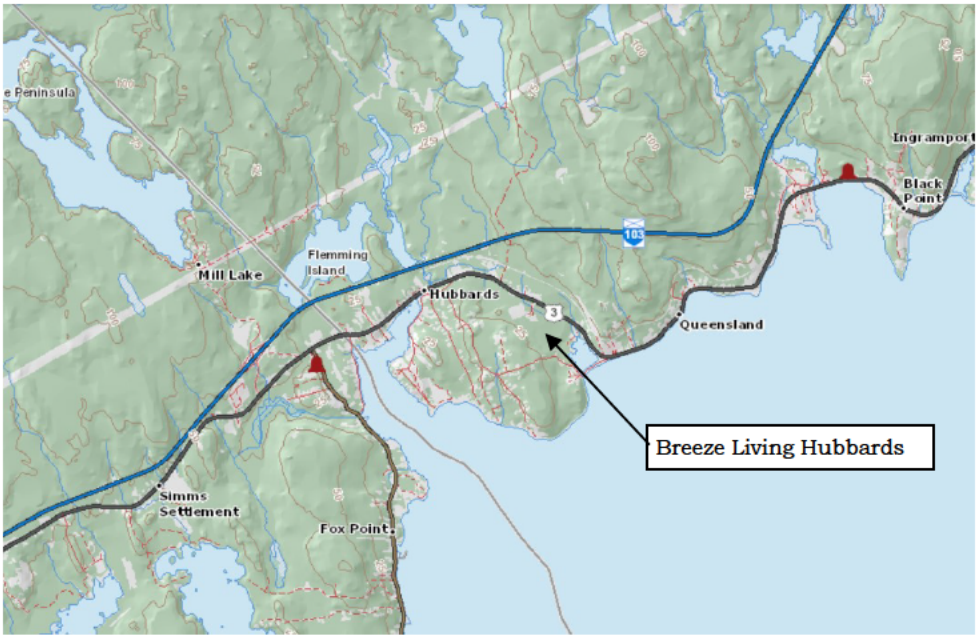
# Breeze Living Hubbards Property

Hubbards, Halifax County, Nova Scotia

## Level I Groundwater Assessment




prepared for:

DesignPoint Engineering and Surveying Ltd.

W.G. Shaw & Associates Ltd.
Consulting Geoscientists
July 12, 2022

**W.G. Shaw & Associates Ltd.**

*Consulting Geoscientists*

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Antigonish , Nova Scotia
Canada B2G 2L3
phone (902) 863 - 1903
E-mail : wgshaw@eastlink.ca

Mr. Logan King, P.Eng.
DesignPoint Engineering and Surveying Ltd.
222 Waterfront Drive, Suite 104
Bedford, Nova Scotia
Canada, B4A 0H3

July 12, 2022

Re : Breeze Living Hubbards Property, Hubbards, Nova Scotia
Level I Groundwater Assessment

Dear Mr. King,

Please find enclosed the technical report on a Level I Groundwater Assessment for the Breeze Living Hubbards Property, Hubbards, Nova Scotia.

Sincerely,

[redacted]

William G. Shaw, *Pigeon.*
President

# Table of Contents

# 1.0 Introduction

## 1.1 General Description of the Project

W.G. Shaw & Associates Ltd. (WGSL) was retained by DesignPoint Engineering and Surveying Ltd. to conduct a Level I Groundwater Assessment, for a proposed residential development for Breeze Living Hubbards Property (the Property), located at Hubbards, Halifax County, Nova Scotia (Figures #1 and #2).

The Property is a roughly square-shaped parcel of land that is 330 metres long by 300 metres wide with a total area of 9.3 hectares (23 acres) (PID #4002 3905).

Proposed plans for the Property consist of residential development on the southern portion of the property near Conrads Road, with the remaining portion of the Property undeveloped. The proposed development consists of 13, 4-unit buildings for a total of 52 residential units within the development. The planned water supply to the Property is a central water system with raw water being supplied by 2 or more drilled water wells depending on the results of future groundwater resource assessments (drilling and testing).

## 1.2 Scope of Work and Methodology

In order to fulfill the requirements, we followed the Nova Scotia Environment's Guide to Groundwater Assessments for Subdivisions Serviced by Private Wells, Level I Requirements. These included the review, compilation and interpretation of the following sources of information and data:

- Geological Reports and Maps: surficial sediments, bedrock geology, and water supply wells, wetlands, historical pump tests and all technical literature on aquifers in the area of the Property.

- Nova Scotia Well Logs Database: well construction records, pump test results and water quality analyses (within 500 metres of the Property).

- Nova Scotia Pump Test Database (within 500 metres of the Property).

- Watershed Information: primary, secondary and tertiary watersheds of the Property; location of local surface water features; annual precipitation patterns.

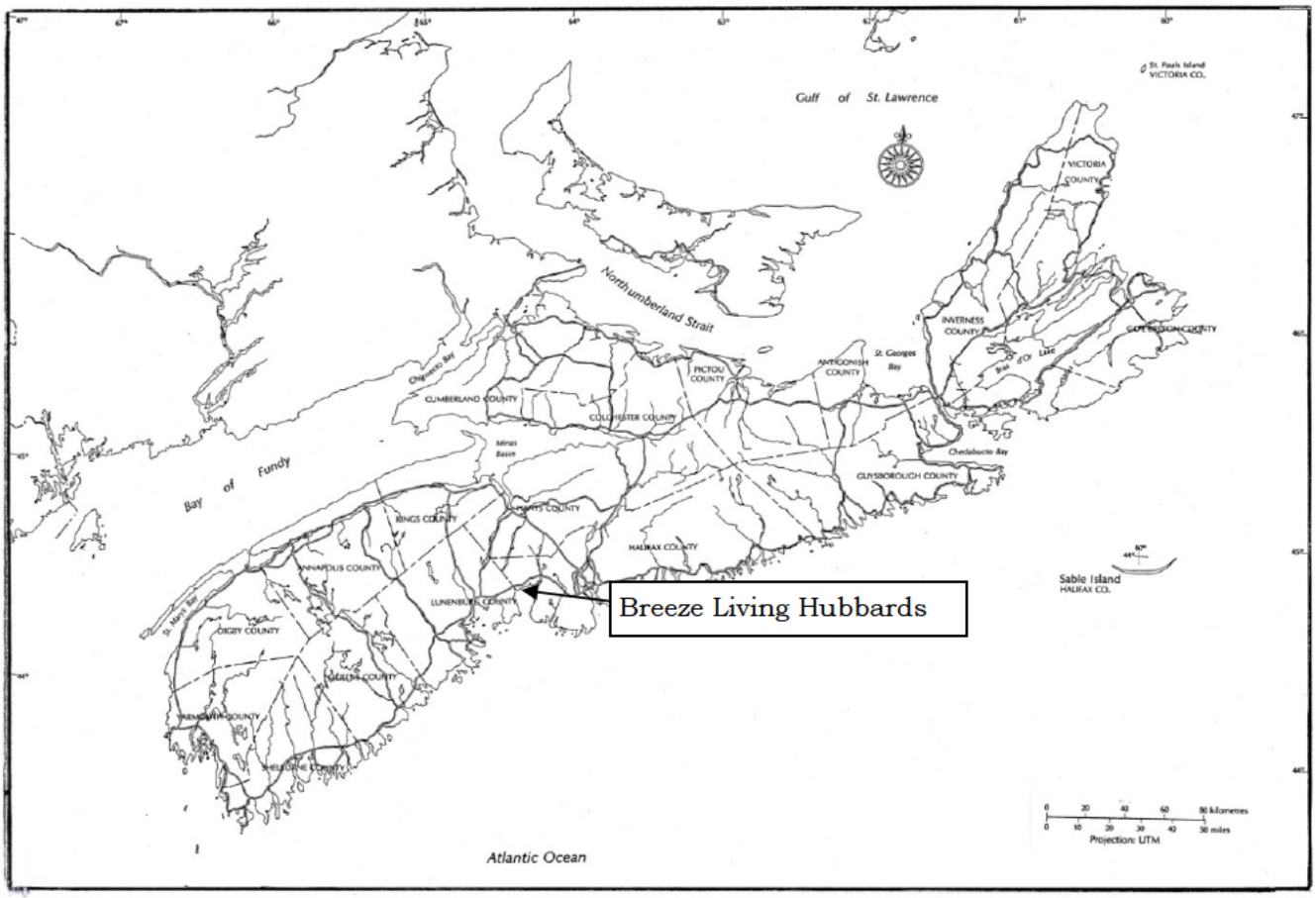



Figure #1 Location of the Breeze Living Hubbards Property on map of Nova Scotia

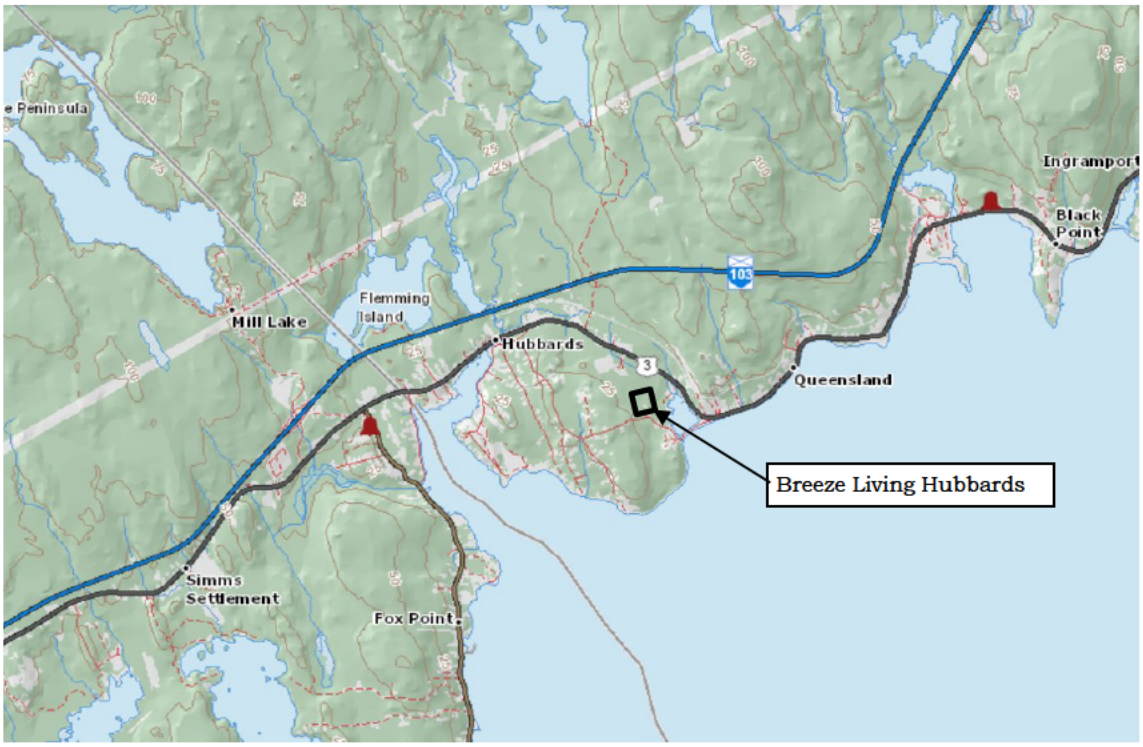



Figure #2 Location of Breeze Living Hubbards Property on Regional Map

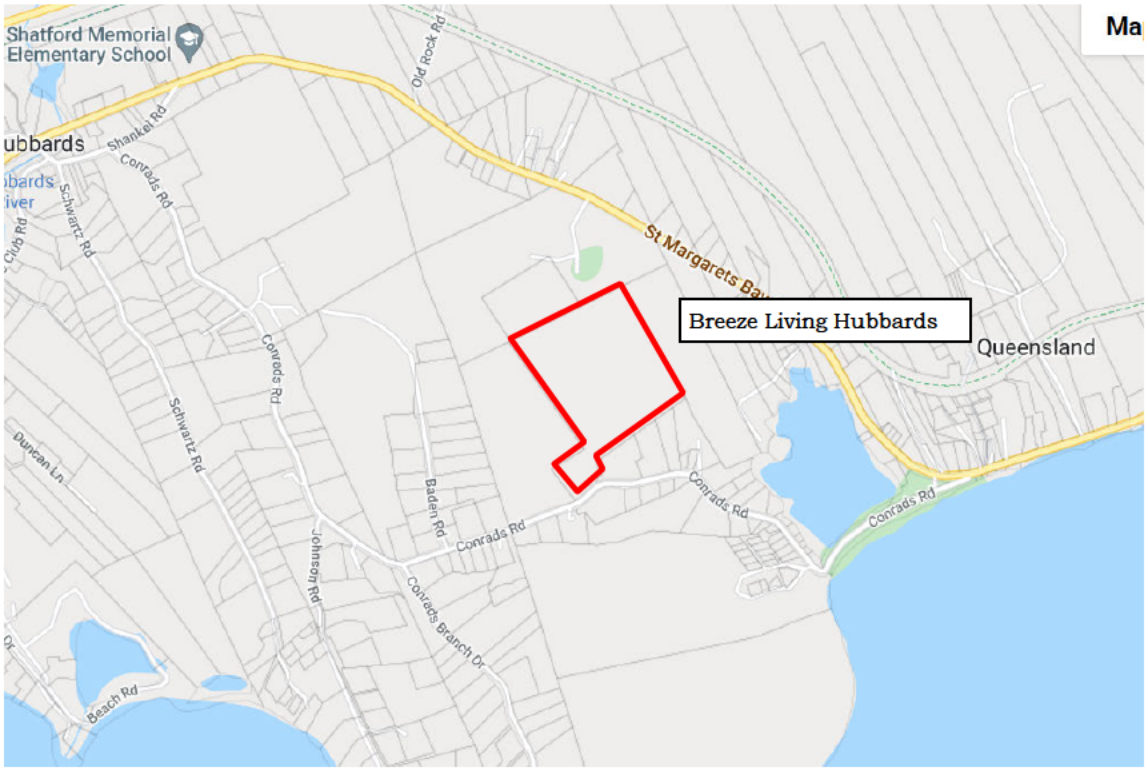



Figure #3 Breeze Living Hubbards Property on Local Property Map

# 2.0 Natural Landscape and Climate

## 2.1 Natural Landscape and Topography

The Property is located within the Pennant Granite Barrens Natural Landscape of Nova Scotia. This landscape is characterized by low and rugged dominated by a mosaic of boreal, coastal coniferous undulating terrain, and by barrens.

The Property lies within a parcel of land that slopes gently toward the east from a maximum elevation of 30 metres on the west side to 10 metres on the east side (Figure #3).


Figure #4 Satellite Air Photo of Breeze Living Hubbards Property

## 2.2 Climate and Precipitation

Climate normals for the Property are derived from the Environment Canada (EC), climate monitoring station located at St. Margaret's Bay which is located approximately 12 kilometres to the northeast. The results indicate the area receives total annual precipitation of from 1,300 to 1,400 millimetres of which approximately 85% occurs as rain.

## 2.3 Surface Water Features

The Property lies within the East Indian River Primary Watershed and within the Hubbards River Secondary Watershed (Figures #4 and #5). Local topographic mapping indicates the Property lies within the tertiary watershed of an un-named brook that is located 100 to 200 metres east of the Property (Figure #6)

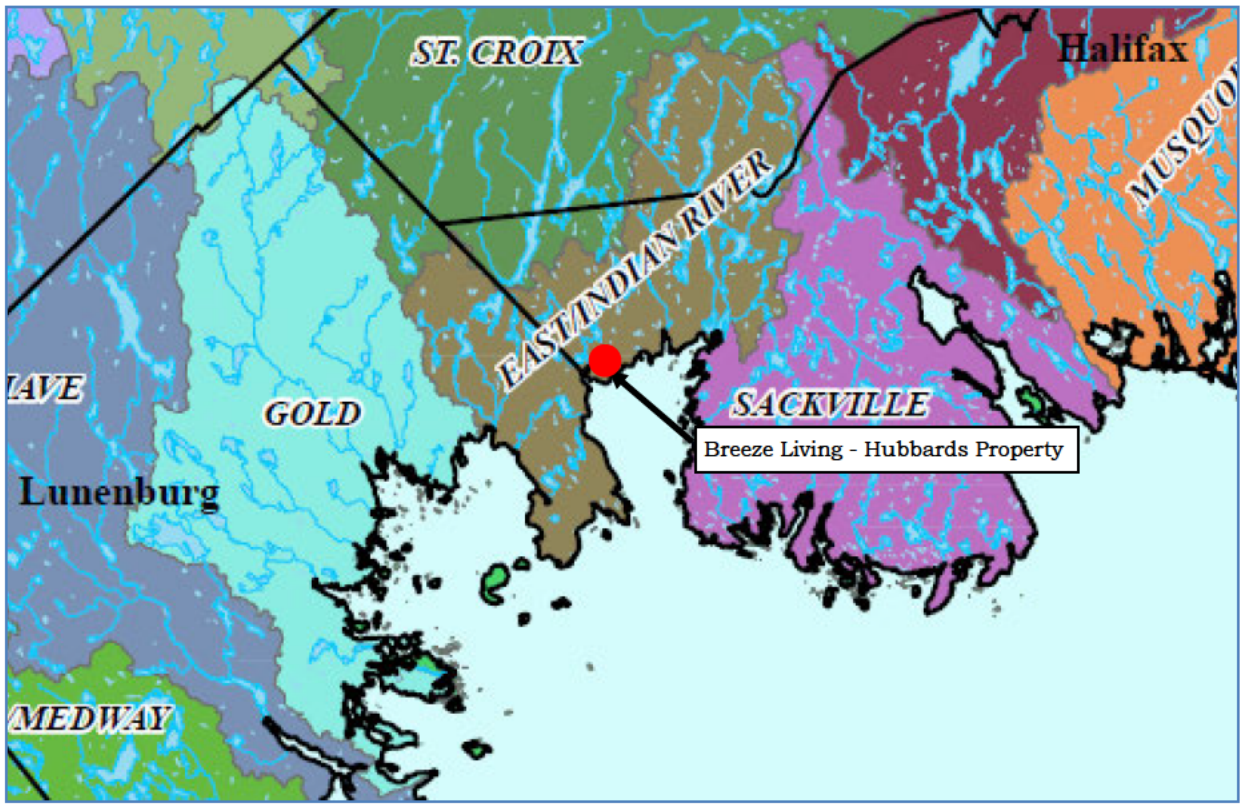



Figure #5 Primary Watersheds of Nova Scotia

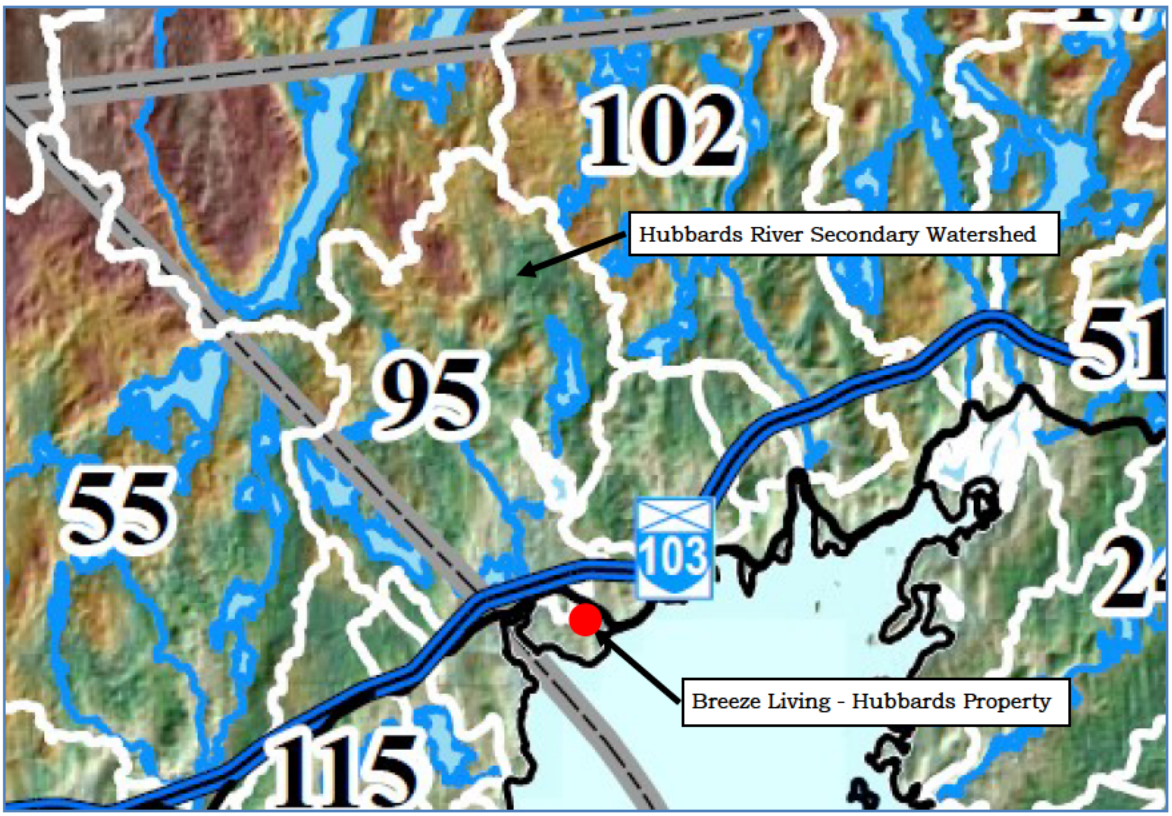



Figure #6 Secondary Watersheds of Nova Scotia

## 2.4 Wetlands

In Nova Scotia, a wetland is a term that includes the land areas that are commonly referred to as a marsh, swamp, fen or bog that either periodically or permanently has a water table at, near or above the land's surface or that is saturated with water. These land areas sustain aquatic processes as indicated by the presence of poorly drained soils, hydrophytic vegetation and biological activities adapted to wet conditions.[1]

A search of the Nova Scotia Ecological Land Classification mapping indicates there are no significant wetlands within the Property or within 2 kilometres of the Property. The proponent is currently conducting a detailed survey of several small wetlands on the Property which will be included in a separate report.

[1] NS *Environment Act* as amended in 2006

# 3.0 Anticipated Demand and Supply of Water

## 3.1 Anticipated Demand

The proposed development consists of 13, 4-unit buildings for a total of 52 residential units within the development for a total of 52 residential units. The following is an estimate of the maximum, anticipated demand for potable water by the development.

52 Units (@ 600 L/day) = 31,200 litres per day

Therefore, at full build-out the total daily water use is expected to be in the range of 31,200 litres.

## 3.2 Anticipated Supply

The planned water supply to the Property is a central water system with the raw water being supplied by 2 or more drilled water wells depending on the results of future groundwater resource assessments (drilling and testing)."

# 4.0 Summary of Hydrogeology

## 4.1 Surficial Sediments

The Property is covered by a layer of surficial sediments that consist of yellowish-grey coloured, gravely sand and silt (glacial till) which, according to local drilled well records are from 2 to 10 to metres thick.

## 4.2 Bedrock Hydrogeology

The Property is underlain by bedrock that consists of orangish-grey coloured granite where all of the porosity, permeability and storage of groundwater is within fractures in the bedrock (Illustration #1).

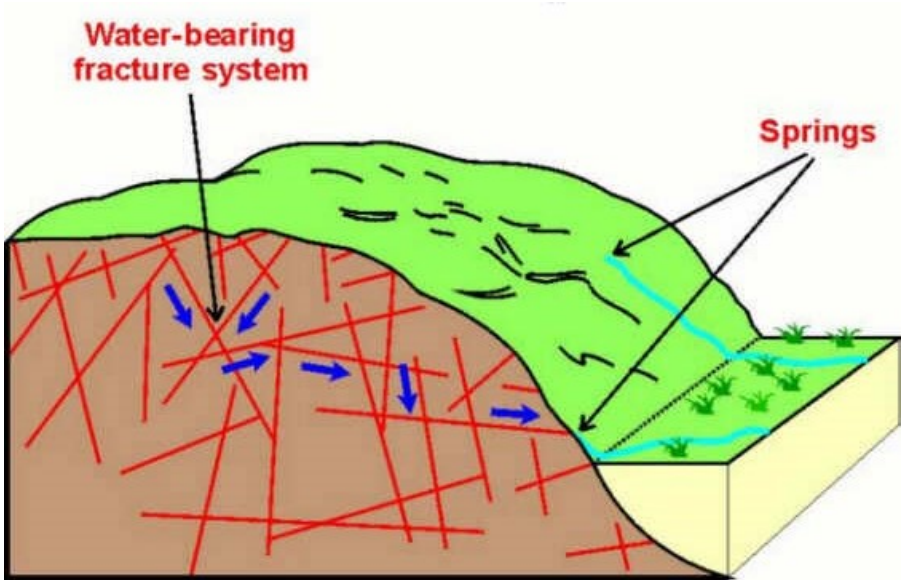


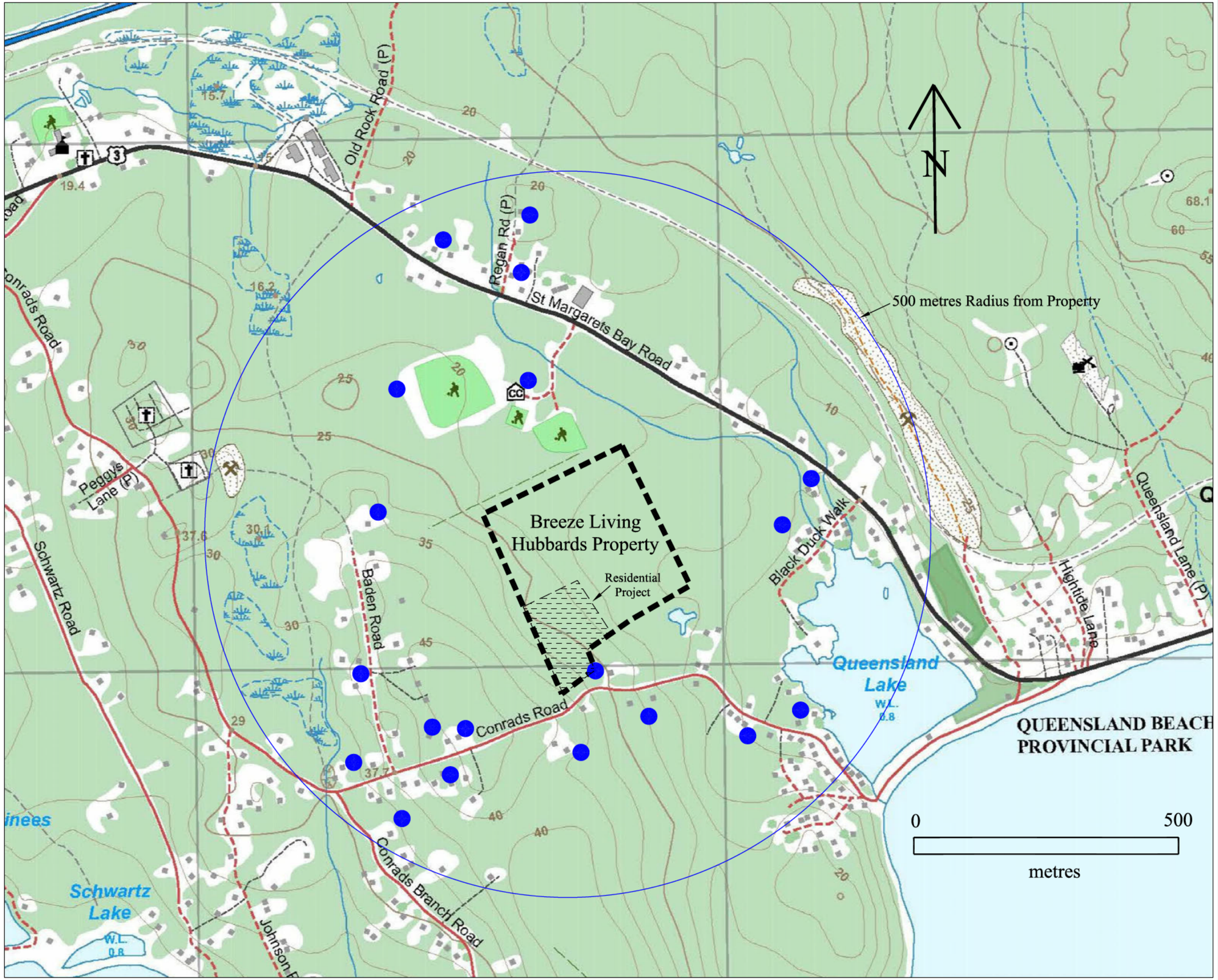

Illustration #1 Schematic Illustration of a Fractured Rock Aquifer System

Permeability of a fractured rock aquifer is dependent on the following factors:

- the number of fracture sets
- the orientation of the fracture sets
- the density of the fracture surfaces (spacing)
- the aperture of the fractures (distance between walls of fractures), and
- the degree of interconnection of the fracture sets.

Fractured rock aquifers generally have a much lower capacity to transmit water than sand & gravel aquifers or sandstone aquifers. This lower capacity

results from both a smaller amount of open space (porosity) and heterogeneities of the fracture patterns that are always present in the aquifer as compared to the primary permeability found in sand & gravel and sandstone aquifers. As a result, many fractured rock aquifers are limited in the amount of water they can reliably produce in the long term and should be assessed in a cautious manner.




# Explanation

Tertiary Watershed

Private Water Wells
(on NS Well Database)

Residential Building
(probable private well)

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# Breeze Living
# Hubbards Property

Hubbards Nova Scotia

Figure #7

July, 2022

# 5.0 Water Supply Wells and Water Quantity

## 5.1 Well Construction Characteristics

There are no existing water wells on the Property. A review of topographic maps and air photos indicates there are approximately 60 residential properties within 500 metres of the Property boundaries.

Research of the NSE Groundwater Atlas and NSE Drilled Well Database indicates NSE has records for 19 of these drilled wells (Table #1 and Figure #5). The NSE Drilled Well Database indicates these drilled wells have total depths of from 32.0 to 109.6 metres with driller's estimates of yields of from 6 to 136 litres per minute[2].

## 5.2 Well Yields

A rough estimate of the anticipated yield of water wells to be constructed on the Property can be made using two methods: 1) using the Nova Scotia Department of Environment's Toolkit for Groundwater Assessments (Nova Scotia Environment, 2011), and 2) comparing these results to driller's estimates of yields for the 19 well records within 500 metres of the Property that are in the NSE database.

For this estimate of yields, it is assumed the future wells will be constructed to total depths of 70 metres, the pumps will be installed to depth of 50 metres and the deepest static water level will be 10 metres below grade. Using the projected well construction characteristics and the Farvolden formula for generating a calculated estimate of yields ($Q_{20}$) of individual wells, the results are as follows:

Method #1

| | | | |
|---|---|---|---|
| Total Depth of Well | = | 70 | metres (below ground surface) |
| Pump Depth | = | 50 | metres |
| Static Water Level | = | 10 | metres (below ground surface) |
| Saturated thickness | = | 40 | metres |
| Available drawdown ($H_A$) | = | 30 | metres (75% of saturated thickness) |
| Aquifer Transmissivity (T) | = | 1.15 | $m^3/day/m$ (median for granites) |

[2] Driller's estimates of well yield are made by the drilling contractor after completion of well construction and are always greater than the sustainable yield of the well.

Safety Factor (Sf) = 0.7

Estimated Yield (rounded) = 16 cubic metres per day

= 16,000 litres per day

= 11 litres/minute

$Q_{20}$ = $(0.683)(T)(H_A)(S_f)$ Farvolden Method

Table #1

Hubbards Property Water Supply Wells within 500 metres of Property

| Well Number | Date Constructed (year-mo-day) | Well Depth metres | Casing Depth metres | Top of Bedrock metres | Static Water Level metres | Well Yield (driller's estimate) litres per minute |
|---|---|---|---|---|---|---|
| 213 | 2000-07-14 | 45.7 | 6.1 | 2.1 | 2.7 | 68 |
| 762 | 2000-06-23 | 77.7 | 6.1 | 4.0 | | 91 |
| 787 | 2000-07-26 | 85 3 | 9.4 | 4.0 | | 6 |
| 20113 | 2002-06-28 | 51.8 | 6.1 | 1.8 | 1.8 | 68 |
| 20183 | 2002-05-30 | 53 3 | 12.2 | 7.6 | 3.0 | 91 |
| 21156 | 2002-10-29 | 109.6 | 12.2 | 7.6 | | 27 |
| 51210 | 2005-04-15 | 59.4 | 6.1 | 3.0 | 4.6 | 136 |
| 60032 | 2006-01-20 | 36 5 | 6.1 | 3.0 | | 7 |
| 130609 | 2013-12-31 | 54.8 | 6.1 | 1.8 | 3.0 | 45 |
| 140216 | 2014-04-04 | 67.0 | 12.2 | 2.7 | | 14 |
| 721359 | 1972-09-15 | 39.6 | 12.8 | 11.3 | | 14 |
| 721378 | 1972-02-01 | 76 1 | 13.1 | 10.7 | | 23 |
| 721402 | 1972-09-14 | 35.0 | 10.1 | 8.5 | | 14 |
| 741092 | 1974-11-15 | 41 1 | 7.0 | 5.5 | 4.6 | 18 |
| 741143 | 1974-08-05 | 32.0 | 11.0 | 9.4 | 21.3 | 18 |
| 741150 | 1974-10-17 | 71.6 | 72.2 | 9.7 | 12.2 | 18 |
| 741169 | 1974-08-07 | 74.6 | 8.8 | 7.6 | 7.6 | 18 |
| 893026 | 1989-08-07 | 56 3 | 32.0 | | | 136 |
| 942009 | 1994-12-06 | 53 3 | 12.2 | | 12.2 | 16 |
| | | | | | | |
| Minimum | | 32.0 | 6.1 | 1.8 | 1.8 | 6 |
| Maximum | | 109.6 | 72.2 | 11.3 | 21.3 | 136 |
| Average (median) | | 59.0 | 13.8 | | | 18.2 |

Notes 1) The average value for Well Yield is the median value for the dataset.

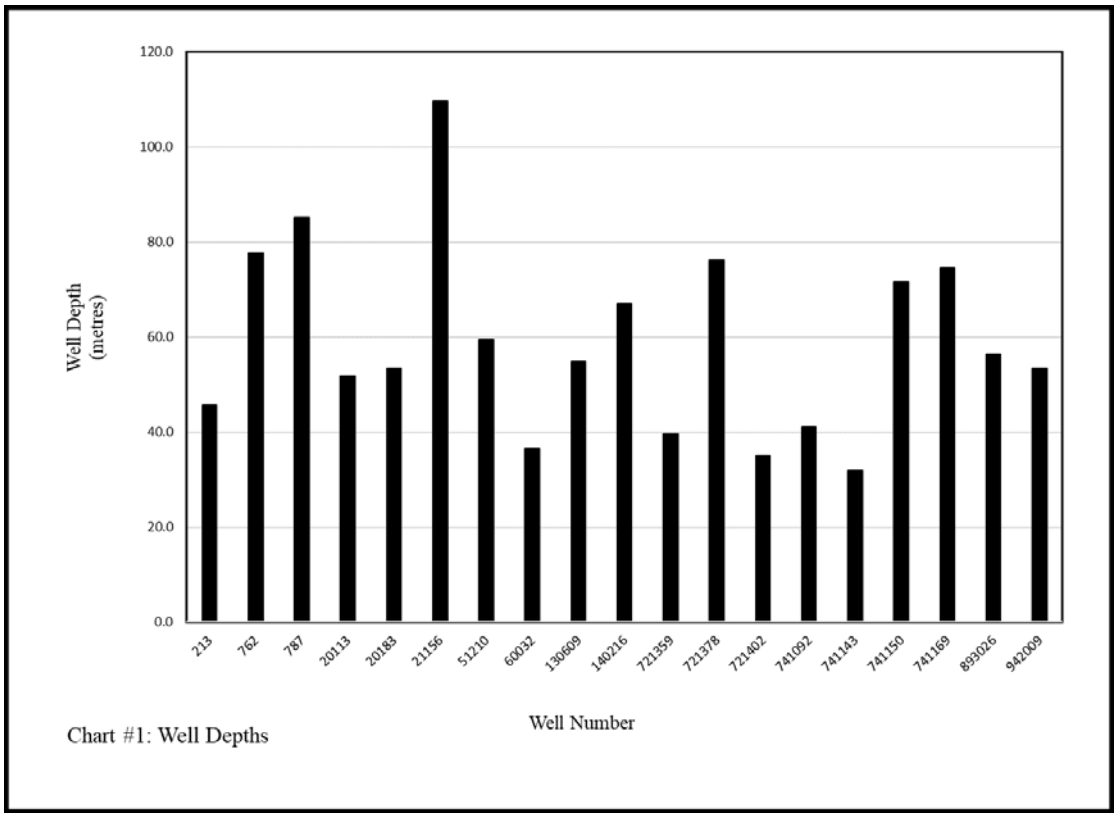


Chart #1: Well Depths

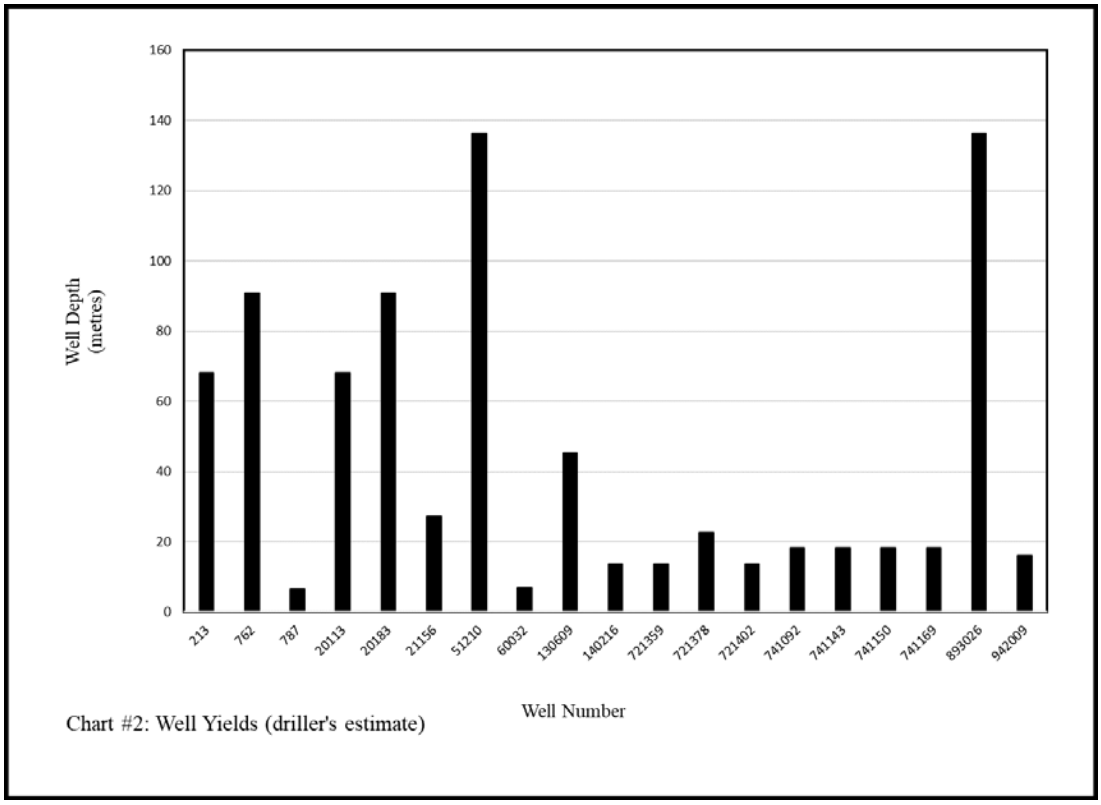


Chart #2: Well Yields (driller's estimate)

Method #2

The second method of predicting the yield of well to be constructed on the Property is to examine the well construction and yield data for existing wells located within 500 metres of the Property.

| | | | |
|---|---|---|---|
| Range of Well Depths | = | 32.1 to 106.9 | metres |
| Range of Driller's Estimates of Yield | = | 6 to 136 | litres/minute |
| Median of Driller's Estimates | = | 18 | litres/minute |
| 70% of Median | = | 12 | litres/minute |

Therefore, a comparison of the two methods of estimating yields of wells to be constructed in the future are similar.

## 6.0 Water Balance (Groundwater Recharge)

Considering the development plans for the 10 hectare property will include a combination of private wells and a central water system, this water balance and groundwater recharge estimate utilizes the entire 10 hectare property as the recharge area (capture zone). In this method, we utilized the annual groundwater recharge estimate for the Indian River Watershed as published by the Nova Scotia Department of Environment of 350 mm, an estimated impervious surface estimate of 8% and NSE's recommended Ecological Maintenance Factor of 50%.

Ecological use refers to groundwater that helps maintain ecological habitats by discharging as baseflow to surface water bodies. Ecological use is assumed to be 50% of the groundwater recharge. The following are the inputs to generate the groundwater recharge estimate:

| | | | |
|---|---|---|---|
| GW Recharge Rate (I) | = | 350 | mm/year (from NSE Toolkit) |
| Area of Lot ($A_{lot}$) | = | 93,000 | $m^2$ (9.3 hectares) |
| Impervious | = | 8 | % |
| Reserve for Ecology ($E_{use}$) | = | 50 | % |

The resultant calculation is as follows:

$Q_{lot}$ = $(I)(A_{lot})(E_{use})/365$ days
= 41,000 litres/day (rounded)

Therefore the estimated long term groundwater recharge to the Property is 41,000 litres per day.

## 7.0 Expected Water Quality

We were not able to find published information on water quality of water samples collected from water wells within 500 metres of the Property.

The Property is located in a part of Nova Scotia that is considered a medium to high risk of concentrations of arsenic, iron, manganese and uranium in groundwater that may exceed the Guidelines for Canadian Drinking Water Quality.

Due to the Property's proximity to Queensland Lake and the Atlantic Ocean, there is a moderate risk of the movement of seawater into coastal aquifers and adversely affecting groundwater withdrawn from water wells (Salt Water Intrusion). This possible effect can be better defined by well construction and hydraulic testing of the wells.

# 8.0 Evaluation of Potential Effects

## 8.1 Potential Well Interference

Considering the Property is expected to have 2 or more water supply wells that will provide raw water to a central water system, a reasonable attempt at determining potential well interference will depend on the results of future test well drilling and hydraulic testing.

## 8.2 Potential Effects on Surface Water and the Environment

The southeast boundary of the Property is approximately 200 metres from Queensland Lake and about 250 metres from an un-named watercourse.

The proposed development may have an influence on surface water resources by increasing the amount of impervious surfaces within the Property after full build-out. The degree to which the development affects run-off coefficients depends on the amount of the Property covered by hard surfaces such as roofs, paved areas, and concrete areas. In the case of the Breeze Living Hubbards Property, an increase in runoff is anticipated to have minimal impact on the local surface water systems as much of the runoff is anticipated to infiltrate within the Property in the pervious areas.

## 8.3 Risk of On-Site Septic Systems on Water Wells

The waste water management plan for the Property is to utilize one centralized septic system for all waste water.

## 9.0 Summary and Conclusions

The Breeze Living Hubbards project is a proposed residential development that will include 13, 4-unit buildings for a total of 52 residential units within the development. The planned water supply to the Property is a central water system with the raw water being supplied by 2 or more drilled water wells depending on the results of future groundwater resource assessments (drilling and testing)."

A summary or the anticipated potable water requirements is as follows:

Anticipated Total Water Use = 31,200 litres per day

The calculated estimate of long term, groundwater recharge to the Property is as follows:

Estimated Groundwater Recharge = 41,000 litres/day

Therefore, on the basis of the results of this Level I Groundwater Assessment, the proposed groundwater withdrawals within the Property are expected to be less than the annual groundwater recharge.