BLOCK SERVICING STRATEGY

FRUITLAND WINONA SECONDARY PLAN
BLOCK 3

City of Hamilton

Hamilton Conservation Authority

Project #: 12-062W

First Submission January 2019
Second Submission August 2019
Third Submission January 2020
Final Submission March 2020

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EXECUTIVE SUMMARY

On May 14, 2014 the City of Hamilton Council passed Amendment No. 17 to incorporate the Fruitland Winona Secondary Plan into the Urban Hamilton Official Plan

The Secondary Plan has identified three blocks, Block 1, Block 2 and Block 3 for the completion of these servicing strategies (as shown in **Appendix A -** Figure 2-1 / Map B.7.4-3 - Block Servicing Strategy Area Delineation). This study is for the Block 3 Servicing Strategy, which extends from McNeilly Road to 440 m east of Lewis Road and is bounded by Highway 8 to the south and Barton Street to the North.

The concept plan included with this report has been prepared to support the Block 3 BSS and is in keeping with the secondary plan.

The Stoney Creek Urban Boundary Expansion (SCUBE) Subwatershed Study was undertaken in support of the Secondary Plan. The SCUBE study has been referenced for the overall strategy and recommended works for the Block 3 lands within this report. Stormwater drainage for Block 3 will be directed to two SWM Ponds which will provide quantity, quality, and erosion control for the area.

The Block 3 lands have no significant environmental features or Natural Heritage System (NHS) areas warranting protection. Environmental recommendations from the Environmental Impact Study (EIS) include the provision of sediment controls during construction and ensuring that vegetation removal occurs outside of the migratory bird breeding window.

Sanitary sewers within Barton Street will be extended to provide service to Areas 1 and 4.

No external servicing improvements are required for the provision of watermain servicing on the site. No external traffic improvements are required beyond the construction of stop-controlled intersections. Discussions with City of Hamilton staff indicated that at the development approval application stage the City may require further Traffic Impact Studies (TIS) and intersection controls (stop controlled or mini-roundabouts) within each development area may be required.

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1 INTRODUCTION

On May 14, 2014 the City of Hamilton Council passed Amendment No. 17 to incorporate the Fruitland Winona Secondary Plan into the Urban Hamilton Official Plan.

"The Secondary Plan establishes the land use, transportation network, infrastructure requirements, development standards and protection of natural areas and heritage resources to guide the development of lands in the Secondary Plan Area over the next 20 years." (City of Hamilton Website – Fruitland Winona Secondary Plan)

The Fruitland-Winona Secondary Plan (Secondary Plan) requires that a Block Servicing Strategy (BSS) be prepared so that development proceeds in a coordinated and comprehensive manner.

The Secondary Plan has identified three blocks, Block 1, Block 2 and Block 3 for the completion of these servicing strategies (as shown in **Appendix A -** Figure 2-1 / Map B.7.4-3 - Block Servicing Strategy Area Delineation). This study pertains to the Block 3 area within the Secondary Plan.

Urbantech West was retained by the Block 3 Landowners Group to prepare a Block Servicing Strategy (BSS) in support of Draft Plan applications for their lands in Block 3 of the Fruitland-Winona Secondary Plan Area. The BSS will address development requirements for the entire Block 3 area Concept Plan. The Concept Plan also includes lands outside of the boundaries of the Secondary Plan that are dependent on Block 3 for servicing infrastructure.

The first submission of the BSS was made to the City of Hamilton and Hamilton Conservation in January of 2019. The second submission was made in August of 2020. Comments were provided by the City of Hamilton and Hamilton Conservation. This report has been updated to updated to include comments received from the relevant approval agencies. Detailed responses have been included in **Appendix M.**

1.1 STUDY AREA

The Block 3 lands are generally bounded in the north by existing commercial and industrial lands (north of Barton St.), in the east by existing residential development (Tuscani Drive), in the west by McNeilly Avenue and in the South by Highway 8. **Figure 1** illustrates the Block 3 area lands.

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For the purposes of this report, the BSS study area site has been divided into four sub-areas (as shown in **Figure 3**).

- Area 1 includes all lands bound by Barton Street to the north, Highway 8 to the south, Lewis Road to the east and McNeilly Road to the west.
- Area 2 includes all lands bound by Barton Street to the south, Lewis Road to the East, McNeilly Road to the west and between 225-275 m north of Barton St.
- Area 3 includes all lands bound by Barton Street to the south, Lewis Road to the west, 250 m north of Barton Street and 440 m east of Lewis Road.
- Area 4 includes all lands bound by Barton Street to the north, Lewis Road to the west, Highway 8 to the south and 440 m east of Lewis Road

The total land area included in Block 3 is approximately 64 ha.

1.2 PURPOSE

This Block Servicing Strategy (BSS) has been completed in accordance with the SCUBE Subwatershed Study and provides detail on how development of the subject lands will be achieved in accordance with the Secondary Plan requirements. The goals for this study are to:

- Demonstrate how the requirements illustrated in the subwatershed study are fulfilled in all the Draft plans for the proposed development.
- Provide sufficient level of conceptual design to implement Natural Heritage System (NHS) components and infrastructure in accordance with SCUBESS.
- Ensure servicing requirements are met.
- Identify detailed development constraints or conflicts and options to resolve them.
- Supply implementation details if required.
- Streamline the Draft Plan approval process.
- Facilitate the development of Draft Plan conditions.
- Demonstrate consultation and general landowner support for lands within the subject Block Servicing Strategy area.

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This study demonstrates how development of the subject lands will meet the requirements of policy B.7.4.14 of the Fruitland Winona Secondary Plan. Detailed analyses in the following areas are provided in subsequent sections:

- Land Use;
- Geology and Hydrogeology;
- Stream system and terrestrial features
- Air Drainage;
- Grading, Drainage and Storm Servicing;
- Stormwater Management and Water Balance;
- Wastewater and Water Servicing;
- Traffic/Transportation;
- Implementation and Phasing.

The Terms of Reference for the study are included in **Appendix A**.

1.3 CONCEPT PLAN

A concept plan (November 2019) has been prepared by Glenn Schnarr and Associates Inc. and forms the basis for this study. The concept plan has been developed to describe how development could occur within the Block 3 lands. Block 3 includes lands that are outside of the Secondary Plan as their development is dependent on infrastructure within Block 3. A copy of the plan is shown in **Appendix A**. The plan includes a mixture of:

- Low and medium density residential;
- Local commercial
- Institutional
- Parks
- Natural Heritage Areas
- Industrial
- Stormwater management facilities

Subsequent to receipt of comments from the City of Hamilton, the concept plan has been refined for the Third Submission. Responses to comments are provided within Appendix M.

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1.4 STUDY TEAM

A multidisciplinary study team has studied the environment and servicing of the Study Area. The team and their responsibilities include:

- Urbantech West Consulting (Urbantech)
  - Lead BSS consultant addressing limits of development, hydrology and floodplain mapping, study integration, team/study management and coordination of BSS report preparation;
  - Lead BSS consultant addressing municipal servicing, stormwater management and site grading;
- GHD – Traffic and Transportation Planning
- Landtek Limited – Geology and Hydrogeology
- AMEC Foster Wheeler – Air Drainage
- Arcadis – Natural Environment and Sciences
- Glenn Schnarr and Associates – Urban Planning
- GEO Morphix Ltd. – Fluvial Geomorphology
- WSP – Water Distribution Hydraulics

1.5 AGENCY AND PUBLIC CONSULTATION

This study and Terms of Reference (TOR) have been developed in consultation with City of Hamilton and Hamilton Conservation Authority (HCA) staff. The BSS requires the approval of both the City and HCA. A copy of the TOR has been provided in **Appendix A.**

Public and landowner consultation has been carried out at various times throughout the study. For details refer to **Appendix N**.

The following is a brief summary of the methods included in the project's public consultation:

- **Stakeholder List -** At project initiation Branthaven prepared a distribution list for all area landowners. This list was used as the basis for initial mailings and was updated throughout the project. In addition the City of Hamilton provided a list of public agencies to circulate. This list has been provided in **Appendix N.**
- **Website –** The city maintained a website to provide updates in relation to all three Blocks within the Secondary Plan (www.hamilton.ca/blockservicingstrategies).

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The third submission of the report was made available for public comment on the website on January 16, 2020.

- **Meetings** – Numerous meetings were held with project stakeholders, City and agency staff, landowners and other interested parties throughout the duration of the project.
- **Newspaper –** Notice was placed in the newspaper prior to PIC 1 and prior to project completion. Notice of completion was in the Stoney Creek News on January 16, 2020 and advised the public of the 30 day commenting period. A copy of this is available in **Appendix N**.
- **Registered Mail** – Registered mailings were provided to area landowners to advise them of the project's initiation, invite them to participate in the study, invitations to meetings and the PIC, and to notify them of project completion. Copies of the letters are included in **Appendix N**.
- **Public Information Centre** – One Public Information Centre (PIC) was held in conjunction with Blocks 1 and 2 on June 8, 2017. Copies of the comment sheet, attendance sheet and PIC boards are included in **Appendix N**.
- **Hard Copy Materials** – Hard copies of the third submission of the report were made available for 30 day public review and comment at the Stoney Creek Municipal Building, City Hall Clerk's and City Hall 6th Floor Reception.
- **Public Comment** – Final materials were made available on the City's website, City Hall and the Stoney Creek Municipal for a 30 day public review.

Landowners Group

In early 2016 it was decided to inform area landowners of the initiation of the study. A letter was prepared by Urbantech West and issued by registered mail on February 23, 2016, informing landowners within the Block 3 area that the BSS study was being initiated and invited them to participate in the study. A summary of the responses are provided in **Appendix M**. In general very few responses were received, and those that responded were looking for more information on the process.

On December 6, 2016 Glenn Schnarr and Associates (GSAI) issued a second letter to landowners within the Block 3 area further advising them of the initiation of the BSS, This letter also advised the area landowners that a meeting would be held to discuss the purpose of the BSS and and that a landowners meeting would be scheduled early in 2017. Landowners were informed that they were invited to participate in the study.

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Subsequently GSAI issued a letter on February 17, 2017 to landowners advising that a meeting of interested landowners was to be held on March 7, 2017. This meeting was held at the Stoney Creek Municipal Centre and consisted of an Open House Component, Presentation by the Consultant Team describing the purpose of the study, the benefits of participating as a member of the developers group, timeline and next steps following the completion of the study. Approximately 50 people attended this meeting. Subsequent meetings were held with interested landowners and resulted in the formation of a Landowners Group. Regular meetings with the Landowners Group having continued throughout the process.

Urbantech was also contacted by a landowner whose lands bordered Block 3 but were not directly within the Block 3 area. Urbantech issued a letter on May 10, 2017 to the landowner inviting them to participate in the study. The landowner did not pursue this option.

Public Information Centre

A Public Information Centre (PIC) was held on June 8, 2017. This PIC was advertised by City of Hamilton staff and carried out in conjunction with the Block 1 and Block 2 project teams. The PIC was facilitated by City staff as well as the various consultant teams for the respective Block Servicing Strategies. Display panels were available at the meeting and continue to be available on the BSS page of the City of Hamilton website - https://www.hamilton.ca/city-planning/master-plans-class-eas/block-servicing-strategies-stoney-creek-and-gordon-dean-class.

A variety of comment were received at the PIC, the majority in person. General themes of the comments included concerns about increased traffic, downstream traffic and concern about "sprawl".

Some of the comments were in relation to future improvements of Highway 8. These were directed to the appropriate City of Hamilton staff conducted the Highway 8 EA.

39 people signed the sign in sheet indicating their presence at the meeting.

Concept Plan Development

Throughout the development of the concept plan the project team has been working with the City to ensure the road network meets the requirements of the Secondary Plan and the City's Traffic Department. Upon the completion of the Concept Plan that formed the basis of the second submission of the study, the City requested that it be circulated again to landowners whose holding were directly affected by the road connections to the existing road network. On May 7, 2019 Urbantech issued letters which included the current Concept Plan.

Subsequent to issuing these letters both Urbantech and the City of Hamilton Staff received correspondence from certain landowners. The primary concerns raised were that landowners did not necessarily want to have their land used for the purposes of future road connections. The landowners were encouraged to document their concerns in writing. It was communicated to all landowners who contacted Urbantech that the Concept Plan did not comprise a final development plan and that it showed one way in which the lands could be developed in accordance with the Secondary Plan. It was further communicated that individual developers would have to submit further applications for rezoning, Draft Plan of Subdivision and Site Plan Approval detailing their development proposals.

The concept plan has been further refined based on second submission comments received from the City.

Official Public Comment

The third submission was made available for public comment from January 16th to February 14th 2020. Hard copies were made available at City Hall – Clerk's Desk and 6th Floor Front Counter, the Stoney Creek Municipal Centre and a digital copy was available on the City's website. Comments are incorporated in the final submission. Notice of the official public comment was in the Stoney Creek News on January 16th, the City's twitter account and in addition the notice was sent by registered mail to all affected landowners. A copy of the notice is included in **Appendix M**. Comments received are incorporated in the final submission, where appropriate.

1.6 BACKGROUND INFORMATION AND STUDIES

Background reports reviewed in the preparation of this document include:

- SCUBE Subwatershed Study (Aquafor Beech Limited, May 2013)
- Terms of Reference (TOR) (City of Hamilton, October 15th, 2013)
- 1119 Barton Street East – 100 Year Floodplain Assessment and Channel Design Report, 4th Submission (A.J. Clarke, September 2017)

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- Fruitland Winona Secondary Plan
- Ridgeview – Storm Management Report (Lamarre Consulting Group Inc., September 2011)
- Lewis Road Channel – City of Hamilton (Stoney Creek) Design Brief (Lamarre Consulting Group Inc., July 2011)
- AME Materials Engineering. 2009. Preliminary Geotechnical Investigation, Barton Street Properties, Barton Street and Fifty Road, Stoney Creek Hamilton, Ontario. Prepared for 1312773 Ontario Inc. Project No. 40236.210. December 2009.
- Lewis Road New Train Layover Facility – Stormwater management Report (Metrolinx, November 2013)

Further details regarding the SCUBE Subwatershed Study are provided below as it is the principal reference material guiding the direction of the BSS study.

1.7 SCUBE SUBWATERSHED STUDY

A Subwatershed study was completed by Aquafor Beech Ltd. (May 2013) in support of the Secondary Plan. This study provides guidance for the City and developers' use in development of the subject lands related to Stormwater Management, Natural Heritage and Groundwater Resources.

The Stoney Creek Urban Boundary Expansion Subwatershed Study (SCUBESS, May 2013) provided the management and implementation strategy for the Fruitland-Winona Secondary Plan area. The Secondary Plan area includes four parcels: SCUBE West, SCUBE Central, SCUBE East - Parcel A and SCUBE East - Parcel B. The limits and bounding streets of the parcels are shown in Figure 1.1 (provided in **Appendix A**). The City of Hamilton has also provided a Block Servicing Schedule for this area (Map B.7.4-4 - Fruitland-Winona Secondary Plan-Block Servicing Strategy Area Delineation, provided in **Appendix A**). The Secondary Plan identifies three blocks that require Block Servicing Studies.

The SCUBESS aims at preserving a sustainable Natural Heritage System (NHS) for preserving landscape diversity within an urban context. It has provided recommendations for management of natural heritage and stream systems. There are certain lands, including watercourses that are restricted from development and have specified limitations or constraints. During the Phase 1 study, investigations were carried out to identify environmental constraints and opportunities for natural resources. A management

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strategy was developed to protect and enhance significant natural features at the Phase 2 study level. This strategy also provided requirements regarding stormwater management, land use policies and servicing. The BSS has been completed to introduce an implementation plan for the Block 3 area.

The SCUBES study proposed two stormwater management facilities (SWMF) within the subject lands:

- SWMF-2 on the west side of Lewis Road; and,
- SWMF-3 on the east side of Lewis Road.

The original SCUBES study Storm Water Management Facility (SWMF) naming convention has been maintained for the BSS #3. The original recommendations for the location and sizing of these SWMFs have been considered for the subject lands, with an excerpt provided in **Appendix A**. However, volumetric sizing and outflow targets have been revised through recent updates to the original SCUBES Study model and via new hydrologic modelling scenarios described in Sections 5.6. The original SCUBESS drainage area plan and flood flow estimates at downstream Watercourse 9 nodes have also been included for reference.

1.8 CONSULTANT TEAM STUDIES

The findings of the various reports prepared by the consultant team are summarized within the text of this report with the detailed studies being included in the Appendices:

- Air Drainage Analysis (Amec Foster Wheeler, May 2018)
- Erosion Threshold Analysis (GEO Morphix, February 2020)
- BSS Water Servicing Study (WSP, October 2018, updated December 2019)
- Preliminary Geotechnical Investigation (Landtek, 2009)
- Test Pitting Investigation (Landtek, June 2017)
- Hydrogeological Investigation (Landtek, November 2018, updated February 2020)
- Natural Environment (Arcadis, December 2018, updated February 2020)
- Traffic Study (GHD, December 2018, updated December 2019)

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2 THE FRUITLAND – WINONA SECONDARY PLAN

The BSS #3 Study Area is located within the Fruitland-Winona Secondary Plan (the Secondary Plan), which was approved and adopted by City Council on May 14, 2014. It was subsequently approved, except for five site specific appeals, by the Local Appeal Planning Tribunal on June 22, 1018.

The vision for the Secondary Plan indicates that it has two distinct areas with different characteristics. These areas are to be designed together to achieve a safe, clean community with green canopy neighbourhoods connected by transportation corridors. The heritage community of Fruitland-Winona will accommodate people of all ages within a variety of housing choices that will be supported by schools, parks and trail systems. People-oriented focal points are to be provided within the heart of the community and include activities such as a farmer's market, recreation centre and other community activities. Fruitland-Winona is generally a low-density community that will support neighbourhood commercial and other higher density housing at appropriate locations. The community is to provide a balance between a forward-looking community and a small-town place to live.

Map B.7.4-1 Fruitland-Winona Secondary Plan – Land Use Plan, identifies the land use designations applicable to the Fruitland-Winona Secondary Plan area. Development within the Secondary Plan area shall provide a mix of housing opportunities in terms of built form, style and tenure that are suitable for residents of different age groups, income levels and household sizes. The Secondary Plan proposes Medium Density Residential 2 and Low Density Residential 3 uses around the periphery of the Study area and along the collector roads that extend throughout it. Low Density Residential 1 and 2 uses are proposed within the interior of the community. Two Neighbourhood Parks are proposed in the central and west areas of the Secondary Plan area. Local Commercial uses are proposed along Highway 8 in proximity to existing and proposed collector roads.

As required by City of Hamilton staff, the land uses in the BSS #3 concept plan have been designed in accordance with Land Use Plan Map B.7.4-1. Refinements to the concept plan will be required to be made through the development application process to reflect actual conditions within the Secondary Plan area.

3 EXISTING CONDITIONS

Currently, the subject lands comprise predominantly agricultural land and a mixture of developed land uses. South of Barton Street, the lands are primarily agricultural with an existing school, single family residential and local commercial uses. North of Barton Street the existing land use is mostly local commercial and industrial lands. At the north east corner of Barton Street and Lewis Road the extension of Arvin Avenue has recently been completed. This work was undertaken as part of an industrial subdivision and the lands in this area are currently being developed as an industrial park.

At the northwest corner of Barton Street and Lewis Road, a new channel has been designed within the Venetian Meats lands. The design of this channel has recently been approved and the works are scheduled to be completed in 2019. This channel has been sized for conveyance of 8.14 m^3/s of flow from the subject lands located upstream of this channel, as referenced from the 100-Year Floodplain Assessment and Channel Design Report by A.J. Clarke (September 2017). For the purposes of the BSS 3 and at the request of the HCA, this infrastructure has been assumed to be in place as an existing feature.

The existing topography of the site is gently sloping from south to north with moderate slopes of 1 to 3 %.

Characterization of existing conditions, including discussion of the geology, hydrogeology, fluvial geomorphology, terrestrial, hydrology and hydraulics was completed as part of the SCUBESS and documented in the SCUBE East Phase 1 Report (May 2013). This work has been thoroughly reviewed and augmented with additional fieldwork as required to characterize existing conditions at the Block Servicing Strategy level of detail.

The following sections outline the existing conditions by discipline. While reported separately by discipline, this work was undertaken and integrated between disciplines to ensure that inter-relationships that exist between surface water, groundwater, receiving watercourse, aquifers and other NHS features were identified.

The Secondary Plan and the Amendment to the Urban Hamilton Official Plan did not identify any Core Natural Heritage Features or Linkages within the Block 3 lands. Subsequent to approval of the Secondary Plan, Hamilton Conservation (HCA) identified four regulated features within the Block 3 lands (identification map of Regulated Features has been included in **Appendix A**). A site walk was undertaken with HCA staff on November 18th, 2016 to assess the 4 features. It was determined that Features 2, 3 and

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4 did not require protection although further investigation into Feature 1 was required (Feature 1 has also been identified in **Figure 2 – Existing Conditions Plan**).

Investigations and discussions with the City and HCA were carried out to determine the future design of Feature 1. These discussions included the most appropriate hydrologic model to use for the flows and the floodplain delineations to determine whether the watercourse should be open or enclosed. Hydrologic modelling using Visual OTTHYMO Version 5 (VO5) was first investigated; however, the unit flow rates from this model were significantly higher than comparable watercourses within the area. As outlined by the Terms of Reference, an update to the original MIKE 11 model was the preferred strategy. The update has been used to reflect the currently proposed levels of imperviousness to confirm the flows and pond volume targets in order to maintain consistency with the previous SCUBE studies. The results of this work are discussed in Section 5.6 and **Appendix F**. After further deliberations with the City and HCA, it was decided that the Feature 1 watercourse could be enclosed to accommodate downstream infrastructure constraints.

3.1 EXISTING TOPOGRAPHY

The site is predominantly flat-lying with elevations increasing gradually towards the Niagara Escarpment to the south. The subject lands are generally gently sloping from north to south with average grades ranging from 0.5% to 5%. Maximum grade differentials are listed below:

- Area 1 – 98 m in the southwest to 87 m in the northeast
- Area 2 – 89 m in the southwest to 85 m in the northeast
- Area 3 – 90 m in the southeast to 85 m in the northwest
- Area 4 – 94 m in the southeast to 87 m in the northwest

The following resources were assessed to determine the existing topography:

- Topographic survey completed by A.T. McLaren Limited (Drawing created March 2, 2017) and is the primary source of topographic data.
- 'The Greater Toronto Area (GTA) Mass Points and Breaklines 2002' data downloaded from Ministry of Natural Resources, Land Information Ontario website. The contours are based on 1.0 m interval.

The existing topographic conditions are shown on **Figure 2 – Existing Conditions Plan**.

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3.2 GEOLOGY AND HYDROGEOLOGY

3.2.1 GEOTECHNICAL INVESTIGATION

The site is located within the Haldimand Clay Plain which occupies the area from the Niagara Escarpment to Lake Erie. The area contains stratified clay and/or silt overlying fine grained till. There are also intermixed layers of till and stratified fine grained sediments.

A geotechnical investigation on the subject lands was conducted by AME Materials Engineering in 2009 (AME, 2009). For this investigation a total of twelve (12) exploratory boreholes were drilled to depths of 3.9 to 6.6 meters below ground surface (mbgs). The soil encountered during this investigation consisted of earth fill/disturbed native soil underlain by native glacial till followed by bedrock. According to the report, the disturbed native soil consisted of brown sandy silt to clayey silt with trace gravel. The glacial till is described as clayey silt with trace sand and gravel. The till contains fragments of weathered shale which becomes more numerous with depth.

All of the boreholes from the AME investigation were terminated in the glacial till or upon reaching probable bedrock. The existing surficial geology of the site shows bedrock outcropping in a general east-west direction throughout the centre of the site. The northern portion of the site is mapped as clay to silt-textured till (Halton Till) and the southern portion is mapped as coarse textured sand and gravel deposits. Recommendations for corrosion protection, groundwater management and pond liners will come from future studies.

This report has been included in **Appendix B**.

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3.2.2 HYDROGEOLOGICAL SCOPE OF WORK

Consistent with the BSS Terms of Reference (TOR) requirements and the SCUBESS Phase 1 and 2 recommendations, a hydrogeological work program was completed to:

- Provide geological and hydrogeological baseline data of the proposed development site to support the SCUBE BSS study for the SCUBE Central Area;
- Evaluate the current conditions of the site, delineate possible post-development effects, and suggest mitigation measures to minimize the effects to the shallow groundwater system post-development;
- Determine the hydrogeologic setting of the property and a summary of the existing soil and groundwater conditions at the site.
- Identify hydrogeologic features such as zones of significant groundwater recharge and discharge;
- Assess the requirement for groundwater control during construction;
- Identify requirements and design measures which can be used to maintain groundwater function at the site;
- Develop a water budget for the site based on the current site development plan and recommendations for mitigation measures in order to maintain groundwater infiltration and aquifer recharge in the area.

The work program was divided into three components:

1. A desktop study to characterize the physical setting based on available information. Establish and identify the Ministry of the Environment and Climate Change (MECP) wells within 500 m radius of the Site;
2. Review of meteorological data to assess the local climate and to use the information for water balance calculations, if required;
3. A field investigation involving drilling / well installation, hydraulic conductivity testing, and based on available information, assess water balance groundwater conditions.

The following sections provide more details of the work performed and the results of the investigation. This report has been included in **Appendix B**.

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3.2.3 HYDROGEOLOGICAL CONDITIONS

As part of the SCUBE Subwatershed Study (Aquafor Beech, 2012), a review was performed on the 2009 AME borehole logs. This review indicated a relatively low groundwater recharge potential and relatively shallow potentiometric surface (<5 m below ground surface) in the area. Silt till and several meters of the underlying shale bedrock were noted as being dry in the 2009 borehole logs, suggesting that the overall recharge potential across the SCUBE area is very low.

The Hydrogeological Investigation of the subject lands was updated by Landtek in January 2020 (Landtek, 2020) to respond to City and HCA comments. Regional hydrogeology conditions were assessed based on local water well records and existing geologic reports.

The January 2020 Landtek study confirms that the Halton till on the site has low infiltration potential due to the composition of the clay and density of the till. The groundwater recharge potential is classified as "moderate" to "low". The coarser grained Proglacial Lake Iroquois deposits near the southern end of the site (closer to the escarpment) represent a zone of high groundwater recharge potential and function as a potential contributor of baseflow to stream reaches to the north (Aquafor Beech Ltd., 2012).

Hydrogeological data has been collected from the site throughout 2017 and 2018 to capture seasonal changes to the water table.

Detailed hydrogeologist recommendations including the requirement for pond liners to be determined at detailed design and through site inspections by a qualified geotechnical professional during excavation.

3.2.4 GROUNDWATER MONITORING WELLS

The Landtek subsurface drilling investigation included a total of 22 boreholes drilled at 19 locations across the site.

The boreholes extended to depths ranging from 4.6 m to 30.5 m below existing grade. The groundwater monitoring wells were installed at varying depths to intersect with more permeable zones and to characterize and sample overburden and bedrock aquifer units.

The results of the study indicate the following hydrogeologic site characteristics:

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- Groundwater flow is controlled by the surficial geology, including the dense Halton Till. The low hydraulic conductivity (10^{-9} to 10^{-8} m/s) of the Halton Till will reduce the amount of groundwater infiltration, recharge, or flow, and as a result, water will tend to flow overland and drain along surface watercourses.

- The groundwater elevations on the subject lands ranges from 93.01 meters above sea level (masl) to 80.91 masl and flows in the northeast direction. The water table present within the underlying Queenston shale ranges from 90.55 masl to 85.60 masl, and also flows to the northeast. These areas are shown in the Landtek 2018 report.

- Seasonal fluctuations in groundwater levels for the site are expected depending on the amount of precipitation and surface runoff.

3.2.5 MECPCC WATER WELL RECORDS AND GROUNDWATER RESOURCES

The Ministry of the Environment and Climate Change (MECPCC) classifies the site as a highly vulnerable aquifer with a score of 6. However, the site location is not in a wellhead protection area or an intake protection zone and is not classified as a significant groundwater recharge area.

The Landtek 202 Hydrogeologic Investigation used data from the MECP Water Well Information System (WWIS), which is a publicly available database containing groundwater well locations, well construction details, static water levels, geologic units encountered with depth, general water quality observations, water use, and dates of construction.

The MECP records for wells located within approximately 500 meters of the site were reviewed to assess the general nature and use of the groundwater resource in the area and to characterize local hydrogeologic conditions. This investigation identified 17 wells within 500 m of the site and concluded that 7 domestic water wells have been completed in bedrock. A summary of the data obtained from this review is presented in the 2020 Landtek Investigation. However, the site is situated within the City of Hamilton in an area serviced by the City water supply system.

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3.2.6 GROUNDWATER RECHARGE

The site is considered to not have significant amounts of groundwater recharge due to the relatively low-permeable soils encountered at surface. However, infiltration rates will be affected by post-development impervious areas such as roadways, parking areas, and building roofs. Low Impact Development (LID) techniques have been recommended for the site to help maintain pre-development water balance and recharge levels. The LIDs proposed for the subject lands are discussed in more detail in Section 5.3.2.

3.2.7 WATER BALANCE

A water balance of the subject lands was included in the 2020 Landtek Hydrogeologic investigation. The Landtek report states that one of the objectives during development should be to ensure that the overall groundwater recharge on the site is not significantly impacted by the reduction in pervious area. The Landtek water balance used precipitation data from the Hamilton A (Hamilton Airport) climate station for the period from 1981 to 2010. The Landtek water balance assumed that no infiltration and evapotranspiration will occur on areas covered by internal roads, public walkways, buildings, driveways, or parking areas.

A summary of the Landtek Pre-development and Post-development water balance is included below.

Development Phase	Precipitation (m^3)	Evap. (m^3)	Infiltration (m^3)	Run-off (m^3)
Pre-Development	983,010	545,177	100,710	337,123
Post-Development	983,010	377,154	69,671	536,185
Post-Development with Mitigation	983,010	377,154	100,710	505,146

The post-development mitigation measures recommended by Landtek have been discussed in Section 3.2.8.

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3.2.8 MITIGATION MEASURES FOR HYDROGEOLOGICAL DISTURBANCE

The site is considered to not have significant amounts of groundwater recharge due to the relatively low-permeable soils encountered at surface. However, infiltration rates will be affected by post-development impervious areas such as roadways, parking areas, and building roofs. Throughout the design of the subject lands, storm water specialists and engineers will collaborate with hydrogeologist professionals to maintain pre-development water balance and recharge at the site using storm water management design techniques. Low Impact Development Best Management Practices (LID BMPs) may be applicable for this site. Based on the information collected in the 2020 Landtek Study, the following recommendations have been made with respect to maintenance of hydrogeologic functions and hydrogeologic conditions at the site:

- **Maintenance of groundwater recharge** through LID facilities and the routing of rooftop flows to areas with high infiltration potential. Approximately 15% of the total roof runoff volume to be re-directed towards overland flow or infiltration facilities in order to match pre-development infiltration rates has been recommended. Per Appendix K of the hydrogeological investigative report, the annual runoff volume from the roofs under post-development conditions is 201,066 m^3. As the total recharge deficit from pre- to post-development conditions is 31,039 m^3, 15% of the total runoff volume from the rooftops represents the minimum volume to be infiltrated to match pre-development water balance conditions. This is equivalent to approximately the first 1.5 mm of rainfall from all storm events across all rooftops (i.e. 100% of all roof area) if compared to Figure 1a from Toronto's Wet Weather Flow Management Guidelines (WWFMG), which equates to a total of approximately 15% of the total annual average rainfall volume. Figure 1a has been included for reference in **Appendix B**. Although the site is not located within the Toronto area, Figure 1a represents a fair representation to the site as Hamilton is in close proximity to the Toronto area and this figure bridges the gap between interpreting the overall recharge requirements to a practical infiltration target depth from the rooftops. Low Impact Development measures for these lands have been discussed in Section 5.9.

- **Maintenance of Groundwater Transmission Pathways** will minimize disruption to the existing groundwater transmission system. This can be achieved by concentrating earthworks and servicing in low permeability areas and ensuring backfill matches or exceeds existing soil permeability. Although this measure has been considered it is not practical and will not be implemented.

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3.3 EXISTING DRAINAGE SYSTEM AND DOWNSTREAM INFRASTRUCTURE CAPACITY

The SCUBE study delineated stream reaches through the Fruitland-Winona Secondary Plan area based on channel characteristics, functions and processes. The SCUBE Central lands discharge to Watercourse 9, or WC9 (Reach 9-1), through the ditch along Lewis Road.

The existing drainage system of the BSS 3 lands include predominantly rural roads with roadside ditches to convey the drainage. These roads include Barton Street, McNeilly Road, Highway 8, and Lewis Road. Across the existing farmlands, the drainage occurs within swales and as sheet flow primarily in the north-eastern direction. Area north of sub-area 2 (beyond the bounds of the BSS study area) has been partially developed by Metrolinx. A portion of the developed area (as shown on **Drawing SWM-5**) is conveyed east to the Lewis Road culvert. The remaining portion drains westerly into Watercourse 8.

There is an existing 1800 mm x 1200 mm concrete box culvert that crosses Highway 8 (at the south end of the site) located about 100 m west of Lewis Road that conveys flows from approximately 67 ha of external drainage area to the site via Feature 1 (as shown by the channel on the west side of Lewis Road between Flow Nodes 1 and 4 on **Drawing SWM-5**). An open channel with intermittent flows conveys this external drainage from the existing culvert through the subject lands to a roadside ditch fronting Winona Elementary School. This open channel also drains a total of approximately 50 ha from lands that include the site area.

The roadside ditch fronting Winona Elementary School drains in the easterly direction prior to discharging to a corrugated metal pipe arch culvert with a 1370 mm diameter that crosses Barton Street where it drains to the west roadside ditch along Lewis Road.

Table 3-1 below lists the existing culvert characteristics and capacity with culvert locations within the subject lands shown on **Figure 2 - Existing Conditions Plan**. The culvert capacity is based on normal water level conditions downstream. A roadside ditch along Lewis Road drains an external drainage area of approximately 28.9 ha from the lands south of Highway 8 that are conveyed via an existing culvert, in addition to approximately 10.4 ha from lands that include the subject lands and school.

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Table 3-1:Existing Condition Culverts – Watercourse 9

Existing Culvert ID	Crossing Location	Crossing Type	Culvert Dimensions	Culvert Capacity (m^3/s)
1	Hwy. 8	Concrete Open bottom box	1800 mm (span) x 1200 mm (rise)	4.10
2	Downstream Hwy. 8	CSP	750 mm diameter	0.74
3	Barton Street, West side of Lewis	Corrugated Metal Pipe Arch	1370 mm diameter	3.50
4	Hwy. 8	CSP	1200 mm diameter	2.20
5	East side of Lewis Road	CSP	900 mm diameter	1.30
6	West side of Lewis Road	CSP	900 mm diameter	1.46
7	Barton Street, East side of Lewis Road	Corrugated Metal Pipe Arch	910 mm (span) x 690 mm (rise)	1.50
8	Arvin Avenue, East side of Lewis Road	Twin Concrete Box	(2) – 2400 mm (span) x 1200 mm (rise)	13.5
9	CNR	Twin Concrete Circular	(2) – 2400 mm diameter	47.00
10	QEW	Twin Conc. Circular	(2) – 2900 mm (span) x 2200 mm (rise)	51.50
11	Crosses Lewis Rd., south of Arvin Ave.	Twin Conc. Box	(2) – 2400 mm (span) x 900 mm (rise)	12.80
12	North of Barton	Twin Conc. Circular	(2) – 500 mm	1.50

A total of approximately 123.4 ha has been determined to drain to the culvert crossing Barton Street on the west side of Lewis Road (Flow Node 5 with characteristics shown in Table 31). A 910 mm x 690 mm CSP culvert has been identified by the survey (characteristics shown in Table 3-1) to cross Barton Street on the east side of Lewis Road. This culvert drains an area of approximately 22 ha (Catchment 202) in the north-westerly direction to the east roadside ditch along Lewis Road.

At a point located approximately 110 m downstream from the Arvin Avenue culvert crossing and 240 m upstream of the CNR, the east and west Lewis roadside ditch flows merge. The SCUBE study indicates that at the CNR Flow Node 9-2 (i.e. Flow Node 12), drainage from approximately 116 ha also drains to this point from lands located east of Lewis Road, i.e. Catchments 93, 98, 97 and 121 (as shown in **Drawing SWM-5**). Flows are drained by existing 2400 mm double barrel concrete culverts below the CNR to a concrete lined channel that extends to the Queen Elizabeth Way (QEW). These flows are drained by two 2900 mm x 2200 mm concrete box culverts under the QEW prior to ultimate discharge to Lake Ontario, with culvert characteristics shown in Table 3-1.

The City of Hamilton has completed an engineered ditch along Lewis Road for capacity improvements. WC 9 exhibits primarily engineered channels north of Canadian National Railway (CNR), ultimately discharging to Lake Ontario. Upstream of the CNR, the engineered channel extends east, along the south side of the tracks to a storm sewer. Other roadside and railside ditches contribute to WC9 from the west.

3.4 EXISTING FLOWS

Pre-development drainage area peak flows are indicated by **Table 3-2** with Flow Nodes and drainage areas shown in **Drawing SWM-5**.

Table 3-2: Existing Peak Flows Summary

Flow Node	Branch, Chainage (MIKE 11)	Existing Conditions Drainage Area to Flow Node (ha)	Catchment I.D's	Return Period Flows Extracted from MIKE 11 Modelling Update (m^3/s) – Return Period Event					
				2	5	10	25	50	100
1	9_5, 18.55	67.2	300	0.486	0.929	1.287	1.796	2.209	2.648
2	9_5, 853.98	77.06	300, 301, 302A	0.185	0.405	0.607	0.933	1.233	1.590
3	9_1, 17.824	41	302B	0.384	0.558	0.645	0.721	0.760	0.786
4	9_1, 406.84	118.06	300, 301, 302A, 302B	0.365	0.665	0.915	1.282	1.590	1.927
5	9_1, 447.14	123.36	300, 301, 302A, 302B, 201B	0.445	0.776	1.023	1.348	1.591	1.831
6	9_3, 2.23	22.4	202	0.149	0.221	0.259	0.294	0.312	0.326
7	9_4, 77.668	-	0 (start of VM Channel)	0.040	0.057	0.063	0.068	0.070	0.072
8	9_1, 708.79	159.25	300, 301, 302A, 302B, 201B, 200, 201A, 101A	0.679	1.170	1.504	1.903	2.174	2.422
9	9_2, 6.712	17.4	100	0.149	0.218	0.254	0.288	0.306	0.319
10	9_1, 876.167	193.05	300, 301, 302A, 302B, 201B, 200, 201A, 202, 101A, 101B	0.684	1.267	1.773	2.541	3.207	3.956

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Flow Node	Branch, Chainage (MIKE 11)	Existing Conditions Drainage Area to Flow Node (ha)	Catchment I.D's	Return Period Flows Extracted from MIKE 11 Modelling Update (m^3/s)					
				Return Period Event					
				2	5	10	25	50	100
11	9_1, 1024.92	210.45	300, 301, 302A, 302B, 201B, 200, 201A, 202, 101A, 101B, 100	1.055	1.760	2.197	2.672	2.967	3.216
12	9, 1450	116	EXT DA1	1.786	2.845	3.447	4.047	4.389	4.657
13	9, 1938.9	361.2	300, 301, 302A, 302B, 201B, 200, 201A, 202, 100, 101, EXT DA1, 99	3.673	5.820	7.038	8.252	8.941	9.480
14	9, 2568.77	375.1	300, 301, 302A, 302B, 201B, 200, 201A, 202, 100, 101, EXT DA1, 99, 910	3.542	5.738	7.042	8.401	9.209	9.866

These results were determined through the updated SCUBE Study design continuous modelling analysis that has been completed through MIKE 11 software and discussed further in Section 5.6. There is a decrease in flows from Node 1 to Node 5 even though the drainage area increases. Watercourse 9 is modelled as a channel in SCUBE MIKE 11 model. The existing channel roughness and floodplain attenuates the peak flows causing the flows at Node 2-5 to be lower than that at Node 1 even though the drainage area is greater. This trend was noted for all events (2-100 year).

3.5 FLUVIAL GEOMORPHOLOGY

3.5.1 EROSION THRESHOLD ANALYSIS

An erosion threshold analysis has been completed by GEO Morphix in February 2018 and and updated to reflect the January 2020 continuous flows. An erosion threshold based on bed materials has been determined for the Watercourse 9 tributary draining the subject lands downstream of its confluence with the Venetian Meats' channel at Node 11 of the hydrological model. This location has been selected as it was the most susceptible location to erosion in the watercourse. The erosion threshold in the form of a critical discharge has

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been determined to be 0.609 m^3/s at this location based on the permissible velocity of 0.61 m/s for non-colloidal silt-loam (Julien 1998), the dominant substrate at this location. This permissible velocity is considered conservative given that it does not take into account the effect of rooted vegetation, which has a strong influence on channel stability and is prevalent within the watercourse.

The Erosion Threshold Analysis report is included in **Appendix E**.

Subsequent to receipt of comments from the City, a conference call was conducted with the City, HCA and Geo Morphix on July 2, 2019. The purpose of this call was to discuss the difference between the SCUBE Study and the site specific assessment completed by Geo Morphix in determining the flows to prevent erosion in the downstream channel. It was confirmed during this call that approach used in the SCUBE study was not based on field verification and does not account for assimilation capacity of the receiving watercourse. The field-based methodology is better tailored to the receiving watercourses as it accounts for cumulative inputs from Stormwater Management Facilities. The conclusion was that the proposed SWM controls will result in a minor increase in erosion of the receiving watercourse.

The exceedance analysis model output completed by GEO Morphix in February 2020 includes six indices which predict the erosion potential of the watercourse; cumulative discharge, cumulative effective discharge, cumulative effective work index, cumulative total work, duration of erosion exceedances and number of erosion events. These indices have been accepted by agencies throughout Southern Ontario including the Toronto and Region Conservation Authority, Credit Valley Conservation and Central Lake Ontario Conservation Authority. Results indicate increases in cumulative effective discharge of 60%, cumulative effective work index of 40%, duration of erosion exceedances and number of erosion events of 69%. However, the total cumulative hydrological regime has remained roughly equivalent with a change in cumulative discharge of 8% and of cumulative work of 5.5%. In relative terms these are large changes in exceedances in cumulative effective work and cumulative effective discharge, however because these increases only lead to a total of 24 hours of erosion every three years which is significantly less than what is anticipated in a typical southern Ontario watercourse, Geo Morphix does not expect exacerbated erosion within the watercourse. We note that the vegetation within the watercourse was not accounted for within the assessment, however they are capable of withstanding velocities in excess of 1 m/s, which provides a further factor of safety.

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3.6 REGULATORY FLOODPLAIN

The Conservation Authority will be undertaking their own floodplain analysis for this area and updating floodplain mapping in the near future. Although the Regulatory storm event for these lands is the 100-year storm, opportunities to capture a portion of the Regional Storm Event (Hurricane Hazel) within the pond outfall pipes will be considered to reduce the Regional flow spilled onto the ROWs adjacent to the SWM facilities.

There is an existing floodplain on the site within Feature 1 on the west side of Lewis north of Highway 8. This floodplain is contained within the Feature 1 channel, with possible spill across Winona Elementary School. Through ongoing discussions with the City and HCA, it has been decided for safety reasons that this channel become enclosed. An enclosed system is also consistent with the Secondary Plan as well as anticipated maintenance costs associated with an open watercourse feature. As such, the 100-year storm, is to be conveyed through an external conveyance storm sewer. For this reason, there will no longer be a floodplain issue for the site. The storm sewer has been sized to accommodate an external peak flow of 4.017 m^3/s from the lands west of Lewis Road and 1.501 m^3/s from the lands east of Lewis Road, south of Highway 8 based on the calculations provided in the storm sewer design sheet included in **Appendix G**.

It is understood that HCA will be undertaking their own flood mapping analysis for this area. However, at the request of the City and HCA, updates to the existing condition floodplain mapping can be provided by Urbantech with the latest approved flows to update earlier work in advance of the floodplain mapping by the HCA. This floodplain mapping work can be used to confirm no upstream impacts will occur as a result of redirecting the external flows through the proposed Lewis Road storm. Once confirmation is received for the flow to be run through the existing conditions HEC-RAS model, the floodplain mapping can be finalized.

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3.7 ENVIRONMENTAL IMPACT ASSESSMENT/FISH HABITAT SELF ASSESSMENT

Arcadis Canada Inc. Updated their Environmental Impact Statement for Block 3 of the Fruitland-Winona Secondary Plan Area in Stoney Creek in December 2020. This report has been included in **Appendix C**.

The Arcadis EIS states that all environmental features on the site have been heavily influenced and/or managed by anthropogenic activities. The natural environment surveys did not identify any development constraints in accordance with the PPS. Development will have no impact on PSWs, significant wetlands, valley lands, wildlife habitat or woodlands or ANSIs.

According to the Arcadis assessment, there are no vegetative Species at Risk or locally rare species present on the site. Two Species at Risk, the barn swallow and the Monarch, were found to use the site for foraging. However, the EIS concluded that the site is not considered a Significant Wildlife Habitat. Negative impacts to these species are not expected due to alternative habitats nearby.

Significant natural features were not identified on the site and there are no Core NHS areas within the study area.

The Arcadis EIS recommends Silt fencing be used during earthworks and construction to mitigate runoff entering drainage ditches. Silt fencing should be inspected regularly to ensure the integrity and effectiveness of the silt fencing barrier.

The EIS recommends that tree preservation plans be developed as part of Draft Plan Applications and that tree, shrub, and vegetation removal occur outside the breeding bird season (March to August).

Long term or residual effects on natural environment features in the vicinity of Block 3 are not expected.

In addition to the EIS, Arcadis carried out a Fish Habitat Self-Assessment. A total of nine sites were assessed for fish habitat and it was determined that the sites are not direct fish habitat. The assessment determined that DFO authorization was not required for the development of the subject lands. A supplemental memo (July 17, 2019) prepared by Arcadis has been included in **Appendix C**.

3.8 AIR DRAINAGE

An air drainage analysis for the subject lands was undertaken by Amec Foster Wheeler in March, 2016 (AMEC, 2016), which has been included in **Appendix D**. The analysis reviewed the topography and the climatology of the region to determine the effect of the proposed development on the local micro-climate. Three nearby weather stations were used to collect climate data (Vineland, Burlington Piers, and Hamilton Airport).

According to the collected data, the predominant winds along the site are from the west and southwest. The proposed development is not expected to block the south-westerly-to-north-easterly air flow. Instead, the proposed development is expected to assist in draining any cold air northward toward Lake Ontario by creating eddies in the boundary air layer that will prevent air stagnation. The proposed local roads within the subject lands will also assist in channelling the air downstream.

4 GRADING, ROADWORKS, AND DRAINAGE

As described in Section 1.1, the study area has been divided into four sub-areas. These areas are shown on **Figure 3**.

- Area 1 includes all lands bound by Barton Street to the north, Highway 8 to the south, Lewis Road to the east and McNeilly Road to the west.
- Area 2 includes all lands bound by Barton Street to the south, Lewis Road to the East, McNeilly Road to the west and between 225-275 m north of Barton St.
- Area 3 includes all lands bound by Barton Street to the south, Lewis Road to the west, Highway 8 to the south and 440 m east of Lewis Road.
- Area 4 includes all lands bound by Barton Street to the south, Lewis Road to the west, 250 m north of Barton Street and 440 m east of Lewis Road.

Areas 1 and 4 are internal to the BSS lands, while Areas 2 and 3 are external to the BSS lands but contribute sanitary drainage to the proposed infrastructure.

4.1 PRELIMINARY GRADING

Based on the proposed road layout of the tertiary plan, road grading and lot grading criteria, the preliminary grading plan has been designed to:

- Match existing road grades at subdivision access points.
- Match existing and proposed boundary grades around the perimeter of the subject lands.
- Provide adequate cover on municipal services.
- Direct major system stormwater management flows to stormwater management facilities.
- Meet municipal standards for minimum and maximum road grades and lot grading criteria.

Preliminary centreline road grading ranges from 0.5% (minimum) to 3.60% (maximum).

Area 1 generally slopes from the southwest towards the northeast to direct overland flow towards the proposed Pond-2 at the northeast corner of Area 1. The western edge of Area 1 will have to be graded up from the existing connection to McNeilly Road in order to allow for conveyance eastwards. The low point within Area 1 will be at Pond-2.

Area 4 generally slopes from the southeast towards the northwest to direct overland flow towards the proposed SWM Pond-3 at the northeast corner of Area 4. The low point within Area 4 will be at SWM Pond-3.

Areas 2 and 3 generally slope from the south to the north. It is anticipated that these sites will generally be (re)developed closely matching existing grades and drainage patterns as only a small portion of the lands north of Barton can be serviced by the proposed infrastructure on Barton St. Should they be (re)developed to direct more drainage towards Barton Street then on-site controls will be required. Detailed grading of Areas 2 and 3 will be dependent on the nature of the various site/draft plans submitted. Each site plan will be required to ensure there is adequate emergency overland relief points, lower than proposed buildings and surrounding developments, directed to the neighbouring ROWs.

Detailed grading for individual lots/blocks are not provided in the preliminary grading plans. Individual development applications will be required to demonstrate conformance with overall Block grading and existing/interim conditions.

Details related to the preliminary grading plan are shown on **Drawings GR-1 and GR-2**.

4.2 ROADWORKS

In general, the proposed concept plan follows the road pattern laid out in the secondary plan. Roads within Area 1 and 4 will be (standard ROW cross-sections have been included in **Appendix L**):

- Local roads – 20 m ROW
- Collector roads – 26 m ROW
  There are no new roads proposed in Area 2 and Area 3. Arvin Avenue is a 26 m ROW.

The Fruitland Winona Secondary Plan and City of Hamilton standards and specifications will guide the grading of the proposed developments. Subdivision roads will be constructed to a full urban standard including asphalt pavement, concrete curb and

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gutters, concrete sidewalks, roadway illumination, cycling facilities and boulevard landscaping all in accordance with the City of Hamilton standards.

To facilitate development of various components of the lands, the City may have to consider temporary accesses, roads and/or standards to permit development until adjacent lands develop.

Barton Street, Lewis Road, McNeilly Road and Highway 8 currently are rural cross sections. Barton Street and Highway 8 are currently undergoing Phase 3 and 4 Municipal Class Environmental Assessments (EA) at the time of this report. All rural roads will be urbanized as development of Block 3 proceeds. Until the Barton Street and Highway 8 EAs are completed the ROW widths are established by the Secondary Plan Policies.

- Barton Street – Major Arterial 40.576m
- Lewis Road and McNeilly Road – Collector 26.213m
- Highway 8 – Arterial 36.576m
- Local Roads – 20.117m

Further details on traffic requirements have been provided in Section 8.

4.3 STORM DRAINAGE

4.3.1 PROPOSED MAJOR AND MINOR SYSTEM DRAINAGE

The major and minor drainage systems are designed to convey storm runoff to the two (2) SWM Pond facilities prior to discharge to the existing Venetian Meats' Channel along Watercourse 9 downstream of the site. **Drawings STM-1 and STM-2** illustrate the storm (minor) system which is designed to accommodate flow from the 5-year storm in accordance with the City's standards; areas of 100-year storm runoff capture are also identified. The major system is contained within the ROW's and is conveyed to the wet cell of the SWM ponds. These drawings illustrate the overland flow (major) routes.

It is important to note that the proposed neighbourhood park located to the south of the existing secondary school is to be primarily serviced from the proposed road networks. Major and minor system flows will be directed to the road network. At the time of detailed design of the park it is anticipated that some swales and transition grading will be required which will result in the requirement to direct some minor and major system drainage directly to the proposed stormwater management facility.

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Under existing conditions, Sub-area 2 drains away from Barton Street, northwards. It is recommended that the existing drainage patterns and flow rates be maintained when the lands are developed. Per the SCUBE study, Pond 2 (West) and 3 are sized based on drainage areas south of Barton Street only. The ponds are not intended to accommodate additional drainage from Sub-area 2. when developed, end of pipe SWM or on-site SWM controls are required to ensure downstream exceedances don't occur. Under future developed conditions, a portion of sub-area 2 is proposed to drain towards McNeilly Road and a portion of the site will outlet as existing to the Venetian Meats channel. Storm flows from these lands can be accommodated through the extension of the 1650mm within McNeilly Road to the future Arvin Avenue.

Storm sewer design sheets and overland flow calculations have been included in **Appendix G**.

The following City of Hamilton design criteria apply to the BSS 3 development and have been used to inform the proposed design:

Intensity-Duration Frequency (IDF) Parameters:

STORM EVENT	A	B	C
2-year	646	6	0.781
5-year	1049.5	8	0.803
10-year	1343.7	9	0.814
25-year	1719.5	10	0.823
50-year	1954.8	10	0.826
100-year	2317.4	11	0.836

Runoff Coefficients:

Land Use	Recommended Coefficient
Parks	0.25
Single Family Residential	0.50-0.65
Semi-Detached Residential	0.65
Townhouses, Maisonettes, Row Houses, Apartments, etc.	0.75
Institutional	0.75
Industrial	0.80

Land Use	Recommended Coefficient
Commercial	0.90
Paved Areas	0.90-1.00

Time of Concentration Methodology

Initial Time of Concentration = 10 minutes.

The time for conveyance of storm flows is based on full pipe flow velocities.

4.3.2 EXTERNAL STORM DRAINAGE REQUIREMENTS

The SWM facilities discharge into the existing Venetian Meats (VM) Channel on the northwest corner of Barton Street and Lewis Road. The west Pond-2 SWM Facility discharges into the upstream end of the VM Channel. The east Pond-3 SWM Facility discharges to the proposed storm sewers on Lewis Road which ultimately outlets to the mid-point of the VM Channel. The 100-year controlled outflow from each of these SWM facilities and external drainage has been considered sizing the downstream storm sewers that discharge into the Venetian Meats Channel.

The external drainage from south of Highway 8 on the east and west side of Lewis Road will be conveyed via a proposed storm sewer on Lewis Road, until it drains in the northerly direction for ultimate discharge to the VM channel. The storm sewer and contributing drainage areas has been shown on **Drawing STM-3** and **Drawing STM-3A**. The sewer has been sized to convey the 100-year storm event from the external lands, in addition to the minor storm event (5-year) from the remaining contributing drainage areas. The 100-year flow from the external lands south of Highway 8 was estimated using the rational method and MIKE 11 model results. Using the rational method, at T_c = 121 minutes, the 100-Year peak flow from Catchment 300 was estimated to be 1.882 m^3/s. At T_c =109 minutes, 100-Year peak flow from Catchment 200 was calculated to be 0.847 m^3/s. Since the 100-year peak flows from the MIKE 11 model results are greater than those determined using the "rational method" (traditional stormwater management flow calculation), the storm sewers are sized using the MIKE 11 Model results. The 100-year peak flow was determined to be 2.648 m^3/s for Catchment 300 and 1.474 m^3/s for Catchment 200 (**Table 3-2**).

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Rational method calculations have been used to size the storm sewers as shown in the storm sewer design sheets included in **Appendix G**.

Further discussions with the City are required for external drainage flow conveyance.

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5 STORMWATER MANAGEMENT

5.1 TOR AND SCUBE STUDY

The Fruitland-Winona Block Servicing Strategy (BSS) Terms of Reference (TOR) requires the following items to be completed in the BSS. The location of where these items have been addressed has been indicated within the brackets:

- Re-run SCUBES original model with proposed areas and impervious values (Section 5.6.1);
- Establish peak flows and runoff volumes (

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- Table 5-5 and Table 5-9);
- Functional SWM pond design (Section 5.7);
- Capacity assessment of receiving system (Section 5.6.1, Table 5-6 and Table 5-7);
- Identification of drainage constraints (discussion in Section 4.1 and Section 4.3.1);
- Screen SWM strategies and recommend SWM solutions (recommendations from the SCUBE study were reviewed for this site; described in Section 5.3);
- Provide general drainage plans (Drawings STM-1, STM-2, STM-3, SWM-5, -6, -8);
- Identify opportunities for passive recreation (Neighbourhood parks have been shown in the BSS #3 Concept Plan - GSAI, July 2019);
- Phasing of the SWM facilities (discussion in Section 9 and shown in Figure 5); and,
- Functional design of proposed realignment of watercourses (no longer relevant as indicated in Section 4.3.2).

The SWM criteria are to be consistent with the SCUBE Subwatershed Study's (SCUBESS) recommendations for surface water quality, quantity, balance, and erosion control.

The SCUBESS recommendations include:

1) SWM design criteria, including unit storage volumes and unit release rates, for erosion and flood control design of SWM facilities (Discussed in Section 5.6);
2) Outlet locations (as shown in **Drawings STM-1 and STM-2**);
a. Requirement for normal water quality design of SWM facilities (discussed in Section 5.5); and
3) LID storage/recharge targets (discussed in Section 5.9).

The following sections summarize technical design requirements for SWM that have been used to guide the BSS SWM designs. These sections also include any revisions to existing drainage patterns, the enclosing of a portion of the watercourse through the subject lands and the design of new road crossings (i.e. culverts). The functional design for the BSS will be refined during the detailed design stages as required.

5.2 SWM TARGETS & DESIGN CRITERIA

The SWM targets and design criteria for the subject lands have been established by the TOR, SCUBES Study, MECP and ongoing discussions with the City and HCA. Additional studies have been undertaken to update the original hydrologic model from the SCUBE

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study for Watercourse 9 (discussed in the First submission and Second submission and updated within Section 5.6). The results of this update have been used to redefine the SWM design criteria with respect to pond volumetric and outflow targets.

A summary of the SWM targets and design criteria is summarized below:

- Ensure that existing flow rates downstream of the subject lands are not exceeded under post-development conditions, thereby providing flood protection for properties downstream of the subject lands;

- Provide an extended detention drawdown volume based on the erosion threshold target unit flow rate;

- Provide a drawdown time for the extended detention volume within the SWM facilities that meets MECP criteria, which is within a range of 24-48 hours, to protect the form and function of the watercourse downstream of the SWM facilities;

- Ensure that the MECP Normal (Level 2) stormwater quality treatment of runoff is provided at minimum (per SCUBESS). However, at the request of the HCA, opportunities to provide MECP Enhanced (Level 1) treatment will be provided wherever possible;

- Maintain water balance by infiltrating a portion of all runoff from the rooftops across the site (per Landtek Ltd. Hydrogeological report recommendations described in Section 3.2) through the use of low impact development and other best management practices, which also addresses SCUBE study groundwater recharge targets;

- Provide safe conveyance for the Regulatory Storm event, i.e. the 100-year storm event.

5.3 DESIGN AND LOCATION OF SWM FACILITIES

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The preliminary locations of Pond-2 (west) and Pond-3 (east) have been designated by the SCUBE report as shown on **Drawing SWM-7 Design Overview Ultimate Condition**. **Drawings SWM-1, -2, -3, and -4** illustrate the west and east SWMF plans and sections, which present preliminary pond grades, water levels, access road, sediment forebays, and inlet and outlet locations. Pond design information has been provided in the following sections.

The SWM facilities have been situated in the proposed locations for the following reasons:

- To be consistent with the SCUBES study recommendations;
- To make use of existing/natural low points in terrain to minimize earthworks/cut and fill operations and maintain existing drainage patterns as much as possible;
- To maintain a permanent pool and drain into the receiving channel or storm sewer system;
- To maintain flow input locations along the receiving watercourses where possible / where required;
- To minimize storm sewer infrastructure size and avoid potential servicing crossing conflicts;
- To optimize land-use by maximizing tableland and serviceable area; and,
- To provide an aesthetic buffer between residential areas and the external roads.

The BSS #3 SWM Plan largely mirrors the SCUBESS SWM Plan with minor revisions – the main revisions being refinements to drainage areas to each SWM facility and the volume and flow targets as determined through the updates to the MIKE 11 Model. A table showing the original SCUBESS SWM targets for the sizing of the SWM ponds has been included in **Appendix A** for reference. The guiding SWMF design criteria from the City of Hamilton has been described in Section 5.3.1 below.

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5.3.1 SWM FACILITY DESIGN CRITERIA

The following table demonstrates conformance to the City of Hamilton SWM Facility design criteria. References have been made to drawings and SWMF calculations included in **Appendix H**.

Table 5-1: SWM FACILITY DESIGN CRITERIA CONFORMANCE

Pond Element	Design Criteria	Conformance
Shape / Size	Incorporate two cells – forebay and main bay (submerged berm)	One forebay and main bay provided by berm. The top of the berm is to be 0.3 m above the permanent pool (PP) with erosion protection above the PP. The berm is to have a 3.0 m top width, with 3:1 max. side slopes. *DWG SWM-2 and SWM-4*
	Length – based on particle size and settling rate (MECP calculation)	Sufficient length provided *Pond-2 and Pond-3, Appendix H*
	Shape - 3:1 length: width	Minimum L:W ratio of 3:1 has been provided within the forebay area but will be provided in the overall SWM facility in future submissions with the inclusion of berms. *DWG SWM-1 and SWM-3*
Pond Depth	Permanent pool: 1.0 - 2.0 m; 2.5 m max. at outlet	Minimum depths provided. *DWGS SWMF-1, -2, -3 and -4*

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Pond Element	Design Criteria	Conformance
	Quantity Control Storage: Max. depth of 2.5 m (100-yr) is the design goal.	Active storage depth measured from permanent pool to 100-year water level has been limited to 2.5 m. *DWGS SWMF-1, -2, -3 and -4*
Bottom Lining	Shale / Clay excavation is satisfactory; if not water tight use clay lining	Pond will be constructed in silty clay till and shale; geotechnical reports did not specify a liner. Additional geotechnical investigations are recommended during pond construction.
Side Slopes	Min. 7 to 1 within 3 m horizontal zone above and below the NWL	7:1 slope provided above and below permanent pool level *DWGS SWMF-, -2, -3 and -4*
	Min 5 to 1 above planting shelf	5:1 slopes above planting shelf have been provided.
	Min 4 to 1 below the "7 to 1" zone; to the pond bottom	4:1 slope provided below 7:1 zone to pond bottom *DWGS SWMF-1, -2, -3 and -4*
Pond Block Size	The required pond block size shall be determined at the Draft Plan stage of the planning approval process. (may be refined prior to registration) 1: Determine the pond storage area based on total flood volume and required side slopes. 2: Add perimeter buffer of 5 m from SWMF property line to commencement of facility grading. A min. of 6 m required between the SWMF block and	The pond storage area was based on the total required volume summarized in Section 5.7. Min. required buffer areas have been applied above the high water level.

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Pond Element	Design Criteria	Conformance
	residential/commercial and industrial lots (includes 4 m maintenance roadway). This 5.0 m buffer zone shall not exceed an average slope of 10:1. Note: Marginal setback area compromises will be allowed to facilitate irregular facility shapes.	*DWGS SWM-1, -3*
Inlet Structures	Pipe invert to be at permanent pool level or if submerged at PP it must be demonstrated that the system will operate under free-flow (non-surcharged) conditions; subject to the 5-year storm.	The storm sewer inverts at the pond inlets will be set at permanent pool level and will be confirmed at detailed design.
	Erosion protection shall be provided between the inlet HW and forebay bottom to prevent localized scouring; and shall match the headwall (HW) width at the inlet and shall extend a min. of 1.5 m on either side of the HW at the forebay bottom. Protection material shall consist of rip-rap or river stone underlain with geotextile.	Erosion protection to the inlet to be provided during detailed design.
	HWs and grating shall conform to OPSD, with railings as required.	Provided as shown on: *DWGS SWMF-2 and -4*
	Flows in excess of the 5-year event (major flows) are to bypass the sediment forebay and discharge to the main cell of the SWM Pond.	The pond layout has been modified such that major system flows bypass to the main cell. *DWGS SWMF-1, -2, -3 and -4*
Outlet Structures	Primary outlet control pipes shall be bottom draw.	A reverse-slope outlet control pipe (extended detention) has been provided. *DWGS SWMF-1, -2, -3 and -4*
	HWs and grating shall conform to OPSD, with railings as required.	Will be provided at detailed design.

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Pond Element	Design Criteria	Conformance
	Overflow (emergency/uncontrolled) per pond berm spillway. A 0.10 m freeboard to the top of the spillway invert shall be at the facility's 100-year or max. water level.	Emergency flow will discharge through the proposed spillway into the receiving ROW municipal storm infrastructure. The invert and maximum water level in the pond ensure during detailed design that the emergency flow can be conveyed without impacting adjacent lots. *DWG SWM-1 and -3*
	Erosion protection for outfalls shall generally consist of a combination of rip-rap or river stone and vegetation, with the size and depth of stone based on consultation with the City.	*N/A – as outflows are* discharged *to the municipal storm sewers.*
Maintenance Drain	Maintenance drains to be installed to allow the facility to drain by gravity flow whenever possible.	A maintenance drain to be provided during detailed design. However, a gravity flow drain is not possible for this site due to physical constraints. A sump will be provided for pumping / dewatering instead of a gravity drain.
Maintenance Access Roads	Maintenance access roadways shall be provided from the City's road allowances to inlet and outlet structures and to the base of sediment forebays. Where feasible, two access points to the City's road allowance shall be provided and access roads shall be looped to access points. Dead end access roads shall be voided and shall be designed with a hammerhead turn around, with a minimum hammerhead width of 17.0 m, roadway width of	Access roads have been provided with a 4.0 m width above the high water level and are shall be designed in accordance with the City's standards. *DWGS SWMF-1, -2, -3 and -4*

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Pond Element	Design Criteria	Conformance
	4.0 m and 12.0 m centreline turning radius. A turning area of 12.0 m diameter may be provided instead of a hammerhead. The following dimensions should be considered in the maintenance access design: Min. Roadway Width: 4.0 m Max. Gradient = 10% Max. Crossfall = 2% Min. Centreline Radius = 12.0 m Stormwater blocks between residential/commercial/industrial lots for the sole purpose of maintenance access shall have a minimum width of 6.0 m with a 4.0 m wide road surface. A curb depression shall be provided at the road allowance and removable, lockable, vehicle barriers shall be installed at the right-of-way limit to prohibit public vehicular access.	

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Pond Element	Design Criteria	Conformance
Pond Landscaping	A landscape plan shall be prepared to the satisfaction of the City and HCA and in conformance with the City of Hamilton Stormwater Management Landscaped Design Guidelines. A landscaping plan shall be prepared by a full member of the Ontario Association of Landscape Architects to City's approval. Acceptable plant species for SWM facilities have been provided within Appendix E – List of Approved Planting Species (ref. MECP-CC, 2003). Species have been classified within the categories of deep water, shallow water, shoreline fringe, flood fringe and upland.	A pond landscaping plan will be prepared in future submissions in conformance with City and HCA guidelines.
Perimeter Fencing	Fencing shall be required where residential areas are located adjacent to the SWM block. Where the Stormwater block abuts open space, ESA lands, industrial and commercial lands, or a right-of-way, fencing will not be required. Fencing will be 1.5 m high, chain link fence, in accordance with City Standards. Fencing shall be located at an offset of 0.10 m within the Stormwater block. Heavy duty black vinyl fence is City Standard.	A 1.5 m chain link is proposed along the interface with private property. *DWGS SWMF-1, -2, -3 and -4*

5.4 IMPERVIOUS AND PERVIOUS LAND USE CALCULATIONS

The SCUBES Study provides recommendations for SWM end-of-pipe facility sizing based on a required storage per impervious hectare and a release rate per hectare. However, as discussed in Section 5.6, the pond volumetric targets had to be adjusted based on revisions to the original SCUBES study MIKE 11 model.

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However, to establish the preliminary pond designs, the imperviousness of the contributing drainage area to each SWM pond is required to calculate the permanent pool volumes for each SWM facility for water quality control.

The catchment imperviousness has been based on a combination of the lot and right-of-way (ROW) imperviousness. The proposed unit types and distribution have been referenced from the Block Servicing Strategy Area #3 – Concept Plan (November 2019, Glen Schnarr & Associates Inc.) included in the drawing set and **Appendix A**. Based on this plan, the recommended runoff coefficients (C) from the City's guidelines in Table F.1 (discussed in Section 4.3.1) have been applied to the areas as shown by the **Drawings STM-1 and STM-2**, the Preliminary West and East Storm Drainage Plans. The composite runoff coefficients for the contributing drainage areas have been converted to imperviousness using the following equation:

$$\text{Imperviousness } \% = (C - 0.05)/0.009$$

A comparison of SCUBE study runoff coefficient (C) and % Imperviousness and those used to design the pond for the BSS has been provided below.

	BSS – Post Development Scenario		SCUBE	
	Composite C	% Imp	Composite C	% Imp
Pond – 2	0.674	69.3	-	50
Pond – 3	0.670	68.9	-	50

A breakdown of the run-off coefficient based on land-use has been included in the pond design calculation within **Appendix H.** The imperviousness calculated in the BSS is higher because the SCUBE study assumes a singular residential land-use. Excerpts from the SCUBE study have been included in **Appendix A**.

Drawing SWM-7 – SWM Design Overview Ultimate Condition, illustrates the total contributing drainage areas and corresponding imperviousness levels to each pond.

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5.5 QUALITY CONTROL

The minimum required water quality level for the SWM Ponds is Level 2. This level of control provides for the removal of 70% of total suspended soils. However, the HCA has requested that an Enhanced Level 1 water quality be provided, which results in the removal of 80% of total suspended solids. As such, an Enhanced Level of water quality has been provided through this functional design but depending on future design constraints a Normal Level may ultimately be proposed. Details of the ponds permanent pools have been provided in Section 5.7.2.

5.6 QUANTITY CONTROL

The original SCUBES Study provides an assessment of the potential impacts of stormwater runoff within the Watercourse 9 sub-watershed associated with the proposed land-use change. The study determined unit storage and release rates to control post-development flows to pre-development levels, assuming no LID measures are in place. These original quantity control and erosion control criteria have been summarized below and include the total volumes and flow based on the proposed drainage areas and levels of imperviousness currently proposed for the BSS 3 lands:

Table 5-2: SCUBESS Original Unit Volumes and Release Rates (Outdated) – Pond 9-2

Storm Event	9-2 (West)			
	Unit Volume	**Volume**	**Unit Release Rates**	**Flow**
	m^3/ha	**m^3**	**L/s/ha**	**m^3/s**
Drainage Area / Imperviousness Level		***53.1 ha; 69%***		***53.1 ha***
Permanent Pool	183	9,741	-	-
Extended Detention / Erosion Control	147	10,824	0.6	0.032
2-Year	210	15,463	4.3	0.228
100-Year	566	41,676	17.4	0.924

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Table 5-3: SCUBESS Original Unit Volumes and Release Rates (Outdated) – Pond 9-3

Storm Event	9-3 (East)			
	Unit Volume	Volume	Unit Release Rates	Flow
	m^3/ha	m^3	L/s/ha	m^3/s
Drainage Area / Imperviousness Level		***18.5 ha; 69%***		***18.5 ha***
Permanent Pool	183	3,378	-	-
Extended Detention / Erosion Control	148	3,777	0.6	0.011
2-Year	211	5,384	4.3	0.080
100-Year	567	14,469	17.4	0.322

The 1st Submission of the Block Servicing Strategy report was prepared by Urbantech West and submitted in January 2019. The BSS 2nd submission was completed in August 2019.

In the 1st and 2nd BSS Submission, the SWM facilities were designed to control the post-development flows to pre-development flows; the assumption being that if post-development flows are controlled to existing, the flows downstream of the subject lands will remain the same as existing. The west pond (Pond 2 (West)) over-controls 53.12 ha to flows below that of existing catchment 302B (41 ha) and the east pond (P3 DA) over-controls 18.5 ha to flows below that of existing catchment 202 (22.4 ha).

In the 1st submission the release rate was determined based on existing conditions return period flows as determined from the MIKE 11 continuous modelling results. Although Ponds 2 and 3 controlled flows to acceptable levels and met both the original SCUBE flow targets and updated targets, flow exceedances for the frequent flow events at nodes downstream of the subject lands were noted. Given the challenges with the frequency flow analysis, design storm / single event modelling was utilized to establish the SWM pond target and design in the 2nd submission. The MIKE 11 model was rerun using a single event-based approach to confirm existing flows and to establish stormwater management targets. The 2nd submission also proposed two SWM strategies where external Catchment 300 is either conveyed through storm sewers on Lewis Road or routed through West pond before being released into the Venetian Meats Channel. Routing catchment 300 to the west pond mirrored the existing scenario, where peak flows are attenuated by channel

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roughness and floodplain. The extended detention release rate was determined based on erosion threshold analysis completed by GEO-Morphix Ltd. The pond rating curves were established using the Visual OTTHYMO hydrological software (controlling post-development land use conditions to the existing targets from the MIKE 11 existing conditions model). The pond rating curves were verified in the MIKE 11 post-development model.

Although differences in the peak flows were expected, the flow results determined through the single event modelling update for the BSS were noted to be significantly higher than those determined through other studies. A primary reason for this is that the peak flows determined in the SCUBE (2013) study and the FDRP (1989) hydrology report, are based on statistical regression of the continuous modelling results which generally results in lower peak flow.

The City and HCA have accepted the proposed bypass of external Catchment 300. Due to the resulting increases in peak flows rates downstream of Barton Street (despite the ponds being adequately sized to mitigate post-development land use impacts to peak flows), HCA has instructed that the SWM targets for the BSS lands are revert to those based on the frequency analysis for existing conditions as determined from the MIKE 11 continuous modelling results, rather than the single event storms. The subsequent sections detail the MIKE 11 modelling update and result analysis.

5.6.1 HYDROLOGICAL ANALYSIS

The hydrological analysis update has been included in a memo prepared by DHI (January 2020), provided in **Appendix F**. The memo documents the statistical regression of the continuous modelling results to determine the return period flows for the following scenarios:

1) Existing Conditions
2) Proposed Conditions with SWM control
3) Proposed Conditions with SWM control (Future Uncontrolled)

Updates to the MIKE 11 model made as part of the 1st and 2nd submission have been carried forward as part of this submission and summarized below; no new updates were made to the model for this submission aside from inclusion of a sensitivity analysis as requested by HCA.

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1) Revisions to the drainage area to the pond based on Drawing SWM-5 and SWM-6
2) The imperviousness of the drainage area to the pond was updated to 69% which is based on the land use. The model initially assumed 50% imperviousness based on a single residential land use
3) Revisions to the catchment slope.
4) Addition of/Revision to the hydraulic routing based on topographic observations.
5) Updates to the network alignment to reflect external conveyance storm sewers (previously shown as channel in the Oct 2018, SCUBE MIKE 11 update)
6) Routing catchments 200, 300, 201A and P3DA to the storm sewers on Lewis Rd.
7) Including storm sewers on Barton Street to reflect passage of flows from Pond 2 (West) to the upstream portion of the Venetian Meats channel (previously shown as channel in the Oct 2018, SCUBE MIKE 11 update)
8) Minor changes to the drainage for catchments 201A, 201B, P2DA, P3DA, 202, 101B and 97.
9) Modifications to connections of external catchments (121 and 101B) to the network alignment. Since these drainage areas will not change during the development of the subject lands, the connection in the proposed conditions MIKE 11 model is updated to match the existing conditions model.

Corrected errors and updates made to original SCUBE MIKE 11 model have been documented by DHI in a memo dated June 2018. The memo has been attached in **Appendix F.**

Using the strategy in the 1st and 2nd BSS Submission, the SWM facilities are designed to control the post-development flows to pre-development flows. Hence the west pond (Pond 2 (West)) over-controls 53.12 ha to flows below that of existing catchment 302B (41 ha) and the east pond (Pond 3 (East)) over-controls 18.5 ha to flows below that of existing catchment 202 (22.4 ha). Flows from existing catchment 302B and 202 are compared to the pond design from the 2nd BSS Submission in **Table 5-4**.

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Table 5-4: Flow Rates (Catchment 302B and 202) vs pond release rate (P3 DA and P2 DA)

Storm Event	Flows* from Catchment 302B m^3/s	Release rate from Pond 2- 2nd BSS Submission (Sc. 2a) m^3/s	Flows* from Catchment 202 m^3/s	Release rate from Pond 3 - 2nd BSS Submission (Sc. 2a) m^3/s
2-year	0.384	0.105	0.149	0.015
5-year	0.558	0.155	0.221	0.019
10-year	0.645	0.185	0.259	0.024
25-year	0.721	0.214	0.294	0.029
50-year	0.760	0.248	0.312	0.032
100-year	0.786	0.273	0.326	0.036

* Flows from statistical regression of continuous modelling results. Refer to memo from DHI attached in Appendix F.

Since the release rate established from the pond design in the 2nd BSS submission is significantly lower than the existing scenario flows from the catchment 302B and 202, the pond rating curves developed as part of the 2nd submission were used in MIKE 11 model's post-development scenario to minimize downstream exceedances to the greatest possible extent. The existing conditions peak flow scenario is compared to the post development scenario in

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Table 5-5 corresponding drainage areas and Node locations are shown in **Drawings SWM-5** and **SWM-6.** The future uncontrolled flows have been included in the table as well.

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Table 5-5: Summary of Existing and Proposed Condition Flows

Flow Node	Ex. Conditions Drainage Area (ha)	Prop. Conditions Drainage Area (ha)	Storm	Flows (m^3/s)			
				Ex.	Prop. Uncont.	Prop. Contr.	% Diff (Ex. Vs. Prop.)
3/4 *	41	53.46	2	0.384	1.305	0.100	-74%
			5	0.558	1.903	0.138	-75%
			10	0.645	2.226	0.169	-74%
			25	0.721	2.531	0.215	-70%
			50	0.760	2.696	0.256	-66%
			100	0.786	2.819	0.301	-62%
				Ex.	Prop. Uncont.	Prop. Contr.	% Diff (Ex. Vs. Prop.)
8	159.25	189.5	2	0.68	2.603	0.95	40%
			5	1.17	4.146	1.62	38%
			10	1.50	5.159	2.25	49%
			25	1.90	6.323	3.33	75%
			50	2.17	7.087	4.39	102%
			100	2.42	7.764	5.71	136%
				Ex.	Prop. Uncont.	Prop. Contr.	% Diff (Ex. Vs. Prop.)
9	17.4	17.2	2	0.15	0.148	0.15	1%
			5	0.22	0.217	0.21	-4%
			10	0.25	0.254	0.25	-2%
			25	0.29	0.288	0.30	4%
			50	0.31	0.306	0.34	10%
			100	0.32	0.320	0.37	17%
				Ex.	Prop. Uncont.	Prop. Contr.	% Diff (Ex. Vs. Prop.)
10	193.05	199.5	2	0.68	2.600	0.92	35%
			5	1.27	4.146	1.59	25%
			10	1.77	5.156	2.23	26%
			25	2.54	6.311	3.34	31%

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Flow Node	Ex. Conditions Drainage Area (ha)	Prop. Conditions Drainage Area (ha)	Storm	Flows (m^3/s)			
			50	3.21	7.066	4.43	38%
			100	3.96	7.733	5.83	47%
11	**210.45**	**216.7**		**Ex.**	**Prop. Uncont.**	**Prop. Contr.**	**% Diff (Ex. Vs. Prop.)**
			2	1.06	2.912	1.23	17%
			5	1.76	4.614	2.01	14%
			10	2.20	5.711	2.72	24%
			25	2.67	6.946	3.91	46%
			50	2.97	7.742	5.05	70%
			100	3.22	8.436	6.44	100%
12	**116**	**115**		**Ex.**	**Prop. Uncont.**	**Prop. Contr.**	**% Diff (Ex. Vs. Prop.)**
			2	1.79	1.829	1.84	3%
			5	2.84	2.892	2.78	-2%
			10	3.45	3.481	3.43	0%
			25	4.05	4.055	4.28	6%
			50	4.39	4.373	4.93	12%
			100	4.66	4.617	5.59	20%
13	**361.2**	**366.6**		**Ex.**	**Prop. Uncont.**	**Prop. Contr.**	**% Diff (Ex. Vs. Prop.)**
			2	3.67	5.611	3.95	7%
			5	5.82	8.811	6.02	3%
			10	7.04	10.727	7.62	8%
			25	8.25	12.735	9.94	21%
			50	8.94	13.937	11.89	33%
			100	9.48	14.921	14.04	48%
14	**375.1**	**380.5**		**Ex.**	**Prop. Uncont.**	**Prop. Contr.**	**% Diff (Ex. Vs. Prop.)**
			2	3.54	5.668	4.06	15%
			5	5.74	8.907	6.19	8%
			10	7.04	10.869	7.84	11%
			25	8.40	12.949	10.22	22%

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Flow Node	Ex. Conditions Drainage Area (ha)	Prop. Conditions Drainage Area (ha)	Storm	Flows (m^3/s)			
			50	9.21	14.210	12.21	33%
			100	9.87	15.251	14.39	46%

* Node 4 (Proposed Condition) is compared to Node 3 (Existing Condition).

From the results in

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Table 5-5, cells highlighted in red are locations of exceedance for a given event. Flow Node 4 is representative of the downstream flows for Pond 2 (West) and as noted by the percent difference between Scenario 1 (existing) and Scenario 2a (proposed controlled) in the above table, the pond controls the post-development flows to well below the existing flows form Catchment 302B (Node 3). No representative flow Node for the east pond exists as outflows are conveyed directly into the storm sewers on Lewis Road. However, Pond 2 (East) is designed to control the flows below existing conditions (Catchment 202).

As concluded in the 2nd BSS submission the alteration in the drainage routing of external catchment 300 results in exceedances downstream. Hence, even when the peak flows from the developed catchments (south of Barton Street) were greatly reduced to below pre-development flows, exceedances at the downstream nodes continued to occur. Further discussions with City of Hamilton and HCA staff in October 2019 concluded that the external catchments will be conveyed through the proposed storm sewers on Lewis Road and the downstream infrastructures (culverts and constructed channels) will be assessed to ensure sufficient capacity.

5.6.2 CAPACITY ASSESSSMENT OF RECEIVING DOWNSTREAM SYSTEM

The capacity of the existing system downstream of the site has been provided in **Table 5-6** and **Table 5-7**. This includes the capacity of the existing culverts and receiving Venetian Meats' Channel. Under proposed conditions, the culverts crossing Highway 8, Lewis Road and Barton Street have been upgraded and redirected with revised characteristics shown in Drawings STM-1, STM-2 and STM-3; storm sewer design calculation sheets have been provided in Appendix G. The downstream infrastructure has been sized for generally higher flows than have been determined through this work, i.e. the Venetian Meats Channel has been sized for a capacity of 5.4 m^3/s at Node 7 and 8.1 m^3/s at Node 8 as determined through review of the 1119 Barton Street East: 100 Year Flood Plain Assessment and Channel Design Report' (September 2017). The proposed 100-year flows determined through the update to the MIKE 11 model (

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Table 5-5) have shown lower proposed flow rates at Node 7 and Node 8. It should be noted that the alignment in the MIKE 11 model is such that flows from Node 4 are conveyed directly to Node 7. Hence the flows at Node 4 and Node 7 are the same. The proposed 100-year flow rates with SWM controls as well as uncontrolled flows are compared to capacity of the VM's channel and the existing culverts in **Table 5-6** and **Table 5-7**.

Table 5-6: Comparison of Proposed 100-year Flow Rates with SWM Controls to Existing Channel Capacity

Existing VM's capacity for 100-Year Flow Rate	Node	Post Development Scenario
m^3/s		**m^3/s**
5.3	7	0.301
8.1	8	5.71

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Table 5-7: Comparison of Proposed 100-year Flow Rates with SWM Controls to Existing Culvert Capacity

				100 Year (m^3/s)	
Culvert ID	**Location**	**Culvert Capacity (m3/s)**	**Node**	**Post Development Scenario**	**Future Uncontrolled**
8	Arvin Avenue, East side of Lewis Road	13.5	**10**	5.83	7.733
9	CNR	47.0	**11**	6.44	8.436
10	QEW	51.5	**13**	14.04	14.921
11	Crosses Lewis Rd., south of Arvin Ave.	12.8	**8**	5.71	7.764

The existing culverts that remain downstream of the subject lands include Existing Culvert I.D.s 8-11. The capacity of these culverts greatly exceeds the post-development flows (with SWM controls) and post-development uncontrolled flows that occur downstream of the subject lands (Nodes 7-14). Therefore, the receiving downstream system has greater capacity than is expected to occur under proposed conditions.

A comparison of the hydraulic model results from MIKE 11 has been provided in **Appendix F-4**. This comparison demonstrates that, in general, increases in water level are limited to several centimeters, with a maximum of approximately 30cm in some areas. Based on the capacity of the system noted in the preceding tables, this minor increase is not expected to cause any issues at the culverts and channels. However, the HCA flood mapping update will confirm the effect of the increased flows attributed to the unrouted external area.

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5.7 POND DESIGN

The MIKE 11 model has been revised for the purpose of providing an update to the original SCUBE study flows and SWM Facility volumetric and flow targets. Based on the results, the subsequent section outlines the design of Pond 2 (west) and Pond 3 (east).

The erosion control target has been based on the erosion threshold exceedance determined by GEO Morphix to be 0.609 m^3/s (refer to **Appendix E** for details). This rate has been converted to a unit flow rate (0.00315 $m^3/s/ha$) for the contributing pre-development drainage area such that the total allowable extended detention flow from each pond could be determined (calculations provided in **Appendix H**). The extended detention volume has been established by controlling the 25mm, 4-hour storm to the calculated extended detention rate. The target release rates based on the erosion threshold exceedance is 0.155 m^3/s and 0.058 m^3/s for Ponds 2 and 3, respectively. The pond sizing scenario is summarized in the following table.

Table 5-8: Pond Rating Curve Scenario

Scenario	Pre-Development Return Period Flow Source	Post-Development Pond Rating Curve and Return Period Flow Source
Release rates from ponds are reduced such that pond storage is optimized. Pond outflows are below pre-development flows from the subject lands.	SCUBE MIKE 11 –Return period flows determined through statistical regression of Continuous modelling flows.	VO5 Model – Flood control to match MIKE 11 pre-development flow results. Extended detention release rate based on erosion threshold analysis and drawdown time.

The pre-development flows have been defined by the pre-development flows from the MIKE 11 model. The pond rating curves established as part of the 2nd BSS submission were used in MIKE 11 model's post-development scenario to determine the return period flows at downstream nodes. The rating curves were developed using Visual OTTHYMO modelling software. Visual OTTHYMO (VO5) modelling schematic and output files have also been included in **Appendix H**. The rating curves were then verified in the MIKE 11 continuous model. The results are summarized in **Table 5-9,**

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Table 5-10 and **Table 5-11**.

Table 5-9: Flow and Required Storage Volume Results

Pond	Pond Level	Pre-Development Flows m^3/s	Post-Development Flows m^3/s	VO5 Required Storage Volume m^3
Pond 2 (West)		Existing Catchment 302B (Node 3)	(Modelled in VO5)	
	ED	-	0.051	6,574
	2	0.384	0.100	14,592
	5	0.558	0.138	21,276
	10	0.645	0.169	25,803
	25	0.721	0.215	30,517
	50	0.760	0.256	35,507
	100	0.786	0.301	39,706
Pond 3 (East)		Existing Catchment 202 (Node 6)	(Modelled in VO5)	
	ED	-	0.013	2,186
	2	0.304	0.015	5,583
	5	0.473	0.019	8,351
	10	0.595	0.024	10,183
	25	0.759	0.029	12,167
	50	0.886	0.032	14,156
	100	1.016	0.036	16,132

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Table 5-10 and **Table 5-11** below illustrate the provided stage-storage relationship based on the pond geometry. Both facilities provide sufficient volumes to control post-development flows to pre-development flows

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Table 5-10: Pond 2 (West) – Provided Stage Storage Relationship

Pond Level	Elevation	Active Storage Volume
	m	m^3
PP	85.57	0
	85.70	1,657
	85.80	2,980
	85.90	4,327
	86.00	5,700
ED	86.10	7,098
	86.20	8,522
	86.30	9,972
	86.40	11,447
	86.50	12,948
	86.60	14,476
2-Year	86.65	15,249
	86.70	16,030
	86.80	17,611
	86.90	19,218
	87.00	20,853
5-Year	87.05	21,680
	87.10	22,515
	87.20	24,204
10-Year	87.30	25,921
	87.40	27,665
	87.50	29,438
25-Year	87.60	31,239
	87.70	33,068
	87.80	34,926
50-Year	87.85	35,865
	87.90	36,812
	88.00	38,727
100-Year	88.07	40,085
	88.20	42,645
	88.40	46,682
Emergency	88.60	50,809
Top of Pond	89.00	59,266

Table 5-11: Pond 3 (East) – Provided Stage Storage Relationship

Pond Level	Elevation	Active Storage Volume
	m	m^3
PP	**86.35**	**0**
	86.75	1,846
ED	86.85	2,394
	86.95	2,959
	87.05	3,542
	87.15	4,142
	87.25	4,759
	87.35	5,395
2-Year	87.45	6,048
	87.55	6,719
	87.65	7,408
	87.75	8,116
5-Year	87.85	8,843
	87.95	9,588
	88.05	10,353
10-Year	88.10	10,742
	88.15	11,136
	88.25	11,939
25-Year	88.35	12,761
	88.45	13,603
	88.55	14,465
50-Year	88.60	14,904
	88.65	15,348
`	88.75	16,250
100-Year	88.85	17,173
	89.25	21,070
Emergency	89.60	24,637
Top of Pond	89.90	27,706

The extended detention levels have been based on the volume required for the erosion threshold unit flow rate controls and the drawdown time required per the MECP criteria. The 100-year water level has been based on the maximum volume within the pond blocks based on the maximum allowable active storage depth of 2.5 m per City standards. As the Regulatory Storm Event for the Block Servicing Study area is the 100-year storm event, no consideration has been required for the Regional storm event. However, the Regional storm event flow was checked for spillway sizing (calculations provided in **Appendix F)**. The emergency spillways for both ponds are sized for the 100-year uncontrolled flows (details provided in Section 5.7.6).

The adjusted pond targets are summarized below.

Table 5-12: SWM Pond Volume and Release Rates - (VO5 Based Pond Rating Curves & MIKE 11 Continuous modelling - Existing Condition)

Storm Event	Pond-2 (West) Area = 53.46 ha; IMP%=69%	
	Unit Volume	**Unit Release Rates L/s/ha**
Permanent Pool (Based on MECP Table 3.2 and 69% IMP)	183 m^3/ha	-
Erosion Control	177 m^3/Imp ha	2.900*
2-Year	394 m^3/Imp ha	1.878
100-Year	1072 m^3/Imp ha	5.638
Storm Event	**Pond-2 (East) Area = 18.56 ha; IMP%=69%**	
	Unit Volume m^3/ha	**Unit Release Rates L/s/ha**
Permanent Pool (Based on MECP Table 3.2 and 69% IMP)	182 m^3/ha	-
Erosion Control	265 m^3/Imp ha	3.144*
2-Year	451 m^3/Imp ha	0.808
100-Year	604 m^3/Imp ha	1.940

* Based on erosion threshold analysis but actual release rate is reduced to meet required Drawdown time

5.7.1 EXTENDED DETENTION STORAGE

Erosion impact mitigation will be provided through the incorporation of an extended detention storage volume within the SWM facilities. Under the original SCUBES Study, the release rate of the extended detention storage volume had been based on 15% of the 2-

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year storm event. The extended detention storage target in the original SCUBE study was 294 m^3/Imp ha. The newly proposed extended detention storage volumes are lower than the original SCUBES study; however, the new volumes have been based on geomorphic studies from the updated continuous flow model. Since these new flow targets are defined by actual pre-development erosion threshold targets, it is more representative of the downstream system and accurate than the original estimation, which was 15% of the 2-year storm event. The Erosion Threshold Analysis report is included in **Appendix E**.

The target release rates based on the erosion threshold exceedance is 0.155 and 0.058 m^3/s for Ponds 2 and 3, respectively. These release rates result in a drawdown time of o 54.4 hours for Pond 2 (West) and 80 hours for Pond 2 (East). These drawdown times are greater than 48 hours per MECP criteria but are within an acceptable range. Therefore, the proposed SWM Strategy for the subject lands will provide adequate erosion control to avoid adverse downstream erosion impacts.

5.7.2 PERMANENT POOL

The permanent pool volumes for Pond 2 (West) and Pond 2 (East) have been established based on MECP criteria from the 2003 Stormwater Management Planning and Design Manual. The imperviousness of the contributing areas to both is based on the runoff coefficient conversion formula preferred by the City of Hamilton;

$$IMP\% = \frac{(C - 0.05)}{0.009}$$

The imperviousness was estimated to be 69% for both ponds. Based on an interpolation of the MECP permanent pool volume requirements at 69% imperviousness, the permanent pool target storage is 183 m^3/ha. A total of 53.46 ha of drainage area has been directed to Pond 2 (West), requiring 9,805 m^3 of storage. The permanent pool for Pond 2 (West) has been sized to provide 17,142 m^3 of storage. A total of 18.56 ha of drainage area is directed to Pond 2 (East), requiring 3,387 m^3 of permanent pool storage. The permanent pool for Pond 2 (East) has been sized to provide 5,239 m^3 of storage.

Although the minimum requirement for water quality treatment of the BSS 3 lands is Normal Level 2 according to the MECP standards, the proposed permanent pool volume storage meets Enhanced Level 1 water quality treatment level.

5.7.3 SEDIMENT FOREBAY

The forebay is designed to accommodate the 5-year flow. The major system will bypass the forebay and be conveyed directly to the wet cell. The criteria for forebays is a length to width ratio greater than 2:1 and sufficient length to meet MECP criteria. The length of the forebays is determined by the distance required to settle particles of a certain size, the MECP manual (2003) recommends settling particles greater than 0.15 mm. The dispersion lengths were checked to ensure sufficient length is provided to slow the incoming pipe flow. It has been determined that minimum forebay lengths of 26 m and 29 m for the two forebay areas of Pond 2 (West) from Headwall 1 and 2 (HW-1 and HW-2), respectively, and a forebay length of 11 m is required by Pond 2 (East) to provide adequate settling.

Similarly, minimum forebay lengths of 102 and 38 m for Pond 2 (West) for HW-1 and HW-2, respectively, and a forebay length 40 m is required for Pond 2 (East) to provide adequate dispersion.

The total forebay lengths for HW-1 and HW-2 of Pond 2 (West) are 105 and 87 m, respectively, whereas the total forebay length for Pond 2 (East) is 56 m and therefore all forebay lengths provided are sufficient for providing the minimum required dispersion and settling lengths. Calculations are provided in **Appendix H**.

5.7.4 POND OUTLET

Pond 2 (West) and Pond 2 (East) will discharge to municipal sewers located on Barton Street and Lewis Street, respectively. Outlet controls have been sized to mitigate erosion and downstream flow increases. The orifice plates will be bolted onto the outlet structures with the inverts set at the permanent pool levels of each facility. Pond 2 (West) and Pond 2 (East) will have additional outlet openings to meet the release rates established in Section 5.7. The pond outlet structures will be designed at the detailed design stage.

Preliminary orifice dimensions and the corresponding target and recommended release rates and drawdown times for each facility have been calculated and are indicated in **Table 5-13**.

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Table 5-13: Orifice Sizing for Extended Detention Flow

Facility	Target Extended Detention Flow (m^3/s)	Preliminary Orifice Diameter to meet target (mm)	Preliminary Drawdown Time (hours)
Pond 2	0.055	200	**54.4**
Pond 3	0.013	100	**80.7**

5.7.5 ACCESS ROAD

A maintenance access road has been provided to allow trucks and other equipment to access the SWM facility for inspection and maintenance. A 4.0 m wide maintenance road around the entire perimeter of the ponds has been proposed within the pond buffer area. The entrance to the maintenance access road to Pond 2 (West) is from Street 'L'. The entrance to the maintenance access road to Pond 2 (East) is from Street 'A'.

5.7.6 EMERGENCY OVERFLOWS

Pond 2 (West) and Pond 2 (East) have been designed to release emergency flows onto Barton Street and Lewis street at elevations of 88.60 m and 89.60 m, respectively. The emergency spillway from the ponds has the following characteristics listed in **Table 5-14**.

Table 5-14: Emergency Outlet Design

	Post Development Scenario	
	Pond 2 (West)	Pond 2 (East)
Spillway Invert	88.60	89.60
HWL (100-Year)	88.07	88.80
Top of Pond	89.00	89.90
Bottom Width; Side Slopes	32.0 m; 10:1	15.0 m; 10:1
Storm Event for Spillway Design	100-year uncontrolled	100-year uncontrolled
Flow Capacity Requirement	9.93 m^3/s	3.61 m^3/s
Flow Capacity Provided	15.56 m^3/s	4.44 m^3/s
Receiving Roadway	Barton Street	Lewis Street

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An emergency overflow grate at the 100-year level for Pond 2 (West) and Pond 2 (East) will be considered in future detailed design submissions. The size of the proposed pond outlet pipes on Barton Street and Lewis Road are restricted by cover and other servicing constraints. Therefore only a portion of the emergency flow can be conveyed through the proposed pond outlets.

5.8 SWM POND OPERATIONS AND MAINTENANCE

The recommended operation/maintenance and monitoring schedules for the proposed ponds will be in accordance with the City of Hamilton Operation and Maintenance Report for Stormwater Management Facilities (2017). This will include dewatering procedures for the forebay. A manual for each facility will be provided during detailed design.

5.9 LOW IMPACT DEVELOPMENT DESIGN CRITERIA AND PLANNING

The Fruitland-Winona Secondary Plan states that Low Impact Development Best Management Practices (LID BMPs) shall be considered in the design of public and private developments in the Fruitland-Winona development area.

One of the objectives of the Secondary Plan was to incorporate a sustainable SWM strategy. Part of this strategy was to identify, at the early planning stages, opportunities to incorporate LID BMP approaches to managing stormwater while also accommodating conventional storm water management approaches as necessary.

The SCUBE Subwatershed Study also recommends that LID BMP techniques be used to maintain the groundwater recharge rates within the study area. Per recommendations included on **Figure 2.2** of the SCUBE Subwatershed Study, LID source controls for groundwater recharge/baseflow will provide the following infiltration volumes for each land use /underlying soil type within the Block 3 lands:

- Residential lands over silt/clay = 1.5 mm
- Commercial/Institutional lands silt/clay = 2.5 mm
- Residential lands over sand/gravel = 3.0 mm

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The LID BMPs that will achieve these targets will be implemented at the individual site or subdivision level and their design will take place at the detailed design stage. The SCUBE Subwatershed Study recommends that preliminary design of centralized/communal LIDs be conducted at the FSR stage. As no centralized or communal LIDs are proposed for the Block 3 lands, LID analysis for specific features is not provided within this report.

5.9.1 LID BMPS FOR GROUNDWATER RECHARGE

In reviewing the feasibility of implementing LID BMPs, consideration was given to the following factors:

- ability to meet SWM goals, objectives and targets listed herein;
- suitability of substrates and groundwater conditions;
- site topography and size of contributing drainage areas;
- compatibility with urban form and natural features, and
- municipal servicing requirements.

In evaluating the practical feasibility of implementing LID BMPs, guidance was obtained from the *MECP Stormwater Management Planning and Design Manual, March 2003*, (referred to herein as the *MECP SWMP Design Manual*). LID BMPs on the Block 3 lands will be designed to better manage potential environmental impacts at or close to their source thereby minimizing downstream impacts. LID BMPs aim to manage stormwater runoff from urban development and replicate the natural or pre-development hydro-regime of a watershed. This is achieved through implementation of engineered, small-scale, source hydrologic controls that include pre-treatment, filtration, infiltration, storage and re-use.

The SCUBE Subwatershed Study recommended implementation of LID design measures to be considered for incorporation into the proposed Draft Plan. These recommendations are included

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Table 5-15 below:

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Table 5-15: BSS 3 – LID BMS's

LID BMP	Residential Land Uses	Employment Land Uses (not applicable to study area)	Notes
Rainwater Harvesting	√	√	Source control for groundwater recharge if used for irrigation.
Green Roofs	-	√*	* This LID does not provide groundwater recharge benefits but may be used for other environmental benefits.
Downspout Disconnection	√	√	Can enhance groundwater recharge when used in conjunction with topsoil amendments
Soakaway Pits/Infiltration Chambers	√*	√	Variable source control designs are available for groundwater recharge. *May not be feasible on residential properties due to maintenance issues.
Bioretention	√*	√	Prioritized for employment land uses. *May not be feasible due to maintenance issues. May take the form of small residential rain gardens. The City of Hamilton does not support ponding/storage in rear lots.
Filter Strips	-	√	Source control for sheet flow from paved areas to adjacent green spaces, providing treatment (or pre-treatment)

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LID BMP	Residential Land Uses	Employment Land Uses (not applicable to study area)	Notes
			for runoff from employment land uses.
Permeable Pavement	√	√	Best used to provide treatment for large parking surfaces associated with employment land uses. May also be used for residential driveways.
Grassed Swales	√	√	Conveyance LID BMP to be located on continuous strips of green space
Additional Top Soil	√	√	Minimum 200 mm of topsoil depth in all landscape areas can enhance groundwater recharge and water balance
Rear Yard Infiltration Trenches/Swales	√		Rear yard drainage swale with 150mm topsoil, granular storage media and perforated underdrain.

Rainwater harvesting is the process of intercepting rainfall on paved surfaces such as a rooftop, and conveying it to a storage tank for later use. Storage tanks can vary in size from rain barrels for residential land uses to large cisterns for industrial or commercial land uses. From the storage tank, rainwater may be used inside the building for non-potable water uses, or for outdoor uses such as irrigation. When used to irrigate landscaped areas, rainwater harvesting may promote infiltration within the SCUBE study area for the purpose of groundwater recharge.

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Downspout disconnection can be used in residential and employment areas and promotes infiltration by directing roof runoff to pervious areas as opposed to directly draining into the storm drain system or flowing across impervious surfaces. The performance of this LID can be enhanced by amending the native topsoil with more pervious material and/or increased topsoil depths.This LID technique is also considered a traditional source control method and is promoted by City of Hamilton for new residential developments in its 2007 Criteria and Guidelines.

Soakaway pits and **infiltration chambers** are stone-filled trenches or galleries that are constructed below grade. They can be constructed under residential yards, parking lots, parks or sports fields. These LID's store and infiltrate runoff from impervious areas such as rooftops and roadways. This LID technique is also considered a traditional source control method that is acceptable to the City of Hamilton where space permits, and where soils are suitable.

Bioretention systems are landscaped areas which capture, store, and treat stormwater runoff by passing it through an engineered soil filter media. The stored and treated rainwater can be infiltrated into groundwater or conveyed into the storm sewer system via an underdrain. Water quality improvements in bioretention cells are provided by a bio-filtration layer consisting of a mixture of sand, soil, and organic material. Pre-treatment, such as a settling forebay or grass filter strip, may be used remove particles and decrease the maintenance needs of the filter bed. For the SCUBE study area, this LID is most applicable for employment land uses where the systems can treat runoff from parking areas and be incorporated into the landscaping design.

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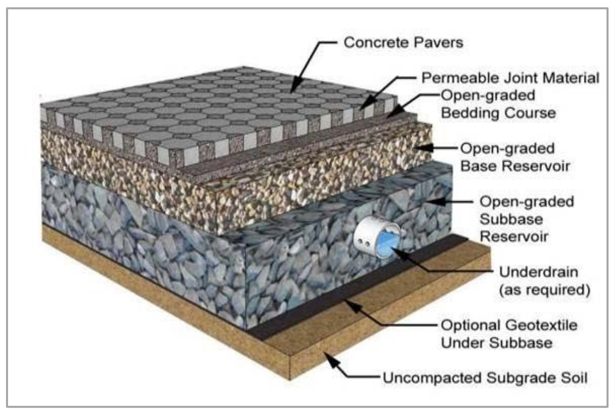
Vegetated filter strips are gently sloping vegetated areas that treat runoff as sheet flow from adjacent impervious surfaces. This LID functions by slowing runoff velocities, filtering suspended sediment, and allowing some infiltration into the underlying soils. Within the SCUBE study area, filter strips may be used within the future employment lands as a pre-treatment practice for parking lot runoff before it is conveyed into adjacent biofilter or grassed swale systems. The filter strips also provide a convenient area for snow storage and treatment.

Permeable pavement systems allow stormwater to percolate through traditionally impervious paved surfaces such as driveways and parking lots and into a stone reservoir where it is infiltrated into the native soil. They can be used for low traffic roads, parking lots, driveways and paths. This LID is most applicable for employment land uses where the system can be used to take advantage of the large parking areas where pervious landscaped areas are limited.



There are several forms of this LID:

- permeable interlocking concrete pavers;
- plastic or concrete grid systems;
- pervious concrete; and
- porous asphalt

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Grassed swales are open vegetated channels designed to convey, treat and attenuate runoff. Design variations include simple grass channels, enhanced grass swales and dry (bio) swales. The vegetation within the swales slows the runoff to allow sedimentation, filtration, and infiltration into the underlying soils. Although they are technically classified as a form of conveyance control, they can be incorporated into network of lot-level LID measures designed to collect, convey, and treat runoff within developed areas.

Additional Topsoil in landscape areas can improve groundwater recharge, enhance a site's water balance and attenuates peak flows. Applying increased topsoil to all pervious surfaces receiving drainage from impervious surfaces (rooftops, roadways etc.) increases runoff reduction. A 2012 study completed by STEP in the Greater Toronto Area assessed the performance of increased topsoil in residential lots. The evaluation confirmed that the practice of applying increased topsoil depth (25 to 30 cm) to grassed pervious areas produces less runoff than a standard 10 cm depth and that additional runoff reduction and water storage benefits can be provided by amending topsoil with compost.

Rear Yard Infiltration Swales/Trenches are stone-filled trenches underneath rear yard drainage swales. They will have an overflow perforated drain to ensure if they become saturated that they do not cause saturation at the surface of yards. These LID's store and infiltrate runoff from impervious areas such as rooftops and grassed areas of the residential lots. This LID technique is also considered a traditional source control method that is acceptable to the City of Hamilton where space permits, and where soils are suitable.

5.9.2 LID PRECEDENTS

The application of LID technologies is often perceived as a new and innovative approach to managing stormwater runoff and achieving SWM objectives. However, LID systems have been implemented throughout the Greater Toronto Area (GTA) over the past three decades. Over 20 years ago, a permeable pavement demonstration parking lot was

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installed at Seneca College's King Campus and in Ottawa, a porous pipe/infiltration system was installed. These older systems have been monitored since their installation and the collected operational data has confirmed the efficacy and sustainability of these LIDs.

In the past thirty years, LIDs in Ontario have been installed in nearly every land-use type and environmental context: from sites with rapid infiltration to areas with impermeable bedrock or a high groundwater table. Successful LID design requires a customized approach that incorporates local site conditions and stormwater management objectives.

5.9.3 LID BMP OWNERSHIP AND MAINTENANCE

As the proposed LID BMP measures are to be located on private property, approval agencies may have concerns related to long-term maintenance and removal potential for these features. To address these concerns, the City of Markham has enacted regulatory by-laws to ensure that LIDs such as permeable pavement driveways and tree pits are maintained by future owners. These tools could be enacted by the City of Hamilton to ensure that permeable pavement driveways and parking lots are not replaced with non-permeable paving and to ensure that proposed trees or bio-retention cells are not removed.

Monitoring of LID performance is currently being undertaken by the Sustainable Technologies Evaluation Program (STEP) implemented by the Conservation Authorities of Ontario. STEP provides a database of performance levels and maintenance requirements for a variety of LID technologies. STEP monitoring data indicates that properly maintained LID technologies such as permeable pavement and infiltration galleries exhibit very little loss in performance over time.

Routine maintenance for LID BMP systems differs from the required maintenance for conventional storm sewer/end-of-pipe pond systems. SWM ponds require an extensive clean out and restoration operation once its capacity is reached. This one-time clean out and restoration operation constitutes a significant disruption of pond operation and considerable expense (several hundred thousand dollars per pond) in order to ensure the long-term performance of the pond over time. LID BMPs such as permeable pavement require routine but relatively low-cost maintenance. Permeable pavement systems require sweeping using conventional street sweeping equipment and periodic topping up of jointing aggregate. LID BMPs that utilize biofiltration such as bio-retention, bio-swales, and rain gardens, may require cleaning or replacement of the inlet media every five to ten years. Operation and Maintenance manuals for proposed LID BMPs will be provided at the detailed design stage.

LID BMPs on the subject lands will be designed to simplify operations and maintenance in order to minimize the obligations of private landowners to maintain components of the system.

5.9.4 INTEGRATING LID BMP DESIGN ELEMENTS

A suite of LID source and conveyance controls will be considered as part of a treatment train approach to provide quality control, infiltration, evapotranspiration, and conveyance on all land uses in the subject lands. The allocation of LID BMPs will be finalized at the detailed design stage and will consider the underlying soil conditions, proposed drainage patterns, land use of adjacent areas, local topography, maintenance responsibilities / costs, and additional factors identified by the City of Hamilton Secondary Plan and SCUBE study.

The SCUBE Study, City of Hamilton Secondary Plan, and the City of Hamilton Innovative Stormwater Source Control Policy prioritize source control, or the treatment of runoff wherever it falls. These criteria align with the upcoming MECPCC RVC_t control hierarchy, which provides a hierarchy for different types of source control ranging from infiltration (more preferred) to surface storage (less preferred). Source control of stormwater runoff will be provided and prioritized for all areas within Block 3.

LID BMP features can reduce stormwater infrastructure costs while providing additional quality improvements and evapotranspiration and infiltration opportunities.

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5.9.5 WATER BALANCE AND GROUNDWATER RECHARGE STRATEGY

As mentioned in the preceding sections, the SCUBE Study established preliminary infiltration targets to meet water balance requirements related to groundwater recharge. The majority of the Block 3 lands consist of residential areas overlying silty/clay soil and require 1.5 mm of infiltration. A smaller section (approximately 18% in the southwest corner of the site) consists of residential areas overlying sandy/gravel soils and will require 3 mm of infiltration. An excerpt has been provided in **Appendix H**.

Landtek Limited has provided recommended measures to meet these water balance requirements in an additional study included in **Appendix B**. Landtek Limited determined that the runoff from a minimum of 15% of all rooftop runoff volume across the site should be infiltrated in order to address the water balance requirements related to groundwater recharge. During detailed design, LIDs will be evaluated to ensure that runoff from a minimum of 15% of all the rooftop runoff will be infiltrated.

It has been assumed that wherever practicable the roofs and lawns would be directed to the LID, while driveways and ROWs would not be directed to LIDs.

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5.10 BSS DETAILED DESIGN

In keeping with the Fruitland-Winona Block Servicing Strategy (BSS) Terms of Reference (TOR), the following items, introduced in the preceding sections will be finalized during detailed design.

Establish basic sub-watershed conditions (peak flows, runoff volumes and erosion threshold assessment) Section 5.6 of the BSS summarizes the pre and post development peak flow results determined through the MIKE 11 modelling update. Even when pond release rates are greatly reduced to well below existing flows, downstream exceedances were noted. The study compares the exceedances to the existing downstream infrastructure to ensure sufficient capacity.
Stormwater Management Pond design The BSS study provides functional pond design as summarized in sections 5.7 - 5.12. The following items pertaining to the pond design will be finalized during detail design. 1) Confirm ultimate definition of water levels and pond targets as established in Table 5-8 and Table 5-12. 2) Refinement of the L:W ratio such that the minimum 3:1 ratio is met for the SWM facility 3) Confirm if watertight liner is required after additional geotechnical investigations. 4) Confirm overland routes to SWM ponds for major system. Overland flow routes have been provided as shown in Drawings STM 1 and STM 2. Major system will bypass the forebay and directed to the wet cell. 5) Confirm pond inlet structure including invert elevation and erosion protection. HGL analysis (if required) will be completed during detailed design. 6) Confirm pond outlet structure. The outlet and invert for extended detention flow has been set based on the permanent pool elevation and required drawdown time. The outlet structure required to dispense the remaining flows will be provided in detailed design. A spillway has been designed to convey emergency flow (100 year uncontrolled/regional) to the ROW. An emergency overflow grate will be considered in the pond outlet manhole, during detailed design, to convey a portion of the emergency flow to the proposed storm

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sewers. At detailed design, pond outlet will take tailwater conditions into consideration and the outlet will be modified if necessary.

7) Confirm decanting area sizing. Decanting area has been provided as shown on Drawing SWM 1, -1A, 3 and -3A and will be confirmed during detailed design

8) Provide a pond landscaping plan in conformance with MECP, City of Hamilton and HCA guidelines

9) Provide an Operation and Maintenance Manual in accordance with the City of Hamilton guidelines

Screen SWM strategies and recommend SWM solutions

Low Impact Development Design

1. Confirm LID BMP to be implemented in residential and commercial blocks.
2. Design LID's such that infiltration targets outlined in Section 3.2.7 are met.
3. Provide operation and maintenance guidelines for proposed LID BMPs

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6 WASTEWATER

For discussion purposes, the study area has been divided into four sub-areas (as illustrated in **Figure 3**).

6.1 EXISTING WASTEWATER SERVICES

There are existing sanitary sewers within the study area as follows (as shown in **Drawings SAN 1 and SAN 2**):

- Existing 250 mm, 300 mm and 375 mm diameter within Highway 8 between McNeilly Rd and Lewis Road;
- Existing 250 mm and 300 mm diameter within McNeilly Road from Highway to Barton Street;
- Existing 375 mm diameter within Barton Street flowing west of from Escarpment Drive to Barton Street;
- Existing 450 mm diameter within Lewis Road from Highway 8 to Barton Street;
- Existing 600 mm diameter within Lewis Road flowing north from Barton Street;
- Existing 450 mm diameter within Barton Street, west of McNeilly Road; and,
- Existing 375 mm sanitary sewer within Arvin Avenue

6.1.1 WASTEWATER DESIGN CRITERIA

Proposed wastewater infrastructure will be designed in accordance with the latest City of Hamilton design standards and specifications (per Comprehensive Development Guidelines Financial Policies Manual 2017). Per the City of Hamilton's request we have also evaluated an additional scenario with higher populations than the City's design criteria.

<u>Population Criteria</u>

- Equivalent Population Densities Section E 1.4 of the Comprehensive Development Guidelines and City comments on first submission.

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Wastewater Design Criteria

- Average Dry Weather Flow — 360 litres per capita per day
- Infiltration — 0.6 litres per second per hectare
- Peaking Factor — Babbitt Formula – PF = $5/(p^{0.2})$ where p = population

Population Criteria – per City Comprehensive Development Guidelines

- Single Detached — 60 persons per hectare
- Semi-Detached — 75 persons per hectare
- Townhouse — 110 persons per hectare
- Parks — 12-25 persons per hectare
- Medium Density apartments (60 upha) — 250 persons per hectare
- School and Institutional Uses — 75-125 persons per hectare
- Commercial — 125-750 persons per hectare
- Industrial and Central Business Districts — 125-750 persons per hectare

Population Criteria – per City Comments

- Single Detached – Low Density 1 — 60 persons per hectare
- Low Density 2 — 110 persons per hectare
- Low Density 3 — 150 persons per hectare
- Medium Density — 250 persons per hectare
- Parks — 12-25 persons per hectare
- School and Institutional Uses — 75-125 persons per hectare
- Commercial — 125-750 persons per hectare
- Industrial and Central Business Districts — 125-750 persons per hectare

6.2 PROPOSED WASTEWATER SERVICING

Development of the subject lands will be serviced for wastewater through the provision of gravity sewers to the existing infratstructure. Wastewater sewers will be constructed within the proposed right of ways (ROW). Sewers will be constructed in City standard locations and at the minimum depth of cover of 2.75 m.

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Wastewater sewers will be designed in accordance with City of Hamilton standards and specifications. Further details on sanitary servicing for each area is provided below (please refer to **Drawings SAN 1, SAN 2, SAN 1a, SAN 2a, SAN 3, SAN 4 and SAN 4a.** for wastewater servicing layout and **Appendix I** for sanitary sewer design sheets). Sanitary sewers have been modelled in two fashions. The first being utilizing densities based on the concept plan, and the second being city criteria. This sensitivity analysis was undertaken to ensure that either scenario of development could be accomodated.

Area 1

Area 1 will be serviced for wastewater through construction of local gravity sewers within the subject lands connecting to:

- The extension of a 450 mm diameter sanitary sewer within Barton Street from Lewis Road to Street E.
- The extension of a 450 mm sanitary sewer within Barton Street from McNeilly Road to Street E.
- The existing 450 mm diameter sewer within Lewis Road.
- The existing 300 mm diameter sewer within McNeilly Road.
- Local connections/service laterals to existing infrastructure for existing uses and proposed development fronting existing ROWs.

Area 2

Area 2 will be serviced for wastewater by:

- The extension of a 450 mm diameter sanitary sewer within Barton Street from Lewis Road to McNeilly Road.
- Local connections/service laterals to existing infrastructure for existing uses and proposed developments fronting existing ROWs.

Area 3

The extension of Arvin Avenue has recently been completed in Area 4 including a 375 mm sanitary sewer. Area 3 will be serviced wastewater by:

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- Private sewers connecting to the existing 375 mm sanitary sewer within Arvin Avenue. Local connections/service laterals to existing infrastructure for existing uses and proposed developments fronting existing ROWs.

Area 4

Area 4 will be serviced for wastewater through construction of local gravity sewers with the subject lands connecting to:

- The extension of a 450 mm diameter sanitary sewer within Barton Street from Lewis Road to Collector Road D.
- The existing 300 mm diameter sanitary sewer within Barton Street
- The existing 450 mm diameter sanitary sewer within Lewis Road
- Local connections/service laterals to existing infrastructure for existing uses and proposed developments fronting existing ROWs.

Based on the design calculations (provided in **Appendix I**) the equivalent population (greater of the two scenarios) contributing to Manhole SMH 007A is 8,561:

- 3,167 from the west
- 1,543 from the south
- 3,851 from the east
- 150 contribute to the run from MH 007A to 010A

The total peak flow exiting Manhole SMH 007A is 199.9 l/s. The existing pipe is a 600mm at 0.39% which has a full flow capacity of 336.6 l/s.

Based on the design calculations (provided in **Appendix I**) the equivalent population (greater of the two scenarios) contributing to Manhole SMH 005A is 7,526:

- 3,308 from the west (existing)
- 1,851 from the south
- 2,367 from the east

The total peak flow exiting Manhole SMH 005A is 153.6 l/s. The existing pipe is a 525mm at 0.13% which has a full flow capacity of 158.1 l/s. At the detailed design stage , if population densities are in keeping with this worst case estimate, this run of sewer will be upsized.

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7 WATER SERVICING

A study entitled **Lower Stoney Creek Block Servicing Study (Water Servicing)** was prepared by WSP (provided in **Appendix J**) in support of the proposed development to identify the hydraulic requirements for the subject lands. These include the analysis of the Average Day, Maximum Day, Peak Hour and Maximum Day plus Fire Flow demand conditions of the development under present (2011), and ultimate buildout (2031) planning horizons. The analysis used the WaterGEMS model of the Hamilton water distribution network for Pressure District 1 (PD1).

7.1 EXISTING WATER SERVICES

The existing water network in close proximity to the proposed development includes:

- a 300 mm diameter watermain along Highway 8 (from McNeilly Road to Lewis Road);
- a 200 mm diameter watermain along Highway 8 (east of Lewis Road)
- a 200 mm diameter watermain along Barton Street from Lewis to Escarpment Drive;
- a 600 mm diameter watermain along Barton Street from Lewis to Escarpment Drive
- a 200 mm diameter watermain along McNeilly Road; and
- a 150 mm diameter watermain along Lewis Road.

7.2 CRITERIA

<u>Water Design Criteria</u>

- Average Daily Demand:
  - Residential 360 litres per capita per day
  - Employment 260 litres per capita per day
- Max. Daily Peaking Factor: 1.9
- Max. Hour Peaking Factor (Residential): 3.0

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7.3 DOMESTIC DEMAND

Population Rate

- Low Development: 2.45 persons per unit
- Medium Development: 3.39 persons per unit
- Commercial employment 1 person per 400 square feet
- Institutional employment 1 person per 700 square feet

Residential Unit Rate

- Low Density 1: 20 unit per hectare
- Low Density 2: 40 unit per hectare
- Low Density 3: 60 unit per hectare
- Med Density 4: 75 unit per hectare

7.4 FIRE FLOW DEMANDS

The fire flows used in the WSP model were calculated using the "Water Supply for Public Fire Protection" 1999, FUS to determine the fire flow requirements for each building within the site. The Required Fire Flows (RFF) were not calculated for the other blocks within the Lower Stoney Creek Development as the block servicing strategy does not provide sufficient information (i.e. building footprints, exposure distances, construction material) for calculating RFF per the procedure noted above. Based on the information in the watermain analysis report submitted in October 2018 for the proposed Winona Hills Development, for the five overlapped junctions, the largest required fire flow for the site was calculated to be 217 L/second. Upon provision of sufficient building information, RFF calculations will need to be performed and checked against modeled fire flows prior to construction.

7.5 THE MODEL

The WSP analysis consisted of two separate models (Coarse_Trunk_System_v7_2_transfer.MDB and Model_Sept02_2009.MDB) were integrated to produce a model of PD1 by adding the proposed watermains for the proposed development.

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7.6 BOUNDARY CONDITIONS

The proposed development is within Pressure District 1 (PD1) distribution system. Three modelling alternatives, characterised by the initial water levels in tanks HDR01, HDR1B and HDR1C, were considered as part of this analysis. The first alternative had all previously mentioned tanks at 50% full: that is 129.0 m, 128.0 m and 129.0 m respectively. The second alternative had all previously mentioned tanks at 75% full: that is 131.2 m, 130.7 m and 131.2 m respectively. Finally, the third alternative had all previously mentioned tanks at approximately 90% full: that is 132.5 m, 132.3 m, and 132.5 m respectively.

7.7 ANALYSIS

The suggested watermain layout was modelled for Average Day, Maximum Day, Maximum Day plus Fire Flow and Peak Hour under the present (2011) and ultimate buildout (2031) planning horizons using a WaterGEMS V8i model of the PD1 network. Pipes in the BSS development area were sized to meet the greater requirement of Peak Hour Demands or Maximum Day Demand plus Fire Flow requirements.

7.8 SYSTEM PRESSURES

The service pressures under existing conditions (2011), and ultimate build-out conditions (2031) were expected to range between 276 kPa and 429 kPa, which are within standards established by the MECP and City of Hamilton Guidelines.

7.9 AVAILABLE FIRE FLOW

Based on the simulations, WSP has determined that the system can maintain a minimum pressure of 140 kPa at ground level at all points in the PD1 distribution system under Maximum Day demand plus Fire Flow conditions at the subject site for the existing (2011) and ultimate buildout (2031) planning horizons when node HA12S002 is not included in PD1.

7.10 RECOMMENDATIONS

As detailed subdivision plans advance and fire flow requirements become available, required fire flows may exceed available fire flows. At that time, it is recommended that

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the following system upgrades be implemented to increase the fire flow capacity of the system:

- Upsize LSP-24 from 200 mm to 300 mm and LSP-16 from 200 mm to 300 mm to increase available fire flows for Blocks 1, 2, 3, and 4;
- Upsize LSP-39 from 200 mm to 300 mm and LSP-40 from 200 mm to 300 mm to increase available fire flows for Block 5;
- Add a new watermain connecting LSJ-4 to LSP-43 to increase available fire flows for Blocks 10, 11, and 12.

In conclusion, the WSP report confirms that the proposed watermain system for the Lower Stoney Creek Development site can achieve hydraulic requirements as prescribed by the Ministry of the Environment and Climate Change and the City of Hamilton watermain design criteria, and all required fire flows for the Winona Hills junctions can be achieved under Maximum Day Demand conditions for the proposed development under existing (2011) and ultimate buildout conditions (2031) provided that node HA12S002 will be omitted from PD1 fire constraints (based on a pending adjustment of the PD2/PD1 boundary).

More information has been provided in the WSP report in **Appendix J**.

8 TRAFFIC/TRANSPORTATION

A Traffic Impact Study (TIS) for the Fruitland Winona Block 3 Servicing area was produced by GHD in December 2018 (provided in **Appendix L**). The GHD TIS recommendations for ROW widths match those outlined in the secondary plan.

Standard ROW cross sections are included in **Appendix L**.

8.1 EXISTING TRAFFIC CONDITIONS

Barton Street, Lewis Road, McNeilly Road and Highway 8 currently are rural cross sections. Existing peak hour traffic data was collected by GHD for the TIS in May 2016 and is included in the July 2019 updated TIS.

The characteristics of the existing roads around the Block 3 Servicing area have been described in the tables below:

Table 8-1: Existing Road Characteristics - 1

ROW	Road Type	Speed Limit	Vertical/horizontal Curves?
Barton Street	2-Lane Arterial	60	None
Highway 8	2-Lane Arterial	60	None
McNeilly Road	2-Lane Collector	50	None
Lewis Road	2-Lane Collector	50	None
Escarpment Drive	2-Lane Collector	50	None

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Table 8-2: Existing Road Characteristics - 2

E-W Road	N-S Road	Intersection Type
Barton Street	McNeilly Road	All-way stop
Barton Street	Lewis Road	All-way stop
Barton Street	Escarpment Drive	Two-way stop
Highway 8	McNeilly Road	Signal
Highway 8	Lewis Road	Two-way stop

8.2 SITE GENERATED TRAFFIC

As stated in the 2019 GHD Traffic Impact Study, the subject lands are estimated to generate 1696 two-way trips during the AM peak hour (425 inbound, 1271 outbound) and a total of 2206 two-way trips during the PM peak hour (1419 inbound, 787 outbound). Data from the 2016 Transportation Tomorrow Survey (TTS) was used to determine the distribution of the site traffic between the subject site and surrounding areas.

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8.2. FUTURE BACKGROUND TRAFFIC CONDITIONS

The GHD TIS applied background traffic growth to all existing study area roads for the 2019 and 2024 build-outs. A conservative growth rate of 2% per annum was applied to account for regional traffic growth in the area. No other development traffic was added to the surrounding road network.

GHD has clarified in their updated TIS that they have accounted for full buildout (2024) of the Block in their analysis.

8.3 FUTURE TOTAL TRAFFIC CONDITIONS

The GHD Traffic Impact Study expects acceptable future operating characteristics for all study intersections.

The GHD report states that while the impact of the added site traffic to the surrounding road network is likely to be noticeable, it is not expected to significantly deteriorate the operational performance of the network.

The intersections for the proposed roads under 2024 conditions are described in the GHD TIS. All proposed intersections will be free flow or stop controlled. It has been further clarified in the 2019 TIS that the requirements for traffic calming and other intersection control can and will be determined at the Draft Plan Approval Stage.

According to the TIS, delays are expected at the existing all-way stop intersections of McNeilly Road and Lewis Road on Barton Street.

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9 IMPLEMENTATION AND PHASING

This section will highlight the required steps for development to occur within the BSS 3 study area.

9.1 PHASING

Detailed phasing plans have not been developed at this time, as all external infrastructure is generally available to the area with limited extensions required. It is anticipated that development would generally proceed from north to south as this follows the logical extension of services throughout the BSS area (i.e. as it relates to storm drainage / stormwater management and trunk sewer layout). The participation or not of various landowners could affect the exact sequence and may require the construction of temporary measures.

The work shall generally be completed in two (2) phases, which include:

- Phase 1: Municipal ROWs – Barton Street and Lewis Road and Pond 2 (West);
- Phase 2: Remaining subject lands.

The areas included within the two phases are shown in **Figure 5**.

9.2 ENVIRONMENTAL IMPLEMENTATION CONSIDERATIONS

The area covered by this study does not include a Natural Heritage System (NHS). As such there are no specific implementation considerations related to the NHS.

Erosion and sediment control plans will be prepared as required in accordance with HCA and City standards to demonstrate protection of downstream receivers

9.2.1 STORMWATER MANAGEMENT AND EXTERNAL IMPROVEMENTS

The development of the subject lands are primarily constrained by:

- Proximity of existing sanitary sewers;
- Conveyance of existing external storm flows currently draining through the site; and,
- Availability of Stormwater management facilities.

This infrastructure will have to be constructed prior to servicing of the subject lands.

Area 1 will require:

- Extension of a 450 mm sanitary sewer within Barton Street;
- Construction of Stormwater Management Pond 2 (West); and,
- Construction of external conveyance measures to divert external flows currently draining through the site.

Area 2 will require:

- Extension of a 450 mm sanitary sewer within Barton Street.
- Area 3 can be serviced through connections to the existing sewer within Barton Street or the proposed 450 mm diameter sanitary sewer.

Area 4 will require:

- Extension of a 450 mm sanitary sewer within Barton Street; and,
- Construction of Stormwater Management Pond 2 (East).

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Table 9-1 summarizes permitting requirements by project type, although it should be noted that various component projects listed in this table may be combined for approval at detailed design.

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Table 9-1: Summary of Permit/Approval Requirements for BSS 3

COMPONENTS OF WORKS	PERMIT/APPROVAL REQUIREMENTS				
	City of Hamilton	HCA	DFO	MNRF	MECPCC
Channel works including filling / decommissioning, grading, stabilization and restoration and SWM ponds and outfalls	Topsoil stripping permit and approval of detailed design drawings	Ontario Reg. 161/06 permit required	TBD	N/A (a fish rescue permit and / or LOA is not required for the channel decommissioning)	Water Resources Act Certificate of Approval for SWM facilities (MECP ECA)
Servicing / Infrastructure	Approval of engineering design submissions	N/A	N/A	N/A	MECP ECA for watermains, sanitary sewers, and storm sewers.
Dewatering for construction, if required	N/A	N/A	N/A	N/A	PTTW required if dewatering volumes exceed 50,000 L/day; approval for discharge to receiving watercourse required

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10 CONCLUSIONS AND RECOMMENDATIONS

As required in the Stoney Creek Secondary Plan, this study provides the framework for orderly development within the Block 3 area of the Fruitland Winona Secondary Plan area. The following conclusions are made based on the investigations and analysis of the consultant team. Recommendations for subsequent stages of the development planning have been included:

- Based on the Urban Hamilton Official Plan Amendment No. 17 and further detailed investigations, no Natural Heritage System (NHS) is proposed within the subject lands.
- The concept plan has been prepared to support the BSS and is in keeping with the secondary plan.
- The Air Drainage Analysis does not indicate any concerns with the proposed concept plan.
- Soils throughout the site have low infiltration rates, although areas to the south have slightly more recharge potential. Groundwater generally flows to the northeast and will tend to concentrate in watercourses and as sheet flow due to the tight soils. Recommendations for corrosion protection, groundwater management and pond liners will be completed as part of future studies.
- Water Balance for the site will be provided by directing roof drainage to pervious areas/LID.
- The one existing stream warranting fluvial geomorphological analysis will be conveyed in a closed channel as described above.
- The EIS concluded that there were no significant environmental features warranting preservation. Recommendations include the provision of sediment controls during construction and ensuring that vegetation removal occurs outside of the migratory bird breeding window.
- The DFO self-assessment has determined that DFO consultation/approval is not required.
- Area 1 requires the construction of an external flow conveyance system designed for the 100-year storm from external areas south of Highway 8.
- Areas 1 and 4 require the construction of stormwater management facilities (Pond 2 (West) and Pond 2 (East)) for the provision of stormwater quality, quantity and erosion control). Overland flow routes from the condo blocks have been provided.

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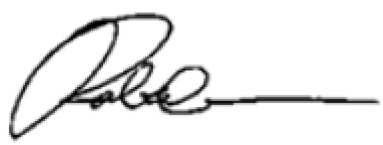
Each individual application will be required to show adequate overland flow routes and/or control to the sewer capacity.

- Future applications within Sub-area 2 will require end of pipe SWM or on-site SWM controls.
- The extension of sanitary sewers within Barton Street is required to provide service to Areas 1 and 4.
- Sanitary service for Area 2 will be provided through an extension of Arvin Avenue. Alternatively pumping to the Barton Street sewer could be considered on a site by site basis.
- The Water Hydraulic Analysis concluded that no external service improvements are required, and the development can be adequately serviced through the construction of local watermains.
- The TIS concluded that no external traffic improvements were required beyond the construction of stop-controlled intersections.



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