LEVEL I GROUNDWATER ASSESSMENT

August 14, 2025

West Petpeswick Development PID 00334953, West Petpeswick Road, West Petpeswick, Nova Scotia

Project Number 25-229

SUBMITTED BY:

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SUBMITTED TO:

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EXECUTIVE SUMMARY

This Level 1 Groundwater Assessment (L1GWA) report was prepared by DesignPoint Engineering & Surveying Ltd. (DesignPoint) for Zzap Architecture + Planning (the client) to characterize the local hydrogeology, surface water features and land use of the proposed development at PID 00334953, West Petpeswick Road, West Petpeswick, Nova Scotia.

The scope consists of the following:

- Review of Nova Scotia Well Logs Database, Nova Scotia Pumping Test Database, water quality data, groundwater maps and reports, geological maps and reports, watershed information, construction and stormwater management plans, sea water intrusion, arsenic and radon potentials mapping.
- Data tabulation and identification of informational gaps.
- Site visit to fulfill the gaps.
- Calculations and numerical modeling of potential rates, drawdowns, well interference and pumping influence.
- Preparation of the L1 GWA report with Conclusions and Recommendations.

No scope deviations were noted.

This report conclusions are based on the review of available information, calculations and the site visit.

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It was concluded that:

- It is concluded that the bedrock aquifer potentially provides better opportunities for the potable water supply on the site.
- Under conservative conditions the site potentially could provide enough water (100 cubic meters per day (m^3/d)) for three hundred thirty-five (335) persons using the bedrock aquifer.
- Two (2) wells of 0.2 m (8 inches) diameter and depth of 110 m, with well casings installed at 46 mbgs or 0 masl were found to perform best, potentially providing combined Q20 of 100 m^3/d.
- Based on the Groundwater Tool well interference calculator it was estimated that the potentially optimal number of wells is two (2) wells spaced at a minimum of 50 m from each other and located across the groundwater flow to mitigate the interference.
- Well interference head losses are concluded to be moderate, ranging from 3.1 m to 5.8 m at distances of 1 km and 200 m, respectively, in 20 years in the future and should not significantly affect existing domestic water supplies in the area.
- It should be noted that the groundwater recharge area required for such a supply is estimated to be by 65.586 m^2 bigger than the site area. Recharge area would include wooded lands outside the proposed development.

- There are no current or historical land uses that may cause groundwater contamination (landfills, gas stations, dry cleaners, other commercial/industrial facilities, etc.)
- There is a low to medium risk of seawater intrusion, which is to be controlled by keeping operational water levels at a minimum of 6 m above the sea level.
- There is a low risk of bacterial and nutrient contamination for the bedrock aquifer due to the planned septic systems locations downgradient of the well locations.
- Groundwater chemistry and quality is expected to slightly change over time due to noted in Section 5 processes of seawater and potential acid rock drainage (ARD) influence noted in the trilinear diagram.
- Water wells in the proposed development are not expected to meet the Health Canada Guidelines for Canadian Drinking Water Quality (HC GCDWQ), with heavy metals being the primary concern. There is a high risk of arsenic, uranium, iron and manganese contamination due to the natural geological conditions.
- Wells will require the regulatory well report and groundwater withdrawal approval, as each well will produce more than 23 m^3/d.
- Wells will have more than fifteen (15) connections serving more than twenty-five (25) persons each, which is above the NSECC thresholds for registered public water supply, as such this water supply system needs to be registered with the Nova Scotia Environment and Climate Change (NSECC).
- Water testing and treatment is concluded to be the landowner's or property operator's responsibility.
- In summary, it was concluded that satisfactory results provided above are based on assumptions, off-site data extrapolation and data averaging. The real situation on the site could significantly differ from our desktop investigation results and further L2GWA intrusive investigation is required.

The following recommendations based on the conclusions of the Level 1 GWA:

1. It is recommended to use the bedrock aquifer for potable water supply.
2. The public central water supply system, consisting of two (2) production wells and water treatment facility, serving the total of 332 persons is recommended.
3. Level 2 GWA is recommended to be completed on the site.
4. The well construction is recommended as follows:
    a. well depths 130 m installed within the bedrock aquifer;
    b. well diameters 0.18 m;
    c. wells equipped with properly capped steel casing and drive shoe. The casing installed in the bedrock at estimated 46 mbgs and extending the minimum 0.6 m above ground; and
    d. bentonite grouting of the well casing annular space from the drive shoe up to the ground surface.
5. The water level is recommended to be always kept inside the casing during testing and future operations.
6. Details of pump placement and test rates to be determined after the well installation and development.
7. The minimum well spacing to mitigate wells interference is recommended to be 50 m.

8. It is recommended to complete 4-step tests and 72-hour constant rate pumping tests on each of the two (2) wells, using idling well as an observation.
9. Phasing of tests is also recommended, with one (1) of the wells drilled and tested before proceeding with the second well drilling.

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Appendix A – Preliminary Site Plans

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1.0 INTRODUCTION

This Level 1 Groundwater Assessment (L1GWA) report was prepared by DesignPoint Engineering & Surveying Ltd. (DesignPoint) for Zzap Architecture + Planning (the client) to characterize the local hydrogeology, surface water features and land use of the proposed development at PID 00334953, West Petpeswick Road, West Petpeswick, Nova Scotia (NS), further referenced as 'the site', as depicted in Plate 1. Detailed preliminary site plans including Site Plan (C-01), Servicing Plan (C-02), Plan and Profile Sta. 0+000 to 0+400 (C-03), Plan and Profile Sta. 0+400 to 0+800 (C-04), and Preliminary Stormwater Management Plan (ST-01) are provided in Appendix A.

The site visit was completed by an environmental scientist Sam Pratt of Halifax DesignPoint office on May 14, 2025.

This report was prepared by Arman Polatbekov, P.Geo., Senior Hydrogeologist of the DesignPoint's Sydney office.

The report was reviewed by Jeremy Wyatt, P.Eng., Civil/Water Resource Engineer.

2.0 SCOPE OF WORK

The scope consists of the following:

- Review of NS Well Logs Database, NS Pumping Test Database, water quality data, groundwater maps and reports, geological maps and reports, watershed information, construction and stormwater management plans, sea water intrusion, arsenic and radon potentials mapping.
- Data tabulation and identification of informational gaps.
- Site visit to fulfill the informational gaps.
- Calculations and numerical modeling of potential rates, drawdowns, well interference and pumping influence.
- Preparation of the L1GWA report with Conclusions and Recommendations.

No scope deviations were noted.

3.0 REGULATORY REQUIREMENTS

This report was prepared in accordance with the NS Environment and Climate Change (ECC) Guide to Groundwater Assessments in Subdivisions Serviced by Private Wells, 2011 and Health Canada Guidelines for Drinking Water Quality (HC GCDWQ).

4.0 SITE DESCRIPTION

4.1 Site Location

The site is located on PID 00334953, West Petpeswick Road, West Petpeswick, NS with the total area of approximately 178,062 square metres (m^2) as illustrated in Plate 1.

Plate 1: Site Location

The site is currently wooded. It is bounded from the east by West Petpeswick Road and residential properties, followed by tidal waters of Jocks Cove in approximately 90 metres (m) distance. From the west the site is bounded by the head of Grassy lake; from the south by a wooded area and from the north also by a wooded area with a trail along the site.

4.2 Future Development & Water Demand

The future development is estimated to consist of approximately 20% impermeable areas occupied by buildings, roads and parking. The rest of the site would remain forested or grassed.

The housing development is proposed to be completed in five (5) phases.

This total development is planned to consist of:

- Thirteen (13) x 4-unit townhouses
- Eight (8) x 6-unit townhouses
- Totaling one hundred (100) units in twenty-one (21) buildings.

As such the total population planned is three hundred thirty-five (335) persons and expected water demand is 101 cubic meters (m^3) per day (d) at approximately 300 liters (L) per person per day.

5.0 DOCUMENT REVIEW

5.1 Site Background

Based on the review of Google Earth historical photographs clear signs of forestry operations that seems to be clear-cutting were visible in 2002, gradually disappearing over the years. Various small trails appeared on the site, supposing All-terrain vehicles (ATV) usage for recreation.

No other historical activity was noted or reported to DesignPoint.

5.1.1 Environmental Registry

A request for environmental registry for the site and surrounding properties was sent to the NSECC for following PIDs:

- 00334953 – the site.
- 00334946, 40548182, 00334920, 00641241, 00334912, 41319237, 00346460, 00346486, 00346502, 40656274, 40485344, and 41305186.

The environmental registry reply indicated that at 800 West Petpeswick Road (PID 41305186) a septic tank had a breakout and clogged disposal field and was leaking to the road ditch. The septic tank was promptly replaced by Strum on March 18, 2018.

No information was located through the Environmental Registry with regards to the remaining above referenced properties, the reply is provided in Appendix B.

A nearest gas station is located approximately 4,000 m to the north, at 7868 Marine Drive #7, Musquodoboit Harbour.

Based on aerial photographs, a car junk yard or local landfill potentially could be located on PIDs 00334920 and 00334912 approximately 380 m to the south of the site.

There are no current or historical land uses that may cause groundwater contamination within 1 km radius (landfills, gas stations, dry cleaners, other commercial/industrial facilities, etc.).

5.2 Land Use

The site is located in the mixed use (MU) land use zone, based on the Musquodoboit Valley/Dutch Settlement Plan Area Zoning and Mapping based on the information provided on their website. The surrounding land use to the north, east and south is also MU.

5.3 Water Use and Property Boundaries

Based on the review of the NSECC and NS Department of Natural Resources and Renewables (DNRR) Well Database and NS Groundwater Atlas (online) there are 21 existing water users served by local groundwater wells located within 1000 m of the site boundary, as illustrated in Plate 2 and listed in Table 1 below.

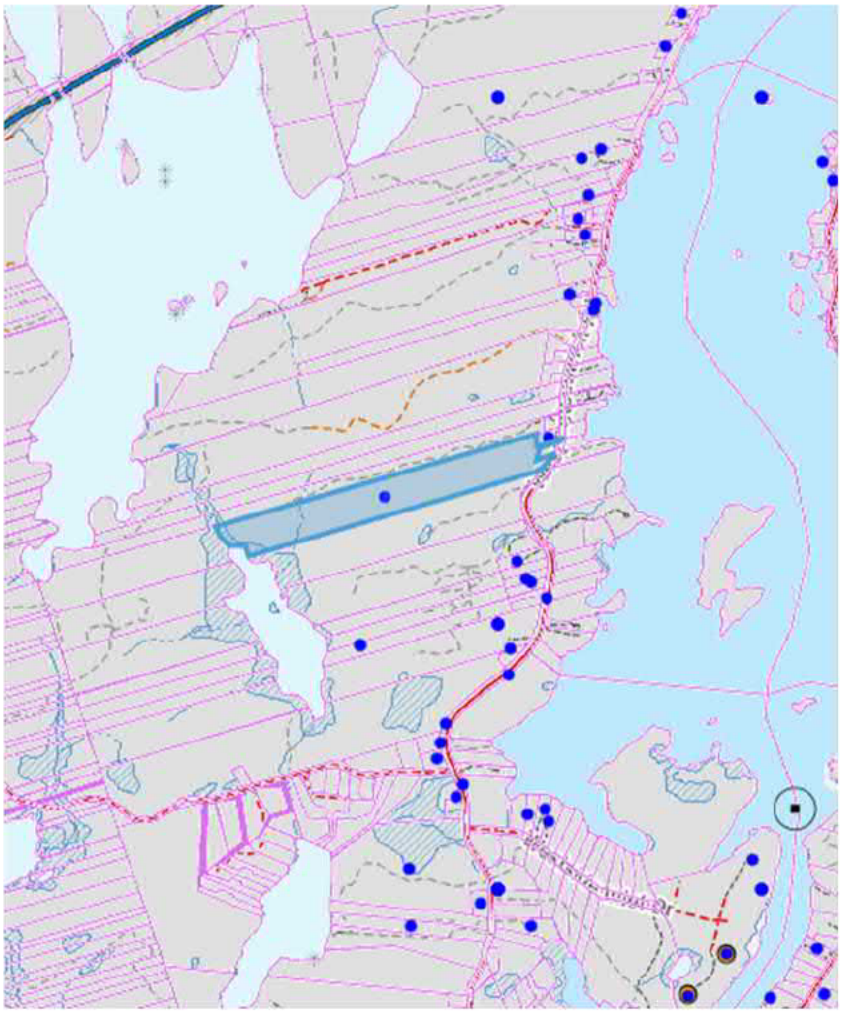


Plate 2: Site Location, Domestic Wells and Property Lines

No municipal potable water wells or provincial observation wells were identified within 1 km of the site.

Table 1: List of Potable Wells within 1000 m

Well ID	Civic Address	Easting, m	Northing, m	Well Depth, mbgs	BDRCK, mbgs	Static Elevation, masl	Yield, m3/d
011811	815 West Petpeswick Road	486070	4954985	38	5.18	37.2417	26
790121	Rr #1 Moser River	485981	4954423	51	NA	4.6986	3
080419	600 West Petpeswick Road	486817	4956269	70	NA	10.5367	13
170091	628 West Petpeswick Road	486848	4956130	123	2.44	NA	3
150128	24 Young Drive, Hrm	486802	4956040	38	7	8.21	131
000391	Young Drive	486835	4955980	106	10	5.0894	10

Well ID	Civic Address	Easting, m	Northing, m	Well Depth, mbgs	BDRCK, mbgs	Static Elevation, masl	Yield, m3/d
110860	680 West Petpeswick Road	486770	4955753	87	2	15.13	46
950672	696 West Petpeswick Road	486871	4955723	55	8	NA	3
950673	700 West Petpeswick Road	486867	4955691	30	6	-0.805	65
021285	808 West Petpeswick Road	486694	4955213	44	5	13.41	20
060058	906 West Petpeswick Road	486574	4954743	93	17	16.8367	8
100249	912 West Petpeswick Road	486607	4954674	93	20	10.58	10
111519	918 West Petpeswick Road	486628	4954663	91	16	NA	10
100512	922 West Petpeswick Road	486687	4954601	55	22	6.39	98
910630	West Petpeswick	486500	4954500	81	6	NA	7
050858	9234 West Petpeswick Road	486547	4954410	38	2	19.55	78
160223	973 West Petpeswick Road	486543	4954309	38	1	25.8133	20
910272	Head Of Chezzetcook	486303	4954125	69	NA	NA	7
062312	1090 West Petpeswick Road	486280	4954056	62	3	22.3604	33
041079	1100 West Petpeswick Road	486270	4953995	93	2	19.92	13
190076	1113 West Petpeswick Road	486372	4953893	62	6	15.36	26
	AVERAGE			**67**	**8**	14	**30**

Plate 3 reflects groundwater elevations reported for domestic wells. It should be noted that the resultant map is approximate, as water levels in wells were measured in different seasons and years.

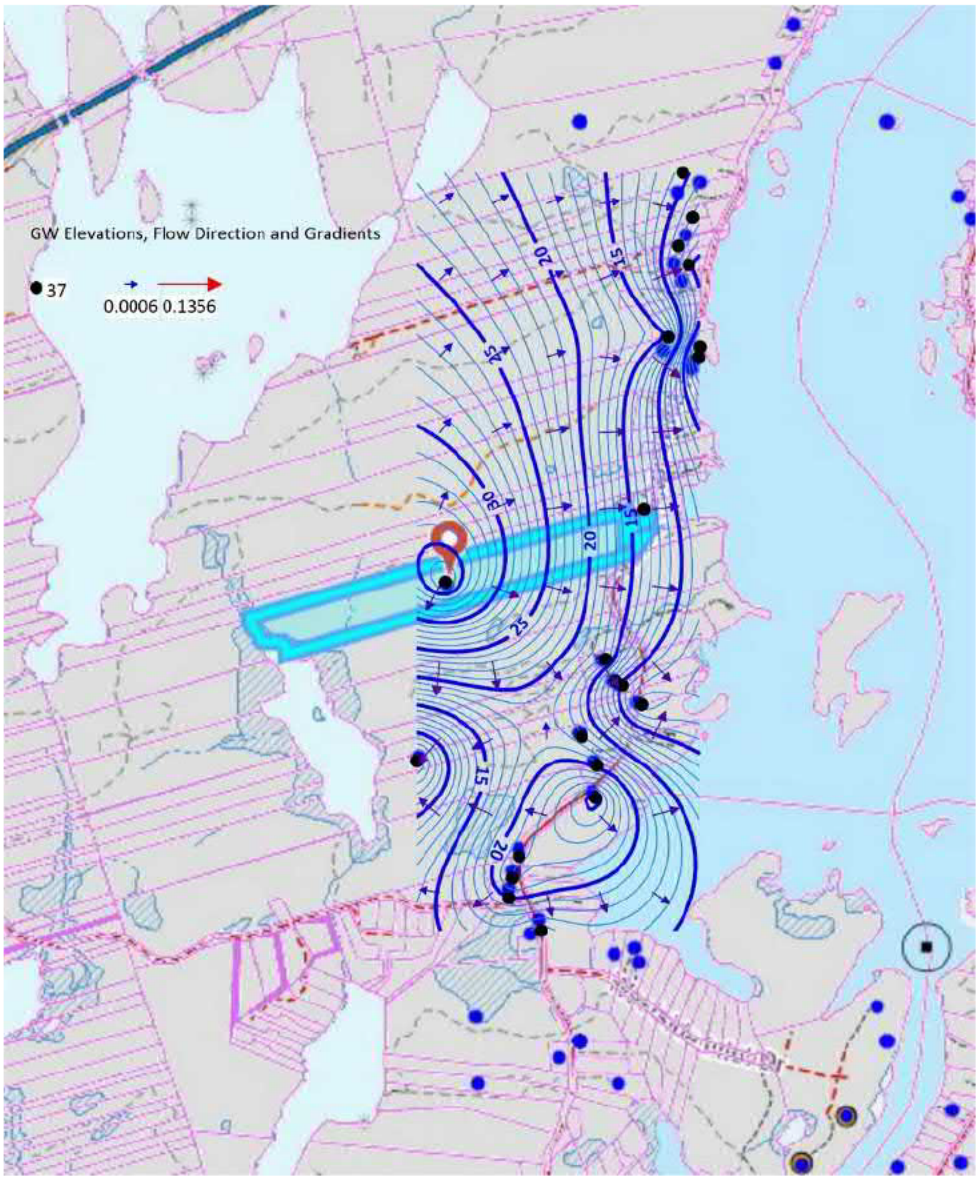


Plate 3: Estimated Groundwater Elevations, Flow Directions and Gradients in the Bedrock

As shown in Plate 3 groundwater flow directions in the bedrock are from the center of the site radial, particularly to the east to the Musquodoboit Harbour, following topography. Gradients ranged from 0.0006 to 0.14.

5.4 Climate Review

Yearly precipitation was estimated with data obtained from Environment Canada Halifax Stanfield Airport Weather Station, as data for the Chester Basin station became unavailable climate station.

Table 2: Climate Normal, Halifax Stanfield Airport

Climate Normal	Total Precipitation, m/year	Snow, m/year	Rainfall, m/year	Average Temperature, °C

1991 to 2020	1.39	0.215	1.20	6.9
1981 to 2010	1.4	0.212	1.12	6.6
1971 to 2000	1.45	0.231	1.24	6.3
1961 to 1990	1.47	0.261	1.22	6.1

These Climate Normal were used to complete simple linear trend analysis, as depicted in Plate 4.

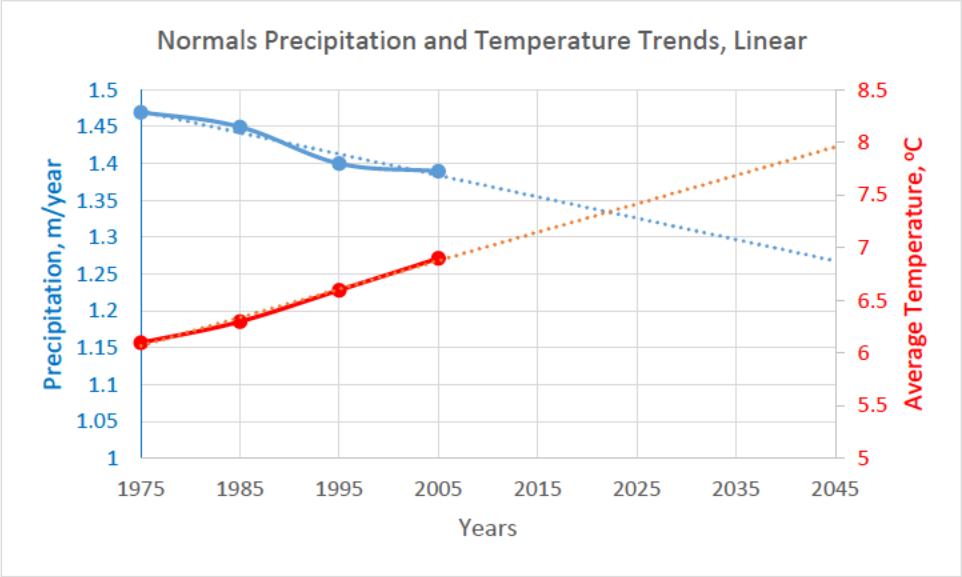


Plate 4: Precipitation and Temperature Normal Trends

The graph predicts potential decrease in precipitation to 1.26 m/year and increase in normal temperature to 8°C in Halifax area within the next 20-year period, in 2045. The 20-year period is a standard life expectancy for a potable water production well. It is assumed that similar conditions will be present in the Musquodoboit Valley area.

5.5 Geological Mapping Review

5.5.1 Topography

The topography of the site is flat to rolling, with many surface boulders.

The center of the site is elevated at approximately 43 m above sea level (asl), while Grassy lake shores are at 20 masl, the West Petpeswick Road is at 15 masl, and Jocks Cove is at 0 masl.

5.5.2 Surficial Geology

Surficial geology is the Quaternary Wisconsinan unit represented by ground moraine and streamlined drift of Stony Till Plain, stony, sandy matrix, material derived from local bedrock sources, material released from the base of an ice sheet by melting; these tills deposited by ice sheets centered over Nova Scotia with thickness ranging from 2 m to 20 m. Moderate limitations to crop use include stoniness, rapid drainage, erodibility; factors affecting use for construction include shallowness, stoniness and high water table; poor buffering capacity for acid rain.

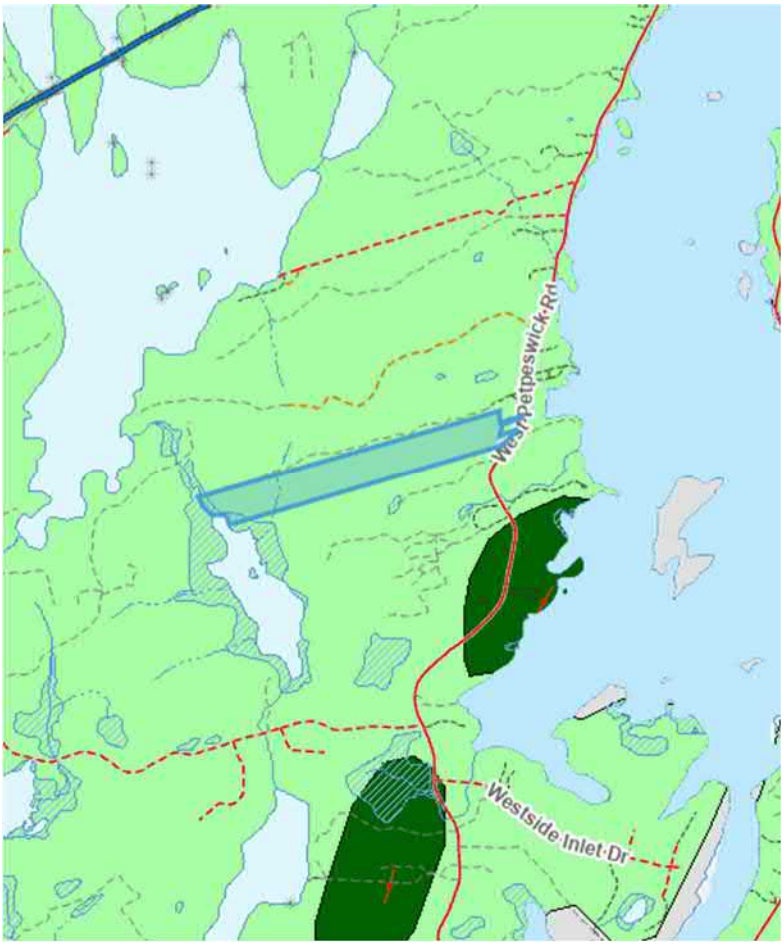


Plate 5: Surficial Geology

5.5.3 Bedrock Geology

Bedrock geology is Cambrian-Ordovician period's Meguma Group, Goldenville Formation: sandstone turbidites and slate: continental rise prism (in places metamorphosed to schist and gneiss), >5600 m (U-Pb concordant zircon and detrital titanite ages near base and top of unit of 566+/-8 and 552+/-5 Ma, respectively).

The Goldenville Formation in Nova Scotia consists primarily of grey, massive metasandstone with interbedded metasiltstone and slate. It also contains minor coarse-grained metasandstone and conglomerate. Metasandstone beds often include carbonate and manganese concretions. The Goldenville Formation is part of the Meguma Group and is believed to have been deposited by turbidity currents.

No geological faults or dykes were noted in the area. The nearest geological contact is with Halifax Formation, approximately 1,000 m to the north.

Plate 6: Meguma Group Bedrock Geology

5.6 Relative Risk of Arsenic in Bedrock Wells

The site is located within the medium-risk zone for arsenic in groundwater in Nova Scotia.

Plate 7 Relative risk of Arsenic in Bedrock, High Risk of Arsenic

The high-risk zone is defined as bedrock units where more than 15% of well water samples exceed the uranium drinking water guideline of 10 µg/L. Wells are recommended to be sampled every 2 years.

Care should be taken when constructing a well to prevent bedrock oxidation and dissolution of heavy metals.

5.7 Relative Risk of Uranium in Bedrock Wells

The site is located within the low-risk zone for uranium and radon in Nova Scotia.

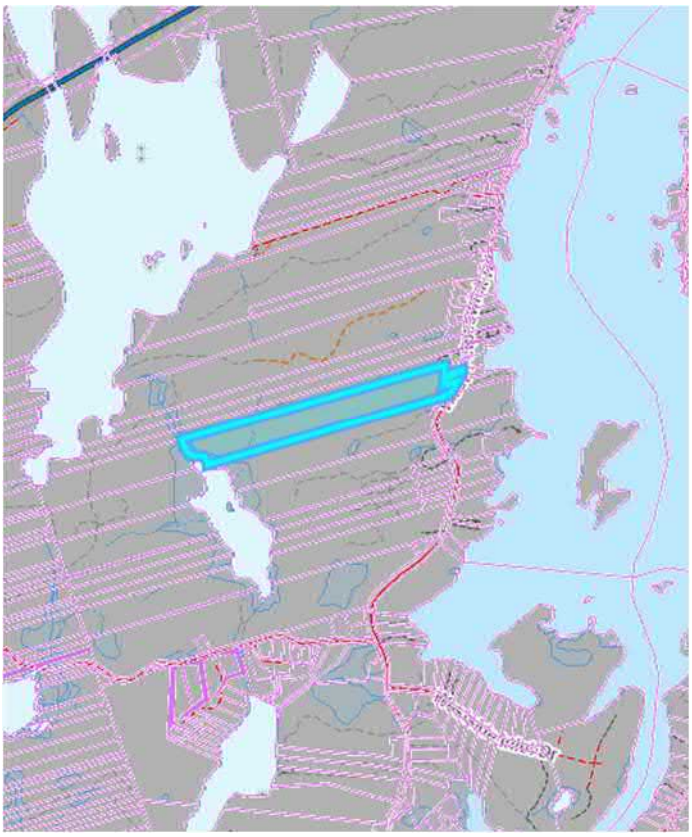


Plate 8 Risk of Radon and Uranium, Low

The low-risk zone is defined as bedrock units where less than 5% of well water samples exceed the uranium drinking water guideline of 20 µg/L. Wells are recommended to be sampled every 2 years.

5.8 Sea Water Intrusion Vulnerability

Seawater intrusion is a low to medium risk concern on the site.

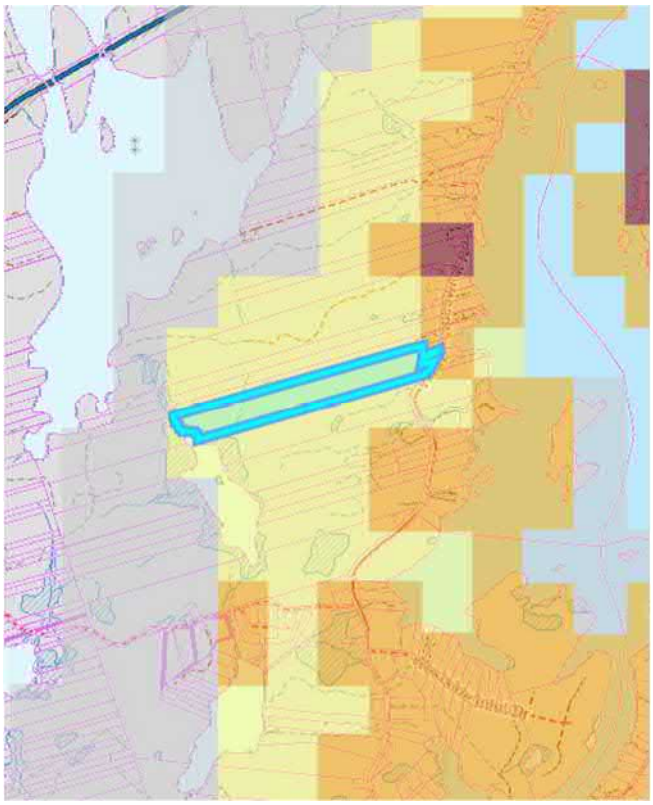


Plate 9: Seawater Intrusion Vulnerability, Low to Medium

As the risk is present, it is concluded that the dynamic (pumping) water level elevation in wells located on the site should not be below 4.5 masl, which would ensure saltwater intrusion not exceeding -180 masl, at 20 m below the end of a 160 m deep well.

5.9 Bedrock Acid Rock Drainage Potential

The bedrock acid rock drainage (ARD) potential is not mapped for this area. It is concluded that a conservative medium risk precautions would be appropriate.

To decrease potential oxidation of the bedrock and subsequent ARD generation, the dynamic water level, including operational drawdown, should be always kept inside the well casing.

5.10 Digital Elevation Model Flood Ranges

Almost the entire site is located above the 5 m, 10 m and 20 m flood ranges, with the maximum elevation of approximately 43 masl and the minimum elevation of 18 masl along the West Petpeswick Road.

5.11 Surface Water Influence & Watershed Review

Surface water influence and watersheds are illustrated in Plate 10.

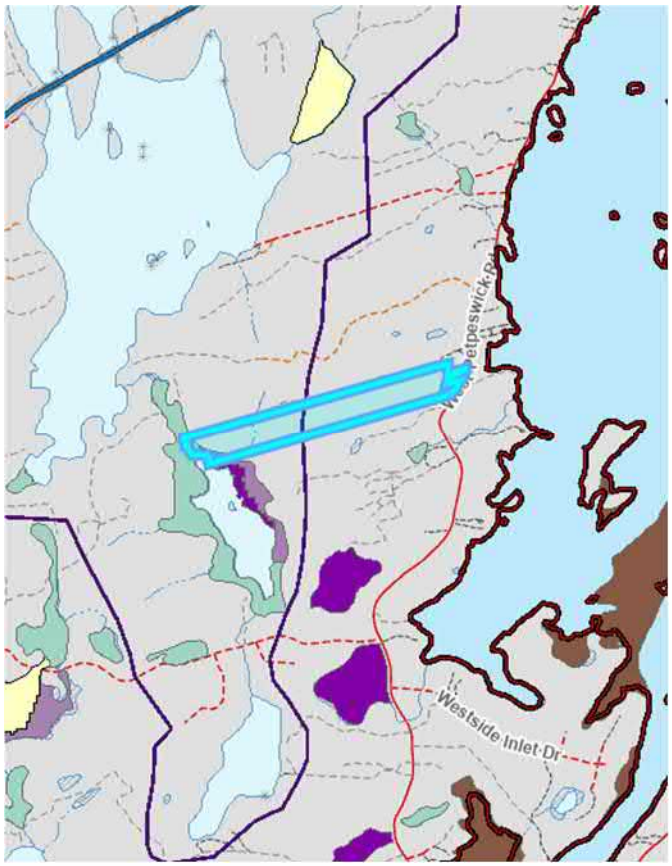


Plate 10: Watershed and Wetlands

The site is located within the primary Musquodoboit watershed #1EK, and two secondary watersheds:

- Chezzetcook River #1EK-3, tertiary B to the west; and
- No name watershed #1EK-SD2 to the east,

both draining in Atlantic Ocean.

Following wetlands are located partially on the site, within the western boundary, around the Grassy Lake:

- A fen with the total area 31,279 m^2,
- A bog with the total area of 16,997 m^2, and
- A swamp with the total area of 12,9353m^2.

The Atlantic Ocean is located within 20 m to the west of the site.

Based on the presence of the open water body (Atlantic Ocean and Beaverdam Ponds) within 90 m of almost all potential well locations on the site, the site's groundwater is suspected to have some surface water influence.

5.12 Water Chemistry & Quality Review

Three (3) water chemistry tests were completed within the investigation area, although average chemistry for water bearing Glaciolacustrine/Till Plains/Colluvial deposits and Morien Group bedrock is available form Nova Scotia Environment, as depicted in Table 5 below:

Table 5: Typical Water Chemistry

#	HU	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	HCO3 (mg/L)	CO3 (mg/L)	Cl (mg/L)	SO4 (mg/L)	F (mg/L)	Alk (mg/L)	Hrd (mg/L)	TDS (mg/L)	pH	NO3 - NO2N (mg/L)	As (ug/L)	U (ug/L)	Fe (ug/L)	Mn (ug/L)	Comments
	Metamorphic	22.5	3.3	17	1.2	63	1	16	11	0.17	65	70.5	149	7.7	0	1.45	0.3	125	65	
	Well # 741677 (Ptest 561	34	6.4	9	2.4	102	2	11	9	0.05	100	110	146	8.25	0.025	230	5.5	25	71	
	Well # 741677 (Ptest 562	29	2.9	9.1	1.1	86	0.5	9	7	0.05	86	85	123	7.37	0.05	28	1.6	25	25	
	Ptest434	118	27	54	1.8	206.4	1.5	202	19	0.1	208	405.833	557.3	7.9	0.025	2.5	NA	640	383	
GCDWQ	AO	--	--	--	--	--	--	--	--	--	--	--	--	7	1	--	--	100	20	GCDWQ
	MAC	--	--	300	--	--	--	250	--	--	--	--	500	10.5	45	10	20	--	120	

Arsenic, uranium, iron and manganese exceeded the GCDWQ.

General water chemistry was assessed using the trilinear diagram method as illustrated in Plate 11.

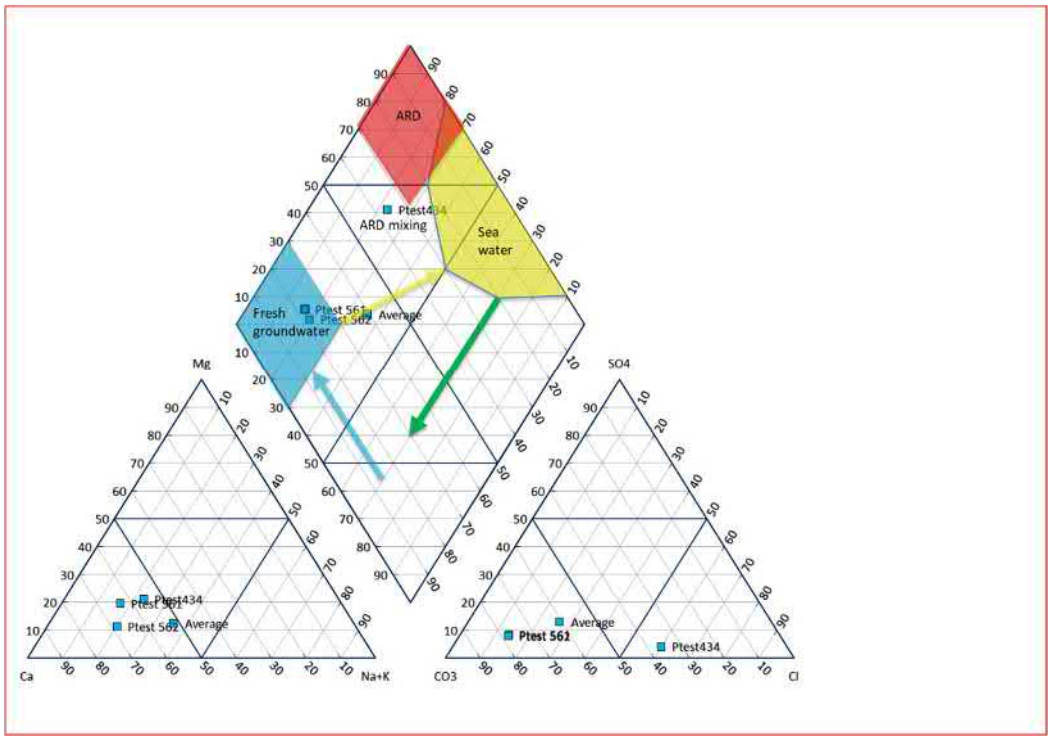


Plate 11: General Water Chemistry Trilinear Diagram

As shown in the diagram, typical water in the metamorphic aquifer had a fresh calcium-bicarbonate type water, exhibiting with traces of seawater. Ptest 561 and Ptest 562 results exhibited similar calcium-bicarbonate, fresh, soft, and sightly alkaline water.

Ptest 434 exhibited significant influence/mixing, potentially with ARD.

Based on the general water chemistry results it is concluded that groundwater on the site potentially could not satisfy the HC GCDWQs.

5.13 Hydrogeological Mapping Review

5.13.1 Surficial Hydrogeology

The site is located within Till hydrogeological region:

- Stony Till Plain consists of material derived from local bedrock sources, and material released from the base of an ice sheet by melting; with thickness ranging from 2 m to 20 m. Factors affecting use for water supply include shallowness.

It was concluded that surficial hydrogeological unit would not be sufficient for water supply of the proposed development.

5.13.2 Bedrock Hydrogeology

The site is located within the Metamorphic bedrock hydrogeological region. The metamorphic, plutonic and volcanic groundwater regions yield lower quantities of groundwater because groundwater can flow only along fractures within the rock.

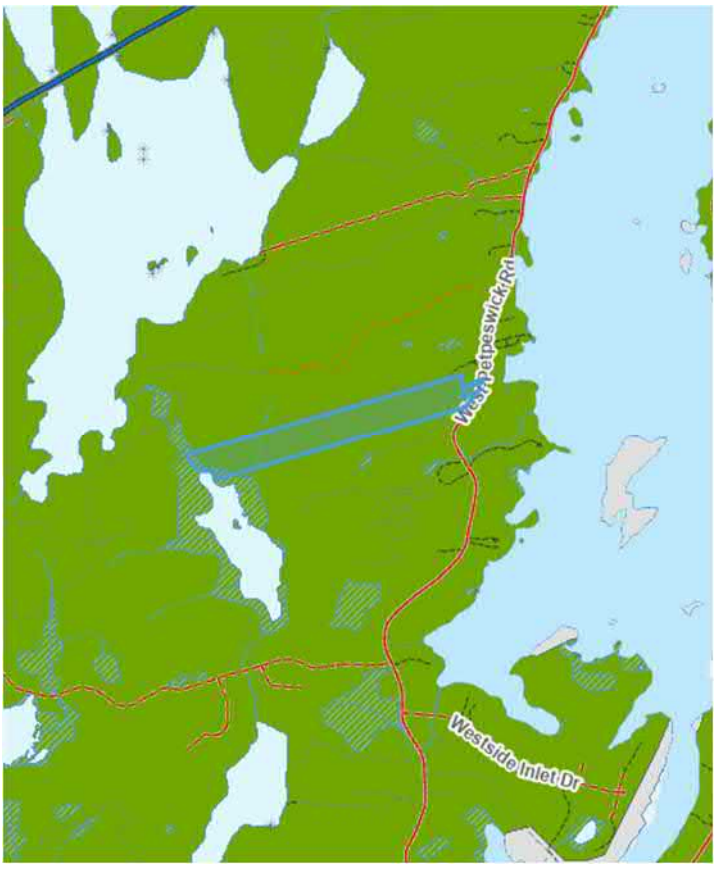


Plate 12: Metamorphic Bedrock Groundwater Region

5.13.3 Historical Pumping Tests

No pumping tests were completed for the local area, but average data for metamorphic hydro stratigraphic unit (HU) is available from NSECC, as depicted in Table 3 below:

Table 3: Metamorphic HU Bedrock Pumping Test Results

Transmissivity, (T), m^2/d	Specific Capacity, (SC), m^2/d	Safe 20-Year Pumping Rate, Q20, LPM
1.26	**2.09**	**19.75**

These average metamorphic values were also validated with local data, collected from pumping tests completed within 10 km radius of the site. Results are presented in Table 4.

Table 4: Local Pumping Test Results

Test/Well ID	Well Depth. m	Static Level, m	Hydraulic Conductivity (K), m/d	Transmissivity (T), m^2/d	Specific Capacity, (SC), m^2/d	Yield m^3/d
HAL-80	73	2.16	1.17	0.16	0.35	6.55
HAL-151.1	92	2.18	0.00017	0.01	0.04	0.44
HAL-151.2	92.4	4.57	1.50E-04	0.01	0.05	0.63
HAL-69	122	0.03	0.0026	0.31	0.45	17.67
HAL-41	25	15	0.15	1.57	5.37	5.24
HAL-53	58	4.21	4.72E-02	2.09	3.26	32.73
HAL-107	98	12.6	4.32E-03	0.32	0.44	9.1
Average	**80**	**6**	**0.0060**	**0.64**	**1.42**	**10**

Based on the above data, plans showing potential aerial distribution of K, T and Q20 were prepared using Surfer software. These plans are presented below in Plates 13, 14 and 15, respectively.

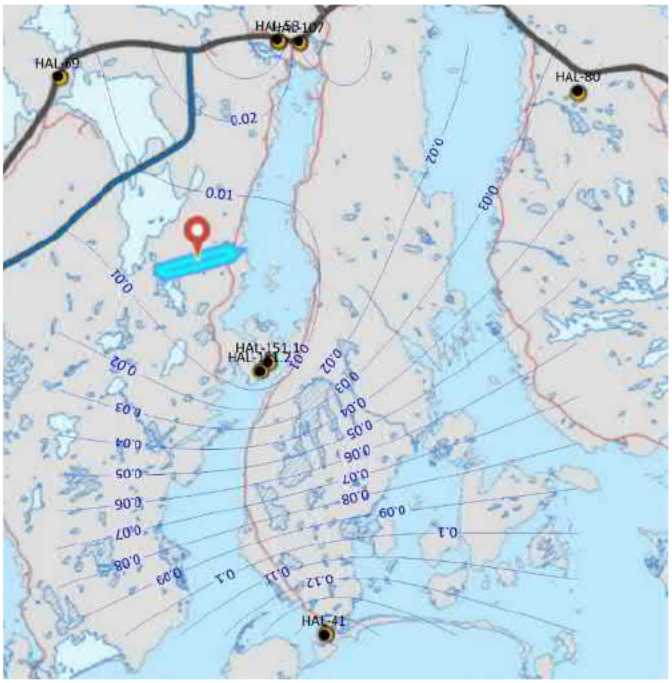


Plate 13 Hydraulic conductivity distribution, m/d

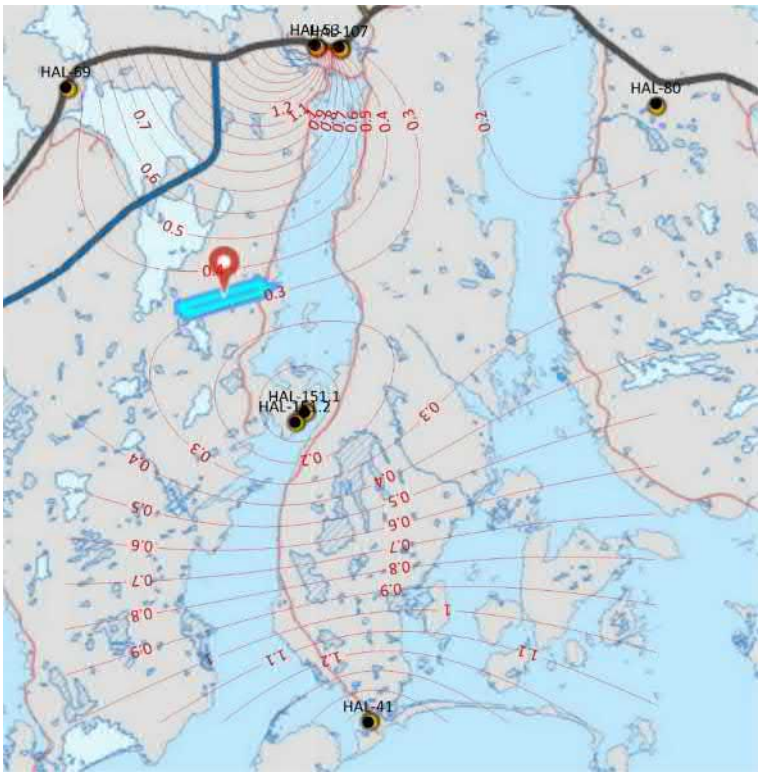


Plate 14: Transmissivity distribution, m^2/d

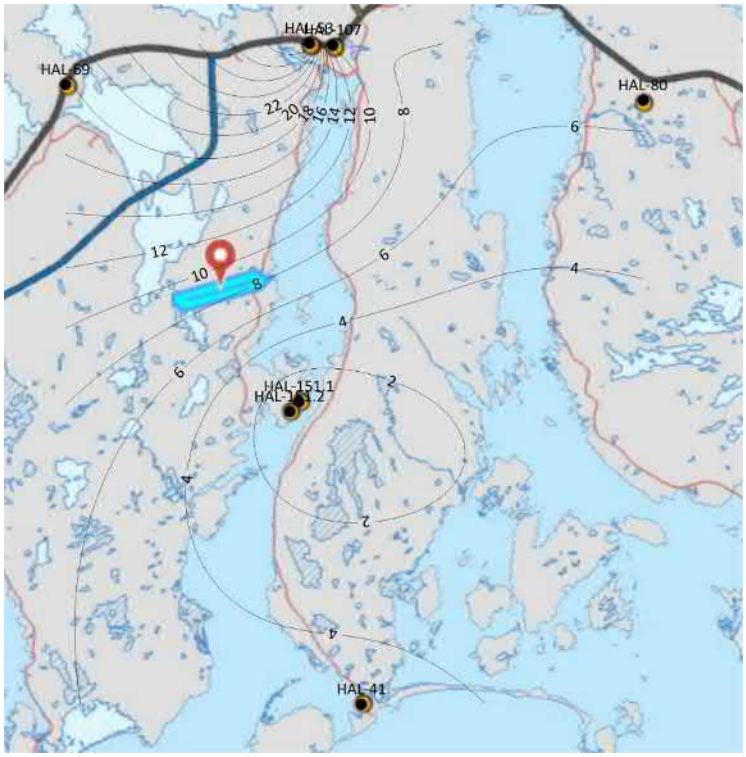


Plate 15 Safe Yields distribution, m^3/d

As shown in these plans, the site is located within a zone of extrapolated K of 0.0055 m/d, T of 0.33 m^2/d and relatively low safe yield of 9 m^3/d. These extrapolated values are within the same range as averaged values presented in Table 4.

Based on the review of the Level II Groundwater Assessment Eastern Portion of PID 00513788 Old Post Road, Enfield HRM, NS Fracflow Consultants Inc. 2013, it was concluded that storativity (S) value could be within 0.002.

These values (K of 0.0055 m^2/d and S of 0.002) were carried for further calculations.

6.0 LONG TERM YIELD MODELING

To understand potential characteristics of aquifers a long-term yield modeling was undertaken using DesignPoint Excel and NSECC Groundwater Tool models. Tabulated data and numerical models are presented in Appendix C.

6.1 Methodology

The potential long-term 20-years production rate (Q20) was modeled in Microsoft Excel using pertinent values for transmissivity previously reported by others and the NSECC Groundwater Tool.

It should be noted that only Farvolden solution was used; due to the absence of actual pumping data the van der Kamp and Maathuis method was not possible.

A number of wells, development lots, well depths, drawdowns and casing lengths were involved in modeling of the Q20, to understand the full aquifer potential and risks of fracture dewatering, bedrock oxidation and seawater intrusion.

The Q20 was estimated using Farvolden formula:

$$Q20 = 0.7*0.683*T*s20$$

- Where 0.7 is the safety coefficient.
- 0.683 is the temporal and radial flow coefficient.

A potential for the groundwater recharge was preliminary investigated using the conservative 5% infiltration for surficial groundwater recharge. Weather Normals data is presented in Table 2 in Section 5. The recharge area was estimated using the following formula:

$$RA = A*ISP$$

- Where RA is the actual recharge area.
- A is the land area of active recharge.
- ISP is the percentage of permeable area, estimated at 70%.

Recharge volumes were estimated as follows:

$$R = RA*Euse$$

- Where R is volume of recharge per RA.

- Euse is ecological water use, the NSECC default is 50%.

6.2 Modeling Results

6.2.1 Bedrock Aquifer

Initial Conditions

Bedrock aquifer initial parameters were obtained from the literature and modeled as follows:

- The estimated value for K (hydraulic permeability) in bedrock (Goldenville and Halifax Formations) was 0.0055 m/d (Plate 10, Table 3), and S (storativity) was 0.002.
- Ground elevation of 46 masl.
- Water static level 4 m below ground surface (bgs) or 42 masl.
- Seasonal water fluctuations of 3 m, which is a standard value.
- Well frictional head loss was conservatively assumed at 4 m.
- Tidal water intrusion safe elevation of 10 masl, ensuring 400 m below sea level (bsl) interface depth for tidal water. For calculation of the interface depth the tidal water was assumed having half of seawater density.
- Well loss due to multiple wells pumping (well interference) of 6 m, based on the Groundwater Tool.
- Safe operational drawdown of 25 m below the static level or 10 masl.
- Maximum 2-hour temporal emergency drawdown of 39 m below the static level or 1 masl.
- Projected yearly precipitation in 20 years in the future is 1.27 m/year.
- Published bedrock recharge rate in the area is 0.18 m/year.
- Ecologically available safe water use of 50%.
- Property's permeable areas of 70%.

Well Construction

A well of 0.18 m (8 inch) diameter and depth of a minimum 130 m; a well casing with a shoe installed in bentonite seal at 46 mbgs or 0 masl was calculated to perform best in these conditions.

8-inch well is typical for the relatively small (less than 300 m^3/day) public water supply settings and proved to be the most effective and economical solution.

Well depth of 110 m was calculated based on the extrapolated K and assumption that T will be increasing with increasing well depth:

$$T = K*m$$

Where m is the open well intervale in the bedrock.

Casing length of 46 m was chosen based on the necessity of keeping the operational water level inside the casing at all times, due to high risk of arsenic contamination. Arsenic naturally present in rocks of Goldenville formation and will start leaching into groundwater upon introduction of oxygen. This introduction happens when water level in a well falls below the casing, exposing ancient anoxic rocks to the atmosphere.

The maximum safe drawdown of 36 m below the static level, or 10 masl is supposed to control seawater or tidal water intrusion, providing freshwater head significant enough to keep the seawater or tidal interfaces at 400 m below sea level (bsl) and 800 mbsl, respectively.

Safe Yield Estimate

Under these conditions the total theoretically estimated Q20 for one (1) well was 50 m^3/d with the immediately available storage in the well of 5.8 m^3.

This Q20 is enough to supply potable water to one hundred sixty-six (166) persons per one (1) well.

Two (2) wells are estimated to provide required 100 m^3/d for 332 persons.

Potential Well Interference Effects.

Potential effects for well interference were estimated using the Groundwater Toolkit provided by NSECC online. This instrument was developed by the NSECC to aid in understanding a distance between production wells. Complete models are presented in Appendix C.

The well interference was estimated using the Theis solution, as provided by the NSECC and Dr. Bruce Hunt of Canterbury University, New Zealand.

It was estimated that two (2) wells will be required to supply the three hundred thirty-two (332) persons population.

Potential off-site well head losses due to the on-site pumping at all twenty wells are represented in Appendix C.

In summary, off-site drawdowns are expected to be as follows:

- Well distances were set at 50 m, pumping rates at 50 m^3/d each well.
- by 3.27 m at 200 m, by 1.78 m in 500 m and by 0.78 m at 1000 m in 1 year.
- by 5.2 m at 200 m, by 3.7m in 500 m and by 2.5 m at 1000 m in 10 years.
- by 5.8 m at 200 m, by 4.2 m in 500 m and by 3.1 m at 1000 m in 20 years.
- The total aquifer head loss (well interference was estimated at 6 m, or 20% of available head. The target drawdown is required to be less than 50% od available head.

These off-site head losses are concluded to be relatively small and should not significantly affect the existing domestic water supplies in the area.

Recharge Estimate

The total required groundwater recharge area was estimated to be 243,520 m^2, which is by 65,458 m^2 more than the whole PID area of 178,062 m^2. This additional recharge will be obtained using water from the adjacent wooded areas to the north and south of the site.

In such a case, it was estimated that three hundred thirty-two (332) persons could be sustainably supplied with groundwater that is recharged on the site and within the adjacent 65,458 m^2.

Approximate recharge area required for water supply is illustrated in Plate 16.

Plate 166: Recharge area required for 332 persons

The recharge area is located mostly within wooded forested lands and supposedly could provide a high-quality water.

6.3 Potential Effects on Surface Water & the Environment

It is thought that conservative 50% available water use should be sufficient enough to mitigate any adverse effects of pumping on the surface water on-site.

It is concluded that surface water (Grassy Lake) would require monitoring related to the on-site water testing. Water samples are recommended to be collected before and after tests completion for general chemistry, metals, PHCs and VOCs.

6.4 Risk of Onsite Septic Systems to Individual Wells

A properly designed, constructed, and maintained septic system can provide long-term, effective treatment of household wastewater.

A malfunctioning system can contaminate groundwater that might be a source of drinking water.

Typical pollutants in household wastewater include, but not limited to nitrogen, phosphorous, and disease-causing bacteria and viruses. If a septic system is working properly, it will remove most of these pollutants.

Poorly treated sewage from septic systems can be a cause of groundwater contamination. It poses a significant threat to drinking water and human health because it can contaminate drinking water wells and cause diseases and infections in people and animals. Improperly treated sewage that enters nearby surface water also

increases the chance of swimmers contracting infectious diseases. These range from eye and ear infections to acute gastrointestinal illness and diseases like hepatitis.

It was concluded that there is a medium risk of bacterial and nutrient contamination in the site's groundwater due to the planned septic systems on-site.

The on-site septic system to be located downstream of the future production wells.

An anti-bacterial treatment would be required for the future water supply.

Projected well and septic locations are presented in Plate 17, along with the surface water flow directions. This Plate is a combination of the Servicing Plan C-01 and Preliminary Stormwater Management Plan STA-01.

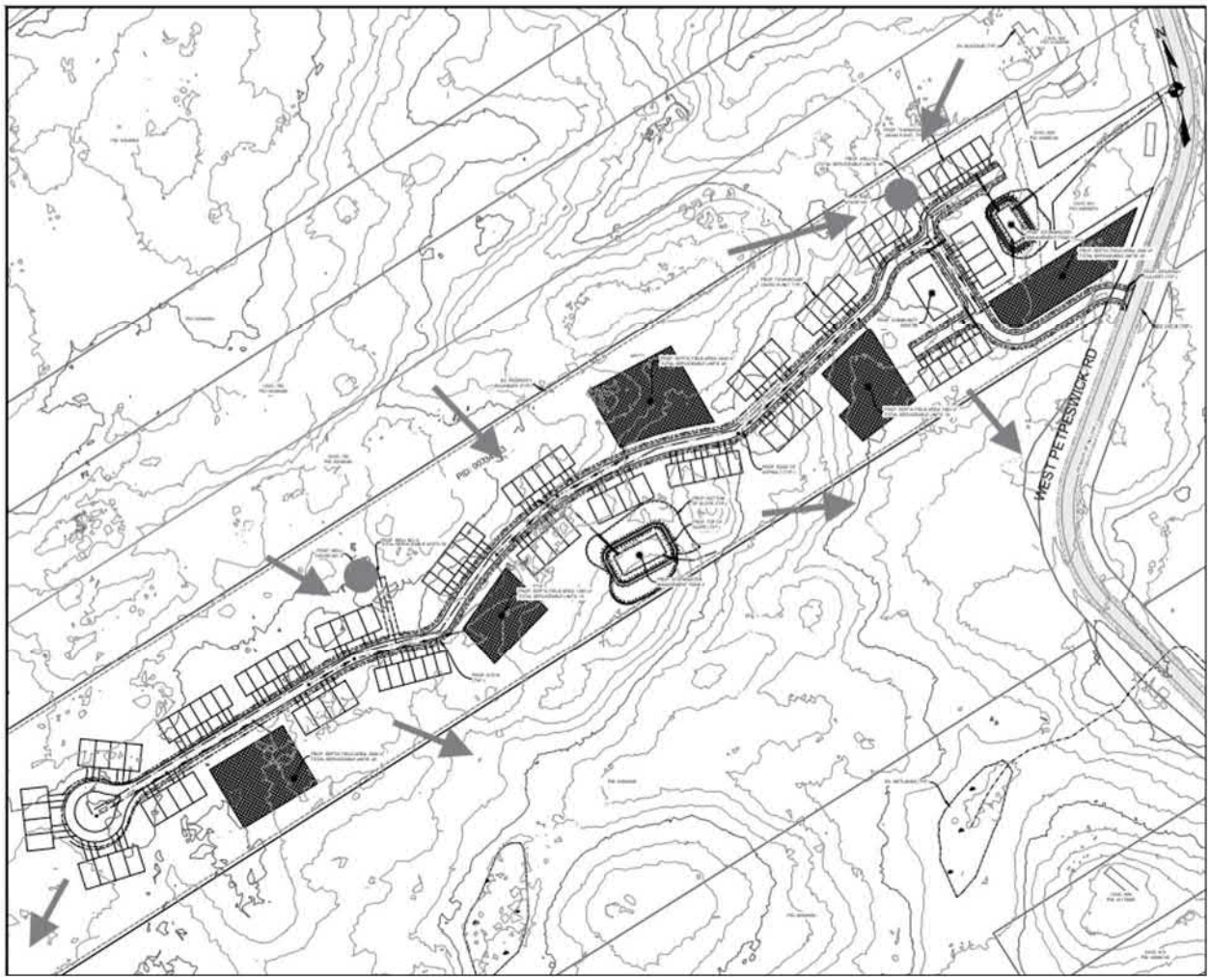


Plate 17: Water Well Locations, Septic Locations, Surface Water Flow and Housing Development Plan, approximate

The distance from the proposed Well #1 and potentially from the Well #2 to the nearest surface water (stormwater ponds) is planned to be less than (Well #1) or close to (Well #2) 90 m, as such further investigation for Groundwater Under Influence (GUDI) of surface water could be expected.

7.0 CONTINGENCY & MITAGATION

If water quantity is lower, or water shortages, following options are suggested.

- Deepening the well to increase the open intervale and transmissivity.
- Well skin improvement by fracturing, surging, and jetting.
- Adding a reserve well.
- Installation of additional water storage.
- Supplement of the well water supply (importing water).

These options to be evaluated further should water shortages be suspected.

Water conservation examples would include, but not limited to:

- Installing water meters to provide awareness of water use, assist in problem investigations, and allow earlier leak detection.
- Using low flow water devices such as toilets and shower heads.
- Considering alternative supplies in combination with drilled/dug wells, such as rainwater cisterns (e.g., use rainwater for outdoor uses such as washing vehicles, lawn watering, garden irrigation, etc.).
- Having water delivered for filling swimming pools.
- Educating property owners about simple water conservation practices in the home, such as spread-out loads of laundry rather than doing several loads at once, avoid using several fixtures at one time (e.g., dishwasher, washing machine, shower), turn off taps when not in use, check for leaks, turn water off when away.

For further information please refer to the Environment Canada and NSECC water conservation fact sheets available online.

8.0 WATER TREATMENT

Water treatment could include suspended solids filtration, standard bacterial treatment (chlorination) and green sand (ionic exchange) treatment for heavy metals.

The treatment facility should be equipped with water parameters (flows, temperature, pH, dissolved oxygen, total suspended and dissolved solids) meters and monitoring devices.

NSECC groundwater withdrawal approval will indicate parameters and frequency of future water quality monitoring.

9.0 CONCLUSIONS

Report conclusions are based on the review of available information, calculations and the site visit.

It was concluded, that:

- It is concluded that the bedrock aquifer potentially provides better opportunities for the potable water supply on the site.
- The proposed development will not significantly affect existing water wells and environment.
- Under conservative conditions the site potentially could provide enough water (100 cubic meters per day (m^3/d)) for three hundred thirty-five (335) persons using the bedrock aquifer.
- Two (2) wells of 0.2 m (8 inches) diameter and depth of 110 m; with well casings installed at 46 mbgs or 0 masl were found to perform best, potentially providing combined Q20 of 101 m^3/d.
- Based on the Groundwater Tool well interference calculator it was estimated that the potentially optimal number of wells is two (2) wells spaced at a minimum of 50 m from each other and located across the groundwater flow to mitigate the interference.
- Well interference head losses are concluded to be moderate, ranging from 3.1 m to 5.8 m at distances of 1 km and 200 m, respectively, in 20 years in the future and should not significantly affect existing domestic water supplies in the area.
- It should be noted that the groundwater recharge area required for such a supply is estimated to be by 65.586 m^2 bigger than the site area. Recharge area would include wooded lands outside the proposed development.
- There are no current or historical land uses that may cause groundwater contamination (landfills, gas stations, dry cleaners, other commercial/industrial facilities, etc.)
- There is a low to medium risk of seawater intrusion, which is to be controlled by keeping operational water levels at a minimum of 6 m above the sea level.
- There is a low risk of bacterial and nutrient contamination for the bedrock aquifer due to the planned septic systems locations downgradient of the well locations.
- Groundwater chemistry and quality is expected to slightly change over time due to noted in Section 5 processes of seawater and potential acid rock drainage (ARD) influence noted in the trilinear diagram.
- Water wells in the proposed development are not expected to meet the HC GCDWQ, with heavy metals being the primary concern. There is a high risk of arsenic, uranium, iron and manganese contamination due to the natural geological conditions.
- Wells will require the regulatory well report and groundwater withdrawal approval, as each well will produce more than 23 m^3/d.
- Wells will have more than fifteen (15) connections serving more than twenty-five (25) persons each, which is above the NSECC thresholds for registered public water supply, as such this water supply system needs to be registered with the NSECC.
- Water testing and treatment is concluded to be the landowner's or property operator's responsibility.
- In summary, it was concluded that satisfactory results provided above are based on assumptions, off-site data extrapolation and data averaging. The real situation on the site could significantly differ from our desktop investigation results and further L2GWA intrusive investigation is required.

10.0 RECOMMENDATONS

The following recommendations based on the conclusions of the Level 1 GWA:

1. It is recommended to use the bedrock aquifer for potable water supply.
2. The public central water supply system, consisting of two (2) production wells and water treatment facility, serving the total of 332 persons is recommended.
3. Level 2 GWA is recommended to be completed on the site.
4. The well construction is recommended as follows:
    a. well depths 130 m installed within the bedrock aquifer;
    b. well diameters 0.18 m;
    c. wells equipped with properly capped steel casing and drive shoe. The casing installed in the bedrock at estimated 46 mbgs and extending the minimum 0.6 m above ground; and
    d. bentonite grouting of the well casing annular space from the drive shoe up to the ground surface.
5. The water level is recommended to be always kept inside the casing during testing and future operations.
6. Details of pump placement and test rates to be determined after the well installation and development.
7. The minimum well spacing to mitigate wells interference is recommended to be 50 m.
8. It is recommended to complete 4-step tests and 72-hour constant rate pumping tests on each of the two (2) wells, using idling well as an observation.
9. Phasing of tests is also recommended, with one (1) of the wells drilled and tested before proceeding with the second well drilling.

11.0 CLOSURE

This report was prepared for the exclusive use of the Zzap Architecture + Planning for evaluating the groundwater condition of the site at the time of the site visit. 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 the third party. Should additional parties require reliance on this report, written authorization from DesignPoint will be required. With respect to third parties, DesignPoint has no liability or responsibility for losses of any kind whatsoever, including direct or consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

The report is based on data and information collected during the Level 1 GWA of the site conducted by DesignPoint. It is based solely on the conditions of the site encountered at the time of the site visits in April 2025. Except as otherwise maybe specified, DesignPoint disclaims any obligation to update this report for events taking place, or with respect to information that becomes available to DesignPoint after the time during which DesignPoint conducted the Level 1 GWA.

In evaluating the property, DesignPoint has relied in good faith on information provided by other individuals noted in this report. DesignPoint has assumed that the information provided is factual and accurate. In

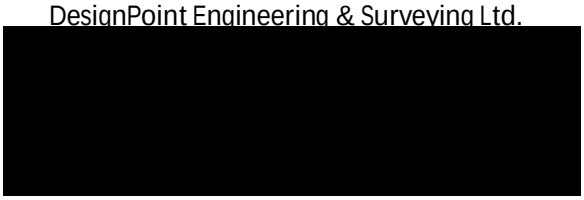
addition, the findings in this report are based, to a large degree, upon information provided by the prospective purchaser, the purchasers agent, and the current managers of the property. DesignPoint accepts no responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of omissions, misinterpretations or fraudulent acts of persons interviewed or contacted.

DesignPoint makes no other representations whatsoever, including those concerning the legal significance of its findings, or as to other legal matters touched on in this report, including, but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel.

We trust that the information contained in this report is adequate for your present purposes. If you have any questions about the contents of the report or if we can be of any other assistance, please contact us at your convenience.

Thank you,

DesignPoint Engineering & Surveying Ltd.



Arman Polatbekov, P.Geo.
Senior Hydrogeologist and Contaminated Site Professional

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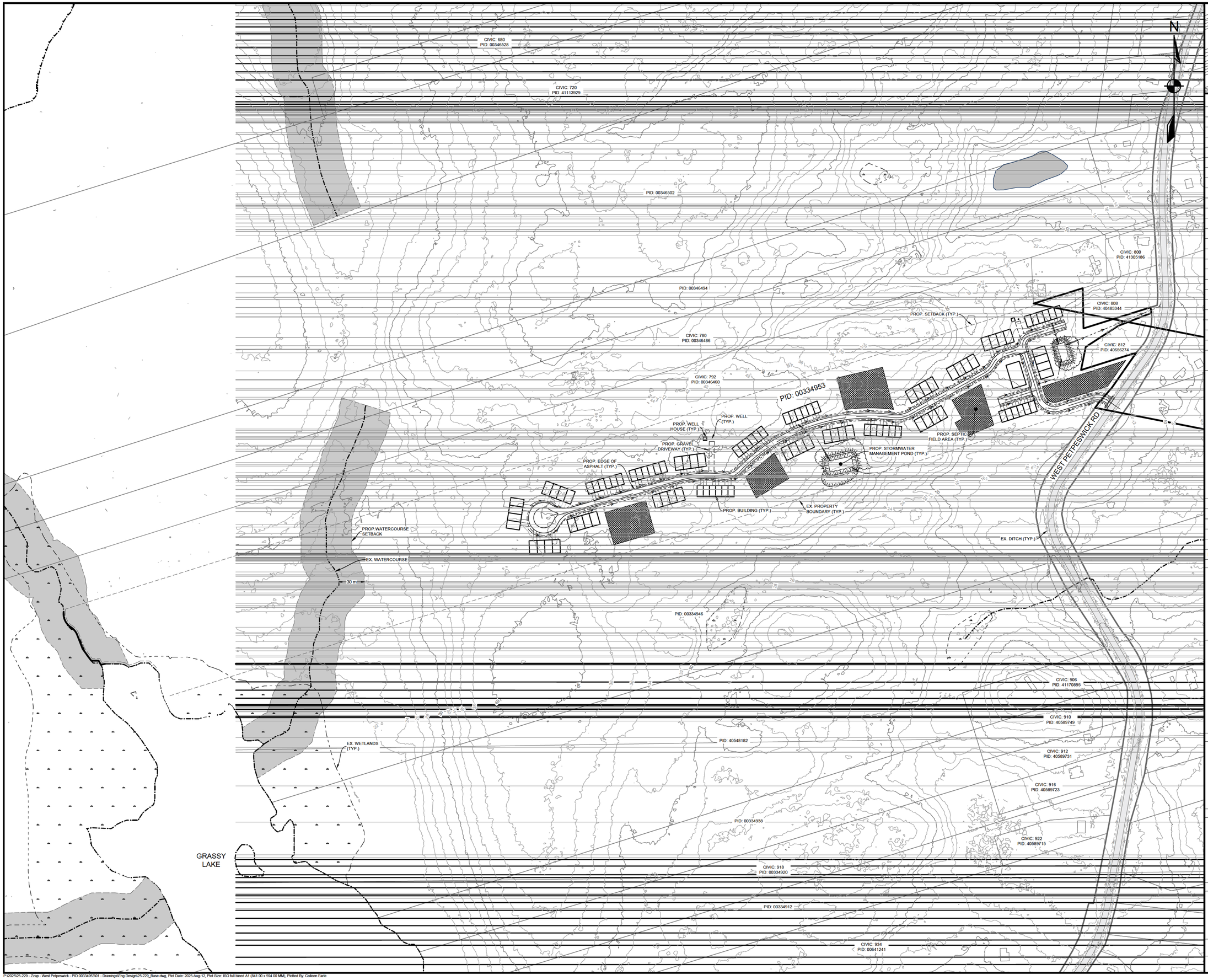
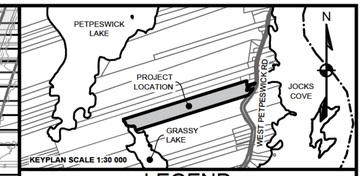
Appendix A – Preliminary Site Plans





LEGEND

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SA-E	SANITARY PIPE	SA SA
ST-E	STORM PIPE	ST ST
GAS-E	NATURAL GAS MAIN	GAS
	WATER LATERAL	
	SANITARY LATERAL	
	STORM LATERAL	
	NATURAL GAS LATERAL	
	SIDEWALK	
	WALKWAY/A.T. TRAIL	
	GUARDRAIL	
	TOP OF SLOPE	
	BOTTOM OF SLOPE	
x x	FENCELINE	x x

	EXISTING	PROPOSED		EXISTING	PROPOSED
CURB CUT/RAMP			AIR RELEASE VALVE		
CURBSTOP			WATER VALVE		
REDUCER			HYDRANT		
PRECAST HEADWALL			CATCHBASIN		
STREET SIGN			UTILITY POLE w/ GUY WIRE		
STREET TREE			GLB		
			URD		

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ISSUE	DATE	DESCRIPTION	INT.
1	AUG. 12, 2025	ISSUED FOR REVIEW	DS

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PRELIMINARY
Aug. 12, 2025

CLIENT

zzap

PROJECT DESCRIPTION

LAND LEASED COMMUNITY DEVELOPMENT

WEST PETPESWICK, NOVA SCOTIA

SHEET DESCRIPTION

SITE PLAN

Drawn	Engineer	Project No.	Drawing No.
D.SUTHAR	J.WYATT	25-229	C-01
Scale	Filename		1 of 5
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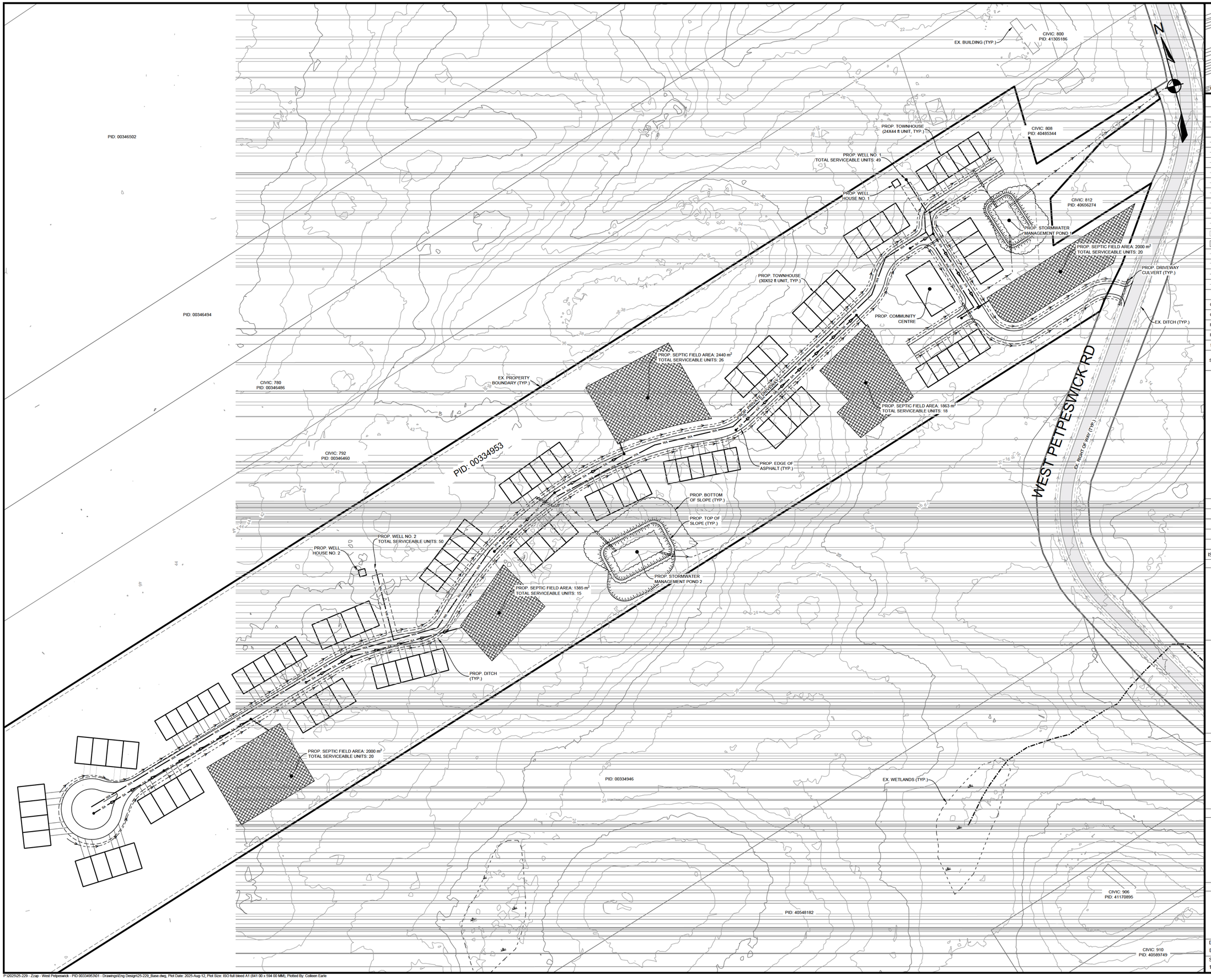

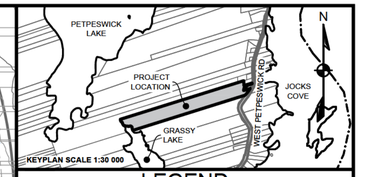

LEGEND

EXISTING		PROPOSED
	VERTICAL PROFILE	
	APPROXIMATE 1 IN 100 YEAR FLOOD LIMIT	100 YR
	EASEMENT	
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SA-E	SANITARY PIPE	SA
ST-E	STORM PIPE	ST
GAS-E	NATURAL GAS MAIN	GAS
	WATER LATERAL	
	SANITARY LATERAL	
	STORM LATERAL	
	NATURAL GAS LATERAL	
	SIDEWALK	
	WALKWAY/A.T. TRAIL	
	GUARDRAIL	
	TOP OF SLOPE	
	BOTTOM OF SLOPE	
X	FENCELINE	X

	EXISTING	PROPOSED		EXISTING	PROPOSED
CURB CUT/RAMP			AIR RELEASE VALVE		
CURBSTOP			WATER VALVE		
REDUCER			HYDRANT		
PRECAST HEADWALL			CATCHBASIN		
STREET SIGN			UTILITY POLE w/ GUY WIRE		
STREET TREE			GLB		
			URD		

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1:1000

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1	AUG. 12, 2025	ISSUED FOR REVIEW	DS

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PROJECT DESCRIPTION

LAND LEASED COMMUNITY DEVELOPMENT

WEST PETPESWICK, NOVA SCOTIA

SHEET DESCRIPTION

SERVICING PLAN

Drawn	Engineer	Project No.	Drawing No.
D.SUTHAR	J.WYATT	25-229	C-02
Scale	Filename		2 of 5
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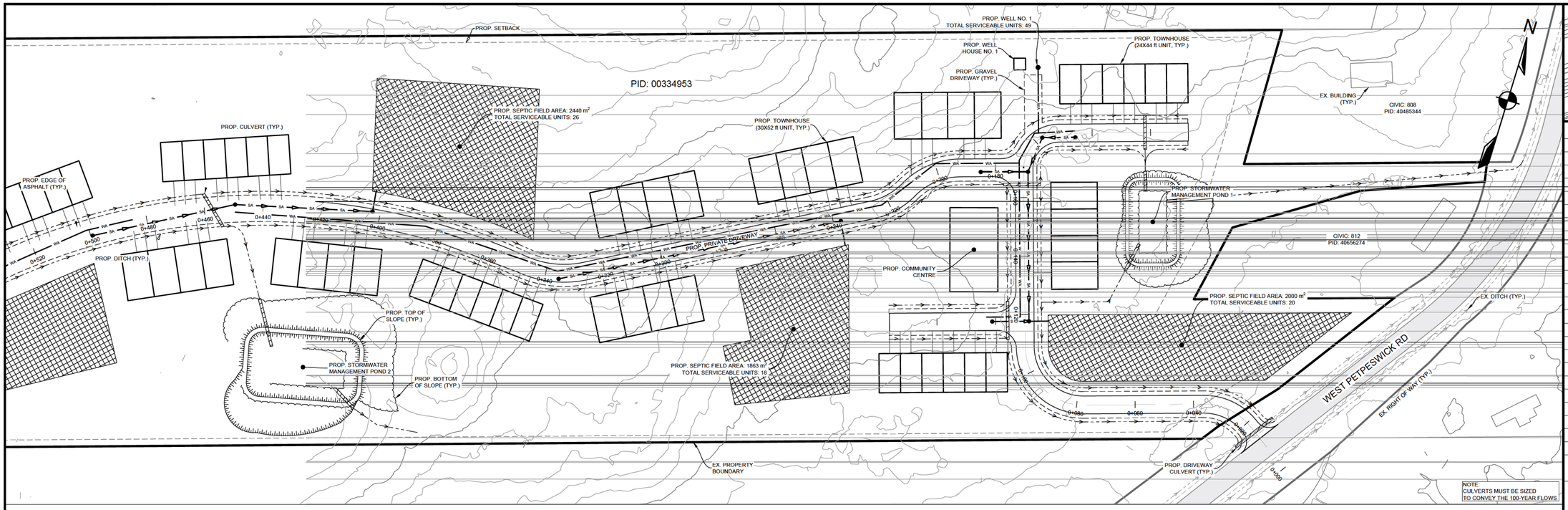

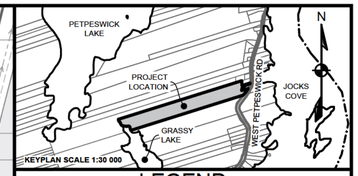

LEGEND

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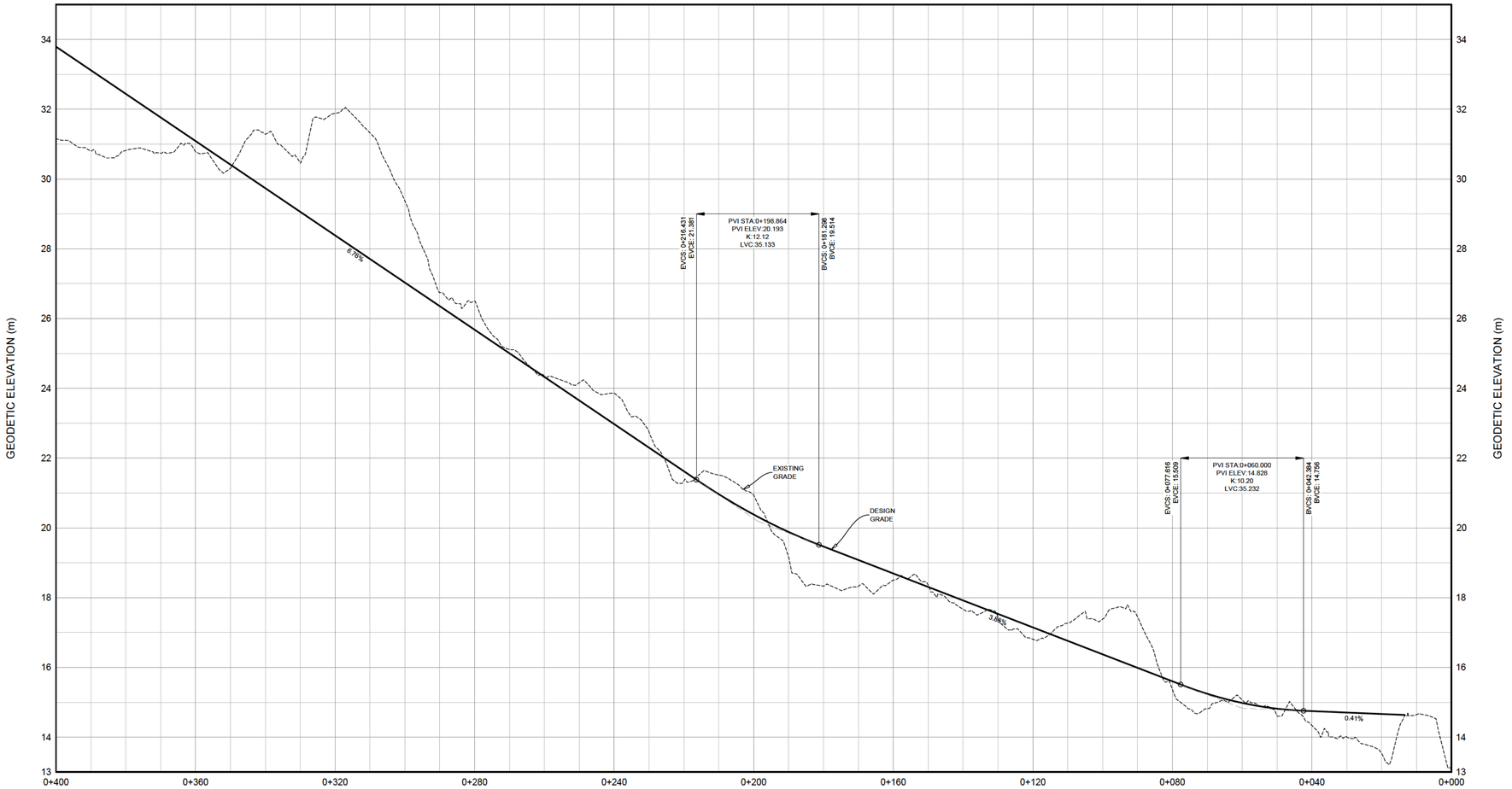
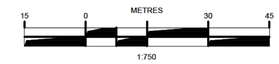
	EASEMENT	
WA-E	WATER PIPE	WA WA
SA-E	SANITARY PIPE	SA SA
ST-E	STORM PIPE	ST ST
GAS-E	NATURAL GAS MAIN	GAS
	WATER LATERAL	
	SANITARY LATERAL	
	STORM LATERAL	
	NATURAL GAS LATERAL	
	SIDEWALK	
	WALKWAY/A.T. TRAIL	
	GUARDRAIL	
	TOP OF SLOPE	
	BOTTOM OF SLOPE	
x x	FENCELINE	x x

	EXISTING	PROPOSED		EXISTING	PROPOSED
CURB CUT/RAMP			AIR RELEASE VALVE		
CURBSTOP			WATER VALVE		
REDUCER			HYDRANT		
PRECAST HEADWALL			CATCHBASIN		
STREET SIGN			UTILITY POLE w/ GUY WIRE		
STREET TREE			GLB		
			URD		

PRIVATE DRIVEWAY PROFILE





ISSUE	DATE	DESCRIPTION	INT.
1	AUG. 12, 2025	ISSUED FOR REVIEW	DS

CONSULTANT

DESIGNPOINT
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designpoint.ca

PRELIMINARY
Aug. 12, 2025

CLIENT

zzap

PROJECT DESCRIPTION

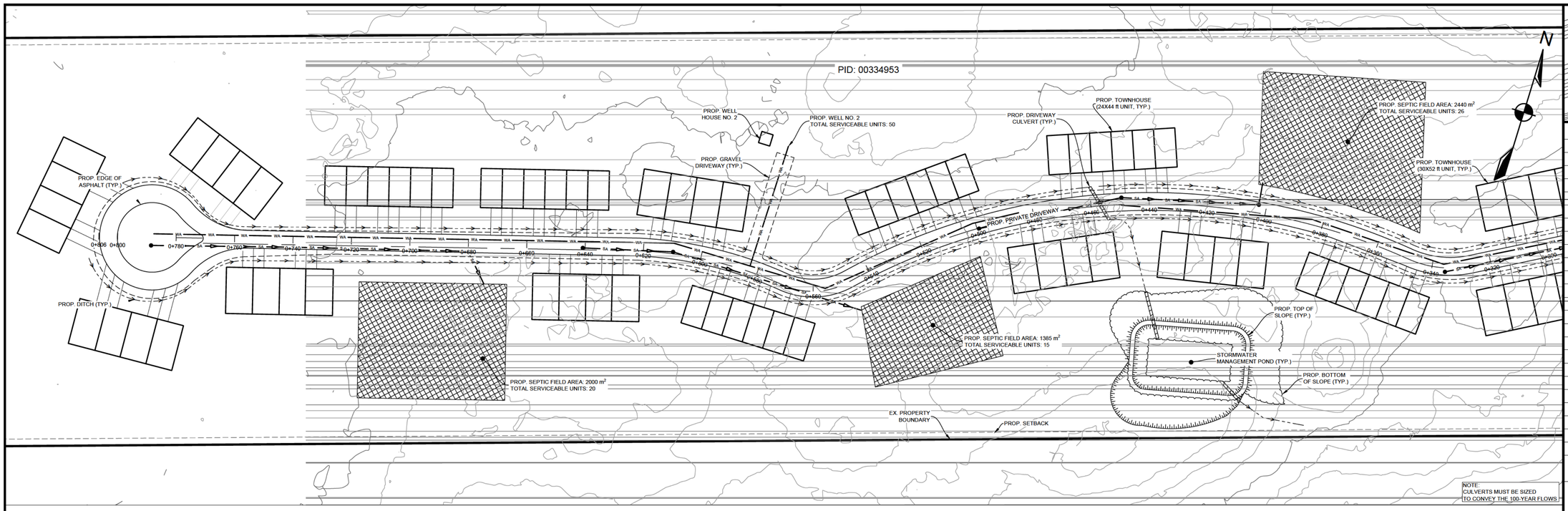
LAND LEASED COMMUNITY DEVELOPMENT

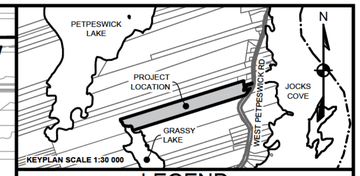
WEST PETPESWICK, NOVA SCOTIA

SHEET DESCRIPTION

PLAN AND PROFILE
STA. 0+000 TO 0+400

Drawn	Engineer	Project No.	Drawing No.
D.SUTHAR	J.WYATT	25-229	C-03
Scale	Filename		3 of 5
1:750	25-229_Base.dwg		





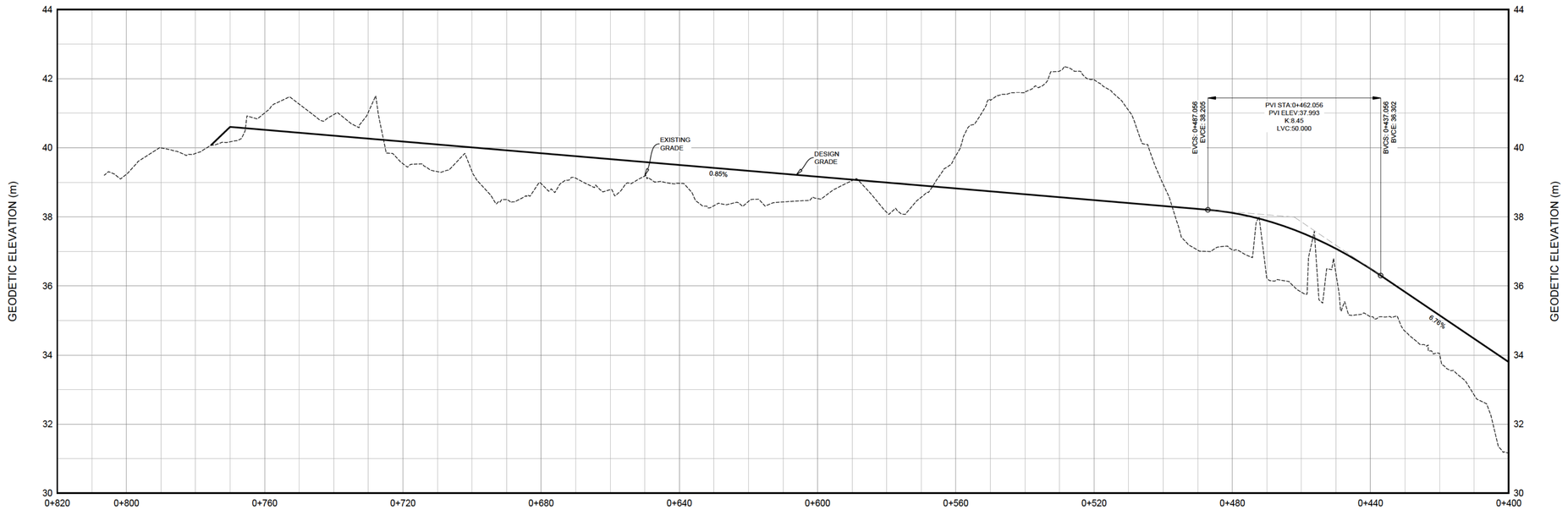
LEGEND

EXISTING		PROPOSED
	VERTICAL PROFILE	
	APPROXIMATE 1 IN 100 YEAR FLOOD LIMIT	100 YR
	EASEMENT	
WA-E	WATER PIPE	WA
SA-E	SANITARY PIPE	SA
ST-E	STORM PIPE	ST
GAS-E	NATURAL GAS MAIN	GAS
	WATER LATERAL	
	SANITARY LATERAL	
	STORM LATERAL	
	NATURAL GAS LATERAL	
	SIDEWALK	
	WALKWAY/A.T. TRAIL	
	GUARDRAIL	
	TOP OF SLOPE	
	BOTTOM OF SLOPE	
x x	FENCELINE	x x

	EXISTING	PROPOSED		EXISTING	PROPOSED
CURB CUT/RAMP			AIR RELEASE VALVE		
CURBSTOP			WATER VALVE		
REDUCER			HYDRANT		
PRECAST HEADWALL			CATCHBASIN		
STREET SIGN			UTILITY POLE w/ GUY WIRE		
STREET TREE			GLB		
			URD		

METRES
15 0 30 45
1:750

PRIVATE DRIVEWAY PROFILE



ISSUE	DATE	DESCRIPTION	INT.
1	AUG. 12, 2025	ISSUED FOR REVIEW	DS

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PROJECT DESCRIPTION

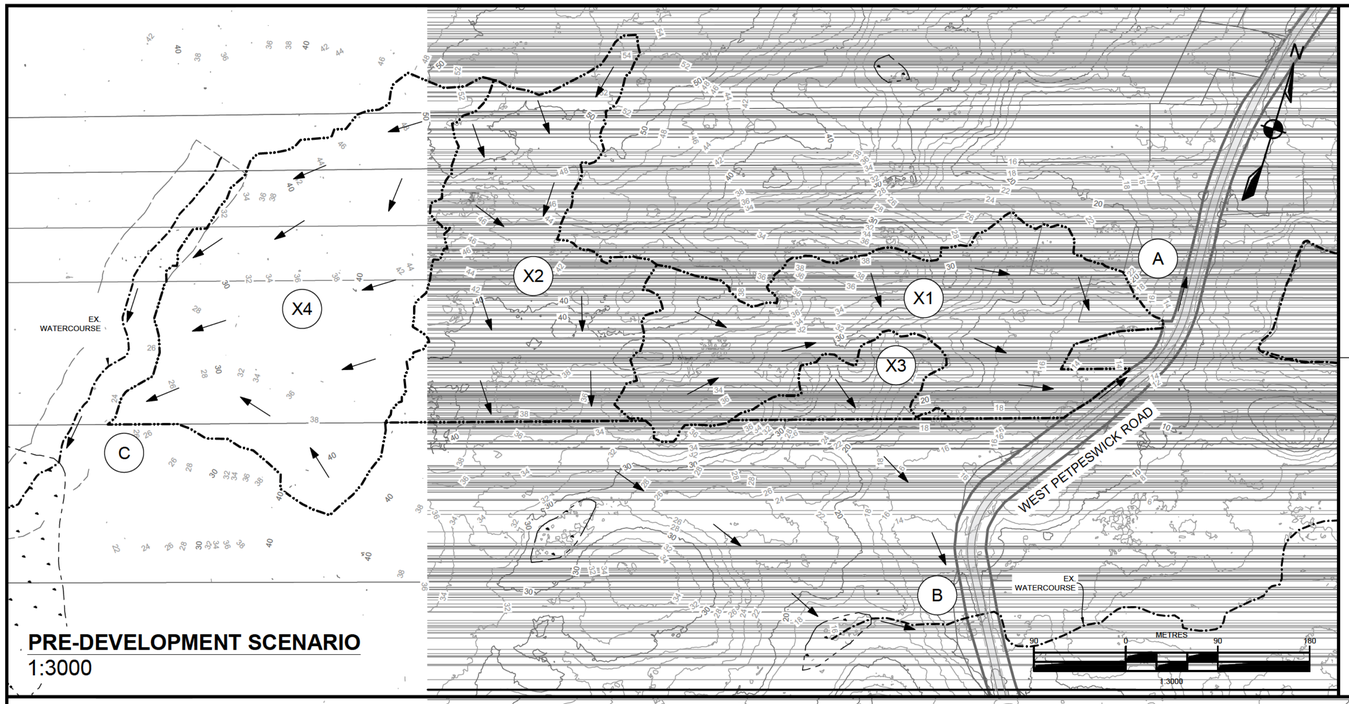
LAND LEASED COMMUNITY DEVELOPMENT

WEST PETPESWICK, NOVA SCOTIA

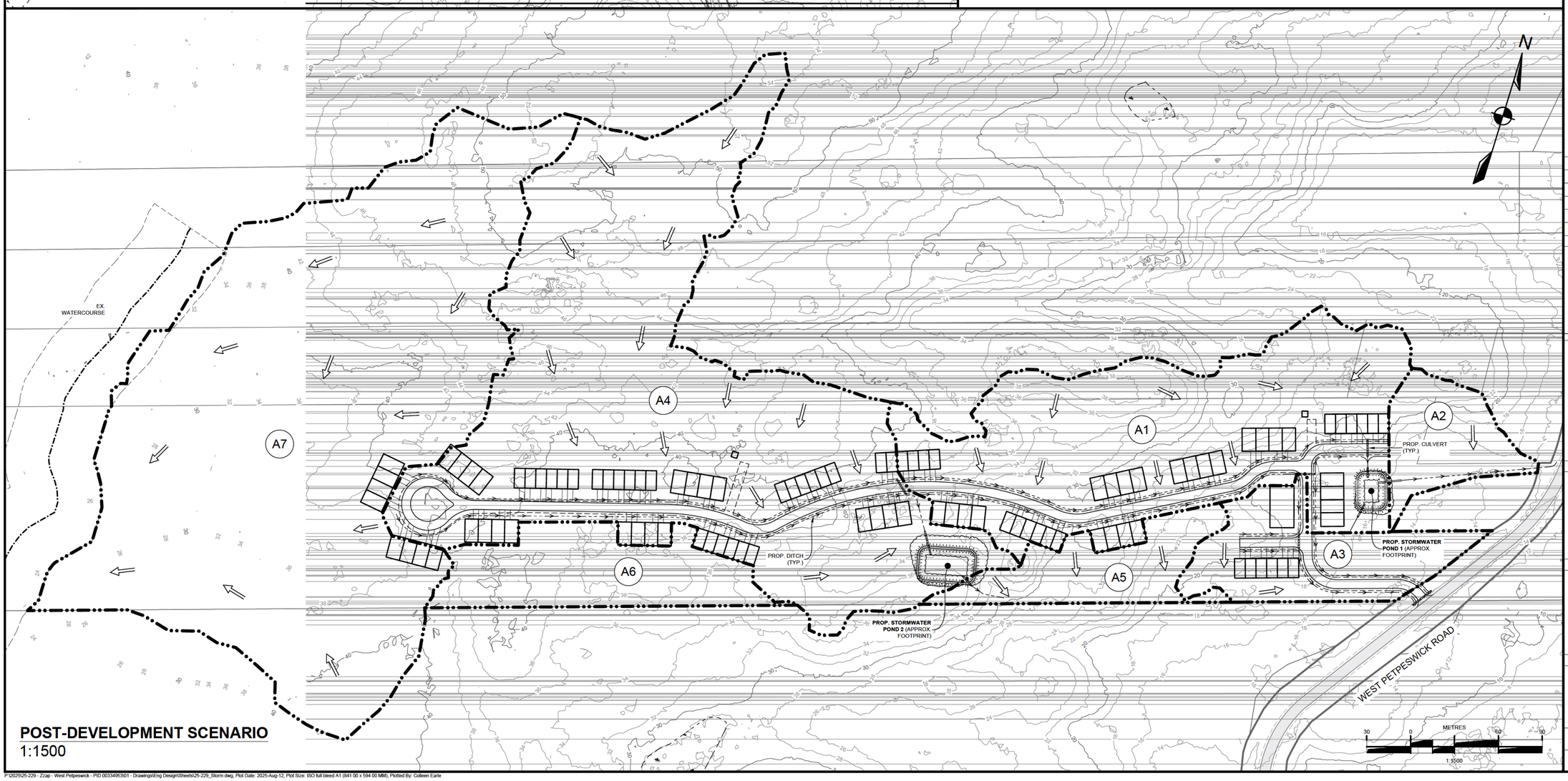
SHEET DESCRIPTION

PLAN AND PROFILE
STA. 0+400 TO 0+820

Drawn	Engineer	Project No.	Drawing No.
D.SUTHAR	J.WYATT	25-229	C-04
Scale	Filename		4 of 5
1:750	25-229_Base.dwg		



PRE-DEVELOPMENT SCENARIO
1:3000



POST-DEVELOPMENT SCENARIO
1:1500

24 HR RAINFALL DEPTHS AS FOLLOWS:

- 5 YEAR RETURN: 92 mm
- 10 YEAR RETURN: 104 mm
- 25 YEAR RETURN: 119 mm
- 50 YEAR RETURN: 130 mm
- 100 YEAR RETURN: 141 mm

ANTECEDENT MOISTURE CONDITION (AMC) = 2

STORARE VOLUME REQUIRED FOR **PROP. STORMWATER POND 1** TO BALANCE PRE/POST-DEVELOPMENT FLOWS:

- 5 YEAR RETURN: 94 m³
- 10 YEAR RETURN: 119 m³
- 25 YEAR RETURN: 145 m³
- 50 YEAR RETURN: 164 m³
- 100 YEAR RETURN: 184 m³

STORARE VOLUME REQUIRED FOR **PROP. STORMWATER POND 2** TO BALANCE PRE/POST-DEVELOPMENT FLOWS:

- 5 YEAR RETURN: 235 m³
- 10 YEAR RETURN: 289 m³
- 25 YEAR RETURN: 351 m³
- 50 YEAR RETURN: 396 m³
- 100 YEAR RETURN: 447 m³

CATCHMENT SCS PARAMETERS			
ID	AREA (Ha)	CN	Tc (min)
X1	6.40	76	25.5
X2	5.92	76	28.1
X3	1.01	76	13.1
X4	8.17	76	22.3
A1	3.63	81	18.5
A2	0.58	76	13.9
A3	0.98	81	15.1
A4	6.63	79	33.3
A5	0.70	76	12.1
A6	0.99	75	11.1
A7	7.99	76	22.3

RETURN PERIOD	PRE- AND POST-DEVELOPMENT RUNOFF "A" (m³/s)	
	PRE-	POST-
5-YR	0.2758	0.2679
10-YR	0.3518	0.3251
25-YR	0.4536	0.4182
50-YR	0.5300	0.4870
100-YR	0.6094	0.5504

RETURN PERIOD	PRE- AND POST-DEVELOPMENT RUNOFF "B" (m³/s)	
	PRE-	POST-
5-YR	0.2747	0.2547
10-YR	0.3500	0.3249
25-YR	0.4510	0.4211
50-YR	0.5268	0.4905
100-YR	0.6056	0.5500

RETURN PERIOD	PRE- AND POST-DEVELOPMENT RUNOFF "C" (m³/s)	
	PRE-	POST-
5-YR	0.3770	0.3686
10-YR	0.4810	0.4702
25-YR	0.6206	0.6067
50-YR	0.7252	0.7089
100-YR	0.8342	0.8154

LEGEND

EXISTING		PROPOSED
10	MAJOR CONTOUR	10
10	MINOR CONTOUR	10
	TOP OF SLOPE	
	BOTTOM OF SLOPE	
	EASEMENT	
	RIGHT OF WAY	
	LOT LINE	
ST-E	STORM PIPE	ST ST
	SUBCATCHMENT AREA	

	EXISTING	PROPOSED		EXISTING	PROPOSED
PRECAST HEADWALL			CATCHBASIN		
CATCHMENT ID	A		SUBCATCHMENT ID	A1	

NOTES:

1. ELEVATIONS ARE REFERENCED TO NOVA SCOTIA PROVINCIAL LIDAR (CGVD2013). CONTOUR INTERVAL IS 2 m.
2. ALL STORM WATER MANAGEMENT INFRASTRUCTURE SUBJECT TO DETAILED DESIGN.

ISSUE	DATE	DESCRIPTION	INT.
1	JUL. 11, 2025	ISSUED FOR REVIEW	AK

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PRELIMINARY
AUG. 08, 2025

CLIENT

zzap

PROJECT DESCRIPTION

WEST PETPESWICK ROAD

WEST PETPESWICK, NOVA SCOTIA

SHEET DESCRIPTION

PRELIMINARY STORMWATER MANAGEMENT PLAN

Drawn	Engineer	Project No.	Drawing No.
A. KITSUTA	J. WYATT	25-229	ST-01
Scale	Filename		5 of 5
AS NOTED	25-229_Storm.dwg		

P:\2025\25-229 - Zzap - West Petpeswick - PID 00334953\01 - Drawings\Eng Design\Sheets\25-229_Storm.dwg, Plot Date: 2025-Aug-12, Plot Size: ISO full bleed A1 (841.00 x 594.00 MM), Plotted By: Colleen Earle

Appendix B – Environmental Registry

NOVA SCOTIA
Environment and Climate Change

Information Access /and Privacy

PO Box 442
Halifax, Nova Scotia
B3J 2P8

ph: (902) 424-2549
fax: (902) 424-6925

May 26, 2025 Our file # ENV-2025-2299/2310

Email: Ryleigh.boudreau@designpoint.ca

Ryleigh Boudreau
Design Point
90 Western Parkway
Bedford NS B4B 2J3

RE: West Petpeswick Rd. (PID 00334953); West Petpeswick Rd. (PID 00334946); 0 West Petpeswick Rd. (PID 40548182); 918 West Petpeswick Rd. (PID 00334920); 934 West Petpeswick Rd. (PID 00641241); West Petpeswick Rd. (PID 00334912); 792 West Petpeswick Rd. Lot W-HB (PID 00346460); 780 West Petpeswick Rd. (PID 00346486); West Petpeswick Rd. (PID 00346502); 812 West Petpeswick Rd. Lot 94-4 (PID 40656274); 808 West Petpeswick Rd. Lot 1 (PID 40485344); and 800 West Petpeswick Rd. Lot HA (PID 41305186), West Petpeswick

I refer to your enquiry of the Environmental Registry received on May 13, 2025. We acknowledge receipt of payment for 12 properties.

Enclosed is the information that was located through the Environmental Registry with regards to 800 West Petpeswick Rd., West Petpeswick.

No information was located through the Environmental Registry with regards to the remaining above referenced properties.

Nova Scotia Environment makes no representations or warranties on the accuracy or completeness of the information provided.

Sincerely,

[redacted]

Tina Skeir
Information Access Officer

Grant

NOVA SCOTIA

In keeping with the privacy provisions of the *Nova Scotia Freedom of Information & Protection of Privacy Act*, Nova Scotia Environment will only use the personal information for the purpose for which the information was obtained or compiled, or for a use compatible with that purpose.

○ Interim report **CERTIFICATE OF INSTALLATION** ◉ Final report

On-site sewage system as built construction details

Notification or Approval information: ◉ Notification number: 2018-101857-00 ○ Approval number:

PID: 41305186

Notifer or applicant (QP/P.Eng) Steven R Williams

QP/.Eng Contact: Telephone: 902-450-1414

Email: @strum.com

Installer contact: Telephone: 902-483-4244

Andrew Holmes Email:

Service provider: (for ATUs only) Name: n/a

Email: n/a Telephone: n/a

System details

Design flow (L/day): 1000 L/day Intended use: 3 bdrm single family occupancy

System type: sloping sand filter

Length of trench (m): 10.0m Width of trench (m): 3.0m

Sand speed(minutes): 4 min 20 sec Hydraulic conductivity(m/s):

As built clearance distances as illustrated on attached site plan								
From Nearest	To Field	To Tanks	From Nearest	To Field	To Tanks	From Nearest	To Field	To Tanks
Lot Boundary	3.4 m	15.5 m	Cistern	n/a m	n/a m	Water Distribution	>10 m	>10 m
Downslope Boundary	11.6 m	14.3 m	Watercourse	n/a m	n/a m	Foundation Drain	12.6 m	8.4 m
Drilled Well	26.8 m	22.6 m	Wetland	n/a m	n/a m	Other	m	m
Dug Well	n/a m	n/a m	Intermittent Drain	n/a m	n/a m	Other	m	m

☑ **I confirm that the system was installed according to the *On-site Sewage Disposal System Regulations, Standard*, and the associated notification or approval.**

Steven R Williams
Print name

Signature [redacted]

May 9, 2018
Date

CERTIFICATE OF INSTALLATION
On-site sewage system as built construction details

Site plan must include drawing of lot layout illustrating the location of the system installed, direction of and % slope, location of structures (proposed or existing), watercourse(s), well(s) and other confining features identified in the Standard including required clearance distances, in relation to the system location.

may include separate attachment for site plan

SEE THE ATTACHED SKETCH DATED MAY 8, 2018 FOR RECORD INFORMATION.

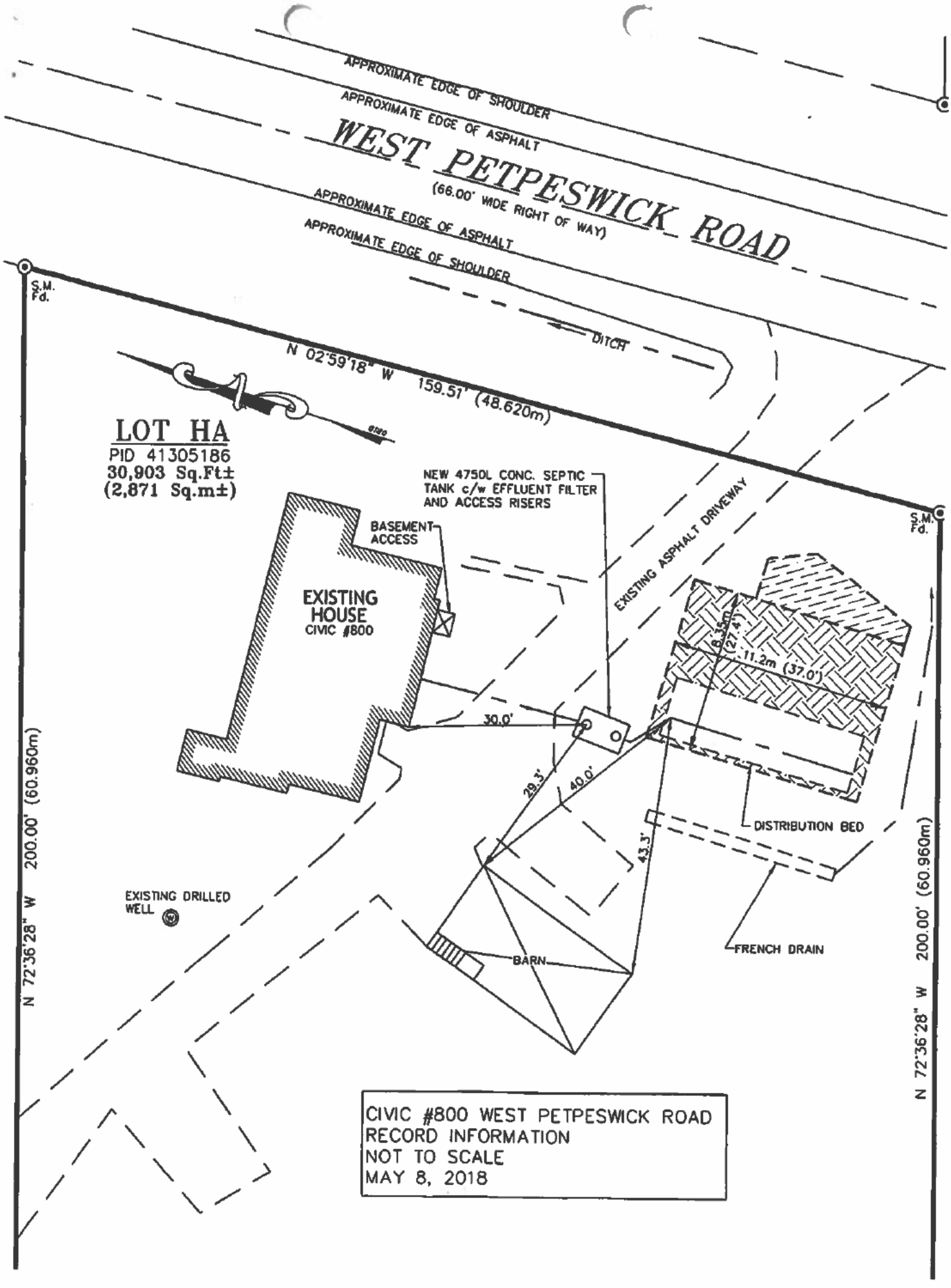
NOTE: THE PROPERTY OWNER IS RESPONSIBLE FOR THE CLEANING OF THE EFFLUENT FILTER LOCATED IN THE SEPTIC TANK ON THE DISCHARGE PIPE. REGULAR MAINTENANCE WILL BE REQUIRED LIKELY ON AN ANNUAL BASE.

DATE: May 9, 2018 Professional engineer or qualified person: [redacted]
(Signature)

QP or P. Eng. #: P.Eng. #5168

1

Steven R Williams
(Print name)



CIVIC #800 WEST PETPESWICK ROAD
RECORD INFORMATION
NOT TO SCALE
MAY 8, 2018

NOVA SCOTIA

Grant

In keeping with the privacy provisions of the *Nova Scotia Freedom of Information & Protection of Privacy Act*, Nova Scotia Environment will only use the personal information for the purpose for which the information was obtained or compiled, or for a use compatible with that purpose.

On-site sewage system 24 hour construction alert

Subsection 4(1) of the *OSSDS Regulations* require a qualified person or professional engineer to inform the Department at least 24 hours before a system is installed.

Notifier or applicant (QP/P.Eng) Steven R Williams

QP/P.Eng contact:
Telephone: 902-450-1414
Email: @strum.com

Installer contact:
Andrew Holmes
Telephone: 902-483-4244
Email:

Approval holder, if different than notifier/applicant:

Notification or Approval information:
(●) Notification number: 2018-101857-00
( ) Approval number:

Date & time construction alert submitted: 20/04/2018 11:30am
dd/mm/yyyy & hh:mm (am or pm)

Date & time of start of system installation: 30/04/2018 7:00 am
dd/mm/yyyy & hh:mm (am or pm)

PID: 41305186

Information Taken By: [redacted]
(internal use only) Print name & sign initials

[redacted]

NOVA SCOTIA

30 Damascus Road, Suite 115
Bedford, NS
Canada B4A 0C1

902-424-7773 T
902-424-0597 F
www.novascotia.ca

Our File Number: 96000-30-BED-2018-101857

March 9, 2018

STEVEN WILLIAMS
1355 BEDFORD HWY, RAILSIDE
BEDFORD, NS B4A1C5

On-site Sewage Disposal Systems
NOTIFICATION RECEIPT

Province of Nova Scotia
***Environment Act*, S.N.S. 1994-95, c.1**
On-site Sewage Disposal Systems

NOTIFIER: STEVEN WILLIAMS

NOTIFICATION #: 2018-101857-00

SITE: 800 WEST PETPESWICK RD. WEST PETPESWICK
HALIFAX COUNTY
PID 41305186

EFFECTIVE DATE: March 9, 2018

EXPIRY DATE: March 9, 2021

DETAILS: Sand Filter
1000 (L/D)
Residential: single unit
3 Bedroom(s)

Pursuant to Part V of the *Environment Act*, S.N.S. 1994-95, c.1 as amended from time to time, notification from the Notifier is acknowledged. The work done under this notification must follow the Nova Scotia On-site Sewage Disposal Systems Standard.

This Notification or a copy is to be kept on-site at all times as required under Section 22(3) of

the Approval and Notification Procedures Regulations. All personnel involved in the project must be made fully aware of the standards associated with this notification. It is the Notifier's responsibility to ensure that they are followed. Failure to comply with the standards is an offence under the *Environment Act*.

It is the Notifier's duty to advise the Department of any new and relevant information respecting any adverse effect that results or may result from the activity, which comes to the Notifier's attention after the issuance of the Notification. This is required under Section 60 of *the Environment Act*.

If the activity is altered, extended or modified beyond the description given in this Notification, please reapply as a new Notification is required.

Despite the issuance of this Notification, the Notifier is still responsible for obtaining any other authorization which may be required to carry out the activity, including those which may be necessary under provincial, federal or municipal law.

NOVA SCOTIA

2018 - 1085 r
Ap 23
Grant

In keeping with the privacy provisions of the *Nova Scotia Freedom of Information & Protection of Privacy Act*, Nova Scotia Environment will only use the personal information for the purpose for which the information was obtained or compiled, or for a use compatible with that purpose.

NOTIFICATION FORM
On-Site Sewage Disposal System - Notification

Notifier contact information:
***effective May 1, 2016 notifier must be a professional engineer or qualified person**

Steven	R	Williams
First Name	Middle Initial	Last Name

902-450-1414			
Primary Phone Number	Ext	Secondary Phone Number	Ext

902-835-5574	@strum.com
Fax Number	Email Address

P.Eng	#5168
Professional designation (QP or P.Eng)	QP or P.Eng #

Notifier mailing address:

1355 Bedford Hwy, Railside
Street name and type, PO Box, RR #, Site #, etc.

Canada	Nova Scotia	Halifax	Bedford	B4A 1C5
Country	Province	County	City/Town	Postal Code

Return Correspondence? ○ Yes ◉ No

Preferred Method of Contact? ◉ Email ○ Letter

Property details/location of activity

800	West Petpeswick Road
Civic number	Street name and type

Halifax	Petpeswick
County	Community

41305186
PID

[redacted]

Property details

Water supply: ● Existing ○ Proposed ○ Other, please specify: _____

Water supply type: ● Drilled well ○ Dug well ○ Other, please specify: _____

Development type: Residential: ● Single Family

Number of bedrooms: 3 ○ Multiple dwelling ○ Other, please specify: _____

System details

● Design ○ Selection

Design capacity (L/day): 1000 L/Day Depth of permeable soil (mm): 1200mm

Disposal field length (m): 10.0m Type of permeable soil: Sandy Silt

Depth to bedrock, water table, or too permeable soil (m): ● > or ○ = 1200mm

Disposal field layout:

Multiple trench: ○ At grade ○ Partially trenched ○ Fully trenched

Areabed: ○ At grade ○ Partially trenched ○ Fully trenched

○ C1 ○ C1 raised ○ C2 ○ C2 raised

○ C3 ○ Mound ● Sand filter

○ Holding tank ○ Other, please specify: _____

Malfunction replacement? ● Yes **(malfunction inspection form required)** ○ No

All clearance distances required by the Standard will be maintained: ● Yes ○ No

Supporting documentation

All supporting documentation is to be submitted in accordance with the *Approvals and Notification Procedure Regulations.*

Attach for *ALL* notifications:

☑ Site plan **Site plan must include drawing of lot layout illustrating the location of the test pit(s), direction of and % slope, location of structures (proposed or existing),watercourse(s), well(s) and other confining features identified in the Standard including required clearance distances, in relation to the planned system location.**

☑ Malfunction inspection form (if system is replacing a malfunction) .

Steven R Williams [redacted] 2018/03/09

Name (please print) Signature Date (yyyy/mm/dd)

Notification declarations must be completed for each submission

Please select the option that applies to your situation

I own the site ☐

I have a lease or other written agreement or option with the landowner or occupier that enables me to carry out the activity on the site ☑

I have the legal right or ability to carry out the activity without the consent of the landowner or occupier ☐

I **consent** to the use of the information I have provided on this form by Nova Scotia Environment and municipal government organizations as required for the purpose of processing my request to perform the activity indicated ☑

I **understand** that I must provide all information about the activity, such as sketches, plans, and calculations, if requested by Nova Scotia Environment for a compliance audit ☑

I have read and understand the regulations and standard that applies to the activity to which the notification relates including Nova Scotia Activities Designation Regulations, and the Nova Scotia Approval and Notification Procedures Regulations ☑

I will carry out the activity in compliance with the *Environment Act* and the applicable regulations and standard ☑

Signature [redacted]

Name (Please print or type) Steven R Williams

NOVA SCOTIA

In keeping with the privacy provisions of the *Nova Scotia Freedom of Information & Protection of Privacy Act*, Nova Scotia Environment will only use the personal information for the purpose for which the information was obtained or compiled, or for a use compatible with that purpose.

On-site sewage system malfunction inspection form

Name & Designation of Assessor/Inspector: Steven R Williams

☐ Inspector ☐ QP ☑ PEng ☐ Installer ☐ Cleaner

Submission Type

☐ Assessment/Inspection only

☑ Application or Notification for system to replace a malfunction

Property Information

Owners Name: _____ **Date:** March 6, 2018

Address: 800 West Petpeswick Road **Telephone #.** _____

County: Halifax **PID:** 41305186

Property size/area: 200' x 160.0'

System Information

System Installer: unknown **System age, or estimate:** 40-50 yrs

Approval #: unknown **System type (e.g. C1):** unknown

System Length: unknown **Interceptor/swale:** ☐ Yes ☑ No

System Selector/Designer: unknown **Pressurized:** ☐ Yes ☑ No

☐ Pump ☐ Siphon ☐ Dose device

Septic tank size: unknown **# of chambers:** 1

Tank constructed from: ✓ Concrete Fiberglass Plastic Other: _____

Condition of tank: poor **Watertight:** Yes ✓ No

Effluent Filter: Yes No **Sewage pumped into tank?** ☐ Yes ✓ No

Date tank pumped: recently **Regular pumping:** Yes No

Usage Information

# of people using system: 4

Occupancy:

✓ Full-time Part-time/seasonal Vacant Other: _____

Water Treatment: Yes ✓ No Backwash connected to system: Yes No

Garbage Grinder: ☐ Yes ☑ No Backwash connection corrected: Yes No

Malfunction Information

Problem first observed: recently **Previous repairs:** Yes ✓ No

Nature of Problem: ✓ Breakout Backup Slow draining ✓ Clogged disposal field
Odour Broken pipe Other, **please provide details:**

Frequency of Problem: ✓ Continuous Occasional After heavy rain Cold temperatures
☐ Other, describe:

Please provide comments/details including potential cause and action taken:

System is very old and is likely plugged organically. It is leaking to the road side ditch system.

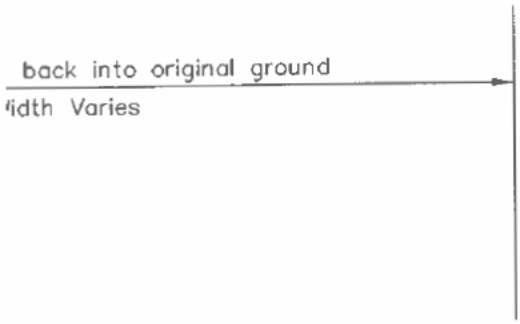
[redacted]

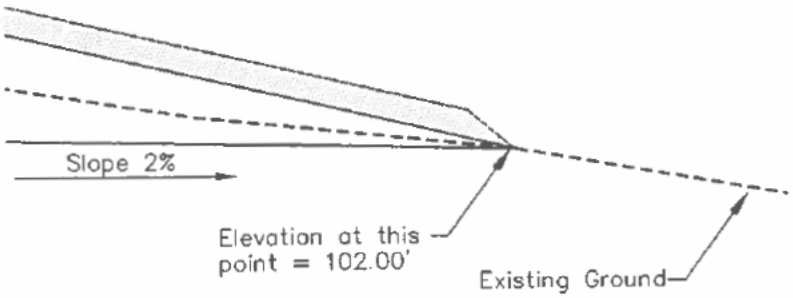
Signature

March 6, 2018

Date

Oversized Map
The cost to provide a copy of a map is $13 If you wish to receive a copy of the map please forward a cheque in the amount of $13 made payable to the Minister of Finance





No	Description	Date	By
0	Issued For Review	Mar 8/18	SRW

Revision or Issue

MAC WILLIAMS ENGINEERING LTD

Strum CONSULTING

Project

Civic #800 West Petpeswick Road
Petpeswick, Nova Scotia
PID# 41305186

Drawing

Sewage Disposal System Design

Scale As Noted

[redacted]

Date Mar 2018			Drawn SRW
Design SRW	Check DMW		Approv. SRW
Project No. 18-6340			Sheet 1 Of 1
Drawing No. 18-6340-F01			Rev. 0

Appendix C – Tabulated Historical Well Data And Models

Table 1
Level 1 Groundwater Assessment
24-229
Residential Development, PID 00334953, LOT 3 WEST PETPESWICK ROAD, WEST PETPESWICK, NS
List of Potable Wells in 1,000 m Distance

#	Well ID	Civic Address	Date Installed	Water Use	Easting, m	Northing, m	Elevation, masl	Well Depth, mbgs	Casing, mbgs	BDRCK, mbgs	Installed in	Static WL, mbgs	Static Elevation, masl	Yield, m3/d	Yield, Lpm
1	011811	815 WEST PETPESWICK ROAD	16-Aug-01	Domestic	486070	4954985	40.2817	38	7	5.18	Silt	3.04	37.2417	26	18
2	790121	RR #1 MOSER RIVER	24-Aug-79	Domestic	485981	4954423	32.0986	51	14	NA	Boulders	27.4	4.6986	3	2
3	080419	600 WEST PETPESWICK ROAD	22-Apr-08	Domestic	486817	4956269	22.7167	70	NA	NA	NA	12.18	10.5367	13	9
4	170091	628 WEST PETPESWICK ROAD	7-Aug-17	Domestic	486848	4956130	13.77	123	6	2.44	Bedrock	NA	NA	3	2
5	150128	24 YOUNG DRIVE, HRM	5-Oct-15	Domestic	486802	4956040	11.86	38	10	7	Bedrock	3.65	8.21	131	91
6	000391	YOUNG DRIVE	13-Aug-00	Domestic	486835	4955980	8.7394	106	12	10	Bedrock	3.65	5.0894	10	7
7	110860	680 WEST PETPESWICK ROAD	18-Dec-11	Domestic	486770	4955753	18.78	87	6	2	Bedrock	3.65	15.13	46	32
8	950672	696 WEST PETPESWICK ROAD	18-Oct-95	Domestic	486871	4955723	0.5925	55	12	8	Bedrock	NA	NA	3	2
9	950673	700 WEST PETPESWICK ROAD	1-Oct-95	Domestic	486867	4955691	3.155	30	11	6	Bedrock	3.96	-0.805	65	45
10	021285	808 WEST PETPESWICK ROAD	7-Aug-02	Domestic	486694	4955213	17.98	44	7	5	Bedrock	4.57	13.41	20	14
11	060058	906 WEST PETPESWICK ROAD	9-Feb-06	Domestic	486574	4954743	29.0167	93	20	17	Bedrock	12.18	16.8367	8	6
12	100249	912 WEST PETPESWICK ROAD	5-Jul-10	Domestic	486607	4954674	19.72	93	22	20	Bedrock	9.14	10.58	10	7
13	111519	918 WEST PETPESWICK ROAD	14-Dec-11	Domestic	486628	4954663	18.75	91	18	16	Granite	NA	NA	10	7
14	100512	922 WEST PETPESWICK ROAD	25-May-10	Domestic	486687	4954601	15.53	55	24	22	Bedrock	9.14	6.39	98	68
15	910630	WEST PETPESWICK	10-Sep-91	Domestic	486500	4954500	16.215	81	8	6	Bedrock	NA	NA	7	5
16	050858	9234 WEST PETPESWICK ROAD	22-Sep-05	Domestic	486547	4954410	21.07	38	7	2	Bedrock	1.52	19.55	78	54
17	160223	973 WEST PETPESWICK ROAD	2-Oct-16	Domestic	486543	4954309	27.3333	38	6	1	Bedrock	1.52	25.8133	20	14
18	910272	HEAD OF CHEZZETCOOK	9-Jul-91	Domestic	486303	4954125	27.91	69	6	NA	Gravel	NA	NA	7	5
19	062312	1090 WEST PETPESWICK ROAD	13-Sep-06	Domestic	486280	4954056	25.4004	62	7	3	Bedrock	3.04	22.3604	33	23
20	041079	1100 WEST PETPESWICK ROAD	28-Oct-04	Domestic	486270	4953995	22.96	93	6	2	Bedrock	3.04	19.92	13	9
21	190076	1113 WEST PETPESWICK ROAD	19-Jul-19	Domestic	486372	4953893	16.88	62	9	6	Bedrock	1.52	15.36	26	18
AVERAGE							20	67	11	8		6	14	30	21

Table 2
Level 1 Groundwater Assessment
24-229
Residential Development, PID 00334953, LOT 3 WEST PETPESWICK ROAD, WEST PETPESWICK, NS
Model for Calculation of Well Construction for a Given Lots/Population

Test/Well ID	Easting	Northing	Well Depth, m	Static Level, m	Hydraulic Conductivity, m/d	Transmissivity, T, m^2/d	Specific Capacity, SC, m^2/d	Yield m^3/d
HAL-80	492743	4957960	73	2.16	0.035	0.16	0.35	6.55
HAL-151.1	487365	4953253	92	2.18	0.00017	0.01	0.04	0.44
HAL-151.2	487219	4953097	92.4	4.57	1.50E-04	0.01	0.05	0.63
HAL-69	483715	4958205	122	0.03	0.0026	0.31	0.45	17.67
HAL-41	488343	4948520	25	15	0.15	1.57	5.37	5.24
HAL-53	487528	4958850	58	4.21	0.0472	2.09	3.26	32.73
HAL-107	487893	4958823	98	12.6	0.0043	0.32	0.44	9.1
Average			**80**	**6**	**0.0060**	**0.64**	**1.42**	**10**

Data	
PID Area m2	33 847
Number of Lots	150
Total Population, persons	450
Persons per Lot	3
Demand, m3/day per person	0.4
Demand, m3/d	180.00
Ground Elevation, masl	40.0
Seasonal Level Fluctuation, m	3.0
Well Loss, m	2.0
SeaWater Intrusion, m	3.0
Static Water Elevation, masl	36.0
Seawater Intrusion Depth masl	-120

Orange requires reporting to NSECC

Well Model			
Well Depth	100.00	m	
Well Top Elevation toc	40.00	masl	Well Depth Slide
Casing length	40.00	m	
Casing Lower End Elevation	0.00	masl	
Well Open Interval, b	60.00	m	
Static Level, WL	4.00	mbgs	
Estimated Average K	0.006	m/day	
Calculated Transmissivity, T - K*b	0.36	m2/d	
MAX Available Drawdown, MAX s	24.00	m	
MAX Drawdown elevation, masl	12.00		
MAX Availble Pumping Rate, MAX Q	4.13	m3/day	3
Drawdown Caused by all Wells at Specified Radial Distance (m)	4.00	m	L/min
Results			
Safe Drawdown, s20	24.00	m	
Safe Drawdown Elevation	12.00	masl	L/min
Safe Rate Q20	181.75	m3/day	126
Persons Supplied	454	Persons	2,294
Number of Wells Required	1	ea	0
Persons Supplied	454	Persons	90
Total PID Persons	450		

One Well Recharge		Radius	
Actual Well Lot Area m2	33 847	326	
Actual Recharge m3/d	13		
Required Recharge Area m2	921 394	1701	Area Radius, m
Additional Land Required, m2	887,547		
Recharge Rate r, 0.18 m/y (m3/m2/d)	0.0004932	m/d	
Safe Usage, 50%	0 5		
Permeable areas, 70%	0 8		
Bedrock Rechage for the Total Recharge Area, m3/d	363 5		

Results	
Well Depth, mbgs	100.00
Casing Depth, mbgs	40.00
Casing Diameter, m	0.18
Apparent Transmissivity, m2/d	0.36
Average Permeability, m/d	0.01
Maximum Available Drawdown, m	24.00
Maximum Available Pumping Rate, m3/d (2 hours)	4.13
Safe s20 Drawdown, m	24.00
Safe Q20 Rate, m3/d	181.75
Seawater Intrusion at, masl	-120
Minimal Distance Between Wells, m	60
Immediately Available Water (Storage) in the Well, m	650
One Lot Balance	
Recharge Area Radius, m	1700.93
Required Recharge Area, m2	921,394
Required Additional Area, m2	887,547
PID Balance	
PID Area,m2	33,847
Required Recharge Area, m2	921,394
Recharge Area Radius, m	104
Additional Area Required for Recharge, m2	887,547
Number of Lots	1

Legend
Insert Data
Calculated Data
Result Exceeds Limits
Result Within Limits
Requires Action

Table 3
Level 1 Groundwater Assessment
24-229
Residential Development, PID 00334953, LOT 3 WEST PETPESWICK ROAD, WEST PETPESWICK, NS
Water Chemistry and Quality

#	HU	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	HCO3 (mg/L)	CO3 (mg/L)	Cl (mg/L)	SO4 (mg/L)	F (mg/L)	Alk (mg/L)	Hrd (mg/L)	TDS (mg/L)	pH	NO3 - NO2N (mg/L)	As (ug/L)	U (ug/L)	Fe (ug/L)	Mn (ug/L)	Comments
	Metamorphic	22.5	3.3	17	1.2	63	1	16	11	0.17	65	70.5	149	7.7	0	1.45	0.3	125	65	
	Well # 741677 (Ptest 561)	34	6.4	9	2.4	102	2	11	9	0.05	100	110	146	8.25	0.025	230	5.5	25	71	
	Well # 741677 (Ptest 562)	29	2.9	9.1	1.1	86	0.5	9	7	0.05	86	85	123	7.37	0.05	28	1.6	25	25	
	Ptest434	118	27	54	1.8	206.4	1.5	202	19	0.1	208	405.833	557.3	7.9	0.025	2.5		640	383	
GCDWQ	AO	--	--	--	--	--	--	--	--	--	--	--	--	7	1	--	--	100	20	GCDWQ
	MAC	--	--	300	--	--	--	250	--	--	--	--	500	10.5	45	10	20	--	120	

Legend:
Exceeds Guideline

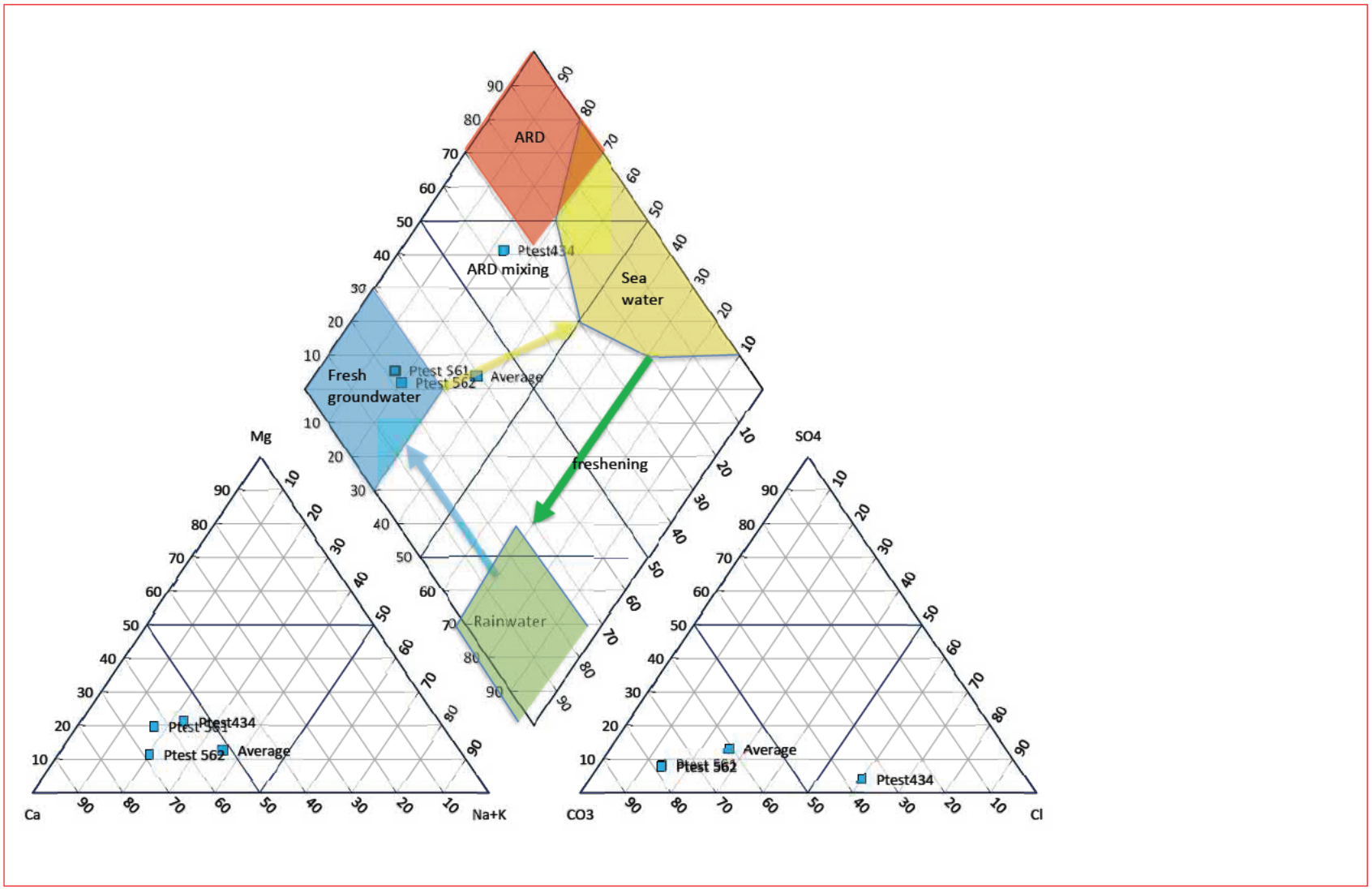
Table 4

Level 1 Groundwater Assessment

24-229

Residential Development, PID 00334953, LOT 3 WEST PETPESWICK ROAD, WEST PETPESWICK, NS

Piper Plot



Groundwater Assessments for Subdivision Developments Toolkit

Version 1, June 2011

Nova Scotia Environment and Nova Scotia Department of Natural Resources

Acknowlegements:

CBCL Limited (Halifax, NS, Canada)

David Scott (Environment Canterbury, Christchurch, New Zealand) provided the Theis solution used in the "Well Interference Calculator".

Disclaimer:

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Safe Yield Calculator

Farvolden Method

Equation B.1:

$$Q_{20} = \frac{4\pi T(H_A/8)}{2.30} S_f = 0.683 T H_A S_f$$

Definitions:

Q_{20} = 20 year safe pumping rate for the well (m^3/day)

T = Transmissivity (m^2/day)

S_f = Safety factor = 0.7 (no units)

H_A = Available head (m)

Q = Pumping rate used during the pumping test (m^3/day)

S_{100min} = Drawdown observed in well during the pumping test at 100 minutes (m)

$(S_{20yrs} - S_{100min})_{theor}$ = The theoretical drawdown in the well after 20 years of pumping minus the theoretical drawdown in the well at 100 minutes, based on the most appropriate theoretical equation for the aquifer, e.g., Theis, Hantush, etc. (m)

Input data:

T (m^2/day) =	4.73
H_A (m) =	28

Results:

Q_{20} (m^3/day) =	63.32
Q_{20} (L/min) =	43.97

Notes:

a. This workbook calculates a 20-year safe pumping rate for a well using the method described in: Farvolden, R.N. 1959. Groundwater supply in Alberta. Alberta Research Council. Unpublished report.

b. Values in the colour shaded cells can be updated by the user; all other cells are protected.

Total Volume Available From Well Storage and 2 Hour Yield (L)

Equation B.3:

Available Water (L) = $500\pi(D/2000)^2 H_A + 120Q_{20}$

Input data:

Well Diameter (mm) =	0.1524

Results:

Available Water (L) =	5276.63

Lot Water Balance Calculator

Equation B.4:

$Q_{lot} = I\ A_{lot}\ E_{use} / 365$

Definitions:

Q_{lot} = Available groundwater from each lot (L/day)
I = Groundwater recharge rate (mm/year)
A_{avg} = Average area of a subdivision lot (m^2)
ISP = Percentage of impervious surface area in subdivision development (%)
E_{use} = Percentage of available groundwater recharge reserved for streamflow and ecological support (%)
$A_{lot} = A_{avg} - (A_{avg}*ISP)$ = Average area of the lot that contributes to recharge, excludes impermeable areas (m^2)

Input data:

I (mm/year) =	151.2
A_{avg} (m^2)[c] =	89031
E_{use}[d] =	50%
ISP =	30%

Results:

A_{lot} (m^2) =	62321.7
Q_{lot} (L/day) =	12908

Notes:

a.	This workbook calculates a the amount of available groundwater on a lot using a simplified water balance approach.
b.	Values in the colour shaded cells can be updated by the user; all other cells are protected.
c.	A_{avg} can be estimated as the total subdivision area divided by the proposed number of lots.
d.	E_{use} default value is 50% of available groundwater recharge.

Time-drawdown calculations using Theis equation

Aquifer parameters		
T	4.73	m2/d
S	0.002	

Pumping rate		
Q	50	m3/d

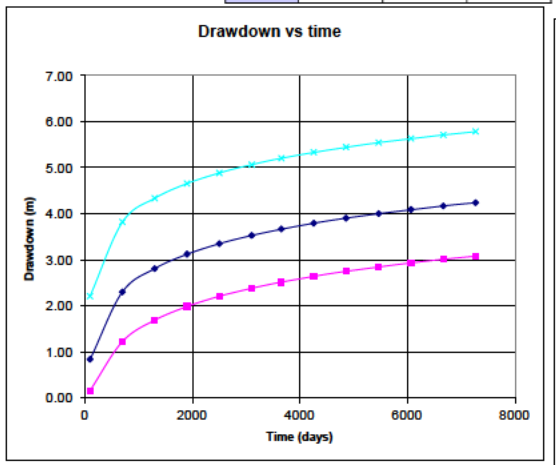
Radius (m)	200	500	1000
Time (days)	Drawdown (m)	Drawdown (m)	Drawdown (m)
100	2.211	0.842	0.168
700	3.817	2.302	1.227
1300	4.336	2.809	1.692
1900	4.654	3.122	1.991
2500	4.885	3.350	2.211
3100	5.065	3.530	2.385
3650	5.203	3.666	2.518
4250	5.330	3.793	2.643
4850	5.441	3.904	2.751
5450	5.539	4.001	2.847
6050	5.627	4.089	2.934
6650	5.707	4.168	3.012
7250	5.779	4.240	3.083

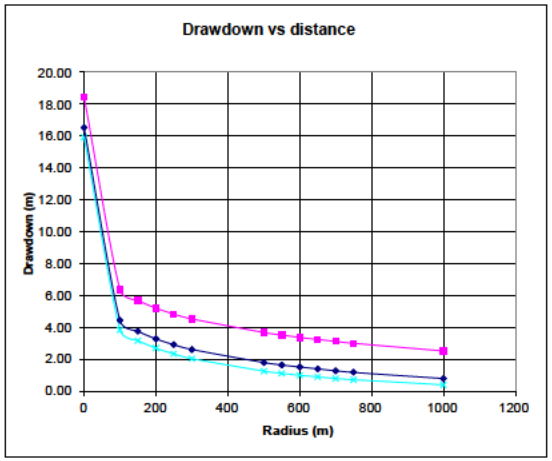
Distance-drawdown calculations using Theis equation

Aquifer parameters		
T	4.73	m2/d
S	0.002	

Pumping rate		
Q	50	m3/d

Time (days)	180	365	3650
Radius (m)	Drawdown (m)	Drawdown (m)	Drawdown (m)
0.076	15.919	16.514	18.451
100	3.841	4.433	6.368
150	3.165	3.754	5.686
200	2.690	3.274	5.203
250	2.325	2.904	4.828
300	2.032	2.604	4.522
500	1.247	1.783	3.666
550	1.111	1.635	3.507
600	0.990	1.502	3.362
650	0.883	1.381	3.229
700	0.788	1.272	3.106
750	0.703	1.173	2.991
1000	0.392	0.784	2.518





Notes

a. This workbook calculates drawdown vs time and drawdown vs distance for radial flow to a well under confined or leaky conditions. If the Leakage coefficient (B) is defined the Hantush-Jacob function is used; otherwise calculations are done using the Theis function. (Note: NSE has disabled the Hantush-Jacob function in this spreadsheet).

b. Values in the colour shaded cells can be updated by the user; all other cells are protected. Data entry cells are validated e.g. Storativity (S) must be between 0 and 1.0

c. Units of transmissivity (T) and pumping rate (Q) can be selected.

d. The plotted curves are colour coded to indicate the time (or drawdown) option

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Acknowledgement

This workbook uses Visual Basic functions supplied by Dr Bruce Hunt (University of Canterbury, Christchurch, New Zealand).

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Summary of Results

1. Safe Yield Calculator			
	Farvolden Q_{20} (L/min) =	43.97	
	van der Kamp and Maathuis Q_{20} (L/min) =	#DIV/0!	*Minimum target volume is 1350 L/day, and it is assumed that this volume*
	Total Volume Available From Well Storage and 2 Hour Yield (L) =	5276.63	*will need to be supplied during a 2 hour period to meet the peak demand*
2. Lot Water Balance Calculator			
	Q_{lot} (L/day) =	12908	*Minimum target volume is 1350 L/day*
3. Well Interference Calculator			
	Drawdown Caused by all Wells at Specified Radial Distance (m)	6	
	Available Head (m)	28	
	% of Available Head	20%	*Target predicted drawdown should be less than 50% of available head*