Prepared By:

County of Bruce & Town of Saugeen Shores
Bruce County Road 33 Re-Alignment - Addendum: Stormwater Management Facility

Schedule 'B' Environmental Assessment - Project File

GMBP File: 217127

October 8, 2019

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA
1260-2ND AVE. E., UNIT 1, OWEN SOUND ON N4K 2J3 P: 519-376-1805
WWW.GMBLUEPLAN.CA

TABLE OF CONTENTS

FIGURES

TABLES

ENCLOSURES

SCHEDULE 'B' ENVIRONMENTAL ASSESSMENT - PROJECT FILE

BRUCE COUNTY ROAD 33 RE-ALIGNMENT - ADDENDUM: STORMWATER MANAGEMENT FACILITY
COUNTY OF BRUCE & TOWN OF SAUGEEN SHORES

OCTOBER 8, 2019

GMBP FILE: 217127

1. INTRODUCTION

In September 2015, the County of Bruce (County), as the proponent, with the Town of Saugeen Shores (Town), as a principle partner, initiated a Master Plan to plan various road and drainage undertakings within a broad area central to Saugeen Shores along Bruce Roads 25 and 33 (BR25 and BR33) in a comprehensive manner. The intention of the Master Plan was to establish an overall context and to assist with the planning of individual projects toward an appropriate overall development strategy. The *Preferred Master Plan* identified several projects for implementation to address the identified problems and opportunities. One of the projects included the re-alignment of BR33 to intersect BR25 from the south at the same location as the Town's planned alignment of Bruce Street from the north. The Master Plan is available on the County and Town websites for reference.

In January 2018, the County initiated a process under Schedule 'B' of the Municipal Class Environmental Assessment (EA), appropriately to plan the Bruce Road 33 re-alignment as considered in the Master Plan. A *Notice of Completion* to the process was advertised on May 1, 2018; however, on May 27, 2018 a Part II Order (PIIO) was requested by a member of the public, requesting that the Ministry of Environment, Conservation and Parks (MECP) review the planning process. By letter dated January 8, 2019, the MECP indicated that the PIIO request would not be considered since the planning process was not complete, citing that additional review of alternatives to the proposed stormwater management (SWM) facility was necessary prior to the *Notice of Completion* being valid. This correspondence is included in **Enclosure A**.

This Addendum to the *'Bruce County Road 33 Re-Alignment - Project File' (April 2018)* is provided to meet the Schedule 'B' requirements for the conceptual stormwater management facility. The MECP has requested that a Schedule 'B' process be followed for stormwater management, which was previously included as a component of the *Preferred Solution* to the Bruce Road 33 re-alignment, because the previously proposed stormwater management facility was situated within lands that required property acquisition for the road re-alignment. The purpose of this Addendum is to document the additional review of alternatives for SWM associated with the road re-alignment planned in the parent Project File. The Parent Project File (i.e. for the Bruce County Road 33 Re-Alignment) is also available on the County and Town websites for reference.

This Project File Addendum, which facilitates the assessment of the stormwater management facility alternatives and the road re-alignment project under one process, is considered a "living document" and will be updated through the planning process. The *Notice of Project Change,* which outlines the additional work completed for the project, was first issued on October 8th, 2019. This initial version of the Project File Addendum for the Bruce Road 33 Stormwater Management Facility is prepared for circulation to members of the public, various government agencies and aboriginal communities, for consideration and comments. Comments received will be considered in a subsequent update to this Project File Addendum in the final analysis of alternatives, with a recommendation to Council of a *Preferred Solution*.

This Project File Addendum (Version 1; October 8th, 2019) presents the Project Statement for the stormwater management facility; identifies the range of Alternative Solutions considered to address the problem or

opportunity; evaluates the anticipated 'environmental' effects and proposed mitigation; and provides a preliminary assessment and evaluation of alternative solutions and the rationale for the consideration of a *Preliminary Recommended Solution*. This portion of the process is considered to address the Phase 2 Mandatory Public Consultation.

2. MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT PLANNING PROCESS

Municipal infrastructure projects are subject to the Ontario Environmental Assessment Act (EA Act). The Class Environmental Assessment (Class EA) is an approved self-assessment process under the EA Act for a specific group or "class" of projects. Projects are considered approved subject to compliance with an approved Class EA process. The Municipal Class EA (Municipal Engineers Association October 2000, as amended in 2007, 2011 and 2015) applies to municipal infrastructure projects including roads, water and wastewater.

The Municipal Class EA outlines a comprehensive planning process (illustrated in **Figure 2**) that provides a rational approach to consider the environmental and technical advantages and disadvantages of alternatives and their trade-offs in order to determine a *Preferred Solution* to address an identified problem (or opportunity), as well as consultation with agencies, aboriginal communities, directly affected stakeholders and the public throughout the process. The key principles of successful environmental assessment planning include:

- Consultation;
- Consideration of a reasonable range of alternatives;
- Consideration of effects on natural, social, cultural, and economic environments and technical components;
- Clear documentation;
- Systematic evaluation;
- Traceable decision making.

The classification of projects and activities under the Municipal Class EA is as follows:

Schedule A: Includes normal or emergency operational and maintenance activities, which are limited in scale and have minimal adverse environmental effects. These undertakings are pre-approved, and the proponent can proceed without further assessment and approval.

Schedule A+: Introduced in 2007, these minor projects are pre-approved. The public is to be advised prior to the implementation of the project.

Schedule B: Includes projects which have the potential for adverse environmental effects. This includes improvements to, and minor expansions of, existing facilities. These projects are approved subject to a screening process which includes consulting with stakeholders who may be directly affected and relevant review agencies.

Schedule C: Includes the construction of new facilities and major expansions to existing facilities. These undertakings have the potential for significant environmental effects and must proceed under the planning and documentation procedures outlined in the Municipal Class EA document.

This Schedule 'B' Project File Addendum, which addresses the Schedule 'B' assessment process for the stormwater management facility associated with the Bruce Road 33 road re-alignment (i.e. the parent project), includes documentation of the Schedule 'B' EA process specific to the stormwater management facility, which is in accordance with the requirements of the Municipal Class EA process and includes Phases 1 and 2, depicted on **Figure 2**:

- Phase 1 consists of identifying the problem or opportunity, and optional (discretionary) public consultation if deemed suitable.

- Phase 2 involves identifying reasonable alternatives to the problem or opportunity, compiling an inventory of the natural, cultural, social, technical and economic environments, evaluating each alternative and recommending a preferred alternative that will address the problem, and provide any measures necessary to mitigate potential environmental impacts. As part of the Phase 2 process, public and agency consultation is required before the preferred solution is selected to ensure all possible impacts are identified, and assessed, as part of the evaluation process. A summary of the key comments/feedback obtained during the Phase 2 consultation period is provided.

For Schedule 'B' or 'C' projects, a *Notice of Project Initiation* (or *Notice of Project Change*) is advertised and the *Preferred Solution* (and for Schedule 'C' projects, the *Preferred Design)* is developed through the process; to be confirmed by Council. The entire process is documented in a Schedule 'B' Project File, or Schedule 'C' Environmental Study Report, which is made available for public and agency review during a 30 calendar day period following the issuance of the *Notice of Completion*. Project Notices specific to this Project File Addendum are provided in **Enclosure B**.

For Schedule 'B' or 'C' projects, if concerns are raised during the 30 calendar day review period, following advertisement of the *Notice of Completion*, that cannot be resolved through discussions with the County and the Town, then members of the public, interested groups or technical agencies may request the Minister of the Environment, Conservation and Parks (MECP) to issue a '*Part II Order'* for the project. Within the Part II Order request, the Minister may be requested to refer the matter to mediation, impose additional project conditions, and/or request an elevated scope of study. A Part II Order request requires the completion of a 'Part II Order Request' Form (i.e. form ID No.012-2206E). The form can be found online on Service Ontario's Central Forms Repository website (http://www.forms.ssb.gov.on.ca/) by searching 'Part II Order' or '012-2206E' (i.e. the form number). It is noted that the Part II Order process outlined herein supersedes that outlined in Section 2 of the Parent Project File.

The completed form and any supporting information must be submitted to the MECP (formerly the MOECC), prior to the end of the 30 calendar day review period, outlining the unresolved issue and requesting the Minister to review the matter.

Part II Order requests are submitted to:

Minister, Ministry of the Environment, Conservation and Parks
Ferguson Block, 77 Wellesley Street West, 11th Floor
Toronto, ON M7A 2T5
Fax: 416-314-8452
Minister.MECP@ontario.ca

Copies of the request must also be sent to the Director of the Environmental Approvals Branch at the MECP and to the County of Bruce at the addresses below:

Director, Environmental Assessment and Permissions Branch
Ministry of the Environment, Conservation and Parks
135 St. Clair Avenue West, 1st Floor
Toronto, ON M4V 1P5
enviropermissions@ontario.ca

County of Bruce
Attn: Kerri Meier, Environmental Coordinator
30 Park Street
P.O. Box 398, Walkerton, ON N0G 2V0
kmeier@brucecounty.ca

The decision whether or not a Part II Order is appropriate or necessary rests with the Minister of the Environment, Conservation and Parks. If no Part II Order request is outstanding by the end of the 30 calendar day review period, the project is considered to have met the requirements of the Class EA, and the County may proceed to design and construct the project subject to resolving any commitments documented in this Project File during the subsequent design phases and obtaining any other outstanding environmental approvals. For further information regarding Part II Order requests and process, please refer to:
https://www.ontario.ca/environment-and-energy/class-environmental-assessments-part-ii-order

3. BACKGROUND

3.1 Master Plan

The County of Bruce proposes to reconstruct the existing BR25 roadway, between Saugeen Beach Road and Goderich Street, as well as to construct a new roadway to re-align BR33 to intersect BR25 at the planned extension of Bruce Street, as illustrated on **Figure 1**. More specifically, as outlined in the parent Project File, the re-aligned BR33 section is proposed to be constructed from the existing BR33 at a location approximately 190 meters to the south of the existing intersection with Baker Road, to BR25 at a location approximately 535 meters to the east of its current intersection with BR25. Proposed BR33 roadworks include the construction of roadside ditches to convey the runoff from the roadways and their upstream lands. The remaining section of the existing BR33, immediately to the south of Baker Road, is proposed to be reconstructed as a cul-de-sac to maintain access to the private properties, although the final configuration may be altered during the design phase.

The approximately 990m re-aligned BR33 section is generally proposed to be constructed with a two-lane rural cross-section, transitioning to either a two-lane plus a left-turn lane urban cross-section at the intersection of BR25 or a roundabout. The configuration of the intersection of BR25 and BR33 will be addressed as part of the Schedule 'B' Project File for the BR25 urbanized cross-section between Bruce Street and Goderich Street, as identified in the Master Plan. A northerly section of the BR33 re-alignment will drain in a northerly direction to the planned BR25 trunk storm sewer, constructed as Phase 1 of the implementation plan outlined in the Master Plan.

3.2 Project Status

GM BluePlan Engineering Limited (GMBP) was retained to undertake the planning process required to advance the re-alignment of BR33, as identified in the Master Plan for Roads and Drainage (2017). A *Notice of Project Completion* for this project was issued on May 1, 2018. The Parent Project File considered that land acquisition necessary for the planned road re-alignment would also be sufficient to accommodate a SWM facility associated with the road and, therefore, implementation of the planned SWM facility ancillary to the road could proceed as a Schedule 'A' EA activity. In its review, the MECP considered that any land acquisition which would support a SWM facility should be planned as a Schedule 'B' EA activity, including a review of various alternative stormwater management solutions and recommended the following:

i. A *Notice of Project Change* be issued explaining that additional work will be completed.
ii. The completion of the Schedule 'B' requirements for the proposed stormwater management facility including, but not limited to:
    - Consultation with the public and review agencies;
    - Assessment of alternative solutions specific to stormwater management;
    - Identification of potential impacts and provisions for mitigation measures;
    - Documentation of the planning process through an amended Project File report; and
    - Re-issuance of the *Notice of Completion*, including a 30-calendar day consultation period.

This Project File Addendum, although prepared as a 'stand-alone document', forms part of the Project File for the Bruce Road 33 Re-Alignment.

Background studies that have been completed in support of this Schedule 'B' EA process for the stormwater management facility include a Conceptual Stormwater Management Design Brief, which includes a review of alternatives, to identify the impacts of the various stormwater management alternatives (outlined in **Section 7**) and mitigation measures required to address identified impacts. The *'Revised Conceptual Stormwater Management Design Brief'* (September 2019) is included in **Enclosure C**.

4. PROJECT STATEMENT

As previously discussed, the need to advance specific project planning for the re-alignment of BR33 was identified in the Master Plan for Roads and Drainage (May 2017). The basic intentions of the Bruce Road 33 re-alignment and drainage improvements were outlined in the Master Plan.

A component of the proposed road re-alignment project included stormwater management, which had initially been addressed in **Section 6.4.4** of the Parent Project File. A conceptual design, which considered the volume of storage required and the land area requirement sufficiently to accommodate the stormwater management planning, was outlined. However, as it was considered that *'right-of-way lands would be acquired for the BR33 re-alignment under the Schedule 'B' process, implementation of the proposed SWM Pond would proceed as a Schedule 'A' activity as long as no additional property was required'*, it was thought that the detailed design of the SWM facility could be advanced as part of Phase 4 of the EA process. In contrast, the Ministry considered that any land acquisition that would support a SWM facility should be planned as a Schedule 'B' EA activity.

Consequently, a related, but project specific, intention of the process is to develop a preferred stormwater management strategy. Stormwater management alternatives under consideration have project specific triggers for a Schedule 'B' EA process (i.e. property acquisition). As part of the Schedule 'B' process specific to stormwater management, a Project Statement is required and is outlined below.

The Schedule 'B' EA planning process is project specific but follows the same process as for the more general Master Plan. Therefore, in consideration of the significant degree of overlap between the Master Plan and the Schedule 'B' EA for the Bruce Road 33 re-alignment and drainage improvements, the Project Statement outlined below is consistent with that presented in the Parent Project File and was adapted from the Master Plan. It is considered appropriately to address the intentions of the Schedule 'B' processes.

> *'The proponent intends to plan safe and efficient road infrastructure, and to support the Town's transportation initiatives with regard to planned development, within the settlement area boundary, by advancing the preferred BR33 re-alignment initiative, including consideration for drainage improvements along BR33, as documented in the Master Plan for Roads and Drainage (May 2017)'.*

The County is, therefore, completing this Schedule 'B' EA process under the Municipal Class Environmental Assessment to ensure that this project is planned appropriately, and to verify that the preferred solutions identified in the Master Plan remain appropriate specifically for the BR33 re-alignment initiative and the completion of drainage ditch improvements along BR33.

5. OFFICIAL PLANS AND GOVERNANCE

5.1 Planning Considerations and Zoning

As an upper tier government, the County establishes land use planning policies within the Bruce County Official Plan (BCOP June 21, 2010 – office consolidation June 2013). The BCOP identifies land uses with a broad area perspective, including such designations as 'primary urban community', 'agricultural areas' and 'hazard land areas', as illustrated in the Schedule A Land Use Plan. The BCOP also identifies a County-wide transportation plan as illustrated in the Schedule B Transportation Plan. Schedules A and B of the BCOP are provided in **Enclosure D**. BR33 is identified as a 'collector rural road', connecting the 'primary urban community' of Port Elgin with the 'secondary urban community' of the Bruce Nuclear Power Development.

As a lower tier government, the Town establishes more local land use planning policies within the Town of Saugeen Shores Local Official Plan (SSLOP, September 2014). The Schedule A Land Use Plan identifies predominantly residential land uses adjacent to BR25 and BR33. The SSLOP Schedule B Transportation Plan identifies Bruce Street as a proposed collector road to align with a southerly connection to BR33 at the Lot 25/26 boundary. SSLOP Schedule A and B are included in **Enclosure D**.

Both the BCOP and SSLOP identify a southerly limit of the 'planned settlement area' generally at the Lot 28/29 boundary but extending southerly along both the Gore Drain and BR33, where shown on **Figure 1**. The balance of the lands south of the Lot 28/29 boundary are designated as agricultural.

5.2 Road Jurisdiction

Currently, the County is responsible for BR25 from the signalized intersection at Goderich Street (i.e. Highway 21) westerly to the intersection of Saugeen Beach Road at Lake Huron, where shown on **Figure 3**. As per the recommendations of the Master Plan, the County intends to divest the portion of BR25 from the planned Bruce Street intersection westerly to Saugeen Beach Road since more local issues are expected to predominate with planned development within the urban designation. In addition, divestiture of BR33 from BR25 to the confluence between the re-aligned BR33 and remnant Lake Range Road, is considered as part of the re-alignment of Bruce Road 33. Bruce Road 33, as aligned, will remain part of the County road network.

Therefore, upon completion of the Schedule 'B' processes for BR25 and BR33, it is likely that the County (i.e. the proponent) will maintain jurisdiction over BR25 between Highway 21 and the planned Bruce Street/BR33 re-alignment. The portion of BR25 between the planned Bruce Street west to Saugeen Beach Road and the cut-off section of Lake Range Road will be divested to the Town. Further, the Town will maintain jurisdiction over the road network associated with the Baker Subdivision.

5.3 Governance of Lands

While the County will maintain jurisdiction over the BR33 right-of-way, as aligned, the Town will maintain jurisdiction over the surrounding lands. Future development will be governed by the Town and, as per the SSLOP, the availability of adequate municipal services to accommodate increased demand on services including storm drainage, will need to be considered. Further, drainage issues within the *'Planned Development'* lands will need to be addressed as part of detailed design for future development. The SSLOP states the following:

> *'Stormwater management studies shall be required for any new residential development consisting of more than five lots or for commercial or industrial developments with large amounts of impervious area. Such plans may be required for other developments, as determined by the Town, if the area has existing drainage problems or if runoff could significantly affect adjacent lands or water quality. Priority areas for future study include Bruce Road 25. Significant findings and recommendations from these studies will be considered when reviewing new development proposals'.*

6. STORMWATER MANAGEMENT CONSIDERATIONS

6.1 Drainage Area: Base Conditions

Elements considered within the *Preliminary Preferred Master Plan* related to drainage improvements generally addressed three separate drainage areas, and included the following:

1. BR25 Stormwater Management System:
   Based on the recommendations of the Master Plan, the reconstruction of BR25 included a recommendation to install a trunk storm sewer to drain runoff from the roadway and upstream lands, to an outlet at Lake Huron, as follows:
   - Construction of a storm sewer, sized to convey the 1:100-year design flow, extending westerly on BR25 from Goderich Street to Lake Range Road.
   - Construction of a storm sewer in line with BR25, sized to convey the 1:5-year design flow, extending westerly from the Lake Range Road intersection to a new outlet at Lake Huron.
   - Provision for a secondary local storm sewer system on BR25 west of Lake Range Road to collect and treat road runoff prior to discharging to the watercourse outlet west of Shipley Ave.
   - For flows in excess of the storm sewer capacity, provision for a 1:100-year overland flow route within an urban road cross section on BR25 from Lake Range Road westerly to spill to the watercourse west of Shipley Avenue.

   The construction of the trunk storm sewer, west of Ridge Street to an outlet at Lake Huron was substantially completed in the Fall 2019. The works associated with constructing the urban road section and associated storm sewers from Lake Range Road to the future Ridge Street is expected to be completed in 2020. It is anticipated that the remainder of the storm sewer (i.e. extension to Goderich Street/Highway 21) will be constructed at a later date; planned for 2021.

2. Baker Subdivision System:
   The Baker Subdivision is located below the bluff west of BR33 and south of BR25. The Master Plan identified that residential lands in the Baker Road area, to the west of the existing BR33 alignment, occasionally suffer from seasonal flooding issues and currently lack a storm sewer system. Therefore, construction of a local area storm sewer system within the Baker Subdivision was recommended as part of the Master Plan, but to be installed concurrently with a planned sanitary sewer collection system.

3. BR33 Storm Water Management System:
   The Master Plan recommended the completion of drainage improvements along BR33. This Project File Addendum is prepared specifically to consider stormwater management alternatives for the BR33 system. However, it is important to note that capacity to accommodate quantity and quality related considerations for runoff from the north end of the re-aligned BR33 is provided within the BR25 storm sewer system, as shown on **Figure 4**. Further, stormwater management specifically within the Baker Subdivision may be addressed separately from, or in addition to, the BR33 system. However, the drainage conditions through Baker Subdivision should be maintained or improved by the construction of the proposed SWM works associated with the construction of BR33.

6.2 Existing Conditions and Drainage

In general, lands to the south of BR25, west of the Gore Drain Trail and east of Lake Range Road (i.e. the existing BR33), drain downward from east to west. The lands associated with the BR33 re-alignment are zoned as 'Planned Development' and 'Agricultural', as shown on **Figure 1**. Current land use is primarily agricultural.

Runoff from lands east of the Baker Subdivision currently drains across the existing BR33 (Lake Range Road) at two locations; via a 750mm Ø culvert approximately 155m to the south of BR25 and via a 750mm Ø culvert

approximately 50m to the south of Baker Road, where shown on **Figure 4**. Runoff draining to the northerly culvert is conveyed through the area to the north of the Baker Street Subdivision towards BR25 and is not considered to contribute to the identified drainage issues within the Baker Subdivision. Runoff draining to the southerly culvert drains in an open watercourse across private properties to a system of roadside ditches within the Baker Subdivision, and ultimately is conveyed to Lake Huron. Under pre-development conditions it is estimated that approximately 48.45 hectares of upstream lands drain to the Baker Subdivision.

6.3 Post Development Conditions

The proposed re-aligned BR33 will intercept runoff from the lands upstream of the Baker Subdivision (i.e. runoff currently draining to the southerly culvert), as a well as a portion of the lands upstream of the existing northerly 750mm Ø culvert crossing Lake Range Road which, under pre-development conditions, do not drain to the Baker Subdivision. Currently, the developed portions of these lands generally drain to BR25 with only several accessory buildings draining westerly towards the location of the proposed re-aligned BR33. The existing accessory buildings are considered to have negligible imperviousness.

The runoff to be intercepted under post-development conditions from the existing northerly 750mm Ø culvert includes approximately 8.07 hectares of land zoned as 'Residential', 'Planned Development', and 'Highway Commercial'. In consideration of the additional 8.07 ha from within Lot 30, it is estimated that under post-development conditions approximately 56.52 hectares of upstream lands will drain to the Baker Subdivision. The post-development catchment area is outlined on **Figure 5**.

Stormwater management alternatives reviewed within the '*Revised Conceptual Stormwater Management Design Brief*' conservatively include these additional lands to ensure that drainage conditions within the Baker Subdivision are not worsened by runoff associated with development within upstream lands and are improved, if possible. At the design development phase, consideration should be given to overland flow routes to address the 'greater than 100-year' runoff condition, as recommended by the SVCA.

7. ALTERNATIVE SOLUTIONS: STORMWATER MANAGEMENT

The BR33 re-alignment considered in the Master Plan, and further planned within the Parent Project File, would introduce a new impervious surface to a currently pervious area, which would increase the rate of runoff. An increased rate of runoff could result in adverse effects downstream. The Master Plan identified that, under existing conditions, residential lands in the Baker Road area to the west of the existing BR33 alignment occasionally suffer from seasonal flooding issues and currently lack a storm sewer system. Further, runoff from road surfaces may contain contaminants, which could adversely affect the natural environment.

7.1 Stormwater Management Design Criteria

Based on pre-development drainage conditions and correspondence with the SVCA, the Town and the County, the stormwater management criteria used to develop appropriate stormwater management strategies for the BR33 re-alignment included the following:

1. Post-development peak flow rates discharging from the proposed BR33 re-alignment and upstream lands to the Baker Subdivision are to be attenuated to less than, or equal to, pre-development conditions.
2. Stormwater management associated with future development, within the lands zoned as 'Planned Development', may be considered in either the current or future developed state.
3. Enhanced water quality treatment (i.e. 80% total suspended solids removal) is to be provided for runoff draining from the proposed development and its upstream lands prior to draining to the Baker Subdivision.

These criteria were considered within the stormwater management alternatives outlined herein.

7.2 Stormwater Management Alternatives

Alternative solutions considered to address the Project Statement are summarized as follows:

1. Do Nothing
2. Construct a stormwater management facility to manage runoff related only to the BR33 re-alignment.
3. Construct a stormwater management facility to manage runoff from BR33 and future development.
4. Construct a new storm sewer system through the Baker Subdivision to Lake Huron.

7.2.1 Alternative 1: Do Nothing

This alternative represents the construction of the proposed roadworks with no stormwater management controls provided for the attenuation and treatment of runoff draining from the re-aligned BR33 and lands upstream of the Baker Subdivision. The 'Do Nothing' alternative would, at minimum, maintain existing conditions. However, the existing deficiencies could be exacerbated due to the potential for increased peak flows and/or impacts to water quality. While the 'Do Nothing' alternative would not address the stormwater management criteria (outlined in **Section 7.1)**, it is considered as a base-line against which to compare other alternative stormwater management solutions and may be implemented at any time during the planning process prior to implementation of the *Preferred Solution*.

7.2.2 Alternative 2: Construct a SWM Facility to Manage Runoff Related Only to BR33 Re-Alignment

This alternative considers the construction of a stormwater management facility (SWM) to provide attenuation of post-development flows from the 56.52 ha catchment area to less than, or equal to, the pre-development peak flow rates. The SWM is envisioned to be a dry pond-type facility that would include water quality treatment provisions such as a "treatment train" consisting of roadside ditches generally designed to the requirements of an enhanced grass swale. This alternative considers that future development lands located upstream of the Baker Subdivision (post-development) would be responsible for lot-specific stormwater management.

This type of SWM facility was considered in the Parent Project File. A Conceptual Stormwater Management Design Brief describing the SWM facility was prepared and provided in **Appendix B** of the Parent Project File.

7.2.3 Alternative 3: Construct a SWM Facility to Manage Runoff from BR33 & Future Development

This alternative considers the construction of a 'centralized' stormwater management facility to provide for the attenuation of post-development flows for runoff draining from the re-aligned BR33 and lands upstream of the Baker Subdivision to less than, or equal to, the pre-development peak flow rates. This alternative would include the construction of a stormwater management facility that would be sized to receive runoff from the re-aligned BR33 and contributing lands in a developed state (limited to lands zoned as 'Planned Development') and designed to meet the water quality treatment requirements.

The SWM is envisioned as a dry pond-type facility with an infiltration feature to address both peak flow attenuation and water quality treatment requirements. Water quality treatment for the entire post-development catchment area would be provided by a single facility, which would be developed in conjunction with the re-alignment of BR33.

7.2.4 Alternative 4: Construct a New Storm Sewer System through Baker Subdivision to Lake Huron

This alternative considers the construction of a storm sewer system through the Baker Subdivision to convey all post-development runoff from the re-aligned BR33 and upstream lands to a new outlet at Lake Huron. The storm sewer would be designed (i.e. sized) sufficiently to prevent an increase in downstream flows and would include the provision for runoff water quality treatment prior to discharging to the Lake (i.e. Oil-Grit Separator). More specifically, the storm sewer would be designed to provide sufficient capacity to convey the upstream runoff associated with a 100-year design storm event. Options include the following:

Option A: The storm sewer would be designed to support post-development peak flow rates to less than, or equal to, pre-development flow rates. Stormwater management associated with future development of lands located upstream of the Baker Subdivision (post-development) would become the responsibility of the developer(s).

Option B: The storm sewer would be designed to support both the BR33 re-alignment and future development within the post-development catchment area located to the east of the Baker Subdivision. In other words, future development would be permitted to drain uncontrolled to a proposed storm sewer system.

7.3 Summary and Comparison of Alternative Solutions

A summary and comparison of the alternative solutions being considered is provided in the following **Table 1**.

TABLE 1: SUMMARY OF STORMWATER MANAGEMENT ALTERNATIVES

ALTERNATIVE	TYPE OF FACILITY	DESCRIPTION OF DRAINAGE AREA CONSIDERED		WATER TREATMENT (TSS Removal)
		Re-Aligned BR33	Planned Dev. Lands	
Alternative 1	None	Increased runoff to Baker Sub.	Existing condition maintained	None
Alternative 2	SWM Pond	Diverted to SWM Pond	Existing condition maintained	Yes
Alternative 3	SWM Pond	Diverted to SWM Pond	Diverted to SWM Pond	Yes
Alternative 4	Storm Sewer	Diverted to Storm Sewer	Inclusion is optional	Yes

8. BACKGROUND STUDIES

The following background studies were prepared to aid in the evaluation and assessment of the BR33 alternatives and are considered herein to inform the impacts of alternative stormwater management solutions. Copies of these background study reports are provided in **Appendix B** of the Parent Project File.

i) Archaeological Assessment (Stage 1) – Bruce County Road 25 Re-Alignment, Port Elgin, Ontario. Prepared by Mayer Heritage Consultants Inc. (February 2010).

ii) Stage 2 Archaeological Assessment – Regional Road #33 Re-Alignment: Part Lots 27, 28, 29 & 30 Lake Range, Municipality of Saugeen Shores, Former Geographic Township of Saugeen, Bruce County, Ontario. Original Report. Prepared by Scarlett Janusas Archaeology Inc. (June 1, 2017).

iii) Stage 2 Archaeological Assessment – Regional Road #33 Re-Alignment: Part Lots 27, 28, 29 & 30 Lake Range, Municipality of Saugeen Shores, Former Geographic Township of Saugeen, Bruce County, Ontario. Supplementary Documentation: Indigenous Engagement. Prepared by Scarlett Janusas Archaeology Inc. (June 1, 2017).

iv) Scoped Natural Heritage Environmental Impact Study: Bruce County Road 33 Re-Alignment. AWS Environmental Consulting Inc. (July 26, 2017)

v) Geotechnical Investigation: Road Reconstruction/Re-Alignment Projects – Bruce County Roads 25 and 33. Saugeen Shores, Ontario. Prepared by Chung & Vander Doelen Engineering Limited (January 30, 2018).

vi) Bruce County Road 33 Re-Alignment: Conceptual Stormwater Management Design Brief, Saugeen Shores. Prepared by GM BluePlan Engineering (April 2018).

One additional background study was completed specifically to support this Schedule 'B' Project File Addendum. The *'Revised Conceptual Stormwater Design Brief, Saugeen Shores'* (August 2019) includes a review of the stormwater management alternatives and identifies the impacts and mitigation measures required to address the identified impacts. The Revised Conceptual Stormwater Design Brief is included in **Enclosure C**.

A summary discussion of background information is provided in the following sections.

9. INVENTORY OF ENVIRONMENTS

9.1 Cultural Environment

9.1.1 Archaeological Study

Based on the recommendations outlined in the Stage 1 Archaeological Assessment (Mayer, 2010), Scarlett Janusas Archaeology Inc. was retained to complete a Stage 2 Archeological Assessment for the BR33 re-alignment. The assessment was conducted under the 2011 Standards and Guidelines for Consultant Archaeologists (S&G) administered by the Ministry of Tourism, Culture and Sport (MTCS).

The Stage 2 archaeological assessment of the study area was conducted on May 26th, 2017. The study area included an area of 50 meters in width along the proposed BR33 right-of-way. No cultural material or features were identified during the Stage 2 assessment. The report generally concludes that no additional assessment is required for the subject lands. In a letter dated June 30, 2017, the MTCS confirmed the entry of the Stage 2 Assessment Report into the Ontario Public Register of Archaeological Reports. This is included in **Appendix B** of the Parent Project File.

9.1.2 Cultural Heritage Landscape Evaluation

The need for a Cultural Heritage assessment was screened out using the MTCS screening tool, as provided in **Appendix B** of the Parent Project File.

9.2 Social Environment

9.2.1 Impacts to Private Property

As outlined in the Parent Project File, the predominant issue related to the proposed BR33 re-alignment is impacts to property. While land acquisition will be required to support the roadworks associated with the re-alignment of BR33, additional land acquisition may be required depending on the stormwater management alternative selected. The acquisition of privately owned lands specifically required to support the roadworks, previously identified in the Parent Project File, includes the following:

- A 30-meter wide right-of-way along the proposed re-alignment of BR33.
- The remnant portion of Lot 28, to the northwest of the proposed BR33 alignment and east of Lake Range Road, is planned to be acquired for the proposed construction of ancillary works. Ancillary works may include, but not be limited to, a cul-de-sac along Lake Range Road to the south of Baker Road to maintain access to private properties and an extension of Baker Road to the east.

The County initiated discussions with the directly affected landowners in conjunction with the Schedule 'B' process for the Bruce Road 33 re-alignment. At that time all parties generally agreed with the project direction and approach to land purchase for the new right-of-way. Upon confirmation of the *Preferred Solutions* to this

Schedule 'B' EA process for both the BR33 re-alignment and stormwater management, the County will continue (or initiate) discussions with the directly affected landowners and an independent assessor will be retained by the County to establish fair market value for the required lands. The impacts to surrounding properties related to each stormwater management alternative are discussed below.

Alternative 1:

The 'Do Nothing' approach would avoid the requirement for land acquisition.

Alternative 2:

The conceptual design for the management of stormwater, limited to the post-development flows associated with the BR33 re-alignment, considers that the area of land required sufficiently to accommodate stormwater management planning is available within the lands required for the BR33 roadworks, including the remnant land situated in the northwest corner of Lot 28 Lake Range, where shown on **Figure 5**. Therefore, in consideration of the area of lands required to accommodate the BR33 re-alignment, including the proposed construction of ancillary roadworks, no additional land acquisition would be required for the development of a SWM facility with sufficient capacity to address water quantity and quality issues limited to the proposed BR33 re-alignment.

Alternative 3:

This alternative would include the construction of a stormwater management facility that would be sized to receive and treat runoff from the re-aligned BR33 and the post-development contributing lands in a developed state. Under this scenario, the larger developed land area would further increase the rate of runoff, resulting in a need for a larger SWM facility and, as a result, additional property acquisition beyond the minimum necessary to permit the construction of the proposed roadworks (where shown on **Figure 5**). In other words, the area proposed to be acquired for ancillary works associated with the Bruce Road 33 re-alignment, would not sufficiently accommodate a stormwater management facility that simultaneously addresses drainage from the post development catchment area in a developed state. Consequently, additional land acquisition would need to be negotiated by the County to accommodate the additional flows from the private development(s) within the Town of Saugeen Shores.

Alternative 4:

This Alternative considers that the increase in runoff due to the proposed BR33 re-alignment could be managed in a new storm sewer system, with provision for water quality treatment prior to discharging to Lake Huron. The storm sewer alternative considers that the system could be designed to either include for flows from the BR33 re-alignment alone or the combined flows from BR33 and future development within the post-development catchment area located to the east of the Baker Subdivision. As both flows and treatment could be achieved via a variety of options, the system could be designed in such a way that, if preferred, the acquisition of additional lands could be avoided.

9.2.2 Baker Subdivision

The Master Plan identified that residential lands in the Baker Road area, to the west of the existing BR33 alignment, occasionally suffer from seasonal flooding issues and currently lack a storm sewer system. Therefore, construction of a local area storm sewer system within the Baker Subdivision was recommended as part of the Master Plan, but to be installed concurrently with a planned sanitary sewer collection system. The installation of a local area storm and sanitary sewer system within the Baker Subdivision was previously pursued by the Town, however Provincial funding for the project was not approved. The Town has indicated a preference to pursue future opportunities for Provincial funding to make the project economically viable. The management of drainage from the area upstream of the Baker Subdivision will result in no negative impacts and potential improvements to the existing drainage conditions through the Baker Subdivision.

9.2.3 Governance

As previously discussed, the proposed BR33 right-of-way and stormwater management specific to the BR33 re-alignment, will be owned and maintained by the County. However, the surrounding lands fall within the jurisdiction of the Town of Saugeen Shores and will be developed privately, subject to the Town's planning policies.

Alternatives 3 and 4B consider stormwater management for the post-development catchment area (i.e. including lands in the Town's Planned Development Area), in a developed state. The Town lands that fall outside of the County parcel required for the BR33 re-alignment are considered to be of little direct interest to the County. Further, the pre-purchase of the development lands would need to be arranged and administered by the Town; a process that would add complexity (i.e. governance issues), time and cost to the project. Consequently, at this time the Town has indicated no interest in pursuing alternatives that simultaneously address future stormwater management within the Town's area of Planned Development, as the degree or structure of future development in the area is currently unknown.

Therefore, alternatives that permit the implementation of a system solely operated and maintained by the County, allowing for the County to complete the required works on its own initiative, are preferred. The management of stormwater within the Town's planned development lands may proceed at a later date.

9.3 Natural Environment

9.3.1 Natural Heritage Environmental Impact Study

A "Scoped Natural Heritage Environmental Impact Study" (EIS) was completed by AWS to further inform the Environmental Assessment for the re-alignment of Bruce Road 33. This study was completed to characterize and document natural heritage features and species at risk (SAR) within the study area and to assess impacts. The report concluded that, since the lands are currently cultivated, the potential for SAR species is low. However, should the land use change from active cultivation to fallow prior to road construction, then an updated SAR review may be necessary to support the construction phase.

Further, the study area considered within the EIS did not address the potential for additional land acquisition required for a larger scale SWM facility. Therefore, a SWM alternative that includes the acquisition of addition lands beyond the area proposed for the BR33 re-alignment, including the lands required for ancillary works, would require that the EIS be updated to confirm the natural heritage features. However, based on the similar land use and site features, it is anticipated that the findings and recommendations would be similar.

9.3.2 Saugeen Valley Conservation Authority

The Study Area is located within the jurisdiction and Screening Limits of the Saugeen Valley Conservation Authority (SVCA). Following the *Notice of Project Initiation* (January 2018) for the Parent Project File, the SVCA completed a review in accordance with the Environmental Planning and Regulations Policies Manual (May 2017). The main comment specific to the approach to stormwater management within the study area generally indicated that runoff events, larger than the '100-year event', be considered given the sensitive receptors in the area. Ultimately, at the design development phase, the project should consider addressing these issues.

SVCA correspondence issued in relation to the Part-II Order request echoed the above comment. Correspondence received following the initial issuance of the *Notice of Completion* (May 2018) for the re-alignment of BR33 is provided in **Enclosure A**.

9.3.3 Storm Water Quality Treatment

Water quality treatment is required to an enhanced level for, at minimum, runoff draining from the re-aligned BR33 and post-development lands upstream of the Baker Subdivision. However, some alternative solutions presented herein also consider the management of stormwater quantity and quality for runoff from post-development contributing lands in a developed state. The water quality control measures considered by each alternative were evaluated in the *'Revised Conceptual Stormwater Management Design Brief"* as follows:

Alternative 1:

As part of the 'Do Nothing' approach no stormwater management controls would be provided for the attenuation and treatment of runoff. Therefore, the water quality associated with runoff draining from the re-aligned BR33 and lands upstream of the Baker Subdivision would be expected to be adversely affected as contaminants from the proposed roadworks would be conveyed downstream without treatment.

Alternative 2:

Water quality treatment for drainage specific to the re-alignment of BR33 and post-development lands upstream of the Baker Subdivision (in an undeveloped state) was considered to be addressed via a treatment train approach. In other words, sufficient treatment capacity would be provided by flow through enhanced grass swales which would convey runoff to the stormwater management facility where it would be further polished. The SWM facility would be designed as a dry pond-type facility and would provide temporary volume to store runoff. The control provided by the outlet of the SWM facility would serve to reduce the velocity of flows discharging to the Baker Subdivision and encourage further settling out of suspended solids. Using this approach, it is expected that the runoff from the proposed roadworks would receive an enhanced level (i.e. 80% TSS removal) of water quality treatment prior to discharging to the Baker Subdivision drainage system.

Alternative 3:

This alternative requires consideration for water quality treatment for runoff from the BR33 re-alignment and the post-development lands upstream of the Baker Subdivision in a developed state. As the volume of runoff (peak flow) draining to the proposed roadworks would be expected to be greater than the capacity that could be treated via a conveyance control (i.e. grass swale), enhanced grass swales were not considered to be a feasible SWM control under this alternative. Therefore, water quality treatment provided via an "end of pipe" approach, such as within a stormwater management pond was proposed. The minimum required area (i.e. footprint) for such a facility is generally governed by the storage volume required for the attenuation of peak flows. Following a review of various types of SWM facilities, a dry-pond with a sub-surface infiltration feature for water quality treatment was considered as it requires the smallest area. However, as previously discussed, the minimum footprint area of approximately 9,430 m^3 for the dry-pond is still greater than that available in the area proposed to be acquired for the ancillary works, therefore additional land acquisition would need to be negotiated.

Alternatives 4A/4B:

Water quality treatment is considered to be addressed via an oil-grit separator (OGS) unit installed in-line with a storm sewer system designed to direct flows from the re-aligned BR33 and post-development lands upstream of the Baker Subdivision, either in an undeveloped state (i.e. Option A) or developed state (i.e. Option B), through the subdivision and discharging to Lake Huron. Based on the assessment provided in the Conceptual SWM Plan (August 2019), it is not expected that a standard OGS unit (i.e. pre-designed) could provide sufficient water quality treatment for runoff from the subject area. While custom Stormceptor MAX units can be designed to meet site-specific needs, the potential application of this technology remains unknown and could be further evaluated should the County decide to further pursue this alternative. Alternatively, multiple water quality treatment provisions would be required to address the design criteria.

9.3.4 Source Water Protection and Climate Change

As part of the EA process, this project was reviewed with respect to the requirements under the Clean Water Act, 2006. The study area is located within the Saugeen Valley Source Protection Area and falls under the Saugeen-Grey Sauble-Northern Bruce Peninsula Source Protection Plan. Based on the Saugeen, Grey Sauble and Northern Bruce Peninsula Source Protection Vulnerable Areas Mapping Application, the Study Area is situated within a Significant Groundwater Recharge Area (SGRA) and a Highly Vulnerable Aquifer (HVA) with a vulnerability score of 6. The SVCA Risk Management Office has been consulted via the *Notice of Project Change*. Based on previous consultation efforts associated with other projects in the area, it is not anticipated that Source Water Protection will be considered to be a significant issue for this project.

The natural environment also includes potential impacts of the project on Climate Change, and of Climate Change on the project. As outlined in the Parent Project File, the project intends to reduce travel time and improve travel safety, which would result in reduced greenhouse gas emissions. Further, considering that the project is intended simultaneously to resolve drainage issues, runoff events greater than the 100-year event may be considered in the design of the stormwater management facility in order to factor in the potential effects of climate change on the project. The proposed BR33 re-alignment is across lands, which are currently cropped. In consideration of public comments received, the proponent has committed to a landscaping plan that will include trees along the new alignment to provide shade and snow screening.

9.4 Technical Environment

9.4.1 Geotechnical Investigation

A geotechnical investigation was completed by Chung & Vander Doelen Engineering to inform the proposed reconstruction of Bruce Road 25 and the proposed re-alignment of BR33. As part of the investigation, recommendations regarding the replacement and construction of underground servicing along BR25 and the southern extent of BR33 to depths in the order of 3 to 5 meters were requested. Borehole data was referenced to confirm sub-surface soil and groundwater conditions. No geotechnical or environmental issues were identified that would affect the construction of a stormwater management facility. However, CVD recommended that groundwater and soil conditions be further examined prior to construction. The report is included in **Appendix B** of the Parent Project File.

9.4.2 Technical Considerations

The proposed BR33 re-alignment will intercept runoff from a portion of the lands upstream of the Baker Subdivision as well about 8.07 hectares of land that are currently situated upstream of the northerly culvert crossing Lake Range Road, which under pre-development conditions, do not drain to the Baker Subdivision. Therefore, under post-development conditions, approximately 56.52 ha of upstream land is expected to drain to the Baker Subdivision.

From a technical perspective, alternatives that best address the stormwater management design criteria for the post-development catchment area, outlined in **Section 7.1**, are considered preferable. The criteria considered generally include the following:

i. Water Quantity Management: Post-development peak flow rates are to be attenuated to less than, or equal to, pre-development conditions.

ii. Area Serviced: Stormwater management for lands zoned as ‘Planned Development’ may be considered in either the current or future developed state.

iii. Water Quality Treatment: Enhanced water quality treatment (i.e. 80% total suspended solids [TSS] removal) is to be provided.

An evaluation of the alternatives being considered compared to the stormwater management criteria is provided in the following **Table 2**.

TABLE 2: TECHNICAL REVIEW AND COMPARISON OF ALTERNATIVES

CRITERIA		i: Water Quantity Management			ii: Area Serviced		iii: Water Quality Treatment		Applicability of Alternative: SWM Criteria Addressed
ALTERNATIVE		SWM Facility Storage Volume (m^3)	Storm Sewer System	Road Restoration	BR33 Re-Alignment	Future Development	Treatment	Type of Treatment	
1	Do Nothing	None	None	No	No	No	No	None	**None**
Stormwater Management Facility									
2	Limited to BR33 Re-alignment.	±8,500	Not Applicable	No	Yes	No	Yes	Pre-treatment: Enhanced Grass Swales	**All**
3	Considers future development in Planned Dev. Lands.	±19,000	Not Applicable	No	Yes	Yes	Yes	Infiltration within SWM facility	**All**
Storm Sewer System through the Baker Subdivision to Lake Huron									
4A	Limited to BR33 Re-alignment.	Not Applicable	±685 meters		Yes	No	TBD	OGS unit not commercially available. Requires further assessment.	**i and ii Only; iii = TBD**
4B	Considers future development in Planned Dev. Lands.	Not Applicable	±685 meters		Yes	Yes	TBD		

Based on the assessment provided in **Table 2**, Alternatives 2 and 3 fully satisfy the design criteria and, as such, are considered preferable from a technical perspective.

With respect to consideration for the Town's Planned Development lands, while the future development plans are considered by the stormwater management alternatives developed to address the water quantity and quality issues associated with the County's proposed BR33 re-alignment, the potential benefits that may be achieved by factoring in the added size and complexity associated with a system that could potentially accommodate the Town's future development plans are further evaluated in **Table 4**.

9.4.3 Efficacy of System Design

While conceptual designs of SWM systems that include for drainage from within the Town's planned development lands are considered, the efficacy of such a system to sufficiently accommodate future flows is uncertain due to the lack of details regarding the future development plans. Therefore, stormwater management within any future development would still need to be evaluated, and additional stormwater management provisions may still be required.

9.5 Economic Environment

The economic environment considers relative construction costs. The conceptual construction costs were considered in the *'Revised Conceptual Stormwater Management Design Brief'* and are summarized herein. The conceptual construction costs presented in this Project File Addendum only consider the required stormwater management features associated with each alternative solution and do not include costs associated with land acquisition. Further, the cost associated with the roadworks for the re-alignment of BR33 are not included as they are considered to be relatively constant among the alternative solutions. It is noted that the 'Do Nothing' option would likely lead to future costs.

The conceptual construction costs of the alternative solutions considered the excavation and construction of the SWM facility, storm sewer installation, manholes, road restoration and OGS unit installation, as applicable. However, while the costs associated with land acquisition, beyond that already required for the proposed BR33 re-alignment including the remnant portion of Lot 28, are not included, additional land acquisition requirements are noted in the following **Table 3**.

TABLE 3: SUMMARY OF CONCEPTUAL CONSTRUCTION COSTS FOR EACH ALTERNATIVE

SWM Design	Description of Alternative	Conceptual Cost	Land Acquisition*
Alternative 1	Do Nothing	$0	No
Alternative 2	SWM facility limited to the management stormwater from the re-alignment of BR33.	$200,000 to $250,000	No
Alternative 3	SWM facility that includes for stormwater management from the post-development catchment area, in a developed state.	$600,000 to $800,000	Yes
Alternative 4A	Construction of a storm sewer system through the Baker Subdivision to Lake Huron limited to the management of stormwater from the BR33 re-alignment.	$4.5M to $5.0M	No
Alternative 4B	Construction of a storm sewer system through the Baker Subdivision to Lake Huron that includes for stormwater management from the post-development catchment area, in a developed state.	$5.0M to $5.5M	No

Notes:
1. *Land acquisition is only noted for lands that are additional to that required for the BR33 re-alignment.
2. Alternatives that consider the management of stormwater from both the County Road BR33 and the Town's Planned Development Lands, in a developed state, would require an agreement between the County and the Town. Cost-sharing would need to be negotiated.

It is noted that cost estimates were prepared with limited design details and are based on probable conditions affecting the project. Therefore, cost estimates are intended the reflect the approximate magnitude of the project costs. A more detailed assessment of overall project costs will be completed as part of the design phase.

As shown in **Table 3**, with the exception of Alternative 1, which is considered to be technically inadequate as it would not address the identified drainage issues within the Baker Subdivision, the least costly alternative solution is Alternative 2. Further, the final costs associated with Alternative 3 are expected to be greater than that presented due to the additional land acquisition requirements associated with the larger footprint area required to manage the stormwater from the Town's planned development lands in a developed state.

10. ASSESSMENT OF ALTERNATIVES

The Municipal Class EA outlines a comprehensive planning process (illustrated in **Figure 2**) that provides a rational approach to consider the advantages and disadvantages of various alternatives and their trade-offs in order to determine a *Preferred Solution* to address an identified problem (or opportunity), as well as consultation with agencies, directly affected stakeholders and the public throughout the process.

The EA Addendum for Bruce Road 33 is being completed to assess the alternatives for the management of stormwater from the proposed BR33 re-alignment. More specifically the management of runoff intercepted from the lands upstream of the Baker Subdivision, under post-development conditions, an area of approximately 56.52 ha. Since a 'Do Nothing' approach is considered technically inadequate as it does not address the identified drainage issues within the Baker Subdivision, which is considered inappropriate, consideration and a decision for action will be necessary moving forward.

The background studies were prepared help to inform the impacts each alternative would have on each of the environments. The process toward the selection of a *Preliminary Recommended Solution* involved the following:

i. Identification of the impacts and mitigating measures of an alternative solution on each environment,
ii. An assessment of the degree of impact each alternative would have on each environment, and
iii. An evaluation based on comparative analysis of the alternative which best addresses the Project Statement.

The following summarizes the impacts and assessment of each of the alternative solutions on each of the environments by providing a relative ranking of the 4 alternatives (not including the Do Nothing alternative); numbered between 1 and 4, with 1 being the least favoured and 4 being the most favoured in each case. Ultimately, the alternative with the highest total ranking would be considered as the *Recommended Solution*.

The following **Table 4** presents a summary of the assessment of alternative solutions.

TABLE 4: ASSESSMENT OF STORMWATER MANAGEMENT ALTERNATIVES: BRUCE ROAD 33 RE-ALIGNMENT

Environment	Alternative 2 SWM Facility BR33 Re-Alignment	Alternative 3 SWM Facility BR33 + Future Development	Alternative 4A Storm Sewer System BR33 Re-Alignment	Alternative 4B Storm Sewer System BR33 + Future Development
SOCIAL				
1. Impacts to Private Property	The area of land required sufficiently to accommodate a SWM facility is available within the lands required for the BR33 roadworks, including the remnant land situated in the northwest corner of Lot 28 Lake Range. Therefore, no additional land aquisition would be required.	The footprint area required to sufficiently address stormwater management would require additional land acquisition beyond that identified for the re-alignment of BR33. This may not be supported by the subject land-owner.	A storm sewer system could be designed in such a way that, if preferred, the acquisition of additional lands could be avoided.	
2. Baker Subdivision	The management of drainage from the area upstream of the Baker Subdivision will result in improvements to the existing drainage conditions through Baker Subdivision.			
3. Governance	COUNTY. Stormwater management provisions would not require long-term agreements between the County and the Town.	COUNTY and TOWN. Stormwater management provisions would not require long-term agreements and cooperation between the County and the Town.	COUNTY. Stormwater management provisions would not require long-term agreements between the County and the Town.	COUNTY and TOWN. Stormwater management provisions would not require long-term agreements and cooperation between the County and the Town.
Ranking	**3.5**	**1**	**3.5**	**2**
NATURAL				
1. Natural Heritage Features & Species at Risk	Since lands are currently cultivated, the potential for species at risk is low.	Since lands are currently cultivated, the potential for species at risk is low. Land aquisition would require additional assessment.	The potential for species at risk is low. No additional investigations are required in existing roadway.	
2. Ability to resolve existing drainage issues in Baker Subdivision.	A SWM facility designed to intercept and control flows from the re-aligned BR33 and upstream lands within the post-development catchment area would serve to improve drainage conditions in the Baker Subdivision.	A SWM facility designed to, at minimum, intercept and control flows from the re-aligned BR33 and upstream lands within the post-development catchment area would serve to improve drainage conditions in the Baker Subdivision.	A storm sewer system designed to intercept and divert flows from the re-aligned BR33 and upstream lands within the post-development catchment area would serve to improve drainage conditions in the Baker Subdivision.	A SWM facility designed to, at minimum, intercept and divert flows from the re-aligned BR33 and upstream lands within the post-development catchment area would serve to improve drainage conditions in the Baker Subdivision.
3. Storm Water Treatment	Would be addressed via a treatment train approach. SWM Pond could be designed as a pond type facility to store and control flows discharging to the Baker Subdivision.	Water quality treatment could be addressed within a stormwater management pond. SWM facility could be designed as a dry pond with a subsurface infiltration feature.	Water quality is considered to be potentially addressed via an oil grit separator unit installed in-line with a storm sewer system. However, based on preliminary assessments a pre-designed OGS unit would not be available. The potential for the application of a custom OGS unit remains unknown. Alternatively, multiple water quality treatment provisions could be considered to address the design criteria.	
Ranking	**4**	**3**	**1.5**	**1.5**
CULTURAL				
1. Archaeological	The Stage 2 Archaeological Assessment concluded there are no archaeological resources in the vicinity of the Bruce Road 33 re-alignment.			
2. Cultural Heritage	The need for a Cultural Heritage Assessment was screened out using the MTCS screening tool.			
Ranking	**Net neutral for all alternatives considered.**			
TECHNICAL				
1. Technical Considerations (i.e. Ability to Satisfy Design Criteria)	Can be designed to sufficiently address the post-development water quantity and quality issues identified.	Can be designed to sufficiently address the post-development water quantity and quality issues identified.	Storm sewer system may be designed to sufficiently address the water quantity issues identified. However, a 'custom' OGS unit would be required for water quality treatment. Potential application of this technology remains unknown.	Storm sewer system may be designed to sufficiently address the water quantity issues identified. However, a 'custom' OGS unit would be required for water quality treatment. Potential application of this technology remains unknown.
2. Efficacy of Design	Based on the post-development conditions identified, a stormwater management facility could be designed to sufficiently accommodate runoff associated with the re-alignment of BR33.	Due to the lack of details regarding the Town's future development, stormwater management within any future development would still need to be evaluated and additional stormwater management provisions may still be required.	Based on the post-development conditions identified, a storm sewer system could be designed to sufficiently accommodate runoff associated with the re-alignment of BR33.	Due to the lack of details regarding the Town's future development, stormwater management within any future development would still need to be evaluated and additional stormwater management provisions may still be required.
3. Timing	Would not have an impact on the schedule developed as part of the Master Plan.	Pre-purchase of lands associated with development within the Town would need to be arranged and administered by the Town, adding time and costs to the project.	Timing would be tied to the construction of the sanitary sewer system which would cause project delaysand would be dependent on Provincial funding.	
Ranking	**4**	**2.5**	**2.5**	**1**
ECONOMIC				
1. **Relative Construction Costs**	$200,000 to $250,000	$600,000 to $800,000	Approximately $4.5M to $5.0M	Approximately $5.0M to $5.5M
2. **Contributors (Budget)**	County	Agreement would be required between the County and the Town. Additional land is of little direct interest to the County.	County	Agreement would be required between the County and the Town.
3. **Land Acquisition**	SWM facility could be accomodated within the area idenfied in the Parent Project File for the re-alignment of BR33.	SWM Facility would require additional land acquisition due to the larger footprint area required to manage the greater volume of flows.	Stormwater management system could be accomodated within the existing (i.e. Baker Subdivision) and proposed (i.e. BR33) right-of-ways.	Stormwater management system could be accomodated within the existing (i.e. Baker Subdivision) and proposed (i.e. BR33) right-of-ways.
Ranking	**4**	**1**	**3**	**2**
OVERALL RANKING	**15.5**	**7.5**	**10.5**	**6.5**

Relative Ranking of Environments: Favoured and/or Positive Impact | Net Neutral | Least Favoured / Negative Impact

11. RECOMMENDED SOLUTION

Based on the results of the relative ranking presented in **Table 4**, Alternative 2, to construct a stormwater management facility to manage runoff from the re-alignment of BR33, is identified as the *Preliminary Recommended Solution*. Conceptually, Alternative 2 proposes the following SWM elements:

- Future development within lands upstream of the Baker Subdivision will be responsible for managing its own stormwater, beyond a pre-development condition.
- Construction of roadside ditches generally designed to the requirements of an enhanced grass swale to convey and treat runoff prior to discharging to a proposed SWM facility.
- The proposed construction of a dry pond-type SWM facility to further polish runoff and attenuate peak flow rates to less than, or equal to, pre-development conditions prior to discharging to the Baker Subdivision.

The *Preliminary Recommended Solution* is circulated with this version of the Project File Addendum to the public, agencies, and aboriginal communities for review and comment. Comments regarding the *Preliminary Recommended Solution* will be considered and presented in an updated Project File Addendum, which will present a *Recommended Preferred Solution,* for consideration and acceptance (or otherwise) by Council.

12. CONSULTATION

Consultation early in and throughout the process is a key feature of environmental assessment planning. The Schedule 'B' Municipal Class EA process has two mandatory points of contact; the *Notice of Project Initiation* (Consultation - Phase 2) and the *Notice of Completion*.

In conjunction with project planning limited to the re-alignment of BR33 (i.e. the Parent Project File), a *Notice of Project Initiation* was issued on January 9, 2018. Several comments from the public and agencies were received through the consultation process, as outlined in Section 8 of the Parent Project File. These were incorporated into the assessment of alternatives considered at that time. The *Notice of Completion* was subsequently issued on May 1, 2018 outlining the *Recommended Preferred Solution*: to re-align BR33 to intersect BR25 at the location of the future Bruce Street.

On May 27, 2018, the Minister of the Environment, Conservation and Parks received one Part-II Order request. However, as the Minister interpreted that the proposed stormwater management works required to service the new alignment of Bruce Road 33 would be within the property acquisition required for the re-alignment of BR33, it was determined that an assessment of the stormwater management alternatives should also be completed in accordance with the Schedule 'B' procedures of the MCEA. As the review of stormwater management alternatives is considered to form a component of the BR33 re-alignment, the Ministry recommended that a *Notice of Project Change* be issued.

12.1 Notice of Project Change

A *Notice of Project Change* was first issued on October 8th, 2019. A copy of the Notice is provided in **Enclosure B**. This Notice outlines that additional work was required for the completion of the Schedule 'B EA process for the re-alignment of BR33 and provides the Preliminary Recommended Solution for stormwater management.

Consistent with the consultation processes previously completed, the Notice was advertised in the Shoreline Beacon Newspaper on October 8th and October 15th, 2019 and was circulated to utility companies and various agencies via email. The Notice was also mailed to directly affected property owners within the Study

Area, as well as to individuals engaged in previous project planning on October 8th, 2019. A Figure outlining the Notification Area is provided in **Enclosure B**.

The Notice invites the public, agencies and aboriginal communities to review this version of the Project File Addendum (i.e. Version 1) and to comment on the *Preliminary Recommended Solution*. Comments received will be incorporated into the review and assessment of alternatives in the Project File Addendum (Version 2), to be issued at a later date.

The *Notice of Completion* is to be issued following acceptance by Council of the *Preferred Solution*. The *Notice of Completion* will initiate the 30 calendar day review period for the BR33 Project File, during which time the Minister of the Environment, Conservation and Parks may be requested to issue a Part II Order to the County to complete further study on the Schedule 'B' project, as outlined in **Section 2**.

12.2 Consultations

12.2.1 Public Consultation

With the circulation of this version of the Schedule 'B' EA Project File Addendum, the public are invited to provide comments regarding the *Recommended Preferred Solution* for the stormwater management requirements for the proposed BR33 re-alignment. Comments received will be summarized in this section. Upon receipt and review of all comments, the review of alternatives will be re-visited, and any new information will be incorporated into the re-assessment of the *Recommended Preferred Solution*, for consideration and acceptance (or otherwise) by Council.

12.2.2 Agency Consultation

Agencies with a regulatory role that may require future permits/approvals, or may have a direct interest in the study, are to be contacted at each 'mandatory point of contact' required as part of the EA process to invite feedback. This version of the Schedule 'B' Project File Addendum was circulated to select key agencies/groups on October 8th, 2019 to solicit agency comments and feedback, which will be incorporated into further assessment of the *Recommended Preferred Solution* for consideration and acceptance (or otherwise) by Council. A complete List of Agencies contacted is provided in **Enclosure B**, but they include the following:

- Saugeen Valley Conservation Authority (SVCA)
- Bruce County Planning and Transportation Departments
- Ministry of Transportation
- Ministry of the Environment, Conservation and Parks (MECP)
- Aboriginal Communities
- Utilities

Comments received from the agency groups will be summarized in this section.

13. NEXT STEPS

This Project File Addendum is issued under Phase 2 - Step 5, as a mandatory point of public contact under the Municipal Class Environmental Assessment process. Next steps in the process include the following:

i. The Project File Addendum is circulated to directly affected landowners, agency groups, and Aboriginal Communities. Comments will be received by the Project Team until November 1, 2019.

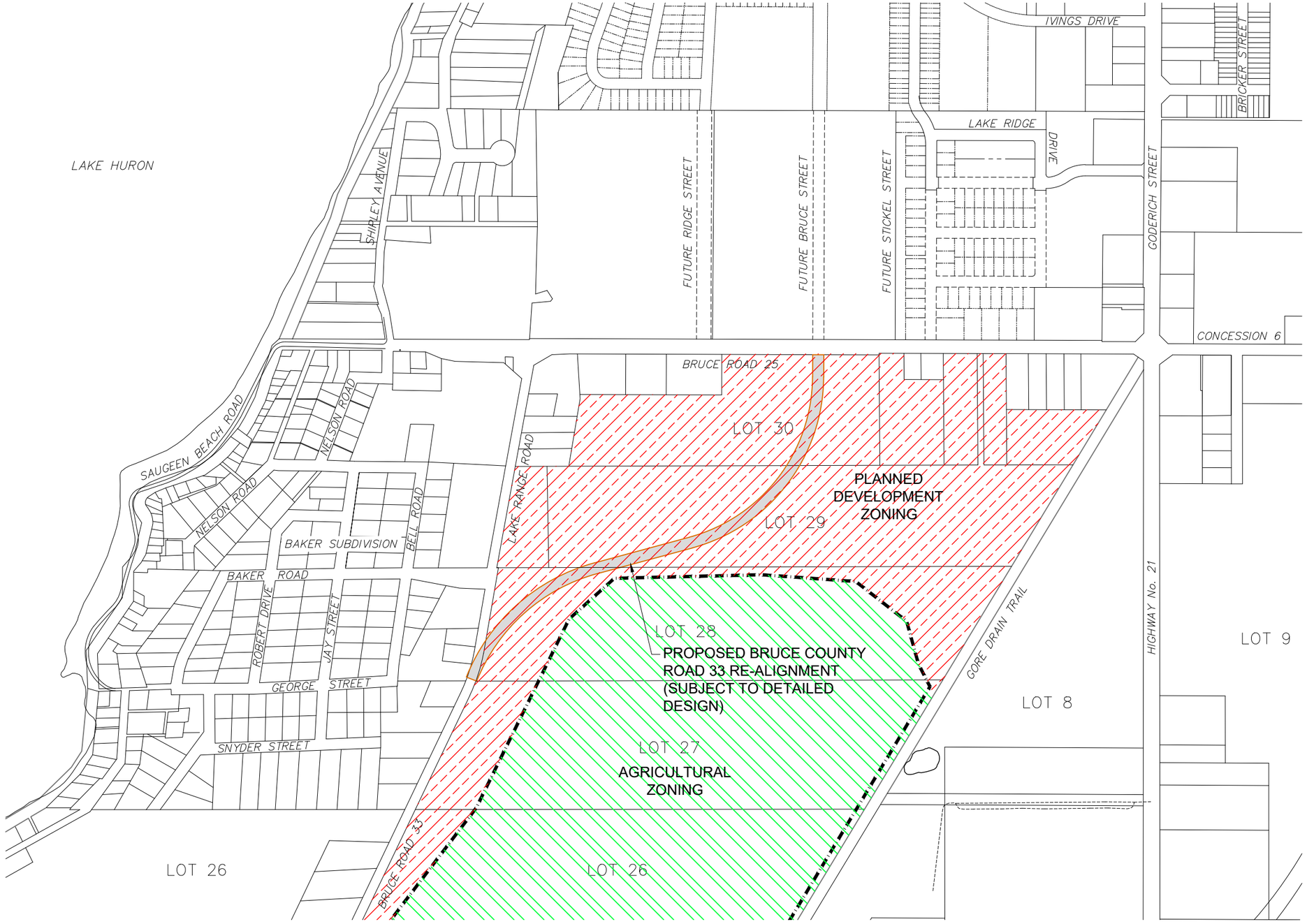
ii. Following the consultation period, any new information received will be incorporated into the Project File Addendum, and the assessment of alternatives and the *Recommended Solution* will be updated for Council to consider as a *Preferred Solution*.

iii. Upon acceptance (or otherwise) by Council of the *Preferred Solution*, the Project File will be finalized, and a *Notice of Completion* will be advertised, advising participants of the outcome to the Schedule 'B' EA process.

iv. A 30-day Public Review Period will follow the *Notice of Completion* date to permit the opportunity for any participant to request the Minister to enact Part II of the Act (i.e. a Part II Order), which would require additional study to verify the project direction.

FIGURES:

217127
Bruce County Road 33
Re-Alignment
SWM Addendum
Town of Saugeen Shores
County of Bruce



LEGEND

PLANNED DEVELOPMENT

AGRICULTURAL

NOT TO SCALE
SEPTEMBER 2019

SITE LOCATION PLAN

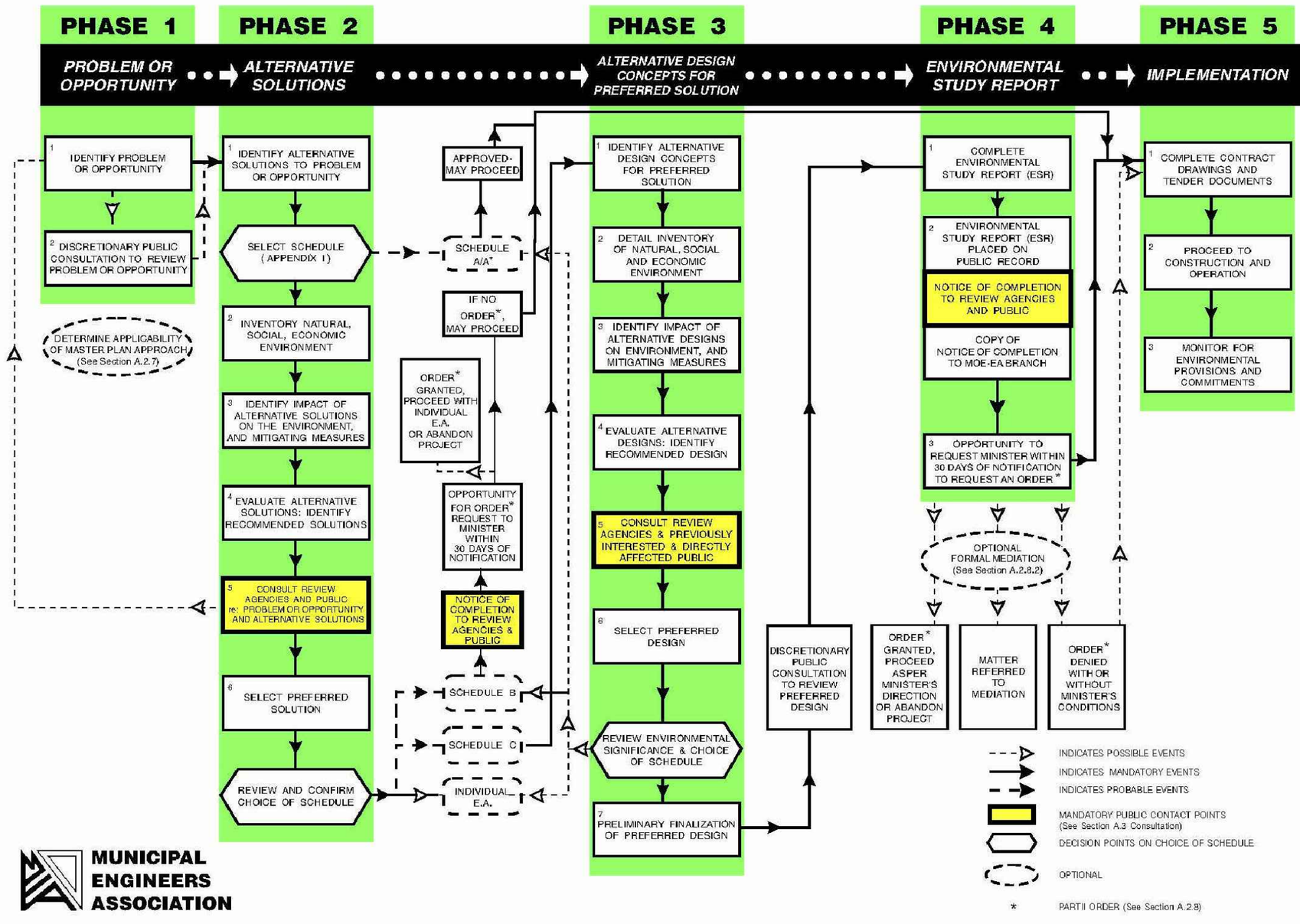
Figure No. 1

BluePlan ENGINEERING

217127
Bruce County Road 33
Re-Alignment
SWM Addendum
Town of Saugeen Shores
County of Bruce

EXHIBIT A.2 MUNICIPAL CLASS EA PLANNING AND DESIGN PROCESS

NOTE: This flow chart is to be read in conjunction with Part A of the Municipal Class EA



MUNICIPAL ENGINEERS ASSOCIATION

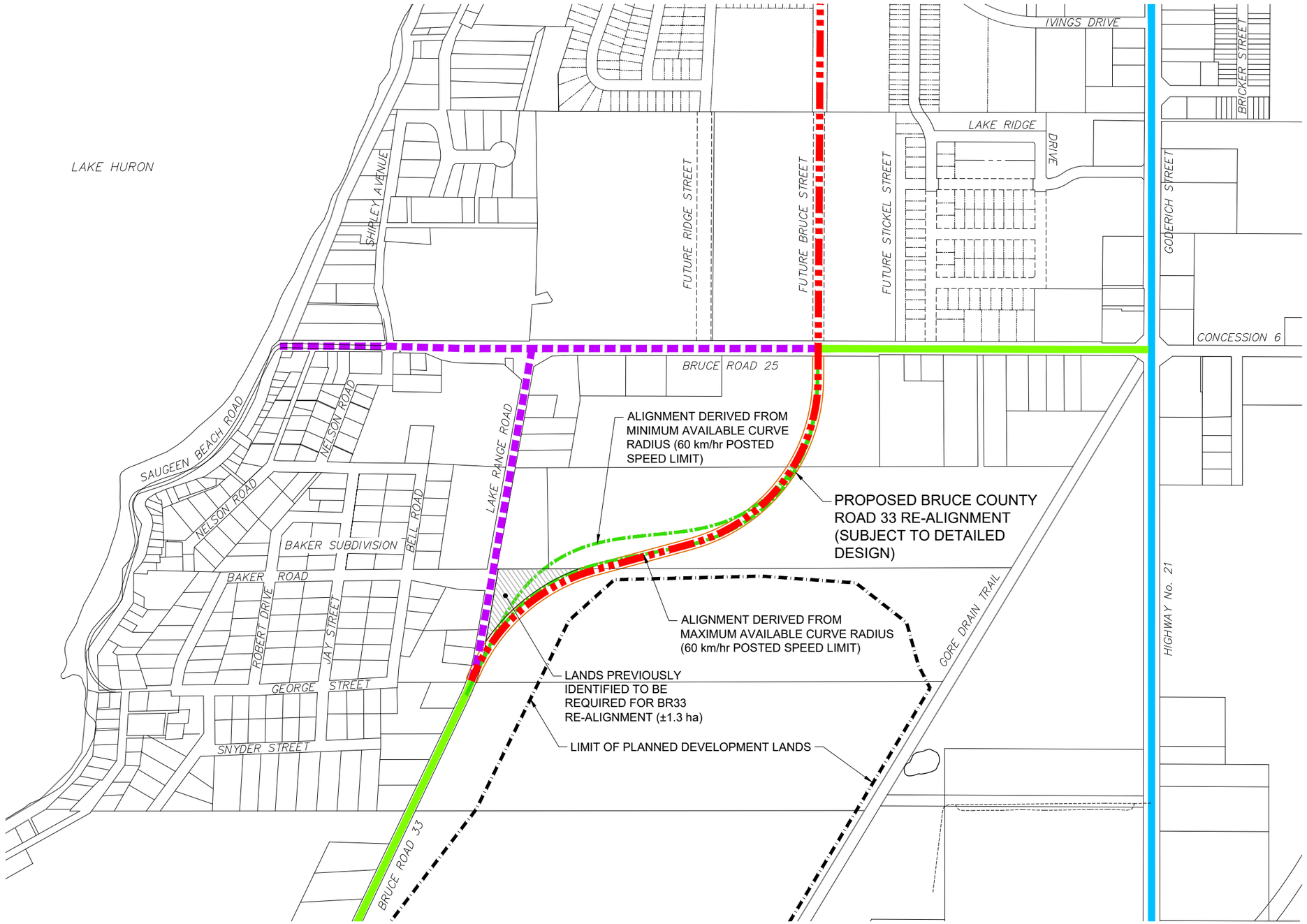
NOT TO SCALE
SEPTEMBER 2019

MASTER PLAN
EA PROCESS

Figure No. 2

BluePlan ENGINEERING

217127
Bruce County Road 33 Re-Alignment SWM Addendum
Town of Saugeen Shores
County of Bruce



LEGEND

- PROVINCIAL HIGHWAY
- BRUCE COUNTY ROAD
- PROPOSED DIVESTURE FROM COUNTY TO TOWN (AS PER MASTER PLAN)
- PROPOSED COLLECTOR ROAD
- RECOMMENDED PREFERRED SOLUTION TO BR33 RE-ALIGNMENT (SCH. B PROJECT FILE) ULTIMATE ALIGNMENT SUBJECT TO DETAILED DESIGN

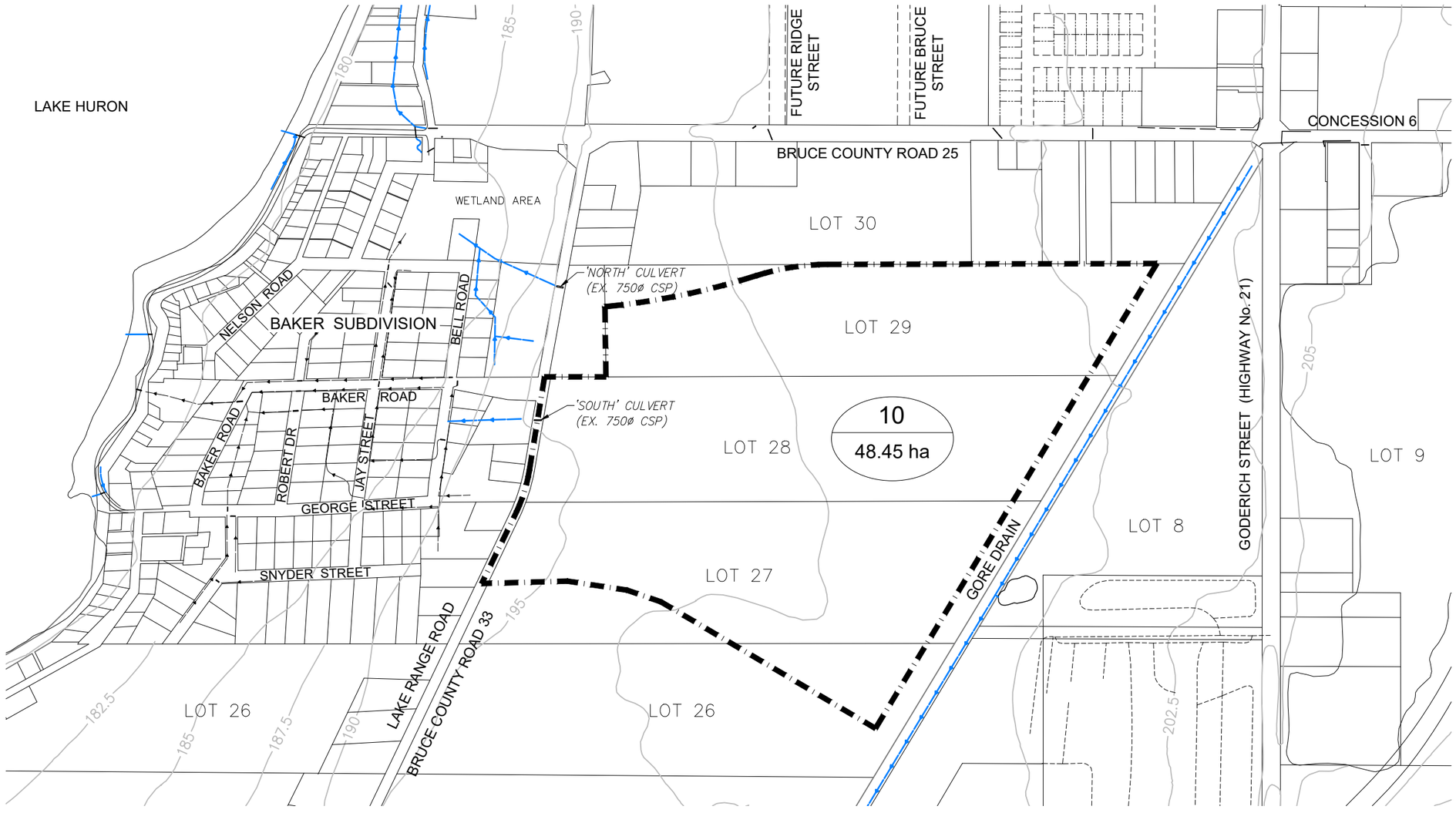
NOT TO SCALE
SEPTEMBER 2019

TRANSPORTATION PLANNING

Figure No. 3

BluePlan ENGINEERING

217127
Bruce County Road 33
Re-Alignment
SWM Addendum
Town of Saugeen Shores
County of Bruce



LEGEND

- DRAINAGE BOUNDARY
- 10 — DRAINAGE AREA No.
- 48.45 ha — DRAINAGE AREA SIZE (Hectares)

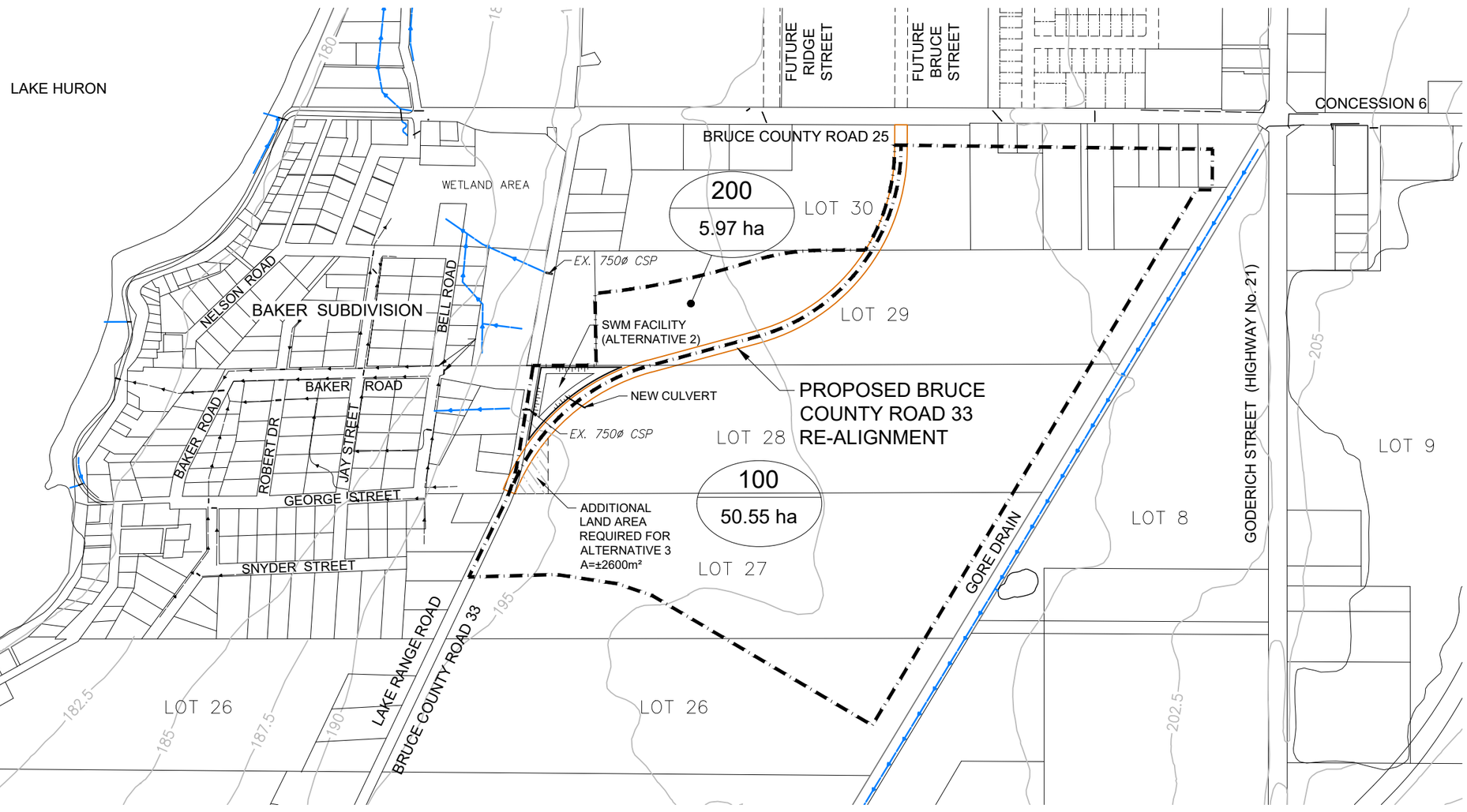
SCALE 1:7,500
SEPTEMBER 2019

PRE-DEVELOPMENT DRAINAGE AREAS

Figure No. 4

BluePlan ENGINEERING

217127
Bruce County Road 33 Re-Alignment
SWM Addendum
Town of Saugeen Shores
County of Bruce



LEGEND

- DRAINAGE BOUNDARY
- 100 — DRAINAGE AREA No.
- 50.55 ha — DRAINAGE AREA SIZE (Hectares)

SCALE 1:7,500
SEPTEMBER 2019

POST-DEVELOPMENT DRAINAGE AREAS

Figure No. 5

BluePlan ENGINEERING

FILE:C:\Civil 3D Projects\217127 Drainage Figures-K.dwg LAYOUT:Post Development (Fig 5)
LAST SAVED BY:Kboers, 9/30/2019 2:34:00 PM PLOTTED BY:Ken Boers - GM BluePlan 9/30/2019 2:55:49 PM

ENCLOSURE A:
BR33 RE-ALIGNMENT: RELEVANT CORRESPONDENCE

Ministry of the Environment, Conservation and Parks

Environmental Assessment and Permissions Branch

135 St. Clair Avenue West
1st Floor
Toronto ON M4V 1P5
Tel.: 416 314-8001
Fax: 416 314-8452

Ministère de l'Environnement, de la Protection de la nature et des Parcs

Direction des évaluations et des permissions environnementales

135, avenue St. Clair Ouest
Rez-de-chaussée
Toronto ON M4V 1P5
Tél : 416 314-8001
Téléc. : 416 314-8452

Ontario

357-2018-1916

January 8, 2019

Kerri Meier
Environmental Planner
County of Bruce
30 Park Street
Walkerton, ON N0G 2V0

Dear Ms. Meier:

On May 27, 2018, the Minister of the Environment, Conservation and Parks received one Part II order request asking that the County of Bruce be required to prepare an individual environmental assessment for the Bruce County Road 33 Re-Alignment.

As outlined in the Project File Report, the preferred solution includes the following components:

- Re-alignment of Bruce Road 33 at the future Bruce Street;
- Stop-controlled tee intersection on Baker Road at Bruce Road 33;
- Landscaping;
- Stormwater management (details to be determined in design phase);
- Driveway re-alignments;
- Paved lane widths to accommodate cyclists; and
- Municipal water and sanitary sewer services.

The ministry understands that the proposed stormwater management works include the construction of a stormwater management facility with a minimum active storage volume of 2000 cubic metres to service the new alignment of Bruce Road 33. If property acquisition is required, the project must be planned in accordance with the Schedule B procedures of the Municipal Class Environmental Assessment.

Staff at the ministry reviewed the project documentation and determined that the project was not planned in accordance with the requirements of the Municipal Class Environmental Assessment. As the class environmental assessment process is a streamlined, self-assessment process, the ministry expects proponents to ensure that the appropriate planning process is followed for their undertaking.

The proposed re-alignment was planned in accordance with the Schedule B procedures of the Municipal Class Environmental Assessment. However, the stormwater management facility was not planned in accordance with the Municipal Class Environmental Assessment. As property acquisition is required for the stormwater management facility, the County should have followed

the Schedule B procedures for the stormwater management facility. You indicated that the proposed stormwater management facility is a component of the proposed realignment project. As such, the projects should be assessed together under one process to avoid a piecemealed approach.

Under Section 13 of the Environmental Assessment Act, a proponent of an undertaking subject to a Class Environmental Assessment shall not proceed with the undertaking unless the proponent does so in accordance with the Class Environmental Assessment. Based on the ministry's review of the project, the County has failed to meet the requirements of the Municipal Class Environmental Assessment. The following actions are recommended to address the ministry's outstanding concerns related to compliance with the Environmental Assessment Act:

- The Notice of Completion for the project is no longer valid. Issue a Notice of Project Change, explaining to the public and any interested persons that additional work will be conducted for the project.

- Complete the Schedule B requirements for the proposed stormwater management facility, which includes, but is not limited to:

    - Consultation with the public and review agencies;
    - Assessing alternative solutions;
    - Identifying the potential impacts of the undertaking and providing mitigation measures;
    - Documenting the planning process for the project though an amended project file report;
    - Issuing a notice of completion for the project. The Project File Report must be made available for a 30-day public consultation period. Copies of the Notice of Completion should be sent directly to the ministry and to the requester.

For consultation purposes, it is important that the recommended solution not be presented as a decision, but as a preliminary preference based on a rational evaluation of available information. Public input is necessary and important to ensure that the best solution is selected for the undertaking. The Project File Report should include information on how public feedback was considered for the project design. Concerns were raised with respect to the environmental assessment process being easily traceable and understandable by the public. As we do with all proponents, we encourage the County to continue to ensure that Class Environmental Assessment documentation and consultation requirements are met to help assist the public's understanding of these important infrastructure projects.

As the class environmental assessment process is not complete for this project, the ministry will not be considering the Part II order request at this time. The Part II order requester will be notified in writing that their request will not be considered at this time, and that the County will be conducting further work for the project. Once the Notice of Completion is issued, the County must notify the requester and advise them that a Part II order can be requested.

If you have additional questions about this matter, please contact Ms. Callee Robinson, Project Evaluator directly at 416-314-0286 or at Callee.Robinson@ontario.ca.

Sincerely,

Kristina Rudzki
Supervisor, Project Review Unit
Environmental Assessment and Permissions Branch
Ministry of the Environment, Conservation and Parks

c: EA File No. 18057
Anneleis Eckert, Regional EA Coordinator / Planner, Southwestern Region
Requester

Drea Nelson - GM BluePlan

Subject: FW: Bruce County Rd. 33 Re-Alignment
Attachments: 2018_02_08_SAUG_EA_33_25_II.pdf

From: Erik Downing <e.downing@svca.on.ca>
Sent: Monday, July 16, 2018 1:46 PM
To: Dubber, Hannah (MOECC) <hannah.dubber@ontario.ca>
Cc: Amanda Froese <amanda.froese@saugeenshores.ca>; John Slocombe - GM BluePlan <John.Slocombe@gmblueplan.ca>
Subject: Re: Bruce County Rd. 33 Re-Alignment

Greetings Hannah,
SVCA staff comments from earlier this year are attached regarding BR33 and BR25. My comments indicate BR33 proposal is much closer to being satisfactory to SVCA staff, but the connection to BR25 had me noting/warning that BR33 as proposed may make BR25 proposal more complex and limit design options to resolve if synergy not achieved between projects. Up to the designer ultimately on this item though.
The Town's design consultant, John Slocombe has stressed informally to me the distinction between the two projects, which I have not disputed. So beyond 'greater then 100yr' being incorporated into the proposed 33 recommendation, and/or further drainage improvements to ensure the proposal achieves as much as possible for local drainage issues, SVCA staff are generally satisfied with the proposed 33 works.

An SVCA permit will likely be required for the most western works at an eroding gully.

Regards,

Erik Downing
Manager, Environmental Planning and Regulations
Saugeen Conservation
1078 Bruce Road 12, P.O. Box 150
Formosa, ON
N0G 1W0

From: Dubber, Hannah (MOECC) <Hannah.Dubber@ontario.ca>
Sent: Thursday, July 12, 2018 10:58 AM
To: Erik Downing
Cc: Robinson, Callee (MOECC)
Subject: Bruce County Rd. 33 Re-Alignment

Good morning Mr. Downing,

The Ministry of Environment, Conservation and Parks is currently reviewing a Part II Order request for the Bruce County Rd. 33 Re-Alignment (Project), which was planned under the Municipal Class Environmental Assessment (EA) process. I have attached the Notice of Completion for your reference. This Project was first planned under the Bruce Road 25 and 33 Master Plan, which also includes drainage projects.

The Part II Order request submitted to the ministry specifically outlines concerns related to the drainage study area. As such, we are inquiring as to whether you have reviewed the Project documentation and if so, does the Saugeen Valley Conservation Authority have any concerns regarding either the Project, the drainage works or the Master Plan document, which has informed this Class Environmental Assessment?

Also, will this Project (Bruce County Road 33) or any of the other Projects require a permit from the Saugeen Valley Conservation Authority?

If it's easier, please feel free to reach out directly to myself or Callee Robinson (416-314-0286) to discuss the Project.

Thank you,

Hannah Dubber
Assistant Project Officer, Project Review Unit
Environmental Assessment and Permissions Branch, Ministry of Environment, Conservation and Parks
135 St. Clair Avenue West, 7th Floor, Toronto ON, M4V 1M2
Hannah.Dubber@ontario.ca || (416)-212-3696

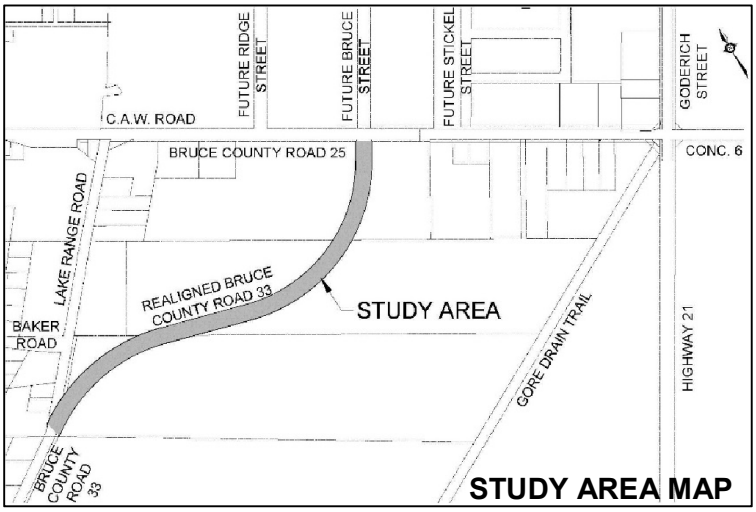
ENCLOSURE B:
ADDENDUM NOTICES AND CONSULTATION

BRUCE COUNTY ROAD 33 RE-ALIGNMENT
MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT (EA): SCHEDULE 'B'

NOTICE OF PROJECT CHANGE

In May 2017, the County of Bruce (County), as the proponent, with the Town of Saugeen Shores (Town), as a principle partner, completed a Master Plan to plan various road and drainage undertakings within a broad area central to Saugeen Shores along Bruce Roads 25 and 33 (BR25 & BR33). The Master Plan identified several projects including the re-alignment of BR33 to intersect BR25 from the south at the same location as the Town's future Bruce Street alignment, where shown on the Study Area Map provided.

In January 2018, the County initiated a Schedule 'B' EA process, appropriately to plan the BR 33 re-alignment as considered in the Master Plan. A *Notice of Study Completion* to the process, identifying the re-alignment of the BR33 intersection with the future Bruce Street intersection as the *Preferred Solution*, was advertised on May 1, 2018. However, during the 30-day public review period, the Ministry of the Environment, Conservation and Parks (MECP) received a Part-II Order Request. In its review of the Project File, the MECP determined that additional study was required appropriately to plan the associated stormwater management (SWM) facility. As such, the MECP concluded that the *Notice of Completion* was no longer valid, citing that additional review of SWM alternatives was necessary. The County is advancing this additional study and is providing additional information via this *Notice of Project Change*.



An Addendum to the 'Bruce County Road 33 Re-Alignment - Project File' (dated April 2018) has been prepared to meet the Schedule 'B' requirements for the conceptual SWM facility and to document the additional review of alternatives for stormwater management associated with the re-alignment of BR33. SWM alternatives reviewed include the following:

Alternative 1: Do Nothing
Alternative 2: Construct a SWM facility to manage runoff related only to the Bruce Road 33 re-alignment
Alternative 3: Construct a SWM facility to manage runoff from Bruce Road 33 & future development
Alternative 4: Construct a new storm sewer system through the Baker Subdivision to Lake Huron

Through the work completed to date, the Study Team has identified Alternative 2, to construct a stormwater management facility to manage runoff from the re-alignment of BR33, as the *Preliminary Recommended Solution*.

The Master Plan (July 2016), the Bruce County Road 33 Re-Alignment Project File (April 2018) and the Schedule 'B' Project File Addendum (October 2019), which provides a review and assessment of the stormwater management alternatives considered, are available on the County and Town websites and at their offices for viewing purposes.

With the circulation of this *Notice of Project Change* and the Project File Addendum, public, stakeholder, agency and aboriginal community comments are invited for incorporation into the planning of this project. Comments will be received by GM BluePlan Engineering and/or the County until November 1st, 2019. Contact information is provided below. Upon receipt of comments, the Study Team will re-evaluate the *Recommended Solution* and present the findings in an updated Project File Addendum.

This *Notice of Project Change* is advertised in the Shoreline Beacon and is also posted on the County and Town websites, where additional information is provided.

This Notice first issued on October 8th, 2019.

The County of Bruce
Mr. Jim Donohoe
30 Park Street, Box 398
Walkerton, ON N0G 2V0
jdonohoe@brucecounty.on.ca
Tel: 519-881-2400
www.brucecounty.on.ca

The Town of Saugeen Shores
Ms. Amanda Froese, P.Eng.
600 Tomlinson Drive, Box 820
Port Elgin, ON N0H 2C0
amanda.froese@saugeenshores.ca
Tel: 519-832-2008
www.saugeenshores.ca

GM BluePlan Engineering Limited
Mr. John Slocombe, P.Eng.
1260-2nd Avenue East, Unit 1
Owen Sound, ON N4K 2J3
john.slocombe@gmblueplan.ca
Tel: 519-376-1805
www.gmblueplan.ca

County of Bruce

Bruce Road 33

Legend

- Rural Community point, labelled
- Ferry
- Provincial Highway
- County Road
- Municipal or Other Road (small scale)
- Propane Facility Buffer
- Wetland
- Body of Water
- Built-up area
- Adjacent Counties
- Lake Huron and Georgian Bay

Notes

landowner mail out circulation area

1.3 0 0.64 1.3 Kilometers

NAD_1983_UTM_Zone_17N

CIRCULATION LIST: AGENCIES
BRUCE ROAD 33 RE-ALIGNMENT
SCHEDULE B EA
PROJECT FILE ADDENDUM

AGENCY	CONTACT INFORMATION		ADDRESS	INFORMATION SENT											COMMENTS/RESPONSE RECEIVED (DESCRIPTION)
				DATE SENT or RECEIVED	VIA			DOCUMENT						DESCRIPTION	
					E-mail	Mail	Phone	Notice of Project Change	Project File Addendum (Oct 2019)	Project File (Final)	Notice of Completion	Other			
MUNICIPAL AGENCIES															
County of Bruce	Contact	Tessa Fortier	County of Bruce	8-Oct-19	S			X	X						
		Planning and Development	Planning and Development												
	Telephone	(226) 909-1601 (Ext. 2)	1243 McKenzie Road												
	E-mail	tfortier@brucecounty.on.ca	Port Elgin, ON N0H 2C6												
	Contact	Kerri Meier													
		Environmental Coordinator													
	Telephone	(519) 881-2400 (Ext. 307)													
	E-mail	kmeier@brucecounty.on.ca													
	Contact	Miguel Pelletier													
		Director of Transportation													
	Telephone	(519) 881-2400 (Ext. 307)													
	E-mail	mpelletier@brucecounty.on.ca													
Town of Saugeen Shores	Contact	Amanda Froese, Director	Town of Saugeen Shores	8-Oct-19	S			X	X						
		Infrastructure and Development Services	P.O. Box 820												
	Telephone	(519) 832-2008 (Ext. 119)	600 Tomlinson Drive												
	Fax	(519) 832-2140	Port Elgin, ON N0H 2C0												
	E-mail	amanda.froese@saugeenshores.ca													
Saugeen Valley Conservation Authority (SVCA)	Contact	Erik Downing	Saugeen Conservation	8-Oct-19	S			X	X						
		Manager, Environmental Planning & Reg.	1078 Bruce Road 12												
	Telephone	(519) 367-3040 (Ext. 241)	P.O. Box 150												
	Fax	(519) 367-3041	Formosa, ON N0G 1W0												
	E-mail	e.downing@svca.on.ca													
Source Water Protection	Contact	Carl Seider, Project Manager	Drinking Water source Protection	8-Oct-19	S			X	X						Including consultation correspondence
	Telephone	(519) 470-3000 (ext.201)	c/o Grey Sauble Conservation Authority												
	Fax	(519) 470-3005	R.R.#4; 237897 Inglis Falls Road												
	E-mail	c.seider@waterprotection.ca	Owen Sound, ON N4K 5N6												
	E-mail	mail@waterprotection.ca													
Grey-Bruce Health Unit	Contact	Public Health Inspector	Grey Bruce Health Unit	8-Oct-19	S			X	X						
	Telephone	(519) 376-9420	101 17th Street East												
	Fax	(519) 376-5043	Owen Sound, ON N4K 0A5												
	E-mail	publichealth@publichealthgreybruce.on.ca													

CIRCULATION LIST: AGENCIES
BRUCE ROAD 33 RE-ALIGNMENT
SCHEDULE B EA
PROJECT FILE ADDENDUM

AGENCY	CONTACT INFORMATION		ADDRESS	INFORMATION SENT											COMMENTS/RESPONSE RECEIVED (DESCRIPTION)
				DATE SENT or RECEIVED	VIA			DOCUMENT						DESCRIPTION	
					E-mail	Mail	Phone	Notice of Project Change	Project File Addendum (Oct 2019)	Project File (Final)	Notice of Completion	Other			
PROVINCIAL AGENCIES															
Ministry of the Environment, Conservation and Parks Owen Sound Area Office	Contact	Ian Mitchell, P.Eng.	MECP	8-Oct-19	S			X	X						
		District Engineer	Owen Sound Area Office												
	Telephone	(519) 371-6191	101 17th Street East, 3rd Floor												
	Fax	(519) 371-2905	Owen Sound, ON N4K 0A5												
	E-mail	ian.mitchell@ontario.ca													
Ministry of the Environment, Conservation and Parks Southwestern Region	Contact	Craig Newton	MECP - Southwest Region	8-Oct-19	S			X	X						
		Environmental Planner	Technical Support Section												
		Southwest Region	733 Exeter Road												
	Telephone	(519) 873-5014	London, ON N6E 1L3												
	Fax														
	Email	craig.newton@ontario.ca													
Ministry of the Environment, Conservation and Parks Southwestern Region	Contact	Anneleis Eckert	MECP	8-Oct-19	S			X	X						Project Information Form included.
		Regional Environmental Planner	Regional EA Coordinator												
		Streamlined EA Notice Submission	733 Exeter Road												
		Southwest Region	London, ON N6E 1L3												
	Telephone	(519) 873-5115													
	Fax	(519) 873-5020													
	E-mail	anneleis.eckert@ontario.ca													
	E-mail	eanotification.swregion@ontario.ca													
Ministry of the Environment, Conservation and Parks Environmental Assessment and Approvals Branch	Contact	Callee Robinson	MECP	8-Oct-19	S			X	X						
		Project Officer	Environmental Approvals Branch												
		Environmental Assessment Services	135 St.Clair Ave W, 1st Floor												
	Telephone	(416) 314-0286	Toronto, ON M4V 1P5												
	Fax														
	Email	callee.robinson@ontario.ca													
Ministry of the Environment, Conservation and Parks Environmental Assessment and Approvals Branch	Contact	Director	MECP	8-Oct-19	S			X	X						Project Information Form included.
	Telephone	(416) 314-7288	Environmental Approvals Branch												
	Fax	(416) 314-8452	135 St.Clair Ave W, 1st Floor												
	E-mail	EAASIBgen@ontario.ca	Toronto, ON M4V 1P5												
		mea.notices.eaab@ontario.ca													Notice of Completion only
Ministry of Natural Resources and Forestry	Contact	Jodi Benvenuti	Ministry on Natural Resources and Forestry	8-Oct-19	S			X	X						
	Telephone	(519) 371-8471	Owen Sound Area Office												
	Fax	(519) 372-3305	1450 7th Avenue East												
	E-mail	jodi.benvenuti@ontario.ca	Owen Sound, ON N4K 2Z1												
Ministry of Natural Resources and Forestry	Contact	Ken Mott, District Planner	Ministry on Natural Resources and Forestry	8-Oct-19	S			X	X						Services Grey, Bruce, Simcoe and Dufferin
	Telephone	(705) 725-7546	Midhurst District												
	Fax	(705) 725-7584	2284 Nursery Road												
	E-mail	ken.mott@ontario.ca	Midhurst, ON L9X 1N8												
Ministry of Agriculture, Food and Rural Affairs	Contact	Carolyn Hamilton	Ministry of Agriculture, Food and Rural Affairs	8-Oct-19	S			X	X						
		Director, Rural Programs Branch	Rural Programs Branch												
	Telephone	(519) 826-3419	Ontario Government Building												
	Fax		1 Stone Road West, 4th Floor NW												
	E-mail	carolyn.hamilton@ontario.ca	Guelph, Ontario N1G 4Y2												
Ministry of Transportation	Contact	Steve Hood	Ministry of Transportation	8-Oct-19	S			X	X						
		Technical Services Supervisor	1450 7th Ave E												
	Telephone	(519) 372-4036	Owen Sound, ON N4K 2Z1												
	E-mail	steve.hood@ontario.ca													
Ministry of Tourism, Culture and Sport Culture Division Heritage Program Unit	Contact	Karla Barboza, Team Lead - Heritage (Acting)	MTCS	8-Oct-19	S			X	X						
	Telephone	(416) 314-7120	401 Bay Street												
	Fax		Toronto, ON M7A 0A7												
	E-mail	karla.barboza@ontario.ca													

CIRCULATION LIST: AGENCIES
BRUCE ROAD 33 RE-ALIGNMENT
SCHEDULE B EA
PROJECT FILE ADDENDUM

AGENCY	CONTACT INFORMATION		ADDRESS	INFORMATION SENT											COMMENTS/RESPONSE RECEIVED (DESCRIPTION)
				DATE SENT or RECEIVED	VIA			DOCUMENT						DESCRIPTION	
					E-mail	Mail	Phone	Notice of Project Change	Project File Addendum (Oct 2019)	Project File (Final)	Notice of Completion	Other			
FEDERAL AGENCIES															
Environment and Climate Change Canada	Contact	Environmental Assessment Coordinator	Environment and Climate Change Canada	8-Oct-19	S			X	X						
	Telephone	(416) 739-4734	Ontario Region												
	Fax	(416) 739-4776	4905 Dufferin Street												
	E-mail	ec.ecoactionon.ec@canada.ca	Toronto, Ontario M3H 5T4												
Indigenous and Northern Affairs Canada	Contact	Environmental Assessment Coordinator	Indigenous and Northern Affairs	8-Oct-19	S			X	X						
	Telephone	(416) 973-4004	Ontario Region												
	Fax	(416) 954-6201	25 St Clair Ave East, 8th Floor												
	E-mail	InfoPubs@aadnc-aandc.gc.ca	Toronto, Ontario M4T 1M2												
UTILITIES															
Bell Access Network	Contact	Nicolas Kellar	Bell Access Network	8-Oct-19	S			X	X						
	Telephone	(519) 371-5450	870-4th Avenue East												
	Fax	(519) 376-3563	Owen Sound, ON												
	E-mail	nicholas.kellar@bell.ca	N4K 2N7												
Hydro One Networks Inc.	Contact	Kevin Brackley	Hydro One Networks Inc.	8-Oct-19	S			X	X						
	Telephone	(888) 664-9376	45 Sargeant Drive, Box 6700												
	Fax	(905) 944-3251	Barrie, ON												
	E-mail	Zone5PlanningDept@HydroOne.com	L4N 4V9												
	cc.	kevin.brackley@hydroone.com													
	cc.	tammy.scott@hydroone.com													
Eastlink	Contact	Dan Oswald	Eastlink	8-Oct-19	S			X	X						
	Telephone	(519) 793-3111	77 Main Street												
	Fax		Lion's Head, ON N0H 1W0												
	E-mail	dan.oswald@corp.eastlink.ca													
Bruce Telecom (BMTS)	Contact	Head Office	BMTS - Tiverton - Head Office	8-Oct-19	S			X	X						
	Telephone	(519) 368-2000	3145 Highway 21												
	Fax		P.O. Box 80												
	E-mail	admin@brucetelecom.com	Tiverton, ON N0G 2T0												
Union Gas Limited	Contact	Kevin Schimus	Union Gas	8-Oct-19	S			X	X						
	Telephone	(519) 377-0214	603 Krumpf Drive												
	Fax	(519) 376-2591	P.O. Box 340												
	E-mail	kschimus@uniongas.com	Waterloo, ON N2J 4A4												
Rogers Cable	Contact	Tony Dominguez	Rogers Cable	8-Oct-19	S			X	X						
	Telephone	(705) 737-4660 ext. 6923	1 Sperling Drive												
	Fax	(705) 737-3840	Barrie, ON L4M 6B8												
	E-mail	Tony.Dominguez@rci.rogers.com													

CIRCULATION LIST: AGENCIES
BRUCE ROAD 33 RE-ALIGNMENT
SCHEDULE B EA
PROJECT FILE ADDENDUM

AGENCY		CONTACT INFORMATION	ADDRESS	INFORMATION SENT											COMMENTS/RESPONSE RECEIVED (DESCRIPTION)
				DATE SENT or RECEIVED	VIA			DOCUMENT						DESCRIPTION	
					E-mail	Mail	Phone	Notice of Project Change	Project File Addendum (Oct 2019)	Project File (Final)	Notice of Completion	Other			
ABORIGINAL COMMUNITIES - Consultations Completed by the County of Bruce															
Historic Saugeen Metis	Contact	Archie Indoe (President)	Historic Saugeen Metis	8-Oct-19	S	S		X	X						
		George Govier (Consultation Coordinator)	204 High Street												
	Telephone	(519) 483-4000	Box 1492												
	Contact	Chris Hatchey	Southampton, ON N0H 2L0												
		hsmasstlrcc@bmts.com													
	E-mail	saugeenmetisadmin@bmts.com													
Saugeen First Nation	Contact	Lester Anoquot (Chief)	Saugeen First Nation	8-Oct-19	S	S		X	X						
		Cheree Urscheler (Band Administrator)	Saugeen Band Office												
	Telephone	(519) 797-2781	6493 Highway 21, R.R.#1												
	Fax	(519) 797-2978	Southampton, ON N0H 2L0												
	E-mail	lester.anoquot@saugeen.org													
Metis Nation of Ontario (MNO)	Contact	James Wagar	Metis Nation of Ontario	8-Oct-19	S	S		X	X						
Great Lakes Metis Council		Consultation Assessment Coordinator	Owen Sound Office												
Owen Sound Office	Telephone	(519) 370-0435	380-9th Street East												
	E-mail	jamesw@metisnation.org	Owen Sound, ON N4K 1P1												
	E-mail	joannem@metisnation.org													
	E-mail	consultations@metisnation.org													
Saugeen Ojibway Nation	Contact	Doran Ritchie	Saugeen Ojibway Nation	8-Oct-19	S	S		X	X						
Environmental Office		Infrastructure Planning Coordinator	Environment Office												
	Telephone	(519) 534-5507 (ext. 226)	25 Maadookii Road												
	Fax	(519) 534-5525	Neyaashiinigmiing, Ont.												
	E-mail	d.ritchie@saugeenojibwaynation.ca	N0H 2T0												
Chippewas of Nawash Unceded	Contact	Chief Gregory Nadjiwon	Chippewas of Nawash Unceded FN	8-Oct-19	S	S		X	X						
First Nation	Telephone	(519) 534-1689	#135 Lakeshore Blvd.												
	Fax	(519) 534-2130	Neyaashiinigmiing, Ont.												
	E-mail	chiefsdesk@nawash.ca	R.R#5 Wiarton, ON N0H 2T0												
	E-mail	cnadministrator@nawash.ca													

CIRCULATION LIST: AGENCIES
BRUCE ROAD 33 RE-ALIGNMENT
SCHEDULE B EA
PROJECT FILE ADDENDUM

AGENCY	CONTACT INFORMATION		ADDRESS	INFORMATION SENT											COMMENTS/RESPONSE RECEIVED (DESCRIPTION)
				DATE SENT or RECEIVED	VIA			DOCUMENT					DESCRIPTION		
					E-mail	Mail	Phone	Notice of Project Change	Project File Addendum (Oct 2019)	Project File (Final)	Notice of Completion	Other			
Private Groups: Circulated by the County (mail) and GMBP (email)															
Lake Ridge Estates	Contact	Andy Kuperus	Lake Ridge Estates	8-Oct-19	S	S		X	X						
	Telephone	(519) 832-2058	P.O. Box 614												
	Fax	(519) 389-4547	R.R.#3												
	E-mail	l.kuperus@bmts.com	Port Elgin, ON N0H 2C0												
Port Elgin & Saugeen Township Beacher's Organization	Contact	David Shemilt	Port Elgin & Saugeen Township	8-Oct-19	S	S		X	X						
	Contact	Dave Reynolds, Director	Beacher's Organization												
	Contact	Greg Schmaltz, President	P.O. Box 377												
	Telephone	(519) 386-0934	Port Elgin, ON N0H 2C0												
	E-mail	davereynolds5959@gmail.com													
	E-mail	manager@beachers.org													
CAW Family Education Centre	Contact		CAW Family Education Centre	8-Oct-19	S	S		X	X						
	Telephone	(519) 389-3200	R.R.#1 Bruce County Road 25												
	Fax		115 Shipley Avenue												
	E-mail	confcentre@unifor.org	Port Elgin, ON N0H 2C5												
Canadian Tire Real Estate	Contact	Victor Simone		8-Oct-19	S			X	X						
	Telephone														
	Fax														
	E-mail	victor.simone@cantire.com													
Unifor (CAW)	Contact	Graeme Brown	Unifor (CAW)	8-Oct-19	S	S		X	X						
	Telephone	(416) 495-3799	205 Placer Court												
	Fax	(416) 495-6559	North York, ON M2H 3H9												
	E-mail	Graeme.Brown@unifor.org													
Cuesta Planning Consultants	Contact	David Ellingwood	Cuesta Planning Consultants	8-Oct-19	S	S		X	X						
	Telephone	(519) 372-9790	978 First Avenue West												
	Fax		Owen Sound, ON N4K 4K5												
	E-mail	cuesta@cuestaplanning.com													
Barry's Construction and Insulation Ltd.	Contact	Barry's Construction and Insulation Ltd.	Barry's Construction and Insulation Ltd.	8-Oct-19	S	S		X	X						
	Telephone	(519) 934-3374	7839 Highway 21												
	Fax		P.O. Box 30												
	E-mail	sue@barrysconstruction.ca	Allenford, ON N0H 1A0												
Interested Public: **Members of the community that previously engaged in the planning process for the re-alignment of Bruce Road 33 were issued Notices via mail or email depending on the contact information previously provided.**															

County of Bruce Transportation &
Environmental Services Department
30 Park Street, P.O. Box 398, Walkerton, ON N0G 2V0
(519) 881-2400

brucecounty.on.ca

October 8, 2019

Historic Saugeen Metis
P.O. Box 1492, 204 High Street
Southampton, ON N0H 2L0

Attention: George Govier

Re: Schedule B Environmental Assessment - Bruce Road 33

The County of Bruce and Town of Saugeen Shores completed a Master Plan for Roads and Drainage for Bruce Road 25 and Bruce Road 33 in May 2017. The Master Plan identified several projects including the realignment of Bruce Road 33 to intersect Bruce Road 25 from the south at the same location as the Town's future Bruce Street alignment. The enclosed map provides an overview of the phases resulting from the Master Plan.

The Department is continuing with the Schedule B Environmental Assessment for Bruce Road 33 as identified in the enclosed Notice of Project Change.

The Master Plan (July 2016), Bruce County Road 33 Re-Alignment Project File (April 2018) and the Schedule B Project File Addendum (October 2019) will be available on the County of Bruce and Saugeen Shores websites and at the County of Bruce Administration Building and Town of Saugeen Shores Municipal Office for viewing on October 8, 2019. We ask that comments regarding this file be provided by November 1, 2019.

We will continue to provide correspondence as the project progresses. Please contact our office or John Slocombe of GMBluePlan Engineering Limited if you have any questions, comments or require additional information.

Yours truly,

Jim Donohoe
Engineering Manager

Encls.

c: John Slocombe, GM BluePlan Engineering Ltd.
Amanda Froese, Town of Saugeen Shores
Kerri Meier, County of Bruce

County of Bruce Transportation & Environmental Services Department
30 Park Street, P.O. Box 398, Walkerton, ON N0G 2V0
(519) 881-2400

brucecounty.on.ca

October 8, 2019

Metis Nation of Ontario
Great Lakes Metis Council
380-9th Street East
Owen Sound, ON N4K 1P1

Attention: James Wagar

Re: Schedule B Environmental Assessment - Bruce Road 33

The County of Bruce and Town of Saugeen Shores completed a Master Plan for Roads and Drainage for Bruce Road 25 and Bruce Road 33 in May 2017. The Master Plan identified several projects including the realignment of Bruce Road 33 to intersect Bruce Road 25 from the south at the same location as the Town's future Bruce Street alignment. The enclosed map provides an overview of the phases resulting from the Master Plan.

The Department is continuing with the Schedule B Environmental Assessment for Bruce Road 33 as identified in the enclosed Notice of Project Change.

The Master Plan (July 2016), Bruce County Road 33 Re-Alignment Project File (April 2018) and the Schedule B Project File Addendum (October 2019) will be available on the County of Bruce and Saugeen Shores websites and at the County of Bruce Administration Building and Town of Saugeen Shores Municipal Office for viewing on October 8, 2019. We ask that comments regarding this file be provided by November 1, 2019.

We will continue to provide correspondence as the project progresses. Please contact our office or John Slocombe of GMBluePlan Engineering Limited if you have any questions, comments or require additional information.

Yours truly,

Jim Donohoe
Engineering Manager

Encls.

c: John Slocombe, GM BluePlan Engineering Ltd.
Amanda Froese, Town of Saugeen Shores
Kerri Meier, County of Bruce

County of Bruce Transportation &
Environmental Services Department
30 Park Street, P.O. Box 398, Walkerton, ON N0G 2V0
(519) 881-2400

brucecounty.on.ca

October 8, 2019

Saugeen Ojibway Nation
SON Environmental Office
25 Maadookii Subdivision
RR#5, Wiarton ON N0H 2T0

Attention: Doran Ritchie

Re: Schedule B Environmental Assessment - Bruce Road 33

The County of Bruce and Town of Saugeen Shores completed a Master Plan for Roads and Drainage for Bruce Road 25 and Bruce Road 33 in May 2017. The Master Plan identified several projects including the realignment of Bruce Road 33 to intersect Bruce Road 25 from the south at the same location as the Town's future Bruce Street alignment. The enclosed map provides an overview of the phases resulting from the Master Plan.

The Department is continuing with the Schedule B Environmental Assessment for Bruce Road 33 as identified in the enclosed Notice of Project Change.

The Master Plan (July 2016), Bruce County Road 33 Re-Alignment Project File (April 2018) and the Schedule B Project File Addendum (October 2019) will be available on the County of Bruce and Saugeen Shores websites and at the County of Bruce Administration Building and Town of Saugeen Shores Municipal Office for viewing on October 8, 2019. We ask that comments regarding this file be provided by November 1, 2019.

We will continue to provide correspondence as the project progresses. Please contact our office or John Slocombe of GMBluePlan Engineering Limited if you have any questions, comments or require additional information.

Yours truly,

Jim Donohoe
Engineering Manager

Encls.

c: John Slocombe, GM BluePlan Engineering Ltd.
Amanda Froese, Town of Saugeen Shores
Kerri Meier, County of Bruce

County of Bruce Transportation &
Environmental Services Department
30 Park Street, P.O. Box 398, Walkerton, ON N0G 2V0
(519) 881-2400

brucecounty.on.ca

October 8, 2019

Chippewas of Nawash Unceded First Nation
135 Lakeshore Boulevard
Neyaashiinigmiing
RR# 5
Wiarton ON N0H 2T0

Attention: Chief Gregory Nadjiwon

Re: Schedule B Environmental Assessment - Bruce Road 33

The County of Bruce and Town of Saugeen Shores completed a Master Plan for Roads and Drainage for Bruce Road 25 and Bruce Road 33 in May 2017. The Master Plan identified several projects including the realignment of Bruce Road 33 to intersect Bruce Road 25 from the south at the same location as the Town's future Bruce Street alignment. The enclosed map provides an overview of the phases resulting from the Master Plan.

The Department is continuing with the Schedule B Environmental Assessment for Bruce Road 33 as identified in the enclosed Notice of Project Change.

The Master Plan (July 2016), Bruce County Road 33 Re-Alignment Project File (April 2018) and the Schedule B Project File Addendum (October 2019) will be available on the County of Bruce and Saugeen Shores websites and at the County of Bruce Administration Building and Town of Saugeen Shores Municipal Office for viewing on October 8, 2019. We ask that comments regarding this file be provided by November 1, 2019.

We will continue to provide correspondence as the project progresses. Please contact our office or John Slocombe of GMBluePlan Engineering Limited if you have any questions, comments or require additional information.

Yours truly,

Jim Donohoe
Engineering Manager

Encls.

c: John Slocombe, GM BluePlan Engineering Ltd.
Amanda Froese, Town of Saugeen Shores
Kerri Meier, County of Bruce

County of Bruce Transportation & Environmental Services Department
30 Park Street, P.O. Box 398, Walkerton, ON N0G 2V0
(519) 881-2400

brucecounty.on.ca

October 8, 2019

Saugeen First Nation
Chippewas of Saugeen First Nation No.29
6493 Highway 21, RR#1
Southampton, ON N0H2L0

Attention: Cheree Urscheler

Re: Schedule B Environmental Assessment - Bruce Road 33

The County of Bruce and Town of Saugeen Shores completed a Master Plan for Roads and Drainage for Bruce Road 25 and Bruce Road 33 in May 2017. The Master Plan identified several projects including the realignment of Bruce Road 33 to intersect Bruce Road 25 from the south at the same location as the Town's future Bruce Street alignment. The enclosed map provides an overview of the phases resulting from the Master Plan.

The Department is continuing with the Schedule B Environmental Assessment for Bruce Road 33 as identified in the enclosed Notice of Project Change.

The Master Plan (July 2016), Bruce County Road 33 Re-Alignment Project File (April 2018) and the Schedule B Project File Addendum (October 2019) will be available on the County of Bruce and Saugeen Shores websites and at the County of Bruce Administration Building and Town of Saugeen Shores Municipal Office for viewing on October 8, 2019. We ask that comments regarding this file be provided by November 1, 2019.

We will continue to provide correspondence as the project progresses. Please contact our office or John Slocombe of GMBluePlan Engineering Limited if you have any questions, comments or require additional information.

Yours truly,

Jim Donohoe
Engineering Manager

Encls.

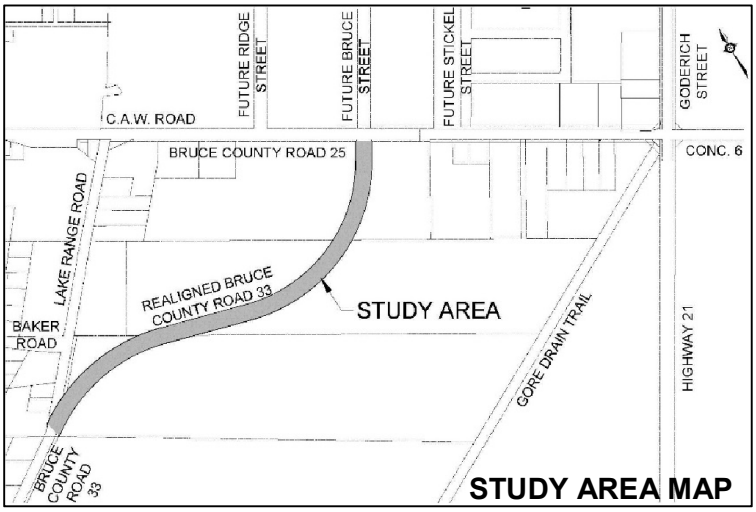
c: John Slocombe, GM BluePlan Engineering Ltd.
Amanda Froese, Town of Saugeen Shores
Kerri Meier, County of Bruce

BRUCE COUNTY ROAD 33 RE-ALIGNMENT
MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT (EA): SCHEDULE 'B'

NOTICE OF PROJECT CHANGE

In May 2017, the County of Bruce (County), as the proponent, with the Town of Saugeen Shores (Town), as a principle partner, completed a Master Plan to plan various road and drainage undertakings within a broad area central to Saugeen Shores along Bruce Roads 25 and 33 (BR25 & BR33). The Master Plan identified several projects including the re-alignment of BR33 to intersect BR25 from the south at the same location as the Town's future Bruce Street alignment, where shown on the Study Area Map provided.

In January 2018, the County initiated a Schedule 'B' EA process, appropriately to plan the BR 33 re-alignment as considered in the Master Plan. A *Notice of Study Completion* to the process, identifying the re-alignment of the BR33 intersection with the future Bruce Street intersection as the *Preferred Solution*, was advertised on May 1, 2018. However, during the 30-day public review period, the Ministry of the Environment, Conservation and Parks (MECP) received a Part-II Order Request. In its review of the Project File, the MECP determined that additional study was required appropriately to plan the associated stormwater management (SWM) facility. As such, the MECP concluded that the *Notice of Completion* was no longer valid, citing that additional review of SWM alternatives was necessary. The County is advancing this additional study and is providing additional information via this *Notice of Project Change*.



An Addendum to the 'Bruce County Road 33 Re-Alignment - Project File' (dated April 2018) has been prepared to meet the Schedule 'B' requirements for the conceptual SWM facility and to document the additional review of alternatives for stormwater management associated with the re-alignment of BR33. SWM alternatives reviewed include the following:

Alternative 1: Do Nothing
Alternative 2: Construct a SWM facility to manage runoff related only to the Bruce Road 33 re-alignment
Alternative 3: Construct a SWM facility to manage runoff from Bruce Road 33 & future development
Alternative 4: Construct a new storm sewer system through the Baker Subdivision to Lake Huron

Through the work completed to date, the Study Team has identified Alternative 2, to construct a stormwater management facility to manage runoff from the re-alignment of BR33, as the *Preliminary Recommended Solution*.

The Master Plan (July 2016), the Bruce County Road 33 Re-Alignment Project File (April 2018) and the Schedule 'B' Project File Addendum (October 2019), which provides a review and assessment of the stormwater management alternatives considered, are available on the County and Town websites and at their offices for viewing purposes.

With the circulation of this *Notice of Project Change* and the Project File Addendum, public, stakeholder, agency and First Nation comments are invited for incorporation into the planning of this project. Comments will be received by GM BluePlan Engineering and/or the County until November 1st, 2019. Contact information is provided below. Upon receipt of comments, the Study Team will re-evaluate the *Recommended Solution* and present the findings in an updated Project File Addendum.

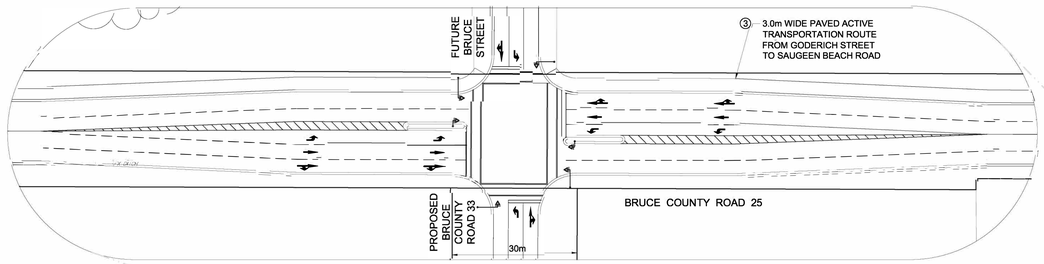
This *Notice of Project Change* is advertised in the Shoreline Beacon and is also posted on the County and Town websites, where additional information is provided.

This Notice first issued on October 8th, 2019.

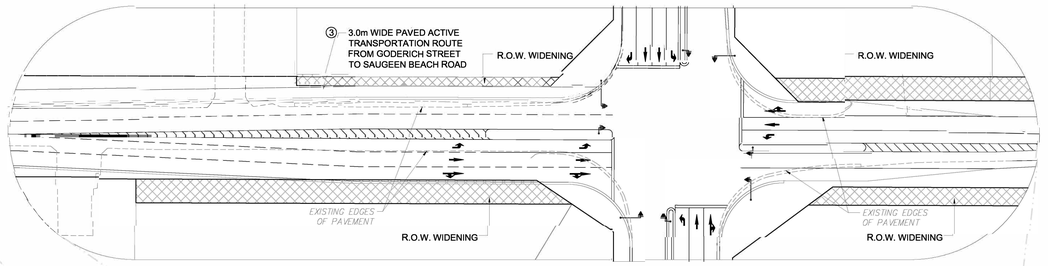
The County of Bruce
Mr. Jim Donohoe
30 Park Street, Box 398
Walkerton, ON N0G 2V0
jdonohoe@brucecounty.on.ca
Tel: 519-881-2400
www.brucecounty.on.ca

The Town of Saugeen Shores
Ms. Amanda Froese, P.Eng.
600 Tomlinson Drive, Box 820
Port Elgin, ON N0H 2C0
amanda.froese@saugeenshores.ca
Tel: 519-832-2008
www.saugeenshores.ca

GM BluePlan Engineering Limited
Mr. John Slocombe, P.Eng.
1260-2nd Avenue East, Unit 1
Owen Sound, ON N4K 2J3
john.slocombe@gmblueplan.ca
Tel: 519-376-1805
www.gmblueplan.ca



PROPOSED SIGNALIZED INTERSECTION
OF BRUCE COUNTY ROADS 25 AND 33



UPGRADED SIGNALIZED INTERSECTION
OF BRUCE COUNTY ROADS 25 AND 33

LAKE HURON

Phase 1 2019
Phase 2 2020
Phase 3 2021
Phase 4 2022

SHIPLEY AVENUE
WATERCOURSE
NORTH AND SOUTH BOUND STOP CONTROLLED INTERSECTION
NORTH BOUND STOP-CONTROLLED INTERSECTION
SOUTH BOUND STOP-CONTROLLED INTERSECTION
1:100 YEAR STORM SEWER TO 1:5 YEAR STORM SEWER WITH SURCHARGED OUTLET TO ROAD SURFACE FOR OVERLAND CONVEYANCE OF MAJOR STORM FLOWS
FUTURE RIDGE STREET
FUTURE BRUCE STREET
STICKEL STREET
LAKE RIDGE DRIVE
1:100 YEAR DESIGN FLOW CRITERIA
NEW 600mmØ PERF. STORM SEWER
NEW 600mmØ PERF. STORM SEWER
NEW 600mmØ PERF. STORM SEWER
NEW 600mmØ PERF. STORM SEWER
R.O.W. WIDENING LAND ACQUISITION BY COUNTY
CONCESSION 6
Road Work
⑤ STORM SEWER 1:5 YEAR DESIGN FLOW CRITERIA
NEW 1200mmØ STORM SEWER
NEW 900mmØ STORM SEWER
NEW 750mmØ STORM SEWER
NEW 1350mmØ STORM SEWER
NEW 1500mmØ STORM SEWER
NEW 1350mmØ
NEW 1350mmØ
NEW 1200mmØ
NEW 1200mmØ
NEW 1200mmØ
NEW 1050mmØ
1:5 YEAR DESIGN FLOW CRITERIA
SCHEDULE A+ EA WITHIN EXISTING ROAD ALLOWANCES AND USING TRENCHLESS TECHNOLOGY FOR WATER COURSE CROSSINGS
Storm Sewer
OIL/GRIT SEPARATOR
TWO LANE URBAN CROSS SECTION c/w ATR
TWO LANES
TWO LANE URBAN CROSS SECTION c/w ATR
TWO LANE URBAN CROSS SECTION c/w ATR
① SIGNALIZED INTERSECTION
④ STORM SEWER 1:100 YEAR DESIGN FLOW CRITERIA
TAPER FIVE LANES TO TWO LANES
DEVELOPED LEFT TURN LANE
③ 3.0m WIDE PAVED ACTIVE TRANSPORTATION ROUTE FROM GODERICH STREET TO SAUGEEN BEACH ROAD
② FOUR LANE URBAN CROSS SECTION
BRUCE COUNTY ROAD 25
DEVELOPED LEFT TURN LANE
TAPER
PARALLEL LANE
DIVESTURE FROM COUNTY TO TOWN
SCHEDULE A+ EA
SCHEDULE B EA
LOCAL 1:5 YEAR STORM SEWER ON BLUFF TO PROVIDE WATER QUALITY TREATMENT
LOT 30
R=310m
NEW 450mmØ CULVERT
LAKE RANGE ROAD
NELSON ROAD
NEW 450mmØ STORM
NEW 525mmØ STORM
NEW 750mmØ STORM
NEW 450mmØ STORM SEWER
NEW 300mmØ STORM SEWER
NEW 900mmØ STORM SEWER
NEW 750mmØ STORM
NEW 450mmØ STORM SEWER
NEW 300mmØ STORM SEWER
BAKER ROAD
ROBERT DRIVE
JAY STREET
BELL ROAD
EX. 750ø CSP
NEW 525mmØ STORM
NEW 525mmØ STORM SEWER
NEW 450mmØ STORM
NEW 375mmØ STORM SEWER
NEW 300mmØ STORM
NEW 375mmØ STORM SEWER
DRIVEWAY LOCATIONS TO BE RESOLVED
PROPOSED BRUCE COUNTY ROAD 33 RE-ALIGNMENT
30m WIDE RIGHT-OF-WAY LAND ACQUISITION BY COUNTY. TWO LANE RURAL CROSS SECTION WITH PARTIALLY PAVED SHOULDERS SCHEDULE B EA (<$2.4m)
LAND ACQUISITION BY COUNTY
STAGE 2 ARCHAEOLOGICAL ASSESSMENT REQUIRED
ENVIRONMENTAL IMPACT STUDY REQUIRED
NEW 525mmØ CULVERT
R=335m
LOT 29
LOT 28
LOT 27
LOT 26
GORE DRAIN
GODERICH STREET (HIGHWAY No. 21)
SCHEDULE A+ EA WITHIN EXISTING ROAD ALLOWANCES AND USING TRENCHLESS TECHNOLOGY FOR WATER COURSE CROSSINGS
⑦ 1:5 YEAR DESIGN FLOW CRITERIA
NEW 750mmØ STORM
NEW 750mmØ STORM SEWER
NEW 600mmØ STORM SEWER
NEW 525mmØ STORM SEWER
NEW 375Ø STORM
GEORGE STREET
NEW 525mmØ STORM SEWER
NEW 450mmØ STORM SEWER
NEW 375mmØ STORM SEWER
SNYDER STREET
SAUGEEN BEACH ROAD
BRUCE COUNTY ROAD 33
LAKE RANGE ROAD
⑩ DITCHING IMPROVEMENTS TO GORE DRAIN SYSTEM
BOUNDARY OF LOCAL PLAN / SETTLEMENT AREA BOUNDARY AS PER TOWN OF SAUGEEN SHORES LOCAL OFFICIAL PLAN
LOT 26

Master Plan - Re-align Bruce Road 33 to Intersect Bruce Road 25 at Future Bruce Street Location and Construct a New Storm Sewer on Bruce Road 25 to a New Outlet at Lake Huron

1. The Master Plan recommends that a new roadway be constructed to re-align BR33 to intersect BR25 at the future Bruce Street location. The intersection would be signalized with dedicated left turn lanes on each leg of the intersecting roads.
2. BR25 would be upgraded to a four lane urban road section from Goderich Street to the future Bruce Street location with an additional dedicated eastbound lane and left turn lane at Goderich Street. BR25 west of the intersection with the future Bruce Street would be a four lane road section, tapering to a two lane urban section to Saugeen Beach Road.
3. A multi purpose trail/active transportation route (ATR) is to be included on the north side of BR25, from Goderich Street to Saugeen Beach Road.
4. The Master Plan recommends the extension of a BR25 storm sewer system, to convey the 1:100 year design flow from the Goderich Street intersection, to the top of the bluff west of the Lake Range Road intersection.
5. A storm sewer, sized to convey the 1:5 year design flow, is recommended to be extended westerly from Lake Range Road to a new outlet at Lake Huron; in-line with BR25.
6. Flows in storm sewer may surcharge to watercourse west of Shipley Avenue to maintain "flushing flows" as per Fish Habitat and Aquatic Impact Assessment (2010). Flows in excess of the storm sewer capacity would surcharge to the road surface on BR25; draining westerly to the existing watercourse outlet west of Shipley Avenue.
7. A storm sewer system, designed to convey the 1:5 year design flows, is recommended within the Baker Subdivision. The system would maintain the existing outlet in-line with Baker Road, with a second, new outlet at the boat launch, in-line with George Street. These storm sewer systems are recommended to be installed at the same time as the planned sanitary sewer system.
8. A new 4-way intersection at Baker Road and Lake Range Road would be necessary with an easterly road extension to intersect with the new BR33 alignment.
9. BR25 west of Bruce Street would be divested from the Countyto the Town, BR33 south of BR25 to Lot 27 would be divested from the County to the town.
10. Basic ditching improvements, to improve drainage along BR33 to the Gore Drain, are recommended for the Master Plan.

BluePlan ENGINEERING
GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | EXETER | HAMILTON | OTA
1280 - 2ND AVENUE EAST, UNIT 1, OWEN SOUND, ON N4K 2J3
TEL 519-515-1900 www.planbluee.ca

MASTER PLAN OF ALTERNATIVE SOLUTIONS FOR DRAINAGE
COUNTY OF BRUCE/
TOWN OF SAUGEEN SHORES
BRUCE ROADS 25 AND 33
MASTER PLAN

DRAWN BY :	APPROVED BY :	PROJECT NO. :	DRAWING NO. :
K.B.	J.B.S.	M-1562	MP
DESIGNED BY :	DATE :	SCALE :	
A.C.W./J.B.S.	JULY 2016	1:2,000	

October 8, 2019
Our File: 217127

Via Email: c.seider@waterprotection.ca

Drinking Water Source Protection
c/o Grey Sauble Conservation Authority
Risk Management Office
237897 Inglis Falls Road, RR#4
Owen Sound, ON N4K 5N6

Attention: Mr. Carl Seider

Re: Source Water Protection Consultation
Bruce Road 33 Re-Alignment
Town of Saugeen Shores
County of Bruce

Dear Carl,

GM BluePlan Engineering has been retained by the County of Bruce, as the proponent, with the Town of Saugeen Shores, as principle partner, to undertake a Schedule 'B' Municipal Class Environmental Assessment (EA) planning process appropriately to plan the Bruce Road 33 re-alignment. A Project File (April 2018) was previously prepared to address the EA process (Municipal Engineers Association, 2015) and is available on the County's and Town's website. An addendum to the *'Bruce County Road 33 Re-Alignment – Project File'* has subsequently been prepared to meet the Schedule 'B' requirements specific to the additional review of alternatives for stormwater management associated with the road re-alignment. The Project File, including the Addendum, discusses the findings, to date, of Phase 1 and, in part, Phase 2 of the Environmental Assessment.

As a simplified summary, the project proposes the re-alignment of Bruce Road 33 to intersect Bruce Road 25 at the Future Bruce Street intersection location, where shown on the attached *Notice of Project Change*, and the construction of a stormwater management facility to manage runoff from the re-aligned Bruce Road 33. This will result in road works outside of the existing rights-of-way and the construction of a stormwater management facility, and will include the following:

- Road works including grading and paving;
- Landscaping of adjacent areas;
- The construction of roadside ditches designed to meet the requirements of an enhanced grass swale; and
- The proposed construction of a dry pond-type stormwater management facility.

The creation of lands that would include chemical or fuel storage are not included as part of this plan.

Based on our preliminary review, the Study Area is situated within the Saugeen Valley Source Protection Area. According to the Saugeen-Grey Sauble-Northern Bruce Peninsula Source Protection Plan, the Study Area is not situated within a wellhead protection area (WHPA) or intake protection zone (IPZ) and therefore cannot be considered a significant drinking water threat. Although it does not alter the evaluation of drinking water threats, it is recognized that the site is situated within a significant groundwater recharge area (SGRA) and a highly vulnerable aquifer (HVA), with a vulnerability score of 6.

We have reviewed the recommended re-alignment of Bruce Road 33 and associated activities in relation to the *Tables for Drinking Water Threats*. Based on the potential scope of the project, it not anticipated that:

i. Any project activities will be considered a prescribed drinking water threat; or
ii. Any activities will change or create new vulnerable areas.

As part of the EA process, we are reviewing the project with respect to requirements under the Clean Water Act. At this time, we are requesting confirmation of the above, as well as whether you are aware of any other potential considerations and policies in the Source Protection Plan that may apply to the project.

Should you have any questions, please feel free to contact our office.

Yours truly,

GM BLUEPLAN ENGINEERING LIMITED
Per:

Matthew Nelson, P.Eng., P.Geo.
AN/kd

cc: County of Bruce: Jim Donohoe, via Email – jdonohoe@brucecounty.on.ca
File No. 217127

ENCLOSURE C:
STORMWATER MANAGEMENT DESIGN BRIEF

Prepared By:

Bruce County Road 33 Re-Alignment

Revised Conceptual Stormwater Management Design Brief
Saugeen Shores, ON

GMBP File: 217127

September 2019

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA
1260-2ND AVE. E., UNIT 1, OWEN SOUND ON N4K 2J3 P: 519-376-1805
WWW.GMBLUEPLAN.CA

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

REVISED CONCEPTUAL STORMWATER MANAGEMENT DESIGN BRIEF

BRUCE COUNTY ROAD 33 RE-ALIGNMENT

SEPTEMBER 2019

GMBP FILE: 217127

1. INTRODUCTION AND BACKGROUND

The County of Bruce (County), as the operating authority for Bruce Road 25 and Bruce Road 33 (BR25 & BR33), proposes to reconstruct the existing BR25 roadway between Saugeen Beach Road and Goderich Street (Provincial Highway 21), as well as to construct a new roadway to re-align BR33 to intersect BR25 at the same location as the Town of Saugeen Shores' (Town) planned alignment of Bruce Street from the north, as shown on Figure 1.

The proposed reconstruction of BR25 and re-alignment of BR33 are supported by the recommendations of the Master Plan for Roads and Drainage (Master Plan: May 2017). The Master Plan identifies that the residential lands in the Baker Road area to the west of the existing BR33 (Lake Range Road), herein referred to as the Baker Subdivision, occasionally suffer from seasonal flooding issues, and currently lack a storm sewer system. As a result, drainage conditions within the Baker Subdivision should not be worsened by runoff associated with development within upstream lands and be improved, if possible.

A Conceptual Stormwater Management (SWM) Design Brief (April 2018) was completed to address, in general terms, the drainage interests associated with the increase in impervious surface area related to the proposed BR33 re-alignment, which would drain through the Baker Subdivision to Lake Huron. The previous SWM Design Brief considered a SWM pond only ancillary to the re-aligned BR33. The proposed SWM pond was conceptually designed to attenuate upstream post-development peak flow rates to less than, or equal to, pre-development conditions prior to draining to the Baker Subdivision; assuming that future development would be responsible to manage its own stormwater, beyond the existing condition. Water quality treatment (WQT) to an enhanced level (80% TSS removal), would be provided to runoff primarily by roadside ditches designed generally to the requirements of Enhanced Grassed (EG) swales. In addition, since the previous SWM Design Brief, the area of upstream lands expected to drain to the proposed BR33 re-alignment under post-development conditions has increased slightly as a result of more detailed roadway design considerations.

The previous Conceptual SWM Design Brief was prepared to support the Schedule 'B' Municipal Class Environmental Assessment (EA) process associated with the proposed BR33 re-alignment project. Since then, the Ministry of the Environment, Conservation and Parks (MECP) has indicated that a review of additional alternatives to the proposed SWM facility is necessary prior to a *Notice of Completion* being valid.

This Revised Conceptual SWM Design Brief identifies, conceptually, several alternative solutions for SWM in support of an Addendum to the *'Bruce County Road 33 Re-alignment – Project File'* that is being prepared to satisfy the requirements of the Environmental Assessment process.

2. EXISTING CONDITIONS (PRE-DEVELOPMENT)

In general, lands to the south of BR25, west of the Gore Drain Trail and east of the Baker Subdivision area, drain downward from east to west. The lands associated with the BR33 re-alignment, and draining to the Baker Subdivision, are zoned as 'Planned Development' and 'Agricultural'. Current land use is for agricultural purposes.

Runoff from lands east of the Baker Subdivision currently drains across Lake Range Road at two locations; via a 750mm Ø culvert approximately 155m to the south of BR25, and via a 750mm Ø culvert approximately 50m to the south of Baker Road, where shown on Figure 2. Runoff draining to the northerly culvert is conveyed through the area to the north of the Baker Subdivision towards BR25 and is not considered to contribute to the identified drainage issues within the Baker Subdivision. Runoff draining to the southerly culvert drains in an open watercourse across private properties to a system of roadside ditches within the Baker Subdivision and is ultimately conveyed to Lake Huron. Under pre-development conditions, approximately 48.45 ha of upstream land is expected to drain to the Baker Subdivision.

3. EVALUATION OF POST-DEVELOPMENT CONDITIONS

3.1 Post-Development Drainage

The re-aligned BR33 section is proposed to be constructed from Lake Range Road at a location approximately 190m to the south of the existing intersection with Baker Road, to BR25 at a location approximately 535m to the east of its existing intersection with BR25. The new, proposed BR25/BR33 intersection is in line with a future extension of Bruce Street, planned by the Town of Saugeen Shores.

The approximately 990m re-aligned BR33 section is generally proposed to be constructed with a two-lane rural cross-section, transitioning to a two-lane plus a left-turn lane urban cross-section at its intersection with BR25, although additional planning study for that intersection is anticipated through a separate planning process.

The proposed re-aligned BR33 will intercept runoff from the lands upstream of the Baker Subdivision, as a well as a portion of the lands currently upstream of the existing northerly 750mm Ø culvert crossing Lake Range Road, which do not drain to the Baker Subdivision under pre-development conditions. The runoff intercepted from the existing northerly 750mm Ø culvert includes lands zoned as 'Residential', 'Planned Development', and 'Highway Commercial'. Currently, the developed portions of these lands generally drain to BR25 with only several accessory buildings draining westerly towards the location of the proposed re-aligned BR33; the existing accessory buildings are considered to have negligible imperviousness within the overall area. Therefore, under post-development conditions, approximately 56.52ha of upstream land is expected to drain to the Baker Subdivision.

In consideration of the BR33 re-alignment, the acquisition of privately owned land is planned to permit, at minimum, a 30m-wide right-of-way along the proposed re-alignment of BR33. In addition, the remnant portion of Lot 28 located to the east of Lake Range Road and west of the re-aligned BR33 is planned to be acquired for the proposed construction of ancillary roadworks, where shown on Figure 1.

The section of Lake Range Road, immediately south of Baker Road, is proposed to be reconstructed as a cul-de-sac to maintain access to private properties, although the design phase may alter the final configuration. An approximately 90m long road with a two-lane rural cross-section is proposed to be constructed between the Lake Range Road / Baker Road intersection and the proposed re-aligned BR33 to maintain access. All proposed roadworks may include the construction of roadside ditches to convey the runoff from the roadways and their upstream lands.

3.2 Stormwater Management Design Criteria

Based on pre-development drainage conditions, and correspondence with the SVCA, Town and County, the SWM criteria used to develop the alternative solutions considered for the proposed project are as follows:

1. Post-development peak flow rates discharging from the proposed BR33 re-alignment and upstream lands to the Baker Subdivision are to be attenuated to less than, or equal to, pre-development conditions.
2. Stormwater management associated with future development, within the lands zoned as 'Planned Development', may be considered in either the current or future developed state.
3. Enhanced WQT (80% total suspended solids [TSS] removal) is to be provided for runoff draining from the proposed development and its upstream lands prior to draining to the Baker Subdivision.

4. ALTERNATIVE SOLUTIONS: STORMWATER MANAGEMENT

The following four (4) alternative solutions are considered to address the previously defined SWM Design Criteria:

1. Do Nothing
2. Construct a SWM facility to manage runoff related only to the BR33 re-alignment
3. Construct a SWM facility to manage runoff from BR33 re-alignment and future development
4. Construct a new storm sewer system through the Baker Subdivision to Lake Huron

4.1 Alternative 1: Do Nothing

The 'Do Nothing' alternative represents the construction of the proposed roadworks with no SWM controls provided for the attenuation or WQT of runoff draining from the re-aligned BR33 and lands upstream of the Baker Subdivision. This alternative does not address the increase in peak flows, the existing drainage deficiencies identified within the Baker Subdivision, or the additional potential impacts to water quality. It is considered as a base-line against which to compare other alternative solutions.

4.2 Alternative 2: Construct a SWM Facility to Manage Runoff Related only to BR33 Re-Alignment

Alternative 2 considers the construction of a SWM facility to provide attenuation of post-development peak flow rates to less than, or equal to, pre-development peak flow rates for runoff draining from the re-aligned BR33 and lands upstream of the Baker Subdivision. Future development within lands upstream of the Baker Subdivision are considered, by this alternative solution, to be responsible for managing their own stormwater beyond the pre-development condition. WQT is expected to be provided via a "treatment train" approach consisting of roadside ditches, generally designed to the requirements of an enhanced grass swale and a dry pond-type facility.

4.3 Alternative 3: Construct a SWM Facility to Manage Runoff from BR33 & Future Development

Alternative 3 considers the construction of a "centralized" SWM facility to provide the attenuation of post-development peak flow rates to less than, or equal to, pre-development peak flow rates for runoff draining from the re-aligned BR33 and lands upstream prior to draining to the Baker Subdivision. Future development within lands upstream of the Baker Subdivision is considered, by this alternative solution, to drain uncontrolled to a central, or common, SWM facility. The SWM facility considered for Alternative 3 is envisioned as a dry pond-type with an infiltration feature to address both peak flow attenuation and WQT requirements. WQT for the catchment areas (i.e. the 56.52 ha area) is considered to be provided by a single SWM facility.

4.4 Alternative 4: Construct a New Storm Sewer System through Baker Subdivision to Lake Huron

Alternative 4 considers the construction of a storm sewer system through the Baker Subdivision to convey all post-development runoff from upstream lands to a new outlet at Lake Huron. In order not to worsen the identified drainage issues within the Baker Subdivision, the storm sewer system would be designed to provide sufficient capacity to convey the upstream runoff associated with a 100-year design storm event. The design of Alternative 4 could consider two options:

Option A: Future development would be responsible to manage its own stormwater, beyond the pre-development conditions.

Option B: Future development would be permitted to drain uncontrolled to the proposed storm sewer system.

It is expected that WQT would be provided for runoff conveyed by the storm sewer system by an Oil-Grit Separator (OGS) unit prior to discharging to Lake Huron.

5. QUANTITY CONTROL CRITERIA PARAMETERS AND MODELLING

5.1 Design Rainfall Events

Rainfall data, collected by Environment Canada for the Goderich area between 1970 and 2007, were used to prepare intensity duration frequency (IDF) statistical rainfall data. The data was entered in the MIDUSS computer modeling software to generate coefficients for the Chicago type rainfall distribution patterns. The Chicago storm input parameters used to model the various design rainfall events for the subject property are summarized in the following Table 1.

Table 1 – Design Rainfall Events (Generated from Environment Canada IDF Data for Goderich)

COEFFICIENT	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
A	1264.60	2258.60	3043.26	4026.22	4882.60	5607.28
B	10.288	14.090	16.180	17.817	19.202	19.798
C	0.8891	0.9265	0.9456	0.9604	0.9719	0.9772
R	0.375	0.375	0.375	0.375	0.375	0.375
Duration (min)	360	360	360	360	360	360
Depth (mm)	39.5	56.0	67.0	80.9	91.3	101.4
Intensity (mm/hr)	85.7	116.7	136.8	162.7	181.2	200.5

5.2 Site Soil Conditions

The soil types within the lands upstream of the Baker Subdivision are generally characterized as Berrien sandy loam and Brady sandy loam, as per the Bruce County Soils Map (Ontario Soil Survey Report No. 16) published by the Department of Agriculture. Berrien sandy loam and Brady sandy loam are known to be of the Hydrological Soil Group AB.

With consideration of the pre-development and post-development pervious ground cover of the proposed roadworks and lands upstream of the Baker Subdivision, which could be defined as “crop and other improved

land", a Group AB soil is represented with an SCS Curve Number of 70 as per the Ministry of Transportation (MTO) Drainage Manual's Design Chart 1.09.

The impervious areas within all catchments are associated with an SCS Curve Number of 98.

5.3 Pre-Development Catchment Areas

For pre-development conditions analysis purposes, the approximately 48.45ha area associated with the proposed roadworks and lands upstream of the Baker Subdivision, are modelled as one (1) drainage catchment, described in Table 2 below, and as shown on Figure 2. The pre-development conditions MIDUSS computer modelling is attached in Appendix 'A'.

Table 2 – Pre-Development Conditions Catchment

Catchment	Description	Area (ha)	Impervious Level (%)
10	Lands Draining to the Baker Subdivision	48.45	0

The results of the pre-development conditions routing analysis are summarized in Section 5.5.

5.4 Post-Development Catchment Areas

For post-development conditions analysis purposes, the approximately 56.52ha area associated with the proposed roadworks and the land upstream of the Baker Subdivision is modelled as two (2) drainage catchments, described in Table 3, and as shown on Figure 3.

Catchment 100 includes about 8.07 hectares within Lot 30 east of the BR33 re-alignment. This area is included conservatively within the SWM facility calculations to ensure no net increase in outflow from the planned SWM facility. At the design development phase, consideration should be given to overland flow routes to address the 'greater than 100-year' runoff condition as recommended by the SVCA.

The imperviousness associated with the post-development drainage catchments is considered to be one of the following two conditions, depending on the alternative solution:

Scenario A:

Future development will be responsible for managing its own stormwater, to pre-development flow conditions. The imperviousness of the catchment lands is based solely on the impervious area of the proposed BR33 re-alignment; negligible imperviousness is considered to currently exist within the upstream lands. *(Applies to Alternatives 1, 2 and 4 Opt. A)*

Scenario B:

Future development will drain uncontrolled to the proposed BR33 re-alignment. The imperviousness is based on the current Town of Saugeen Shores Zoning By-Law 75-2006. The approximately 28.60ha portion of catchment lands zoned as 'Planned Development' and 'Residential' are associated with an imperviousness described as a Rational Method runoff coefficient of 0.50. A runoff coefficient of 0.50 is considered appropriate for most residential uses (single family, semi-detached, townhouse and institutional) as per Table 5-1 of the Design Guidelines for Sewage Works (DGSW) published by the MECP. The approximately 0.14 ha portion of catchments lands zoned as 'Highway Commercial' are associated with an imperviousness described as a

Rational Method runoff coefficient of 0.80; an acceptable value as per Table 5-1 of the DSGW. Considering that, from the same Table, impervious surfaces and grassed areas can be associated with a runoff coefficient of 0.90 and 0.25, respectively, runoff coefficients of 0.50 and 0.80 correspond to imperviousness values of approximately 40% and 85%, respectively. The approximately 27.78ha portion of the catchment lands zoned as 'Agricultural' is considered to be completely pervious. *(Applies to Alternatives 3 and 4 Opt. B).*

The post-development conditions MIDUSS computer modelling is attached in Appendix 'B'.

Table 3 – Post-Development Conditions Catchments

Catchment	Description	Area (ha)	Impervious Level (%)	
			Scenario A	Scenario B
100	Lands easterly of the re-aligned BR33 draining to the Baker Subdivision: ±27.78ha zoned as 'Agricultural'; ±0.14ha zoned as 'Highway Commercial'; ±22.63ha zoned as 'Highway Commercial'	50.55	2	19
200	Lands westerly of the re-aligned BR33 draining to the Baker Subdivision. (Entirely zoned as 'Planned Development')	5.97	13	40

The results of the post-development conditions routing analysis are summarized in Section 5.5.

5.5 MIDUSS Quantity Control Modelling Results

MIDUSS modelling software was used to model the expected peak flow rates draining to the Baker Subdivision under pre-development conditions and the post-development conditions of each alternative solution during the various design storm events. Results from the models are summarized in the following Table 4, and the modelling is provided for reference in Appendix 'A' and Appendix 'B'.

Table 4 below provides the total peak flow rates discharging from the modelled catchments to the Baker Subdivision under pre-development conditions as well as the uncontrolled post-development peak flow rates associated with both imperviousness scenarios. The total post-development runoff volume expected to drain to the Baker Subdivision during a 100-year design storm event are also shown in Table 4.

Table 4 – Summary of Uncontrolled Peak Flow Rate Results

Development Conditions	Return Storm Frequency (yr)					
	2	5	10	25	50	100
Pre-Development Conditions – Peak Flow Rate (m^3/s)						
Existing Level	0.087	0.287	0.493	0.820	1.120	1.448
Post-Development Conditions – Peak Flow Rate (m^3/s) (Total Volume of Runoff)						
Scenario A (Alt. 1, 2 & 4 Opt. A)	0.232	0.451	0.764	1.261	1.717	2.218 (24,189 m^3)
Scenario B (Alt. 3 & 4 Opt. B)	2.053	3.133	3.916	5.404	6.787	8.289 (29,397 m^3)

Alternative 1 is represented by the post-development peak flow rates associated with Scenario A in Table 4, as no SWM controls are proposed as part of the alternative solution. Thus, an increase in peak flow rates is associated with Alternative 1, confirming that a "Do Nothing" approach would worsen the existing drainage issues identified within the Baker Subdivision.

From the uncontrolled post-development peak flow rates shown in Table 4, a conceptual SWM facility was designed within the MIDUSS modelling for both Alternatives 2 and 3 to estimate the active storage volume required to provide attenuation of peak flow rates to pre-development levels prior to discharging to the Baker Subdivision. For both Alternatives 2 and 3, an infiltration basin-type facility is not considered to be feasible in addressing peak flow control requirements considering that a runoff volume of approximately 24,189 m^3 and 29,397 m^3, respectively, would be expected to drain to the proposed SWM facility during the 100-year design storm event. From the Stormwater Management Planning and Design (SWMPD) Manual published by the MECP, the maximum storage depth within an infiltration basin-type is 0.6m to prevent the compaction of underlying soils and resulting decrease in their infiltration potential. Therefore, the minimum infiltration basin footprint area for Alternatives 2 and 3 would be expected to be approximately 40,315m^2 and 48,995m^2, respectively, to infiltrate the entirety of the post-development runoff volume. Considering that approximately 6,850m^2 of area is available for the construction of a SWM facility within the remnant portion of Lot 28, it is believed that alternative SWM facility types may be more appropriate given the land requirements of an infiltration basin.

From the results of the modelling, an active storage volume of approximately 8,500m^3 would be necessary within the SWM facility related to Alternative 2 to attenuate post-development runoff to a pre-development peak flow rate for all design storm events up to, and including, the 100-year return period. Considering that approximately 6,850m^2 of area is available for the construction of a SWM facility, this active storage volume would correspond to a depth of approximately 1.24m. From the SWMPD Manual published by the MECP, a maximum active storage depth of 2m is permitted for a wet or dry pond-type facility. For Alternative 2, a dry pond-type facility is envisioned as these are typically associated with lower construction, maintenance and design costs than a wet pond-type facility and offer opportunity for infiltration considering the sandy nature of local soils.

For Alternative 3, an active storage volume of approximately 20,100m^3 would be necessary within the SWM facility to attenuate post-development runoff to a pre-development peak flow rate for all design storm events up to, and including, the 100-year return period. Assuming that a maximum 2m mean active storage depth could be achieved by a dry or wet pond-type facility with favourable site conditions (the greatest maximum mean active storage depths defined for SWM facilities within the SWMPD Manual), the minimum footprint area of the facility would be approximately 10,050m^2, or approximately 150% greater than the area considered to be available within the remnant portion of Lot 28 for the construction of a SWM facility. Therefore, lands additional to the minimum required for the proposed roadworks would be necessary to construct the SWM facility associated with Alternative 3. To limit the level of land acquisition, a dry or wet pond-type facility would be proposed as part of Alternative 3 to achieve peak flow attenuation objectives. Land acquisition of this nature would need to be negotiated with adjacent land owners.

The 100-year, post-development peak flow rates shown in Table 4 for Scenarios A and B, represent the peak design flow to be conveyed by the envisioned storm sewer system through the Baker Subdivision as considered by Alternative 4, Options A and B, respectively. Possible additional flows from potential, future lateral sewers within the Baker Subdivision are not considered at this time by these peak flow rate values. The storm sewer system would be expected to be installed from Lake Range Road, along Baker Road, Bell Road and George Street, to a new outlet at Lake Huron. The expected length of the proposed storm sewer system would be approximately 685m and, based on the modelling of the Master Plan, the average pipe grade within the system (weighted for section length) would be expected to be approximately 0.80%. To provide sufficient capacity to convey the entirety of the upstream 100-year peak flow rates associated with Options A (2.218m^3/s) and B (8.289m^3/s) of Alternative 4, minimum pipe diameters of 1050mm (Q_{CAP} = 2.442m^3/s) and

1800mm (Q_{CAP} = 10.281m^3/s) would be required, respectively (assuming a Manning's n = 0.013). Based on the Master Plan, the total length of storm sewer proposed through the Baker Subdivision is expected to be approximately 685m. These minimum pipe diameters would be expected to be larger once future lateral sewers, from within the Baker Subdivision, are considered.

6. STORMWATER QUALITY TREATMENT

Water quality treatment is required to be provided to an Enhanced level for runoff draining from the re-aligned BR33 and lands upstream of the Baker Subdivision prior to draining to the Baker Subdivision. For alternative solutions that consider future development to be responsible for managing its own stormwater beyond the pre-development condition, such as Alternatives 1, 2 and 4 Option A, runoff is considered to be treated to an Enhanced level prior to draining to the proposed roadworks. However, the runoff draining from these lands must still be considered in the design and sizing of downstream SWM controls intended to treat runoff from the proposed roadworks, as appropriate, since they would confluence prior to draining to the Baker Subdivision.

For alternative solutions that consider runoff from future development to drain uncontrolled to the proposed roadworks, such as Alternatives 3 and 4 Option B, water quality treatment must be provided to an Enhanced level by their proposed SWM facilities for all lands upstream of the Baker Subdivision.

The water quality control measures considered by each of the alternative solutions are outlined and evaluated within the following sub-sections.

6.1 Alternative 1: Do Nothing

As part of the "Do Nothing" approach of Alternative 1, no SWM controls are proposed to provide WQT to runoff prior to draining to the Baker Subdivision. As a result, the water quality of runoff draining to the Baker Subdivision would be expected to be adversely affected as contaminants from the proposed roadworks would be conveyed downstream without treatment.

6.2 Alternative 2: Construct a SWM Facility to Manage Road Runoff Only

WQT for Alternative 2 is considered to be addressed via a treatment train approach. Runoff would be conveyed and treated by EG Swales and further polished by the SWM facility, designed as a dry pond-type facility.

Under Alternative 2, the roadside ditches along the proposed roadworks are generally considered to meet the criteria of an EG Swale as per the Low Impact Development Stormwater Management Planning and Design (LIDSWMPD) Guide published by the Credit Valley Conservation Authority and the Toronto and Regional Conservation Authority TRCA. In general, the roadside ditches are considered with maximum side slopes of 3:1 (Horizontal : Vertical), a minimum 1.05m-wide bottom, and a longitudinal slope of about 0.5%. Table 5 below compares the characteristics of the maximum peak flow rate expected to be conveyed by the EG Swales (the peak flow rate from Catchment 100) during a 4 hour, 25mm Chicago storm event for Alternative 2 in comparison with the requirements set by the LIDSWMPD Guide; MIDUSS modelling for the results are attached as Appendix 'C'.

Table 5 – Enhanced Grass Swale Design in Comparison to Requirements

Characteristics	During 4 hour, 25mm Chicago Storm Event	
	As Designed*	As Required
Maximum depth of flow through EG Swale	0.10m	0.10m
Maximum flow velocity through EG Swale	0.48m/s	0.50m/s

** Conservatively considers the peak flow rate draining from Catchment 100; the relatively lesser flows through Catchment 200 are expected to yield a more desirable WQT performance.*

As shown in Table 5, the design depth and velocity of flow through the EG Swale during a 4 hour, 25mm Chicago storm event meets the requirements of the LIDSWMPD Guide. According to the CVCA and TRCA's LIDSWMPD Guide, an EG Swale provides a median TSS removal rate of 76%.

The EG Swales would convey runoff to the SWM facility where it further would be polished. The SWM facility would provide temporary volume to store runoff. Infiltration of low flows within the SWM facility may also be considered in the detailed design phased. The attenuation provided by the outlet of the SWM facility reduces the velocity of flows through the SWM facility and encourages further settling out of suspended solids.

Overall, given the initial WQT provided by conveying runoff along the roadside ditches designed as EG Swales, and the further polishing provided by the SWM facility's temporary storage volume, it is expected that the runoff from the proposed roadworks will receive an Enhanced level (80% TSS removal) of WQT prior to discharging to the Baker Subdivision drainage system.

6.3 Alternative 3: Construct a SWM Facility to Manage Runoff from Road and Future Development

The peak flow rate of runoff considered by Alternative 3 to be draining to the proposed roadworks is expected to be too great to be treated first via a conveyance control such as an EG Swale. The maximum peak flow rate that would be expected to be conveyed by roadside EG Swales (the peak flow rate draining from Catchment 100) during a 4 hour, 25mm Chicago storm event for Alternative 3 is approximately 1.017m^3/s; MIDUSS modelling for the results are attached as Appendix 'C'. Considering the maximum bottom width of 3m permitted by the LIDSWMPD Guide for EG Swales, and the 3:1 (H:V) side slopes and longitudinal slope of about 0.5% of the proposed roadside ditches, an approximately 0.28m of flow depth is required to convey the approximately 1.017m^3/s peak flow rate. Since this depth of flow is considerably greater than the 0.10m maximum required for the design of an EG Swale, EG Swales are not considered to be a feasible SWM control for WQT under the proposed conditions of Alternative 3.

Therefore, WQT must be provided for the runoff via an "end-of-pipe" approach such as within a SWM facility, which is already considered for peak flow attenuation, prior to discharging to the Baker Subdivision. Considering the land constraints, the SWM facility type proposed by Alternative 3 would be one that can provide the required level of WQT with the smallest footprint area while also considering the active storage volume necessary to achieve peak flow attenuation requirements. The minimum footprint area of several SWM facility types were calculated based on the storage volumes requirements of the SWMPD Manual for an Enhanced level of WQT and are summarized in Table 6; supporting calculations are attached as Appendix 'D'.

Table 6 – Min. Storage Volumes and Corresponding Min. Footprint Area by SWM Facility Type

SWM Facility Type	Req. Water Quality Treatment (WQT) Volumes (m^3)		Req. Peak Flow Attenuation (PFA) Active Volume ** (m^3)	Governing Storage Volume Component	Corresponding Minimum SWM Facility Footprint Area (m^2)
	Active	Permanent			
Infiltration *	1,245		20,100	PFA - Active	33,500
Wetland	2,265	1,360	20,100	PFA - Active	20,100
Wet Pond	2,265	3,845	20,100	PFA - Active	10,050

Notes:
Enhanced WQT storage requirements for Dry Pond-type facility not provided within SWMPD Manual.
** Considers an Infiltration Basin-type facility; sub-surface infiltration facilities are discussed below.*
*** Volume for peak flow attenuation requirements determined in Section 5.5.*

For all SWM facilities types shown in Table 6, the minimum required footprint area is governed by the storage volume required for peak flow attenuation objectives. Thus, of these SWM facility types, that which has the deepest permitted active pool depth, the wet pond-type, results in the smallest footprint area. However, given the typically sandy soils within the Port Elgin area, the provision of the required infiltration volume through a sub-surface feature of the SWM facility is possible. For the same footprint area as a wet pond-type facility, a dry pond with a sub-surface infiltration feature could be considered as they both have the same permitted active storage depth. A sub-surface infiltration feature with a wet pond-type facility is not considered to be suitable since the wet pond area would need to be lined with an impervious layer.

Furthermore, the storage volume provided by a sub-surface infiltration feature for WQT could also be considered to reduce the active storage requirements of the dry pond portion of the SWM facility and, consequently, the land area requirements of the proposed SWM facility as a whole. If the required 1,245m^3 infiltration volume for WQT was provided by the sub-surface feature, the dry pond portion would be required to provide approximately 18,855m^3 of active storage volume to satisfy peak flow attenuation objectives. Considering a maximum mean active storage depth of 2m, the minimum footprint area of the SWM facility would be approximately 9,430m^2. Considering a porosity of 0.4 for clear stone, the sub-surface feature would be proposed to have a volume of approximately 3,115m^3 to provide approximately 1,245m^3 of storage volume within the voids of the clear stone. For the reduced footprint area of the proposed SWM facility, this clear stone volume would correspond to an approximately 0.33m-deep layer which is generally considered to be achievable assuming favourable groundwater conditions.

Therefore, the envisioned SWM facility proposed by Alternative 3 is a dry pond with a sub-surface infiltration feature for WQT since it has the smallest land acquisition requirements.

6.4 Alternative 4: Construct a New Storm Sewer System through Baker Subdivision to Lake Huron

WQT for Alternative 4 is considered to be addressed via an OGS unit installed in-line with the storm sewer system proposed to be constructed through the Baker Subdivision. Installed either at the inlet or outlet section of the storm sewer system, the OGS unit would provide an Enhanced level of WQT to runoff draining from the proposed roadworks and lands upstream of the Baker Subdivision prior to discharging to Lake Huron. If future lateral storm sewers were planned to drain Baker Subdivision lands to the proposed storm sewer system, the size of the OGS unit considered by Alternative 4 may need to be increased to accommodate the additional runoff or installed at the inlet of the storm sewer system with additional SWM controls considered for runoff received by the storm sewer system from downstream lands.

The PCSWMM for Stormceptor tool provided by Imbrium Solutions Inc. for the sizing of Stormceptor STC OGS units was used to determine the appropriate size of OGS unit considered by Alternative 4 as the STC line of units typically provides a broader range of options for relatively larger tributary areas such as the subject one. Given the limitations of available OGS unit sizing tools, both Options A and B of Alternative 4 are represented by the same design parameters with an approximately 56.52ha tributary area having a "developed" imperviousness of approximately 22%. The scenario of development lands managing their own stormwater beyond the existing condition cannot be properly represented within the simulation of the sizing tool. Considering the aforementioned tributary area characteristics, the sizing tool was used to determine an appropriate unit to provide an Enhanced level of WQT to 90% of the annual runoff volume for a fine particle distribution. The results of the sizing tool calculations are included as Appendix 'E'.

From the results of the sizing tool, it is determined that no pre-designed Stormceptor STC unit is readily available to satisfy the proposed project's WQT requirements. A Stormceptor MAX unit, which involves custom, detailed design by the manufacturer on a site-specific basis, would have to be considered and it is not known whether a Stormceptor MAX unit could be designed to achieve the WQT requirements.

Therefore, Alternative 4 is not expected to provide sufficient water quality treatment to runoff draining to the Baker Subdivision from upstream lands including the proposed roadworks. Multiple water quality treatment provisions would be required to address the design criteria.

7. CONCEPTUAL CONSTRUCTION COSTS OF ALTERNATIVE SOLUTIONS

To facilitate a more comprehensive comparison of the alternative solutions, construction costs estimates for each alternative have been estimated at a conceptual level. The conceptual construction costs consider only the SWM features associated with each alternative solution and do not include the construction costs associated with the proposed roadworks which are considered to be generally constant among the alternative solutions. Similarly, the costs do not consider those associated with land acquisition required by the proposed roadworks, which is considered to include the remnant portion of Lot 28. Alternately, a note is made of any alternative solution that would require lands additional to those required for the proposed roadworks.

Conceptual construction costing of the alternative solutions is based on the following components:

- **Storage Volume of the SWM Facility:** Considered to be earth excavation including removal from site.
- **Volume of Clear Stone:** Supplied and installed.
- **Storm Sewer:** This excludes costs associated with the outlet systems of the SWM facilities as they are expected to be relatively minor and generally similar between the alternative solutions considered.
- **Manholes / Headwall:** Assumes one (1) headwall structure and several 3600mmØ pipes; supplied and installed.
- **OGS Unit:** Supplied and installed.
- **Road Restoration:** Any restoration of roadways associated with the installation of SWM components.

The conceptual costing of the alternative solutions is summarized in the following Table 7 below.

Table 7 – Summary of Conceptual Construction Costs of Each Alternative Solution

Alternative	Description of Alternative Solution	Conceptual Cost of SWM Components	Req. Additional Land Acquisition
1	Do Nothing	$0	No
2	Construct a SWM Facility to Manage Road Runoff Only	$200,000 to $250,000	No
3	Construct a SWM Facility to Manage Runoff from Road and Future Development	$600,000 to $800,000	Yes
4: Opt. A	Construct a New Storm Sewer System through the Baker Subdivision to Lake Huron	$4.5M to $5.0M	No
4: Opt. B		$5.0M to $5.5M	No

As shown in Table 7, omitting Alternative 1 – Do Nothing, which is not expected to address the identified drainage issues within Baker Subdivision, the least costly alternative solution is Alternative 2. In addition, the final construction cost associated with Alternative 3 is expected to be greater than shown in Table 7 due to the required land acquisition as a result of the relatively larger footprint area associated with its proposed SWM facility.

8. DISCUSSION AND COMPARISON OF SWM ALTERNATIVE SOLUTIONS

In evaluating the alternative solutions, the impact to social, cultural, natural, technical and economic environments should be considered. While mention may be made to other "environments", this technical document focuses on the technical and related economic (in terms of construction cost) environments.

8.1 Alternative 1: Do Nothing

Alternative 1, which proposes a 'Do Nothing' approach, is the most economical approach but is technically inadequate since it does not address the identified drainage issues within Baker Subdivision. Therefore, Alternative 1 is not considered appropriate.

8.2 Alternative 2: Construct a SWM Facility to Manage Road Runoff Only

Alternative 2 satisfies the SWM Design Criteria defined within Section 3.2 in terms of both water quality and quantity requirements. Alternative 2 is associated with the lowest conceptual construction cost. In addition, the land requirements of Alternative 2 coincide with that of the proposed roadworks and additional land acquisition would not be required.

8.3 Alternative 3: Construct a SWM Facility to Manage Runoff from Road and Future Development

Alternative 3 also satisfies the SWM Design Criteria defined within Section 3.2 in terms of both water quality and quantity requirements. The increase in conceptual construction costs from Alternative 2 to Alternative 3 could be justified on the basis that the proposed "centralized" SWM facility may encourage development within lands upstream of the Baker Subdivision and/or a cost sharing program could be implemented to recoup the construction costs from future developers. However, development interest within the upstream lands is

impeded by the absence of municipal sanitary and water servicing infrastructure within the lands upstream of the Baker Subdivision. This may result in a long period of time before the economic objective of a cost sharing program is fully realized.

In addition, the relatively large footprint area of the SWM facility proposed by Alternative 3 would require additional land acquisition greater than the minimum necessary to permit the construction of the proposed roadworks. Additional costs would be incurred as a result of the purchase of these lands.

8.4 Alternative 4: Construct a New Storm Sewer System through Baker Subdivision to Lake Huron

Alternative 4 does not conclusively satisfy the SWM Design Criteria defined within Section 3.2 in terms of water quality. It is not expected that a single OGS unit of sufficient size to provide WQT to an enhanced level is commercially available and, if it were, the costs associated with such a unit, or multiple units, are expected to be considerable. Although Alternative 4 is expected to mitigate the identified drainage issues within Baker Subdivision by conveying upstream runoff through it as piped flow, the discharge location to Lake Huron would require additional studies to assess the impact and possible mitigations for the outlet. In relation to the other alternative solutions considered, the conceptual construction costs associated with both Options A and B of Alternative 4 are significant.

To their benefit, the opportunity exists for the Town to construct planned storm and sanitary sewers within the Baker Subdivision concurrently with the Alternative 4 storm sewer system. Assuming that the Town would choose to exploit this opportunity, significant delays to the project would be anticipated as the Town does not currently have approvals or the funding for such an undertaking. Based on the review of the technical and economic considerations, Alternative 4, including both Option A and Option B, is considered to be not as favourable in comparison to Alternative 2.

Therefore, from the comparative discussion above, Alternative 2 is concluded to be the recommended alternative solution from a construction cost and technical environment perspective.

9. SUMMARY

This Revised Conceptual SWM Design Brief was been prepared to identify, conceptually design, and assess possible SWM alternative solutions in support of an Addendum to the *'Bruce County Road 33 Re-alignment – Project File'* that is being prepared to satisfy the planning requirements of the MECP. The following SWM design alternatives were considered:

1. Do Nothing
2. Construct a SWM facility to manage runoff related only to the BR33 re-alignment
3. Construct a SWM facility to manage runoff from BR33 re-alignment and future development
4. Construct a new storm sewer system through the Baker Subdivision to Lake Huron

From the conceptual-level evaluation and comparison of primarily technical and economic impacts, Alternative 2, to construct a stormwater management facility to manage runoff related to the BR33 re-alignment is concluded to be the Recommended Alternative Solution for stormwater management. Alternative 2 proposes the following SWM elements:

- Future development within lands upstream of the Baker Subdivision will be responsible for managing its own stormwater, beyond a pre-development condition.

- Construction of roadside ditches generally designed to the requirements of an enhanced grass swale to convey and treat runoff prior to discharging to a proposed SWM facility.
- The proposed construction of a dry pond-type SWM facility to further polish runoff and attenuate peak flow rates to less than, or equal to, pre-development conditions prior to discharging to the Baker Subdivision.

Additional design details of Alternative 2 would be prepared, as necessary, during the project design phase.

All of which is respectfully submitted,

GM BLUEPLAN ENGINEERING LIMITED

Per:

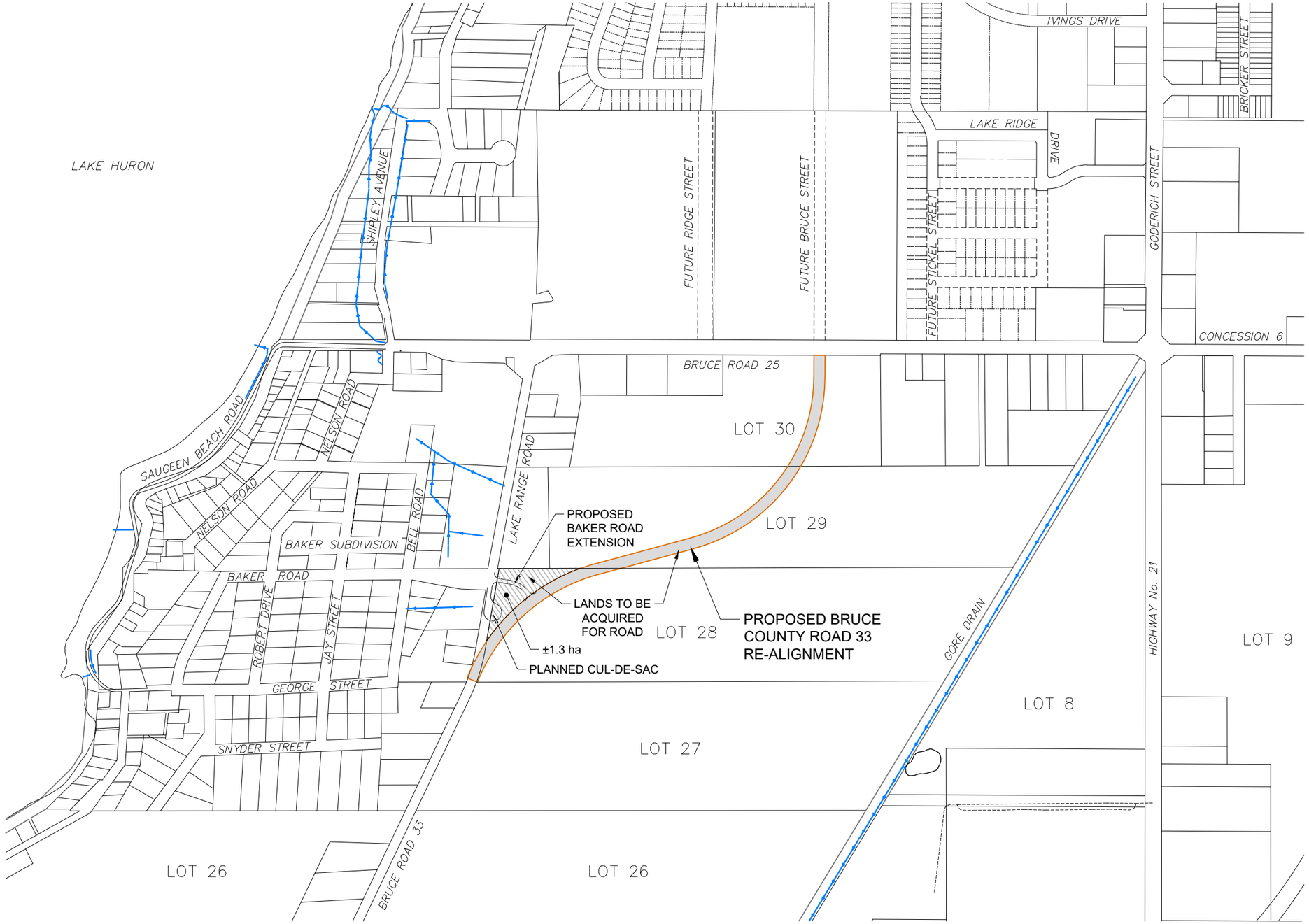
for Alex Wilkinson, E.I.T.

Reviewed by:

John Slocombe, P.Eng.

FIGURES:

217127
Bruce County Road 33
Town of Saugeen Shores



SCALE 1:7,500
SEPTEMBER 2019

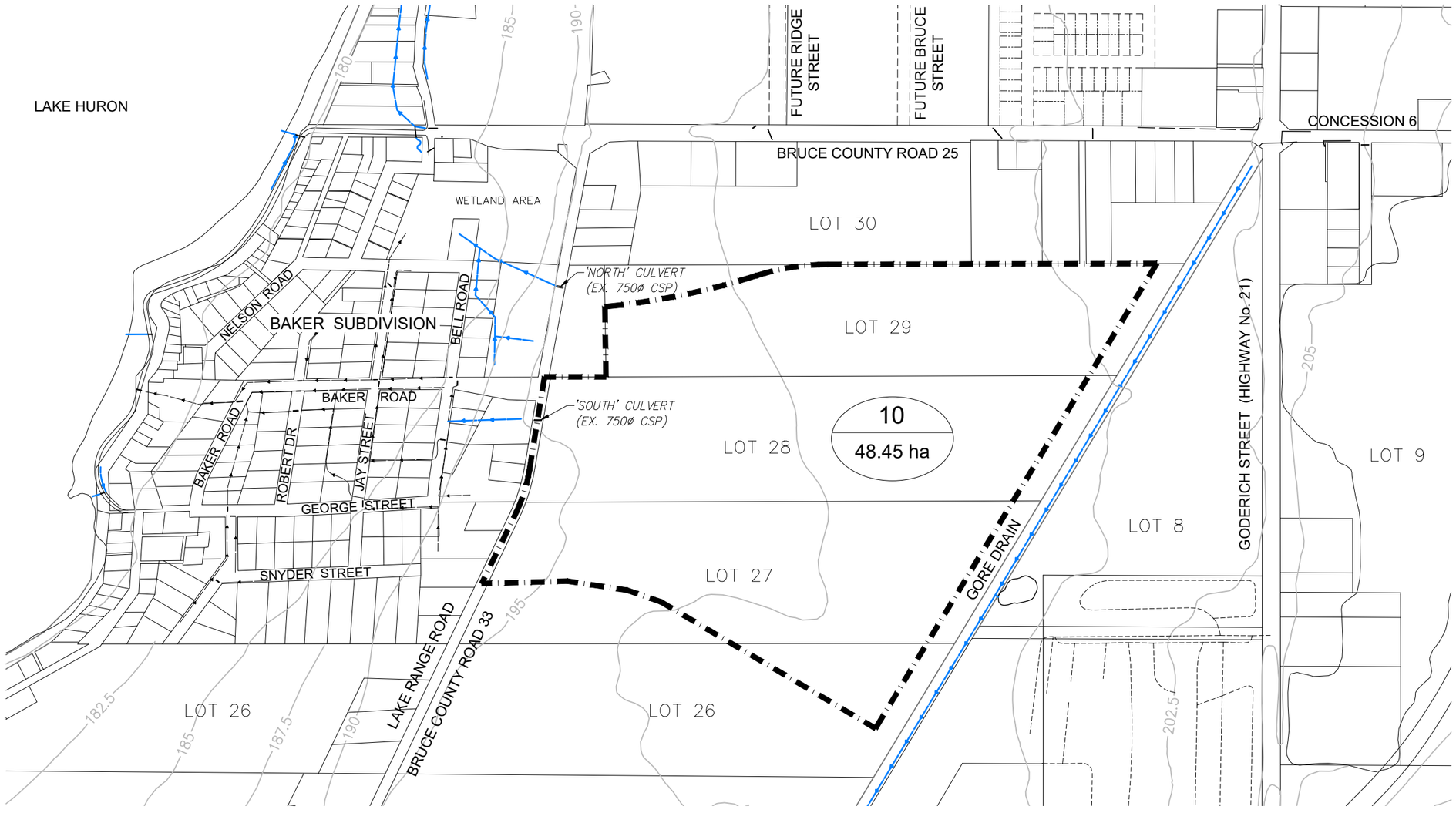
SITE LOCATION PLAN

BRUCE COUNTY ROAD 33 RE-ALIGNMENT

Figure No. 1

BluePlan ENGINEERING

217127
Bruce County Road 33
Town of Saugeen Shores



LEGEND

- DRAINAGE BOUNDARY
- 10 — DRAINAGE AREA No.
- 48.45 ha — DRAINAGE AREA SIZE (Hectares)

SCALE 1:7,500
SEPTEMBER 2019

PRE-DEVELOPMENT DRAINAGE AREAS

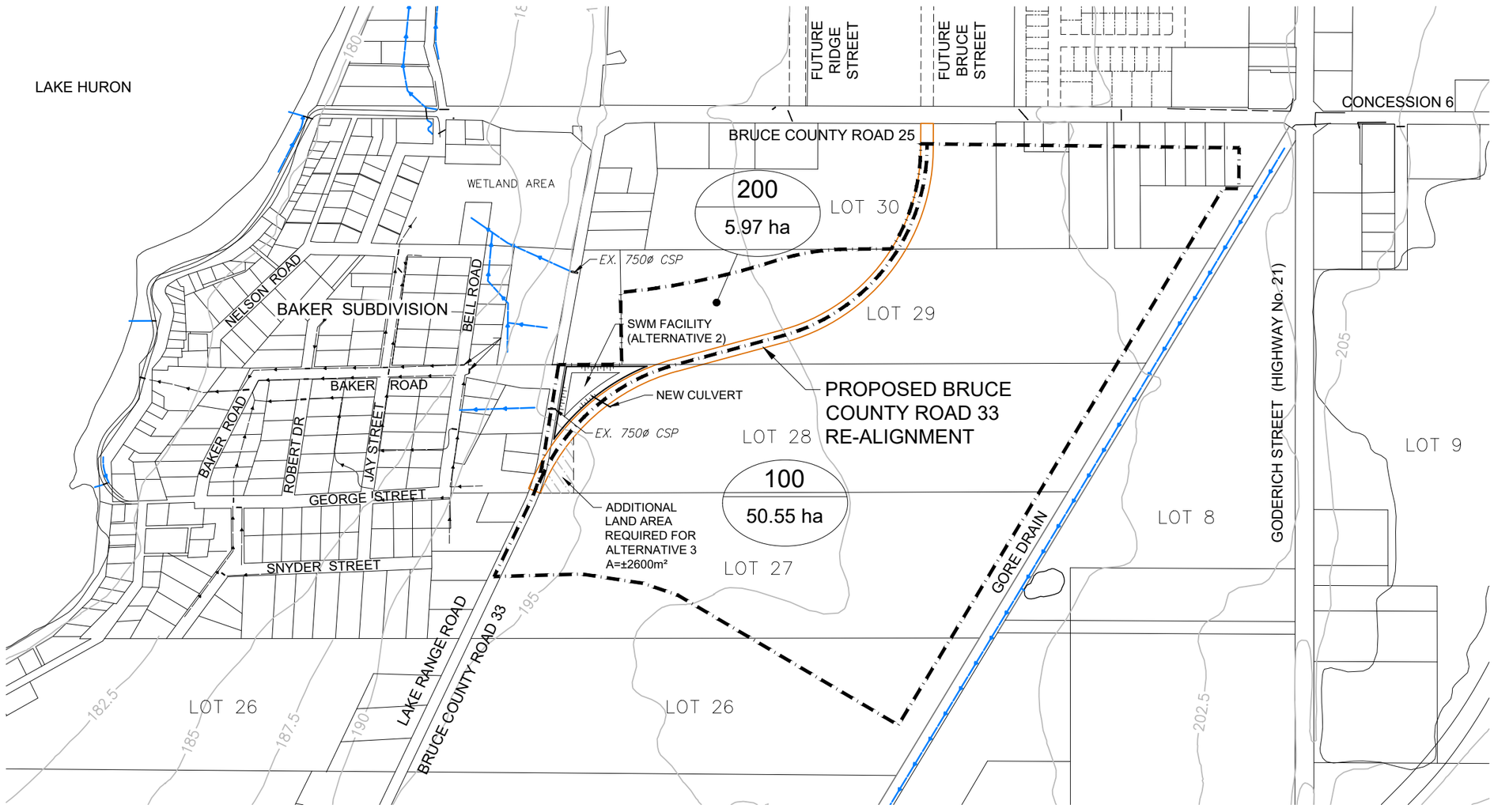
BRUCE COUNTY ROAD 33 RE-ALIGNMENT

Figure No. 2

BluePlan ENGINEERING

FILE:C:\Civil 3D Projects\217127 Drainage Figures-K.dwg LAYOUT:Pre Development
LAST SAVED BY:Kboers, 9/30/2019 2:34:00 PM PLOTTED BY:Ken Boers - GM BluePlan 9/30/2019 2:59:57 PM

217127
Bruce County Road 33
Town of Saugeen Shores



LEGEND

- DRAINAGE BOUNDARY
- 100 — DRAINAGE AREA No.
- 50.55 ha — DRAINAGE AREA SIZE (Hectares)

SCALE 1:7,500
SEPTEMBER 2019

POST-DEVELOPMENT DRAINAGE AREAS

BRUCE COUNTY ROAD 33 RE-ALIGNMENT

Figure No. 3

BluePlan ENGINEERING

FILE:C:\Civil 3D Projects\217127 Drainage Figures-K.dwg LAYOUT:Post Development
LAST SAVED BY:Kboers, 9/30/2019 2:34:00 PM PLOTTED BY:Ken Boers - GM BluePlan 9/30/2019 2:59:58 PM

APPENDIX A:
MIDUSS MODELLING – PRE-DEVELOPMENT CONDITIONS

```
                MIDUSS Output ------------------------------------------------>"
                MIDUSS version                              Version 2.25  rev. 473"
                MIDUSS created                          Sunday, February 07, 2010"
          10    Units used:                                                ie METRIC"
                Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
                                                                      MIDUSS\217127"
                Output filename:                  217127 - Pre 2 yr - Aug19.out"
                Licensee name:                                             gmbp"
                Company                                    Hewlett-Packard Company"
                Date & Time last used:                      8/5/2019 at 6:55:25 PM"
31            TIME PARAMETERS"
      10.000    Time Step"
     360.000    Max. Storm length"
    2400.000    Max. Hydrograph"
32            STORM Chicago storm"
           1    Chicago storm"
    1264.600    Coefficient A"
      10.288    Constant B"
       0.889    Exponent C"
       0.375    Fraction R"
     360.000    Duration"
       1.000    Time step multiplier"
             Maximum intensity            85.761    mm/hr"
             Total depth                  39.507    mm"
           6    002hyd   Hydrograph extension used in this file"
33           CATCHMENT 10"
           1    Triangular SCS"
           1    Equal length"
           1    SCS method"
          10    Lands Draining to the Baker Subdivision"
       0.000    % Impervious"
      48.450    Total Area"
     850.000    Flow length"
       0.500    Overland Slope"
      48.450    Pervious Area"
     850.000    Pervious length"
       0.500    Pervious slope"
       0.000    Impervious Area"
     850.000    Impervious length"
       0.500    Impervious slope"
       0.250    Pervious Manning 'n'"
      70.000    Pervious SCS Curve No."
       0.151    Pervious Runoff coefficient"
       0.100    Pervious Ia/S coefficient"
      10.886    Pervious Initial abstraction"
       0.015    Impervious Manning 'n'"
      98.000    Impervious SCS Curve No."
       0.000    Impervious Runoff coefficient"
       0.100    Impervious Ia/S coefficient"
       0.518    Impervious Initial abstraction"
                  0.087     0.000     0.000     0.000 c.m/sec"
             Catchment 10           Pervious   Impervious Total Area "
             Surface Area           48.450     0.000      48.450     hectare"
             Time of concentration  378.236    27.426     378.234    minutes"
             Time to Centroid       646.152    203.881    646.149    minutes"
             Rainfall depth         39.507     39.507     39.507     mm"
             Rainfall volume        1.9141     0.0000     1.9141     ha-m"
             Rainfall losses        33.549     5.184      33.548     mm"
             Runoff depth           5.958      34.323     5.958      mm"
             Runoff volume          2886.83    0.02       2886.85    c.m"
             Runoff coefficient     0.151      0.000      0.151      "
             Maximum flow           0.087      0.000      0.087      c.m/sec"
40           HYDROGRAPH Add Runoff "
           4   Add Runoff "
                  0.087     0.087     0.000     0.000"
40           HYDROGRAPH Copy to Outflow"
           8   Copy to Outflow"
                  0.087     0.087     0.087     0.000"
40           HYDROGRAPH   Combine    1"
           6   Combine "
           1   Node #"
               Total Runoff Draining to Baker Subdivision"
             Maximum flow                  0.087    c.m/sec"
```



```
           Hydrograph volume          2886.848    c.m"
                 0.087     0.087     0.087     0.087"
38         START/RE-START TOTALS 10"
3    Runoff Totals on EXIT"
           Total Catchment area                      48.450    hectare"
           Total Impervious area                      0.000    hectare"
           Total % impervious                         0.000"
19         EXIT"
```

```
                MIDUSS Output ---------------------------------------------->"
                MIDUSS version                          Version 2.25  rev. 473"
                MIDUSS created                       Sunday, February 07, 2010"
          10    Units used:                                          ie METRIC"
                Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
                                                                    MIDUSS\217127"
                Output filename:                 217127 - Pre 5 yr - Aug19.out"
                Licensee name:                                            gmbp"
                Company                                  Hewlett-Packard Company"
                Date & Time last used:                    8/5/2019 at 6:59:31 PM"
31            TIME PARAMETERS"
    10.000    Time Step"
   360.000    Max. Storm length"
  2400.000    Max. Hydrograph"
32            STORM Chicago storm"
     1        Chicago storm"
  2258.600    Coefficient A"
    14.090    Constant B"
     0.927    Exponent C"
     0.375    Fraction R"
   360.000    Duration"
     1.000    Time step multiplier"
             Maximum intensity          116.710    mm/hr"
             Total depth                 55.992    mm"
          6    005hyd   Hydrograph extension used in this file"
33          CATCHMENT 10"
          1    Triangular SCS"
          1    Equal length"
          1    SCS method"
         10    Lands Draining to the Baker Subdivision"
     0.000    % Impervious"
    48.450    Total Area"
   850.000    Flow length"
     0.500    Overland Slope"
    48.450    Pervious Area"
   850.000    Pervious length"
     0.500    Pervious slope"
     0.000    Impervious Area"
   850.000    Impervious length"
     0.500    Impervious slope"
     0.250    Pervious Manning 'n'"
    70.000    Pervious SCS Curve No."
     0.236    Pervious Runoff coefficient"
     0.100    Pervious Ia/S coefficient"
    10.886    Pervious Initial abstraction"
     0.015    Impervious Manning 'n'"
    98.000    Impervious SCS Curve No."
     0.000    Impervious Runoff coefficient"
     0.100    Impervious Ia/S coefficient"
     0.518    Impervious Initial abstraction"
                 0.287     0.000     0.000     0.000 c.m/sec"
             Catchment 10           Pervious   Impervious Total Area "
             Surface Area           48.450     0.000      48.450     hectare"
             Time of concentration  257.804    23.930     257.803    minutes"
             Time to Centroid       498.738    194.961    498.737    minutes"
             Rainfall depth         55.992     55.992     55.992     mm"
             Rainfall volume        2.7128     0.0000     2.7128     ha-m"
             Rainfall losses        42.781     5.379      42.781     mm"
             Runoff depth           13.211     50.613     13.211     mm"
             Runoff volume          6400.68    0.02       6400.70    c.m"
             Runoff coefficient     0.236      0.000      0.236      "
             Maximum flow           0.287      0.000      0.287      c.m/sec"
40           HYDROGRAPH Add Runoff "
          4    Add Runoff "
                 0.287     0.287     0.000     0.000"
40           HYDROGRAPH Copy to Outflow"
          8    Copy to Outflow"
                 0.287     0.287     0.287     0.000"
40           HYDROGRAPH   Combine    1"
          6    Combine "
          1    Node #"
               Total Runoff Draining to Baker Subdivision"
             Maximum flow                  0.287    c.m/sec"
```



```
             Hydrograph volume          6400.704    c.m"
                 0.287     0.287     0.287     0.287"
38           START/RE-START TOTALS 10"
3          Runoff Totals on EXIT"
             Total Catchment area                      48.450    hectare"
             Total Impervious area                      0.000    hectare"
             Total % impervious                         0.000"
19           EXIT"
```

```
"                MIDUSS Output ---------------------------------------------->"
"                MIDUSS version                              Version 2.25  rev. 473"
"                MIDUSS created                          Sunday, February 07, 2010"
"          10    Units used:                                              ie METRIC"
"                Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
"                                                                      MIDUSS\217127"
"                Output filename:                 217127 - Pre 10 yr - Aug19.out"
"                Licensee name:                                             gmbp"
"                Company                                  Hewlett-Packard Company"
"                Date & Time last used:                    8/5/2019 at 7:00:47 PM"
" 31          TIME_PARAMETERS"
"      10.000   Time Step"
"     360.000   Max. Storm length"
"    2400.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"           1   Chicago storm"
"    3043.260   Coefficient A"
"      16.180   Constant B"
"       0.946   Exponent C"
"       0.375   Fraction R"
"     360.000   Duration"
"       1.000   Time step multiplier"
"            Maximum intensity          136.818    mm/hr"
"            Total depth                 67.019    mm"
"           6   010hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 10"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"          10   Lands Draining to the Baker Subdivision"
"       0.000   % Impervious"
"      48.450   Total Area"
"     850.000   Flow length"
"       0.500   Overland Slope"
"      48.450   Pervious Area"
"     850.000   Pervious length"
"       0.500   Pervious slope"
"       0.000   Impervious Area"
"     850.000   Impervious length"
"       0.500   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      70.000   Pervious SCS Curve No."
"       0.285   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"      10.886   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.000   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                 0.493     0.000     0.000     0.000 c.m/sec"
"            Catchment 10           Pervious   Impervious Total Area "
"            Surface Area           48.450     0.000      48.450     hectare"
"            Time of concentration  216.691    22.353     216.690    minutes"
"            Time to Centroid       448.709    191.014    448.708    minutes"
"            Rainfall depth         67.019     67.019     67.019     mm"
"            Rainfall volume        3.2471     0.0000     3.2471     ha-m"
"            Rainfall losses        47.922     5.401      47.922     mm"
"            Runoff depth           19.097     61.617     19.097     mm"
"            Runoff volume          9252.29    0.03       9252.32    c.m"
"            Runoff coefficient     0.285      0.000      0.285      "
"            Maximum flow           0.493      0.000      0.493      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.493     0.493     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                 0.493     0.493     0.493     0.000"
" 40          HYDROGRAPH   Combine    1"
"           6   Combine "
"           1   Node #"
"               Total Runoff Draining to Baker Subdivision"
"            Maximum flow                 0.493    c.m/sec"
```



```
"            Hydrograph volume          9252.323    c.m"
"                  0.493     0.493     0.493     0.493"
" 38          START/RE-START TOTALS 10"
"          3   Runoff Totals on EXIT"
"            Total Catchment area                        48.450    hectare"
"            Total Impervious area                        0.000    hectare"
"            Total % impervious                           0.000"
" 19          EXIT"
```

```
            MIDUSS Output ------------------------------------------------>"
            MIDUSS version                              Version 2.25  rev. 473"
            MIDUSS created                           Sunday, February 07, 2010"
       10   Units used:                                                ie METRIC"
            Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
                                                                      MIDUSS\217127"
            Output filename:                  217127 - Pre 25 yr - Aug19.out"
            Licensee name:                                               gmbp"
            Company                                        Hewlett-Packard Company"
            Date & Time last used:                          8/5/2019 at 7:03:16 PM"
31        TIME PARAMETERS"
    10.000   Time Step"
   360.000   Max. Storm length"
  2400.000   Max. Hydrograph"
32        STORM Chicago storm"
     1.000   Chicago storm"
  4026.220   Coefficient A"
    17.817   Constant B"
     0.960   Exponent C"
     0.375   Fraction R"
   360.000   Duration"
     1.000   Time step multiplier"
          Maximum intensity          162.743    mm/hr"
          Total depth                 80.877    mm"
       6   025hyd   Hydrograph extension used in this file"
33        CATCHMENT 10"
       1   Triangular SCS"
       1   Equal length"
       1   SCS method"
      10   Lands Draining to the Baker Subdivision"
    0.000   % Impervious"
   48.450   Total Area"
  850.000   Flow length"
    0.500   Overland Slope"
   48.450   Pervious Area"
  850.000   Pervious length"
    0.500   Pervious slope"
    0.000   Impervious Area"
  850.000   Impervious length"
    0.500   Impervious slope"
    0.250   Pervious Manning 'n'"
   70.000   Pervious SCS Curve No."
    0.339   Pervious Runoff coefficient"
    0.100   Pervious Ia/S coefficient"
   10.886   Pervious Initial abstraction"
    0.015   Impervious Manning 'n'"
   98.000   Impervious SCS Curve No."
    0.000   Impervious Runoff coefficient"
    0.100   Impervious Ia/S coefficient"
    0.518   Impervious Initial abstraction"
            0.820     0.000     0.000     0.000 c.m/sec"
          Catchment 10           Pervious   Impervious Total Area "
          Surface Area           48.450     0.000      48.450     hectare"
          Time of concentration  183.705    20.779     183.704    minutes"
          Time to Centroid       406.582    187.462    406.582    minutes"
          Rainfall depth         80.877     80.877     80.877     mm"
          Rainfall volume        3.9185     0.0000     3.9185     ha-m"
          Rainfall losses        53.490     5.698      53.490     mm"
          Runoff depth           27.388     75.180     27.388     mm"
          Runoff volume          1.3269     0.0000     1.3269     ha-m"
          Runoff coefficient     0.339      0.000      0.339      "
          Maximum flow           0.820      0.000      0.820      c.m/sec"
40        HYDROGRAPH Add Runoff "
       4   Add Runoff "
            0.820     0.820     0.000     0.000"
40        HYDROGRAPH Copy to Outflow"
       8   Copy to Outflow"
            0.820     0.820     0.820     0.000"
40        HYDROGRAPH   Combine    1"
       6   Combine "
       1   Node #"
           Total Runoff Draining to Baker Subdivision"
          Maximum flow                 0.820    c.m/sec"
```



```
          Hydrograph volume          13269.350    c.m"
            0.820     0.820     0.820     0.820"
38        START/RE-START TOTALS 10"
3   Runoff Totals on EXIT"
          Total Catchment area                        48.450    hectare"
          Total Impervious area                        0.000    hectare"
          Total % impervious                           0.000"
19        EXIT"
```

```
            MIDUSS Output ------------------------------------------------>"
            MIDUSS version                                Version 2.25  rev. 473"
            MIDUSS created                             Sunday, February 07, 2010"
       10   Units used:                                                ie METRIC"
            Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
                                                                      MIDUSS\217127"
            Output filename:                  217127 - Pre 50 yr - Aug19.out"
            Licensee name:                                                gmbp"
            Company                                          Hewlett-Packard Company"
            Date & Time last used:                            8/5/2019 at 7:04:28 PM"
31        TIME PARAMETERS"
  10.000   Time Step"
 360.000   Max. Storm length"
2400.000   Max. Hydrograph"
32        STORM Chicago storm"
       1   Chicago storm"
4882.600   Coefficient A"
  19.202   Constant B"
   0.972   Exponent C"
   0.375   Fraction R"
 360.000   Duration"
   1.000   Time step multiplier"
        Maximum intensity          181.226    mm/hr"
        Total depth                 91.285    mm"
       6   050hyd   Hydrograph extension used in this file"
33      CATCHMENT 10"
       1   Triangular SCS"
       1   Equal length"
       1   SCS method"
      10   Lands Draining to the Baker Subdivision"
   0.000   % Impervious"
  48.450   Total Area"
 850.000   Flow length"
   0.500   Overland Slope"
  48.450   Pervious Area"
 850.000   Pervious length"
   0.500   Pervious slope"
   0.000   Impervious Area"
 850.000   Impervious length"
   0.500   Impervious slope"
   0.250   Pervious Manning 'n'"
  70.000   Pervious SCS Curve No."
   0.374   Pervious Runoff coefficient"
   0.100   Pervious Ia/S coefficient"
  10.886   Pervious Initial abstraction"
   0.015   Impervious Manning 'n'"
  98.000   Impervious SCS Curve No."
   0.000   Impervious Runoff coefficient"
   0.100   Impervious Ia/S coefficient"
   0.518   Impervious Initial abstraction"
           1.120     0.000     0.000     0.000 c.m/sec"
        Catchment 10          Pervious   Impervious Total Area "
        Surface Area          48.450     0.000      48.450     hectare"
        Time of concentration 166.813    19.867     166.812    minutes"
        Time to Centroid      383.546    185.293    383.546    minutes"
        Rainfall depth        91.285     91.285     91.285     mm"
        Rainfall volume       4.4227     0.0000     4.4227     ha-m"
        Rainfall losses       57.131     6.266      57.131     mm"
        Runoff depth          34.153     85.019     34.153     mm"
        Runoff volume         1.6547     0.0000     1.6547     ha-m"
        Runoff coefficient    0.374      0.000      0.374      "
        Maximum flow          1.120      0.000      1.120      c.m/sec"
40      HYDROGRAPH Add Runoff "
       4   Add Runoff "
           1.120     1.120     0.000     0.000"
40      HYDROGRAPH Copy to Outflow"
       8   Copy to Outflow"
           1.120     1.120     1.120     0.000"
40      HYDROGRAPH   Combine    1"
       6   Combine "
       1   Node #"
           Total Runoff Draining to Baker Subdivision"
        Maximum flow                1.120    c.m/sec"
```



```
        Hydrograph volume        16547.338    c.m"
           1.120     1.120     1.120     1.120"
38      START/RE-START TOTALS 10"
3   Runoff Totals on EXIT"
        Total Catchment area                      48.450    hectare"
        Total Impervious area                      0.000    hectare"
        Total % impervious                         0.000"
19      EXIT"
```

```
"              MIDUSS Output ------------------------------------------------>"
"              MIDUSS version                                Version 2.25  rev. 473"
"              MIDUSS created                             Sunday, February 07, 2010"
"          10  Units used:                                                ie METRIC"
"              Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
"                                                                        MIDUSS\217127"
"              Output filename:                  217127 - Pre 100 yr - Aug19.out"
"              Licensee name:                                                gmbp"
"              Company                                          Hewlett-Packard Company"
"              Date & Time last used:                            8/5/2019 at 7:05:57 PM"
" 31        TIME PARAMETERS"
"     10.000   Time Step"
"    360.000   Max. Storm length"
"   2400.000   Max. Hydrograph"
" 32        STORM Chicago storm"
"         1   Chicago storm"
"   5607.280   Coefficient A"
"     19.798   Constant B"
"      0.977   Exponent C"
"      0.375   Fraction R"
"    360.000   Duration"
"      1.000   Time step multiplier"
"           Maximum intensity           200.453    mm/hr"
"           Total depth                 101.430    mm"
"         6   100hyd   Hydrograph extension used in this file"
" 33        CATCHMENT 10"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"          10   Lands Draining to the Baker Subdivision"
"       0.000   % Impervious"
"      48.450   Total Area"
"     850.000   Flow length"
"       0.500   Overland Slope"
"      48.450   Pervious Area"
"     850.000   Pervious length"
"       0.500   Pervious slope"
"       0.000   Impervious Area"
"     850.000   Impervious length"
"       0.500   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      70.000   Pervious SCS Curve No."
"       0.405   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"      10.886   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.000   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                 1.448     0.000     0.000     0.000 c.m/sec"
"           Catchment 10           Pervious   Impervious Total Area "
"           Surface Area           48.450     0.000      48.450     hectare"
"           Time of concentration  153.552    19.057     153.551    minutes"
"           Time to Centroid       366.557    183.652    366.556    minutes"
"           Rainfall depth         101.430    101.430    101.430    mm"
"           Rainfall volume        4.9143     0.0000     4.9143     ha-m"
"           Rainfall losses        60.321     6.026      60.321     mm"
"           Runoff depth           41.109     95.403     41.109     mm"
"           Runoff volume          1.9917     0.0000     1.9917     ha-m"
"           Runoff coefficient     0.405      0.000      0.405      "
"           Maximum flow           1.448      0.000      1.448      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"         4   Add Runoff "
"                 1.448     1.448     0.000     0.000"
" 40        HYDROGRAPH Copy to Outflow"
"         8   Copy to Outflow"
"                 1.448     1.448     1.448     0.000"
" 40        HYDROGRAPH   Combine    1"
"         6   Combine "
"         1   Node #"
"             Total Runoff Draining to Baker Subdivision"
"          Maximum flow                  1.448    c.m/sec"
```



```
"           Hydrograph volume          19917.244    c.m"
"                 1.448     1.448     1.448     1.448"
" 38        START/RE-START TOTALS 10"
"3    Runoff Totals on EXIT"
"           Total Catchment area                        48.450    hectare"
"           Total Impervious area                        0.000    hectare"
"           Total % impervious                           0.000"
" 19        EXIT"
```

APPENDIX B:
MIDUSS MODELLING – POST-DEVELOPMENT CONDITIONS

```
"              MIDUSS Output ------------------------------------------------>"
"              MIDUSS version                              Version 2.25  rev. 473"
"              MIDUSS created                           Sunday, February 07, 2010"
"         10   Units used:                                              ie METRIC"
"              Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
"                                                                    MIDUSS\217127"
"              Output filename:   217127 - Post 2 yr - Scenario A - Aug19.out"
"              Licensee name:                                              gmbp"
"              Company                                  Hewlett-Packard Company"
"              Date & Time last used:                    8/5/2019 at 8:56:15 PM"
" 31        TIME PARAMETERS"
"      10.000   Time Step"
"     360.000   Max. Storm length"
"    2400.000   Max. Hydrograph"
" 32        STORM Chicago storm"
"           1   Chicago storm"
"    1264.600   Coefficient A"
"      10.288   Constant B"
"       0.889   Exponent C"
"       0.375   Fraction R"
"     360.000   Duration"
"       1.000   Time step multiplier"
"           Maximum intensity            85.735    mm/hr"
"           Total depth                  39.484    mm"
"           6   002hyd   Hydrograph extension used in this file"
" 33        CATCHMENT 100"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         100   Lands Easterly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"       2.000   % Impervious"
"      50.550   Total Area"
"     500.000   Flow length"
"       0.500   Overland Slope"
"      49.539   Pervious Area"
"     500.000   Pervious length"
"       0.500   Pervious slope"
"       1.011   Impervious Area"
"     500.000   Impervious length"
"       0.500   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      70.000   Pervious SCS Curve No."
"       0.151   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"      10.886   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.864   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                 0.122     0.000     0.000     0.000 c.m/sec"
"           Catchment 100          Pervious   Impervious Total Area "
"           Surface Area           49.539     1.011      50.550     hectare"
"           Time of concentration  275.226    19.951     248.478    minutes"
"           Time to Centroid       521.419    192.540    486.958    minutes"
"           Rainfall depth         39.484     39.484     39.484     mm"
"           Rainfall volume        1.9560     0.0399     1.9959     ha-m"
"           Rainfall losses        33.534     5.362      32.970     mm"
"           Runoff depth           5.950      34.122     6.513      mm"
"           Runoff volume          2947.36    344.97     3292.33    c.m"
"           Runoff coefficient     0.151      0.864      0.165      "
"           Maximum flow           0.118      0.109      0.122      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.122     0.122     0.000     0.000"
" 33        CATCHMENT 200"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         200   Lands Westerly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"      13.000   % Impervious"
```



```
"       5.970   Total Area"
"     150.000   Flow length"
"       0.500   Overland Slope"
"       5.194   Pervious Area"
"     150.000   Pervious length"
"       0.500   Pervious slope"
"       0.776   Impervious Area"
"     150.000   Impervious length"
"       0.500   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      70.000   Pervious SCS Curve No."
"       0.151   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"      10.886   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.864   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                 0.121     0.122     0.000     0.000 c.m/sec"
"           Catchment 200          Pervious   Impervious Total Area "
"           Surface Area           5.194      0.776      5.970      hectare"
"           Time of concentration  133.648    9.688      76.429     minutes"
"           Time to Centroid       349.893    176.910    270.046    minutes"
"           Rainfall depth         39.484     39.484     39.484     mm"
"           Rainfall volume        2050.73    306.43     2357.17    c.m"
"           Rainfall losses        33.535     5.355      29.872     mm"
"           Runoff depth           5.948      34.128     9.612      mm"
"           Runoff volume          308.95     264.87     573.82     c.m"
"           Runoff coefficient     0.151      0.864      0.243      "
"           Maximum flow           0.023      0.119      0.121      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.121     0.232     0.000     0.000"
" 54        POND DESIGN"
"     0.232   Current peak flow    c.m/sec"
"     0.001   Target outflow    c.m/sec"
"    3866.2   Hydrograph volume    c.m"
"        7.   Number of stages"
"     0.000   Minimum water level    metre"
"     6.000   Maximum water level    metre"
"     0.000   Starting water level    metre"
"         0   Keep Design Data: 1 = True; 0 = False"
"               Level Discharge    Volume"
"               0.000     0.000     0.000"
"               1.000   0.08700  1370.000"
"               2.000    0.2870  2940.000"
"               3.000    0.4930  4135.000"
"               4.000    0.8200  5780.000"
"               5.000     1.120  7120.000"
"               6.000     1.448  8485.000"
"           Peak outflow                    0.087    c.m/sec"
"           Maximum level                   0.998    metre"
"           Maximum storage              1367.673    c.m"
"           Centroidal lag                 11.951   hours"
"                 0.121     0.232     0.087     0.000 c.m/sec"
" 40        HYDROGRAPH   Combine    1"
"           6   Combine "
"           1   Node #"
"               Total Runoff Draining to Baker Subdivision"
"           Maximum flow                    0.087    c.m/sec"
"           Hydrograph volume            3860.840    c.m"
"                 0.121     0.232     0.087     0.087"
" 38        START/RE-START TOTALS 200"
"           3   Runoff Totals on EXIT"
"           Total Catchment area                      56.520    hectare"
"           Total Impervious area                      1.787    hectare"
"           Total % impervious                         3.162"
" 19        EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                                  Version 2.25  rev. 473"
"                MIDUSS created                               Sunday, February 07, 2010"
"           10   Units used:                                                ie METRIC"
"                Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
"                                                                          MIDUSS\217127"
"                Output filename:   217127 - Post 5 yr - Scenario A - Aug19.out"
"                Licensee name:                                                gmbp"
"                Company                                     Hewlett-Packard Company"
"                Date & Time last used:                       8/5/2019 at 8:57:20 PM"
" 31           TIME PARAMETERS"
"       10.000   Time Step"
"      360.000   Max. Storm length"
"     2400.000   Max. Hydrograph"
" 32           STORM Chicago storm"
"            1   Chicago storm"
"     2258.600   Coefficient A"
"       14.090   Constant B"
"        0.927   Exponent C"
"        0.375   Fraction R"
"      360.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           116.710    mm/hr"
"             Total depth                  55.992    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33           CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          100   Lands Easterly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"        2.000   % Impervious"
"       50.550   Total Area"
"      500.000   Flow length"
"        0.500   Overland Slope"
"       49.539   Pervious Area"
"      500.000   Pervious length"
"        0.500   Pervious slope"
"        1.011   Impervious Area"
"      500.000   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       70.000   Pervious SCS Curve No."
"        0.236   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.886   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.904   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                  0.400     0.000     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           49.539     1.011      50.550     hectare"
"             Time of concentration  187.508    17.405     175.169    minutes"
"             Time to Centroid       412.049    185.269    395.599    minutes"
"             Rainfall depth         55.992     55.992     55.992     mm"
"             Rainfall volume        2.7738     0.0566     2.8304     ha-m"
"             Rainfall losses        42.779     5.353      42.030     mm"
"             Runoff depth           13.214     50.639     13.962     mm"
"             Runoff volume          6545.91    511.96     7057.87    c.m"
"             Runoff coefficient     0.236      0.904      0.249      "
"             Maximum flow           0.392      0.180      0.400      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                  0.400     0.400     0.000     0.000"
" 33           CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          200   Lands Westerly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"       13.000   % Impervious"
```



```
"        5.970   Total Area"
"      150.000   Flow length"
"        0.500   Overland Slope"
"        5.194   Pervious Area"
"      150.000   Pervious length"
"        0.500   Pervious slope"
"        0.776   Impervious Area"
"      150.000   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       70.000   Pervious SCS Curve No."
"        0.236   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.886   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.896   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                  0.189     0.400     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           5.194      0.776      5.970      hectare"
"             Time of concentration  91.053     8.452      61.152     minutes"
"             Time to Centroid       292.453    172.194    248.920    minutes"
"             Rainfall depth         55.992     55.992     55.992     mm"
"             Rainfall volume        2908.18    434.56     3342.74    c.m"
"             Rainfall losses        42.781     5.827      37.977     mm"
"             Runoff depth           13.212     50.166     18.016     mm"
"             Runoff volume          686.20     389.33     1075.53    c.m"
"             Runoff coefficient     0.236      0.896      0.322      "
"             Maximum flow           0.075      0.177      0.189      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                  0.189     0.451     0.000     0.000"
" 54           POND DESIGN"
"        0.451   Current peak flow    c.m/sec"
"        0.001   Target outflow    c.m/sec"
"      8133.4   Hydrograph volume    c.m"
"           7.   Number of stages"
"        0.000   Minimum water level    metre"
"        6.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"                 0.000     0.000     0.000"
"                 1.000   0.08700  1370.000"
"                 2.000    0.2870  2940.000"
"                 3.000    0.4930  4135.000"
"                 4.000    0.8200  5780.000"
"                 5.000     1.120  7120.000"
"                 6.000     1.448  8485.000"
"             Peak outflow                    0.287    c.m/sec"
"             Maximum level                   1.999    metre"
"             Maximum storage              2938.128    c.m"
"             Centroidal lag                  9.741    hours"
"                  0.189     0.451     0.287     0.000 c.m/sec"
" 40           HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Runoff Draining to Baker Subdivision"
"             Maximum flow                    0.287    c.m/sec"
"             Hydrograph volume            8127.396    c.m"
"                  0.189     0.451     0.287     0.287"
" 38           START/RE-START TOTALS 200"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                        56.520    hectare"
"             Total Impervious area                        1.787    hectare"
"             Total % impervious                           3.162"
" 19           EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                              Version 2.25  rev. 473"
"                MIDUSS created                           Sunday, February 07, 2010"
"           10   Units used:                                              ie METRIC"
"                Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
"                                                                        MIDUSS\217127"
"                Output filename:  217127 - Post 10 yr - Scenario A - Feb19.out"
"                Licensee name:                                                gmbp"
"                Company                                      Hewlett-Packard Company"
"                Date & Time last used:                       2/14/2019 at 5:59:07 PM"
" 31          TIME PARAMETERS"
"       10.000   Time Step"
"      360.000   Max. Storm length"
"     2400.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"           1   Chicago storm"
"     3043.260   Coefficient A"
"       16.180   Constant B"
"        0.946   Exponent C"
"        0.375   Fraction R"
"      360.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          136.818    mm/hr"
"             Total depth                 67.019    mm"
"           6   010hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         100   Lands to the East of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"        2.000   % Impervious"
"       42.650   Total Area"
"      600.000   Flow length"
"        0.500   Overland Slope"
"       41.797   Pervious Area"
"      600.000   Pervious length"
"        0.500   Pervious slope"
"        0.853   Impervious Area"
"      600.000   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       70.000   Pervious SCS Curve No."
"        0.285   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.886   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.918   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                  0.518     0.000     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           41.797     0.853      42.650     hectare"
"             Time of concentration  175.825    18.138     166.099    minutes"
"             Time to Centroid       397.300    184.859    384.197    minutes"
"             Rainfall depth         67.019     67.019     67.019     mm"
"             Rainfall volume        2.8012     0.0572     2.8583     ha-m"
"             Rainfall losses        47.925     5.521      47.077     mm"
"             Runoff depth           19.094     61.498     19.942     mm"
"             Runoff volume          7980.69    524.58     8505.26    c.m"
"             Runoff coefficient     0.285      0.918      0.298      "
"             Maximum flow           0.509      0.179      0.518      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                  0.518     0.518     0.000     0.000"
" 33          CATCHMENT 200"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         200   Lands to the West of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"       10.000   % Impervious"
```



```
"        5.800   Total Area"
"      150.000   Flow length"
"        0.500   Overland Slope"
"        5.220   Pervious Area"
"      150.000   Pervious length"
"        0.500   Pervious slope"
"        0.580   Impervious Area"
"      150.000   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       70.000   Pervious SCS Curve No."
"        0.285   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.886   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.903   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                  0.184     0.518     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           5.220      0.580      5.800      hectare"
"             Time of concentration  76.532     7.895      58.653     minutes"
"             Time to Centroid       272.413    170.062    245.753    minutes"
"             Rainfall depth         67.019     67.019     67.019     mm"
"             Rainfall volume        3498.38    388.71     3887.09    c.m"
"             Rainfall losses        47.938     6.531      43.798     mm"
"             Runoff depth           19.080     60.487     23.221     mm"
"             Runoff volume          996.00     350.83     1346.82    c.m"
"             Runoff coefficient     0.285      0.903      0.346      "
"             Maximum flow           0.128      0.160      0.184      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                  0.184     0.591     0.000     0.000"
" 54          POND DESIGN"
"        0.591   Current peak flow    c.m/sec"
"        0.001   Target outflow    c.m/sec"
"       9852.1   Hydrograph volume    c.m"
"           7.   Number of stages"
"        0.000   Minimum water level    metre"
"        6.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                  0.000     0.000     0.000"
"                  1.000   0.09600   470.000"
"                  2.000    0.3180   980.000"
"                  3.000    0.5430  1385.000"
"                  4.000    0.9090  1920.000"
"                  5.000     1.243  2350.000"
"                  6.000     1.604  2800.000"
"             Peak outflow                    0.543    c.m/sec"
"             Maximum level                   2.999    metre"
"             Maximum storage              1384.503    c.m"
"             Centroidal lag                  7.010    hours"
"                  0.184     0.591     0.543     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"           6   Combine "
"           1   Node #"
"               Total Runoff Draining to Baker Subdivision"
"             Maximum flow                    0.543    c.m/sec"
"             Hydrograph volume            9851.292    c.m"
"                  0.184     0.591     0.543     0.543"
" 38          START/RE-START TOTALS 200"
"           3   Runoff Totals on EXIT"
"             Total Catchment area                    48.450    hectare"
"             Total Impervious area                    1.433    hectare"
"             Total % impervious                       2.958"
" 19          EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                              Version 2.25  rev. 473"
"                MIDUSS created                           Sunday, February 07, 2010"
"           10   Units used:                                                ie METRIC"
"                Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
"                                                                      MIDUSS\217127"
"                Output filename:  217127 - Post 25 yr - Scenario A - Aug19.out"
"                Licensee name:                                              gmbp"
"                Company                                      Hewlett-Packard Company"
"                Date & Time last used:                        8/5/2019 at 8:49:15 PM"
" 31           TIME PARAMETERS"
"       10.000   Time Step"
"      360.000   Max. Storm length"
"     2400.000   Max. Hydrograph"
" 32           STORM Chicago storm"
"            1   Chicago storm"
"     4026.220   Coefficient A"
"       17.817   Constant B"
"        0.960   Exponent C"
"        0.375   Fraction R"
"      360.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           162.743    mm/hr"
"             Total depth                  80.877    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33           CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          100   Lands Easterly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"        2.000   % Impervious"
"       50.550   Total Area"
"      500.000   Flow length"
"        0.500   Overland Slope"
"       49.539   Pervious Area"
"      500.000   Pervious length"
"        0.500   Pervious slope"
"        1.011   Impervious Area"
"      500.000   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       70.000   Pervious SCS Curve No."
"        0.339   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.886   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.927   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    1.126     0.000     0.000     0.000 c.m/sec"
"              Catchment 100          Pervious   Impervious Total Area "
"              Surface Area           49.539     1.011      50.550     hectare"
"              Time of concentration  133.614    15.113     127.345    minutes"
"              Time to Centroid       342.987    179.391    334.332    minutes"
"              Rainfall depth         80.877     80.877     80.877     mm"
"              Rainfall volume        4.0066     0.0818     4.0884     ha-m"
"              Rainfall losses        53.491     5.918      52.540     mm"
"              Runoff depth           27.386     74.959     28.338     mm"
"              Runoff volume          1.3567     0.0758     1.4325     ha-m"
"              Runoff coefficient     0.339      0.927      0.350      "
"              Maximum flow           1.109      0.315      1.126      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                    1.126     1.126     0.000     0.000"
" 33           CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          200   Lands Westerly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"       13.000   % Impervious"
```



```
"        5.970   Total Area"
"      150.000   Flow length"
"        0.500   Overland Slope"
"        5.194   Pervious Area"
"      150.000   Pervious length"
"        0.500   Pervious slope"
"        0.776   Impervious Area"
"      150.000   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       70.000   Pervious SCS Curve No."
"        0.339   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.886   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.909   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.307     1.126     0.000     0.000 c.m/sec"
"              Catchment 200          Pervious   Impervious Total Area "
"              Surface Area           5.194      0.776      5.970      hectare"
"              Time of concentration  64.882     7.339      48.408     minutes"
"              Time to Centroid       255.738    168.161    230.666    minutes"
"              Rainfall depth         80.877     80.877     80.877     mm"
"              Rainfall volume        4200.70    627.69     4828.39    c.m"
"              Rainfall losses        53.500     7.387      47.506     mm"
"              Runoff depth           27.377     73.491     33.372     mm"
"              Runoff volume          1421.94    570.36     1992.30    c.m"
"              Runoff coefficient     0.339      0.909      0.413      "
"              Maximum flow           0.207      0.258      0.307      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                    0.307     1.261     0.000     0.000"
" 54           POND DESIGN"
"        1.261   Current peak flow    c.m/sec"
"        0.001   Target outflow    c.m/sec"
"     16317.1    Hydrograph volume    c.m"
"           7.   Number of stages"
"        0.000   Minimum water level    metre"
"        6.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                  0.000     0.000    0.000"
"                  1.000   0.08700  1370.000"
"                  2.000    0.2870  2940.000"
"                  3.000    0.4930  4135.000"
"                  4.000    0.8200  5780.000"
"                  5.000     1.120  7120.000"
"                  6.000     1.448  8485.000"
"              Peak outflow                    0.819    c.m/sec"
"              Maximum level                   3.998    metre"
"              Maximum storage              5776.709    c.m"
"              Centroidal lag                  8.002    hours"
"                    0.307     1.261     0.819     0.000 c.m/sec"
" 40           HYDROGRAPH   Combine    1"
"             6   Combine "
"             1   Node #"
"                 Total Runoff Draining to Baker Subdivision"
"              Maximum flow                    0.819    c.m/sec"
"              Hydrograph volume            16311.807    c.m"
"                    0.307     1.261     0.819     0.819"
" 38           START/RE-START TOTALS 200"
"             3   Runoff Totals on EXIT"
"              Total Catchment area                        56.520    hectare"
"              Total Impervious area                        1.787    hectare"
"              Total % impervious                           3.162"
" 19           EXIT"
```

```
"               MIDUSS Output ------------------------------------------------>"
"               MIDUSS version                              Version 2.25  rev. 473"
"               MIDUSS created                          Sunday, February 07, 2010"
"          10   Units used:                                              ie METRIC"
"               Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
                                                                    MIDUSS\217127"
"               Output filename:  217127 - Post 50 yr - Scenario A - Aug19.out"
"               Licensee name:                                              cmbp"
"               Company                                    Hewlett-Packard Company"
"               Date & Time last used:                      8/5/2019 at 8:50:30 PM"
" 31          TIME PARAMETERS"
"       10.000   Time Step"
"      360.000   Max. Storm length"
"     2400.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"           1   Chicago storm"
"     4882.600   Coefficient A"
"       19.202   Constant B"
"        0.972   Exponent C"
"        0.375   Fraction R"
"      360.000   Duration"
"        1.000   Time step multiplier"
"               Maximum intensity          181.226    mm/hr"
"               Total depth                 91.285    mm"
"           6   O50hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         100   Lands Easterly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"        2.000   % Impervious"
"       50.550   Total Area"
"      500.000   Flow length"
"        0.500   Overland Slope"
"       49.539   Pervious Area"
"      500.000   Pervious length"
"        0.500   Pervious slope"
"        1.011   Impervious Area"
"      500.000   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       70.000   Pervious SCS Curve No."
"        0.374   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.886   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.932   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    1.529     0.000     0.000     0.000 c.m/sec"
"               Catchment 100          Pervious   Impervious Total Area "
"               Surface Area           49.539     1.011      50.550     hectare"
"               Time of concentration  121.328    14.450     116.154    minutes"
"               Time to Centroid       325.776    177.648    318.606    minutes"
"               Rainfall depth         91.285     91.285     91.285     mm"
"               Rainfall volume        4.5222     0.0923     4.6144     ha-m"
"               Rainfall losses        57.135     6.168      56.115     mm"
"               Runoff depth           34.150     85.117     35.170     mm"
"               Runoff volume          1.6918     0.0861     1.7778     ha-m"
"               Runoff coefficient     0.374      0.932      0.385      "
"               Maximum flow           1.508      0.361      1.529      c.m/sec"
" 40            HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                    1.529     1.529     0.000     0.000"
" 33          CATCHMENT 200"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         200   Lands Westerly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"       13.000   % Impervious"
```



```
"        5.970   Total Area"
"      150.000   Flow length"
"        0.500   Overland Slope"
"        5.194   Pervious Area"
"      150.000   Pervious length"
"        0.500   Pervious slope"
"        0.776   Impervious Area"
"      150.000   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       70.000   Pervious SCS Curve No."
"        0.374   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.886   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.919   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.363     1.529     0.000     0.000 c.m/sec"
"               Catchment 200          Pervious   Impervious Total Area "
"               Surface Area           5.194      0.776      5.970      hectare"
"               Time of concentration  58.916     7.017      44.976     minutes"
"               Time to Centroid       246.510    166.943    225.139    minutes"
"               Rainfall depth         91.285     91.285     91.285     mm"
"               Rainfall volume        4741.24    708.46     5449.70    c.m"
"               Rainfall losses        57.151     7.392      50.682     mm"
"               Runoff depth           34.134     83.892     40.602     mm"
"               Runoff volume          1772.88    651.09     2423.95    c.m"
"               Runoff coefficient     0.374      0.919      0.445      "
"               Maximum flow           0.283      0.290      0.363      c.m/sec"
" 40            HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                    0.363     1.717     0.000     0.000"
" 54          POND DESIGN"
"       1.717   Current peak flow    c.m/sec"
"       0.001   Target outflow    c.m/sec"
"     20202.1   Hydrograph volume    c.m"
"          7.   Number of stages"
"       0.000   Minimum water level    metre"
"       6.000   Maximum water level    metre"
"       0.000   Starting water level    metre"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"                 0.000     0.000     0.000"
"                 1.000   0.08700  1370.000"
"                 2.000    0.2870  2940.000"
"                 3.000    0.4930  4135.000"
"                 4.000    0.8200  5780.000"
"                 5.000     1.120  7120.000"
"                 6.000     1.448  8485.000"
"               Peak outflow                  1.118    c.m/sec"
"               Maximum level                 4.999    metre"
"               Maximum storage            7118.040    c.m"
"               Centroidal lag                7.539    hours"
"                    0.363     1.717     1.118     0.000 c.m/sec"
" 40            HYDROGRAPH   Combine    1"
"             6   Combine "
"             1   Node #"
"                 Total Runoff Draining to Baker Subdivision"
"               Maximum flow                  1.118    c.m/sec"
"               Hydrograph volume          20197.775    c.m"
"                    0.363     1.717     1.118     1.118"
" 38          START/RE-START TOTALS 200"
"             3   Runoff Totals on EXIT"
"               Total Catchment area                    56.520    hectare"
"               Total Impervious area                    1.787    hectare"
"               Total % impervious                       3.162"
" 19          EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                              Version 2.25  rev. 473"
"                MIDUSS created                          Sunday, February 07, 2010"
"           10   Units used:                                                ie METRIC"
"                Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
"                                                                      MIDUSS\217127"
"                Output filename: 217127 - Post 100 yr - Scenario A - Aug19.out"
"                Licensee name:                                              gmbp"
"                Company                                    Hewlett-Packard Company"
"                Date & Time last used:                      8/5/2019 at 8:52:04 PM"
" 31           TIME PARAMETERS"
"       10.000   Time Step"
"      360.000   Max. Storm length"
"     2400.000   Max. Hydrograph"
" 32           STORM Chicago storm"
"            1   Chicago storm"
"     5607.280   Coefficient A"
"       19.798   Constant B"
"        0.977   Exponent C"
"        0.375   Fraction R"
"      360.000   Duration"
"        1.000   Time step multiplier"
"              Maximum intensity           200.453    mm/hr"
"              Total depth                 101.430    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33           CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          100   Lands Easterly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"        2.000   % Impervious"
"       50.550   Total Area"
"      500.000   Flow length"
"        0.500   Overland Slope"
"       49.539   Pervious Area"
"      500.000   Pervious length"
"        0.500   Pervious slope"
"        1.011   Impervious Area"
"      500.000   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       70.000   Pervious SCS Curve No."
"        0.405   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.886   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.936   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    1.966     0.000     0.000     0.000 c.m/sec"
"              Catchment 100          Pervious   Impervious Total Area "
"              Surface Area           49.539     1.011      50.550     hectare"
"              Time of concentration  111.683    13.860     107.278    minutes"
"              Time to Centroid       313.209    176.381    307.048    minutes"
"              Rainfall depth         101.430    101.430    101.430    mm"
"              Rainfall volume        5.0247     0.1025     5.1273     ha-m"
"              Rainfall losses        60.322     6.451      59.245     mm"
"              Runoff depth           41.107     94.979     42.185     mm"
"              Runoff volume          2.0364     0.0960     2.1324     ha-m"
"              Runoff coefficient     0.405      0.936      0.416      "
"              Maximum flow           1.936      0.408      1.966      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.966     1.966     0.000     0.000"
" 33           CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          200   Lands Westerly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"       13.000   % Impervious"
```



```
"        5.970   Total Area"
"      150.000   Flow length"
"        0.500   Overland Slope"
"        5.194   Pervious Area"
"      150.000   Pervious length"
"        0.500   Pervious slope"
"        0.776   Impervious Area"
"      150.000   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       70.000   Pervious SCS Curve No."
"        0.405   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.886   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.927   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.423     1.966     0.000     0.000 c.m/sec"
"              Catchment 200          Pervious   Impervious Total Area "
"              Surface Area           5.194      0.776      5.970      hectare"
"              Time of concentration  54.232     6.731      42.135     minutes"
"              Time to Centroid       239.795    166.061    221.018    minutes"
"              Rainfall depth         101.430    101.430    101.430    mm"
"              Rainfall volume        5268.15    787.20     6055.35    c.m"
"              Rainfall losses        60.323     7.437      53.448     mm"
"              Runoff depth           41.107     93.993     47.982     mm"
"              Runoff volume          2135.04    729.48     2864.51    c.m"
"              Runoff coefficient     0.405      0.927      0.473      "
"              Maximum flow           0.354      0.319      0.423      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.423     2.218     0.000     0.000"
" 54           POND DESIGN"
"        2.218   Current peak flow    c.m/sec"
"        0.001   Target outflow    c.m/sec"
"     24189.0    Hydrograph volume    c.m"
"           7.   Number of stages"
"        0.000   Minimum water level    metre"
"        6.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                  0.000     0.000     0.000"
"                  1.000   0.08700  1370.000"
"                  2.000    0.2870  2940.000"
"                  3.000    0.4930  4135.000"
"                  4.000    0.8200  5780.000"
"                  5.000     1.120  7120.000"
"                  6.000     1.448  8485.000"
"              Peak outflow                    1.446    c.m/sec"
"              Maximum level                   5.999    metre"
"              Maximum storage              8483.927    c.m"
"              Centroidal lag                  7.190    hours"
"                  0.423     2.218     1.446     0.000 c.m/sec"
" 40           HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Runoff Draining to Baker Subdivision"
"              Maximum flow                    1.446    c.m/sec"
"              Hydrograph volume           24183.135    c.m"
"                  0.423     2.218     1.446     1.446"
" 38           START/RE-START TOTALS 200"
"            3   Runoff Totals on EXIT"
"              Total Catchment area                      56.520    hectare"
"              Total Impervious area                      1.787    hectare"
"              Total % impervious                         3.162"
" 19           EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                                Version 2.25  rev. 473"
"                MIDUSS created                             Sunday, February 07, 2010"
"           10   Units used:                                                ie METRIC"
"                Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
"                                                                    MIDUSS\217127"
"                Output filename:   217127 - Post 2 yr - Scenario B - Aug19.out"
"                Licensee name:                                              gmbp"
"                Company                                    Hewlett-Packard Company"
"                Date & Time last used:                     8/6/2019 at 11:10:06 AM"
" 31          TIME PARAMETERS"
"       10.000   Time Step"
"      360.000   Max. Storm length"
"     2400.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1264.600   Coefficient A"
"       10.288   Constant B"
"        0.889   Exponent C"
"        0.375   Fraction R"
"      360.000   Duration"
"        1.000   Time step multiplier"
"              Maximum intensity            85.735    mm/hr"
"              Total depth                  39.484    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          100   Lands Easterly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"       19.000   % Impervious"
"       50.550   Total Area"
"       50.000   Flow length"
"        2.000   Overland Slope"
"       40.945   Pervious Area"
"       50.000   Pervious length"
"        2.000   Pervious slope"
"        9.604   Impervious Area"
"       50.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       70.000   Pervious SCS Curve No."
"        0.151   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.886   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.860   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    1.648     0.000     0.000     0.000 c.m/sec"
"              Catchment 100          Pervious   Impervious Total Area "
"              Surface Area           40.945     9.604      50.550     hectare"
"              Time of concentration  45.611     3.306      21.389     minutes"
"              Time to Centroid       243.269    166.977    199.587    minutes"
"              Rainfall depth         39.484     39.484     39.484     mm"
"              Rainfall volume        1.6167     0.3792     1.9959     ha-m"
"              Rainfall losses        33.540     5.542      28.220     mm"
"              Runoff depth           5.944      33.941     11.263     mm"
"              Runoff volume          2433.60    3259.89    5693.48    c.m"
"              Runoff coefficient     0.151      0.860      0.285      "
"              Maximum flow           0.408      1.621      1.648      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.648     1.648     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          200   Lands Westerly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"       40.000   % Impervious"
```



```
"        5.970   Total Area"
"       50.000   Flow length"
"        2.000   Overland Slope"
"        3.582   Pervious Area"
"       50.000   Pervious length"
"        2.000   Pervious slope"
"        2.388   Impervious Area"
"       50.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       70.000   Pervious SCS Curve No."
"        0.151   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.886   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.860   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.405     1.648     0.000     0.000 c.m/sec"
"              Catchment 200          Pervious   Impervious Total Area "
"              Surface Area           3.582      2.388      5.970      hectare"
"              Time of concentration  45.611     3.306      12.107     minutes"
"              Time to Centroid       243.269    166.977    182.848    minutes"
"              Rainfall depth         39.484     39.484     39.484     mm"
"              Rainfall volume        1414.30    942.87     2357.17    c.m"
"              Rainfall losses        33.540     5.542      22.341     mm"
"              Runoff depth           5.944      33.941     17.143     mm"
"              Runoff volume          212.90     810.52     1023.41    c.m"
"              Runoff coefficient     0.151      0.860      0.434      "
"              Maximum flow           0.036      0.403      0.405      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.405     2.053     0.000     0.000"
" 54          POND DESIGN"
"       2.053   Current peak flow    c.m/sec"
"       0.001   Target outflow    c.m/sec"
"      6716.9   Hydrograph volume    c.m"
"          7.   Number of stages"
"       0.000   Minimum water level    metre"
"       6.000   Maximum water level    metre"
"       0.000   Starting water level    metre"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"                 0.000     0.000     0.000"
"                 1.000   0.08700  5375.000"
"                 2.000    0.2870  8810.000"
"                 3.000    0.4930  11345.00"
"                 4.000    0.8200  14770.00"
"                 5.000     1.120  17425.00"
"                 6.000     1.448  20065.00"
"              Peak outflow                  0.087    c.m/sec"
"              Maximum level                 0.999    metre"
"              Maximum storage            5368.302    c.m"
"              Centroidal lag               19.757    hours"
"                    0.405     2.053     0.087     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Runoff Draining to Baker Subdivision"
"              Maximum flow                  0.087    c.m/sec"
"              Hydrograph volume          5927.753    c.m"
"                    0.405     2.053     0.087     0.087"
" 38          START/RE-START TOTALS 200"
"            3   Runoff Totals on EXIT"
"              Total Catchment area                    56.520    hectare"
"              Total Impervious area                   11.993    hectare"
"              Total % impervious                      21.218"
" 19          EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                              Version 2.25  rev. 473"
"                MIDUSS created                           Sunday, February 07, 2010"
"           10   Units used:                                                ie METRIC"
"                Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
"                                                                    MIDUSS\217127"
"                Output filename:   217127 - Post 5 yr - Scenario B - Aug19.out"
"                Licensee name:                                              gmbp"
"                Company                                    Hewlett-Packard Company"
"                Date & Time last used:                     8/6/2019 at 11:12:51 AM"
" 31          TIME PARAMETERS"
"       10.000   Time Step"
"      360.000   Max. Storm length"
"     2400.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     2258.600   Coefficient A"
"       14.090   Constant B"
"        0.927   Exponent C"
"        0.375   Fraction R"
"      360.000   Duration"
"        1.000   Time step multiplier"
"              Maximum intensity           116.710    mm/hr"
"              Total depth                  55.992    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          100   Lands Easterly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"       19.000   % Impervious"
"       50.550   Total Area"
"       50.000   Flow length"
"        2.000   Overland Slope"
"       40.945   Pervious Area"
"       50.000   Pervious length"
"        2.000   Pervious slope"
"        9.604   Impervious Area"
"       50.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       70.000   Pervious SCS Curve No."
"        0.235   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.886   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.892   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    2.529     0.000     0.000     0.000 c.m/sec"
"              Catchment 100          Pervious   Impervious Total Area "
"              Surface Area           40.945     9.604      50.550     hectare"
"              Time of concentration  31.074     2.884      17.807     minutes"
"              Time to Centroid       218.148    163.616    192.483    minutes"
"              Rainfall depth         55.992     55.992     55.992     mm"
"              Rainfall volume        2.2926     0.5378     2.8304     ha-m"
"              Rainfall losses        42.819     6.064      35.836     mm"
"              Runoff depth           13.173     49.929     20.156     mm"
"              Runoff volume          0.5394     0.4795     1.0189     ha-m"
"              Runoff coefficient     0.235      0.892      0.360      "
"              Maximum flow           1.273      2.377      2.529      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    2.529     2.529     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          200   Lands Westerly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"       40.000   % Impervious"
```



```
"        5.970   Total Area"
"       50.000   Flow length"
"        2.000   Overland Slope"
"        3.582   Pervious Area"
"       50.000   Pervious length"
"        2.000   Pervious slope"
"        2.388   Impervious Area"
"       50.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       70.000   Pervious SCS Curve No."
"        0.235   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.886   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.892   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.604     2.529     0.000     0.000 c.m/sec"
"              Catchment 200          Pervious   Impervious Total Area "
"              Surface Area           3.582      2.388      5.970      hectare"
"              Time of concentration  31.074     2.884      10.877     minutes"
"              Time to Centroid       218.148    163.616    179.078    minutes"
"              Rainfall depth         55.992     55.992     55.992     mm"
"              Rainfall volume        2005.64    1337.10    3342.74    c.m"
"              Rainfall losses        42.819     6.064      28.117     mm"
"              Runoff depth           13.173     49.929     27.875     mm"
"              Runoff volume          471.85     1192.29    1664.14    c.m"
"              Runoff coefficient     0.235      0.892      0.498      "
"              Maximum flow           0.111      0.591      0.604      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.604     3.133     0.000     0.000"
" 54          POND DESIGN"
"        3.133   Current peak flow    c.m/sec"
"        0.001   Target outflow    c.m/sec"
"     11853.2    Hydrograph volume    c.m"
"           7.   Number of stages"
"        0.000   Minimum water level    metre"
"        6.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                  0.000     0.000    0.000"
"                  1.000   0.08700  5375.000"
"                  2.000    0.2870  8810.000"
"                  3.000    0.4930  11345.00"
"                  4.000    0.8200  14770.00"
"                  5.000     1.120  17425.00"
"                  6.000     1.448  20065.00"
"              Peak outflow                        0.287    c.m/sec"
"              Maximum level                       1.998    metre"
"              Maximum storage                  8804.438    c.m"
"              Centroidal lag                     16.094    hours"
"                  0.604     3.133     0.287     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Runoff Draining to Baker Subdivision"
"              Maximum flow                        0.287    c.m/sec"
"              Hydrograph volume                10825.848    c.m"
"                  0.604     3.133     0.287     0.287"
" 38          START/RE-START TOTALS 200"
"            3   Runoff Totals on EXIT"
"              Total Catchment area                          56.520    hectare"
"              Total Impervious area                         11.993    hectare"
"              Total % impervious                            21.218"
" 19          EXIT"
```

```
                MIDUSS Output ------------------------------------------------>"
                MIDUSS version                              Version 2.25  rev. 473"
                MIDUSS created                           Sunday, February 07, 2010"
           10   Units used:                                                ie METRIC"
                Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
                                                                      MIDUSS\217127"
                Output filename:  217127 - Post 10 yr - Scenario B - Aug19.out"
                Licensee name:                                               gmbp"
                Company                                    Hewlett-Packard Company"
                Date & Time last used:                     8/6/2019 at 11:13:38 AM"
 31           TIME PARAMETERS"
       10.000   Time Step"
      360.000   Max. Storm length"
     2400.000   Max. Hydrograph"
 32          STORM Chicago storm"
            1   Chicago storm"
     3043.260   Coefficient A"
       16.180   Constant B"
        0.946   Exponent C"
        0.375   Fraction R"
      360.000   Duration"
        1.000   Time step multiplier"
              Maximum intensity          136.818    mm/hr"
              Total depth                 67.019    mm"
            6   010hyd   Hydrograph extension used in this file"
 33          CATCHMENT 100"
            1   Triangular SCS"
            1   Equal length"
            1   SCS method"
          100   Lands Easterly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
       19.000   % Impervious"
       50.550   Total Area"
       50.000   Flow length"
        2.000   Overland Slope"
       40.945   Pervious Area"
       50.000   Pervious length"
        2.000   Pervious slope"
        9.604   Impervious Area"
       50.000   Impervious length"
        2.000   Impervious slope"
        0.250   Pervious Manning 'n'"
       70.000   Pervious SCS Curve No."
        0.284   Pervious Runoff coefficient"
        0.100   Pervious Ia/S coefficient"
       10.886   Pervious Initial abstraction"
        0.015   Impervious Manning 'n'"
       98.000   Impervious SCS Curve No."
        0.904   Impervious Runoff coefficient"
        0.100   Impervious Ia/S coefficient"
        0.518   Impervious Initial abstraction"
                  3.187     0.000     0.000     0.000 c.m/sec"
              Catchment 100          Pervious   Impervious Total Area "
              Surface Area           40.945     9.604      50.550     hectare"
              Time of concentration  26.119     2.694      16.104     minutes"
              Time to Centroid       209.065    162.130    188.998    minutes"
              Rainfall depth         67.019     67.019     67.019     mm"
              Rainfall volume        2.7441     0.6437     3.3878     ha-m"
              Rainfall losses        48.001     6.465      40.109     mm"
              Runoff depth           19.018     60.554     26.910     mm"
              Runoff volume          0.7787     0.5816     1.3603     ha-m"
              Runoff coefficient     0.284      0.904      0.402      "
              Maximum flow           1.955      2.867      3.187      c.m/sec"
 40           HYDROGRAPH Add Runoff "
            4   Add Runoff "
                  3.187     3.187     0.000     0.000"
 33          CATCHMENT 200"
            1   Triangular SCS"
            1   Equal length"
            1   SCS method"
          200   Lands Westerly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
       40.000   % Impervious"
```



```
        5.970   Total Area"
       50.000   Flow length"
        2.000   Overland Slope"
        3.582   Pervious Area"
       50.000   Pervious length"
        2.000   Pervious slope"
        2.388   Impervious Area"
       50.000   Impervious length"
        2.000   Impervious slope"
        0.250   Pervious Manning 'n'"
       70.000   Pervious SCS Curve No."
        0.284   Pervious Runoff coefficient"
        0.100   Pervious Ia/S coefficient"
       10.886   Pervious Initial abstraction"
        0.015   Impervious Manning 'n'"
       98.000   Impervious SCS Curve No."
        0.904   Impervious Runoff coefficient"
        0.100   Impervious Ia/S coefficient"
        0.518   Impervious Initial abstraction"
                  0.740     3.187     0.000     0.000 c.m/sec"
              Catchment 200          Pervious   Impervious Total Area "
              Surface Area           3.582      2.388      5.970      hectare"
              Time of concentration  26.119     2.694      10.196     minutes"
              Time to Centroid       209.065    162.130    177.160    minutes"
              Rainfall depth         67.019     67.019     67.019     mm"
              Rainfall volume        2400.61    1600.41    4001.02    c.m"
              Rainfall losses        48.001     6.465      31.386     mm"
              Runoff depth           19.018     60.554     35.632     mm"
              Runoff volume          681.23     1446.03    2127.26    c.m"
              Runoff coefficient     0.284      0.904      0.532      "
              Maximum flow           0.171      0.713      0.740      c.m/sec"
 40           HYDROGRAPH Add Runoff "
            4   Add Runoff "
                  0.740     3.916     0.000     0.000"
 54          POND DESIGN"
        3.916   Current peak flow    c.m/sec"
        0.001   Target outflow    c.m/sec"
    15730.2   Hydrograph volume    c.m"
           7.   Number of stages"
        0.000   Minimum water level    metre"
        6.000   Maximum water level    metre"
        0.000   Starting water level    metre"
            0   Keep Design Data: 1 = True; 0 = False"
                  Level Discharge    Volume"
                  0.000     0.000     0.000"
                  1.000   0.08700  5375.000"
                  2.000    0.2870  8810.000"
                  3.000    0.4930  11345.00"
                  4.000    0.8200  14770.00"
                  5.000     1.120  17425.00"
                  6.000     1.448  20065.00"
              Peak outflow                    0.493    c.m/sec"
              Maximum level                   2.998    metre"
              Maximum storage             11340.784    c.m"
              Centroidal lag                 14.185    hours"
                  0.740     3.916     0.493     0.000 c.m/sec"
 40           HYDROGRAPH   Combine    1"
            6   Combine "
            1   Node #"
              Total Runoff Draining to Baker Subdivision"
              Maximum flow                    0.493    c.m/sec"
              Hydrograph volume           14617.795    c.m"
                  0.740     3.916     0.493     0.493"
 38           START/RE-START TOTALS 200"
            3   Runoff Totals on EXIT"
              Total Catchment area                        56.520    hectare"
              Total Impervious area                       11.993    hectare"
              Total % impervious                          21.218"
 19           EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                              Version 2.25  rev. 473"
"                MIDUSS created                           Sunday, February 07, 2010"
"           10   Units used:                                                ie METRIC"
"                Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
"                                                                        MIDUSS\217127"
"                Output filename:  217127 - Post 25 yr - Scenario B - Aug19.out"
"                Licensee name:                                              gmbp"
"                Company                                  Hewlett-Packard Company"
"                Date & Time last used:                   8/6/2019 at 11:15:32 AM"
" 31          TIME PARAMETERS"
"       10.000   Time Step"
"      360.000   Max. Storm length"
"     2400.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     4026.220   Coefficient A"
"       17.817   Constant B"
"        0.960   Exponent C"
"        0.375   Fraction R"
"      360.000   Duration"
"        1.000   Time step multiplier"
"              Maximum intensity          162.743    mm/hr"
"              Total depth                 80.877    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          100   Lands Easterly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"       19.000   % Impervious"
"       50.550   Total Area"
"       50.000   Flow length"
"        2.000   Overland Slope"
"       40.945   Pervious Area"
"       50.000   Pervious length"
"        2.000   Pervious slope"
"        9.604   Impervious Area"
"       50.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       70.000   Pervious SCS Curve No."
"        0.338   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.886   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.914   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                  4.610     0.000     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           40.945     9.604      50.550     hectare"
"             Time of concentration  22.143     2.505      14.523     minutes"
"             Time to Centroid       201.442    160.850    185.692    minutes"
"             Rainfall depth         80.877     80.877     80.877     mm"
"             Rainfall volume        3.3116     0.7768     4.0884     ha-m"
"             Rainfall losses        53.542     6.991      44.697     mm"
"             Runoff depth           27.335     73.887     36.180     mm"
"             Runoff volume          1.1193     0.7096     1.8289     ha-m"
"             Runoff coefficient     0.338      0.914      0.447      "
"             Maximum flow           3.112      3.499      4.610      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                  4.610     4.610     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          200   Lands Westerly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"       40.000   % Impervious"
```



```
"        5.970   Total Area"
"       50.000   Flow length"
"        2.000   Overland Slope"
"        3.582   Pervious Area"
"       50.000   Pervious length"
"        2.000   Pervious slope"
"        2.388   Impervious Area"
"       50.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       70.000   Pervious SCS Curve No."
"        0.338   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.886   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.914   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                  0.923     4.610     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           3.582      2.388      5.970      hectare"
"             Time of concentration  22.143     2.505      9.513      minutes"
"             Time to Centroid       201.442    160.850    175.337    minutes"
"             Rainfall depth         80.877     80.877     80.877     mm"
"             Rainfall volume        2897.03    1931.35    4828.39    c.m"
"             Rainfall losses        53.542     6.991      34.922     mm"
"             Runoff depth           27.335     73.887     45.956     mm"
"             Runoff volume          979.15     1764.42    2743.57    c.m"
"             Runoff coefficient     0.338      0.914      0.568      "
"             Maximum flow           0.272      0.870      0.923      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                  0.923     5.404     0.000     0.000"
" 54          POND DESIGN"
"        5.404   Current peak flow    c.m/sec"
"        0.001   Target outflow    c.m/sec"
"     21032.6    Hydrograph volume    c.m"
"           7.   Number of stages"
"        0.000   Minimum water level    metre"
"        6.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                  0.000     0.000     0.000"
"                  1.000   0.08700  5375.000"
"                  2.000    0.2870  8810.000"
"                  3.000    0.4930  11345.00"
"                  4.000    0.8200  14770.00"
"                  5.000     1.120  17425.00"
"                  6.000     1.448  20065.00"
"             Peak outflow                    0.820    c.m/sec"
"             Maximum level                   3.999    metre"
"             Maximum storage             14767.254    c.m"
"             Centroidal lag                 12.450    hours"
"                  0.923     5.404     0.820     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"               Total Runoff Draining to Baker Subdivision"
"             Maximum flow                    0.820    c.m/sec"
"             Hydrograph volume           19836.637    c.m"
"                  0.923     5.404     0.820     0.820"
" 38          START/RE-START TOTALS 200"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      56.520    hectare"
"             Total Impervious area                     11.993    hectare"
"             Total % impervious                        21.218"
" 19          EXIT"
```

```
"                MIDUSS Output ---------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                      Sunday, February 07, 2010"
"           10   Units used:                                        ie METRIC"
"                Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
"                                                                  MIDUSS\217127"
"                Output filename:  217127 - Post 50 yr - Scenario B - Aug19.out"
"                Licensee name:                                          gmbp"
"                Company                                 Hewlett-Packard Company"
"                Date & Time last used:                  8/6/2019 at 11:16:38 AM"
" 31          TIME PARAMETERS"
"       10.000   Time Step"
"      360.000   Max. Storm length"
"     2400.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"           1   Chicago storm"
"     4882.600   Coefficient A"
"       19.202   Constant B"
"        0.972   Exponent C"
"        0.375   Fraction R"
"      360.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          181.226    mm/hr"
"             Total depth                 91.285    mm"
"           6   050hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         100   Lands Easterly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"        19.000   % Impervious"
"        50.550   Total Area"
"        50.000   Flow length"
"         2.000   Overland Slope"
"        40.945   Pervious Area"
"        50.000   Pervious length"
"         2.000   Pervious slope"
"         9.604   Impervious Area"
"        50.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        70.000   Pervious SCS Curve No."
"         0.372   Pervious Runoff coefficient"
"         0.100   Pervious Ia/S coefficient"
"        10.886   Pervious Initial abstraction"
"         0.015   Impervious Manning 'n'"
"        98.000   Impervious SCS Curve No."
"         0.918   Impervious Runoff coefficient"
"         0.100   Impervious Ia/S coefficient"
"         0.518   Impervious Initial abstraction"
"                   5.840     0.000     0.000     0.000 c.m/sec"
"              Catchment 100          Pervious   Impervious Total Area "
"              Surface Area           40.945     9.604      50.550     hectare"
"              Time of concentration  20.107     2.395      13.613     minutes"
"              Time to Centroid       197.269    160.078    183.634    minutes"
"              Rainfall depth         91.285     91.285     91.285     mm"
"              Rainfall volume        3.7377     0.8767     4.6144     ha-m"
"              Rainfall losses        57.308     7.442      47.833     mm"
"              Runoff depth           33.977     83.843     43.452     mm"
"              Runoff volume          1.3912     0.8053     2.1965     ha-m"
"              Runoff coefficient     0.372      0.918      0.476      "
"              Maximum flow           4.171      3.952      5.840      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                   5.840     5.840     0.000     0.000"
" 33          CATCHMENT 200"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         200   Lands Westerly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"        40.000   % Impervious"
```



```
"         5.970   Total Area"
"        50.000   Flow length"
"         2.000   Overland Slope"
"         3.582   Pervious Area"
"        50.000   Pervious length"
"         2.000   Pervious slope"
"         2.388   Impervious Area"
"        50.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        70.000   Pervious SCS Curve No."
"         0.372   Pervious Runoff coefficient"
"         0.100   Pervious Ia/S coefficient"
"        10.886   Pervious Initial abstraction"
"         0.015   Impervious Manning 'n'"
"        98.000   Impervious SCS Curve No."
"         0.918   Impervious Runoff coefficient"
"         0.100   Impervious Ia/S coefficient"
"         0.518   Impervious Initial abstraction"
"                   1.062     5.840     0.000     0.000 c.m/sec"
"              Catchment 200          Pervious   Impervious Total Area "
"              Surface Area           3.582      2.388      5.970      hectare"
"              Time of concentration  20.107     2.395      9.091      minutes"
"              Time to Centroid       197.269    160.078    174.139    minutes"
"              Rainfall depth         91.285     91.285     91.285     mm"
"              Rainfall volume        3269.82    2179.88    5449.70    c.m"
"              Rainfall losses        57.308     7.442      37.361     mm"
"              Runoff depth           33.977     83.843     53.923     mm"
"              Runoff volume          1217.06    2002.16    3219.22    c.m"
"              Runoff coefficient     0.372      0.918      0.591      "
"              Maximum flow           0.365      0.983      1.062      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                   1.062     6.787     0.000     0.000"
" 54          POND DESIGN"
"        6.787   Current peak flow    c.m/sec"
"        0.001   Target outflow    c.m/sec"
"     25184.0   Hydrograph volume    c.m"
"           7.   Number of stages"
"        0.000   Minimum water level    metre"
"        6.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"           0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"                 0.000     0.000     0.000"
"                 1.000   0.08700  5375.000"
"                 2.000    0.2870  8810.000"
"                 3.000    0.4930  11345.00"
"                 4.000    0.8200  14770.00"
"                 5.000     1.120  17425.00"
"                 6.000     1.448  20065.00"
"              Peak outflow                    1.118    c.m/sec"
"              Maximum level                   4.999    metre"
"              Maximum storage             17421.602    c.m"
"              Centroidal lag                 11.435    hours"
"                   1.062     6.787     1.118     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"           6   Combine "
"           1   Node #"
"               Total Runoff Draining to Baker Subdivision"
"              Maximum flow                    1.118    c.m/sec"
"              Hydrograph volume           23960.918    c.m"
"                   1.062     6.787     1.118     1.118"
" 38          START/RE-START TOTALS 200"
"           3   Runoff Totals on EXIT"
"              Total Catchment area                    56.520    hectare"
"              Total Impervious area                   11.993    hectare"
"              Total % impervious                      21.218"
" 19          EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                              Version 2.25  rev. 473"
"                MIDUSS created                          Sunday, February 07, 2010"
"           10   Units used:                                                ie METRIC"
"                Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
"                                                                      MIDUSS\217127"
"                Output filename: 217127 - Post 100 yr - Scenario B - Aug19.out"
"                Licensee name:                                              gmbp"
"                Company                                    Hewlett-Packard Company"
"                Date & Time last used:                     8/6/2019 at 11:07:25 AM"
" 31          TIME PARAMETERS"
"       10.000   Time Step"
"      360.000   Max. Storm length"
"     2400.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"           1   Chicago storm"
"     5607.280   Coefficient A"
"       19.798   Constant B"
"        0.977   Exponent C"
"        0.375   Fraction R"
"      360.000   Duration"
"        1.000   Time step multiplier"
"              Maximum intensity           200.453    mm/hr"
"              Total depth                 101.430    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"             1   Triangular SCS"
"             1   Equal length"
"             1   SCS method"
"           100   Lands Easterly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"        19.000   % Impervious"
"        50.550   Total Area"
"        50.000   Flow length"
"         2.000   Overland Slope"
"        40.945   Pervious Area"
"        50.000   Pervious length"
"         2.000   Pervious slope"
"         9.604   Impervious Area"
"        50.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        70.000   Pervious SCS Curve No."
"         0.403   Pervious Runoff coefficient"
"         0.100   Pervious Ia/S coefficient"
"        10.886   Pervious Initial abstraction"
"         0.015   Impervious Manning 'n'"
"        98.000   Impervious SCS Curve No."
"         0.921   Impervious Runoff coefficient"
"         0.100   Impervious Ia/S coefficient"
"         0.518   Impervious Initial abstraction"
"                    7.181     0.000     0.000     0.000 c.m/sec"
"               Catchment 100          Pervious   Impervious Total Area "
"               Surface Area           40.945     9.604      50.550     hectare"
"               Time of concentration  18.508     2.297      12.847     minutes"
"               Time to Centroid       194.137    159.548    182.057    minutes"
"               Rainfall depth         101.430    101.430    101.430    mm"
"               Rainfall volume        4.1531     0.9742     5.1273     ha-m"
"               Rainfall losses        60.581     7.969      50.584     mm"
"               Runoff depth           40.849     93.461     50.845     mm"
"               Runoff volume          1.6726     0.8976     2.5702     ha-m"
"               Runoff coefficient     0.403      0.921      0.501      "
"               Maximum flow           5.289      4.414      7.181      c.m/sec"
" 40            HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                    7.181     7.181     0.000     0.000"
" 33          CATCHMENT 200"
"             1   Triangular SCS"
"             1   Equal length"
"             1   SCS method"
"           200   Lands Westerly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"        40.000   % Impervious"
```



```
"         5.970   Total Area"
"        50.000   Flow length"
"         2.000   Overland Slope"
"         3.582   Pervious Area"
"        50.000   Pervious length"
"         2.000   Pervious slope"
"         2.388   Impervious Area"
"        50.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        70.000   Pervious SCS Curve No."
"         0.403   Pervious Runoff coefficient"
"         0.100   Pervious Ia/S coefficient"
"        10.886   Pervious Initial abstraction"
"         0.015   Impervious Manning 'n'"
"        98.000   Impervious SCS Curve No."
"         0.921   Impervious Runoff coefficient"
"         0.100   Impervious Ia/S coefficient"
"         0.518   Impervious Initial abstraction"
"                    1.209     7.181     0.000     0.000 c.m/sec"
"               Catchment 200          Pervious   Impervious Total Area "
"               Surface Area           3.582      2.388      5.970      hectare"
"               Time of concentration  18.508     2.297      8.717      minutes"
"               Time to Centroid       194.136    159.548    173.245    minutes"
"               Rainfall depth         101.430    101.430    101.430    mm"
"               Rainfall volume        3633.21    2422.14    6055.35    c.m"
"               Rainfall losses        60.581     7.969      39.536     mm"
"               Runoff depth           40.849     93.461     61.894     mm"
"               Runoff volume          1463.21    2231.84    3695.05    c.m"
"               Runoff coefficient     0.403      0.921      0.610      "
"               Maximum flow           0.463      1.097      1.209      c.m/sec"
" 40            HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                    1.209     8.289     0.000     0.000"
" 54          POND DESIGN"
"         8.289   Current peak flow    c.m/sec"
"         0.001   Target outflow    c.m/sec"
"       29397.3   Hydrograph volume    c.m"
"            7.   Number of stages"
"         0.000   Minimum water level    metre"
"         6.000   Maximum water level    metre"
"         0.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                   0.000     0.000     0.000"
"                   1.000   0.08700  5375.000"
"                   2.000    0.2870  8810.000"
"                   3.000    0.4930  11345.00"
"                   4.000    0.8200  14770.00"
"                   5.000     1.120  17425.00"
"                   6.000     1.448  20065.00"
"               Peak outflow                    1.448    c.m/sec"
"               Maximum level                   5.999    metre"
"               Maximum storage             20061.805    c.m"
"               Centroidal lag                 10.671    hours"
"                    1.209     8.289     1.448     0.000 c.m/sec"
" 40            HYDROGRAPH   Combine    1"
"             6   Combine "
"             1   Node #"
"                 Total Runoff Draining to Baker Subdivision"
"               Maximum flow                    1.448    c.m/sec"
"               Hydrograph volume           28140.645    c.m"
"                    1.209     8.289     1.448     1.448"
" 38          START/RE-START TOTALS 200"
"             3   Runoff Totals on EXIT"
"               Total Catchment area                    56.520    hectare"
"               Total Impervious area                   11.993    hectare"
"               Total % impervious                      21.218"
" 19          EXIT"
```

APPENDIX C:
MIDUSS MODELLING – ENHANCED GRASS SWALES

```
"               MIDUSS Output ---------------------------------------------->"
"               MIDUSS version                          Version 2.25  rev. 473"
"               MIDUSS created                       Sunday, February 07, 2010"
"          10   Units used:                                            ie METRIC"
"               Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
"                                                                  MIDUSS\217127"
"               Output filename:217127 - Post 4hr25mm - Scenario A - Aug19.out"
"               Licensee name:                                            gmbp"
"               Company                                 Hewlett-Packard Company"
"               Date & Time last used:                  8/6/2019 at 11:50:54 AM"
" 31         TIME PARAMETERS"
"       10.000   Time Step"
"      240.000   Max. Storm length"
"     2400.000   Max. Hydrograph"
" 32         STORM Chicago storm"
"           1   Chicago storm"
"      847.870   Coefficient A"
"       10.288   Constant B"
"        0.889   Exponent C"
"        0.375   Fraction R"
"      240.000   Duration"
"        1.000   Time step multiplier"
"            Maximum intensity            46.347    mm/hr"
"            Total depth                  25.000    mm"
"            6   001hyd   Hydrograph extension used in this file"
" 33         CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          100   Lands Easterly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"        2.000   % Impervious"
"       50.550   Total Area"
"      500.000   Flow length"
"        0.500   Overland Slope"
"       49.539   Pervious Area"
"      500.000   Pervious length"
"        0.500   Pervious slope"
"        1.011   Impervious Area"
"      500.000   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       70.000   Pervious SCS Curve No."
"        0.065   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.886   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.804   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                  0.064     0.000     0.000     0.000 c.m/sec"
"            Catchment 100          Pervious   Impervious Total Area "
"            Surface Area           49.539     1.011      50.550     hectare"
"            Time of concentration  469.153    25.665     379.531    minutes"
"            Time to Centroid       643.230    146.398    542.828    minutes"
"            Rainfall depth         25.000     25.000     25.000     mm"
"            Rainfall volume        1.2385     0.0253     1.2637     ha-m"
"            Rainfall losses        23.380     4.897      23.010     mm"
"            Runoff depth           1.620      20.103     1.990      mm"
"            Runoff volume          802.49     203.24     1005.73    c.m"
"            Runoff coefficient     0.065      0.804      0.080      "
"            Maximum flow           0.021      0.063      0.064      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                  0.064     0.064     0.000     0.000"
" 52         CHANNEL DESIGN"
"       0.064   Current peak flow    c.m/sec"
"       0.027   Manning 'n'"
"          0.   Cross-section type: 0=trapezoidal; 1=general"
"       1.050   Basewidth    metre"
"       3.000   Left bank slope"
"       3.000   Right bank slope"
```



```
"       1.000   Channel depth    metre"
"       0.500   Gradient   %"
"            Depth of flow                 0.098    metre"
"            Velocity                      0.483    m/sec"
"            Channel capacity              7.113    c.m/sec"
"            Critical depth                0.068    metre"
" 53         ROUTE Zero Route"
"        0.00   Zero Route Reach length   ( metre)"
"                  0.064     0.064     0.064     0.000 c.m/sec"
" 40         HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Maximum Water Quality Flow through EGS"
"            Maximum flow                  1.044    c.m/sec"
"            Hydrograph volume          3589.901    c.m"
"                  0.064     0.064     0.064     1.044"
" 38         START/RE-START TOTALS 100"
"            3   Runoff Totals on EXIT"
"            Total Catchment area                    50.550    hectare"
"            Total Impervious area                    1.011    hectare"
"            Total % impervious                       2.000"
" 19         EXIT"
```

```
"               MIDUSS Output ------------------------------------------------>"
"               MIDUSS version                              Version 2.25  rev. 473"
"               MIDUSS created                          Sunday, February 07, 2010"
"          10   Units used:                                              ie METRIC"
"               Job folder:       \\os-2k8\users_private\awilkinson\Documents\"
"                                                                       MIDUSS\217127"
"               Output filename:217127 - Post 4hr25mm - Scenario B - Aug19.out"
"               Licensee name:                                             gmbp"
"               Company                                  Hewlett-Packard Company"
"               Date & Time last used:                    8/6/2019 at 11:49:31 AM"
" 31          TIME PARAMETERS"
"       10.000   Time Step"
"      240.000   Max. Storm length"
"     2400.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"           1   Chicago storm"
"      847.870   Coefficient A"
"       10.288   Constant B"
"        0.889   Exponent C"
"        0.375   Fraction R"
"      240.000   Duration"
"        1.000   Time step multiplier"
"              Maximum intensity            46.347    mm/hr"
"              Total depth                  25.000    mm"
"           6   001hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         100   Lands Easterly of the Re-Aligned BR33 Draining to the Baker
Subdivision"
"        19.000   % Impervious"
"        50.550   Total Area"
"        50.000   Flow length"
"         2.000   Overland Slope"
"        40.945   Pervious Area"
"        50.000   Pervious length"
"         2.000   Pervious slope"
"         9.604   Impervious Area"
"        50.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        70.000   Pervious SCS Curve No."
"         0.065   Pervious Runoff coefficient"
"         0.100   Pervious Ia/S coefficient"
"        10.886   Pervious Initial abstraction"
"         0.015   Impervious Manning 'n'"
"        98.000   Impervious SCS Curve No."
"         0.800   Impervious Runoff coefficient"
"         0.100   Impervious Ia/S coefficient"
"         0.518   Impervious Initial abstraction"
"                    1.017     0.000     0.000     0.000 c.m/sec"
"              Catchment 100          Pervious   Impervious Total Area "
"              Surface Area           40.945     9.604      50.550     hectare"
"              Time of concentration  77.749     4.253      23.109     minutes"
"              Time to Centroid       222.988    118.447    145.267    minutes"
"              Rainfall depth         25.000     25.000     25.000     mm"
"              Rainfall volume        1.0236     0.2401     1.2637     ha-m"
"              Rainfall losses        23.381     4.997      19.888     mm"
"              Runoff depth           1.619      20.003     5.112      mm"
"              Runoff volume          662.98     1921.18    2584.17    c.m"
"              Runoff coefficient     0.065      0.800      0.204      "
"              Maximum flow           0.076      1.014      1.017      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                    1.017     1.017     0.000     0.000"
" 52          CHANNEL DESIGN"
"       1.017   Current peak flow    c.m/sec"
"       0.027   Manning 'n'"
"          0.   Cross-section type: 0=trapezoidal; 1=general"
"       3.000   Basewidth    metre"
"       3.000   Left bank slope"
"       3.000   Right bank slope"
```



```
"       1.000   Channel depth    metre"
"       0.500   Gradient   %"
"            Depth of flow                 0.276    metre"
"            Velocity                      0.962    m/sec"
"            Channel capacity             11.712    c.m/sec"
"            Critical depth                0.211    metre"
" 53        ROUTE Zero Route"
"        0.00   Zero Route Reach length   ( metre)"
"                  1.017     1.017     1.017     0.000 c.m/sec"
" 40        HYDROGRAPH   Combine    1"
"           6   Combine "
"           1   Node #"
"               Maximum Water Quality Flow through EGS"
"            Maximum flow                  1.017    c.m/sec"
"            Hydrograph volume          2584.167    c.m"
"                  1.017     1.017     1.017     1.017"
" 38        START/RE-START TOTALS 100"
"           3   Runoff Totals on EXIT"
"            Total Catchment area                    50.550    hectare"
"            Total Impervious area                    9.604    hectare"
"            Total % impervious                      19.000"
" 19        EXIT"
```

APPENDIX D:
MIN. WQT VOLUME AND FOOTPRINT AREA CALCULATIONS

Project : **Bruce Road 33 Re-Aignment**
Project No. : **217127**
Date : **August 2019**

INVESTIGATION OF SWM FACILITY FOOTPRINT AREA FOR ALTERNATIVE 3

Type of Facility	Required Total Storage Volume for WQT (m^3/ha)			Required Storage Volume by Components for WQT		Active Storage					Permanent Storage			Min. Area based on Facility Type	
	Imperviousness			Active (m^3/ha)	Permanent (m^3/ha)	Req. for WQT (m^3)	Req. for Peak Flow Att. *** (m^3)	Governing Active Storage (m^3)	Max. Active Storage Depth (m)	Min. Area - Active Storage (m^2)	Req. for WQT (m^3)	Max. Perm. Storage Depth (m)	Min. Area - Perm. Storage (m^2)	Governing Storage Volume Component	Corresponding Min. Area (m^2)
	35 % *	55 % *	22 % **												
Infiltration Basin	25	30	22	22		1,245	20,100	20,100	0.6	33,500	1,245	0.6	2,075	Active (Peak Flow Att.)	33,500
Wetland	80	105	64	40	24	2,265	20,100	20,100	1	20,100	1,360	0.3	4,535	Active (Peak Flow Att.)	20,100
Wet Pond	140	190	108	40	68	2,265	20,100	20,100	2	10,050	3,845	3	1,285	Active (Peak Flow Att.)	10,050

- Water Quality Treatment (WQT) is considered to be provided to an Enhanced level (80% TSS Removal)

* Defined within Table 3.2 of the Stormwater Management Planning and Design Manual
** Extrapolated for tributary imperviousness
*** From Section 5.5 of text

APPENDIX E:
PCSWMM FOR STORMCEPTOR SIZING TOOL

Detailed Stormceptor Sizing Report – BR33 - Alternative 4

Project Information & Location			
Project Name	Bruce Road 33 Re-Alignment	**Project Number**	217127
City	Town of Saugeen Shores	**State/ Province**	Ontario
Country	Canada	**Date**	2/14/2019
Designer Information		**EOR Information (optional)**	
Name	Alexander Wilkinson	**Name**	
Company	GM BluePlan Engineering Limited	**Company**	
Phone #	519-376-1805	**Phone #**	
Email	alex.wilkinson@gmblueplan.ca	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	BR33 - Alternative 4
Recommended Stormceptor Model	StormceptorMAX
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	-
PSD	Fine Distribution
Rainfall Station	OWEN SOUND MOE

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary		
Stormceptor Model	**% TSS Removal Provided**	**% Runoff Volume Captured Provided**
STC 300	15	15
STC 750	30	25
STC 1000	34	25
STC 1500	34	25
STC 2000	40	37
STC 3000	42	37
STC 4000	49	50
STC 5000	50	50
STC 6000	55	59
STC 9000	62	69
STC 10000	61	69
STC 14000	67	76
StormceptorMAX	Custom	Custom

Stormceptor
The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.
Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology
Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:
• Site parameters
• Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
• Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
• TSS load
• Detention time of the system

Hydrology Analysis
PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour). Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station			
State/Province	Ontario	**Total Number of Rainfall Events**	3762
Rainfall Station Name	OWEN SOUND MOE	**Total Rainfall (mm)**	18531.0
Station ID #	6132	**Average Annual Rainfall (mm)**	463.3
Coordinates	44°35'N, 80°56'W	**Total Evaporation (mm)**	443.6
Elevation (ft)	580	**Total Infiltration (mm)**	14427.7
Years of Rainfall Data	40	**Total Rainfall that is Runoff (mm)**	3659.7

Notes
• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules. • Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed. • For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

Drainage Area	
Total Area (ha)	56.52
Imperviousness %	22.0

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.000	0.000

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	90.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Design Details	
Stormceptor Inlet Invert Elev (m)	
Stormceptor Outlet Invert Elev (m)	
Stormceptor Rim Elev (m)	
Normal Water Level Elevation (m)	
Pipe Diameter (mm)	
Pipe Material	
Multiple Inlets (Y/N)	No
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Site Name	BR33 - Alternative 4

Site Details

Drainage Area

Total Area (ha)	56.52
Imperviousness %	22.0

Surface Characteristics

Width (m)	1504.00
Slope %	2
Impervious Depression Storage (mm)	0.508
Pervious Depression Storage (mm)	5.08
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency

Maintenance Frequency (months) >	12

Infiltration Parameters

Horton's equation is used to estimate infiltration

Max. Infiltration Rate (mm/hr)	61.98
Min. Infiltration Rate (mm/hr)	10.16
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Evaporation

Daily Evaporation Rate (mm/day)	2.54

Dry Weather Flow

Dry Weather Flow (lps)	0

Winter Months

Winter Infiltration	0

TSS Loading Parameters

TSS Loading Function	

Buildup/Wash-off Parameters

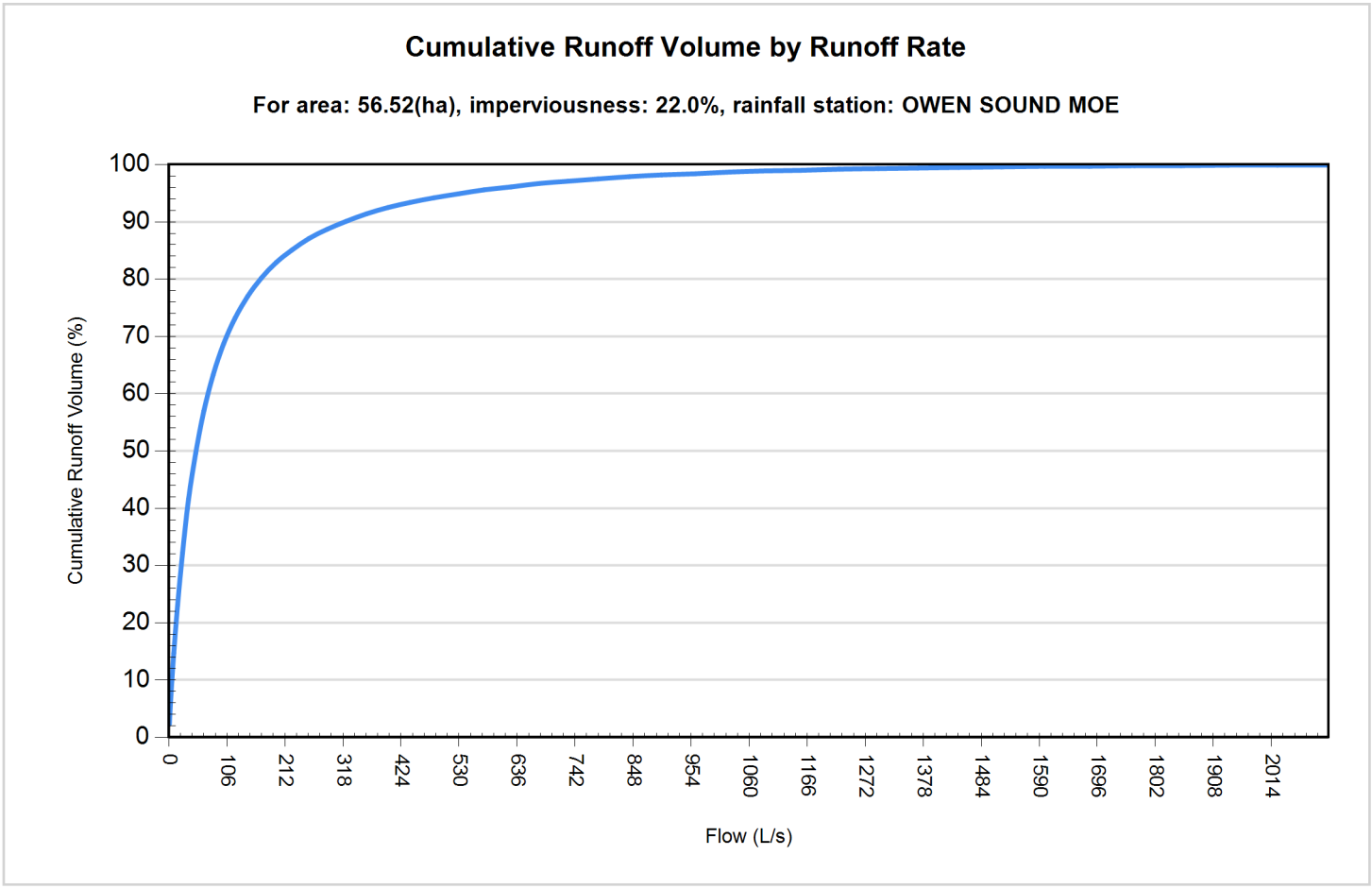
Target Event Mean Conc. (EMC) mg/L	
Exponential Buildup Power	
Exponential Washoff Exponent	

TSS Availability Parameters

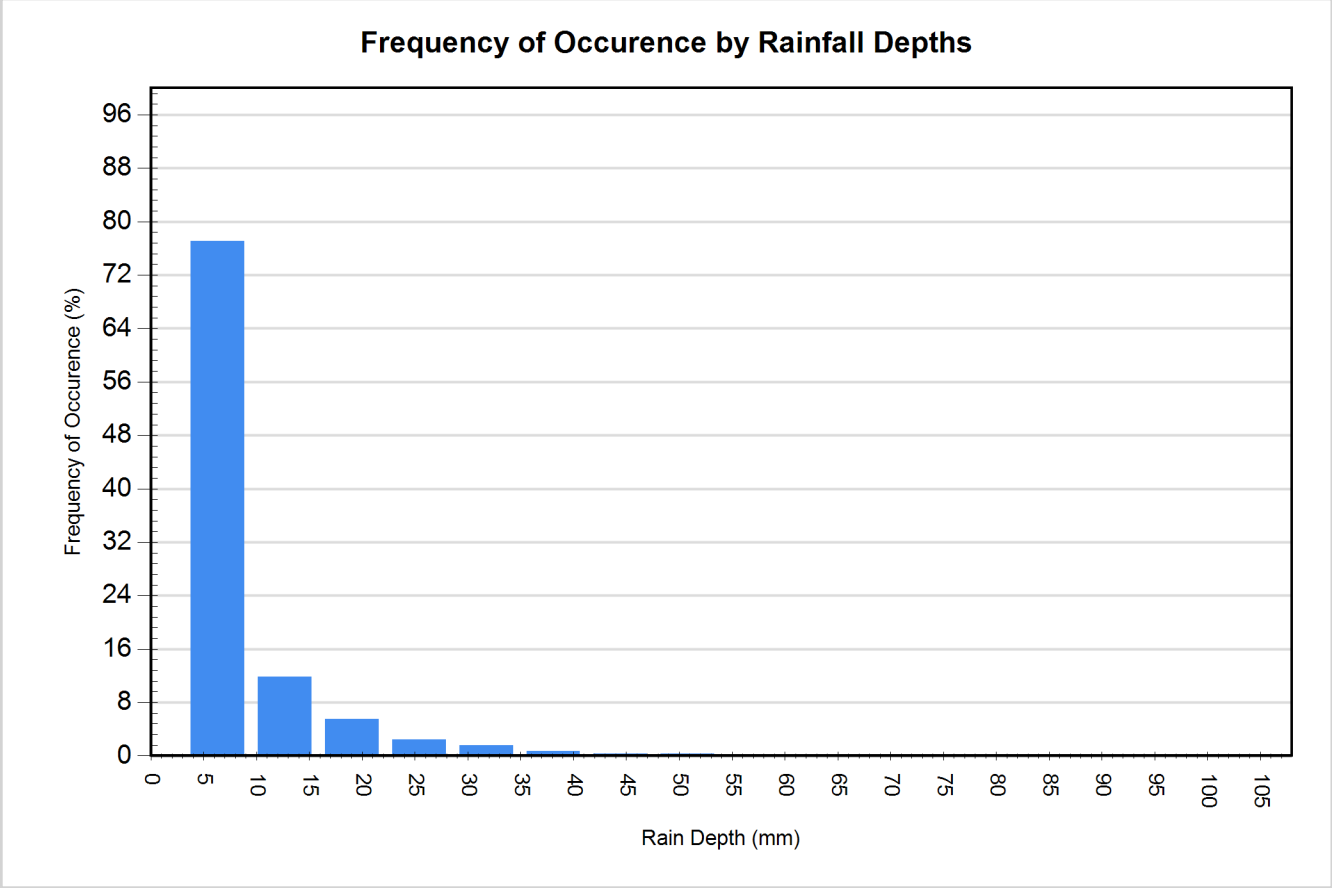
Availability Constant A	
Availability Factor B	
Availability Exponent C	
Min. Particle Size Affected by Availability (micron)	

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (L/s)	Runoff Volume (m^3)	Volume Over (m^3)	Cumulative Runoff Volume (%)
1	47148	2027227	2.3
4	158235	1916187	7.6
9	305597	1768856	14.7
16	478559	1595760	23.1
25	668509	1405427	32.2
36	862944	1211960	41.6
49	1029179	1045479	49.6
64	1181661	892710	57.0
81	1313535	761046	63.3
100	1424839	649445	68.7
121	1518186	556268	73.2
144	1597384	477125	77.0
169	1663417	410842	80.2
196	1718644	355626	82.9
225	1765445	308825	85.1
256	1805724	268597	87.1
289	1840272	234013	88.7
324	1869811	204479	90.1
361	1895399	178897	91.4
400	1917865	156489	92.5
441	1937527	136815	93.4
484	1954531	119766	94.2
529	1969396	104931	94.9
576	1982514	91799	95.6
625	1994390	79931	96.1
676	2004971	69330	96.7
729	2014451	59869	97.1
784	2022693	51627	97.5
841	2029959	44348	97.9
900	2036322	37983	98.2
961	2041916	32388	98.4
1024	2046726	27582	98.7
1089	2050734	23571	98.9
1156	2054118	20186	99.0
1225	2057110	17195	99.2
1296	2059742	14566	99.3
1369	2061964	12343	99.4

1444	2063818	10486	99.5
1521	2065515	8789	99.6
1600	2067138	7165	99.7
1681	2068633	5671	99.7
1764	2069883	4421	99.8
1849	2070845	3459	99.8
1936	2071611	2693	99.9
2025	2072199	2104	99.9
2116	2072631	1672	99.9



Rainfall Event Analysis				
Rainfall Depth (mm)	**No. of Events**	**Percentage of Total Events (%)**	**Total Volume (mm)**	**Percentage of Annual Volume (%)**
6.35	2901	77.1	5026	27.1
12.70	444	11.8	3983	21.5
19.05	207	5.5	3215	17.4
25.40	90	2.4	1973	10.6
31.75	59	1.6	1656	8.9
38.10	26	0.7	898	4.8
44.45	12	0.3	504	2.7
50.80	10	0.3	470	2.5
57.15	8	0.2	433	2.3
63.50	1	0.0	63	0.3
69.85	0	0.0	0	0.0
76.20	2	0.1	144	0.8
82.55	1	0.0	79	0.4
88.90	1	0.0	87	0.5
95.25	0	0.0	0	0.0
101.60	0	0.0	0	0.0

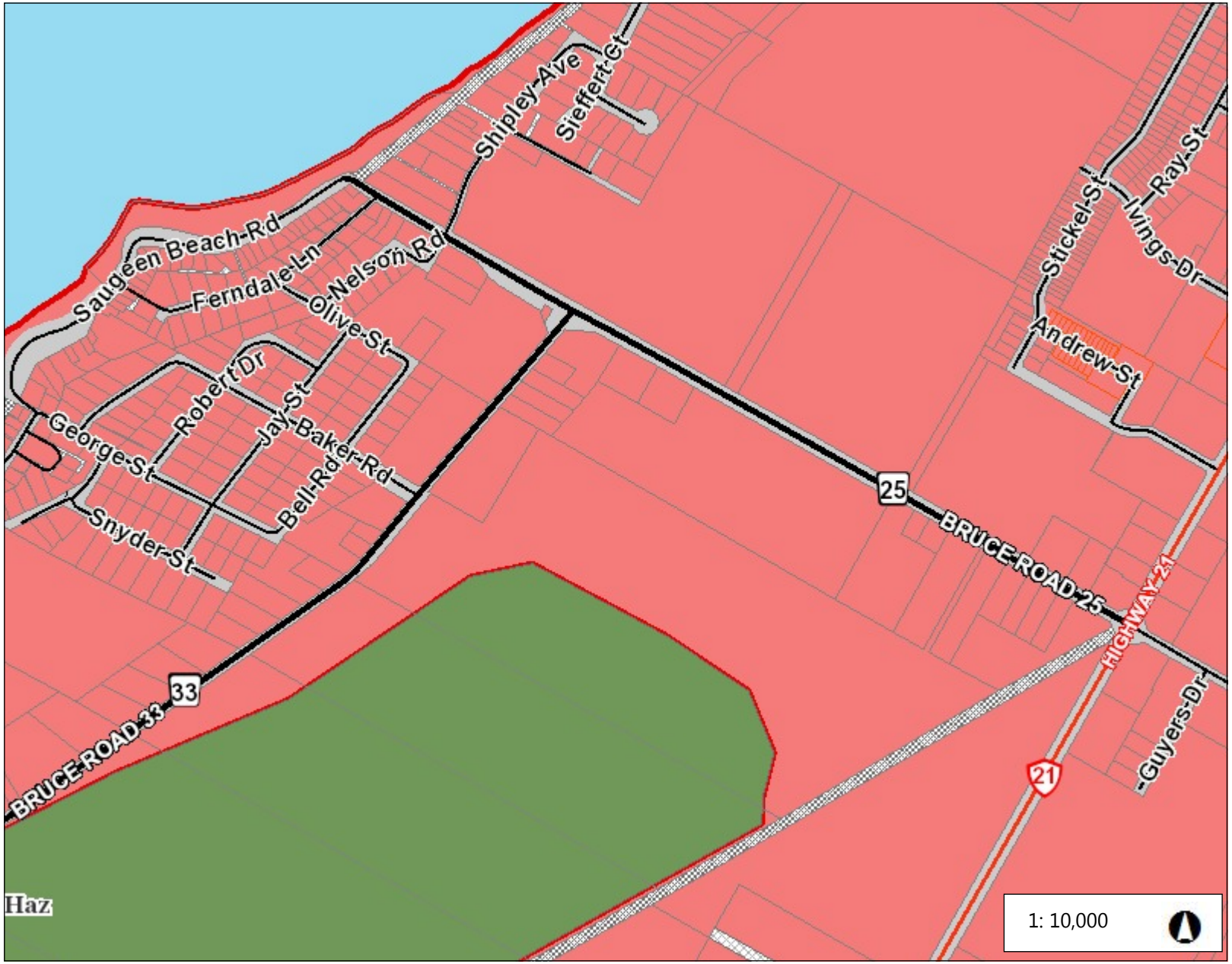


For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

ENCLOSURE D:
TRANSPORTATION PLANNING MAPS

County of Bruce

Bruce County Official Plan: Schedule A (Land Use)



Legend

- BCOP hazard labels
- Municipal or Other Road (large scale labels)
- Ferry
- Provincial Highway
- County Road
- Municipal or Other Road
- Road Allowance/Right-of-way
  - Private Road Allowance
  - Right-of-Way
  - Road Allowance or Condo Road
  - Unopened Road Allowance
- Hamlet
- Hazard
- BCOP Plan Designation
  - Agricultural
  - Bruce Nuclear Power Development
  - Escarpment Natural Area
  - Estate Residential Development
  - Inland Lake Development
  - Major Open Space
  - Primary Urban Community
  - Secondary Urban Community
  - Rural
  - Rural Recreational
  - Travel Trailer Park/Commercial Campgrou
- Body of Water (small scale)
- Adjacent Counties (small scale)
- Wetland
- Adjacent Counties
- Lake Huron and Georgian Bay
- Adjacent Counties
- Lake Huron and Georgian Bay
- Adjacent Counties

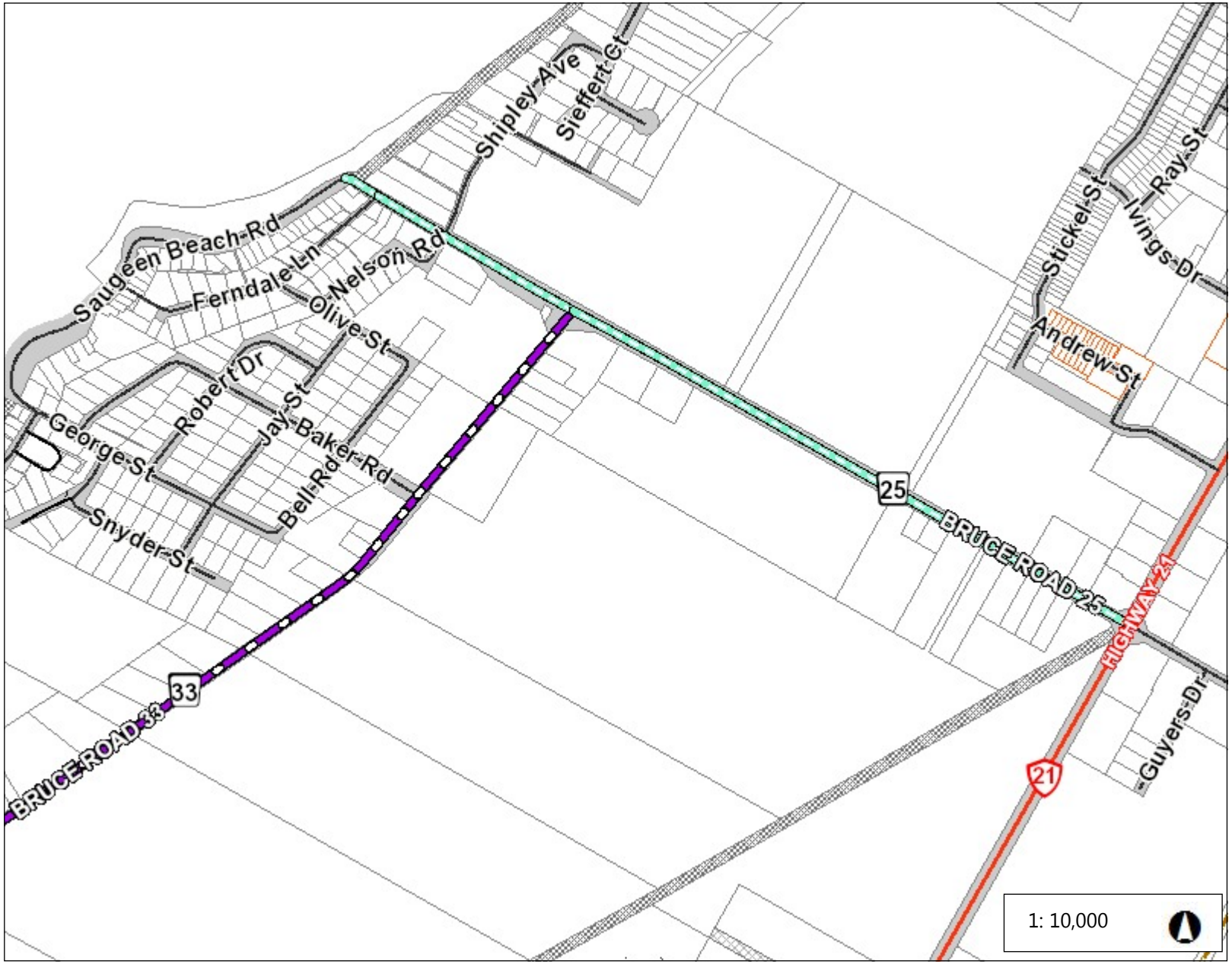
Notes

0.5 0 0.25 0.5 Kilometers

NAD_1983_UTM_Zone_17N

County of Bruce

Bruce County OP: Schedule B (Transportation Plan)



Legend

- Municipal or Other Road (large scale labels)
- Airport
- Classified Roads
  - Arterial Urban
  - Arterial Rural
  - Collector Urban
  - Collector Rural
- Bruce County Rail Trail
- Municipal Road
- Provincial Highway
- County Road
- Municipal or Other Road
- Road Allowance/Right-of-way
  - Private Road Allowance
  - Right-of-Way
  - Road Allowance or Condo Road
  - Unopened Road Allowance

Notes

0.5 0 0.25 0.5 Kilometers

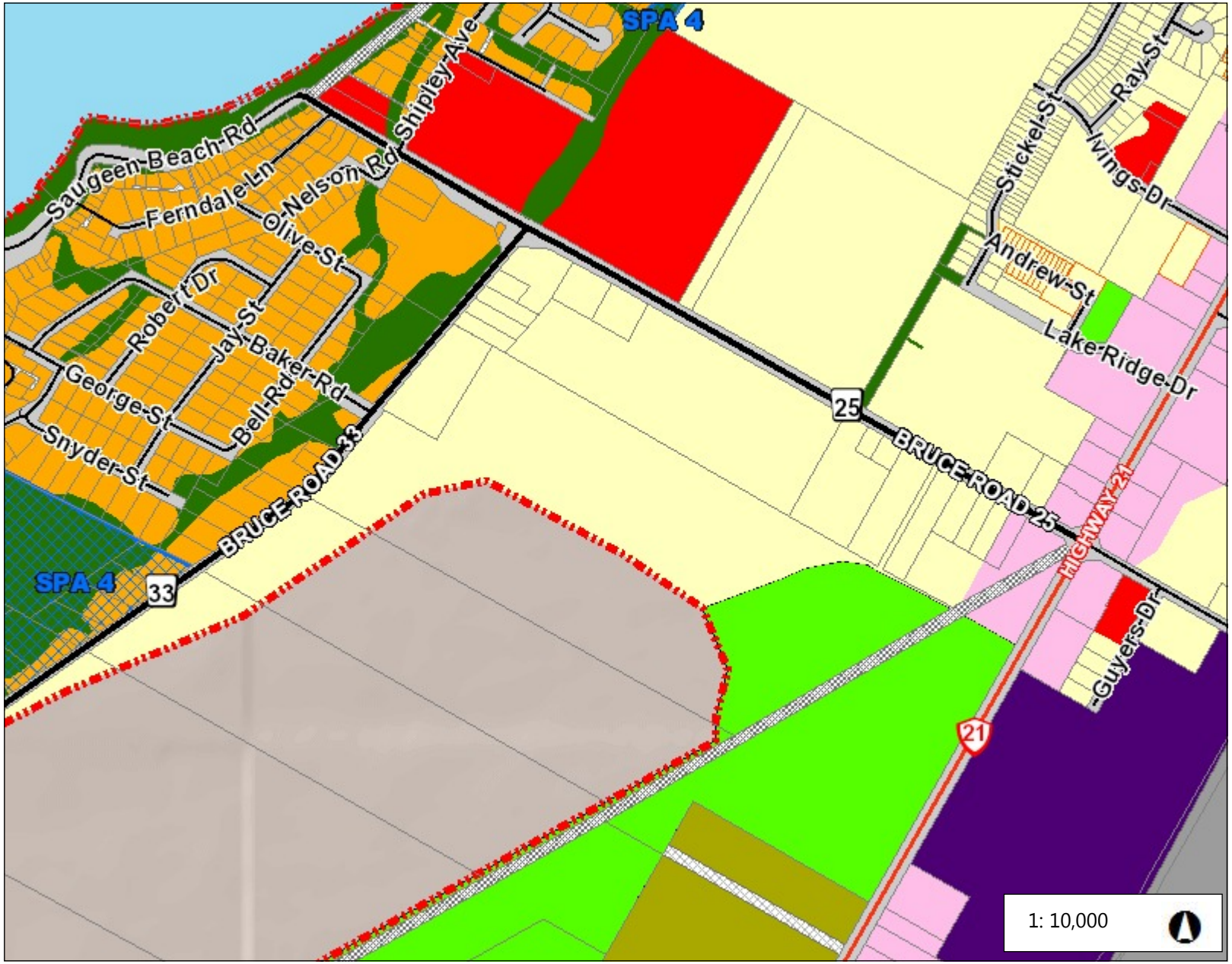
NAD_1983_UTM_Zone_17N

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

THIS MAP IS NOT TO BE USED FOR NAVIGATION

County of Bruce

Town of SS OP: Schedule A



Legend

- Local OP SPA labels (SS)
- Municipal or Other Road (large scale labels)
- Provincial Highway
- County Road
- Municipal or Other Road
- Road Allowance/Right-of-way
  - Private Road Allowance
  - Right-of-Way
  - Road Allowance or Condo Road
  - Unopened Road Allowance
- Special Policy Area
- Overlay
  - Methane Buffer
  - Significant Woodland
- Boundary of Local Plan/Settleme Area
- SS Plan Designation
  - Residential
  - Commercial
  - Open Space
  - Resort Recreational
  - High Density Residential
  - Medium Density Residential
  - Low Density Residential
  - Shoreline Residential
  - Recreational
  - Core Commercial Area
  - Office Residential
  - Highway Commercial
  - Marine Commercial
  - Employment
  - Extractive Industrial
  - Institutional
  - Parks and Open Space
  - Environmental Hazard

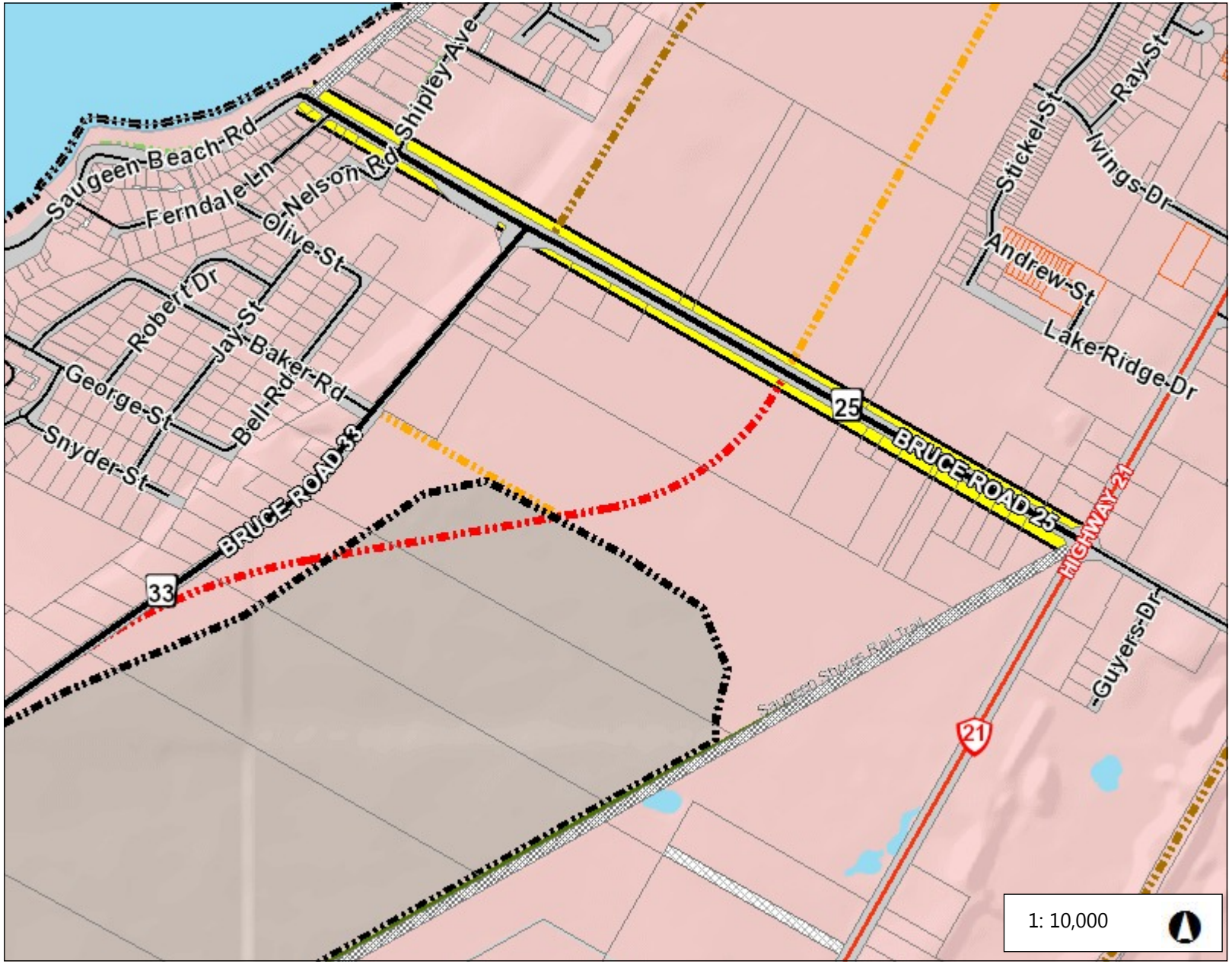
Notes

0.5 0 0.25 0.5 Kilometers

NAD_1983_UTM_Zone_17N

County of Bruce

Town of SS OP: Schedule B



Legend

- Municipal or Other Road (large scale labels)
- Provincial Highway
- County Road
- Municipal or Other Road
- Road Allowance/Right-of-way
  - Private Road Allowance
  - Right-of-Way
  - Road Allowance or Condo Road
  - Unopened Road Allowance
- Trail
  - Existing Trail
  - Proposed Trail
  - Saugeen Shores Rail Trail
  - Proposed Active Transportation Route
- Boundary of Local Plan/Settleme Area
- Roads and Proposed Roads
  - Arterial Road
  - Collector Road
  - Proposed Arterial
  - Proposed Collector
  - Local Road
- Active Transportation
- Body of Water (small scale)
- Adjacent Counties (small scale)
- Wetland
- Adjacent Counties
- Lake Huron and Georgian Bay
- Adjacent Counties
- Lake Huron and Georgian Bay
- Adjacent Counties
- Wetland
- Body of Water

Notes

0.5 0 0.25 0.5 Kilometers

NAD_1983_UTM_Zone_17N