Planning Justification Report

Zoning By-law Amendment and Site Plan

465 Garafraxa Street West, Fergus

Township of Centre Wellington

February 2023

Prepared for:
Habitat for Humanity (Guelph-Wellington)

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1.0 Introduction

1.1 Background

Dryden, Smith & Head Planning Consultants Ltd. has been retained by Habitat for Humanity (Guelph-Wellington) to process a Zoning By-law Amendment application for 465 Garafraxa Street West in Fergus. This Planning Justification Report and the above-noted application are being prepared in order to facilitate the proposed development of a 32-unit Stacked Townhouse condominium development on the subject property.

This report is to be read in conjunction with the formal Planning application and additional required studies that will be included with the final submission package to the Township.

1.2 Proposed Applications

A Zoning Application has been submitted to the Township of Centre Wellington to request that the subject lands be rezoned from the existing "Future Development" zone, to the "Residential R4" zone with site-specific provisions (R4**.**__**.**_) to facilitate the Proposed Development of 32 Stacked Townhouse condominium units (Habitat for Humanity). The rezoning to R4 is required as the "Future Development" zone does not permit new development, and is assigned to lands within the Urban Centre that are expected to be developed.

The "Residential R4" zone is appropriate for the subject site and Proposed Development due to the R4 zone recognizing Stacked Townhouses as a permitted use. The site-specific zoning provisions that are being requested are: Minimum *Interior Side Yard* of 2.3±m, minimum *Building Separation* of 3.0±m, minimum *Private Amenity Area Depth* of 4.0±m, and minimum above-grade unit *Private Amenity Area* of 4.65±m^2.

Due to the findings of the Phase 1 ESA, and through discussions with Township Staff, it was concluded that the proposed area to-be-zoned as R4 would encompass approximately 99% of the subject property, with a small portion of the eastern corner of the lot remaining as 'Future Development'. For more details on the specifics of the area to-be rezoned, please refer to the attached Conceptual Site Plan/ZBA Sketch Plan (Figure 2).

Further details on the Zoning By-law Amendment application can be found in Section 6.5.1 of this report, as well as in the Draft Zoning By-law Amendment that is detailed in Appendix C attached.

Site Plan Approval is also required and will be applied for following the approval of the noted Zoning By-law Amendment application. In addition, the proposed units will be 'Condominium' units, which will result in the need for a Plan of Condominium application to be submitted concurrently with the future application for Site Plan Approval.

1.3 Scope

This Planning Justification Report will include the following:

- A brief overview explaining the Proposed Development, as well as a summary of the Proposed Applications that will allow this intensification to occur
- A brief introduction discussing the proposed applications that are required in order for this development to occur;
- A summary of the Pre-Consultation Staff Comments (Appendix A);
- A description of the subject lands with an explanation of how it fits within the context of neighbouring properties;
- A description of the development proposal for the subject property;
- A summary of the prepared Technical Reports/Plans;
- A run-through of the relevant Provincial and Municipal planning policies/ regulations that affect the Proposed Development/Applications; and,
- An assessment of the proposed planning/development proposal in respect to the relevant provincial and municipal policies; concluding with a planning justification and final opinion on the Proposed Development and Zoning Amendment for 465 Garafraxa Street West in Fergus.

1.4 Pre-Consultation

An initial Pre-Consultation meeting was held with comments being provided on February 10, 2022. The meeting/comments provided an opportunity for Township/County Planning staff, as well other agencies, to review the proposed development and to establish the requirements for a complete submission for the Zoning By-law Amendment application (Appendix A). Planning staff identified the requirement for a Planning Justification Report.

To address the Pre-Consultation comments and noted requirements from Staff/agencies, the following sections have been incorporated into this report:

- Public Consultation Strategy (Section 4.0)
- Functional Servicing Report (Appendix D)
- Stormwater Management Report (Appendix D)
- Associated Engineering Plans/Drawings (Appendix E)
- Geotechnical Report (Appendix F)
- Lighting/Photometrics Plan (Appendix G)

Note: Danielle Walker (Source Protection Coordinator, Wellington Source Water Protection) noted in the attached Source Water Protection Comments (Appendix B) that a Section 59 Source Water Protection Form should be completed for this Proposed Development as required by the *Planning Act*. This form has been completed, and is included with the completed Zoning By-law Amendment submission package.

2.0 Site Description & Surrounding Context

2.1 Site Description

The subject lands are located at 465 Garafraxa Street West, Fergus, in the Township of Centre Wellington. These lands are legally described as 'Part of Block 4, Registered Plan 77' (Figures 1 & 3).

As per the Conceptual Site Plan and Legal Survey for the property, the subject site is listed as having a Lot Area of 4,181.30m^2. The property has a *lot frontage* of 63.05m and a *lot depth* of 120.05m (Figures 2 & 3).

The subject lands are currently vacant, and contain some scattered trees which will be removed prior to development commencing on-site (Figure 1 & Appendix E).

Currently there is no access point to the subject property. A new access point will be created from Garafraxa Street West to provide access to the future residential units on-site (Figure 2).

2.2 Surrounding Land Uses

The immediate surrounding area of the subject property consists of "Future Development" lands and "General Industrial" zoned areas, with some Residential lands located slightly further out. To the North are lands zoned "Future Development" which contain primarily grassland and remnants of a trail. Located to the immediate Southeast of the property is Garafraxa Street West, with "General Industrial" zoned lands on the opposite side of the street, and "Residential R4" lands containing apartment units being located further East on Maiden Lane. The Southwest of the property is additional "Future Development" land, containing a farm field (Figures 1 & 3).

2.3 Transportation Context

The subject property is located on Garafraxa Street West. Garafraxa Street West is designated as a *collector* road. Garafraxa Street West begins at Beatty Line to the southwest, and runs northeast to St. David Street, at which point Garafraxa St West transitions into Garafraxa Street East.

2.4 Municipal Servicing

The subject lands are located within the Grand River Crossing West Servicing area (Figure 7). Currently, municipal servicing is not available to the subject site along Garafraxa Street. New services will be installed to the site, with "full urbanization from where it (*roads and drainage)* currently terminates (55m west of Maiden Lane)". The summary of information below is taken directly from the completed Functional Servicing Report (FSR). For detailed information on servicing please refer to the attached Functional Servicing Report document (Appendix D).

Water Supply

Water supply for the proposed development will be provided via a future 150mm diameter watermain along Garafraxa Street West, and a 150mm diameter service connection to the/from the 150mm watermain on Garafraxa Street West.

The watermain will be installed to a minimum depth of 2.0 meters below finished grade.

Fire protection for the proposed development will be provided by the proposed on-site fire hydrant, near the West end of the Subject Property. Please refer to the prepared Engineering Reports/Plans for more detailed information (Appendix D and Appendix E).

Storm Sewer

Under existing conditions, runoff generated from the site sheetflows overland to the existing ditch along the northwesterly boundary of the site.

Storm service for the proposed development will be provided via the installation of storm sewers on site and connection to the future storm sewer on Garafraxa Street West. The on-site storm sewers will convey runoff to the future storm sewers to be installed on Garafraxa Street West.

All storm sewers within the development will be sized (at minimum) to accommodate the 5-year design storm event. Major storm runoff will be conveyed within the limits of the internal road network, ultimately discharging to the Garafraxa Street West right-of-way. Storm sewer design sheets have been provided in the Functional Servicing Report (FSR). The FSR is attached at the end of this report (Appendix D).

Sanitary Servicing

Sanitary servicing for the proposed development will be provided via the extension of a 200mm diameter sanitary sewer from the future 200mm diameter sanitary sewer on Garafraxa Street West. Detailed information and plans for the proposed sanitary servicing for the property can be found attached at the end of this report (Appendix D and Appendix E).

Sanitary sewers (minimum grade of 0.5%) will be installed at a minimum depth of 2.5 metres below finished grade. Sanitary sewer design sheets have been provided in the Functional Servicing Report (Appendix D).

Hydro and Cable

Bell cable (buried), and Hydro connections (aerial) are currently present opposite the subject property on the East side of Garafraxa Street W.

3.0 Proposed Development

The proposed development can be seen on the attached Conceptual Site Plan (Figure 2), with further details on the Proposed Stacked Townhouse condominium units found on the attached Elevations and Floor Plans (Appendix H). These prepared plans and drawings are preliminary at this time and will be refined further during the Site Plan Approval stage.

3.1 Land Use

The subject site is currently vacant and designated as "Future Development. The proposed intensification will bring a medium-density residential use to the property (Figures 10 and 11).

3.2 Site Layout

The conceptual site plan/site layout (Figure 2) has been designed to have a centralized two-way drive aisle to serve the proposed stacked townhouse condominium units on both sides of the site (North and South). This two-way drive aisle will also act as the fire route for the proposed development. A 1.8m sidewalk also extends through the length of the subject site to maximize pedestrian walkability.

Three separate Stacked Townhouse structures are being proposed; with one 10-unit 3-storey building ('Block A') being proposed on the North side of the site, and two 3-storey townhouse buildings being proposed on the South end of the site (Block B, 10 units; and Block C, 12 units). 32 Stacked Townhouse units will be located on-site in total. These units will be built and managed by Habitat for Humanity Guelph Wellington.

For the proposed ground-level townhouse units, there will be a porch area at the front, and a private deck at the rear of the building. Balconies will be provided for each of the second/third storey above-grade units, that will serve as *Private Amenity Areas*. The location of the proposed units has allowed for rear-yard space for residents, while also offering plenty of additional amenity/landscape areas at different locations across the subject site.

The proposed development will include a *Deep Well Garbage, Recycling, and Food Waste* area on the North Side of the site. This garbage and recycling area will be easily accessible to residents by using the 1.8m sidewalk that will extend the length of the subject site. Refer to the attached *Conceptual Site Plan* for more details on the proposed site layout (Figure 2).

3.3 Parking

The parking requirement listed in the Zoning By-law for Stacked Townhouse Dwelling units is *"1.0 space per dwelling unit, plus 0.5 spaces per unit for the first 20 units and 0.25 spaces per unit for each additional unit. A minimum of 50% of the additional parking spaces shall be devoted exclusively to visitor*

parking". This would equate to 45 required resident spaces, with 50% of the additional parking spaces being dedicated to visitor parking. The proposed development exceeds the required parking requirement with 47 total spaces being provided (Figure 2).

The Barrier-Free parking requirement is defined by the number of total parking spaces required. In this case where *"between 26-50 parking spaces"* are being proposed, three (3) of these spaces are required to be Barrier-Free.

A total of 47 parking spaces are being provided for the proposed Stacked Townhouse development. 45 of these spaces are for Resident parking, which includes 3 barrier-free spaces. The two additional parking spaces will be dedicated to Visitor parking. All proposed parking will be located at-grade.

3.4 Site Plan Control

Site Plan controls are in place in the Township of Centre Wellington. Township Staff noted in the Pre-Consultation Comments that Site Plan Approval would be required for this development (Appendix A). The applicant will look to apply for Site Plan Approval immediately following the approval of the proposed Zoning By-law Amendment application. With the units being Condominium units, a future Plan of Condominium application will be submitted concurrently along with the application for Site Plan Approval.

4.0 Public Consultation Strategy

In accordance with the requirements of the *Planning* Act, a Public Consultation Strategy is to be provided which will outline opportunities for members of the public to be involved in the processing of the proposed Zoning By-law and amendment application.

As required by the Planning Act, the County of Wellington will provide public notice of the amendment application, and will hold a Statutory Public Meeting to discuss the subject application and to provide the opportunity for any individuals or property owners to listen to the development proposal, and to provide any verbal comments or feedback on the proposal if they wish.

5.0 Summary of Technical Reports

5.1 Functional Servicing and Stormwater Management Design Report

GM BluePlan was retained to complete a Functional Servicing and Stormwater Management Design Report in support of the proposed development. The purpose of this report was to examine the existing conditions and existing services that are available to the subject lands, as well as provide details on the proposed servicing and stormwater management system design for the proposed development at 465 Garafraxa Street West.

Based on this examination, GM BluePlan prepared a grading and functional servicing plan for the proposed development as well as a stormwater management design (Appendix D and Appendix E). The report concluded that:

- Water supply for the proposed development will be provided via a future 150mm diameter watermain along Garafraxa Street W, and a 150mm diameter service connection to the 150mm watermain on Garafraxa St W.
- Sanitary servicing for the proposed development will be provided via the extension of a 200mm diameter sanitary sewer from the future 200mm diameter sanitary sewer on Garafraxa Street West.
- Storm service for the proposed development will be provided via the installation of storm sewers on site and connection to the future storm sewer on Garafraxa Street West. All storm sewers within the development have been sized to accommodate the 5-year design storm event.
- The post-development flow rates for the 5 through 100-year design storm events have been attenuated to less than the allowable release rates.
- Major overland flows are routed through the site to Garafraxa Street West, while not exceeding a maximum ponding depth of 0.30m.
- Prior to construction, a silt fence will be installed along the property boundary in all locations where runoff will discharge from the site to adjacent lands. A mud mat will be installed at the entrance/exit location for the site. Silt sacks will be placed in each catch basin, as outlined in the Erosion and Sediment Control Plan. This will minimize the transport of sediment off-site during the construction period.
- Quality control for the site is provided via the proposed oil/grit separator (Stormceptor EFO4 or approved equivalent).

5.1.2 Supporting Engineering Plans

In support of the aforementioned Functional Servicing and Stormwater Management Design Report, GM BluePlan completed the following *Plans* for the proposed development. These plans can be found in Appendix E attached to this Report. The completed plans are as follows:

- Existing Conditions and Removals Plan
- Site Grading Plan
- Site Servicing Plan

- Erosion and Sediment Control Plan
- Section Plan
- Asphalt Laneway Plan; and,
- Notes and Details Plan

5.2 Geotechnical Report

CMT Engineering was retained to complete a Geotechnical Investigation in support of the proposed development. The purpose of the geotechnical investigation was to assess the existing soil and groundwater conditions encountered in the boreholes (Appendix F). Included in the assessment are:

- the soil classification and groundwater observations, as well as comments and recommendations regarding geotechnical resistance (bearing capacity);
- serviceability limit states (anticipated settlement); dewatering considerations;
- site classification for seismic site response;
- recommendations for site grading, site servicing, excavations and backfilling;
- recommendations for slab-on-grade construction;
- pavement design/drainage; soil design properties; and,
- a summary of the laboratory results.

The report concludes that the proposed development can be supported from a geotechnical perspective, subject to recommendations during the design/construction phase of the proposed Stacked Townhouse structures.

5.3 Lighting & Photometrics Plan

Mighton Engineering was retained to prepare a Lighting/Photometric Plan in support of the proposed development. The purpose of this Lighting Plan was to demonstrate the lighting fixture locations, illumination levels, and photometric layout for the subject lands. This plan can be found in Appendix G attached to this report.

5.4 Environmental Site Assessment (Phases 1 & 2)

Pinchin Ltd. was retained by Habitat for Humanity to complete a Phase 1 and Phase 2 Environmental Site Assessment ('ESA') for the subject site. Please refer to the full Environmental Site Assessment for further details.

The Phase 1 assessment concluded that *"one or more contaminants originating from PCAs located on the Phase One Property and within the Phase One Study Area outside of the Phase One Property may have affected land or water on, in, or under the Phase One Property."*. With these findings, Pinchin recommended that a Phase Two ESA be conducted.

The Phase 2 assessment concluded that *"Table 2 Standards for soil and groundwater at the Phase Two Property have been met as of the Certification Date of April 5, 2022 and that no further subsurface investigation is required in relation to assessing the environmental quality of soil and groundwater at the Phase Two Property".*

6.0 Planning Policy Framework & Analysis

6.1 Provincial Policy Statement, 2020

On February 28, 2020, the ministry of Municipal Affairs and Housing released the Provincial Policy Statement, 2020 ("PPS"), which came into effect on May 1, 2020.

The PPS provides policy direction on matters of Provincial interest related to land use planning and development. In accordance with Section 3(5) of the Planning Act, all planning matters and council decisions are required to be consistent with the PPS. Additionally, Policy 4.2 of the PPS states that the document "shall be read in its entirety and all relevant policies are to be applied to each situation".

The excerpts below will list the PPS sections and policies that apply to the proposed development of the subject property. The end of each policy section will contain a detailed summary explaining how the proposed development is in-keeping with the listed policies, followed by an overarching 'Planning Analysis' at the end of Section 5.1 of this report.

1.1.1 Healthy, livable and safe communities are sustained by:

a) promoting efficient development and land use patterns which sustain the financial well-being of the Province and municipalities over the long term;

b) accommodating an appropriate affordable and market-based range and mix of residential types (including single-detached, additional residential units, multi-unit housing, affordable housing and housing for older persons), employment (including industrial and commercial), institutional (including places of worship, cemeteries and long-term care homes), recreation, park and open space, and other uses to meet long-term needs;

The proposed residential development is located on a parcel of land within the Fergus Urban Centre that is currently underutilized and undeveloped. The stacked townhouse proposal is an efficient intensification of the subject property, and follows the land use goals that are set-out by the County, Township, and Province. The Zone Change from 'Future Development' to 'R4 Residential' on the subject property will follow the planned land-use structure noted in the Township of Centre Wellington Official Plan and is an ideal location for residential intensification.

The proposed development will help to create a healthy, livable, and safe community by contributing to a mix of residential unit types; specifically, by providing new multi-unit residential stacked townhouses in an area that

features predominantly single-detached dwellings at this time. The proposed townhouse units managed by Habitat for Humanity will have a positive contribution towards the long-term needs of the County, Township, and to the residents who live within.

With wages not keeping pace with steep rises in housing/rent in the Centre of Wellington and across the province as a whole, it is becoming increasingly difficult for families to afford to own a home/unit. The Habitat for Humanity organization aims to mitigate this important issue by offering a unique ownership model that sees them partner with lower-income families, allowing these families to build independence through homeownership.

1.1.3 Settlement Areas

1.1.3.1 *Settlement areas shall be the focus of growth and development.*

1.1.3.2 *Land use patterns within settlement areas shall be based on densities and a mix of land uses which:*

a) efficiently use of land and resources;

b) are appropriate for, and efficiently use, the infrastructure and public service facilities which are planned or available, and avoid the need for their unjustified and/or uneconomical expansion;

1.1.3.3 *Planning authorities shall identify appropriate locations and promote opportunities for transit-supportive development, accommodating a significant supply and range of housing options through intensification and redevelopment where this can be accommodated taking into account existing building stock or areas, including brownfield sites, and the availability of suitable existing or planned infrastructure and public service facilities required to accommodate projected needs.*

The subject site at 465 Garafraxa Street West is located within the settlement area of Fergus; following the directives of the PPS which state that new growth and development should primarily take place within settlement areas. The proposed development is an efficient use of land as the property is currently vacant and underutilized, and is located within the Fergus Urban Centre (Figure 4).

The proposal will bring a new multi-unit residential use to a parcel of land that is designated as *Greenfield* in the Official Plan, and will help contribute towards supplying a range of housing options in the nearby community. These units will be run by Habitat for Humanity and will provide the potential opportunity for low-income families in the area to enter home ownership.

The subject property being located within the Urban Centre also ensures that no boundary expansion will be required.

1.4 Housing

1.4.3 *Planning authorities shall provide for an appropriate range and mix of housing options and densities to meet projected market-based and affordable housing needs of current and future residents of the regional market area by:*

a) establishing and implementing minimum targets for the provision of housing which is affordable to low- and moderate-income households and which aligns with applicable housing and homelessness plans. However, where planning is conducted by an upper-tier municipality, the upper-tier municipality in consultation with the lower-tier municipalities may identify a higher target(s) which shall represent the minimum target(s) for these lower-tier municipalities;

The proposed development will help to provide a mix of housing options in order to meet the needs of current and future residents. Providing new stacked townhouse units within the Urban Centre will help contribute towards supplying a range of housing options that will be attainable for low to moderate income households.

As a Habitat for Humanity build, these condo/townhouse units will be sold to families that have met a specific eligibility criterion for Habitat's home ownership program. These "Habitats" offer a safe and more attainable living alternative for low-income families. Once a family has been chosen for one of Habitat's units, they will agree to volunteer 500 hours with Habitat and will also make regular mortgage payments on their unit. This model allows Habitat for Humanity to provide homes/units at lower-than-market prices, while instilling a renewed sense of pride and responsibility for the families that do get chosen for these units.

1.6 Sewage, Water and Stormwater

1.6.6.2 *Municipal sewage services and municipal water services are the preferred form of servicing for settlement areas to support protection of the environment and minimize potential risks to human health and safety. Within settlement areas with existing municipal sewage services and municipal water services, intensification and redevelopment shall be promoted wherever feasible to optimize the use of the services.*

As noted in the pre consultation comments, and through further discussions with Township Engineers, it has been determined that the proposed residential stacked townhouse development can be serviced through the extension of municipal water and sanitary services along Garafraxa Street.

The services currently terminate at the intersection of Garafraxa Street West and Maiden Lane north of the site, and the services will be extended south in

order to reach and provide water/sanitary service to 465 Garafraxa (Appendix D).

Planning Analysis (*PPS*)

To summarize, it is our opinion that the Proposed Development and Zoning By-law Amendment are consistent with the policy directions listed in the Provincial Policy Statement (PPS).

The County of Wellington is mandated by Province policy to meet a certain target density due to the projected increases in population in the coming years. In order to meet this required density target, a variety of new residential types will need to be developed to house this growing population.

The proposed development will help to create a healthy, livable, and safe community for current and future residents by contributing to a mix of residential unit types; specifically, by providing new stacked townhouse units in an area that features predominantly single-detached dwellings at this-time. Providing new multi-unit residential options within the Settlement Area and Urban Centre of Fergus will help contribute towards supplying a range of housing options in the area that will be attainable for low to moderate income households, while eliminating the need for any boundary expansion. The proposed development is an efficient residential intensification of an underutilized parcel of land.

Being Habitat built and funded, these units will provide the opportunity for low-income families to enter homeownership through a partnership with Habitat for Humanity.

6.2 Growth Plan for the Greater Golden Horseshoe, 2020

The Growth Plan for the Greater Golden Horseshoe, 2020 (“Growth Plan”) builds on the policies of the Provincial Policy Statement in order to establish a unique land-use planning framework that supports the achievement of complete communities, a thriving economy, a clean and healthy environment, and social equity.

The section below will contain relevant Growth Plan policies that are applicable towards the proposed redevelopment of Garafraxa Street West, followed by a policy analysis and justification for the proposed zone change and subsequential stacked townhouse development on the subject site.

1.2 A Place to Grow: Growth Plan for the Greater Golden Horseshoe

1.2.1 Guiding Principles

The policies of this Plan regarding how land is developed, resources are managed and protected, and public dollars are invested are based on the following principles:

- *Support the achievement of complete communities that are designed to support healthy and active living and meet people's needs for daily living throughout an entire lifetime.*
- *Prioritize intensification and higher densities in strategic growth areas to make efficient use of land and infrastructure and support transit viability.'*
- *Support a range and mix of housing options, including additional residential units and affordable housing, to serve all sizes, incomes, and ages of households.*
- *Provide for different approaches to manage growth that recognize the diversity of communities in the GGH.*

The proposed stacked townhouse development will support the achievement of complete communities by contributing to a mix of housing options in the area that will accommodate for varying resident incomes and household sizes.

Specifically, the proposed Habitat for Humanity units will act as an affordable homeownership option for low-income families that are struggling to enter the market.

2.2 Policies for Where and How to Grow

2.2.1 Managing Growth

2. Forecasted growth to the horizon of this Plan will be allocated based on the following:

a. the vast majority of growth will be directed to settlement areas that:

i. have a delineated built boundary;

ii. have existing or planned municipal water and wastewater systems; and

iii. can support the achievement of complete communities;

4. Applying the policies of this Plan will support the achievement of complete communities that:

a) feature a diverse mix of land uses, including residential and employment uses, and convenient access to local stores, services, and public service facilities;

b) improve social equity and overall quality of life, including human health, for people of all ages, abilities, and incomes;

c) provide a diverse range and mix of housing options, including additional residential units and affordable housing, to accommodate people at all stages of life, and to accommodate the needs of all household sizes and incomes;

The proposed development will be located within the Settlement Area of Fergus, and will have access to municipal water and sanitary service following the extension of municipal services along Garafraxa Street as noted in the Pre-Consultation comments (Appendix A).

The proposed units will support the achievement of complete communities by providing a mix of housing options in the area, that can accommodate varying resident incomes and household sizes. The units will be managed by Habitat for Humanity and will help provide an improved social equity and overall quality of life for low-income families looking to enter homeownership.

2.2.6 Housing

1. Upper- and single-tier municipalities, in consultation with lower-tier municipalities, the Province, and other appropriate stakeholders, will:

a) support housing choice through the achievement of the minimum intensification and density targets in this Plan, as well as the other policies of this Plan by:

i. identifying a diverse range and mix of housing options and densities, including additional residential units and affordable housing to meet projected needs of current and future residents; and

ii. establishing targets for affordable ownership housing and rental housing;

2.2.7 Designated Greenfield Areas

2. The minimum density target applicable to the designated greenfield area of each upper- and single-tier municipality is as follows:

b) The City of Kawartha Lakes and the Counties of Brant, Dufferin, Haldimand, Northumberland, Peterborough, Simcoe and Wellington will plan to achieve within the horizon of this Plan a minimum density target that is not less than 40 residents and jobs combined per hectare.

The Proposed Development and Zoning By-law amendment for the subject site will support the need to provide residents with a choice of housing options and sizes, while also assisting the County of Wellington in achieving its minimum density target of *40 residents and jobs combined per hectare* as noted in the Growth Plan.

Planning Analysis (*Growth Plan*)

In summary, it is our opinion that the Proposed Development and Zoning By-law Amendment is consistent with the policy framework listed in the *Growth Plan for the Greater Golden Horseshoe, 2020*.

The Proposed Development will assist the County of Wellington in achieving its density targets noted in Section 2.2.7.2 b) of the Growth Plan by providing 32 new residential stacked townhouse units to an underutilized parcel of land within the Urban Centre and Settlement Area of Fergus.

The proposed stacked townhouse units will support the achievement of complete communities by providing a mix of housing options in the area, while also accommodating for varying resident incomes and household sizes. More specifically, these Habitat for Humanity units will provide the opportunity of homeownership to qualified low-income families that otherwise would be out-of-reach. Habitat homeownership instills a sense of pride and responsibility for its residents, with lasting effects.

6.3 County of Wellington Official Plan, 1999

The County of Wellington Official Plan provides a policy framework that establishes the County's goals and objectives, land use designations, and planning policies. The County Official Plan was created with the purpose of *"giving direction over the next 20 years, to the physical development of the County, its local municipalities and to the long-term protection of County resources.".* The fundamental beliefs of the plan highlight the prioritization of sustainable development, land stewardship and healthy communities.

The County of Wellington Official Plan Schedule A1 map indicates that the subject site is located in the "Urban Centre" of Fergus (see Figure 4), and that the site is designated as 'Greenfield'. The subject site also falls within a 'Source Protection Plan Area' (Figure 5).

The section below will contain policies from the County of Wellington Official Plan that apply towards the proposed redevelopment of 465 Garafraxa Street West, as well as justification for how these Official Plan policies are applied to the proposed development.

Part 3: Growth Strategy

3.1 General Strategy (Growth)

Wellington County will grow from approximately 96,000 people in 2016 to approximately 140,000 in 2041. Wellington will plan for new housing, commerce, employment and services for about 46,000 new residents.

As a general strategy, Wellington will encourage development patterns which:

- *are cost efficient*
- *are environmentally sound*
- *are compatible with existing uses*
- *maintain small town character*

To achieve the general growth strategy Wellington will encourage a greater share of the County's growth to locate in the urban system than has been the norm. New multiple lots and units for residential development will be directed to Urban Centres and Hamlets, and may be allowed in site-specific locations with existing approved zoning or designation that permits this type of development. The priorities for directing growth will be as follows:

- *the majority of growth will be directed to urban centres that offer municipal water and sewage services.*

3.3 Guiding Growth

Wellington has the following objectives for growth:

- *to encourage more efficient use of land through increased densities in designated Greenfield areas of urban centres;*
- *to provide choice for residents and businesses by providing a variety of growth opportunities, housing types, services, recreation and cultural activities, and public open space;*

3.3.1 Targets (Greenfield Density)

- *the designated greenfield area of the County will be planned to achieve an overall minimum density of not less than 40 residents and jobs per hectare.*

The proposed residential development on the subject property follows the general growth strategy as stated in the County OP. The population of the County is increasing at a rapid rate, and the Proposed Development of 32 Stacked Townhouse units will help to provide new housing for the projected 46,000 new residents who will be living in the County by 2041. The development is cost efficient and will not have any negative effects on environmental features. The Residential intensification of the subject property will be compatible with existing surrounding uses (designated as vacant/*future development*), and will be compatible with future surrounding uses as well due to the surrounding lands being identified in the local Township OP as areas for future Residential development.

The proposed development follows the guidelines for growth as stated in Section 3.3 of the County OP, as the Subject Lands are designated as Greenfield and are located within the Urban Centre of Fergus. The residential Stacked Townhouse intensification of the subject property provides for an increase in density and contributes to a variety of housing types in the County.

Part 4: General County Policies

4.4 Housing

4.4.2 *The County will provide for a variety of housing types to satisfy the present and future social, health and well-being requirements of residents of the regional market area. New residential developments will be promoted at densities which efficiently use available servicing and are appropriate to site conditions and existing patterns of development.*

4.4.3 *This Plan contains policies encouraging intensification primarily in urban centres but also, to a much lesser extent in hamlets. The strategic approach to intensification intends to retain small town character and revitalize downtown areas which includes:*

a) supporting increased densities in newly developing greenfield areas with a broader mix of housing types than has been the norm in small towns;

4.4.4 *In greenfield areas, the County will encourage increased densities and a broader mix of housing and will:*

a) require new developments to achieve densities which promote the overall greenfield density target of 40 persons and jobs per hectare and specifically:

iv) encourage the introduction of medium density housing types in new subdivisions and other Greenfield areas.

The Proposed Development follows the General Housing Policies as stated in Section 4 of the County OP and is designated as Greenfield within the Urban Centre of Fergus. The intensification will contribute to a variety of housing types in this greenfield/urban centre area (Stacked Townhouses) to satisfy the present and future requirements of residents.

The proposal will introduce medium-density residential housing on a greenfield parcel of land within the urban centre and will help contribute to meeting the greenfield density target of 40 persons and jobs per hectare.

4.9.5 Source Water Protection

The Clean Water Act, 2006 is intended to ensure the protection of drinking water supplies by setting out a risk-based process on a watershed basis to identify vulnerable areas and associated drinking water threats and issues through the preparation of Assessment Reports; and develop policies and programs to eliminate or reduce the risks posed by identified drinking water threats through the preparation of Source Protection Plans. This process is otherwise known as Source Protection Planning.

4.9.5.1 Vulnerable Areas

Vulnerable areas within the County include:

- *Wellhead Protection Areas (WHPAs);*
- *Surface Water Intake Protection Zones (IPZs); and*
- *Issue Contributing Areas (ICAs)*

Schedule B of the Official Plan identifies vulnerable areas for each municipal water supply source and their associated vulnerability score, as mapped in the applicable Source Protection Plan. Schedule B also identifies policy areas to protect selected private communal wells in the County that were identified in the County of Wellington Groundwater Study, 2006.

Wellhead Protection Areas

A Wellhead Protection Area is an area that is related to a wellhead and within which it is desirable to regulate or monitor drinking water threats because land use activities in these areas have the potential to affect the quality or quantity of water that flows into the well. WHPAs associated with water quality are identified on Schedule B as Wellhead Protection Areas A, B, C and E. WHPADs are not identified on Schedule B as there are no significant drinking water threat policies identified in the relevant Source Protection Plans for these WHPAs. WHPAs associated with water quantity are identified on Schedule B as Wellhead Protection Areas Q1 and Q2. Table 9 summarizes the time of travel factors that represents each WHPA.

Table 9: WHPAs and Associated Time of Travel Zones and Vulnerability Scores.

Water Quality Wellhead Protection Areas		
Wellhead Protection Area	**Time of Travel (ToT)**	**Vulnerability Score**
WHPA-A	100-metre radius surrounding well.	10
WHPA-B	2 year travel time for water to enter the well.	6 to 10
WHPA-C	5 year travel time for water to enter the well.	2 to 8
WHPA-D	25 year travel time for water to enter the well.	2 to 6
WHPA-E	The vulnerable area of groundwater supplies which are under the direct influence of surface water. The area is calculated based on a two hour travel time of surface water to the well.	7 to 9
Water Quantity Wellhead Protection Areas		
WHPA-Q1	The combined area that is the cone of influence of the well and the whole of the cones of influence of all other wells that intersect that area.	
WHPA-Q2	The WHPA-Q1 area and any area where a future reduction in recharge would significantly impact that area.	

i. *Table 9 (from County OP, page 52)*

Issue Contributing Area

An Issue Contributing Area (ICA) is an area within a WHPA where the existing or trending concentration of a parameter (i.e. trichloroethylene, chlorine, nitrate, or sodium) or a pathogen at a municipal well would result in the deterioration of the quality of water for use as a source of drinking water. ICAs are not assigned a vulnerability score. ICAs are identified on Schedule B as Issue Contributing Areas

The subject lands are located within Wellhead Protection Areas (WHPAs) and an Issue Contributing Area (ICA). Specifically, Township Staff have determined in their Source Water comments (Appendix B) that the subject lands are located within the following:

a) Wellhead Protection Areas C and D (WHPA-C, D), 5- and 25-year time-of-travel, respectively, with low to moderate vulnerability scores of 2-6;

b) Issue Contributing Areas (ICA); and

c) a Wellhead Protection Area for Quantity (WHPA-Q) with a significant risk level

As required by the Planning Act, a Section 59 Notice under the Clean Water Act is required for all Planning applications. This Section 59 form has been filled-out and completed as required, and will be submitted concurrently with the Zoning By-law Amendment application.

Planning Analysis (*County OP*)

To summarize, it is our opinion that the proposed development is consistent with the policies and guidelines listed in the County of Wellington Official Plan.

The proposed development will be located within the Settlement Area of Fergus on greenfield land, and will have full access to municipal services along Garafraxa Street West once the services are extended towards the subject property from Maiden Lane.

The completed Geotechnical (Appendix F) and Engineering Reports (Appendix D and E) provide details regarding how the soils and source water will be protected within the Wellhead Protection Area and Issue Contributing Area.

The proposed units will help to support the achievement of complete communities by contributing to a mix of housing options in the area that can be accommodated by varying resident/household incomes and household sizes. Specifically, this proposal presents a unique residential development opportunity with these units being managed by Habitat for Humanity. Habitat for Humanity will help to provide opportunities for low-income families to enter the homeownership market in a time where this is becoming increasingly more costly and difficult to do so.

6.4 Township of Centre Wellington Official Plan, 2013

There are two Official Plan documents that provide planning policies for properties located in the County of Wellington: The County of Wellington Official Plan (“County OP”), and the Township of Centre Wellington Official Plan (“Township OP”). As stated in Section A.2 of the Township OP, the County OP governs land use in the rural areas, and sets out the broad policies applying to urban areas. The Township OP has chosen to prepare its own

municipal plan which will apply specifically and exclusively to the three Urban Centres located within the Township, these being: Fergus, Elora-Salem and Belwood. The Township OP applies to this development due to the subject site being located within the Urban Centre of Fergus.

The Township of Centre Wellington Official Plan ("Township OP') was first adopted in November 2003, and was most recently updated in January 2013. The Township OP is a policy document that outlines various goals, objectives, and policies that will guide future development within the Township. According to Schedule A1 *Land Use* of the Township OP (Figure 4) the Subject Site is designated as Residential and Greenfield, and is also located within the Urban Centre of Fergus. Additionally, Schedule B of the Township OP identifies that the site is located within the Grand River Crossing West Municipal Servicing Area (Figure 7). The proposed Residential Stacked Townhouse intensification on the property is in-line with the designations noted in Schedule A1 of the Township OP (Figure 6).

The excerpts below will list the Township OP policy sections that are applicable to the Proposed Development and subject property as a whole, as well as detailed analyses for each section explaining how the Proposed Development is in conformity with the Plan.

B.4 Major Goals

The major goals of the Township of Centre Wellington are to:

3. Ensure that adequate lands and services are available to allow for the future needs of the community.

4. Provide opportunities for housing, shopping, employment and recreation to serve the needs of a community.

6. Provide an adequate supply and diversity of housing to satisfy the varied needs of the community.

10. Provide improved municipal services and community facilities to serve the needs of the community and to anticipate future needs.

12. Ensure that new development is compatible with existing and approved land uses.

The Proposed Development will contribute to meeting the goals highlighted in Section B.4 of the Township OP. The proposed medium-density residential intensification will contribute towards providing a diversity of housing in the area to serve the current and future needs of the community. The property is primarily surrounded by lands that are zoned for future residential development (Future Development designation), and therefore is compatible with existing and future land uses surrounding the property.

The Proposed Development will also be extending municipal services farther west down Garafraxa Street (*from the current endpoint at Maiden Lane*), which

will help to serve future residential projects that may occur on Garafraxa Street West.

C.5.1 Housing Policies: Variety of Housing

The Township of Centre Wellington encourages the production of a wide range of housing types to meet future housing need. Council shall provide for the opportunity, through subdivision approval and zoning by-law approvals, for a variety of housing types to be provided. Prior to approving new development or redevelopment, Council will consider the housing need within the community and the housing market area and provide opportunities for a range of housing types throughout the community that are appropriate given existing site conditions, neighbouring developments, and servicing options.

C.5.4 Affordable Housing

For ownership housing, affordable means housing for which the purchase price is at least 10 percent below the average purchase price of a resale unit in the regional market area. In consultation with the County of Wellington, the Township will ensure that opportunities exist to provide housing to moderate- and lower-income households. A substantial portion of the Township's existing housing stock is affordable. In order that this continues as Centre Wellington grows, the Township will support the County policy of ensuring that a minimum of 25% of new housing units in the County will be affordable. Accessory residences, semi-detached, duplex, townhouse and low rise apartment units will provide the bulk of affordable housing opportunities.

C.5.5 Residential Intensification

a) supporting increased densities in newly developing greenfield areas with a broader mix of housing types than has been the norm in small towns;

d) encouraging intensification within urban centres along major roadways and arterial roads;

g) encouraging intensification which results in new rental accommodation;

i) encouraging the development of appropriate standards for residential intensification, redevelopment and new residential development which are cost effective, environmentally sound and compatible with existing uses, small town scale and character.

The Proposed Zoning By-law Amendment and subsequent medium-density intensification of the subject property will follow the planned direction of the Township by contributing to providing a wide range of housing types in the area.

Section C.5.4 of the Township OP discusses the definition, and goals for implementing *affordable housing* in the Township. Although the proposed

Stacked Townhouse units do not fall under the definition of affordable housing; they are considered to be more attainable than most other residential unit options in the area. Habitat for Humanity strives to provide and develop residential units for ownership for first-time home buyers. These units provide an opportunity for low-moderate income homebuyers to ease into the housing market in a time where it is becoming increasingly more difficult to do-so.

Section C.5.5 of the Township OP discusses the importance of providing increased densities and a broader mix of housing in Greenfield designated areas. The subject site is located within a Greenfield area, and the Proposed Development will provide smart, medium-density residential intensification to the subject property.

C.5.6 Greenfield Housing

In Greenfield areas, the Township will encourage increased densities and a broader mix of housing and will:

2. require new developments to achieve densities which promote the overall greenfield density target of 40 persons and jobs per hectare

3. encourage the introduction of medium density housing types in new subdivisions and other Greenfield areas.

The Proposed Development will implement a medium-density residential use into a Greenfield area, and will assist the Township in achieving their overall density target of 40 persons and jobs per hectare while also providing for a mix of housing types in the area.

C.6.1 General Servicing Policies

This Plan anticipates that all new development and redevelopment will have access to a full range of appropriate municipal services. These services will be expanded in a rational, cost-effective manner that minimizes the tax burden on existing residents. Servicing costs to new developments will normally be recovered from developers through servicing agreements and development charges.
It shall be the policy of the Township of Centre Wellington that:
1. All new development and redevelopment within the Fergus and Elora-Salem Urban Centres shall be provided with full municipal services, to such standards as may be required by the Township, including:
a) Sanitary sewage disposal facilities
b) Water supply facilities
c) Storm drainage facilities
d) Hydro
e) Public roads
f) Telecommunications
2. Telephone, cable television and natural gas services will be provided to all new development, wherever feasible and appropriate,

3. The Township may require and enter into agreements to provide for the staging of development in order to allow the efficient and orderly provision of municipal services,
4. The Township may pass by-laws and enter into agreements, including financial arrangements with property owners, for the installation of municipal services

The Proposed Stacked Townhouse Development will be provided with full municipal services (Appendix A, D, and E). Municipal services currently terminate at the intersection of Garafraxa Street West and Maiden Lane north of the site, and the services will be extended south in order to reach and provide water and sanitary service to 465 Garafraxa. The extension of these services also includes full urbanization such as installation of curb and gutter, storm sewer, new road base/asphalt, and new sidewalk from Maiden Lane. The cost of extending the municipal services/full urbanization will be covered by Habitat for Humanity. The estimate of these costs, as well as a detailed breakdown of all required works, can be found in the attached Pre-Submission comments (Appendix A).

D.2.1 Detailed Land Use Policies: Residential

The single-detached home is currently the dominant housing type in the urban centres and this situation is expected to continue. However, new housing types are needed to provide a greater variety of residential accommodation as well as a more affordable housing supply. The Municipal Plan anticipates that semi-detached, townhouse and apartment dwellings will be developed to respond to this need and that these units may eventually account for at least one quarter of all housing units in Fergus and Elora-Salem where full municipal services are available.

The Township is committed to preserving the character and integrity of existing residential areas and will make reasonable efforts to ensure that development is compatible with established. We are also committed to ensuring that controlled growth and development occur within the community in order to maintain and enhance the small-town character of urban centres.

D.2.2 Objectives for Residential Development

1. To ensure that an adequate supply of land is available to accommodate anticipated population growth over the planning period;
2. To provide a variety of dwelling types to satisfy a broad range of residential requirements including affordable housing;
7. To encourage intensification, development proposals provided they maintain the stability and character of existing neighbourhoods;
9. To encourage residential developments which incorporate innovative and appropriate design principles which contribute to public safety, affordability, energy conservation and that protect, enhance and properly manage the natural environment;

The Proposed Development will intensify a currently vacant Greenfield property within the Urban Centre of Fergus, while contributing to the provision of a variety of dwelling types in the Township. The development will also maintain and build on the character of the surrounding neighbourhood.

As previously noted, the proposed units do not fall under the definition of "affordable housing", however they are considered to be more "attainable" than most other residential unit options in the area. Units developed and run by Habitat for Humanity provide an opportunity for low-income families to ease into the homeownership market during a time where it is becoming increasingly more difficult to do so.

D.2.5 Medium Density Development

Multiple residential developments such as townhouses and apartments may be allowed in areas designated RESIDENTIAL subject to the requirements of the Zoning By-law and further provided that the following criteria are satisfactorily met:

***1.** that medium density development on full municipal services should not exceed 35 units per hectare (14 units per acre) for townhouses or row houses, and 75 units per hectare (30 units per acre) for apartments, although it may not always be possible to achieve these densities on smaller sites.*	The Proposed Development slightly exceeds the maximum allowed density of 75 units per hectare; proposing a density of 76.5 units per hectare (UPH). See attached Conceptual Site Plan (Figure 2)
***2.** That the design of the proposed height, setbacks, landscaping and vehicular circulation, will ensure that it will be compatible with existing or future development on adjacent properties;*	This will be looked after during Site Plan Approval, which will be sought following the approval of the Zoning By-law Amendment
***3.** That the site of the proposed development has a suitable area and shape to provide:* *a) Adequate on-site landscaping to screen outdoor amenity areas both on the site and on adjoining property, to buffer adjacent residential areas and to improve the overall appearance of the development;* *b) On-site amenity areas for the occupants of the residential units;*	The proposed development will: - Provide landscaping and amenity areas (common and private) for residents of the proposed units - Provide more than the required amount of off-street parking spaces (45 required, 47 provided), and also provide for appropriate vehicular circulation

c) Adequate off-street parking, access and appropriate circulation for vehicular traffic, particularly emergency vehicles; and *d) Adequate grading to ensure that drainage from the property is directed to public storm drainage facilities and not to adjoining properties.*	- Grading and drainage plans have been prepared for the subject property by GM BluePlan. For more details refer to the attached Grading and Drainage Plans (Appendix E)
4. *That adequate services such as water, sewage disposal, storm water, roads and hydro are available or shall be made available to service the development;*	Municipal servicing will be extended from Maiden Lane towards 465 Garafraxa to service the proposed residential units; see attached Functional Servicing Report (Appendix D)
5. *That within the built boundary, medium density is encouraged to locate on major roadways and arterial roads;*	N/A. Site is greenfield, and is not located within the built boundary
6. *That in greenfield areas, medium density is encouraged to locate on major roadways, and roads designed to serve an arterial or collector function, while 40 street townhouses are allowed on local roads.*	The Proposed Development will bring medium-density/stacked townhouse residential units to a greenfield site (465 Garafraxa Street W). Garafraxa Street is a *collector* road
7. *That a separate zone(s) is established for multiple residential developments.*	N/A

Planning Analysis (*Township OP*)

In summary, it is our opinion that the Proposed Development is consistent with the policy framework listed in the Township of Centre Wellington Official Plan.

The Proposed Development will follow the goals/guidelines set-out in the Township OP by:

- Proposing a medium-density residential use (stacked townhouse units)
  - On a greenfield site located in the Urban Centre of Fergus
  - Contributing towards the provision of a diverse range of housing types in the area to serve current and future residents
- Assisting the Township of Centre Wellington in meeting its density target of 40 persons and jobs per hectare
- Ensuring the development will have access to municipal services (water, sanitary, etc.) with these services being extended to 465 Garafraxa from Maiden Lane (Appendix D)

- Habitat for Humanity provides “attainable” ownership units for low-moderate income homebuyers to ease into the housing market

6.5 Township of Centre Wellington Zoning By-law, 2009-045

The Township of Centre Wellington *Zoning By-law No. 2009-045* is the current in-force Zoning By-law. In this Zoning By-law, the subject property of 465 Garafraxa Street West is zoned as Future Development (FD) (Figure 10).

The Future Development zone is defined in the Zoning By-law as follows:

> *“FD Zone applies to lands that are part of the Elora-Salem or Fergus Urban Centres that are expected to be developed or redeveloped in the future, but for which further planning review is needed before further development approvals can be granted. Permitted uses are limited to existing uses, buildings and structures only.”.*

To permit the Proposed Development of 32 stacked townhouse units on the Subject Property, a Zoning By-law Amendment that **proposes a zone change from Future Development (FD) to Residential (R4) with site-specific provisions** is required. The next section of this report will provide an overview of the proposed Zoning By-law Amendment to Zoning By-law 2009-045.

6.5.1 Proposed Zoning By-law Amendment

A Zoning By-law Amendment is being proposed to change the zoning of the property from Future Development (FD) to R4 Residential, with site-specific provisions. This Zone Change is necessary in order to allow for a Residential use to be located on the subject property. The residential use is appropriate for this subject property as it follows the planned Land Use Structure shown on Schedule A1 of the Township of Centre Wellington Official Plan (Figure 4).

The R4 Residential zone has been chosen as the appropriate zone due to the R4 zone allowing for *stacked townhouse dwellings* as a permitted use. The requested Site-specific provisions are as follows:

a) Minimum *Interior Side Yard* of 2.3 ±m
b) Minimum *Building Separation* of 3.0 ±m
c) Minimum *Private Amenity Area Depth* of 4.0 ±m
d) Minimum above-grade unit *Private Amenity Area* of 4.65 ±m^2

See the table below indicating how the proposed development complies with the R4 zone, as well as the highlighted site-specific provisions:

	Required	**Provided**
Minimum Lot Area	700 m2	4,181.30 m2
Minimum Lot Frontage	20.0 m	63.05 m
Minimum Front Yard	6.0 m	6.0 ±m
Minimum Side Yard	**3.0 m**	**2.3 ±m provided (Site Specific)**
Minimum Rear Yard	7.5 m	44.3 ±m
Maximum Building Height	4 storeys / 15 m	3 storeys
Minimum Dist. Between Buildings	**15 m**	**3.0 ±m provided (Site Specific)**
Parking *(standard)*	1.0 space per dwelling unit, plus 0.5 spaces per unit for the first 20 units and 0.25 spaces per unit for each additional unit. (45 spaces) *A minimum of 50% of the additional parking spaces shall be devoted exclusively to visitor parking*	47 Parking Spaces (45 resident, 2 visitor)
Minimum Common Amenity Area	a) 30 m2 (322.9 ft2) of common amenity area shall be provided for each of the first 20 dwelling units, and an additional 20 m2 (215.3 ft2) provided for each additional unit above 20. Common amenity areas shall be aggregated into areas of not less than 50 m2 (538 ft2). b) Common Amenity Areas shall be designed and located so that the length does not exceed 4 times the width. c) A Common Amenity Area shall be located in any Yard other than the required Front Yard or required Exterior Side Yard.	Common amenity areas are provided on-site as required for the proposed residential units. Refer to the attached Conceptual Site Plan for more details (Figure 2)
Minimum Landscaped Open Space	40%	44.79 ±% provided

Private Amenity Area	A Private Amenity Area shall be provided for each unit and it shall: a) have a minimum area of 20 m2 (215.3 ft2), **b) have a minimum depth (from the wall of the dwelling unit) of 4.5 m (14.8 ft);** c) have a minimum width equal to the width of the unit when the layout of the unit permits. If the preceding cannot be accomplished the minimum width of the private amenity area shall be 4.5 m (14.8 ft); d) not form part of a required front or exterior side yard; e) not face onto a public street; f) be accessed through a doorway to a hall or habitable room, other than a bedroom g) be separate and not include walkways, play areas, or any other communal area; and h) be defined by a wall or fence. --- Notwithstanding the foregoing, for stacked townhouse units above grade, each private amenity area shall: a) **have a minimum area of 10 m2 (107.6 ft2);** b) consist of a patio or terrace; and c) be defined by a wall or railing between adjacent units height of 1.8m	a) 44.7 ±m2 for units at ground level **b) 4.0±m provided (Site Specific)** c) Yes. 11.2m d) Not part of front/exterior side e) Not facing onto public street f) Acknowledged g) Acknowledged h) Acknowledged --- Above-grade units: **a) 4.65 ±m^2 balconies provided (Site Specific)** b) Yes, patio/balcony c) Acknowledged

Due to the findings of the Phase 1 Environmental Site Assessment (ESA), and through discussions with Township Staff, it has been concluded that the proposed area to-be rezoned as ‘R4’ Residential will encompass approximately 99% of the subject property, with a small portion of the eastern corner of the lot along Garafraxa Street West remaining as ‘Future Development’.

For more details on the specifics of the area to-be rezoned, please refer to the attached Conceptual Site Plan/ZBA Sketch Plan (Figure 2), and Draft Zoning Schedule (Appendix C).

Zoning By-law Analysis / Compatibility

In summary, we believe the proposed Zone Change from the existing zoning of Future Development (FD) to the R4 Residential zone with site-specific provisions is appropriate, as it follows the planned land-use structure as indicated on the Township’s Official Plan (Figure 4).

We are of the opinion that that the requested site-specific minimum requirements are minor in nature, and that the nature of the Habitat for Humanity “attainable” units justify the slight reduction in private amenity area and depth.

7.0 Conclusions

This Report has been prepared in support of a Zoning By-law Amendment application for 465 Garafraxa Street West, with Site Plan Approval to follow. The proposed applications are being sought in order to allow for the development of 32 Stacked Townhouse units on the subject lands. For the proposed By-law Amendment, Habitat is requesting to amend the existing zoning of the property from "Future Development (FD)" Zone to the "Residential (R4)" Zone with site-specific provisions (Appendix C). The proposed site-specific provisions for the Zoning Amendment are minor in nature, and are appropriate in this scenario to reflect the unique residential development opportunity being proposed.

These units would be built by Habitat for Humanity, and would follow the Habitat homeownership model that assists working low-income families to realize their dream of owning a home. The model allows families to apply for these residential units, and if accepted/approved, would purchase their unit through a no-down payment mortgage geared towards their income level while also contributing 500 volunteer hours to Habitat to Humanity. These proposed units will provide the opportunity for its chosen residents to improve their health, education, and employment outcomes. Every unit/home that is built by Habitat benefits the local surrounding community.

Based on the analysis contained within this report we have concluded that the Proposed Development and associated Zoning By-law Amendment application is appropriate and represents good planning for the following reasons:

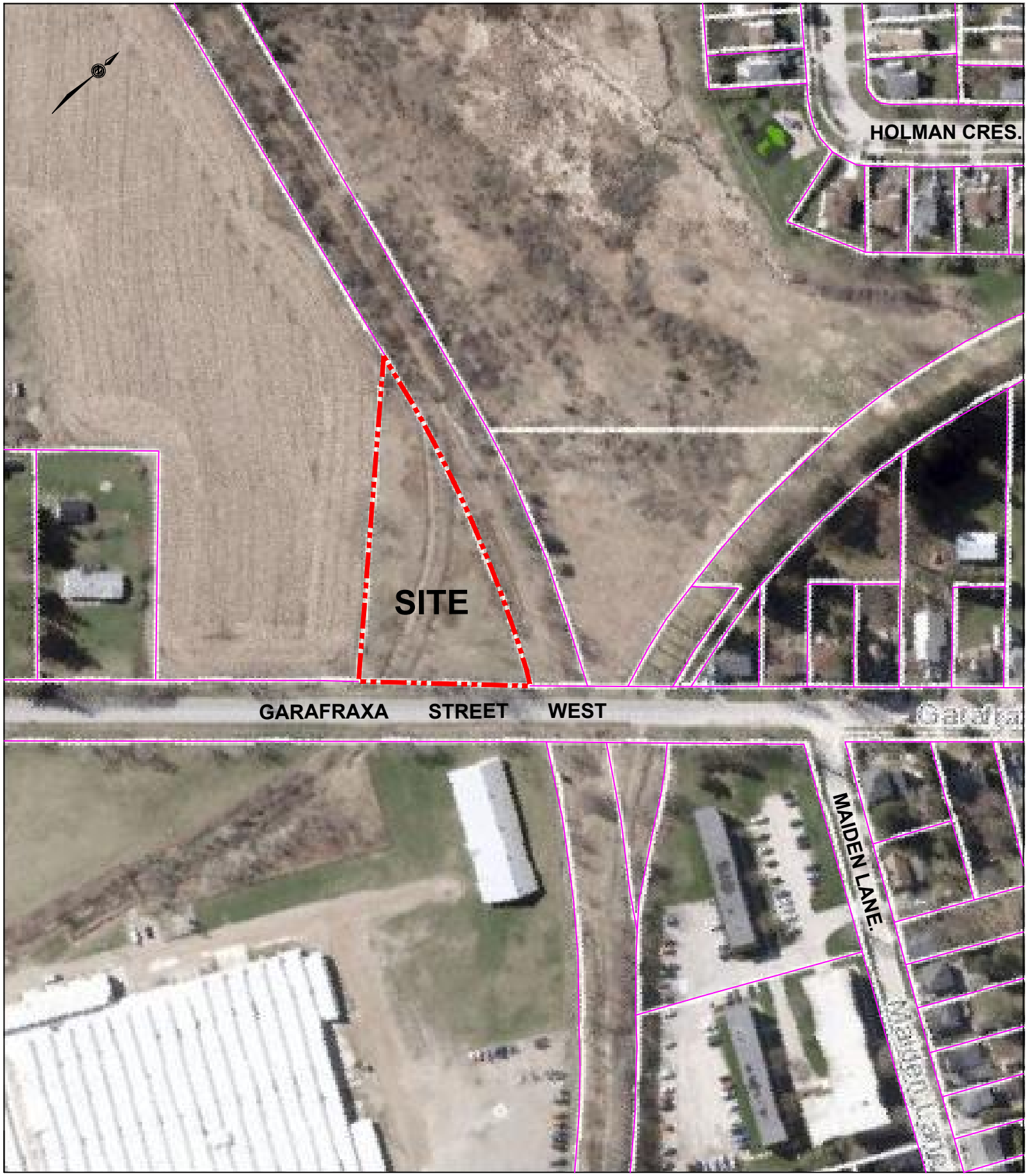
- The proposed development is consistent with the Provincial Policy Statement;
- The proposed development conforms to the Growth Plan and represents smart intensification of a Greenfield property located within a Settlement Area;
- The proposed development conforms to the County of Wellington Official Plan and contributes to the listed intensification/density targets by providing new medium-density residential units to the area;
- The proposed development will seek to intensify an existing and underutilized Greenfield site located within the Township of Centre Wellington;
- The proposed development will contribute to providing a mix of housing/unit types in the community, while also providing for more affordable housing options within the Township.

We appreciate your support of this application.

Respectfully submitted,

Brock Linklater,
Planner
Dryden, Smith & Head
Planning Consultants Ltd.

Andrew Head,
Planner
Dryden, Smith & Head
Planning Consultants Ltd.

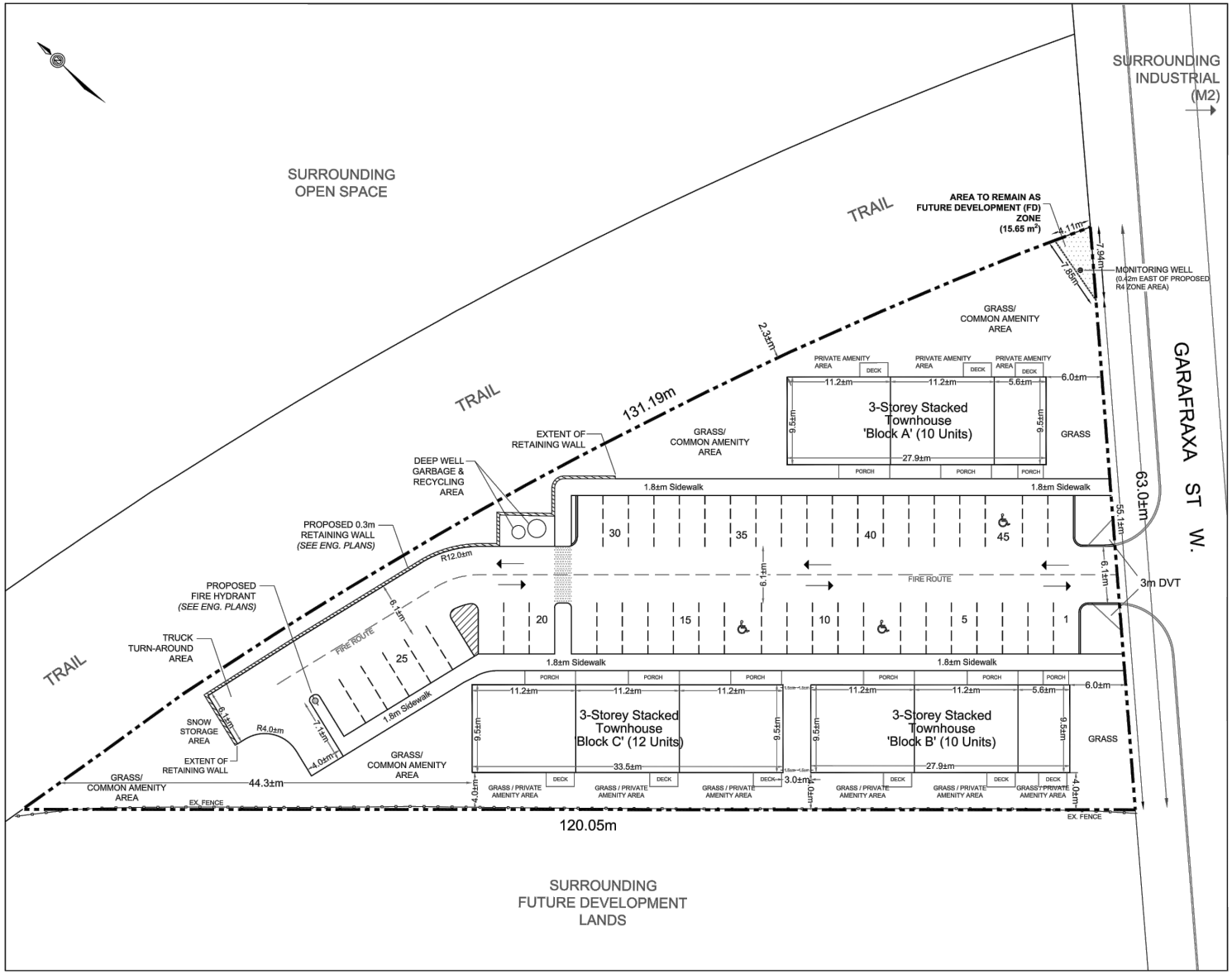


DRYDEN SMITH & HEAD
Planning Consultants Ltd.

LOCATION OF SUBJECT LANDS

465 Garafraxa Street West, Fergus, Ontario

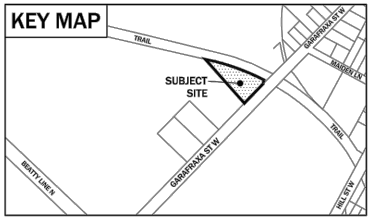
FIGURE: 1



SITE PLAN

465 GARAFRAXA ST W.
PT BLOCK 4
REGISTERED PLAN 77
TOWNSHIP OF CENTRE WELLINGTON
COUNTY OF WELLINGTON
ROLL # 232600006016050000

KEY MAP



ZONING REQUIREMENTS: R4 (PROPOSED)

	REQUIRED	PROVIDED	VARIANCE
LOT AREA	700 m²	4,181.30 m²	-
LOT FRONTAGE	20.0 m	63.05 m	-
FRONT YARD	6.0 m	6.0 ±m	-
SIDE YARD	3.0 m	2.3 ±m	0.7 ±m
REAR YARD	7.5 m	44.3 ±m	-
LANDSCAPED AREA	40 %	44.79 ±%	-
PARKING	45 spaces	47 spaces	-

PROPOSED DEVELOPMENT

- Requesting a **Zoning By-law amendment to change the Zoning designation on the property from 'Future Development' to R4 Residential with site-specific provisions**, to allow for the development of **32 Stacked Townhouse units** on the subject property (3 x 3-Storey Stacked Townhouse buildings). **The requested site-specific minimum requirements are as follows:**
  - **a) Min. Interior Side Yard of 2.3±m**
  - **b) Min. Building Separation of 3.0±m**
  - **c) Min. Private Amenity Area Depth of 4.0±m**
  - **d) Min. above-grade unit Private Amenity Area of 4.65±m²**

NOTES

Present Zoning: Future Development
Proposed Zoning: R4 Residential (with site-specific provisions)
OP Designations: Urban Centre, Residential, Greenfield
Parking Dimensions: 2.75m x 5.5m (Standard space)
4.0m x 5.5m (Barrier-Free space)

DRYDEN SMITH & HEAD Planning Consultants Ltd.

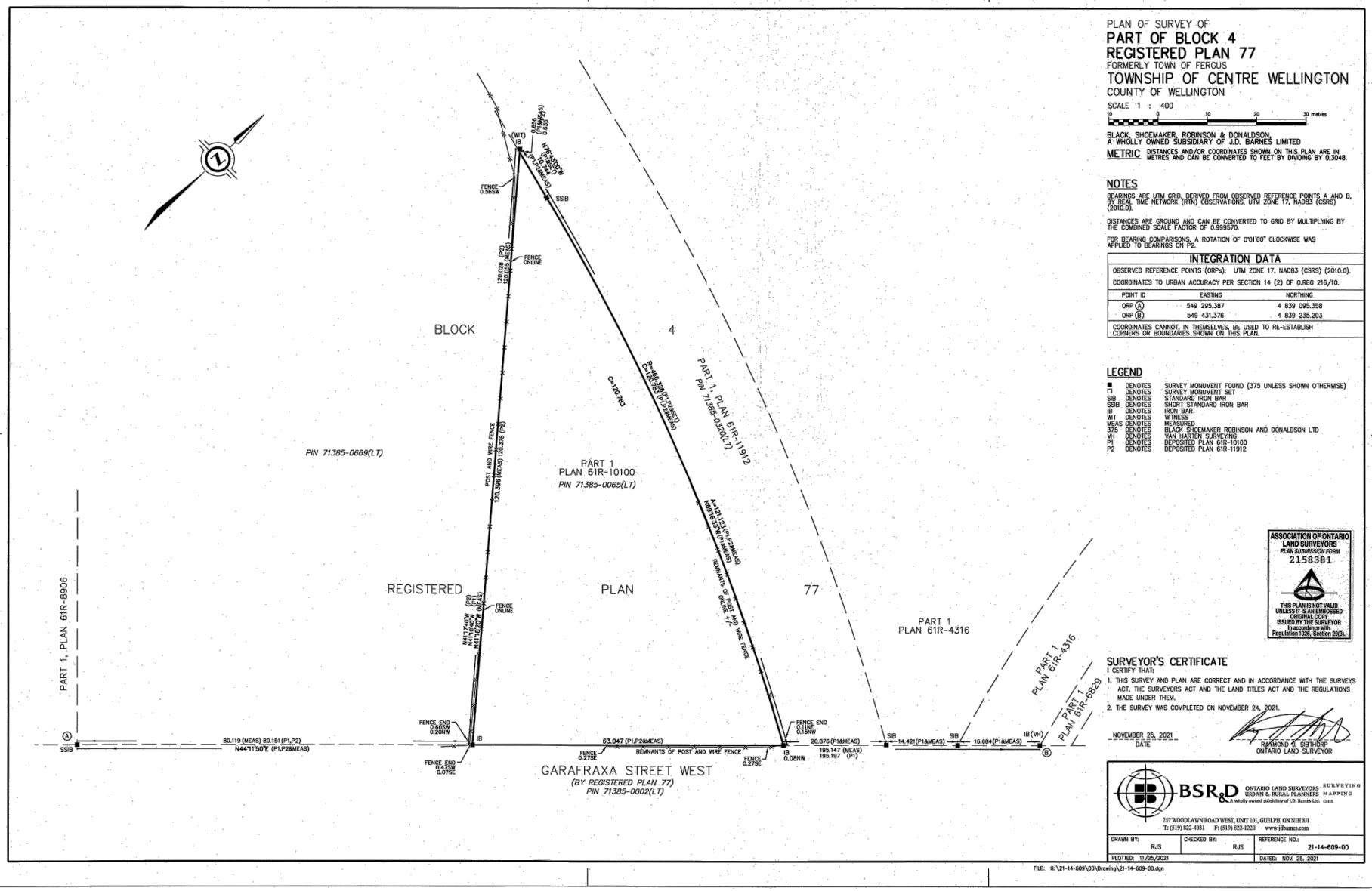
REVISION: FEBRUARY 09, 2023
DATE: JANUARY 23, 2023
SCALE:
ACAD DWG. FILE:16370(1) SKETCH PLAN
JOB NO.:16370(1)
FILE NO.:16370(1)

DRYDEN SMITH & HEAD Planning Consultants Ltd.

CONCEPTUAL SITE PLAN

465 Garafraxa Street West, Fergus, Ontario

FIGURE: 2



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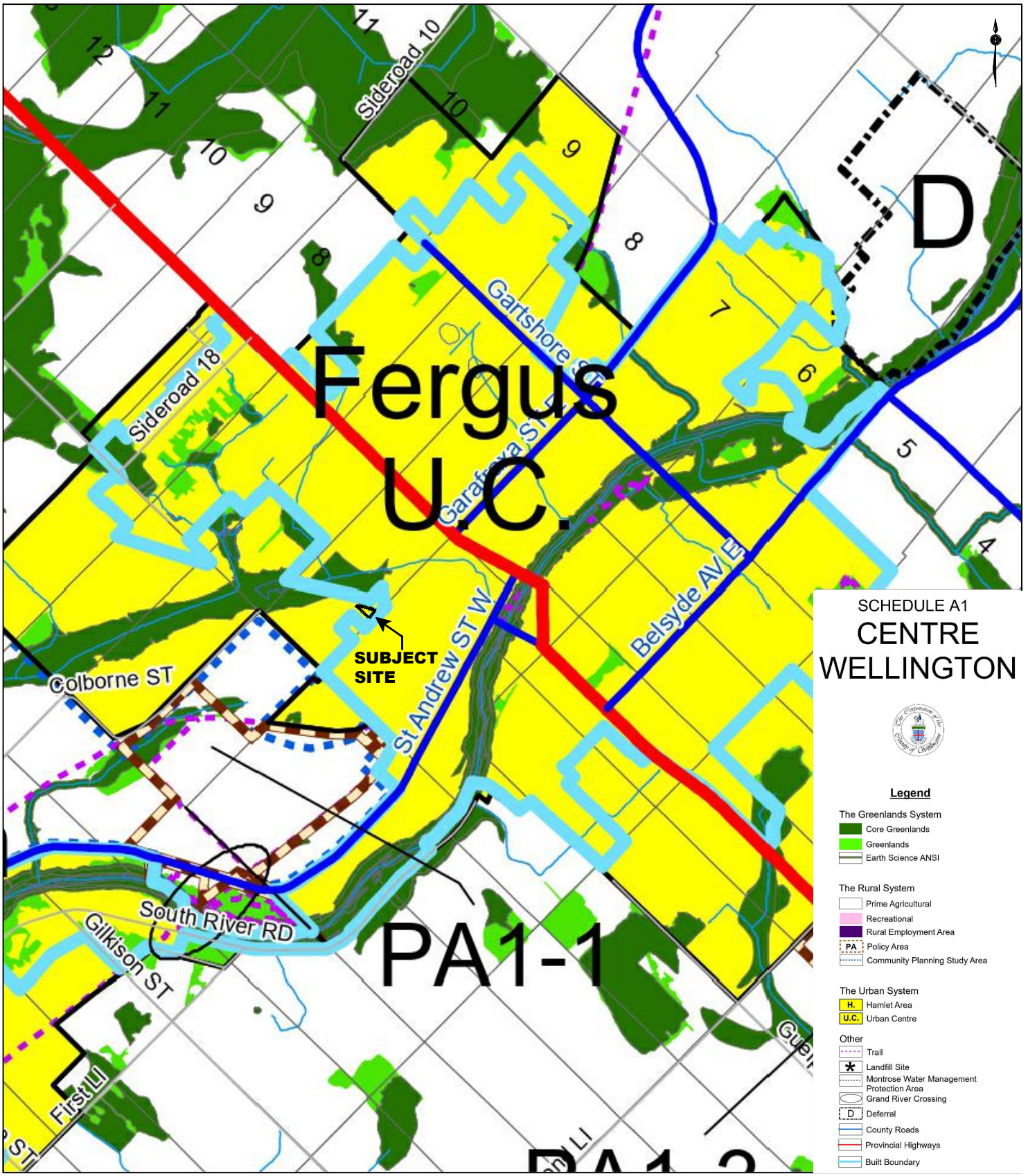
LEGAL SURVEY

465 Garafraxa Street West, Fergus, Ontario

FIGURE: 3



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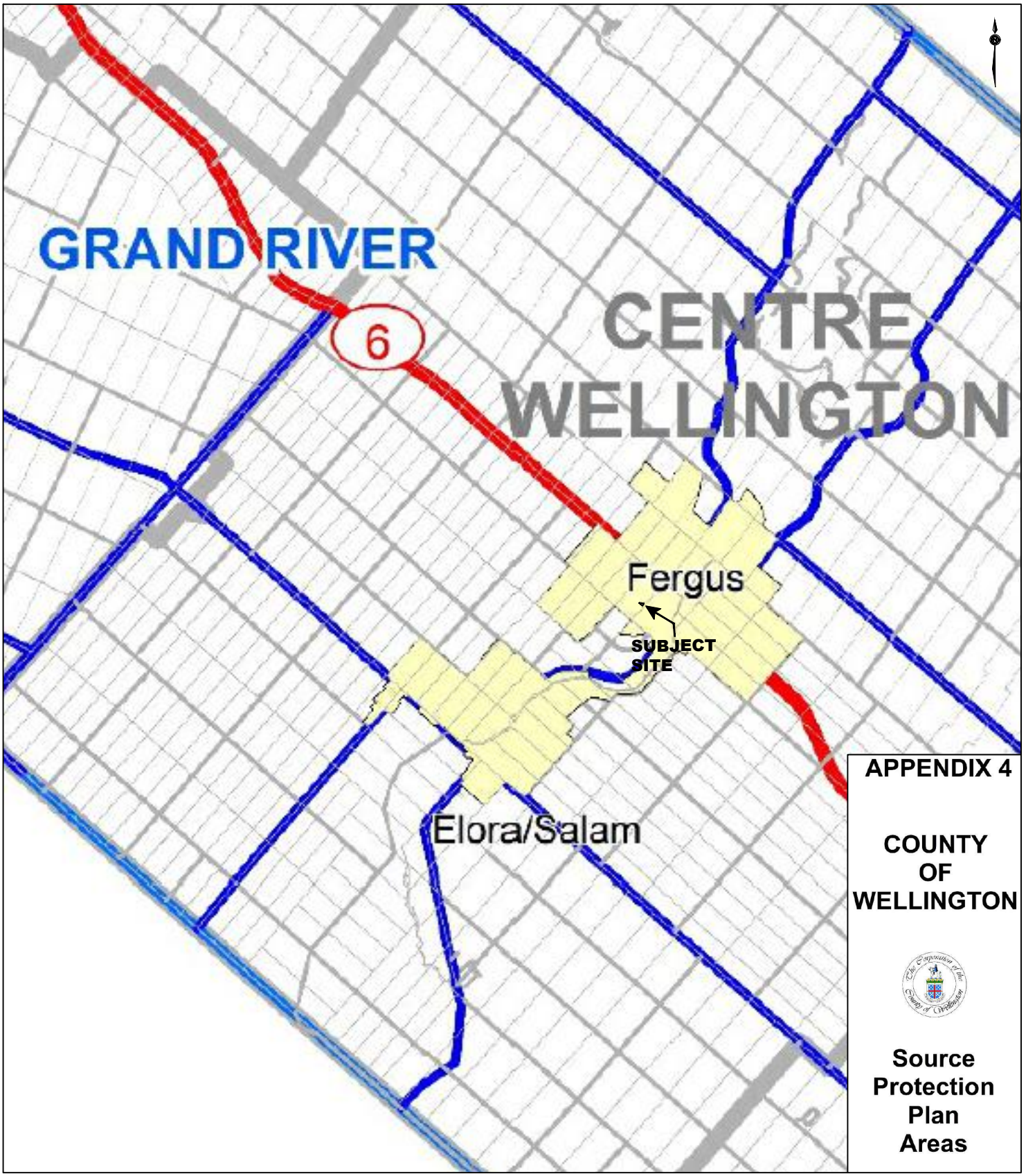
COUNTY OF WELLINGTON OP: SCHEDULE A1 LAND USE

465 Garafraxa Street West, Fergus, Ontario

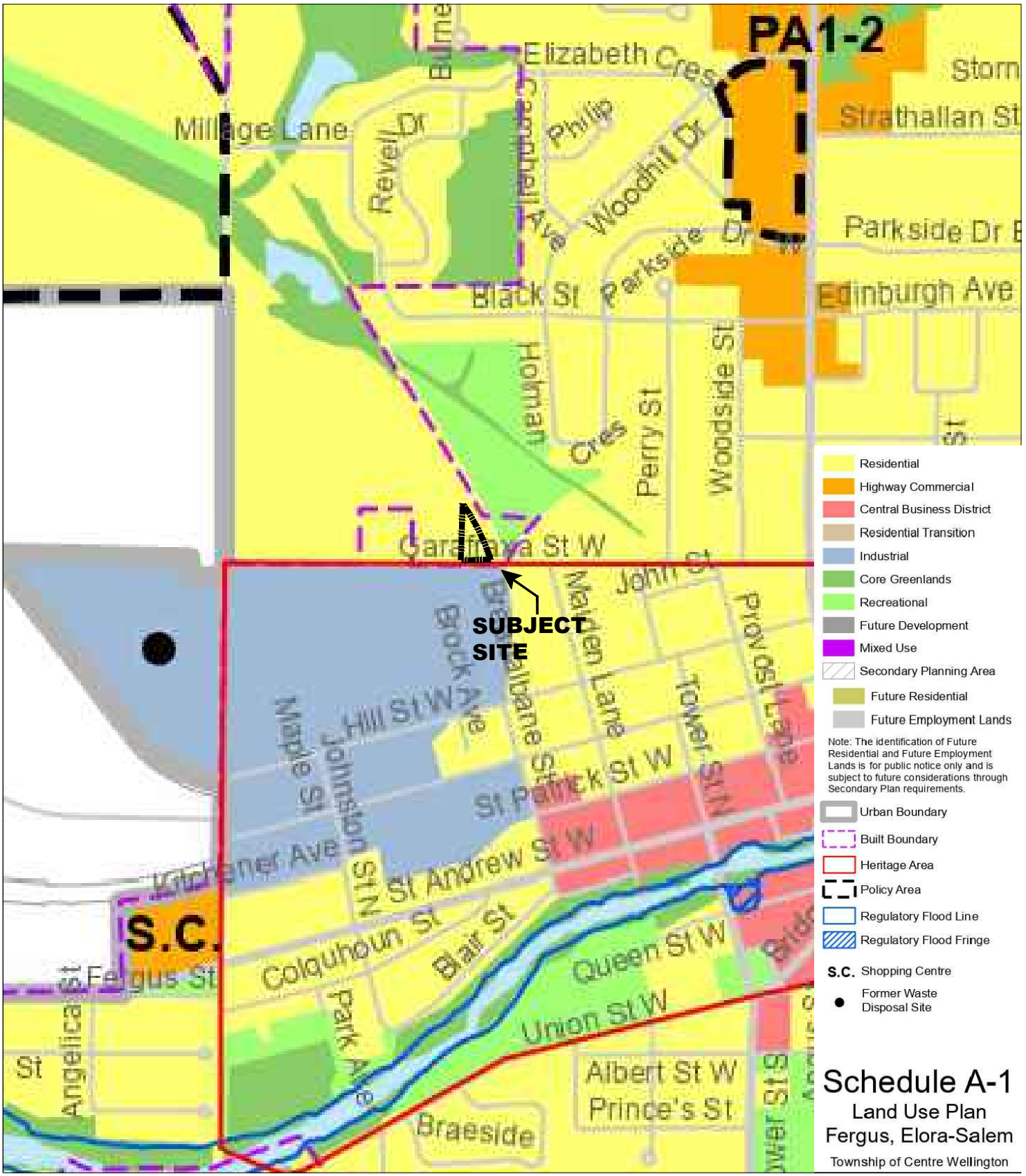
FIGURE: 4



DRYDEN & SMITH HEAD
Planning Consultants Ltd.

COUNTY OF WELLINGTON OP:
SOURCE PROTECTION PLAN AREAS
465 Garafraxa Street West, Fergus, Ontario

FIGURE: 5

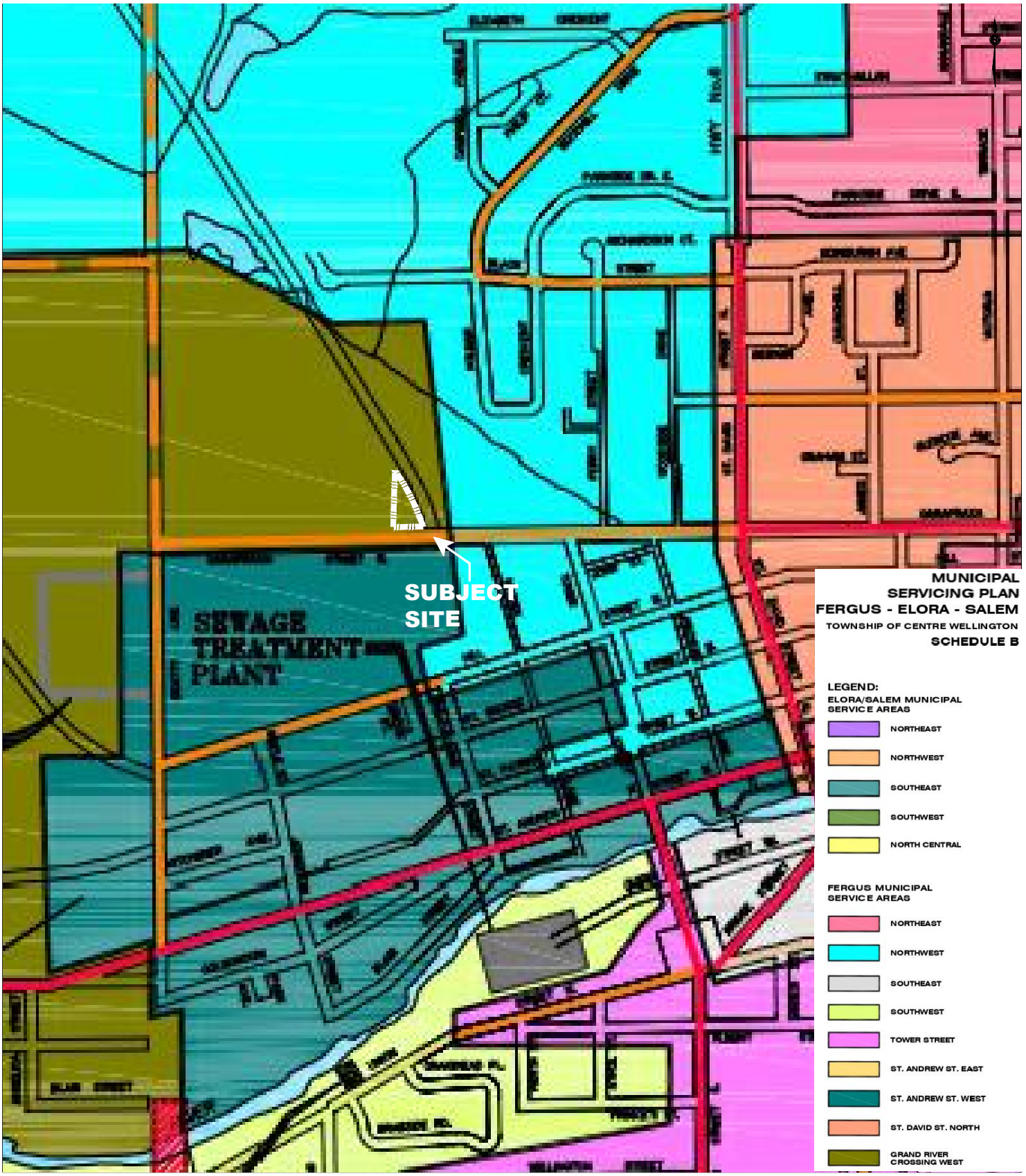


DRYDEN & SMITH HEAD
Planning Consultants Ltd.

TOWNSHIP OF CENTRE WELLINGTON OP: SCHEDULE A1 LAND USE

465 Garafraxa Street West, Fergus, Ontario

FIGURE: 6



DRYDEN & SMITH HEAD
Planning Consultants Ltd.

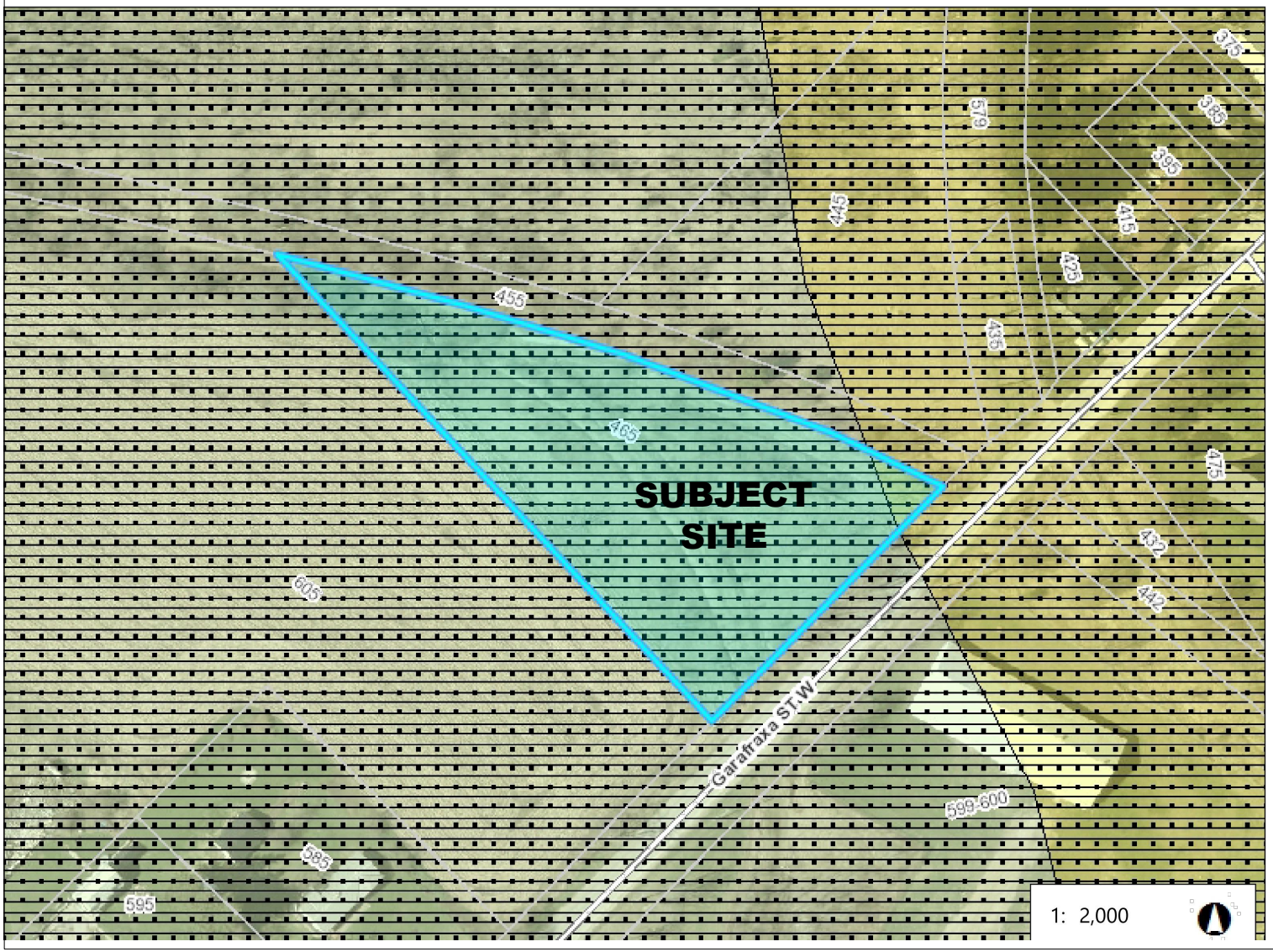
TOWNSHIP OF CENTRE WELLINGTON OP: SCHEDULE B MUNICIPAL SERVICING

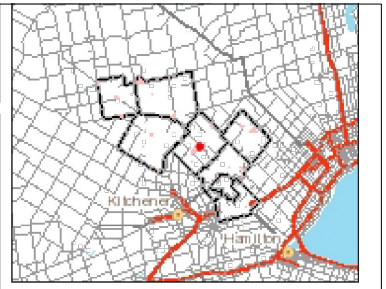
465 Garafraxa Street West, Fergus, Ontario

FIGURE: 7

Explore Wellington

465 Garafraxa Street West, Fergus





Legend

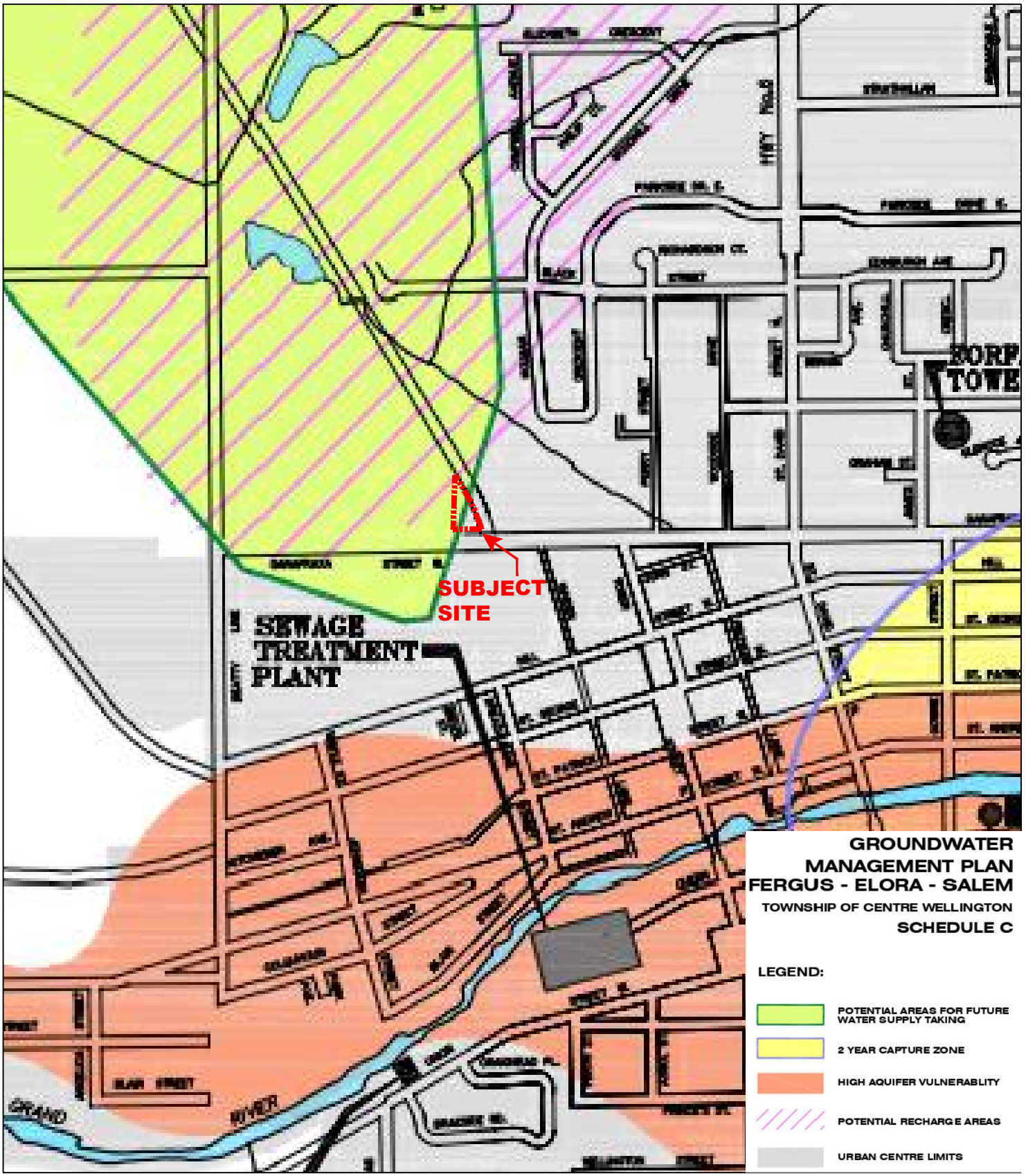
- Parcels
- Roads
  - Local Road
  - County Road
  - Highway
- Well Locations
- Wellhead Protection Area Bou
  - A
  - B
  - C
  - D
- Issue Contributing Area
  - Chloride
  - Nitrate
  - Sodium
  - TCE
- Vulnerability Score
  - 10
  - 8, D; 8; 8, C
  - 2, 4, 6 (A, B or C)
  - 2,4,6, D; 2,4, D; 2, 4, 6 (D); 4, D; 6,
- HVA
- RoadsLookup

DRYDEN & SMITH HEAD Planning Consultants Ltd.

TOWNSHIP OF CENTRE WELLINGTON OP:
SCHEDULE B1 SOURCE WATER

465 Garafraxa Street West, Fergus, Ontario

FIGURE: 8

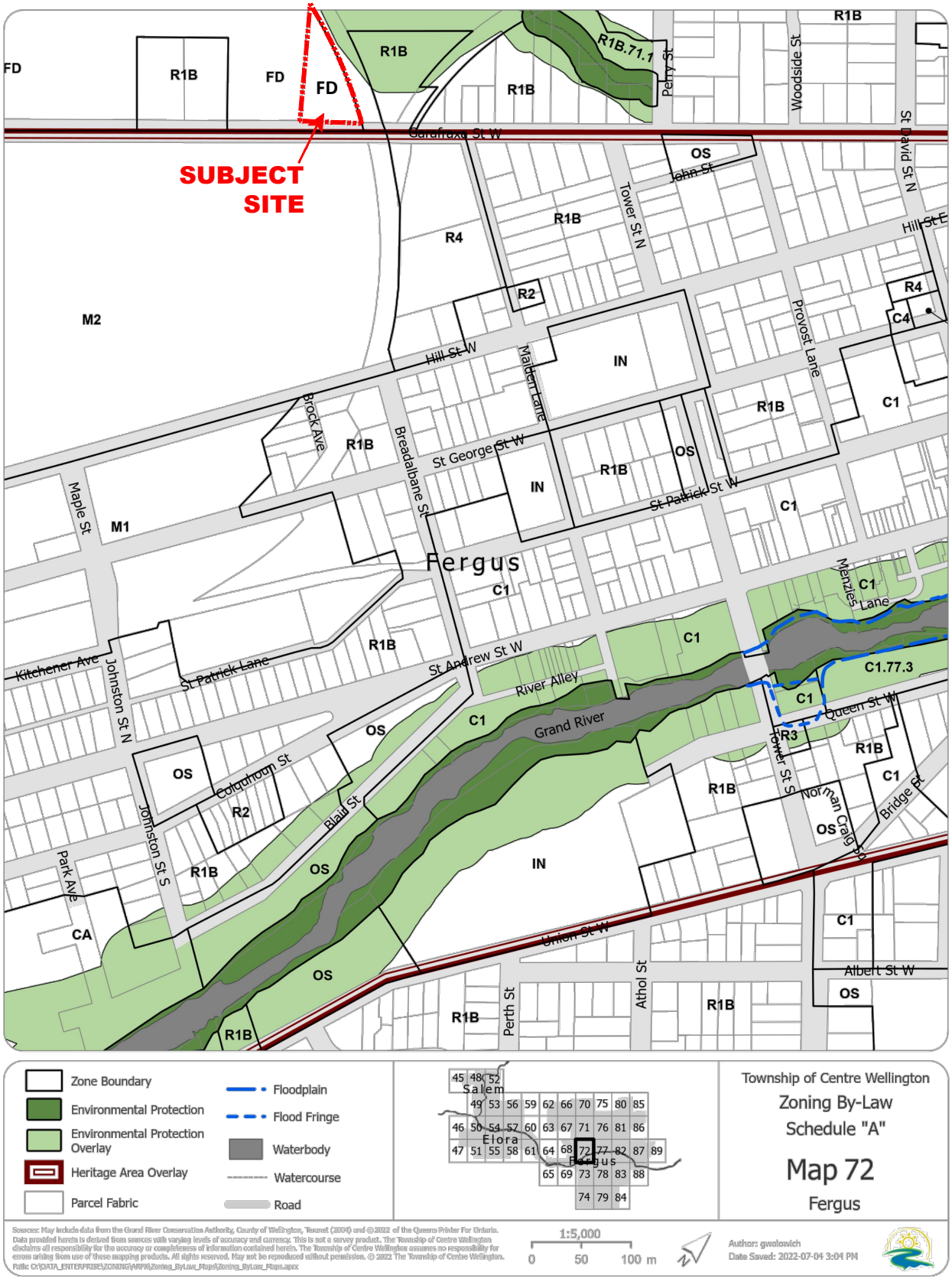


DRYDEN & SMITH HEAD
Planning Consultants Ltd.

TOWNSHIP OF CENTRE WELLINGTON OP:
SCHEDULE C GROUNDWATER MANAGEMENT

465 Garafraxa Street West, Fergus, Ontario

FIGURE: 9



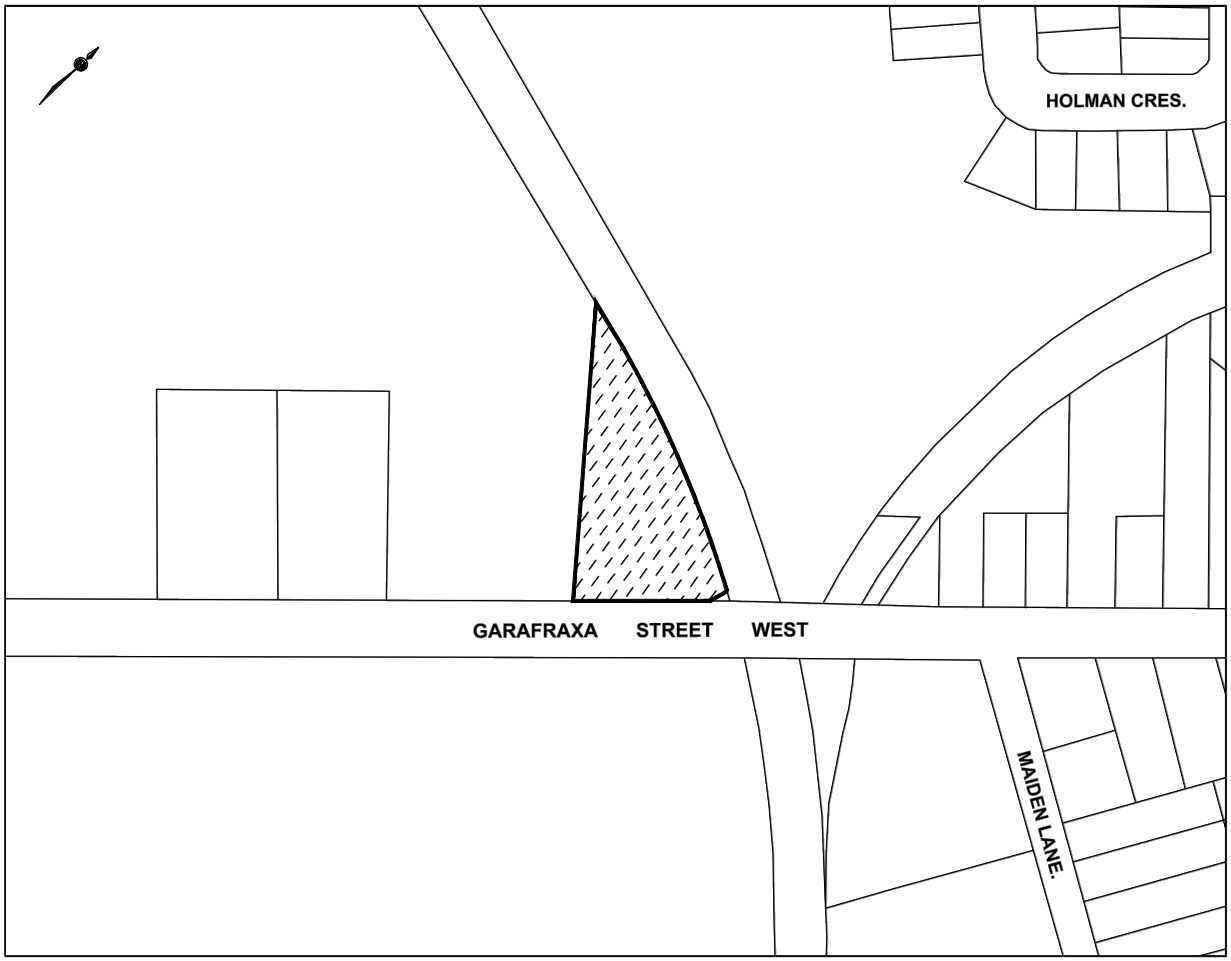
DRYDEN SMITH & HEAD
Planning Consultants Ltd.

CENTRE WELLINGTON ZONING BY-LAW
EXISTING ZONING

465 Garafraxa Street West, Fergus, Ontario

FIGURE: 10

DRAFT
Schedule 'A'
Zoning By-Law Amendment
Township of Centre Wellington
465 Garafraxa Street West



Lands redesignated from Future Development (FD) to the Residential R4 Zone with Site-Specific provisions

Appendix C
Zoning By-law Amendment Schedule 'A' (DRAFT)
465 Garafraxa Street West
Township of Centre Wellington

DRYDEN & SMITH HEAD Planning Consultants Ltd.

CENTRE WELLINGTON ZONING BY-LAW PROPOSED ZONING (DRAFT SCHEDULE A)

465 Garafraxa Street West, Fergus, Ontario

FIGURE: 11

Appendix A –

Pre-Consultation Comments

Centre Wellington

February 10, 2022 VIA EMAIL

Dryden, Smith & Head Planning Consultants Ltd.
Attn: Andrew Head
54 Cedar Street North
Kitchener, ON N2H 2X1

Dear Mr. Head,

Staff have reviewed your preliminary concept plan for 465 Garafraxa Street West in Fergus regarding a proposed residential development for Habitat for Humanity. The following comments have been provided by staff.

Development Engineering:

Reporting/Plan Requirements

- Source Water Protection documentation
- Functional Servicing Report
- Stormwater Management Report. Post Development to meet pre development conditions. Additionally, promoting the infiltration of roof runoff to achieve a site water balance shall be explored and implemented (if feasible).
- Geotechnical Report
- Lighting/Photometrics Plan

Draft Site Plan comments

Grading

Grading of property to meet Township Standards (min. swale slope = 2%, depth of swale min. 0.15m (preferred 0.30m).

Additional Grading requirements;

- Min. grassed area slope = 2.0%, Max. 6.0%.
- Roadway Min. slope = 0.5%, Parking Lots Min. slope = 1.0%
- Driveway Entrances Min. 2.0%, Max. 6.0% (label all slopes on grading plan)
- Max. slope grading 3:1, slopes in excess of 3:1 will require the use of retaining wall(s).
- Existing drainage patterns from adjacent properties cannot be blocked/dammed, and drainage areas from adjacent properties will need to be taken into consideration with the stormwater management design of the property.

Servicing

- There are no existing sanitary, water or storm services fronting the property currently. These will need to be extended from existing services Garafraxa Street West at the developer's cost. Existing Water and Sanitary sewer services are a approx. +/-

90.0m east of the east property limits of 465 Garafraxa Street West, and Storm Sewer is +/-50.0m east of the east limits of the property.
- Sanitary Sewer 225mm dia. VC
- Watermain 150mm dia. PVC
- Storm Sewer 450mm dia.
- Municipal Servicing and Entrance Permit will be required through the Infrastructure Services Department.

Please note: the property owner's have been in discussion with Brandon re: additional requirements for servicing (see attached email).

Building Department:
- The building at the north of the driveway appears to be 1m from the property line, no glazing (unprotected openings) are permitted within 1.2m of the property line, the walls must be designed with a fire resistance rating.
- The distance between the 2 buildings on the south side of the road (12 unit building and 10 unit building), the 3m setback between the buildings must be divided into two separate limiting distances (likely 1.5m each) and unprotected openings / fire resistance ratings must be designed accordingly.
- Fire Hydrants shall be indicated on the site plan indicating OBC conforming coverage for all units.
- A minimum 12m turning radius is required into and out of the site.

Planning Department:
See attached comment matrix.

Infrastructure Services:
See attached email.

Source Water Protection:
Comments forthcoming.

Yours truly,

Chantalle Pellizzari

Chantalle Pellizzari
Development Coordinator

cc: Rob Gobbi

PRECONSULTATION COMMENT MATRIX

Property Address	465 Garafraxa St W, Fergus	
Official Plan Designation	Urban Centre, Residential, Greenfield	
Present Zoning	Future Development	
Proposed Zoning	R4	The concept plan applies the R3 zone requirements when the proposal appears to be for stacked townhouses and the R4 zone should apply.
Official Plan Provisions	D.2.5 Medium Density Development Multiple residential developments such as townhouses and apartments may be allowed in areas designated RESIDENTIAL subject to the requirements of the Zoning By-law and further provided that the following criteria are satisfactorily met: 1) that medium density development on full municipal services should not exceed 35 units per hectare (14 units per acre) for townhouses or row houses, and 75 units per hectare (30 units per acre) for apartments, although it may not always be possible to achieve these densities on smaller sites. 2) That the design of the proposed height, setbacks, landscaping and vehicular circulation, will ensure that it will be compatible with existing or future development on adjacent properties; 3) That the site of the proposed development has a suitable area and shape to provide:	The density appears to slightly exceed the maximum of 75 units per hectare. Site plan approval will be required. Unclear if these requirements can be met based on the concept plan.

	a) Adequate on-site landscaping to screen outdoor amenity areas both on the site and on adjoining property, to buffer adjacent residential areas and to improve the overall appearance of the development; b) On-site amenity areas for the occupants of the residential units; c) Adequate off-street parking, access and appropriate circulation for vehicular traffic, particularly emergency vehicles; and d) Adequate grading to ensure that drainage from the property is directed to public storm drainage facilities and not to adjoining properties. 4) That adequate services such as water, sewage disposal, storm water, roads and hydro are available or shall be made available to service the development; 5) That within the built boundary, medium density is encouraged to locate on major roadways and arterial roads; 6) That in greenfield areas, medium density is encouraged to locate on major roadways, and roads designed to serve an arterial or collector function, while street townhouses are allowed on local roads. 7) That a separate zone(s) is established for multiple residential developments.	Municipal services are not available to this site at present. Not applicable – site is greenfield Garafraxa would be considered a collector road so medium density is acceptable here.
Zoning Regulations		Meets the minimum lot area and frontage requirements for the R4 zone. Insufficient

		information provided to determine compliance with other regulations. No indication that adequate common or private amenity areas have been provided.
Subject to SPA?	Yes	
Applicable Design Guidelines	No	
Applicable Design Standards	Yes	Township applies the City of Kitchener standards for multi-residential information. There is insufficient information provided to determine adherence to the standards.

From: Brandon Buehler
To: Lee Wheildon
Subject: FW: 465 Garafraxa St W - Fergus
Date: February 8, 2022 2:34:45 PM

FYI

Brandon Buehler | Engineering Technologist – Water/Wastewater

Township of Centre Wellington | 1 MacDonald Square, Elora, ON N0B 1S0
519.846.9691 x356 centrewellington.ca

Office located at: 7444 Wellington Road 21, Elora, ON N0B 1S0

From: Brandon Buehler
Sent: October 19, 2021 9:24 AM
To: 'Rob Gobbi' <Rob@habitatgw.ca>
Cc: Adam Gilmore (AGilmore@centrewellington.ca) <AGilmore@centrewellington.ca>
Subject: RE: 465 Garafraxa St W - Fergus

Morning Rob,

As requested, we had our consultants pull together an estimate to have municipal services installed to the subject property from where they will terminate in future at 435 Garafraxa St W. Below we have broken out what is all required and factored into the estimate.

Roads and Drainage:

- full urbanization from where it currently terminates (55m west of Maiden Lane) including curb and gutter and storm sewer
- new road base and asphalt (road width to match ex urbanized width of 8.5m west of Maiden Lane)
- new sidewalk from Maiden Lane
- urbanization limits terminate at the west limit of 465 Garafraxa
- ditch inlets and pipe required to deal with ditches at termination of urbanization and ditches along trails/railway bed
- storm lead and MH at property included for development
- construction of entrance to development

Sanitary:

- 80m - 200mm dia sanitary extension
- 200mm sanitary sewer and MH included for development

Waterworks:

- 80m - 150mm dia watermain extension
- 150mm watermain and gate valve included for development
- Included 1 new Fire Hydrant

Miscellaneous/Eng:

- Included: bonding, construction layout, materials testing, excess soil management (QP), Geotech investigation, engineering, contract administration, permit fees, hydro vac and pole support allowance, site trailer, legal survey

The total estimate cost to complete all the above **$630,000.00.** As I mentioned in my email below, if this is still of interest to you, we will require you to entre into a Financing Agreement where we collect 120% of the estimate costs. Once this is in place, we would then engage our consultants to complete the detailed design, submit for the Ministry approvals then work at pulling together a tender for the work. Given the scope of work and the size of project, this would be a Township administered project and would procced thought our purchasing department and tendered by the Township.

Hope this helps with your planning, let me know if you have any further questions.

Thanks,

Brandon Buehler | Engineering Technologist – Water/Wastewater

Township of Centre Wellington | 1 MacDonald Square, Elora, ON N0B 1S0
519.846.9691 x356 centrewellington.ca

Office located at: 7444 Wellington Road 21, Elora, ON N0B 1S0

From: Brandon Buehler
Sent: October 6, 2021 8:57 PM
To: 'Rob Gobbi' <Rob@habitatgw.ca>
Cc: Adam Gilmore (AGilmore@centrewellington.ca) <AGilmore@centrewellington.ca>; Olivia Beirnes <OBeirnes@centrewellington.ca>
Subject: RE: 465 Garafraxa St W - Fergus

Hi Rob,

In order for us to pull together an accurate estimate to have the watermain and sanitary sewer extended to 465 Garafraxa St W, there is a fee that you will need to pay to help offset the costs of having this estimate prepared by our consultants. Please provide us with who we need to contact to collect this fee and Olivia Beirnes from our office will contact them and process the payment via credit card. The fee amount to be paid is $105.00.

In terms of timing and the possibility of “piggy backing” on the upcoming servicing works associated with 435 Garafraxa St W, unfortunately this will not be an option. As I mentioned, we are in the position to submit or application to the Ministry later this week and if we were to try and include the extension of the sanitary sewer to 465 Garafraxa St W in this same application, will delay the commitments we have already made with the owners of 435 Garafraxa St W. Therefore should you

choose to proceed with extending the watermain and sanitary sewer to 465 Garafraxa St W, we will have to complete the detailed design and submit a separate application to the Ministry for approval. Given that we are already in October, I would say we could be in a position to submit an application to the Ministry by early/mid-December for your project and a typical review period from the Ministry is 6 months therefore we could expect to have Ministry approval by June/July of 2022. We are hoping to have started and possibly completed the servicing works associated with 435 Garafraxa St W before this time (pending Ministry approval).

If you choose to proceed with extending the watermain and sanitary sewer to 465 Garafraxa St W, and given the timing I've mentioned about regarding Ministry approvals, you will want to give some thought about when to actually construct the services. This work will be required to be tender by the Township and we will not issue a tender until we receive Ministry approvals therefore let's assume we receive Ministry approvals in June, this is not an ideal time to be tendering work. In our experience, in order to get competitive pricing from contractors, this type of work should be tender before March of any given year. If you tender beyond that, you may end up paying more to have the services constructed simply because most contractors already have their work for the year and not really interested in getting more. That is not always the case however that has been our experience. Given that this is a relatively small project, contractors might still be interested in it as a "filler job" and the time of year that we tender it might not matter as much however something for you and your team to consider.

Finally, once we have an estimate prepared and if you find that the costs are worth proceeding with the development, we will have you enter into a Service Financing Commitment Agreement where we collect 120% of the total estimated costs which includes all costs associated with design, permits/approvals, bonding, construction of the services, geotechnical services, contract administration/inspection and contingency. Any balance left upon completion of the work would be returned. Adversely, if additional funds are required to complete the works, these overages would be billed back to you.

Hope this gives you what you are looking for, please advise if you would like for the Township to proceed with preparing an estimate to have the watermain and sanitary sewer extended to 465 Garafraxa St W. If so, please make the necessary arrangements to have the fee noted above paid at which point we will commence with the estimate. Once the estimate has been prepared and provided, we can work out the next steps at that time.

Call if you wish to discuss in further detail.

Thanks,

Brandon Buehler | Engineering Technologist – Water/Wastewater

Township of Centre Wellington | 1 MacDonald Square, Elora, ON N0B 1S0
519.846.9691 x356 centrewellington.ca

Office located at: 7444 Wellington Road 21, Elora, ON N0B 1S0

From: Rob Gobbi [mailto:Rob@habitatgw.ca]
Sent: October 4, 2021 2:26 PM
To: Brandon Buehler <BBuehler@centrewellington.ca>
Subject: RE: 465 Garafraxa St W - Fergus

HI Brandon.
Hope you had a good weekend
We now have a conditional offer on the property.
So….in continuance of our due diligence,
Can you please provide me the "cost" associated with having the water, sewer, ect brought out to our site.
.please detail the specifics……length and cost ect……
.along with timing involved.
I know we discussed last month that 435 is having services done next year?
.could we "piggy" back this and have ours done at the same time?

Please advise.
I appreciate your help and assistance with this.

Regards,
Robert Gobbi
Project Manager
Habitat For Humanity
Guelph / Fergus

From: Brandon Buehler <BBuehler@centrewellington.ca>
Sent: October 1, 2021 11:11 AM
To: Rob Gobbi <Rob@habitatgw.ca>
Subject: RE: 465 Garafraxa St W - Fergus

Ok give me a call on Monday, I am just heading out for the day.

Brandon Buehler | Engineering Technologist – Water/Wastewater

Township of Centre Wellington | 1 MacDonald Square, Elora, ON N0B 1S0
519.846.9691 x356 centrewellington.ca

Office located at: 7444 Wellington Road 21, Elora, ON N0B 1S0

From: Rob Gobbi [mailto:Rob@habitatgw.ca]
Sent: October 1, 2021 11:06 AM
To: Brandon Buehler <BBuehler@centrewellington.ca>
Subject: RE: 465 Garafraxa St W - Fergus

HI Brandon…

.ok will do.
Just in a meeting right now.
We have a conditional offer in for 465 Garafaxa West
.so I need “solid info” on the services ……..
.to bring to the site

I will call you and discuss.

Thanks
Rob

From: Brandon Buehler <BBuehler@centrewellington.ca>
Sent: October 1, 2021 10:34 AM
To: Rob Gobbi <Rob@habitatgw.ca>
Subject: 465 Garafraxa St W - Fergus

Hi Rob,

I tried calling you however you voicemail is too full to leave a message. Give me call when you have a minute to discuss servicing the above noted property.

Thanks,

Brandon Buehler | Engineering Technologist – Water/Wastewater

Township of Centre Wellington | 1 MacDonald Square, Elora, ON N0B 1S0
519.846.9691 x356 centrewellington.ca

Office located at: 7444 Wellington Road 21, Elora, ON N0B 1S0

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Appendix B –

Wellington Source Water Protection Comments

March 16, 2022

Memorandum

To: Chantalle Pellizzari – Planning Coordinator, Township of Centre Wellington

Cc: Brett Salmon – Managing Director of Planning & Development, Township of Centre Wellington
Randy Bossence – Chief Building Official, Township of Centre Wellington

From: Danielle Walker – Source Protection Coordinator, Wellington Source Water Protection

Reviewed By: Kyle Davis – Risk Management Official, Township of Centre Wellington

RE: Pre-consultation - Zoning By-Law Amendment Application, 465 Garafraxa Road West, Fergus (Habitat for Humanity Guelph Fergus)

General

The owners and applicant of 465 Garafraxa Road West in Fergus (site) are proposing to construct 28 stacked townhouse units and have requested a pre-consultation for a Zoning By-law Amendment. The following documents/discussions were used to develop these comments:

a. Sketch plan, dated November 9, 2021;
b. Memo from Dryden Smith & Head Planning Consultants Ltd., dated December 6, 2021;
c. Pre-Consultation Request Form; and
d. Vulnerable area mapping, provided to Wellington County by Grand River Conservation Authority.

Summary of Source Protection Vulnerable Areas and Drinking Water Threats

The site is located in:

a) Wellhead Protection Area's C and D (WHPA-C, D), 5 and 25 year time-of-travel, respectively, with low to moderate vulnerability scores of 2-6;
b) Issue Contributing Area's (ICA); and
c) a Wellhead Protection Area for Quantity (WHPA-Q) with a significant risk level.

Attachments show the relevant mapping. Please note the site is not located in a Highly Vulnerable Aquifer (HVA) or a Significant Groundwater Recharge Area (SGRA).

Based on the site sketch, the following drinking water threat activities are proposed or more information is required: stormwater management, consumptive water taking, winter maintenance activities, reduction to groundwater recharge, and potentially handling / storage of liquid fuel and / or chemicals. These threat activities, risk levels and management are discussed in more detail below.

Comments Related to Legal Requirements

1. Due to the site's location in an ICA, a Section 59 Notice under the *Clean Water Act* is required (see Fact Sheet 6) for **all applications** under the *Planning Act* or *Ontario Building Code*.

2. The applicant should fill out, and submit with all future submissions, the attached Drinking Water Source Protection Screening Form. The form is an important tool that the Risk Management office uses to determine how Source Protection Plan policies may affect the site. Please complete this form submit digitally, if possible. Specifically, the screening form should be filled out to clarify the following potential drinking water threat activities: stormwater management, winter maintenance activities, reduction to groundwater recharge and handling / storage of liquid fuel and / or chemicals. Please ensure to note if temporary fuel storage will occur during construction.

3. The proposed development does not meet the 'major development' definition outlined in the Grand River SPP, therefore, the applicable policy is WC-MC-23.4. This policy states the following:

   To ensure that any Recharge Reducing Activity never becomes a significant drinking water threat, where this activity would be a significant drinking water threat as prescribed by the CWA, the Planning Approval Authorities, within the WHPA-Q shall require that all site plan applications under the Planning Act, to facilitate New development not meeting the Major Development definition for new residential, commercial, industrial and institutional uses, implement best management practices such as LID with the goal to maintain predevelopment recharge. This shall include consideration of how recharge will be maintained and water quality will be protected such as from the application and storage of winter maintenance materials including Salt.

   See attached Grand River SPP for full policy text. It is required that this policy be implemented and responded to in future site plan submissions.

4. In our records, it is noted that depending on whether Ontario Regulation 153/04 site condition standards are exceeded, it is possible that a Record of Site Condition may be required for the site. Please consult with the Ontario Ministry of the Environment, Conservation and Parks regarding whether this requirement is needed and provide documentation on whether it is or is not needed with your application to the municipality.

5. Significant drinking water threats and activities must be managed with a legally binding risk management plan pursuant to the *Clean Water Act* and Grand River Source Protection Plan. These include the stormwater management facility, application, storage, and handling of road salt, and storage of snow. The risk management plan must be negotiated and signed prior to the issuance of the final building permits. The risk management plan is drafted by the Risk Management Official and will be forwarded for review. Please contact the undersigned with any questions regarding the risk management plan. Once it is acceptable to the applicant, the applicant must sign and return a copy of the risk management plan so the Risk Management Official can issue it and the relevant notices required for the building permits.

6. Any preferential pathways (transport pathways) existing or created must be reported to the Source Protection Authority by the Township. These include, but are not limited to:

    a. old and/or unused wells that have not been properly abandoned
    b. new vertical geothermal systems
    c. underground infrastructure (parking garages, maintenance tunnels etc.)
    d. removal of large portions of overburden (gravel pits, fill removal)
    e. construction of deep pilings

    There is a 'deep well garbage and recycling' area indicated on the site sketch. Please provide details and depths of this in future submissions as it may be a potential transport pathway.

Comments Related to Non-Legally Binding Recommendations

7. As part of site plan submissions and, if required, the following reports are requested to be circulated to the Risk Management office for review or reference:

    - Site Plan
    - Planning Justification Report
    - Functional Servicing Report
    - Stormwater Management Brief/Report

- Hydrogeological/Water Balance Study
- Drinking Water Threat Screening Form
- Record of Site Condition documentation

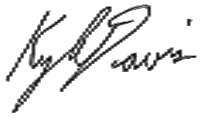
The applicant should please clearly identify all Provincial Instruments, such as Permits to Take Water, Environmental Compliance Approvals, and Environmental Activity and Sector Registrations (EASRs) that will be required for the proposal and provide any necessary technical details or refer to the technical details provided in either the Hydrogeological Study and/or the Stormwater Management Brief/Report.

It is requested that the applicant provide written responses to all of the above comments during the site plan submission. For more information contact one of the undersigned:

Sincerely,

Mar 16, 2022

Danielle Walker, Source Protection Coordinator
519-846-9691 ext 236
dwalker@centrewellington.ca

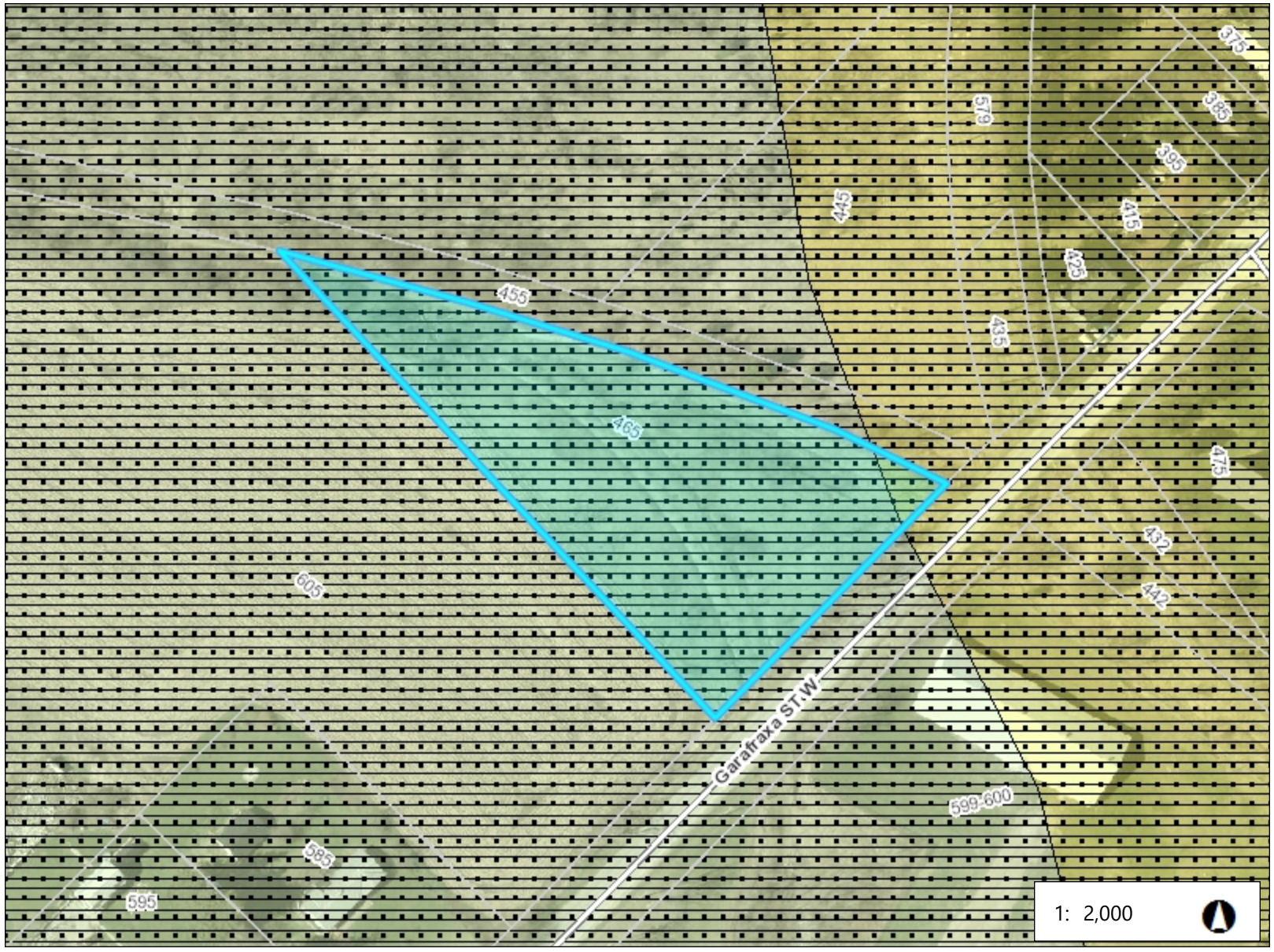


Mar 16, 2022

Kyle Davis, Risk Management Official
519-846-9691 ext 362
kdavis@centrewellington.ca

Attachments –WHPA_Maps
Source Water Protection Screening Form
Grand River Source Protection Policies

465 Garafraxa Street West, Fergus



Legend

- Parcels
- Roads
  - Local Road
  - County Road
  - Highway
- Well Locations
- Wellhead Protection Area Bou
  - A
  - B
  - C
  - D
- Issue Contributing Area
  - Chloride
  - Nitrate
  - Sodium
  - TCE
- Vulnerability Score
  - 10
  - 8, D; 8; 8, C
  - 2, 4, 6 (A, B or C)
  - 2,4,6, D; 2,4, D; 2, 4, 6 (D); 4, D; 6,
- HVA
- RoadsLookup

0.1 0 0.05 0.1 Kilometers

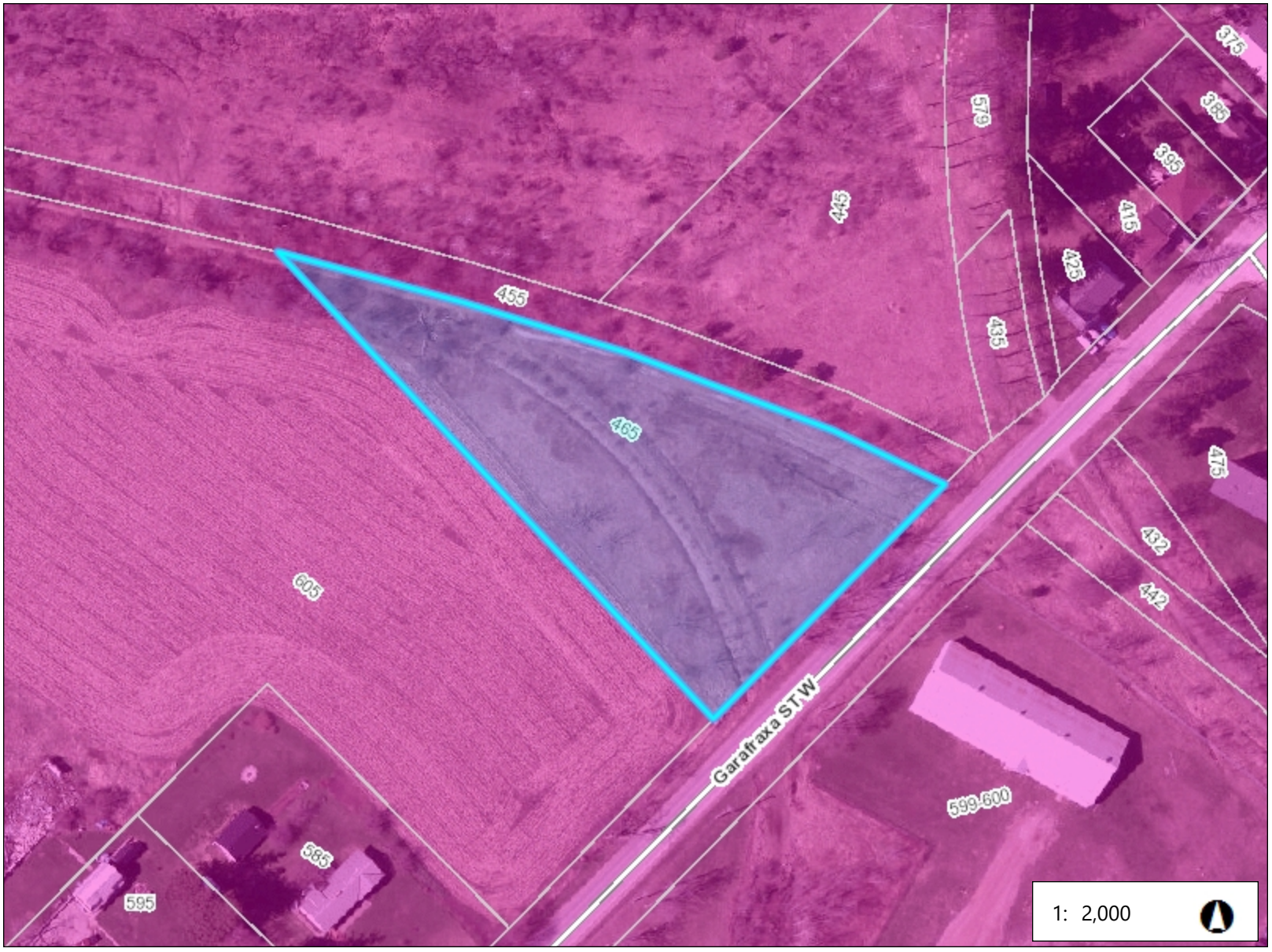
WGS_1984_Web_Mercator_Auxiliary_Sphere

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS IS NOT SURVEY DATA. Parcels - Teranet 2002, Wellington County 2022

Notes

465 Garafraxa Street West, Fergus-Quantity



Legend

- Parcels
- Roads
  - Local Road
  - County Road
  - Highway
- Well Locations
- Q1 and Q2 Boundary
- Q1 and Q2
  - Approved
  - Draft
- SGRA
- RoadsLookup

Notes

0.1 0 0.05 0.1 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS IS NOT SURVEY DATA. Parcels - Teranet 2002, Wellington County 2022

Source_Protection_Comments_GarafraxaW_465_final

Final Audit Report 2022-03-16

Created:	2022-03-16
By:	Danielle Walker (dwalker@centrewellington.ca)
Status:	Signed
Transaction ID:	CBJCHBCAABAAUSoy_sgB0ZiyFvhQnd1ZKXRpw0k3kIGe

"Source_Protection_Comments_GarafraxaW_465_final" History

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Agreement completed.
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Appendix C –

Draft Zoning By-law Amendment and Schedule

DRAFT ZONING BY-LAW

THE CORPORATION OF
THE TOWNSHIP OF CENTRE WELLINGTON

BY-LAW NO. 15.__._

A By-law to amend Zoning By-law 2009-045, as amended, being a Zoning-By-law for the Township of Centre Wellington;

WHEREAS an application was received from Dryden, Smith and Head Planning Consultants (on behalf of Habitat for Humanity Guelph-Wellington) with respect to the lands described as Pt Block 4, Registered Plan 77, Township of Centre Wellington, County of Wellington, known Municipally as 465 Garafraxa Street West, to change the present zone of the lands from Future Development (FD) to Residential R4 zone with an Exemption 15.__._ to permit minimum site specific regulations.

AND WHEREAS this By-law conforms to the Township of Centre Wellington Official Plan;

NOW THEREFORE Township Council enacts as follows:

1. That By-law Number 2019-051, as amended, is hereby further amended insofar as the zoning on these lands, described as Pt Block 4, Registered Plan 77, Township of Centre Wellington, Municipally known as 465 Garafraxa Street West, to amend By-law Number 2019-051, in accordance with Schedule 'A' attached hereto, to change the present zone of Future Development (FD) to Residential R4 (R4) with an exemption 15.__._—to permit minimum site-specific regulations. Section 15.__._ is as follows:

15.__._ Notwithstanding any other provision of this By-law to the contrary, in a R4.__._ Zone the following special provisions shall apply:

Lot Regulations

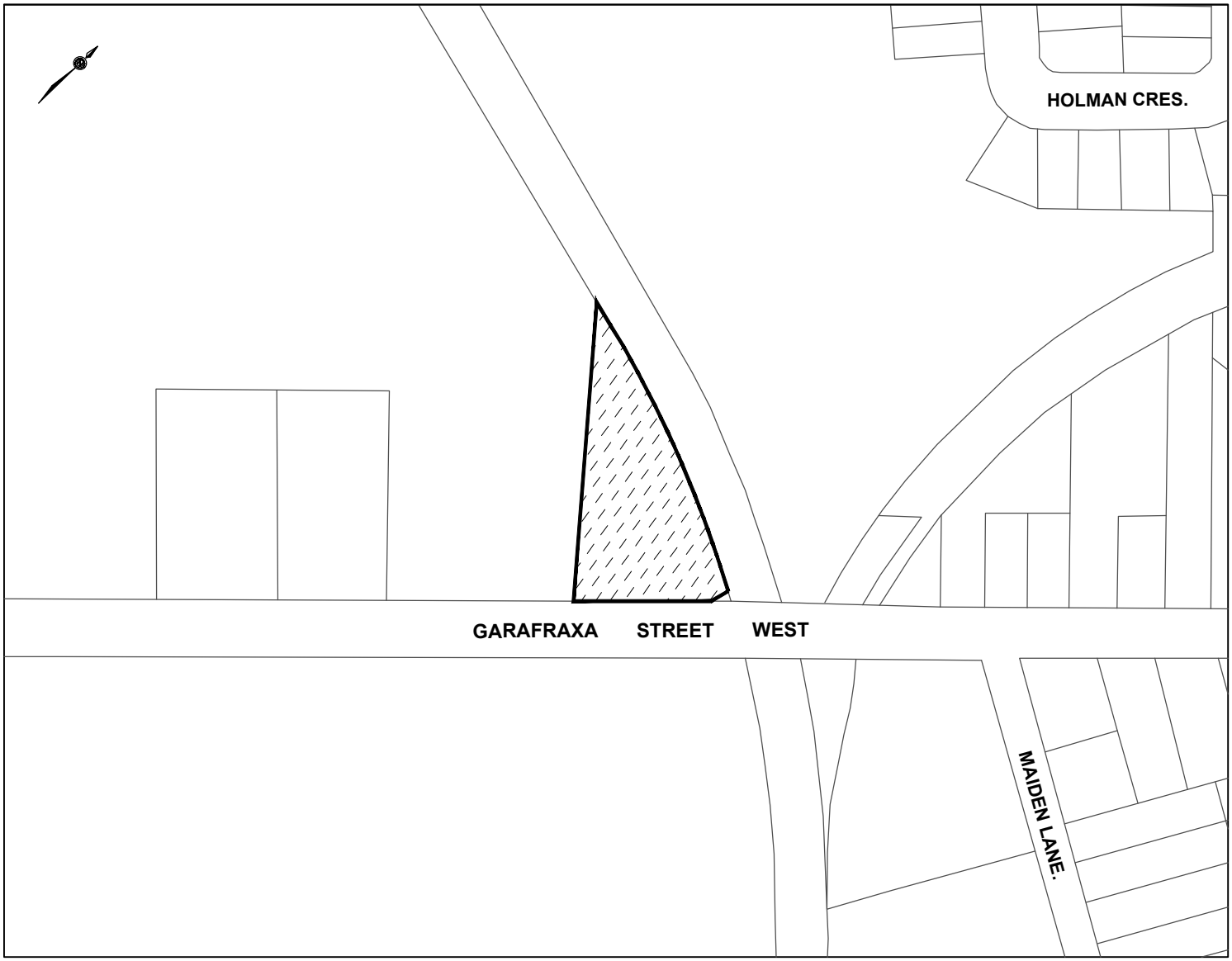
a) Minimum *Interior Side Yard* of 2.3 ±m
b) Minimum *Building Separation* of 3.0 ±m
c) Minimum *Private Amenity Area Depth* of 4.0 ±m
d) Minimum above-grade unit *Private Amenity Area* of 4.65 ±m^2

Read the first and second time in the Council Chambers of the Township of Centre Wellington this _____ day of _____, 2023.

Read the third time and **passed** in the Council Chambers of the Township of Centre Wellington this _____ day of _____, 2023.

_____	_____
S. Watters	K. O'Kane
Mayor	Municipal Clerk

DRAFT
Schedule 'A'
Zoning By-Law Amendment
Township of Centre Wellington
465 Garafraxa Street West



**Lands redesignated from Future Development (FD)
to the Residential R4 Zone with Site-Specific provisions**

Appendix C
Zoning By-law Amendment Schedule 'A' (DRAFT)
465 Garafraxa Street West
Township of Centre Wellington

Appendix D –

Functional Servicing and Stormwater Management Report

Functional Servicing and Stormwater Management Design Report for:

465 Garafraxa Street West
Township of Centre Wellington (Fergus)

GMBP File: 422144

January 2023

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA
330 TRILLIUM DRIVE, UNIT D , KITCHENER ON N2E 3J2 P: 519-748-1440
WWW.GMBLUEPLAN.CA

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APPENDICES

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT DESIGN REPORT

465 GARAFRAXA STREET WEST

TOWNSHIP OF CENTRE WELLINGTON (FERGUS)

JANUARY 2023

GMBP FILE: 422144

1. INTRODUCTION

This report documents the proposed servicing and stormwater management system design for the proposed development at 465 Garafraxa Street West in the Township of Centre Wellington (Fergus).

The Owner is required to have a Professional Engineer design a stormwater management system and have said Engineer supervise and certify that the stormwater management system was installed in accordance with the approvals given under Section 41 of the Planning Act.

The topographic survey of the site was completed by GM BluePlan Engineering Limited (dated January 30, 2022). The site layout was prepared by Dryden, Smith and Head Planning Consultants Ltd. (dated January 2023).

2. SITE INFORMATION

The 0.42-hectare site is located at 465 Garafraxa Street West in the Township of Centre Wellington (Fergus). The site is bound by Garafraxa Street West to the east and farmland to the north, south and west.

Under existing conditions, runoff generated from the site sheetflows generally from west to east of the roadside ditch on Garafraxa Street West.

At this time, the intent of the Owner is to construct three 3-storey stacked townhouse buildings. The total number of units is proposed to be 32. The site will be serviced with municipal sanitary sewer and water, via an extension of the existing municipal services on Garafraxa Street West from Maiden Lane.

3. PROPOSED DEVELOPMENT

3.1 Site Grading

The site layout and the internal roads are shown on the Site Grading Plan (GM BluePlan Engineering Limited Drawing No. 2). The elevations of the internal road network is controlled by the centerline road elevations of Garafraxa Street West, the building elevations, and the existing property line elevations.

3.2 Water Supply

Water supply for the proposed development will be provided via a future 150mm diameter watermain along Garafraxa Street West, and a 150mm diameter service connection to the from the 150mm watermain on Garafraxa Street West.

Watermain will be installed to a minimum depth of 2.0 meters below finished grade.

Fire protection for the proposed development will be provided by the proposed on-site fire hydrant.

3.3 Sanitary Servicing

Sanitary servicing for the proposed development will be provided via the extension of a 200mm diameter sanitary sewer from the future 200mm diameter sanitary sewer on Garafraxa Street West.

Sanitary sewers (minimum grade of 0.5%) will be installed at a minimum depth of 2.5 metres below finished grade. Sanitary sewer design sheets have been provided in Appendix C.

3.4 Storm Servicing

Under existing conditions, runoff generated from the site sheetflows overland to the existing ditch along the northwesterly boundary of the site.

Storm service for the proposed development will be provided via the installation of storm sewers on site and connection to the future storm sewer on Garafraxa Street West. The on-site storm sewers will convey runoff to the future storm sewers to be installed on Garafraxa Street West.

All storm sewers within the development will be sized (at minimum) to accommodate the 5-year design storm event. Major storm runoff will be conveyed within the limits of the internal road network, ultimately discharging to the Garafraxa Street West right-of-way. Storm sewer design sheets have been provided in Appendix D.

4. STORMWATER MANAGEMENT DESIGN

4.1 Stormwater Management Criteria

The stormwater management criteria for the site are as follows:

1. Post-development flows from the site are to be attenuated to pre-development levels.
2. Promoting the infiltration of rooftop runoff, if feasible, to achieve a site water balance should be explored.
3. Enhanced (80% TSS removal) quality control treatment is required for runoff generated by the site.
4. Major storm flows are to be routed overland to an appropriate outlet.

The Fergus Shad Dam Chicago Storm parameters and the total depth of rainfall used for the full range of design storms are as follows:

Table No. 1: Chicago Rainfall Distribution Parameters

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
a =	695.047	1,459.072	2,327.596	3,701.648	5,089.418	6,933.019
b =	6.387	13.690	19.500	25.500	30.000	34.699
c =	0.793	0.850	0.894	0.937	0.967	0.998
r =	0.380	0.380	0.380	0.380	0.380	0.380
Duration (minutes) =	180	180	180	180	180	180
Rainfall Depth (mm) =	33.014	49.792	61.359	75.581	86.737	97.921

The Horton infiltration method was used in the runoff calculations. The parameters used in MIDUSS are as follows:

Table No. 2: Horton Infiltration Parameters

	Impervious Areas	Pervious Areas
Maximum Infiltration	0.0 mm/hr	75.0 mm/hr
Minimum Infiltration	0.0 mm/hr	12.5 mm/hr
Lag Constant	0.0 hr	0.25 hr
Depression Storage	1.5 mm	5.0 mm

The hydrologic model MIDUSS was used to create runoff hydrographs and to route the flows through the storage structures.

4.2 Existing Conditions

For the existing condition analysis, the site was modelled as one (1) drainage catchment (see Figure No. 1).

Catchment 10 (0.42-hectares, 0% Impervious) represents the entire site under existing conditions. Runoff generated from Catchment 10 discharges to the existing swale at the rear of the property, and ultimately to the existing pond adjacent to Beatty Line North and Black Street.

Table No. 3: Existing Condition Flow Rates

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Catchment 10	0.003 m^3/s	0.033 m^3/s	0.054 m^3/s	0.085 m^3/s	0.109 m^3/s	0.132 m^3/s

4.3 Allowable Release Rates

From the Township of Centre Wellington, the post-development flows generated from the site are to be attenuated to the existing condition levels. Therefore, the allowable release rates from the site under post-development conditions are as follows:

Table No. 4: Allowable Release Rates

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Catchment 10	0.003 m^3/s	0.033 m^3/s	0.054 m^3/s	0.085 m^3/s	0.109 m^3/s	0.132 m^3/s

4.4 Post-Development Condition Drainage Areas

For the post-development condition analysis, the site was modelled as five (5) drainage catchments (see Figure No. 2).

Catchment 100 (0.03-hectares, 100% Impervious) represents the rooftop of Block A. Discharge from Block A is directed to a proposed infiltration gallery.

The on-site infiltration gallery proposed for Catchment 100, having an area of $42m^2$, provides $14m^3$ of storage. This gallery was designed to infiltrate the 5-year design storm event runoff volume from the rooftop of Block A. Overflow from the on-site infiltration gallery is directed to the proposed on-site storm sewers via a 250mm diameter pipe connected to MH.8.

Catchment 200 (0.03-hectares, 100% Impervious) represents the rooftop of Block B. Discharge from Block B is directed to a proposed infiltration gallery.

Catchment 300 (0.04-hectares, 100% Impervious) represents the rooftop of Block C. Discharge from Block C is directed to a proposed infiltration gallery.

The on-site infiltration gallery proposed for Catchments 200 and 300, having an area of $95m^2$, provides $31.7m^3$ of storage. This gallery was designed to infiltrate the 5-year design storm event runoff volume from the rooftop of Blocks B and C. Overflow from the on-site infiltration gallery is directed to the proposed on-site storm sewers via a 250mm diameter pipe connected to MH.85

Catchment 400 (0.13-hectares, 0% Impervious) represents the perimeter of the site. Runoff generated from Catchment 400 will continue to discharge to the existing ditch to the northwest of the site via sheetflow overland.

Catchment 500 (0.19-hectares, 95% Impervious) represents the proposed on-site driving and parking areas. Runoff generated from Catchment 500 will discharge to the proposed storm sewers, prior to discharging to the future storm sewers on Garafraxa Street West. Quantity control for runoff generated by Catchment 500 will be provided by a 90mm diameter orifice plate installed in CBMH.6, along with pipe storage and parking lot ponding. The proposed oversized storm sewers pipe will provide approximately $12.1m^3$ of storage and the proposed parking lot ponding will provide an additional $15.8m^3$ of storage up to the weir elevation of 415.32.

Quality control treatment for runoff generated by Catchment 500 will be provided via the proposed oil/grit separator structure (Stormceptor EFO4 or approved equivalent).

Stormceptor sizing details can be found in Appendix B.

4.5 Routing

The hydrologic model MIDUSS was used to create the design storm runoff hydrographs and to route the hydrographs. A copy of the final printout of the hydrologic modelling is appended in Appendix "B".

The results of the routing analysis are as follows:

Table No. 5: Catchment 100 Infiltration Gallery Stage/Storage/Discharge Capacities

	Available Capacity			Actual Capacity Used		
	Peak Flow m^3/s	**Storage Volume m^3**	**Storage Elevation m**	**Peak Flow m^3/s**	**Storage Volume m^3**	**Storage Elevation m**
Bottom of Stone	0.000	0.0	412.55	---	---	---
2-Year	---	---	---	0.0001	8.1	413.13
5-Year	---	---	---	0.002	12.6	413.45
Top of Stone	0.0002	14.0	413.55	---	---	---
Invert of Overflow Pipe	0.0002	14.2	413.85	---	---	---
10-Year	---	---	---	0.001	14.2	413.86
25-Year	---	---	---	0.004	14.2	413.88
50-Year	---	---	---	0.006	14.2	413.89
100-Year	---	---	---	0.009	14.2	413.91
Obvert of Overflow Pipe	0.0463	14.5	414.10	---	---	---

Table No. 6: Catchment 200 & 300 Infiltration Gallery Stage/Storage/Discharge Capacities

	Available Capacity			Actual Capacity Used		
	Peak Flow m^3/s	**Storage Volume m^3**	**Storage Elevation m**	**Peak Flow m^3/s**	**Storage Volume m^3**	**Storage Elevation m**
Bottom of Stone	0.000	0.0	411.80	---	---	---
2-Year	---	---	---	0.0001	17.9	412.37
5-Year	---	---	---	0.0003	28.6	412.70
Top of Stone	0.0003	31.7	412.80	---	---	---
Invert of Overflow Pipe	0.0003	31.7	413.10	---	---	---
10-Year	---	---	---	0.002	31.7	413.11
25-Year	---	---	---	0.008	31.8	413.15
50-Year	---	---	---	0.013	31.8	413.19
100-Year	---	---	---	0.020	31.9	413.22
Obvert of Overflow Pipe	0.0465	32.0	413.35	---	---	---

Table No. 7: Catchment 500 Superpipe and Parking Lot Ponding Stage/Storage/Discharge Capacities

	Available Capacity			Actual Capacity Used		
	Peak Flow m^3/s	Storage Volume m^3	Storage Elevation m	Peak Flow m^3/s	Storage Volume m^3	Storage Elevation m
Invert of Orifice Plate	0.000	0.0	413.59	---	---	---
Invert of Pipe	0.002	0.0	413.62	---	---	---
Obvert of Pipe	0.012	12.1	414.15	---	---	---
T/G DCB.6	0.020	13.0	415.02	---	---	---
2-Year	---	---	---	0.021	14.7	415.15
5-Year	---	---	---	0.022	27.4	415.32
Weir	0.022	27.9	415.32	---	---	---
10-Year	---	---	---	0.040	28.4	415.32
25-Year	---	---	---	0.065	28.7	415.32
50-Year	---	---	---	0.072	28.8	415.33
100-Year	---	---	---	0.089	29.1	415.33
Overflow	0.505	58.4	415.47	---	---	---

In summary, the post-development flow rates from the site are as follows:

Table No. 8: Post-Development Condition Flow Rates

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Catchment 100	0.000 m^3/s	0.000 m^3/s	0.000 m^3/s	0.000 m^3/s	0.000 m^3/s	0.000 m^3/s
Catchment 200 & 300	0.000 m^3/s	0.000 m^3/s	0.000 m^3/s	0.000 m^3/s	0.000 m^3/s	0.000 m^3/s
Catchment 400	0.001 m^3/s	0.008 m^3/s	0.014 m^3/s	0.023 m^3/s	0.029 m^3/s	0.035 m^3/s
Catchment 500 and overflow from Catchments 100, 200 & 300	0.021 m^3/s	0.022 m^3/s	0.040 m^3/s	0.065 m^3/s	0.072 m^3/s	0.089 m^3/s
Total	**0.021 m^3/s**	**0.030 m^3/s**	**0.050 m^3/s**	**0.076 m^3/s**	**0.087 m^3/s**	**0.122 m^3/s**

Table No. 9: Comparison of Allowable Release Rate and Post-Development Condition Flow Rates

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Post-Development Flow Rate	0.021 m^3/s	0.030 m^3/s	0.050 m^3/s	0.076 m^3/s	0.087 m^3/s	0.122 m^3/s
Allowable Release Rate	0.003 m^3/s	0.033 m^3/s	0.054 m^3/s	0.085 m^3/s	0.109 m^3/s	0.132 m^3/s

Therefore, under post-development conditions, runoff during the 5 through 100-yar design storm events has been attenuated to less than the allowable release rates.

5. MAINTENANCE PLAN

To ensure that the stormwater management system continues to function as designed and constructed, we recommend that the following inspections and maintenance activities be completed on an annual basis:

1. Is there any noticeable damage to the asphalt and grassed swale (i.e. erosion, blockages)? If yes, complete any necessary repairs.
2. Is there any indication of a spill (i.e. frothy water, oily sheen)? If yes, investigate, inform the appropriate agencies and complete the necessary clean-up and restoration.
3. Inspect all roof drains and associated piping. Remove and dispose of any accumulated sediment, trash/litter, debris (i.e. leaves).
4. Inspect the oil/grit structure and complete any necessary maintenance/repair activities as identified by the manufacturer.
5. Inspect all catchbasins, and manholes. Remove and dispose of any accumulated sediment, trash/litter, debris (i.e. sediment, garbage, leaves, etc.).
6. Inspect all swales and overflow locations. Remove and dispose of any accumulated sediment, trash/litter, debris (i.e. sediment, garbage, leaves. etc.).

Please note that any structures identified during the annual inspection to be worn, missing or damaged are to be repaired or replaced within 48 hours.

6. SEDIMENT AND EROSION CONTROL

A silt fence will be installed along the property boundary in all locations where runoff will discharge from the site to adjacent lands. The silt fence will serve to minimize the opportunity for waterborne sediments to be washed on to the adjacent properties.

Inspection and maintenance of all silt fencing will start after installation is complete. The fence will be inspected on a weekly basis during active construction or after a rainfall event of 13 mm or greater. Maintenance will be carried out, within 48 hours, on any part of the facility found to need repair.

Once construction and landscaping has been substantially completed, the silt fence will be removed, any accumulated sediment will be removed and the landscaping will be completed.

Prior to construction, a mud mat will be installed at the entrance/exit location for the site. Similarly, prior to construction silt sacks will be placed in each catchbasin, as outlined in the Erosion and Sediment Control Plan. Once construction and landscaping has been substantially completed, the mud mat, catchbasin silt sacks, and any accumulated sediment therein will be removed.

After construction of the complete development, erosion and sediment transport will be minimal.

7. CONCLUSIONS

In summary, the features of the design for the proposed development at 465 Garafraxa Street West in the Township of Centre Wellington (Fergus) are as follows:

1. Water supply for the proposed development will be provided via a future 150mm diameter watermain along Garafraxa Street West, and a 150mm diameter service connection to the from the 150mm watermain on Garafraxa Street West.
2. Sanitary servicing for the proposed development will be provided via the extension of a 200mm diameter sanitary sewer from the future 200mm diameter sanitary sewer on Garafraxa Street West.
3. Storm service for the proposed development will be provided via the installation of storm sewers on site and connection to the future storm sewer on Garafraxa Street West. All storm sewers within the development have been sized to accommodate the 5-year design storm event.
4. The post-devleopment flow rates for the 5 through 100-year design storm events have been attenuated to less than the allowable release rates.
5. Major overland flows are routed through the site to Garafraxa Street West, while not exceeding a maximum ponding depth of 0.30m.
6. Prior to construction, a silt fence will be installed along the property boundary in all locations where runoff will discharge from the site to adjacent lands. A mud mat will be installed at the entrance/exit location for the site. Silt sacks will be placed in each catchbasin, as outlined in the Erosion and Sediment Control Plan. This will minimize the transport of sediment off-site during the construction period.
7. Quality control for the site is provided via the proposed oil/grit separator (Stormceptor EFO4 or approved equivalent).

All of which is respectfully submitted.

GM BLUEPLAN ENGINEERING LIMITED

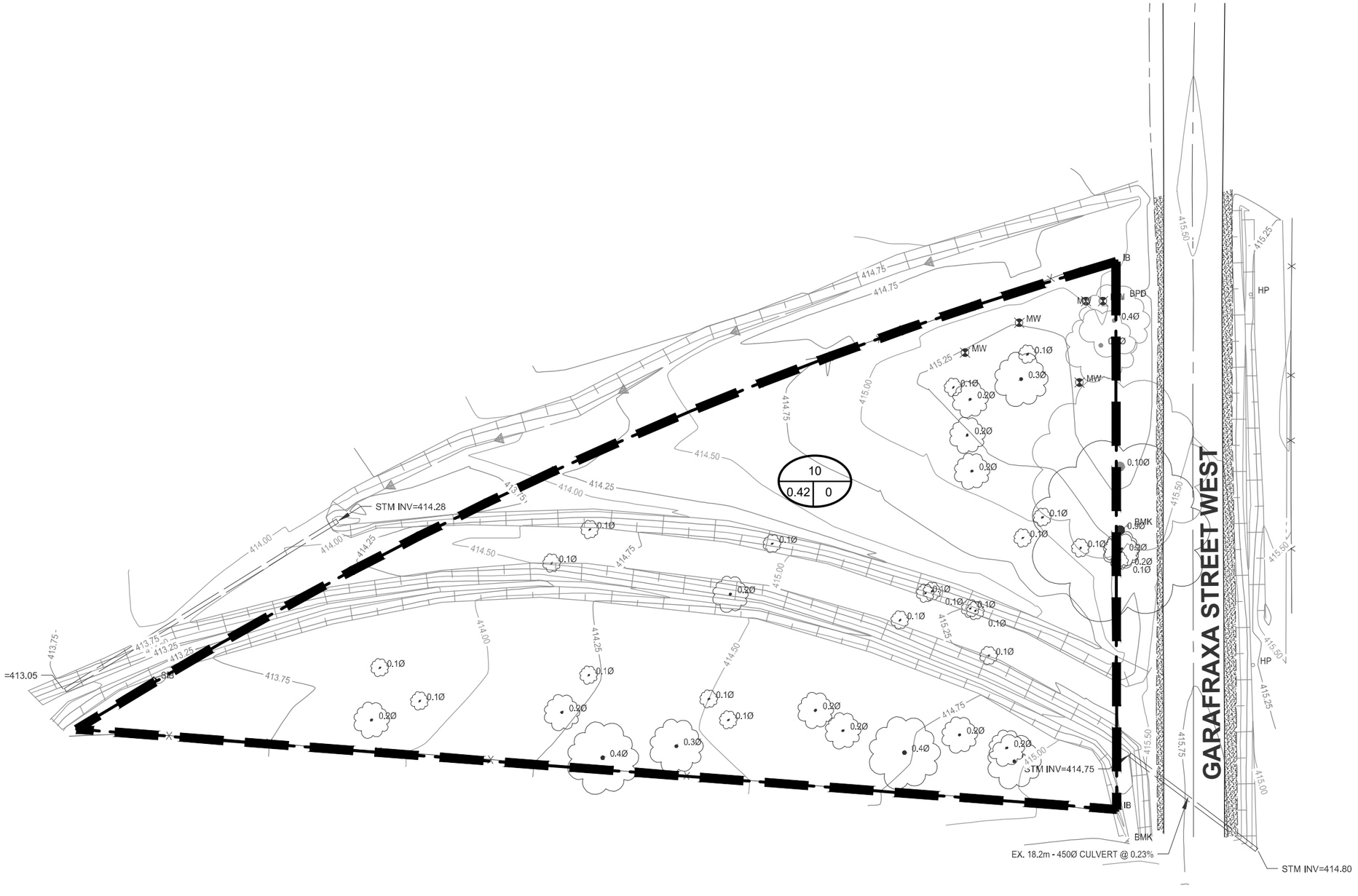
Per:

Patrick Grier, P. Eng.

Encl.

W:\Kitchener\422-2022\422144 - 465 Garafraxa Street West Fergus\Design Phase\Reports - SWM, FSR, Design Brief, etc\422144 FSR and SWM Report - 2023-01-30.docx

465 GARAFRAXA STREET WEST TOWNSHIP OF CENTRE WELLINGTON



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LEGEND

- EX. STORM SEWER
- DRAINAGE AREA BOUNDARY
- 100 / 0.11 | 80 — CATCHMENT NUMBER; % IMPERVIOUS; CATCHMENT AREA IN HECTARES

5 0 5 10 20
1:500 (m)

EXISTING CONDITIONS DRAINAGE AREA PLAN

Figure No. 1

BluePlan ENGINEERING

422144
JANUARY 2023
Scale: 1:500 | NAD 1983 UTM Zone 17N

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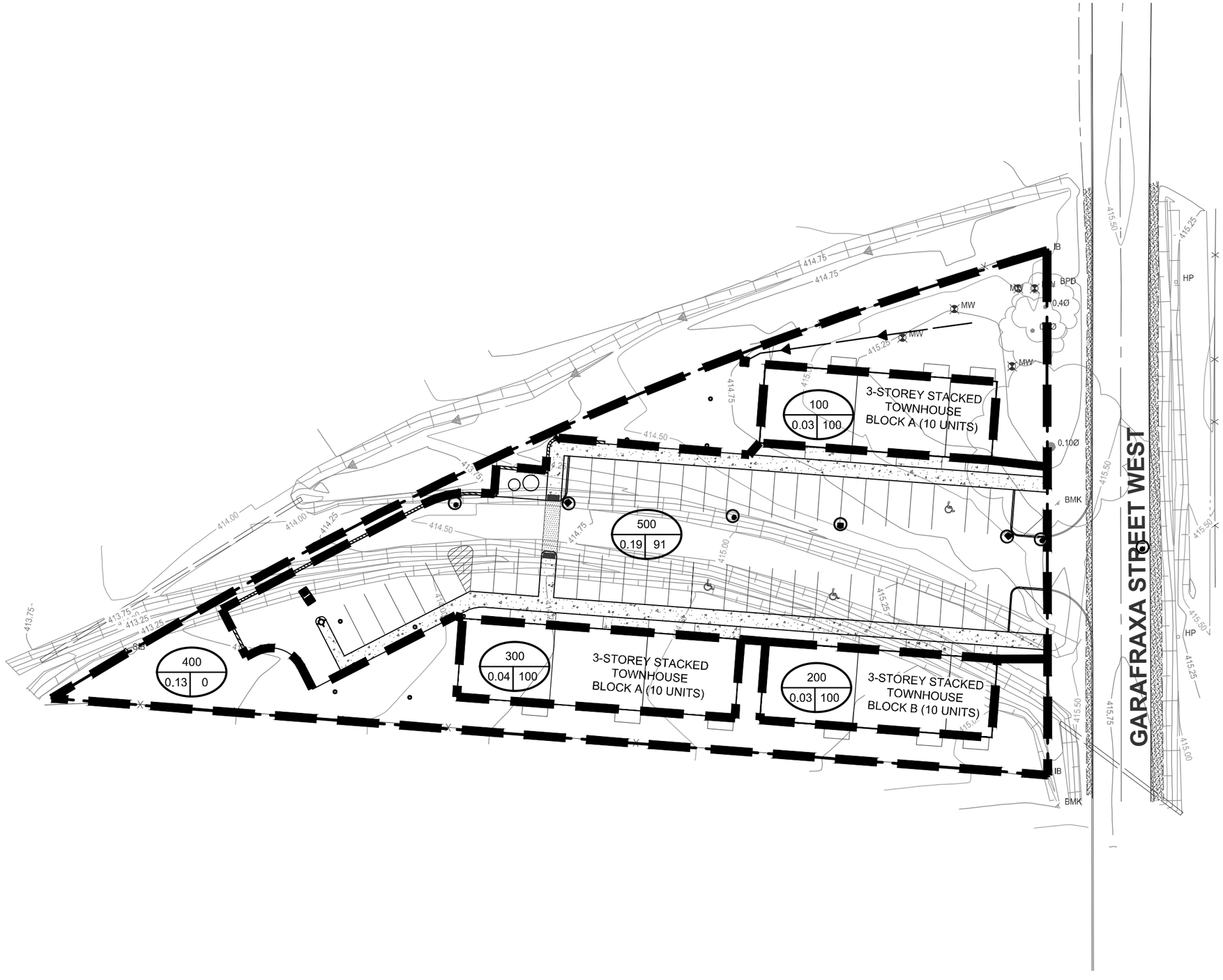
465 GARAFRAXA STREET WEST TOWNSHIP OF CENTRE WELLINGTON



LEGEND

- PROP. STORM SEWER
- DRAINAGE AREA BOUNDARY
- 1000 / 0.11 | 80 — CATCHMENT NUMBER; % IMPERVIOUS; CATCHMENT AREA IN HECTARES

5 0 5 10 20
1:500 (m)

POST DEVELOPMENT DRAINAGE AREA PLAN

Figure No. 2

BluePlan ENGINEERING

422144
JANUARY 2023
Scale: 1:500 | NAD 1983 UTM Zone 17N

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APPENDIX A:
Geotechnical Investigation
(CMT Engineering Inc., November 28, 2022)

GEOTECHNICAL INVESTIGATION

GEOTECH – PROPOSED TOWNHOUSE DEVELOPMENT
465 GARAFRAXA STREET WEST
FERGUS, ONTARIO

CMT Project 22-765.R01

Prepared for:

Habitat for Humanity

November 28, 2022

CMT Engineering Inc.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Tel: 519-699-5775
Fax: 519-699-4664
www.cmtinc.net

November 28, 2022 22-765.R01

Habitat for Humanity
104 Dawson Road
Suite 100B
Guelph, Ontario
N1H 1A6

Attention: Janey Secnic

Dear Janey:

Re: Geotechnical Investigation
Geotech – Proposed Townhouse Development
465 Garafraxa Street West
Fergus, Ontario

As requested, CMT Engineering Inc. conducted a geotechnical investigation at the above referenced site, and we are pleased to present the enclosed report.

We trust that this information meets your present requirements, and we thank you for allowing us to undertake this project. Should you have any questions, please do not hesitate to contact our office.

Yours truly,

Jake Feeney P. Eng.

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TABLE OF CONTENTS

1.0 INTRODUCTION

The services of CMT Engineering Inc. (CMT Inc.) were retained by Janey Secnic of Habitat for Humanity to conduct a geotechnical investigation for the proposed new townhouse development to be constructed at 465 Garafraxa Street West, Fergus, Ontario. The location of the site is shown on Drawing 1.

It is understood that the project will involve the construction of three (3) townhouse blocks with associated roadways and parking areas.

The purpose of the geotechnical investigation was to assess the existing soil and groundwater conditions encountered in the boreholes. Included in the assessment are the soil classification and groundwater observations, as well as comments and recommendations regarding geotechnical resistance (bearing capacity); serviceability limit states (anticipated settlement); dewatering considerations; site classification for seismic site response; recommendations for site grading, site servicing, excavations and backfilling; recommendations for slab-on-grade construction; pavement design/drainage; soil design properties; and a summary of the laboratory results.

The recommendations provided in this report are solely based on the information obtained from the boreholes advanced on the subject site.

2.0 EXISTING SITE CONDITIONS

The site of the proposed residential development is located to the Northwest of Garafraxa Street West. The site is bounded by Garafraxa Street West to the Southeast, undeveloped land to the Northeast and Northwest, and agricultural land to the Southwest. The site currently comprises vacant land, with some trees and a walking trail. In general, the site topography is relatively flat with existing ditches throughout the proposed construction area. It is understood that the site is to be serviced by municipal services.

3.0 FIELD AND LABORATORY PROCEDURES

The field investigation was conducted on November 16, 2022 and comprised the advancement of seven (7) boreholes (referenced as Boreholes 1 to 7), utilizing a Geoprobe 7822DT drillrig operated by employees of CMT Drilling Inc. Boreholes 1 to 5 were advanced to depths of approximately 5.18 m (17.00 ft) below the existing ground surface in the area of the proposed townhouses. Boreholes 6 and 7 were advanced to depths of approximately 1.52 m (5.00 ft) below the existing ground surface in the area of the proposed parking lot. Prior to the field investigation being carried out, underground service locates were undertaken to ensure that existing utilities would not be damaged, or any personnel injured.

Standard penetration testing and sampling was carried out in Boreholes 1 to 5 using 38 mm inside diameter split spoon sampling equipment and an automatic hammer, in accordance with ASTM D1586 "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". SPT soil sampling was generally conducted at 0.76 m (2.5 ft) intervals to 3.05 m (10.00 ft) and every 1.52 m (5.00 ft) thereafter, to borehole termination. Macro core (MC5) direct push sampling was conducted between the SPT soil samples conducted below 3.05 m (10.0 ft) depth and throughout Boreholes 6 and 7. Technical staff from CMT Inc. observed the drilling operation and collected and logged the recovered soil samples. A small portion of each sample was placed in a sealed, marked jar for moisture content determinations.

Representative soil samples from the boreholes at the following depths were submitted to the CMT Inc. laboratory in St. Clements, Ontario for grain size analyses:

- Borehole 3 – depth 1.52 m to 2.13 m (5.00 ft to 7.00 ft); and
- Borehole 5 – depth 3.05 m to 3.66 m (10.00 ft to 12.00 ft).

The borehole logs are provided in Appendix A and the resulting grain size analyses can be found in Appendix B.

The ground surface elevations of the boreholes were surveyed by CMT Inc. (using laser survey equipment) following the completion of drilling. The ground surface elevation of the existing bell pedestal located on the Southeast side of the site beside Garafraxa Street West was utilized as a temporary benchmark, with an assumed elevation of 100.00 m. As such, the ground surface elevation at the borehole locations ranged from approximately 99.34 m to 100.20 m. The locations of the boreholes are shown on Drawing 2.

4.0 SUBSOIL CONDITIONS

The soils encountered in the boreholes are described briefly below and a more detailed stratigraphic description is provided on the borehole logs in Appendix A. The following paragraphs have been simplified into terms of major soil strata. The soil boundaries indicated have been inferred from non-continuous samples and observations of sampling and drilling resistance and typically represent transitions from one soil type to another rather than exact planes of geological change. Further, the subsurface conditions are anticipated to vary between and beyond the borehole locations.

4.1. Topsoil

Loose, dark brown, silty, organic topsoil in a moist state was encountered at the surface of Boreholes 4 and 7 and buried within the sand and gravel fill soil at Boreholes 1 and 2. The thickness of the topsoil was observed to range from about 300 mm to 600 mm (average 450 m) at the borehole locations, however the thickness of the topsoil is anticipated to vary throughout the site. Materials noted as topsoil in this report were classified based on visual and textural evidence. Testing of organic content or for other nutrients was not carried out.

4.2. Sand and Gravel Fill

Brown sand and gravel fill was encountered at the surface of Boreholes 1 to 3 and 6. Black buried topsoil was observed within the sand and gravel fill at Boreholes 1 and 2. The sand and gravel fill were compact with SPT N-values ranging from about 14 to 19 blows per 0.30 m (average 17 blows per 0.30 m). The sand and gravel fill soils are considered to be moist, with moisture contents ranging from about 7.6% to 10.6% (average 9.4%).

4.3. Silt Fill

Brown silt fill with trace gravel was encountered at the surface of Borehole 4. Black staining was observed within the silt fill. The silt fill was considered to be firm with a SPT N-value of about 4 blows per 0.30 m. The silt fill was considered to be moist, with a moisture content of about 11.8%.

4.4. Silty Sand

Brown silty sand was encountered underlying the sand and gravel fill at Borehole 1, the sandy silt at Borehole 2, the silt fill at Borehole 4 and the topsoil at Borehole 5 and 7. The silty sand was observed to extend to the termination depth of Borehole 7. The silty sand was considered to be loose to compact with SPT N-values ranging from about 9 to 29 blows per 0.30 m (average 18 blows per 0.30 m). The silty sand soils are considered to be moist, with moisture contents ranging from about 5.2% to 14.3% (average 9.7%).

4.5. Sandy Silt/Sandy Silt Till

Brown to grey sandy silt/sandy silt till with some clay and trace gravel were encountered underlying the silty sand at Boreholes 1, 2, 4 and 5 and underlying the sand and gravel fill at Boreholes 2, 3 and 6. The sandy silt/sandy silt till was observed to extend to the termination depths of Boreholes 1 to 6. The sandy silt/sandy silt till was considered to be stiff to hard with SPT N-values ranging from about 10 to greater than 100 blows per 0.30 m (average 43 blows per 0.30 m). The sandy silt/sandy silt till soils are considered to be moist, with moisture contents ranging from about 3.1% to 15.9% (average 9.3%).

4.6. Groundwater

No accumulated groundwater or seepage was observed upon completion of the boreholes. It should be noted that the stiff to hard sandy silt till soils encountered in the boreholes have the potential to created perched groundwater conditions in any overlying soils. Groundwater conditions (particularly perched water) are generally dependent on the weather conditions, amount of precipitation, site grading and other measures in place to control surface water drainage, as well as the time of year, and can fluctuate significantly in elevation over time.

Recommendations with respect to dewatering conditions are provided in Section 5.8 of this report, and recommendations regarding waterproofing and drainage are presented in Section 5.10.

5.0 DISCUSSION AND RECOMMENDATIONS

This section of the report provides CMT Inc.'s interpretation of the factual geotechnical data obtained during the investigation and is intended for the guidance of the owner and design engineer. Where comments are made on construction, they are provided only to highlight those aspects which could affect the design of the project. Contractors bidding on or undertaking the work should make their own independent interpretation of the factual subsurface information provided as it affects their proposed construction means and methods, equipment selection, scheduling, pricing, and the like.

Utilizing the information gathered during the geotechnical investigation and assuming that the borehole information is representative of the subsoil conditions throughout the site, the following comments and recommendations are provided.

5.1. Serviceability and Ultimate Limit Pressure

Based on the information obtained from the boreholes, the following table provides a summary of the estimated geotechnical reaction at the Serviceability Limit State (SLS) and the factored geotechnical resistance at the Ultimate Limit State (ULS) at the various elevations, including soil type:

BH No.	Ground Surface Elevation (m)	SLS kPa (psf)	ULS kPa (psf)	Estimated Highest Founding Elevations (m)	Depth Below Existing Grade to Founding Elevation (m)	Soil Type
BH1	100.20	150 (3,000)	225 (4,500)	99.13 to 97.15	1.07	Sand and Gravel Fill/Silty Sand/Sandy Silt Till
		200 (4,000)	300 (6,000)	97.15 to 95.02 (termination)	3.05	
BH2	99.83	150 (3,000)	225 (4,500)	98.86 to 97.54	0.97	Sandy Silt/Silty Sand/Sandy Silt Till
		200 (4,000)	300 (6,000)	97.54 to 94.65 (termination)	2.29	
BH3	99.34	150 (3,000)	225 (4,500)	98.58 to 97.05	0.76	Sandy Silt Till
		200 (4,000)	300 (6,000)	97.05 to 94.16 (termination)	2.29	
BH4	99.40	100 (2,000)	150 (3,000)	98.64 to 97.11	0.76	Silty Sand/Sandy Silt Till
		150 (3,000)	225 (4,500)	97.11 to 96.35	2.29	
		200 (4,000)	300 (6,000)	96.35 to 94.22 (termination)	3.05	
BH5	100.17	150 (3,000)	225 (4,500)	99.57 to 97.12	0.60	Silty Sand/Sandy Silt Till
		200 (4,000)	300 (6,000)	97.12 to 94.99 (termination)	3.05	

Based on the bearing capacities and elevations provided in the table above, soils suitable to support conventional foundations designed with an estimated bearing capacity of 150 kPa (3,000 psf) at SLS and 225 kPa (4,500 psf) at ULS were typically encountered in the shallower native soils encountered underlying the fill soils in the boreholes at depths ranging from 0.6 m to 2.29 m below the existing ground surface.

Based on the bearing capacities and elevations provided in the table above, soils suitable to support conventional foundations designed with an estimated bearing capacity of 200 kPa (4,000 psf) at SLS and 300 kPa (6,000 psf) at ULS were typically encountered in the deeper native till soils encountered in the boreholes at depths ranging from 2.29 m to 3.05 m below the existing ground surface.

Should footings be designed to be constructed at elevations higher than the elevations indicated in the table above, then structural fill will be required in order to achieve the design grades for the proposed foundations. The serviceability limit pressure for granular structural fill placed and compacted in accordance with Section 5.4.4 of this report is estimated to be at least 150 kPa (3,000 psf). Alternatively, lean mix concrete fill could be used for this application.

Footings could also be stepped down to bear on approved undisturbed founding soils. Due to the presence of fill soils on the subject site, it is imperative that the founding soils be assessed at the time of construction by qualified geotechnical personnel in order to confirm their founding suitability.

Footings founded on soil may be placed at a higher elevation relative to another footing provided that the slope between the outside face of the footings is separated by a minimum slope of 10 horizontal to 7 vertical (10H:7V) with an imaginary line projected from the underside of the footings.

It is recommended that the structural foundation drawings be cross-referenced with site servicing drawings to ensure that service pipes do not conflict with building foundations (including the zone of influence down and away from the footings).

With respect to the Serviceability Limit State (SLS), the total and differential footing settlements are not expected to exceed the generally acceptable limits of 25 mm (1") and 19 mm (3/4") respectively.

All exterior footings must be provided with a minimum of 1.2 m of soil cover or equivalent thermal insulation in order to provide protection against frost action.

CMT Inc. would be pleased to review design drawings when they become available and provide further recommendations with respect to bearing and foundation elevations.

5.2. Seismic Site Classification

The site classification for seismic response in Table 4.1.8.4 of the 2012 Ontario Building Code relates to the average properties of the upper 30.0 m of strata. The information obtained in the geotechnical field investigation was gathered from the upper 5.18 m of strata. Based on the information gathered in the geotechnical field investigation, the site classification for seismic site response would be considered Site Class D (stiff soils) for structures founded on the native soils or structural fill at the recommended founding elevations provided in Section 5.1 of this report. The structural engineer responsible for the design of the structure should review the earthquake loads and effects.

5.3. Soil Design Parameters

The following table provides estimated soil design parameters for imported granular fill, as well as the existing native soils encountered on-site. It should be noted that earth pressure coefficients (Ka, Kp, Ko) provided are for flat ground surface conditions and will differ for areas with slopes or embankments.

The estimated soil design parameters can be utilized for the design of perimeter shoring, foundations and retaining walls, as required.

Soil Type	Soil Density (kg/m^3)	Friction Angle (Degree)	Coefficient of Active Pressure (K_a)	Coefficient of Passive Pressure (K_p)	Coefficient of At-Rest Pressure (K_o)	Coefficient of Friction (μ)	Cohesion (Undrained) (kPa)
Imported Granular 'A'/ Granular 'B' (OPSS 1010)	2,100	34°	0.28	3.54	0.44	0.45	0
Silty Sand	1,800	32°	0.31	3.25	0.47	0.41	0
Sandy Silt Till	1,850	30°	0.33	3.00	0.50	0.38	0
Sand and Gravel	1,900	34°	0.28	3.54	0.44	0.45	0

5.4. Site Preparation

The site preparation for the proposed new townhouses is anticipated to include the removal of topsoil and vegetation, the subexcavation of any unsuitable fill and any native soils deemed not capable of supporting the design bearing capacity, removal, or relocation of any existing services, followed by the placement of structural fill (as required) and site grading to achieve proposed grades.

5.4.1. Topsoil Stripping/Vegetation Removal

All topsoil (including buried topsoil) must be removed from within the proposed building, parking lot and driveway areas to expose approved competent subgrade soils. The topsoil may be used in landscaped areas where some settlement can be tolerated; otherwise, it should be properly disposed of off-site.

All vegetation and trees (including tree root structures as well as any loose soils that are typically associated with root structures) must be removed from within the proposed building, parking lot and driveway areas to expose approved competent subgrade soils.

The volume of topsoil removed during the stripping process can be influenced by the equipment utilized for the stripping process as well as the moisture conditions at the time of stripping.

5.4.2. Removal/Relocation of Existing Buried Piping

Any existing underground services (if present) that may be located within the proposed building areas should be removed/relocated. If left in place, the location of existing services must be reviewed to ensure that they do not conflict with proposed foundation locations. This includes any existing subdrains that may be present. Any piping that is left in place that is no longer active must be completely sealed with watertight mechanical covers, concrete, or grout at termination points to prevent the migration of soils into pipe voids, which may result in potential settlement. All existing trench backfill material associated with any underground services must be subexcavated and the subsequent excavation must be backfilled with approved soils placed in accordance with Section 5.4.4 of this report.

5.4.3. Fill Removal

Any existing fill (including any existing trench backfill), as well as any native soils that have inadequate bearing capacity or have been disturbed by construction processes and is deemed unsuitable to support foundations or slab-on-grades, must be subexcavated from within the proposed building areas, exterior entranceways, perimeter sidewalks, and perimeter concrete slab areas to expose approved competent subgrade soils. It would also be sound construction practice to subexcavate all existing unsuitable fill from the paved parking areas; however, this may not be cost-effective. At a minimum, thorough inspection will be required at the time of construction to assess the existing fill to ensure there is no buried topsoil or other deleterious materials within the subgrade soils.

Remedial action may also be required to further consolidate any existing fill if it is decided to leave it in place. If any existing fill is left in place, provisions for the alterations to the design of the pavement structure should be included in the tender documents. Review of the subgrade and potential changes to the design of the pavement structure, as required, will be addressed at the time of construction.

Prior to reusing excavated material on-site as potential bulk fill, thorough field inspection and approval by qualified geotechnical personnel would be required to ensure that existing fill materials are not comprised of organics, topsoil, or other deleterious materials.

5.4.4. Site Grading

Following removal of the debris as well as the subexcavation of any fill or native soils deemed unsuitable of supporting the design bearing capacity, the exposed subgrade soils must be proof-rolled, and any soft or unstable areas must be subexcavated and replaced with approved fill materials.

Any fill materials required to achieve the design grades should be placed according to the following procedures:

- Prior to placement of any structural fill or bulk fill, the subgrade for the proposed buildings and parking lot must be prepared large enough to accommodate a 1:1 slope commencing a distance of 1.0 m beyond the outside edge of the proposed foundation and pavement edge (where feasible) to the approved competent founding soils;

- Soils approved for use as structural fill must be placed in loose lifts not exceeding 0.3 m (12") in depth for granular soils (recommended fill material) and 0.2 m (8") in depth for silts and clays (not recommended for this application), or the capacity of the compactor (whichever is less);

- Granular fill materials (OPSS 1010 Type III Granular 'B' recommended for this application) can be compacted utilizing adequate heavy vibratory smooth drum or padfoot compaction equipment;

- Fine-grained silt and clay soils (not recommended) must be compacted utilizing adequate heavy padfoot vibratory compaction equipment;

- Approved fill materials must be at suitable moisture contents to achieve the specified compaction. Soil moisture will also be dependent on weather conditions at the time of construction. Granular soils may require the addition of water in order to achieve the specified compaction;

- Approved structural fill materials that will support structures (including foundations, interior slab-on-grades, sidewalks and large expansive exterior slabs) must be compacted to 100% standard Proctor maximum dry density (SPMDD);

- Approved bulk fill (foundation wall backfill, bulk fill under slab-on-grades that will not support footings or heavy point loading) must be compacted to a minimum 98% SPMDD. It would be expected that the native soils would be suitable for use as bulk fill; however, depending on the time of year and weather conditions when construction takes place, soils excavated at depth may require air-drying in order to achieve the specified density;

- Granular 'B' subbase and Granular 'A' base materials for the paved parking areas must be compacted to 100% SPMDD.

Any wet soils encountered in the boreholes will require significant air-drying along with working of the soils in order to achieve the specified compaction. Utilizing the existing soils during site grading may be more achievable if work is completed during the generally drier summer months. It should be noted, however, that due to the nature of some of the soils, during hot dry weather, the addition of water might be required in order to achieve the specified compaction. Reuse of excavated soils on-site will be subject to approval from qualified geotechnical personnel.

5.5. Foundation Subgrade Preparation

The native soils encountered in the boreholes are sensitive to changes in moisture content and can become loose/soft if the soils are subjected to additional water or precipitation, as well as severe drying conditions. The native subgrade soils could also be easily disturbed if traveled on during construction. Once they become disturbed, they are no longer considered adequate for the support of shallow foundations.

To ensure and protect the integrity of the founding soils during construction operations, the following is recommended:

- Should the native soils at the design founding elevation in the proposed building envelope comprise wet or saturated soils, then a granular drainage layer, constructed in accordance with Section 9.14.4 of the current Ontario Building Code (OBC) may be required. Alternatively, a lean mix concrete mud mat may be poured overlying the subgrade soils to provide a stable base;

- During construction, the subgrade should be sloped to a sump (as required) located outside the building footprints (if feasible) in the excavation to promote surface drainage of rainwater or seepage and the collected water should be pumped out of the excavation. It is critical that all water be controlled (not allowed to pond) and that the subgrade and foundation preparation commence in dry conditions;

- Construction equipment travel and foot traffic on the founding soils should be minimized;

- If construction is to be undertaken during subzero weather conditions, the founding native soils and any potential fill materials must be maintained above freezing;

- Prior to placing concrete for the footings, the footing area must be cleaned of all disturbed or caved materials;

- The foundation formwork and concrete should be installed as soon as practical following the excavation, inspection, and approval of the founding soils. The longer that the excavated soils remain open to weather conditions and groundwater seepage, the greater the potential for construction problems to occur;

- If it is expected that the founding soils will be left open to exposure for an extended period of time, it is recommended that a 75 mm concrete mud slab be placed in order to protect the structural integrity of the founding soils.

Due to the variability of the native soils encountered in the boreholes, all foundation excavations must be reviewed by qualified personnel to confirm the suitability of the founding fill soils prior to foundation placement.

5.6. Slab-on-Grade/Modulus of Subgrade Reaction

Prior to the placement of the granular base for any slab-on-grades, the subgrade soils must be proof-rolled. Any soft or weak zones, as well as the unsuitable fill in the subgrade, should be subexcavated and backfilled with approved fill materials (see Sections 5.4.4 and 5.10 of this report).

The following table provides the estimated modulus of subgrade reaction (k) for imported granular fill, as well as the native soils encountered on-site:

Soil Type	Estimated Modulus of Subgrade Reaction (k)
Imported Sand and Gravel (OPSS 1010)	81,000 kN/m^3 (300 lb/in^3)
Sandy Silt/Sandy Silt Till	61,200 kN/m^3 (225 lb/in^3)
Silty Sand	61,200 kN/m^3 (225 lb/in^3)
Sand and Gravel	68,000 kN/m^3 (250 lb/in^3)

In dry conditions, floor slabs can be founded on a minimum thickness of 150 mm (6") of Granular 'A' (OPSS 1010) and compacted to 100% SPMDD. If wet to saturated conditions are encountered during the excavation of the site, it would be recommended that for any basement floor slabs, 150 mm (6") of 19 mm clear crushed stone (OPSS 1004) should be used instead of Granular 'A'. Utilizing clear crushed stone for the slab-on-grade base can assist in providing a moisture barrier by reducing the potential for capillary rise of moisture from the subgrade soils. Compactive effort is required to consolidate the clear stone. The 19 mm clear crushed stone should meet the physical property and gradation requirements of OPSS 1004.

It is recommended that areas of extensive exterior slab-on-grade (sidewalks and accessibility ramps) be constructed with a Granular 'B' subbase (450 mm) and a Granular 'A' base (150 mm), as well as incorporating subdrains, to promote rapid drainage and reduce the effects of frost heaving. This is particularly critical at barrier-free access points. Alternatively, structural frost slabs could be designed and constructed, or sufficient thermal insulation could be provided, at all door entrances and areas of barrier-free access.

5.7. Excavations

All excavations must be carried out in accordance with Ontario Regulation 213/91 (Reg 213/91) of the Occupational Health and Safety Act and Regulations for Construction Projects.

Type 2 Soils - In general, the native sandy silt till soils encountered in the boreholes in a drained state (not saturated), would be classified as Type 2 soils under Reg 213/91. The Type 2 soils must be sloped from within 1.2 m of the bottom of the excavation having a minimum gradient of 1 horizontal to 1 vertical. Soils underlain by Type 3 or 4 soils that are exposed in the excavation must be treated accordingly as Type 3 or 4 soils (see below). All saturated soils encountered must be treated as Type 4 soils, as described below.

Type 3 Soils - In general, the silty sand/silty sand and any existing fill materials (including backfill of existing foundations and services) in a drained state (not saturated), would be classified as Type 3 soils under Reg 213/91. The Type 3 soils must be sloped from the bottom of the excavation at a minimum gradient of 1 horizontal to 1 vertical. Soils underlain by Type 4 soils that are exposed in the excavation must be treated accordingly as Type 4 soils (see below). All saturated soils encountered must be treated as Type 4 soils, as described below.

Type 4 Soils - In general, any wet to saturated soils would be classified as Type 4 soils under Reg 213/91. Type 4 soils must be sloped from the bottom of the excavation at a minimum gradient of 3 horizontal to 1 vertical.

If it is not practical to excavate according to the above requirements, then a trench support system (designed in accordance with the Ontario Health and Safety Act Regulations) may be utilized. When using a temporary trench support system consisting of trench boxes to reduce the lateral extent of the excavations, it should be noted that the support system is intended primarily to protect workers as opposed to controlling lateral soil movement. Any voids between the excavation walls and the support system should be immediately filled to reduce the potential for loss of ground and to provide support to existing adjacent utilities and structures, and it is recommended that the excavation be carried out in short sections, with the support system installed immediately upon excavation completion.

5.8. Construction Dewatering Considerations

Groundwater conditions (particularly perched water) are generally dependent on the amount of precipitation, control of surface water, as well as the time of year, and can fluctuate significantly in elevation and volume. As such, provisions for site dewatering should be part of the site development and construction process.

Seepage control requirements during construction will depend upon the area of work on the site, the depth of the excavations, the time of year, the amount of precipitation and the control of surface water. As required, seepage should generally be adequately controlled using conventional construction dewatering techniques such as pumping from sump pits. However, if heavy seepage occurs (particularly in the saturated soil deposits), it may be necessary to increase the number of pumps during construction.

Dewatering should be performed in accordance with OPSS 517 and the control of water must be in accordance with OPSS 518. It is the responsibility of the contractor to propose a suitable dewatering system based on the groundwater elevation at the time of construction. Collected water should discharge a sufficient distance away from the excavation to prevent re-entry. Sediment control measures must be installed at the discharge point of the dewatering system to avoid any potential adverse impacts on the environment.

5.9. Service Pipe Bedding

The native soils encountered in the geotechnical investigation are generally considered suitable for indirect support of the site service pipes. Should instability due to saturated soil conditions be encountered, it may be necessary to increase the thickness of the granular base and utilize 19 mm clear stone to create an adequate supporting base for the service pipes and/or manholes. Pipe embedment, cover and backfill for both flexible and rigid pipes should be in accordance with all current and applicable OPSD, OPSS and OBC standards and guidelines and as follows:

Flexible Pipes – The pipe bedding should be shaped to receive the bottom of the pipe. If necessary, pipe culvert frost treatment should be undertaken in accordance with OPSD-803.031. The trench excavations should be symmetrical with respect to the centreline of the pipe. The granular material placed under the haunches of the pipe must be compacted to 100% SPMDD prior to the continued placement and compaction of the embedment material. The homogeneous granular material used for embedment should be placed and compacted uniformly around the pipe. Should wet conditions be encountered at the base of the trench, then the pipe bedding should consist of 19 mm clear stone (meeting OPS Specifications) wrapped completely in a geotextile fabric such as Terrafix 270 or equivalent.

Rigid Pipes - In general, the pipe installation recommendations for rigid pipes are the same as those for flexible pipes, except that the minimum bedding depth below a rigid pipe should be 0.15*D* (where *D* is the pipe diameter). In no case should this dimension be less than 150 mm or greater than 300 mm.

Any service pipes that are not provided with sufficient frost coverage must be protected with the necessary equivalent thermal insulation. The general contractor is responsible to protect existing and new service piping from damage by heavy equipment.

5.10. Perimeter Building Drainage, Foundation Wall Backfill and Trench Backfill

In order to assist in maintaining a dry building with respect to surface water seepage, it is recommended that exterior grades around the building be sloped down and away at a 2% gradient or more, for a distance of at least 1.5 m. Any surface discharge rainwater leaders must be constructed with solid piping that discharges with positive drainage at least 1.5 m away from the building foundation and/or beyond sidewalks to a drainage swale or appropriate storm drainage system.

In order to reduce the effects of surficial frost heave in areas that will be hard surfaced, it is recommended that the exterior foundation backfill consist of free-draining granular material such as approved on-site sand or sand and gravel or imported Granular 'B' Type I or Type III (OPSS 1010), with a maximum aggregate size not exceeding 100 mm, and that it extend a minimum lateral distance of 600 mm out from the foundation walls and/or beyond perimeter sidewalks and entranceway slabs. It is critical that particles greater than 100 mm in diameter are not in contact with the foundation wall to prevent point loading and overstressing. The backfill material used against the foundation walls must be placed so that the allowable lateral capacities of the foundation walls are not exceeded. Where only one side of a foundation wall will be backfilled, and the height of the wall is such that lateral support is required, or where the concrete strength has not been achieved, the wall must be braced or laterally supported prior to backfilling. In situations where both sides of the wall are backfilled, the backfill should be placed in equal lifts, not exceeding 200 mm differential on each side during backfill operations and the backfill should be compacted to a minimum of 98% SPMDD.

Foundations constructed within or below the any zone of wet soils may be subject to flooding in the event of a power failure or equipment malfunction. Therefore, it would be recommended that foundations be constructed above any saturated zones. If this is not feasible, it is recommended that good quality sump pumps be utilized and that, at a minimum, the systems be equipped with a battery backup (in the event of a power outage) preferably with a separate functioning sump pump(s). Groundwater elevations (perched and regional water tables) are dependent on weather and seasonal conditions and should be expected to fluctuate. The construction of foundations, slabs-on-grade, and deep structures such as sump pits within or below zones of saturation will require design of site-specific waterproofing and dewatering systems constructed in accordance with the 2012 OBC.

If the proposed townhouses are to have basements, an exterior perimeter drainage system comprising perforated drainage pipe with a factory installed filter sock, bedded in 19 mm clear crushed stone, and wrapped in a geotextile filter fabric such as Terrafix 270R (or equivalent), must be installed at an elevation that is below the proposed basement slab-on-grade elevation and provided with positive drainage into a sump pit or pits. The portion of the piping that connects the exterior drainage system into the sump pit must comprise solid piping to prevent exterior water from being introduced into the interior subslab stone. It may be prudent to install perforated drainage pipe in the interior basement as well to provide an outlet for any water that may collect in the subslab stone. It is also recommended that a capped cleanout port(s) be extended up to the ground surface elevation to provide future access (if required). The rainwater leaders must not be connected to the perimeter drainage system.

The native soils, as well as approved fill materials (non-organic) are generally considered suitable for reuse as trench backfill and bulk fill in the parking lot; however, any wet soils encountered may require air-drying in order to achieve the specified compaction. Air-drying cannot typically be achieved during winter construction; therefore, depending on the time of year that construction takes place, it may be more feasible to utilize an imported granular fill for this project.

The existing fill soils are generally considered suitable for reuse as trench backfill and bulk fill in the parking lot areas.

Backfilling operations should be carried out with the following minimum requirements:

- Adequate heavy smooth drum or padfoot vibratory compaction equipment should be used for the compaction and to break down any large blocky pieces of soil;

- Loose lift thicknesses should not exceed 0.3 m (12") for granular soils or 0.2 m (8") for silt soils or the capacity of the compactor (whichever is less);

- The soils must be at suitable moisture contents to achieve compaction to a minimum 98% SPMDD in non-structural bulk fill areas. Service trenches excavated within the zone of influence of footings for structures must be compacted to a minimum of 100% SPMDD;

- It is recommended that inspection and testing be carried out during construction to confirm backfill quality, thickness and to ensure that compaction requirements are achieved;

- Service trench backfill materials may consist of approved excavated soils with no particles greater than 100 mm and no topsoil or other deleterious materials;

- If construction operations are undertaken in the winter, strict consideration should be given to the condition of the backfill material to make certain that frozen material is not used.

5.11. Pavement Design/Drainage

Any soils containing organics or other deleterious material must be stripped/subexcavated from within the parking area. It is recommended to either subexcavate any existing loose subgrade materials or provide further consolidation with vibratory compaction equipment in order to prepare a proper, stable subgrade. Prior to placement of the new granular base, the subgrade soils must be proof-rolled, and any soft or unstable areas should be subexcavated and replaced with suitable drier materials. The subgrade should be graded smooth (free of depressions) and properly crowned to ensure positive drainage, with a minimum grade of 3% toward the drainage outlet or curb line. When service pipes are installed, pipe bedding and backfilling should be undertaken as indicated in Sections 5.9 and 5.10 of this report.

Rapid drainage of the pavement structure is critical to ensure long-term performance. The requirement for subdrains will be dependent on the composition of the prepared parking subgrade soils. Based on the information from the boreholes it is expected that the subgrade will comprise fine-grained, frost-susceptible soils. As such, it is recommended to install subdrains, provided gravity drainage to a suitable outlet can be provided. It is recommended to install minimum 100 mm diameter perforated subdrains to collect and redirect water beneath the pavement surface. Subdrains should be designed and installed in accordance with OPSS 405 and OPSD 216.021. If Granular 'A' bedding (OPSS 1010) is utilized, the subdrains should be equipped with a factory installed filter sock. If 19 mm clear stone (OPSS 1004) is utilized as bedding for the subdrain, then the bedding must be wrapped completely with geotextile filter fabric such as Terrafix 270R (or equivalent) and a factory installed filter sock is not required. Installation of rigid subdrains allows for better grade control and less potential for damage during installation; however, it would be expected that there would be higher cost implications associated with the installation of rigid subdrains over flexible subdrains. Positive drainage through grade control of subdrains is critical, as improperly installed subdrains can turn drainage systems into reservoirs, which can fuel frost action. The subdrains will hasten the removal of water, thereby reducing the risk and effects of frost heaving and load transfer in saturated conditions. It is suggested that, at a minimum, subdrains be installed along the edge of the roadway pavement to prevent water from entering the subbase. The subdrains should be installed in a 0.3 m (1.0 ft) by 0.3 m (1.0 ft) trench in the subgrade and bedded approximately 50 mm (2") above the bottom of the trench. The subgrade must be prepared with positive drainage to the subdrains and the subdrains must be installed with positive drainage into a catch basin structure or other suitable outlet.

The native subgrade soils are sensitive to change in moisture content and can become loose or soft if the soils are subject to inclement weather and seepage or severe drying. Furthermore, the subgrade soils could be easily disturbed if traveled on during construction. As such, where this material will be exposed, it is recommended that the granular subbase be placed immediately upon completion of the subgrade preparation to protect the integrity of the subgrade soils.

Should wet to saturated conditions be encountered during construction, site assessments may be required to determine what options can be undertaken to construct a modified pavement base. These options may include subexcavation of wet soils and increasing the thickness of the granular base, the use of reinforcing geotextiles, or a combination of both.

It is expected that the parking lot will be subject to mostly light traffic (personal vehicles) as well as some heavy traffic (delivery trucks, maintenance, and emergency vehicles).

Based on the anticipated loading, the following pavement design is provided:

Material	**Recommended Thickness For New Pavement**	
	Light Duty	**Heavy Duty**
Asphaltic Concrete	HL3 - 40 mm (1.5") HL4 or HL8 - 50 mm (2.0")	HL3 - 50 mm (2.0") HL4 or HL8 - 60 mm (2.5")
Granular 'A' Base (OPSS 1010)	150 mm (6.0")	150 mm (6.0")
Granular 'B' Subbase (OPSS 1010)	400 mm (16.0")	450 mm (18.0")

Frost tapers must be constructed at any changes from light traffic to heavy traffic areas. If heavy traffic routes are not delineated by barriers or if it is anticipated that heavy equipment (loader and dump trucks) will be utilized for snow removal, it would be recommended that the heavy traffic pavement structure be utilized throughout.

Construction joints in the surface asphalt must be offset a minimum of 150 mm to 300 mm (6" to 12") from construction joints in the binder asphalt so that longitudinal joints do not coincide.

Where new asphalt is joined into existing asphalt, it is recommended that the existing asphalt be sawcut in a straight line prior to being milled to a depth of 40 mm and a width of 150 mm as per OPSD 509.010. It is recommended that a tackcoat in conformance with OPSS 308 be applied to the edge and surface of all milled asphalt prior to placement of new asphalt.

The granular base and subbase materials must conform to the physical property and gradation requirements of OPSS 1010 and must be compacted to 100% SPMDD. Asphaltic concrete should be supplied, placed and compacted to a minimum 92.0% Marshall maximum relative density, in accordance with OPSS 1150 and OPSS 310.

The pavement should be designed to ensure that water will not pond on the pavement surface. If the surface asphalt is not placed within a reasonable time following placement of the binder asphalt, it is recommended that the catch basin lids are set at a lower elevation or apertures provided to allow surface water to drain into the catch basins and not accumulate around the catch basins. The strength of the pavement structure relies on all of the components to be in place in order to provide the design strength; therefore, it is strongly recommended that the surface asphalt be placed shortly after placement of the binder asphalt so as to avoid undue stress on the binder asphalt by not having the complete pavement structure in place.

It should be noted that, currently, asphalt mixes tend to be more flexible and, as such, there is a tendency for damage to occur from vehicles turning their steering wheels or applying excessive brake pressure. The damage can occur from both passenger vehicles as well as large vehicles. The condition is further intensified during hot weather. In high traffic areas, it is recommended that rigid Portland cement pavement be considered.

5.12. Excess Soil Management

5.12.1. Chemical Testing was NOT Undertaken

Generally, if surplus soils are to be exported off-site, it will be necessary to perform chemical analysis of the soils. Chemical analysis was **not** undertaken as part of this geotechnical investigation. Should chemical analysis tests be required, the required tests vary and will be dependent on the disposal site utilized by the general contractor.

5.12.2 Leachate Testing Requirement

If soils are transported off-site, additional chemical testing may be required. The extent of the leachate testing will be determined by the results of the initial chemical testing as well as the requirements of the disposal site.

The chemical analysis results would be compared to the site condition standards of Ontario Regulation 406/19. Typically, the results are compared to; *T1-Leachate Screening Levels – Res/Park/Inst/Ind/Com/Commu Property Use; T3.1-Leachate Screening Levels – Ind/Com/Commu/Property Use.*

When transporting soils off-site, the following is recommended:

- All chemical analyses and environmental assessment reports must be fully disclosed to the receiving site owners/authorities, whom must agree to receive the material;

- An environmental consultant must confirm the land use at the receiving site is compatible to receive the material;

- An environmental consultant must monitor the transportation and placement of the materials to ensure that the material is placed appropriately at the pre-approved site;

- The excess materials may not be transported to a site that has previously had a Record of Site Condition (RSC) filed, unless the material meets the criteria outlined in the RSC.

It should be noted that landfill sites will generally only accept laboratory test results that have been completed within 30 days of exporting. Therefore, it is recommended that provisions for chemical analysis be included in the tender documents. It should also be noted that the laboratory testing generally takes five (5) working days to process with a regular turnaround time.

5.13. Radon

According to information provided by Health Canada, radon is a radioactive gas that is naturally formed through the breakdown of uranium in soil, rock, and water. When radon escapes the earth in the outdoors, it mixes with fresh air, resulting in concentrations that are too low to be of concern. However, when radon enters an enclosed space, such as a building, high concentration of radon can accumulate and become a health concern. Health Canada indicates that most buildings and homes have some level of radon in them. Unfortunately, it is not possible to predict before construction whether or not a new building will have high radon levels as radon can only be detected by radon measurement devices, which would be installed in a building, post construction. Section 9.13.4.1 Soil Gas Control of the current 2012 Ontario Building Code (OBC) states that *"Where methane or radon gases are known to be a problem, construction shall comply with the requirements for soil gas control in MMAH Supplementary Standard SB-9, Requirements for Soil Gas Control"*.

6.0 SITE INSPECTION

Qualified geotechnical personnel should supervise excavation inspections as well as compaction testing for structural filling, site grading, and site servicing. This will ensure that footings are founded in the proper strata and that proper material and techniques are used and the specified compaction is achieved. CMT Engineering Inc. would be pleased to review the design drawings and provide an inspection and testing program for the construction of the proposed development.

7.0 LIMITATIONS OF THE INVESTIGATION

The recommendations made in this report are in accordance with our present understanding of the project. We request that we be permitted to review our recommendations when the drawings and specifications are complete, or if the proposed construction should differ from that mentioned in this report.

It is important to emphasize that a soil investigation is, in fact, a random sampling of a site and the comments are based on the results obtained at the test locations only. It is therefore assumed that these results are representative of the subsoil conditions across the site. Should any conditions at the site be encountered which differ from those found at the test locations, we request that we be notified immediately in order to permit a reassessment of our recommendations.

It should be noted that this report specifically addresses geotechnical aspects of the project and does not include any investigations or assessments relating to potential subsurface contamination. As such, there should be no assumptions or conclusions derived from this report with respect to potential soil or water contamination. Soil or water contamination is generally caused by the presence of xenobiotic (human-made) chemicals or other alteration processes in the natural soil and groundwater environment. If necessary, the investigation, assessment and rehabilitation of soil and water contaminants should be undertaken by qualified environmental specialists.

The samples obtained during the geotechnical investigation will be stored for a period of three months, after which time they will be disposed of unless alternative arrangements are made.

This report is intended solely for the client named. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the reliability of such third parties. The factual data, interpretation, and recommendations in this report pertain to a specific project as described in this report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, deviates from the assumptions stated herein, CMT Inc. should be given an opportunity to confirm that the recommendations are still valid. The subject geotechnical exploration and this report address only the geotechnical aspects of the proposed project; potential environmental impacts or related issues are beyond the defined scope of this work and have not been addressed.

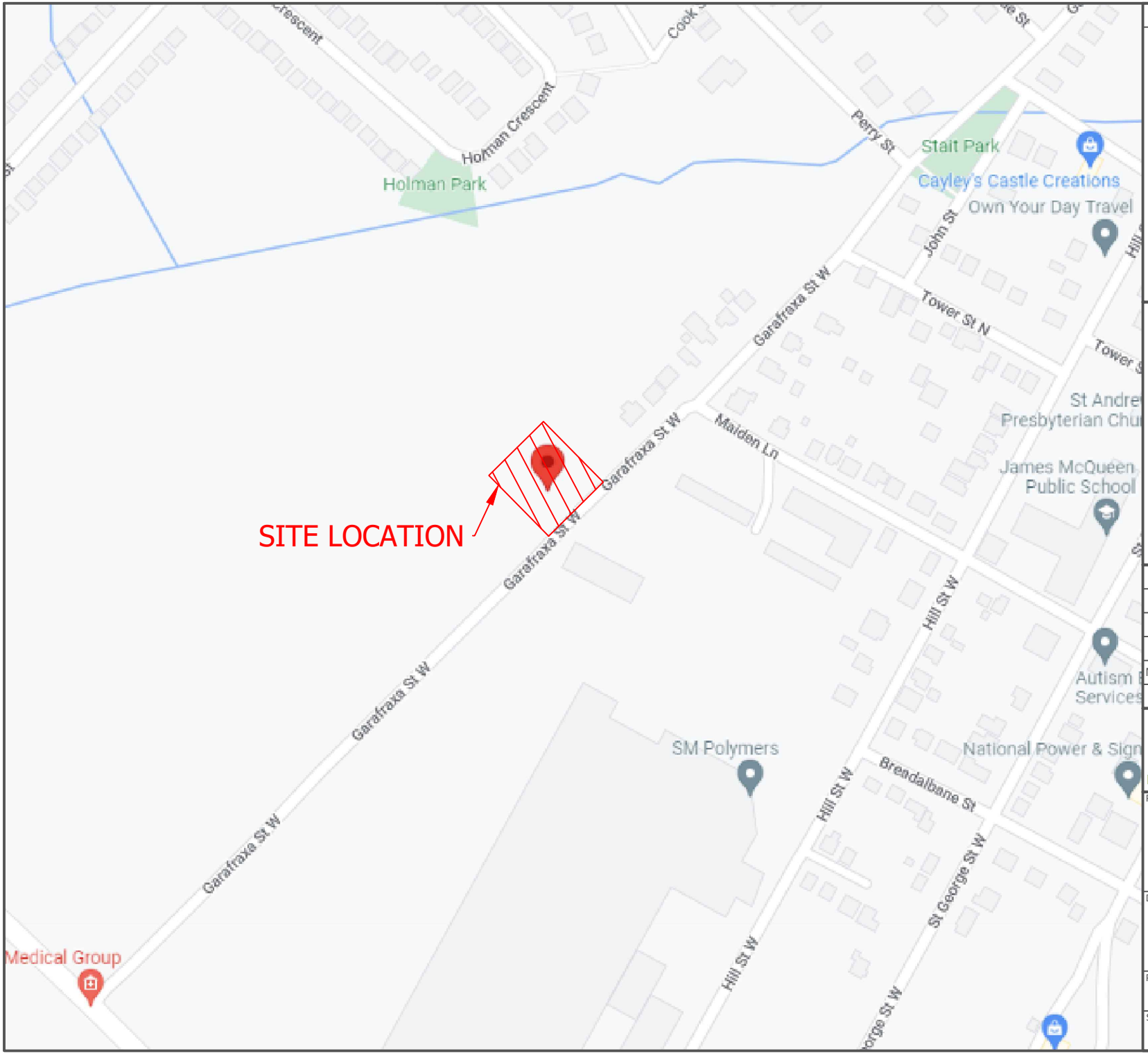
We trust that this report meets with your present requirements. Should you have any questions, please do not hesitate to contact our office.

Prepared by:

Jake Feeney P. Eng.
ht

Reviewed by:

Nathan Chortos, P.Eng.
Senior Geotechnical Engineer



NOTES:

Base map provided by Google.

N

NO.	DESCRIPTION	DATE

REVISIONS

CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Tel.: 519-699-5775
Fax: 519-699-4664
www.cmtinc.net

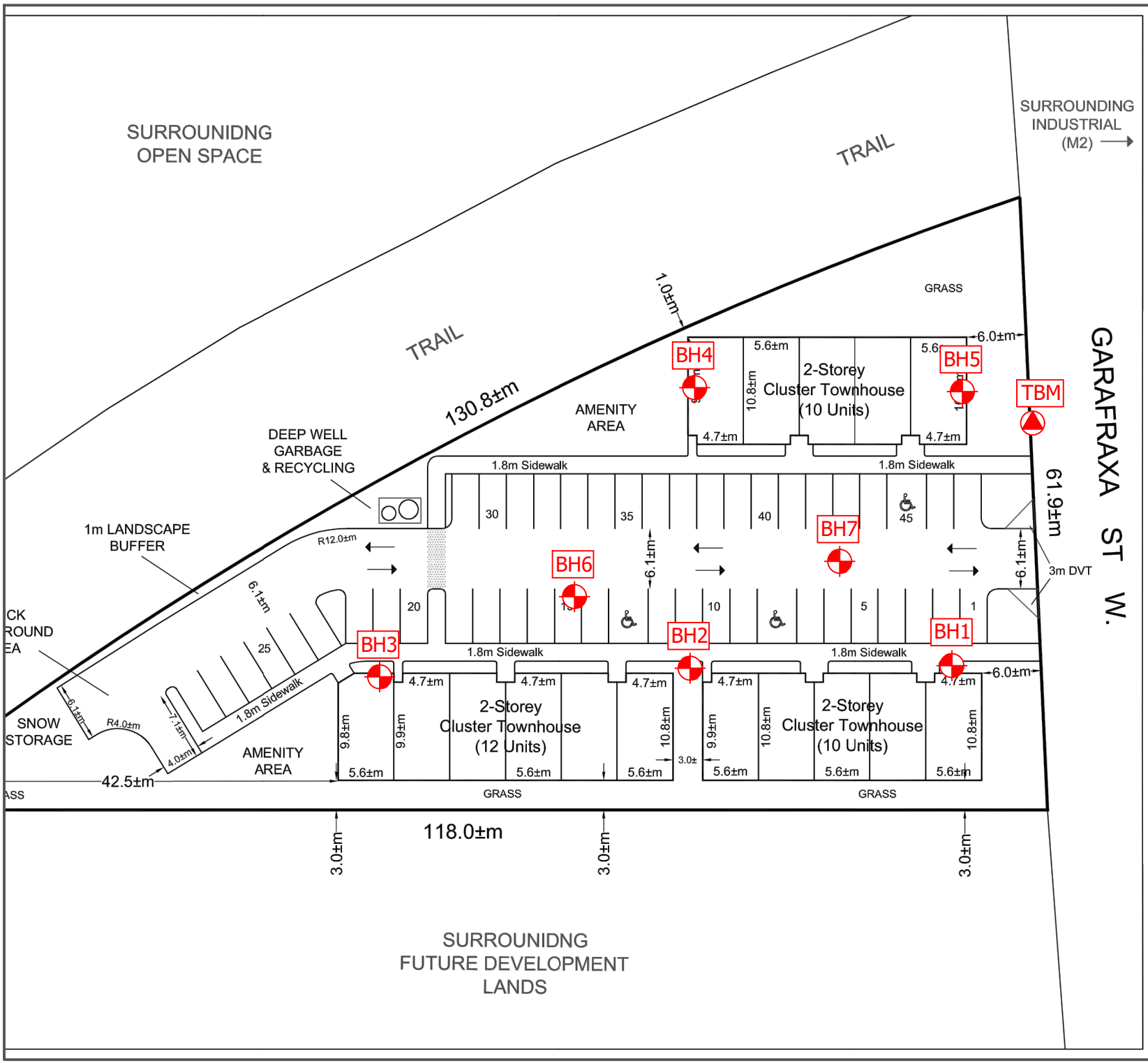
PROJECT:

TOWNHOUSE DEVELOPMENT
465 Garafraxa Street West
Fergus, Ontario

DRAWING TITLE:

SITE LOCATION MAP

PROJECT NO.:	DATE:
22-765	November 24, 2022
SCALE:	DRAWING NO.
N.T.S.	1



NOTES:

Base map provided by Dryden Smith & Head Planning Consultants Ltd.

Legend

CMT Borehole - 2022

Temporary Benchmark

NO.	DESCRIPTION	DATE

REVISIONS

CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
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www.cmtinc.net

PROJECT:

TOWNHOUSE DEVELOPMENT
465 Garafraxa Street West
Fergus, Ontario

DRAWING TITLE:

AERIAL VIEW SHOWING
BOREHOLE LOCATIONS

PROJECT NO.:	DATE:
22-765	November 24, 2022
SCALE:	DRAWING NO.
N.T.S.	2

APPENDIX A

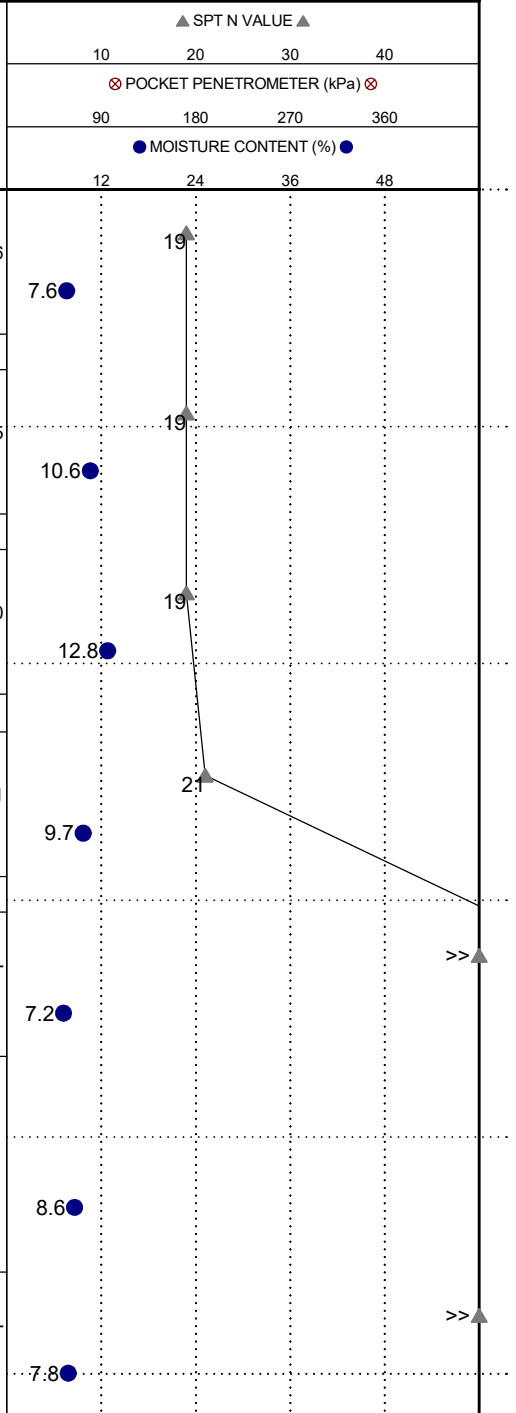
BOREHOLE LOGS

CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 1

PROJECT: Proposed Townhouse Development
PROJECT ADDRESS: 465 Garafraxa Street West
PROJECT NUMBER: 22-765
PROJECT LOCATION: Fergus, Ontario
DRILLING DATE: 22-11-16
GROUND ELEVATION: 100.20 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
	Sand and Gravel Fill: Compact, brown sand and gravel fill, trace silt, moist	0.00, 100.20	SPT 1	49	2-7-12-16 (19)
	Topsoil: Black silty, organic, buried topsoil layer	0.60, 99.60			
1			SPT 2	100	3-5-14-15 (19)
	Sand and Gravel Fill: Compact, brown sand and gravel fill, trace silt, moist	1.07, 99.13			
	Silty Sand: Compact, brown silty sand, moist	1.52, 98.68	SPT 3	100	8-9-10-10 (19)
2					
	Sandy Silt Till: Very stiff, brown sandy silt till, some clay, trace gravel, moist	2.29, 97.91	SPT 4	100	5-9-12-11 (21)
3					
	becoming hard	3.05, 97.15	SPT 5	100	10-28-33-33 (61)
4			MC5 6	100	
	becoming grey	4.57, 95.63	SPT 7	100	30-48-44-37 (92)
5					



Borehole open to about 5.18 m below the ground surface. No accumulated groundwater observed upon completion.

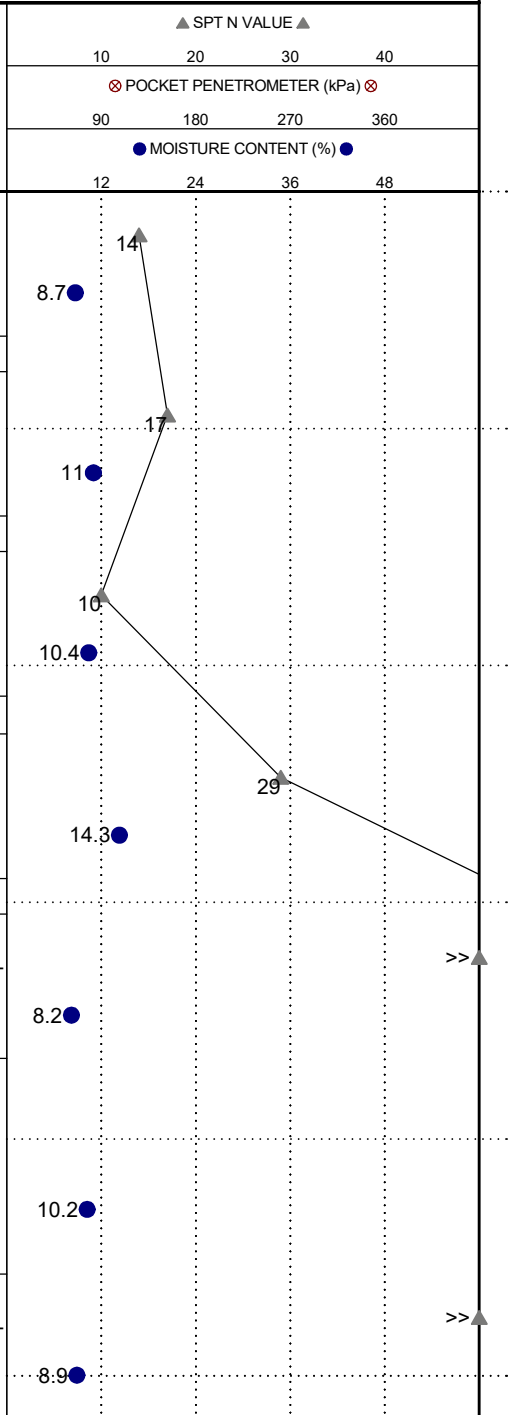
Bottom of borehole at 5.18 m, Elevation 95.02 m.

CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 2

PROJECT: Proposed Townhouse Development
PROJECT ADDRESS: 465 Garafraxa Street West
PROJECT NUMBER: 22-765
PROJECT LOCATION: Fergus, Ontario
DRILLING DATE: 22-11-16
GROUND ELEVATION: 99.83 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
		Sand and Gravel Fill: Compact, brown sand and gravel fill, trace silt, moist Black silty topsoil layer observed at about 0.76 m (210 mm)	0.00, 99.83	SPT 1	49	2-7-7-14 (14)
1		Black silty, organic, buried topsoil layer	0.76, 99.07	SPT 2	100	7-8-9-10 (17)
		Sandy Silt: Stiff to very stiff, brown sandy silt, some clay, trace gravel, moist	0.97, 98.86			
2				SPT 3	25	4-5-5-12 (10)
		Silty Sand: Compact, brown silty sand, moist	2.29, 97.54	SPT 4	100	4-10-19-26 (29)
3						
		Sandy Silt Till: Hard, brown sandy silt till, some clay, trace gravel, moist	3.05, 96.78	SPT 5	100	12-30-38-50 (68)
4				MC5 6	100	
5				SPT 7	100	50-50-50-50 (100)



Borehole caved at about 2.95 m below the ground surface. No accumulated groundwater observed upon completion.

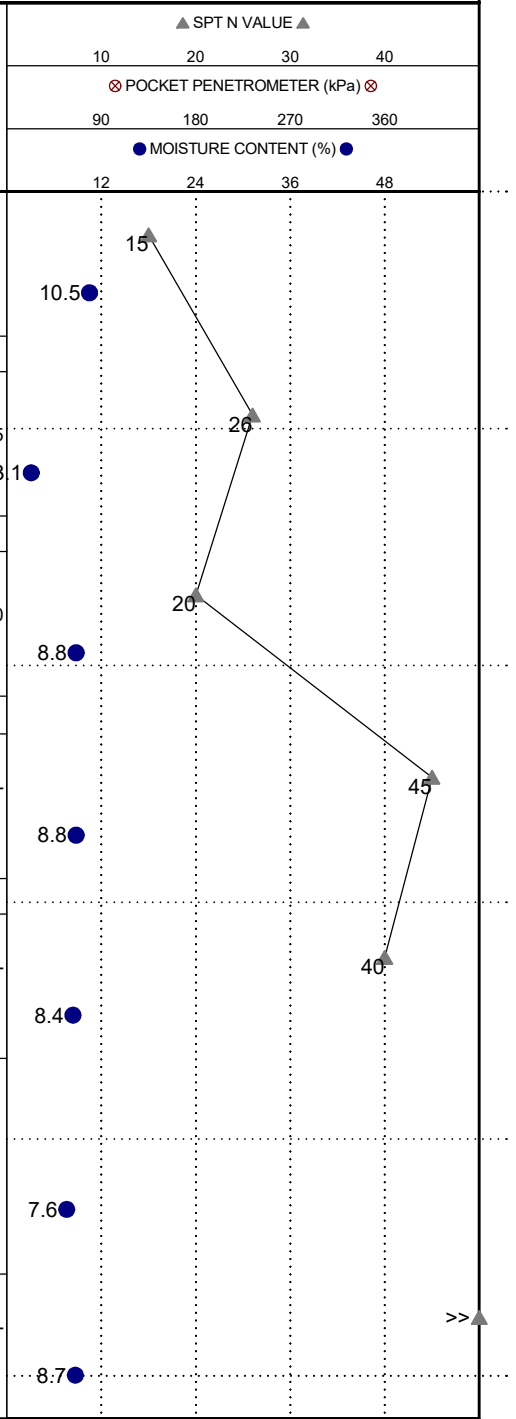
Bottom of borehole at 5.18 m, Elevation 94.65 m.

CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 3

PROJECT: Proposed Townhouse Development
PROJECT ADDRESS: 465 Garafraxa Street West
PROJECT NUMBER: 22-765
PROJECT LOCATION: Fergus, Ontario
DRILLING DATE: 22-11-16
GROUND ELEVATION: 99.34 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
		Sand and Gravel Fill: Compact, brown sand and gravel fill, trace silt, moist	0.00, 99.34	SPT 1	25	3-9-6-18 (15)
1		**Sandy Silt Till:** Very stiff, brown sandy silt till, some clay, trace gravel, moist Black staining observed at about 0.76 m below the ground surface (210 mm)	0.76, 98.58	SPT 2	100	13-18-8-5 (26)
				SPT 3	100	4-8-12-10 (20)
2		becoming hard	2.29, 97.05	SPT 4	100	16-26-19-21 (45)
3				SPT 5	100	15-16-24-38 (40)
4				MC5 6	100	
				SPT 7	100	29-50-50-50 (100)
5						



Borehole caved at about 4.88 m below the ground surface. No accumulated groundwater observed upon completion.

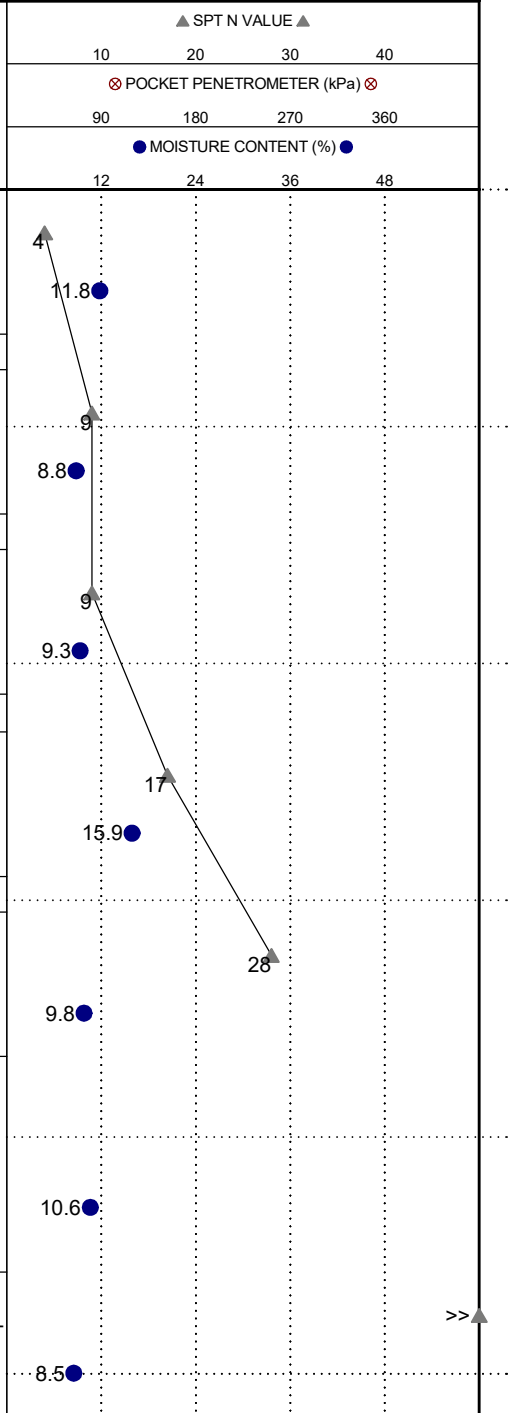
Bottom of borehole at 5.18 m, Elevation 94.16 m.

CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 4

PROJECT: Proposed Townhouse Development
PROJECT ADDRESS: 465 Garafraxa Street West
PROJECT NUMBER: 22-765
PROJECT LOCATION: Fergus, Ontario
DRILLING DATE: 22-11-16
GROUND ELEVATION: 99.40 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
	Silt Fill: Firm, brown silt fill, trace gravel, moist Black staining observed	0.00, 99.40	SPT 1	49	1-2-2-2 (4)
1	**Silty Sand:** Loose, brown silty sand, moist	0.76, 98.64	SPT 2	100	3-4-5-7 (9)
2	**Sandy Silt Till:** Stiff, brown sandy silt till, some clay, trace gravel, moist	1.52, 97.88	SPT 3	100	6-6-3-3 (9)
	becoming very stiff	2.29, 97.11	SPT 4	100	7-7-10-7 (17)
3			SPT 5	100	8-13-15-16 (28)
4			MC5 6	100	
	becoming hard	4.57, 94.83	SPT 7	100	30-27-25-23 (52)
5					



Borehole open to about 5.18 m below the ground surface. No accumulated groundwater observed upon completion.

Bottom of borehole at 5.18 m, Elevation 94.22 m.

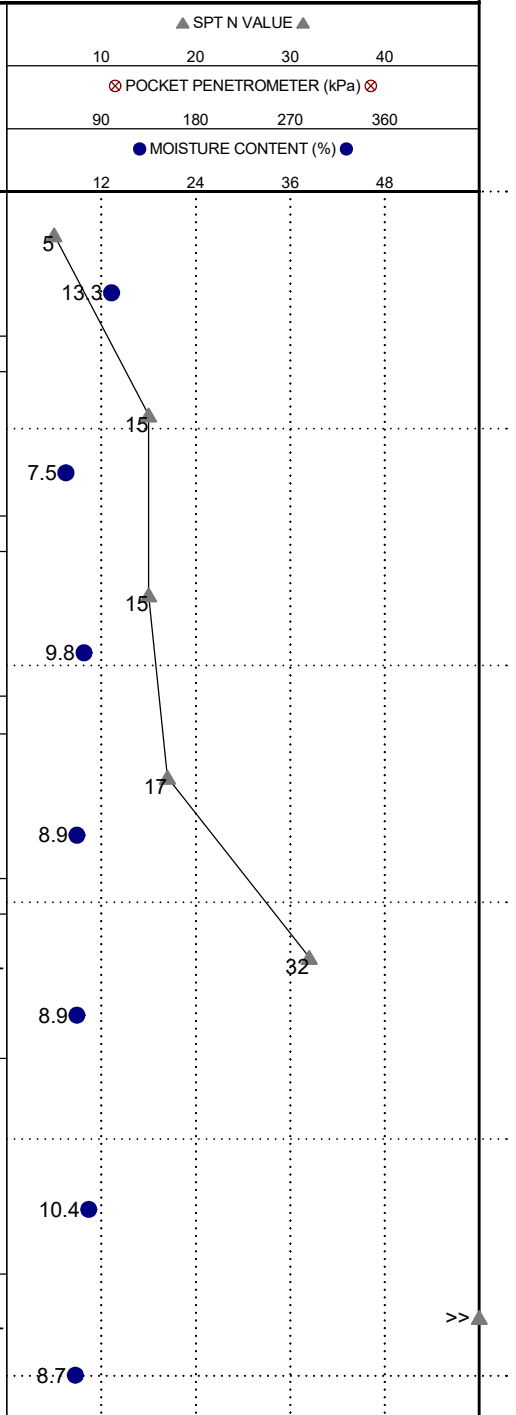
BOREHOLE LOG2 22-765.GPJ CMT_TEMPLATE_2020-05-15.GDT 22-11-28

CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 5

PROJECT: Proposed Townhouse Development
PROJECT ADDRESS: 465 Garafraxa Street West
PROJECT NUMBER: 22-765
PROJECT LOCATION: Fergus, Ontario
DRILLING DATE: 22-11-16
GROUND ELEVATION: 100.17 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
		Topsoil: Loose, dark brown, silty, organic topsoil, moist	0.00, 100.17	SPT 1	49	2-2-3-4 (5)
		Silty Sand: Compact, brown silty sand, moist	0.60, 99.57			
1				SPT 2	100	6-6-9-14 (15)
		Sandy Silt Till: Stiff to very stiff, brown sandy silt till, some clay, trace gravel, moist	1.52, 98.65	SPT 3	100	8-8-7-7 (15)
2						
				SPT 4	100	7-8-9-15 (17)
3		becoming hard	3.05, 97.12	SPT 5	100	18-13-19-19 (32)
				MC5 6	100	
4						
				SPT 7	100	32-50-50-50 (100)
5						



Borehole open to about 5.18 m below the ground surface. No accumulated groundwater observed upon completion.

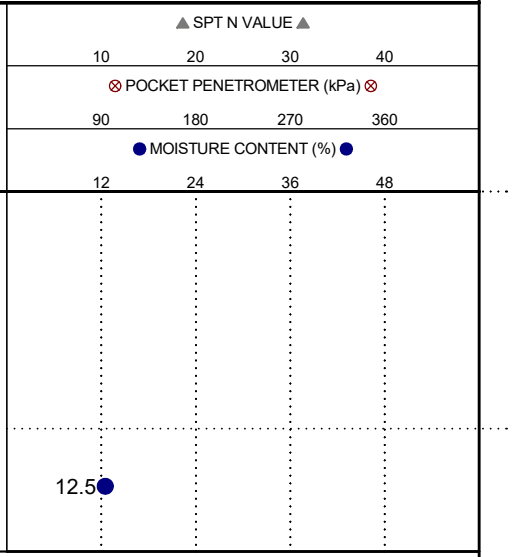
Bottom of borehole at 5.18 m, Elevation 94.99 m.

CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 6

PROJECT: Proposed Townhouse Development
PROJECT ADDRESS: 465 Garafraxa Street West
PROJECT NUMBER: 22-765
PROJECT LOCATION: Fergus, Ontario
DRILLING DATE: 22-11-16
GROUND ELEVATION: 99.51 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: MC5

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
		Sand and Gravel Fill: Brown sand and gravel fill, trace silt, moist	0.00, 99.51			
1		**Sandy Silt Till:** Brown sandy silt till, some clay, trace gravel, moist	0.60, 98.91	MC5 1	100	
		Borehole open to 1.52 m below the ground surface , elevation. No accumulated groundwater observed upon completion.				
		Bottom of borehole at 1.52 m, Elevation 97.99 m.				



CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 7

PROJECT: Proposed Townhouse Development
PROJECT ADDRESS: 465 Garafraxa Street West
PROJECT NUMBER: 22-765
PROJECT LOCATION: Fergus, Ontario
DRILLING DATE: 22-11-16
GROUND ELEVATION: 99.70 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: MC5

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
		Topsoil: Dark brown, silty, organic topsoil, moist	0.00, 99.70			
		Silty Sand: Brown silty sand, moist	0.30, 99.40			
1				MC5 1	100	

SPT N VALUE: 10, 20, 30, 40
POCKET PENETROMETER (kPa): 90, 180, 270, 360
MOISTURE CONTENT (%): 12, 24, 36, 48
5.2

Borehole open to 1.52 m below the ground surface , elevation. No accumulated groundwater observed upon completion.

Bottom of borehole at 1.52 m, Elevation 98.18 m.

APPENDIX B

GRAIN SIZE ANALYSES

Particle Size Distribution Report

	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	7.2	2.7	6.7	21.4	46.0	16.0

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH3	3	1.52-2.13m	sandy silt, some clay, trace gravel	ML
				Sampled by JF of CMT Engineering Inc. November 16, 2022	
				Tested by JM of CMT Engineering Inc. November 18, 2022	

CMT Engineering Inc.

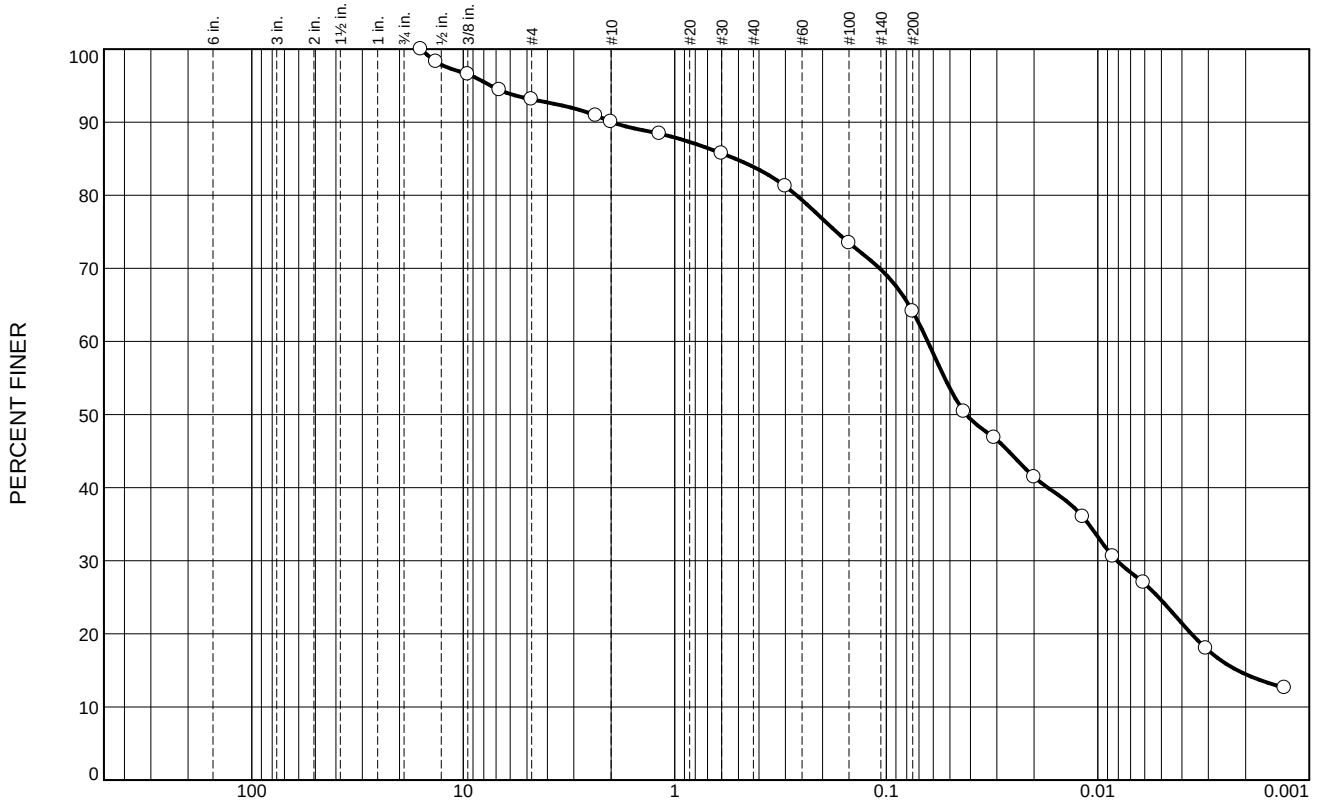
St. Clements, ON

Client: Habitat for Humanity

Project: 465 Garafraxa Street West
Fergus, Ontario

Project No.: 22-765 **Figure** 1

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	6.9	3.0	6.2	19.8	49.6	14.5

SOIL DATA					
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH5	5	3.05-3.66m	sandy silt, some clay, trace gravel	ML
				Sampled by JF of CMT Engineering Inc. November 16, 2022	
				Tested by JM of CMT Engineering Inc. November 18, 2022	

CMT Engineering Inc.

St. Clements, ON

Client: Habitat for Humanity

Project: 465 Garafraxa Street West
Fergus, Ontario

Project No.: 22-765 **Figure** 2

APPENDIX B:
Stormwater Management Analysis

Existing Condition Modelling Files
Stage-Storage-Discharge Tables
Post-Development Condition Modelling Files
Oil/Grit Separator Sizing Details

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                        ie METRIC"
"                Job folder:                   C:\Users\pgrier\Documents\Work\"
"                                                       422144  465 Garafraxa"
"                Output filename:                       422144  2-year pre.out"
"                Licensee name:                                          gmbp"
"                Company                                                    "
"                Date & Time last used:                 1/3/2023 at 4:30:05 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      695.047   Coefficient A"
"        6.387   Constant B"
"        0.793   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           93.292    mm/hr"
"             Total depth                 33.014    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 10"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"           10   Catchment 10"
"        0.000   % Impervious"
"        0.420   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.420   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.003     0.000     0.000     0.000 c.m/sec"
"             Catchment 10           Pervious   Impervious Total Area "
"             Surface Area           0.420      0.000      0.420      hectare"
"             Time of concentration  24.993     2.044      24.993     minutes"
"             Time to Centroid       93.891     0.000      93.891     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        138.66     0.00       138.66     c.m"
"             Rainfall losses        32.003     33.014     32.003     mm"
"             Runoff depth           1.010      0.000      1.010      mm"
"             Runoff volume          4.24       0.00       4.24       c.m"
"             Runoff coefficient     0.031      0.000      0.031      "
"             Maximum flow           0.003      0.000      0.003      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.003     0.003     0.000     0.000"
" 38          START/RE-START TOTALS 10"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     0.420    hectare"
"             Total Impervious area                    0.000    hectare"
"             Total % impervious                       0.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                        ie METRIC"
"                Job folder:                   C:\Users\pgrier\Documents\Work\"
"                                                       422144  465 Garafraxa"
"                Output filename:                       422144  5-year pre.out"
"                Licensee name:                                          gmbp"
"                Company                                                    "
"                Date & Time last used:                 1/4/2023 at 8:29:49 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1459.072   Coefficient A"
"       13.690   Constant B"
"        0.850   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          113.586    mm/hr"
"             Total depth                 49.792    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 10"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"           10   Catchment 10"
"        0.000   % Impervious"
"        0.420   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.420   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.033     0.000     0.000     0.000 c.m/sec"
"             Catchment 10           Pervious   Impervious Total Area "
"             Surface Area           0.420      0.000      0.420      hectare"
"             Time of concentration  13.471     1.890      13.470     minutes"
"             Time to Centroid       90.770     85.354     90.770     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        209.12     0.00       209.13     c.m"
"             Rainfall losses        39.012     2.179      39.012     mm"
"             Runoff depth           10.780     47.613     10.780     mm"
"             Runoff volume          45.28      0.00       45.28      c.m"
"             Runoff coefficient     0.217      0.000      0.217      "
"             Maximum flow           0.033      0.000      0.033      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.033     0.033     0.000     0.000"
" 38          START/RE-START TOTALS 10"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     0.420    hectare"
"             Total Impervious area                    0.000    hectare"
"             Total % impervious                       0.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                        ie METRIC"
"                Job folder:                   C:\Users\pgrier\Documents\Work\"
"                                                        422144  465 Garafraxa"
"                Output filename:                     422144  10-year pre.out"
"                Licensee name:                                          gmbp"
"                Company                                                    "
"                Date & Time last used:                1/4/2023 at 8:30:55 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     2327.596   Coefficient A"
"       19.500   Constant B"
"        0.894   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          126.171    mm/hr"
"             Total depth                 61.359    mm"
"            6   010hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 10"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"           10   Catchment 10"
"        0.000   % Impervious"
"        0.420   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.420   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.054     0.000     0.000     0.000 c.m/sec"
"             Catchment 10           Pervious   Impervious Total Area "
"             Surface Area           0.420      0.000      0.420      hectare"
"             Time of concentration  12.045     1.812      12.045     minutes"
"             Time to Centroid       90.582     84.870     90.582     minutes"
"             Rainfall depth         61.359     61.359     61.359     mm"
"             Rainfall volume        257.71     0.00       257.71     c.m"
"             Rainfall losses        41.728     2.332      41.728     mm"
"             Runoff depth           19.631     59.027     19.631     mm"
"             Runoff volume          82.45      0.00       82.45      c.m"
"             Runoff coefficient     0.320      0.000      0.320      "
"             Maximum flow           0.054      0.000      0.054      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.054     0.054     0.000     0.000"
" 38          START/RE-START TOTALS 10"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     0.420    hectare"
"             Total Impervious area                    0.000    hectare"
"             Total % impervious                       0.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
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"                Job folder:                   C:\Users\pgrier\Documents\Work\"
"                                                        422144  465 Garafraxa"
"                Output filename:                     422144  25-year pre.out"
"                Licensee name:                                          gmbp"
"                Company                                                    "
"                Date & Time last used:                1/4/2023 at 8:32:57 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     3701.648   Coefficient A"
"       25.500   Constant B"
"        0.937   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          143.371    mm/hr"
"             Total depth                 75.581    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 10"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"           10   Catchment 10"
"        0.000   % Impervious"
"        0.420   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.420   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.085     0.000     0.000     0.000 c.m/sec"
"             Catchment 10           Pervious   Impervious Total Area "
"             Surface Area           0.420      0.000      0.420      hectare"
"             Time of concentration  10.252     1.722      10.252     minutes"
"             Time to Centroid       90.488     84.485     90.488     minutes"
"             Rainfall depth         75.581     75.581     75.581     mm"
"             Rainfall volume        317.44     0.00       317.44     c.m"
"             Rainfall losses        44.281     2.520      44.280     mm"
"             Runoff depth           31.300     73.061     31.300     mm"
"             Runoff volume          131.46     0.00       131.46     c.m"
"             Runoff coefficient     0.414      0.000      0.414      "
"             Maximum flow           0.085      0.000      0.085      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.085     0.085     0.000     0.000"
" 38          START/RE-START TOTALS 10"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      0.420    hectare"
"             Total Impervious area                     0.000    hectare"
"             Total % impervious                        0.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                        ie METRIC"
"                Job folder:                   C:\Users\pgrier\Documents\Work\"
"                                                        422144  465 Garafraxa"
"                Output filename:                     422144  50-year pre.out"
"                Licensee name:                                          gmbp"
"                Company                                                    "
"                Date & Time last used:                1/4/2023 at 8:34:37 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     5089.418   Coefficient A"
"       30.000   Constant B"
"        0.967   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          156.350    mm/hr"
"             Total depth                 86.737    mm"
"            6   050hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 10"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"           10   Catchment 10"
"        0.000   % Impervious"
"        0.420   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.420   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.109     0.000     0.000     0.000 c.m/sec"
"             Catchment 10           Pervious   Impervious Total Area "
"             Surface Area           0.420      0.000      0.420      hectare"
"             Time of concentration  9.574      1.663      9.574      minutes"
"             Time to Centroid       90.779     84.291     90.779     minutes"
"             Rainfall depth         86.737     86.737     86.737     mm"
"             Rainfall volume        364.29     0.00       364.29     c.m"
"             Rainfall losses        45.966     2.621      45.966     mm"
"             Runoff depth           40.771     84.116     40.771     mm"
"             Runoff volume          171.24     0.00       171.24     c.m"
"             Runoff coefficient     0.470      0.000      0.470      "
"             Maximum flow           0.109      0.000      0.109      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.109     0.109     0.000     0.000"
" 38          START/RE-START TOTALS 10"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    0.420    hectare"
"             Total Impervious area                   0.000    hectare"
"             Total % impervious                      0.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                        ie METRIC"
"                Job folder:                   C:\Users\pgrier\Documents\Work\"
"                                                        422144  465 Garafraxa"
"                Output filename:                     422144  100-year pre.out"
"                Licensee name:                                           gmbp"
"                Company                                                     "
"                Date & Time last used:                 1/4/2023 at 8:35:33 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     6933.019   Coefficient A"
"       34.699   Constant B"
"        0.998   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          168.777    mm/hr"
"             Total depth                 97.921    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 10"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"           10   Catchment 10"
"        0.000   % Impervious"
"        0.420   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.420   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.132     0.000     0.000     0.000 c.m/sec"
"              Catchment 10           Pervious   Impervious Total Area "
"              Surface Area           0.420      0.000      0.420      hectare"
"              Time of concentration  9.201      1.613      9.201      minutes"
"              Time to Centroid       90.800     84.151     90.800     minutes"
"              Rainfall depth         97.921     97.921     97.921     mm"
"              Rainfall volume        411.27     0.00       411.27     c.m"
"              Rainfall losses        47.274     2.759      47.274     mm"
"              Runoff depth           50.647     95.162     50.647     mm"
"              Runoff volume          212.72     0.00       212.72     c.m"
"              Runoff coefficient     0.517      0.000      0.517      "
"              Maximum flow           0.132      0.000      0.132      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                    0.132     0.132     0.000     0.000"
" 38           START/RE-START TOTALS 10"
"             3   Runoff Totals on EXIT"
"              Total Catchment area                    0.420    hectare"
"              Total Impervious area                   0.000    hectare"
"              Total % impervious                      0.000"
" 19           EXIT"
```

465 Garafraxa Street West
Township of Centre Wellington
Our File: 422144
January 19, 2023

Catchment 100 - Infiltration Gallery

Storage Volume Calculations

Elevation (m)	Depth (m)	Surface Area (m^2)	Incremental Stone Volume (m^3)	Incremental Storage Volume (m^3)	Accum. Storage Volume (m^3)	
412.55	0.000	42.00	0.00	0.00	0.00	Bottom of Stone
412.56	0.010	42.00	0.42	0.14	0.14	
412.65	0.100	42.00	3.78	1.26	1.40	
412.75	0.200	42.00	4.20	1.40	2.80	
412.85	0.300	42.00	4.20	1.40	4.20	
412.95	0.400	42.00	4.20	1.40	5.60	
413.05	0.500	42.00	4.20	1.40	7.00	
413.15	0.600	42.00	4.20	1.40	8.40	
413.25	0.700	42.00	4.20	1.40	9.80	
413.35	0.800	42.00	4.20	1.40	11.20	
413.45	0.900	42.00	4.20	1.40	12.60	
413.55	1.000	42.00	4.20	1.40	14.00	Top of Stone
413.70	1.150	1.13	0.00	0.00	14.00	
413.85	1.300	1.13	0.00	0.17	14.17	Invert of Overflow
414.10	1.550	1.13	0.00	0.28	14.45	Obvert of Overflow

465 Garafraxa Street West
Township of Centre Wellington
Our File: 422144

Bottom Infiltration			**Side Infiltration (2 Sides Only)**			**Overflow Pipe**		
L(dw) =	6.00	m	L(dw) =	12.00	m	Q =	0.046	m^3/s
W(dw) =	7.00	m	W(dw) =	7.00	m	Cd =	0.6	
D(dw) =	1.00	m	D(dw) =	1.00	m	H =	0.125	m
A(c) =	42.0	sq m	A(c) =	24.0	sq m	2g =	19.62	
VOL(dw)=	42.0	cu m				A =	0.049	m^2
VOL(st)=	14.0	cu m				D =	0.250	m
K =	10.0	mm/hr	K =	10.0	mm/hr	D/2 =	0.125	m
	2.78E-04	cm/s		2.78E-04	cm/s			

Stage/Storage/Discharge Table

Stage (m)	**Storage (m^3)**	**Infiltration (m^3/s)**	**Overflow Pipe (m^3/s)**	**Discharge (m^3/s)**	
412.55	0.00	0.0000	0.000	0.0000	Bottom of Stone
412.56	0.14	0.00012	0.000	0.0001	
412.65	1.40	0.00012	0.000	0.0001	
412.75	2.80	0.00012	0.000	0.0001	
412.85	4.20	0.00013	0.000	0.0001	
412.95	5.60	0.00013	0.000	0.0001	
413.05	7.00	0.00013	0.000	0.0001	
413.15	8.40	0.00014	0.000	0.0001	
413.25	9.80	0.00014	0.000	0.0001	
413.35	11.20	0.00014	0.000	0.0001	
413.45	12.60	0.00015	0.000	0.0001	
413.55	14.00	0.00015	0.000	0.0002	Top of Stone
413.70	14.00	0.00015	0.000	0.0002	
413.85	14.17	0.00016	0.000	0.0002	Invert of Overflow
414.10	14.45	0.00017	0.046	0.0463	Obvert of Overflow

465 Garafraxa Street West
Township of Centre Wellington
Our File: 422144

Catchment 200 & 300 - Infiltration Gallery

Storage Volume Calculations

Elevation (m)	Depth (m)	Surface Area (m^2)	Incremental Stone Volume (m^3)	Incremental Storage Volume (m^3)	Accum. Storage Volume (m^3)	
411.80	0.000	95.00	0.00	0.00	0.00	Bottom of Stone
411.81	0.010	95.00	0.95	0.32	0.32	
411.90	0.100	95.00	8.55	2.85	3.17	
412.00	0.200	95.00	9.50	3.17	6.33	
412.10	0.300	95.00	9.50	3.17	9.50	
412.20	0.400	95.00	9.50	3.17	12.67	
412.30	0.500	95.00	9.50	3.17	15.83	
412.40	0.600	95.00	9.50	3.17	19.00	
412.50	0.700	95.00	9.50	3.17	22.17	
412.60	0.800	95.00	9.50	3.17	25.33	
412.70	0.900	95.00	9.50	3.17	28.50	
412.80	1.000	95.00	9.50	3.17	31.67	Top of Stone
413.05	1.250	1.13	0.00	0.00	31.67	
413.10	1.300	1.13	0.00	0.06	31.72	Invert of Overflow
413.35	1.550	1.13	0.00	0.28	32.01	Obvert of Overflow

465 Garafraxa Street West
Township of Centre Wellington
Our File: 422144

Bottom Infiltration			**Side Infiltration (2 Sides Only)**			**Overflow Pipe**		
L(dw) =	10.00	m	L(dw) =	20.00	m	Q =	0.046	m^3/s
W(dw) =	9.50	m	W(dw) =	9.50	m	Cd =	0.6	
D(dw) =	1.00	m	D(dw) =	1.00	m	H =	0.125	m
A(c) =	95.0	sq m	A(c) =	40.0	sq m	2g =	19.62	
VOL(dw)=	95.0	cu m				A =	0.049	m^2
VOL(st)=	31.7	cu m				D =	0.250	m
K =	10.0	mm/hr	K =	10.0	mm/hr	D/2 =	0.125	m
	2.78E-04	cm/s		2.78E-04	cm/s			

Stage/Storage/Discharge Table

Stage (m)	Storage (m^3)	Infiltration (m^3/s)	Overflow Pipe (m^3/s)	Discharge (m^3/s)	
411.80	0.00	0.0000	0.000	0.0000	Bottom of Stone
411.81	0.32	0.00026	0.000	0.0003	
411.90	3.17	0.00027	0.000	0.0003	
412.00	6.33	0.00028	0.000	0.0003	
412.10	9.50	0.00028	0.000	0.0003	
412.20	12.67	0.00029	0.000	0.0003	
412.30	15.83	0.00029	0.000	0.0003	
412.40	19.00	0.00030	0.000	0.0003	
412.50	22.17	0.00030	0.000	0.0003	
412.60	25.33	0.00031	0.000	0.0003	
412.70	28.50	0.00031	0.000	0.0003	
412.80	31.67	0.00032	0.000	0.0003	Top of Stone
413.05	31.67	0.00033	0.000	0.0003	
413.10	31.72	0.00034	0.000	0.0003	Invert of Overflow
413.35	32.01	0.00035	0.046	0.0465	Obvert of Overflow

465 Garafraxa Street West
Township of Centre Wellington
Our File: 422144

Catchment 500 - Parking Lot Ponding

Storage Volume Calculations

Elevation (m)	Depth (m)	Surface Area (m^2)	Pipe Area (m^2)	Incremental Storage Volume (m^3)	Accum. Storage Volume (m^3)	
413.59	0.000	1.13	0.00	0.00	0.00	Invert of Orifice Plate
413.62	0.030	1.13	0.00	0.03	0.03	Invert of Pipe
413.80	0.205	1.13	3.81	4.01	4.04	
413.97	0.380	1.13	3.81	4.01	8.05	
414.15	0.555	1.13	3.81	4.01	12.06	Obvert of Pipe
414.40	0.805	1.13	0.00	0.28	12.34	
414.65	1.055	1.13	0.00	0.28	12.62	
414.90	1.305	1.13	0.00	0.28	12.91	
415.02	1.430	0.36	0.00	0.09	13.00	T/G DCB.6
415.05	1.460	4.0	0.00	0.07	13.06	
415.10	1.510	13.0	0.00	0.43	13.49	
415.15	1.560	29.0	0.00	1.05	14.54	
415.20	1.610	53.0	0.00	2.05	16.59	
415.25	1.660	86.0	0.00	3.48	20.06	
415.32	1.730	139.0	0.00	7.87	27.94	Weir
415.37	1.780	205.0	0.00	8.60	36.54	
415.42	1.830	215.0	0.00	10.50	47.04	
415.47	1.880	241.0	0.00	11.40	58.44	Overflow

465 Garafraxa Street West
Township of Centre Wellington
Our File: 422144

Overflow Weir

Elevation=415.25

d1 =	1.88	m
h =	1.73	m
H =	0.15	m
2g =	19.62	
L =	6	m
Q =	0.482	m^3/s

Orifice

invert = 413.25

Q =	0.023	m^3/s
Cd =	0.6	
H =	1.84	m
2g =	19.62	
A =	0.006	m^2
D =	0.090	m
D/2 =	0.045	m

Stage/Storage/Discharge Table

Stage (m)	Storage (m^3)	Orifice Discharge (m^3/s)	Weir Discharge (m^3/s)	Total Discharge (m^3/s)	
413.59	0.00	0.000	0.000	0.000	Invert of Orifice Plate
413.62	0.03	0.002	0.000	0.002	Invert of Pipe
413.80	4.04	0.007	0.000	0.007	
413.97	8.05	0.010	0.000	0.010	
414.15	12.06	0.012	0.000	0.012	Obvert of Pipe
414.40	12.34	0.015	0.000	0.015	
414.65	12.62	0.017	0.000	0.017	
414.90	12.91	0.019	0.000	0.019	
415.02	13.00	0.020	0.000	0.020	T/G DCB.6
415.05	13.06	0.020	0.000	0.020	
415.10	13.49	0.020	0.000	0.020	
415.15	14.54	0.021	0.000	0.021	
415.20	16.59	0.021	0.000	0.021	
415.25	20.06	0.021	0.000	0.021	
415.32	27.94	0.022	0.000	0.022	Weir
415.37	36.54	0.022	0.476	0.498	
415.42	47.04	0.023	0.479	0.502	
415.47	58.44	0.023	0.482	0.505	Overflow

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                   C:\Users\pgrier\Documents\Work\"
"                                             422144  465 Garafraxa\2023-01-18"
"                Output filename:                      422144  2-year post.out"
"                Licensee name:                                           gmbp"
"                Company                                                     "
"                Date & Time last used:              1/18/2023 at 11:42:18 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      695.047   Coefficient A"
"        6.387   Constant B"
"        0.793   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           93.292    mm/hr"
"             Total depth                 33.014    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Catchment 100"
"      100.000   % Impervious"
"        0.030   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.030   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.006     0.000     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.030      0.030      hectare"
"             Time of concentration  24.993     2.044      2.044      minutes"
"             Time to Centroid       93.891     86.566     86.566     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        0.00       9.90       9.90       c.m"
"             Rainfall losses        32.003     1.926      1.926      mm"
"             Runoff depth           1.010      31.087     31.087     mm"
"             Runoff volume          0.00       9.33       9.33       c.m"
"             Runoff coefficient     0.000      0.942      0.942      "
"             Maximum flow           0.000      0.006      0.006      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.006     0.006     0.000     0.000"
" 54          POND DESIGN"
"         0.006   Current peak flow    c.m/sec"
"         0.003   Target outflow    c.m/sec"
"           9.3   Hydrograph volume    c.m"
"           15.   Number of stages"
"         0.000   Minimum water level    metre"
"         3.000   Maximum water level    metre"
"         0.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 412.550     0.000     0.000"
"                 412.560   0.00012    0.1400"
"                 412.650   0.00012     1.400"
"                 412.750   0.00012     2.800"
"                 412.850   0.00013     4.200"
"                 412.950   0.00013     5.600"
"                 413.050   0.00013     7.000"
"                 413.150   0.00014     8.400"
"                 413.250   0.00014     9.800"
"                 413.350   0.00014    11.200"
"                 413.450   0.00015    12.600"
"                 413.550   0.00015    14.000"
"                 413.700   0.00016    14.000"
"                 413.850   0.00016    14.170"
"                 414.100   0.04629    14.450"
"             Peak outflow                  0.000    c.m/sec"
"             Maximum level               413.130    metre"
"             Maximum storage               8.125    c.m"
"             Centroidal lag               10.645   hours"
"                  0.006     0.006     0.000     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Infiltrated on-site"
"             Maximum flow                  0.000    c.m/sec"
```

```
"             Hydrograph volume              9.326    c.m"
"                    0.006     0.006     0.000     0.000"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.006     0.000     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Catchment 200"
"      100.000   % Impervious"
"        0.030   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.030   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.006     0.000     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.030      0.030      hectare"
"             Time of concentration  24.993     2.044      2.044      minutes"
"             Time to Centroid       93.891     86.566     86.566     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        0.00       9.90       9.90       c.m"
"             Rainfall losses        32.003     1.926      1.926      mm"
"             Runoff depth           1.010      31.087     31.087     mm"
"             Runoff volume          0.00       9.33       9.33       c.m"
"             Runoff coefficient     0.000      0.942      0.942      "
"             Maximum flow           0.000      0.006      0.006      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.006     0.006     0.000     0.000"
" 33          CATCHMENT 300"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          300   Catchment 300"
```

```
"      100.000   % Impervious"
"        0.036   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.036   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.007     0.006     0.000     0.000 c.m/sec"
"             Catchment 300          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.036      0.036      hectare"
"             Time of concentration  24.993     2.044      2.044      minutes"
"             Time to Centroid       93.891     86.566     86.566     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        0.00       11.88      11.88      c.m"
"             Rainfall losses        32.003     1.926      1.926      mm"
"             Runoff depth           1.010      31.087     31.087     mm"
"             Runoff volume          0.00       11.19      11.19      c.m"
"             Runoff coefficient     0.000      0.942      0.942      "
"             Maximum flow           0.000      0.007      0.007      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.007     0.013     0.000     0.000"
" 54          POND DESIGN"
"        0.013   Current peak flow    c.m/sec"
"        0.003   Target outflow    c.m/sec"
"         20.5   Hydrograph volume    c.m"
"          15.   Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                411.800     0.000     0.000"
"                411.810   0.00026    0.3200"
"                411.900   0.00027     3.170"
"                412.000   0.00027     6.330"
"                412.100   0.00028     9.500"
```

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"               412.200   0.00029    12.670"
"               412.300   0.00029    15.830"
"               412.400   0.00030    19.000"
"               412.500   0.00030    22.170"
"               412.600   0.00031    25.330"
"               412.700   0.00031    28.500"
"               412.800   0.00032    31.670"
"               413.050   0.00033    31.670"
"               413.100   0.00034    31.720"
"               413.350   0.04647    32.010"
"            Peak outflow                  0.000    c.m/sec"
"            Maximum level               412.365    metre"
"            Maximum storage              17.884    c.m"
"            Centroidal lag               10.650   hours"
"                 0.007     0.013     0.000     0.000 c.m/sec"
" 40         HYDROGRAPH   Combine    1"
"           6   Combine "
"           1   Node #"
"               Infiltrated on-site"
"            Maximum flow                  0.000    c.m/sec"
"            Hydrograph volume            29.843    c.m"
"                    0.007     0.013     0.000     0.000"
" 40         HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                    0.007     0.000     0.000     0.000"
" 33         CATCHMENT 400"
"           1   Triangular SCS"
"           1   Equal length"
"           2   Horton equation"
"         400   Catchment 400"
"       0.000   % Impervious"
"       0.130   Total Area"
"      45.000   Flow length"
"       2.000   Overland Slope"
"       0.130   Pervious Area"
"      45.000   Pervious length"
"       2.000   Pervious slope"
"       0.000   Impervious Area"
"      45.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      75.000   Pervious Max.infiltration"
"      12.500   Pervious Min.infiltration"
"       0.250   Pervious Lag constant (hours)"
"       5.000   Pervious Depression storage"
"       0.015   Impervious Manning 'n'"
"       0.000   Impervious Max.infiltration"
"       0.000   Impervious Min.infiltration"
"       0.050   Impervious Lag constant (hours)"
"       1.500   Impervious Depression storage"
```

```
"                    0.001     0.000     0.000     0.000 c.m/sec"
"             Catchment 400          Pervious   Impervious Total Area "
"             Surface Area           0.130      0.000      0.130      hectare"
"             Time of concentration  35.561     2.909      35.560     minutes"
"             Time to Centroid       101.605    87.888     101.605    minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        42.92      0.00       42.92      c.m"
"             Rainfall losses        32.002     2.087      32.002     mm"
"             Runoff depth           1.012      30.926     1.012      mm"
"             Runoff volume          1.32       0.00       1.32       c.m"
"             Runoff coefficient     0.031      0.000      0.031      "
"             Maximum flow           0.001      0.000      0.001      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.001     0.001     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.001     0.001     0.001     0.000"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Off-Site"
"             Maximum flow                 0.001    c.m/sec"
"             Hydrograph volume            1.315    c.m"
"                    0.001     0.001     0.001     0.001"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.001     0.000     0.001     0.001"
" 33          CATCHMENT 500"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          500   Catchment 500"
"       95.000   % Impervious"
"        0.194   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.010   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.184   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
```

```
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.037     0.000     0.001     0.001 c.m/sec"
"             Catchment 500          Pervious   Impervious Total Area "
"             Surface Area           0.010      0.184      0.194      hectare"
"             Time of concentration  24.993     2.044      2.084      minutes"
"             Time to Centroid       93.891     86.566     86.579     minutes"
"             Rainfall depth         33.014     33.014     33.014     mm"
"             Rainfall volume        3.20       60.84      64.05      c.m"
"             Rainfall losses        32.003     1.926      3.430      mm"
"             Runoff depth           1.010      31.087     29.584     mm"
"             Runoff volume          0.10       57.29      57.39      c.m"
"             Runoff coefficient     0.031      0.942      0.896      "
"             Maximum flow           0.000      0.037      0.037      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.037     0.037     0.001     0.001"
" 54          POND DESIGN"
"        0.037   Current peak flow    c.m/sec"
"        0.002   Target outflow    c.m/sec"
"         57.4   Hydrograph volume    c.m"
"          18.   Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                413.590     0.000     0.000"
"                413.620   0.00200   0.03000"
"                413.800   0.00700     4.040"
"                413.970   0.01000     8.050"
"                414.150   0.01200    12.060"
"                414.400   0.01500    12.340"
"                414.650   0.01700    12.620"
"                414.900   0.01900    12.910"
"                415.020   0.02000    13.000"
"                415.050   0.02000    13.060"
"                415.100   0.02000    13.490"
"                415.150   0.02100    14.540"
"                415.200   0.02100    16.590"
"                415.250   0.02100    20.060"
"                415.320   0.02200    27.940"
"                415.370    0.4980    36.540"
"                415.420    0.5020    47.040"
"                415.470    0.5050    58.440"
"             Peak outflow                  0.021    c.m/sec"
"             Maximum level               415.153    metre"
"             Maximum storage              14.669    c.m"
"             Centroidal lag                1.614   hours"
```

```
"                0.037     0.037     0.021     0.001 c.m/sec"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Off-Site"
"             Maximum flow                  0.021    c.m/sec"
"             Hydrograph volume            58.678    c.m"
"                     0.037     0.037     0.021     0.021"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                Infiltrated on-site"
"             Maximum flow                  0.000    c.m/sec"
"             Hydrograph volume            29.843    c.m"
"                     0.037     0.000     0.021     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.037     0.000     0.000     0.000"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                TOTAL"
"             Maximum flow                  0.000    c.m/sec"
"             Hydrograph volume            29.843    c.m"
"                     0.037     0.000     0.000     0.000"
" 40          HYDROGRAPH   Confluence    2"
"            7   Confluence "
"            2   Node #"
"                Off-Site"
"             Maximum flow                  0.021    c.m/sec"
"             Hydrograph volume            58.678    c.m"
"                     0.037     0.021     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.037     0.021     0.021     0.000"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                TOTAL"
"             Maximum flow                  0.022    c.m/sec"
"             Hydrograph volume            88.521    c.m"
"                     0.037     0.021     0.021     0.022"
" 40          HYDROGRAPH   Confluence    3"
"            7   Confluence "
"            3   Node #"
"                TOTAL"
"             Maximum flow                  0.022    c.m/sec"
"             Hydrograph volume            88.521    c.m"
"                     0.037     0.022     0.021     0.000"
" 38          START/RE-START TOTALS 3"
```

```
"            3   Runoff Totals on EXIT"
"             Total Catchment area                        0.420    hectare"
"             Total Impervious area                       0.280    hectare"
"             Total % impervious                         66.738"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                   C:\Users\pgrier\Documents\Work\"
"                                             422144  465 Garafraxa\2023-01-18"
"                Output filename:                      422144  5-year post.out"
"                Licensee name:                                           gmbp"
"                Company                                                     "
"                Date & Time last used:              1/18/2023 at 11:46:09 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1459.072   Coefficient A"
"       13.690   Constant B"
"        0.850   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          113.586    mm/hr"
"             Total depth                 49.792    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Catchment 100"
"      100.000   % Impervious"
"        0.030   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.030   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.008     0.000     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.030      0.030      hectare"
"             Time of concentration  13.471     1.890      1.890      minutes"
"             Time to Centroid       90.770     85.354     85.354     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        0.00       14.94      14.94      c.m"
"             Rainfall losses        39.012     2.179      2.179      mm"
"             Runoff depth           10.780     47.613     47.613     mm"
"             Runoff volume          0.00       14.28      14.28      c.m"
"             Runoff coefficient     0.000      0.956      0.956      "
"             Maximum flow           0.000      0.008      0.008      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.008     0.008     0.000     0.000"
" 54          POND DESIGN"
"         0.008   Current peak flow    c.m/sec"
"         0.003   Target outflow    c.m/sec"
"          14.3   Hydrograph volume    c.m"
"           15.   Number of stages"
"         0.000   Minimum water level    metre"
"         3.000   Maximum water level    metre"
"         0.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 412.550     0.000     0.000"
"                 412.560   0.00012    0.1400"
"                 412.650   0.00012     1.400"
"                 412.750   0.00012     2.800"
"                 412.850   0.00013     4.200"
"                 412.950   0.00013     5.600"
"                 413.050   0.00013     7.000"
"                 413.150   0.00014     8.400"
"                 413.250   0.00014     9.800"
"                 413.350   0.00014    11.200"
"                 413.450   0.00015    12.600"
"                 413.550   0.00015    14.000"
"                 413.700   0.00016    14.000"
"                 413.850   0.00016    14.170"
"                 414.100   0.04629    14.450"
"             Peak outflow                  0.000    c.m/sec"
"             Maximum level               413.450    metre"
"             Maximum storage              12.603    c.m"
"             Centroidal lag               15.124   hours"
"                  0.008     0.008     0.000     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Infiltrated on-site"
"             Maximum flow                  0.000    c.m/sec"
```

```
"             Hydrograph volume            11.915    c.m"
"                    0.008     0.008     0.000     0.000"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.008     0.000     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Catchment 200"
"      100.000   % Impervious"
"        0.030   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.030   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.008     0.000     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.030      0.030      hectare"
"             Time of concentration  13.471     1.890      1.890      minutes"
"             Time to Centroid       90.770     85.354     85.354     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        0.00       14.94      14.94      c.m"
"             Rainfall losses        39.012     2.179      2.179      mm"
"             Runoff depth           10.780     47.613     47.613     mm"
"             Runoff volume          0.00       14.28      14.28      c.m"
"             Runoff coefficient     0.000      0.956      0.956      "
"             Maximum flow           0.000      0.008      0.008      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.008     0.008     0.000     0.000"
" 33          CATCHMENT 300"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          300   Catchment 300"
```

```
"      100.000   % Impervious"
"        0.036   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.036   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.009     0.008     0.000     0.000 c.m/sec"
"             Catchment 300          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.036      0.036      hectare"
"             Time of concentration  13.471     1.890      1.890      minutes"
"             Time to Centroid       90.770     85.354     85.354     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        0.00       17.92      17.93      c.m"
"             Rainfall losses        39.012     2.179      2.179      mm"
"             Runoff depth           10.780     47.613     47.613     mm"
"             Runoff volume          0.00       17.14      17.14      c.m"
"             Runoff coefficient     0.000      0.956      0.956      "
"             Maximum flow           0.000      0.009      0.009      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.009     0.017     0.000     0.000"
" 54          POND DESIGN"
"        0.017   Current peak flow    c.m/sec"
"        0.003   Target outflow    c.m/sec"
"         31.4   Hydrograph volume    c.m"
"          15.   Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                411.800     0.000     0.000"
"                411.810   0.00026    0.3200"
"                411.900   0.00027     3.170"
"                412.000   0.00027     6.330"
"                412.100   0.00028     9.500"
```

```
"               412.200   0.00029    12.670"
"               412.300   0.00029    15.830"
"               412.400   0.00030    19.000"
"               412.500   0.00030    22.170"
"               412.600   0.00031    25.330"
"               412.700   0.00031    28.500"
"               412.800   0.00032    31.670"
"               413.050   0.00033    31.670"
"               413.100   0.00034    31.720"
"               413.350   0.04647    32.010"
"            Peak outflow                  0.000    c.m/sec"
"            Maximum level               412.702    metre"
"            Maximum storage              28.554    c.m"
"            Centroidal lag               15.389   hours"
"                 0.009     0.017     0.000     0.000 c.m/sec"
" 40         HYDROGRAPH   Combine    1"
"           6   Combine "
"           1   Node #"
"               Infiltrated on-site"
"            Maximum flow                  0.000    c.m/sec"
"            Hydrograph volume            37.823    c.m"
"                    0.009     0.017     0.000     0.000"
" 40         HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                    0.009     0.000     0.000     0.000"
" 33         CATCHMENT 400"
"           1   Triangular SCS"
"           1   Equal length"
"           2   Horton equation"
"         400   Catchment 400"
"       0.000   % Impervious"
"       0.130   Total Area"
"      45.000   Flow length"
"       2.000   Overland Slope"
"       0.130   Pervious Area"
"      45.000   Pervious length"
"       2.000   Pervious slope"
"       0.000   Impervious Area"
"      45.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      75.000   Pervious Max.infiltration"
"      12.500   Pervious Min.infiltration"
"       0.250   Pervious Lag constant (hours)"
"       5.000   Pervious Depression storage"
"       0.015   Impervious Manning 'n'"
"       0.000   Impervious Max.infiltration"
"       0.000   Impervious Min.infiltration"
"       0.050   Impervious Lag constant (hours)"
"       1.500   Impervious Depression storage"
```

```
"                    0.008     0.000     0.000     0.000 c.m/sec"
"             Catchment 400          Pervious   Impervious Total Area "
"             Surface Area           0.130      0.000      0.130      hectare"
"             Time of concentration  19.167     2.689      19.167     minutes"
"             Time to Centroid       96.350     86.563     96.350     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        64.73      0.00       64.73      c.m"
"             Rainfall losses        39.010     2.419      39.010     mm"
"             Runoff depth           10.782     47.373     10.782     mm"
"             Runoff volume          14.02      0.00       14.02      c.m"
"             Runoff coefficient     0.217      0.000      0.217      "
"             Maximum flow           0.008      0.000      0.008      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.008     0.008     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.008     0.008     0.008     0.000"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Off-Site"
"             Maximum flow                 0.008    c.m/sec"
"             Hydrograph volume           14.016    c.m"
"                    0.008     0.008     0.008     0.008"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.008     0.000     0.008     0.008"
" 33          CATCHMENT 500"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          500   Catchment 500"
"       95.000   % Impervious"
"        0.194   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.010   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.184   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
```

```
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.048     0.000     0.008     0.008 c.m/sec"
"             Catchment 500          Pervious   Impervious Total Area "
"             Surface Area           0.010      0.184      0.194      hectare"
"             Time of concentration  13.471     1.890      2.026      minutes"
"             Time to Centroid       90.770     85.354     85.417     minutes"
"             Rainfall depth         49.792     49.792     49.792     mm"
"             Rainfall volume        4.83       91.77      96.60      c.m"
"             Rainfall losses        39.012     2.179      4.020      mm"
"             Runoff depth           10.780     47.613     45.771     mm"
"             Runoff volume          1.05       87.75      88.80      c.m"
"             Runoff coefficient     0.217      0.956      0.919      "
"             Maximum flow           0.001      0.047      0.048      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.048     0.048     0.008     0.008"
" 54          POND DESIGN"
"        0.048   Current peak flow    c.m/sec"
"        0.002   Target outflow    c.m/sec"
"         88.8   Hydrograph volume    c.m"
"          18.   Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                413.590     0.000     0.000"
"                413.620   0.00200   0.03000"
"                413.800   0.00700     4.040"
"                413.970   0.01000     8.050"
"                414.150   0.01200    12.060"
"                414.400   0.01500    12.340"
"                414.650   0.01700    12.620"
"                414.900   0.01900    12.910"
"                415.020   0.02000    13.000"
"                415.050   0.02000    13.060"
"                415.100   0.02000    13.490"
"                415.150   0.02100    14.540"
"                415.200   0.02100    16.590"
"                415.250   0.02100    20.060"
"                415.320   0.02200    27.940"
"                415.370    0.4980    36.540"
"                415.420    0.5020    47.040"
"                415.470    0.5050    58.440"
"             Peak outflow                  0.022    c.m/sec"
"             Maximum level               415.315    metre"
"             Maximum storage              27.412    c.m"
"             Centroidal lag                1.650   hours"
```

```
"                0.048     0.048     0.022     0.008 c.m/sec"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Off-Site"
"             Maximum flow                  0.030    c.m/sec"
"             Hydrograph volume           102.829    c.m"
"                     0.048     0.048     0.022     0.030"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                Infiltrated on-site"
"             Maximum flow                  0.000    c.m/sec"
"             Hydrograph volume            37.823    c.m"
"                     0.048     0.000     0.022     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.048     0.000     0.000     0.000"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                TOTAL"
"             Maximum flow                  0.000    c.m/sec"
"             Hydrograph volume            37.823    c.m"
"                     0.048     0.000     0.000     0.000"
" 40          HYDROGRAPH   Confluence    2"
"            7   Confluence "
"            2   Node #"
"                Off-Site"
"             Maximum flow                  0.030    c.m/sec"
"             Hydrograph volume           102.829    c.m"
"                     0.048     0.030     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.048     0.030     0.030     0.000"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                TOTAL"
"             Maximum flow                  0.030    c.m/sec"
"             Hydrograph volume           140.653    c.m"
"                     0.048     0.030     0.030     0.030"
" 40          HYDROGRAPH   Confluence    3"
"            7   Confluence "
"            3   Node #"
"                TOTAL"
"             Maximum flow                  0.030    c.m/sec"
"             Hydrograph volume           140.653    c.m"
"                     0.048     0.030     0.030     0.000"
" 38          START/RE-START TOTALS 3"
```

```
"            3   Runoff Totals on EXIT"
"             Total Catchment area                        0.420    hectare"
"             Total Impervious area                       0.280    hectare"
"             Total % impervious                         66.738"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                   C:\Users\pgrier\Documents\Work\"
"                                             422144  465 Garafraxa\2023-01-18"
"                Output filename:                     422144  10-year post.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:               1/18/2023 at 11:48:58 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     2327.596   Coefficient A"
"       19.500   Constant B"
"        0.894   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          126.171    mm/hr"
"             Total depth                 61.359    mm"
"            6   010hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Catchment 100"
"      100.000   % Impervious"
"        0.030   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.030   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.009     0.000     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.030      0.030      hectare"
"             Time of concentration  12.045     1.812      1.812      minutes"
"             Time to Centroid       90.582     84.870     84.870     minutes"
"             Rainfall depth         61.359     61.359     61.359     mm"
"             Rainfall volume        0.00       18.41      18.41      c.m"
"             Rainfall losses        41.728     2.332      2.332      mm"
"             Runoff depth           19.631     59.027     59.027     mm"
"             Runoff volume          0.00       17.71      17.71      c.m"
"             Runoff coefficient     0.000      0.962      0.962      "
"             Maximum flow           0.000      0.009      0.009      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.009     0.009     0.000     0.000"
" 54          POND DESIGN"
"         0.009   Current peak flow    c.m/sec"
"         0.003   Target outflow    c.m/sec"
"          17.7   Hydrograph volume    c.m"
"           15.   Number of stages"
"         0.000   Minimum water level    metre"
"         3.000   Maximum water level    metre"
"         0.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 412.550     0.000     0.000"
"                 412.560   0.00012    0.1400"
"                 412.650   0.00012     1.400"
"                 412.750   0.00012     2.800"
"                 412.850   0.00013     4.200"
"                 412.950   0.00013     5.600"
"                 413.050   0.00013     7.000"
"                 413.150   0.00014     8.400"
"                 413.250   0.00014     9.800"
"                 413.350   0.00014    11.200"
"                 413.450   0.00015    12.600"
"                 413.550   0.00015    14.000"
"                 413.700   0.00016    14.000"
"                 413.850   0.00016    14.170"
"                 414.100   0.04629    14.450"
"             Peak outflow                  0.001    c.m/sec"
"             Maximum level               413.856    metre"
"             Maximum storage              14.176    c.m"
"             Centroidal lag               14.277   hours"
"                  0.009     0.009     0.001     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                    0.009     0.001     0.001     0.000"
" 56          DIVERSION"
"           100   Node number"
```

```
"        0.000   Overflow threshold"
"        1.000   Required diverted fraction"
"            0   Conduit type; 1=Pipe;2=Channel"
"             Peak of diverted flow         0.001    c.m/sec"
"             Volume of diverted flow       2.038    c.m"
"             DIV00100.010hyd"
"             Major flow at 100"
"                     0.009     0.001     0.000     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Infiltrated on-site"
"             Maximum flow                  0.000    c.m/sec"
"             Hydrograph volume            12.447    c.m"
"                     0.009     0.001     0.000     0.000"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.009     0.000     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Catchment 200"
"      100.000   % Impervious"
"        0.030   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.030   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.009     0.000     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.030      0.030      hectare"
"             Time of concentration  12.045     1.812      1.812      minutes"
"             Time to Centroid       90.582     84.870     84.870     minutes"
"             Rainfall depth         61.359     61.359     61.359     mm"
"             Rainfall volume        0.00       18.41      18.41      c.m"
```

```
"             Rainfall losses        41.728     2.332      2.332      mm"
"             Runoff depth           19.631     59.027     59.027     mm"
"             Runoff volume          0.00       17.71      17.71      c.m"
"             Runoff coefficient     0.000      0.962      0.962      "
"             Maximum flow           0.000      0.009      0.009      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.009     0.009     0.000     0.000"
" 33          CATCHMENT 300"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          300   Catchment 300"
"      100.000   % Impervious"
"        0.036   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.036   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.011     0.009     0.000     0.000 c.m/sec"
"             Catchment 300          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.036      0.036      hectare"
"             Time of concentration  12.045     1.812      1.812      minutes"
"             Time to Centroid       90.582     84.870     84.870     minutes"
"             Rainfall depth         61.359     61.359     61.359     mm"
"             Rainfall volume        0.00       22.09      22.09      c.m"
"             Rainfall losses        41.728     2.332      2.332      mm"
"             Runoff depth           19.631     59.027     59.027     mm"
"             Runoff volume          0.00       21.25      21.25      c.m"
"             Runoff coefficient     0.000      0.962      0.962      "
"             Maximum flow           0.000      0.011      0.011      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.011     0.020     0.000     0.000"
" 54          POND DESIGN"
"        0.020   Current peak flow    c.m/sec"
```

```
"        0.003   Target outflow    c.m/sec"
"         39.0   Hydrograph volume    c.m"
"          15.   Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                411.800     0.000     0.000"
"                411.810   0.00026    0.3200"
"                411.900   0.00027     3.170"
"                412.000   0.00027     6.330"
"                412.100   0.00028     9.500"
"                412.200   0.00029    12.670"
"                412.300   0.00029    15.830"
"                412.400   0.00030    19.000"
"                412.500   0.00030    22.170"
"                412.600   0.00031    25.330"
"                412.700   0.00031    28.500"
"                412.800   0.00032    31.670"
"                413.050   0.00033    31.670"
"                413.100   0.00034    31.720"
"                413.350   0.04647    32.010"
"             Peak outflow                  0.002    c.m/sec"
"             Maximum level               413.111    metre"
"             Maximum storage              31.733    c.m"
"             Centroidal lag               15.130   hours"
"                  0.011     0.020     0.002     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                    0.011     0.002     0.002     0.000"
" 56          DIVERSION"
"           300   Node number"
"        0.000   Overflow threshold"
"        1.000   Required diverted fraction"
"            0   Conduit type; 1=Pipe;2=Channel"
"             Peak of diverted flow         0.002    c.m/sec"
"             Volume of diverted flow       4.796    c.m"
"             DIV00300.010hyd"
"             Major flow at 300"
"                    0.011     0.002     0.000     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Infiltrated on-site"
"             Maximum flow                  0.001    c.m/sec"
"             Hydrograph volume            38.473    c.m"
"                    0.011     0.002     0.000     0.001"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
```

```
"                    0.011     0.000     0.000     0.001"
" 33          CATCHMENT 400"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          400   Catchment 400"
"        0.000   % Impervious"
"        0.130   Total Area"
"       45.000   Flow length"
"        2.000   Overland Slope"
"        0.130   Pervious Area"
"       45.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       45.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.014     0.000     0.000     0.001 c.m/sec"
"             Catchment 400          Pervious   Impervious Total Area "
"             Surface Area           0.130      0.000      0.130      hectare"
"             Time of concentration  17.138     2.578      17.138     minutes"
"             Time to Centroid       95.559     86.001     95.559     minutes"
"             Rainfall depth         61.359     61.359     61.359     mm"
"             Rainfall volume        79.77      0.00       79.77      c.m"
"             Rainfall losses        41.654     2.661      41.654     mm"
"             Runoff depth           19.705     58.698     19.705     mm"
"             Runoff volume          25.62      0.00       25.62      c.m"
"             Runoff coefficient     0.321      0.000      0.321      "
"             Maximum flow           0.014      0.000      0.014      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.014     0.014     0.000     0.001"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.014     0.014     0.014     0.001"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Off-Site"
"             Maximum flow                 0.014    c.m/sec"
"             Hydrograph volume           25.617    c.m"
```

```
"                    0.014     0.014     0.014     0.014"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.014     0.000     0.014     0.014"
" 47          FILEI_O Read/Open DIV00100.010hyd"
"            1   1=read/open; 2=write/save"
"            2   1=rainfall; 2=hydrograph"
"            1   1=runoff; 2=inflow; 3=outflow; 4=junction"
"             DIV00100.010hyd"
"             Major flow at 100"
"             Total volume                  2.038    c.m"
"             Maximum flow                  0.001    c.m/sec"
"                  0.001     0.000     0.014     0.014 c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.001     0.001     0.014     0.014"
" 47          FILEI_O Read/Open DIV00300.010hyd"
"            1   1=read/open; 2=write/save"
"            2   1=rainfall; 2=hydrograph"
"            1   1=runoff; 2=inflow; 3=outflow; 4=junction"
"             DIV00300.010hyd"
"             Major flow at 300"
"             Total volume                  4.796    c.m"
"             Maximum flow                  0.002    c.m/sec"
"                  0.002     0.001     0.014     0.014 c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.002     0.003     0.014     0.014"
" 33          CATCHMENT 500"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          500   Catchment 500"
"       95.000   % Impervious"
"        0.194   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.010   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.184   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
```

```
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.055     0.003     0.014     0.014 c.m/sec"
"             Catchment 500          Pervious   Impervious Total Area "
"             Surface Area           0.010      0.184      0.194      hectare"
"             Time of concentration  12.045     1.812      1.988      minutes"
"             Time to Centroid       90.582     84.870     84.968     minutes"
"             Rainfall depth         61.359     61.359     61.359     mm"
"             Rainfall volume        5.95       113.09     119.04     c.m"
"             Rainfall losses        41.728     2.332      4.302      mm"
"             Runoff depth           19.631     59.027     57.057     mm"
"             Runoff volume          1.90       108.79     110.69     c.m"
"             Runoff coefficient     0.320      0.962      0.930      "
"             Maximum flow           0.001      0.055      0.055      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.055     0.055     0.014     0.014"
" 54          POND DESIGN"
"        0.055   Current peak flow    c.m/sec"
"        0.002   Target outflow    c.m/sec"
"        117.5   Hydrograph volume    c.m"
"          18.   Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                413.590     0.000     0.000"
"                413.620   0.00200   0.03000"
"                413.800   0.00700     4.040"
"                413.970   0.01000     8.050"
"                414.150   0.01200    12.060"
"                414.400   0.01500    12.340"
"                414.650   0.01700    12.620"
"                414.900   0.01900    12.910"
"                415.020   0.02000    13.000"
"                415.050   0.02000    13.060"
"                415.100   0.02000    13.490"
"                415.150   0.02100    14.540"
"                415.200   0.02100    16.590"
"                415.250   0.02100    20.060"
"                415.320   0.02200    27.940"
"                415.370    0.4980    36.540"
"                415.420    0.5020    47.040"
"                415.470    0.5050    58.440"
"             Peak outflow                  0.040    c.m/sec"
"             Maximum level               415.323    metre"
"             Maximum storage              28.442    c.m"
"             Centroidal lag                1.715   hours"
```

```
"                0.055     0.055     0.040     0.014 c.m/sec"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Off-Site"
"             Maximum flow                  0.050    c.m/sec"
"             Hydrograph volume           141.329    c.m"
"                     0.055     0.055     0.040     0.050"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                Infiltrated on-site"
"             Maximum flow                  0.001    c.m/sec"
"             Hydrograph volume            38.473    c.m"
"                     0.055     0.001     0.040     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.055     0.001     0.001     0.000"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                TOTAL"
"             Maximum flow                  0.001    c.m/sec"
"             Hydrograph volume            38.473    c.m"
"                     0.055     0.001     0.001     0.001"
" 40          HYDROGRAPH   Confluence    2"
"            7   Confluence "
"            2   Node #"
"                Off-Site"
"             Maximum flow                  0.050    c.m/sec"
"             Hydrograph volume           141.329    c.m"
"                     0.055     0.050     0.001     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.055     0.050     0.050     0.000"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                TOTAL"
"             Maximum flow                  0.051    c.m/sec"
"             Hydrograph volume           179.801    c.m"
"                     0.055     0.050     0.050     0.051"
" 40          HYDROGRAPH   Confluence    3"
"            7   Confluence "
"            3   Node #"
"                TOTAL"
"             Maximum flow                  0.051    c.m/sec"
"             Hydrograph volume           179.801    c.m"
"                     0.055     0.051     0.050     0.000"
" 38          START/RE-START TOTALS 3"
```

```
"            3   Runoff Totals on EXIT"
"             Total Catchment area                        0.420    hectare"
"             Total Impervious area                       0.280    hectare"
"             Total % impervious                         66.738"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                   C:\Users\pgrier\Documents\Work\"
"                                             422144  465 Garafraxa\2023-01-18"
"                Output filename:                     422144  25-year post.out"
"                Licensee name:                                           gmbp"
"                Company                                                     "
"                Date & Time last used:               1/18/2023 at 11:51:50 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     3701.648   Coefficient A"
"       25.500   Constant B"
"        0.937   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          143.371    mm/hr"
"             Total depth                 75.581    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Catchment 100"
"      100.000   % Impervious"
"        0.030   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.030   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.010     0.000     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.030      0.030      hectare"
"             Time of concentration  10.252     1.722      1.722      minutes"
"             Time to Centroid       90.488     84.485     84.485     minutes"
"             Rainfall depth         75.581     75.581     75.581     mm"
"             Rainfall volume        0.00       22.67      22.67      c.m"
"             Rainfall losses        44.281     2.520      2.520      mm"
"             Runoff depth           31.300     73.061     73.061     mm"
"             Runoff volume          0.00       21.92      21.92      c.m"
"             Runoff coefficient     0.000      0.967      0.967      "
"             Maximum flow           0.000      0.010      0.010      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.010     0.010     0.000     0.000"
" 54          POND DESIGN"
"         0.010   Current peak flow    c.m/sec"
"         0.003   Target outflow    c.m/sec"
"          21.9   Hydrograph volume    c.m"
"           15.   Number of stages"
"         0.000   Minimum water level    metre"
"         3.000   Maximum water level    metre"
"         0.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 412.550     0.000     0.000"
"                 412.560   0.00012    0.1400"
"                 412.650   0.00012     1.400"
"                 412.750   0.00012     2.800"
"                 412.850   0.00013     4.200"
"                 412.950   0.00013     5.600"
"                 413.050   0.00013     7.000"
"                 413.150   0.00014     8.400"
"                 413.250   0.00014     9.800"
"                 413.350   0.00014    11.200"
"                 413.450   0.00015    12.600"
"                 413.550   0.00015    14.000"
"                 413.700   0.00016    14.000"
"                 413.850   0.00016    14.170"
"                 414.100   0.04629    14.450"
"             Peak outflow                  0.004    c.m/sec"
"             Maximum level               413.875    metre"
"             Maximum storage              14.197    c.m"
"             Centroidal lag               12.459   hours"
"                  0.010     0.010     0.004     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                    0.010     0.004     0.004     0.000"
" 56          DIVERSION"
"           100   Node number"
```

```
"        0.000   Overflow threshold"
"        1.000   Required diverted fraction"
"            0   Conduit type; 1=Pipe;2=Channel"
"             Peak of diverted flow         0.004    c.m/sec"
"             Volume of diverted flow       5.767    c.m"
"             DIV00100.025hyd"
"             Major flow at 100"
"                     0.010     0.004     0.000     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Infiltrated on-site"
"             Maximum flow                  0.000    c.m/sec"
"             Hydrograph volume            12.538    c.m"
"                     0.010     0.004     0.000     0.000"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.010     0.000     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Catchment 200"
"      100.000   % Impervious"
"        0.030   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.030   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.010     0.000     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.030      0.030      hectare"
"             Time of concentration  10.252     1.722      1.722      minutes"
"             Time to Centroid       90.488     84.485     84.485     minutes"
"             Rainfall depth         75.581     75.581     75.581     mm"
"             Rainfall volume        0.00       22.67      22.67      c.m"
```

```
"             Rainfall losses        44.281     2.520      2.520      mm"
"             Runoff depth           31.300     73.061     73.061     mm"
"             Runoff volume          0.00       21.92      21.92      c.m"
"             Runoff coefficient     0.000      0.967      0.967      "
"             Maximum flow           0.000      0.010      0.010      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.010     0.010     0.000     0.000"
" 33          CATCHMENT 300"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          300   Catchment 300"
"      100.000   % Impervious"
"        0.036   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.036   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.012     0.010     0.000     0.000 c.m/sec"
"             Catchment 300          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.036      0.036      hectare"
"             Time of concentration  10.252     1.722      1.722      minutes"
"             Time to Centroid       90.488     84.485     84.485     minutes"
"             Rainfall depth         75.581     75.581     75.581     mm"
"             Rainfall volume        0.00       27.21      27.21      c.m"
"             Rainfall losses        44.281     2.520      2.520      mm"
"             Runoff depth           31.300     73.061     73.061     mm"
"             Runoff volume          0.00       26.30      26.30      c.m"
"             Runoff coefficient     0.000      0.967      0.967      "
"             Maximum flow           0.000      0.012      0.012      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.012     0.023     0.000     0.000"
" 54          POND DESIGN"
"        0.023   Current peak flow    c.m/sec"
```

```
"        0.003   Target outflow    c.m/sec"
"         48.2   Hydrograph volume    c.m"
"          15.   Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                411.800     0.000     0.000"
"                411.810   0.00026    0.3200"
"                411.900   0.00027     3.170"
"                412.000   0.00027     6.330"
"                412.100   0.00028     9.500"
"                412.200   0.00029    12.670"
"                412.300   0.00029    15.830"
"                412.400   0.00030    19.000"
"                412.500   0.00030    22.170"
"                412.600   0.00031    25.330"
"                412.700   0.00031    28.500"
"                412.800   0.00032    31.670"
"                413.050   0.00033    31.670"
"                413.100   0.00034    31.720"
"                413.350   0.04647    32.010"
"             Peak outflow                  0.008    c.m/sec"
"             Maximum level               413.151    metre"
"             Maximum storage              31.779    c.m"
"             Centroidal lag               12.657   hours"
"                  0.012     0.023     0.008     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                    0.012     0.008     0.008     0.000"
" 56          DIVERSION"
"           300   Node number"
"        0.000   Overflow threshold"
"        1.000   Required diverted fraction"
"            0   Conduit type; 1=Pipe;2=Channel"
"             Peak of diverted flow         0.008    c.m/sec"
"             Volume of diverted flow      13.855    c.m"
"             DIV00300.025hyd"
"             Major flow at 300"
"                    0.012     0.008     0.000     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Infiltrated on-site"
"             Maximum flow                  0.001    c.m/sec"
"             Hydrograph volume            38.620    c.m"
"                    0.012     0.008     0.000     0.001"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
```

```
"                    0.012     0.000     0.000     0.001"
" 33          CATCHMENT 400"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          400   Catchment 400"
"        0.000   % Impervious"
"        0.130   Total Area"
"       45.000   Flow length"
"        2.000   Overland Slope"
"        0.130   Pervious Area"
"       45.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       45.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.023     0.000     0.000     0.001 c.m/sec"
"             Catchment 400          Pervious   Impervious Total Area "
"             Surface Area           0.130      0.000      0.130      hectare"
"             Time of concentration  14.587     2.450      14.587     minutes"
"             Time to Centroid       94.912     85.513     94.912     minutes"
"             Rainfall depth         75.581     75.581     75.581     mm"
"             Rainfall volume        98.25      0.00       98.26      c.m"
"             Rainfall losses        44.164     2.905      44.164     mm"
"             Runoff depth           31.417     72.676     31.417     mm"
"             Runoff volume          40.84      0.00       40.84      c.m"
"             Runoff coefficient     0.416      0.000      0.416      "
"             Maximum flow           0.023      0.000      0.023      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.023     0.023     0.000     0.001"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.023     0.023     0.023     0.001"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Off-Site"
"             Maximum flow                 0.023    c.m/sec"
"             Hydrograph volume           40.842    c.m"
```

```
"                    0.023     0.023     0.023     0.023"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.023     0.000     0.023     0.023"
" 47          FILEI_O Read/Open DIV00100.025hyd"
"            1   1=read/open; 2=write/save"
"            2   1=rainfall; 2=hydrograph"
"            1   1=runoff; 2=inflow; 3=outflow; 4=junction"
"             DIV00100.025hyd"
"             Major flow at 100"
"             Total volume                  5.767    c.m"
"             Maximum flow                  0.004    c.m/sec"
"                  0.004     0.000     0.023     0.023 c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.004     0.004     0.023     0.023"
" 47          FILEI_O Read/Open DIV00300.025hyd"
"            1   1=read/open; 2=write/save"
"            2   1=rainfall; 2=hydrograph"
"            1   1=runoff; 2=inflow; 3=outflow; 4=junction"
"             DIV00300.025hyd"
"             Major flow at 300"
"             Total volume                 13.855    c.m"
"             Maximum flow                  0.008    c.m/sec"
"                  0.008     0.004     0.023     0.023 c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.008     0.012     0.023     0.023"
" 33          CATCHMENT 500"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          500   Catchment 500"
"       95.000   % Impervious"
"        0.194   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.010   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.184   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
```

```
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.065     0.012     0.023     0.023 c.m/sec"
"             Catchment 500          Pervious   Impervious Total Area "
"             Surface Area           0.010      0.184      0.194      hectare"
"             Time of concentration  10.252     1.722      1.910      minutes"
"             Time to Centroid       90.488     84.485     84.617     minutes"
"             Rainfall depth         75.581     75.581     75.581     mm"
"             Rainfall volume        7.33       139.30     146.63     c.m"
"             Rainfall losses        44.281     2.520      4.608      mm"
"             Runoff depth           31.300     73.061     70.973     mm"
"             Runoff volume          3.04       134.65     137.69     c.m"
"             Runoff coefficient     0.414      0.967      0.939      "
"             Maximum flow           0.002      0.064      0.065      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.065     0.065     0.023     0.023"
" 54          POND DESIGN"
"        0.065   Current peak flow    c.m/sec"
"        0.002   Target outflow    c.m/sec"
"        157.3   Hydrograph volume    c.m"
"          18.   Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                413.590     0.000     0.000"
"                413.620   0.00200   0.03000"
"                413.800   0.00700     4.040"
"                413.970   0.01000     8.050"
"                414.150   0.01200    12.060"
"                414.400   0.01500    12.340"
"                414.650   0.01700    12.620"
"                414.900   0.01900    12.910"
"                415.020   0.02000    13.000"
"                415.050   0.02000    13.060"
"                415.100   0.02000    13.490"
"                415.150   0.02100    14.540"
"                415.200   0.02100    16.590"
"                415.250   0.02100    20.060"
"                415.320   0.02200    27.940"
"                415.370    0.4980    36.540"
"                415.420    0.5020    47.040"
"                415.470    0.5050    58.440"
"             Peak outflow                  0.065    c.m/sec"
"             Maximum level               415.324    metre"
"             Maximum storage              28.709    c.m"
"             Centroidal lag                1.701   hours"
```

```
"                0.065     0.065     0.065     0.023 c.m/sec"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Off-Site"
"             Maximum flow                  0.076    c.m/sec"
"             Hydrograph volume           199.371    c.m"
"                      0.065     0.065     0.065     0.076"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                Infiltrated on-site"
"             Maximum flow                  0.001    c.m/sec"
"             Hydrograph volume            38.620    c.m"
"                      0.065     0.001     0.065     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                      0.065     0.001     0.001     0.000"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                TOTAL"
"             Maximum flow                  0.001    c.m/sec"
"             Hydrograph volume            38.620    c.m"
"                      0.065     0.001     0.001     0.001"
" 40          HYDROGRAPH   Confluence    2"
"            7   Confluence "
"            2   Node #"
"                Off-Site"
"             Maximum flow                  0.076    c.m/sec"
"             Hydrograph volume           199.371    c.m"
"                      0.065     0.076     0.001     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                      0.065     0.076     0.076     0.000"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                TOTAL"
"             Maximum flow                  0.076    c.m/sec"
"             Hydrograph volume           237.992    c.m"
"                      0.065     0.076     0.076     0.076"
" 40          HYDROGRAPH   Confluence    3"
"            7   Confluence "
"            3   Node #"
"                TOTAL"
"             Maximum flow                  0.076    c.m/sec"
"             Hydrograph volume           237.992    c.m"
"                      0.065     0.076     0.076     0.000"
" 38          START/RE-START TOTALS 3"
```

```
"            3   Runoff Totals on EXIT"
"             Total Catchment area                        0.420    hectare"
"             Total Impervious area                       0.280    hectare"
"             Total % impervious                         66.738"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                   C:\Users\pgrier\Documents\Work\"
"                                             422144  465 Garafraxa\2023-01-18"
"                Output filename:                     422144  50-year post.out"
"                Licensee name:                                           gmbp"
"                Company                                                     "
"                Date & Time last used:               1/18/2023 at 11:55:29 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     5089.418   Coefficient A"
"       30.000   Constant B"
"        0.967   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          156.350    mm/hr"
"             Total depth                 86.737    mm"
"            6   050hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Catchment 100"
"      100.000   % Impervious"
"        0.030   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.030   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.011     0.000     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.030      0.030      hectare"
"             Time of concentration  9.574      1.663      1.663      minutes"
"             Time to Centroid       90.779     84.291     84.291     minutes"
"             Rainfall depth         86.737     86.737     86.737     mm"
"             Rainfall volume        0.00       26.02      26.02      c.m"
"             Rainfall losses        45.966     2.621      2.621      mm"
"             Runoff depth           40.771     84.116     84.116     mm"
"             Runoff volume          0.00       25.23      25.23      c.m"
"             Runoff coefficient     0.000      0.970      0.970      "
"             Maximum flow           0.000      0.011      0.011      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.011     0.011     0.000     0.000"
" 54          POND DESIGN"
"         0.011   Current peak flow    c.m/sec"
"         0.003   Target outflow    c.m/sec"
"          25.2   Hydrograph volume    c.m"
"           15.   Number of stages"
"         0.000   Minimum water level    metre"
"         3.000   Maximum water level    metre"
"         0.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 412.550     0.000     0.000"
"                 412.560   0.00012    0.1400"
"                 412.650   0.00012     1.400"
"                 412.750   0.00012     2.800"
"                 412.850   0.00013     4.200"
"                 412.950   0.00013     5.600"
"                 413.050   0.00013     7.000"
"                 413.150   0.00014     8.400"
"                 413.250   0.00014     9.800"
"                 413.350   0.00014    11.200"
"                 413.450   0.00015    12.600"
"                 413.550   0.00015    14.000"
"                 413.700   0.00016    14.000"
"                 413.850   0.00016    14.170"
"                 414.100   0.04629    14.450"
"             Peak outflow                  0.006    c.m/sec"
"             Maximum level               413.891    metre"
"             Maximum storage              14.216    c.m"
"             Centroidal lag               11.510   hours"
"                  0.011     0.011     0.006     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                    0.011     0.006     0.006     0.000"
" 56          DIVERSION"
"           100   Node number"
```

```
"        0.000   Overflow threshold"
"        1.000   Required diverted fraction"
"            0   Conduit type; 1=Pipe;2=Channel"
"             Peak of diverted flow         0.006    c.m/sec"
"             Volume of diverted flow       8.703    c.m"
"             DIV00100.050hyd"
"             Major flow at 100"
"                     0.011     0.006     0.000     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Infiltrated on-site"
"             Maximum flow                  0.000    c.m/sec"
"             Hydrograph volume            12.571    c.m"
"                     0.011     0.006     0.000     0.000"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.011     0.000     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Catchment 200"
"      100.000   % Impervious"
"        0.030   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.030   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.011     0.000     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.030      0.030      hectare"
"             Time of concentration  9.574      1.663      1.663      minutes"
"             Time to Centroid       90.779     84.291     84.291     minutes"
"             Rainfall depth         86.737     86.737     86.737     mm"
"             Rainfall volume        0.00       26.02      26.02      c.m"
```

```
"             Rainfall losses        45.966     2.621      2.621      mm"
"             Runoff depth           40.771     84.116     84.116     mm"
"             Runoff volume          0.00       25.23      25.23      c.m"
"             Runoff coefficient     0.000      0.970      0.970      "
"             Maximum flow           0.000      0.011      0.011      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.011     0.011     0.000     0.000"
" 33          CATCHMENT 300"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          300   Catchment 300"
"      100.000   % Impervious"
"        0.036   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.036   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.014     0.011     0.000     0.000 c.m/sec"
"             Catchment 300          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.036      0.036      hectare"
"             Time of concentration  9.574      1.663      1.663      minutes"
"             Time to Centroid       90.779     84.291     84.291     minutes"
"             Rainfall depth         86.737     86.737     86.737     mm"
"             Rainfall volume        0.00       31.23      31.23      c.m"
"             Rainfall losses        45.966     2.621      2.621      mm"
"             Runoff depth           40.771     84.116     84.116     mm"
"             Runoff volume          0.00       30.28      30.28      c.m"
"             Runoff coefficient     0.000      0.970      0.970      "
"             Maximum flow           0.000      0.014      0.014      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.014     0.025     0.000     0.000"
" 54          POND DESIGN"
"        0.025   Current peak flow    c.m/sec"
```

```
"        0.003   Target outflow    c.m/sec"
"         55.5   Hydrograph volume    c.m"
"           15.   Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                411.800     0.000     0.000"
"                411.810   0.00026    0.3200"
"                411.900   0.00027     3.170"
"                412.000   0.00027     6.330"
"                412.100   0.00028     9.500"
"                412.200   0.00029    12.670"
"                412.300   0.00029    15.830"
"                412.400   0.00030    19.000"
"                412.500   0.00030    22.170"
"                412.600   0.00031    25.330"
"                412.700   0.00031    28.500"
"                412.800   0.00032    31.670"
"                413.050   0.00033    31.670"
"                413.100   0.00034    31.720"
"                413.350   0.04647    32.010"
"             Peak outflow                  0.013    c.m/sec"
"             Maximum level               413.186    metre"
"             Maximum storage              31.820    c.m"
"             Centroidal lag               11.684   hours"
"                  0.014     0.025     0.013     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     0.014     0.013     0.013     0.000"
" 56          DIVERSION"
"           300   Node number"
"        0.000   Overflow threshold"
"        1.000   Required diverted fraction"
"            0   Conduit type; 1=Pipe;2=Channel"
"             Peak of diverted flow         0.013    c.m/sec"
"             Volume of diverted flow      20.356    c.m"
"             DIV00300.050hyd"
"             Major flow at 300"
"                     0.014     0.013     0.000     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Infiltrated on-site"
"             Maximum flow                  0.001    c.m/sec"
"             Hydrograph volume            38.688    c.m"
"                     0.014     0.013     0.000     0.001"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
```

```
"                    0.014     0.000     0.000     0.001"
" 33          CATCHMENT 400"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          400   Catchment 400"
"        0.000   % Impervious"
"        0.130   Total Area"
"       45.000   Flow length"
"        2.000   Overland Slope"
"        0.130   Pervious Area"
"       45.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       45.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.029     0.000     0.000     0.001 c.m/sec"
"             Catchment 400          Pervious   Impervious Total Area "
"             Surface Area           0.130      0.000      0.130      hectare"
"             Time of concentration  13.622     2.366      13.622     minutes"
"             Time to Centroid       95.105     85.267     95.105     minutes"
"             Rainfall depth         86.737     86.737     86.737     mm"
"             Rainfall volume        112.76     0.00       112.76     c.m"
"             Rainfall losses        45.735     3.110      45.735     mm"
"             Runoff depth           41.002     83.627     41.002     mm"
"             Runoff volume          53.30      0.00       53.30      c.m"
"             Runoff coefficient     0.473      0.000      0.473      "
"             Maximum flow           0.029      0.000      0.029      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.029     0.029     0.000     0.001"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.029     0.029     0.029     0.001"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Off-Site"
"             Maximum flow                 0.029    c.m/sec"
"             Hydrograph volume           53.302    c.m"
```

```
"                    0.029     0.029     0.029     0.029"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.029     0.000     0.029     0.029"
" 47          FILEI_O Read/Open DIV00100.050hyd"
"            1   1=read/open; 2=write/save"
"            2   1=rainfall; 2=hydrograph"
"            1   1=runoff; 2=inflow; 3=outflow; 4=junction"
"             DIV00100.050hyd"
"             Major flow at 100"
"             Total volume                   8.703    c.m"
"             Maximum flow                   0.006    c.m/sec"
"                  0.006     0.000     0.029     0.029 c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.006     0.006     0.029     0.029"
" 47          FILEI_O Read/Open DIV00300.050hyd"
"            1   1=read/open; 2=write/save"
"            2   1=rainfall; 2=hydrograph"
"            1   1=runoff; 2=inflow; 3=outflow; 4=junction"
"             DIV00300.050hyd"
"             Major flow at 300"
"             Total volume                  20.356    c.m"
"             Maximum flow                   0.013    c.m/sec"
"                  0.013     0.006     0.029     0.029 c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.013     0.019     0.029     0.029"
" 33          CATCHMENT 500"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          500   Catchment 500"
"       95.000   % Impervious"
"        0.194   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.010   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.184   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
```

```
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.072     0.019     0.029     0.029 c.m/sec"
"             Catchment 500          Pervious   Impervious Total Area "
"             Surface Area           0.010      0.184      0.194      hectare"
"             Time of concentration  9.574      1.663      1.860      minutes"
"             Time to Centroid       90.779     84.291     84.452     minutes"
"             Rainfall depth         86.737     86.737     86.737     mm"
"             Rainfall volume        8.41       159.86     168.27     c.m"
"             Rainfall losses        45.966     2.621      4.788      mm"
"             Runoff depth           40.771     84.116     81.948     mm"
"             Runoff volume          3.95       155.03     158.98     c.m"
"             Runoff coefficient     0.470      0.970      0.945      "
"             Maximum flow           0.003      0.070      0.072      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.072     0.072     0.029     0.029"
" 54          POND DESIGN"
"        0.072   Current peak flow    c.m/sec"
"        0.002   Target outflow    c.m/sec"
"        188.0   Hydrograph volume    c.m"
"          18.   Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                413.590     0.000     0.000"
"                413.620   0.00200   0.03000"
"                413.800   0.00700     4.040"
"                413.970   0.01000     8.050"
"                414.150   0.01200    12.060"
"                414.400   0.01500    12.340"
"                414.650   0.01700    12.620"
"                414.900   0.01900    12.910"
"                415.020   0.02000    13.000"
"                415.050   0.02000    13.060"
"                415.100   0.02000    13.490"
"                415.150   0.02100    14.540"
"                415.200   0.02100    16.590"
"                415.250   0.02100    20.060"
"                415.320   0.02200    27.940"
"                415.370    0.4980    36.540"
"                415.420    0.5020    47.040"
"                415.470    0.5050    58.440"
"             Peak outflow                  0.072    c.m/sec"
"             Maximum level               415.325    metre"
"             Maximum storage              28.834    c.m"
"             Centroidal lag                1.686   hours"
```

```
"                0.072     0.072     0.072     0.029 c.m/sec"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Off-Site"
"             Maximum flow                  0.087    c.m/sec"
"             Hydrograph volume           238.934    c.m"
"                     0.072     0.072     0.072     0.087"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                Infiltrated on-site"
"             Maximum flow                  0.001    c.m/sec"
"             Hydrograph volume            38.688    c.m"
"                     0.072     0.001     0.072     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.072     0.001     0.001     0.000"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                TOTAL"
"             Maximum flow                  0.001    c.m/sec"
"             Hydrograph volume            38.688    c.m"
"                     0.072     0.001     0.001     0.001"
" 40          HYDROGRAPH   Confluence    2"
"            7   Confluence "
"            2   Node #"
"                Off-Site"
"             Maximum flow                  0.087    c.m/sec"
"             Hydrograph volume           238.934    c.m"
"                     0.072     0.087     0.001     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.072     0.087     0.087     0.000"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                TOTAL"
"             Maximum flow                  0.088    c.m/sec"
"             Hydrograph volume           277.622    c.m"
"                     0.072     0.087     0.087     0.088"
" 40          HYDROGRAPH   Confluence    3"
"            7   Confluence "
"            3   Node #"
"                TOTAL"
"             Maximum flow                  0.088    c.m/sec"
"             Hydrograph volume           277.622    c.m"
"                     0.072     0.088     0.087     0.000"
" 38          START/RE-START TOTALS 3"
```

```
"            3   Runoff Totals on EXIT"
"             Total Catchment area                        0.420    hectare"
"             Total Impervious area                       0.280    hectare"
"             Total % impervious                         66.738"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                   C:\Users\pgrier\Documents\Work\"
"                                             422144  465 Garafraxa\2023-01-18"
"                Output filename:                     422144  100-year post.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                1/18/2023 at 11:57:15 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     6933.019   Coefficient A"
"       34.699   Constant B"
"        0.998   Exponent C"
"        0.380   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          168.777    mm/hr"
"             Total depth                 97.921    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Catchment 100"
"      100.000   % Impervious"
"        0.030   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.030   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.012     0.000     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.030      0.030      hectare"
"             Time of concentration  9.201      1.613      1.613      minutes"
"             Time to Centroid       90.800     84.151     84.151     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        0.00       29.38      29.38      c.m"
"             Rainfall losses        47.274     2.759      2.759      mm"
"             Runoff depth           50.647     95.162     95.162     mm"
"             Runoff volume          0.00       28.55      28.55      c.m"
"             Runoff coefficient     0.000      0.972      0.972      "
"             Maximum flow           0.000      0.012      0.012      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.012     0.012     0.000     0.000"
" 54          POND DESIGN"
"         0.012   Current peak flow    c.m/sec"
"         0.003   Target outflow    c.m/sec"
"          28.5   Hydrograph volume    c.m"
"           15.   Number of stages"
"         0.000   Minimum water level    metre"
"         3.000   Maximum water level    metre"
"         0.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 412.550     0.000     0.000"
"                 412.560   0.00012    0.1400"
"                 412.650   0.00012     1.400"
"                 412.750   0.00012     2.800"
"                 412.850   0.00013     4.200"
"                 412.950   0.00013     5.600"
"                 413.050   0.00013     7.000"
"                 413.150   0.00014     8.400"
"                 413.250   0.00014     9.800"
"                 413.350   0.00014    11.200"
"                 413.450   0.00015    12.600"
"                 413.550   0.00015    14.000"
"                 413.700   0.00016    14.000"
"                 413.850   0.00016    14.170"
"                 414.100   0.04629    14.450"
"             Peak outflow                  0.009    c.m/sec"
"             Maximum level               413.905    metre"
"             Maximum storage              14.232    c.m"
"             Centroidal lag                9.266   hours"
"                  0.012     0.012     0.009     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                    0.012     0.009     0.009     0.000"
" 56          DIVERSION"
"           100   Node number"
```

```
"        0.000   Overflow threshold"
"        1.000   Required diverted fraction"
"            0   Conduit type; 1=Pipe;2=Channel"
"             Peak of diverted flow         0.009    c.m/sec"
"             Volume of diverted flow      12.894    c.m"
"             DIV00100.100hyd"
"             Major flow at 100"
"                     0.012     0.009     0.000     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Infiltrated on-site"
"             Maximum flow                  0.000    c.m/sec"
"             Hydrograph volume            12.603    c.m"
"                     0.012     0.009     0.000     0.000"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.012     0.000     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Catchment 200"
"      100.000   % Impervious"
"        0.030   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.030   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.012     0.000     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.030      0.030      hectare"
"             Time of concentration  9.201      1.613      1.613      minutes"
"             Time to Centroid       90.800     84.151     84.151     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        0.00       29.38      29.38      c.m"
```

```
"             Rainfall losses        47.274     2.759      2.759      mm"
"             Runoff depth           50.647     95.162     95.162     mm"
"             Runoff volume          0.00       28.55      28.55      c.m"
"             Runoff coefficient     0.000      0.972      0.972      "
"             Maximum flow           0.000      0.012      0.012      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.012     0.012     0.000     0.000"
" 33          CATCHMENT 300"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          300   Catchment 300"
"      100.000   % Impervious"
"        0.036   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.036   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.015     0.012     0.000     0.000 c.m/sec"
"             Catchment 300          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.036      0.036      hectare"
"             Time of concentration  9.201      1.613      1.613      minutes"
"             Time to Centroid       90.800     84.151     84.151     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        0.00       35.25      35.25      c.m"
"             Rainfall losses        47.274     2.759      2.759      mm"
"             Runoff depth           50.647     95.162     95.162     mm"
"             Runoff volume          0.00       34.26      34.26      c.m"
"             Runoff coefficient     0.000      0.972      0.972      "
"             Maximum flow           0.000      0.015      0.015      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.015     0.027     0.000     0.000"
" 54          POND DESIGN"
"        0.027   Current peak flow    c.m/sec"
```

```
"        0.003   Target outflow    c.m/sec"
"         62.8   Hydrograph volume    c.m"
"          15.   Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                411.800     0.000     0.000"
"                411.810   0.00026    0.3200"
"                411.900   0.00027     3.170"
"                412.000   0.00027     6.330"
"                412.100   0.00028     9.500"
"                412.200   0.00029    12.670"
"                412.300   0.00029    15.830"
"                412.400   0.00030    19.000"
"                412.500   0.00030    22.170"
"                412.600   0.00031    25.330"
"                412.700   0.00031    28.500"
"                412.800   0.00032    31.670"
"                413.050   0.00033    31.670"
"                413.100   0.00034    31.720"
"                413.350   0.04647    32.010"
"             Peak outflow                  0.020    c.m/sec"
"             Maximum level               413.218    metre"
"             Maximum storage              31.857    c.m"
"             Centroidal lag                9.408   hours"
"                  0.015     0.027     0.020     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                      0.015     0.020     0.020     0.000"
" 56          DIVERSION"
"           300   Node number"
"        0.000   Overflow threshold"
"        1.000   Required diverted fraction"
"            0   Conduit type; 1=Pipe;2=Channel"
"             Peak of diverted flow         0.020    c.m/sec"
"             Volume of diverted flow      29.618    c.m"
"             DIV00300.100hyd"
"             Major flow at 300"
"                      0.015     0.020     0.000     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Infiltrated on-site"
"             Maximum flow                  0.001    c.m/sec"
"             Hydrograph volume            38.752    c.m"
"                      0.015     0.020     0.000     0.001"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
```

```
"                    0.015     0.000     0.000     0.001"
" 33          CATCHMENT 400"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          400   Catchment 400"
"        0.000   % Impervious"
"        0.130   Total Area"
"       45.000   Flow length"
"        2.000   Overland Slope"
"        0.130   Pervious Area"
"       45.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       45.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.035     0.000     0.000     0.001 c.m/sec"
"             Catchment 400          Pervious   Impervious Total Area "
"             Surface Area           0.130      0.000      0.130      hectare"
"             Time of concentration  13.091     2.295      13.091     minutes"
"             Time to Centroid       94.931     85.055     94.931     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        127.30     0.00       127.30     c.m"
"             Rainfall losses        47.175     3.229      47.175     mm"
"             Runoff depth           50.747     94.693     50.747     mm"
"             Runoff volume          65.97      0.00       65.97      c.m"
"             Runoff coefficient     0.518      0.000      0.518      "
"             Maximum flow           0.035      0.000      0.035      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.035     0.035     0.000     0.001"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.035     0.035     0.035     0.001"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Off-Site"
"             Maximum flow                 0.035    c.m/sec"
"             Hydrograph volume           65.971    c.m"
```

```
"                    0.035     0.035     0.035     0.035"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.035     0.000     0.035     0.035"
" 47          FILEI_O Read/Open DIV00100.100hyd"
"            1   1=read/open; 2=write/save"
"            2   1=rainfall; 2=hydrograph"
"            1   1=runoff; 2=inflow; 3=outflow; 4=junction"
"             DIV00100.100hyd"
"             Major flow at 100"
"             Total volume                  12.894    c.m"
"             Maximum flow                   0.009    c.m/sec"
"                  0.009     0.000     0.035     0.035 c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.009     0.009     0.035     0.035"
" 47          FILEI_O Read/Open DIV00300.100hyd"
"            1   1=read/open; 2=write/save"
"            2   1=rainfall; 2=hydrograph"
"            1   1=runoff; 2=inflow; 3=outflow; 4=junction"
"             DIV00300.100hyd"
"             Major flow at 300"
"             Total volume                  29.618    c.m"
"             Maximum flow                   0.020    c.m/sec"
"                  0.020     0.009     0.035     0.035 c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.020     0.029     0.035     0.035"
" 33          CATCHMENT 500"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          500   Catchment 500"
"       95.000   % Impervious"
"        0.194   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.010   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.184   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
```

```
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.078     0.029     0.035     0.035 c.m/sec"
"             Catchment 500          Pervious   Impervious Total Area "
"             Surface Area           0.010      0.184      0.194      hectare"
"             Time of concentration  9.201      1.613      1.820      minutes"
"             Time to Centroid       90.800     84.151     84.332     minutes"
"             Rainfall depth         97.921     97.921     97.921     mm"
"             Rainfall volume        9.50       180.47     189.97     c.m"
"             Rainfall losses        47.274     2.759      4.985      mm"
"             Runoff depth           50.647     95.162     92.936     mm"
"             Runoff volume          4.91       175.38     180.30     c.m"
"             Runoff coefficient     0.517      0.972      0.949      "
"             Maximum flow           0.003      0.077      0.078      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.078     0.089     0.035     0.035"
" 54          POND DESIGN"
"        0.089   Current peak flow    c.m/sec"
"        0.002   Target outflow    c.m/sec"
"        222.8   Hydrograph volume    c.m"
"          18.   Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                413.590     0.000     0.000"
"                413.620   0.00200   0.03000"
"                413.800   0.00700     4.040"
"                413.970   0.01000     8.050"
"                414.150   0.01200    12.060"
"                414.400   0.01500    12.340"
"                414.650   0.01700    12.620"
"                414.900   0.01900    12.910"
"                415.020   0.02000    13.000"
"                415.050   0.02000    13.060"
"                415.100   0.02000    13.490"
"                415.150   0.02100    14.540"
"                415.200   0.02100    16.590"
"                415.250   0.02100    20.060"
"                415.320   0.02200    27.940"
"                415.370    0.4980    36.540"
"                415.420    0.5020    47.040"
"                415.470    0.5050    58.440"
"             Peak outflow                  0.089    c.m/sec"
"             Maximum level               415.327    metre"
"             Maximum storage              29.142    c.m"
"             Centroidal lag                1.667   hours"
```

```
"                0.078     0.089     0.089     0.035 c.m/sec"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Off-Site"
"             Maximum flow                  0.122    c.m/sec"
"             Hydrograph volume           285.245    c.m"
"                     0.078     0.089     0.089     0.122"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                Infiltrated on-site"
"             Maximum flow                  0.001    c.m/sec"
"             Hydrograph volume            38.752    c.m"
"                     0.078     0.001     0.089     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.078     0.001     0.001     0.000"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                TOTAL"
"             Maximum flow                  0.001    c.m/sec"
"             Hydrograph volume            38.752    c.m"
"                     0.078     0.001     0.001     0.001"
" 40          HYDROGRAPH   Confluence    2"
"            7   Confluence "
"            2   Node #"
"                Off-Site"
"             Maximum flow                  0.122    c.m/sec"
"             Hydrograph volume           285.245    c.m"
"                     0.078     0.122     0.001     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.078     0.122     0.122     0.000"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                TOTAL"
"             Maximum flow                  0.123    c.m/sec"
"             Hydrograph volume           323.997    c.m"
"                     0.078     0.122     0.122     0.123"
" 40          HYDROGRAPH   Confluence    3"
"            7   Confluence "
"            3   Node #"
"                TOTAL"
"             Maximum flow                  0.123    c.m/sec"
"             Hydrograph volume           323.997    c.m"
"                     0.078     0.123     0.122     0.000"
" 38          START/RE-START TOTALS 3"
```

```
"            3   Runoff Totals on EXIT"
"             Total Catchment area                        0.420    hectare"
"             Total Impervious area                       0.280    hectare"
"             Total % impervious                         66.738"
" 19          EXIT"
```

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

01/18/2023

Province:	Ontario
City:	Fergus
Nearest Rainfall Station:	WATERLOO WELLINGTON AP
Climate Station Id:	6149387
Years of Rainfall Data:	34

Site Name:	465 Garafraxa

Drainage Area (ha):	0.19
% Imperviousness:	95.00

Runoff Coefficient 'c': 0.87

Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	6.26
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Site Sediment Transport Rate (kg/ha/yr):	

Project Name:	465 Garafraxa
Project Number:	60503
Designer Name:	Patrick Grier
Designer Company:	GM BluePlan Engineering Limited
Designer Email:	patrick.grier@gmblueplan.ca
Designer Phone:	519-748-1440
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	93
EFO6	98
EFO8	99
EFO10	100
EFO12	100

Recommended Stormceptor EFO Model: EFO4

Estimated Net Annual Sediment (TSS) Load Reduction (%): 93

Water Quality Runoff Volume Capture (%): > 90

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THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterwavs.

PARTICLE SIZE DISTRIBUTION (PSD)

►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

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Stormceptor® EF Sizing Report

Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.5	8.5	8.5	0.23	14.0	11.0	100	8.5	8.5
1	18.3	26.8	0.46	28.0	23.0	100	18.3	26.8
2	14.4	41.3	0.92	55.0	46.0	100	14.4	41.3
3	10.2	51.5	1.38	83.0	69.0	100	10.2	51.5
4	8.0	59.5	1.84	110.0	92.0	97	7.8	59.2
5	6.9	66.4	2.30	138.0	115.0	95	6.6	65.8
6	5.9	72.3	2.76	165.0	138.0	92	5.4	71.2
7	3.8	76.1	3.22	193.0	161.0	88	3.3	74.6
8	2.6	78.7	3.68	221.0	184.0	86	2.2	76.8
9	2.5	81.1	4.14	248.0	207.0	83	2.1	78.8
10	2.2	83.3	4.60	276.0	230.0	82	1.8	80.6
11	2.5	85.8	5.05	303.0	253.0	81	2.0	82.6
12	2.0	87.8	5.51	331.0	276.0	80	1.6	84.2
13	1.6	89.4	5.97	358.0	299.0	79	1.3	85.5
14	0.9	90.4	6.43	386.0	322.0	78	0.7	86.2
15	1.6	91.9	6.89	414.0	345.0	77	1.2	87.4
16	1.1	93.0	7.35	441.0	368.0	76	0.8	88.2
17	1.0	94.0	7.81	469.0	391.0	74	0.8	89.0
18	0.5	94.6	8.27	496.0	414.0	73	0.4	89.4
19	0.2	94.8	8.73	524.0	437.0	72	0.2	89.6
20	0.6	95.4	9.19	551.0	460.0	71	0.4	90.0
21	0.6	96.1	9.65	579.0	483.0	70	0.5	90.5
22	0.3	96.4	10.11	607.0	505.0	69	0.2	90.7
23	0.8	97.2	10.57	634.0	528.0	68	0.6	91.2
24	0.4	97.6	11.03	662.0	551.0	67	0.3	91.5
25	0.2	97.8	11.49	689.0	574.0	66	0.1	91.6
30	0.9	98.7	13.79	827.0	689.0	64	0.6	92.2
35	0.8	99.5	16.08	965.0	804.0	63	0.5	92.7
40	0.2	99.7	18.38	1103.0	919.0	62	0.1	92.9
45	0.3	100.0	20.68	1241.0	1034.0	61	0.2	93.0
Estimated Net Annual Sediment (TSS) Load Reduction =								**93 %**

Climate Station ID: 6149387 *Years of Rainfall Data*: 34

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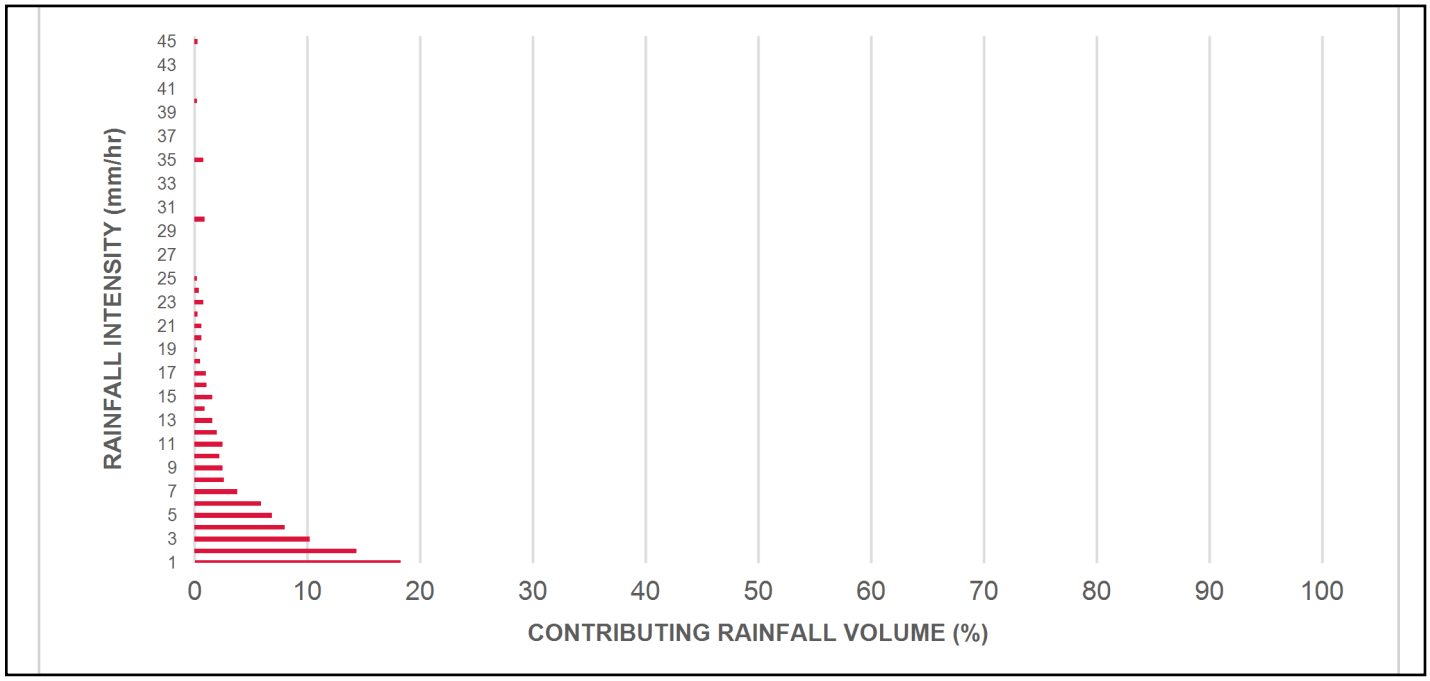
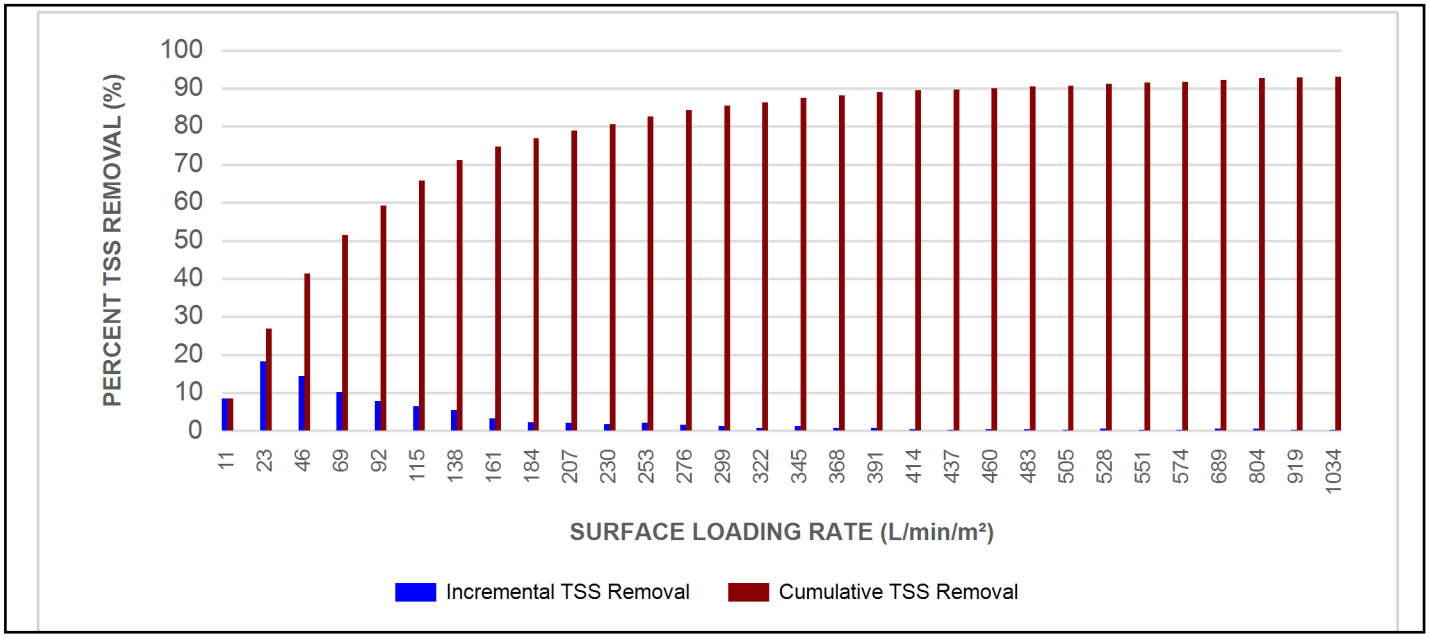
RAINFALL DATA FROM WATERLOO WELLINGTON AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

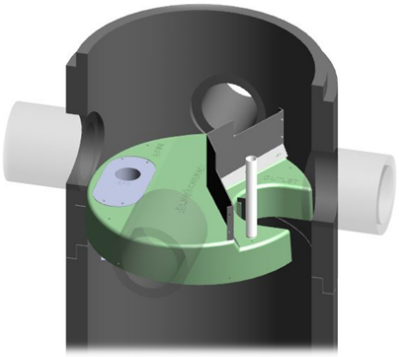
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

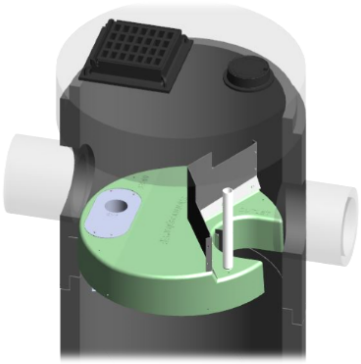
DESIGN FLEXIBILITY

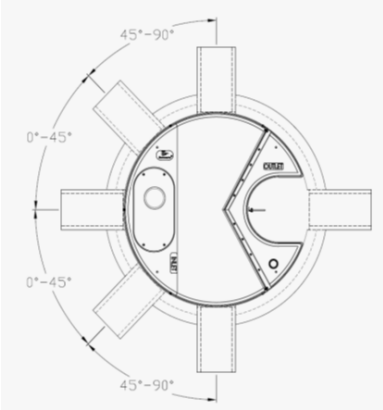
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall

remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

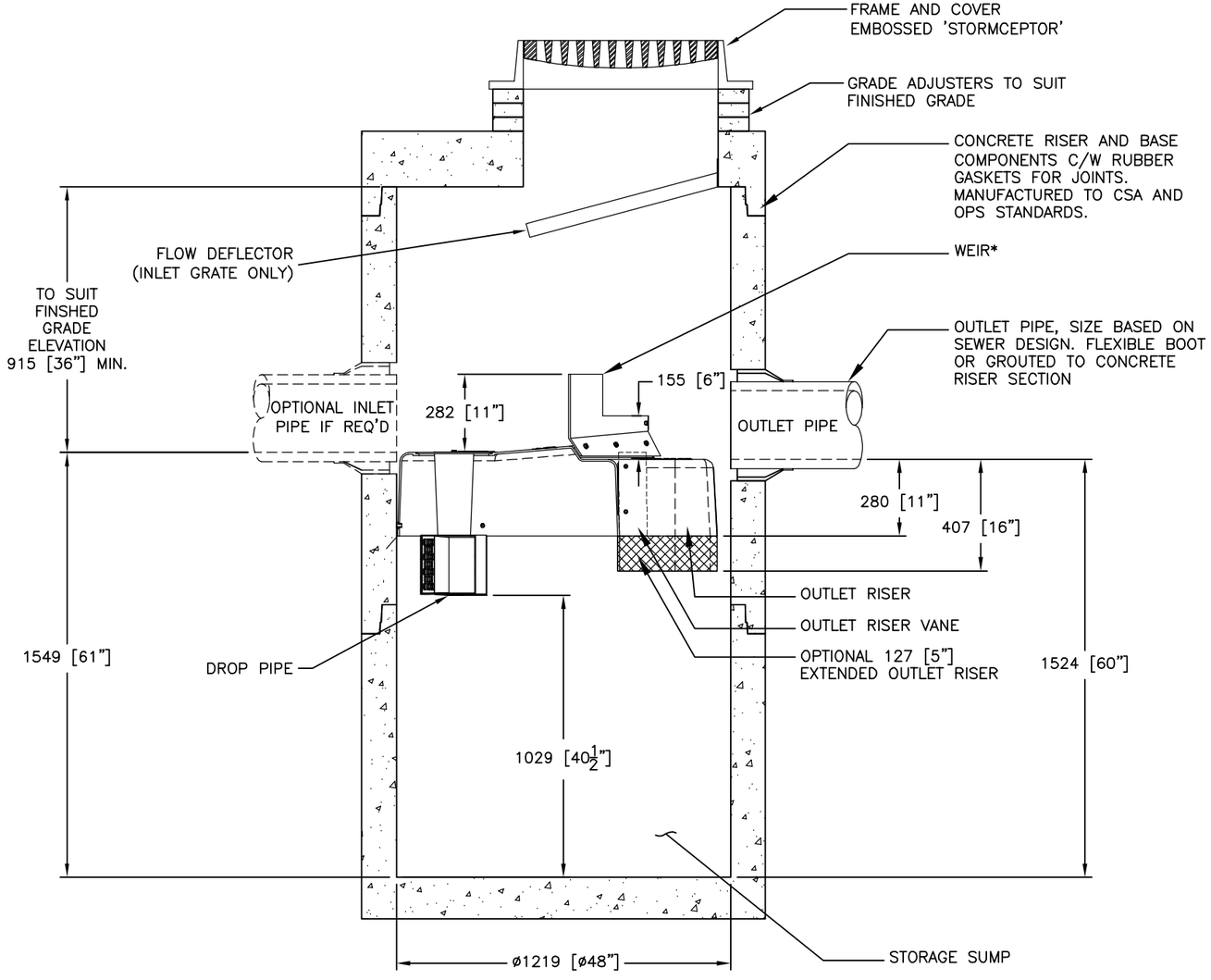
3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

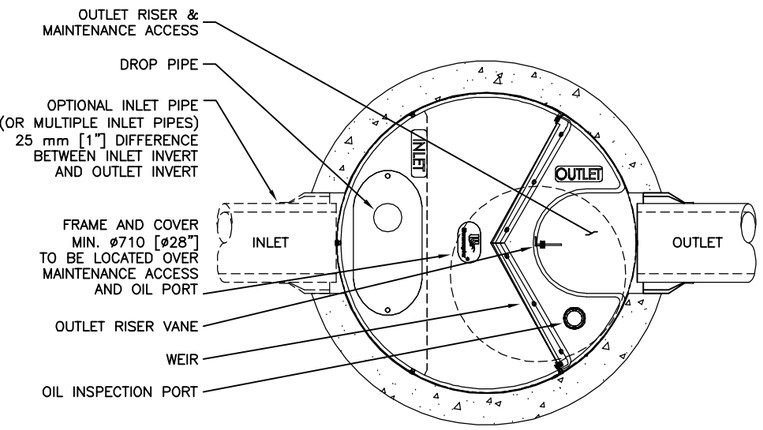
The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to

assess whether light liquids captured after a spill are effectively retained at high flow rates.

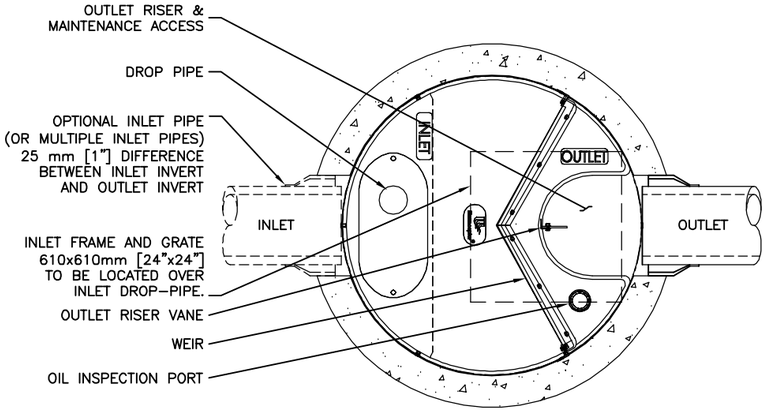
3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.



SECTION VIEW



PLAN VIEW (STANDARD)



PLAN VIEW (INLET TOP)

FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT YOUR LOCAL STORMCEPTOR REPRESENTATIVE. SITE SPECIFIC DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME. SOME FIELD REVISIONS TO THE SYSTEM LOCATION OR CONNECTION PIPING MAY BE NECESSARY BASED ON AVAILABLE SPACE OR SITE CONFIGURATION REVISIONS. ELEVATIONS SHOULD BE MAINTAINED EXCEPT WHERE NOTED ON BYPASS STRUCTURE (IF REQUIRED).

GENERAL NOTES:

* MAXIMUM SURFACE LOADING RATE (SLR) INTO LOWER CHAMBER THROUGH DROP PIPE IS 1135 L/min/m^2 (27.9 gpm/ft^2) FOR STORMCEPTOR EF4 AND 535 L/min/m^2 (13.1 gpm/ft^2) FOR STORMCEPTOR EFO4 (OIL CAPTURE CONFIGURATION). WEIR HEIGHT IS 150 mm (6 INCH) FOR EF04.

1. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE SPECIFIED.
2. STORMCEPTOR STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
3. UNLESS OTHERWISE NOTED, BYPASS INFRASTRUCTURE, SUCH AS ALL UPSTREAM DIVERSION STRUCTURES, CONNECTING STRUCTURES, OR PIPE CONDUITS CONNECTING TO COMPLETE THE STORMCEPTOR SYSTEM SHALL BE PROVIDED AND ADDRESSED SEPARATELY.
4. DRAWING FOR INFORMATION PURPOSES ONLY. REFER TO ENGINEER'S SITE/UTILITY PLAN FOR STRUCTURE ORIENTATION.
5. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR TO PROJECT BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT THE DEVICE FROM CONSTRUCTION-RELATED EROSION RUNOFF.
E. DEVICE ACTIVATION, BY CONTRACTOR, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE STORMCEPTOR UNIT IS CLEAN AND FREE OF DEBRIS.

STANDARD DETAIL
NOT FOR CONSTRUCTION

SITE SPECIFIC DATA REQUIREMENTS

STORMCEPTOR MODEL	EFO4
STRUCTURE ID	*
HYDROCARBON STORAGE REQ'D (L)	*
WATER QUALITY FLOW RATE (L/s)	*
PEAK FLOW RATE (L/s)	*
RETURN PERIOD OF PEAK FLOW (yrs)	*
DRAINAGE AREA (HA)	*
DRAINAGE AREA IMPERVIOUSNESS (%)	*

PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*

* PER ENGINEER OF RECORD

MARK	DATE	REVISION DESCRIPTION	BY
1	6/8/18	UPDATES	JSK
0	5/26/17	INITIAL RELEASE	JSK

Stormceptor® EF

SCALE = NTS

imbrium®
407 FAIRVIEW DRIVE, WHITBY, ON, L1N 9A9
TF 800-565-4501 CA 416-800-9000 INTL +1-416-800-9000

DATE: 10/13/2017

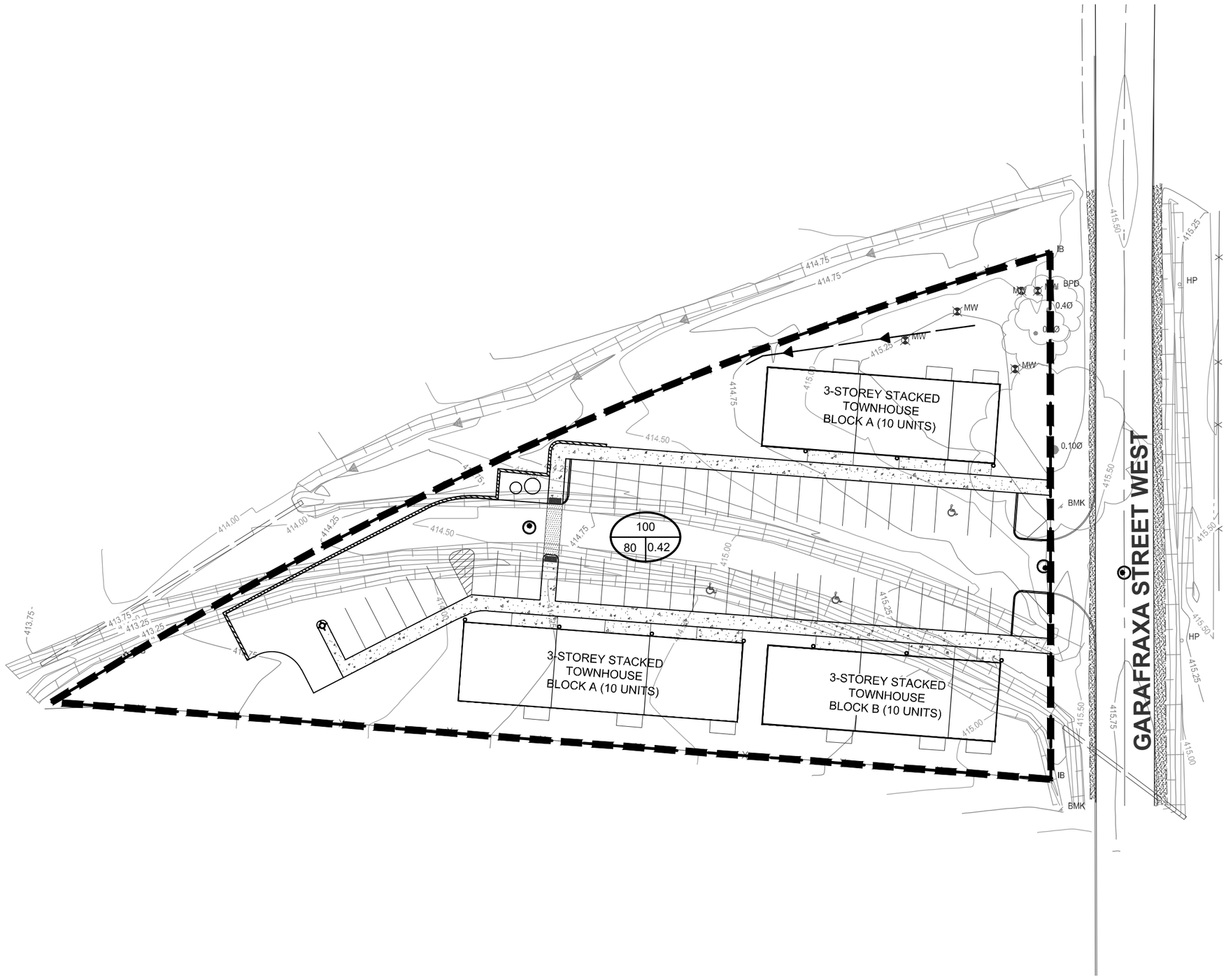
DESIGNED:	DRAWN:
JSK	JSK
CHECKED:	APPROVED:
BSF	SP
PROJECT No.:	SEQUENCE No.:
EFO4	*

SHEET: 1 OF 1

APPENDIX C:
Sanitary Sewer Design

Sanitary Sewer Drainage Area Plan
Sanitary Sewer Design Sheet

465 GARAFRAXA STREET WEST TOWNSHIP OF CENTRE WELLINGTON



N

LEGEND

- PROP. SANITARY SEWER
- DRAINAGE AREA BOUNDARY
- 201 / 25 | 0.21 — CATCHMENT NUMBER; CATCHMENT AREA IN HECTARES; POPULATION

5 0 5 10 20
1:500 (m)

SANITARY SEWER DRAINAGE AREA PLAN

Figure No. 3

BluePlan ENGINEERING

422144
JANUARY 2023
Scale: 1:500 | NAD 1983 UTM Zone 17N

FILE:W:\Kitchener\422-2022\422144 - 465 Garafraxa Street West Fergus\Design Phase\Drawings\422144 - Design.dwg LAYOUT:San Plan
LAST SAVED BY:Earmstrong, 1/23/2023 2:07:33 PM PLOTTED BY:Erin Armstrong - GM BluePlan 1/23/2023 2:09:24 PM

q = average daily per capita flow (450 L/cap.d)
I = unit of peak extraneous flow (0.15 L/ha/s)
A = Tributary area in gross hectares
M = Peaking factor
Q(p) = peak population flow (L/s)
Q(i) = peak extraneous flow (L/s)
Q(d) = peak design flow

SANITARY SEWER DESIGN

TOWNSHIP OF CENTRE WELLINGTON

Sheet 1 of 1

$M = 1 + \frac{14}{4 + (P)^{1/2}}$ where P is population in 1000's

$Q(p) = \frac{PqM}{86.4}$ (L/s)

Q(i) = IA

Q(d) = Q(p) + Q(i) (L/s)

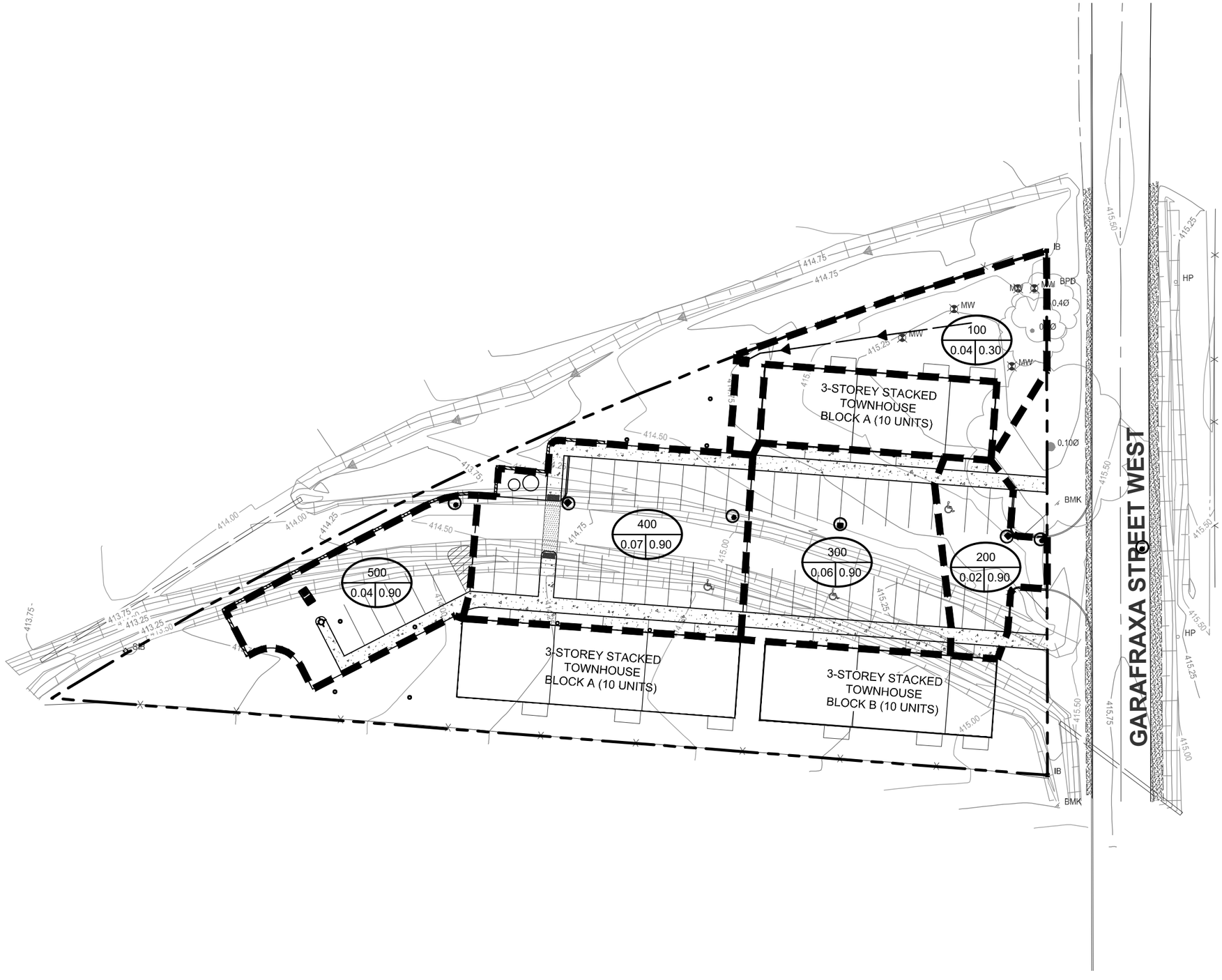
Location			Individual Population	Cumulative Population	Individual Area (ha)	Cumulative Area	Peaking Factor (M)	Pop. Flow Q(p) (L/s)	Peak Extraneous Flow Q(i) (L/s)	Peak Design Flow Q(d) (m3/s)	Proposed Sewer						
Street	From	To									Length (m)	Pipe Size (mm)	Type of Pipe	Grade %	Capacity (m^3/s)	Full Flow Velocity (m/s)	Actual velocity at Q(d)
	MH C	MH B	80	80	0.42	0.42	4.269	1.78	0.063	0.0018	61.8	200	0.013	0.60	0.0254	0.809	0.460

Date Revised:	January 23, 2023	Project: 465 Garafraxa Street West
Designed By:	PFG	G&M File: 422144
Checked By:		

APPENDIX D:
Storm Sewer Design

Storm Sewer Drainage Area Plan
Storm Sewer Design Sheet

465 GARAFRAXA STREET WEST TOWNSHIP OF CENTRE WELLINGTON



LEGEND

- PROP. STORM SEWER
- DRAINAGE AREA BOUNDARY
- 201 / 0.30 | 0.30 — CATCHMENT NUMBER; RUN-OFF CO-EFFICIENT
- CATCHMENT AREA IN HECTARES

5 0 5 10 20
1:500 (m)

STORM SEWER DRAINAGE AREA PLAN

Figure No. 4

BluePlan ENGINEERING

422144
JANUARY 2023
Scale: 1:500 | NAD 1983 UTM Zone 17N

Fergus Shand IDF Curves
A = 1459.072
B = 13.69
C = 0.85
Intensity = A / (t + B) ^ C

STORM SEWER DESIGN

5 Year Design

Township of Centre Wellington

Sheet 1 of 1

Location				Area (ha)	Runoff Coefficient	A x C	Cumulative A x C	TC (min.)	Intensity (mm/hr)	Flow (cms)	Proposed Sewer						
Reach No.	Catchment	From	To								Length (m)	Pipe Size (mm)	Type of Pipe	Grade %	Capacity (m^3/s)	Full Flow Velocity (m/s)	Time of Flow (min.)
	500	DCB.6	MH.5	0.04	0.90	0.04	0.04	10.00	99.01	0.010	21.0	250	0.013	0.50	0.04	0.86	0.41
	---	MH.5	CBMH.4	0.00	0.00	0.00	0.04	10.41	97.59	0.010	13.7	250	0.013	0.50	0.04	0.86	0.27
	400	CBMH.4	MH.8	0.07	0.90	0.06	0.10	10.68	96.68	0.027	19.8	525	0.013	0.50	0.30	1.40	0.23
	100	CB.7	MH.8	0.04	0.30	0.01	0.01	10.00	99.01	0.003	18.6	250	0.013	0.50	0.04	0.86	0.36
	---	MH.8	CBMH.3	0.00	0.00	0.00	0.11	10.36	97.75	0.030	13.0	525	0.013	0.50	0.30	1.40	0.15
	300	CBMH.3	CBMH.6	0.06	0.90	0.05	0.17	10.52	97.22	0.045	20.1	525	0.013	0.50	0.30	1.40	0.24
	200	CBMH.6	STC	0.02	0.90	0.02	0.18	10.75	96.41	0.049	4.1	300	0.013	0.50	0.07	0.97	0.07
	---	STC	MH.2	0.00	0.00	0.00	0.18	10.83	96.17	0.049	12.3	300	0.013	0.50	0.07	0.97	0.21

	Date: 01/23/23	Revised:	Project: 465 Garafraxa Road West
	Designed By: PFG	Revised By:	422144
	Checked By:	Checked By:	

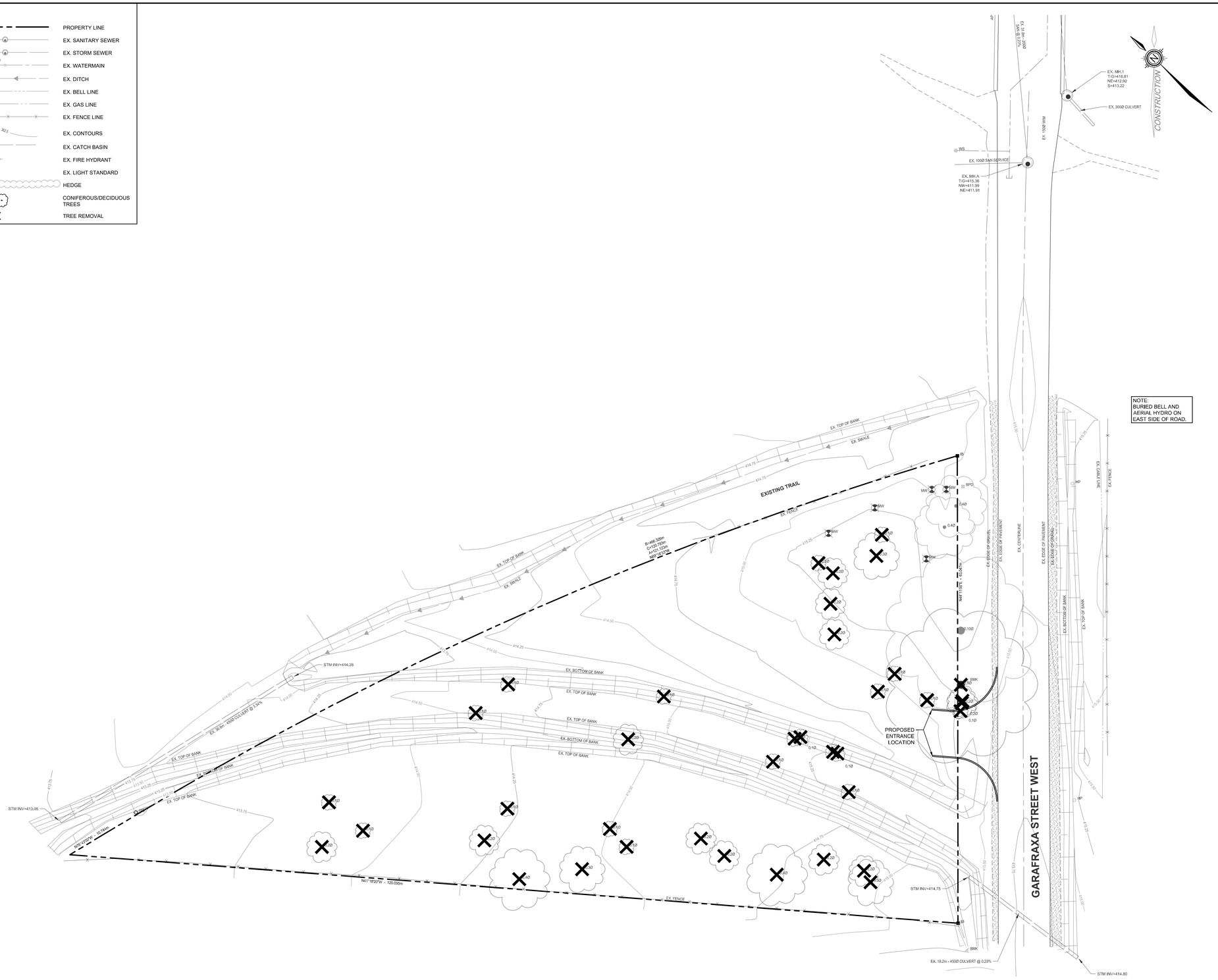
Appendix E –

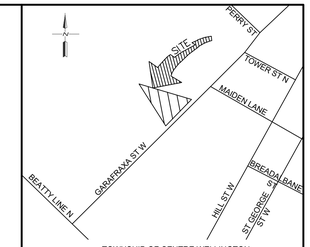
Engineering Plans

- Existing Conditions and Removals Plan;
- Site Grading Plan;
- Site Servicing Plan;
- Erosion and Sediment Control Plan;
- Section Plan;
- Asphalt Laneway Plan; and,
- Notes and Details Plan

LEGEND

- PROPERTY LINE
- EX. SANITARY SEWER
- EX. STORM SEWER
- EX. WATERMAIN
- EX. DITCH
- EX. BELL LINE
- EX. GAS LINE
- EX. FENCE LINE
- EX. CONTOURS
- EX. CATCH BASIN
- EX. FIRE HYDRANT
- EX. LIGHT STANDARD
- HEDGE
- CONIFEROUS/DECIDUOUS TREES
- TREE REMOVAL





TOWNSHIP OF CENTRE WELLINGTON
KEY PLAN
NOT TO SCALE

NOTES :

1. EXISTING CONDITIONS AND TOPOGRAPHIC SURVEY COMPLETED BY GM BLUEPLAN ENGINEERING LIMITED DATED DECEMBER 07, 2022.
2. SITE LAYOUT PROVIDED BY DRYDEN, SMITH & HEAD DATED JANUARY 20, 2023.
3. LEGAL INFORMATION FOR 465 GARAFRAXA STREET WEST OBTAINED FROM "PLAN OF SURVEY OF PART OF BLOCK 4 REGISTERED PLAN 77" COMPLETED BY BSR&D DATED NOVEMBER 25, 2021.
4. GEOTECHNICAL INFORMATION PROVIDED BY CMT ENGINEERING INC. DATED NOVEMBER 28, 2022.
5. SOIL VAPOUR MITIGATION SYSTEMS EVALUATION PROVIDED BY PINCHIN DATED AUGUST 26, 2022.

ALL WORKS ON GARAFRAXA STREET WEST BY TOWNSHIP FORCES

BENCH MARKS :

COSINE BENCHMARK - 0011916U119F

FERGUS POST OFFICE, BOLT IN SOUTH SIDE OF WALLL, IN LINTEL OF BASEMENT WINDOW WHICH IS BETWEEN CLOCK TOWER AND LETTER DROP.
ELEV = 399.321

LICENSED PROFESSIONAL ENGINEER
Jan. 30/22
P.F. GRIER
100188305
PROVINCE OF ONTARIO

NO.	DATE	REVISION DESCRIPTION	CHKD
3.	2023/01/31	ISSUED FOR APPROVAL	P.F.G.
2.	2023/01/23	ISSUED FOR SITE PLAN APPROVAL	P.F.G.
1.	2023/01/16	ISSUED FOR REVIEW	P.F.G.

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465 GARAFRAXA STREET WEST, FERGUS

HABITAT FOR HUMANITY

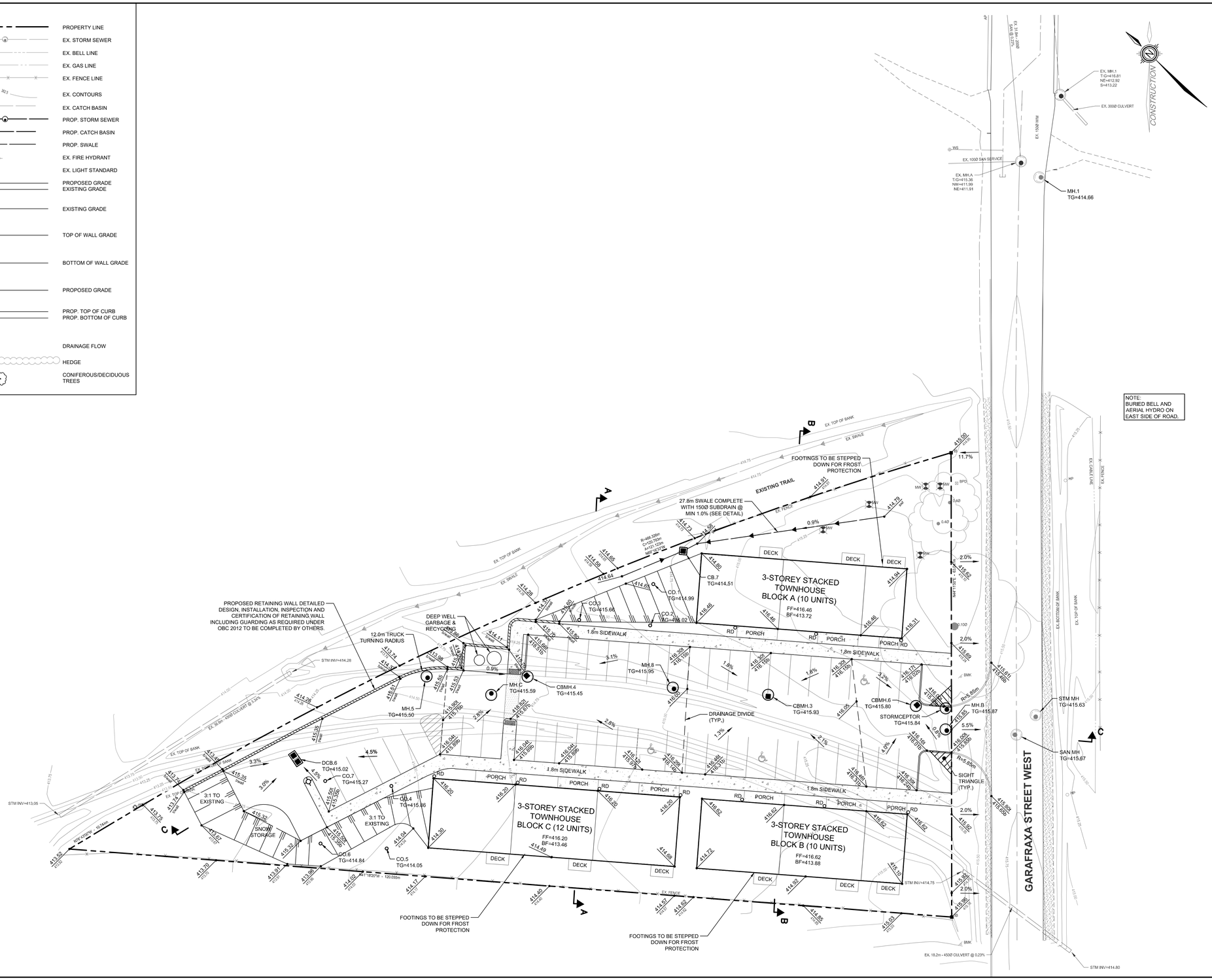
TOWNSHIP OF CENTRE WELLINGTON

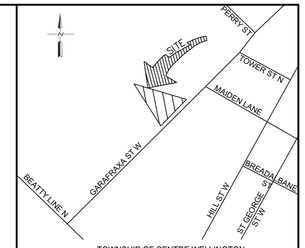
EXISTING CONDITIONS AND REMOVALS PLAN

DRAWN BY :	APPROVED BY :	PROJECT NO. :	DRAWING NO. :
E.A.	G.E.A.	422144	1
DESIGNED BY :	DATE :	SCALE :	
P.F.G.	DECEMBER 2022	1:250	

LEGEND

- PROPERTY LINE
- EX. STORM SEWER
- EX. BELL LINE
- EX. GAS LINE
- EX. FENCE LINE
- 362 — EX. CONTOURS
- CB — EX. CATCH BASIN
- PROP. STORM SEWER
- PROP. CATCH BASIN
- PROP. SWALE
- HYD — EX. FIRE HYDRANT
- LS — EX. LIGHT STANDARD
- 336.75 / 336.72 — PROPOSED GRADE / EXISTING GRADE
- 336.75 / EXIST — EXISTING GRADE
- 336.75 / TWALL — TOP OF WALL GRADE
- 336.75 / TWALL — BOTTOM OF WALL GRADE
- 336.75 — PROPOSED GRADE
- 336.79 / 336.729 — PROP. TOP OF CURB / PROP. BOTTOM OF CURB
- DRAINAGE FLOW
- HEDGE
- CONIFEROUS/DECIDUOUS TREES





TOWNSHIP OF CENTRE WELLINGTON

KEY PLAN

NOT TO SCALE

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ALL WORKS ON GARAFRAXA STREET WEST BY TOWNSHIP FORCES

BENCH MARKS :

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FERGUS POST OFFICE, BOLT IN SOUTH SIDE OF WALLL, IN LINTEL OF BASEMENT WINDOW WHICH IS BETWEEN CLOCK TOWER AND LETTER DROP.
ELEV = 399.321

LICENSED PROFESSIONAL ENGINEER — Jan. 30/22 — P.F. GRIER — 100188305 — PROVINCE OF ONTARIO

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465 GARAFRAXA STREET WEST, FERGUS

HABITAT FOR HUMANITY

TOWNSHIP OF CENTRE WELLINGTON

SITE GRADING PLAN

DRAWN BY :	APPROVED BY :	PROJECT NO. :	DRAWING NO. :
E.A.	G.E.A.	422144	2
DESIGNED BY :	DATE :	SCALE :	
P.F.G.	DECEMBER 2022	1:250	

FILE:W:\Kitchener\422\-2022\422144 - 465 Garafraxa Street West Fergus\Design Phase\Drawings\422144 - Design.dwg LAYOUT:Grading Plan
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LEGEND

- PROPERTY LINE
- EX. SANITARY SEWER
- EX. STORM SEWER
- EX. WATERMAIN
- EX. DITCH
- EX. BELL LINE
- EX. GAS LINE
- EX. FENCE LINE
- EX. CONTOURS
- EX. CATCH BASIN
- PROP. SANITARY SEWER
- PROP. STORM SEWER
- PROP. WATER
- PROP. FIRE HYDRANT
- PROP. CATCH BASIN
- PROP. SANITARY SERVICE
- PROP. WATER SERVICE
- PROP. SWALE
- EX. FIRE HYDRANT
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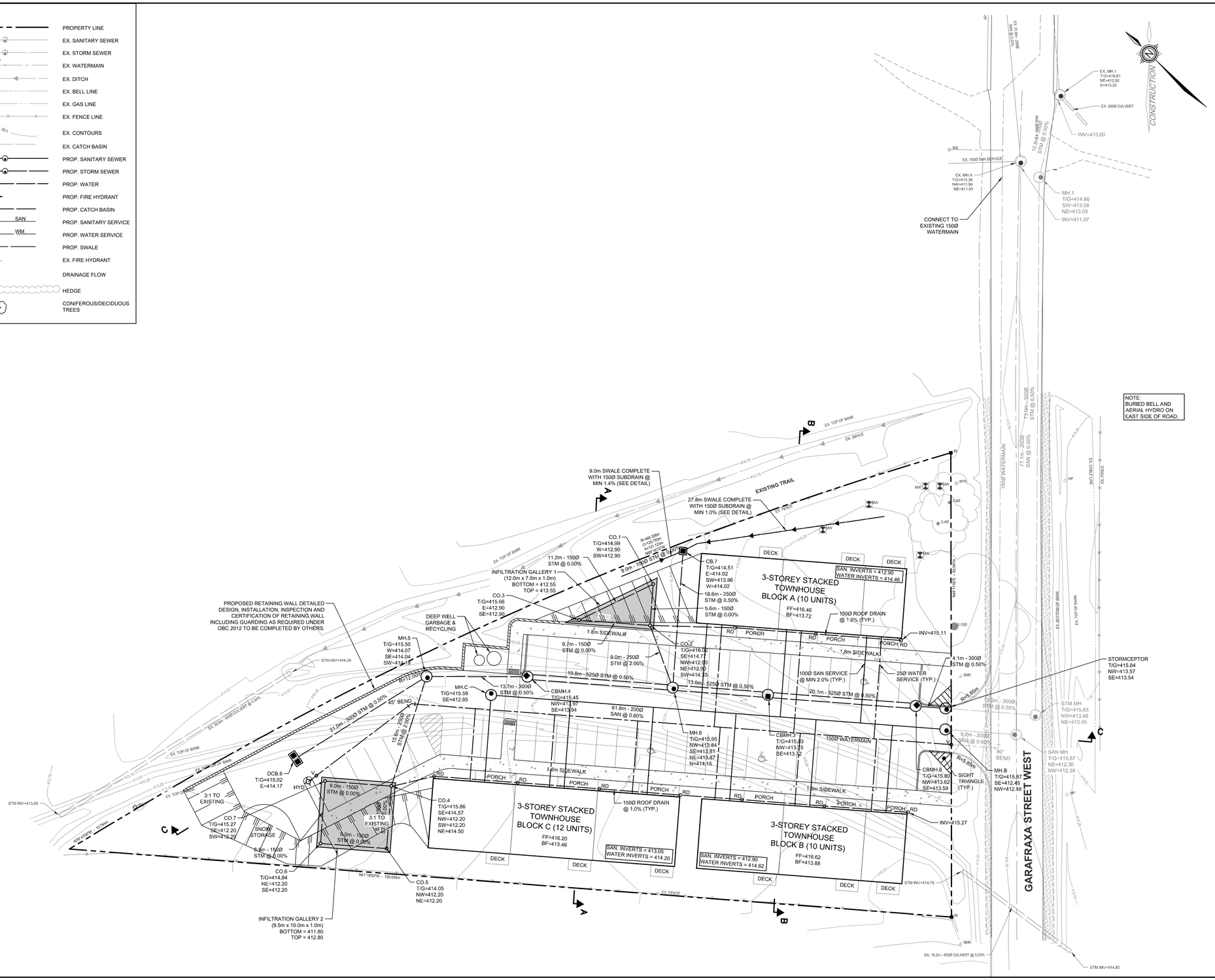

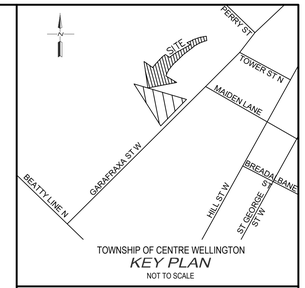

TOWNSHIP OF CENTRE WELLINGTON
KEY PLAN
NOT TO SCALE

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ALL WORKS ON GARAFRAXA STREET WEST BY TOWNSHIP FORCES

BENCH MARKS :

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FERGUS POST OFFICE, BOLT IN SOUTH SIDE OF WALLL, IN LINTEL OF BASEMENT WINDOW WHICH IS BETWEEN CLOCK TOWER AND LETTER DROP.
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465 GARAFRAXA STREET WEST, FERGUS

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TOWNSHIP OF CENTRE WELLINGTON

SITE SERVICING PLAN

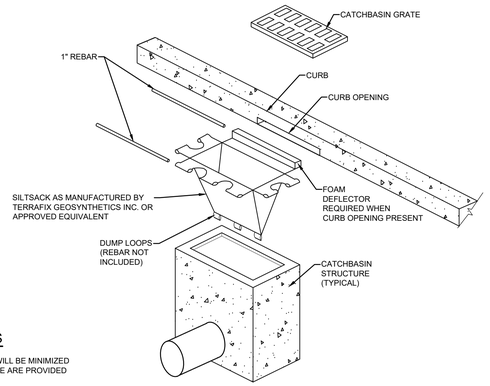
DRAWN BY :	APPROVED BY :	PROJECT NO. :	DRAWING NO. :
E.A.	G.E.A.	422144	3
DESIGNED BY :	DATE :	SCALE :	
P.F.G.	DECEMBER 2022	1:250	

LEGEND

- PROPERTY LINE
- EX. SANITARY SEWER
- EX. STORM SEWER
- EX. WATERMAIN
- EX. DITCH
- EX. BELL LINE
- EX. GAS LINE
- EX. FENCE LINE
- EX. CONTOURS
- EX. CATCH BASIN
- PROP. FIRE HYDRANT
- HEDGE
- CONIFEROUS/DECIDUOUS TREES
- SILT SACK IN STRUCTURE
- SILT FENCE

SEDIMENT AND EROSION CONTROL NOTES

1. SITE WORKS ARE TO BE STAGED IN SUCH A MANNER THAT EROSION WILL BE MINIMIZED AND THAT BARRIERS AND SEDIMENTATION FACILITIES WITHIN THE SITE ARE PROVIDED TO CONTROL ANY EROSION THAT DOES OCCUR.
2. PRIOR TO THE ISSUANCE OF A BUILDING PERMIT, A SEDIMENT POND OR STORAGE AREA MUST BE ESTABLISHED TO COLLECT SURFACE DRAINAGE FROM ALL AREAS THAT WILL BE DISTURBED. WATER PUMPED FROM EXCAVATION OR DEWATERING OPERATIONS MUST BE DIRECTED TO THE SEDIMENT POND.
3. ALL SILT FENCING TO BE INSTALLED PRIOR TO THE COMMENCEMENT OF ANY GRADING EXCAVATION OR DEMOLITION.
4. CLEARING AND GRUBBING OF THE SITE SHOULD BE KEPT TO A MINIMUM AND VEGETATION REMOVED ONLY IN ADVANCED OF IMMEDIATE CONSTRUCTION.
5. STOCKPILES OF EARTH OR TOPSOIL ARE TO BE LOCATED AND PROTECTED TO MINIMIZE ENVIRONMENTAL INTERFERENCE. STOCKPILES SHOULD NOT BE LOCATED IMMEDIATELY ADJACENT TO DITCHES OR ROAD ALLOWANCES. EROSION CONTROL FENCING IS TO BE INSTALLED AROUND THE BASE OF ALL STOCKPILES. A PERIMETER DITCH LEADING TO A SETTLING AREA OR SEDIMENTATION TRAP SHOULD BE INSTALLED AROUND THE STOCKPILE.
6. EROSION PROTECTION TO BE PROVIDED AROUND ALL STORM AND SANITARY MANHOLES CATCH BASINS, DITCHES SWALES AND WATERCOURSES.
7. ADDITION EROSION CONTROL MEASURES MAY BE REQUIRED AS SITE DEVELOPMENT PROGRESSES. THE CONTRACTOR IS TO PROVIDE ALL ADDITIONAL EROSION CONTROL STRUCTURES.
8. THE DESIGN CONSULTANT IS TO MONITOR EROSION CONTROL STRUCTURES TO ENSURE FENCING IS INSTALLED AND MAINTENANCE IS PERFORMED TO TOWNSHIP REQUIREMENTS.
9. EROSION CONTROL STRUCTURES ARE TO BE MONITORED REGULARLY AND ANY DAMAGE TO STRUCTURES REPAIRED IMMEDIATELY. SEDIMENTS ARE TO BE REMOVED WHEN ACCUMULATIONS REACH A MAXIMUM OF 50% OF THE FENCE. CLOGGED FILTER MATERIALS SUCH AS CRUSHED STONE, STRAW BALES OR FILTER CLOTH MUST BE REPLACED AS REQUIRED.
10. ALL EROSION CONTROL STRUCTURES ARE TO REMAIN IN PLACE UNTIL ALL DISTURBED GROUND SURFACES HAVE BEEN STABILIZED EITHER BY PAVING OR RESTORATION OF VEGETATIVE GROUND COVER.
11. NO ALTERNATIVE METHODS OF EROSION PROTECTION SHALL BE PERMITTED UNLESS APPROVED BY THE DESIGN CONSULTANT AND THE TOWNSHIP.
12. THE CONTRACTOR IS RESPONSIBLE TO ENSURE THAT MUNICIPAL ROADWAYS AND SIDEWALKS AREA CLEANED OF ALL SEDIMENTS FROM VEHICULAR TRACKING ETC. TO AND FROM THE SITE AT THE END OF EACH WORK DAY.
13. ALL DISTURBED AREAS NOT INCLUDED IN CONSTRUCTION TO BE RE-TOPSOILED AND RE-SEEDED IMMEDIATELY AFTER COMPLETION OF AREA GRADING.

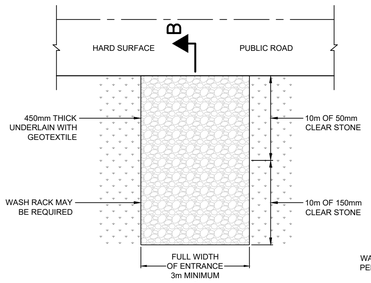


TYPE 'B'

1. REFER TO MANUFACTURER'S SPECIFICATIONS FOR INSTALLATION AND MAINTENANCE PROCEDURES.

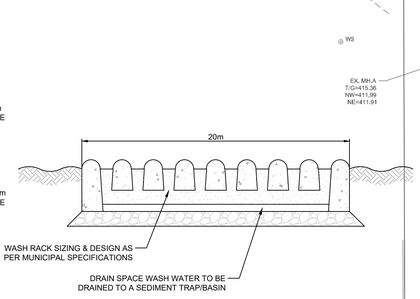
SILTSACK DETAIL

N.T.S.



TYPICAL MUD TRACKING PAD - PLAN VIEW

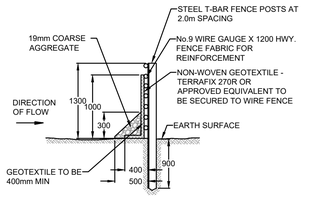
N.T.S.



TYPICAL MUD TRACKING PAD SECTION B-B

N.T.S.

NOTE:
THE CONTRACTOR SHALL INSPECT MUD TRACKING PAD WEEKLY AS WELL AS AFTER ANY RAINFALL EVENT GREATER THAN 13mm. SHOULD THE MUD TRACKING PAD NOT BE FUNCTIONING AS DESIGNED, THE CONTRACTOR SHALL REPLACE THE CLEAR STONE IMMEDIATELY. LOCATION AND WIDTH OF CONSTRUCTION ENTRANCES TO BE DETERMINED BY CONTRACTOR AND APPROVED BY THE ENGINEER.

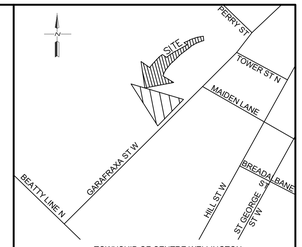


NOTES:
1. TO BE READ IN CONJUNCTION WITH OPSD 219.130.

SEDIMENT FENCE HEAVY DUTY - NO TRENCH

N.T.S.

NOTE:
BURIED BELL AND AERIAL HYDRO ON EAST SIDE OF ROAD.



TOWNSHIP OF CENTRE WELLINGTON
KEY PLAN
NOT TO SCALE

NOTES :

1. EXISTING CONDITIONS AND TOPOGRAPHIC SURVEY COMPLETED BY GM BLUEPLAN ENGINEERING LIMITED DATED DECEMBER 07, 2022.
2. SITE LAYOUT PROVIDED BY DRYDEN, SMITH & HEAD DATED JANUARY 20, 2023.
3. LEGAL INFORMATION FOR 465 GARAFRAXA STREET WEST OBTAINED FROM "PLAN OF SURVEY OF PART OF BLOCK 4 REGISTERED PLAN 77" COMPLETED BY BSR&D DATED NOVEMBER 25, 2021.
4. GEOTECHNICAL INFORMATION PROVIDED BY CMT ENGINEERING INC. DATED NOVEMBER 28, 2022.
5. SOIL-VAPOUR MITIGATION SYSTEMS EVALUATION PROVIDED BY PINCHIN DATED AUGUST 26, 2022.

ALL WORKS ON GARAFRAXA STREET WEST BY TOWNSHIP FORCES

BENCH MARKS :

COSINE BENCHMARK - 0011916U119F

FERGUS POST OFFICE, BOLT IN SOUTH SIDE OF WALLL, IN LINTEL OF BASEMENT WINDOW WHICH IS BETWEEN CLOCK TOWER AND LETTER DROP.
ELEV = 399.321

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.

BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR ANY DAMAGE TO THEM.

LICENSED PROFESSIONAL ENGINEER
Jan. 30/22
P.F. GRIER
100188305
PROVINCE OF ONTARIO

NO.	DATE	REVISION DESCRIPTION	CHKD
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2.	2023/01/23	ISSUED FOR SITE PLAN APPROVAL	P.F.G.
1.	2023/01/16	ISSUED FOR REVIEW	P.F.G.

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465 GARAFRAXA STREET WEST, FERGUS

HABITAT FOR HUMANITY

TOWNSHIP OF CENTRE WELLINGTON

EROSION AND SEDIMENT CONTROL PLAN

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E.A.	G.E.A.	422144	4
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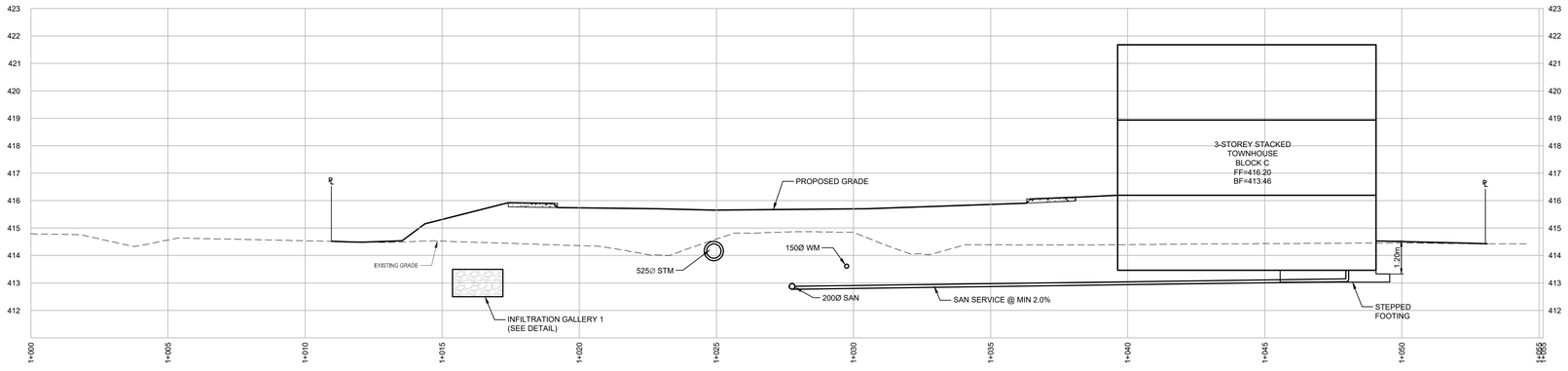
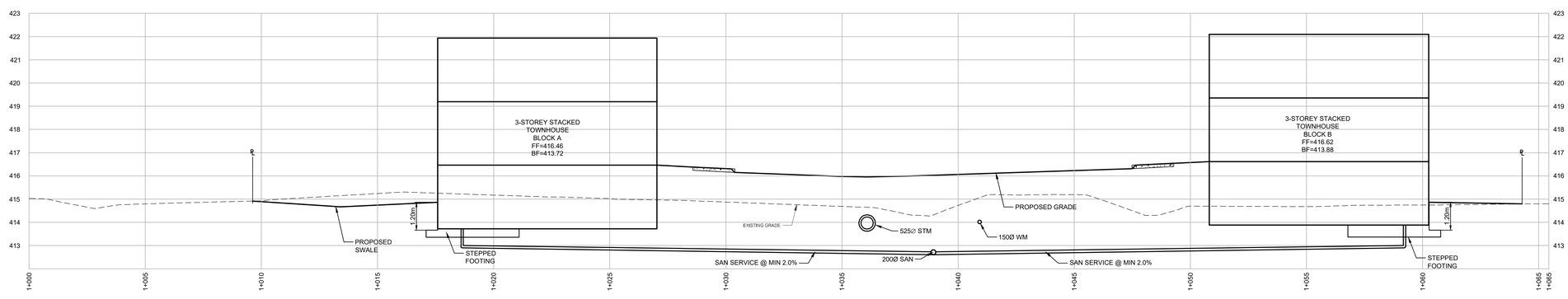


SECTION A-A

1:100



SECTION B-B

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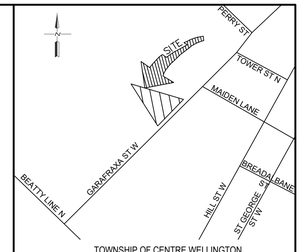

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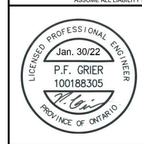

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465 GARAFRAXA STREET WEST, FERGUS

HABITAT FOR HUMANITY

TOWNSHIP OF CENTRE WELLINGTON

SECTION PLAN

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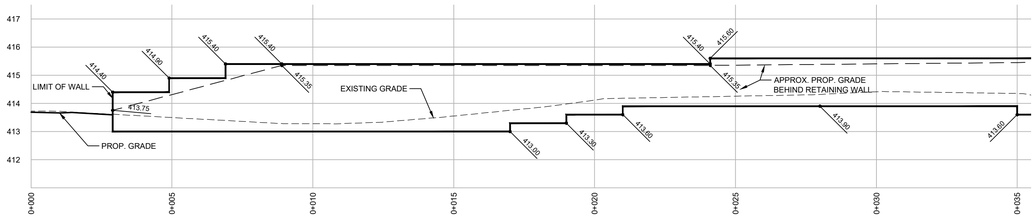
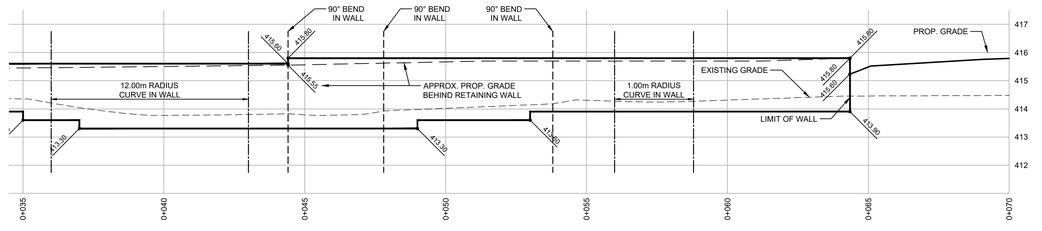
E.A.	G.E.A.	422144	5
DESIGNED BY :	DATE :	SCALE :	
P.F.G.	DECEMBER 2022	AS NOTED	



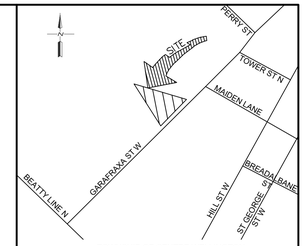
RETAINING WALL PROFILE 1 OF 2

1:100



RETAINING WALL PROFILE 2 OF 2

1:100



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LICENSED PROFESSIONAL ENGINEER
Jan. 30/22
P.F. GRIER
100188305
PROVINCE OF ONTARIO

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465 GARAFRAXA STREET WEST, FERGUS

HABITAT FOR HUMANITY

TOWNSHIP OF CENTRE WELLINGTON

SECTION PLAN 2

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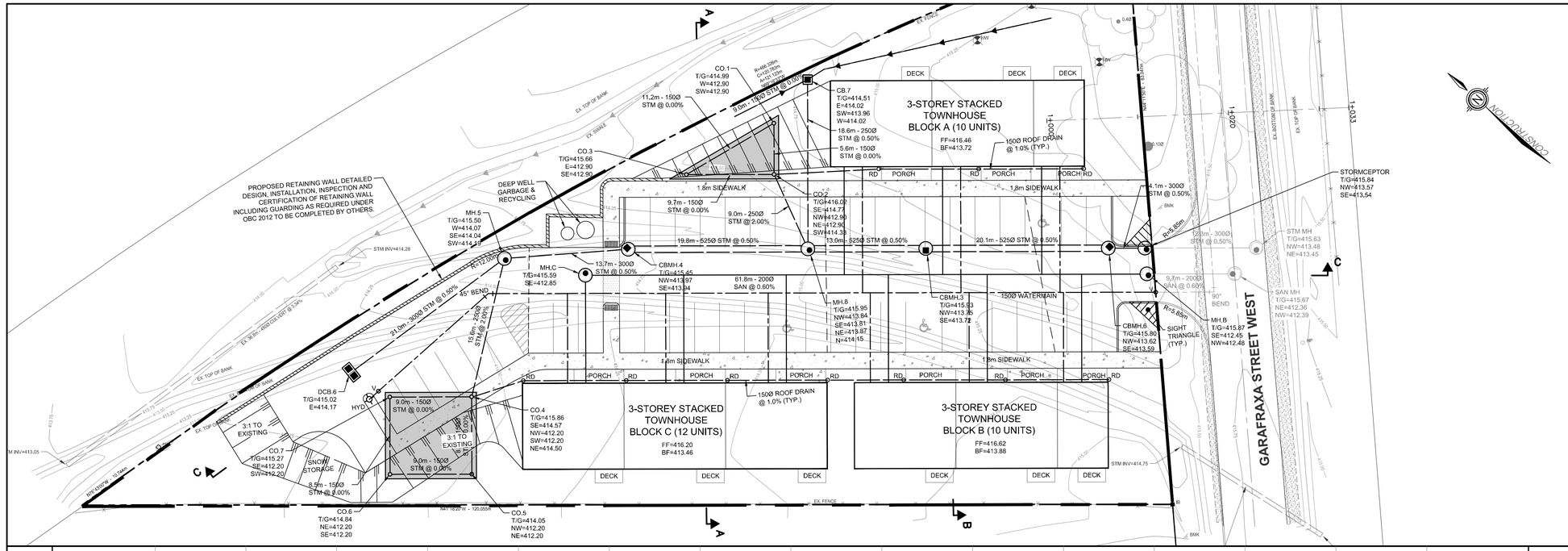
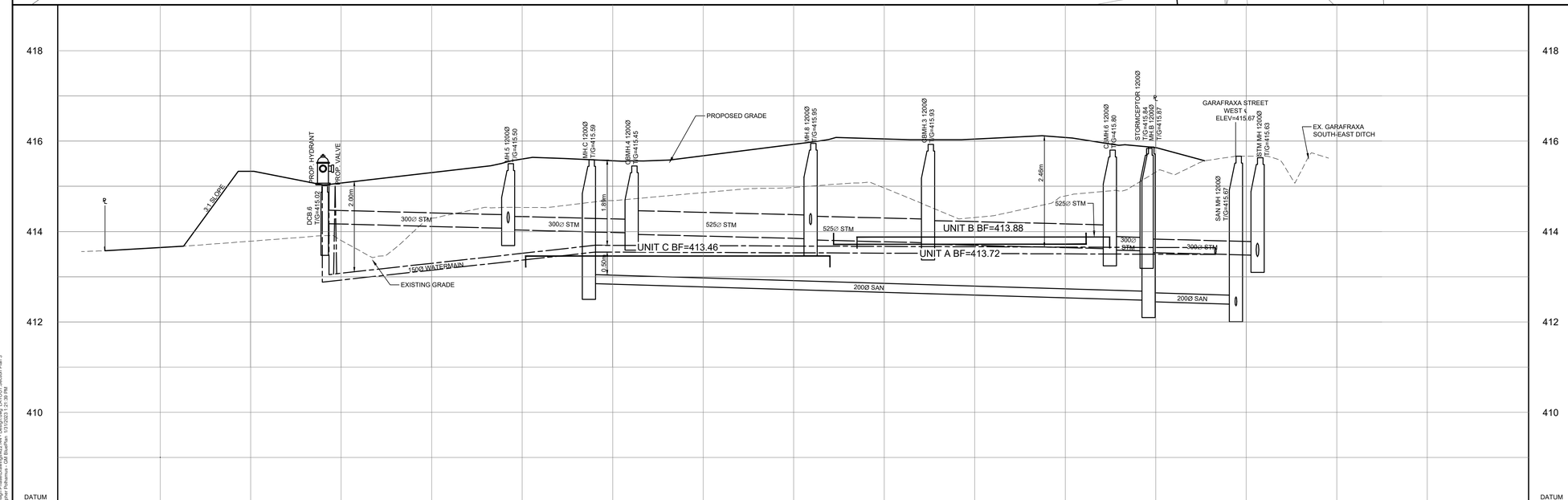
E.A.	G.E.A.	422144	6
DESIGNED BY :	DATE :	SCALE :	
P.F.G.	DECEMBER 2022	AS NOTED	





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Jan. 30/22
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465 GARAFRAXA STREET WEST, FERGUS

HABITAT FOR HUMANITY

TOWNSHIP OF CENTRE WELLINGTON

ASPHALT LANEWAY PLAN & PROFILE

DRAWN BY :	APPROVED BY :	PROJECT NO. :	DRAWING NO. :
E.A.	G.E.A.	422144	7
DESIGNED BY :	DATE :	SCALE :	
P.F.G.	DECEMBER 2022	H=1:250 H=1:50	

GENERAL NOTES

1. DRAWINGS ARE NOT TO BE SCALED.
2. ALL DIMENSIONS TO BE CHECKED AND VERIFIED ON THE SITE PRIOR TO ANY CONSTRUCTION. ANY DISCREPANCIES ARE TO BE REPORTED TO THE ENGINEER BEFORE PROCEEDING.
3. UNLESS OTHERWISE NOTED ON THE DRAWINGS THE STANDARD TOWNSHIP, REGION (OR COUNTY), MTO AND OPSD DRAWINGS AND OPSS ARE TO CONSTITUTE PART OF THIS CONTRACT AND DRAWINGS.
4. REFER TO O.B.C. - 2012 STANDARDS AND SPECIFICATIONS AND TOWNSHIP SPECIFICATIONS AND STANDARD DRAWINGS FOR LIST OF APPROVED MANUFACTURERS AND MATERIALS.
5. EXISTING STRUCTURES ARE NOT TO BE DISTURBED, NOR ENCROACH ON ADJACENT PROPERTIES UNLESS INSTRUCTED BY THE ENGINEER.
6. THE APPROVAL OF THIS PLAN DOES NOT EXEMPT THE OWNERS CONTRACTOR FROM OBTAINING, BUT NOT LIMITED TO THE FOLLOWING PERMITS, ROAD CUTS, SEWER PERMITS, RELOCATION OF SERVICES, ENCROACHMENT AGREEMENTS, APPROACH APPROVAL PERMITS, ETC.
7. PRIOR TO CONSTRUCTION, THE ENGINEER IS TO BE NOTIFIED BY THE OWNER AND THE CONTRACTOR AS TO THE EXTENT OF THE CONSTRUCTION LIMITS THEY PROPOSE. THE TOWNSHIP, BUILDING AND PLUMBING OFFICIALS ARE TO BE NOTIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION.
8. THIS PLAN IS TO BE READ IN CONJUNCTION WITH THE SERVICING PLANS, LANDSCAPE PLAN, SITE ELECTRICAL PLANS, AND ANY OTHER PLANS OR DRAWINGS WHICH DEPICT WORKS THAT ARE PROPOSED FOR THIS SITE.
9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL TRAFFIC CONTROL AND SAFETY MEASURES DURING THE CONSTRUCTION PERIOD, INCLUDING THE SUPPLY, INSTALLATION AND REMOVAL OF ALL NECESSARY SIGNAGE, DELINEATORS, MARKERS AND BARRIERS. ALL SIGNS, ETC. SHALL CONFORM TO THE STANDARDS AND SPECIFICATIONS FOR THE TOWNSHIP AND THE MTO MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES FOR ONTARIO.
10. THE CONTRACTOR SHALL ENDEAVOUR TO PREVENT MUD TRACKING ONTO EXISTING RIGHT-OF-WAYS AND SHALL PROVIDE FOR CLEANUP AT HIS OWN EXPENSE AS DIRECTED BY THE TOWNSHIP. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE TO CONTROL DUST ON THE PROJECT AND HE SHALL PROVIDE CONTROLLING MEASURES AS DIRECTED BY THE TOWNSHIP.
11. THE CONTRACTOR IS RESPONSIBLE FOR LOCATING AND PROTECTING ALL EXISTING UTILITIES PRIOR TO AND DURING CONSTRUCTION. LOCATION OF EXISTING UTILITIES TO BE VERIFIED IN THE FIELD.
12. ALL SERVICES AND/OR UTILITIES LOCATED ON CONCRETE SIDEWALKS OR CURBS TO BE ISOLATED FROM THE SIDEWALK OR CURB AS PER OPSD 310.040.
13. ALL UTILITIES SHALL BE LOCATED, SUPPORTED AND PROTECTED TO THE SATISFACTION OF THE UTILITY COMPANY DURING THE CONSTRUCTION PERIOD.
14. THE CONTRACTOR SHALL RECTIFY ALL DISTURBED AREAS TO ORIGINAL CONDITION OR BETTER AND TO THE SATISFACTION OF THE TOWNSHIP.
15. THE CONTRACTOR IS TO OBTAIN, AND PAY FOR ANY NECESSARY PERMITS FOR ANY MUNICIPAL ROAD CUTS FOR THE INSTALLATION OF SANITARY, STORM, AND WATER SERVICE CONNECTIONS. ROAD CUTS TO BE RESTORED AS PER TOWNSHIP SATISFACTION.
16. BLASTING WILL NOT BE ALLOWED UNLESS AUTHORIZED BY THE TOWNSHIP.
17. ANY UTILITY RELOCATIONS DUE TO THIS DEVELOPMENT TO BE UNDERTAKEN AT THE EXPENSE OF THE OWNER/DEVELOPER.
18. ALL DRAWINGS AND SPECIFICATIONS ARE INSTRUMENTS OF SERVICE AND THE PROPERTY OF THE ENGINEER WHICH MUST BE RETURNED AT THE COMPLETION OF WORK.
19. DRIVEWAYS SHALL BE SETBACK A MINIMUM CLEARANCE OF 1.0m FROM ALL ABOVEGROUND SERVICES OR OTHER OBSTRUCTIONS.
20. ALL CONSTRUCTION WORK IS TO BE CARRIED OUT IN ACCORDANCE WITH THE REQUIREMENTS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS FOR CONSTRUCTION PROJECTS.
21. ANY CONFLICTS WITH EXISTING SERVICES SHALL BE RECTIFIED AT THE OWNER'S EXPENSE.

GENERAL TESTING AND INSPECTION NOTES

1. TESTING OF ALL SERVICES BY GENERAL CONTRACTOR.
2. THE GENERAL CONTRACTOR IS RESPONSIBLE FOR CONTACTING GM BLUEPLAN ENGINEERING LIMITED FOR THE COMPLETION OF ALL REQUIRED SITE INSPECTIONS.
3. ALL STORM SEWERS ARE TO BE MANDREL TESTED PRIOR TO FINAL ACCEPTANCE BY THE ENGINEER. ALL MANDREL TESTING AS PER OPSS 410.
4. ALL STORM REQUIRE FIELD INSPECTION BY THE SITE SERVICING ENGINEERING DURING INSTALLATION INSPECTION SERVICES REQUIRE A MINIMUM OF 4 HOURS NOTICE.

SERVICING NOTES - SANITARY

1) ALL SANITARY SEWERS ARE TO BE PVC-DR 35 IN ACCORDANCE WITH CSA-B182.2, ASTM D-2779 AND ASTM D-3034 OR LATEST REVISIONS, RUBBER GASKET. SERVICES TO BE PVC-DR 28.
2) EXISTING SEWER INVERTS, MATERIAL TYPE, AND SIZE TO BE CONFIRMED ON SITE PRIOR TO COMMENCEMENT OF CONSTRUCTION.
3) PRECAST MANHOLES TO BE MANUFACTURED TO REQUIREMENTS OF CSA A257.4 AND A.S.T.M. DESIGNATION C478M. 1200Ø MANHOLES AS PER OPSD 701.010, 1500Ø MANHOLES AS PER OPSD 701.011 MANHOLE FRAMES AND COVERS AS PER OPSD 401.010 TYPE 'A'.
4) ALL MAINTENANCE HOLES SHALL BE BENCHED UP TO 1/2 HEIGHT REGARDLESS OF PIPE SIZE. ALL BENCHING SHALL SLOPE UP AND AWAY FROM THE PIPE AT 8% SLOPE. SANITARY SEWER MAINTENANCE HOLES SHALL NOT BE PRE-BENCHED BY THE MANUFACTURER EXCEPT IN NEW DEVELOPMENT. BENCHING MAINTENANCE HOLES MUST BE COMPLETED DURING CONSTRUCTION ON SITE.
5) BEDDING FOR PVC SANITARY SEWERS AS PER OPSD 802.010, GRANULAR 'A', COMPACTED TO 100% SPMDD.
6) ALL TESTING OF SANITARY SERVICES TO BE IN ACCORDANCE WITH O.B.C. - 2012 AND TOWNSHIP SPECIFICATIONS.

SERVICING NOTES - WATER

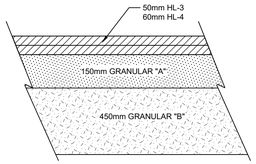
1) WATER SERVICE PIPE TO BE PVC-DR 18 CL 150 CONFORMING TO CSA B137.3, INCLUDING 12 GAUGE 7 STRAND TRACER WIRE BETWEEN HYDRANTS OR OTHER CONDUCTING APPURTENANCES. PIPE SHALL HAVE A MINIMUM COVER OF 2.0m. ALL WATERMAIN JOINTS TO BE APPROVED PUSH-ON. MECHANICAL OR FLANGE TYPE JOINTS AS REQUIRED FOR 1000 kPa RATED PRESSURE. CORROSION PROTECTION FOR ALL FITTINGS, VALVES AND HYDRANTS.
2) WATERMAINS SHALL HAVE A MINIMUM VERTICAL SEPARATION OF 0.5m AND HORIZONTAL SEPARATION OF 2.4m BETWEEN ANY SEWER OR MANHOLE.
3) CONTRACTOR TO CONFIRM THE SIZE, LOCATION AND MATERIAL TYPE OF EXISTING WATER SERVICE AND WATERMAIN PRIOR TO COMMENCING ANY WORK.
4) EXISTING WATERMAIN OBVERTS TO BE CONFIRMED ON SITE AT THE TIME OF CONSTRUCTION.
5) FLUSHING, SWABBING, AND TESTING OF WATERMAIN AS PER ONTARIO PROVINCIAL STANDARD SPECIFICATIONS.
6) ALL WATERMAIN MATERIALS, INSTALLATION METHODS AND TESTING SHALL CONFORM TO OBC-2012 AND TOWNSHIP SPECIFICATIONS.
7) ALL METALLIC WATER FITTINGS ARE TO HAVE ANODES, TRACE WIRE AND WRAPPED IN A THREE PART PETROLEUM TAPE SYSTEM IN ACCORDANCE WITH THE REGION OF WATERLOO DGSSMS.

SERVICING NOTES - STORM

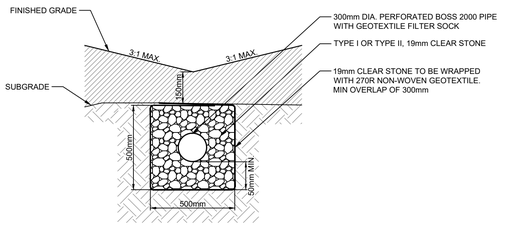
1. ALL STORM SEWERS 375mmØ AND SMALLER TO BE PVC SDR 35 IN ACCORDANCE WITH CSA-B182.2 ASTM D-2779 AND ASTM D-3034 OR LATEST REVISIONS. 450mmØ AND LARGER TO BE CONCRETE IN ACCORDANCE WITH CSA A257.2, CLASS 65D OR LATEST REVISIONS. UNLESS OTHERWISE NOTED.
2. BEDDING FOR PVC STORM SEWERS AS PER OPSD 802.010, GRANULAR 'A', COMPACTED TO 98% SPD.
3. BEDDING FOR CONCRETE PIPE AS PER OPSD-802.030, CLASS B, GRANULAR 'A', COMPACTED TO 98% SPMDD.
4. EXISTING SEWER INVERTS, MATERIAL TYPE, AND SIZE TO BE CONFIRMED ON SITE PRIOR TO COMMENCEMENT OF CONSTRUCTION.
5. ALL CATCHBASINS SHALL BE INSTALLED IN ACCORDANCE WITH OPSD 705.010 OR OPSD 705.020. ALL CATCHBASIN FRAMES AND COVERS IN THE ROADWAY AS PER OPSD 400.110. ALL CATCHBASIN FRAMES AND COVERS IN WALKWAY AREAS AS PER OPSD 400.100.
6. ALL EXISTING SEWERS ARE TO BE CONFIRMED ON SITE PRIOR TO CONSTRUCTION.
7. ALL CATCHBASIN LEADS TO BE MINIMUM 250mmØ PVC SDR 35 IN ACCORDANCE WITH CSA-B182.2, ASTM D-2779 AND ASTM D-3034, OR NON-REINFORCED CONCRETE PIPE, OR BOSS 2000 HDPE IN ACCORDANCE WITH CSA-B182.8, ASTM D-3350, UNLESS NOTED OTHERWISE.
8. ALL MAINTENANCE HOLES AND CATCHBASIN MAINTENANCE HOLES SHALL BE BENCHED UP TO 3/4 HEIGHT REGARDLESS OF PIPE SIZE. ALL BENCHING SHALL SLOPE UP AND AWAY FROM THE PIPE AT 8% SLOPE. STORM SEWER MAINTENANCE HOLES SHALL NOT BE PRE-BENCHED BY THE MANUFACTURER EXCEPT IN NEW DEVELOPMENT. BENCHING MAINTENANCE HOLES MUST BE COMPLETED DURING CONSTRUCTION ON SITE.

GRADING

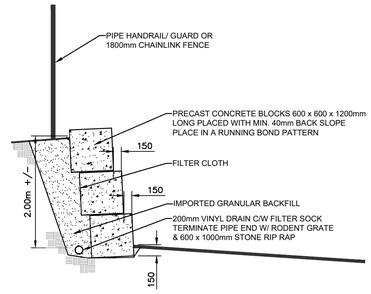
1. THE GRADING PLAN IS TO BE READ WITH THE SITE SERVICES DRAWINGS.
2. CONTRACTOR TO RESTORE AREAS ON PUBLIC R.O.W. OR ADJACENT LANDS THAT HAVE BEEN DISTURBED DURING CONSTRUCTION.
3. ALL DRIVEWAY AND GRADING MATERIAL AND CONSTRUCTION METHODS MUST CONFORM TO CURRENT TOWNSHIP STANDARDS AND SPECIFICATIONS.
4. ALL FILL WITHIN THE SITE TO BE COMPACTED TO A MIN. OF 98% Std. PROCTOR DRY DENSITY. ALL FILL WITHIN THE SITE PARKING AREA TO BE COMPACTED TO A MIN. OF 95% SPD. THE SUITABILITY OF ALL FILL MATERIALS ARE TO BE CONFIRMED BY A RECOGNIZED SOILS CONSULTANT TO THE DIRECTOR OF PUBLIC WORKS PRIOR TO INSTALLATION OF ANY ROAD BASE MATERIALS.
5. LANDSCAPING SHALL NOT ENCROACH ON BOULEVARD NOR SHALL BOULEVARD GRADES BE ALTERED.
6. SILT FENCE(S) TO BE INSTALLED AND MAINTAINED TO PREVENT SILT FLOWING ONTO ADJACENT LANDS. SILTATION CONTROL SHALL BE ERECTED PRIOR TO ANY GRADING OR CONSTRUCTION AND SHALL BE IN GOOD REPAIR THROUGHOUT THE CONSTRUCTION AND GRADING PHASES.
7. ANY CHANGES IN GRADES, CATCH BASINS, SERVICES LATERALS, STORM AND SANITARY SEWERS REQUIRE THE APPROVAL OF GM BLUEPLAN ENGINEERING LIMITED.
8. THE CONTRACTOR SHALL RECTIFY ALL DISTURBED AREAS TO ORIGINAL CONDITION OR BETTER AND TO THE SATISFACTION OF GM BLUEPLAN ENGINEERING LIMITED.
9. ALL LANDSCAPING TO BE INSTALLED AS SOON AS POSSIBLE OR PRIOR TO THE END OF THE FIRST GROWING SEASON. LANDSCAPING TO BE MAINTAINED UNTIL IT IS ESTABLISHED.
10. ALL COMPACTION TO BE CERTIFIED BY A GEOTECHNICAL CONSULTANT.
11. ALL CURBS ARE TO BE 150mm ABOVE THE PROPOSED GUTTER LINE (G/L) UNLESS NOTED OTHERWISE.
12. PAVEMENT GRADE SHALL BE MIN. 0.5%, MAX. 8%.
13. DRAINAGE SWALE GRADE SHALL BE MIN. 2%, MAX. 6%.
14. SLOPES IN LANDSCAPE AREAS AND ON BERMS SHALL NOT EXCEED 3 HORIZONTAL TO 1 VERTICAL, UNLESS NOTED OTHERWISE.



ASPHALT PAVEMENT
N.T.S.

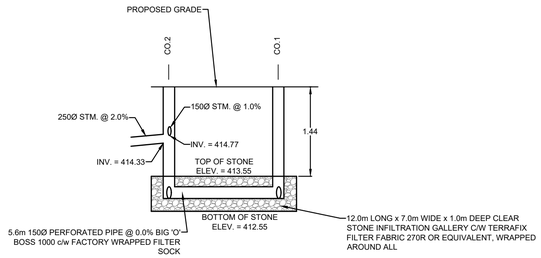


TYPICAL SWALE SUBDRAIN DETAIL
N.T.S.

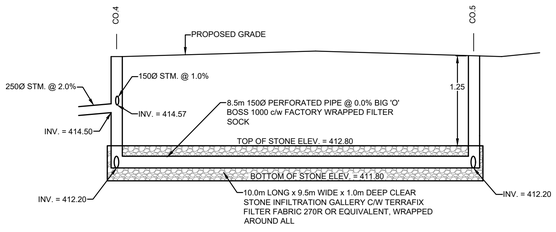


RETAINING WALL DETAIL
N.T.S.

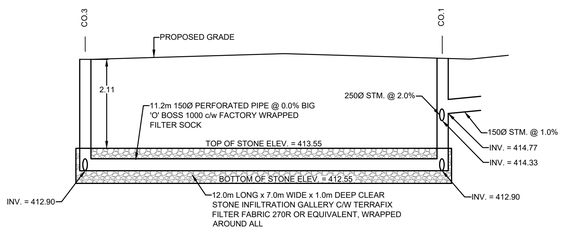
NOTE:
PROPOSED RETAINING WALL DETAILED DESIGN, INSTALLATION, INSPECTION AND CERTIFICATION OF RETAINING WALL INCLUDING GUARDING AS REQUIRED UNDER OBC 2012 TO BE COMPLETED BY OTHERS.



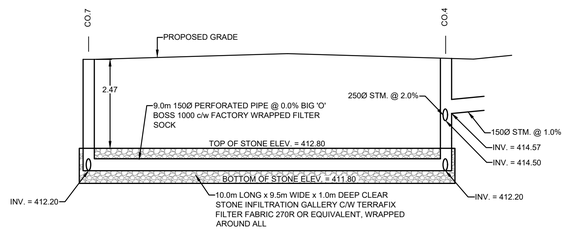
STONE INFILTRATION GALLERY 1 - SECTION DETAIL
N.T.S.



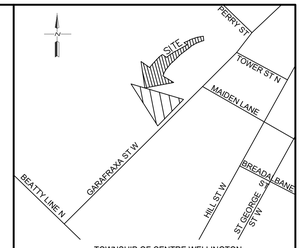
STONE INFILTRATION GALLERY 2 - SECTION DETAIL
N.T.S.



STONE INFILTRATION GALLERY 1 - SECTION DETAIL
N.T.S.



STONE INFILTRATION GALLERY 2 - SECTION DETAIL
N.T.S.



TOWNSHIP OF CENTRE WELLINGTON
KEY PLAN
NOT TO SCALE

NOTES :

1. EXISTING CONDITIONS AND TOPOGRAPHIC SURVEY COMPLETED BY GM BLUEPLAN ENGINEERING LIMITED DATED DECEMBER 07, 2022.
2. SITE LAYOUT PROVIDED BY DRYDEN, SMITH & HEAD DATED JANUARY 20, 2023.
3. LEGAL INFORMATION FOR 465 GARAFRAXA STREET WEST OBTAINED FROM "PLAN OF SURVEY OF PART OF BLOCK 4 REGISTERED PLAN 77" COMPLETED BY BSR&D DATED NOVEMBER 25, 2021.
4. GEOTECHNICAL INFORMATION PROVIDED BY CMT ENGINEERING INC. DATED NOVEMBER 28, 2022.
5. SOIL-VAPOUR MITIGATION SYSTEMS EVALUATION PROVIDED BY PINCHIN DATED AUGUST 26, 2022.

BENCH MARKS :

COSINE BENCHMARK - 0011916U119F

FERGUS POST OFFICE, BOLT IN SOUTH SIDE OF WALLL, IN LINTEL OF BASEMENT WINDOW WHICH IS BETWEEN CLOCK TOWER AND LETTER DROP.
ELEV = 399.321

LICENSED PROFESSIONAL ENGINEER
Jan. 30/22
P.F. GRIER
100188305
PROVINCE OF ONTARIO

NO.	DATE	REVISION DESCRIPTION	CHKD
3.	2023/01/31	ISSUED FOR APPROVAL	P.F.G.
2.	2023/01/23	ISSUED FOR SITE PLAN APPROVAL	P.F.G.
1.	2023/01/16	ISSUED FOR REVIEW	P.F.G.

GM BluePlan ENGINEERING
GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA
330 TRILLIUM DRIVE, UNIT D, KITCHENER, ON N2E 3J2
TEL. 519-748-1440
www.gmblueplan.ca

465 GARAFRAXA STREET WEST, FERGUS

HABITAT FOR HUMANITY

TOWNSHIP OF CENTRE WELLINGTON

NOTES AND DETAILS PLAN

DRAWN BY :	APPROVED BY :	PROJECT NO. :	DRAWING NO. :
E.A.	G.E.A.	422144	8
DESIGNED BY :	DATE :	SCALE	
P.F.G.	DECEMBER 2022	AS NOTED	

Appendix F –

Geotechnical Report

GEOTECHNICAL INVESTIGATION

GEOTECH – PROPOSED TOWNHOUSE DEVELOPMENT
465 GARAFRAXA STREET WEST
FERGUS, ONTARIO

CMT Project 22-765.R01

Prepared for:

Habitat for Humanity

November 28, 2022

CMT Engineering Inc.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Tel: 519-699-5775
Fax: 519-699-4664
www.cmtinc.net

November 28, 2022 22-765.R01

Habitat for Humanity
104 Dawson Road
Suite 100B
Guelph, Ontario
N1H 1A6

Attention: Janey Secnic

Dear Janey:

Re: Geotechnical Investigation
Geotech – Proposed Townhouse Development
465 Garafraxa Street West
Fergus, Ontario

As requested, CMT Engineering Inc. conducted a geotechnical investigation at the above referenced site, and we are pleased to present the enclosed report.

We trust that this information meets your present requirements, and we thank you for allowing us to undertake this project. Should you have any questions, please do not hesitate to contact our office.

Yours truly,

Jake Feeney P. Eng.

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TABLE OF CONTENTS

1.0 INTRODUCTION

The services of CMT Engineering Inc. (CMT Inc.) were retained by Janey Secnic of Habitat for Humanity to conduct a geotechnical investigation for the proposed new townhouse development to be constructed at 465 Garafraxa Street West, Fergus, Ontario. The location of the site is shown on Drawing 1.

It is understood that the project will involve the construction of three (3) townhouse blocks with associated roadways and parking areas.

The purpose of the geotechnical investigation was to assess the existing soil and groundwater conditions encountered in the boreholes. Included in the assessment are the soil classification and groundwater observations, as well as comments and recommendations regarding geotechnical resistance (bearing capacity); serviceability limit states (anticipated settlement); dewatering considerations; site classification for seismic site response; recommendations for site grading, site servicing, excavations and backfilling; recommendations for slab-on-grade construction; pavement design/drainage; soil design properties; and a summary of the laboratory results.

The recommendations provided in this report are solely based on the information obtained from the boreholes advanced on the subject site.

2.0 EXISTING SITE CONDITIONS

The site of the proposed residential development is located to the Northwest of Garafraxa Street West. The site is bounded by Garafraxa Street West to the Southeast, undeveloped land to the Northeast and Northwest, and agricultural land to the Southwest. The site currently comprises vacant land, with some trees and a walking trail. In general, the site topography is relatively flat with existing ditches throughout the proposed construction area. It is understood that the site is to be serviced by municipal services.

3.0 FIELD AND LABORATORY PROCEDURES

The field investigation was conducted on November 16, 2022 and comprised the advancement of seven (7) boreholes (referenced as Boreholes 1 to 7), utilizing a Geoprobe 7822DT drillrig operated by employees of CMT Drilling Inc. Boreholes 1 to 5 were advanced to depths of approximately 5.18 m (17.00 ft) below the existing ground surface in the area of the proposed townhouses. Boreholes 6 and 7 were advanced to depths of approximately 1.52 m (5.00 ft) below the existing ground surface in the area of the proposed parking lot. Prior to the field investigation being carried out, underground service locates were undertaken to ensure that existing utilities would not be damaged, or any personnel injured.

Standard penetration testing and sampling was carried out in Boreholes 1 to 5 using 38 mm inside diameter split spoon sampling equipment and an automatic hammer, in accordance with ASTM D1586 "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". SPT soil sampling was generally conducted at 0.76 m (2.5 ft) intervals to 3.05 m (10.00 ft) and every 1.52 m (5.00 ft) thereafter, to borehole termination. Macro core (MC5) direct push sampling was conducted between the SPT soil samples conducted below 3.05 m (10.0 ft) depth and throughout Boreholes 6 and 7. Technical staff from CMT Inc. observed the drilling operation and collected and logged the recovered soil samples. A small portion of each sample was placed in a sealed, marked jar for moisture content determinations.

Representative soil samples from the boreholes at the following depths were submitted to the CMT Inc. laboratory in St. Clements, Ontario for grain size analyses:

- Borehole 3 – depth 1.52 m to 2.13 m (5.00 ft to 7.00 ft); and
- Borehole 5 – depth 3.05 m to 3.66 m (10.00 ft to 12.00 ft).

The borehole logs are provided in Appendix A and the resulting grain size analyses can be found in Appendix B.

The ground surface elevations of the boreholes were surveyed by CMT Inc. (using laser survey equipment) following the completion of drilling. The ground surface elevation of the existing bell pedestal located on the Southeast side of the site beside Garafraxa Street West was utilized as a temporary benchmark, with an assumed elevation of 100.00 m. As such, the ground surface elevation at the borehole locations ranged from approximately 99.34 m to 100.20 m. The locations of the boreholes are shown on Drawing 2.

4.0 SUBSOIL CONDITIONS

The soils encountered in the boreholes are described briefly below and a more detailed stratigraphic description is provided on the borehole logs in Appendix A. The following paragraphs have been simplified into terms of major soil strata. The soil boundaries indicated have been inferred from non-continuous samples and observations of sampling and drilling resistance and typically represent transitions from one soil type to another rather than exact planes of geological change. Further, the subsurface conditions are anticipated to vary between and beyond the borehole locations.

4.1. Topsoil

Loose, dark brown, silty, organic topsoil in a moist state was encountered at the surface of Boreholes 4 and 7 and buried within the sand and gravel fill soil at Boreholes 1 and 2. The thickness of the topsoil was observed to range from about 300 mm to 600 mm (average 450 m) at the borehole locations, however the thickness of the topsoil is anticipated to vary throughout the site. Materials noted as topsoil in this report were classified based on visual and textural evidence. Testing of organic content or for other nutrients was not carried out.

4.2. Sand and Gravel Fill

Brown sand and gravel fill was encountered at the surface of Boreholes 1 to 3 and 6. Black buried topsoil was observed within the sand and gravel fill at Boreholes 1 and 2. The sand and gravel fill were compact with SPT N-values ranging from about 14 to 19 blows per 0.30 m (average 17 blows per 0.30 m). The sand and gravel fill soils are considered to be moist, with moisture contents ranging from about 7.6% to 10.6% (average 9.4%).

4.3. Silt Fill

Brown silt fill with trace gravel was encountered at the surface of Borehole 4. Black staining was observed within the silt fill. The silt fill was considered to be firm with a SPT N-value of about 4 blows per 0.30 m. The silt fill was considered to be moist, with a moisture content of about 11.8%.

4.4. Silty Sand

Brown silty sand was encountered underlying the sand and gravel fill at Borehole 1, the sandy silt at Borehole 2, the silt fill at Borehole 4 and the topsoil at Borehole 5 and 7. The silty sand was observed to extend to the termination depth of Borehole 7. The silty sand was considered to be loose to compact with SPT N-values ranging from about 9 to 29 blows per 0.30 m (average 18 blows per 0.30 m). The silty sand soils are considered to be moist, with moisture contents ranging from about 5.2% to 14.3% (average 9.7%).

4.5. Sandy Silt/Sandy Silt Till

Brown to grey sandy silt/sandy silt till with some clay and trace gravel were encountered underlying the silty sand at Boreholes 1, 2, 4 and 5 and underlying the sand and gravel fill at Boreholes 2, 3 and 6. The sandy silt/sandy silt till was observed to extend to the termination depths of Boreholes 1 to 6. The sandy silt/sandy silt till was considered to be stiff to hard with SPT N-values ranging from about 10 to greater than 100 blows per 0.30 m (average 43 blows per 0.30 m). The sandy silt/sandy silt till soils are considered to be moist, with moisture contents ranging from about 3.1% to 15.9% (average 9.3%).

4.6. Groundwater

No accumulated groundwater or seepage was observed upon completion of the boreholes. It should be noted that the stiff to hard sandy silt till soils encountered in the boreholes have the potential to created perched groundwater conditions in any overlying soils. Groundwater conditions (particularly perched water) are generally dependent on the weather conditions, amount of precipitation, site grading and other measures in place to control surface water drainage, as well as the time of year, and can fluctuate significantly in elevation over time.

Recommendations with respect to dewatering conditions are provided in Section 5.8 of this report, and recommendations regarding waterproofing and drainage are presented in Section 5.10.

5.0 DISCUSSION AND RECOMMENDATIONS

This section of the report provides CMT Inc.'s interpretation of the factual geotechnical data obtained during the investigation and is intended for the guidance of the owner and design engineer. Where comments are made on construction, they are provided only to highlight those aspects which could affect the design of the project. Contractors bidding on or undertaking the work should make their own independent interpretation of the factual subsurface information provided as it affects their proposed construction means and methods, equipment selection, scheduling, pricing, and the like.

Utilizing the information gathered during the geotechnical investigation and assuming that the borehole information is representative of the subsoil conditions throughout the site, the following comments and recommendations are provided.

5.1. Serviceability and Ultimate Limit Pressure

Based on the information obtained from the boreholes, the following table provides a summary of the estimated geotechnical reaction at the Serviceability Limit State (SLS) and the factored geotechnical resistance at the Ultimate Limit State (ULS) at the various elevations, including soil type:

BH No.	Ground Surface Elevation (m)	SLS kPa (psf)	ULS kPa (psf)	Estimated Highest Founding Elevations (m)	Depth Below Existing Grade to Founding Elevation (m)	Soil Type
BH1	100.20	150 (3,000)	225 (4,500)	99.13 to 97.15	1.07	Sand and Gravel Fill/Silty Sand/Sandy Silt Till
		200 (4,000)	300 (6,000)	97.15 to 95.02 (termination)	3.05	
BH2	99.83	150 (3,000)	225 (4,500)	98.86 to 97.54	0.97	Sandy Silt/Silty Sand/Sandy Silt Till
		200 (4,000)	300 (6,000)	97.54 to 94.65 (termination)	2.29	
BH3	99.34	150 (3,000)	225 (4,500)	98.58 to 97.05	0.76	Sandy Silt Till
		200 (4,000)	300 (6,000)	97.05 to 94.16 (termination)	2.29	
BH4	99.40	100 (2,000)	150 (3,000)	98.64 to 97.11	0.76	Silty Sand/Sandy Silt Till
		150 (3,000)	225 (4,500)	97.11 to 96.35	2.29	
		200 (4,000)	300 (6,000)	96.35 to 94.22 (termination)	3.05	
BH5	100.17	150 (3,000)	225 (4,500)	99.57 to 97.12	0.60	Silty Sand/Sandy Silt Till
		200 (4,000)	300 (6,000)	97.12 to 94.99 (termination)	3.05	

Based on the bearing capacities and elevations provided in the table above, soils suitable to support conventional foundations designed with an estimated bearing capacity of 150 kPa (3,000 psf) at SLS and 225 kPa (4,500 psf) at ULS were typically encountered in the shallower native soils encountered underlying the fill soils in the boreholes at depths ranging from 0.6 m to 2.29 m below the existing ground surface.

Based on the bearing capacities and elevations provided in the table above, soils suitable to support conventional foundations designed with an estimated bearing capacity of 200 kPa (4,000 psf) at SLS and 300 kPa (6,000 psf) at ULS were typically encountered in the deeper native till soils encountered in the boreholes at depths ranging from 2.29 m to 3.05 m below the existing ground surface.

Should footings be designed to be constructed at elevations higher than the elevations indicated in the table above, then structural fill will be required in order to achieve the design grades for the proposed foundations. The serviceability limit pressure for granular structural fill placed and compacted in accordance with Section 5.4.4 of this report is estimated to be at least 150 kPa (3,000 psf). Alternatively, lean mix concrete fill could be used for this application.

Footings could also be stepped down to bear on approved undisturbed founding soils. Due to the presence of fill soils on the subject site, it is imperative that the founding soils be assessed at the time of construction by qualified geotechnical personnel in order to confirm their founding suitability.

Footings founded on soil may be placed at a higher elevation relative to another footing provided that the slope between the outside face of the footings is separated by a minimum slope of 10 horizontal to 7 vertical (10H:7V) with an imaginary line projected from the underside of the footings.

It is recommended that the structural foundation drawings be cross-referenced with site servicing drawings to ensure that service pipes do not conflict with building foundations (including the zone of influence down and away from the footings).

With respect to the Serviceability Limit State (SLS), the total and differential footing settlements are not expected to exceed the generally acceptable limits of 25 mm (1") and 19 mm (3/4") respectively.

All exterior footings must be provided with a minimum of 1.2 m of soil cover or equivalent thermal insulation in order to provide protection against frost action.

CMT Inc. would be pleased to review design drawings when they become available and provide further recommendations with respect to bearing and foundation elevations.

5.2. Seismic Site Classification

The site classification for seismic response in Table 4.1.8.4 of the 2012 Ontario Building Code relates to the average properties of the upper 30.0 m of strata. The information obtained in the geotechnical field investigation was gathered from the upper 5.18 m of strata. Based on the information gathered in the geotechnical field investigation, the site classification for seismic site response would be considered Site Class D (stiff soils) for structures founded on the native soils or structural fill at the recommended founding elevations provided in Section 5.1 of this report. The structural engineer responsible for the design of the structure should review the earthquake loads and effects.

5.3. Soil Design Parameters

The following table provides estimated soil design parameters for imported granular fill, as well as the existing native soils encountered on-site. It should be noted that earth pressure coefficients (Ka, Kp, Ko) provided are for flat ground surface conditions and will differ for areas with slopes or embankments.

The estimated soil design parameters can be utilized for the design of perimeter shoring, foundations and retaining walls, as required.

Soil Type	Soil Density (kg/m^3)	Friction Angle (Degree)	Coefficient of Active Pressure (K_a)	Coefficient of Passive Pressure (K_p)	Coefficient of At-Rest Pressure (K_o)	Coefficient of Friction (μ)	Cohesion (Undrained) (kPa)
Imported Granular 'A'/ Granular 'B' (OPSS 1010)	2,100	34°	0.28	3.54	0.44	0.45	0
Silty Sand	1,800	32°	0.31	3.25	0.47	0.41	0
Sandy Silt Till	1,850	30°	0.33	3.00	0.50	0.38	0
Sand and Gravel	1,900	34°	0.28	3.54	0.44	0.45	0

5.4. Site Preparation

The site preparation for the proposed new townhouses is anticipated to include the removal of topsoil and vegetation, the subexcavation of any unsuitable fill and any native soils deemed not capable of supporting the design bearing capacity, removal, or relocation of any existing services, followed by the placement of structural fill (as required) and site grading to achieve proposed grades.

5.4.1. Topsoil Stripping/Vegetation Removal

All topsoil (including buried topsoil) must be removed from within the proposed building, parking lot and driveway areas to expose approved competent subgrade soils. The topsoil may be used in landscaped areas where some settlement can be tolerated; otherwise, it should be properly disposed of off-site.

All vegetation and trees (including tree root structures as well as any loose soils that are typically associated with root structures) must be removed from within the proposed building, parking lot and driveway areas to expose approved competent subgrade soils.

The volume of topsoil removed during the stripping process can be influenced by the equipment utilized for the stripping process as well as the moisture conditions at the time of stripping.

5.4.2. Removal/Relocation of Existing Buried Piping

Any existing underground services (if present) that may be located within the proposed building areas should be removed/relocated. If left in place, the location of existing services must be reviewed to ensure that they do not conflict with proposed foundation locations. This includes any existing subdrains that may be present. Any piping that is left in place that is no longer active must be completely sealed with watertight mechanical covers, concrete, or grout at termination points to prevent the migration of soils into pipe voids, which may result in potential settlement. All existing trench backfill material associated with any underground services must be subexcavated and the subsequent excavation must be backfilled with approved soils placed in accordance with Section 5.4.4 of this report.

5.4.3. Fill Removal

Any existing fill (including any existing trench backfill), as well as any native soils that have inadequate bearing capacity or have been disturbed by construction processes and is deemed unsuitable to support foundations or slab-on-grades, must be subexcavated from within the proposed building areas, exterior entranceways, perimeter sidewalks, and perimeter concrete slab areas to expose approved competent subgrade soils. It would also be sound construction practice to subexcavate all existing unsuitable fill from the paved parking areas; however, this may not be cost-effective. At a minimum, thorough inspection will be required at the time of construction to assess the existing fill to ensure there is no buried topsoil or other deleterious materials within the subgrade soils.

Remedial action may also be required to further consolidate any existing fill if it is decided to leave it in place. If any existing fill is left in place, provisions for the alterations to the design of the pavement structure should be included in the tender documents. Review of the subgrade and potential changes to the design of the pavement structure, as required, will be addressed at the time of construction.

Prior to reusing excavated material on-site as potential bulk fill, thorough field inspection and approval by qualified geotechnical personnel would be required to ensure that existing fill materials are not comprised of organics, topsoil, or other deleterious materials.

5.4.4. Site Grading

Following removal of the debris as well as the subexcavation of any fill or native soils deemed unsuitable of supporting the design bearing capacity, the exposed subgrade soils must be proof-rolled, and any soft or unstable areas must be subexcavated and replaced with approved fill materials.

Any fill materials required to achieve the design grades should be placed according to the following procedures:

- Prior to placement of any structural fill or bulk fill, the subgrade for the proposed buildings and parking lot must be prepared large enough to accommodate a 1:1 slope commencing a distance of 1.0 m beyond the outside edge of the proposed foundation and pavement edge (where feasible) to the approved competent founding soils;

- Soils approved for use as structural fill must be placed in loose lifts not exceeding 0.3 m (12") in depth for granular soils (recommended fill material) and 0.2 m (8") in depth for silts and clays (not recommended for this application), or the capacity of the compactor (whichever is less);

- Granular fill materials (OPSS 1010 Type III Granular 'B' recommended for this application) can be compacted utilizing adequate heavy vibratory smooth drum or padfoot compaction equipment;

- Fine-grained silt and clay soils (not recommended) must be compacted utilizing adequate heavy padfoot vibratory compaction equipment;

- Approved fill materials must be at suitable moisture contents to achieve the specified compaction. Soil moisture will also be dependent on weather conditions at the time of construction. Granular soils may require the addition of water in order to achieve the specified compaction;

- Approved structural fill materials that will support structures (including foundations, interior slab-on-grades, sidewalks and large expansive exterior slabs) must be compacted to 100% standard Proctor maximum dry density (SPMDD);

- Approved bulk fill (foundation wall backfill, bulk fill under slab-on-grades that will not support footings or heavy point loading) must be compacted to a minimum 98% SPMDD. It would be expected that the native soils would be suitable for use as bulk fill; however, depending on the time of year and weather conditions when construction takes place, soils excavated at depth may require air-drying in order to achieve the specified density;

- Granular 'B' subbase and Granular 'A' base materials for the paved parking areas must be compacted to 100% SPMDD.

Any wet soils encountered in the boreholes will require significant air-drying along with working of the soils in order to achieve the specified compaction. Utilizing the existing soils during site grading may be more achievable if work is completed during the generally drier summer months. It should be noted, however, that due to the nature of some of the soils, during hot dry weather, the addition of water might be required in order to achieve the specified compaction. Reuse of excavated soils on-site will be subject to approval from qualified geotechnical personnel.

5.5. Foundation Subgrade Preparation

The native soils encountered in the boreholes are sensitive to changes in moisture content and can become loose/soft if the soils are subjected to additional water or precipitation, as well as severe drying conditions. The native subgrade soils could also be easily disturbed if traveled on during construction. Once they become disturbed, they are no longer considered adequate for the support of shallow foundations.

To ensure and protect the integrity of the founding soils during construction operations, the following is recommended:

- Should the native soils at the design founding elevation in the proposed building envelope comprise wet or saturated soils, then a granular drainage layer, constructed in accordance with Section 9.14.4 of the current Ontario Building Code (OBC) may be required. Alternatively, a lean mix concrete mud mat may be poured overlying the subgrade soils to provide a stable base;

- During construction, the subgrade should be sloped to a sump (as required) located outside the building footprints (if feasible) in the excavation to promote surface drainage of rainwater or seepage and the collected water should be pumped out of the excavation. It is critical that all water be controlled (not allowed to pond) and that the subgrade and foundation preparation commence in dry conditions;

- Construction equipment travel and foot traffic on the founding soils should be minimized;

- If construction is to be undertaken during subzero weather conditions, the founding native soils and any potential fill materials must be maintained above freezing;

- Prior to placing concrete for the footings, the footing area must be cleaned of all disturbed or caved materials;

- The foundation formwork and concrete should be installed as soon as practical following the excavation, inspection, and approval of the founding soils. The longer that the excavated soils remain open to weather conditions and groundwater seepage, the greater the potential for construction problems to occur;

- If it is expected that the founding soils will be left open to exposure for an extended period of time, it is recommended that a 75 mm concrete mud slab be placed in order to protect the structural integrity of the founding soils.

Due to the variability of the native soils encountered in the boreholes, all foundation excavations must be reviewed by qualified personnel to confirm the suitability of the founding fill soils prior to foundation placement.

5.6. Slab-on-Grade/Modulus of Subgrade Reaction

Prior to the placement of the granular base for any slab-on-grades, the subgrade soils must be proof-rolled. Any soft or weak zones, as well as the unsuitable fill in the subgrade, should be subexcavated and backfilled with approved fill materials (see Sections 5.4.4 and 5.10 of this report).

The following table provides the estimated modulus of subgrade reaction (k) for imported granular fill, as well as the native soils encountered on-site:

Soil Type	Estimated Modulus of Subgrade Reaction (k)
Imported Sand and Gravel (OPSS 1010)	81,000 kN/m^3 (300 lb/in^3)
Sandy Silt/Sandy Silt Till	61,200 kN/m^3 (225 lb/in^3)
Silty Sand	61,200 kN/m^3 (225 lb/in^3)
Sand and Gravel	68,000 kN/m^3 (250 lb/in^3)

In dry conditions, floor slabs can be founded on a minimum thickness of 150 mm (6") of Granular 'A' (OPSS 1010) and compacted to 100% SPMDD. If wet to saturated conditions are encountered during the excavation of the site, it would be recommended that for any basement floor slabs, 150 mm (6") of 19 mm clear crushed stone (OPSS 1004) should be used instead of Granular 'A'. Utilizing clear crushed stone for the slab-on-grade base can assist in providing a moisture barrier by reducing the potential for capillary rise of moisture from the subgrade soils. Compactive effort is required to consolidate the clear stone. The 19 mm clear crushed stone should meet the physical property and gradation requirements of OPSS 1004.

It is recommended that areas of extensive exterior slab-on-grade (sidewalks and accessibility ramps) be constructed with a Granular 'B' subbase (450 mm) and a Granular 'A' base (150 mm), as well as incorporating subdrains, to promote rapid drainage and reduce the effects of frost heaving. This is particularly critical at barrier-free access points. Alternatively, structural frost slabs could be designed and constructed, or sufficient thermal insulation could be provided, at all door entrances and areas of barrier-free access.

5.7. Excavations

All excavations must be carried out in accordance with Ontario Regulation 213/91 (Reg 213/91) of the Occupational Health and Safety Act and Regulations for Construction Projects.

Type 2 Soils - In general, the native sandy silt till soils encountered in the boreholes in a drained state (not saturated), would be classified as Type 2 soils under Reg 213/91. The Type 2 soils must be sloped from within 1.2 m of the bottom of the excavation having a minimum gradient of 1 horizontal to 1 vertical. Soils underlain by Type 3 or 4 soils that are exposed in the excavation must be treated accordingly as Type 3 or 4 soils (see below). All saturated soils encountered must be treated as Type 4 soils, as described below.

Type 3 Soils - In general, the silty sand/silty sand and any existing fill materials (including backfill of existing foundations and services) in a drained state (not saturated), would be classified as Type 3 soils under Reg 213/91. The Type 3 soils must be sloped from the bottom of the excavation at a minimum gradient of 1 horizontal to 1 vertical. Soils underlain by Type 4 soils that are exposed in the excavation must be treated accordingly as Type 4 soils (see below). All saturated soils encountered must be treated as Type 4 soils, as described below.

Type 4 Soils - In general, any wet to saturated soils would be classified as Type 4 soils under Reg 213/91. Type 4 soils must be sloped from the bottom of the excavation at a minimum gradient of 3 horizontal to 1 vertical.

If it is not practical to excavate according to the above requirements, then a trench support system (designed in accordance with the Ontario Health and Safety Act Regulations) may be utilized. When using a temporary trench support system consisting of trench boxes to reduce the lateral extent of the excavations, it should be noted that the support system is intended primarily to protect workers as opposed to controlling lateral soil movement. Any voids between the excavation walls and the support system should be immediately filled to reduce the potential for loss of ground and to provide support to existing adjacent utilities and structures, and it is recommended that the excavation be carried out in short sections, with the support system installed immediately upon excavation completion.

5.8. Construction Dewatering Considerations

Groundwater conditions (particularly perched water) are generally dependent on the amount of precipitation, control of surface water, as well as the time of year, and can fluctuate significantly in elevation and volume. As such, provisions for site dewatering should be part of the site development and construction process.

Seepage control requirements during construction will depend upon the area of work on the site, the depth of the excavations, the time of year, the amount of precipitation and the control of surface water. As required, seepage should generally be adequately controlled using conventional construction dewatering techniques such as pumping from sump pits. However, if heavy seepage occurs (particularly in the saturated soil deposits), it may be necessary to increase the number of pumps during construction.

Dewatering should be performed in accordance with OPSS 517 and the control of water must be in accordance with OPSS 518. It is the responsibility of the contractor to propose a suitable dewatering system based on the groundwater elevation at the time of construction. Collected water should discharge a sufficient distance away from the excavation to prevent re-entry. Sediment control measures must be installed at the discharge point of the dewatering system to avoid any potential adverse impacts on the environment.

5.9. Service Pipe Bedding

The native soils encountered in the geotechnical investigation are generally considered suitable for indirect support of the site service pipes. Should instability due to saturated soil conditions be encountered, it may be necessary to increase the thickness of the granular base and utilize 19 mm clear stone to create an adequate supporting base for the service pipes and/or manholes. Pipe embedment, cover and backfill for both flexible and rigid pipes should be in accordance with all current and applicable OPSD, OPSS and OBC standards and guidelines and as follows:

Flexible Pipes – The pipe bedding should be shaped to receive the bottom of the pipe. If necessary, pipe culvert frost treatment should be undertaken in accordance with OPSD-803.031. The trench excavations should be symmetrical with respect to the centreline of the pipe. The granular material placed under the haunches of the pipe must be compacted to 100% SPMDD prior to the continued placement and compaction of the embedment material. The homogeneous granular material used for embedment should be placed and compacted uniformly around the pipe. Should wet conditions be encountered at the base of the trench, then the pipe bedding should consist of 19 mm clear stone (meeting OPS Specifications) wrapped completely in a geotextile fabric such as Terrafix 270 or equivalent.

Rigid Pipes - In general, the pipe installation recommendations for rigid pipes are the same as those for flexible pipes, except that the minimum bedding depth below a rigid pipe should be 0.15*D* (where *D* is the pipe diameter). In no case should this dimension be less than 150 mm or greater than 300 mm.

Any service pipes that are not provided with sufficient frost coverage must be protected with the necessary equivalent thermal insulation. The general contractor is responsible to protect existing and new service piping from damage by heavy equipment.

5.10. Perimeter Building Drainage, Foundation Wall Backfill and Trench Backfill

In order to assist in maintaining a dry building with respect to surface water seepage, it is recommended that exterior grades around the building be sloped down and away at a 2% gradient or more, for a distance of at least 1.5 m. Any surface discharge rainwater leaders must be constructed with solid piping that discharges with positive drainage at least 1.5 m away from the building foundation and/or beyond sidewalks to a drainage swale or appropriate storm drainage system.

In order to reduce the effects of surficial frost heave in areas that will be hard surfaced, it is recommended that the exterior foundation backfill consist of free-draining granular material such as approved on-site sand or sand and gravel or imported Granular 'B' Type I or Type III (OPSS 1010), with a maximum aggregate size not exceeding 100 mm, and that it extend a minimum lateral distance of 600 mm out from the foundation walls and/or beyond perimeter sidewalks and entranceway slabs. It is critical that particles greater than 100 mm in diameter are not in contact with the foundation wall to prevent point loading and overstressing. The backfill material used against the foundation walls must be placed so that the allowable lateral capacities of the foundation walls are not exceeded. Where only one side of a foundation wall will be backfilled, and the height of the wall is such that lateral support is required, or where the concrete strength has not been achieved, the wall must be braced or laterally supported prior to backfilling. In situations where both sides of the wall are backfilled, the backfill should be placed in equal lifts, not exceeding 200 mm differential on each side during backfill operations and the backfill should be compacted to a minimum of 98% SPMDD.

Foundations constructed within or below the any zone of wet soils may be subject to flooding in the event of a power failure or equipment malfunction. Therefore, it would be recommended that foundations be constructed above any saturated zones. If this is not feasible, it is recommended that good quality sump pumps be utilized and that, at a minimum, the systems be equipped with a battery backup (in the event of a power outage) preferably with a separate functioning sump pump(s). Groundwater elevations (perched and regional water tables) are dependent on weather and seasonal conditions and should be expected to fluctuate. The construction of foundations, slabs-on-grade, and deep structures such as sump pits within or below zones of saturation will require design of site-specific waterproofing and dewatering systems constructed in accordance with the 2012 OBC.

If the proposed townhouses are to have basements, an exterior perimeter drainage system comprising perforated drainage pipe with a factory installed filter sock, bedded in 19 mm clear crushed stone, and wrapped in a geotextile filter fabric such as Terrafix 270R (or equivalent), must be installed at an elevation that is below the proposed basement slab-on-grade elevation and provided with positive drainage into a sump pit or pits. The portion of the piping that connects the exterior drainage system into the sump pit must comprise solid piping to prevent exterior water from being introduced into the interior subslab stone. It may be prudent to install perforated drainage pipe in the interior basement as well to provide an outlet for any water that may collect in the subslab stone. It is also recommended that a capped cleanout port(s) be extended up to the ground surface elevation to provide future access (if required). The rainwater leaders must not be connected to the perimeter drainage system.

The native soils, as well as approved fill materials (non-organic) are generally considered suitable for reuse as trench backfill and bulk fill in the parking lot; however, any wet soils encountered may require air-drying in order to achieve the specified compaction. Air-drying cannot typically be achieved during winter construction; therefore, depending on the time of year that construction takes place, it may be more feasible to utilize an imported granular fill for this project.

The existing fill soils are generally considered suitable for reuse as trench backfill and bulk fill in the parking lot areas.

Backfilling operations should be carried out with the following minimum requirements:

- Adequate heavy smooth drum or padfoot vibratory compaction equipment should be used for the compaction and to break down any large blocky pieces of soil;

- Loose lift thicknesses should not exceed 0.3 m (12") for granular soils or 0.2 m (8") for silt soils or the capacity of the compactor (whichever is less);

- The soils must be at suitable moisture contents to achieve compaction to a minimum 98% SPMDD in non-structural bulk fill areas. Service trenches excavated within the zone of influence of footings for structures must be compacted to a minimum of 100% SPMDD;

- It is recommended that inspection and testing be carried out during construction to confirm backfill quality, thickness and to ensure that compaction requirements are achieved;

- Service trench backfill materials may consist of approved excavated soils with no particles greater than 100 mm and no topsoil or other deleterious materials;

- If construction operations are undertaken in the winter, strict consideration should be given to the condition of the backfill material to make certain that frozen material is not used.

5.11. Pavement Design/Drainage

Any soils containing organics or other deleterious material must be stripped/subexcavated from within the parking area. It is recommended to either subexcavate any existing loose subgrade materials or provide further consolidation with vibratory compaction equipment in order to prepare a proper, stable subgrade. Prior to placement of the new granular base, the subgrade soils must be proof-rolled, and any soft or unstable areas should be subexcavated and replaced with suitable drier materials. The subgrade should be graded smooth (free of depressions) and properly crowned to ensure positive drainage, with a minimum grade of 3% toward the drainage outlet or curb line. When service pipes are installed, pipe bedding and backfilling should be undertaken as indicated in Sections 5.9 and 5.10 of this report.

Rapid drainage of the pavement structure is critical to ensure long-term performance. The requirement for subdrains will be dependent on the composition of the prepared parking subgrade soils. Based on the information from the boreholes it is expected that the subgrade will comprise fine-grained, frost-susceptible soils. As such, it is recommended to install subdrains, provided gravity drainage to a suitable outlet can be provided. It is recommended to install minimum 100 mm diameter perforated subdrains to collect and redirect water beneath the pavement surface. Subdrains should be designed and installed in accordance with OPSS 405 and OPSD 216.021. If Granular 'A' bedding (OPSS 1010) is utilized, the subdrains should be equipped with a factory installed filter sock. If 19 mm clear stone (OPSS 1004) is utilized as bedding for the subdrain, then the bedding must be wrapped completely with geotextile filter fabric such as Terrafix 270R (or equivalent) and a factory installed filter sock is not required. Installation of rigid subdrains allows for better grade control and less potential for damage during installation; however, it would be expected that there would be higher cost implications associated with the installation of rigid subdrains over flexible subdrains. Positive drainage through grade control of subdrains is critical, as improperly installed subdrains can turn drainage systems into reservoirs, which can fuel frost action. The subdrains will hasten the removal of water, thereby reducing the risk and effects of frost heaving and load transfer in saturated conditions. It is suggested that, at a minimum, subdrains be installed along the edge of the roadway pavement to prevent water from entering the subbase. The subdrains should be installed in a 0.3 m (1.0 ft) by 0.3 m (1.0 ft) trench in the subgrade and bedded approximately 50 mm (2") above the bottom of the trench. The subgrade must be prepared with positive drainage to the subdrains and the subdrains must be installed with positive drainage into a catch basin structure or other suitable outlet.

The native subgrade soils are sensitive to change in moisture content and can become loose or soft if the soils are subject to inclement weather and seepage or severe drying. Furthermore, the subgrade soils could be easily disturbed if traveled on during construction. As such, where this material will be exposed, it is recommended that the granular subbase be placed immediately upon completion of the subgrade preparation to protect the integrity of the subgrade soils.

Should wet to saturated conditions be encountered during construction, site assessments may be required to determine what options can be undertaken to construct a modified pavement base. These options may include subexcavation of wet soils and increasing the thickness of the granular base, the use of reinforcing geotextiles, or a combination of both.

It is expected that the parking lot will be subject to mostly light traffic (personal vehicles) as well as some heavy traffic (delivery trucks, maintenance, and emergency vehicles).

Based on the anticipated loading, the following pavement design is provided:

Material	**Recommended Thickness For New Pavement**	
	Light Duty	**Heavy Duty**
Asphaltic Concrete	HL3 - 40 mm (1.5") HL4 or HL8 - 50 mm (2.0")	HL3 - 50 mm (2.0") HL4 or HL8 - 60 mm (2.5")
Granular 'A' Base (OPSS 1010)	150 mm (6.0")	150 mm (6.0")
Granular 'B' Subbase (OPSS 1010)	400 mm (16.0")	450 mm (18.0")

Frost tapers must be constructed at any changes from light traffic to heavy traffic areas. If heavy traffic routes are not delineated by barriers or if it is anticipated that heavy equipment (loader and dump trucks) will be utilized for snow removal, it would be recommended that the heavy traffic pavement structure be utilized throughout.

Construction joints in the surface asphalt must be offset a minimum of 150 mm to 300 mm (6" to 12") from construction joints in the binder asphalt so that longitudinal joints do not coincide.

Where new asphalt is joined into existing asphalt, it is recommended that the existing asphalt be sawcut in a straight line prior to being milled to a depth of 40 mm and a width of 150 mm as per OPSD 509.010. It is recommended that a tackcoat in conformance with OPSS 308 be applied to the edge and surface of all milled asphalt prior to placement of new asphalt.

The granular base and subbase materials must conform to the physical property and gradation requirements of OPSS 1010 and must be compacted to 100% SPMDD. Asphaltic concrete should be supplied, placed and compacted to a minimum 92.0% Marshall maximum relative density, in accordance with OPSS 1150 and OPSS 310.

The pavement should be designed to ensure that water will not pond on the pavement surface. If the surface asphalt is not placed within a reasonable time following placement of the binder asphalt, it is recommended that the catch basin lids are set at a lower elevation or apertures provided to allow surface water to drain into the catch basins and not accumulate around the catch basins. The strength of the pavement structure relies on all of the components to be in place in order to provide the design strength; therefore, it is strongly recommended that the surface asphalt be placed shortly after placement of the binder asphalt so as to avoid undue stress on the binder asphalt by not having the complete pavement structure in place.

It should be noted that, currently, asphalt mixes tend to be more flexible and, as such, there is a tendency for damage to occur from vehicles turning their steering wheels or applying excessive brake pressure. The damage can occur from both passenger vehicles as well as large vehicles. The condition is further intensified during hot weather. In high traffic areas, it is recommended that rigid Portland cement pavement be considered.

5.12. Excess Soil Management

5.12.1. Chemical Testing was NOT Undertaken

Generally, if surplus soils are to be exported off-site, it will be necessary to perform chemical analysis of the soils. Chemical analysis was **not** undertaken as part of this geotechnical investigation. Should chemical analysis tests be required, the required tests vary and will be dependent on the disposal site utilized by the general contractor.

5.12.2 Leachate Testing Requirement

If soils are transported off-site, additional chemical testing may be required. The extent of the leachate testing will be determined by the results of the initial chemical testing as well as the requirements of the disposal site.

The chemical analysis results would be compared to the site condition standards of Ontario Regulation 406/19. Typically, the results are compared to; *T1-Leachate Screening Levels – Res/Park/Inst/Ind/Com/Commu Property Use; T3.1-Leachate Screening Levels – Ind/Com/Commu/Property Use.*

When transporting soils off-site, the following is recommended:

- All chemical analyses and environmental assessment reports must be fully disclosed to the receiving site owners/authorities, whom must agree to receive the material;

- An environmental consultant must confirm the land use at the receiving site is compatible to receive the material;

- An environmental consultant must monitor the transportation and placement of the materials to ensure that the material is placed appropriately at the pre-approved site;

- The excess materials may not be transported to a site that has previously had a Record of Site Condition (RSC) filed, unless the material meets the criteria outlined in the RSC.

It should be noted that landfill sites will generally only accept laboratory test results that have been completed within 30 days of exporting. Therefore, it is recommended that provisions for chemical analysis be included in the tender documents. It should also be noted that the laboratory testing generally takes five (5) working days to process with a regular turnaround time.

5.13. Radon

According to information provided by Health Canada, radon is a radioactive gas that is naturally formed through the breakdown of uranium in soil, rock, and water. When radon escapes the earth in the outdoors, it mixes with fresh air, resulting in concentrations that are too low to be of concern. However, when radon enters an enclosed space, such as a building, high concentration of radon can accumulate and become a health concern. Health Canada indicates that most buildings and homes have some level of radon in them. Unfortunately, it is not possible to predict before construction whether or not a new building will have high radon levels as radon can only be detected by radon measurement devices, which would be installed in a building, post construction. Section 9.13.4.1 Soil Gas Control of the current 2012 Ontario Building Code (OBC) states that *"Where methane or radon gases are known to be a problem, construction shall comply with the requirements for soil gas control in MMAH Supplementary Standard SB-9, Requirements for Soil Gas Control"*.

6.0 SITE INSPECTION

Qualified geotechnical personnel should supervise excavation inspections as well as compaction testing for structural filling, site grading, and site servicing. This will ensure that footings are founded in the proper strata and that proper material and techniques are used and the specified compaction is achieved. CMT Engineering Inc. would be pleased to review the design drawings and provide an inspection and testing program for the construction of the proposed development.

7.0 LIMITATIONS OF THE INVESTIGATION

The recommendations made in this report are in accordance with our present understanding of the project. We request that we be permitted to review our recommendations when the drawings and specifications are complete, or if the proposed construction should differ from that mentioned in this report.

It is important to emphasize that a soil investigation is, in fact, a random sampling of a site and the comments are based on the results obtained at the test locations only. It is therefore assumed that these results are representative of the subsoil conditions across the site. Should any conditions at the site be encountered which differ from those found at the test locations, we request that we be notified immediately in order to permit a reassessment of our recommendations.

It should be noted that this report specifically addresses geotechnical aspects of the project and does not include any investigations or assessments relating to potential subsurface contamination. As such, there should be no assumptions or conclusions derived from this report with respect to potential soil or water contamination. Soil or water contamination is generally caused by the presence of xenobiotic (human-made) chemicals or other alteration processes in the natural soil and groundwater environment. If necessary, the investigation, assessment and rehabilitation of soil and water contaminants should be undertaken by qualified environmental specialists.

The samples obtained during the geotechnical investigation will be stored for a period of three months, after which time they will be disposed of unless alternative arrangements are made.

This report is intended solely for the client named. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the reliability of such third parties. The factual data, interpretation, and recommendations in this report pertain to a specific project as described in this report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, deviates from the assumptions stated herein, CMT Inc. should be given an opportunity to confirm that the recommendations are still valid. The subject geotechnical exploration and this report address only the geotechnical aspects of the proposed project; potential environmental impacts or related issues are beyond the defined scope of this work and have not been addressed.

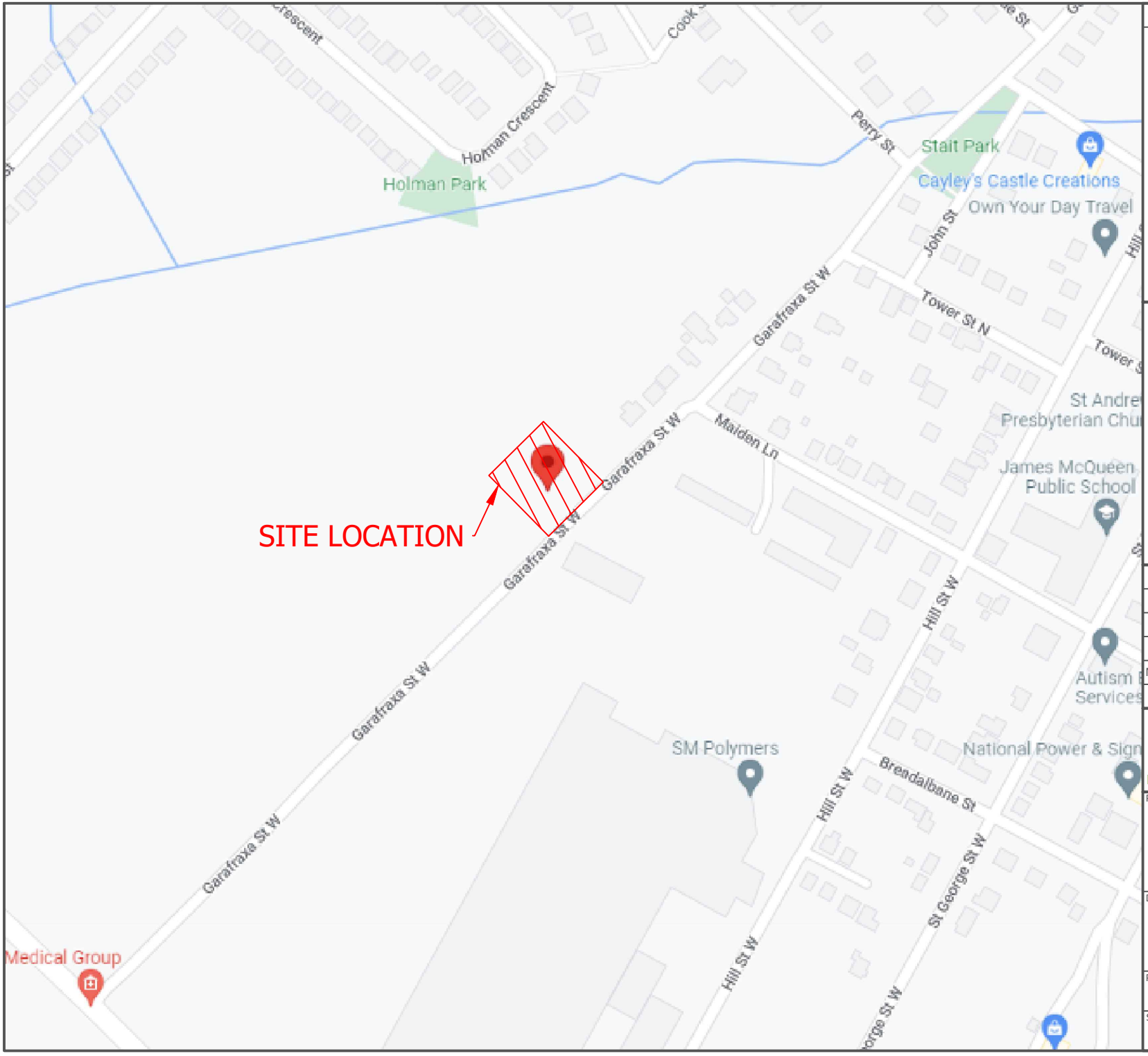
We trust that this report meets with your present requirements. Should you have any questions, please do not hesitate to contact our office.

Prepared by:

Jake Feeney P. Eng.
ht

Reviewed by:

Nathan Chortos, P.Eng.
Senior Geotechnical Engineer



NOTES:

Base map provided by Google.

N

NO.	DESCRIPTION	DATE

REVISIONS

CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Tel.: 519-699-5775
Fax: 519-699-4664
www.cmtinc.net

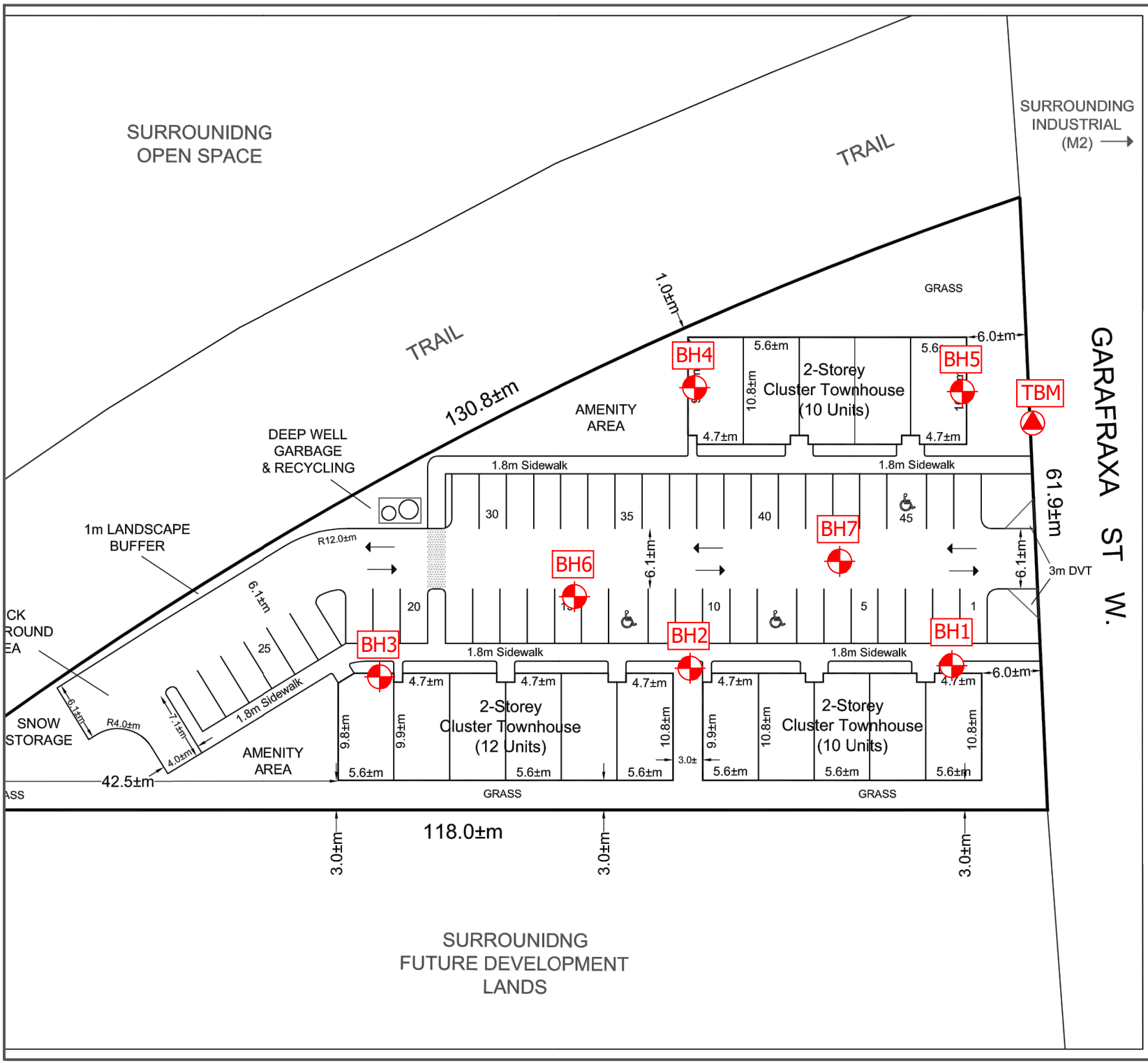
PROJECT:

TOWNHOUSE DEVELOPMENT
465 Garafraxa Street West
Fergus, Ontario

DRAWING TITLE:

SITE LOCATION MAP

PROJECT NO.:	DATE:
22-765	November 24, 2022
SCALE:	DRAWING NO.
N.T.S.	1



NOTES:

Base map provided by Dryden Smith & Head Planning Consultants Ltd.

Legend

CMT Borehole - 2022

Temporary Benchmark

NO.	DESCRIPTION	DATE

REVISIONS

CMT ENGINEERING INC.
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PROJECT:

TOWNHOUSE DEVELOPMENT
465 Garafraxa Street West
Fergus, Ontario

DRAWING TITLE:

AERIAL VIEW SHOWING
BOREHOLE LOCATIONS

PROJECT NO.:	DATE:
22-765	November 24, 2022
SCALE:	DRAWING NO.
N.T.S.	2

APPENDIX A

BOREHOLE LOGS

CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
Telephone: 519-699-5775
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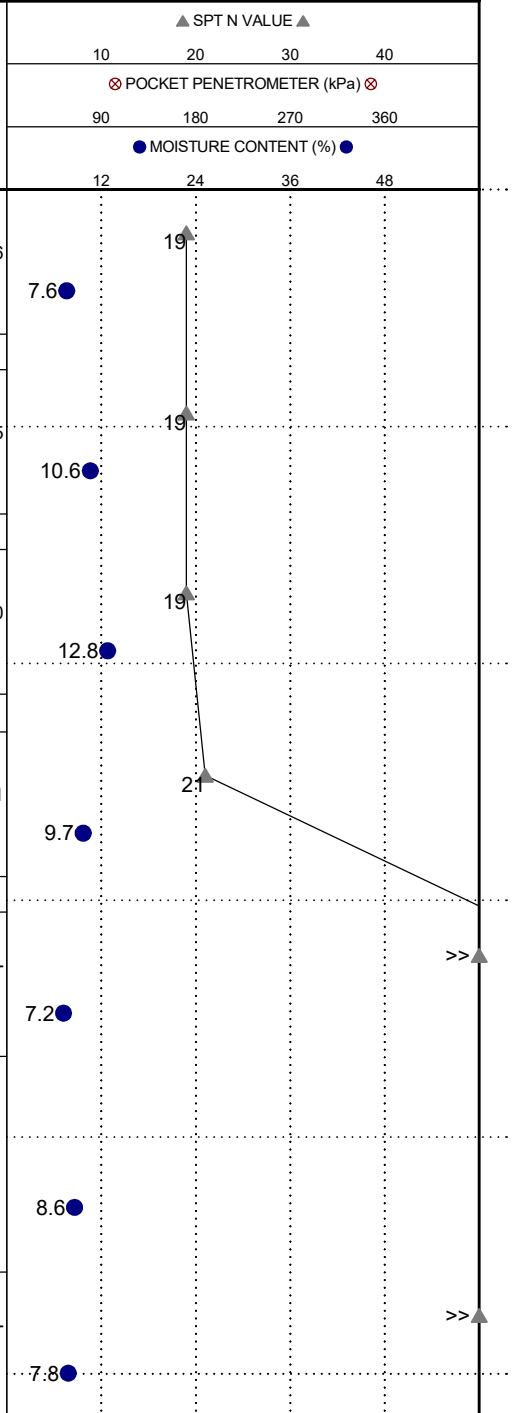
BOREHOLE NUMBER 1

PROJECT: Proposed Townhouse Development
PROJECT ADDRESS: 465 Garafraxa Street West
PROJECT NUMBER: 22-765
PROJECT LOCATION: Fergus, Ontario
DRILLING DATE: 22-11-16
GROUND ELEVATION: 100.20 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
	Sand and Gravel Fill: Compact, brown sand and gravel fill, trace silt, moist	0.00, 100.20	SPT 1	49	2-7-12-16 (19)
	Topsoil: Black silty, organic, buried topsoil layer	0.60, 99.60			
1			SPT 2	100	3-5-14-15 (19)
	Sand and Gravel Fill: Compact, brown sand and gravel fill, trace silt, moist	1.07, 99.13			
	Silty Sand: Compact, brown silty sand, moist	1.52, 98.68	SPT 3	100	8-9-10-10 (19)
2					
	Sandy Silt Till: Very stiff, brown sandy silt till, some clay, trace gravel, moist	2.29, 97.91	SPT 4	100	5-9-12-11 (21)
3					
	becoming hard	3.05, 97.15	SPT 5	100	10-28-33-33 (61)
4			MC5 6	100	
	becoming grey	4.57, 95.63	SPT 7	100	30-48-44-37 (92)
5					



Borehole open to about 5.18 m below the ground surface. No accumulated groundwater observed upon completion.

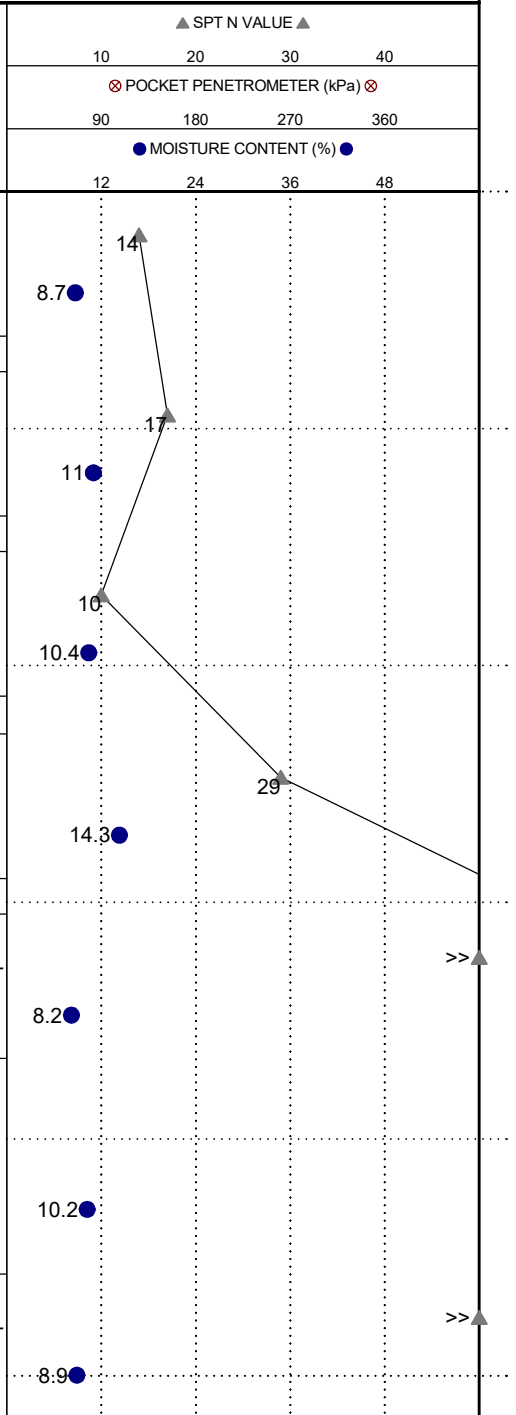
Bottom of borehole at 5.18 m, Elevation 95.02 m.

CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 2

PROJECT: Proposed Townhouse Development
PROJECT ADDRESS: 465 Garafraxa Street West
PROJECT NUMBER: 22-765
PROJECT LOCATION: Fergus, Ontario
DRILLING DATE: 22-11-16
GROUND ELEVATION: 99.83 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
		Sand and Gravel Fill: Compact, brown sand and gravel fill, trace silt, moist Black silty topsoil layer observed at about 0.76 m (210 mm)	0.00, 99.83	SPT 1	49	2-7-7-14 (14)
1		Black silty, organic, buried topsoil layer	0.76, 99.07	SPT 2	100	7-8-9-10 (17)
		Sandy Silt: Stiff to very stiff, brown sandy silt, some clay, trace gravel, moist	0.97, 98.86			
2				SPT 3	25	4-5-5-12 (10)
		Silty Sand: Compact, brown silty sand, moist	2.29, 97.54	SPT 4	100	4-10-19-26 (29)
3						
		Sandy Silt Till: Hard, brown sandy silt till, some clay, trace gravel, moist	3.05, 96.78	SPT 5	100	12-30-38-50 (68)
4				MC5 6	100	
5				SPT 7	100	50-50-50-50 (100)



Borehole caved at about 2.95 m below the ground surface. No accumulated groundwater observed upon completion.

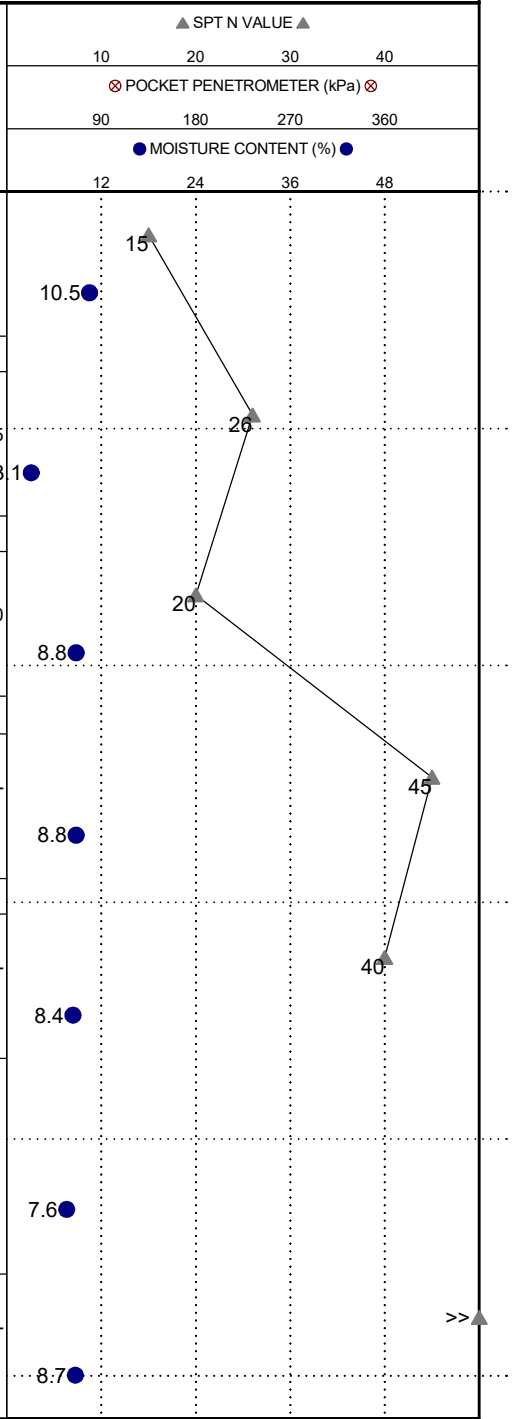
Bottom of borehole at 5.18 m, Elevation 94.65 m.

CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 3

PROJECT: Proposed Townhouse Development
PROJECT ADDRESS: 465 Garafraxa Street West
PROJECT NUMBER: 22-765
PROJECT LOCATION: Fergus, Ontario
DRILLING DATE: 22-11-16
GROUND ELEVATION: 99.34 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
		Sand and Gravel Fill: Compact, brown sand and gravel fill, trace silt, moist	0.00, 99.34	SPT 1	25	3-9-6-18 (15)
1		**Sandy Silt Till:** Very stiff, brown sandy silt till, some clay, trace gravel, moist Black staining observed at about 0.76 m below the ground surface (210 mm)	0.76, 98.58	SPT 2	100	13-18-8-5 (26)
				SPT 3	100	4-8-12-10 (20)
2		becoming hard	2.29, 97.05	SPT 4	100	16-26-19-21 (45)
3				SPT 5	100	15-16-24-38 (40)
4				MC5 6	100	
				SPT 7	100	29-50-50-50 (100)
5						



Borehole caved at about 4.88 m below the ground surface. No accumulated groundwater observed upon completion.

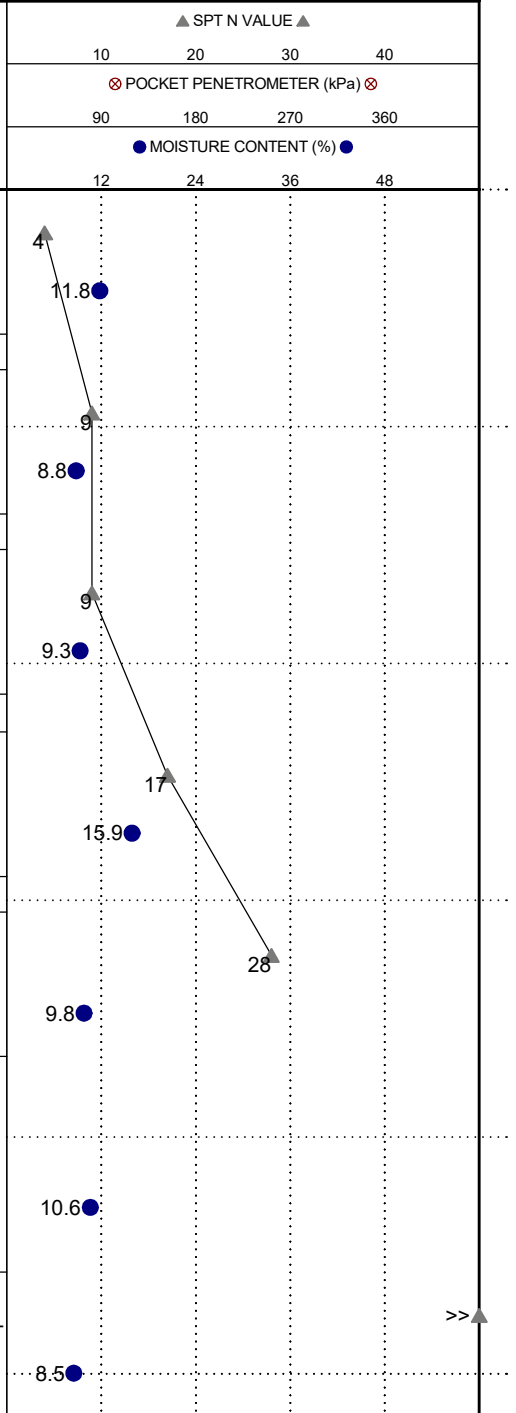
Bottom of borehole at 5.18 m, Elevation 94.16 m.

CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 4

PROJECT: Proposed Townhouse Development
PROJECT ADDRESS: 465 Garafraxa Street West
PROJECT NUMBER: 22-765
PROJECT LOCATION: Fergus, Ontario
DRILLING DATE: 22-11-16
GROUND ELEVATION: 99.40 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
	Silt Fill: Firm, brown silt fill, trace gravel, moist Black staining observed	0.00, 99.40	SPT 1	49	1-2-2-2 (4)
1	**Silty Sand:** Loose, brown silty sand, moist	0.76, 98.64	SPT 2	100	3-4-5-7 (9)
2	**Sandy Silt Till:** Stiff, brown sandy silt till, some clay, trace gravel, moist	1.52, 97.88	SPT 3	100	6-6-3-3 (9)
	becoming very stiff	2.29, 97.11	SPT 4	100	7-7-10-7 (17)
3			SPT 5	100	8-13-15-16 (28)
4			MC5 6	100	
	becoming hard	4.57, 94.83	SPT 7	100	30-27-25-23 (52)
5					



Borehole open to about 5.18 m below the ground surface. No accumulated groundwater observed upon completion.

Bottom of borehole at 5.18 m, Elevation 94.22 m.

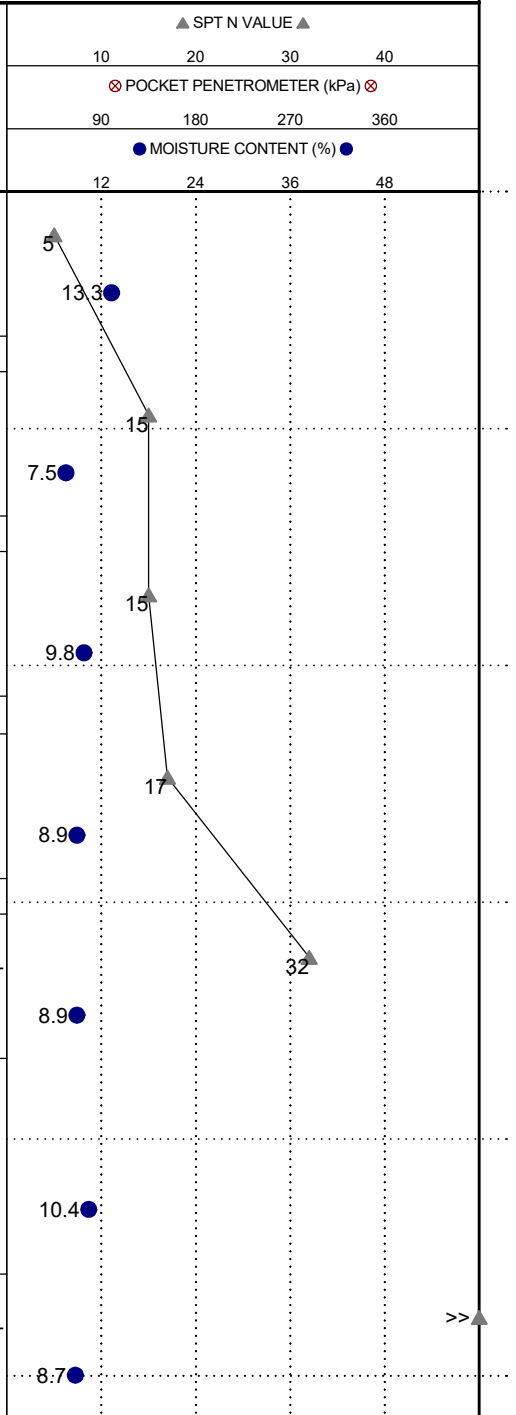
BOREHOLE LOG2 22-765.GPJ CMT_TEMPLATE_2020-05-15.GDT 22-11-28

CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 5

PROJECT: Proposed Townhouse Development
PROJECT ADDRESS: 465 Garafraxa Street West
PROJECT NUMBER: 22-765
PROJECT LOCATION: Fergus, Ontario
DRILLING DATE: 22-11-16
GROUND ELEVATION: 100.17 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
		Topsoil: Loose, dark brown, silty, organic topsoil, moist	0.00, 100.17	SPT 1	49	2-2-3-4 (5)
		Silty Sand: Compact, brown silty sand, moist	0.60, 99.57			
1				SPT 2	100	6-6-9-14 (15)
		Sandy Silt Till: Stiff to very stiff, brown sandy silt till, some clay, trace gravel, moist	1.52, 98.65	SPT 3	100	8-8-7-7 (15)
2						
				SPT 4	100	7-8-9-15 (17)
3		becoming hard	3.05, 97.12	SPT 5	100	18-13-19-19 (32)
				MC5 6	100	
4						
				SPT 7	100	32-50-50-50 (100)
5						



Borehole open to about 5.18 m below the ground surface. No accumulated groundwater observed upon completion.

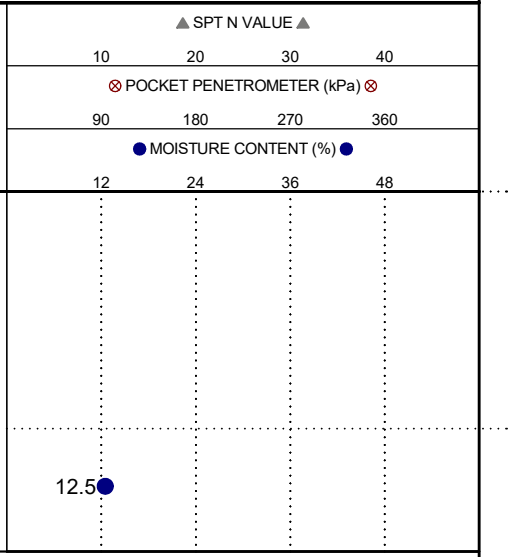
Bottom of borehole at 5.18 m, Elevation 94.99 m.

CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 6

PROJECT: Proposed Townhouse Development
PROJECT ADDRESS: 465 Garafraxa Street West
PROJECT NUMBER: 22-765
PROJECT LOCATION: Fergus, Ontario
DRILLING DATE: 22-11-16
GROUND ELEVATION: 99.51 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: MC5

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
		Sand and Gravel Fill: Brown sand and gravel fill, trace silt, moist	0.00, 99.51			
1		**Sandy Silt Till:** Brown sandy silt till, some clay, trace gravel, moist	0.60, 98.91	MC5 1	100	
		Borehole open to 1.52 m below the ground surface , elevation. No accumulated groundwater observed upon completion.				
		Bottom of borehole at 1.52 m, Elevation 97.99 m.				



CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 7

PROJECT: Proposed Townhouse Development
PROJECT ADDRESS: 465 Garafraxa Street West
PROJECT NUMBER: 22-765
PROJECT LOCATION: Fergus, Ontario
DRILLING DATE: 22-11-16
GROUND ELEVATION: 99.70 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: MC5

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
		Topsoil: Dark brown, silty, organic topsoil, moist	0.00, 99.70			
		Silty Sand: Brown silty sand, moist	0.30, 99.40			
1				MC5 1	100	

SPT N VALUE: 10, 20, 30, 40
POCKET PENETROMETER (kPa): 90, 180, 270, 360
MOISTURE CONTENT (%): 12, 24, 36, 48
5.2

Borehole open to 1.52 m below the ground surface , elevation. No accumulated groundwater observed upon completion.

Bottom of borehole at 1.52 m, Elevation 98.18 m.

APPENDIX B

GRAIN SIZE ANALYSES

Particle Size Distribution Report

	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	7.2	2.7	6.7	21.4	46.0	16.0

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH3	3	1.52-2.13m	sandy silt, some clay, trace gravel	ML
				Sampled by JF of CMT Engineering Inc. November 16, 2022	
				Tested by JM of CMT Engineering Inc. November 18, 2022	

CMT Engineering Inc.

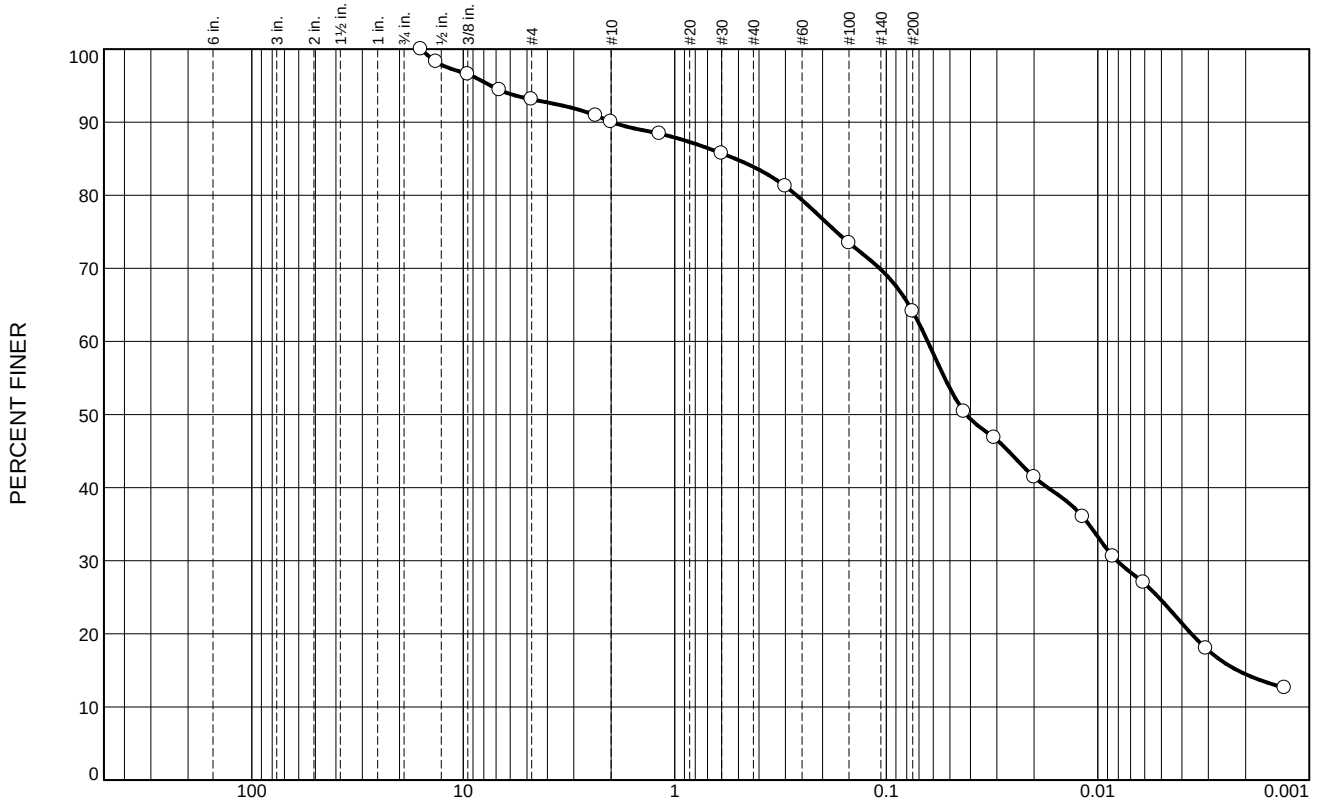
St. Clements, ON

Client: Habitat for Humanity

Project: 465 Garafraxa Street West
Fergus, Ontario

Project No.: 22-765 **Figure** 1

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	6.9	3.0	6.2	19.8	49.6	14.5

SOIL DATA					
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH5	5	3.05-3.66m	sandy silt, some clay, trace gravel	ML
				Sampled by JF of CMT Engineering Inc. November 16, 2022	
				Tested by JM of CMT Engineering Inc. November 18, 2022	

CMT Engineering Inc.

St. Clements, ON

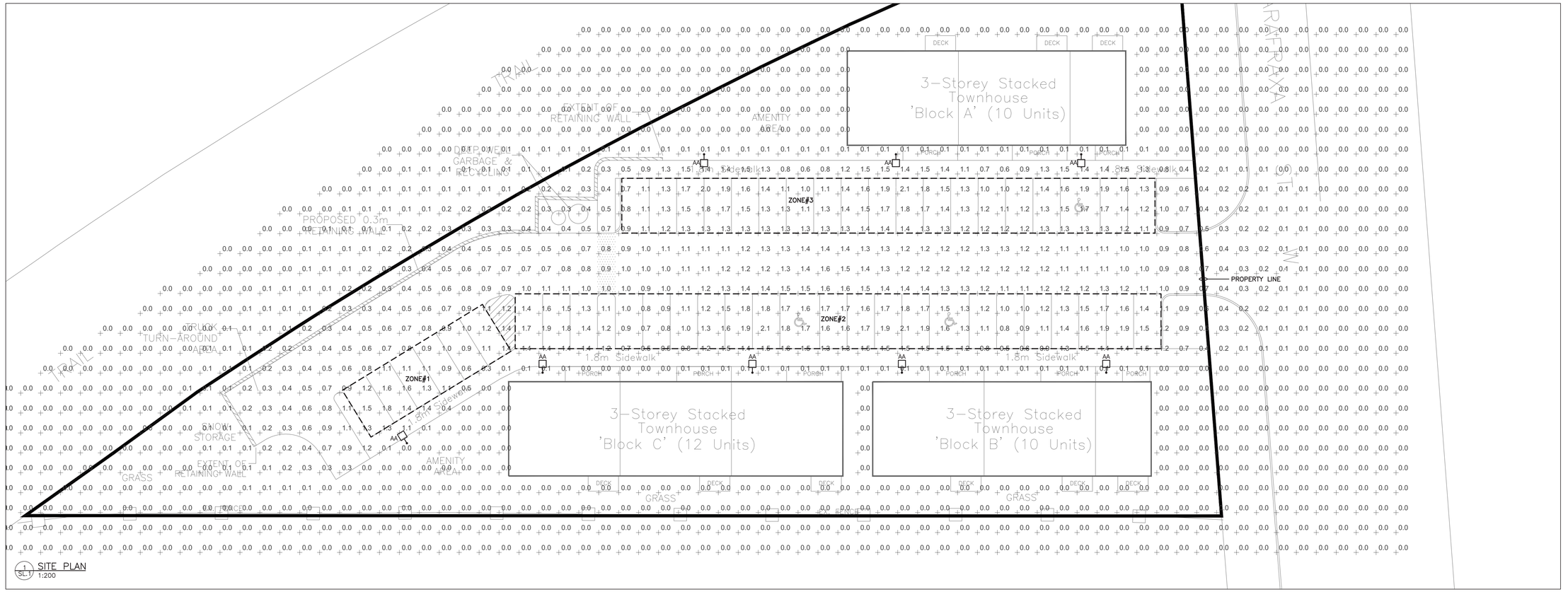
Client: Habitat for Humanity

Project: 465 Garafraxa Street West
Fergus, Ontario

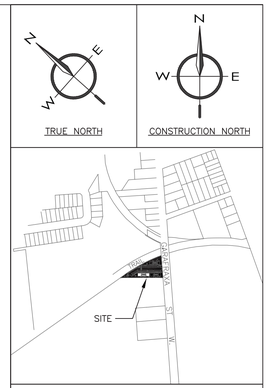
Project No.: 22-765 **Figure** 2

Appendix G –

Lighting and Photometrics Plan



1 SL.1 SITE PLAN
1:200

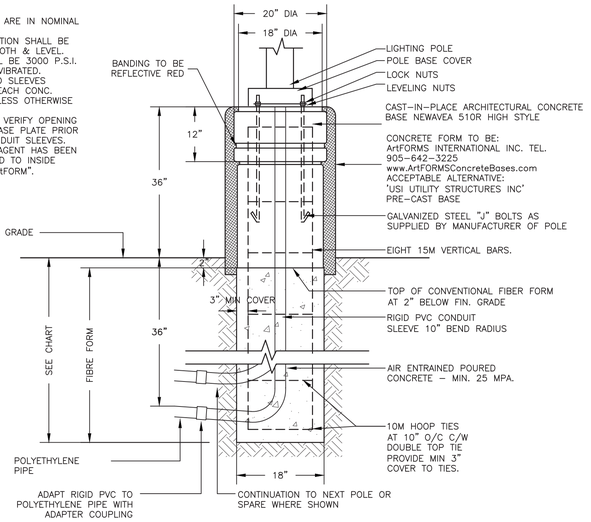


TRUE NORTH

CONSTRUCTION NORTH

KEY PLAN

NOTES:
1. ALL DIMENSIONS ARE IN NOMINAL FEET OR INCHES
2. TOP OF FOUNDATION SHALL BE TROWELLED SMOOTH & LEVEL.
3. CONCRETE SHALL BE 3000 P.S.I. AND SHALL BE VIBRATED.
4. MINIMUM OF TWO SLEEVES REQUIRED FOR EACH CONC. FOUNDATION UNLESS OTHERWISE SHOWN.
5. CONTRACTOR TO VERIFY OPENING SIZE IN POLE BASE PLATE PRIOR TO SETTING CONDUIT SLEEVES.
6. FORM RELEASE AGENT HAS BEEN FACTORY-APPLIED TO INSIDE SURFACE OF "ArtForm".



POLE LENGTH	BASE BURIAL DEPTH
10'	5'
19'	7'
29'	8'
35'	8.5'
40'	9'
45'	9.5'
50'	10'

REFER TO MANUFACTURER'S DETAIL FOR ACTUAL INSTALLATION INSTRUCTIONS. DETAIL IS PROVIDED AS AN APPROXIMATION OF THE WORK REQUIRED TO INSTALL AND MAY NOT REPRESENT CURRENT REQUIREMENTS.

2 SL.1 ARTFORMS POLE BASE
N.T.S.

LIGHTING LEVEL CALCULATIONS	
MEASUREMENT (ZONE#1)	HORIZONTAL ILLUMINATION (FC)
AVERAGE	1.2
MAXIMUM	1.8
MINIMUM	0.6
MAXIMUM:MINIMUM	3.0:1
AVERAGE:MINIMUM	2.0:1

LIGHTING LEVEL CALCULATIONS	
MEASUREMENT (ZONE#2)	HORIZONTAL ILLUMINATION (FC)
AVERAGE	1.4
MAXIMUM	2.1
MINIMUM	0.7
MAXIMUM:MINIMUM	3.0:1
AVERAGE:MINIMUM	2.0:1

LIGHTING LEVEL CALCULATIONS	
MEASUREMENT (ZONE#3)	HORIZONTAL ILLUMINATION (FC)
AVERAGE	1.5
MAXIMUM	2.1
MINIMUM	1.0
MAXIMUM:MINIMUM	2.1:1
AVERAGE:MINIMUM	1.5:1

ELECTRICAL LEGEND

S	WALL MOUNTED LIGHT FIXTURE (z = TYPE AS PER SCHEDULE)
Z	LIGHT FIXTURE (z = TYPE AS PER SCHEDULE)
Z	POLE LIGHT FIXTURE (z = TYPE AS PER SCHEDULE)

FIXTURE TYPE 'AA'

LUMINAIRE SCHEDULE

TYPE	ACCEPTABLE MANUFACTURES	MODELS	CATALOGUE NUMBERS	DESCRIPTION NUM OF LAMPS VOLTAGE	LOCATION MOUNTING HEIGHT	NOTES
AA	LITHONIA	DSX0	DSX0.LED.P1.30K.80CRI.BLC4. MVOLT.SPA.DBLXD	LED AREA LIGHT 34W 3000K 120V	EXTERIOR POLE 15' A.F.G	PROVIDE 12', 4"X4" SQUARE STEEL POLE. REFER TO DETAIL 2/SL.1 FOR POLE BASE DETAILS. CONNECT TO TIME CLOCK CONTROL.

SITE LIGHTING NOTES:

1. THIS DRAWING IS FOR FIXTURE LOCATIONS AND PHOTOMETRIC LAYOUT OF SITE LIGHTING ONLY. CONTACT ELECTRICAL CONSULTANT FOR BUILDING ELECTRICAL SITE PLAN TO CONFIRM LAYOUT OF CONDUIT ROUTING, CIRCUIT ARRANGEMENT, AND WIRE SIZING.
2. VOLTAGES OF FIXTURES ARE TO BE VERIFIED WITH THE ELECTRICAL SITE PLANS PRIOR TO ORDERING FIXTURES.
3. ELEVATIONS OF BASES ARE TO BE COORDINATED WITH SITE GRADING PLAN.
4. LIGHT STANDARDS ARE TO BE COORDINATED WITH WINDOW LOCATIONS. ANY FIXTURES WITHIN 10' (3m) OF THE BUILDING OR ANY CHANGES MADE TO THE BUILDING ENVELOPE ARE TO BE BROUGHT TO THE ATTENTION OF THE SITE LIGHTING CONSULTANT OR PROJECT MANAGER.
5. SUBSTITUTIONS OF LIGHT FIXTURES ARE NOT PERMITTED. IF THE CONTRACTOR SUBSTITUTES LIGHTING FIXTURES THE CONTRACTOR SHALL CARRY ALL COSTS TO HAVE PHOTOMETRIC CALCULATIONS DONE BY THE OFFICE OF THE SITE LIGHTING CONSULTANT AND ALL COSTS ASSOCIATED WITH SITE PLAN RE-SUBMISSION TO THE CITY.
6. PHOTOMETRICS SHOWN CONSIDER ALL FACTORS AFFECTING LIGHT OUTPUT LEVELS SUCH AS LAMP AND BALLAST DEPRECIATION AND DIRT ACCUMULATION OVER AN ESTIMATED ONE-YEAR PERIOD.
7. PHOTOMETRIC VALUES ARE SHOWN IN FOOTCANDLES(fc). A LIGHT LOSS FACTOR OF 0.9 WAS USED IN THE CALCULATION.
8. TYPE 'AA' LIGHTING FIXTURES CONTAIN A BACK-LIGHT CONTROL FEATURE THAT SIGNIFICANTLY REDUCES LIGHT OUTPUT AND GLARE AT THE BACK OF FIXTURE.
9. ALL EXTERIOR LIGHTING POLES ARE TO BE GALVANIZED TO PREVENT CORROSION.
10. ALL EXTERIOR LIGHTING MUST BE CONTROLLED BY AN ASTRONOMICAL TIME CLOCK **(INTERMATIC CAT#ET2825CR)** TO ENSURE THAT IT IS NOT 'ON' DURING TIMES WHEN SUFFICIENT DAYLIGHT IS AVAILABLE.
11. BUILDING MOUNTED LIGHTING AT PORCHES AND DECKS ARE NOT MODELED. ALL BUILDING MOUNTED LIGHTING TO BE CONTROLLED BY THE UNIT IT SERVES, DARK SKY COMPLIANT, DIRECT LIGHT DOWNWARD AND NOT EXCEED 5W LED.

EXTENT OF LIGHTING ZONE

LICENSED PROFESSIONAL ENGINEER
T. ALI
100084607
Jan 31, 2023
PROVINCE OF ONTARIO

No	REVISION	DATE
5		
4		
3		
2	ISSUED FOR SPA	2023.01.31
1	ISSUED FOR REVIEW	2023.01.31

MIGHTON ENGINEERING
300 VICTORIA ST N, 2ND FL
KITCHENER, ON
N2H 6R9
PH (519) 745-3703
FAX (519) 745-5081
WEB www.mighton.com

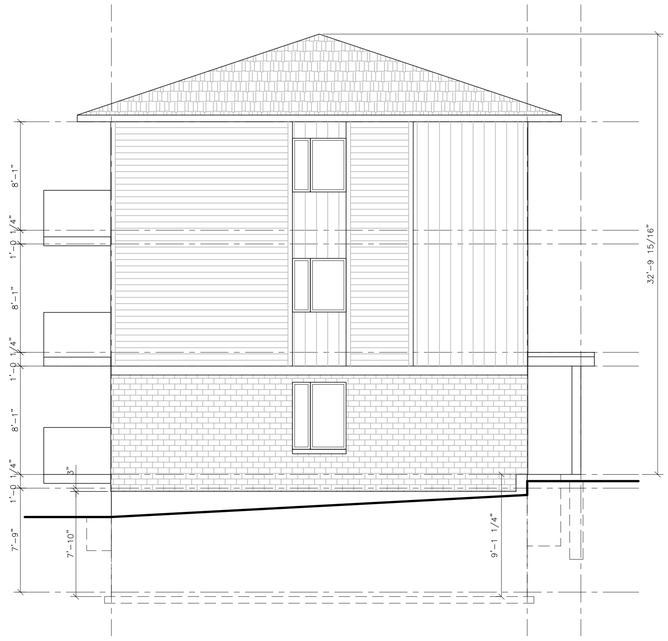
PROJECT TITLE:
RESIDENTIAL DEVELOPMENT
465 GARAFRAXA ST. WEST,
TOWNSHIP OF CENTRE WELLINGTON, ONTARIO

DRAWING TITLE:
SITE LIGHTING PLAN

DRAWN BY: J.L	CUSTOMER PROJECT No. ---
CHECKED BY: T.A	MIGHTON PROJECT No. 43122
DATE: JAN 2023	DRAWING No. SL.1
SCALE AS NOTED	

Appendix H –

Floor Plans and Building Elevations



EAST (STREET) ELEVATION

NORTH/SOUTH (FRONT) ELEVATION

NORTH/SOUTH (REAR) ELEVATION

Preliminary BLOCK A
REVERSED

Habitat for Humanity®

Rogan Home Design

Ron Rogan, MAATO
Architectural Technologist

530 South River Rd,
Elora, Ontario N0B 1S0
519 572-8740
roganhomedesign@gmail.com

I Ron Rogan have reviewed and taken responsibility for the design activities. I'm qualified and the firm is registered in the appropriate classes/categories.

Ron Rogan
BCIN 31434

PRELIMINARY

Rogan Home Design
BCIN 31434

Signature

No.	Description	Date

Stacked Townhouses
465 Garafraxa Rd. W
Fergus, Ontario

Preliminary Block B
ELEVATIONS

Project number	N/A
Date	JAN 13, 2023
Drawn by	RR
Checked by	RR

A107

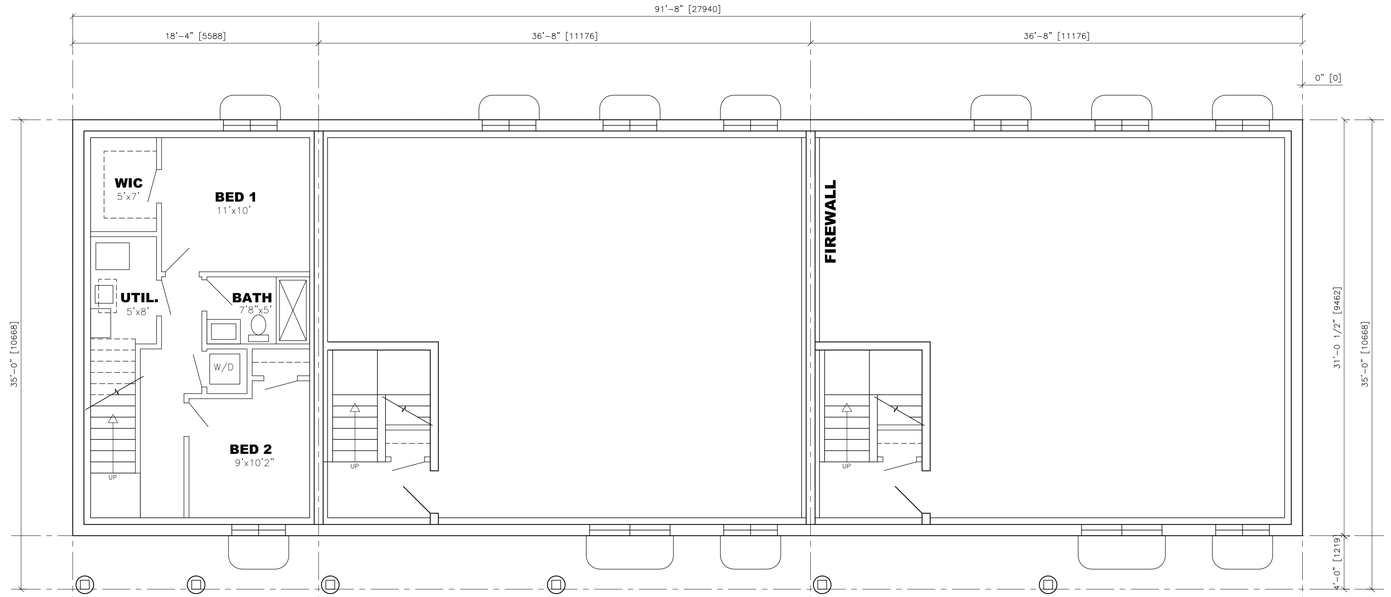
Scale 3/16" = 1'-0"

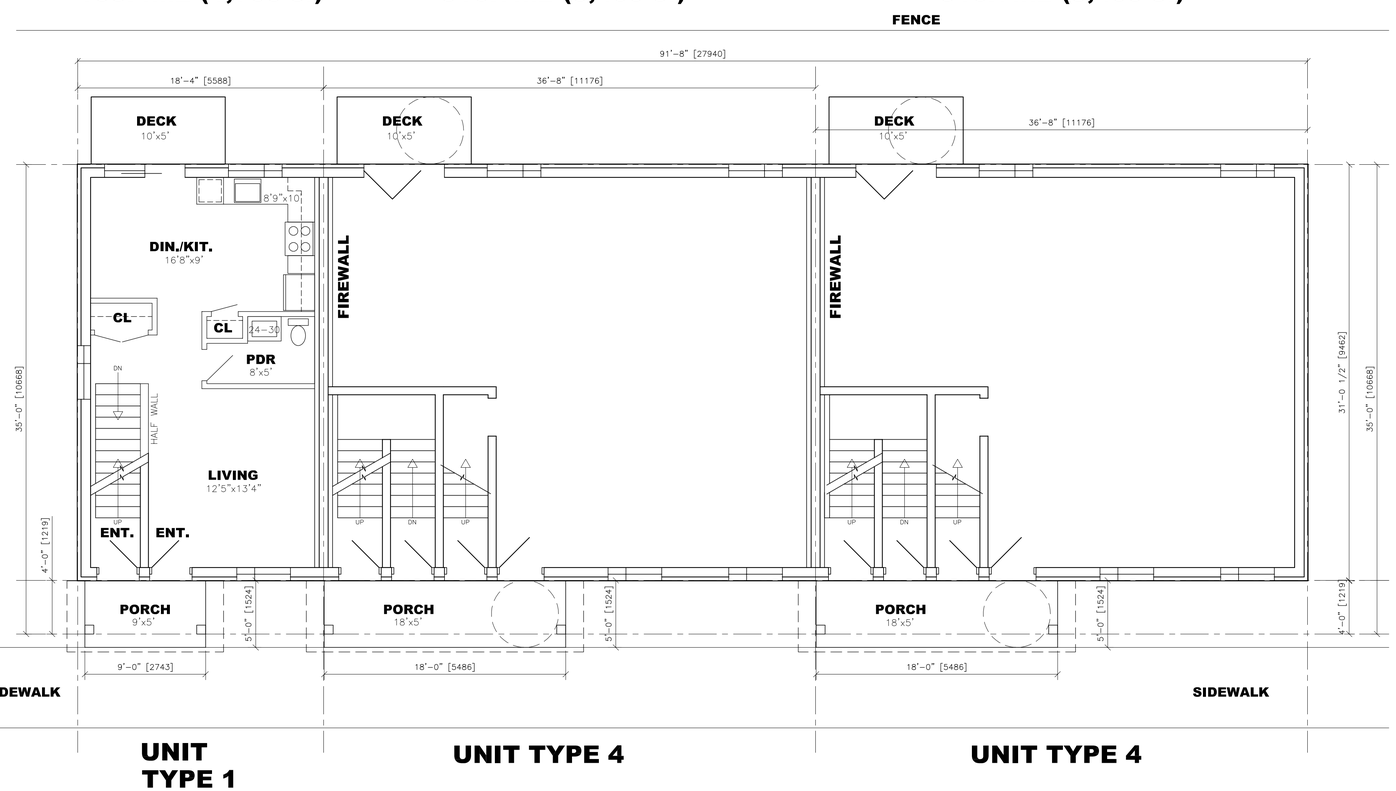
03/01/2023

Total Block Area
= 263.8m2 (2,840 sf)

Total Block Gross Area
(Basements Included)
= 1,055.4m2 (11,360 sf)

Total 2-Bed
2 - Level Lower
Unit Area
= 99.0m2 (1,066 sf)





Preliminary BLOCK A
REVERSED

Habitat for Humanity®

Rogan Home Design
Ron Rogan, MAATO
Architectural Technologist
530 South River Rd.
Elora, Ontario N0B 1S0
519 572-8740
roganhomedesign@gmail.com

I Ron Rogan have reviewed and taken responsibility for the design activities. I'm qualified and the firm is registered in the appropriate classes/categories.

Ron Rogan
BCIN 31434

PRELIMINARY

Rogan Home Design
BCIN 31434

Signature

No.	Description	Date

Stacked Townhouses
465 Garafraxa Rd. W
Fergus, Ontario

Preliminary Block B
FLOOR PLANS

Project number	N/A
Date	JAN 13, 2023
Drawn by	RR
Checked by	RR

A101

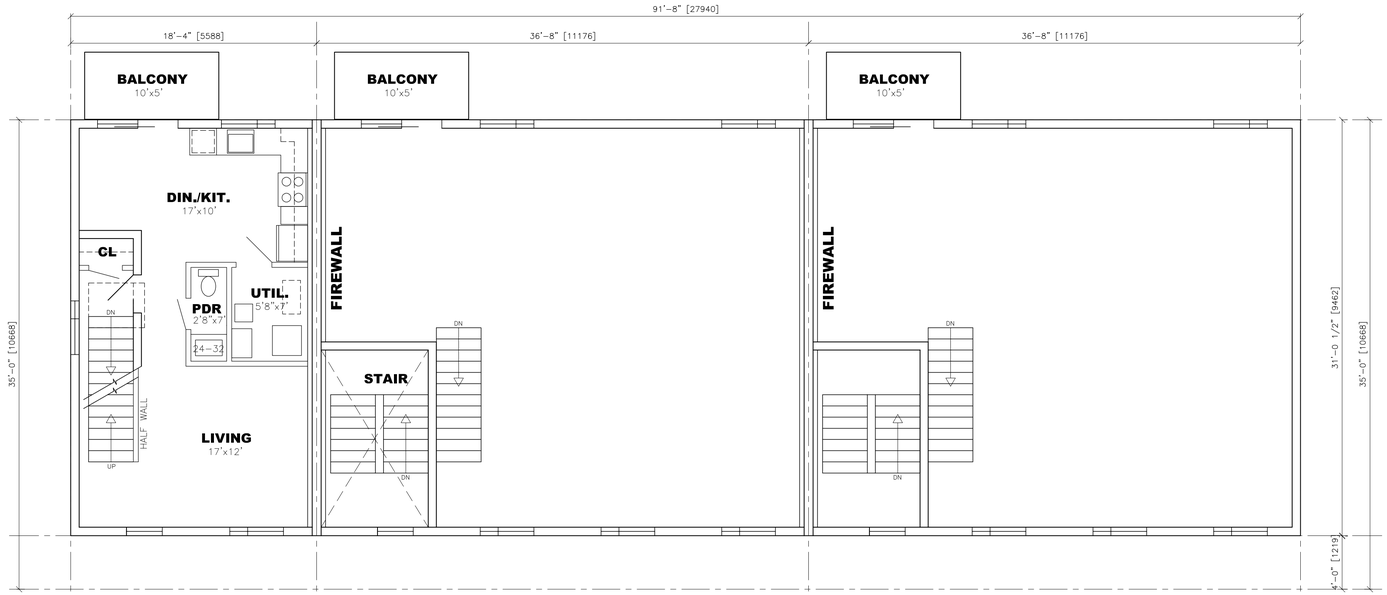
Scale 3/16" = 1'-0"

03/01/2023

Total Block Area
= 263.8m2 (2,840 sf)

Total Block Gross Area
(Basements Included)
= 1,055.4m2 (11,360 sf)

Total 3-Bed
2 - Level Upper
End Unit Area
= 111.7.0m2 (1,202 sf)



UNIT TYPE 2

BUILDING 1
GROSS AREA
158.4m2 (1,705 sf)

UNIT TYPE 5

BUILDING 2
GROSS AREA
316.7m2 (3,409 sf)

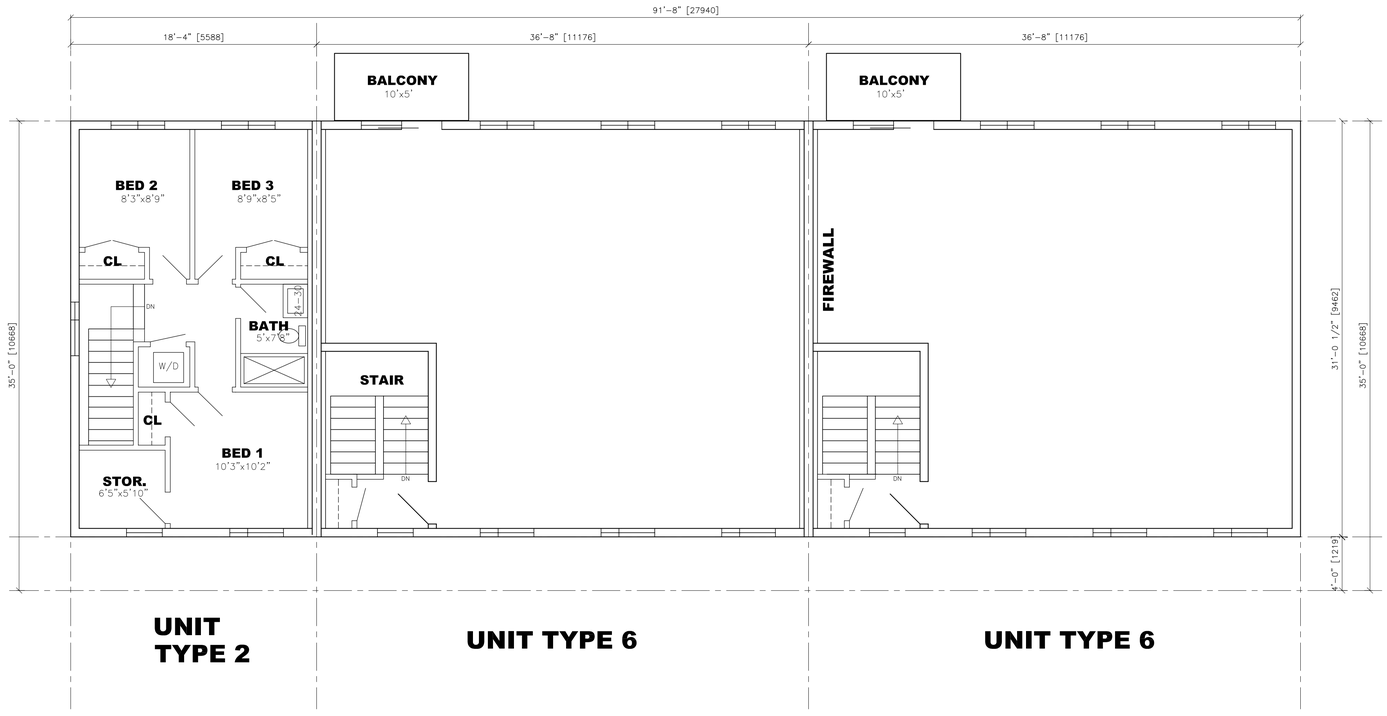
UNIT TYPE 5

BUILDING 2
GROSS AREA
316.7m2 (3,409 sf)

Total Block Area
= 263.8m2 (2,840 sf)

Total Block Gross Area
(Basements Included)
= 1,055.4m2 (11,360 sf)

Total 3-Bed
2 - Level Upper
End Unit Area
= 111.7.0m2 (1,202 sf)



UNIT TYPE 2

UNIT TYPE 6

UNIT TYPE 6

Preliminary BLOCK A
REVERSED

Habitat for Humanity®

Rogan Home Design

Ron Rogan, MAATO
Architectural Technologist

530 South River Rd.
Elora, Ontario N0B 1S0
519 572-8740
roganhomedesign@gmail.com

I Ron Rogan have reviewed and taken responsibility for the design activities. I'm qualified and the firm is registered in the appropriate classes/categories.

Ron Rogan
BCIN 31434

Rogan Home Design
BCIN 31434

PRELIMINARY

Signature

No.	Description	Date

Stacked Townhouses
465 Garafraxa Rd. W
Fergus, Ontario

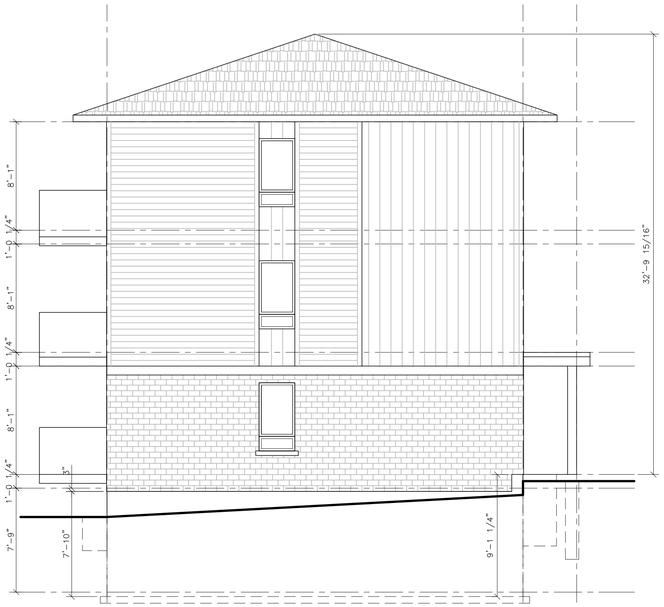
Preliminary BLOCK B
FLOOR PLANS

Project number	N/A
Date	JAN 13, 2023
Drawn by	RR
Checked by	RR

A102

Scale 3/16" = 1'-0"

03/01/2023



EAST/WEST (SIDE) ELEVATION

NORTH/SOUTH (FRONT) ELEVATION

NORTH/SOUTH (REAR) ELEVATION

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PRELIMINARY

Rogan Home Design
BCIN 31434

Signature

No.	Description	Date

Stacked Townhouses
465 Garafraxa Rd. W
Fergus, Ontario

Preliminary BLOCK C ELEVATIONS

Project number	N/A
Date	JAN 13, 2023
Drawn by	RR
Checked by	RR

A108

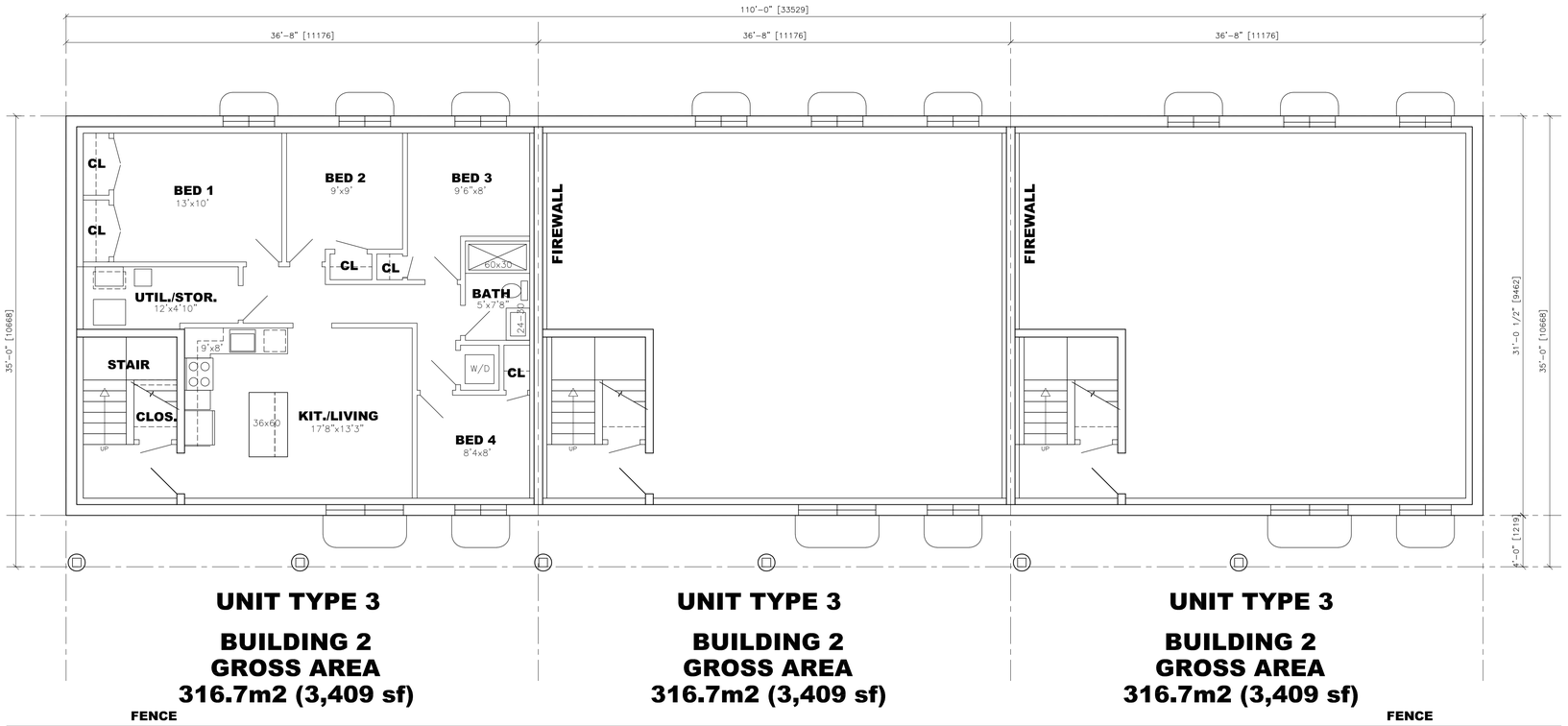
Scale 3/16" = 1'-0"

03/01/2023

Total Block Area
= 316.8m2 (3,410 sf)

Total Block Gross Area
(Basements Included)
= 1,267.2m2 (13,640 sf)

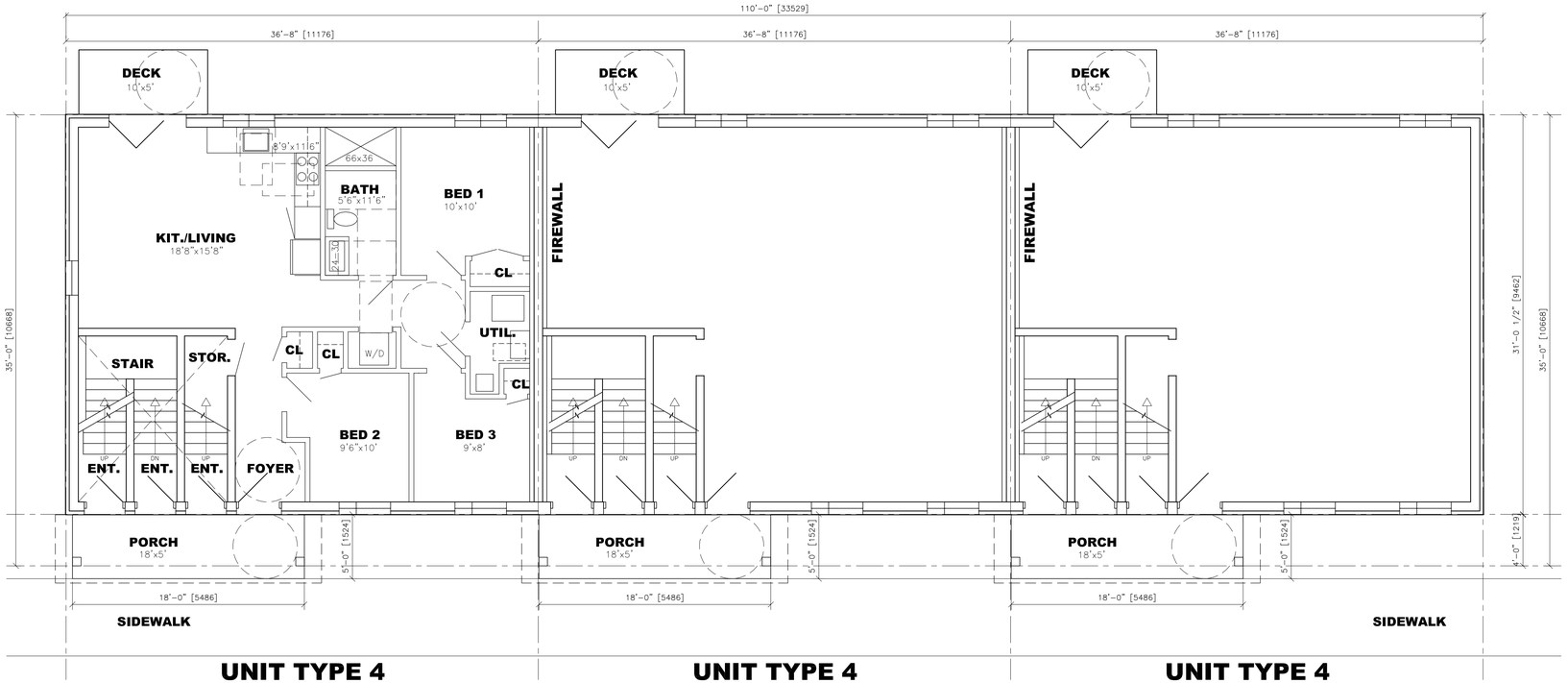
Total 4-Bed
Basement Unit Area
= 29.4m2 (1,137 sf)



Total Block Area
= 316.8m2 (3,410 sf)

Total Block Gross Area
(Basements Included)
= 1,267.2m2 (13,640 sf)

Total 3-Bed
Main Floor (Accessible)
Unit Area
= 91.0m2 (979 sf)



Habitat for Humanity®

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Ron Rogan
BCIN 31434

PRELIMINARY

Rogan Home Design
BCIN 31434

Signature

No.	Description	Date

Stacked Townhouses
465 Garafraxa Rd. W
Fergus, Ontario

Preliminary BLOCK C
FLOOR PLANS

Project number	N/A
Date	JAN 13, 2023
Drawn by	RR
Checked by	RR

A103

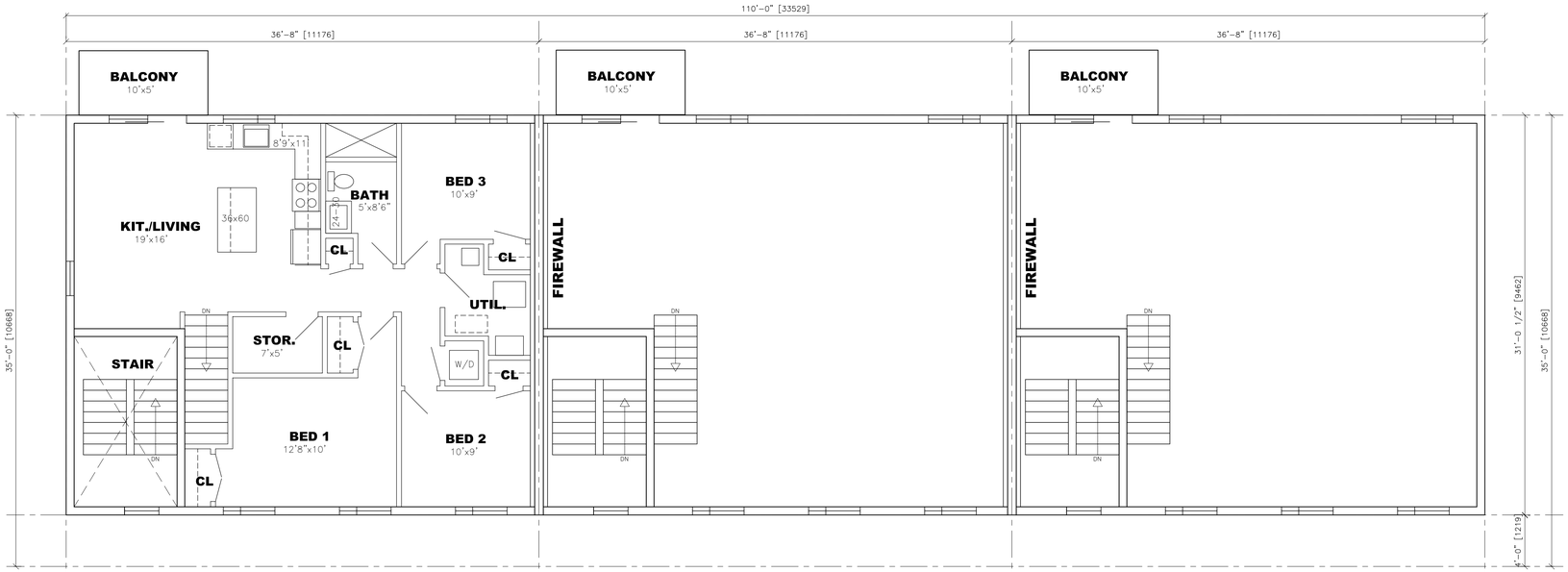
Scale 3/16" = 1'-0"

03/01/2023

Total Block Area
= 316.8m2 (3,410 sf)

Total Block Gross Area
(Basements Included)
= 1,267.2m2 (13,640 sf)

Total 3-Bed
2nd Floor Unit Area
= 96.2m2 (1,036 sf)



UNIT TYPE 5

BUILDING 2
GROSS AREA
316.7m2 (3,409 sf)

UNIT TYPE 5

BUILDING 2
GROSS AREA
316.7m2 (3,409 sf)

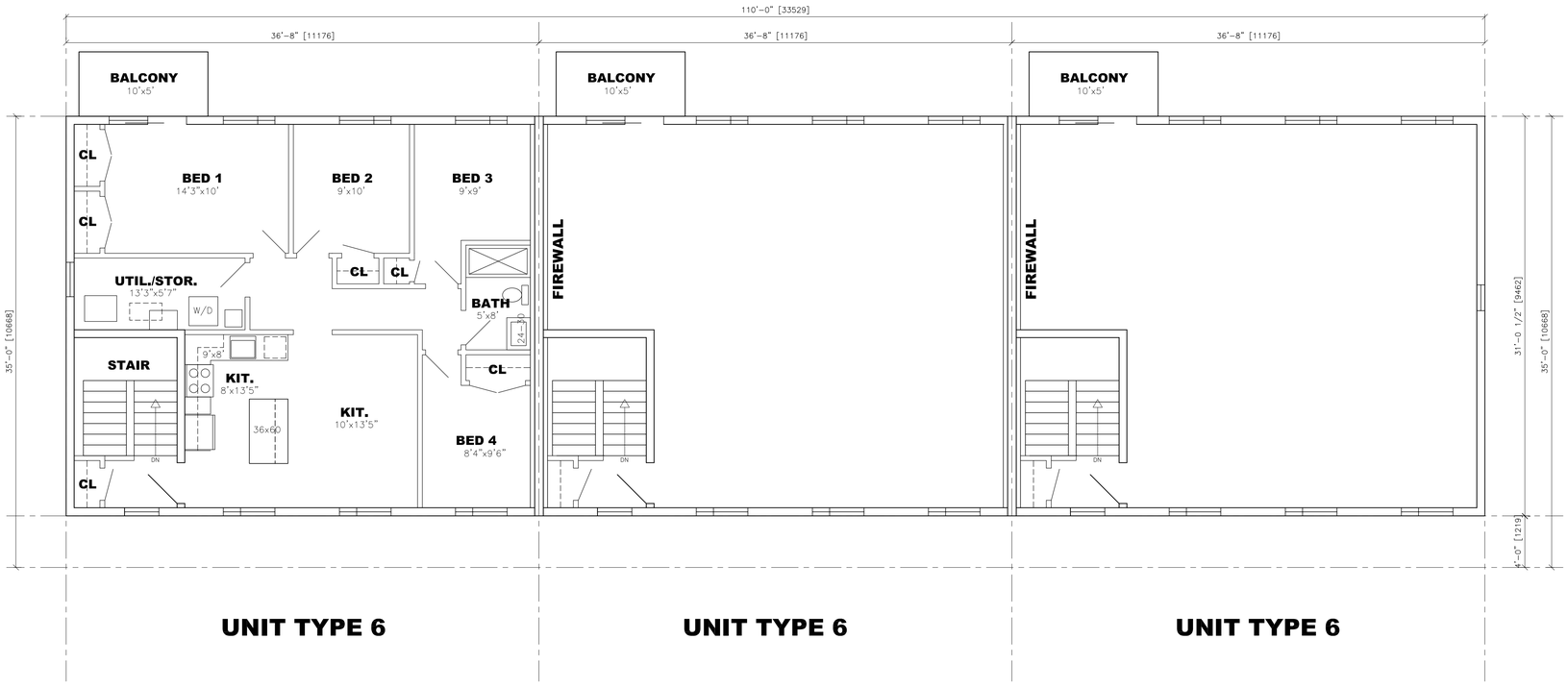
UNIT TYPE 5

BUILDING 2
GROSS AREA
316.7m2 (3,409 sf)

Total Block Area
= 316.8m2 (3,410 sf)

Total Block Gross Area
(Basements Included)
= 1,267.2m2 (13,640 sf)

Total 4-Bed
3rd Floor Unit Area
= 107.4m2 (1,156 sf)



UNIT TYPE 6

UNIT TYPE 6

UNIT TYPE 6

Habitat for Humanity®

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Ron Rogan
BCIN 31434

Rogan Home Design
BCIN 31434

Signature

PRELIMINARY

No.	Description	Date

Stacked Townhouses
465 Garafraxa Rd. W
Fergus, Ontario

Preliminary BLOCK C
FLOOR PLANS

Project number	N/A
Date	JAN 13, 2023
Drawn by	RR
Checked by	RR

A104

Scale 3/16" = 1'-0"

03/01/2023