roots, charcoal and wood debris |
| III BCg | 54-65 | 0 | LS | moist | Common, medium, distinct mottles, contains roots |
| IV Cg1 | 65-100 | 0 | SiC | moist | Common, medium, prominent mottles, contains roots, and wood debris, has some structure |
| IV Cg2 | 100-160+ | 0 | SiC | wet | contains some roots and sand lenses, no structure - massive |




Vegetation and soil at Site 546

## Sample Site 547

SOIL SERIES: Annis

SOIL CLASSIFICATION: Orthic Gleysol peaty phase

PARENT MATERIAL: Shallow organic accumulations overlaying moderately fine to fine textured fluvial and deltaic deposits.

DRAINAGE: Poor

WATERTABLE at TIME of SAMPLING: 120 cm

SURFACE STONINESS: Non Stony

ROOT RESTRICTING LAYER: None.

TOPOGRAPHY: Gently undulating (0.5-2% slopes)

VEGETATION & LAND USE: Reed canary grass

Table 3 Profile description Site 547

| Horizon | Depth (cm) | Coarse Fragments (% by volume) | Texture | Moisture | Comments |
|---|---|---|---|---|---|
| Op | 28-0 | 0 | Humic | moist | Well decomposed organic matter |
| Bgj | 0-19 | 0 | SiCL | moist | Few, fine faint mottles, well structured, contains roots |
| BCg | 19-96 | 0 | SiC | moist | Common, medium prominent mottles, well structured, contains roots |
| Cg | 96-135 | 0 | SiC | wet | No mottles, no structure - massive |

Vegetation and soil at Site 547

Water table at Site 547

# Appendix II Soil laboratory analysis

Chemical analysis – Soil quality laboratory results from selected soil horizons for the composited sample of the three GPS locations

| GPS Site # | Horizon | pH 1:2 water extract | EC (dS/m) saturated paste 1:2 | OM % loss on ignition |
|---|---|---|---|---|
| 545<br>546<br>547 | Op<br>Surface<br>horizon | 5.5<br>Acidic * | 0.14<br>Non saline | 52.6<br>High |
| 545<br>546<br>547 | B<br>Subsurface<br>horizon | 5.8<br>Acidic * | 0.10<br>Non saline | Not determined |

* Soil Reaction Class: The Canadian System of Soil Classification 3rd edition. 1998. Soil Classification Working Group. Research Branch, Agriculture and Agri-Food Canada Publication 1646. National Research Council, Ottawa, Canada. 187 pages.

Chemical analysis – Nutrient analysis laboratory results from selected soil horizons for the composited sample of the three GPS locations

| | | Nutrient analysis (ppm) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GPS Site # | Horizon | N* | P | K | S** | Ca | Mg | Fe | Cu | Zn | B | Mn | Cl |
| 545<br>546<br>547 | Op | 2<br>$D^1$ | 25<br>$M^2$ | 43<br>$D^1$ | 3<br>$M^2$ | 1570<br>$O^3$ | 195<br>$O^3$ | 226<br>$O^3$ | 0.6<br>$M^2$ | 5.1<br>$O^3$ | 0.2<br>$D^1$ | 1.9<br>$M^2$ | 5.1<br>$M^2$ |
| 545<br>546<br>547 | B | <2<br>$D^1$ | | | 3<br>$M^2$ | | | | | | | | |

N* nitrate-N

S** sulphate-S

$D^1$ deficient nutrient status

$M^2$ marginal nutrient status

$O^3$ optimum nutrient status

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The chemical data indicate that the soils in the subject property are non-saline, are acidic in terms of soil pH, and are deficient in nitrogen, potassium and boron. The nutrient levels of copper, manganese, chlorine, and phosphorus are marginal, whereas the levels for the other nutrients measured are optimal.

* Note: 14400 & 14300 Burrows Road are not included in the subject application

Active Earth Engineering Ltd

July 27, 2016 AE Project No. 1148

Pacific Land Group
212 – 12992-76 Avenue,
Surrey, B.C., V3W 2V6

**ATTENTION:** Laura Jones, MCIP, RPP
Senior Development Planner

**Re: Preliminary Geotechnical Investigation**
**14920, 14680, 14540, 14400 and 14300 Burrows Road ***
**Richmond, BC**

---

## 1.0 INTRODUCTION

This report presents the results of a preliminary geotechnical site assessment conducted by Active Earth Engineering (Active Earth) for the above referenced properties. The purpose of the geotechnical assessment was to evaluate soil conditions in order to provide recommendations in relation to the following:

- Subgrade preparation for building foundations.
- Depth to competent subgrade.
- General geotechnical design recommendations.

Environmental considerations are outside the scope of this geotechnical assessment.

## 2.0 SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The subject site comprises of five properties, namely 14300, 14400, 14540, 14680 and 14920 located on the south side of Burrows Road, in Richmond. The site is rectangular in shape and measures approximately 400 m east - west by 150 m north - south. The site is bounded by Burrows Road to the north and farm land to the other three sides. Single family dwellings occupy three properties, 14300, 14400 and 14680. Property 14540 was used for stables and 14920 was vacant at the time of site investigation. The site is flat-lying, however, the site and is approximately 0.5-1 m below the Burrows Road.

It is understood that the site will be developed into commercial at grade buildings, with surface parking. Preliminary information reveals that the site would be raised by approximately 2. 5 m to bring the site grades at minimum flood construction level. The conceptual building plans were

not available at the time of writing this report. Once available, these should be forwarded to us so that we may revise this report, if necessary.

## 3.0 SUBSURFACE INVESTIGATION

The geotechnical investigation consisted of advancing four auger holes (AH1 – AH4) and three electronic Cone Penetration Tests (CPT1-CPT3). The CPT and auger holes were advanced up to 25 and 10 m depths below the existing surface. The approximate locations of these tests are shown on the attached site plan. Track mounted drill rig operated by Ontrack Drilling was utilized for the site investigation. CPT provides a continuous plot of soil strength parameters with depth. Shear wave velocity test was also completed in CPT2. A representative from Active Earth supervised the field work and classified the soils encountered in the auger holes.

The report attachments include a site plan and soil logs. The depths indicated on the logs are related to the ground surface at the time of the investigation.

## 4.0 SOIL AND GROUNDWATER CONDITIONS

Geological map (GeoMap Vancouver – Robert J.W. Turner and John J. Clauge) indicates that the site is located within a formation of sand and silt belonging to Modern Age sediments. The subsurface conditions encountered were generally consistent with the published geological information and consistent between the augerholes. The following soil conditions were encountered in the order of increasing depth:

- **Silt and Clay** - Surficial layer of topsoil and root mat is underlain by approximately 1.5-2.1 m thick layer of silt and clay. Undrained shear strength (Su) of this deposit as inferred from the CPT was in the order of 50 kPa. Liquid and Plastic Limits of a sample collected were 38% and 25% respectively, indicating that the soils are low plastic; overlying
- **SAND** - Medium to fine grained sand was encountered below silt and clay. The sand was compact and generally becomes dense at 5 m depth. The equivalent Standard Penetration Test (SPT) blows were 20 below 5 m depth. All the augerholes and CPT tests terminated in this layer.

**Groundwater:** The groundwater table was encountered at an average of 1.2 m depth, on May 1st, 2016. Groundwater typically fluctuates with changes in season, precipitation and land use. Therefore, minor changes in groundwater levels should be expected.

The soil conditions as described above are generalized and are based on the soil investigation. Minor variations in the soil stratigraphy should be expected between the test locations and the areas of the site not investigated.

## 5.0 DISCUSSION AND RECOMMENDATIONS

### 5.1 General

Based on the subsurface investigation, the site has competent soil conditions for the proposed development. The buildings will be supported on conventional footings. The existing site grades are at approximate elevation (EL) 1 m and the proposed development would be at flood construction EL of 3 m. Therefore the site will be raised by approximately 2 m. Although the existing surficial 1.5 m thick clays soils are stiff, however, these are moderately compressible under 2 m thick proposed fills. Therefore the fills should be allowed to consolidate the existing clays prior to building construction. A minimum consolidation period of 4 months is recommended. The filling should be completed at least beyond 10 m from the building so that any future fill around the building may not trigger the consolidation again. Similarly, the fill soils should not be stockpiled within 10 m of the existing building. Since the entire site will be occupied by buildings and surface parking. Therefore the fills should be structural fills and compacted under strict quality control, as described in the following section.

Liquefaction analysis of CPT data (collected at three locations) was completed and is attached. The analysis indicates that the dense sands underlying the site are non-liquefiable. However, the surficial approximately 1 m sand will liquefy under the design seismic event and the site is likely to settle 30 mm under the design seismic event. The following sections of the report provide our recommendation in detail.

### 5.2 Subgrade Preparation

The area of building envelope, sidewalks, parking and driveways should be stripped and cleared of topsoil, organics, loose soils, fill and other deleterious material to expose a non-organic native subgrade consisting of clay. Stripping should be carried out with clean-up bucket of an excavator to minimize disturbance to the subgrade. Stripped subgrade should be reviewed and approved by Active prior to placement of structural fill.

It is recommended that the site preparation (stripping and filling) should be done during the extended dry season.

### 5.3 Structural Fill

Structural fill is defined as fill placed beneath any load bearing area. Imported structural fill should consist of well-graded, 75 mm minus pit run sand and gravel or other granular material approved by the Geotechnical Engineer. It should be non-organic and clean (less than 8% fines passing 0.075 mm sieve by weight). Structural fill should be placed in maximum 0.3 m lifts. In building envelope and parking areas, it should be compacted to the satisfaction of geotechnical engineer. Typically, the fills are tested for compaction, by proof rolling under a fully loaded truck and observing the rutting under the wheels.

### 5.4 Foundations

The proposed buildings may be supported on spread and strip footings on the compacted and approved fills. The serviceability bearing resistance of footings depends on the type of fills, and compaction level. Geotechnical Engineer must be retained for each property to provide geotechnical recommendations for a specific building. A Site Class "D" may be used for the seismic design, based on table 4.1.8.4A of the BCBC 2012.

Minimum footing widths should be 0.45 m for strip footings and 0.9 m for pad footings, in accordance with the requirements of the 2012 British Columbia Building Code. Footings should have a minimum embedment of 0.45 m for frost protection and confinement. Footing subgrades should be stripped of water softened or loose soil prior to placing concrete.

Adjacent footings at different elevations should be offset from each other by a distance at least equal to the difference in elevation and the sloped subgrade between the footings should be undisturbed native. In addition, a geotechnical review will be required at the time of form-work. Similarly, the utility excavation bottom should be beyond a 1.5H:1V line projected down from the outer edge of footing to avoid its undermining.

## 6.0 CLOSURE AND LIMITATIONS

The subsurface conditions may vary between auger holes. The interpretation of subsurface conditions provided is an opinion and not a certification. Stratigraphic variations in ground conditions are expected due to its historic nature. As such, all explorations involve an inherent uncertainty that some conditions will not be detected, as expected. Environmental considerations are outside the scope of this geotechnical report. Samples obtained from the Site will be retained in our laboratory for 60 days. Should no instructions be received to the contrary, these samples will then be discarded.

This report has been made in accordance with the generally accepted soil and foundation engineering practices. No other warranty expressed or implied is made. If the project does not start with two years of the report date, the report may become invalid and further review may be required.

This report has been prepared for the exclusive use of Pacific Land Group- and their "Approved Users" for specific application to the development mentioned in the report. Active Earth and its employees accept no responsibility to another party for loss or liability incurred as a result of the use of this report. Any use of this report for purposes other than the intended use should be approved in writing by Active Earth. Contractors should rely upon their own explorations for costing purposes.

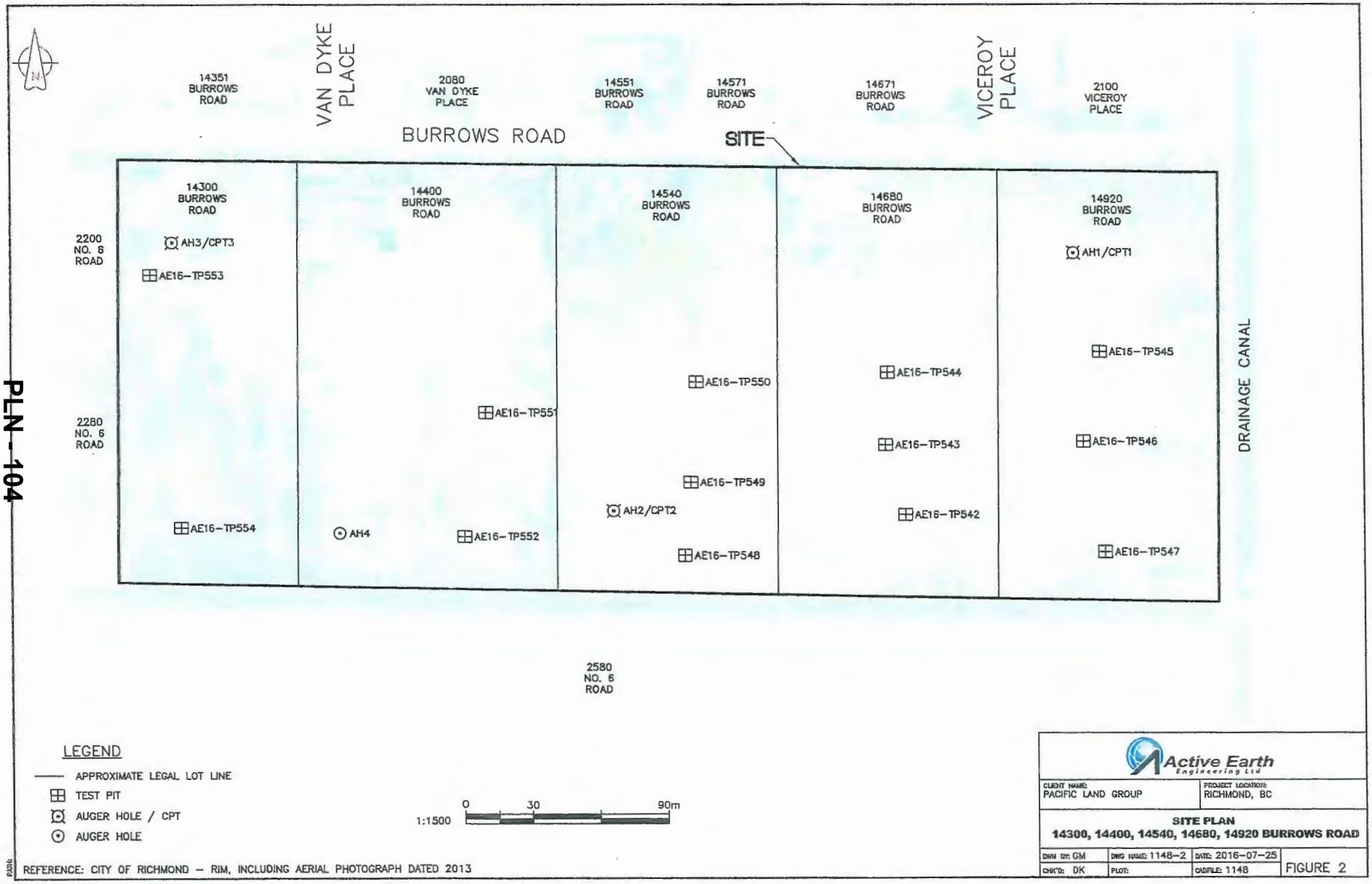
If you have any questions regarding the contents of this report, or if we can be of further assistance to you on this project, please call any of the undersigned.

Yours truly,
***Active Earth Engineering Ltd.***


David Kneale, P.Geo.
Principal, Project Manager

Attachments: Location Plan
Site Plan
Borehole Logs
CPT Logs
Liquefaction Analysis
Atterberg Limits

# ATTACHMENTS


14351 BURROWS ROAD
VAN DYKE PLACE
2080 VAN DYKE PLACE
14551 BURROWS ROAD
14571 BURROWS ROAD
14671 BURROWS ROAD
VICEROY PLACE
2100 VICEROY PLACE
BURROWS ROAD
SITE
14300 BURROWS ROAD
14400 BURROWS ROAD
14540 BURROWS ROAD
14680 BURROWS ROAD
14920 BURROWS ROAD
2200 NO. 6 ROAD
2280 NO. 6 ROAD
2580 NO. 6 ROAD
DRAINAGE CANAL
AH3/CPT3
AE16-TP553
AE16-TP554
AH4
AE16-TP552
AE16-TP551
AE16-TP550
AH2/CPT2
AE16-TP549
AE16-TP548
AE16-TP544
AE16-TP543
AE16-TP542
AH1/CPT1
AE16-TP545
AE16-TP546
AE16-TP547
LEGEND
APPROXIMATE LEGAL LOT LINE
TEST PIT
AUGER HOLE / CPT
AUGER HOLE
1:1500
0
30
90m
REFERENCE: CITY OF RICHMOND – RIM, INCLUDING AERIAL PHOTOGRAPH DATED 2013
Active Earth Engineering Ltd
CLIENT NAME: PACIFIC LAND GROUP
PROJECT LOCATION: RICHMOND, BC
SITE PLAN
14300, 14400, 14540, 14680, 14920 BURROWS ROAD
DWN BY: GM
DWG NAME: 1148-2
DATE: 2016-07-25
CHK'D: DK
PLOT:
CADFILE: 1148
FIGURE 2

PLN - 104

Active Earth Engineering Ltd

# AH1

(Page 1 of 1)

Burrows Road
Richmond, BC

AE Project No. 1148

| | | | |
|---|---|---|---|
| Date Started | : May 1, 2016 | Company Rep. | : TB |
| Date Completed | : May 1, 2016 | Lab Analysis | : *Indicates sent for analysis |
| Hole Diameter | : n/a | Drilled By | : Ontrack Drilling |
| Drilling Method | : Track mounted drill rig | Logged By | : TB |
| Sampling Method | : Grab | | |

| Depth in Meters | Surf. Elev. | USCS | GRAPHIC | DESCRIPTION | Lab Analysis | Sample No. | Soil Vapours ppm |
|---|---|---|---|---|---|---|---|
| 0 | | | | SILT and CLAY, 100mm thick topsoil and rootmat, grey-brown, firm upto 0.3m, moist, low plastic | | | |
| | | | | becomes soft below 0.4m | | | |
| 1 | | | | becomes saturated below 1m | | | |
| | | | | SAND, medium to fine grained, compact, saturated, clean | | | |
| 2 | | | | | | | |
| | | SW | | | | | |
| 3 | | | | | | | |
| 4 | | | | isolated silty pockets below 4m | | | |
| 5 | | | | | | | |
| 6 | | | | End of Hole | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |
| 11 | | | | | | | |

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Active Earth Engineering Ltd

# AH2



Burrows Road
Richmond, BC

AE Project No. 1148

| | | | |
|---|---|---|---|
| Date Started | : May 1, 2016 | Company Rep. | : TB |
| Date Completed | : May 1, 2016 | Lab Analysis | : *indicates sent for analysis |
| Hole Diameter | : n/a | Drilled By | : Ontrack Drilling |
| Drilling Method | : Track mounted drill rig | Logged By | : TB |
| Sampling Method | : Grab | | |

| Depth in Meters | Surf. Elev. | USCS | GRAPHIC | DESCRIPTION | Lab Analysis | Sample No. | Soil Vapours ppm |
|---|---|---|---|---|---|---|---|
| 0 | | | | SILT and CLAY, 100mm thick topsoil and rootmat, grey-brown, firm upto 0.3m, moist, low plastic | | | |
| | | | | becomes soft below 0.4m | | | |
| 1 | | | | becomes saturated below 1m | | | |
| 2 | | SW | | SAND, medium to fine grained, compact, saturated, clean | | | |
| 3 | | | | becomes silty sand below 3m | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | End of Hole | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |
| 11 | | | | | | | |

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Active Earth Engineering Ltd

# AH3

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Burrows Road
Richmond, BC

AE Project No. 1148

| | | | |
|---|---|---|---|
| Date Started | : May 1, 2016 | Company Rep. | : TB |
| Date Completed | : May 1, 2016 | Lab Analysis | : *Indicates sent for analysis |
| Hole Diameter | : n/a | Drilled By | : Ontrack Drilling |
| Drilling Method | : Track mounted drill rig | Logged By | : TB |
| Sampling Method | : Grab | | |

| Depth in Meters | Surf. Elev. | USCS | GRAPHIC | DESCRIPTION | Lab Analysis | Sample No. | Soil Vapours ppm |
|---|---|---|---|---|---|---|---|
| 0 | | | | SILT and CLAY, 100mm thick topsoil and rootmat, grey-brown, firm upto 0.3m, moist, low plastic | | | |
| | | | | becomes soft below 0.4m | | | |
| 1 | | | | becomes saturated below 1m | | | |
| 2 | | SW | | SAND, medium to fine grained, compact, saturated, clean | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | End of Hole | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |
| 11 | | | | | | | |

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# AH4

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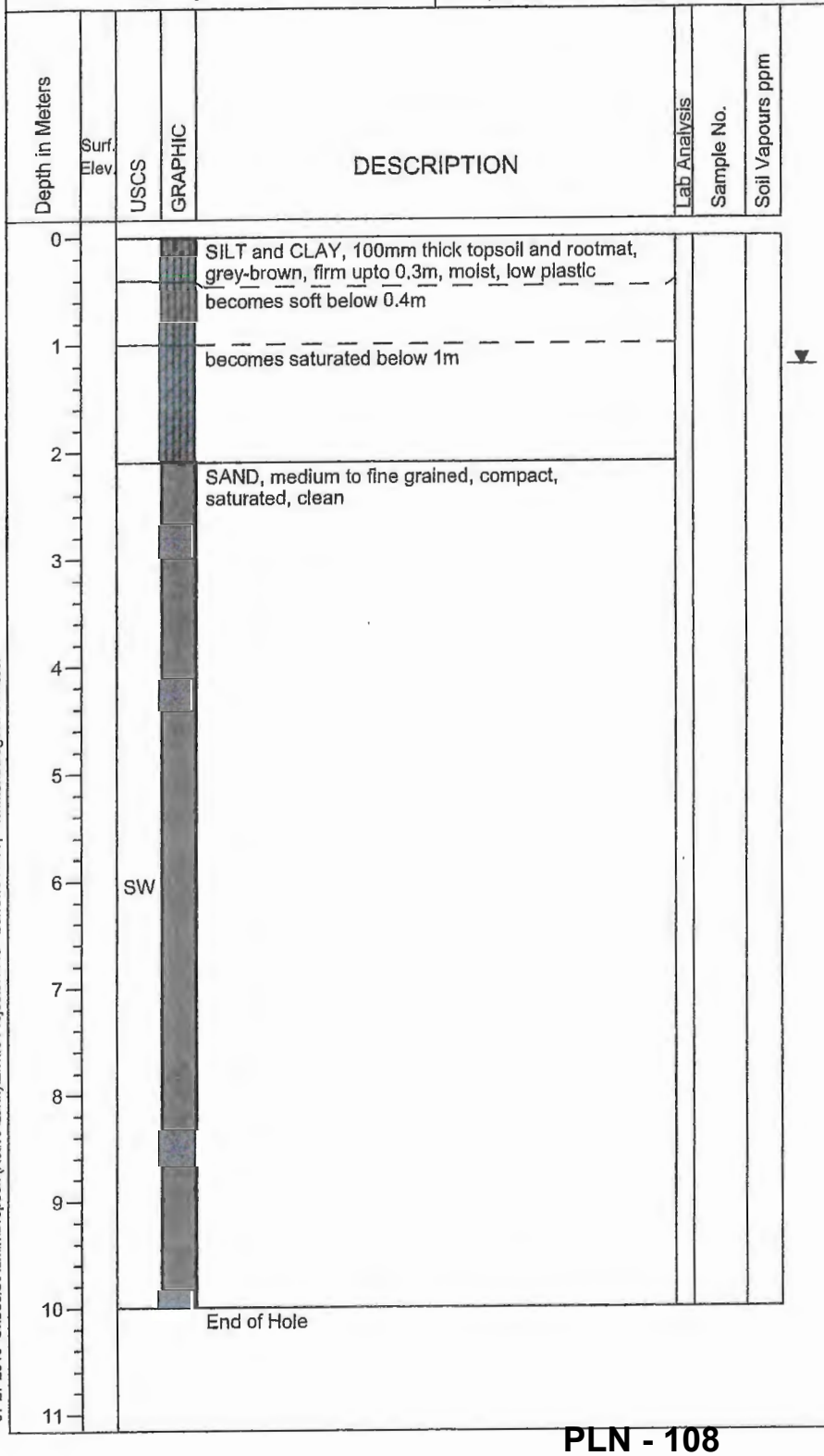
Burrows Road
Richmond, BC

AE Project No. 1148

| | | | |
|---|---|---|---|
| Date Started | : May 1, 2016 | Company Rep. | : TB |
| Date Completed | : May 1, 2016 | Lab Analysis | : *indicates sent for analysis |
| Hole Diameter | : n/a | Drilled By | : Ontrack Drilling |
| Drilling Method | : Track mounted drill rig | Logged By | : TB |
| Sampling Method | : Grab | | |

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Active Earth Engineering Ltd

# AE16-TP542



Burrows Road
Richmond, BC

AE Project No. 1148

| | | | |
|---|---|---|---|
| Date Started | : May 5, 2016 | Company Rep. | : DK |
| Date Completed | : May 5, 2016 | Lab Analysis | : *indicates sent for analysis |
| Hole Diameter | : n/a | Drilled By | : Jakes Construction |
| Drilling Method | : Backhoe | Logged By | : DK |
| Sampling Method | : Grab | | |

| Depth in Meters | Surf. Elev. | USCS | GRAPHIC | DESCRIPTION | Lab Analysis | Sample No. | Soil Vapours ppm |
|---|---|---|---|---|---|---|---|
| 0 | | | | TOPSOIL, peaty, black | | | |
| | | | | SILTY CLAY, grey, slightly oxidized, firm to soft, roots to 0.86m | | | |
| 1 | | | | seepage at 1.09m | | | |
| 2 | | | | End of Hole | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |

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# AE16-TP543

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Burrows Road
Richmond, BC

AE Project No. 1148

| | | | |
|---|---|---|---|
| Date Started | : May 5, 2016 | Company Rep. | : DK |
| Date Completed | : May 5, 2016 | Lab Analysis | : *indicates sent for analysis |
| Hole Diameter | : n/a | Drilled By | : Jakes Construction |
| Drilling Method | : Backhoe | Logged By | : DK |
| Sampling Method | : Grab | | |

| Depth in Meters | Surf. Elev. | USCS | GRAPHIC | DESCRIPTION | Lab Analysis | Sample No. | Soil Vapours ppm |
|---|---|---|---|---|---|---|---|
| 0 | | | | TOPSOIL, peaty, black | | | |
| | | | | TOPSOIL, reddish-brown | | | |
| | | ML | | SILT, reddish-brown | | | |
| | | | | SILTY CLAY, grey, occassional oxidization zones, firm to soft, roots to 0.64m | | | |
| 1 | | | | seepage at 1.02m | | | |
| | | | | End of Hole | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |

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Active Earth Engineering Ltd

# AE16-TP544



Burrows Road
Richmond, BC

AE Project No. 1148

| | | | |
|---|---|---|---|
| Date Started | : May 5, 2016 | Company Rep. | : DK |
| Date Completed | : May 5, 2016 | Lab Analysis | : *Indicates sent for analysis |
| Hole Diameter | : n/a | Drilled By | : Jakes Construction |
| Drilling Method | : Backhoe | Logged By | : DK |
| Sampling Method | : Grab | | |

| Depth in Meters | Surf. Elev. | USCS | GRAPHIC | DESCRIPTION | Lab Analysis | Sample No. | Soil Vapours ppm |
|---|---|---|---|---|---|---|---|
| 0 | | | | TOPSOIL, peaty, black | | | |
| | | ML | | SILT, reddish-brown | | | |
| | | | | SILTY CLAY, grey, occassional oxidation zones, firm to soft, roots to 0.84m | | | |
| 1 | | | | seepage at 1.07m | | | |
| | | | | End of Hole | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |

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Active Earth Engineering Ltd

# AE16-TP545

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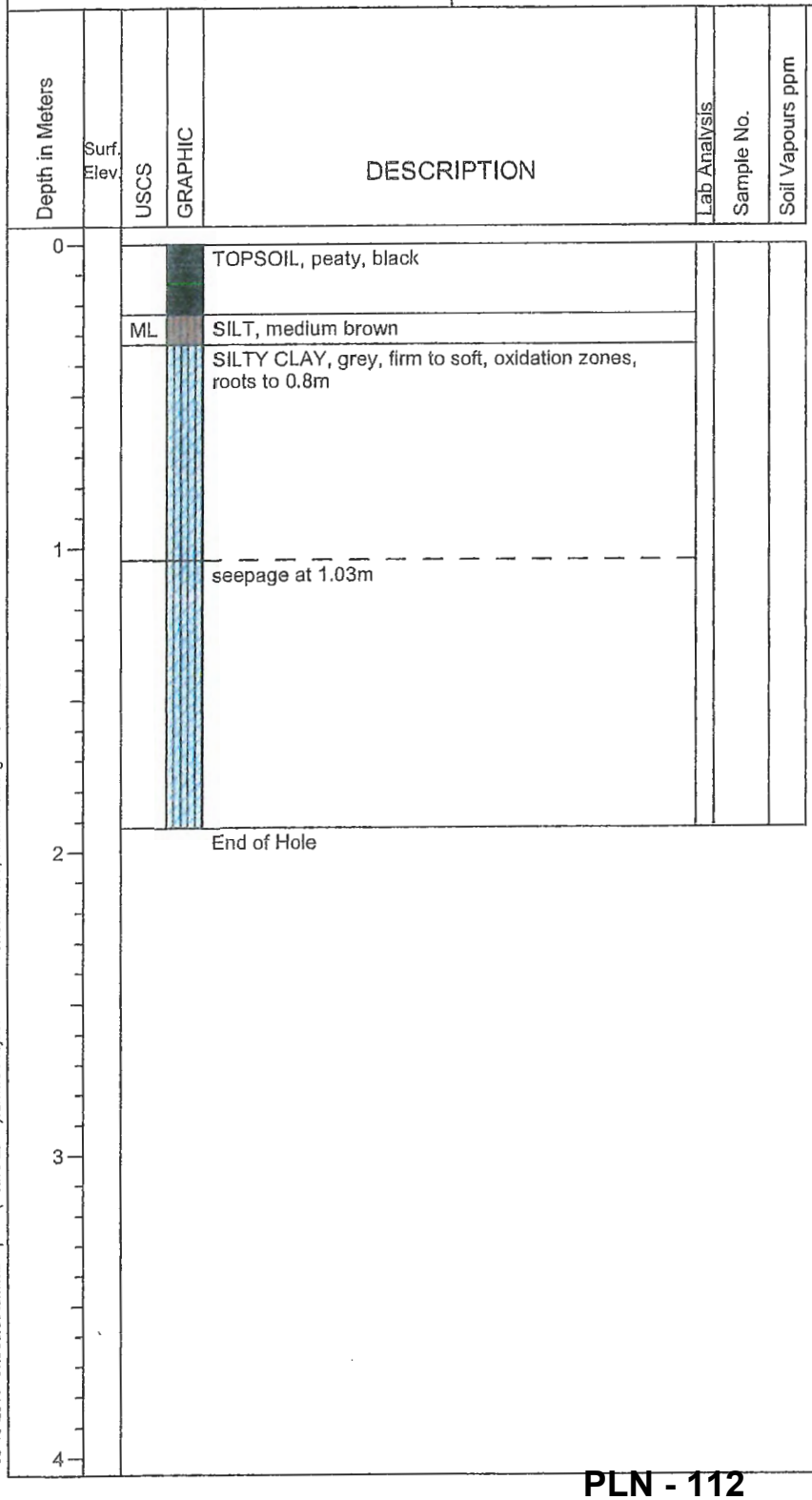
Burrows Road
Richmond, BC

AE Project No. 1148

| | | | |
|---|---|---|---|
| Date Started | : May 5, 2016 | Company Rep. | : DK |
| Date Completed | : May 5, 2016 | Lab Analysis | : *indicates sent for analysis |
| Hole Diameter | : n/a | Drilled By | : Jakes Construction |
| Drilling Method | : Bakhoe | Logged By | : DK |
| Sampling Method | : Grab | | |

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Active Earth Engineering Ltd

# AE16-TP546



Burrows Road
Richmond, BC

AE Project No. 1148

| | | | |
|---|---|---|---|
| Date Started | : May 5, 2016 | Company Rep. | : DK |
| Date Completed | : May 5, 2016 | Lab Analysis | : *indicates sent for analysis |
| Hole Diameter | : n/a | Drilled By | : Jakes Construction |
| Drilling Method | : Backhoe | Logged By | : DK |
| Sampling Method | : Grab | | |

| Depth in Meters | Surf. Elev. | USCS | GRAPHIC | DESCRIPTION | Lab Analysis | Sample No. | Soil Vapours ppm |
|---|---|---|---|---|---|---|---|
| 0 | | | | TOPSOIL, peaty, black | | | |
| | | ML | | SILT (wood), reddish-brown | | | |
| | | | | SILTY CLAY, grey, firm to soft, oxidation zones | | | |
| 1 | | | | seepage at 0.86m | | | |
| | | | | roots to 1.16m | | | |
| | | | | End of Hole | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |

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# AE16-TP547



Active Earth Engineering Ltd

Burrows Road
Richmond, BC

AE Project No. 1148

| | | | |
|---|---|---|---|
| Date Started | : May 5, 2016 | Company Rep. | : DK |
| Date Completed | : May 5, 2016 | Lab Analysis | : *indicates sent for analysis |
| Hole Diameter | : n/a | Drilled By | : Jakes Construction |
| Drilling Method | : Backhoe | Logged By | : DK |
| Sampling Method | : Grab | | |

| Depth in Meters | Surf. Elev. | USCS | GRAPHIC | DESCRIPTION | Lab Analysis | Sample No. | Soil Vapours ppm |
|---|---|---|---|---|---|---|---|
| 0 | | | | TOPSOIL, peaty, black | | | |
| | | ML | | SILT, reddish-brown | | | |
| | | | | SILTY CLAY, grey, firm to soft | | | |
| | | | | seepage at 0.8m | | | |
| 1 | | | | oxidation zones and roots to 1.11m | | | |
| | | | | End of Hole | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |

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Active Earth Engineering Ltd

# AE16-TP548



Burrows Road
Richmond, BC

AE Project No. 1148

| | | | |
|---|---|---|---|
| Date Started | : May 5, 2016 | Company Rep. | : DK |
| Date Completed | : May 5, 2016 | Lab Analysis | : *indicates sent for analysis |
| Hole Diameter | : n/a | Drilled By | : Jakes Construction |
| Drilling Method | : Backhoe | Logged By | : DK |
| Sampling Method | : Grab | | |

| Depth in Meters | Surf. Elev. | USCS | GRAPHIC | DESCRIPTION | Lab Analysis | Sample No. | Soil Vapours ppm |
|---|---|---|---|---|---|---|---|
| 0 | | | | GRASS, roots | | | |
| | | | | TOPSOIL, peaty, black | | | |
| | | ML | | SILT, reddish-brown | | | |
| | | | | SILTY CLAY with roots, grey, firm to soft, oxidation zones to 1.01m | | | |
| 1 | | | | slighty oxidized | | | |
| | | | | End of Hole | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |

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Active Earth Engineering Ltd

# AE16-TP549



Burrows Road
Richmond, BC

AE Project No. 1148

| | | | |
|---|---|---|---|
| Date Started | : May 5, 2016 | Company Rep. | : DK |
| Date Completed | : May 5, 2016 | Lab Analysis | : *indicates sent for analysis |
| Hole Diameter | : n/a | Drilled By | : Jakes Construction |
| Drilling Method | : Backhoe | Logged By | : DK |
| Sampling Method | : Grab | | |

| Depth in Meters | Surf. Elev. | USCS | GRAPHIC | DESCRIPTION | Lab Analysis | Sample No. | Soil Vapours ppm |
|---|---|---|---|---|---|---|---|
| 0 | | | | TOPSOIL, peaty, black | | | |
| | | ML | | SILT, reddish-brown | | | |
| | | | | SILTY CLAY, grey, firm to soft, occassional oxidation zones, roots to 0.86m | | | |
| 1 | | | | seepage at 0.91m | | | |
| | | | | End of Hole | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |

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Active Earth Engineering Ltd

# AE16-TP550



Burrows Road
Richmond, BC

AE Project No. 1148

| | | | |
|---|---|---|---|
| Date Started | : May 5, 2016 | Company Rep. | : DK |
| Date Completed | : May 5, 2016 | Lab Analysis | : *indicates sent for analysis |
| Hole Diameter | : n/a | Drilled By | : Jakes Construction |
| Drilling Method | : Backhoe | Logged By | : DK |
| Sampling Method | : Grab | | |

| Depth in Meters | Surf. Elev. | USCS | GRAPHIC | DESCRIPTION | Lab Analysis | Sample No. | Soil Vapours ppm |
|---|---|---|---|---|---|---|---|
| 0 | | | | TOPSOIL, peaty, black | | | |
| | | | | SILTY CLAY, grey, firm to soft, occassional oxidation zones, roots to 1.06m | | 550-1 | |
| 1 | | | | seepage at 1.21m | | | |
| | | | | End of Hole | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |

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Active Earth Engineering Ltd

# AE16-TP551



Burrows Road
Richmond, BC

AE Project No. 1148

| | | | |
|---|---|---|---|
| Date Started | : May 5, 2016 | Company Rep. | : DK |
| Date Completed | : May 5, 2016 | Lab Analysis | : *indicates sent for analysis |
| Hole Diameter | : n/a | Drilled By | : Jakes Construction |
| Drilling Method | : Backhoe | Logged By | : DK |
| Sampling Method | : Grab | | |

| Depth in Meters | Surf. Elev. | USCS | GRAPHIC | DESCRIPTION | Lab Analysis | Sample No. | Soil Vapours ppm |
|---|---|---|---|---|---|---|---|
| 0 | | | | TOPSOIL, black (FILL) | | | |
| | | SM | | SANDY SILT, reddish-brown (FILL) | | | |
| | | GW | | SAND and GRAVEL, silty, roots to 0.43m (FILL) | | | |
| | | ML | | SILT, black (reworked) | | | |
| | | SM | | SAND and SILT, reddish-brown (reworked) | | | |
| | | | | SILTY CLAY, grey, firm to soft (NATIVE) | | | |
| 1 | | | | seepage at 0.91m | | | |
| | | | | End of Hole | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |

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Active Earth Engineering Ltd

# AE16-TP552



Burrows Road
Richmond, BC

AE Project No. 1148

| | | | |
|---|---|---|---|
| Date Started | : May 5, 2016 | Company Rep. | : DK |
| Date Completed | : May 5, 2016 | Lab Analysis | : *Indicates sent for analysis |
| Hole Diameter | : n/a | Drilled By | : Jakes Construction |
| Drilling Method | : Backhoe | Logged By | : DK |
| Sampling Method | : Grab | | |

| Depth in Meters | Surf. Elev. | USCS | GRAPHIC | DESCRIPTION | Lab Analysis | Sample No. | Soil Vapours ppm |
|---|---|---|---|---|---|---|---|
| 0 | | | | TOPSOIL, black | | | |
| | | ML | | SILT, reddish-brown, roots to 0.33m | | | |
| | | | | SILTY CLAY, grey, firm to soft | | | |
| 1 | | | | seepage at 0.91m | | | |
| | | | | End of Hole | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |

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*Note: 14400 & 14300 Burrows Road are not included in the subject application.

Active Earth Engineering Ltd

November 24, 2016 AE Project No. 1148

Pacific Land Group
212 – 12992-76 Avenue,
Surrey, B.C., V3W 2V6

**ATTN:** **Laura Jones, MCIP, RPP**
**Senior Development Planner**

**RE:** **Preliminary Hydrology Assessment**
**14920, 14680, 14540, 14400 and 14300 Burrows Road, Richmond, BC** *

## *INTRODUCTION*

Active Earth Engineering Ltd. (Active Earth) has completed a hydrology study for the above-referenced project. The location of the property is shown on the attached Location Plan (Figure 1).

The study area comprises five properties, namely 14300, 14400, 14540, 14680 and 14920 Burrows Road, in Richmond, and is collectively referred to as the "Site" in this report.

The purpose of this work is to evaluate the hydrogeology and the drainage characteristics of the Site.

## *SCOPE OF WORK*

The following scope of work was completed:

1. *Review of well logs using the provincial online* WELLS data base (https://a100.gov.bc.ca/pub/wells/public/indexreports.jsp);
2. Review of Surficial Geology Map 1486A;
3. Review of the Active Earth Engineering Geotechnical Report for the Site;
4. A Site visit and inspection/logging of 13 test pits excavated for McTavish Resource Management Consultants Ltd.;
5. Review of "*Soil and land capability assessment*" reports for the properties located at 14920, 14680, 14540, 14400, & 14300 Burrows Road, Richmond, BC, prepared by McTavish Resource Management Consultants Ltd.;
6. Review/assessment of a topographic survey completed by South Fraser Land Surveying Ltd;
7. Personal communication with City of Richmond Engineering; and
8. Completion of this report.

## *DESCRIPTION*

The Site is rectangular in shape and measures approximately 400 m east-west by 150 m north-south and is bounded by Burrows Road to the north and farm land on the remaining three sides. The Site boundaries, including the five individual parcels, are shown on the attached Site Plan (Figure 2).

Single family dwellings occupy three of the properties that comprise the Site (14300, 14400 and 14680 Burrows Road). The properties at 14540 and 14920 Burrows Road were vacant at the time of the investigations, and 14440 was used for horse boarding. The ground surface is flat-lying and is generally covered with grasses.

## *HYDROLOGY ASSESSMENT*

### Stratigraphy

Surficial Geology Map 1486A refers to the surficial deposits as sandy loam to clay loam 15 to 40 m thick, overlying deltaic and distributary channel fill 10 to 25 m in thickness with interbedded fine to medium sand and minor silt. The following stratigraphy was encountered within the test pits and boreholes:

- 0.15 to 0.30m TOPSOIL; overlying,
- 1.5 to 2.1m Silty CLAY; overlying,
- 2.1 to 25.0 m SAND, medium to fine grained with occasional lenses of silty sand and silty clay.

The locations of the test pits and boreholes are shown on the attached Site Plan (Figure 2), and the logs are included in Appendix A. The stratigraphy encountered within the test pits and boreholes is consistent with the surficial geology mapping of the area.

### Groundwater

Groundwater was encountered at an average of 1.0 m depth on May 6, 2016. Groundwater typically fluctuates with changes in season, precipitation, and tidal influences. Discussions with local residents indicate that the property contains standing surface water during the winter wet season.

A search of the BC Water Resource Atlas (BCWRA) revealed there are no groundwater wells in the vicinity of the Site.

### Drainage

The ground surface elevation at the Site occurs generally between 0.8 and 1.0 m-geodetic, with the exception of an area at 14400 Burrows Road where the elevation has been raised by soil filling to approximately 1.5 m-geodetic near the centre of the property. Overall, the ground surface is generally flat with no discernible slope. Burrows Road occurs at an approximate elevation between 1.5 and 1.7 m-geodetic and is 0.5 to 0.9 m above the typical Site grades.

A drainage ditch is present to the immediate north of the Site, along the south side of Burrows Road (see Figure 3 – City of Richmond Drainage Plan). The inverts of the drainage ditch along the northern Site boundary range from elevation 0.18 to -0.22 m-geodetic. Water was sporadically present in the ditch at the time of the field work (May 2016), and no flow was identified. This ditch drains to the City of Richmond No. 6 Road Pumping Station, where it is pumped into the Fraser River. The drainage works run approximately 1.3 km in length from the east end of Burrows Road to the pumping station. Discussions with the City of Richmond Engineering Department indicate that the pumping start level at the pumping station varies between 0.13 and -0.22 m-geodetic elevation. The City also noted that the hydraulic grade from the pumping station is approximately 0.05%. As such, the level of water in drainage ditch is calculated to vary between 0.43 and 0.73 m-geodetic elevation (see Figure 4 - Schematic Drainage Section A).

There are dykes to south and east of the Site. The dyke on the south varies between 1.9 and 2.7 m-geodetic in elevation (1.1 to 2.4 m above Site grades). The dyke surrounds a property used for cranberry production.

The crest of the raised dyke located immediately east of the Site varies between 2.99 and 1.74 m-geodetic elevation (0.9 to 2.2 m above Site grades). A drainage canal is present to the east of this dyke, and the adjacent fields to the east are used for cranberry production. The water level in the drainage canal measured in June 2016 was 1.11 m-geodetic elevation, and the high water mark was surveyed at 1.33 m-geodetic elevation (see Figure 4 - Schematic Drainage Section B).

It is noted that the Flood Construction Level for this Site is elevation 3.0 m-geodetic, which represents a freeboard of 0.6 m above the Fraser River 200-year flood level.

## *CONCLUSIONS*

The Site is poorly drained for the following reasons:

1. The ground surface is flat with no discernible grades to surface water drainage on any side of the Site.
2. There are dykes located up to 2.4m higher than the property on the south and east sides which prevent runoff in these directions. Evidence indicates surface water cannot gravity flow to the existing drainages located along Burrows Road and the east side of the Site.
3. According to Mr. Bruce McTavish, M.Sc., the existing vegetation is dominated by reed canary grass and woody species such as Spirea douglasii found in soils that are subject to prolonged saturation.
4. The Site is underlain by up to 2m of silty clay. The hydraulic conductivity of this layer is expected to be $1x10^{-7}$ to $1x10^{-8}$ m/sec, which is considered relatively impervious.
5. Water levels in the drainage canal along with the low permeability clay soils and insufficient surface grade prevent shallow groundwater and runoff from flowing to the east.

The site is poorly drained and is inundated with water during portions of the year. Surface water and groundwater cannot flow effectively to surrounding drainages.

According to the British Columbia Agricultural Drainage Manual[1], drain depths would be at least 1.2m below the ground surface. This depth would be insufficient to allow for gravity flow to the Burrows Road ditch at the current site grades. As a result pumping would be required to effectively drain the area if the current ground surface elevations were maintained. Pumping would also be required to direct flow to the drainage canal on the east of the property.

Drain spacing on the Site will be dependent on the type of crop, but would likely be less than 5m on center using the existing soil conditions. Drainage along the Burrows Road ditch is controlled by pumping at the No.6 Road Pumping Station, however, the flow in the ditch is impeded to a certain extent by vegetation and the culvert inverts.

Based on the current ground surface elevations, subsoil drains and a pump station would be required to direct flow from the Site to the Burrows Road ditch or the drainage canal..

On-Site drainage may also be improved by soil filling by at least 1.5m and providing an approximate 2% slope to the north to allow for gravity drainage (no pumping required) to the Burrows Road ditch. Pumping would still be required to direct flow to the drainage canal. Subsurface drainage may also be required depending on the consistency of the soil used as fill and reclamation.

It is likely that improvements to the Burrows Road ditch would be required to accept additional flows that would result from improving drainage at the Site.

---

[1] British Columbia Agricultural Drainage Manual, Ministry of Agriculture, Fisheries and Food, 1997.

## *CLOSURE*

This letter has been prepared by Active Earth Engineering Ltd. exclusively for the Pacific Land Group and their clients and consultants and is intended to provide an assessment of the hydrogeology of the Site. The conclusions made in this report reflect Active Earth's best judgment in light of the information available at the time of testing. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Active Earth accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made or actions based on this letter.

Should this report be submitted to the City of Richmond, the City is authorized to rely on the results within the limitations of this report.

The findings and conclusions documented in this report have been prepared for specific application to this and have been developed in a manner consistent with that level of care normally exercised by hydrogeological professionals currently practicing under similar conditions in the area.

Yours Truly,

**ACTIVE EARTH ENGINEERING LTD.**


David Kneale, P.Geo.
Senior Hydrogeologist

Attachments:

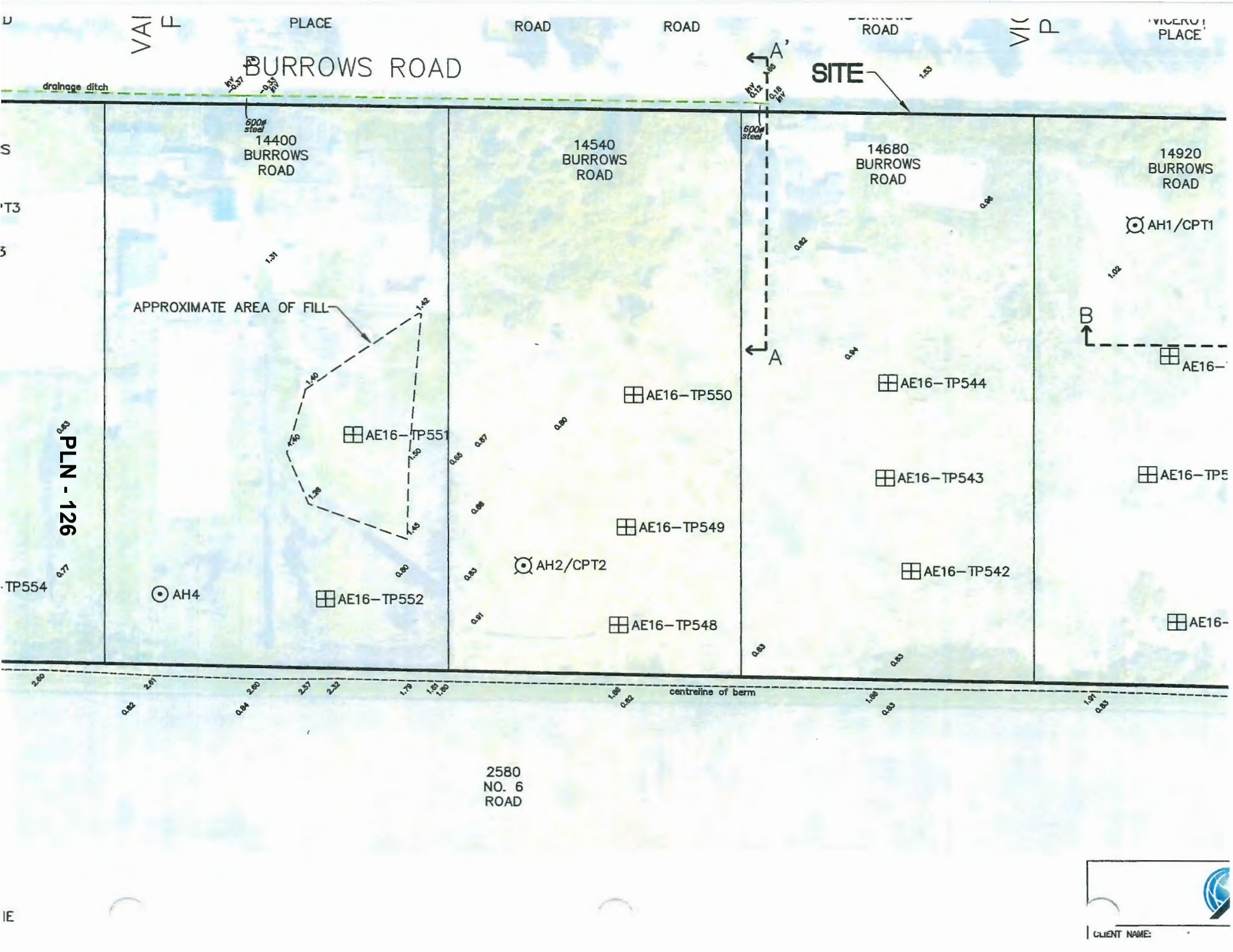
Figures

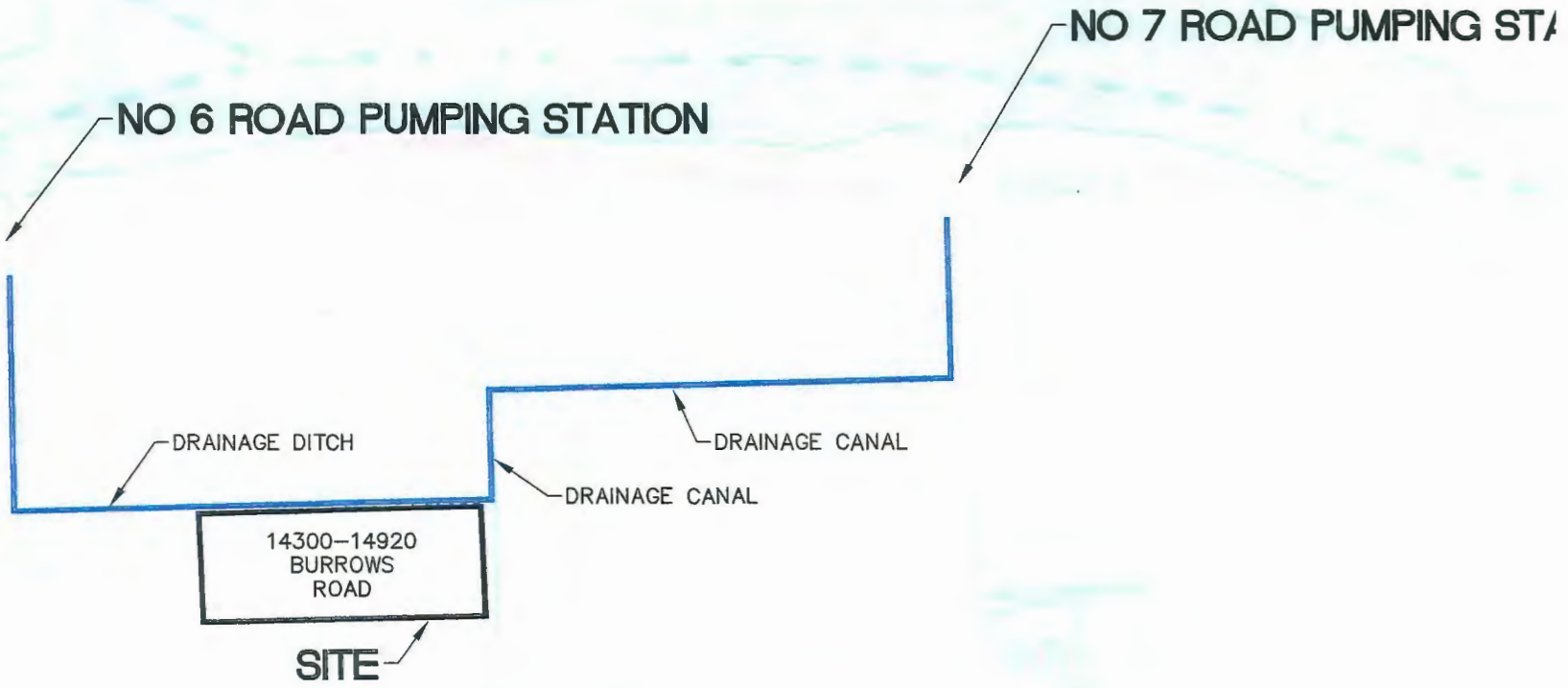
| | |
|---|---|
| Figure 1 | Location Plan |
| Figure 2 | Site Plan |
| Figure 3 | City of Richmond Drainage Plan |
| Figure 4 | Schematic Drainage Cross-sections |

Appendices

| | |
|---|---|
| Appendix A | Borehole and Test Pit Logs |
| Appendix B | BC Water Resources Atlas Results |

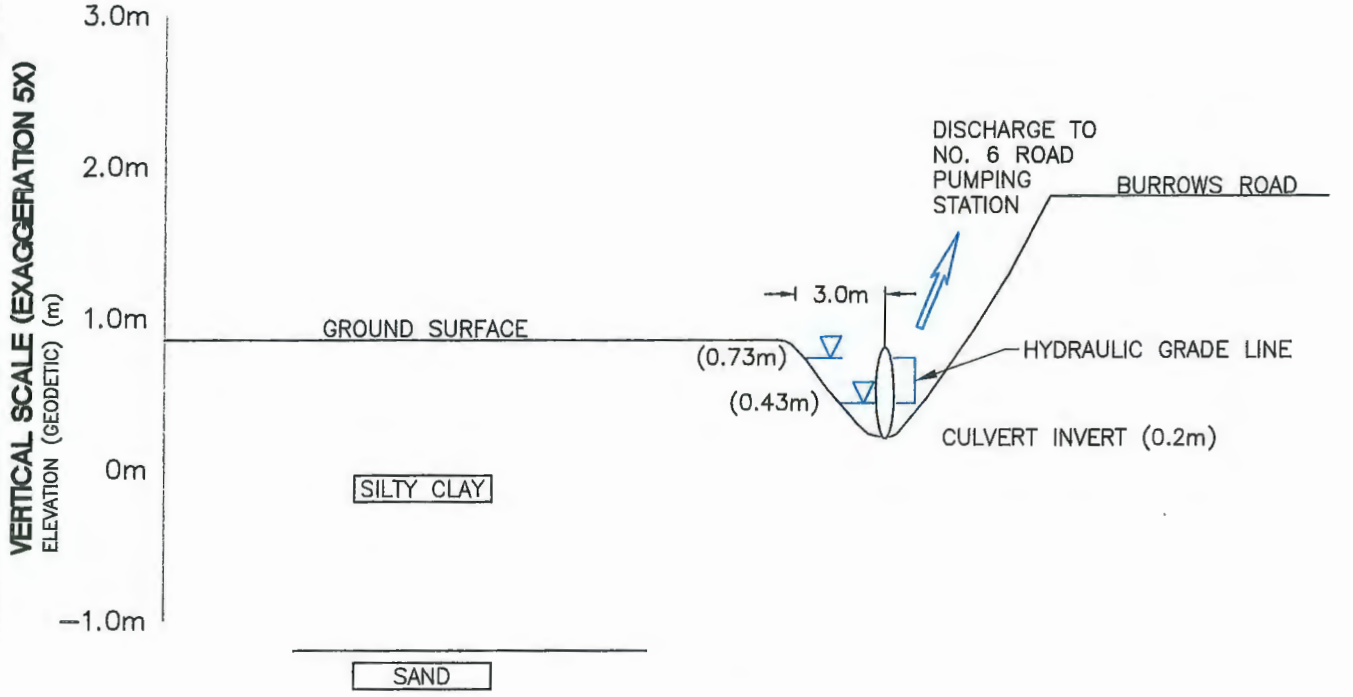
# FIGURES


PLACE
ROAD
ROAD
ROAD
PLACE
BURROWS ROAD
drainage ditch
SITE
A'
A
B
600ø steel
14400 BURROWS ROAD
14540 BURROWS ROAD
14680 BURROWS ROAD
14920 BURROWS ROAD
APPROXIMATE AREA OF FILL
AE16–TP550
AE16–TP544
AE16–TP551
AE16–TP543
AE16–TP549
AE16–TP542
AE16–TP548
AE16–TP552
AH1/CPT1
AH2/CPT2
AH4
TP554
centreline of berm
2580 NO. 6 ROAD
PLN - 126
CLIENT NAME:



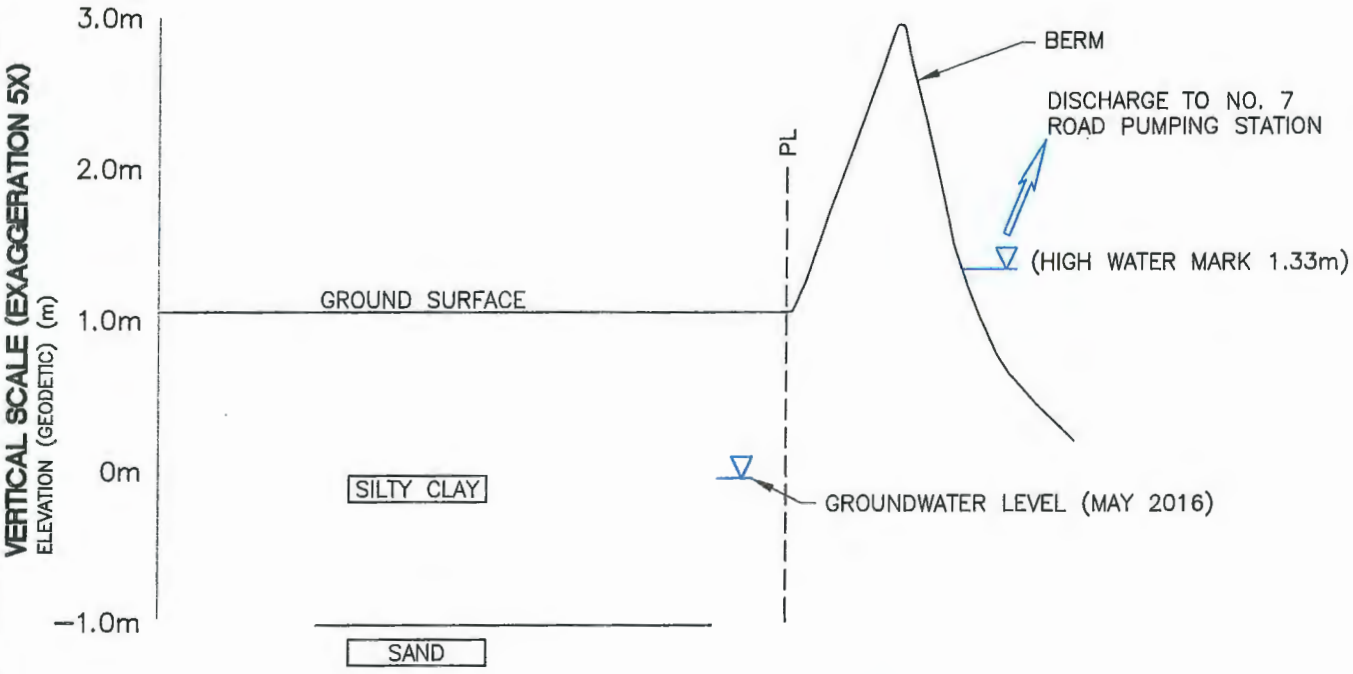

PLN - 127

CLIENT NAME:




## SECTION A–A'

SCALE: N.T.S.




## SECTION B–B'

SCALE: N.T.S.

LEGEND

▽ GROUNDWATER ELEVATION

Active Earth Engineering Ltd

SCHEMATIC DRAINAGE CROSS–SECTIONS
14360, 14400, 14540, 14680, 14920
BURROWS ROAD
RICHMOND, BC

| | |
|---|---|
| date: AUG 18 | scale: N.T.S. |
| | drawn: GM |
| | checked: DK |
| | file: 1148-4 |
| client: PACIFIC LAND GROUP | |
| drawing no: FIGURE 4 | issue: A |

* Note - 14400 & 14300 Burrows Road are not included in the subject application.

Active Earth
Engineering Ltd

June 26, 2017 AE Project No. 1148

Pacific Land Group
212 – 12992-76 Avenue,
Surrey, B.C., V3W 2V6

**ATTN:** **Laura Jones, MCIP, RPP**
**Senior Development Planner**

**RE:** **Preliminary Drainage Cost Assessment**
**14920, 14680, 14540, 14400 and 14300 Burrows Road, Richmond, BC** *

---

**Drainage Assumptions and Cost Estimate**

In accordance with your request, Active Earth Engineering Ltd. (Active Earth) has completed a cost evaluation for the above-referenced project. The following assumptions have been used in this assessment:

1. The study area comprises five properties, namely 14300, 14400, 14540, 14680 and 14920 Burrows Road, in Richmond.
2. The land would remain for agricultural land use.
3. No site filling.
4. Each property would be drained by individually with drainage to Burrows Road storm drainage system operated by the City of Richmond.
5. As noted in our Preliminary Hydrology Report[1], the hydraulic grade line in the Burrows Road drainage varies between 0.43 to 0.73 masl.
6. The native ground surface varied between 0.6 and 1.0 masl.
7. The surficial soils are clay-based.
8. Agricultural drainage typically varies between 600 and 1000 mm. For the purpose of this evaluation, we have assumed the minimum depth of 600 mm. As such there is insufficient grade for gravity drainage to Burrows Road and pumping will be required.
9. No electrical up-grade is required.
10. Drains will consist of Big 'O' pipe 4.5m on centre.

---

[1] Preliminary Hydrology Assessment, 14920, 14680, 14540, 14400 and 14300 Burrows Road, Richmond, BC, Active Earth Engineering Ltd., November, 2016

Active Earth engaged the assistance of WaterTec Irrigation Ltd., who specializes in agricultural drainage and irrigation design. The following presents a summary of the drainage cost estimates for each property. The detailed cost spreadsheet is attached for reference.

| Property | Supply and Install Drains and Pumping Equipment |
|---|---|
| 14920 Burrows Road | $52,815 |
| 14680 Burrows Road | $69,022 |
| 14540 Burrows Road | $69,022 |
| 14400 Burrows Road | $78,538 |
| 14300 Burrows Road | $54,399 |
| Total (not incl GST) | ***$323,796*** |

★ 14400 & 14300 Burrows Road are not included in the subject application.

***CLOSURE***

This letter has been prepared by Active Earth Engineering Ltd. exclusively for the Pacific Land Group and their clients and consultants and is intended to provide an assessment of the hydrogeology of the Site. The conclusions made in this report reflect Active Earth's best judgment in light of the information available at the time of testing. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Active Earth accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made or actions based on this letter.

The City of Richmond is authorized to rely on the results within the limitations of this report.

The findings and conclusions documented in this report have been prepared for specific application to this and have been developed in a manner consistent with that level of care normally exercised by hydrogeological professionals currently practicing under similar conditions in the area.

Yours Truly,

**ACTIVE EARTH ENGINEERING LTD.**

DKneale

David Kneale, P.Geo.
Senior Hydrogeologist

Attachments: Detailed Cost Spreadsheet

Burrows Road Agricultural Drainage Estimate June-02-17 Project 1148

| Description | Cost $ | Comments |
|---|---|---|
| anical/Electrical Costs per lot | | |
| 5 Hp Sewage pump (500 | $4,390.00 | |
| Control system includes fl | $650.00 | |
| 48" Plastic hdpe sump | $1,450.00 | |
| 12" Valve - Isolation | $610.00 | |
| 6" dischange piping & valv | $990.00 | |
| Service Crane | $690.00 | |
| Electrical Supply and Insta | $4,000.00 | estimated |
| Mechanical Installation | $3,000.00 | estimated |
| Total | $15,780.00 | |

| Address | Item | Unit | Number | Unit Cost $ | Sub-Total |
|---|---|---|---|---|---|
| 14920 Burrows Road | 4" Big O Pipe (4.5m spacing) | | | | |
| | Supply and Install | ft | 9450 | $4 | $33,075 |
| | 4 inch connections w/ cleanouts | each | 16 | $15 | $240 |
| | 12 inch HDPE header | ft | 310 | $12 | $3,720 |
| | Pumping Equipment | | | | |
| | Supply and Install | each | 1 | 15,780 | $15,780 |
| | | | | Total | $52,815 |
| 14680 Burrows Road | 4" Big O Pipe (4.5m spacing) | | | | |
| | Supply and Install | ft | 12992 | $4 | $45,472 |
| | 4 inch connections w/ cleanouts | each | 22 | $15 | $330 |
| | 12 inch HDPE header | ft | 620 | $12 | $7,440 |
| | Pumping Equipment | | | | |
| | Supply and Install | each | 1 | 15,780 | $15,780 |
| | | | | Total | $69,022 |
| 14540 Burrows Road | 4" Big O Pipe (4.5m spacing) | | | | |
| | Supply and Install | ft | 12992 | $4 | $45,472 |
| | 4 inch connections w/ cleanouts | each | 22 | $15 | $330 |
| | 12 inch HDPE header | ft | 620 | $12 | $7,440 |
| | Pumping Equipment | | | | |
| | Supply and Install | each | 1 | 15,780 | $15,780 |
| | | | | Total | $69,022 |
| 14440 Burrows Road | 4" Big O Pipe (4.5m spacing) | | | | |
| | Supply and Install | ft | 15355 | $4 | $53,743 |
| | 4 inch connections w/ cleanouts | each | 25 | $15 | $375 |
| | 12 inch HDPE header | ft | 720 | $12 | $8,640 |
| | Pumping Equipment | | | | |
| | Supply and Install | each | 1 | 15,780 | $15,780 |
| | | | | Total | $78,538 |
| 14300 Burrows Road | 4" Big O Pipe (4.5m spacing) | | | | |
| | Supply and Install | ft | 9450 | $4 | $33,075 |
| | 4 inch connections w/ cleanouts | each | 16 | $15 | $240 |
| | 12 inch HDPE header | ft | 442 | $12 | $5,304 |
| | Pumping Equipment | | | | |
| | Supply and Install | each | 1 | 15,780 | $15,780 |
| | | | | Total | $54,399 |

| Total all Properties | *$323,796* |
|---|---|

**Assumptions**

Electrical service does not require upgrading

Big 'O' pipe 15 ft on centre

12 inch header at north and south end of each property to make interconnected drainage network

Pump chamber and pump on each property

* 14400 & 14300 Burrows Road are not included in the subject application.

# Agricultural business analysis
# Small lot agriculture (less than 5 acres)
# for the properties located at 14920, 14680, 14540, 14400 * & 14300 Burrows Road, Richmond, BC

Prepared for:

Pacific Land Resource Group

Prepared by:

Bruce McTavish, MSc MBA PAg RPBio
McTavish Resource & Management Consultants Ltd.
15300 Croydon Road, Suite 300 Surrey BC V3Z 0Z5
bruce@mctavishconsultants.ca

June 8, 2017

# Table of Contents



# List of Tables



# List of Figures

*14400 & 14300 Burrows Road are not included in the subject application

## Executive Summary

This report provides a financial analysis of developing small lot farm operations of approximately 3 acres each on the land located at 14920, 14680, 14540, 14400 & 14300 Burrows Road, Richmond, BC. The plan assumes that the land is drained and ready for final preparation to plant crops.

This analysis uses projections based on production of a variety of vegetable crops with a mix of sales directly to the public and to local retailers. The pricing per crop is based on the historical average of hand-picked wholesale and hand-picked farm gate retail prices[1].

It is assumed that each parcel will be operated independently and machinery, buildings and other facilities will need to be purchased and/or constructed. The cost projections assume that all product is sold at farm gate to the public, direct retailed as fresh product or sold at farmer's markets. Therefore, cold storage facilities are not costed in the financial scenarios. Based on this assumption the estimated capital costs for each parcel is approximately $46,000 without accounting for the required drainage improvements.

The agricultural capability of the land (improved 3W and 4WD) restrict the crops that can be grown on these properties. Mixed annual vegetables can be produced, though in some years seeding and planting may be delayed due to wet soil conditions. Blueberries could also be established with improved drainage and planting on raised beds. Hay crops were considered but the small size of the parcels make this option unrealistic.

The projected earnings for blueberry production operations for each property are provided in the following table.

Blueberry before tax profit based on an average selling price of $1.25/lb

| Property | Projected profit year 0 | Projected profit year 8 |
|---|---|---|
| 14920 Burrows Road (3.6 acres) | -$ 62,149.00 | $ 16,000.00 |
| 14680 Burrows Road (2.5 acres) | -$ 59,700.00 | $ 4,421.00 |
| 14540 Burrows Road (3.6 acres) | -$ 62,149.00 | $ 16,000.00 |
| 14440 Burrows Road (3.6 acres) | -$ 62,149.00 | $ 16,000.00 |
| 14300 Burrows Road (2.5 acres) | -$ 59,700.00 | $ 4,421.00 |

The projected earnings for a mixed vegetable operations for each property are provided in the following table.

| Property | Annual projected profit before tax |
|---|---|
| 14920 Burrows Road (3.6 acres) | $ 20,453.98 |
| 14680 Burrows Road (2.5 acres) | $ 3,598.52 |
| 14540 Burrows Road (3.6 acres) | $ 20,453.98 |
| 14440 Burrows Road (3.6 acres) | $ 20,453.98 |
| 14300 Burrows Road (2.5 acres) | $ 3,598.52 |

[1] Five Acre Mixed Vegetable Operation (2008) Planning For Profit. BC Ministry of Agriculture.

# 1.0 Introduction

The following document outlines the start-up costs, operating costs and estimated revenue for small lot agricultural operations for the five properties located at 14920, 14680, 14540, 14400 & 14300 Burrows Road, Richmond, BC (Figure 1). The operational scenario provided is based on each privately-owned property operating as an independent unit.

This report assumes that the drainage for all the properties is improved as described in the McTavish 2016 report and the Active Earth 2016 drainage analysis report. With a significant investment in drainage of approximately $324,000 most of the land can be improved to class 3DW and O3LW. The 3W classification (with drainage) indicates that the water level will still be near the surface until mid-spring forcing late seeding. Based on site observations there are portions that can only be improved to class 4D due to the shallow compacted clay layer that will restrict roots even with improved drainage.

For the purpose of this report, a mixed vegetable operation and a hand-picked blueberry operation are analyzed. The vegetable crops in this plan are used as examples only and a variety of crops could be produced on this land if the drainage is improved. The revenue and costs for the vegetable farms are based on the BC Ministry of Agriculture Planning for Profit Series for Mixed Vegetables and Berries.[2] The revenue and costs for the blueberry farming are based on the BC Ministry of Agriculture Planning for Profit for Hand-Picked Blueberries.

Start-up costs and operating costs are based on industry averages but may fluctuate from farm to farm. It should also be noted that all expenses in this report have been adjusted based on the Farm Input Price Index[3] and the Farm product price index.[4]

Based on the McTavish (2016) report the soils on the properties are mainly Annis and Richmond soil series. Review of soil information, vegetation, hydrologist report and landowner interviews indicate that large portions of the properties observed are borderline unimproved class 5W. The hydrological isolation of the property to the south and east combined with the culvert invert elevations and shallow slope of the Burrow Road ditch results in long-term water retention on the subject properties. A soil wetness (poor drainage) transition has been observed on the subject properties resulting in their land capability for agricultural classification deteriorating from 4W to 5W.

The subsoil on the majority of the properties is a massive grey silty clay that restricts drainage and root development. This results in a 4D classification (root-restricting limitation) in addition to the wetness limitation. This root restricting layer will remain even with improved drainage.

If the land was properly drained, which would require significant improvements in the drainage infrastructure, the land capability could be improved to Class 3W except where the root restricting layer indicates class 4WD

The crops that are suitable for these soils when drained are provided in Table 1.

---

[2] BC Ministry of Agriculture. 2008. Planning for Profit Five Acre Mixed Vegetable and Berry Operation Full Production.
[3] Farm input price Index. http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3280015 Accessed May 2017.
[4] Farm product price index. http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=20068 Accessed May 2017.

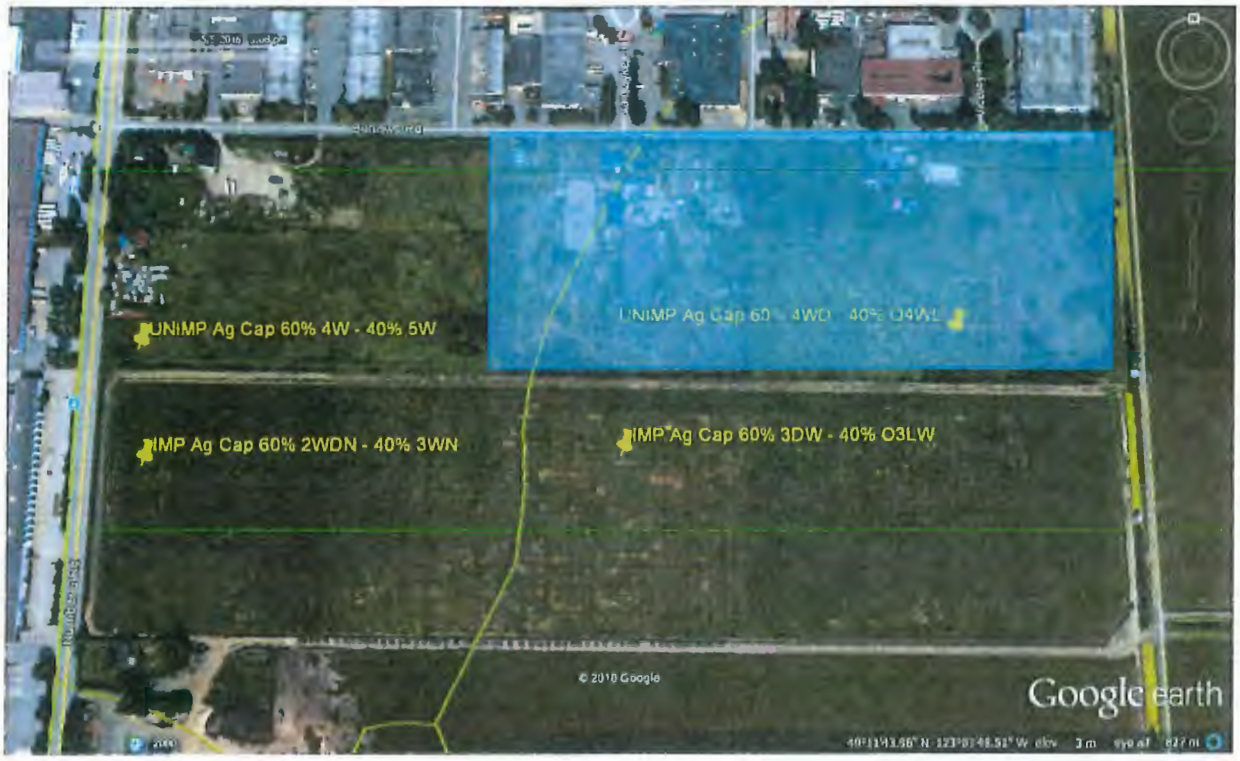



Figure 1 Property location and agricultural capability

Table 1 Soil management and crop considerations

| Soil name | Soil management considerations from Bertrand et Al, 1991 and Luttmerding, 1984 | Crop suitability from Bertrand et Al, 1991 and Luttmerding, 1984 |
|---|---|---|
| Annis | Poor drainage is the main agricultural limitation.<br><br>Underdrains need to be closely spaced due to the moderately to slow perviousness of the subsoils.<br><br>Periodic subsoiling will be required to loosen the silty clay subsoils is required to maintain the underdrains' efficiency as well as to improve aeration and root distribution<br><br>Management required to minimize loss of the organic surface layer.<br><br>Liming will generally be required to improve crop production.<br><br>High water tables and variable bearing strengths also make road and building construction difficult and basements impractical. | Suited crops include pasture and forage crops and blueberries; and annual field crops including annual legumes, cereals, cole crops, corn, root crops excluding carrots, and shallow-rooted annual vegetables.<br><br>Unsuited crops include nursery and Christmas trees, raspberries, strawberries and tree fruits because the soils will still have excessive water, even with artificial drainage, to allow for the production of these crops. |
| Richmond | Poor drainage and high water tables, especially during the winter, are the main agricultural limitations.<br><br>Drainage controls require close spacing. Soils tend to be very acidic and liming management is required to minimize loss of the organic surface layer.<br><br>Exposed soil surfaces are prone to wind and water erosion.<br><br>High water tables and variable bearing strengths also make road and building construction difficult and basements impractical. | Suited crops include pasture and forage crops and blueberries; and annual field crops including annual legumes, cereals, cole crops, corn, root crops, and shallow-rooted annual vegetables.<br><br>With adequate water table control these soils can be productive for intensive vegetable production.<br><br>Unsuited crops include nursery and Christmas trees, raspberries, strawberries and tree fruits because the soils will still have excessive water. even with artificial drainage, to allow for the production of these crops. |

## 2.0 Crop Potential

With significant improvements in drainage the properties could support the following crops:

- annual legumes
- blueberries
- cereals
- cole crops
- corn
- perennial forage crops (though first cut may be late due to wet conditions)
- root vegetables (except carrots)
- shallow-rooted annual vegetables (except celery)

Artificial drainage will be required for water table control during the winter and to facilitate earlier cultivation and planting in the spring. The soils on this site will be susceptible to puddling and compaction, and should not be cultivated when wet. Winter cover crops on clean cultivated fields are also beneficial. Subsoil are relatively impervious, therefore subsoiling will improve water infiltration and rooting depth. Even though the water holding capacity of these soils is high, supplemental irrigation is required for optimum crop production during dry summers.

## 3.0 Projected Income and Expenses

The following section provides financial information on the projected revenue and expenses for the potential crops that could be produced on the subject properties. The financial data is provided on a per-acre basis since each property is a different size. The size of each property and the effective area for farming is provided in Table 2.

Table 2 Effective farming area for each property

| Address | Property size (Acres) | Area available for farming (Acres) |
|---|---|---|
| 14920 Burrows Road | 4.6 | 3.6 (20% reduction for access roads and infrastructure) |
| 14680 Burrows Road | 4.6 | 2.5 (reduced for home footprint, access roads and infrastructure) |
| 14540 Burrows Road | 4.6 | 3.6 (20% reduction for access roads and infrastructure) |
| 14400 Burrows Road | 5.37 | 3.5 (reduced for home footprint, access roads and infrastructure) |
| 14300 Burrows Road | 3.7 | 2.4 (reduced for home footprint, access roads and infrastructure) |

## 3.1 Handpicked blueberries

Table 3 shows the estimated gross margin (gross profit) per acre for hand-picked blueberries. The data is based on Planning for Profit 2007[5]. The estimated capital costs to start a farm, assuming a new farmer with no existing equipment, is approximately $46,000 as shown in Appendix I. Indirect or administrative costs will vary considerably between operations, and therefore the information on indirect costs provided in Appendix I must be treated with caution. The projections do not incorporate drainage improvement costs.

Revenue for the blueberry model is based on farm gate sales direct to the public at a selling price of $2.00 per pound. If blueberries are sold into the wholesale market, the price based on 2016 sales data is closer to $0.70 per pound.

Based on $2.00 per pound selling price the revenue per acre peaks in year 8 (mature plants) is ~$16,000 per acre (Table 4). For a 3.6-acre farm with an owner salary allocation of $10,000 per year starting in year 3, the total profit in year 8 would be ~$42,500.00 with a negative cash position for 6 years (Table 5). If some of the product is sold wholesale or is sold at a discount to large retail buyers a blended price of $1.25 per pound is used, resulting in a gross profit per acre would be ~$6,700 (Table 6).

For a 3.6-acre blueberry farm using a blended selling price of $1.25 per pound, the profit would peak at year 8 (plant maturity) at $16,000.00 and the farm would still have an accumulated negative cash position at the end of year 8 (Table 6). The scenario for the smaller farms is worse as the allocation of capital start up costs are spread over a smaller acreage.

Table 2 provides the projected earning at year zero (planting year) and eight years after planting for each property at the blended price of $1.25 per pound.

Table 3 Projected income per property at year 0 and year 8 at $1.25/lb

| Property | Projected profit year 0 | Projected profit year 8 |
|---|---|---|
| 14920 Burrows Road (3.6 acres) | -$ 62,149.00 | $ 16,000.00 |
| 14680 Burrows Road (2.5 acres) | -$ 59,700.00 | $ 4,421.00 |
| 14540 Burrows Road (3.6 acres) | -$ 62,149.00 | $ 16,000.00 |
| 14440 Burrows Road (3.6 acres) | -$ 62,149.00 | $ 16,000.00 |
| 14300 Burrows Road (2.5 acres) | -$ 59,700.00 | $ 4,421.00 |

[5] BC Ministry of Agriculture Planning for Profit Handpicked Blueberries 2007

## 3.2 Mixed vegetables

To determine 2017 income and expenses for a mixed vegetable farm, the data in the Planning for Profit Mixed Fruit and Vegetables from 2008[6] has been adjusted by the Farm Input Price Index[7] and revenue has been adjusted by the Farm Product Price Index.[8] This model assumes no cold storage and product sold directly to the public through the farm gate or at farmer's markets.

Based on the data provided in Table 7 and the calculation of indirect and capital costs provided in Appendix 2, the projected income statements for each farm are provided in Table 8. The projections include projected revenue based on direct marketing with no cold storage facility, direct costs and indirect costs. The projections assume that the owners pay themselves $10,000 per year. The projections do not incorporate the cost of drainage infrastructure.

## 3.3 Forage

Due to the relatively poor improved agricultural capability of this site (3W to 4WD) grass forage would be the most appropriate crop. However, the small size of the land makes it impractical to grow forage as a commercial venture.

[6] BC Ministry of Agriculture. 2008. Planning for Profit, Five Acre Mixed Vegetable Operation: Full Production.

[7] Statistics Canada table 002-0069 http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3280015 Web Accessed May 2017

[8] Statistics Canada table 022-0070. http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=20068 Web Accessed May 2017

Table 4 Projected blueberry profit per acre (includes capital costs but not drainage improvement)

| **Revenue** | **Year 0** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Year 6** | **Year 7** | **Year 8** |
|---|---|---|---|---|---|---|---|---|---|
| Harvest lb/acre | 0 | 0 | 0 | 4000 | 7000 | 10000 | 11000 | 12000 | 13000 |
| Price | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Revenue/acre | 0 | 0 | 0 | 8000 | 14000 | 20000 | 22000 | 24000 | 26000 |
| Total Acres | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Total Revenue | 0 | 0 | 0 | $ 8,000.00 | $ 14,000.00 | $ 20,000.00 | $ 22,000.00 | $ 24,000.00 | $ 26,000.00 |
| Expenses per 1 Acres | | | | | | | | | |
| Labour expenses | $ 391.54 | $ 391.54 | $ 391.54 | $ 391.54 | $ 391.54 | $ 391.54 | $ 391.54 | $ 391.54 | $ 391.54 |
| Land Lease Costs ($400/acre) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Harvest labour expenses | $ - | $ - | $ - | $ 2,733.00 | $ 4,782.00 | $ 6,832.00 | $ 5,636.00 | $ 6,149.00 | $ 6,661.00 |
| One time capital equpment | $ 42,100.00 | | | | | | | | |
| Establishment costs | $ 1,136.00 | | | | | | | | |
| Other non labour expenses | $ 48,336.00 | $ 1,695.00 | $ 1,345.54 | $ 2,101.00 | $ 2,157.00 | $ 2,163.00 | $ 2,108.00 | $ 2,108.00 | $ 2,108.00 |
| Agriculture Input Index applied to non-labour | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 |
| Adjusted Expenses | 58,177.33 | 2,378.08 | 1,968.51 | 5,586.91 | 7,701.54 | 9,758.58 | 8,498.12 | 9,011.12 | 9,523.12 |
| **Gross Profit (including capital)** | **$ (58,177.33)** | **$ (2,378.08)** | **$ (1,968.51)** | **$ 2,413.09** | **$ 6,298.46** | **$ 10,241.42** | **$ 13,501.88** | **$ 14,988.88** | **$ 16,476.88** |

Table 5 Projected income statement for 3.6 acres of blueberries selling price of $2.00/lb

| **Revenue** | **Year 0** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Year 6** | **Year 7** | **Year 8** |
|---|---|---|---|---|---|---|---|---|---|
| Harvest lb/acre | 0 | 0 | 0 | 4000 | 7000 | 10000 | 11000 | 12000 | 13000 |
| Price | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Revenue/acre | 0 | 0 | 0 | 8000 | 14000 | 20000 | 22000 | 24000 | 26000 |
| Total Acres | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 |
| Total Revenue | 0 | 0 | 0 | $ 28,800.00 | $ 50,400.00 | $ 72,000.00 | $ 79,200.00 | $ 86,400.00 | $ 93,600.00 |
| Expenses per 1 Acre | | | | | | | | | |
| Labour expenses | $ 1,409.54 | $ 1,409.54 | $ 1,409.54 | $ 1,409.54 | $ 1,409.54 | $ 1,409.54 | $ 1,409.54 | $ 1,409.54 | $ 1,409.54 |
| Owner salary | $ - | $ - | $ - | $ 10,000.00 | $ 10,000.00 | $ 10,000.00 | $ 10,000.00 | $ 10,000.00 | $ 10,000.00 |
| Harvest labour expenses | $ - | $ - | $ - | $ 9,838.80 | $ 17,215.20 | $ 24,595.20 | $ 20,289.60 | $ 22,136.40 | $ 23,979.60 |
| One time capital equpment | $ 42,100.00 | | | | | | | | |
| Establishment costs | $ 4,089.60 | | | | | | | | |
| Other non labour expenses | $ 48,336.00 | $ 6,102.00 | $ 6,102.00 | $ 6,102.00 | $ 6,102.00 | $ 6,102.00 | $ 6,102.00 | $ 6,102.00 | $ 6,102.00 |
| Agriculture Input Index applied to non-labour | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 |
| Adjusted Expenses | 62,148.94 | 8,561.09 | 8,561.09 | 28,399.89 | 35,776.29 | 43,156.29 | 38,850.69 | 40,697.49 | 42,540.69 |
| **Gross Profit (including capital)** | **$ (62,148.94)** | **$ (8,561.09)** | **$ (8,561.09)** | **$ 400.11** | **$ 14,623.71** | **$ 28,843.71** | **$ 40,349.31** | **$ 45,702.51** | **$ 51,059.31** |
| Accumulated cash | $ (62,148.94) | -$ 70,710.02 | -$ 79,271.11 | -$ 78,871.00 | -$ 64,247.29 | -$ 35,403.58 | $ 4,945.74 | $ 50,648.25 | $ 101,707.56 |

Table 6 Blueberry projected income statement at $1.25/lb selling price

| **Revenue** | **Year 0** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Year 6** | **Year 7** | **Year 8** |
|---|---|---|---|---|---|---|---|---|---|
| Harvest lb/acre | 0 | 0 | 0 | 4000 | 7000 | 10000 | 11000 | 12000 | 13000 |
| Price | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 |
| Revenue/acre | 0 | 0 | 0 | 5000 | 8750 | 12500 | 13750 | 15000 | 16250 |
| Total Acres | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 |
| Total Revenue | 0 | 0 | 0 | $ 18,000.00 | $ 31,500.00 | $ 45,000.00 | $ 49,500.00 | $ 54,000.00 | $ 58,500.00 |
| Expenses per 1 Acre | | | | | | | | | |
| Labour expenses | $ 1,409.54 | $ 1,409.54 | $ 1,409.54 | $ 1,409.54 | $ 1,409.54 | $ 1,409.54 | $ 1,409.54 | $ 1,409.54 | $ 1,409.54 |
| Owner salary | $ - | $ - | $ - | $ 10,000.00 | $ 10,000.00 | $ 10,000.00 | $ 10,000.00 | $ 10,000.00 | $ 10,000.00 |
| Harvest labour expenses | $ - | $ - | $ - | $ 9,838.80 | $ 17,215.20 | $ 24,595.20 | $ 20,289.60 | $ 22,136.40 | $ 23,979.60 |
| One time capital equpment | $ 42,100.00 | | | | | | | | |
| Establishment costs | $ 4,089.60 | | | | | | | | |
| Other non labour expenses | $ 48,336.00 | $ 6,102.00 | $ 6,102.00 | $ 6,102.00 | $ 6,102.00 | $ 6,102.00 | $ 6,102.00 | $ 6,102.00 | $ 6,102.00 |
| Agriculture Input Index applied to non-labour | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 |
| Adjusted Expenses | 62,148.94 | 8,561.09 | 8,561.09 | 28,399.89 | 35,776.29 | 43,156.29 | 38,850.69 | 40,697.49 | 42,540.69 |
| **Gross Profit (including capital)** | **$ (62,148.94)** | **$ (8,561.09)** | **$ (8,561.09)** | **$(10,399.89)** | **$ (4,276.29)** | **$ 1,843.71** | **$ 10,649.31** | **$ 13,302.51** | **$ 15,959.31** |
| Accumulated cash | $ (62,148.94) | -$ 70,710.02 | -$ 79,271.11 | -$ 89,671.00 | -$ 93,947.29 | -$ 92,103.58 | -$ 81,454.26 | -$ 68,151.75 | -$ 52,192.44 |

Table 7 Mixed vegetable production gross profit margin per acre

| VEGETABLE CROP | PRODUCTION AREA | REVENUE | REVENUE FOR TOTAL PRODUC- TION AREA = Production Area X Revenue | DIRECT COSTS | DIRECT COSTS FOR TOTAL PRODUCTION AREA = Production Area X Direct Cost | GROSS MARGIN = Revenue less Direct Costs | GROSS MARGIN FOR TOTAL PRODUCTION AREA =Revenue less Direct Costs |
|---|---|---|---|---|---|---|---|
| Unit | sq.ft | $/sq.ft. | $ | $/sq.ft. | $ | per sq/ ft | $ |
| **Brussel Sprouts** | 2,500 | 0.2636 | 659.00 | 0.141 | 352.50 | 0.1226 | **306.50** |
| **Beets** | 3,750 | 0.3852 | 1,444.50 | 0.183 | 686.25 | 0.2022 | **758.25** |
| **Broccoli** | 2,500 | 0.2100 | 525.00 | 0.128 | 320.00 | 0.0820 | **205.00** |
| **Cabbage** | 3,750 | 0.5090 | 1,908.75 | 0.149 | 558.75 | 0.3600 | **1,350.00** |
| **Lettuce** | 4,250 | 0.4604 | 1,956.70 | 0.135 | 573.75 | 0.3254 | **1,382.95** |
| **Onions** | 3,750 | 0.7377 | 2,766.38 | 0.154 | 577.50 | 0.5837 | **2,188.88** |
| **Peas** | 2,500 | 0.4824 | 1,206.00 | 0.280 | 700.00 | 0.2024 | **506.00** |
| **Potatoes** | 3,000 | 0.3124 | 937.20 | 0.156 | 468.00 | 0.1564 | **469.20** |
| **Pumpkin** | 2,500 | 0.2574 | 643.50 | 0.090 | 225.00 | 0.1674 | **418.50** |
| **Rhubarb** | 2,500 | 0.4421 | 1,105.25 | 0.134 | 335.00 | 0.3081 | **770.25** |
| **Spinach** | 2,500 | 0.5434 | 1,358.50 | 0.328 | 820.00 | 0.2154 | **538.50** |
| **Squash** | 2,500 | 0.4388 | 1,097.00 | 0.092 | 230.00 | 0.3468 | **867.00** |
| **Turnips/Rutabaga** | 5,000 | 0.9694 | 4,847.00 | 0.210 | 1,050.00 | 0.7594 | **3,797.00** |
| **Zucchini** | 2,500 | 0.1675 | 418.75 | 0.099 | 247.50 | 0.0685 | **171.25** |
| **TOTAL FOR ALL CROPS PER ACRE** | **43,500** | | **20,873.53** | | **7,144.25** | | **13,729.28** |
| Adjustment for farm price index | | | 1.18 | | 1.207 | | |
| Adjusted Total Per Acre | | | $24,630.76 | | $8,623.11 | | $16,007.65 |

Table 8 Summary of projected vegetable farm profit per property

| Property | Annual projected profit before tax |
|---|---|
| 14920 Burrows Road (3.6 acres) | $ 20,453.98 |
| 14680 Burrows Road (2.5 acres) | $ 3,598.52 |
| 14540 Burrows Road (3.6 acres) | $ 20,453.98 |
| 14440 Burrows Road (3.6 acres) | $ 20,453.98 |
| 14300 Burrows Road (2.5 acres) | $ 3,598.52 |

## 4.0 Summary

The poor soil conditions that lead to an improved agricultural capability of 3W to 4WD and the small lot size limit the crop choices on these properties. Based on the analysis in this report, mixed vegetables and/or blueberries could be produced on these properties. Both scenarios require capital investments in buildings and equipment as well as the required drainage improvements.

## Appendix I Details on cost analysis for blueberries

Table 9 Estimated Capital Costs per property

| Capital Item | Cost |
|---|---|
| Storage Building and Machine Shed | $ 17,100.00 |
| Tractor and Implements | $ 25,000.00 |
| Fencing | $ 0.00 |
| Irrigation (per acre) | $ 1,368.00 |
| Posts and trellises | $ 1,254.00 |
| Cold storage | $ 0.00 |
| Other | $ 1,368.00 |
| **Total Estimated** | **$ 46,090.00** |

Table 10 Estimated Indirect Costs

| Indirect Costs | Cost |
|---|---|
| Accounting and Legal | $ 2,000.00 |
| Bank Charges | $ 500.00 |
| Insurance | $ 1,500.00 |
| Utilities | $ 5,000.00 |
| Auto expenses | $ 1,500.00 |
| Office supplies and postage | $ 1,000.00 |
| Telephone | $ 1,500.00 |
| Small tools and Supplies | $ 3,000.00 |
| WCB, EI CPP | $ 1,800.00 |
| **Total** | **$ 17,800.00** |

Since this is assumed to be a start-up operation there will be additional costs of interest on bank loans, depreciation and salary for the farm owner.

Table 11 Other Indirect Costs

| Item | Cost |
|---|---|
| Assume Start Up Loan of $25,000 with Interest of 6% | $ 1,500.00 |
| Assume operating line of $20,000 at 8% for 6 Months | $ 800.00 |
| Total Interest | $ 2,300.00 |
| Depreciation at 10% | $ 2,500.00 |
| Owner Salary | $ 10,000.00 |

Table 12 Projected income statement per acre with blended price of $1.25 per pound

| **Revenue** | **Year 0** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Year 6** | **Year 7** | **Year 8** |
|---|---|---|---|---|---|---|---|---|---|
| Harvest lb/acre | 0 | 0 | 0 | 4000 | 7000 | 10000 | 11000 | 12000 | 13000 |
| Price | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 |
| Revenue/acre | 0 | 0 | 0 | 5000 | 8750 | 12500 | 13750 | 15000 | 16250 |
| Total Acres | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Total Revenue | 0 | 0 | 0 | $ 5,000.00 | $ 8,750.00 | $ 12,500.00 | $ 13,750.00 | $ 15,000.00 | $ 16,250.00 |
| Expenses per 1 Acres | | | | | | | | | |
| Labour expenses | $ 391.54 | $ 391.54 | $ 391.54 | $ 391.54 | $ 391.54 | $ 391.54 | $ 391.54 | $ 391.54 | $ 391.54 |
| Land Lease Costs ($400/acre) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Harvest labour expenses | $ - | $ - | $ - | $ 2,733.00 | $ 4,782.00 | $ 6,832.00 | $ 5,636.00 | $ 6,149.00 | $ 6,661.00 |
| One time capital equpment | $ 42,100.00 | | | | | | | | |
| Establishment costs | $ 1,136.00 | | | | | | | | |
| Other non labour expenses | $ 48,336.00 | $ 1,695.00 | $ 1,345.54 | $ 2,101.00 | $ 2,157.00 | $ 2,163.00 | $ 2,108.00 | $ 2,108.00 | $ 2,108.00 |
| Agriculture Input Index applied to non-labour | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 | 1.17 |
| Adjusted Expenses | 58,177.33 | 2,378.08 | 1,968.51 | 5,586.91 | 7,701.54 | 9,758.58 | 8,498.12 | 9,011.12 | 9,523.12 |
| **Gross Profit (including capital)** | **$ (58,177.33)** | **$ (2,378.08)** | **$ (1,968.51)** | **$ (586.91)** | **$ 1,048.46** | **$ 2,741.42** | **$ 5,251.88** | **$ 5,988.88** | **$ 6,726.88** |
| Accumulated cash | $ (58,177.33) | -$ 60,555.41 | -$ 62,523.92 | -$ 63,110.84 | -$ 62,062.38 | -$ 59,320.96 | -$ 54,069.07 | -$ 48,080.19 | -$ 41,353.30 |