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CONSULTING



LEVEL 1 GROUNDWATER ASSESSMENT REVIEW

Revision 1

East Uniacke, NS

February 11, 2026

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Mr. Bruce McDow
3230225 Nova Scotia Ltd.

Dear Mr. McDow,

Re: Level 1 Groundwater Assessment Review
East Uniacke, NS

Attached is the Level 1 Groundwater Assessment Review prepared for the proposed future development in East Uniacke, NS.

The report documents our observations, findings, and recommendations.

We trust this to be satisfactory at this time. Once you have had an opportunity to review this correspondence, please contact us to address any questions you may have.

Thank you,



Alex Scott, MIT, EPT
Environmental Scientist
Environmental Assessment & Approvals
ascott@strum.com



François Gascon, P.Eng.
Environmental Engineer
Environmental Assessment & Approvals
fgascon@strum.com

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1.0 INTRODUCTION

Strum was commissioned by 3230225 Nova Scotia Ltd. (the “Client”) to complete a review (Revision 1) (the “Review”) of the Level 1 Groundwater Assessment completed by earth-water Concepts inc. (ewC, 2023) (the “Level 1”) for the proposed future development of the Villages of Long Lake (the “Development”) in East Uniacke, Nova Scotia (NS). The Development will consist of single-unit residential dwellings (the “Units”).

2.0 BACKGROUND

ewC completed the Level 1 for the Development in March 2023. Subsequently, ewC provided a follow-up to the March 2023 Level 1 report, revising the Level 1 well interference estimate to account for fewer occupants per unit (2024). Based upon updates to the Development, Strum completed updates to the well interference and water balance analysis (Review Revision 0) in 2025, and again with this Review.

The Level 1 and the Review Revision 0 and associated documents were submitted to the Municipality of East Hants (MEH). Following MEH’s initial review, further clarification is required for the list of items addressed in this Review (Section 9.0).

3.0 DEVELOPMENT OVERVIEW

The Level 1 completed by ewC in March 2023 was based on the following details:

- The Development consisted of six land parcels with property identification (PID) numbers: 45147154, 45147253, 45155314, 45187242, 45155306, and 45392602, making up Villages 3 to 8.
- The Development consisted of 600 new lots, each occupying approximately 0.5 ha (1.2 acres).
- The Units ranged from 1 bedroom to 4 bedrooms.
- The Development consisted of many wet and open areas.
- The Development area totalled approximately 510 hectares (ha).

Currently, the Client has revised the proposed Development (Drawing 1, Appendix A) to consist of:

- Approximately 370 Units, across four interconnected areas of development (i.e., Areas 1 to 4).
 - The Units will range from 1 bedroom to 3 bedrooms.
 - Additional mixed-zone spaces (10.2 ha) will be reserved for local commercial usage.
- Many wet and open areas.

- An area totalling approximately 312 ha, each unit occupying approximately 0.5 ha (Drawing 1, Appendix A).
 - Note that the 312 ha excludes the areas dedicated to the Municipality of East Hants, and additional retained lands by the Client, as indicated on Drawing 1.

4.0 SITE DESCRIPTION

The Development is situated between East Uniacke Road in the southeast and sparsely developed residential properties along Long Lake to the east. Largely undeveloped or partially developed lands are located adjacent to the Development in the north, east, and west.

For this Review, a Study Area has been defined as a 500 m buffer surrounding the Development.

5.0 TOPOGRAPHY, DRAINAGE, AND WATERSHEDS

5.1 Regional Topography, Drainage, and Watersheds

The topography, drainage, and watersheds for the Development area are described in the Level 1 report. The Development is located within the St. Croix primary watershed, and drainage primarily follows topography into Long Lake or Herbert River (ewC, 2023).

6.0 HYDROGEOLOGY

6.1 Surficial Hydrogeology

The surficial geology and surficial hydrogeology for the Development area are described in the Level 1 report. The Development is underlain by silty and stony till plains as well as drumlins. The water quality and quantity of the surficial aquifers on the site are unknown, as desktop data are limited. Generally, surficial aquifers have good water quality in NS, but seasonal variations in water availability lead to some surficial wells going dry at certain times of the year. Furthermore, surficial wells are more easily contaminated; therefore, they require larger setbacks from sources of contamination such as fuel storage tanks and septic systems (ewC, 2023).

The Level 1 reviewed well logs within several kilometres (assumed 5 km) of the Development. The Level 1 assessment identified three dug wells; however, this limited dataset provides little insight into the overall performance of the surficial aquifer.

The NS Guide to Groundwater Assessments for Subdivisions Served by Private Wells (NSECC, 2011) requires well logs to be reviewed within a 500 m radius of the Development, which has been done for this Review. No dug wells were found within a 500 m radius of the Development.

6.2 Bedrock Hydrogeology

The bedrock geology and bedrock hydrogeology for the Development area are described in the Level 1 report. The Development area is underlain by the Taylor's Head Formation of the Goldenville Group. Lineaments and several structural folds cross the Development. The Level 1 concluded that historic mining in the area is unlikely to bear any concern for the Development area. Naturally high levels of arsenic and other metals may be of concern for the Development area (ewC, 2023).

It should be noted that, undifferentiated, this bedrock is often characterized as the Goldenville Formation, which is how the underlying bedrock is referred to in this Review.

6.2.1 Water Quality Data

6.2.1.1 *Water Quality from the Bedrock Aquifer*

The Level 1 reviewed hydrogeochemical conditions and chemistry wells within several kilometres (assumed 5 km) of the Development. The Level 1 found nine chemistry wells (including on-site wells). Water quality exceedances in these wells occur for the parameters of manganese and arsenic (ewC, 2023).

According to the NS Groundwater Atlas (NSNR, 2024), no chemistry wells are located within 500 m of the Development. However, this Development area is considered a high risk for manganese and arsenic, and a low risk for uranium in bedrock wells (Kennedy, 2021; Kennedy & Drage, 2020; 2016). All these contaminants can be treated by conventional treatment, generally at the point of use (POU), at a single faucet for water used for drinking, cooking, and other human consumption purposes.

6.2.2 Water Quantity Data

6.2.2.1 *Water Quantity from the Bedrock Aquifer*

The Level 1 reviewed well logs within several kilometres (assumed 5 km) of the Development. Based on the Level 1, nearby wells have a depth range of 13.7 m to 158.3 m, and a median well depth of approximately 79.2 m. Short-term drillers' yields ranged from 0.5 litres per minute (Lpm) to 227.0 Lpm with a mean of 14.6 Lpm.

The NS Guide to Groundwater Assessments for Subdivisions Served by Private Wells (NSECC, 2011) requires well logs to be reviewed within a 500 m radius of the Development, which has been completed for this Review. It should be noted that wells with a spatial resolution accuracy of 1,000 m or greater were excluded from this analysis, as this introduces too much uncertainty regarding proximity to the Development area.

Strum conducted a provincial water well database search and identified 31 drilled wells within 500 m of the Development (Table 1, Appendix B). The wells were all installed in bedrock or assumed to be where well logs are incomplete. The well depths, as indicated by the well logs, range from 32.0 m to 137.0 m, with a median of 73.1 m. The short-term drillers' yields ranged

between 2.3 Lpm and 227.0 Lpm, with a median of 4.5 Lpm (Table 1, Appendix B) (NSECC & NSNR, 2022). Short-term driller's yields are estimates based on short-duration airlift tests completed by the driller at the end of the well construction. It is important to note that long-term well production rates are typically 20% to 50% of the driller's estimates.

Longer-term or more continuous safe yields must be evaluated by aquifer testing. The Level 1 identified nine pumping test wells within several kilometres (assumed 5 km) of the Development. The results indicate a long-term safe yield (Q_{20}) of approximately 12.5 Lpm and a transmissivity (T) of 0.48 square metres per day (m^2/d).

According to the NS Groundwater Atlas (NSNR, 2024), no pumping test wells are located within 500 m of the Development. However, Strum reviewed wells out to 10 km from the Development, of which 11 were identified in the Goldenville Formation (Table 2, Appendix B). The pumping rates of these wells ranged from 2.7 Lpm to 88.9 Lpm, with a median of 27.3 Lpm. The transmissivity of these wells ranged from 0.05 m^2/d to 9.9 m^2/d , with a median of 2.0 m^2/d . It should be noted that these wells are located far from the Development and may not accurately reflect well performance at or across the Development. Furthermore, these wells are listed as being constructed in the Goldenville Formation; however, except for Han-14 and Han-18, they are within or near the Halifax Formation. It is therefore possible that these wells are constructed within or partially within the Halifax Formation but were mischaracterized by the driller during construction. For that reason, the transmissivity and storativity values used in this assessment considered a wider selection of pumping tests for the water balance and well interference estimations.

6.2.2.2 NS Groundwater Observation Well Network

The Level 1 reviewed the Observation Well Network (NSECC, 2015) and concluded that the nearest wells in the Goldenville Group formations are Lawrencetown (network well 043) and Musquodoboit Harbour (network well 078). The Level 1 then concluded that wells drilled on the site should expect groundwater level fluctuations between 1.0 m and 1.8 m (ewC, 2023).

6.2.2.3 Municipal Wells

According to the NS Groundwater Atlas (NSNR, 2024), no municipal wells are located within 500 m of the Development.

7.0 WATER BALANCE

Per NSECC (2011), each well serving a single-family residential household must provide at least 1,350 litres per day (Lpd) continuously. The NSECC (2011) requirement to provide 1,350 Lpd for single residential households is an estimate based on the average home (four bedrooms), yet it does not account for variations in home size. As stated in the Level 1 report, 1,350 Lpd may not accurately represent the water needs for a single-family residence.

Based on the Development as described to Strum, 370 Units, with up to three bedrooms each, are proposed for construction within the Development. Strum can assume, at a minimum, that

1,000 Lpd is required for each Unit, based on the NSECC On-site Sewage Disposal Systems: Technical Guidelines, Appendix F (2013).

Water treatment systems may require water to flush (backwash) and/or recharge the system. Concerns are especially relevant when reverse osmosis (RO) is used, as it is only approximately 50% efficient (i.e., half of the water is rejected) (NSECC, 2009). Based on the water quality of the Development area, residents may require ion exchange systems, which are relatively low-cost and highly efficient, with minimal water usage and waste (Water Quality Association, 2013).

Mitigation activities to reduce the water treatment system's demand include extending the time between backwashes whenever possible, scheduling backwashes during nighttime hours when other household water uses are minimal, and being mindful of other large water uses after a backwash to allow the well to recover adequately. Other water conservation measures should be considered and discussed with potential unit owners to reduce stress on water demands (i.e., low-flow toilets and faucets, rainwater capture for yard uses, etc.).

The water treatment system must be adequately designed, operated, and maintained according to the manufacturer's instructions, and regularly tested and monitored to ensure the integrity of the supply and provide safe, potable water, as well as user satisfaction, over the long term.

A simplified water balance calculation was used to estimate whether the available groundwater across a site, or within each lot, will meet the target water volume of 1,000 Lpd (NSECC, 2013).

According to NSECC (2011):

"The calculation assumes that the available groundwater is equal to the groundwater recharge that occurs on the lot, minus the amount of groundwater reserved for ecological use. Ecological use refers to groundwater that helps maintain ecological habitats by discharging as baseflow to surface waterbodies. Ecological use is assumed to be 50% of the groundwater recharge."

$$Q = \frac{I(A * ISP)E_{use}}{365 \text{ days}} \quad (\text{Eq. 1})$$

Where:

Q represents the available groundwater for an area (Lpd).

I represents the groundwater recharge rate (mm/year).

A represents the area receiving precipitation (m²).

ISP represents the percentage of impervious surface area in subdivision development (%).

E_{use} represents the percentage for recharge reserved for baseflow/ecological support (%).

Based on communication with the Client and a review of design drawings, the proposed Development's total area is 3,120,560 m² (312 ha), including proposed lots, roads, and green spaces (Drawing 1, Appendix A). A geospatial analysis of neighbouring properties surrounding the Development was conducted to understand the built environment and its impact on groundwater infiltration and recharge. The properties from Villages 1 and 2 were used in this analysis, as these homes were constructed by the Client, and Strum understands that the Development will be similar. The analysis determined that the impervious surface area percent (ISP) [where precipitation will not infiltrate the ground (buildings, paved driveways, etc.)] within a property lot is 4.7%. It is assumed that homes within the proposed Development will conform to a similar property design; therefore, the same ISP will be used.

7.1 Groundwater Recharge

Two methods for the simplified water balance were used to determine water availability for the Development based on recharge estimates.

The first method, Lot Recharge, examines the proposed lots independently and determines whether the average lot (based on the Development's average lot size) can support the required lot consumption of 1,000 Lpd.

The second method, Site Recharge, examines the total Development area, including areas more receptive to groundwater recharge outside of individual lots (e.g., green spaces). This method then determines if the total Development area can support the number of homes proposed to be built, based on the required consumption of 1,000 Lpd per lot.

7.1.1 Lot Recharge

The total area of all lots in the Development is 1,953,600 m², and 370 lots are proposed, with an average lot area of 5,280 m². Based on the Development's design and adjacent land use (existing phases), the ISP for the Development area is approximately 4.7% (Table 7.1).

Table 7.1: Parameters for Water Balance Calculation – Lot Area

A _{LOT} (m ²)	I (mm/Y) *	E _{use} (%)	ISP (%)	Q _{LOT} (Lpd)	Number of Lots Supported
5,280	237	50	4.7	1,634	604

* Based on an average recharge from the St. Croix watershed (Kennedy et al., 2010). Note that the groundwater recharge rate used to estimate recharge was averaged, and may underestimate/overestimate the available groundwater.

Q_{LOT} = The groundwater available for the proposed lots based on recharge estimates.

The average proposed lot has an estimated recharge of 1,634 Lpd, which exceeds the 1,000 Lpd required per lot by the NSECC guidelines and modified water demand based on NSECC septic flows (NSECC, 2011; 2013). Given the long-term yield for the lot recharge, the combined total area of the proposed lots can support up to 604 lots, greater than the 370 proposed, while still meeting the 1,000 Lpd per lot guidelines (NSECC, 2011). Therefore, the proposed Development satisfies the Lot Recharge criteria (per the simplified calculation), and sufficient water should be available for the Development.

7.1.2 Site Recharge

The Development area is 3,120,560 m² (312 ha). In this scenario, the ISP for the Development area was maintained at 4.7% (Table 7.2). Strum understands that the roads within the Development will be gravel and therefore are assumed not to contribute to ISP.

Table 7.2: Parameters for Water Balance Calculation – Site Area

A _{SITE} (m ²)	I (mm/Y) *	E _{use} (%)	ISP (%)	Q _{SITE} (Lpd)	Number of Lots Supported
3,120,560	237	50	4.7	965,497	965

* Based on an average recharge from the St. Croix watershed (Kennedy et al., 2010). Note that the groundwater recharge rate used to estimate recharge was averaged, and may underestimate/overestimate the available groundwater.

Q_{SITE} = The groundwater available for the Site based on recharge estimates.

The Development area has an estimated recharge of 965,497 Lpd, and can support up to 965 homes, based on the 1,000 Lpd required per lot by the NSECC guidelines and modified water demand based on NSECC septic flows (NSECC, 2011; 2013). Therefore, the Development satisfies the Site Recharge criteria.

Note that estimating infiltration for groundwater recharge is subject to limitations. Not all infiltrated water contributes to recharge, as losses can occur through evapotranspiration, root uptake, and soil moisture retention. Differences in soil types and material layers introduce uncertainty about how water moves down through the soil and whether it reaches the groundwater. Additionally, infiltration rates are highly variable over time, influenced by factors such as rainfall intensity, land use changes, and antecedent soil moisture conditions. In regions with deep water tables, much of the infiltrated water may never reach the aquifer.

7.1.3 Mixed-Use Zones

The Development proposes to construct mixed-use zones, designed to provide local commercial space. The details for these areas of the Development are high-level; therefore, an adequate water demand for these mixed-use zones cannot be accurately assessed at this time. However, as illustrated in Sections 7.1.1 and 7.1.2, the available groundwater recharge for the Development exceeds the anticipated demand for the 370 units.

Based on the scenario illustrated in Section 7.1.1, up to 604 lots can be supported within the Development. When the proposed 370 units are accounted for, this results in an excess of 234 units with an anticipated water demand of 1,000 Lpd. Therefore, 234,000 Lpd of excess water is available for the Development.

Based on the scenario illustrated in Section 7.1.2, up to 965 lots can be supported within the Development. When the proposed 370 units are accounted for, this results in an excess of 595 units with an anticipated water demand of 1,000 Lpd. Therefore, 595,000 Lpd of excess water is available for the Development.

Approximately 10.2 ha of mixed-use areas are incorporated in the Development (Drawing 1, Appendix A). Although the anticipated water demand for the local commercial areas is

unknown, the minimum groundwater demand is expected to match the minimum septic flows specified in the NSECC On-site Sewage Disposal Systems: Technical Guidelines, Appendix F (2013). The minimum flows for a commercial building are 500 Lpd; however, higher flows are required for businesses such as restaurants and veterinary clinics. Considering the minimum commercial flows, there is sufficient recharge across the Development to support between 468 and 1,190 commercial businesses and 370 proposed single-family units.

However, higher level flows, such as those seen in veterinary clinics, require a minimum of 5,700 Lpd (NSECC, 2013). For these types of structures, the Development can support between 41 and 104 clinics, in addition to the 370 proposed single-family units.

8.0 WELL INTERFERENCE

The Level 1 (ewC, 2023; 2024) concluded that reducing the number of lots, drilling deeper wells, or reducing the assumed groundwater consumption could be considered to meet the required well interference guidelines (NSECC, 2011).

Based on the Development as described to Strum, 370 Units, each with up to three bedrooms, are proposed to be constructed on-site. Strum can assume, at a minimum, that 1,000 Lpd is required for each Unit, based on the NSECC On-site Sewage Disposal Systems: Technical Guidelines, Appendix F (2013). It was further assumed that each mixed-use zone would require a single well (four wells total), with the same water demand (1,000 Lpd).

Using the groundwater toolkit (NSECC & NSNR, 2011), Strum recalculated the well interference for the Development based on the new number of Units (370), mixed-use zones (1 well per zone), and the new minimum water demand (1,000 Lpd) (NSECC, 2011; 2013). Well performance values for transmissivity and storativity from the Level 1 were used in the updated calculation (ewC, 2023; 2024).

Strum cannot independently verify the pump test data provided in the Level 1 report (ewC, 2023; 2024), with the exception of the wells available through the NS Groundwater Atlas (Han-18 and Han-14) (NSNR, 2024). However, published data have shown that transmissivity values in metamorphic bedrock (as underlies the Development area) in NS have a median value of 1.3 m²/d (Kennedy & Drage, 2009). Furthermore, pumping test wells within 10 km of the Development (Section 6.2.2) are available and provide information for well performance within the Goldenville Formation bedrock.

The data provided in Table 8.1 was assumed for the updated well interference calculator.

Table 8.1: Updated Well Interference Input Parameters

Lot Density	Well Depth ⁽¹⁾ (m)	Available Head ⁽²⁾ (m)	Transmissivity ⁽³⁾ (m ² /d)	Storativity ⁽³⁾	Pumping Rate ⁽⁴⁾ (m ³ /d)
100% (370)	82	72	0.35	4.28E ⁻⁴	1.0
100% (370)	108 ⁽⁵⁾	98 ⁽⁵⁾	0.35	4.28E ⁻⁴	1.0

⁽¹⁾ Based on the proposed scenario in the Level 1 (ewC, 2023; 2024).

⁽²⁾ Assumes a static water elevation of 6 m and a pump clearance of 4 m.

⁽³⁾ Based on the Level 1 (ewC, 2023; 2024).

⁽⁴⁾ Based on the NSECC On-site Sewage Disposal Systems: Technical Guidelines, Appendix F (2013).

⁽⁵⁾ Theoretical well characteristics which would satisfy the well interference guideline (NSECC, 2011).

The data provided in Table 8.2 contains the updated well interference results.

Table 8.2: Updated Well Interference Table

Radial Distance to the Development's Center (m)	Predicted DD Caused by Single Well (m)	No. of Wells Located at Specified Radial Distance	DD Caused by All Wells at Specified Radial Distance (m)	% of available DD at the central well (72 m)*	% of available DD at central well (98 m)*
0.076	4.22	1	4.22	5.86	4.31
100	0.96	4	8.05	11.19	8.22
200	0.65	8	13.24	18.39	13.51
300	0.47	11	18.45	25.62	18.83
400	0.36	16	24.13	33.52	24.62
500	0.27	21	29.79	41.38	30.40
600	0.21	20	33.89	47.07	34.58
700	0.16	33	39.03	54.21	39.83
800	0.12	38	43.51	60.60	44.52
900	0.09	41	47.14	65.64	48.23
1,000	0.07	26	48.86	68.02	49.98

Note: Single-family units (1 well per unit) and mixed-use zones (1 well per zone) are included in this Table.

DD = drawdown

* Available drawdown, not total well depth.

All calculated scenarios are based on a 365-day pumping rate, as the proposed homes are anticipated to be used for year-round occupation.

Bold red values exceed the well interference guidelines (NSECC, 2011).

The updated well interference calculation indicates that wells at least 108 m in depth are required to meet the well interference guidelines for all distances out to 1,000 m (Table 8.1 and 8.2) (NSECC, 2011, 2013).

Strum calculated well interference for the Development using the groundwater toolkit and publicly available well performance data (Tables 8.3 and 8.4) (NSECC & NSNR, 2011). The published transmissivity value (1.3 m²/d) was used instead of the pumping test data (Section 6.2.2) to provide a more conservative estimate of the median transmissivity. A single pumping test well reported a value for storativity (7.15E⁻⁴), and based on the provided mapping and well log data, its construction was ambiguous and was therefore not used in this assessment. Alternatively, the median storativity value was calculated based on all available pumping test

data within the Goldenville Formation ($1.4E^{-4}$). Consumption values are assumed to be 1,000 Lpd.

The data in Table 8.3 was assumed for the updated well interference calculator.

Table 8.3: Strum Calculated Well Interference Input Parameters

Lot Density	Well Depth ⁽¹⁾ (m)	Available Head ⁽²⁾ (m)	Transmissivity ⁽³⁾ (m ² /d)	Storativity ⁽³⁾	Pumping Rate ⁽⁴⁾ (m ³ /d)
100% (370)	82	72	1.3	1.4E ⁻⁴	1.0
100% (370)	92.5 ⁽⁵⁾	82.5 ⁽⁵⁾	1.3	1.4E ⁻⁴	1.0

⁽¹⁾ Based on the proposed scenario in the Level 1 (ewC, 2023; 2024).

⁽²⁾ Assumes a static water elevation of 6 m and a pump clearance of 4 m.

⁽³⁾ Based on the Level 1 (ewC, 2023; 2024).

⁽⁴⁾ Based on the NSECC On-site Sewage Disposal Systems: Technical Guidelines, Appendix F (2013).

⁽⁵⁾ Theoretical well characteristics which would satisfy the well interference guideline (NSECC, 2011).

The data provided in Table 8.4 contains the updated well interference results (Strum Calculated).

Table 8.4: Strum Calculated Well Interference Table

Radial Distance to the Development's Centre (m)	Predicted DD Caused by Single Well (m)	No. of Wells Located at Specified Radial Distance	DD Caused by All Wells at Specified Radial Distance (m)	% of available DD at the central well (72 m)*	% of available DD at central well (82.5 m)*
0.076	1.29	1	1.29	1.79	1.56
100	0.41	4	2.91	4.04	3.53
200	0.32	8	5.48	7.61	6.64
300	0.27	11	8.47	11.77	10.27
400	0.24	16	12.27	17.04	14.87
500	0.21	21	16.68	23.17	20.22
600	0.19	20	20.45	28.40	24.79
700	0.17	33	26.06	36.20	31.59
800	0.15	39	32.09	44.57	38.89
900	0.14	41	37.86	52.58	45.89
1,000	0.13	26	41.20	57.23	49.94

Note: Single-family units (1 well per unit) and mixed-use zones (1 well per zone) are included in this Table.

DD = drawdown

* Available drawdown, not total well depth.

All calculated scenarios are based on a 365-day pumping rate, as the proposed homes are anticipated to be used for year-round occupation.

Bold red values exceed the well interference guidelines (NSECC, 2011).

The transmissivity and storativity values for the Development cannot be determined accurately without conducting onsite pumping tests. However, publicly available pumping test data and literature for the area indicate that wells constructed to a depth of 92.5 m should have sufficient performance to satisfy the well interference guidelines for all distances out to 1,000 m (Table 8.4) (NSECC, 2011).

However, if, upon completing on-site pump testing, on-site well performance is found to be less than assumed in this analysis, wells may need to be constructed to greater depths, or lot density may need to be reduced to meet the well interference guideline (NSECC, 2011).

It should be noted that well interference was calculated out to 1,000 m from the theoretical central well. This maximal distance is based on the lower interference values predicted by the groundwater toolkit when the drawdown was extrapolated to 1,000 m. Note that Villages 1 and 2 were considered to the extent that the existing Development fell within the 1,000 m.

Furthermore, it is assumed that, in a real-world setting, interference is unlikely to be significant beyond 1,000 m. Based on on-site characteristics determined through fieldwork and pump testing, this assumption may need to be refined.

Finally, it is essential to understand that the groundwater toolkit is a simplified tool for groundwater estimation. This tool serves as a high-level investigative tool and is utilized for Level 2 groundwater assessments; however, it does not guarantee definitive results (NSECC & NSNR, 2011).

9.0 RESPONSE TO MUNICIPALITY

The following are responses to the comments provided by the Municipality of East Hants.

1. **Comment:** The Level 1 Groundwater Assessment prepared by Strum Consulting is for 335 single unit dwellings, ranging from 1 to 3 bedrooms. The development agreement application is for 370 dwelling units, plus 9-hectares of mixed-use development. The groundwater recharge calculations need to be updated to reflect 370 dwelling units and the mixed-use area. Consideration of the impervious surfaces that may be created by commercial development should be included in the calculations, as well as the amount of water these businesses may require. Additionally, there is no mention of the existing gravel quarry and its potential impact on groundwater recharge. In the conclusion of the study, it states that "...if more units are proposed above 335, or if the type of units to be constructed is changed (e.g., recreational facilities, mixed-use zones, or buildings requiring water, etc.), the conclusions and recommendations in this Review may no longer be valid".

Response: This Review has been updated to include 370 dwelling units and to provide greater context surrounding the mixed-use zones. At this stage, the water demand for the mixed-use zones cannot be determined. However, sufficient water is expected to be available for a variety of commercial operations. Further study through a Level 2 Groundwater Assessment will be required to refine the Review's findings. Furthermore, the results of the Groundwater Assessment may need to be updated if water demand from commercial or residential structures is higher than anticipated, or if the number of such structures is higher than anticipated.

The Client has described the gravel quarry to Strum as operational and active under an Approval issued by Nova Scotia Environment and Climate Change (NSECC). The Client has confirmed that the quarry is not operating below the water table, reducing the risk to the Development's groundwater supply. Furthermore, the Client has indicated that the quarry is at the end of its life and will be relocated outside of the Development. Further study through a Level 2 Groundwater Assessment will be required to refine the Review's findings and confirm on-site groundwater quality and quantity for the Development.

2. Comment: Under 10.0 Recommendations of the Review, the first bullet states "Maintain proposed green space for groundwater recharge and reduce lot density." What does this mean? How far should the lot density be reduced? Are the "green spaces" the condo park/open spaces? Should these areas be left natural? No trails?

Response: This is a typo in the Review (Revision 0). The statement should have read "Maintain proposed green space for groundwater recharge and reduced lot density." Based on the 335 units proposed in the Review (Revision 0), there is sufficient recharge for the Development. The recommendation was provided to ensure that the stated density is maintained. The updated Development, with 370 proposed units and mixed-use zones, was reassessed in this Review (Revision 1) and remains supported by the available recharge under the assumptions in this Review.

Green spaces include parks and undeveloped areas. Strum understands that the "Condo Park/Open Spaces" as described by the Client are green spaces. These spaces may include trails or be left undeveloped.

3. Comment: Planning staff have identified 76 homes within the 500-metre buffer of the development site. The majority of these are newly constructed homes within the Cottage Country Development. Given that both the homes and their wells are new, why hasn't the consultant incorporated data from these wells into their analysis? From what I understand, the Developer hired the well driller for many of the condominium units.

Response: Strum has not been provided with the well logs (Driller Reports) for the homes from the neighbouring developments and has therefore decided to perform the Review with available provincial datasets. It should be noted that a Level 2 Groundwater Assessment is both required (per NSECC guidelines) and recommended. A Level 2 Groundwater Assessment will help to refine any desktop assessment.

4. Comment: As part of the current Cottage Country development, the Developer hired earth-water Concepts Inc. to complete a Level 2 Groundwater Assessment. The Assessment is dated April 2014. Why weren't the results of the Level 2 Assessment referenced in the current Level 1 Groundwater Assessment?

Response: The results from the Level 2 Groundwater Assessment completed by ewC (2014) for Villages 1 and 2 were incorporated into the Level 1 Groundwater Assessment completed by ewC (2023) for Villages 3 to 8. However, Strum was unable to independently verify the pumping-test results from ewC, and therefore, they were not included in the Review. Instead, Strum relied on available provincial datasets. It should be noted that a Level 2 Groundwater Assessment is both required (per NSECC guidelines) and recommended. A Level 2 Groundwater Assessment will help to refine any desktop assessment.

5. Comment: Does the recommended 1000 Lpd account for the water to be used in a household water treatment system? If yes, what type of water treatment system? Strum's review mentions ion exchange systems; is it the Developer's intention to only permit ion treatment systems as part of new home construction?

Response: The 1,000 Lpd recommendation is based on the NSECC On-site Sewage Disposal Systems: Technical Guidelines, Appendix F (2013).

Strum recommends that every constructed home or building (e.g., mixed-use structure) have its water quality tested to inform the design of its water treatment system (if a system is required). The discussion of ion exchange systems (a common treatment system used in Nova Scotia) was intended to provide context for the requirement to backwash the treatment system, or in some cases, discharge rejected (effluent) water, as in the case of RO systems. This additional water demand is not included in the 1,000 Lpd design standard; however, on-site testing (Level 2 Groundwater Assessment) is required to refine the Level 1 and this Review to ensure that sufficient water quality and quantity can be provided on-site.

6. Comment: A Level 2 Groundwater Assessment will be required in the Development Agreement as per the recommendations identified in the Level 1 Groundwater Assessment.

Response: This Review agrees that a Level 2 Groundwater Assessment is required.

10.0 CONCLUSIONS

Strum was commissioned by the Client to complete a review of the Level 1 completed by ewC (2023; 2024) for the proposed Villages of Long Lake Development in East Uniacke, NS. The Development proposes to construct 370 Units, each with one to three bedrooms, and 10.2 ha of mixed-use zones for local commercial spaces. Except for the updates to the Development

details, the Level 1 report (ewC, 2023; 2024) provides an accurate desktop overview of the Development.

Based on a simplified water balance for groundwater recharge, the proposed Development can support 370 single-family units and a minimum of 41 commercial spaces, under the assumptions in this Review. The proposed Development meets the lot water balance guideline (NSECC, 2011).

A well interference calculation was completed by (ewC, 2023; 2024) in the Level 1 report. The Level 1 was reviewed and updated by Strum using newly provided Development details from the Client. The updated calculation demonstrates that the Client must construct wells to a depth of 108 m to satisfy the well interference guidelines (NSECC, 2011). However, Strum completed a review of available pumping test data and relevant literature on the underlying metamorphic Goldenville Formation bedrock and concluded that the Client should construct wells to a depth of 92.5 m to satisfy the well interference guidelines (NSECC, 2011). That said, on-site pumping tests should be conducted to verify these desktop-level results. Well performance may be lower or higher than the median value of nearby wells or as reported in the published literature.

If the details of the proposed Development change in a way that invalidates the assumptions of this Review, the enclosed calculations and Review should be revised by, or under the supervision of, a hydrogeologist.

The next step for the Development should be a Level 2 Groundwater Assessment.

11.0 RECOMMENDATIONS

Based on a review of current desktop data, sufficient potable water is available from groundwater to support the proposed Development. Well interference calculations were conducted and show that with sufficient depth, well performance is anticipated to be adequate to support the Development without dewatering neighbouring wells due to well interference.

Based on the size of the development, a Level 2 Groundwater Assessment is required, and a minimum of 10 test wells will be required across the Development (NSECC, 2011). Additional test wells may be required once the water demand from the mixed-use zones is known through more detailed engineering design of those anticipated structures.

The test wells should be constructed to minimize capital costs by locating them where they can be reused as completed groundwater wells for a proposed lot. Additionally, to reduce capital risk, the Client is advised to engage with the local municipality to conduct the Level 2 assessment in phases (e.g., Area 1), starting with a limited number of test wells (at least three or four) to be constructed and pump-tested. If the results of the initial pumping tests are positive, further well construction and pumping tests can proceed as the Development advances.

In addition to the recommendations forwarded in the Level 1 report (ewC, 2023; 2024) and this Review, the following should be considered:

- Maintain proposed green space for groundwater recharge and reduced lot density.
- Construct test wells to a minimum depth of 92.5 m, with the possibility of increased well depths up to approximately 108 m, depending on well performance at the time of drilling.
- Engage a qualified hydrogeologist to plan the test well construction.
 - Ensure test wells are located to allow for reuse as completed groundwater wells, to be sold with lots, and to ensure optimal determination of well performance across the Development and considering major structural trends.
 - Ensure test wells are located such that they may monitor the impacts of well yield and interference.
- Construct test wells through a reputable and certified well driller and under the supervision of a qualified hydrogeologist.
 - Ensure a minimum of three test wells are constructed within the first phase of the Level 2 assessment, for a total of at least 10 across the entire Development (including all phases). Note: additional test wells may be required depending on the anticipated water demand of the mixed-use zone structures.
 - Ensure test wells are located such that they may monitor the impacts of well interference.
 - Ensure wells are sufficiently separated to ensure well interference is not an issue for the proposed Development.
- Conduct constant rate pumping tests for a minimum of 24 hours and up to 72 hours at strategically located wells.
- Design the Development to optimize groundwater recharge (e.g., minimize steep slopes, erosion, soil compaction, and impermeable ground cover).
- Consider installing low-water-use devices, such as ultra-low-flow toilets, low-flow showerheads, and water-efficient appliances.

12.0 STATEMENT OF QUALIFICATIONS AND LIMITATIONS

This Report (the "Report") has been prepared by Strum Consulting (the "Consultant") for the benefit of 3230225 Nova Scotia Ltd. (the "Client") in accordance with the agreement between the Consultant and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations, and conclusions contained in the Report (collectively, the "Information"):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the "Limitations")
- represents the Consultant's professional judgement in light of the Limitations and industry standards for the preparation of similar reports
- may be based on information provided to the Consultant, which has not been independently verified
- has not been updated since the date of issuance of the Report, and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued
- must be read as a whole, and sections thereof should not be read out of such context
- was prepared for the specific purposes described in the Report and the Agreement
- in the case of subsurface, environmental, or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time

The Consultant shall be entitled to rely upon the accuracy and completeness of information that was provided and has no obligation to update such information. The Consultant accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental, or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

Consultant agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but Consultant makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

The Report is to be treated as confidential and may not be used or relied upon by third parties, except:

- as agreed in writing by the Consultant and Client
- as required by law
- for use by governmental reviewing agencies

Consultant accepts no responsibility, and denies any liability whatsoever, to parties other than Client who may obtain access to the Report or the Information for any injury, loss, or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report or any of the Information ("improper use of the Report"), except to the extent those parties have obtained the prior written consent of Consultant to use and rely upon the Report and the Information. Any damages arising from improper use of the Report or parts thereof shall be borne by the party making such use.

This Statement of Qualifications and Limitations forms part of the Report, and any use of the Report is subject to the terms hereof.

Should additional information become available, Strum requests that this information be brought to our attention immediately so that we can reassess the conclusions presented in this report. This report was prepared by Alex Scott, MIT, EPT., Environmental Scientist and reviewed by François Gascon, P.Eng., Environmental Engineer.

13.0 REFERENCES

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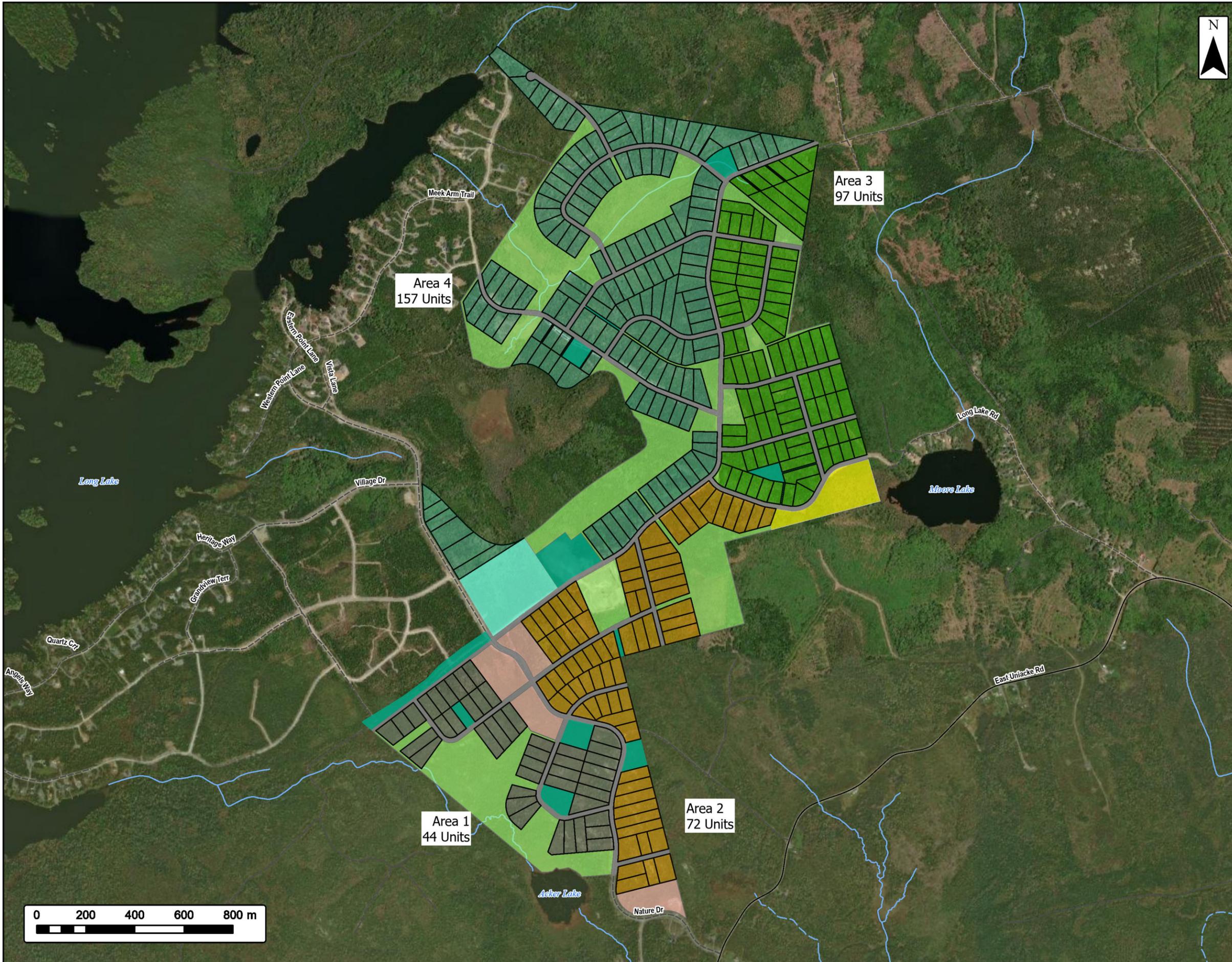
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APPENDIX A DRAWING



Villages of Long Lake

Development Plan

3230225 NS Ltd.

Lots	
Area 1	
Area 2	
Area 3	
Area 4	
Condo Park Land	
Developer to Retain These Lands	
Mixed Use	
Open Space Lands Dedicated to the Municipality of East Hants	
Greenspace / Undeveloped	
Roadway	
Transportation	
Road	
Unpaved Road	
Water Features	
Mapped Stream	
Mapped Indefinite Stream	



Coordinate System: NAD83 UTM Zone 20N
 Sources: ESRI Basemaps, Google Basemaps, GeoNOVA, SISIS, NSNRR, ACCDC, IBA Canada, CNW, HERE, Garmin, USGS

Date: 2/2/2026	Project #: 25-11662
Scale: 1:15,000	Drawing #: 1
Drawn By: P. Opra	
Checked By: A. Scott	



APPENDIX B DATA TABLES

Table 1: Summary of Water Well Data from the NS Well Logs Database within 500 m of the Site - Long Lake, East Uniacke NS

DRILLED WELL LOCATION					DRILLED WELL INSTALLATION DETAILS								
Well Number	Address	Community	County	Elevation (masl)	Date	Driller Certificate NO.	Well Depth (m)	Casing (m)	Bedrock (m)	Static (m)	Estimated Driller's Yield (Lpm)	Water Use	Well Type
000702	EAST UNIACKE ROAD	EAST UNIACKE	HANTS	176	2000-08-03	178	39.58	24.06	21.32	-	22.70	DRILLED	Domestic
000703	-	EAST UNIACKE	HANTS	176	2000-07-04	178	37.45	20.1	19.18	-	31.78	DRILLED	Domestic
000710	862 EAST UNIACKE ROAD	EAST UNIACKE	HANTS	168	2000-08-09	178	121.8	13.4	2.74	-	4.54	DRILLED	Domestic
002198	120 LONG LAKE ROAD	EAST UNIACKE	HANTS	158	2000-05-26	114	71.56	10.66	8.53	6.09	2.27	DRILLED	Domestic
002658	LAKE CREST DRIVE	MOUNT UNIACKE	HANTS	175	2000-08-01	32	88.3	6.09	1.83	6.09	2.27	DRILLED	Domestic
022334	50 LONG LAKE ROAD	EAST UNIACKE	HANTS	175	2002-08-17	607	76.12	12.18	9.14	8.22	11.35	DRILLED	Domestic
050399	1071 East Uniacke Road, Mount Uniacke	EAST UNIACKE	HANTS	179	2005-09-20	32	74.6	12.18	10.96	-	13.62	DRILLED	Domestic
070275	5 LONG LAKE ROAD	EAST UNIACKE	HANTS	171	2007-06-14	170	109.62	-	-	-	2.27	DRILLED	Domestic
070276	114 LONG LAKE ROAD	EAST UNIACKE	HANTS	160	2007-06-15	170	42.63	12.18	9.14	3.96	136.20	DRILLED	Domestic
070504	869 EAST UNIACKE ROAD	EAST UNIACKE	HANTS	162	2007-08-22	228	98.96	6.09	0.91	1.52	15.89	DRILLED	Domestic
111523	959 EAST UNIACKE ROAD, EAST UNIACKE	MOUNT UNIACKE GOLD DISTRICT	HANTS	169	2011-12-20	738	73.08	12.18	9.74	-	13.62	DRILLED	Domestic
180210	MEEK ARM TRAIL	EAST UNIACKE	HANTS	130	2018-09-21	817	73.08	6.09	1.22	-	4.54	DRILLED	Domestic
180211	MEEK ARM TRAIL	LONG LAKE	HANTS	130	2018-10-12	817	60.9	6.09	2.13	-	9.08	DRILLED	Domestic
180218	EASTERN POINT LANE	EAST UNIACKE	HANTS	130	2018-11-26	817	42.63	6.09	2.13	-	22.70	DRILLED	Domestic
180285	1065 EAST UNIACKE ROAD	MOUNT UNIACKE	HANTS	188	2018-11-23	843	137.02	-	-	-	2.27	DRILLED	Domestic
190031	MEEK ARM TRAIL	EAST UNIACKE	HANTS	138	2019-07-15	817	71.56	6.09	0.61	-	4.54	DRILLED	Domestic
190205	MEEK ARM TRAIL	EAST UNIACKE	HANTS	138	2019-10-14	817	66.99	6.09	2.74	-	3.40	DRILLED	Domestic
190206	MEEK ARM TRAIL	EAST UNIACKE	HANTS	138	2019-10-11	817	66.99	6.09	2.74	-	3.40	DRILLED	Domestic
190208	165 MEEK ARM TRAIL	EAST UNIACKE	HANTS	130	2019-10-09	817	54.81	6.09	1.52	-	6.81	DRILLED	Domestic
190213	110 LONG LAKE ROAD	MOUNT UNIACKE	HANTS	158	2019-11-06	847	31.97	10.66	6.7	-	227.00	DRILLED	Domestic
200033	MEEK-ARM TRAIL	EAST UNIACKE	HANTS	130.8	2020-06-17	817	60.9	6.09	0.61	-	45.40	DRILLED	Domestic
200041	31 NATURE DRIVE	EAST UNIACKE	HANTS	163.7	2020-07-14	817	73.08	6.09	2.44	-	2.27	DRILLED	Domestic
200043	MEEK ARM TRAIL	EAST UNIACKE	HANTS	130.8	2020-07-03	817	74.6	6.09	0.91	-	2.27	DRILLED	Domestic
200046	61 MEEK ARM TRAIL	EAST UNIACKE	HANTS	130.8	2020-02-20	817	73.08	-	0.61	-	2.27	DRILLED	Domestic
200060	MEEK ARM TRAIL	EAST UNIACKE	HANTS	130.8	2020-10-23	817	79.17	6.09	0	-	2.27	DRILLED	Domestic
200061	MEEK ARM TRAIL	EAST UNIACKE	HANTS	130.8	2020-10-22	817	79.17	6.09	0.3	-	2.27	DRILLED	Domestic
200062	MEEK ARM TRAIL	EAST UNIACKE	HANTS	130.8	2020-10-21	817	79.17	6.09	0.61	-	-	DRILLED	Domestic
902949	LEWIS MILLS, EAST UNIACKE ROAD	EAST UNIACKE	HANTS	165	1990-08-25	178	73.99	12.18	-	-	2.27	DRILLED	Domestic
920188	LONG LAKE ROAD	EAST UNIACKE	HANTS	175	1992-06-16	114	39.58	8.53	6.7	-	7.72	DRILLED	Domestic
920333	LONG LAKE ROAD	EAST UNIACKE	HANTS	175	1992-06-17	114	39.58	8.53	6.39	-	15.89	DRILLED	Domestic
960160	INTERNATIONAL DRIVE	EAST UNIACKE	HANTS	175	1996-04-23	228	83.13	14.01	11.88	10.66	4.54	DRILLED	Domestic

Lpm = litres per minute

DRILLED WELL LOCATION			PUMP TEST DETAILS															
Well Number	Pump Test ID	Address	Test Start	Test End	Well Depth (m)	Casing (m)	Static (m)	Pump Depth (m)	Available DD (m)	Max DD (m)	Total Recovery (m)	Recovery (minutes)	Hydraulic Conductivity (m/d)	Apparent Transmissivity (m ² /d)	Specific Capacity (m ² /d)	Q20 (m ³ /d)	Q20 (Lpm)	Storativity
980965	HAL-112	Beaver Bank Villa, Stevens Group (Well 3?)	1998-06-15	1998-06-18	76.2	152.4	19.09	42.67	23.6	5.92	4.09	240	0.199	9.88	14.4	81.82	56.8	-
791592	HAN-14	Parkview Manor, NS Housing Commission Proposed Senior Citizens Home	1979-10-31	1979-11-03	99.06	152.4	3.02	96.01	89.92	27.55	-	-	-	-	0.24	8.18	5.7	-
891804	HAN-17	Happy Valley Mobile Home Park, S. Havill (Pumping Well #6)	1990-10-31	1990-11-03	91.44	152.4	2.34	85.34	57.91	20.62	-	-	0.0575	5.12	4.54	93.6	65	0.000715
891831	HAN-18	Uniacke House Storage Building, NS Museum, NS Dept. of Government Services	1989-05-23	1989-05-26	72.54	152.4	-0.03	67.06	67.06	17.37	16.56	50	0.0168	1.18	2.26	39.27	27.3	-
831254	HAN-26.1	Valley Gate Mobile Home Park (Well 1)	2004-05-25	2004-05-28	109.8	152.4	7.17	91.5	27.83	25.8	25.6	80	0.00633	0.65	-	9.85	6.84	-
831253	HAN-26.2	Valley Gate Mobile Home Park (Well 2)	2004-07-19	2004-07-26	91.5	152.4	5.09	90	30.91	12.1	11.52	90	0.0334	2.87	-	48.33	33.56	-
891804	HAN-26.3	Valley Gate Mobile Home Park (Well 6)	2004-06-15	2004-06-18	90.8	152.4	3.05	86.4	58.95	57.58	56.34	75	-	0.38	-	12.2	8.47	-
50986	HAN-26.4	Valley Gate Mobile Home Park (Well 12)	2005-07-21	2005-07-24	105.2	152.4	7.17	85.5	65.83	25.09	24.28	100	0.00741	0.52	-	-	-	-
50987	HAN-26.5	Valley Gate Mobile Home Park (Well 13)	2005-06-28	2005-07-02	105.2	152.4	3.28	-	20.49	15.78	12.21	500	0.0345	3.52	-	-	-	-
51033	HAN-26.6	Valley Gate Mobile Home Park (Well 14)	2005-09-07	2005-09-10	62.5	152.4	2.11	54.4	28.89	21.25	20.6	1060	0.157	8.13	-	127.95	88.85	-
-	HAN-26.7	Valley Gate Mobile Home Park (Well 3)	2004-06-07	2004-06-10	219.2	152.4	7.67	152.4	144.73	102.39	67.56	620	-	0.05	-	3.94	2.74	-

Notes

Shaded cells indicate wells possibly located in slate, Halifax Formation, bedrock.

DD = Drawdown

m/d = metres per day

m²/d = square metres per day

m³/d = cubic metres per day

Lpm = litres per minute