December 6, 2017

Mr. Joe Arab
**3283920 Nova Scotia Limited**
25 Oakley Avenue
Halifax, NS, B3M 3G6

**Subject :** **CBCL Limited October 23 Review– Level 2 Groudwater Assessment report**
Lot B, Peggy's Cove Road
Upper Tantallon, Nova Scotia
Ref. : P-0012667-0-00-200

Mr Arab,

We are pleased to provide you with our additional comments following the second review by CBCL Limited of the Level 2 Groundwater Assessment report conducted by Englobe on the above-mentioned property.

Aquifer Yield

For the safe yield calculations we have reviewed the water bearing fractures, as shown on table 7-1 of the report, the first water bearing fractures has been observed at a depth of 44.81 mbgs and 27.43 mbgs respectively for well 3 and well 4. We considered that the first observed water bearing fracture must not be dewatered, therefore, the available head has been revised in the calculations to the depth of the first water bearing fractures.

The Twenty Year Safe Well Yield calculation is used to estimate the long-term safe pumping rate for a well, and can be calculated using the two following methods. The Safe Well Yield calculations assume continuous pumping for twenty years.

The first method is based on the Farvolden equation (Nova Scotia Environment, 2011), and is described as follows:

$$Q_{20} = 0.683 T H_A S_f$$

Where:
**$Q_{20}$** = 20 Year Safe pumping rate for the well ($m^3$/day)
**$S_f$** = Safety Factor, 0.7 (no units)
**T** = Transmissivity (1.19 $m^2$/day)
**$H_A$** = Available head

According to the Farvolden equation, the estimated Twenty Year Safe Yield for Well 3 is 16.05 L/min (23.11 $m^3$/day) assuming an available head, $H_A$, of 40.62 m based on the first fracture at a depth of 44.81 mBGS, and a static water level at 4.19 mBGS.

For Well 4, the estimated Twenty Year Safe Yield is 8.80 L/min (12.68 m³/day) assuming an available head, $H_A$, of 22.28 m based the first fracture at a depth of 27.43 mBGS, and a static water level at 5.15 mBGS.

The second method is based on the Van der Kamp and Maathuis equation (Nova Scotia Environment, 2011), and is described as follows:

$$Q_{20} = S_f H_A Q / (S_{100\min} + (S_{20yrs} - S_{100\min})_{theor})$$

Where:

**$Q_{20}$** = 20 Year Safe pumping rate for the well (m³/day)

**$S_f$** = Safety Factor, 0.7 (no units)

**Q** = Pumping rate used during pumping test

**T** = Transmissivity (1.19 m²/day)

**$H_A$** = Available head

**$S_{100min}$** = Drawdown observed in well during the pumping test at 100 min

**$(S_{20yrs}-S_{100min})$theor** = The theoretical drawdown in the well after 20 years of pumping minus the theoretical drawdown in the well at 100 minutes, based on Graphs 106 and 107 in Appendix 5 of the report.

According to the Van der Kamp and Maathuis equation, the estimated Twenty Year Safe Yield for Well 3 is 28.67 L/min (41.28 m³/day) assuming an available head, $H_A$, of 44.81 m on the first fracture at a depth of 44.81 mBGS, and a static water level at 4.19 mBGS.

For Well 4, the estimated Twenty Year Safe Yield is 17.82 L/min (25.66 m³/day) assuming an available head, $H_A$, of 22.28 m based on the first fracture at a depth of 44.81 mBGS, and a static water level at 4.19 mBGS.

The calculated Twenty Year Safe Yields are summarized in Table .

Table 1. Twenty Year Safe Yields.

| | Well 3 | | Well 4 | |
|---|---|---|---|---|
| | m³/day | Lpm | m³/day | Lpm |
| Fracture Depth (mBGS) | 44.81m | | 27.43m | |
| Static Water Level (mBGS) | 4.19m | | 5.15m | |
| T (m²/day) | 1.2 | | | |
| Available head ($H_A$) | 40.62m | | 22.28m | |
| Farvolden | 23.11 | 16.05 | 12.68 | 8.80 |
| Van der Kamp and Maathuis | 41.28 | 28.67 | 25.66 | 17.82 |

Long term pumping test data showed a pseudo steady state when Well 3 flow rate is 31.8 L/min (45.82 m³/day) and Well 4 flow rate is 20.46 L/min (29.45 m³/day). However, according to the Farvolden equation, the revised estimated Twenty Year Safe Yield for Well 3 is 16.05 L/min (23.11 m³/day) and is 8.80 L/min (12.68 m³/day) for Well 4.

Since these calculations are conservative and that we don't know which fracture has the greatest contribution in the flow rate (as shown on Figures 3 and 4 of Appendix 1 of the report, there are 3 and 5 water bearing fractures), the recommended pumping rate has been revised to 16.05 L/min (23.11 $m^3$/day) at Well 3, and to 8.92 L/min (12.84 $m^3$/day) at Well 4. Note that even at a higher flow rate during the pumping test, the first fracture of well 4 was not dewatered. To confirm that fractures are not dewatered, we recommend verifying water levels in Well 4 at the beginning of production in the well.

These recommended pumping rates will satisfy the theoretical demand of 35,950 L/d.

Salt Water Intrusion

Concerning the possible intrusion of saltwater, as noted, there was no evidence of salt water intrusion during the Level 2 assessment. Given the conservative nature of the assessment and safe yield calculations, coupled with the water conservation measures being implemented, in our opinion the salt water intrusion potential is adequately addressed. As a mitigation measure we recommend verifying the conductivities in Well 3 during production; Well 3 is between the sea and the pumping wells. If indications of salt water intrusion into Well 3 (rising of conductivities) are observed, pumping will be stopped before there is saltwater in the system, and the safe yield calculations be re-evaluated. The verification of conductivities should be completed for a period of a year.

Closing

We trust this letter meets your current requirements. Please contact the undersigned if you require any additional information.

Sincerely,
**Englobe Corp.**

Aven Cole, M.Sc.E., P.Eng.
Project Engineer, Environmental Engineering