SMITHVILLE SUBWATERSHED STUDY AND STORMWATER MANAGEMENT PLAN – EXECUTIVE SUMMARY

SUBMITTED BY WSP E&I CANADA LIMITED

Introduction

The Township of West Lincoln has initiated a Master Community Plan Study to plan for future growth in the Community of Smithville. This process includes the preparation of a Subwatershed Study (SWS), as a companion study being completed in parallel with the Master Community Plan Study. The Study Area for the Subwatershed Study is located along the perimeter of the existing urban boundary of the Community of Smithville and is generally bounded by Young Street to the north, the North Creek to the south, South Grimsby Road 6 to the west, and South Grimsby Road 2 to the east.

Subwatershed Study Process

The Subwatershed Study ensures that all applicable Provincial, Regional and Municipal land use planning requirements, including Conservation Authority regulations, are achieved. The core Work Plan of the Subwatershed Study process has been structured to be carried out in the following three (3) phases:

- Phase 1: Subwatershed Characterization and Integration
- Phase 2: Impact Assessment,
- Phase 3: Management, Implementation and Monitoring Plan,

The purpose of Phase 1 Subwatershed Characterization and Integration is to gain a better understanding of the state, health and general character of the subwatershed. Reviews of existing studies and reports, fieldwork and, where appropriate, modelling has been undertaken, in order to understand the baseline of conditions related to the following key components: Hydrology/Hydraulics, Hydrogeology, Karst Features, Water Quality, Stream Morphology and Aquatic and Terrestrial Resources. These components have been considered and assessed as part of the Phase 1 report to characterize the Subwatershed areas of interest.

The Phase 2 Impact Assessment involves evaluating the impacts of future planned urbanization of the land use plan, as prescribed by the Master Community Plan. This initial evaluation is intended to provide direction to the Land Use Team, who then refined the Land Use Plan in accordance with the direction from the first iteration of testing. The refined Land Use Plan was then advanced for a second round of testing and assessment. Working Targets and preliminary management strategies to address potential impacts associated with future development, as related to the natural environment and stormwater, have been developed. Watercourses and natural heritage features have been assessed and given a constraint ranking, followed by an overall net rating. Any refinements to the Region's Natural Heritage System have been identified and discussed through this phase.

The Phase 3 Management, Implementation and Monitoring Plan formalizes the recommendations for water management, including traditional and low impact development practices, as well as specifics related to environmental management, including parameters for stream stability and terrestrial and aquatic system protection and enhancement. This process also included developing an implementation and monitoring plan, to provide further direction on the implementation procedures related to the plan recommendations, including priorities, specific policies, need for follow-up studies and related study requirements.

Phase 1: Subwatershed Characterization and Integration

Hydrogeology

The study area lies within the Haldimand Clay Plain physiographic region. The larger region generally consists of stratified clay related to glacial Lake Warren although the northern area, including Smithville, may consist of an intermixture of stratified clay and till.

The bedrock underlying the study area consists of a sequence of bedded dolostones and shales, generally sloping from north to south with an elevation range of approximately 25 metres in the area of the proposed urban expansion. Elevated bedrock areas exist south of Twenty Mile Creek in the southwestern portion of the urban expansion area and in the northern portion of the urban expansion area, as well further north beyond the urban expansion area. Twenty Mile Creek tends to follow a bedrock depression just west of, and through, the Community of Smithville.

The surficial geology consists primarily of fine-grained sediments characterized by the glaciolacustrine clay and silt throughout the majority of the urban expansion area with minor areas of clay to clayey silt till. Stream deposits are predominately clay and silt with some sand and gravel. The Eramosa dolostone is exposed in bedrock outcrops along portions of Twenty Mile Creek and areas northeast of the urban expansion area.

The overburden is less than 6 m thick throughout the majority of the urban expansion area, with the least amount of overburden correlating with the bedrock highs and bedrock outcrops. Overburden thickness generally increases south of the urban expansion area in a southerly direction correlated with the slope of the bedrock.

Fractures occur in lateral bedding planes and as vertical and sub-vertical fractures above and below the bedding planes. Joint spacing is noted to be more frequent in the uppermost portions of the bedrock and decreases with depth and exhibits preferential orientations.

Groundwater flow within the bedrock is governed by the horizontal and vertical hydraulic gradients as well as the general characteristics of the fracture network and solution channels. Groundwater flow moves from the bedrock surface vertically through the vertical fractures (joints) to the bedding planes where the joints are connected. The vertical flux through the upper bedrock will depend on the spatial frequency of the joints, and their size, particularly related to the history of dissolution, and the water made available from ground surface through the overburden. The combined bedding plane/joint network provides for significant lateral groundwater flow and less frequent vertical flow conduits.

Groundwater flow within the upper bedrock is considered to be the primary flow pathway that is potentially connected to Twenty Mile Creek and the majority of the domestic wells. Groundwater flow in the upper bedrock generally flows from northwest to the southeast but within the Town of Smithville flow is directed towards Twenty Mile Creek from the north and from Townline Road in the south. There is a strong correlation between the horizontal flow direction in the shallow bedrock and the bedrock topography. It is expected that more local shallow groundwater flow will be controlled to varying extents by the fractured nature of the bedrock and particularly the larger solution channels and conduit flow. The orientation of these features may direct flow in directions not consistent with the larger scale hydraulic gradients.

Twenty Mile Creek is known to have no flow through the study area at various periods in the summer months. Groundwater discharge may occur seasonally when the more regional

groundwater levels are higher, thus feeding some amount groundwater discharge. Pools along Twenty Mile Creek also exist in the summer months indicating varying amounts of local discharge, likely through the discrete fracture/solution channel network. Substantive spring flow contributes to Twenty Mile Creek in the vicinity of Canborough Street and its source is related to a significant conduit connected to the Smithville Cave along with additional springs in the vicinity of Rock Park.

The local wetlands within the study area are currently not considered to have any significant functional groundwater discharge associated with them consistent with observations and the characteristics of the low permeability overburden groundwater flow system.

The municipal water supply for the Community of Smithville is a lake-based supply. Outside of the existing urban area, individual water supplies are provided through domestic wells that generally get their water from the fractures and solution channels that are more common in upper 15 metres of the bedrock.

Areas referred to as Highly Vulnerable Aquifer have been developed through the Source Water Protection study. The Niagara Peninsula Conservation Authority used an overburden thickness of less than 5 metres to delineate these areas as the thinner overburden offers less protection of contaminants migrating to the shallow bedrock aquifers related to the Eramosa Member and the Guelph Formation. These Highly Vulnerable Aquifer areas correlate well with the areas of overburden less than 6 metres thick. This current subwatershed study presented that an overburden thickness of less than 6 metres represents a more accurate value hydrogeological sensitivity related to contaminant migration to the underlying bedrock aquifer.

Karst

Reconnaissance and detailed site investigations focused on known and potential karst features but also involved observing water flow in ditches and surface channels as well surface ponding during rain events and spring snowmelt.

Surface water observations in December 2019 and March 2020, during rain and snowmelt did not provide indications of significant karst capture in road-side ditches or along several streams. Significant surface ponding was observed during 2020, particularly in northern portions of the study area between Young Road and the southern boundary of the hydro right-of-way. Surface pondings in the northern area did not demonstrate reductions in that area from March 10 through March 26, 2020 and many wet ponds and saturated soils continued into early May of the same year.

A total of 11 karst features were investigated and documented. Seven of the features were located within the study area of which 6 were distinct sinkholes and the other a short stream reach that appeared to be gradually losing flow in the downstream direction and is likely not karstic.

In general, the largest most significant karst features occur in the western portion of the study area adjacent to South Grimsby Road 6 in the vicinity of the rail road and west of Wade Road. Of these features, 2 appear to be the result of man-made factors such as an under-sized culvert beneath the rail line resulting in upstream flooding and, possibly consequences of forest clearing prior to agricultural tilling. All features are within about 500 metres of Twenty Mile Creek, averaging 330 metres.

Karst hazard assessments are required by the Provincial Policy Statement. Hazardous sites are also regulated under the Conservation Authorities Act and the Niagara Peninsula Conservation Authority's specific regulation for development in these areas is Ontario Reg. 155/06. The specific hazard defined by the Provincial Policy Statement is "unstable bedrock" related to

solution and removal of bedrock potentially creating a geophysical hazard to development and/or the public. However, development in and around Karst Hazardous Sites can also result in problems associated with flooding or loss of flow to connected springs. The latter situation is the most common in Southwest Ontario and also has the potential to create ecological impacts.

In this regard, the assessment of hazard constraints depends on the size and depth of the karst solution, rate of soil sloughing, and the capacity of the conduits to transport surface flows underground. Mitigation alternatives range from leave in place and buffer to accommodate potential flooding to complete removal and by-pass of the feature. In all cases, development should not result in increased flows to the feature. Depending on water balance and flow dynamics, the feature may be subject to excavation and grouting.

Shallow overburden over bedrock represents a broad constraint. The silt-clay glaciolacustrine deposits in the study area generally restrict significant infiltration, particularly in the area of the hydro line right-of-way, along Young Street, and in the Southwest from Townline Road and South Grimsby Road 6.

All karst features occur with about 500 metres straight line distance of Twenty Mile Creek, the longest being about 550 metres. No surface karst was observed in the northernmost portion of the study area including along the hydro line and towards Young Road. This suggests that the hydraulic gradient provided by the creek valley is playing a role in the initiation and development of the karst. Smithville Cave is known to be connected to the creek in terms of taking water directly from the creek and discharging within the creek valley.

The Eramosa Formation within the study area is a karst aquifer. This conclusion is principally defined on the basis of relatively high hydraulic gradients, the presence of at least one large cave, and several sinkholes.

Hydrology and Hydraulics

The urban expansion area and the existing urban area fall within three subwatersheds, namely the Twenty Mile Creek subwatershed, the North Creek subwatershed, and the Spring Creek subwatershed. The main branch of Twenty Mile Creek runs west to east across the existing urban area. The main branch of North Creek runs west to east along the south boundary of the urban expansion area. A major tributary of Spring Creek runs northwest to southeast outside of the urban expansion area and through the existing urban area towards the east. The urban expansion area is characterized with mainly headwater drainage features along with several regulated watercourses. The existing urban area is characterized with open ditches and storm sewer drainage systems, overland flow drainage systems, and stormwater management facilities.

Soils within the urban expansion area and the existing urban area are noted to primarily consist of glaciolacustrine clay and silt, with small deposits of diamicton clay to clayey silt, stream deposits of clay and silt, and paleozoic bedrock. Stream deposits and Lockport Formation are concentrated along Twenty Mile Creek. Overall, the soils exhibit low permeability and low infiltration potential, with high potential for generating runoff. The surface slopes within the urban expansion area and the existing urban area tend to be moderate between 1 percent and 2 percent. There are slightly steeper areas along Twenty Mile Creek.

Within the urban expansion area, the existing land use conditions are primarily agricultural lands with headwater drainage features. Within the existing urban area, the land use conditions are a mixture of median to high density residential areas, park areas and open lands, industrial areas along Industrial Park Road, and commercial areas along West Street and St. Catherines Street.

A field monitoring program was implemented to collect streamflow data to support the validation of the hydrologic modelling. In addition, a rain gauge was installed at the Smithville Arena to collect continuous rainfall amount data. A local hydrologic model has been developed for the urban expansion area and the existing urban area at the local level. In addition, the Niagara Peninsula Conservation Authority's hydrologic model for the watershed has been refined within the study area.

The erosive flows occurred for 0.5 percent of the 22 year simulation period along the Twenty Mile Creek tributary, 0.6 percent to 0.8 percent of the 22 year simulation period along the North Creek, and 1.0 percent to 1.3 percent of the 22 year simulation period along the Spring Creek reach.

Hydraulic models have been developed for the regulated watercourses within and downstream of the study area. The resulting Regulatory Floodplain is contained within the current flood hazard defined by Niagara Peninsula Conservation Authority.

Fluvial Geomorphology

Using topographical data, watercourse reaches were identified as unconfined, partially confined, and confined. Based on their degree of confinement, meander belt and stable top of slope hazards were delineated accordingly based on channel planform or valley geometry, aerial photography, surface contours, and base mapping. This was completed at a high-level for the purpose of characterizing the subwatershed study area, and developing an initial characterization of area hazards.

Field Investigations were completed to fill data gaps, and confirm or update the desktop results. Watercourses underwent Rapid Field Assessments and detailed geomorphic reach surveys. The rapid assessments noted that stream reaches were mainly in a state of "transition", or "in regime".

Detailed field surveys were completed for 3 reaches to characterize the system and develop threshold values for particle entrainment which highlights the channel capacity to mobilize the median particle size.

Headwater Drainage Features within the Study Area were first identified through a review of Niagara Peninsula Conservation Authority watercourse mapping and recent aerial photography. A detailed field study of Headwater Drainage Features was completed following the *Evaluation, Classification and Management of Headwater Drainage Features Guidelines*.

Several Headwater Drainage Features provide linkages to provincially significant wetlands. In addition, several Headwater Drainage Features appear to be seasonally fed by small wetland pockets that are found in the middle of tilled agricultural fields. In general, there were more wetland connections to Headwater Drainage Features in the northwest and northeast parts of the Study Area, in the Twenty Mile Creek and Spring Creek subwatersheds respectively. Several Headwater Drainage Features within the study area were also found to be connected to karst features. In several cases where Headwater Drainage Features were dry but showed evidence of recent flow, such as fresh erosion or sorted sediment, the features were classified as Mitigation to provide a conservative recommendation.

Surface Water Quality

The water quality monitoring samples received from the Niagara Peninsula Conservation Authority indicate that the concentrations of typical contaminants in the proximity of the study area are generally in comparable ranges with relatively higher levels compared with similar land uses in other study areas. High concentrations of organics, nutrients, and metals are noted for

Twenty Mile Creek and North Creek. The existing land use conditions are largely agricultural. Therefore, the high concentrations and exceedances are considered largely attributable to intensive farming activities and lack of formal water quality measures.

Aquatic Resources

The watercourses occurring within the study area are located within the Twenty Mile Creek, North Creek, and Spring Creek Subwatersheds. Most of the watercourses lie within the Twenty Mile Creek subwatershed and functionally collect and convey the majority of water from within the study area to the main branch of Twenty Mile Creek. Watercourses within the southern portion of the study area, and generally south of Smithville, flow south to North Creek. The northeast corner of the study area occurs within the Spring Creek subwatershed, which collects and diverts flow southeast toward Spring Creek, which lies outside of the study area boundary. Watercourses were classified as Critical, Important, and Marginal habitats and were assigned a cold, cold-cool, cool, cool-warm, or warm water designations based on summer temperature measurements and fish presence.

Three watercourses were confirmed as permanent within the study area, namely the main channel of Twenty Mile Creek, the main channel of North Creek, and a small portion of an inflowing tributary located south of Twenty Mile Creek in Rock Street Park. Portions of Twenty Mile and North Creeks are intermittently dry, isolating the wetted portions of each feature. Twenty Mile Creek contains many areas of exposed bedrock and its flows are influenced heavily by karst features in the area. Twenty Mile Creek is confirmed fish habitat, providing a cool-warm water thermal regime. North Creek also provides direct fish habitat, and a cool water thermal regime. The small watercourse in Rock Street Park provides indirect fish habitat and coldwater contribution to Twenty Mile Creek throughout the year.

The study area contains intermittent watercourses and small ponds, as well as Headwater Drainage Features.

During field surveys, 19 fish species were observed within the study area, including one new species for the area. The fish community is considered fairly diverse and is characterized by a variety of small-bodied and larger-bodied fish, including recreationally valuable species. The highest fish diversity (17 species) and abundance was observed within the main channel of Twenty Mile Creek, which is the largest watercourse of the three, and which provided the most habitat. One species of Special Concern has the potential to occur in Twenty Mile Creek and North Creek, but the species was not observed during field investigations. Critical Habitat for the species is not found within the study area.

Terrestrial Resources

The study area consists primarily of agricultural fields and rural properties surrounding the Community of Smithville, within Ecoregion 7E. Isolated natural heritage features are found distributed through the study area, and along Twenty Mile Creek, which bisects the Community of Smithville. The study area borders numerous residential subdivisions, industrial and commercial lands comprised within the Community of Smithville. The natural features within the study area consist of woodlands, wetlands, and watercourses. The wetlands are generally part of the Lower Twenty Mile Creek Provincially Significant Wetland Complex.

In regard to vegetation, 3 Species of Conservation Concern were observed, 13 regionally rare vegetation species, and 19 species that are considered uncommon. In total, 27 species were documented that are indicative of high quality intact habitats.

Two bird Species at Risk were observed in the study area. These species may be breeding within the study area, depending on the crop and management of the agricultural fields. Species of Special Concern are present in the study area.

Field investigations confirmed the presence of 12 herpetofaunal species, including 5 species of anurans that were noted as generally well-distributed throughout the study area, 3 species of snakes, 2 turtle species, and 1 salamander species. Other wildlife observations included 12 species of mammal, 9 butterfly species, and 13 odonate species.

Wildfire Screening

A Wildland Fire Screening was conducted for the subject lands and no areas were identified to pose a high threat for wildland fire within the study area.

Phase 2: Impact Assessment

Hydrogeology

An increase in impervious surfaces reduces the natural infiltration of groundwater and when unmitigated generally leads to a subsequent decrease in groundwater levels and potential decrease to groundwater discharge to wetlands and stream reaches where it may occur. The integrated groundwater, aquatic and terrestrial characterization indicates a lack of significant groundwater connection supporting the related ecological functions with limited groundwater input, and as such the potential ecological impacts related to groundwater are expected to be limited and more related to potential changes to overland flow.

This reduction in infiltration may also lead to a potential decrease in recharge to the deeper water producing units and more specifically to the shallow fractured dolostone. The potential reduction in recharge to the bedrock is expected to be greater where the overburden is thinner and hydraulically more connected to the bedrock. As has been characterized, the areas of greater hydraulic connection to the bedrock can occur where the overburden is less than 6 metres thick.

Where there are direct overland flow inputs to karst features, the local groundwater levels appear to respond quickly and more dramatically with regard to water quantity. Changes to the quantity and quality of water directed to any karst sinkholes will result in potential changes to the local recharge quantity and quality the upper bedrock groundwater flow system.

The installation of water and sewer infrastructure can lead to the interception of the shallow water table altering shallow groundwater flow paths and creating leakage into sanitary and storm sewers. Installation of infrastructure below the water table leads to the potential need for dewatering during construction and post construction and a decrease in groundwater levels. The potential infrastructure groundwater impacts would be greater and more prevalent in geologic units that have a greater hydraulic conductivity, particularly the shallow fracture bedrock or areas where there is sand and gravel at the bedrock contact.

Groundwater flow within the overburden where it is less than 6 m thick and groundwater flow within the shallow fractured bedrock allow for a greater potential for contaminant movement. Any existing domestic wells within the development area can provide a direct conduit from ground surface to the open portion of the well for contaminants to enter the groundwater flow system. Additionally, monitoring wells can provide the same short-circuiting pathway if they are not maintained.

Karst

Karst sinkholes have the potential to impact development via bedrock instability and flooding. The Provincial Policy Statement defines “Karst Topography” as having the potential to be a “Karst Hazardous Site” which could impact development. The Niagara Peninsula Conservation Authority regulates karst features under Regulation 155/06 which requires an evaluation of each feature. The Niagara Peninsula Conservation Authority Policy Document does not specify setbacks/buffers to all karst features, but those deemed to be a Karst Hazardous Site require buffers of 50 metres subject to confirmation from further studies.

Of the 7 karst features mapped within the study area, three have been evaluated as having a high constraint based factors such as size, positon in the landscape, and hydrological/hydrogeological role. These are all considered to be Karst Hazardous Sites with a requirement to buffer by 50 m.

Most of the sinkholes are located in or adjacent to open fields without significant flow during most of the year. Two features have a more regular flow regime and lie within naturally vegetated valleys which has greater consideration pertaining to ecolgical features or functions.

One feature was likely formed due to back flooding from an undersized culvert beneath the rail line. Although this feature does not pose significant structural or flooding hazards, its location within the Right-of-Way of South Grimsby Road 6 could pose minor flooding issues for the road. The best mitigation for this would be to re-size the culvert.

Two karst features also do not pose significant structural or flooding hazards and could be left or by-passed.

One feature, is probably not a karst feature. It most likely represents shallow soil groundwater conditions along the small creek.

All identified karst features, as well as any new features identified through the subsequent stages of planning and design, are to be assessed as part of the Master Environmental Servicing Plans, and management recommendations established accordingly in consultation with Niagara Peninsula Conservation Authority.

Hydrology and Hydraulics

In the absence of stormwater management, the future development within the urban expansion boundary for the Community of Smithville would result in increased local flood risk and erosion potential alond the local watercourses, and would be anticipated to decrease groundwater recharge and increase surface runoff volume to area karst features. The impacts to the development may be mitigated by implementing extended detention storage and drawdown within stormwater management plans, as well as the application of quantity controls for all future development within the Spring Creek Subwatershed, and strategic quantity controls for future development within development areas discharging toward the North Creek and Twenty Mile Creek to mitigate local flood risk as outlined herein. Unitary sizing criteria have been developed to provide the requisite erosion and flood control for the future development.. Opportunities exist to refine the unitary sizing criteria as part of future studies, which should also account for the application of Low Impact Development Best Management Practices within the overall stormwater management plan.

Water Quality

The future development within the future development in the Community of Smithville is anticipated to result in increased mass loadings of various water quality contaminants, including heavy metals, nutrients, and thermal enrichment. The stormwater management system within future development area is required to address Provincial standards for stormwater quality

control to an Enhanced standard of treatment by adopting a treatment train approach per Provincial guidance, as well as measures to mitigate increased temperature of storm runoff.

Watercourses and Headwater Drainage Features

A review of the Land Use Plan has revealed that the preliminary Natural Heritage System largely protects watercourse and Headwater Drainage Features and associated setbacks. The current preliminary state of the plan does not allow for further detailed analysis in terms of road crossings and grading, which should be evaluated at subsequent planning and design stages. Erosion thresholds were evaluated through a duration and volume exceedance analysis, and the recommended stormwater management plan and sizing criteria would adequately mitigate impacts related to channel erosion or aggradation.

Ecological Resources and Natural Heritage System

A proposed Natural Heritage System has been developed for the Community of Smithville to protect its signficant natural heritage features through a connected system that will have the greatest benefit to the ecological features. The proposed Smithville Natural Heritage System has been identified based on a review of existing provincial, regional, and municipal policy and integration of field work conducted as part of the Subwatershed Study. The Smithville Natural Heritage System is comprised of Core Areas, Conceptual Buffers, Linkages, and Recommended Restoration Areas. Core Areas are comprised of Significant Wetlands, Significant Woodlands, Significant Valleylands, Significant Wildlife Habitat, fish habitat, and habitat for endangered and threatened species. Although there is flexibility in the precise identification of Linkages, Buffers, and Restoration Areas, the size of these as identified through the Subwatershed Study is required to come close to the 30 percent cover target aspired to in the Township Official Plan, as well as recommended through the Subwatershed Study. Buffers are generally recommended to be 30 metres wide. Linkages within the study area are generally mapped as Primary Linkages 200 metres wide and Secondary Linkages 50 metres wide. High constraint watercourses typically require a buffer of 30 metres, thereby leading to a 60 metre wide Linkage. The Smithville Natural Heritage System, if implemented as recommended, provides 28.4 percent natural cover the Community once the areas are naturalized. This includes Linkages, Restoration Areas, and Buffers that all require naturalization as they are currently comprised of active agrictultural fields for the most part.

Additional areas may be added to the Smithville Natural Heritage System through site specific study, as in the further identification of Significant Wildlife Habitat or habitat for Species at Risk, and the integration of small wetland units, karst, floodplain, or erosion hazard sites. It is recommended that compatible land uses be situated next to the Smithville Natural Heritage System that will contribute to the protection of natural heritage features and the overall enhancement of the natural environment within the community. For instance, locating stormwater management facilities, Low Impact Development practices, parks, and schools next to the Smithville Natural Heritage System can provide opportunities to enhance the Natural Heritage System even further, while also providing the public with access to natural areas for their enjoyment, recreation, and nature appreciation. The Smithville Natural Heritage System provides an opportunity to design the proposed development in an environmentally sensitive way that mitigates climate change, protects and enhances the natural heritage features, and benefits the adjacent development.

It is recommended that buffers, Linkages, and Restoration Areas be naturalized through active restoration of these areas by planting and seeding of native species. Through the development approval processes, it is recommended that detailed planting plans be established for the restoration of these areas adjacent to the proposed development. It is recommended that the active agricultural areas identified for restoration be graded appropriately and amended with

additional topsoil. A variety of habitats may be restored, depending on the adjacent natural areas, such as woodlands, wetlands, or watercourses, as well as providing some meadow and thicket habitats. Providing habitat for significant species should be considered. For instance, Milkweed should be included in most seeding plans to benefit Monarch butterfly. Native seed mixes should be used along with plantings in a range of sizes. It is recommended that the Linkage aligned with the hydro corridor be naturalized.

A trail network should be considered at the outset of development. Creating a network of trails within the Smithville Natural Heritage System, especially within the buffer areas, will provide residents with walking trails at the outset, which will discourage the creation of ad hoc trails. Trails will foster nature appreciation and allow for passive recreation opportunities, which is part of a sustainable community.

The Smithville Natural Heritage System must be managed and maintained, which includes stewardship and management opportunities.

Future studies may refine the proposed Smithville Natural Heritage System by identifying additional natural heritage constraints, identifying appropriate buffers, and refining restoration areas. However, the Smithville Natural Heritage System proposed through the Subwatershed Study provides the Township with the direction it needs to create and maintain a robust, sustainable Natural Heritage System that will protect and enhance existing natural heritage features, provide climate change resiliency, and provide residents with the “green” system they desire.

Climate Change

It is widely accepted that, as warming increases, climate-related risks and impacts also increase. Higher rates and amounts of warming make it more difficult for adaptation actions to offer sufficient protection against these impacts. Consequently, significant impacts would remain despite the implementation of adaptation measures, thus limiting the effectiveness and potential of achieving adaptation. The limitations to adaptation are reached when there are no longer any practical or feasible adaptation options available, requiring that otherwise unacceptable risks must be accepted, adaptation objectives must be abandoned and/or transformation and “last resort” measures, such as relocation or retreat, must take place.

Within Niagara, the Region’s Background Study Report states “climate change is expected to result in increased variability in extreme local weather events that will affect natural features, ecological functions and natural processes” and states “municipalities need to consider the potential impacts of climate change as part of natural environment planning in order to better protect the natural environment system and reduce economic costs”. Although the specific magnitude of impact/change remains uncertain, the anticipated impacts noted above are supported by observations and analysis and result in significant economic and health impacts.

There are important linkages between actions that reduce greenhouse gas emissions and actions that build resilience to deal with climate change impacts. Co-benefits and synergies between these actions can also be obtained. These co-benefits and synergies include the use of nature-based approaches to adaptation in cities to create urban environments that are more resilient to heat waves and to intense rainfall, while also sequestering carbon and reducing energy demand. As well, it is recognized that risk trade-offs can emerge from particular actions that are designed to meet only one objective, but that can adversely affect the other objective, such as certain adaptation decisions which can result in an increase in greenhouse gas emissions, as well as certain mitigation choices which would increase local vulnerability or risk. As a general practice and preference, priority should be given to minimizing or avoiding these negative consequences when planning actions to respond to climate change.

The management recommendations presented in the Subwatershed Study are recognized to address requirements to mitigate impacts of climate change by incorporating Green Infrastructure into stormwater management plans to promote resiliency and enhance stormwater quality, erosion, and quantity control, providing green spaces which reduce heat effects and provide additional opportunities for incorporating Green Infrastructure into development, and planning for a robust Natural Heritage System, including linkages and enhancement areas, which actively reduces harmful greenhouse gas emissions, mitigates heat effects from urban development, and maintains water budget.

Phase 3: Management, Implementation, and Monitoring Plan

Implementation Plan

The urban expansion area for the Community of Smithville has been subdivided into contiguous blocks, representing areas with common infrastructure for servicing and transportation. At the next stage of planning, the land use for the blocks will be refined to develop more detail for the respective Block Plans. These Block Plans may represent the individual blocks identified, or encompass contiguous groups of blocks, depending upon the timing of development for the respective blocks and serivicing and transportation infrastructure. The Block Plans are to be supported by Master Environmental Servicing Plans.

Monitoring Plan

Monitoring and Adaptive Management Plans are generally developed as part of Master Environmental Servicing Plans, Environmental Impact Studies, or as conditions of approval for stormwater management plans and watercourse reconstructions/realignments. The information collected as part of these plans is intended to verify the performance of the environmental and stormwater management system, as well as to provide guidance for potential modifications to the management plan to satisfy the objectives of the Subwatershed Study.

Overall, the baseline monitoring program would extend 2 to 3 years, then annual during-construction monitoring, followed by three years of monitoring spread over 5 years post-construction. This is to be confirmed on a site-by-site basis through the development of an Environmental Monitoring and Adaptive Management Plan as approved by the Niagara Peninsula Conservation Authority, Township, and Region, and may include scoping various components of the program based upon site-specific conditions and findings from the initial years of monitoring. Additional details regarding the framework for various components of the monitoring and adaptive management plan are provided within the main reports of the Subwatershed Study.

Annual reports are to be prepared for all monitoring programs. Annual monitoring reports to verify facility performance prior to assumption by the Township should be submitted to the Township and any other permitting agencies per the conditions of approval. Annual monitoring reports for the holistic monitoring programs should be submitted to Township of West Lincoln, Niagara Region, and Niagara Peninsula Conservation Authority.