TOWNSHIP OF LUCAN BIDDULPH

2021 LUCAN URBAN MUNICIPAL SERVICING

MASTER PLAN

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October 5, 2021

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File No. 20158

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TOWNSHIP OF LUCAN BIDDULPH
2021 LUCAN URBAN MUNICIPAL SERVICING MASTER PLAN

ES 1.0 INTRODUCTION

ES 1.1 Purpose of the Master Plan

The Township of Lucan Biddulph initiated a Master Plan in July 2020 to identify infrastructure requirements associated with water supply, storage, and distribution, wastewater collection and treatment, and the stormwater management systems in Lucan.

This Master Plan establishes infrastructure improvement and expansion needs to accommodate current and projected growth in the community of Lucan.

The Master Plan will become the basis for, and used in support of, future projects required to accommodate approved growth.

ES 2.0 KEY FINDINGS

ES 2.1 Growth and Development

The most recent population count for Lucan comes from the 2016 Census. The Census population of the community is 2,541.

To estimate the 2021 population of Lucan, the number of new residents was calculated based on the building permits issued for Lucan from 2017 to 2020. The estimated 2021 population is approximately 3,300.

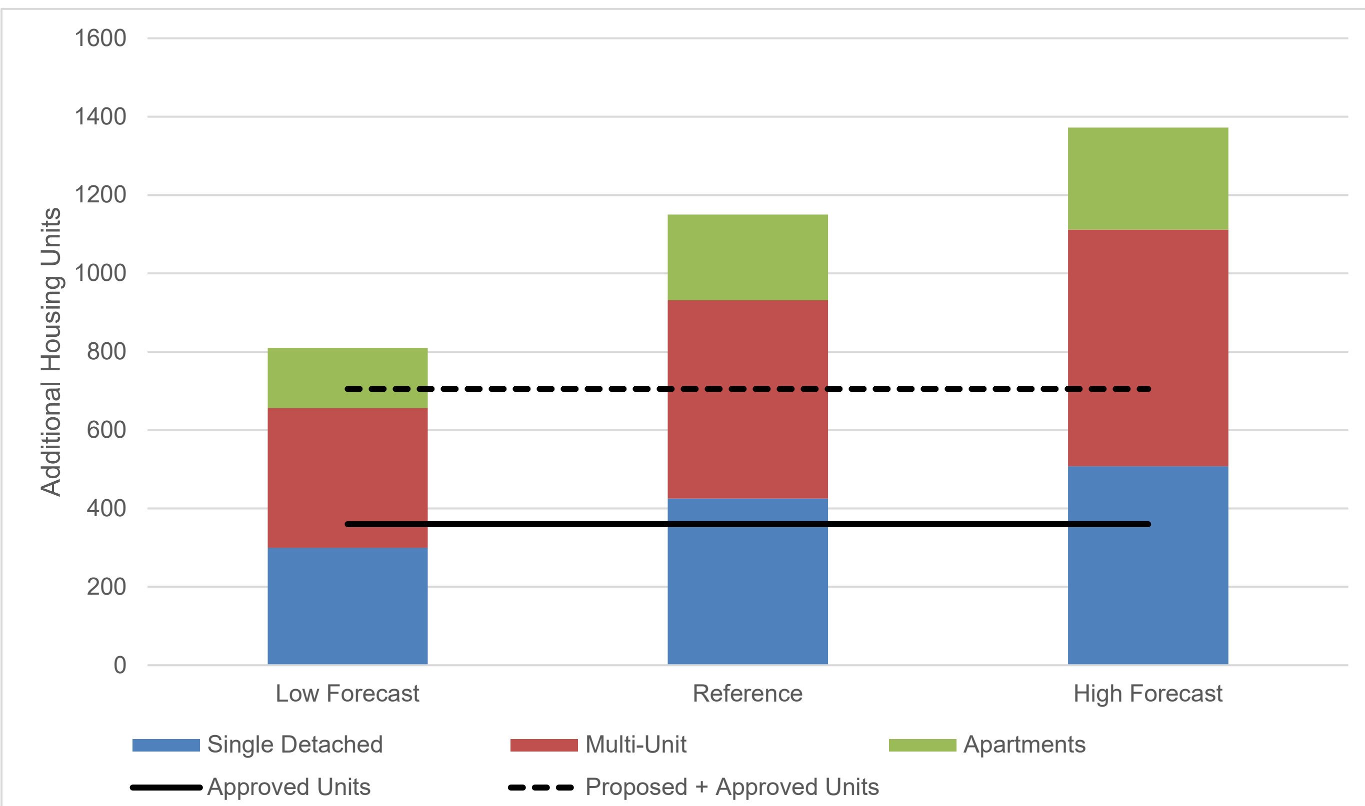
There are a number of approved residential developments within the settlement area of Lucan. These developments include apartment, townhouse, and single family units and 8.5 ha of future development. There is a total of 360 units approved. In addition to the approved developments, there are several proposed developments under consideration. The proposals total a further 345 units. Table ES 2.1 summarizes this information and also expresses the units as Equivalent Residential Units (ERUs) where one ERU is considered equivalent to a single detached residence.

Table ES 2.1 – Number Approved and Proposed Units

Development	No. of Units	No. of ERUs
Approved development	360	268
Proposed development	345	307
Totals	**705**	**575**

Currently, the County of Middlesex is in the process of updating their Official Plan. This update includes new population and dwelling forecasts for the lower tier municipalities to use for future land use planning purposes. The forecasts were presented as three scenarios; high and low growth and an intermediate forecast identified as the Reference Scenario. Figure ES 2.1 shows the County forecasts relative to current approved and proposed developments in Lucan.

Figure ES 2.1 – Forecasted Units for Growth Scenarios and Approved and Proposed Development Units



Using the County growth forecast as summarized above, the total growth in ERUs for the period 2021 to 2046 has been calculated to be:

- Low Growth Scenario = 659 ERUs
- Reference Growth Scenario = 936 ERUs
- High Growth Scenario = 1,115 ERUs

These values have been used in the evaluation of capacity requirements for the major water and wastewater facilities.

ES 2.2 Lucan Biddulph Drinking Water System

ES 2.2.1 Description

The communities of Lucan and Granton are serviced by a single distribution system that takes water from the Lake Huron Primary Water Supply System (LHPWSS). In total there is approximately 25.6 km of watermain 100 mm diameter or greater, within the community of Lucan. As of December 2020 there were approximately 1,400 customers in Lucan and an additional 130 in Granton.

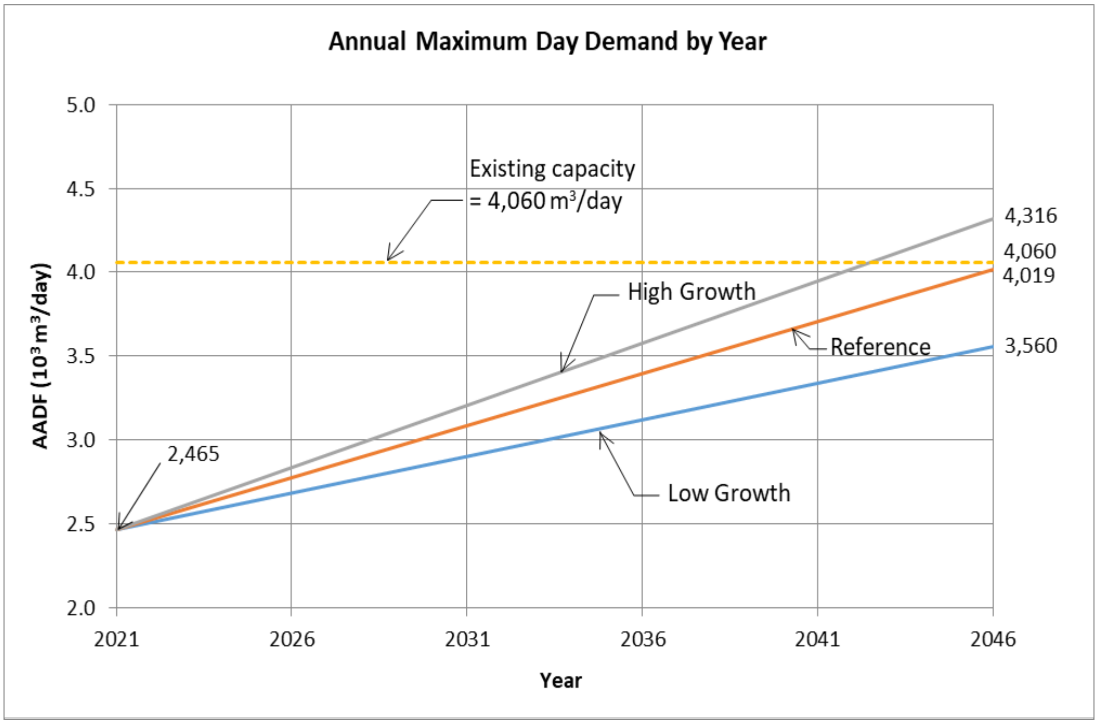
The major facilities include a booster pumping station at the intersection of William Street and Denfield Road which is required to increase pressures on the supply from the LHPWSS connection, a 2,270 m^3 elevated tank in Lucan, and a 500 m^3 reservoir and pumping station in Granton.

ES 2.2.2 Water Supply

As currently equipped and operated the supply capacity is 4,060 m^3/day. Current maximum daily usage is approximately 2,465 m^3/day which is 1.66 m^3/day per ERU.

Figure ES 2.2 shows the projected increase in demand compared to capacity.

Figure ES 2.2 – Annual Maximum Day Demand by Year



Based on the projections, no increase in supply capacity is required before 2042, although planning would have to start by 2036.

ES 2.2.3 Water Storage

The theoretical required storage is based on a formula in the Ministry of the Environment, Conservation and Parks (MECP) Design Guidelines. The Guidelines recommend storage be provided for peak flow equalization, fire flows and emergencies.

Based on current rates of usage there is sufficient water storage to accommodate development commitments. After accounting for current unapproved development proposals, existing storage volumes will be fully utilized.

With reference to the high growth and water demand forecast Figure ES 2.2, it is anticipated that the existing storage will be fully utilized by approximately 2036. Planning for additional storage should begin by 2030.

ES 2.2.4 Water Distribution

The Lucan water distribution system was modelled using WaterCAD®. The purpose of the modelling was to identify potential flow and pressure issues during periods of high demand for the existing system, and to determine constraints related to supplying future development areas.

The modelling of the existing and future conditions for the distribution system has identified three issues:

- Available fire flows at a limited number of model junctions are below target values. These locations are generally at the extremities (i.e. dead-ends) of the system and generally are considered to be impractical to improve.

- Currently available fire flow in the industrial/commercial park near Fallon Drive and Saintsbury Line is less than the target value (i.e. 150 L/s). Options to improve fire flow include a parallel main on Saintsbury, or storage within the immediate area.

- The northwest area of the community is planned for commercial development in the near term and potentially additional residential development in the longer term. Flows for fire protection for these land uses are currently unavailable. Alternatives for servicing include replacing the existing 100 mm watermain with a larger capacity watermain, or provision of a looped watermain through private lands.

The preferred approach for water distribution servicing relies on a number of factors, including scale of development in areas outside the urban growth boundary unknown at the time of this report. Where possible, water and sewer infrastructure should be designed and constructed concurrently.

ES 2.3 Lucan Wastewater System

ES 2.3.1 Description

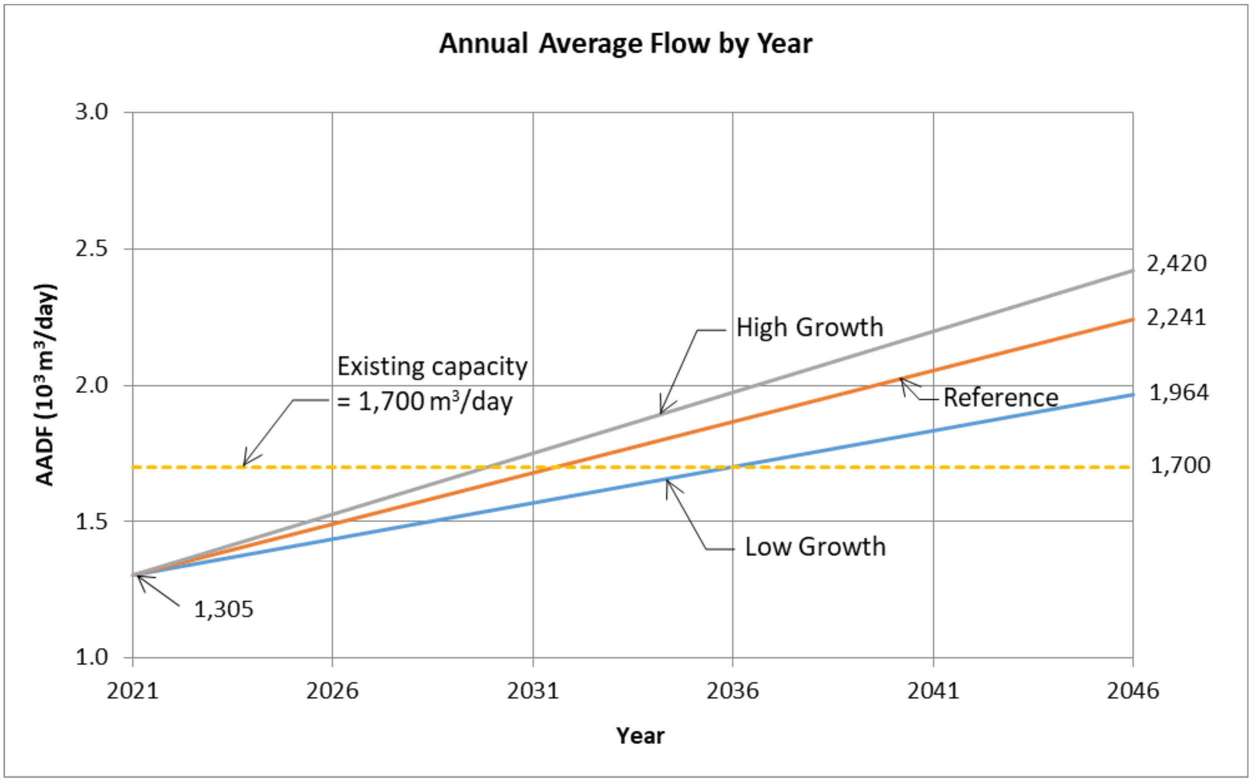
The community of Lucan is serviced by a communal sewage system consisting of approximately 19.7 km of gravity sewer, two SPSs and a WWTP. One of the SPSs (Chestnut) discharges directly to the WWTP. The other SPS (Joseph St.) is a smaller secondary station discharging to a location within the collection system which, in turn, drains by gravity to Chestnut. There is approximately 2.8 km of forcemain related to the SPSs. The current service area is approximately 150 ha. As of 2020 there were approximately 1,300 sewage customers in Lucan.

The WWTP operates under ECA No. 7008-B7CJWY dated February 11, 2019. The plant provides tertiary level treatment and discharges continuously to the Heenan Drain which, in turn, drains to the Little Ausable River. The rated capacity is 1,700 m^3/day as an annual average daily flow.

ES 2.3.2 Wastewater Pumping and Treatment

With reference to the growth projections presented previously, Figure ES 2.3 shows the expected annual average sewage flows from 2021 to 2046. The figure indicates that, at the highest growth rate, the existing treatment capacity will be adequate until approximately 2029. It is important to note that at recent rates of development expansion will be required as early as 2026.

Figure ES 2.3 – Annual Average Day Sewage Flow by Year



Additional issues that have been identified are:

- The existing WWTP Headworks which includes screening and de-gritting equipment is a peak flow constraint for the entire WWTP. Also, the equipment has reached its useful life.

- Existing biosolids treatment and storage facilities are substantially undersized for even the current plant rating. The current operating approach is to transfer excess biosolids from the holding facilities to the existing lagoons when land application is not feasible. This is at best an interim solution.

Currently approved and proposed development within the urban boundaries of Lucan will add an additional 575 ERUs to the Chestnut SPS drainage area. Potential additional peak flows will be in the order of 30 L/s. It will be important to consider the increased peak in any plans to change the pumps as well as WWTP peak flow capacity. In our opinion there is limited value in modifying the SPS until WWTP peak capacity is increased.

The Township has initiated a Class EA to determine the preferred method of increasing wastewater pumping and treatment capacity.

ES 2.3.3 Wastewater Collection

The Lucan wastewater collection system was modelled using a system-wide sanitary sewer design sheet. The purpose of the modelling was to identify potential pipe capacity constraints during periods of peak flow, and to determine constraints related to servicing future development areas.

The results indicate that there are a number of sewer segments that are currently theoretically over-committed in terms of capacity for the existing system conditions. With further development, the number of sewer segments with constrained capacity increases.

Given that theoretical values indicate constraints in the existing system, but there have not been reports or observances of capacity issues (i.e. surcharges, sewer backups), it is possible that the theoretical data over-estimates actual flows or that some sewer capacities are greater than calculated. Prior to planning to replace existing constrained sewers, especially in areas not impacted by future development, it is recommended that a sewer flow monitoring study be conducted to verify actual flow conditions. The resultant data will be useful for either confirming or disproving capacity issues.

The identification of constrained sewer capacity in some sewer sections that are affected by future development is to be expected given the significant number of development units contemplated.

ES 2.4 Stormwater Management

The community of Lucan lies within in the Little Ausable watershed, located in the jurisdiction of the Ausable Bayfield Conservation Authority (ABCA).

The immediate area around Lucan has extensive artificial drainage established under the Drainage Act. The existing urban area is serviced by a network of storm sewers and end-of-pipe stormwater management facilities (SWMFs), with discharge to several receiving municipal drains. Drainage patterns generally flow in a northwestern direction to the Little Ausable River

Additional SWM facilities and conveyance infrastructure is required as Lucan continues to experience growth. Historically SWM works were initiated using a piecewise approach to serve individual developments. This approach was generally feasible in the past as new developments resided adjacent to receiving open watercourses of the Benn and Whitfield Drain. Additional servicing constraints exist as development progresses into adjacent subwatersheds of the Haskett, Hardy-Engel, and Hardy (1984 & 1952) Drains. Development within these subwatersheds tends to be within the headwaters of the respective drainage areas, with outlet capacity and routing of controlled drainage relying on existing rural municipal drains and downstream lands.

To reduce SWM facility land requirements, capital and long-term maintenance costs, the coordination of planning and sizing of storm infrastructure is recommended. The Master Plan provides a detailed list of problems and opportunities and servicing alternatives for each subwatershed. The recommended SWM strategy for each subwatershed is also summarized.

To support recommended regional SWM facilities, detailed stormwater management plans or a subwatershed study will be required. Future studies will determine the location of regional SWM facilities and service area. Infill or redevelopment of lands within the existing settlement area should promote best management practices and low impact development measures as feasible and appropriate. Infrastructure renewal programs should aim to reduce the number of storm outlets and implement LID/source control water quality controls as feasible.

Additional Floodplain Assessment studies are required for proposed SWM facilities and developments located adjacent to or potentially within flood hazard lands. Floodplain studies must address impacts to flood elevation, conveyance, storage, erosion, ecological resources and performance of planned works to the satisfaction of the Township and ABCA.

ES 3.0 SUMMARY OF PREFERRED SOLUTIONS

The following table provides a summary of the preferred solutions to existing and future servicing issues. In most cases the solutions are subject to additional more detailed investigations.

Table ES 3.1 – Summary of Preliminary Preferred Solutions

Service	Facility	Identified Issue	Required by Year	Preferred Solutions	Probable Cost (2021$)	Class EA Schedule
Water Supply	Pipeline from LHPWSS to the Lucan elevated tank and the Booster Pumping Station.	Need for additional capacity in long-term	2042	Expand supply facilities. May result in the need to parallel existing pipes and increase pump capacity. Cost is for study only. Study should begin by 2036.	$50,000 for study.	A+
Water Storage	Lucan elevated tank.	Need for additional storage in long-term	2036	Construct additional storage facility. Requires Class EA which should begin by 2030.	$75,000 for Class EA	B
Water distribution system	Watermains	Improved fire flows in two areas.	Varies – refer to Section 4.	Preferred solution is linked to development scale and timing and also storage Class EA.	TBD	A
Wastewater Pumping	Chestnut SPS	Need for increased pumping capacity	Coincident with increase in WWTP Capacity	Replace existing sewage pumps and related works. May require forcemain paralleling.	TBD through WWTP EA Study.	A+
Wastewater Treatment	Lucan WWTP	Increase existing Headworks' capacity	Required now but timing is linked to WWTP expansion.	Replace existing facility with a new Headworks.	$2,200,000	Part of WWTP Expansion – Schedule C.
Wastewater Treatment	Lucan WWTP	Need for increase In AADF rated capacity	2029	To be determined through a Class EA process	$170,000 for Class EA	C

Service	Facility	Identified Issue	Required by Year	Preferred Solutions	Probable Cost (2021$)	Class EA Schedule
Wastewater Treatment	Lucan WWTP	Increase biosolids treatment and storage capacity	Required now but timing is linked to WWTP expansion	To be determined through a Class EA process	TBD through WWTP EA Study.	Part of WWTP Expansion – Schedule C
Wastewater Collection	Sanitary Sewer System	Improvements are required to accommodate development	Varies	Improvements are dependent on the timing of specific developments. Costs are dependent on what other work (e.g. street reconstruction) is completed simultaneously.	TBD	A
Stormwater Management	Lucan SWMFs and storm sewers	Need for SWM for future development areas.	Development driven	Coordinate stormwater management planning on a subwatershed basis	TBD	TBD

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1.0 INTRODUCTION

1.1 Purpose of the Master Plan

The Township of Lucan Biddulph initiated a Master Plan in July 2020 to identify infrastructure requirements associated with water supply, storage, and distribution, wastewater collection and treatment, and the stormwater management systems in Lucan.

This Master Plan establishes infrastructure improvement and expansion needs to accommodate current and projected growth in the community of Lucan.

In this regard, the Master Plan will become the basis for, and used in support of, future specific projects required to accommodate approved growth.

1.2 General Description of Master Plans

Master Plans are long-range plans which integrate infrastructure requirements for existing and future land uses with environmental assessment planning principles (Municipal Engineers Association, 2000). These plans examine existing infrastructure systems within defined areas in order to provide a framework for planning subsequent works. Master Plans typically exhibit several common characteristics. They:

- Address the key principles of successful environmental planning;
- Provide a strategic level assessment of various options to better address overall system needs and potential impacts and mitigation;
- Address at least the first two phases of the Municipal Class Environmental Assessment (MCEA) process;
- Are generally long-term in nature;
- Apply a system-wide approach to planning which relates infrastructure either geographically or by a particular function;
- Recommend an infrastructure servicing plan which can be implemented through the completion of separate projects; and
- Include descriptions of the specific projects needed to implement the Master Plan.

1.3 Integration with the Class EA Process

1.3.1 Class EA Phases

The Master Plan has been completed in accordance with the planning and design process of the Municipal Class EA. The Class EA is an approved planning document which describes the environmental assessment process that proponents must follow in order to meet the requirements of the Environmental Assessment Act (EA Act) (Municipal Engineers Association, 2000).

The Class EA approach allows for the evaluation of alternative methods of carrying out a project and identifies potential environmental impacts.

The Class EA planning process is divided into five phases which are described below and illustrated in Figure 1.1.

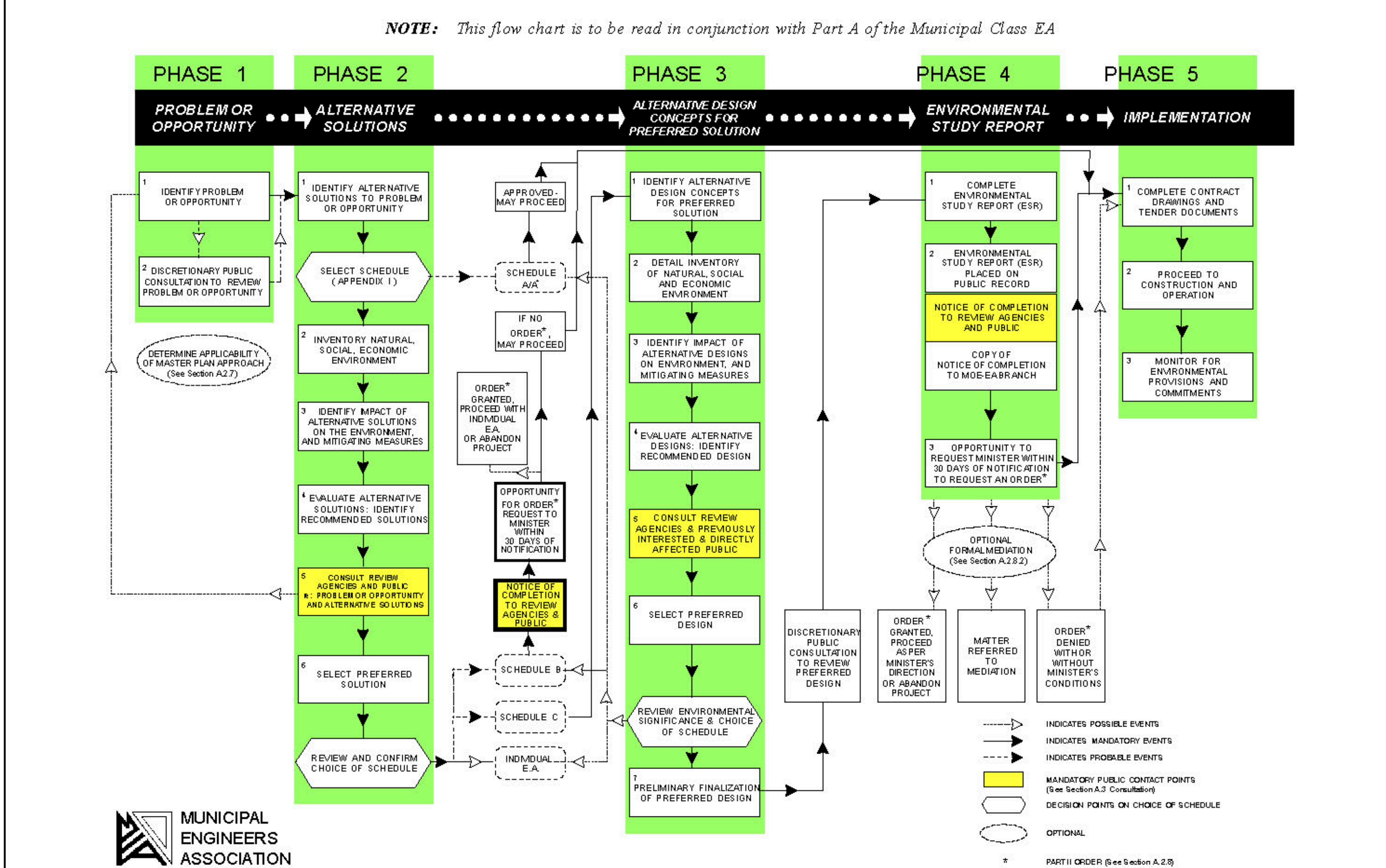
- Phase 1 - Problem or Opportunity identification;
- Phase 2 - Evaluation of alternative solutions to the defined problems and selection of a preferred solution;
- Phase 3 - Identification and evaluation of alternative design concepts and selection of a preferred design concept;
- Phase 4 - Preparation and submission of an Environmental Study Report (ESR) for Stakeholder review; and
- Phase 5 - Implementation of the preferred alternative and monitoring of any impacts.

1.3.2 Classification of Project Schedules

Projects associated with master plans are classified to different project schedules according to the potential complexity and the degree of environmental impacts that could be associated with the project. There are four schedules:

- Schedule A – Projects that are pre-approved with no need to follow the Class EA Process;
- Schedule A+ – Projects that are pre-approved but require some form of public notification;

Figure 1.1 Class EA Process



BMROSS engineering better communities	TOWNSHIP OF LUCAN BIDDULPH LUCAN URBAN MUNICIPAL SERVICING MASTER PLAN CLASS EA PROCESS	DATE JAN. 04, 2021	PROJECT No. 20158
		SCALE None	FIGURE No. 1.1

- Schedule B – Projects that are approved following the completion of a screening process that incorporates Phases 1 and 2 of the Class EA process, as a minimum; and

- Schedule C – Projects that are approved subject to following the full Class EA process.

The Class EA process is self-regulatory, and municipalities are expected to identify the appropriate level of environmental assessment based upon the project they are considering.

1.4 Master Plan Framework

1.4.1 Master Plan Approaches

Given the broad nature and scope of master plans the Class EA document provides proponents with four approaches to conducting master plan investigations. Proponents are encouraged to adapt and tailor the master planning process to suit the needs of the study being undertaken, providing that, at a minimum, the assessment involves an evaluation of servicing deficiencies followed by a review of possible solutions (i.e., Phases 1 and 2 of the Class EA process).

Table 1.1 summarizes the primary components associated with each of the four Master Plan approaches outlined within the Municipal Class EA document (MCEA).

Table 1.1 – Summary of MCEA Master Plan Approaches

Approach	Key Characteristics	Project Implementation
1	- Master Plan prepared at the conclusion of Phases 1 and 2 of the Class EA process. - Completed at a broad level of assessment. - Serves as basis for future investigations associated with specific Schedule B and C projects.	- Schedule B and C projects would require further Class EA investigations.
2	- Master Plan prepared at the conclusion of Phases 1 and 2 of MEA Class EA process. - Includes a more detailed level of investigation and consultation completed, such that it satisfies requirements for Schedule B screenings. - Final public notice for Master Plan serves as Notice of Completion for individual Schedule B projects.	- Schedule B projects are approved. - Schedule C projects must complete Phase 3 and 4 of Class EA process.

Approach	Key Characteristics	Project Implementation
3	- Master Plan prepared at the conclusion of Phase 4 of Class EA process. - Level of review and consultation encompasses Phases 1 to 4 of the Class EA process. - Final public notice for Master Plan serves as Notice of Completion for Schedule B and C projects reviewed through the Master Plan.	- Further Class EA investigations are not required for projects reviewed through the Master Plan.
4	- Integration of Master Plan with associated Planning Act approvals. - Establishes need and justification in a very broad context. - Best suited when planning for a significant geographical area for an extended time period.	- Depending on level of investigation associated with the Master Plan, Class EA investigations may be required for specific projects.

1.4.2 Applied Framework

For the purposes of this Master Plan, it was determined during the course of the investigation that Approach 2 would be the most appropriate planning framework to utilize for this assessment. The Master Plan therefore defines broad infrastructure requirements within the study area and serves as the basis of future detailed investigations and also provides detail concerning alternative investigations and public consultation for Schedule B projects that are required to accommodate growth.

This Master Plan identifies future infrastructure projects, timing for infrastructure needs and any requirements for additional MCEA investigations for Schedule C projects. Approval Requirements

The Master Plan is subject to approval from the Township of Lucan but does not require formal approval under the EA Act. A Completion Notice will be issued at the conclusion of the Master Plan. Any projects identified within this Master Plan that are considered Schedule C activities will be required to complete additional investigations to satisfy the requirements of Class EA process, prior to approval, design and construction.

2.0 STUDY AREA AND EXISTING CONDITIONS

2.1 Study Area

The Township of Lucan Biddulph is located in the County of Middlesex. The Township was formed through the amalgamation of the Village of Lucan and the Township of Biddulph in 1999. The Township is bordered by the Municipality of Middlesex Centre to the south, the Municipality of North Middlesex to the west and the Municipality of South Huron to the north. The latter is in the County of Huron.

The landscape throughout the township is predominately rural in nature, with three settlement areas. The population of Lucan Biddulph is approximately 4,700 as reported in the 2016 Census, with over half the population residing in the community of Lucan which is the largest settlement area. Smaller settlement areas within the Township include Granton and Clandeboye. The general location of the Township, as well as the community of Lucan is shown in Figure 2.1.

The focus of this Master Plan is the urban area of Lucan which, as mentioned previously, is the largest urban community in the Township. It is located approximately 20 kilometers north of London along Provincial Highway 4 in the west-central portion of the Township. Given the close proximity to London and availability of residential homes, Lucan has evolved into primarily a bedroom community. The community supports a downtown core along Richmond Street/Main Street (Highway 4) and a number of commercial, industrial and institutional uses.

The population of Lucan, as reported in the 2016 census, was approximately 2,540 residents. As of 2020 the estimated population had increased to approximately 3,300. The urban settlement area for Lucan, as identified in ‘Schedule A’ of the Township of Lucan Biddulph Official Plan (2015), is shown in Figure 2.2.

2.2 General Description of the Water, Wastewater and Stormwater Facilities

2.2.1 Lucan Biddulph Distribution System

A more detailed description of the Lucan Biddulph drinking water system (DWS) is included in Section 4.0 of the Master Plan.

The DWS is a single water distribution system serving Lucan as well as the community of Granton, which is also in the Township, and approximately 10 km east of Lucan. The system has a single source of water at the Lake Huron Primary Water Supply System (LHPWSS). The connection is approximately 5 km west of Lucan in North Middlesex.

The LHPWSS connection also serves properties outside of the Lucan urban boundary in both the Township and the Municipality of North Middlesex (e.g. Clandeboye), but these are not considered as part of the Lucan Biddulph DWS.

Water from the LHPWSS passes through a Booster Pumping Station (BPS) near the intersection of William Street and Denfield Road. At this location pressure is boosted to supply Lucan and the properties along Denfield Road including those in North Middlesex.

Figure 2.1 – Location of Lucan Biddulph

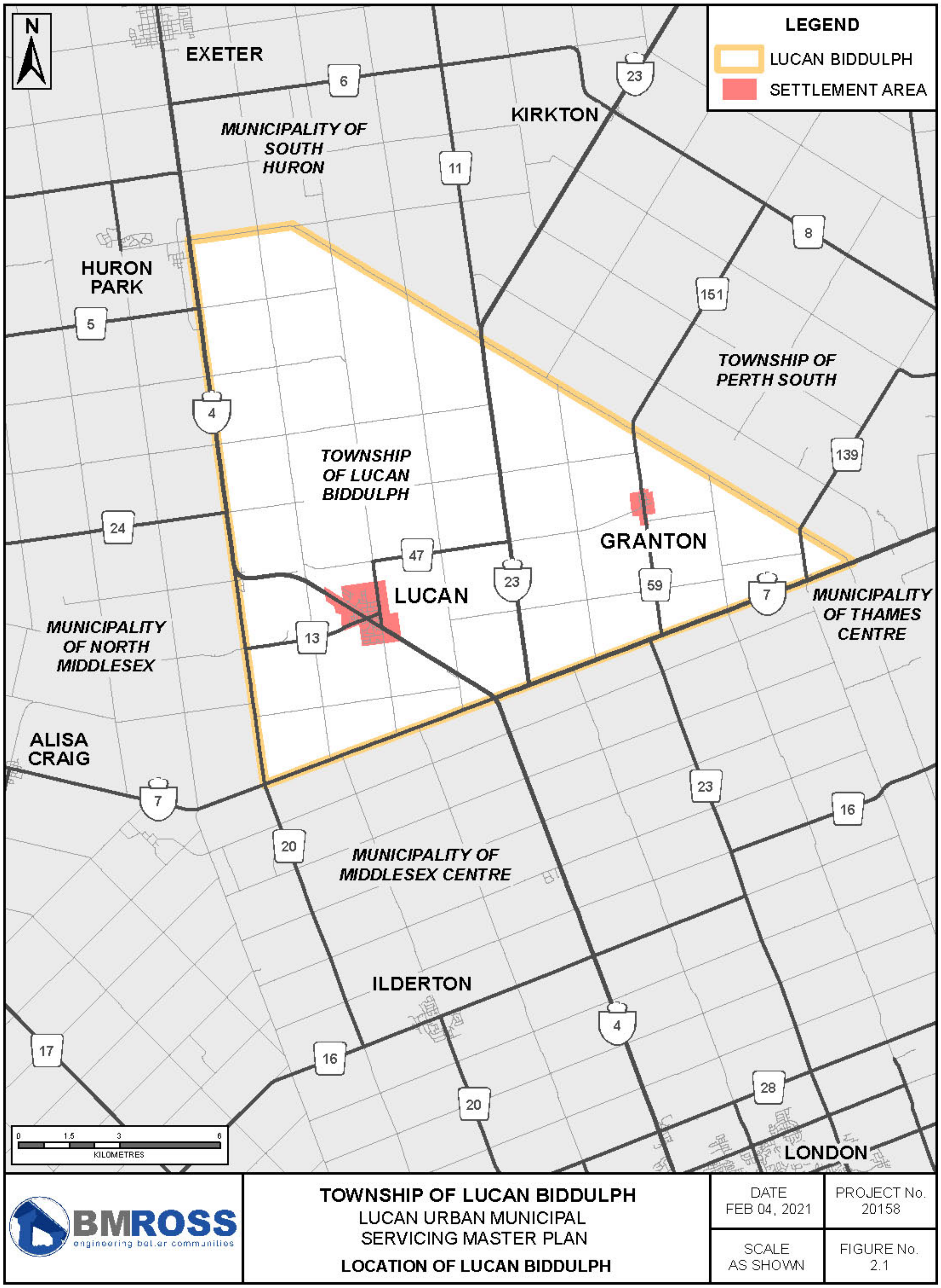
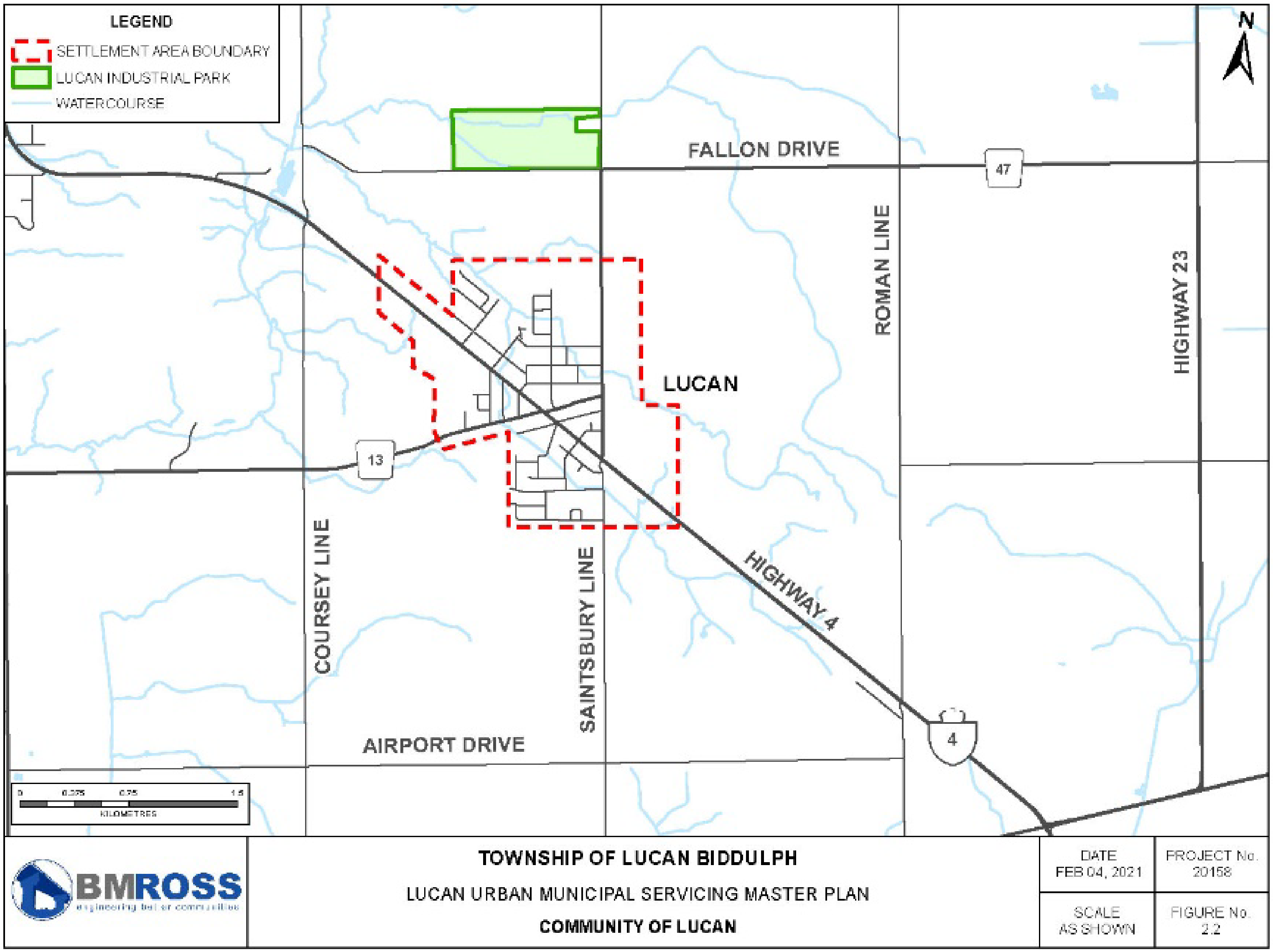


Figure 2.2 – Lucan Urban Area



Treated water storage facilities currently exist in both Lucan and Granton. The distribution system has two pressure zones. Zone 1 is the entire system up to the point of discharge to a BPS serving Granton. Zone 2 is the Granton distribution system. As of December 2020, there is approximately 38 km of watermain and 1,400 customers.

2.2.2 Lucan Wastewater System

In Lucan the collection system generally drains south to north with a larger sewage pumping station (SPS) located in the north part of the community on Campanale Way north of Walnut Street. That SPS, known as the Chestnut SPS, pumps directly to the Wastewater Treatment Plant (WWTP) located north of Fallon Drive. One smaller secondary SPS, the Joseph St. SPS is located near the south limit of Lucan.

The WWTP, with a rated capacity of 1,700 m3/day, discharges treated effluent to the Heenan Drain which then drains to the Little Ausable River.

In Lucan there are approximately 20 km of gravity sewer and 1,300 (2020) customers.

2.2.3 Lucan Stormwater Management System

The existing urban area of Lucan is serviced by a network of storm sewers and end-of-pipe stormwater management facilities (SWMFs). Stormwater is directed to several municipal drains, with drainage generally in a northwestern direction to the Little Ausable River, located within the jurisdiction of the Ausable Bayfield Conservation Authority.

The largest receiving municipal drain is the Benn Drain, which bisects the existing urban area. The Whitfield and Hardy-Engel Drains are both tributary to the Benn Drain, which discharges to the Little Ausable approximately 1.4 km downstream of the Lucan urban boundary. Other receiving municipal drains include the Hardy Drain (1954 and 1984) and the Haskett Drain. North and east of the urban area, flows are conveyed to the Heenan Drain, which discharges to the Little Ausable River upstream of the Benn Drain. It is noted that flows southwest of the urban boundary are directed to the Stanley Creek Drain, which discharges to Nairn Creek and ultimately the Ausable River at Nairn.

Most streets in Lucan have an urban road section (i.e. curbing and storm sewer). The existing storm network is largely comprised of relatively small drainage areas with direct discharge to the receiving municipal drains. Based on available GIS data, 39 stormwater outlets and approximately 17.6 km of storm sewer have been identified within the existing urban area. There are five existing end-of-pipe SWMFs providing water quality and water quantity control for more recent developments along the peripheral limits of the urban area. One oil and grit separator (OGS) has been constructed as part of recent Ridge Crossing development along Campanale Way.

A more detailed description of the Lucan Stormwater System is included in Section 6 of the Master Plan.

2.3 Environmental Setting

2.3.1 General

The MCEA Master Plan process requires an inventory of the environment. The environmental review represents a general overview of local conditions. This environmental inventory is used to identify factors that could influence the identification and selection of alternative solutions to the problem or opportunity being investigated. The background review for the Master Plan process incorporated the assembly of information about the local environment.

Information was collected as part of a desktop analysis, based on the following key sources:

- Ausable Bayfield Conservation Authority, website and mapping.
- Government of Canada Species at Risk website.
- Ministry of Natural Resources and Forestry Natural Heritage Information Centre (NHIC) website.
- Existing files and reports completed by BMROSS.

2.3.2 General Physiography

Lucan is located within the physiographic region known as the Stratford Till Plain. This region is a large clay plain that stretches from London, north towards Blyth and Listowel. Another branch extends towards Arthur and Grand Valley. This till plain is characterized by the closely spaced moraines and having a knoll and sag relief (Chapman & Putnam, 1984). The till in this area is relatively uniform, consisting primarily of silty clays. Given the clay composition of the till, artificial drainage is generally required to support agriculture. Soils in the Lucan area are characterized as being silt loam or silty clay loam with poor drainage.

2.3.3 Significant Natural Features

(a) General

The community of Lucan is surrounded predominately by a rural landscape with a focus on agriculture as a primary use. The existing village boundary is surrounded by scattered riparian forested habitat and limited aquatic habitat (see Figure 2.3). Woodlands surrounding Lucan appear relatively fragmented and disconnected based on historic and present agricultural land uses.

Within the urban settlement boundary of Lucan, there are relatively few natural features.

(b) Watercourses

The Little Ausable River is located approximately 1.5 km west and northwest of the existing village boundary flowing south and eventually making a significant meander to flow west to connect to the Ausable River. A Significant Valley System (SVS) associated with the Little Ausable was identified by the Middlesex Natural Heritage Study (2014). An SVS designation recognizes the importance of valleys for linkages and corridors for wildlife movement, habitat opportunities and a large-scale connectivity of natural areas. The SVS lands coincide with the hazard lands associated with the municipal drains and the Little Ausable River. The Little Ausable River is regulated by the Ausable Bayfield Conservation Authority under O. Reg 147/06 (Regulation of development, interference, with wetlands and alterations to shorelines and watercourses). Based on the background information compiled, there are records of Rainbow Mussel and Wavy-rayed Lampmussel, two species at risk mussels and their associated habitats exist within the Little Ausable River, west of Lucan near its convergence with the Ausable River.

Within the existing village boundaries, there are two open municipal drains: the Benn Drain and Whitfield Drain. Both drains collect runoff from the area and flow towards the northwest, eventually reaching the Little Ausable River.

Other drains outside of the existing built-up area include the Hardy-Engel, Hardy and Haskett Drains. Based on the background information compiled, there are no known aquatic species at risk and/or associated habitat known to exist within the Benn and Whitfield Drains in the existing village boundary.

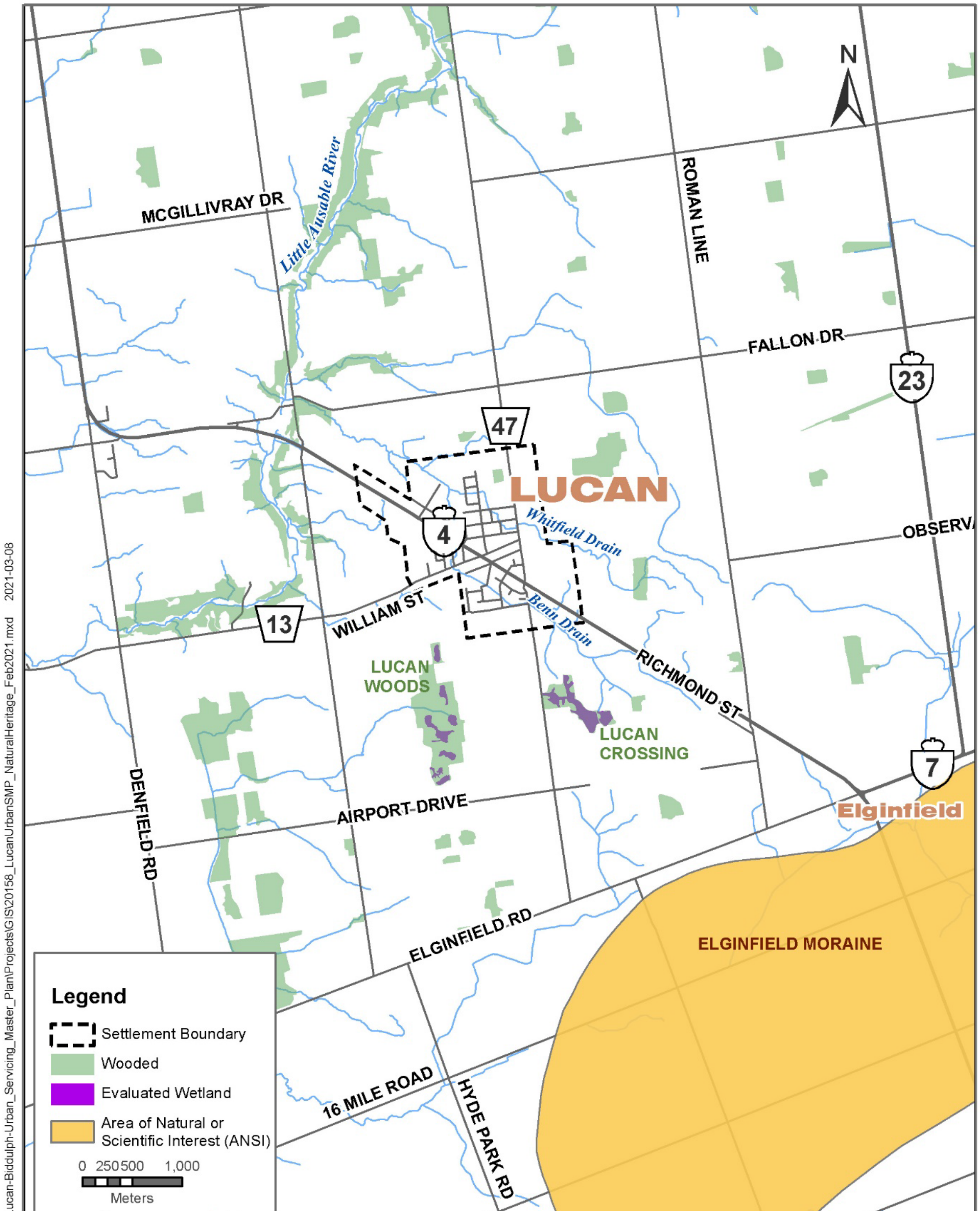
(c) Areas of Natural and Scientific Interest

The Ministry of Natural Resources and Forestry (MNRF) maintains an inventory of Areas of Natural and Scientific Interest (ANSIs) in Ontario. These life science or earth science features are recognized for their importance related to natural heritage, scientific study, or education. To identify ANSIs within the vicinity of Lucan, the MNRF Make a Map: Natural Heritage Areas application was consulted (Ministry of Natural Resources and Forestry, 2017). There is one ANSI located near Lucan, the Elginfield Area Moraine. This feature is an Earth Science ANSI, located approximately 3 km south of Lucan (see Figure 2.3).

(d) Wetlands and Woodlands

The following wooded and wetland areas were identified through a search of the NHIC database:

Figure 2.3 – Natural Features



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		SCALE As Shown	FIGURE No. 2.3

Table 2.1 – Natural Areas within Proximity to Lucan

Type	Name	Description
Natural Area	Lucan Crossing	Non-provincially significant wetland that has been evaluated approximately 1km south of Lucan
Natural Area	Lucan Woodlot	Non-provincially significant wetland that has been evaluated approximately 1km southwest of Lucan

Woodlands surrounding Lucan appear relatively fragmented and disconnected based on historic and present agricultural land uses. Lucan Woodlot and Lucan Crossing are two woodlands (with associated wetlands) located south and southwest of the village (Upper Thames River Conservation Authority, 2014). In addition to these areas, there are a number of other woodland areas that were identified as Significant Vegetation Patches within the Middlesex Natural Heritage Study (2014). These woodlands are shown in Figure 2.3.

2.3.4 Species at Risk

An evaluation for the presence of significant species and their associated habitats within the study area has been incorporated into the project planning process. A review of available information on species and habitat occurrences determined that the study area may contain species and/or associated habitats that are legally protected under Provincial and Federal legislation.

The protection of species at risk and their associated habitats comes from the following federal and provincial legislation:

- The Federal Species at Risk Act, 2020 (SARA) provides for the recovery and legal protection of listed wildlife species and associated critical habitats that are extirpated, endangered, threatened or of special concern and secures the necessary actions for their recovery. On lands that are not federally owned, only aquatic species and bird species included in the Migratory Bird Convention Act (1994) are legally protected under SARA. (Environment Canada, 2017)

- The Provincial Endangered Species Act, 2007 (ESA) provides legal protection of endangered and threatened species and their associated habitat in Ontario. Under the legislation, measures to support their recovery are also defined.

To identify what species at risk may be located in the vicinity of Lucan, the following sources were consulted:

- Natural Heritage Information Centre, Make a Heritage Map
- Environment Canada, Species at Risk Public Registry. SARA Schedule 1 Species List
- Ontario Reptile & Amphibian Atlas

- Ontario Species at Risk Website
- Fisheries and Oceans Canada Aquatic Species at Risk Online Mapping
- Ontario Breeding Bird Atlas, Region 4
- Atlas of the Mammals of Ontario
- TEA Ontario Butterfly Atlas

A list of potential species at risk found within the County of Middlesex, provided by the MNRF is included in Appendix A. The County incorporates a large area and wide variety of environs that include terrestrial and aquatic habitats. To identify species more likely to be found within the study area, the NHIC database was consulted. The NHIC database provides species occurrences based on 1 km^2 square system. The squares that overlapped with the settlement areas of Lucan were searched for species occurrences. The review identified the following species occurrences within the general vicinity of the study area:

- Heart-leaved Plantain (*Plantago cordata*), an endangered species both provincially and federally has been known to occur in the general area. This species is found within stream channels and emergent zones between open water and upland vegetation along stable, low-gradient streams and their adjacent floodplains. The species has been recognized as being extirpated for the area by the MNRF (Ontario Ministry of Natural Resources, 2017). Based on the habitat needs of the species, the preferred habitat would be within the Little Ausable River and adjacent floodplain area.

- Dense Blazing Star (*Liatris spicata*), a threatened species both provincially and federally has been known to occur in the general area. This species is known to occur in open habitat types such as prairie, grasslands, wet meadows between abandoned fields and sand dunes.

It should be noted that the majority of the study area for this Master Plan is within an existing urban settlement area, with extensive previously disturbed areas and limited habitat potential.

2.3.5 Breeding Birds

The Atlas of Breeding Birds of Ontario (2001-2005) was used to identify the bird species with confirmed, probable and possible breeding habitat in proximity to the study area. The study area lies within the 100 km2 area identified by the Atlas as Square 17MH68, in Region 4: London (Bird Studies Canada, 2009). Within that square, a total of 79 species were observed within the square. A total of 54 species of breeding birds were confirmed to have habitat within the area. In addition to the confirmed species, 21 species are considered to have probable and 4 possible breeding habitats in the area. The Eastern Meadowlark (*Sturnella magna*) and Barn Swallow (*Hirundo rustica*), threatened species in Ontario are identified as being confirmed within the atlas square and Bobolink (*Dolichonyx oryzivorus*), a threatened as identified as being probable within the square.

The survey area includes key habitat for identified species, such as forest (in all stages of growth), riverine areas, agricultural areas, wetlands and shoreline areas.

2.3.6 Cultural Heritage and Archaeological Resources

The Township Official Plan outlines in Section 4.0 (Heritage Resources) that where appropriate, all heritage resources shall be protected, conserved and preserved. Development is encouraged to occur in harmony with heritage resources and these resources are to be incorporated and utilized, where feasible. Furthermore, prior to development occurring, the Township requires the site to be assessed in order to verify the potential of archaeological resources. Where archaeological resources are found, appropriate measures to remove and document, in accordance with the Ontario Heritage Act is required.

In order to evaluate the potential for archaeological concerns within the settlement area of Lucan, a review of the registered archaeological sites, historic plaques, cemeteries, known settlement areas and previous archaeological assessments within and surrounding the village of Lucan was completed by Timmins Martelle Heritage Consultants Inc. in February of 2019.

The following is a summary of the findings from the review:

- Archaeological Sites: There are two registered archaeological sites within the existing village boundary. These sites were completely excavated, so there is no further archaeological potential associated with them.

- Previous Archaeological Assessments: Six archaeological assessments have been completed within the existing village boundary for residential development. No archaeological resources were found with these sites based on reports available.

- Historic Plagues: A historic plaque is located on the Main Street in Lucan adjacent to Lucan Area Heritage and Donnelly Museum. This historic plaque is identified as designated under the Ontario Heritage Act in the Official Plan.

- Cemeteries and Burial Sites: Three known cemetery locations and three burials are known to exist; however, the locations of these burials are unknown. Further investigation into the definitive boundary of the three known cemeteries and confirmation of the three burial locations is required.

- 19th Century Structures: Several 19th-century structures and travel routes exist within the study area. There is the potential for archaeological sites to exist on the property, other than the buildings themselves. St. Patrick’s Church is identified as designated under the Ontario Heritage Act in the Official Plan.

Of interest, two important historical settlements were identified for the Lucan area, the Wilberforce Settlement and the Donnelly Family settlement.

The review identified an early Black settlement, the Wilberforce Settlement area is known to be in the area surrounding the village of Lucan. The Wilberforce Settlement purchased 325 hectares of land in the Lucan area in 1830. Records indicate that the Wilberforce settlement dwindled in the mid-19th century when the area experienced an influx in Catholic Irish settlers. Background information suggests the location of the settlement may extend beyond the known location. Additional review of the Wilberforce Settlement is required in order to identify the extent of the settlement boundary and any connection between the known 19th century archaeological structures. The potential for additional archaeological concerns associated with this settlement is possible and requires further investigations to be completed.

The other potential source of archaeological potential that was identified is associated with the Donnelly Family in the mid-19th century. Although the location of where the family lived is known and outside of the existing study area, any work occurring immediately adjacent to the area may require additional archaeological work to be completed.

The archaeological review that was completed is a summary of all known information for the study area. The review concluded that the entire study area, given the settlement history, has the potential for additional archaeological concerns to be present. This is consistent with the results of the Ministry of Heritage, Sport, Tourism and Culture Industries checklists for Criteria for Evaluating Archaeological Potential and Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes. The checklists completed for this Master Plan are included in Appendix B.

The majority of the study area for this Master Plan is within the existing urban settlement area of Lucan. Given the focus of this study is on servicing infrastructure, it is anticipated that most of the projects identified as part of this Master Plan will be within areas that have previously been disturbed by the original installation of infrastructure. However, any projects identified outside of disturbed areas will be individually evaluated for their potential for archaeological and built heritage resources and impacts to cultural heritage landscapes prior to construction.

2.3.7 Climate Change

As part of the Class EA process, potential impacts associated with climate change need to be evaluated. Some of the phenomena associated with climate change that may be considered during impact evaluations include:

- Changes in the frequency, intensity and duration of precipitation, wind and heat events;
- Changes in soil moisture;
- Changes in sea/lake levels;
- Shifts in plant growth and growing seasons; and

- Changes in the geographic extent of species ranges and habitat.

There are two approaches that can be utilized to address climate change in project planning. These are as follows:

- Reducing a project's impact on climate change (climate change mitigation). Mitigation of climate change impacts may include:
    - Reducing greenhouse gas emissions related to the project.
    - Alternative methods of completing the project that would reduce any adverse contributions to climate change.
- Increasing the project's and local ecosystem's resilience to climate change (climate change adaptation). Considerations related to climate adaptation include:
    - How vulnerable is the project to climate-related severe events?
    - Are there alternative methods of carrying out the project that would reduce the negative impacts of climate change on the project?

Through the evaluation of alternatives as part of the second phase of the Class EA, consideration of each of these approaches should be completed and included in the final determination of the preferred approach to completing a project. Consideration of impacts of climate change within this Master Plan is undertaken for any projects identified as part of the evaluation of alternatives.

2.4 Planning Policies

2.4.1 Provincial Planning Policies

Under the Planning Act (Section 3), the Provincial Policy Statement (PPS) guides the policies in relation to land use and development applications within the Province of Ontario (Ministry of Munical Affairs and Housing, 2020). Decisions surrounding land use and development must be consistent with the policies contained within the PPS in order to support the overarching provincial interest. Given the intent of the Master Plan, the following policies of the PPS have been identified to support consideration of a servicing strategy (Ministry of Munical Affairs and Housing, 2020):

<u>Section 1.1: Managing and Directing Land Use to Achieve Efficient and Resilient Development and Land Use Patterns</u>

- The Master Plan will sustain a healthy, liveable and safe community by promoting efficient development and land use patterns through a servicing strategy;

- The servicing works identified in the Master Plan will allow development and land use patterns that will not prevent the potential expansion of any settlement area to adjacent areas;

- The Master Plan will provide a servicing strategy that will promote cost-effective development patterns to minimize servicing costs; and

- The intent of the Master Plan is to ensure the necessary water, wastewater and stormwater infrastructure is available to meet current and future needs.

Section 1.1.3: Settlement Areas

- The Master Plan, and identified servicing strategy, will provide a basis for planning land use patterns that are appropriate for, and efficiently use, existing and planned infrastructure.

- It will assist in the development and implementation of phasing policies to ensure the orderly progression of development and timely provision of infrastructure.

Section 1.6.1: Infrastructure and Public Service Facilities

- The servicing strategy identified in the Master Plan will allow for the provision of coordinated, efficient and cost-effective infrastructure that accommodates existing and future need.

- The development of the servicing strategy was coordinated with land use planning principles to ensure infrastructure is financially viable and able to meet current and future needs.

- It will consider existing infrastructure and how it may be optimized.

Section 1.6.6: Sewage, Water and Stormwater

- The Master Plan incorporates expected growth and development, and the servicing strategy will promote the efficient use and optimization of existing municipal water, sewage and stormwater services; and

- Development of the servicing strategy considered feasibility, financial viability, regulatory compliance requirements, sustainability, impacts of climate change, and protection of human health and the natural environment.

- The Master Plan supports the provision of municipal servicing as the preferred form of servicing within the settlement areas.

2.4.2 Local Planning Policies

The Middlesex County Official Plan serves as the upper tier planning policy framework for the municipalities within the County. The County Official Plan provides direction on growth and planning policies, including growth forecasts, and servicing and settlement requirements. In terms of growth-related policies, the Middlesex County Official Plan directs growth to primary Settlement areas (including Lucan and Granton), forecasting that a ‘healthy’ amount of growth will occur within the County due to affordable housing and close proximity to employment cores, including London (Middlesex County, 2006).

Under the County Official Plan, the preferred form of servicing is full (water and wastewater) municipal services. The Official Plan requires a multi-year water and sewage servicing plan to support any new local Official Plan or Official Plan reviews. Furthermore, planning policies at the municipal level are to incorporate and have regard for the direction and conclusions of any multi-year servicing study.

The Township of Lucan Biddulph Official Plan (2015) incorporates local policies and implementation strategies based on the policy direction from the PPS and County OP. The purpose of the Township Official Plan is to provide direction on land use, development, resources, existing and future direction of settlement areas, specific to the existing conditions within the Township. Growth within the Township, as stated in the OP, is to be directed firstly to the village of Lucan, and secondly to the village of Granton. There are limited residential development opportunities in the remainder of the Township, reflecting the lack of water and sanitary servicing infrastructure. Future residential development is directed to occur adjacent to existing development, to ensure the cost-efficient extension of existing services.

Section 2.1 of the OP provides the overall goals and objectives for Lucan in relation to future development needs. Opportunities exist within the existing settlement area for redevelopment and infilling, with the Township requiring 15% of development to occur by the way of intensification and redevelopment, as outlined in section 2.1.5.11 the Plan (Township of Lucan Biddulph, 2015). The Plan recognizes the need for additional medium density residential development to support the socio-economic needs of the community. Future development in the form of medium density housing should be in proximity to arterial or collector roads, appropriate community services and where municipal infrastructure services are available.

Currently, reviews of the County and Township Official Plan are underway. It is expected that the updates to the Plans will include population and housing forecasts, as well as policies to bring the Plans into conformity with the 2020 PPS.

2.5 Clean Water Act (Source Water Protection)

The intent of the Clean Water Act (CWA), 2006 is to “protect existing and future drinking water” sources in Ontario. Under the Act, source protection areas and regions were established, giving conservation authorities the duties and power of a drinking water source protection authority. These duties focus on the development, implementation, monitoring and enforcement of information and policies related to source water protection.

Lucan is located with the Ausable Bayfield Source Protection Area. The Source Protection Plan (SPP) in this region came into effect in 2019. The SPP outlines policies developed to protect municipal drinking water sources from threats and the Approved Assessment Report summarizes the watershed characteristics and drinking water threats.

The village of Lucan is serviced by the Lake Huron Primary Water Supply System (LHPWSS) which is a surface water intake system, drawing raw water from Lake Huron. It supplies treated drinking water to the Lucan Biddulph Water Distribution (LBWD) via the Lucan Booster Station located on Denfield Road (Country Road 20). LHPWSS intake is located north of Grand Bend, approximately 2.5 kilometers offshore and at a depth of 9 meters. Approximately 350,000 people and most of the Ausable Bayfield Source Protection Area rely on the LHPWSS for drinking water (Ausable Bayfield Maitland Valley Source Protection Region, 2019). Water quality from water sourced by the LHPWSS is considered excellent as the pipe is located far offshore and deep within the lake. The intake protection zones for the LHPWSS are not located within the study area.

There are no municipal wells or Wellhead Protection Areas within Lucan. Additionally, there are no Significant Groundwater Recharge Areas (SGRA) or Highly Vulnerable Aquifers (HVA) within the study area. Given the absence of vulnerable areas, there are no applicable Source Water Protection policies for the study area (Ausable Bayfield Maitland Source Protection Region, 2019).

3.0 POPULATION GROWTH AND FUTURE DEVELOPMENT

3.1 Information Sources

Population information for Lucan is available from the 2016 Census of Population from Statistics Canada. The 2016 Census identifies Lucan as a ‘population centre’ and as such, has population and dwellings counts available for the community. Census data was used as the source of background population information for the purposes of this study.

Municipal staff provided information on approved and proposed developments within and adjacent to the urban settlement area. In addition to the proposed developments, recent population and housing projections completed by Watson and Associates for Middlesex County and the lower tier municipalities have been approved by County Council. These 25-year forecasts were developed in conjunction with the 5-year review of the Middlesex County Official Plan and provide a range of forecasts (low, reference and high growth) that municipalities can use in their own planning policies.

The intent of this Master Plan is to identify infrastructure needs, including facilities that may be required for growth beyond a 25-year planning horizon. Given this, the growth forecasts approved by the County are being considered in addition to potential future developments that may extend beyond the 25-year planning horizon.

3.2 Existing Population

The most recent population count for the Township of Lucan Biddulph is the 2016 Census. In 2016, the population of Lucan Biddulph was 4,700 residents, an increase of 362 persons from the 2011 count and 513 persons from the 2006 Census (Statistics Canada, 2017). The increase in population between 2011 and 2016 equates to an annual average growth rate of 1.62%. Over the last 10 years of census data, the annual average growth rate was 1.16%.

The growth in the Township occurred entirely within the community of Lucan, which increased in population from 2,014 persons in 2011 to 2,541 persons in 2016. This amounts to a 26% increase between 2011 and 2016. The lower amount of growth for the Township as a whole over the last census period is the result of a decline in the rural population. Table 3.1 summarizes the census population data for both Lucan and Lucan Biddulph.

To estimate the 2021 population of Lucan, the number of new residents was calculated based on the building permits issued for Lucan from 2017 to 2020. The number of new residential builds between 2017 and 2020 is summarized in Table 3.2, including the average number of persons per unit type, based on Census data.

Table 3.1 – Census Population Counts, 1981-2016

Year	Lucan	Lucan Biddulph
1981	1,616	3,876
1986	1,728	3,973
1991	1,847	4,041
1996	1,958	4,085
2001	2,010	4,201
2006	1,997	4,187
2011	2,014	4,338
2016	2,541	4,700
5-year population change	**527**	**362**
10-year population change	**544**	**513**
5-year Average Annual Growth Rate (%)	**4.76**	**1.62**
10-year Average Annual Growth Rate (%)	**2.44**	**1.16**
5-year Population Change (%)	**26.17**	**8.34**
10-year population change (%)	**27.24**	**12.25**

Table 3.2 – Number of New Residential Units in Lucan (2017-2019)

Year	Single Detached Units	Apartments	Multi
2017	69	23	0
2018	67	0	0
2019	81	0	0
2020	22	0	47
Density (persons per unit)	2.72	1.5	1.94

Given the number of units constructed and the average densities per unit type, the estimated 2021 population for Lucan is approximately 3,300 persons.

3.3 Growth Expressed as Equivalent Units

To assess capacity needs for the major water and wastewater facilities the expected growth in households has been expressed in Equivalent Household Units (ERUs). A single detached residence is considered to be one ERU. Multi-family and apartment units are made equivalent using the current population density values for each type. Results are as follows:

- Single detached = 2.72 PPU = 1.00 ERU
- Multi-family = 1.94 PPU = 0.75 ERU
- Apartments = 1.50 PPU = 0.60 ERU

3.4 Future Development

3.4.1 Approved Developments

There are a number of approved residential developments within the settlement area of Lucan. These developments include apartment, townhouse, and single family units and 8.5 ha of future development. The approved developments are shown in Figure 3.1. There is a total of 360 units approved, in addition to the 8.5 ha of future development associated with the Olde Clover development. The number of approved units by type and development are summarized in Table 3.3 along with the ERU values.

Table 3.3 – Number and Type of Approved Units, By Development

Development	No. of Approved Units	No. of ERUs
Ridge Crossing (multi-family)	96	72
Lucan Woods (apartments)	46	28
Verhoog Property (multi-family)	39	29
Olde Clover (single detached)	73	73
Olde Clover (multi-family)	16	12
280 Main Street (apartments)	90	54
Total Approved Units	**360**	**268**

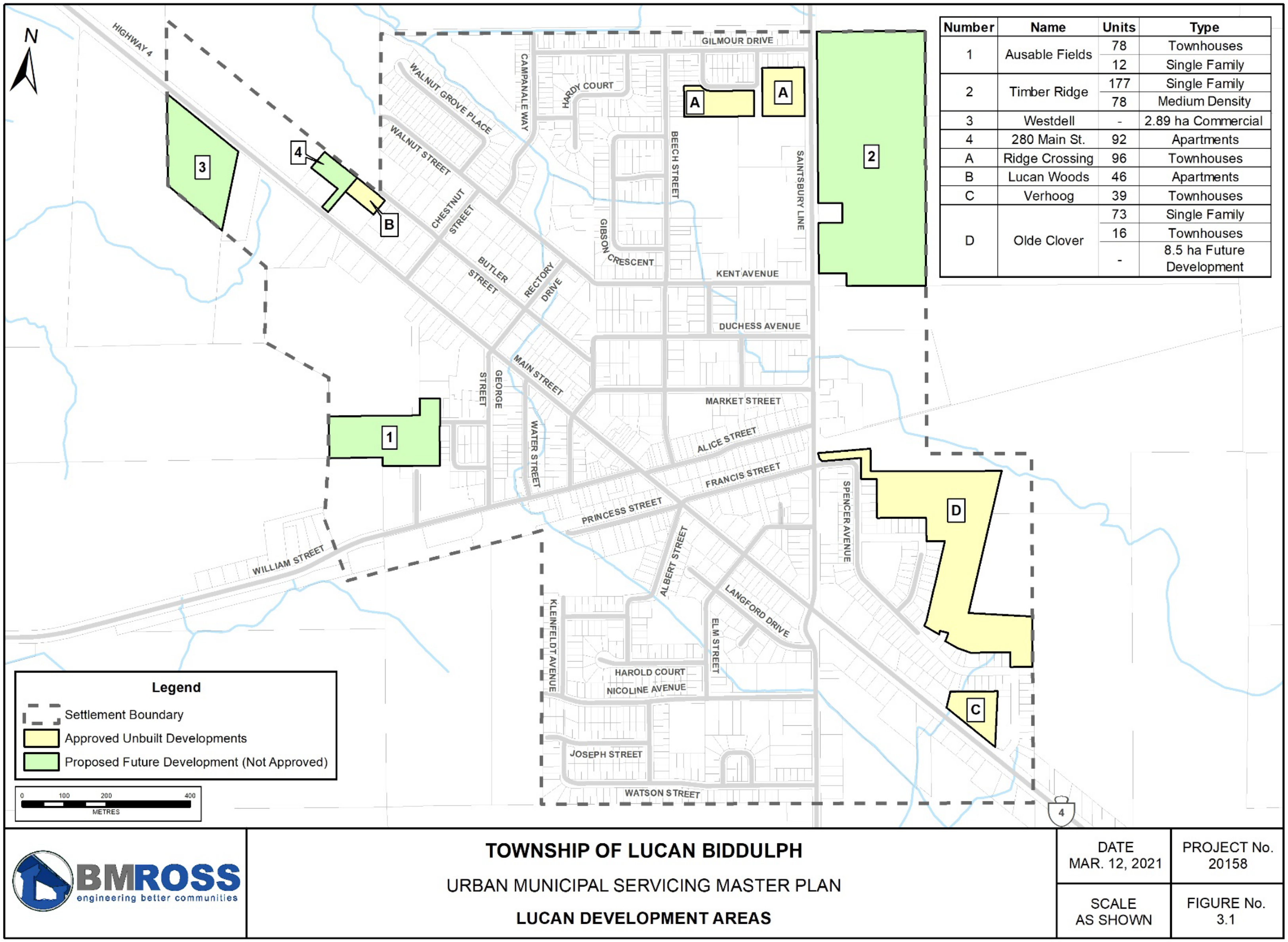
3.4.2 Proposed Developments

There are a number of proposed residential developments, both within and outside of the urban settlement area. Within the current settlement area, the proposed developments include: 345 residential units (townhouses and single family units) and 2.89 ha of commercial development. Approximately 290 additional residential units are proposed outside of the current urban boundary. The proposed developments within the urban boundary are shown in Figure 3.1. The number of proposed units, by unit type and development are summarized in Table 3.4.

Table 3.4 – Proposed Units, by Type and Development

Development	No. of Proposed Units	No. of ERUs
Ausable Fields (multi-family)	78	12
Ausable Fields (single detached)	12	59
Timber Ridge (multi-family)	78	177
Timber Ridge (single detached)	177	59
Total Proposed Units	**345**	**307**

Figure 3.1 – Lucan Development Area



Number	Name	Units	Type
1	Ausable Fields	78	Townhouses
		12	Single Family
2	Timber Ridge	177	Single Family
		78	Medium Density
3	Westdell	-	2.89 ha Commercial
4	280 Main St.	92	Apartments
A	Ridge Crossing	96	Townhouses
B	Lucan Woods	46	Apartments
C	Verhoog	39	Townhouses
D	Olde Clover	73	Single Family
		16	Townhouses
		-	8.5 ha Future Development

3.5 Population and Growth Forecasts

Currently, the County of Middlesex is in the process of updating their Official Plan. This update includes new population and dwelling forecasts for the lower tier municipalities to use for future land use planning purposes. The forecasts, developed by Watson and Associates were approved by County Council in January 2021 and include low, reference and high growth scenarios (Watson and Associates Economist Ltd, 2020). The 25-year scenarios reflect recent development trends within the County and expected demographic and socioeconomic trends. The forecasts anticipate the majority of future housing across the County will be single detached homes (low density) but the proportion of medium and high density units built will increase in the future. Additionally, it is anticipated that the average household density (Person Per Unit, PPU) will continue to decline over the next 25 years across the County.

The forecasts developed for Lucan Biddulph are summarized below in Table 3.5.

Table 3.5 – Population and Household Forecast Growth Scenarios for Lucan Biddulph.

Year	Low Scenario Population	Low Scenario Households	Reference Scenario Population	Reference Scenario Households	High Scenario Population	High Scenario Households
2021	5,200	1,970	5,300	2,010	5,390	2,040
2026	5,300	2,080	5,700	2,230	5,860	2,300
2031	5,500	2,210	6,200	2,470	6,420	2,570
2036	5,800	2,380	6,600	2,690	7,080	2,850
2041	6,200	2,560	7,100	2,910	7,660	3,110
2046	6,800	2,780	7,800	3,160	8,410	3,410
Change (2021-2046)	1,600	810	2,500	1,150	3,710	1,370

Across all the forecasts, the population of Lucan Biddulph as a proportion of the total population of Middlesex County is expected to remain at 7%. For these scenarios, it is assumed that the majority of the predicted growth will occur within Lucan.

Under the low growth scenario, Lucan Biddulph will add 810 new homes beyond the 2020 number of total households. This is equivalent to 7% of the growth within Middlesex County and a 1.5% annual average growth rate. The reference scenario forecasts an additional 1,160 homes between 2021 and 2046, or an annual growth rate of 1.9%. The high growth scenario predicts an annual growth rate of 2.2%, with 1,370 new homes constructed during the forecast period (Watson and Associates Economist Ltd, 2020).

For all the County forecasts, it is anticipated that there will be shift towards an increased proportion of medium and high-density housing types (e.g. townhouses and apartments).

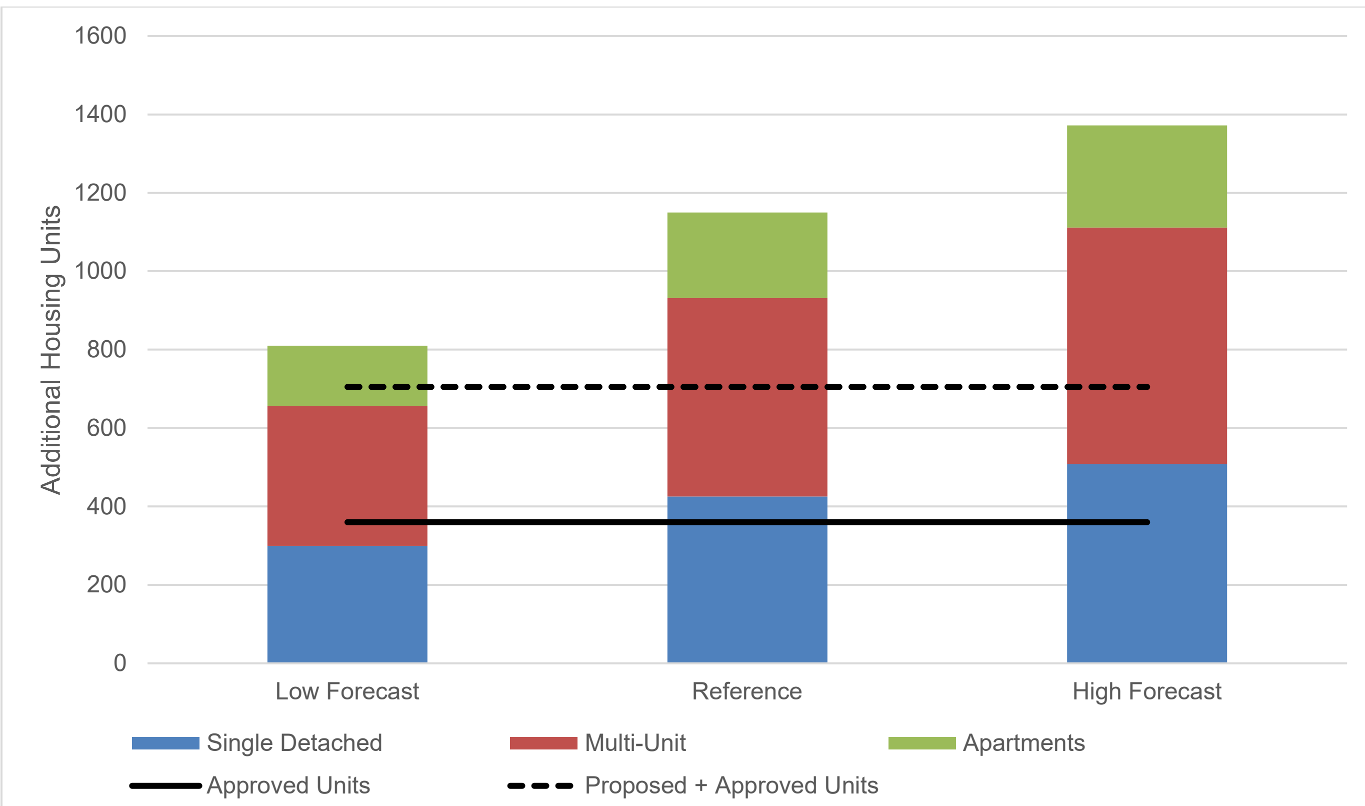
Currently, for Lucan Biddulph the density split for approved and proposed properties is as follows:

- Single Detached - 37%
- Multi- family - 44%
- Apartments - 19%

3.6 Comparison to Current Commitments and Proposals

In order to compare the County's forecasted growth against current commitments and proposed developed, the number of single detached, multi-unit and apartments for each forecast scenario was estimated. The proportion of single detached, multi-unit and apartment units is based on ratio of units currently proposed for development in Lucan. The number of new housing units by type for each forecasting scenario is summarized in Figure 3.2.

Figure 3.2 – Forecasted Units for Growth Scenarios and Approved and Proposed Development Units



In Figure 3.2, the total numbers of currently approved and proposed units are also shown. For all the growth scenarios, the total number of forecasted units over the next 25 years surpasses the number of approved and proposed units within the existing urban limits for Lucan. The number of proposed and approved units is relatively close to the forecasted 25-year growth under the low growth scenario; however for the reference and high growth forecasts, there are an additional 345 and 565 units forecasted beyond what is currently approved and proposed.

3.7 Future Growth Lands

The Township of Lucan Biddulph is currently updating their Official Plan. The Official Plan is expected to include an expansion to the urban boundary of Lucan, based on the population forecasts provided by the County of Middlesex (see Section 3.4). At this time, it is not known how much additional land will be incorporated into the urban settlement area for Lucan, nor where the additional lands will be located. A previous study of constraints and opportunities related to future growth by BMROSS identified potential growth lands northeast of the existing boundary although some current proposals are for development in other areas.

For the purposes of this Master Plan, it is anticipated that the urban boundary of Lucan will expand in the short term. However, as the location of new urban lands is unknown, the technical analyses completed in this Master Plan are focused on the known proposed developments in relation to major infrastructure facilities within or servicing the current settlement area. For infrastructure with specific capacity (e.g. water storage facilities), future needs are based on the forecasted growth to 2046.

3.8 Growth Expressed as Equivalent Units

Using the County growth forecast as summarized in Table 3.5 and the density split summarized in Figure 3.1 the total growth in ERUs for the period 2021 to 2046 has been calculated to be:

- Low Growth Scenario = 659 ERUs
- Reference Growth Scenario = 936 ERUs
- High Growth Scenario = 1,115 ERUs

These values have been used in the evaluation of capacity requirements for major water and wastewater facilities as presented in the following sections of the Master Plan.

4.0 LUCAN BIDDULPH WATER DISTRIBUTION SYSTEM

4.1 Description

4.1.1 Supply and Storage Facilities

The communities of Lucan and Granton are serviced by a single distribution system that takes water from the Lake Huron Primary Water Supply System (LHPWSS). The system operates under Municipal Drinking Water License (MDWL) No. 050-101 Issue No. 4 and Drinking Water Works Permit (DWWP) No. 050-201 Issue No. 4; both dated, February 22, 2017.

Table 4.1 summarizes the approved water supply and effective storage capacities for the Saugeen Shores DWS.

Table 4.1 – Lucan Biddulph Water Facility Capacity

System Component	Capacity	Source Information
Lucan Booster Pumping Station (BPS)	3 fixed speed pumps rated at 42 L/s at 100 m TDH 250 kW Generator	DWWP
Granton Booster Pumping Station (BPS)	3 pumps rated 4.9 L/s at 41 m TDH 1 pump rated at 47 L/s at 41 m TDH A 60 kW Generator Re-chlorination facilities	DWWP
Lucan Water Storage	2,270 m^3 Elevated Tank	DWWP
Granton Water Storage	500 m^3 Reservoir at the Granton BPS	DWWP

The capacity of the Lucan water system is limited by the capacity of the watermain connecting the LHPWSS to the Lucan BPS. The capacity is variable depending on pressures at the LHPWSS. A review of the system established that the minimum supply, provided the LHPWSS is operational, would be in the order of 47 L/s (4,060 m^3/day). Historically the LHPWSS has been unable to supply Lucan for as much as two days. Normal outages are reported to be typically restricted to a few hours.

4.1.2 Water Distribution System

The Lucan Biddulph water distribution system is divided into two pressure zones:

- Zone 1 - From the Lucan BPS to the supply to the Granton BPS. Pressures are controlled by the Lucan Elevated Tank.
- Zone 2 - The Granton distribution system. Pressure is controlled by the pumps at the Granton BPS.

In total there is approximately 25.6 km of watermain 100 mm diameter or greater within the community of Lucan. As of December 2020, there were approximately 1,400 customers in Lucan and an additional 130 in Granton.

Figure 4.1 shows the locations of the watermains and major facilities.

4.2 Existing and Future Water Demands

4.2.1 Methodology

Water supply capability is assessed using annual maximum day demands. Given that the supply constraint is considered to be the supply to the BPS, and that the BPS supplies Lucan, Granton and a portion of North Middlesex, then the existing maximum day demand is the flow measured at the BPS. These values are recorded daily and reported on a monthly basis.

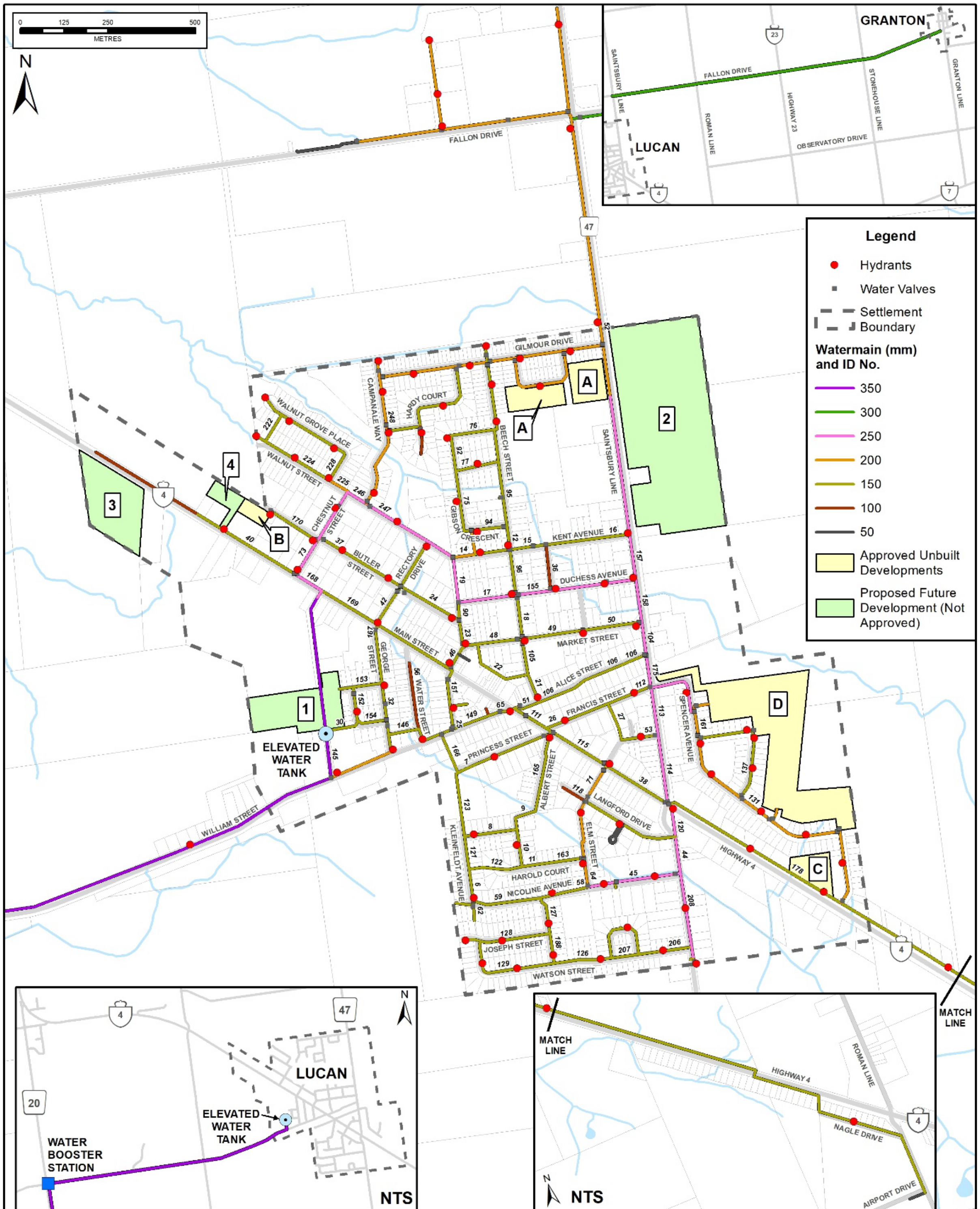
4.2.2 Maximum Day Demand

Table 4.2 identifies the maximum day flows for 2017-2020.

Table 4.2 – Maximum Day Demand 2017-2020

Year	Lucan, Granton and North Middlesex (m^3/d)	Granton Only (m^3/d)	Lucan Only (m^3/d)	Lucan and North Middlesex (m^3/d)
2017	1,866	128	1,612	1,755
2018	2,031	238	1,666	1,888
2019	1,645	141	1,344	1,509
2020	2,465	208	2,120	2,380
Maximum	**2,465**	**238**	**2,120**	**2,380**

Figure 4.1 – Lucan Water System



	TOWNSHIP OF LUCAN BIDDULPH	DATE MAR. 24, 2021	PROJECT No. 20158
BMROSS engineering better communities	URBAN MUNICIPAL SERVICING MASTER PLAN **LUCAN WATER SYSTEM AND DEVELOPMENT AREAS**	SCALE AS SHOWN	FIGURE No. 4.1

4.2.3 Unit Demands

On the basis that the existing per customer flow plus 10% is the flow per ERU; the maximum daily unit flow for Lucan is:

Flow per Customer $= \frac{2,120 \text{ m}^3\text{/day}}{1,406 \text{ customers}}$

$= 1.51 \text{ m}^3\text{/day}$

Flow per ERU $= 1.51 \times 1.1 =$ **1.66 m^3/day**

4.3 Reserve Capacity for Supply

4.3.1 Lucan Total Reserve Capacity

As noted previously, the total reserve capacity is the difference between the supply to the BPS and the existing maximum day demand for Lucan, Granton and North Middlesex.

Supply to BPS	= 4,060 m^3/day
Existing Max. Day	= 2,465 m^3/day
Total Reserve	= **1,595 m^3/day**

Assuming that growth and demands in Granton and North Middlesex will be limited, most of the 1,595 m^3/day should be available for growth in Lucan.

4.3.2 Lucan Uncommitted Reserve Capacity

Tables 3.3 and 3.4 summarize existing development commitments and known proposals. Based on these values, and a unit demand of 1.66 m^3/ERU·day, the uncommitted reserve is:

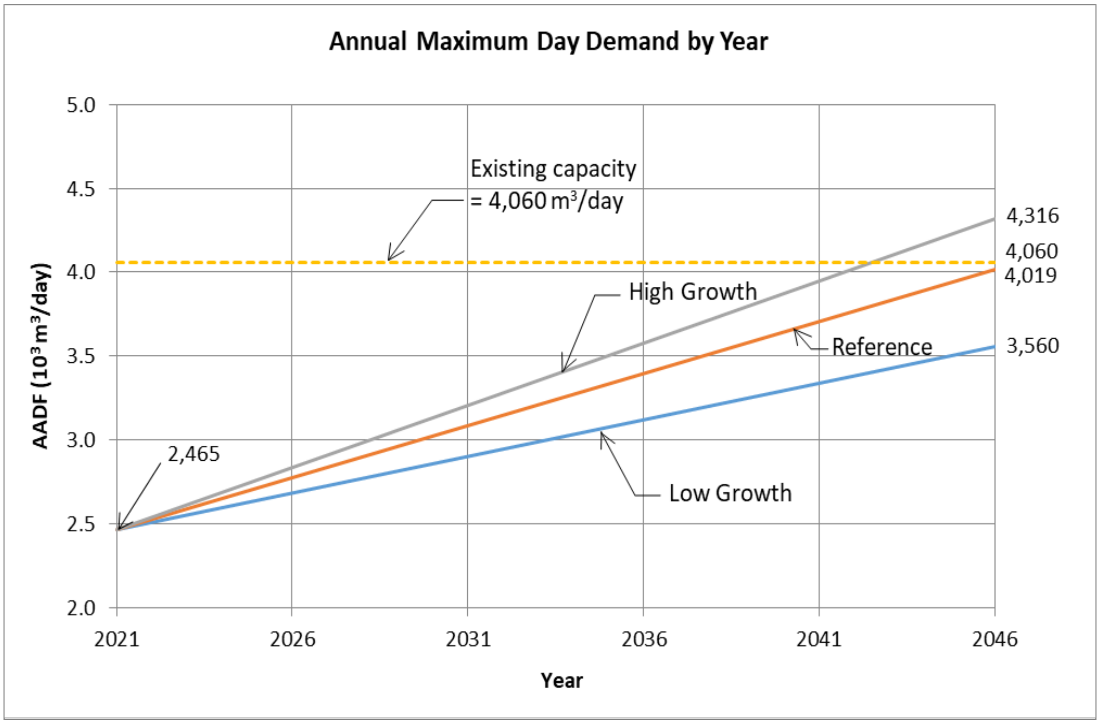
Total Reserve	= 1,595 m^3/day
Committed Reserve (268 ERUs x 1.66)	= 445 m^3/day
Uncommitted Reserve	= **1,150 m^3/day**

The uncommitted reserve could supply an additional 693 ERUs, which exceeds the currently known development proposals within the existing urban boundary by 386 ERUs.

4.3.3 Supply Capacity by Year

With reference to the growth projections presented in Section 3.4 Figure 4.2 shows the expected maximum day demand from 2021 to 2046. The figure indicates that, at the highest growth rate the existing supply will be adequate until approximately 2042.

Figure 4.2 – Annual Maximum Day Demand by Year



4.4 Reserve Capacity for Storage

4.4.1 Existing Facilities

Table 4.3 identifies the existing storage facilities and their volumes.

Table 4.3 – Water Storage Facilities

Facility	Total Volume (m^3)	Effective Volume (m^3)
Lucan Elevated Storage Tank	2,270	2,270
Granton Reservoir	500	500

4.4.2 Basis of Assessment

The theoretical required storage is based on a formula in the Ministry of the Environment, Conservation and Parks (MECP) design guidelines. The guidelines recommend storage be provided for peak flow equalization, fire flows and emergencies. The equalization component is 25% of the maximum daily demand. Fire flow rates and durations are linked to the population served. The emergency storage component is calculated as 25% of the equalization and fire values. Essentially all are linked to the population served.

The water system in Granton, although supplied from Lucan, has independent storage and pumping facilities. Therefore, the storage required for Lucan is related only to the Lucan population. The equalization component is related to the maximum day demand for Lucan plus North Middlesex.

4.4.3 Required Water Storage

The Lucan elevated tank has a total storage of 2,270 m^3. Tables 4.4 summarizes the storage required for the individual components and total required storage volumes for Lucan.

Table 4.4 – Storage Summary – Lucan

Scenario	Volume Required (m^3) for Equalization	Volume Required (m^3) for Fire Protection	Volume Required (m^3) for Emergency	Total Volume Required (m^3)
Existing	583	814	349	1,746
Existing + Commitments	694	893	397	1,984
Existing + Commitments +Proposals	822	1,001	456	2,279

Therefore, based on current rates of usage there is sufficient water storage to accommodate development commitments. After accounting for current unapproved development proposals, existing storage volumes will be fully utilized.

From Table 3.5 we note that the projected population for 2046 under the high growth scenario is 8,410 for the whole Township. Assuming all growth occurs in Lucan, the population of Lucan will be approximately 6,500. For 6,500 people the required storage volume will be 3,500 m^3 or 1,230 m^3 additional to existing.

With reference to the high growth and water demand forecast Figure 4.2, it is anticipated that the existing storage will be fully utilized by approximately 2036.

4.5 Water Distribution System Modelling

4.5.1 Background

The Lucan water distribution system was modelled using WaterCAD®. The purpose of the modelling was to identify potential flow and pressure issues during periods of high demand for the existing system, and to determine constraints related to supplying future development areas.

4.5.2 Model Details

(a) WaterCAD® Software

BMROSS used Bentley® WaterCAD® CONNECT Edition Update 2 for the water distribution system modelling. The model contains 206 pipes and 161 junctions for the existing Lucan network, which includes the source of supply starting at the LHPWSS Chamber No. 44 and distribution to the point of Granton.

It is noted that the community of Granton is supplied with water via connection to the Lucan system. Water is supplied to a reservoir in Granton, from which it is pumped and distributed to the community. Supply up the point of the Granton reservoir is included in the Lucan model, while the Granton distribution system was not modelled.

(b) Sources of Data

The Township provided an existing WaterCAD® model for Lucan. The model provided was created circa 2014. Several sources of information were used to update the model, including:

- New watermain installation locations and diameters, since 2014-2015, were obtained from distribution system mapping (i.e. GIS files) provided by the Township and interviews with Township staff.

- Watermain C-factors were assigned in accordance with values provided in the MECP Guidelines (MOE, 2008), as summarized in the table below.

Diameter (mm)	C
150	100
200-250	110
300-600	120

- Elevation information for new infrastructure constructed since the 2014 model was obtained from data provided by the Township. Where specific data was not available, particularly for future development areas, Google™ Earth imagery was used.

- Source of supply flow and pressure information was verified through interviews with LHPWSS staff and field data obtained through site visits with Township staff.

- Pump and storage characteristics were obtained from a combination of the 2014 model report (Dillon Consulting, 2014) and the DWWP for the Lucan Biddulph Distribution System.

- Water demand information was developed as part of this Master Plan.

- Assessments for fire protection capability were made using typical fire flow values including the following, each assessed at 140 kPa minimum system residual pressure:
  - 40 to 50 L/s for residential areas
  - 100 to 150 L/s for dispersed commercial development such as highway commercial, as well as industrial lands
- Water levels associated with the top and bottom of fire storage in ET were obtained from the 1992 ET design notes.

(c) Establishing Flows at Junctions

WaterCAD® model "junctions" are created at every pipe intersection or dead-end. Water demands for the system are applied at these junctions. A review of the top 40 customer usage indicated there were no large water users significant to the point of requiring allocation of specific demands to specific junctions. For the existing Lucan model, the demand associated with Granton was applied to a single junction representing the reservoir for that community and the remaining water demand for the total system was divided by the total number of remaining model junctions in order to calculate the demand per junction. Appendix C contains a detailed summary of the demand allocation methodology.

For the future condition model, known locations for proposed future watermains were incorporated, creating a series of additional pipes and junctions within some of the development lands. Not all development areas have proposed street/watermain layouts available at this time. Demands associated with each development area were applied to the nearest junction(s) adjacent to the development lands.

4.5.3 Analyses Run

In general, the model was used to determine system pressures under average and peak demands, and available fire flows under maximum day demands, for both existing and future development scenarios. Varying pump status (i.e. on/off) and water storage level in the ET were analyzed. A detailed list of all model scenarios includes, for both existing and future conditions:

- Average demand, peak demand:
  - ET at operational LWL, one HLP on
  - ET at operational HWL, no HLPs on

These scenarios are anticipated to cover the range of maximum and minimum pressures to be experienced at each junction during typical system operation.

- Maximum day demand plus fire flow:
  - ET at operational HWL, one HLP on

- ET at top of design fire storage, one HLP on
- ET at bottom of design fire storage, one HLP on

These scenarios are used to compare to past modelling results, as well as evaluate the range of fire flows anticipated from start to finish of a fire flow event.

4.5.4 Qualifications on Results

Results of the distribution system modelling are based on the system information as described above. Calibration was limited to adjusting the Lucan Water Station characteristics to best match upstream and downstream pressure data obtained from site visits and verifying distribution system pressures at less than ten locations in Lucan from past hydrant testing. From this calibration work, model pressures were found to match system measurements by ± 20 kPa (i.e. within approximately 4 to 5%). In our opinion the data represents a relatively good match, though we note this is based on a limited data set.

4.5.5 Results of Analysis

The results of the WaterCAD® analysis for both the existing and future conditions are presented in Table 4.5.

Junctions upstream (i.e. west) of approximately Coursey Line are excluded from the table; it is noted that some junctions upstream of the Lucan Water Station have pressures less than 275 kPa and some junctions immediately downstream of the Station have pressures greater than 700 kPa, but these are considered irrelevant to the evaluation of the general Lucan distribution system.

For the fire flow results, junctions east of Saintsbury Line (i.e. distribution line to Granton) and junctions on 100 mm diameter watermain (i.e. no hydrant; not designed for fire flow) are excluded from the table.

Table 4.5 – Summary of WaterCAD® Analysis

Analysis[1,2] and Criteria[3]	Existing	Future
Average Flow		
No. of junctions with kPa > 700	0	0
No. of junctions with kPa > 480 and <= 700	4	4
No. of junctions with kPa > 350 and <= 480	146	152
No. of junctions with kPa > 275 and <= 350	5	5
No. of junctions with kPa < 275	0	0
Peak Flow		
No. of junctions with kPa > 700	0	0
No. of junctions with kPa > 480 and <= 700	3	1
No. of junctions with kPa > 350 and <= 480	147	151

Analysis[1,2] and Criteria[3]	Existing	Future
No. of junctions with kPa > 275 and <= 350	5	9
No. of junctions with kPa < 275	0	0
Fire Flows[4]		
No. of junctions with Q < 40 L/s at 140 kPa	10	10
No. of junctions with Q > 40 and < 100 L/s at 140 kPa	50	82
Q at 140 kPa at Intersection of Saintsbury Line & Fallon Drive (J-905)	40 L/s	35 L/s
Q at northwest limit of 150 mm diameter watermain on Main Street (J-855)	31 L/s	31 L/s

Notes:

1. For peak/average flow kPa > 700 used “One HLP On”. For other ranges, used “HLPs Off”.
2. 20 year scenario assumes same pipe as existing model plus several extensions to development lands where proposed watermain is known.
3. Pressure and flow criteria base on MECP Guidelines 2008
   Pressures (kPa)
   > 700 not recommended
   > 480 but < 700 and > 275 but < 350 are acceptable
   < 275 unacceptable
   > 350 but < 480 is optimum
   Fire Flows
   < 40 L/s not recommended for residential areas
4. Fire flow data in table is for “One HLP On” and ET at bottom of fire storage.

The flow and pressure conditions for existing and future scenarios are presented on figures in Appendix C.

4.5.6 Findings for Existing Arrangement

The Lucan Water Distribution System obtains water from the LHPWSS at Chamber No. 44. The Lucan Booster Pumping Station increases water system pressure using pumps to supply the community of Lucan. The Lucan system also supplies Granton. The WaterCAD® model identified the following conditions for the existing arrangement, focusing on the portions of the distribution system generally within the community of Lucan (i.e. upstream of Coursey Line and downstream of Saintsbury Line are excluded from the results summary below):

- There are no junctions with normal (i.e. up to peak hour) pressures greater than 700 or less than 275 kPa.

- Approximately 95% of the model junctions are in the optimum pressure range (350 to 480 kPa) during average and peak flows.

- 10 junctions (≈ 6.5%) have <40 L/s fire flow; this excludes junctions on 100 mm diameter watermains which would not have been originally designed to provide fire flow.

- In general, the location of greatest concern with respect to available fire flow is the industrial-commercial lands adjacent to the intersection of Fallon Drive and Saintsbury Line. This area is currently fed by a single, relatively long, 200 mm diameter watermain which must also supply Granton.

4.5.7 Findings for Future Scenario

With reference to Table 4.5, the model predicts the following for the future scenario:

- The pressure and flow conclusions for the future scenario are generally similar to the existing scenario. Most junctions experience a slight decrease in available fire flow, reflective of the increase in maximum day demand projected for the future.

- In general, servicing of development lands beyond the existing developed area will require suitably sized extensions and internal development looping, without the need for upgrading any existing trunk watermain. An exception is development at the northwest end of Main Street. Available fire flow in this area is already less than target values, and this will be exacerbated by the addition of development in the area. Options to improve available fire flows within this area include:

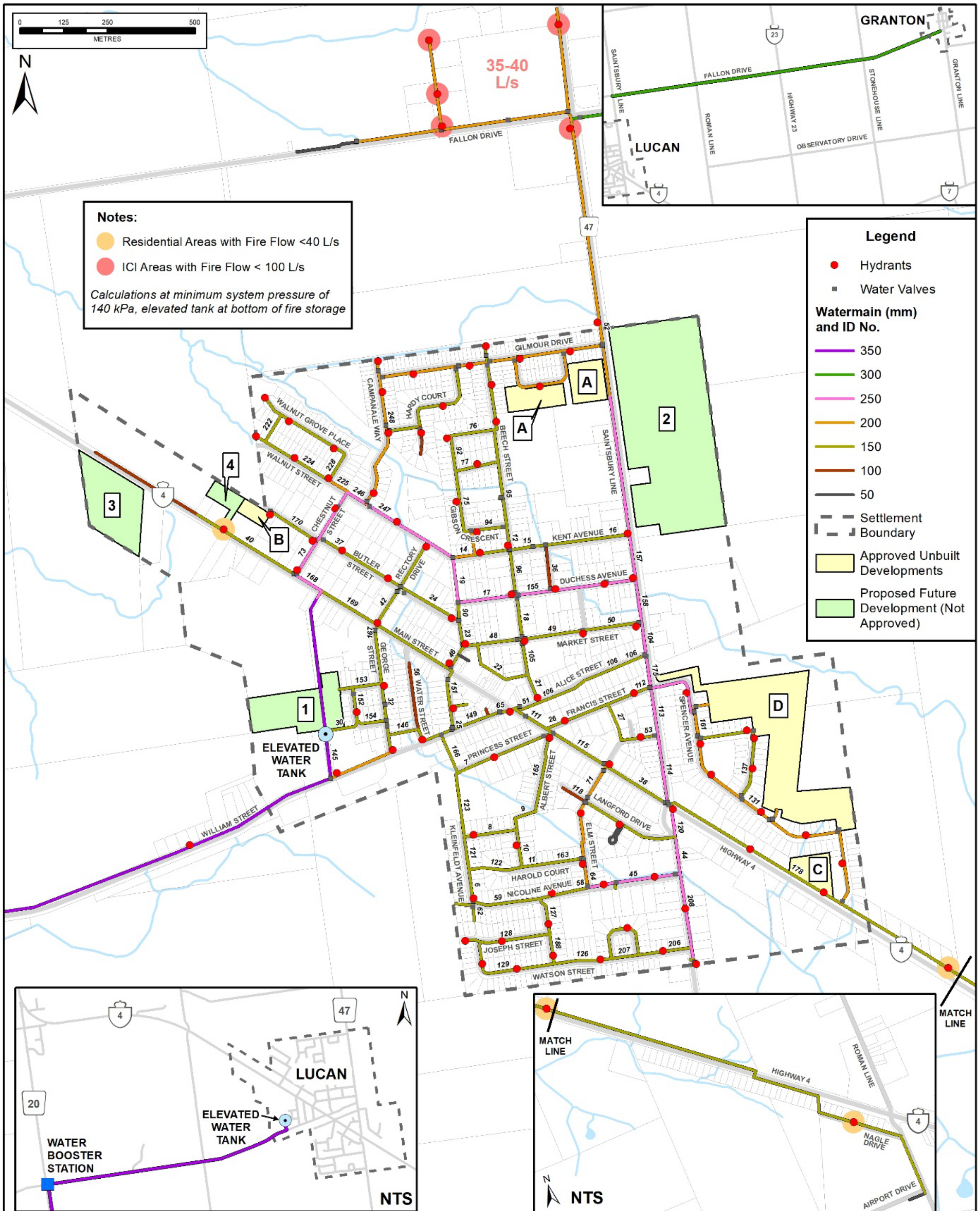
    - Replacing the existing watermain along Main Street, at least as far upstream in the system as Chestnut Street, with a larger capacity watermain. In any event, the 100 mm diameter section of watermain should be replaced with larger diameter pipe if development of any significance will occur in this area.

    - Provide a looped watermain feed to this area. It is noted that to do so may require an easement through private land(s) depending on route.

    - Depending on the scale of development in the area, it is possible that a larger diameter watermain on Main Street and a looped feed would both be desired. A looped feed would increase the security of the supply.

- Selection of a preferred alternative should consider a number of factors, including the reality that servicing of such development lands will require new infrastructure for sanitary servicing as well. Where possible, water and sewer infrastructure should be designed and constructed concurrently.

Figure 4.3 – Proposed Watermain Extension



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		SCALE AS SHOWN	FIGURE No. 4.3

4.5.8 Conclusions and Recommendations

The following are general conclusions reached as a result of the modelling. Conclusions and recommendations for the existing system and development are as follows:

- There are no junctions with normal (i.e. up to peak hour) pressures greater than 700 or less than 275 kPa.
- 10 junctions (≈ 6.5%) have less than 40 L/s fire flow. This excludes junctions on 100 mm diameter watermains which would not have been originally designed to provide fire flow.
- In general, the location of greatest concern with respect to available fire flow is the industrial-commercial lands adjacent to the intersection of Fallon Drive and Saintsbury Line. This area is currently fed by a single, relatively long, 200 mm diameter watermain which must also supply Granton. Options to improve available fire flows within this area include the:
    - Addition of a parallel watermain along Saintsbury Line, or
    - Provision of an additional water storage facility within the area

Selection of a preferred alternative should consider a number of factors, including the potential to address more than one servicing concern through a single project. For example, an additional water storage facility could improve available fire flows and increase the available storage within the system for other purposes as well. Additional study is required to determine a preferred approach.

The future condition was examined by adding approved and proposed development within the existing urban area to the existing system model. Conclusions and recommendations for the future system are as follows:

- The pressure and flow conclusions for the future scenario are generally similar to the existing scenario. Most junctions experience a slight decrease in available fire flow, reflective of the increase in maximum day demand projected for the future.
- In general, servicing of development lands beyond the existing developed area will require suitably sized extensions and internal development looping, without the need for upgrading any existing trunk watermain. An exception is development at the northwest end of Main Street. Available fire flow in this area is already less than target values, and this will be exacerbated by the addition of development in the area. Options to improve available fire flows within this area include:
    - Replacing the existing watermain along Main Street, at least as far upstream in the system as Chestnut Street, with a larger capacity watermain. In any event, the 100 mm diameter section of watermain should

be replaced with larger diameter if development of any significance will occur in this area.

- Provide a looped watermain feed to this area. It is noted that to do so may require an easement through private land(s) depending on route.

- Depending on the scale of development in the area, it is possible that a larger diameter watermain on Main Street and a looped feed would both be desired. A looped feed would increase the security of the supply.

Selection of a preferred alternative should consider a number of factors, including the reality that servicing of such development lands will require new infrastructure for sanitary servicing as well. Where possible, water, sewer and storm infrastructure should be designed and constructed concurrently.

4.6 Climate Change Considerations

Climate change is predicted to result in more intense storms and potentially, periods of prolonged drought. The Lucan Biddulph water supply comes from the LHPWSS which, as a source of water, has a capacity far greater than the potential takings of Lucan Biddulph. However, prolonged droughts could encourage more water use for discretionary uses such as lawn watering in the summer period. There is potential for the pumping and storage facilities to become overtaxed at some point in the future. Increased restrictions and/or seasonal water rates may be required to manage demand and potential impacts on supply and storage.

The number of supply outages required for maintenance on the LHPWSS has been increasing over time. Increased demands on the entire system related to climate change or system age could potentially increase the frequency and duration of outages. Consideration should be given to increasing storage within the Lucan Biddulph system to compensate.

4.7 Problems and Opportunities for Water

4.7.1 General

For the Lucan drinking water system problems and opportunities fall into three categories: supply, storage and distribution. No short-term issues have been identified for either supply or storage. Existing distribution system issues are more significant, and improvements will be required to support individual developments.

4.7.2 Water Supply

Maximum day demands increased significantly in 2020, probably related to new growth. The 2020 maximum day demand was 2,465 m^3/day which is approximately 61% of the available supply, which is 4,050 m^3/day.

Approved development is expected to increase the demand to 2,910 m^3/day. Approved development plus current known proposals will increase demands to 3,420 m^3/day which is approximately 85% of the supply.

With reference to Figure 4.2, the existing water supply capacity will be adequate until approximately 2042 at the highest projected growth rate. To increase the supply will likely involve replacing or paralleling all or part of the existing supply main from Chamber 44 on the LHPWSS to the elevated tank. The supply is also impacted by operating pressures within the LHPWSS.

The supply capacity should be re-evaluated at five year intervals and detailed planning should begin no later than six years ahead of the actual need to increase supply.

4.7.3 Water Storage

As the population increases so will the need for treated water storage. In Section 4.4 it was identified that with the build-out of the current development commitments and proposals within the Lucan urban boundary the existing storage volume will be fully utilized. Based on the high growth scenario additional storage could be required to be in place as early as 2036.

In addition to storage needs to accommodate general system operations and fire protection, consideration should be given to risks related to loss of supply as a result of issues with the LHPWSS or the single pipe connection between the LHPWSS and the elevated tank. As the community grows the consequences of a loss of supply increase.

4.7.4 Distribution

Modelling of the existing and future conditions for the water distribution system have identified three issues:

- Available fire flows at a limited number of model junctions are below target values. These locations are generally at the extremities (i.e. dead-ends) of the system and generally are considered to be impractical to improve.
- Currently available fire flow in the industrial/commercial park near Fallon Drive and Saintsbury Line is less than the target value (i.e. 150 L/s). Options to improve fire flow include a parallel main on Saintsbury, or storage within the immediate area.
- The northwest area of the community is planned for commercial development in the near term and potentially additional residential development in the longer term. Flows for fire protection for these land uses are currently unavailable.

5.0 LUCAN WASTEWATER SYSTEM

5.1 Description

5.1.1 Pumping and Treatment

The community of Lucan is serviced by a communal sewage system consisting of approximately 19.7 km of gravity sewer, two SPSs and a WWTP. One of the SPSs (Chestnut) discharges directly to the WWTP. The other SPS (Joseph St.) is a smaller secondary station discharging to a location within the collection system which, in turn, drains by gravity to Chestnut. There is approximately 2.8 km of forcemain related to the SPSs. The current service area is approximately 150 ha. As of 2020 there were approximately 1,300 sewage customers in Lucan.

The WWTP operates under ECA No. 7008-B7CJWY dated February 11, 2019. The plant provides tertiary level treatment and discharges continuously to the Heenan Drain which, in turn, drains to the Little Ausable River.

Table 5.1 provides a summary of the capacity of the major facilities. Figure 5.1 provides a map of the collection system and shows the location of the SPSs and WWTP.

Table 5.1 – Lucan Wastewater Facility Capacities

System Component	Capacity	Source Information
Chestnut SPS	40 L/s (firm)[1.]	BMROSS review of operational data.
Wastewater Treatment Plant (WWTP)	1,700 m^3/day as an AADF 3,600 m3/day as a Peak Flow	ECA

Notes:
1. The SPS has five pumps. Two pump directly to the existing lagoons. The other three consist of a small first duty pump and two larger pumps (PU2 and PU3) which pump directly to the WWTP. 40 L/s is the capacity of each of PU2 and PU3.

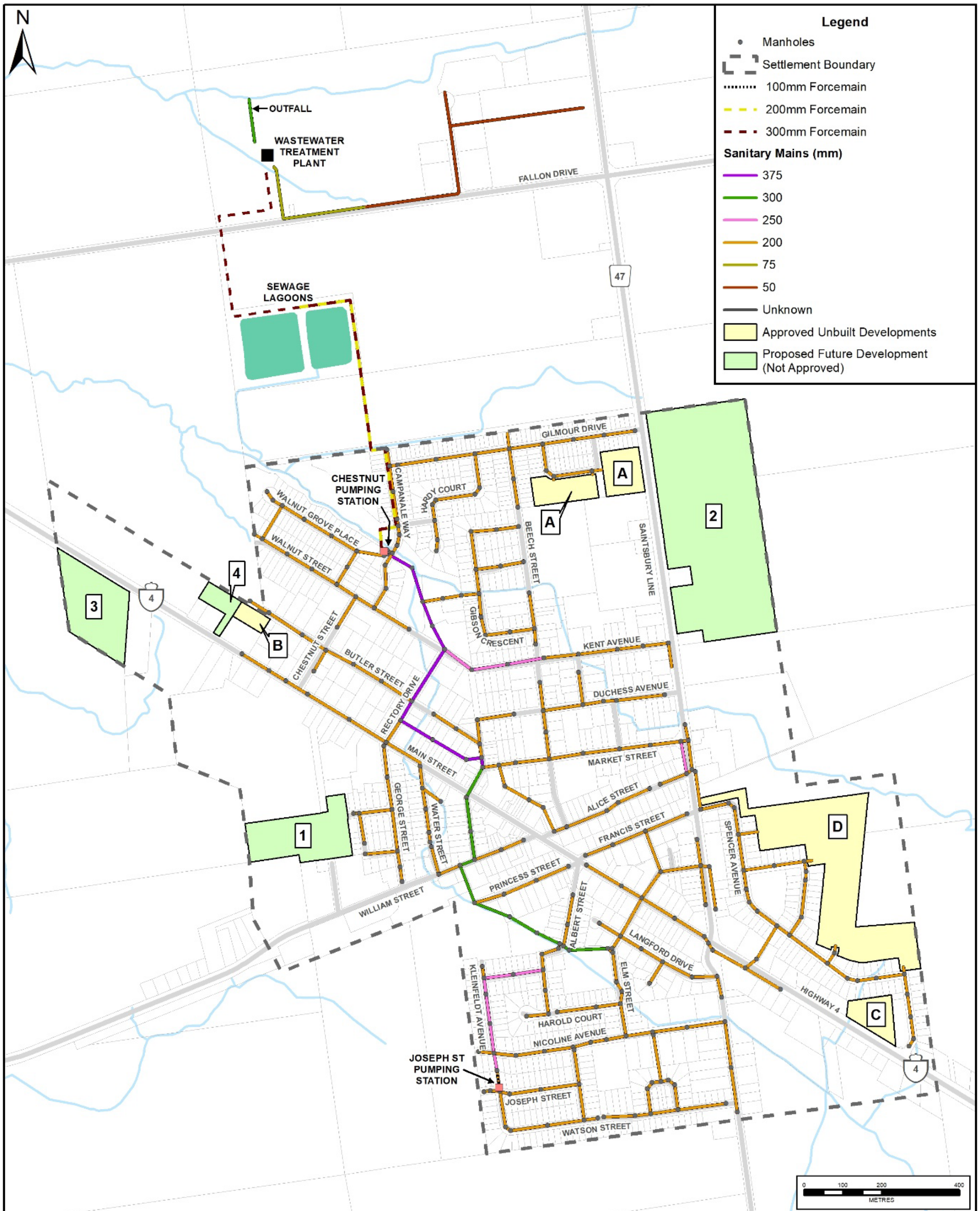
An important consideration for the WWTP is the fact that it was originally constructed to treat 1,100 m^3/day as an AADF. In 2012 It was re-rated, without physical changes, to the current 1,700 m^3/day value. After the re-rating the peak flow rating remained at the original 3,600 m^3/day value.

5.1.2 Collection System

Including the relatively small area draining to the Joseph St. SPS, the Lucan collection system has a single drainage area draining the Chestnut SPS.

At the Chestnut SPS wastewater is pumped to the WWTP. Provision has been built into the SPS to divert peak flows to the existing lagoons. This is accomplished with dedicated pumps and a separate forcemain. During low flow periods the forcemain to the lagoons is

Figure 5.1 – Lucan Wastewater System



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		SCALE AS SHOWN	FIGURE No. 5.1

used to drain wastewater back from the lagoons to the SPS wet well where it is then pumped to the WWTP. Peak flow management through diversion is required because of limitations in the WWTP hydraulic capacity. Currently the return of wastewater from the lagoons to the SPS is a manual operation.

In total there is approximately 20 km of sewer and 2.8 km of forcemain.

5.2 Existing and Future Wastewater Flows

5.2.1 Existing Wastewater Flows

The following is a summary of recent historical wastewater flow information.

Table 5.2 – Lucan – Historical Wastewater Flows[1.]

Year	AADF[2] (m^3/day)	Max. Single Day to WWTP (m^3)
2017	982	3,392
2018	1,102	3,047
2019	1,143	2,871
2020	1,051	5,641

Notes:
1. Rounded Values
2. AADF = Annual Average Daily Flow

5.2.2 Unit Sewage Flows

Wastewater flows were examined for the period 2019 to 2020. During that interval, the number of customers increased steadily, so the total flows have been assessed on a per customer basis.

Table 5.3 – Annual Average Flows per Customer

Year	Estimated No. of Customers [1]	Annual Average Flow (m^3/day)	Average Flow per Customer (m^3/day·cust)
2019	1,263	1,143	0.905
2020	1,305	1,051	0.805
		2 Year Average	**0.855**

Note: 1. Estimated average annual value considering customer data and building permits.

The values in Table 5.3 indicate considerable variability in the total and per customer flow values. For this reason, we propose to use the greater unit value for capacity forecast purposes (i.e. 0.90 m^3/day·customer). For flow forecasting purposes we propose to consider a customer as equivalent to an ERU which is in turn equivalent to a detached residence.

To account for non-residential growth the “per customer flow” has been increased by approximately 10%, resulting in a unit flow of **1.0 m^3/ERU·day** for forecasting purposes.

5.3 Reserve Treatment Capacity

5.3.1 Total Reserve

Typically, the Reserve Capacity of a WWTP is assessed by deducting the average flow from the previous 3 to 5 years from the ECA rated capacity. AADFs at Lucan have been increasing every year, consistent with observed development. For that reason, we have chosen to use the 2020 number of customers multiplied by the design unit flow of 1.0 m^3/ERU.day.

The Lucan WWTP is rated for an AADF of 1,700 m^3/day. The Total Reserve Capacity at the end of 2021 is as follows:

Rated Capacity = 1,700 m^3/day
Existing AADF = 1,305
Total Reserve = **395 m^3/day**

5.3.2 Uncommitted Reserve

The Uncommitted Reserve Capacity is calculated by deducting from the Total Reserve Capacity, the anticipated flow from development commitments. This approach has been extended to proposed developments as well.

Table 3.1 identifies the number of committed ERUs as 268, therefore:

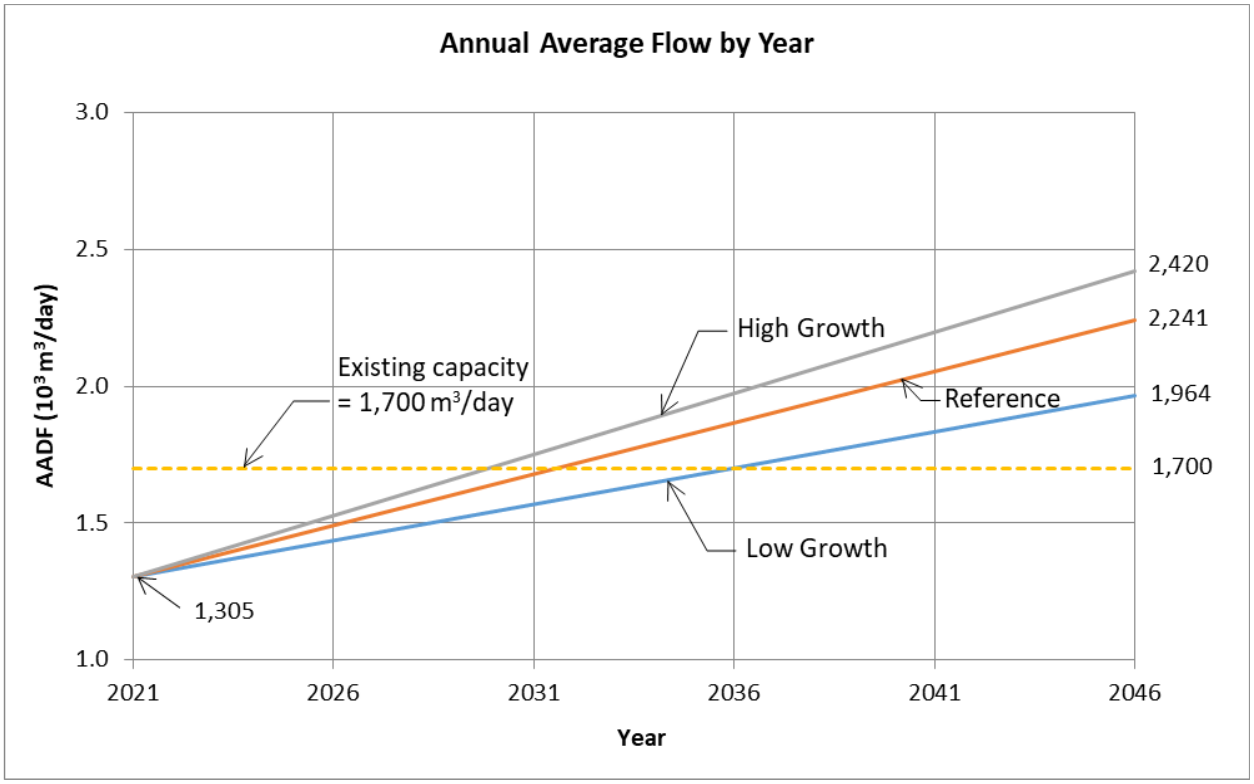
Uncommitted Reserve = Total Reserve – Commitments
= 395 m^3/day – (268 x 1.0 m^3/day)
= **127m^3/day**
= **127 ERUs**

Currently the Township is considering development proposals within the existing urban boundary for 307 ERUs, which would equate to approximately 240% of the capacity available to commit.

5.3.3 Treatment Capacity by Year

With reference to the growth projections presented in Section 3.4, Figure 5.2 shows the expected annual average sewage flows from 2021 to 2046. The figure indicates that, at the highest growth rate, the existing treatment capacity will be adequate until approximately 2029. It is important to note that at recent rates of development expansion will be required as early as 2026.

Figure 5.2 – Annual Average Day Sewage Flow by Year



5.3.4 Other Issues

Additional issues that have been identified are:

- The existing WWTP Headworks which includes screening and de-gritting equipment is a peak flow constraint for the entire WWTP. Also, the equipment has reached its useful life.

- Existing biosolids treatment and storage facilities are substantially undersized for even the current plant rating. The current operating approach is to transfer excess biosolids from the holding facilities to the existing lagoons when land application is not feasible. This is at best an interim solution.

5.4 Reserve Pumping Capacity – Chestnut Street

5.4.1 General

The Chestnut SPS has five sewage pumps. Three of the pumps are arranged to discharge wastewater to the WWTP. There is one 3.75 kW pump operating at approximately 13.75 L/s. This pump is the first duty pump and is referred to as a “jockey pump”. The remaining two pumps are 15 kW and operating at approximately 40 L/s. The capacity of each of the larger pumps is approximately equal to the peak inflow capacity of the WWTP.

The remaining two pumps operate during peak flow periods and discharge wastewater to the lagoons. These pumps are 56.25 kW and are estimated to discharge 134 L/s. Based on a review of the operating records, when flows exceed the capacity of the Jockey pump, one of the 15 kW pumps starts as the second duty and flow continues to go to the WWTP. All inflow in excess of the capacity of the 15 kW pump goes directly to the lagoons. The system has been put in place for peak flow management to protect the WWTP.

With the current arrangement, under low flow conditions, the contents of the lagoon are allowed to flow backwards from the lagoon to the Chestnut SPS through the existing forcemain and are then sent to the WWTP. The backflow arrangement is manually initiated.

The firm capacity (largest pump out of service) for each arrangement is:

- To WWTP – 3,600 /m^{3}day.
- To lagoon – 11,575 m^3/day

A review of the 2019 operating data established that approximately 2% of the total annual flow was directed to the lagoon. This is well within the capability of the lagoon system. However, as flows increase with growth, this value will also increase.

5.4.2 Proposed Upgrades

It is currently proposed (Stantec 2018) to replace the two 15 kW pumps with smaller 11.25 kW pumps each rated at approximately 37 L/s at 18 m TDH. With parallel operation, the two pumps would discharge approximately 42 L/s to the WWTP. The 56.25 kW units would only be initiated if flows exceed the capacity of the two new units operating in parallel. The result is that the lagoon pumps would become 4th and 5th duty and overall more wastewater would be delivered to the WWTP and less to the lagoon.

In addition to the pump size changes, the backflow from the lagoon to the SPS would be automated by installation of an electrically actuated plug valve and modifications to the controls.

5.4.3 Potential Issues

Currently approved and proposed development within the urban boundaries of Lucan will add an additional 575 ERUs to the Chestnut SPS drainage area. Potential additional peak flows will be in the order of 30 L/s. It will be important to consider the increased peak in any plans to change the pumps as well as WWTP peak flow capacity.

In our opinion there is limited value in modifying the SPS until WWTP peak capacity is increased.

5.5 Lucan WWTP Treatment Performance

5.5.1 Effluent Criteria

The existing ECA for the Lucan WWTP provides both treatment objectives and limits. The final effluent objective criteria are set out in Schedule B of the ECA and are as follows:

Final Effluent Parameter	Averaging Calculator	Objective
CBOD5	Monthly Average Effluent Concentration	5 mg/L
Total Suspended Solids	Monthly Average Effluent Concentration	5 mg/L
Total Phosphorus	Monthly Average Effluent Concentration	0.2 mg/L
Total Ammonia Nitrogen	Monthly Average Effluent Concentration	1.0 mg/L (May 1-October 30) 2.0 mg/L (November 1-April 30)
Dissolved Oxygen	Monthly Average Effluent Concentration	Greater than 5
E. coli	Geometric Mean Density	*80 CFU/100 ml for any calendar month
pH	Single Sample Result	6.5 - 8.5 inclusive

The final effluent compliance criteria are set out in Schedule C of the ECA. Both concentration and loading criteria are stipulated and are as follows:

Final Effluent Parameter	Averaging Calculator	Limit
CBOD5	Monthly Average Effluent Concentration	10 mg/L
Total Suspended Solids	Monthly Average Effluent Concentration	10 mg/L
Total Phosphorus	Monthly Average Effluent Concentration	0.32 mg/L
Total Ammonia Nitrogen	Monthly Average Effluent Concentration	1.3 mg/L (May 1-October 30) 2.6 mg/L (November 1-April 30)
E. coli	Geometric Mean Density	100 CFU per 100 mL
pH	Single Sample Result	between 6.0 - 8.5 inclusive

Final Effluent Parameter	Averaging Calculator	Limit
$CBOD_5$	Monthly Average Effluent Concentration	17 kg/d
Total Suspended Solids	Monthly Average Effluent Concentration	17 kg/d
Total Phosphorus	Monthly Average Effluent Concentration	.55 kg/d
Total Ammonia Nitrogen	Monthly Average Daily Effluent Loading	2.3 kg/d (May 1-October 30) 4.4 kg/d (November 1-April 30)

5.5.2 Performance Review

A review of Annual Reports for 2017 to 2020 was undertaken. The review established that the WWTP consistently meets the performance criteria. However, a more intensive review of the individual sample results for Total Phosphorus (TP) indicated that there is an increasing trend towards non-compliance. The Township has commissioned an investigation into the cause of the increasing TP values with a goal of resolving the issue.

5.6 Wastewater Collection System Modelling

5.6.1 Background

The Lucan wastewater collection system was modelled using a system-wide sanitary sewer design sheet. The purpose of the modelling was to identify potential pipe capacity constraints during periods of peak flow, and to determine constraints related to servicing future development areas.

5.6.2 Model Details

(a) Software

BMROSS used an MS Excel® based sanitary sewer design sheet for the wastewater collection system modelling. The model includes all known sanitary sewer segments between all known maintenance holes (MHs) in the system. Refer to Appendix D for model details.

(b) Methodology

The Township provided an existing sewer design sheet for Lucan. The file provided was created circa 2014. Several sources of information were used to update the sheet, including:

- New sewer installation locations and diameters, constructed since 2014, were obtained from distribution system mapping (i.e. GIS files) and street As-Recorded drawings provided by the Township.
- A Manning's n value of 0.013 was used for all gravity sewer pipes.
- Residential population densities, and unit flow values were developed as part of this Master Plan. Wastewater flows for each existing catchment area were revised as part of this Master Plan.
- Assessments of sanitary sewer pipes were completed on the basis of comparing calculated flow in the pipe to full-flow capacity. Pipes were identified where the ratio of flow to capacity:
    - Exceeded 80% but was below 100%
    - Exceeded 100%

(c) Establishing Flows in Sewer Pipes

The flow applied to each sewer segment is a combination of flow coming from upstream sources (i.e. upstream pipe(s)), the sanitary flow from adjacent lands which discharge sanitary flow to that pipe, and the infiltration allowance applicable to the area surrounding the pipe. The sanitary design sheet summarizes the peak cumulative sewage flow applicable to each pipe section.

Existing wastewater flows were established using the following assumptions:

- All existing developed areas were modelled as low density (i.e. single detached residences) with 30 units per ha and 2.75 people per unit (see Section 3).
- Non-residential areas were modelled as equivalent to low density residential.
- Average day flows were assumed to be 330 L/capita·day based on an analysis of water meter data.
- A 10% uncertainty factor was added to the calculated wastewater flows.
- Peaking factors were calculated using the Harmon formula, and were based on the equivalent population serviced by each sewer pipe (i.e. all area at upstream of the pipe).
- An infiltration allowance of 0.2 L/s·ha was used for all areas.

For the future development modelling, flow values and discharge locations for development lands were taken from development proposal information where available. For development areas without preliminary design information, flow values were calculated based on number of development units planned based on an ERU calculation as described in Section 3. Flows were applied to existing MHs adjacent to the development lands.

5.6.3 Analyses Run

The model was used to calculate the flow in each sanitary sewer pipe, and percentage of full-flow capacity utilized, for peak flow conditions in the following scenarios:

- Existing development flows.
- Future flows based on full development of areas 1, 2, 3, 4, A, B, C, and D (refer to Figure 5.1).

5.6.4 Qualifications on Results

Results of the wastewater system modelling are based on the collection system information as described above. No work has been completed to verify sewer elevation data from data sources to actual field measurements. Peak flows were calculated based on the methodology described above.

Where the model indicates that flows are near (i.e. > 80% of capacity) or exceeding the existing sewer capacity there would be value in field checking elevation information and/or installing flow meters to determine actual flows.

5.6.5 Model Results

Table 5.4 summarizes the results of the analysis for the existing system, as well as the future conditions. Full details are provided in Appendix D.

Figure 5.3 illustrates the existing sanitary collection system, highlighting sewer sections that are approaching (>80% of capacity) or over capacity. Figure 5.4 illustrates the same capacity constraints for the full development of all areas currently approved or proposed within the existing urban boundary.

Table 5.4 – Summary of Sewer Analysis

Analysis and Criteria	Existing System and Flows	Future System and Flows – All Areas Developed
Approximate No. of pipes with flow <80% design capacity	256	237
Approximate No. of pipes with flow >80% and <100% design capacity	14	21
Approximate No. of pipes with flow >100% design capacity	7	19

The results indicate that there are a number of sewer segments that are currently theoretically over-committed in terms of capacity for the existing system conditions. With further development, the number of sewer segments with constrained capacity increases.

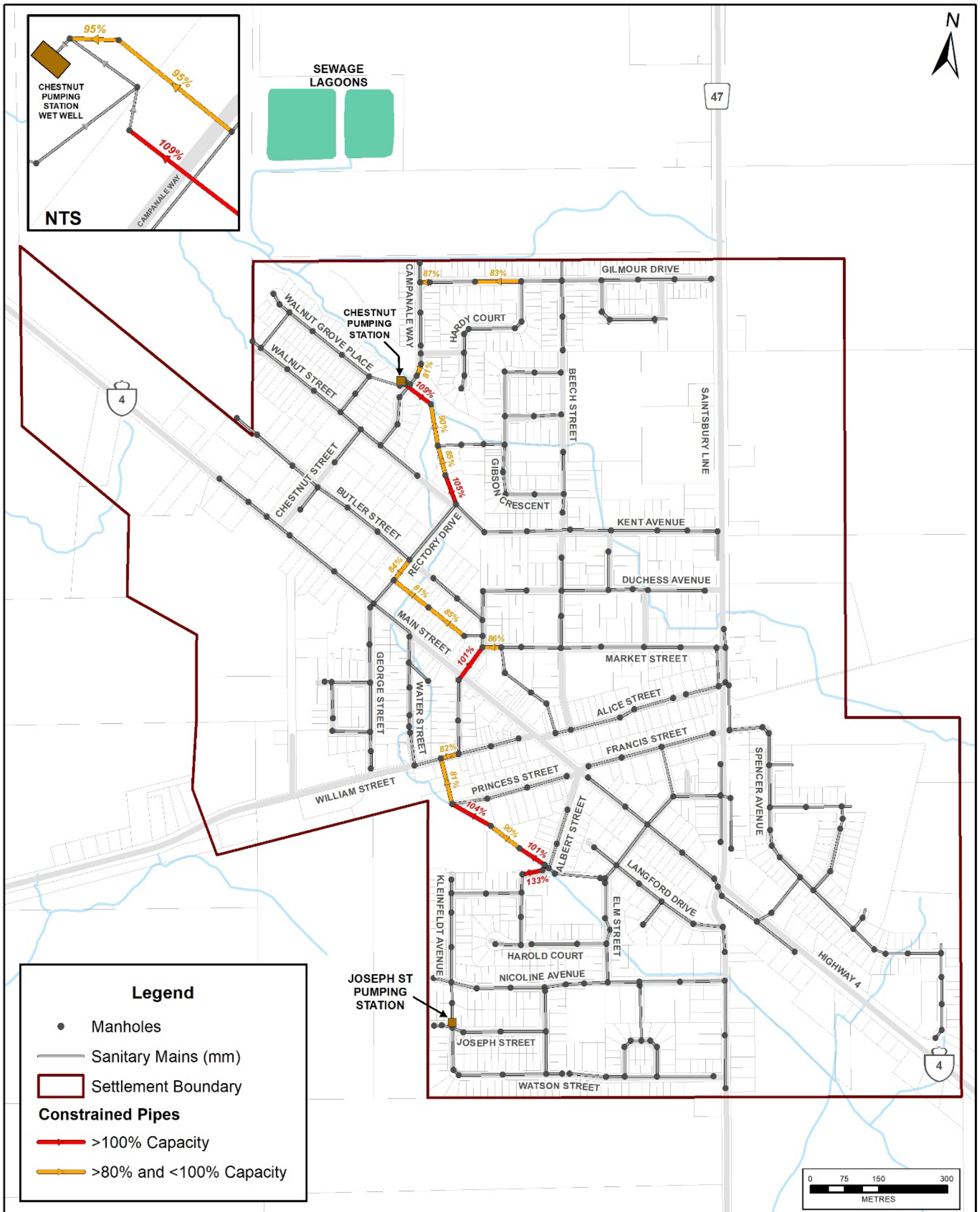
5.7 Climate Change Considerations

Climate change is predicted to result in more intense storms and potentially, periods of prolonged drought. The Lucan Biddulph wastewater system will potentially be impacted by precipitation events that increase the amount of extraneous flow in the sanitary collection system. This could impact on both the ability to convey the wastewater and treat it at the WWTP.

The existing system has the capability to divert high flows to the existing lagoons. This ability or equivalent means of flow equalization should be retained in any expansion of the system.

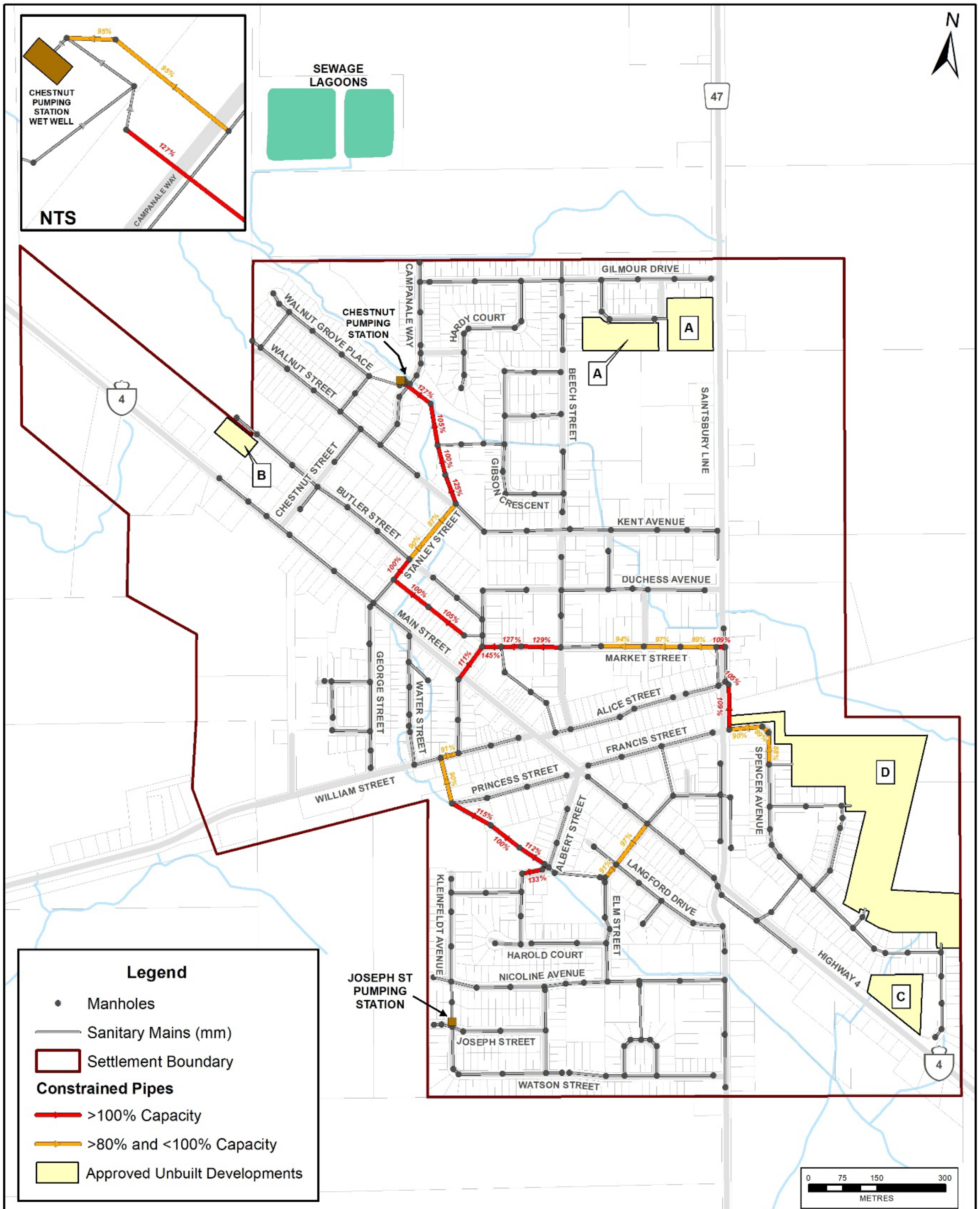
The number of power outages related to extreme weather events could increase in the future. It will be important to ensure that emergency power facilities (i.e. generators) are properly sized and maintained.

Figure 5.3 – Constrained Pipes; Existing Sanitary Collection System



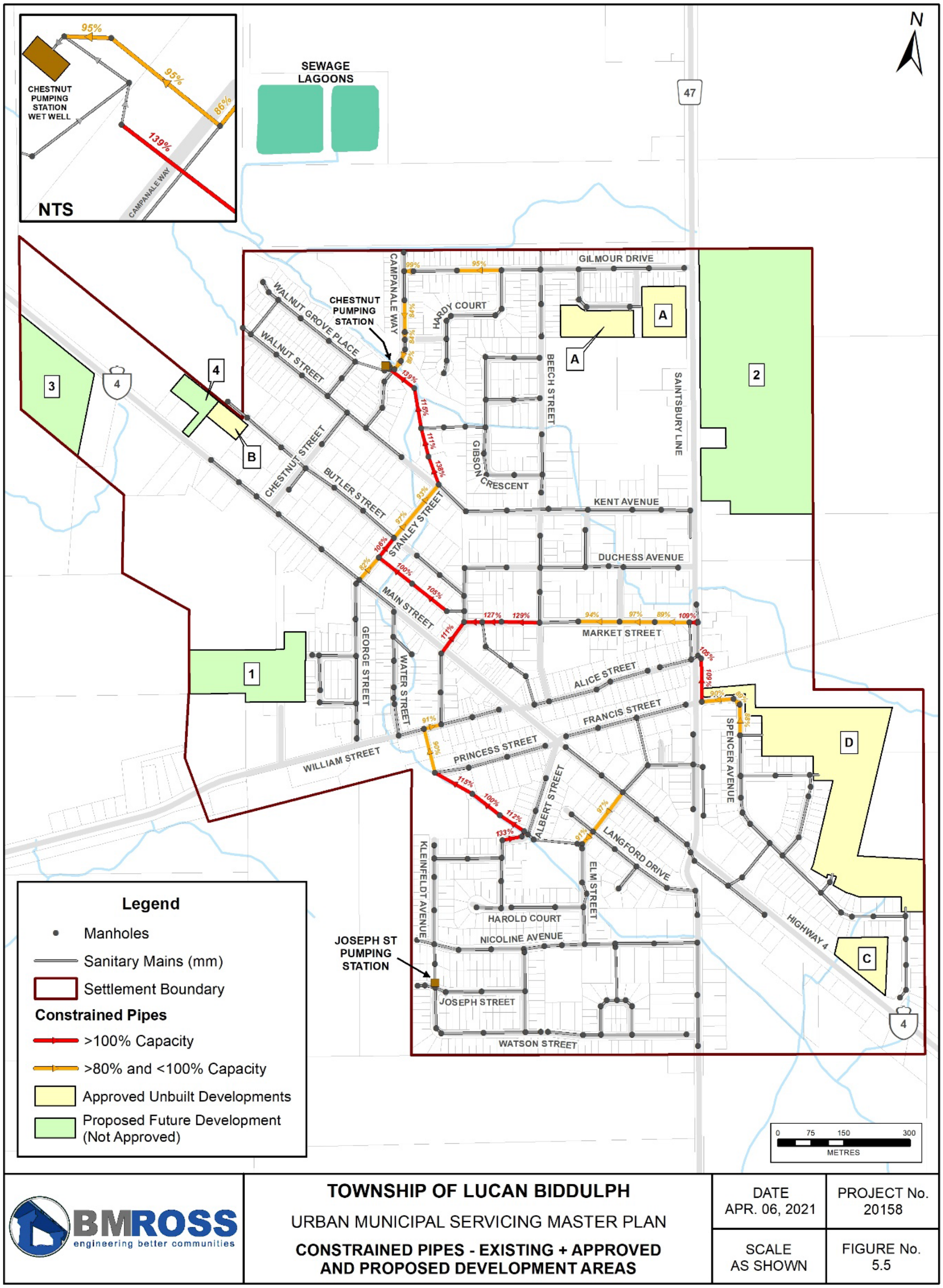
BMROSS engineering better communities	**TOWNSHIP OF LUCAN BIDDULPH** URBAN MUNICIPAL SERVICING MASTER PLAN **CONSTRAINED PIPES** **EXISTING SANITARY COLLECTION SYSTEM**	DATE APR. 06, 2021	PROJECT No. 20158
		SCALE AS SHOWN	FIGURE No. 5.3

Figure 5.4 – Constrained Pipes; Existing + Development Area



BMROSS engineering better communities	TOWNSHIP OF LUCAN BIDDULPH URBAN MUNICIPAL SERVICING MASTER PLAN **CONSTRAINED PIPES EXISTING + APPROVED DEVELOPMENT AREAS**	DATE MAY 13, 2021	PROJECT No. 20158
		SCALE AS SHOWN	FIGURE No. 5.4

Figure 5.5 – Constrained Pipes; Existing + Approved and Proposed Development Areas



5.8 Problems and Opportunities

5.8.1 Wastewater Treatment

The following wastewater treatment issues have been identified:

- The current un-committed reserve capacity for the WWTP is adequate for 127 ERUs which is less than the active development proposals being considered.
- The existing WWTP Headworks equipment has reached its useful life and the facilities are a constraint to the plant's peak treatment capacity.
- Biosolids treatment and storage facilities are substantially undersized resulting in a need to periodically transfer biosolids to the existing lagoons.
- Although the WWTP effluent remains in compliance with the plant's approval documents, Total Phosphorus concentrations are increasing.

5.8.2 Wastewater Pumping

The Chestnut SPS has the capability of diverting flows in excess of the WWTP's peak flow capacity to the existing lagoons. As growth and flows increase more diversion will occur. This is an operational issue.

At this time there can be no increase in the peak flows to the WWTP. Flow diversion will have to continue until the Plant capacity is increased.

5.8.3 Wastewater Collection

The wastewater collection system (sewers) in Lucan was modelled with an updated MS Excel® based sanitary sewer design sheet for both the existing development and potential future development, as defined in Section 3. Sewer capacities were assessed against estimated existing flows and future flows.

The results indicate that there are a number of sewer segments that are currently theoretically over-committed in terms of capacity for the existing system conditions. With further development, the number of sewer segments with constrained capacity increases.

Given that theoretical values indicate constraints in the existing system, but there have not been reports or observances of capacity issues (i.e. surcharges, sewer backups), it is possible that the theoretical data over-estimates actual flows or that some sewer capacities are greater than calculated. Prior to planning to replace existing constrained sewers, especially in areas not impacted by future development, it is recommended that a sewer flow monitoring study be conducted to verify actual flow conditions. The resultant data will be useful for either confirming or disproving capacity issues.

The identification of constrained sewer capacity in some sewer sections that are affected by future development is to be expected given the significant number of development units contemplated.

6.0 LUCAN STORMWATER MANAGEMENT SYSTEM

6.1 Objectives and Scope

6.1.1 Objectives

Lucan continues to experience significant growth and the need for additional stormwater management (SWM) infrastructure. The majority of recent development and storm systems within Lucan have been completed using a piecemeal approach to serve each development. Historically this approach has been generally feasible as new developments have resided close to receiving watercourses. As development in Lucan progresses into other subwatersheds additional restrictions on outlet capacity become present. Because development within these subwatersheds tends to be within the headwaters of the respective drainage areas, the outlet capacity and routing of controlled drainage relies on downstream lands, thereby requiring coordination of planning and storm infrastructure.

Section 6 of the Master Plan identifies existing conditions, opportunities and constraints, and alternatives for drainage infrastructure. General recommendations are made on a subwatershed basis for:

- Potential regional SWMFs servicing multiple developments.
- Support for temporary SWMFs prior to expansion of the settlement boundary.
- Recommendations for retrofits or expansions to existing SWMFs to serve greater catchment areas where feasible.
- Conveyance measures, including the need for trunk storm sewers or ditching, including realignment or abandonment of municipal drains.
- Low Impact Development (LID)/source controls for small infill developments.

6.1.2 Scope

The Master Plan provides the framework and vision for stormwater servicing needs for Lucan. The study area encompasses the existing settlement boundary for the community. Lands currently outside of the settlement boundary are considered within a subwatershed approach such that flexibility for servicing potential growth lands is considered.

The stormwater analysis included the following tasks:

- A review of available stormwater servicing reports, municipal drainage reports, drawings, mapping, and planning data.
- A desktop inventory of existing storm sewers and SWM facilities, including the establishment of major and minor storm drainage components in order to develop a thorough understanding of the extent of the drainage system.
- Review of municipal design criteria and establish storm design objectives.
- Identification of constraints and opportunities for storm servicing.
- Identification of servicing alternatives based on constraints and opportunities.
- Recommendations for preferred servicing strategies to meet future growth.

6.2 Background

6.2.1 Drainage Context

The community of Lucan lies within in the Little Ausable watershed, located in the jurisdiction of the Ausable Bayfield Conservation Authority (ABCA). Figure 6.1 illustrates Lucan's location within the greater ABCA watershed.

Figure 6.1 ABCA Watershed Overview

Note: Adapted from ABCA (https://www.abca.ca/watershedreportcard/)

The immediate area around Lucan has extensive artificial drainage established under the Drainage Act. The existing urban area is serviced by a network of storm sewers and end-of-pipe stormwater management facilities (SWMFs), with discharge to several receiving municipal drains. Drainage patterns generally flow in a northwestern direction to the Little Ausable River.

Figure 6.2 provides an overview of the subwatersheds surrounding Lucan.

The largest receiving municipal drain is the Benn Drain, which bisects the existing urban area. The Whitfield and Hardy-Engel Drain are both tributary to the Benn Drain, which discharges to the Little Ausable approximately 1.4 km downstream of the Lucan settlement boundary. Other receiving municipal drains include the Hardy Drain (1954 and 1984) and the Haskett Drain. North and east of the urban area, flows are conveyed to the Heenan Drain, which discharges to the Little Ausable River upstream of the Benn Drain. It is noted that flows southeast of the urban boundary are directed to the Stanley Creek Drain, with discharge to Nairn Creek and ultimately the Ausable River. Information on each subwatershed is provided in further sections.

Surficial geology of the study is predominately Huron soils, with a silty clay loam and silty clay surface texture as per the Middlesex County Soil Survey (Soil Survey Report No. 56). The impervious nature of the soils results in a high amount of runoff.

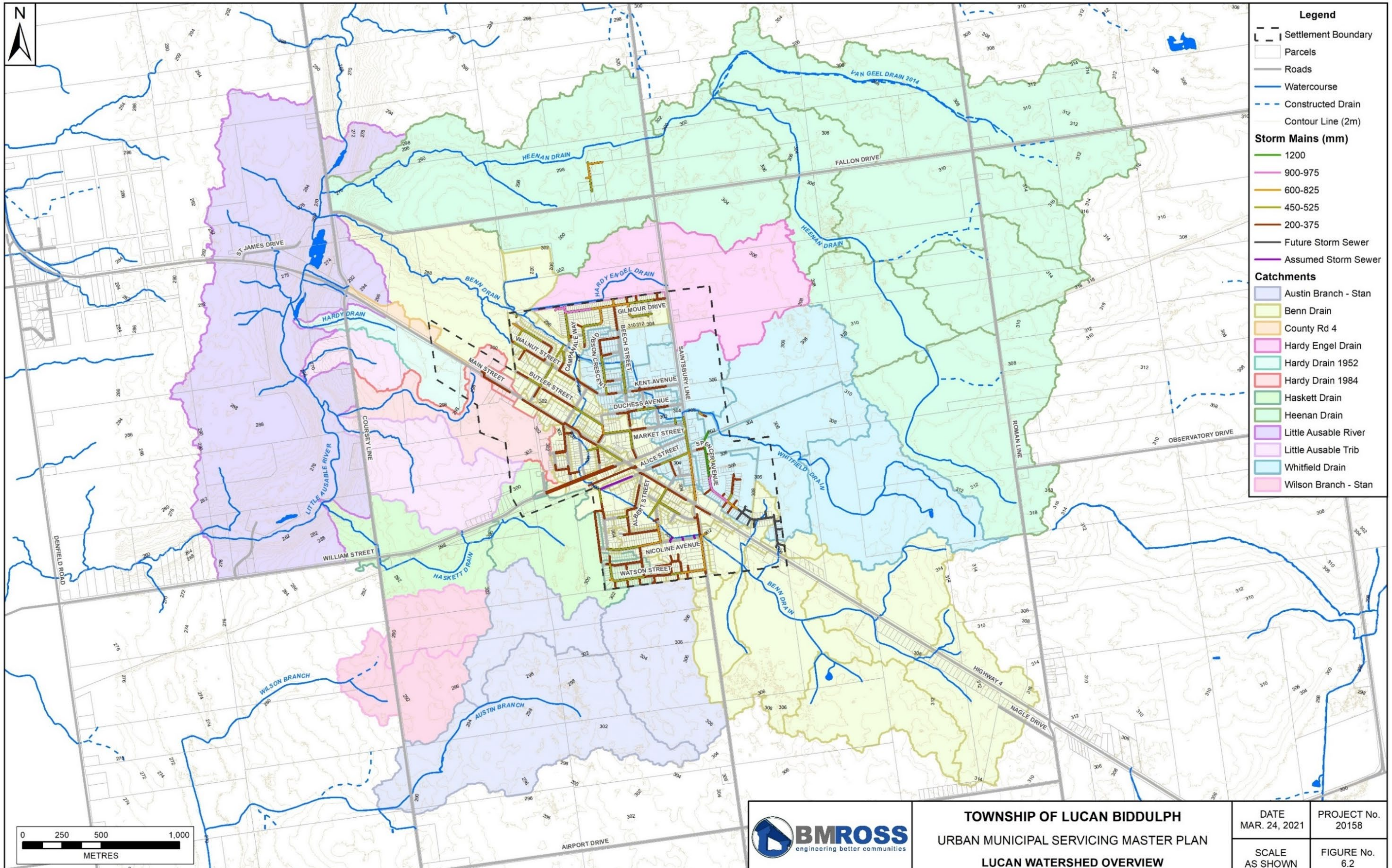
6.2.2 2000 Benn/Whitfield Drainage Master Plan

A Stormwater Master Plan for the urban area of Lucan was previously completed by Dillon Consulting in 2000. The study was undertaken on behalf of the ABCA and the former Village of Lucan in response to development pressures at the time. The study area was limited to the Benn and Whitfield subwatersheds as defined in historical drainage reports, and specifically excluded the Haskett and Hardy Drain subwatersheds. The planning horizon of the 2000 study was for the foreseeable growth area from 1995 to 2015 (Dillon Consulting Limited, 2000).

The primary focus of the 2000 study was on identifying the stormwater criteria for future development, based on the updated stormwater practices at the time as outlined in the MOE's 1994 Stormwater Management Practices, Planning and Design Manual and identifying locations for regional stormwater facilities along the Benn and Whitfield Drains. The study reviewed previous hydrologic and hydraulic studies and included the development of a HYMO hydrology model for the area.

Recommendations from the 2000 study included four regional SWMFs as shown in Figure 6.3 below. Larger regional facilities were expected to be more cost effective in the long term requiring less land and less maintenance (Dillon Consulting Limited, 2000). The study also acknowledged that development plans might proceed in a piecewise manner based on market conditions and individual development needs as opposed to larger scale regional measures. It was acknowledged that larger scale developments may provide the opportunity to implement larger facilities. It is noted that Pond 1 and 2 were initially recommended as online SWMFs with very large drainage areas of approximate 240 ha each. In the core area of Lucan, localized BMPs on an individual lot/development basis were recommended to achieve SWM objectives.

Figure 6.2 – Lucan Watershed Overview



Existing Condition SWM Implementation

Since the 2000 study, development areas have shifted and planning policies for SWM have evolved. Initial proposals for online facilities, as per the 2000 Master Plan, have been deemed unacceptable. Standard industry practices and the current 2009 ABCA Stormwater Management Policies and Technical Guidelines, no longer support the use of large online SWMFs due to impacts on fish habitat, impacts to water quality (e.g. thermal heating along the watercourse by large open water bodies), continuous impacts to baseflow, and potential impacts to regulatory flood storage within floodplains (Ausable Bayfield Conservation Authority, 2009). As such the implementation of SWM facilities in recent proposals within Lucan have been adjusted, and SWMFs have been designed as offline facilities discharging to receiving drains.

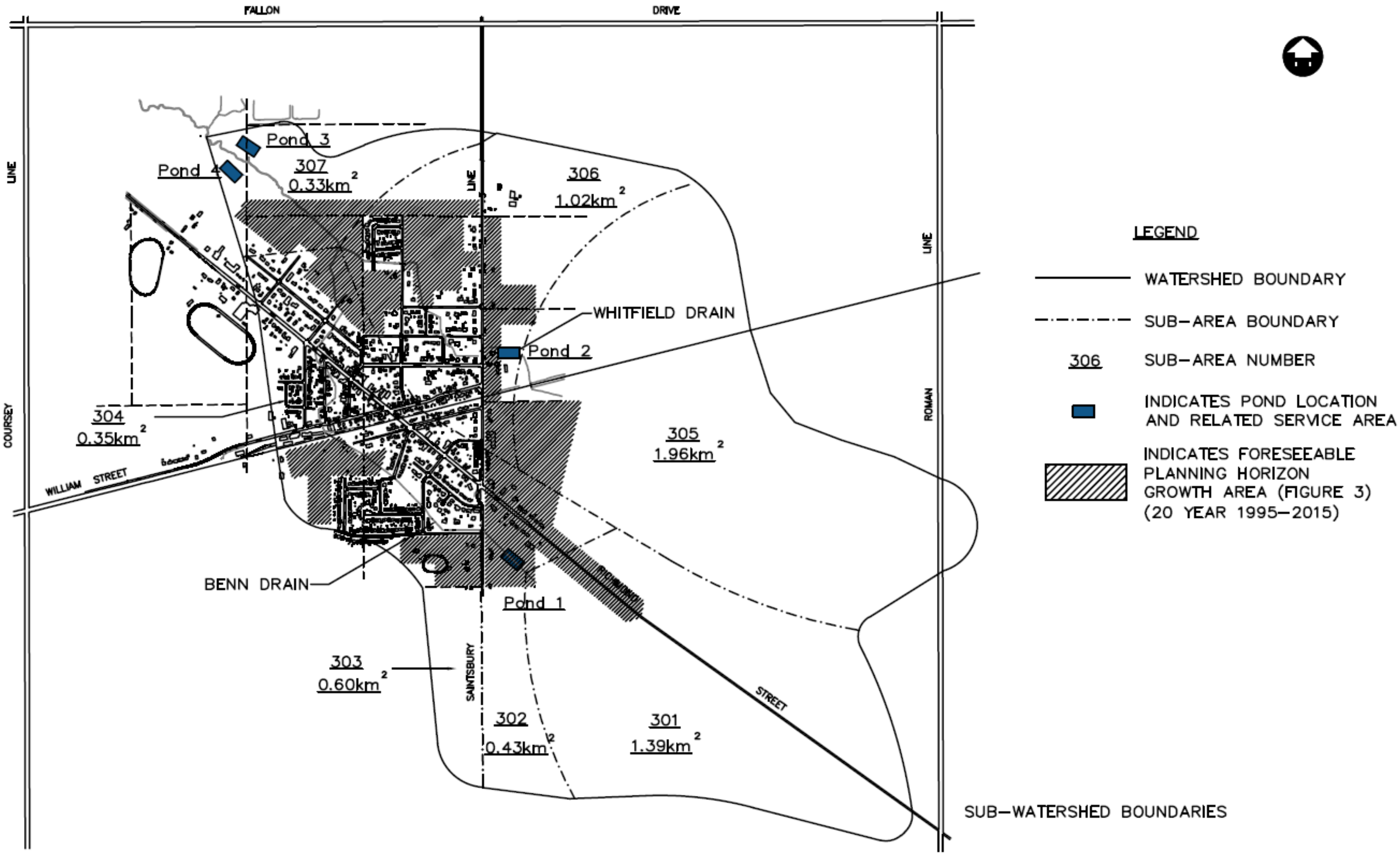
To-date, five SWMFs have been implemented in the urban area of Lucan and have generally been sized only for individual subdivision plans rather than regional facilities. Four of the existing facilities are located within the Benn and Whitfield Drain subwatershed and are in the general locations of the recommended regional SWM facilities from the 2000 study. The following provides detailed descriptions of the current status of the SWMFs. Refer to Figure 6.4 for the existing SWMF locations.

- **Pond No. 1** was recommended to be located east of Saintsbury Line on the Benn Drain, to be located online and control flows from 242 ha of upstream drainage area. To-date, only a portion of the facility has been implemented. The **Van Roestel SWM facility** was constructed in 2004 to service the Van Roestel Subdivision along the east end of Watson Street, servicing a 10.6 ha drainage area. The facility was constructed off-line and discharges to the Benn Drain. It was noted that, as future development proceeds in the area, the facility could be expanded to provide additional stormwater controls. Currently, the Township retains ownership of a 2.2 ha parcel of land along the north side of the Benn Drain. The existing Van Roestel SWM facility currently takes up approximately 0.6 ha (27 %) of the available lands.

- **Pond No. 2** was recommended to be located east of Saintsbury Line on the Whitfield Drain, to be located online and control flows from of 241.9 ha of upstream drainage area. Following the 2000 Master Plan the Township acquired a SWM block to support the construction of Pond 2. To-date, the **Olde Clover SWMF** has been constructed within the southwest corner of the block servicing the Lucan Estates (Olde Clover), with a service area of 21 ha. No allowances were made in the existing facility for additional lands. Plans for the remaining SWMF block lands to the north and west are currently intended to service future development lands to the North/Northwest, including the current Timber Ridge subdivision proposal.

- **Pond No. 3** was recommended on the east side of the Benn Drain, downstream of the confluence of the Benn and Whitfield Drains. This pond was intended to service generally the Hardy-Engel Drain subwatershed. To-date, the **Ridge Crossing**

Figure 6.3 – 2000 Master Plan Recommended SWMF Locations and Growth Area



Note: Figure obtained from the Township of Lucan-Biddulph Benn/Whitfield Drainage Area Master Plan, by Dillon Consulting Limited (January 2000)

- **SWMF is located just south of the general location of Pond 3 and services a drainage area of 16 ha. The Ridge Crossing SWMF, constructed in 2014 only services a portion of the original intended catchment area for Pond 3. It is noted that the Ridge Crossing SWMF was constructed with additional capacity to potentially service lands immediately north of Gilmore Drive.**

- **Pond No. 4** was recommended to be located on the west side of the Benn Drain, downstream of the confluence of the Benn and Whitfield Drains. To-date, the **Loyen Subdivision SWMF** has been constructed east of the original location indicated for Pond 4. The Loyen Subdivision, constructed in 2006, services a relatively small drainage area of 7 ha with direct discharge to the Benn Drain.

An additional SWMF, the Reliance SWMF, which services approximately 6.25 ha of residential area, discharges to the headwaters of the Haskett Drain. The Reliance SWMF was constructed in 2006. At the time of approval, the MECP requested the facility be considered temporary and further discouraged the proliferation of small individual SWM facilities. It was intended that the facility be temporary and a future SWMF, located along the Haskett Drain, would allow for the decommissioning of the facility and development of an additional three properties. A sub-watershed study was recommended to identify long-term planning for the Haskett Drain.

6.2.3 Previous Floodplain and Hydraulic Studies

The last floodplain study undertaken for the entire urban area of Lucan was the “Lucan Two Zone Study” completed by BMROSS in 1994 for the ABCA. The study resulted in the Lucan Two Zone Flood Policy (1993), provided in Appendix E. The 1994 study was based on a HEC-2 model of the Benn/Whitfield Drain and hydrologic data from the 1984 Urban Floodline Delineation Study. The limits of the 1994 study were set as the historical limits of the Village of Lucan. As such, no floodline delineation was conducted for lands upstream (east) of Saintsbury Line, which is currently subject to development. The study identified possible encroachment areas in the floodplain. Encroachment would only be permitted if a detailed hydraulic analysis demonstrated no impact to the general floodplain continuity and development proposals met the ABCA polices regarding floodplain developments. A floodplain spill was noted along the Benn Drain to the Haskett Drain, south of William Street. Lands below elevation 301.84 m were noted to be subject to flood fringe development conditions.

Since the completion of the 1994 study, additional hydraulic studies have been completed as part of recent servicing studies including the Ridge Crossing Subdivision in 2009, and the Olde Clover SWMF (also known as Lucan Estates SWMF) in 2011.

The Ridge Crossing Stormwater Management Report by Dillon Consulting Limited (2009) included a hydraulic assessment and definition of associated flood impacts for the Campanale Way road crossing proposed for the subdivision and the SWMF outlet. That study used the previous hydraulic and hydrology data from the 1994 Lucan Two Zone Study and converted the HEC-2 model to a HEC-RAS format. Recommendations for the culvert crossing included some upstream channel enlargements to increase the conveyance capacity of the Benn Drain and limit impacts to regional storm flood levels.

The Ridge Crossing SWMF outlet was designed to be above the 100-year floodline elevations in the Benn Drain to avoid adverse hydraulic conditions during normal operating conditions within the pond.

The servicing study for the Lucan Estates Development (Olde Clover) by Development Engineering (2011) and conceptual SWM studies by Vallee Consulting Engineers (VCE) (2009), expanded hydraulic floodline assessments upstream of Saintsbury Line from the 1994 Lucan Two Zone Study. As part of the development, the existing culvert crossing at the abandoned railway line was recommended to be twinned to significantly reduce floodline elevations and remove the proposed Lucan Estates development from the floodplain. Due to limited grades, the Olde Clover SWMF outlet was designed and approved with a flap gate to the Whitfield Drain, as required to reduce imported fill requirements and make the development financially feasible. Sizing of the SWMF accounted for tailwater conditions at the outlet. Floodplain mapping completed as part of this study was restricted to the limits of the Olde Clover SWMF. The flood inundation extent on lands north of the Whitfield Drain, currently subject to development, were not mapped.

6.3 Existing Conditions

6.3.1 Watershed Overview

The following provides an overview of each major subwatershed in the study area. Figure 6.2 illustrates of the subwatersheds surrounding Lucan.

Benn Drain

The Benn Drain is the primary receiver for the existing urban area of Lucan. The subwatershed extends through agricultural areas along Highway 4, from west of Roman Line through the urban area of Lucan prior to discharging to the Little Ausable River. The Whitfield and Hardy-Engel Drains are both tributary to the Benn Drain with confluences near the northwest limits of the urban boundary. The drain bisects the existing urban area and flow in a general northwest orientation. The drain is an open watercourse with a total subwatershed area of approximately 722 ha, including contributory areas from the Whitfield and Hardy-Engel Drains.

The drain was originally constructed through the existing urban area to east of Saintsbury Line in 1928. Portions of the drain were reconstructed in 1985 and 1999, including deepening, grubbing, culvert replacements and installations of erosion control measures along the drain.

Under existing conditions, approximately 20 storm sewer outlets have been identified along the water course. Three SWM facilities discharge directly to the drain, including the Van Roestel SWMF, the Loyen SWMF and the Ridge Crossing SWMF. Discharge from the Olde Clover SWMF, which discharges to the Whitfield drain, eventually is conveyed to the Benn Drain.

Whitfield Drain

The Whitfield Drain is tributary to the larger Benn Drain as previously noted. The subwatershed extends in a northwest orientation, along agricultural lands north of

Highway 4, crosses the abandoned railway line and passes through the existing urban area to its confluence with the Benn Drain. The total subwatershed area is approximately 227 ha.

The drain is an open watercourse and was originally constructed in 1925, and reconstructed in 1951 and 1983 with deepening, erosion protection at existing crossings. Drainage reports have historically indicated that the drain has limited capacity and is prone to siltation. Reconstruction works in 1985 included deepening and erosion protection at existing crossings.

Under existing conditions, nine storm sewer outlets have been identified, and one existing SWMF, the Old Clover SWMF discharges to the Whitfield Drain upstream of Saintsbury Line.

Hardy-Engel Drain

The Hardy-Engel Drain is located on the northwest edge of the existing urban boundary. Under existing conditions, the total subwatershed area is approximately 82 ha of agricultural lands.

The Hardy-Engel Drain was recently realigned to support the development of the Ridge Crossing Subdivision, along Gilmour Drive. According to the Hardy-Engel Drain 2014 report by Spriet Associates Ltd., the realignment included reconstruction of the main branch with a 525 mm tile and an overland flow swale along the north limit of the Ridge Crossing development. It is noted that the realignment was designed to rural drainage standards. The design of future upstream development will need to limit flows to allowable levels of the receiving swale and tile system or additional upgrades will be required.

It is noted that the Ridge Crossing SWMF was oversized for water quantity and water quality control. It is understood the excess capacity was intended to service lands outside the current settlement boundary west of Saintsbury Line and immediately north of the drainage easement. However, the existing major flow swale servicing all upstream lands tributary to the Hardy-Engel Drain may present a barrier to conveying both major and minor flows from potential development north of Gilmore Drive to the existing of Ridge Crossing to the SWMF.

Hardy 1984 and 1952 Drain

The Hardy 1984 Drain and Hardy 1952 Drain are located on the west edge of the existing urban boundary, with total drainage areas of 22 ha and 36 ha respectively. The original drain was constructed in 1952 to service the agricultural lands south of Main Street (Highway 4). The 1984 section was constructed to improve drainage and divert flows from the original 1952 drain. Both drains are sized for rural drainage with limited capacity.

The west limits of the existing urban area discharge to the Hardy 1984 drain. The drain consists of a 250 mm tile from Community Drive; and runs through the Lucan Community Centre property. The drain increases to a 400 mm tile at the confluence of the A and C Branches, and outlets just west of Coursey Line. No future development was accounted for in the sizing of the drain.

Haskett Drain

The Haskett Drain catchment area is located in the southwest quadrant of Lucan. The total drainage area for the Drain is approximately 94 ha. According to the 1973 drain report, the Haskett Drain was originally constructed in 1950. In 1973 the drain was reconstructed as a result of frequent flooding along the lower portion of the drain caused by numerous broken tiles, a railway crossing and insufficient capacity for the drainage area. The 1973 works included the construction of a new drain alignment south of the original 1950 drain along the CNR ditchline. The new drain included approximately 80 m of open ditch and 1053 m of 300 mm to 400 mm tile.

Under existing conditions, a small portion of the urban boundary, dedicated to commercial and industrial land uses near the existing grain elevator, is directed to the Haskett Drain. To the south limit, the Reliance SWMF, which services approximately 6.25 ha of residential area, discharges to the headwaters of the Drain. The Reliance SWMF was constructed in 2006. It was intended that the facility be temporary. The Township has received interest in the development of lands adjacent to the Reliance SWMF, however these lands are still located outside of the current settlement boundary, and development timing is currently unknown.

6.3.2 Inventory of Existing Storm Systems and Stormwater Management Facilities

The existing storm network is generally comprised of relatively small drainage areas with direct discharge to the receiving municipal drains. Most streets in Lucan have an urban road section (i.e. curbing and storm sewer).

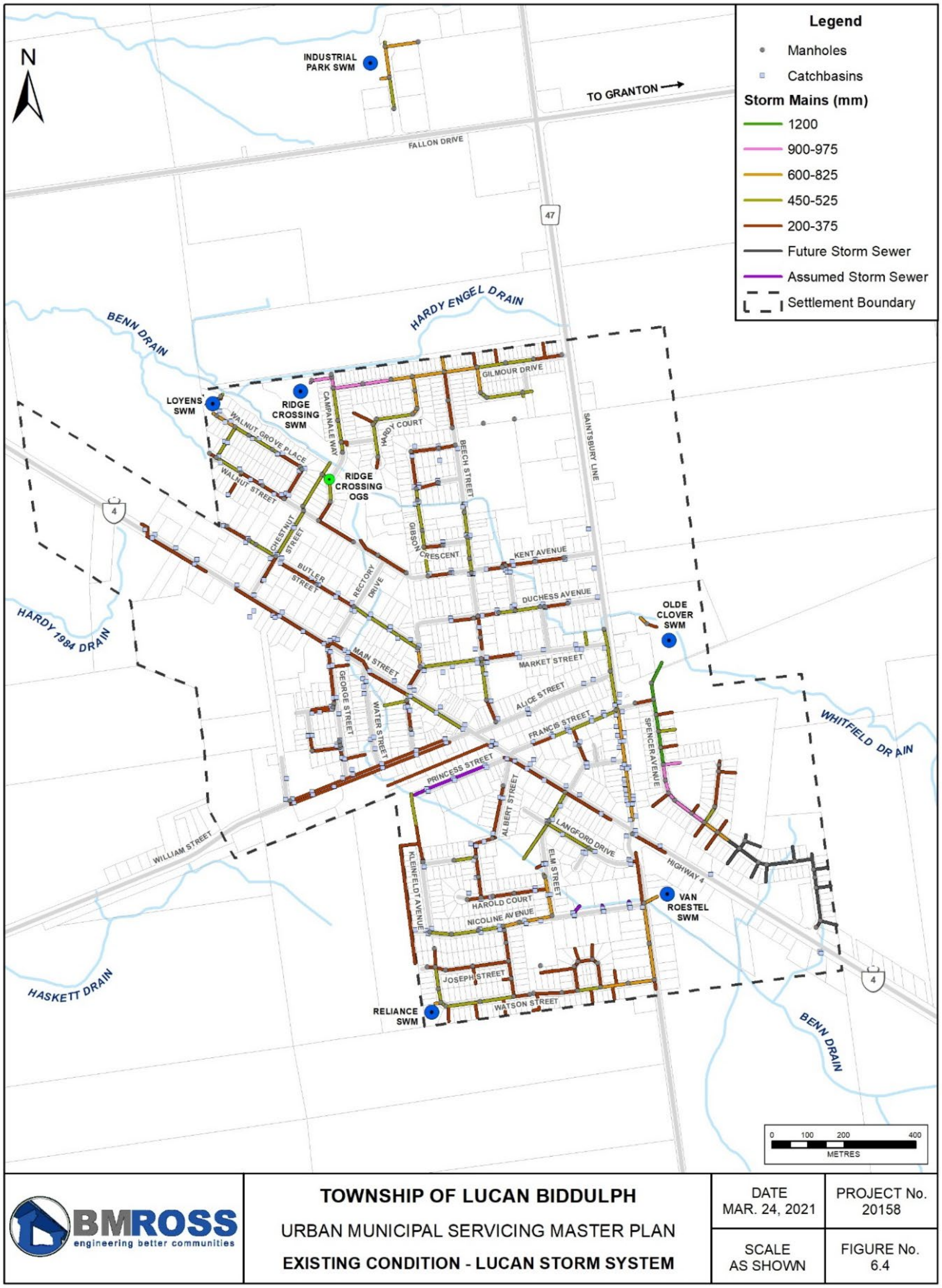
Based on available GIS data, 39 stormwater outlets and approximately 17.6 km of storm sewer have been identified within the existing urban area. There are five existing end-of-pipe stormwater management facilities providing water quality and water quantity control for more recent developments along the peripheral limits of the urban area. One oil and grit separator (OGS) has been constructed as part of recent Ridge Crossing development along Campanale Way. Figure 6.4 illustrates the existing storm sewers and SWMF locations. Table 6.1 provides a summary of the existing SWMFs.

The general location of storm sewers and stormwater management facilities provided by the Township in GIS files were reviewed for consistency. The GIS data provided for storm sewers indicated general sewer sizes, but slopes and invert elevations were missing from the dataset.

Table 6.1 – Inventory of Existing SWMFs

Name	Location	SWMF Facility Type	Year	Serviced Drainage Area (ha)	Percent Impervious (%)	Receiving Watercourse	Treatment Provided	Water Quality Treatment
Ridge Crossing SWMF	Campanale Way	Wetpond	2014	17.1	52	Benn Drain	Water Quantity, Water Quality, Extended Detention	Enhanced (80%)
Ridge Crossing OGS	Campanale Way STM-151	OGS	2014	1.5	52	Benn Drain	Water Quality	Enhanced (80%)
Lucan Estates SWMF	East of Saintsbury Line, north of old rail line	Wetpond	2010	21	55	Whitfield Drain	Water Quantity, Water Quality, Extended Detention	Enhanced (80%)
Reliance Temporary SWMF	West end of Watson Street	Wetpond	2006, As-recorded 2013	6.3	40	Haskett Drain	Water Quantity, Water Quality	Normal (70%) (oversized ~Enhanced 80%)
Loyen SWMF	West end of Walnut Grove Place	Wetpond	2006	6.7	40	Benn Drain	Water Quantity, Water Quality, Extended Detention	Normal (70%)
Van Roestel Subdivision SWMF	East of Saintsbury Line and Nicoline Ave	Wetpond	2004	5.9	30	Benn Drain	Water Quantity, Water Quality, Extended Detention	Normal (70%)

Figure 6.4 – Existing Condition – Lucan Storm System



6.3.3 Minor and Major Storm Catchment Areas

Minor and Major catchment areas were delineated using the sewer GIS network and the Provincial Digital Elevation Terrain Model (DTM). Catchment boundaries were confirmed against available municipal drainage reports and subdivision plans. Where discrepancies were evident, a reasonable effort was made to try and resolve them. No additional field verification was conducted.

Figure 6.5 illustrates the existing minor system sub-catchments, drainage infrastructure, as well as the outlet locations.

Figure 6.6 illustrates the existing major system, general flow paths and confined low areas. Generally major and minor catchments are tributary to the same outlet. Sub-catchments with split minor and major flow routes (where surface flow along the road profile and storm sewers have different outlets) are indicated. Major flow splits occur along Watson Street, the west end of Nicoline Avenue, along Beech Street and at the Lucan Community Centre property. Major flow splits are important to consider in any future stormwater assessments for the urban area of Lucan.

Confined low points are shown for areas where water may pond during large events. Confined low points were calculated using GIS processes to identify sag storage locations in the study area with no surface outlet according to the Provincial DEM data. Sags locations are shown for areas with depths greater than 0.3 m and an area greater than 5 m^2. It is noted that identified areas include locations upstream of culverts and areas serviced by storm sewers, but may be susceptible to flooding. It is noted that confined low areas coincide with regulatory flood mapping along the drain corridors.

Sag locations along municipal road right-of-ways should be highlighted for maintenance to reduce nuisance ponding and spill on private lands. Confined low points are noted along Kent Avenue, Duchess Avenue, Maple Street, and Alice Street. Catch basins within these locations should be regularly cleared to ensure ponding of water does not impact private lands during a large event. Any future road reconstruction should ensure no changes in road grade along sags within designated flood hazards lands. Sags are to be maintained for flood conveyance particularly within the Whitfield drainage area.

6.3.4 Level of Service

The level of stormwater servicing for the existing urban area is illustrated in Figure 6.7. Storm servicing level is defined as areas serviced by storm sewers, OGS and storm sewers, SWMF and storm sewers, internal drainage to watercourse, or external agricultural drainage. The core of the existing urban area is serviced strictly by storm sewers and internal lot drainage to the receiving Benn and Whitfield Drains. Developments on the peripheral limits of the existing urban area have both storm sewers and SWMFs as per current management practices.

Figure 6.5 – Existing Condition – Minor System

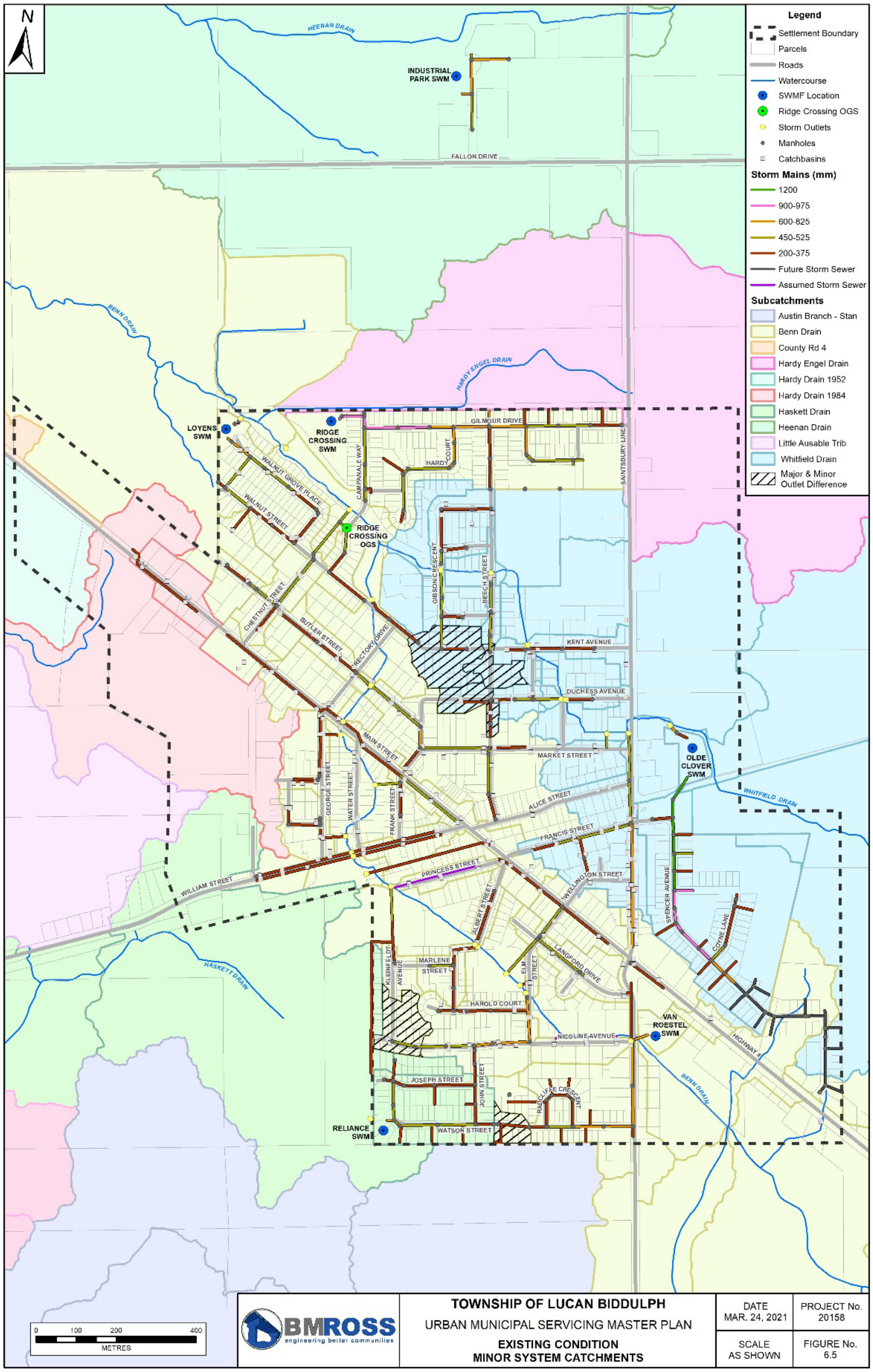


Figure 6.6 – Existing Condition - Major System

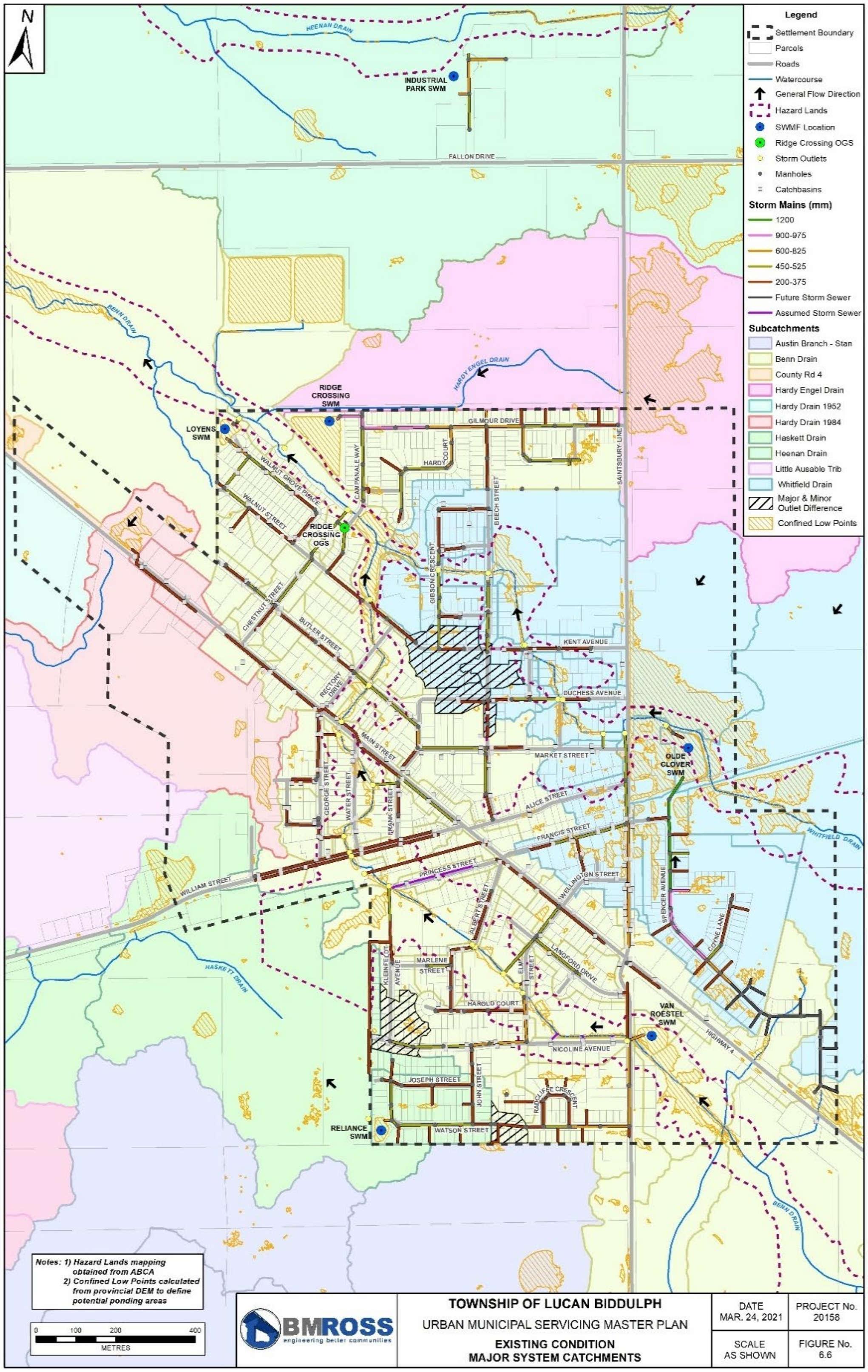
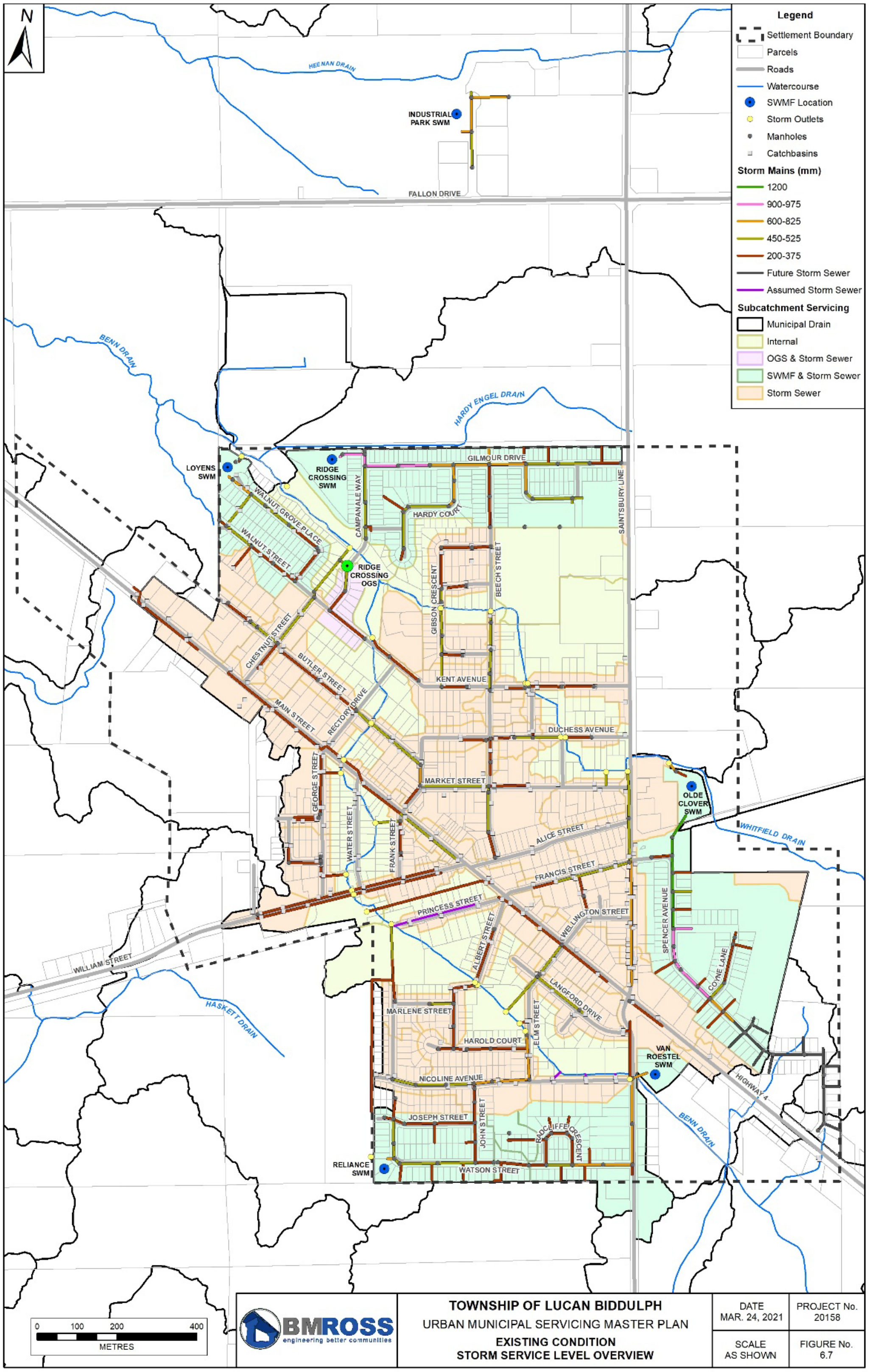


Figure 6.7 – Existing Condition – Service Level Overview



6.4 Stormwater Management Design Criteria and Suggested Standards

Current stormwater management design standards require the restriction of stormwater flows discharging from a new development to not exceed existing values. The impact of future flows on downstream systems should be no greater than at present, but will also be contingent on the condition of the outlet. All new development proposals should undergo a pre-consultation process with the Township of Lucan-Biddulph and the ABCA to review design criteria relative to the proposal and the current environmental conditions of the subwatershed.

A Stormwater Management Report setting out the existing and proposed drainage pattern shall be submitted to and approved by the Township, the ABCA and the Ministry of Environment, Conservation and Parks (MECP). The design of the stormwater management system shall be in accordance with the latest version of the “Stormwater Management Practices, Planning and Design Manual” as prepared by MECP and the “ABCA Stormwater Policy and Technical Guidelines” (2009 and as revised).

General requirements are described in the following sections.

6.4.1 Water Quantity Control

Quantity controls shall restrict post-development runoff flows to pre-development flows between the 2 year and 100 year storm events, unless higher control measures are required.

The capacity of the receiving system should be reviewed to identify any hydraulic constraints or existing flooding hazards that require strict quantity control measures. Outlet works, including open channels and trunk storm sewers, may be proposed to improve conveyance of stormwater. SWM controls are required to ensure pre-development levels are not exceeded to receiving system.

The stormwater management system shall be designed using an approved hydrologic model. Assumptions and justifications for the choice of hydrologic/hydraulic model are to be provided. All hydrologic modelling parameters are to be summarized and modeling schematics provided for pre and post development conditions. Stage-storage relationship of proposed SWMFs and operating characteristics during design events are required.

The ABCA should be contacted with respect to the appropriate storm distribution and duration to be used. The Developer's Engineer shall advise the Township in writing as to the Authority's requirements. Typically, variable event duration and durations (i.e. 3-hour Chicago, 12-hr AES, 24-hr SCS, etc.) are required with the most conservative results used for the design basis for SWMF outlet design and storage requirements.

6.4.2 Water Quality Control

Water quality controls are to be provided to Level 1 (enhanced) 80% long-term total suspended solids removal water as per MECP guidelines. Controls may be provided by existing or planned SWMFs with a water quality design component. For infill or retrofit sites, quality controls may be provided by the use of oil-grit-separators (OGS) or Low Impact Development (LID) measures upon approval by the Township and the ABCA. The sizing of OGS units should limit cleanout requirements to once a year as feasible.

6.4.3 Extended Detention and Erosion Control

All end-of-pipe facilities are to provide 40 m^3/ha of extended detention storage, as per MECP requirements. At a minimum erosion control is to be provided in all SWM facilities such that a 25 mm, 4-hour Chicago storm event is detained and release over a 24-hour period.

Future studies and assessments on receiving watercourses may identify the need for higher erosion control measures. A site specific geomorphological/fluvial assessment may be required to establish additional erosion control requirements.

6.4.4 Conveyance – Major and Minor Systems

The design of major and minor systems is to be provided. The minor system comprises swales, street gutters, ditches, catch basins and storm sewers. The major system comprises the natural streams and valleys and man-made channels, roads, or other overland conveyance systems. Minor and major system components should be located in the street right-of-way or in an approved easement.

- Detailed calculations and engineering drawings for all elements of the SWM system are required including grading and servicing plans, and major/minor system layout.
- The major system shall be designed to convey the regional storm event. Calculations substantiating the capacity of the proposed major system are required.
- The design storm for the minor systems shall be the 5 year storm for new local storm sewers (the system of street gutters, catch basins, storm sewers or open ditches, where permitted). Use of shallow grassy swales for storm water conveyance is recommended where it can be practically implemented.
- The Rational Method shall be used for the sizing of the minor sewer system at the final design stage. Calculations based on a hydrologic simulation model (such as MIDUSS, OTTHYMO, PCSWMM or other such methods as approved by the ABCA and the Township are required for systems serving large areas or involving treatment and/or storage systems.
- Storm sewers shall be connected to the municipal storm sewer system (where feasible) or discharged to a natural watercourse/receiving drain as approved by the Township, Conservation Authority, and MECP. If storm sewers are installed in easements, the major storm flow system can be included as an overland swale or ditch within an easement. The hydraulic grade line should be checked to ensure the major storm event does not overtop of major flow route to result in unacceptable flooding of buildings, roadways or other infrastructure.
- Culverts or sewers crossing of County or Provincial highways shall be designed and approved in accordance with the requirements of the County Highways Department or the Ministry of Transportation, respectively.

- Hydraulic gradeline studies are required when a free discharge is not provided for the storm system. This is applied to SWMF inlets, SWMF outlets, and storm sewers with direct outlets to watercourses. Inlets to SWMFs should be located above the projected 2 year ponding elevation. SWMF outlets shall consider impacts of any tailwater conditions in the receiving watercourse from the 2 to 100 year design storm event, including additional storage requirements. A free draining outlet to the 100 year is preferred for a SWMF. Storm sewer outlets to watercourses shall be above the 2 year level of the receiving watercourse at a minimum. In cases where a free outlet cannot be provided, the hydraulic gradeline study shall ensure sewers are not surcharging for design event and properties are protected from excess surface ponding.

6.4.5 Infill Developments

Small infill developments or redevelopment of lands should promote best management practices and low impact development measures as feasible and appropriate. Infill developments within the existing settlement area are to provide site controls for water quality (80% long-term total suspended solids removal) and water quantity control to predevelopment levels, or overcontrolled to allowable release rates to existing infrastructure.

6.4.6 Rationalization of SWM Facilities

Large-scale planning and implementation of SWM facilities on a catchment basis is encouraged to reduce land requirements, capital and long-term maintenance costs.

For large site developments, approximately 5% (minimum, up to what is required) of the proposed development lands should be used for storm water retention in order to satisfy the storage and retention requirements established through the pre-consultation process. This will ideally be located in lower areas of the site.

Restoration and design of the SWMF’s should have regard for landscape ecology and is to be reviewed with the Township and ABCA prior to plan finalization.

6.4.7 Development Constraints for Hazard Land Areas

The OP and Zoning By-law identify hazard lands associated with the Little Ausable River, its tributaries, and municipal drains. Based on the potential risk to life and property due to ‘flooding, erosion, subsidence, slumping, inundation, and the presence of steep slopes’, development within these areas is limited. Although these areas are considered hazard lands, they also exhibit natural heritage value that is deemed significant. Due to the potential risk to life and property, as well as the natural heritage value, development and site alteration in the designated ‘hazard lands’ or the ‘ABCA regulatory area’ is restricted.

For the historical urban area of Lucan, flood hazards have been previously defined in the ABCA Lucan Two Zone Study (1994) and Policy (1993), previously discussed in Section 6.2. The Lucan Two Zone Policy and Floodplain Map is provided in Appendix E. The former study and policy outline the criteria for limiting development in the flood hazard lands. The flood hazard area is defined as the limit of the regulatory storm floodplain. The floodway is determined from channel capacity and floodwater storage requirements. Flood fringe is the floodplain area between the designated floodway and the limit of the regional storm floodplain. According to the accepted flood policy, no new development, or filling is permitted within the floodway area. Only essential municipal services are permitted if required. Development within flood fringe areas is permitted provided flood proofing to the regulatory flood plain is undertaken. Detailed requirements are outlined in the policy.

For regions outside the historical two-zone policy area, ABCA requires new developments to follow a one-zone approach, with development located outside of the flood hazard area (the limit of the regional storm floodplain). Detailed investigations and approval from ABCA are required to obtain an exemption to locate a SWMFs in the flood hazard areas, further discussed below. It is noted that floodplain mapping is considered out of date and will required updating ahead of or part of future development proposals.

SWMFs within Riverine Flood Hazard Areas

From a development perspective, SWM infrastructure is considered part of the development, and should be located outside of regulatory area, with the exception of outlet works. According to the ABCA stormwater Management Policies and Technical Guidelines (2009), the ABCA does not support:

- on-line SWM facilities designed to enhance water quality;
- the use of natural wetlands for SWM;
- SWM facilities within natural hazards, such as floodplains or erosion hazards, except outlets; and
- SWM facilities within significant natural heritage features

ABCA does acknowledge that developments may be faced with technical, economic and environmental design constraints that necessitate the location of SWM infrastructure within hazard or near hazard lands. ABCA policies state that SWM infrastructure ***may*** be considered within these areas if it can be shown the hazard condition is not worsened by virtue of having the SWM measure within or nearby, and that the functionality the SWM infrastructure is not compromised by virtue of being within or near the hazard. Planning must be done on a comprehensive basis for a net ecological benefit of locating the SWM facility in the floodplain. It must be demonstrated that no other location is suitable for the SWM facility location.

The following criteria must be addressed in any SWMF proposal within Riverine Flooding Hazards. Detailed calculations and hydraulic modeling analysis are required, completed to the satisfaction of the subject to the satisfaction of the Township and ABCA. Refer to Appendix F for full list of requirements extracted from the ABCA guideline document for locating SWMFs within Riverine Floodplains.

Flood Elevation

- No significant increase or decrease in upstream or downstream flood levels.

Flood Conveyance

- Facility must be located outside of the 100 year floodplain or hydraulic floodway, whichever is greater

- No significant change in cross sectional, incremental flood plain flow and velocity distribution.

Flood Storage

- No significant change or loss of floodplain storage volume based on cumulative analysis of future potential SWM facilities in a planning reach of the watercourse (remedial or new).
- Basins should be primarily excavated with a balance of cut and fill provided at corresponding flood stage. Maximum berm heights above existing grades should be no higher than 0.3 m.
- Storage volumes within the pond are considered to be non-available in calculations since they are designed to be occupied by water.

Erosion and Sedimentation

- Facility should not be susceptible to scour or erosion associated with the watercourse, and will not significantly increase upstream or downstream floodplain scour/deposition
- Construction of facility should have no impact on watercourse or long-term adjustment (100 year morphology changes).

Ecological Resources

- No impact to groundwater levels and discharge. Pond design may include clay lining to insure permanent pool is maintained as designed.
- Stream set back of 30 m required, unless an Environmental Impact Study (EIS) is prepared to support the reduced buffer.
- Restores/enhances function of natural heritage systems

Performance

- Design accounts for backwater conditions of outlet

6.4.8 Best Management Practices and Low Impact Development Measures

The design phase for developments, redevelopments and infrastructural renewal programs should give consideration for reducing runoff and promoting onsite infiltration. Best management practices can be achieved by:

- decreasing impervious areas,
- intercepting runoff to onsite gardens or grassed areas,
- increasing topsoil depth, and
- reducing lot grading.

Low Impact Development (LID) methods should be incorporated as technically feasible and appropriate, as determined through consultation with the Township and the Conservation Authority.

LID measures located within municipal road ROWs or Township property are to be owned and maintained by the Township. LID measures for municipal road right-of-way or easements may include:

- Grassed swales – similar to rural road cross-section with ditches/swales designed to infiltration runoff and/or slow flows.
- Bio-retention systems - a shallow basin designed to collect, filter and infiltrate storm water and may include a connection to a storm sewer system. Bio-retention facilities landscaping can be grassed, naturalized or landscaped.
- third pipe systems (perforated exfiltration pipes in a granular bedding) or French drain systems.

For new developments with single family lots, LID systems should be located within the proposed municipal right-of-way or dedicated easement to ensure access and maintenance.

For new developments of multifamily, commercial and institutional sites, LID systems are encouraged with maintenance conducted by private owners.

It is noted that the soils within the study area are generally silty clay loam and silty clay soil types. LIDs may be implemented in “tight soils” with adaptations such as underdrains and overflows with connections to downstream storm sewers/conveyance systems. It is also noted that there are no applicable Source Water Protection policies for the study area limiting the use of LIDs.

All LID designs should include a detailed design brief included as part a Functional Stormwater Management Report. The design of the LIDs should include (as applicable):

- detailed design calculations,
- design drawings,
- field testing,
- soil specifications,
- landscaping plans,
- construction sequencing and temporary by-passes,
- erosion and sediment plans to protect LID features, and
- operation and maintenance requirements.

6.4.9 Climate Change and Resiliency

The impact of climate change should be considered in consultation with the Township and the ABCA. This should include the impact of extreme storm events on stormwater collection systems and end of pipe facilities as well as the resultant implications on the ongoing maintenance of the facilities.

To reduce risk, a suite of synthetic storms given a fixed frequency (i.e. 100 year), should be applied with different durations, distributions and intensities to assess system performance. A minimum freeboard of 0.3 m should be provided in SWM facilities as a safety factor to extreme events and climate change resiliency.

6.4.10 Maintenance and Operation Easements

Maintenance and operation easements are to be identified and included as part of proposed development lands. Easements are required to ensure the Township can properly install and maintain storm sewers, drains, stormwater management facilities, channels and/or access roads. Easement width requirements depend on the nature and extent of the proposed infrastructure. Minimum widths for sewers may be determined based on the City of London Design Specifications and Requirements Manual (2017 and as updated/revised).

6.4.11 Sediment and Erosion Control

Sediment and erosion control plans are to be prepared are to be prepared and detailed on Site Plans or a separate plan as part of SWM submissions. Measures shall be identified for works to be included during the construction and for permanent measures.

6.4.12 Monitoring and Maintenance

In general, maintenance considerations for both existing and proposed facilities should follow the requirements detailed in Chapter 6.0 of the Stormwater Management Planning & Design Manual, (MECP 2003) regarding “Operation, Maintenance and Monitoring”.

Stormwater Management Reports should outline required maintenance frequencies and anticipated sediment cleanout intervals. Long term sediment removal and disposal operations will vary depending on the effectiveness of erosion and sediment control measures implemented during construction, the frequency and magnitude of winter sanding applications, the frequency and magnitude of rainfall events, and other related factors. The design of OGS units should limit cleanout requirements to once a year as feasible. It is recommended that sediment depth monitoring be completed for all water quality infrastructure, including SWM facilities, OGS units, and low impact development infrastructure. Long-term monitoring will help confirm frequency of required cleanouts and cost.

Monitoring requirements for SWM facilities are identified as part of the MECP environmental compliance approval (ECA) for a facility, and may include short-term and long-term requirements for sampling. Where it is deemed necessary for monitoring to be completed, the program shall be developed based on the requirements of the ABCA and/or the MECP.

The Township should ensure routine maintenance is being completed for its stormwater infrastructure including stormwater management facilities, outlets, sewers (e.g. CCTV), sewer structures (CBs; MHs), major runoff flow paths, and drainage routes. Inspections should be logged and any “Action Items” addressed. Routine maintenance may include removed of debris, minor sediment accumulations or minor structural repairs to outlet structures. It is noted that any significant remedial works will require the submission of a revised engineering design for the stormwater management system to the Township, the ABCA and MECP. Remedial works are considered to be major maintenance activities completed to repair failed components of the stormwater management system (ex. Modifications to outlet structures, structural failure, significant erosion site, channel works, etc.)

6.4.13 Municipal Drain Works

The receiving outlets of the Benn, Whitfield, Hardy-Engel, Hardy, and Haskett Drain have municipal drain status. Proposed works that require modifications, maintenance or repair to the existing drains may be completed under the Drainage Act.

The Drainage Act or the Water Resource Act can be used for urban drainage works, however the Drainage Act is best suited for rural areas. Drainage systems designed and constructed under the Drainage Act are funded by assessed property owners benefiting from the drainage works. Typical urban storm sewers are designed and constructed under the Ontario Water Resources Act and funded by municipal taxes or developers for new sites/subdivisions. Applying the Drainage Act to urban areas introduces complexes due to the number of landowners assessed in the works, landowners not familiar with the Act and paying directly for drainage works, design standards (urban vs rural), and the continuing need for MECP approvals under the Water Resource Act to support required SWMF approvals for new developments. Upon urbanization of catchment areas, the Township may elect to abandon a municipal drain or branches, and/or assume existing infrastructure under the Ontario Water Resource Act.

Infrastructure designed and constructed under the Drainage Act may be assumed under the Water Resource Act at a future date. The Drainage Act may be used to obtain an outlet for a new urban drainage system across private agricultural lands. Alternatively, an easement can be obtained for a drainage infrastructure under the Water Resource Act initially (as outlined in section 6.4.10) The decision to use either act can be made based on site specific details, drainage area land uses, and timing future developments.

The design of municipal drain works servicing urban areas should meet all MECP criteria with respect to sizing, minimum diameter, velocity, slope, maintenance hole spacing and catch basin spacing required for urban servicing.

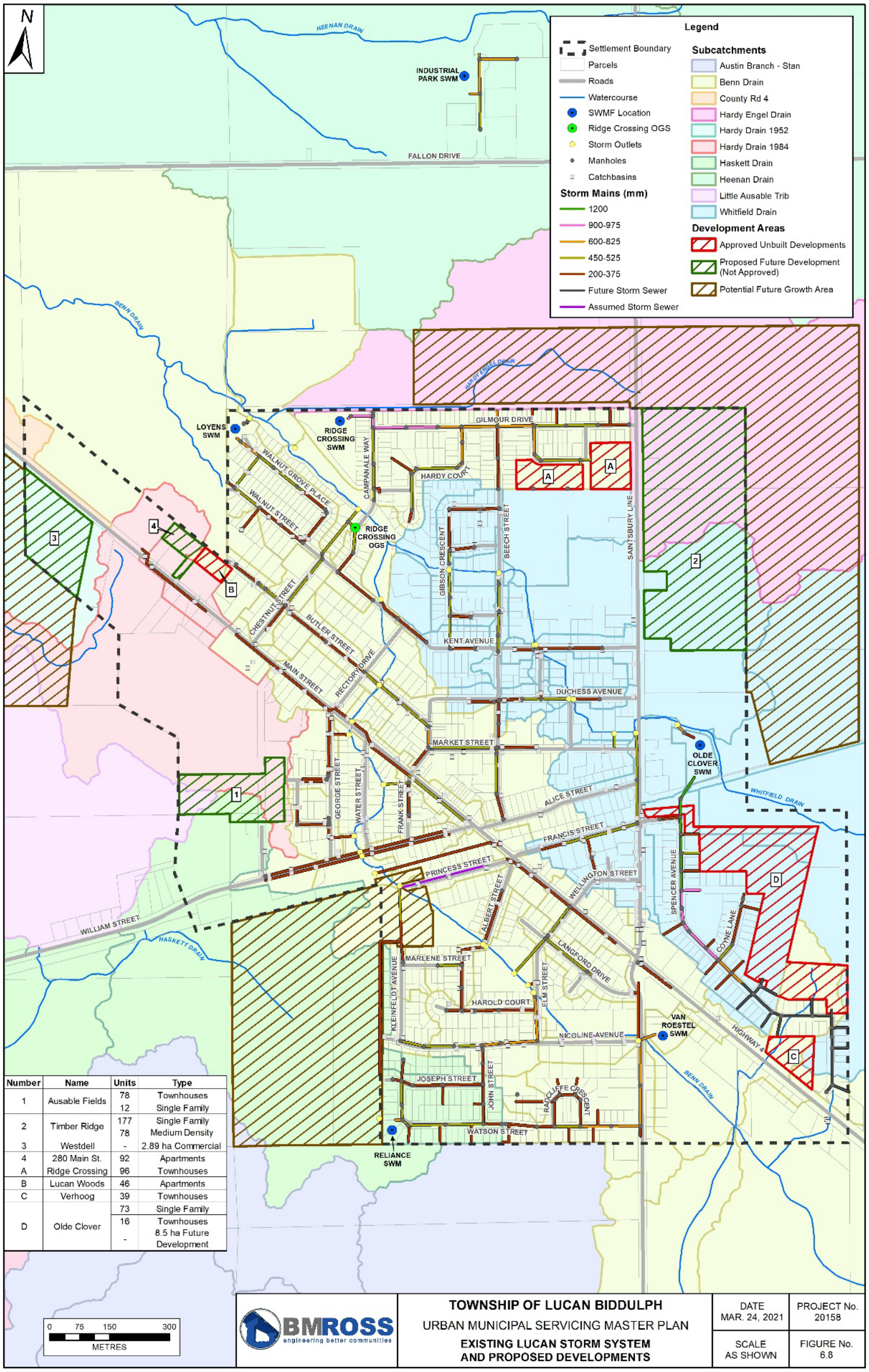
6.5 Problems, Opportunities and Alternatives for Stormwater Management

6.5.1 General

Upon review of the previous studies, existing conditions, current development proposals and potential future settlement boundary expansions, the following opportunities and constraints have been defined for the existing urban area and for future development areas in each subwatershed. Future development areas were previously discussed in Section 3.4. Figure 6.8 provides an overview of existing storm network, subwatersheds boundaries, and the approved and proposed developments within and adjacent to the urban settlement area. Potential future developments, subject to settlement boundary expansions, are indicated for discussion purposes only.

As a detailed assessment of the existing storm sewer capacity was not completed as part of the current master plan, problems and opportunities are identified for the system in general terms. Servicing strategies are proposed to achieve the stormwater management design criteria and standards set out in Section 6.4. The aim of the proposed servicing strategy is to promote efficient development, minimize servicing costs and ensure necessary infrastructure is available for to meet current and future needs. Regional SWM controls are encouraged where practical and feasible within development timing windows.

Figure 6.8 – Existing Lucan Storm System and Proposed Developments



Number	Name	Units	Type
1	Ausable Fields	78	Townhouses
		12	Single Family
2	Timber Ridge	177	Single Family
		78	Medium Density
3	Westdell	-	2.89 ha Commercial
4	280 Main St.	92	Apartments
A	Ridge Crossing	96	Townhouses
B	Lucan Woods	46	Apartments
C	Verhoog	39	Townhouses
D	Olde Clover	73	Single Family
		16	Townhouses
		-	8.5 ha Future Development

6.5.2 Benn Drain

Most of the Lucan's urban core drains to the Benn Drain. The existing storm network is highly fragmented with relatively small drainage areas and numerous outlets. Limited opportunity for future development within the existing settlement boundary is available within the subwatershed. Infill developments are currently proposed along Main Street with onsite controls. On the northwest limit of the existing settlement area, vacant lands zoned for Highway commercial are subject to potential development along Main Street. A potential development south of William Street includes a portion of lands within the settlement boundary north of Kleinfeldt Avenue and Marlene Street. These lands are located within the regulatory floodplain for the Benn Drain. Any potential development of these lands will be subject to further floodplain assessment for approval.

The following opportunities and constraints have been identified for the Benn Drain subwatershed and are illustrated in Figure 6.9.

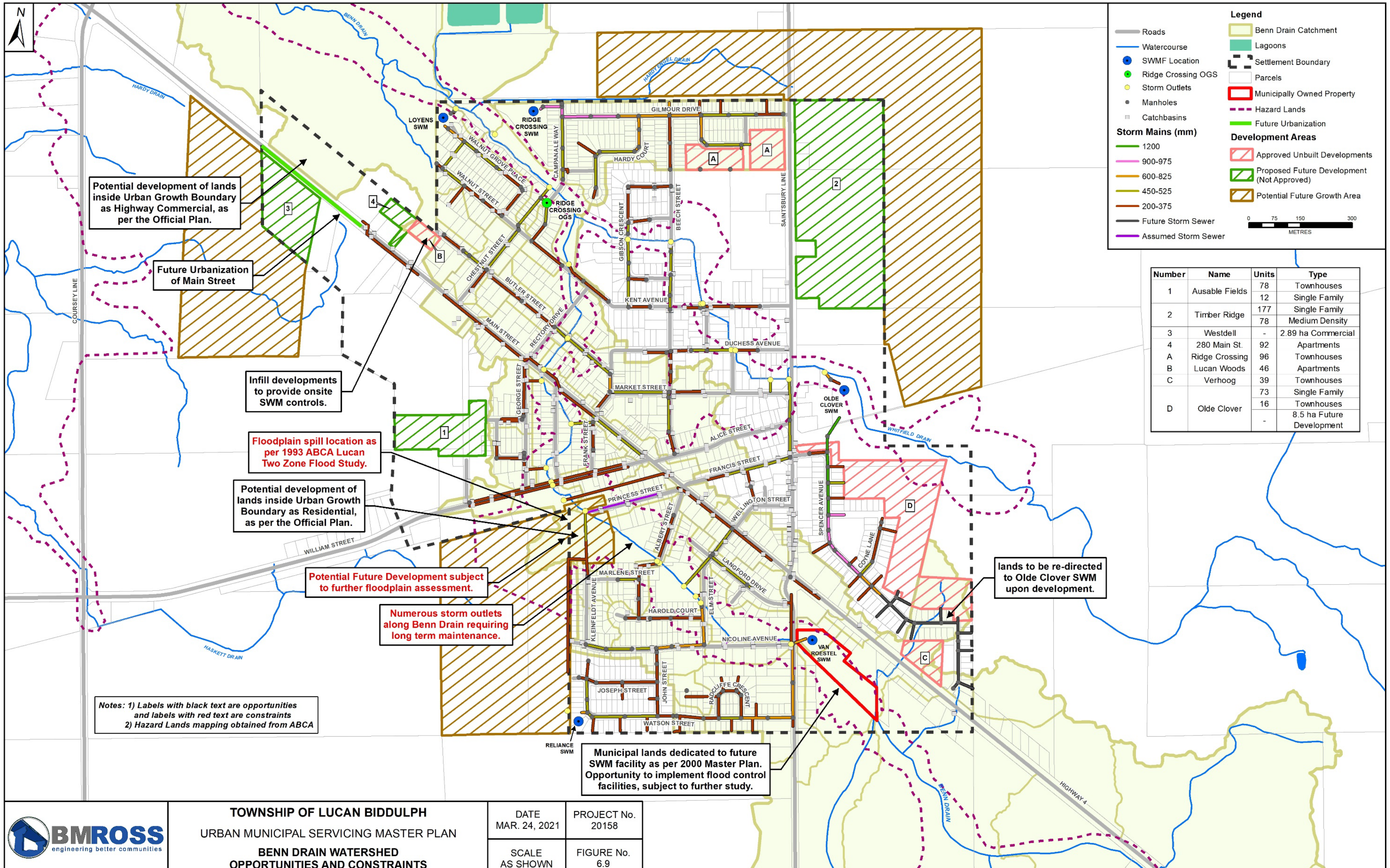
Opportunities:

- Small existing storm service areas provide opportunity for use of oil-grit-separators (OGS) and low impact development solutions (LID). These could be retrofits for road reconstructions and infill developments.
- Infill developments are currently proposed along Main Street with onsite controls for water quality and water quantity.
- Potential development of Highway Commercial lands along Main Street, as per the official plan.
- Municipal lands along the Benn Drain, east of Saintsbury Line, dedicated to future SWM facility as per 2000 Master Plan. Opportunity to implement additional flood control facilities subject to further study.
- Approximately 3.5 ha of land will be diverted from the Benn Drain to the Old Clover SWMF (Whitfield Drain) upon development.

Constraints*:*

- The existing fragmented storm network provides numerous outlets (~20 storm sewer outlets) along the Benn Drain, requiring long-term maintenance.
- Floodplain areas are subject to development restrictions throughout the urban area.
- Future development within the floodplain area north of Kleinfeldt Avenue and Marlene Street will require detailed floodplain assessments. This area was identified as a floodplain spill location as per the 1993 ABCA Lucan Two Zone Flood Study.
- Existing capacity of the Benn Drain to receive flows is limited.

Figure 6.9 – Benn Drain Watershed – Opportunities and Constraints



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A	Ridge Crossing	96	Townhouses
B	Lucan Woods	46	Apartments
C	Verhoog	39	Townhouses
D	Olde Clover	73	Single Family
		16	Townhouses
		-	8.5 ha Future Development

Servicing Recommendations

Based on the above, the following SWM servicing recommendations are proposed for the Benn Drain subwatershed:

- Reduce the number of outlets long-term with efforts to streamline storm infrastructure through road reconstruction and infrastructure renewal programs.
- Implement LID and source level water quality controls as part of road reconstruction and infrastructure renewal projects where feasible and appropriate.
- Conduct routine inspections and maintenance of storm CBs, MHs, outlets. Mitigate impacts of sag locations, with routine maintenance of catch basin grates.
- Obtain dataset of storm sewer network, including length, diameter, slope, inverts to support future capacity analysis and upgrades.
- Incorporate major flow conveyance and capture in areas with limited relief. This may include oversizing CB inlets and storm sewers to limit ponding within the Road ROW and mitigate impacts to private lands.
- Require detailed flood assessment studies for developments within or near flood hazards lands, including assessment of safe flood depths, flood conveyance, flood elevations, and flood storage. Previous studies have indicated the spill south of William Street is due to the undersized culvert system under the railway lands.
- Alternatives for floodplain storage loss may be accommodated within the Township owned lands located upstream of Saintsbury. Detailed hydraulic studies would be required.

6.5.3 Whitfield Drain

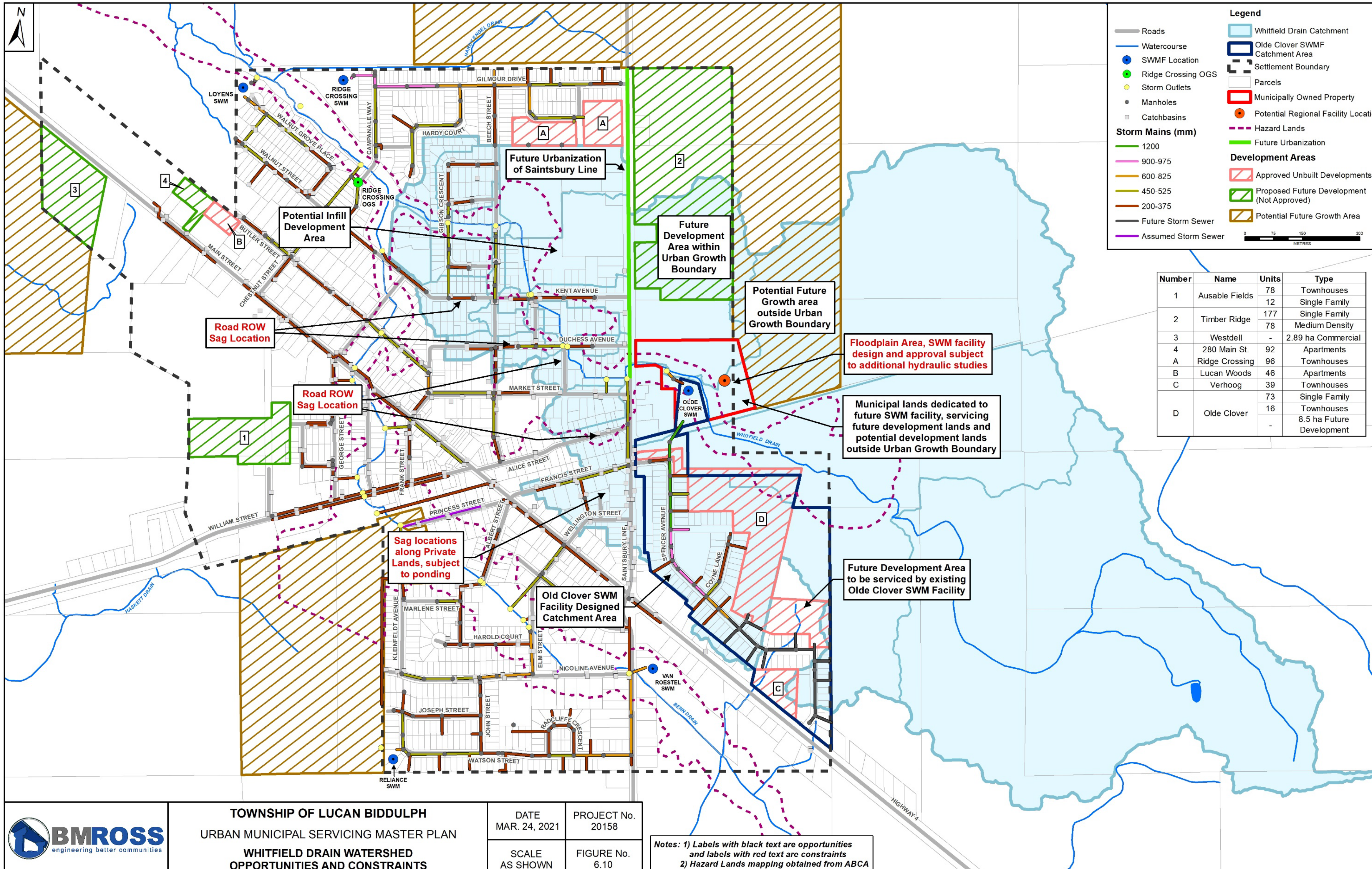
Historical development within the Whitfield Drain subwatershed has generally been limited to west of Saintsbury Line. Eight storm sewer outlets servicing relatively small catchment areas were identified in available GIS data. The Olde Clover SWM facility provides SWM control for the Lucan Estates subdivision and unbuilt approved developments, east of Saintsbury Line and south of the Whitfield Drain. Future development within the settlement boundary (Timber Ridge and Southside Subdivisions) is proposed east of Saintsbury Line and north of the Whitfield Drain. There is known development interest for lands immediately east of the proposed Timber Ridge subdivision outside the current settlement boundary.

The following opportunities and constraints have been identified for the subwatershed and are illustrated in Figure 6.10.

Opportunities

- Small existing storm service areas provide opportunity for use of oil-grit-separators (OGS) units and low impact development solutions (LID) for water quality retrofits for road reconstructions and infill developments.
- Future urbanization of Saintsbury Line may allow for local minor/major system improvements and water quality retrofits.
- The Olde Clover SWMF provides regional control for unbuilt approved developments within the service area.

Figure 6.10 Whitfield Drain Watershed – Opportunities and Constraints



Number	Name	Units	Type
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B	Lucan Woods	46	Apartments
C	Verhoog	39	Townhouses
D	Olde Clover	73	Single Family
		16	Townhouses
		-	8.5 ha Future Development

- There is potential for infill development west of Saintsbury Line and north of Kent Avenue.
- Municipal SWM block along the Whitfield Drain, east of Saintsbury Line, may be used for future SWM facilities. Approximately 3.2 ha of the SWM block remain undeveloped on the north/east side of the drain. There is opportunity to provide regional SWM controls for proposed developments within the settlement boundary, with potential oversizing or future expansion to service potential growth areas outside of the settlement boundary.

Constraints

- Township SWM block is located within Whitfield Drain regulatory floodplain. Approval and implementation of SWM facility requires detailed flood hazard assessment, as outlined in Section 6.4.7.
- Floodplain hazard mapping upstream (east) of Saintsbury Line requires further assessment to confirm existing conditions and development restrictions. The previous 1994 ABCA Lucan Two Zone Study truncated at Saintsbury Line and current Hazard mapping from ABCA in this region is indicated for general purposes. Additional floodline studies have been conducted east of Saintsbury Line to support the Lucan Estates subdivision (Olde Clover SWMF), as summarized in Section 6.2. Based on these previous studies, it is known that the existing regulatory floodline encroaches the SWM block, most notably just upstream of Saintsbury Line, including some encroachment into the proposed development lands for the Southside Development. Potentially one hectare of the SWM block is located outside of the regulatory flood line, including lands immediately adjacent to the abandoned rail line, and east property line.
- There are areas of limited major overland flow relief. There is potential for nuisance ponding on road ROW and spill to private lands along Kent Avenue, Duchess Avenue, Maple Street, and Alice Street.
- There are sag locations and limited major overland flow relief for private lands within the Francis Street, Wellington Street and Saintsbury Line block.

Servicing Recommendations

Based on the above, the following SWM recommendations are proposed for the Whitfield Drain subwatershed:

- Require detailed flood assessment studies for developments and SWM facilities within or near flood hazards lands, including assessment of safe flood depths, flood conveyance, flood elevations, and flood storage. Refer to Section 6.4.7 for criteria.
- Encourage the development of a regional SWM facility servicing lands within the settlement boundary east of Saintsbury Line discharging to the Whitfield Drain.
- Opportunities to service future development areas currently outside of the settlement boundary through facility expansion is recommended to limit long-term

SWM infrastructure requirements. The location of the regional facility is to be within the Municipal SWM block, subject to further hydraulic studies. It is noted that additional land requirements outside the existing SWM block may be required to provide required SWM controls for proposed developments subject to pond size requirements and mitigation of floodplain impacts.

- To limit potential impacts to floodplain storage and flood levels, it is recommended that the regional SWM facility be located to along the east portion of the SWM block to reduce impacts associated with deeper flood levels adjacent to Saintsbury Line. Flood storage compensation may be considered along the north side of the Whitfield drain closer to Sainsbury Line as required, within SWM block lands.
- Reduce the number of outlets long-term with efforts to streamline storm infrastructure through road reconstruction and infrastructure renewal programs.
- Implement LID and source level water quality controls as part of road reconstruction and infrastructure renewal projects where feasible and appropriate.
- Conduct routine inspections and maintenance of storm CBs, MHs, outlets. Mitigate impacts of sag locations with routine maintenance of catch basin grates.
- Incorporate major flow conveyance and capture in areas with limited relief. This may include oversizing CB inlets and storm sewers to limit ponding within the Road ROW and mitigate impacts to private lands. Any future road reconstruction should ensure no changes in road grade along sags within designated flood hazards lands. Sags are to be maintained for flood conveyance.
- Create a dataset of the storm sewer network, including length, diameter, slope, inverts to support future capacity analysis.

6.5.4 Hardy-Engel Drain

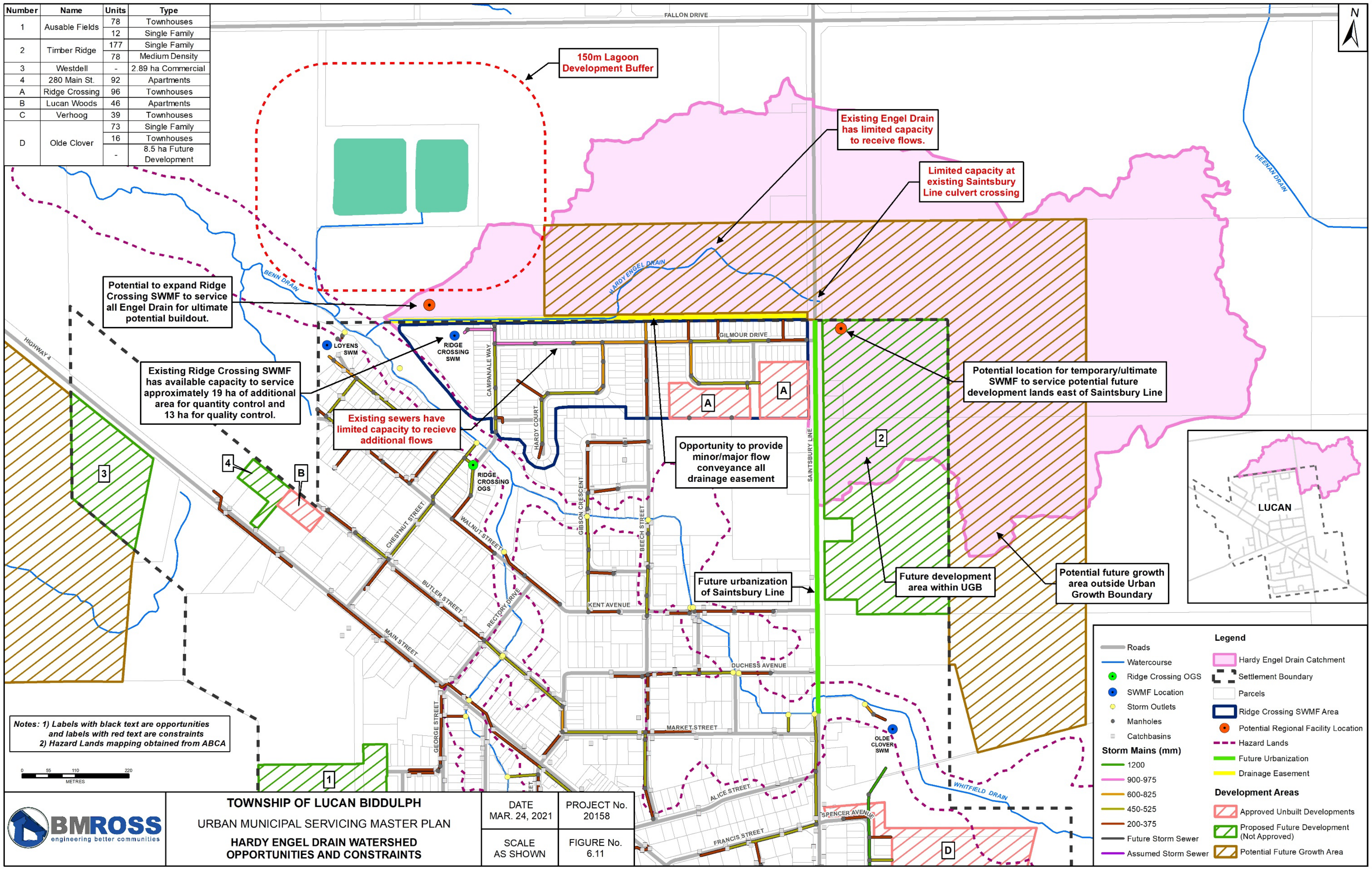
The Hardy-Engel Drain is located on the northwest edge of the existing settlement boundary, servicing approximately 82 ha of agricultural lands. The drain was realigned in 2014 to support the development of the Ridge Crossing subdivision along Gilmore Drive/Campanale Way. The drain was replaced with a 525 concrete tile drain and major flow swale on west half of the established drainage easement north of Gilmore Drive. The capacity of the Hardy-Engel Drain is limited as it was designed to rural drainage standards.

The following opportunities and constraints have been identified for the subwatershed and are illustrated in Figure 6.11:

Opportunities

- Future development of residential lands east of Saintsbury Line (Timber Ridge Subdivision) as per the official plan.
- Potential future growth area outside settlement boundary, north of Gilmore Drive and further east of Saintsbury Line.
- The Hardy-Engel Drain has a dedicated drainage easement, for future servicing, that was established as part of the 2014 drain realignment for the

Figure 6.11 Hardy-Engel Drain Watershed – Opportunities and Constraints



- Ridge Crossing subdivision development. This easement can provide an efficient corridor for ultimate storm infrastructure (open channel/storm sewers).
- The existing Ridge Crossing SWMF is oversized and has available capacity to service approximately 19 ha of addition area for quantity control and 13 ha for quality control. Excess capacity was originally intended to service a future development area outside the settlement boundary, north of Gilmore Drive and west of Saintsbury Line (approximately 10 ha).
- Lands immediately north of the Ridge Crossing SWM facility provide a potential location of a future regional SWMF or expansion of the existing Ridge Crossing SWM facility. It is noted that a 150 m setback from the wastewater treatment plant and sewage lagoons is applied along these lands, limiting potential future residential development. Other opportunities may include new open space/soccer field.
- Opportunity to use a temporary/ultimate SWM facility upstream (east) of Saintsbury Line to aligned with current development plans, ahead of ultimate SWMF construction.
- Future urbanization of Saintsbury Line may allow for local minor/major system improvements and water quality retrofits.

Constraints

- Timing and sequence of development is uncertain.
- Capacity of the existing Hardy-Engel drain to receive flow is limited. Based on the design drawings details in Spriet Associates Inc. 2014 report, the capacity of the closed 525 mm tile drain is estimated at 0.3 m^3/s and the overland flow swale is estimated at 1.5 m^3/s, for a total combined capacity of 1.8 m^3/s. The design of future upstream development will need to limit flows to allowable levels of the receiving swale and tile system or additional upgrades will be required.
- Increasing the service area of the Ridge Crossing SWM Facility is constrained.
  - The existing Ridge Crossing SWMF does not have capacity to take in the entire Hardy-Engel Drain subwatershed. Retrofits and expansion of the facility would be required if the entire Hardy-Engel Drain was redirected to the SWMF for servicing.
  - The existing Hardy-Engel Drain easement and major flow swale isolates the area north of the urban boundary and west of Saintsbury Road from potential servicing to the Ridge Crossing SWMF. Servicing analysis indicates that minor flows could be conveyed by storm sewer via a storm sewer crossing of the drain to the Ridge Crossing Subdivision. Storm sewer upsizing would be required for the inlet sewer along Campanale Way to the SWMF forebay. Major capture and conveyance by storm sewer to the Ridge Crossing SWM facility may be difficult and not feasible. An additional facility to attenuate only major flows may be required north of Gilmore Drive.

- Storm sewers along Gilmore Drive have limited capacity for additional flows from proposed development areas east of Saintsbury Line.

Servicing Alternatives

Based on the above, the following ultimate servicing options are outlined. The Alternatives assume the Hardy-Engel Drain subwatershed will be subject to additional growth, including possible expansion of the settlement boundary to the north and east.

- **Alternative 1: Two SWMFs servicing lands east and west of Saintsbury Line**. This alternative would involve a regional SWMF upstream of Saintsbury Line, and an additional SWMF for lands north of Gilmore Drive. The SWMF servicing lands north of Gilmore Drive may be required only for major flows, with minor flows directed to the Ridge Crossing Subdivision. A dry pond could provide major flow attenuation, and could be incorporated into future open space north of the Hardy-Engel Drain easement. Under this scenario, conveyance works along the drainage easement would need to be sized for ultimate post-development controlled flows.
  - Pro:
    - Developer driven. In line with current proposals.
    - Can be developed in phases. A temporary SWM facility can be constructed upstream of Saintsbury Line, and expanded in future to receive flows from future lands.
    - Smaller infrastructure requirements along drainage easement required, as flows are controlled upstream of Saintsbury Line.
  - Con:
    - Does not maximize the surplus capacity of the Ridge Crossing SWMF.
    - Under full build out conditions, there will potentially be three SWM facilities constructed (Ridge Crossing SWMF, Timber Ridge SWM (Interim/Ultimate), and north of Gilmore SWMF/Dry Pond)

- **Alternative 2: A Single Regional SWMF servicing Hardy-Engel Drain.** This option could involve the use of a temporary SWMF constructed as part of the current development proposal for Timber Ridge upstream of Saintsbury Line. Upon ultimate built out of the subwatershed, the Ridge Crossing SWMF could be expanded to service the additional upstream area, or a second separate SWMF could be constructed in the lands within the lagoon buffer immediate north of the Ridge Crossing stormwater pond, receiving flows from the Hardy-Engel drain. Under this servicing alternative, conveyance works along the drainage easement would need to be sized for ultimate post-development uncontrolled flows.
  - Pro:
    - Future decommissioning of temporary facilities upstream servicing Phase 1 of Timber Ridge.

        - Reduces the number of stormwater facilities in the ultimate build-out from three SWMFs (Ridge Crossing, Timber Ridge, Land North of Gilmore) to potentially 1 (expanded Ridge Crossing SWMF).
    - Con:
        - Requires coordination of ultimate SWM servicing.
        - SWM conveyance infrastructure must be sized for uncontrolled ultimate flows. Requires larger channel works and culvert crossing of Saintsbury Line to convey major and minor flows to a regional SWM Facility at the downstream end of the easement.

Servicing Recommendations

The preferred SWM strategy for the Hardy-Engel Drain subwatershed is Alternative 2, a single ultimate regional SWM facility to promote efficient development, minimize servicing costs and ensure necessary infrastructure is available for to meet current and future needs. An expansion of the existing Ridge Crossing SWMF is preferred to maximum the existing excess capacity. It is recommended that conveyance to the regional SWMF from future development lands be provided along the existing Hardy-Engel Drain easement. An open channel is recommended to convey ultimate build out condition flows, including potential future developments lands further east of Saintsbury Line and lands immediately north of Gilmore Drive. A preliminary servicing assessment has indicated that, due to existing topography, some sections of the open channel may be quite deep and require the installation of gabions/retaining walls to stay within the existing easement corridor. An increased easement width may be necessary. The preferred strategy and sizing of infrastructure is subject to further study.

A temporary SWMF may be constructed upstream of Saintsbury Line ahead of the recommended future expansion works to the Ridge Crossing SWMF and conveyance measures along the drainage easement. The temporary SWMF facility would be decommissioned once a regional facility is established. Interim measures may include a temporary SWMF and drainage infrastructure along the existing drainage easement. Timing of future expansions to the settlement boundary should be considered in the design of any infrastructure in the Hardy-Engel Drain easement. As noted, it is preferred that infrastructure is established for ultimate build-out conditions as feasible.

It is acknowledged that Alternative 1 is most aligned with historical development patterns for stormwater management in Lucan, with larger developments implementing SWMF on their own lands. If this option is preferred to be implemented, it is recommended that any works conducted within the drainage easement are sized for the entire upstream drainage area east of Saintsbury. This will remove the need for lands north of Gilmore Drive to account for flows directed to the existing Hardy-Engel drain (east of Saintsbury) upon future development.

6.5.5 Hardy 1984 and Hardy 1952 Drain

The Hardy 1984 Drain and Hardy 1952 Drain subwatersheds are located on the west edge of the existing urban boundary, with total drainage areas of 22 ha and 36 ha respectively. An unnamed tributary to the Little Ausable River is located to the south of the Hardy 1984 drain and receives drainage from approximately 50 ha of agricultural lands and some rural residential properties along William Street.

The west limits of the existing urban area discharge to the Hardy 1984 drain. The drain consists of a 250 mm tile from Community Drive (unopened road ROW) and runs through the Lucan Community Centre property. The drain increases to a 400 mm tile at the confluence of the A and C Branches, and outlets just west of Coursey Line. The Hardy 1952 Drain consists of 200 mm and 250 mm tile servicing lands south of Main Street, and outlets west of Coursey Line. At the time of reporting, there is an ongoing petition under the Drainage Act to improve drainage for the 1952 Hardy Drain.

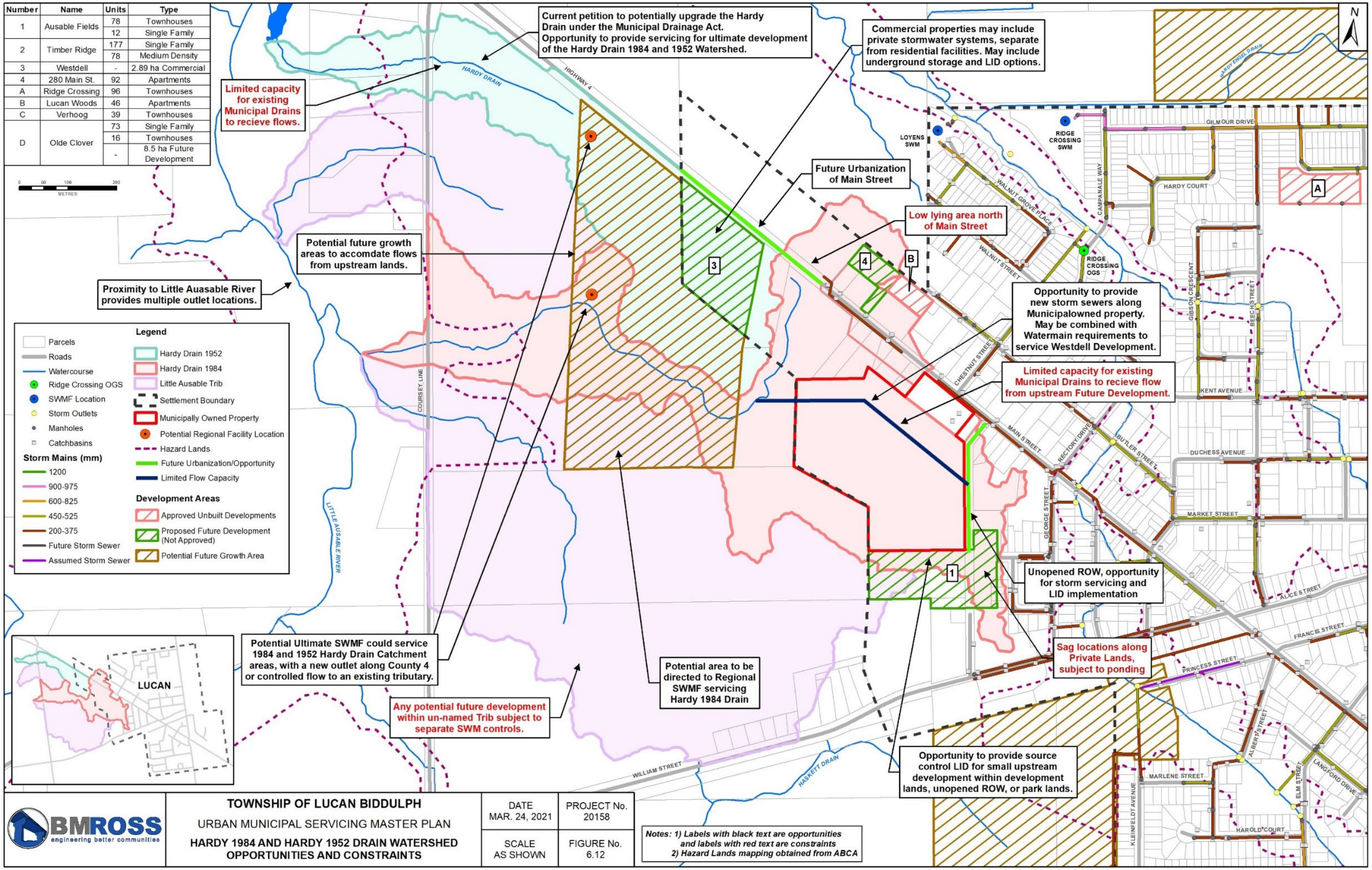
Future developments are proposed within the settlement boundary, commercial lands south of Main Street (Westdell), apartments north of Main Street (280 Main St) and townhomes west of Philip Street (Ausable Fields). Both municipal drains are sized for rural drainage and have limited capacity. No future development was accounted for in the original sizing of the drains.

The following opportunities and constraints have been identified for the subwatershed and are illustrated in Figure 6.12:

Opportunities

- Future developments are proposed within the settlement boundary,
    - Westdell - Commercial lands south Main Street
    - 280 Main Street - apartments north of Main Street
    - Ausable Fields – townhome block and 12 single family residential homes west of Philip Street.
- Future urbanization of Main Street may allow for local minor/major system improvements and water quality retrofits.
- Proximity to the Little Ausable River provides multiple outlet locations.
- There is a current petition to potentially upgrade the Hardy 1952 Drain under the Drainage Act. This is an opportunity to provide servicing for ultimate development of the Hardy 1984 and 1952 subwatersheds.
- Potential for future growth areas to include regional SWM controls and accommodate flows from upstream lands.
- Opportunity to provide source control/LIDs for small upstream development within development lands, unopened road ROW and/or park lands.
- There is opportunity to provide new storm sewers along Township owned property (Lucan Community Centre). Works may be combined with watermain requirements to service future developments (i.e. Westdell).

Figure 6.12 Hardy 1984 and Hardy 1952 Drain Watershed – Opportunities and Constraints



Number	Name	Units	Type
1	Ausable Fields	78	Townhouses
		12	Single Family
2	Timber Ridge	177	Single Family
		78	Medium Density
3	Westdell	-	2.89 ha Commercial
4	280 Main St.	92	Apartments
A	Ridge Crossing	96	Townhouses
B	Lucan Woods	46	Apartments
C	Verhoog	39	Townhouses
D	Olde Clover	73	Single Family
		16	Townhouses
		-	8.5 ha Future Development

Constraints

- The limited capacity of existing drains to receive flow from proposed developments.
- A low-lying area north of Main Street is subject to ponding.
- A low-lying area west of Philips Street within the Ausable Fields development is subject to ponding.
- The Ausable Fields development, of approximately three hectares, including a town house block and 12 single family homes, sits on a watershed divide between the Hardy 1984 Drain, an unnamed Little Ausable Tributary and the Haskett Drain. Preliminary servicing plans for the development (May 2020) identified a lack of outlet capacity if discharged to the Hardy 1984 Drain.
- Redirection of catchments must ensure pre-development flows are maintained. If new outlets are used, the receiving channel/drain must be assessed to ensure property quantity and erosion controls are provided as part of SWM Strategy.

Servicing Alternatives

a) General Servicing Alternatives

Based on the above, the following ultimate servicing options are outlined. The Alternatives assume the Hardy 1952 and 1984 Drains will be subject to flows from future development, including potential long-term expansion of the settlement boundary to the west, within the planning horizon.

- **Alternative 1: Site Controls.** This option would involve each development proceeding with separate site controls. This approach is applicable to infill developments and may require over control to discharge to existing drainage infrastructure. Developments downstream along the Hardy Drain, including any expansion of the settlement boundary, would be required to realign/incorporate drainage from upstream lands. This may result in duplication of infrastructure as additional storm sewer/major flow easements are required to convey upstream flows through development lands separate from the proposed development's SWM system. This option does not provide efficient use of the ultimate infrastructure.

- **Alternative 2: Two Regional SWMFs and Site controls.** This option would involve the long-term development of two SWMFs servicing the Hardy 1952 and 1984 subwatersheds respectively. SWMF locations and service areas would aim to maintain pre-development catchments such that facilities can be designed to discharge at pre-development flow rates to the receiving watercourses. Small infill developments would require site controls for water quality and water quantity ahead of regional SWM facility construction and where existing infrastructure is limited in its ability to receive flows.

- **Alternative 3: Single Regional SWMF and Site controls.** This option would involve the ultimate servicing of both the Hardy 1984 and Hardy 1952 Drains discharging to a single regional SWMF. Similar to Option 2, source controls would be required for infill developments ahead of the regional SWM facility construction and where existing infrastructure is limited to receive flows. The outlet for the facility could be planned along County Road 4 with future outlet works to the Little Ausable River or potentially incorporated into the 1952 Drain upgrades. This option would involve the redirection of flows to a single outlet. A direct outlet to the Little Ausable along County Road 4, complete with engineered energy dissipation measures, would allow flows to discharge at rated pre-development levels at a single outlet. If the existing tributary of the 1952 Hardy Drain is used for the outlet, additional quantity control may be required to ensure the watercourse and valley system is not impacted by increased flows. Further detailed assessment is required. It is acknowledged that redirection of flows may not be favourable due to natural heritage factors.

b) Ausable Fields Servicing Alternatives

The proposed Ausable Fields townhouse development, of approximately three hectares, currently sits on a watershed divide between the Hardy 1984 Drain, an unnamed Little Ausable Tributary and the Haskett Drain. Preliminary servicing plans for the development (May 2020) identified the lack of outlet capacity of the Hardy 1984 Drain, and described three alternatives to improve outlet conditions:

A. **Upsize Hardy 1984 Drain** (1.3 km storm sewer).

B. **Twin Hardy 1984 Drain** (1.3 km storm sewer).

New Drain/Storm Sewer Outlet (1 km storm sewer to Un-named Little Ausable Tributary).The construction of a single 1 to 1.3 km storm outlet to service three hectares is considered inefficient use of storm infrastructure when future downstream development is anticipated. Potential future development within the Hardy 1984 and 1952 Drain subwatersheds will need to accommodate drainage from upstream lands upon development. Two additional alternative servicing options are outlined below.

Maintain Existing Drainage with Source/LID controls. This alternative would require that drainage splits be maintained to existing subwatersheds as per existing conditions, with source controls being LIDs (e.g. raingardens, swales) with discharge to surface or underdrained with discharge to available storm outlets. Any source controls/LID systems implemented for single family residential developments should be located within the road ROW or municipal lands to be maintained by the Township. Source controls located within apartment/townhome complexes would remain the responsibility of the owner to operate and maintain.

Source Controls/LID Controls with Discharge to the Hardy 1984 Drain. This alternative is similar to Alternative D, except all drainage from the Ausable Fields development would be directed to the Hardy 1984 Drain with source controls and LID measures for the condo townhouse and single family units. This alternative may result in larger source control requirements as flows would need to be over controlled due to directing all drainage north to the Hardy 1984 Drain which has limited capacity.

If a regional facility is constructed downstream as part of future development, a new storm sewer could be constructed along the Lucan Community Centre property to accommodate increased flows. LIDs/source control could be considered interim and eligible for decommissioning.

Servicing Recommendations

The recommended SWM approach for the Hardy 1984 and Hardy 1952 subwatersheds is Alternative 2: Two Regional SWMFs and Site controls. This option provides a regional approach, supports proposed development plans, and includes best management practices to conserve existing drainage areas.

For the Ausable Fields development, both alternatives D and E are viable SWM servicing options. Option D, maintaining drainage areas is preferred, as limited capacity is available in the existing Hardy 1984 Drain. However, site servicing may limit the ability to discharge LIDs to the surface. Additional land for LID siting may be made available within the Lucan Community Centre Park lands, subject to further consultation with the Town. It is noted that LID implementation within public park lands may include educational signage for public education and awareness, and be landscaped, naturalized, or grassed. Section 6.4.8 provides details and design requirements for implementing LIDs.

6.5.6 Haskett Drain

The Haskett Drain, located along to the southwest limit of Lucan, services approximately 94 ha of existing mostly agricultural lands. A small portion of the urban lands, dedicated to commercial and industrial uses near a grain elevator, are directed to the drain. The Reliance SWMF located on the southeast limit of the subwatershed serves 6.35 ha of existing residential area, and discharges to the surface via a level spreader swale. The Reliance SWM facility was intended to be temporary and a future SWM facility located along the Haskett Drain would allow for the decommissioning of the facility.

There is known development interest in the lands immediately west of the existing settlement boundary, south of William Street. These lands are outside of the current settlement boundary and subject to further floodplain assessment, due to the regional spill from the Benn Drain to the Haskett Drain south of William Street, identified in the 1994 Lucan Two Zone Study. Development timing is currently unknown.

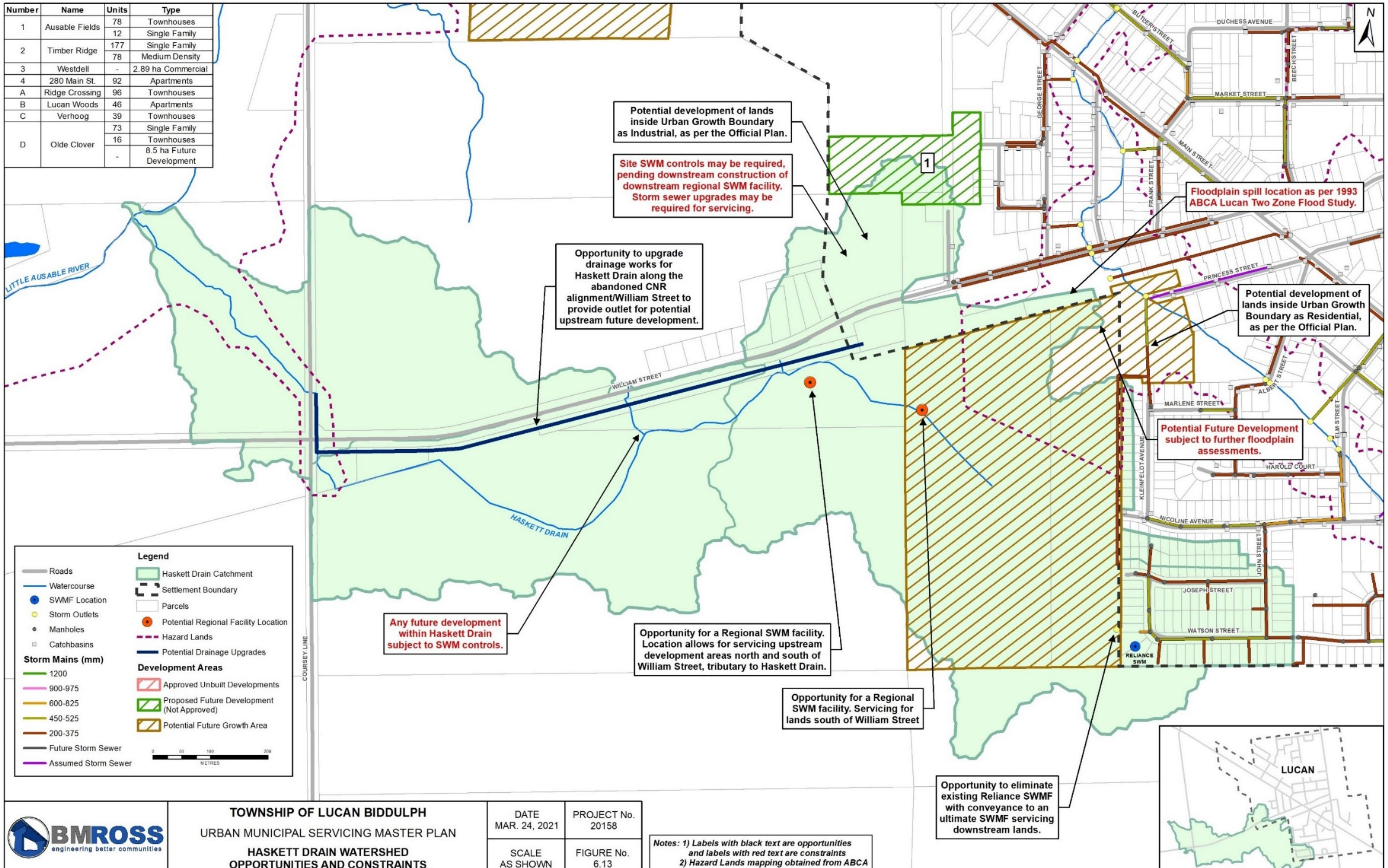
The following opportunities and constraints have been identified for the subwatershed and are illustrated in Figure 6.13:

Opportunities

- There are potential development lands inside the existing settlement boundary north of William Street planned as Industrial, as per the Official Plan.
- There is a potential future growth area outside the existing settlement boundary, south of William Street and west of Kleinfeldt Avenue.

Figure 6.13 Haskett Drain Watershed – Opportunities and Constraints

Number	Name	Units	Type
1	Ausable Fields	78	Townhouses
		12	Single Family
2	Timber Ridge	177	Single Family
		78	Medium Density
3	Westdell	-	2.89 ha Commercial
4	280 Main St.	92	Apartments
A	Ridge Crossing	96	Townhouses
B	Lucan Woods	46	Apartments
C	Verhoog	39	Townhouses
D	Olde Clover	73	Single Family
		16	Townhouses
		-	8.5 ha Future Development



- There is opportunity to upgrade drainage works for the Haskett Drain along the CNR alignment/William Street to provide outlet for potential upstream development.
- There is opportunity for a regional SWM facility to service both the north and south sides of William Street, subject to potential development.
- There is opportunity for a regional SWM facility located within potential future development lands to service lands south of William Street.
- There is opportunity to eliminate the existing Reliance SWMF with conveyance to an ultimate regional SWM facility servicing downstream lands. Upon decommissioning of the existing SWMF, the SWM block may be developed into an additional three residential lots.

Constraints

- SWM controls are required for any future development downstream of a potential regional SWM facility.
- Site SWM controls may be required for industrial lands, pending construction of a downstream regional SWM facility. New storm sewers or drainage upgrades may be required to convey flows to a regional SWM facility.

Servicing Alternatives

Based on the above, the following ultimate servicing options are outlined. The alternatives assume the watershed of the Haskett Drain will be subject to future development, including potential long-term expansion of the settlement boundary to the west.

Alternative 1: Site Controls. This option would involve each development proceeding with separate site controls. This approach is applicable to infill developments and may require over control of discharge to existing drainage infrastructure. Large developments would be required to realign/incorporate drainage from upstream lands. This may result in duplication of infrastructure as additional storm sewer/major flow easements may be required to convey upstream flows through development lands separate from the proposed development SWM system. This option does not provide efficient use of ultimate infrastructure. Upgrades to the Haskett Drain will be required for any significant development south of William Street.

Alternative 2: Regional SWMF and Site controls. This option would involve the long-term development of a regional SWM facility servicing the Haskett Drain subwatershed. The outlet for a regional SWM facility could be planned south of William Street and incorporated into future Haskett Drain upgrades. Small infill developments would require site controls for water quality and water quantity ahead of a regional SWM facility construction. Additional quantity controls may be required where existing infrastructure has limited capacity to receive flows. Further detailed assessment is required.

Siting of a regional SWM facility requires further assessment. The location of the regional SWM facility will dictate the potential upstream service area. A SWM facility located within the lands indicated for potential development, south of William Street, will allow for servicing of the subject lands and upstream existing areas, including the decommissioning of the Reliance SWM facility. Locating the regional SWMF further west, may allow for additional lands north of William Street to be serviced by a regional SWM facility. Additional SWM studies for the Haskett Drain subwatershed are required.

Servicing Recommendations

The recommended SWM approach for the Haskett Drain subwatershed is **Alternative 2: Regional SWMF and Site Controls**. This option provides a regional approach, supports infill and potential future development plans, and includes best management practices. Upon future expansion of the settlement boundary, the location of the regional SWM facility should be revaluated based on anticipated development south and north of William Street. Further floodplain assessments are required to characterize the regulatory spill from the Benn Drain to the Haskett Drain. Development within flood fringe and floodplain spill areas may be permitted following further study and flood proofing to the regulatory floodplain is undertaken. Refer to Section 6.4.7 for development restrictions and locating SWMFs within flood hazards.

7.0 Summary of Servicing Issues and Alternatives

7.1 Summary of Servicing Issues

7.1.1 Water Supply

The existing major facilities for potable water supply include:

- A connection to the LHPWSS at Chamber 44 and approximately 5.3 km of 350 mm dia. pipeline to a booster pumping station at Denfield Road and William Street.
- A Booster Pumping Station (BPS) at Denfield Road and William Street.
- Approximately 3.3 km of watermain extending from the BPS to the area of the Lucan Elevated Tank.

With reference to Section 4.2, the issues identified relative to water supply include:

- Approved development is expected to increase the maximum day demand to 2,910 m^3/day. Approved development plus current known proposals will increase demands to 3,420 m^3/day which is approximately 85% of the supply.
- The existing available water supply from the LHPWSS connection to the Lucan elevated tank will be adequate until approximately 2042 at the highest projected growth rate.

Theoretically, reducing existing water demands is equivalent to increasing supply.

To increase the supply will likely involve replacing or paralleling all or part of the existing supply main from Chamber 44 on the LHPWSS to the elevated tank. The supply is also impacted by operating pressures within the LHPWSS.

The supply capacity should be re-evaluated at five year intervals and detailed planning should begin no later than ten years ahead of the actual need to increase supply.

7.1.2 Water Storage

Treated water storage is provided in two structures:

- An Elevated Water Tank in Lucan with a capacity of 2,270 m3.
- Water storage and pumping facilities at Granton supplied from the Lucan distribution system.

The available water storage volume is adequate until approximately 2036 at the highest projected growth rate.

The preferred approach to providing additional storage (i.e. volume, type and location) needs to be the subject of further study. This study, in the form of a Schedule B Class EA, should take place within the next five years to ensure that a preferred solution is known ten or so years prior to the absolute need. Within the study the following should be considered:

- The opportunity to decrease existing maximum day demands.
- Longer term (e.g. 50 years) potential growth given the typical life of a storage facility.
- Risks associated with the loss of supply.
- Specific local needs within the water distribution system (see the next section of the report).

7.1.3 Water Distribution

Modelling of the water system has identified two existing issues.

1. Additional flows for fire protection are required for the existing industrial/commercial area near Fallon Drive and Saintsbury Line.
2. Additional flows are required to accommodate planned development in the northwest part of Lucan on Main Street generally north of Chestnut Street.

Alternatives to address the two identified issues are:

Fallon Drive/Saintsbury Line Industrial Area

Options to improve fire flow include a parallel main on Saintsbury, or storage within the immediate area. Selection of a preferred alternative should consider a number of factors, including the potential to address more than one servicing concern through a single project. For example, an additional water storage facility could improve available fire flows and increase the available storage within the system for other purposes as well. Additional study is required to determine a preferred approach.

Northwest Area

Alternatives are available to resolve the current problem and improve conditions in this area for growth. Replacing the existing watermain along Main Street, at least as far south in the system as Chestnut Street, with a larger capacity watermain is likely the preferred approach. In any event, the 100 mm diameter section of watermain should be replaced.

An alternative option is the provision of a looped watermain feed to this area. It is noted that to do so may require an easement through private land(s) depending on route.

Depending on the scale of development in the area, it is possible that a larger diameter watermain on Main Street and a looped feed would both be desired. A looped feed would increase the security of the supply.

Selection of a preferred alternative should consider a number of factors, including the reality that servicing of such development lands will require new infrastructure for sanitary servicing as well. Where possible, water and sewer infrastructure should be designed and constructed concurrently.

7.1.4 Wastewater Pumping and Treatment

The major facilities for wastewater pumping and treatment include:

A single sewage pumping station referred to as the Chestnut SPS which has the capability to discharge to the WWTP and also discharge to the existing sewage lagoons.

Treatment is provided by the Lucan WWTP rated at:

- 1,700 m^3/day AADF.
- 3,600 m^3/day Peak Day Flow.

The issues identified in Section 5 of the Master Plan relative to wastewater pumping and treatment include:

- At the highest projected growth rate the AADF capacity of the WWTP will be exceeded by 2030.
- There are currently new development applications that exceed the uncommitted reserve capacity of the treatment system.
- Currently peak flows in the order of 2% of the total annual flow are being diverted to the lagoons prior to receiving treatment before discharge. As growth occurs the volume diverted will increase.
- The existing WWTP Headworks which includes screening and de-gritting equipment is a peak flow constraint for the entire WWTP. Also, the equipment has reached its useful life.
- Existing biosolids treatment and storage facilities are substantially undersized for even the current plant rating. The current operating approach is to transfer excess biosolids from the holding facilities to the existing lagoons when land application is not feasible. This is at best an interim solution.
- Although effluent criteria for TP concentrations are currently being met there is an increasing trend in the values.
- The capacity of the Chestnut SPS will have to be increased to accommodate projected growth. Currently the ability of the station to discharge to the WWTP is constrained by the peak hydraulic capacity of the existing WWTP Headworks.

With the exception of an observed trend of increasing TP concentrations, all of the issues at the WWTP relate to plant capacity, both average and peak flow. The TP issue is currently being addressed through a study and implementation of relatively minor modifications.

The plant capacity issue is best addressed through a Municipal Class EA process that would consider projected growth and other related factors. Township Council has initiated the EA which will consider at least the following alternatives:

- Restrict growth within the community.
- Reduce Annual Average flows.
- Increase rated treatment capacity.
- Do Nothing

Because of the direct relationship between the maximum discharge from the Chestnut SPS and WWTP peak flow capacity, increases to the capacity of the Chestnut SPS should be considered simultaneously with the WWTP EA.

7.1.5 Wastewater Collection

Table 5.4 and Figures 5.3 and 5.4 provide a summary of existing and potential future issues within the sanitary sewer collection system. Of 277 pipe sections in the system, 21 are operating at 80% or greater of their theoretical capacity. Seven of these are at greater than 100%. After build-out of proposed development within the urban area there will be 40 pipe sections at greater than 80% and 19 at greater than 100%.

Replacing undersized sewers with greater capacity pipes is one option to remove constraints.

Before planning a pipe replacement to increase flow capacity consideration should be given to the potential impact at the downstream Chestnut SPS (i.e. the SPS may not have capacity to handle the increased flow). For some development, particularly in the north portion of the community, a new SPS and forcemain directly connected to the WWTP may be considered as an alternative to increasing the capacity of existing collection system infrastructure.

It is recommended that, as part of detailed servicing design for such developments, these alternatives be compared in terms of technical feasibility, and overall economics which would include sewer construction, upgraded existing or new SPS and forcemain construction, and also where new watermain and/or storm sewer works may also be constructed to service the new development.

7.1.6 Stormwater Management

Additional SWM facilities and conveyance infrastructure is required as Lucan continues to experience growth. Historically SWM works were initiated using a piecewise approach to serve individual developments. This approach was generally feasible in the past as new developments resided adjacent to receiving open watercourses of the Benn and Whitfield Drain. Additional servicing constraints exist as development progresses into adjacent subwatersheds of the Haskett, Hardy-Engel, and Hardy (1984 & 1952) Drain. Development within these subwatersheds tends to be within the headwaters of the respective drainage areas, with outlet capacity and routing of controlled drainage relying on existing rural municipal drains and downstream lands. To reduce SWM facility land requirements, capital and long-term maintenance costs, the coordination of planning and sizing of storm infrastructure is required. Refer to Section 6.5 for a detailed list of problems and opportunities and servicing alternatives for each subwatershed.

7.2 List of Alternatives

Table 7.1 presents preliminary details of the alternative solutions available to address identified issues.

Under the MCEA, the Do Nothing option is always to be considered as a potential alternative. Doing nothing means that no solution will be implemented. In many cases the identified problem will worsen. Do Nothing is included as an alternative because there may be circumstances when the other alternatives are not feasible, whether from a cost perspective or if they will have significant environmental impacts that cannot be mitigated.

For all of the issues identified in Table 7.2, the Do Nothing alternative is not considered feasible. Doing nothing will not address the need for additional capacity. It is not feasible from a technical and policy perspective to maintain the status quo in light of forecasted population growth and requirements for the provision of servicing under the Provincial Policy Statement, and MECP Design Guidelines. Given this, the Do Nothing options for the identified issues are not considered feasible alternatives and were not further evaluated as part of this Master Plan.

In some situations (e.g. water supply) the need to address capacity is many years in the future and will be the subject of future studies and approvals. The alternatives to be investigated may change from the list in Table 7.2. What is presented is a preliminary list based on current information.

Table 7.1 Preliminary Summary of Alternative Solutions

Service	Facility	Identified Issue	Critical Year	Alternative Solutions
Water Supply	Supply watermain from the LHPWSS to the Lucan Elevated Tank and the Booster Pumping Station	Need for additional capacity (See Section 4.3 and Figure 4.2)	2042	• 1A Reduce Maximum Day Demand. • 1 B Increase supply capacity
Water Storage	Existing Elevated Tank	Need for additional treated water storage for: • Flow equalization, fire flow and emergency. • Supply security.	2036	• 2A – Reduce Maximum Day Demand • 2B – Modify the existing storage facilities • 2C – Construct additional storage
Water Distribution	Distribution watermains	Water supply for fire protection to: • Fallon Drive/Saintsbury Line industrial area. • Main Street generally north of Chestnut Street.	There are existing needs.	• The preferred solutions depend on the timing of additional development and investigation of options regarding water storage expansion.
Wastewater Pumping	Chestnut SPS	Need for increased capacity. (See Section 5.4)	To coincide with WWTP capacity increase.	• 3A Reduce existing peak flows • 3B Provide larger pumps in the SPS

Service	Facility	Identified Issue	Critical Year	Alternative Solutions
Wastewater Treatment	Lucan WWTP	Need for increase In AADF and Peak day rated capacity (See Section 5.3 and Figure 5.2) Increase capacity of Headworks (See Section 5.3.3). Increase Biosolids treatment and storage capacity (See Section 5.3.3).	2029 but dependent on the actual rate of development.	• 4A – Reduce AADF • 4B – Increase rated treatment capacity
Wastewater Collection	Lucan sanitary sewers	Collection system improvements are potentially required to address current issues and are definitely required to accommodate new development (See Section 5.4).	Timing depends on further investigations and specific developments.	• Replace problem sewer sections with larger sewers • Construct one or more additional SPSs to discharge flow directly to the WWTP
Stormwater Management	Lucan SWMFs and storm sewers	Need for SWM controls (water quality, water quantity, erosion control) for future development areas Need for increased capacity	Development driven	• 5A – Coordinate stormwater management planning on a subwatershed basis • 5B – Review developments on a parcel by parcel basis as developments proceed within future growth areas.

7.3 Preliminary Evaluation of Alternatives

7.3.1 Water Supply

Table 7.2 identifies that, at the highest projected growth rate, the maximum daily demand will essentially be at the calculated capacity of the existing supply system by approximately 2042.

Therefore, prior to 2042 it will be necessary to:

- Alternative 1A – Reduce Maximum Day water demands.
- Alternative 1B – Increase supply capacity.

As noted previously, future evaluations may establish that additional alternatives warrant evaluation or that the preliminary opinions set out below might change as a result of new information at the time.

Alternative 1A – Reduce Maximum Day Water Demands

Recent evaluations completed in conjunction with a grant application (ICIP 2020) established, based on metered water consumption, that the average annual use for a residential property was 137 m^3 in 2018. On the basis that the average persons per household is in the order of 2.6 (Watson, 2020), the average per capita water consumption was approximately 145 L/capita·day. Design Guidelines (MOE, 2008) indicate that domestic water demands will range from 270 to 450 L/capita·day. The existing Lucan value is actually less than the low end of expected domestic consumption ranges.

A review of available water supply records indicates that the ratio between maximum daily use and annual average use is approximately 2.5. MECP design guidelines (MOE 2008) suggest that a reasonable value for the ratio for a population of 3,000 is in the range of 2.0 to 2.25. In our opinion the higher ratio is possibly caused by the low value for average consumption rather than excessive maximum day use.

In summary, there is no apparent indication that water demands could be decreased significantly. Regardless, consumption should be reviewed periodically and opportunities to conserve should be implemented where feasible.

Alternative 1B – Increase Supply Capacity

To increase supply capacity, it will be necessary to increase the capacity of the existing supply mains from the connection to the LHPWSS at Chamber 44 and the Lucan Elevated Tank. It may also be necessary to change the booster pumps at the Lucan Water Booster Station.

A capacity increase can be achieved by replacing or paralleling the existing 350 mm dia. supply main. The option to do this work in stages matching demand requirements exists.

Increasing pressures at the LHPWSS connection would also increase supplies to Lucan. The feasibility of increasing pressures would have to be investigated with the LHPWSS.

Ultimately more detailed study is required. A summary of the potential environmental impacts of each alternative is provided in Table 7.2:

Table 7.2 – Environmental Impacts Associated with the Water Supply Alternatives

Type of Impact	1A – Demand Reduction	1B – Increase WTP Capacity
Technical	-No evidence of excessive use or significant leaks -May not be feasible to achieve necessary reductions to offset increased need.	-Will require pipe replacement or paralleling or a supply pressure increase. -Will require technical investigations to determine a preferred solution. -There is sufficient capacity to accommodate immediate needs.
Socio-cultural	-Would require residents to significantly decrease water consumption. -May limit future non-residential developments, depending on water usage needs. -May limit future population growth	-Would allow for future population growth. -Would not require significant alterations to water usage.
Natural Environment	-No impacts anticipated	-Some impacts expected during construction.
Economic	-Less costly than Alternative 1B, but there would be costs associated with investigations into water usage and leaks. -Would need to invest in a water usage reduction and education program. -If population growth is limited, there may be economic impacts relating to tax revenue and reduced non-residential development.	-More costly than Alternative 1A -Will allow for continued growth and development in the communities. -Costs may be collected from future development through development charges

7.3.2 Water Storage

There is a long term need to increase treated water storage capacity. The identified alternative approaches to address this issue are:

- Alternative 2A – Reduce Maximum Day water demands.
- Alternative 2B – Modify existing facilities.

- Alternative 2C – Construct additional storage facilities.

A detailed evaluation of the alternatives will require additional study, probably as a Schedule B Class EA. The following opinions are based on current information.

Alternative 2A – Demand Reduction
Opportunities for reducing maximum day demands were discussed in the previous section and were concluded to be non-viable. This conclusion also applies to water storage, particularly given that fire storage needs will increase proportional to population growth. Regardless, opportunities for demand reduction should be pursued where feasible.

Alternative 2B – Modify Existing Facilities
The existing storage facility in Lucan is an elevated tank. There is no economically feasible way to modify it to increase capacity. Further investigations should focus on providing additional storage to work in conjunction with the existing.

Alternative 2C – Construct Additional Storage
The exact nature of how additional storage would be provided is subject to more detailed design and potentially a Schedule B Class Environmental Assessment. The following descriptions provide an outline of what will have to be considered.

Table 7.3 – Environmental Impacts Associated with the Water Storage Alternatives

Type of Impact	2A – Demand Reduction	2C – Construct Additional Facilities
Technical	-There is no evidence of excessive use. -May not be feasible to achieve necessary reductions to offset increased need.	-Will address long term storage needs. -Opportunity to have storage benefit distribution system issues, if desired.
Socio-cultural	-Would require residents to significantly decrease water consumption. -May limit future non-residential developments, depending on water usage needs -May limit future population growth	-Will provide sufficient fire flow and emergency storage needs. -Will support continued growth and development -May require an archaeological assessment.
Natural Environment	-No impacts anticipated.	-Impacts will depend on the site. -Impacts may be minimized if additional facilities are constructed at an existing developed site.

Type of Impact	2A – Demand Reduction	2C – Construct Additional Facilities
Economic	-Lower capital cost than Alternative 3C, but there would be costs associated with investigations into water usage. -Would need to invest in a water usage reduction and education program. -If population growth is limited, there may be economic impacts relating to tax revenue as well as reduced non-residential development.	-Most costly Alternative. - Will allow for continued growth and development in the community. -Costs may be recovered from future development through development charges.

7.3.3 Wastewater Pumping – Chestnut SPS

Currently all wastewater in Lucan drains to the Chestnut SPS. The SPS discharges to the WWTP. Flows in excess of the WWTP's peak capacity are diverted via a separate set of pumps and a dedicated forcemain to the existing sewage lagoons. The flows to the WWTP cannot increase until plant capacity is increased. As the community grows there will be more diversion to the lagoons. Analysis indicates that the diversion system has adequate capacity.

Once the WWTP capacity is increased it will be possible to increase the capacity of the pumps that discharge to the plant. In our opinion, the preferred approach is best determined within the context of the Class EA study for WWTP expansion. As part of that study the following should be evaluated:

- Alternative 3A – Reduce existing peak flows.
- Alternative 3B – Provide larger pumps and possibly forcemain.

Alternative 3A – Reduce Existing Peak Flows

Currently approximately 2% of the annual flow is diverted to the lagoons. An increase in the peak flow capacity at the WWTP will have the capability of reducing or at least maintaining this value.

To actually reduce peak flows arriving at the Chestnut SPS would require an infiltration and inflow (I-I) investigation of the collection system. The typical approach is to undertake an investigation of existing flows by installing temporary flow meters within the collection system and conducting a physical examination of all of the maintenance holes. Sewer sections suspected of problems can then be examined by CCTV.

The costs of a complete I-I investigation at Lucan would be in the order of $100,000 to $150,000. The investigations can proceed incrementally over several budget years.

It is not anticipated that peak flows can be reduced to the extent that an increase in SPS capacity can be avoided.

Alternative 3B – Increase Pumping Capacity

Larger pumps can be placed in the existing pumping station. Pump capacity needs to be assessed in conjunction with both the WWTP peak flow capacity and the needs of known and potential future development. As noted previously, there are existing flow constraints within the existing collection system. Required pumping capacity will also depend on the approach taken to increase sewer capacity. Installing larger pumps will also impact the SPS's electrical systems.

Preliminary analyses indicates that there may be a need to increase the capacity of the existing sewage forcemain between the Chestnut SPS and the WWTP. The need and preferred approach are dependent on the factors noted above including both sewer and WWTP capacity.

Tentatively, we expect the following upgrades would be required at SPS 1.

- Replacement of the existing sewage pumps including conversion to variable capacity.
- Replacement of the existing generator set to accommodate the larger pumps.
- Modification or replacement of the existing electrical systems (MCC).

The evaluation of the environmental impacts associated with the options being considered is summarized in Table 7.4:

Table 7.4 – Environmental Impacts Associated with the Wastewater Pumping Alternatives

Type of Impact	3A – Reduce Peak Flows	3B – Install Larger Pumps
Technical	-Reducing peak flows through eliminating extraneous flows will reduce or delay the need to increase capacity.	-Will require the WWTP to accommodate periodic greater flows. -Will provide needed increase in capacity
Socio-cultural	-If inflow and infiltration attributed to cross connections, residents may be required to disconnect. -May limit future non-residential developments, depending on sewage flows. -May limit future population growth.	-Will provide sufficient pumping capacity to support growth.

Type of Impact	3A – Reduce Peak Flows	3B – Install Larger Pumps
Natural Environment	-No impacts anticipated	-Minimal impacts expected if the pumps can be accommodated within the existing SPS footprint. - Some impact if the forcemain is replaced or paralleled.
Economic	-Potentially the least costly Alternative depending on how flows can be reduced. -If population growth is limited, there may be economic impacts relating to tax revenue and reduced non-residential development.	- Will allow for continued growth and development in the communities. -Costs may be recovered from future development through development charges

7.3.4 Wastewater Treatment

The Lucan WWTP is rated at 1,700 m^3/day as an AADF and 3,600 m^3/day for peak day. Wastewater strengths are within typical design ranges therefore hydraulic limitations are the capacity controlling factor.

With reference to Section 5.3, at the highest projected growth rate, the existing AADF capacity will be exceeded by approximately 2029. A peak flow capacity increase is already warranted.

Two alternatives have been identified for the WWTP:

- Alternative 4A – Reduce Annual Average flows.
- Alternative 4B – Increase rated treatment capacity.

These alternatives are currently being examined through a Schedule C Class EA process initiated by the Township. Preliminary comments regard each are as follows:

Alternative 4A – Reduce Annual Average Flows
The WWTP is rated on the basis of annual average daily flow. Decreasing the average inflow will result in a corresponding increase in capacity.

The true sewage component is a function of water usage. Section 7.3 explained that unit water consumption is at the low end of recommended design ranges and demand reductions although desirable, were considered to not be viable as a tool to increase capacity. The same conclusion applies to sewage flows.

Extraneous flows represent a proportion of total flows. In order to assess the potential to reduce extraneous flows a detailed I-I study would be required. Details of such an investigation are described in the Section regarding the Chestnut SPS.

Although flow reduction will be examined in more detail within the WWTP expansion Class EA, it is our opinion flow reduction is not a viable approach to increasing WWTP reserve capacity sufficient to accommodate new development on the scale proposed. Regardless, I-I investigations and reduction efforts, where feasible, should be initiated.

Alternative 4B – Increase Rated Treatment Capacity

The preferred approach to increasing WWTP capacity will be determined through the current Schedule C Class EA process already initiated by Council.

Table 7.5 provides a preliminary outline of the impacts associated with the options for meeting capacity needs at the WWTP:

Table 7.5 – Environmental Impacts Associated with the Wastewater Treatment Alternatives (Port Elgin)

Type of Impact	4A – Reduce Annual Flows	4B – Increase WWTP Capacity
Technical	-Decrease in flows is not expected to be sufficient. -I-I investigations may identify some extraneous flows, but not likely enough to reduce flows enough to accommodate future need.	-Will meet future capacity needs.
Socio-cultural	-I-I investigations may identify cross sections from residences. Residents may be required to eliminate cross-connections. -Could limit future growth and development	-Would allow for future population growth -If expansion is required outside of existing site footprint, an archaeological assessment will be required.
Natural Environment	-No impacts anticipated	-Impacts will depend on the nature of the expansion. -Assimilative capacity of the receiver must be considered.
Economic	-Potentially less costly than Alternative B, but there would be costs associated with I-I investigations and rehabilitation of the system. -If population growth is limited, there may be economic impacts relating to tax revenue and reduced non-residential development.	-Most costly Alternative. Cost will depend on the method of expansion. -Will allow for continued growth and development. -Will impact sewage rates - A portion of the costs may be collected through development charges

7.3.5 Stormwater Management

Two general alternatives for stormwater management are identified:

Alternative 5A - Coordinate stormwater management planning on a subwatershed basis

- Develop stormwater management policies for future development areas on a subwatershed basis so that all developments within a defined catchment area are developed in a coordinated manner.
- Identify locations and general criteria for SWM facilities to service each subwatershed.
- Develop general guidelines for conveyance measures and lot level controls within each subwatershed.

Alternative 5B - Review developments on a parcel by parcel basis as developments proceed within future growth areas

- Review stormwater management plans for each development as it is proposed.

Table 7.6 provides a summary of the potential environmental impacts of the SWM planning alternatives.

Table 7.6 – Environmental Impacts Associated with the Stormwater Management Alternatvies

Type of Impact	5A – Coordinate stormwater management planning on a subwatershed basis	5B – Review developments on a parcel by parcel basis as developments proceed within future growth areas
Technical	- Results in an improved drainage system for future development lands. - Provides the development community with clear guidelines and criteria to address SWM requirements.	- Would address drainage requirements for each development parcel as development proceeds. - Not addressing SWM requirements could result in localized flooding and aggravate existing drainage concerns.
Socio-cultural	- Minimizes potential impacts as works occur predominately within vacant future development lands. - Presents few long-term impacts to air quality, noise levels and local aesthetics, following completion of construction.	- Minimizes potential impacts as works occur predominately within vacant future development lands. - Presents few long-term impacts to air quality, noise levels and local aesthetics, following completion of construction.

Type of Impact	5A – Coordinate stormwater management planning on a subwatershed basis	5B – Review developments on a parcel by parcel basis as developments proceed within future growth areas
Natural Environment	- Minimizes potential impacts as works occur predominately within vacant future development lands. - It is anticipated that environmental studies will be undertaken as part of the development review process to ensure that sensitive habitat features are identified and protected during construction and implementation of the SWM components.	- Minimizes potential impacts as works occur predominately within vacant future development lands. - It is anticipated that environmental studies will be undertaken as part of the development review process to ensure that sensitive habitat features are identified and protected during construction and implementation of the on-site SWM components. - Downstream impacts may occur within other parts of the community due to the lack of a coordinated approach with addressing SWM planning.
Economic	- Costs associated with SWM on future development lands are financed by the development community. - A coordinated approach to SWM planning should not result in additional costs to developers and may result in efficiencies. - Coordinating the SWM needs for all future development lands will result in reduced maintenance requirements for the Township in the long term.	- Costs associated with SWM on future development lands are financed by the development community. - Additional costs to the development community may result by individually addressing SWM needs, rather than coordinating detention facilities within subwatersheds. - Additional maintenance requirements by the Township may be needed due to the number of SWM facilities associated with multiple development sites.

7.4 Preferred Alternatives

A number of capacity issues have been identified and alternatives examined. This section of the Master Plan provides a summary of the preferred solutions and the rationale for each. In most cases final selection of the preferred approach is dependent on more detailed analysis.

7.4.1 Water Supply

It is expected that the existing supply capacity will be adequate until at least 2042. Prior to that (say 2036) it will be necessary to begin to examine alternatives for increasing capacity including both demand reduction and replacing or paralleling the supply main from the LHPWSS. At this time the expectation is that physical expansion will be required.

7.4.2 Water Storage

Existing treated water storage is adequate until approximately 2036 at the highest projected growth rate. The existing storage facility cannot be expanded. Prior to 2036 (say 2030) it will be necessary to initiate a Schedule B Class EA that will examine at least the possibility of demand reduction and storage expansion.

7.4.3 Water Distribution

Fire flow issues have been identified for both the Fallon Drive industrial area and the north end of Main Street. Resolution of the former should consider the possibility of additional treated water storage in this area. The latter will require a larger watermain. The size of the main is dependent on the potential for additional residential expansion in this area beyond the current urban boundary.

7.4.4 Wastewater Pumping – Chestnut SPS

Continued growth will drive the need to increase the capacity of the Chestnut SPS. The preferred approach is contingent on both expansion of sewer capacity upstream of the SPS and WWTP peak flow capacity downstream. The latter should be examined simultaneously with the WWTP expansion Class EA.

7.4.5 Wastewater Treatment

The capacity of the Lucan WWTP must be increased by approximately 2029. Expansion is the subject of a current Class EA.

7.4.6 Stormwater Management

a) General

Coordinate stormwater management planning on a subwatershed basis, was selected as the preferred Master Plan Alternative. The coordination of long-term infrastructure addresses the larger needs of the community and is the most cost effective approach when considering asset management and planning requirements. The implementation of this alternative is dependent on additional detailed analysis at a subwatershed level and includes the following:

- Construction of individual or regional SWM facilities at the downstream end of all future development drainage areas.
- Supports the use temporary SWM facilities prior to expansion of the settlement boundary and construction of ultimate regional SWM facilities.

- Retrofits or expansions to existing SWM facilities to serve greater catchment areas where feasible.
- Minor and major flow conveyance measures (storm sewers, open channels, major flow paths)
- Streamline SWM infrastructure and reduce number of outlets long-term.
- Low Impact Development (LID)/source controls for small infill developments and infrastructure renewal programs.

Based on the preferred alternative, the following outlines a recommended strategy for the existing settlement area and future development on a subwatershed basis.

b) Existing Settlement Areas

Infrastructure renewal programs should aim to reduce the number of storm outlets and implement LID/source control water quality controls as feasible. Renew programs should incorporate major flow conveyance and capture in areas with limited relief. This may include oversizing CB inlets and storm sewers to limit ponding within the road ROW and mitigate flooding of private lands. Any future road reconstruction should ensure no changes in road grade along sags within designated flood hazards lands. Sags are to be maintained for flood conveyance particularly within the Whitfield drainage area. The need for storm sewer upgrades within existing area is subject to further study.

Infill or redevelopment of lands within the existing settlement area should promote best management practices and low impact development measures as feasible and appropriate. Infill developments are to provide site controls for water quality (80% long-term total suspended solids removal) and water quantity control to predevelopment levels, or overcontrolled to allowable release rates to existing infrastructure.

The Township shall ensure maintenance is conducted for low points along existing roads, and conduct regular inspections and maintenance of receiving municipal drains and outlet locations.

c) Future Development Areas

The recommended SWM strategy for each subwatershed is summarized below. The anticipated regional stormwater works are outlined in **Table 7.7** and illustrated in **Figure 7.1**. Refer to **Section 6.5** for additional discussion and servicing alternatives for each subwatershed. The location and sizing of recommended works are subject to further study.

Table 7.8 outlines the Class EA schedules for each type of SWM work. Depending on whether SWM works are undertaken by the Township or as part of the subdivision process will dictate the need for more detailed Schedules B Class EA for future Regional SWMFs.

Table 7.7 – Recommended SWM Works

ID	Description	Implementation Timing
1	Hardy-Engel Drain - Regional SWMF	Urban Growth Expansion/Development Driven
2	Hardy-Engel Drain - Major/Minor Drainage Works within Existing Easement	2021-2023 Development Driven
3	Hardy-Engel Drain - Interim SWMF Servicing Proposed Development Upstream of Saintsbury Line	Development Driven
4	Whitfield Drain - Regional SWMF Servicing	Development Driven
5	Infill Developments with Source Controls/LIDs	Development Driven
6	Hardy 1952 - Regional SWMF	Urban Growth Expansion/Development Driven
7	Hardy 1984 - Regional SWMF	Urban Growth Expansion/Development Driven
8	Hardy Drain 1984 – Trunk Storm Sewer Upgrades	Provisional on Future Regional SWMF [7]
9	Haskett Drain - Regional SWMF	Urban Growth Expansion/Development Driven
10	Haskett Drain - Major/Minor Drainage Works along drain/Abandon Rail Alignment	Provisional on Future Regional SWMF [6]
11	Reliance SWMF Decommissioning	Provisional on Future Regional SWMF [6]

Table 7.8 – SWM Class EA Schedules

SWM Works	Class EA Schedule
Modifications to an existing SWM Facility	A+
SWM Facility planned in conjunction with Plan of Subdivision Review	A
Construction of Municipal SWM Facility	B
Stormwater collection system to connect to detention facility - If located within existing road allowances or easements - If located outside of existing road allowances or easements If approved in conjunction with draft Plan of Subdivision	 A+ B A

Benn Drain

The Benn Drain subwatershed is subject to small future infill developments, subject to required SWM controls. Any development within or near flood hazard lands will require additional flood assessment studies.

Whitfield Drain

The Whitfield Drain is subject to future development east of Saintsbury Line and infill developments within the existing settlement area.

Recommendations for the subwatershed include the development of a regional SWM facility within the municipal owned SWM block, located east of Saintsbury line. Additional land outside the existing SWM block may be required to subject to pond size requirements and mitigation of floodplain impacts. Refer to Section 6.4.7 for development restrictions and locating SWMFs within flood hazards.

It is recommended that the regional SWM facility be sited along the east portion of the SWM block, outside the 100 year floodline as feasible. Locating the SWMF further east will make use of higher lands and reduce impacts associated with deeper flood levels adjacent to Saintsbury Line. Flood storage compensation may be implemented within the SWM block lands on the north side Whitfield drain closer to Sainsbury Line as required subject to further study.

Hardy-Engel Drain

The Hardy-Engel Drain is subject to future and potential future development pressures east of Saintsbury Line and north of Gilmore Drive.

A single regional SWM facility servicing the Hardy-Engel Drain subwatershed is preferred for ultimate servicing. Upon ultimate built out of the subwatershed, the existing Ridge Crossing SWMF could be expanded to service the additional upstream area, or a second separate SWMF could be constructed in the lands within the lagoon buffer immediately north of the existing Ridge Crossing SWM facility. An open channel along the existing Hardy-Engel Drain easement is recommended to provide conveyance to an ultimate regional facility. Location of the regional SWM facility and drainage easement works is subject further study.

A temporary SWMF may be constructed as part of the current development proposal for Timber Ridge east of Saintsbury Line. It is recommended that any interim works conducted within the drainage easement are sized for the entire upstream drainage area.

Hardy 1984 and Hardy 1952 Drains

The recommended SWM approach for the Hardy 1984 and Hardy 1952 subwatersheds is two Regional SWMFs and site controls. This alternative provides a regional approach, supports proposed development plans, and includes best management practices to conserve existing drainage areas.

Prior to the construction of a regional SWM facility, source controls for infill developments will be required. Additional quantity controls may be required where existing infrastructure has limited capacity to receive flows.

For the Ausable Fields development, SWM servicing using source controls is recommended ahead of a regional SWM facility construction. Maintaining drainage areas is preferred as limited capacity is available within the existing Hardy Drain. Overcontrol to the Hardy Drain may be acceptable subject to further study. The unopened road ROW and park lands may provide the opportunity for additional LID implementation subject to further consultation with the Town.

Proposed commercial developments along Main Street will be required to complete source controls for development approval, if not serviced by regional SWM facility.

Future studies will determine the location of regional SWM facilities and service area. Consideration of future development of lands immediately east of Coursey Line should be considered. To improve servicing of the existing settlement area long term, a new trunk storm sewer could be constructed along the Lucan Community Centre property, through future development lands to a regional SWM facility. The construction of a trunk storm sewer should be considered in conjunction with any watermain looping identified to support future development lands. Upon construction of a regional SWM facility and trunk storm sewers, some source controls may be deemed redundant and permitted to be decommissioned. This is subject to future study.

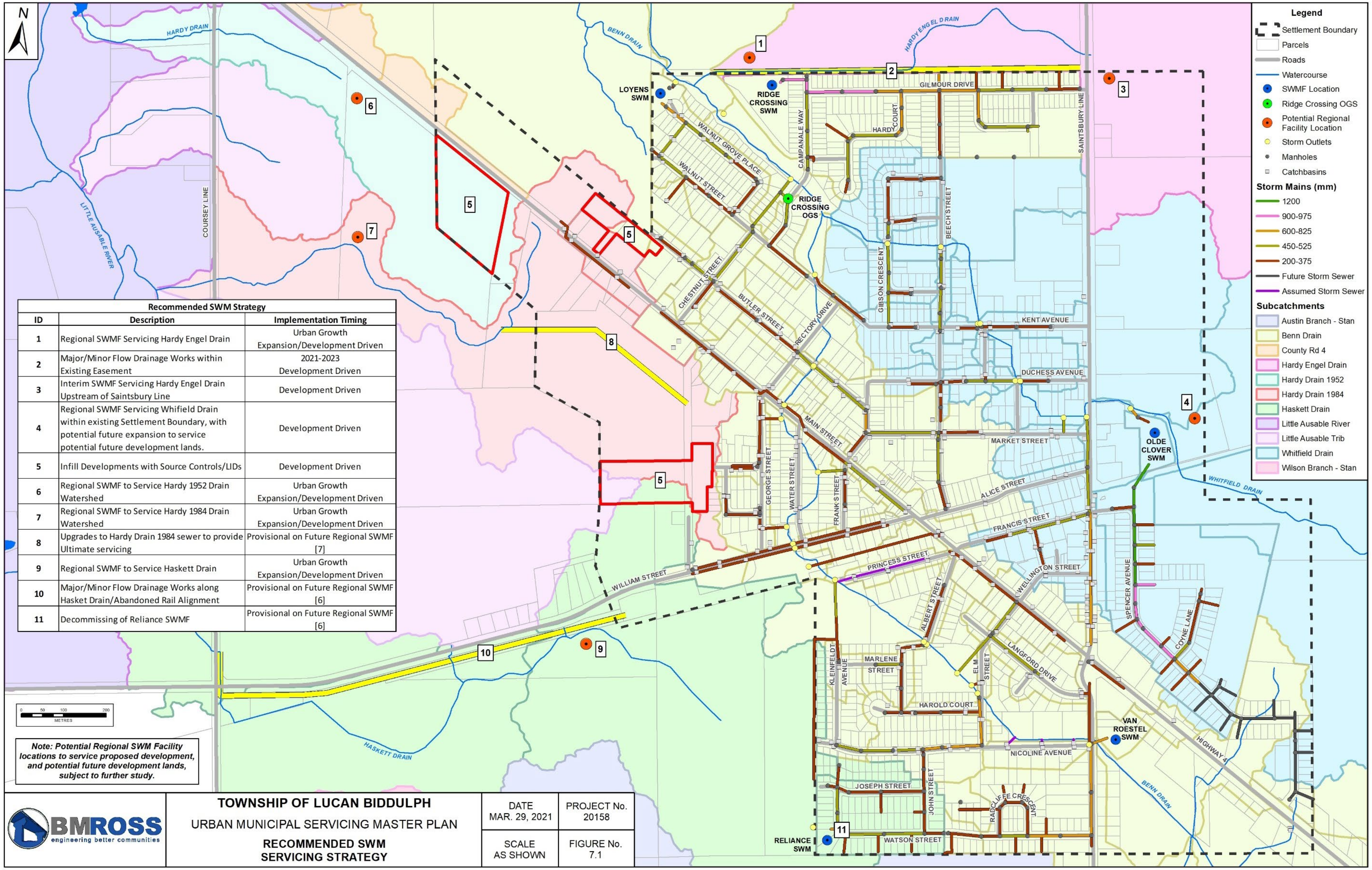
Haskett Drain

The recommended SWM approach for the Haskett Drain subwatershed includes the implementation of a regional SWM facility and site controls. This option provides a regional approach, supports infill and potential future development plans, and includes best management practices.

The location of the regional SWM facility should be revaluated based on anticipated development south and north of William Street upon future expansion of the settlement boundary. Any regional SWM facility should be designed to support the decommissioning of the Reliance SWM facility. Locating the regional SWMF further west, may allow for additional lands south of William Street and lands north of William Street to be serviced. Drainage works along the Haskett Drain are anticipated. New conveyance works could be planned south of William Street and incorporated along the abandoned rail alignment. Additional studies are required.

Detailed Floodplain assessments are required to characterize the regulatory spill from the Benn Drain to the Haskett Drain. Development within flood fringe and floodplain spill area may be permitted following further study and flood proofing to the regulatory flood plain is undertaken. Refer to Section 6.4.7 for development restrictions and locating SWMFs within flood hazards.

Figure 7.1 – Recommended SWM Servicing Strategy



Recommended SWM Strategy

ID	Description	Implementation Timing
1	Regional SWMF Servicing Hardy Engel Drain	Urban Growth Expansion/Development Driven
2	Major/Minor Flow Drainage Works within Existing Easement	2021-2023 Development Driven
3	Interim SWMF Servicing Hardy Engel Drain Upstream of Saintsbury Line	Development Driven
4	Regional SWMF Servicing Whifield Drain within existing Settlement Boundary, with potential future expansion to service potential future development lands.	Development Driven
5	Infill Developments with Source Controls/LIDs	Development Driven
6	Regional SWMF to Service Hardy 1952 Drain Watershed	Urban Growth Expansion/Development Driven
7	Regional SWMF to Service Hardy 1984 Drain Watershed	Urban Growth Expansion/Development Driven
8	Upgrades to Hardy Drain 1984 sewer to provide Ultimate servicing	Provisional on Future Regional SWMF [7]
9	Regional SWMF to Service Haskett Drain	Urban Growth Expansion/Development Driven
10	Major/Minor Flow Drainage Works along Hasket Drain/Abandoned Rail Alignment	Provisional on Future Regional SWMF [6]
11	Decommissing of Reliance SWMF	Provisional on Future Regional SWMF [6]

7.4.7 Summary of Preliminary Preferred Solutions

The following table provides a summary of the preferred solutions to existing and future servicing issues. In most cases the solutions are subject to additional more detailed investigations.

Table 7.9 – Summary of Preliminary Preferred Solutions

Service	Facility	Identified Issue	Required by Year	Preferred Solutions	Probable Cost (2021$)	Class EA Schedule
Water Supply	Pipeline from LHPWSS to the Lucan elevated tank and the Booster Pumping Station.	Need for additional capacity in long-term	2042	Expand supply facilities. May result in the need to parallel existing pipes and increase pump capacity. Cost is for study only. Study should begin by 2036.	$50,000 for study.	A+
Water Storage	Lucan elevated tank.	Need for additional storage in long-term	2036	Construct additional storage facility. Requires Class EA which should begin by 2030.	$75,000 for Class EA	B
Water distribution system	Watermains	Improved fire flows in two areas.	Varies – refer to Section 4.	Preferred solution is linked to development scale and timing and also storage Class EA.	TBD	A
Wastewater Pumping	Chestnut SPS	Need for increased pumping capacity	Coincident with increase in WWTP Capacity	Replace existing sewage pumps and related works. May require forcemain paralleling.	TBD through WWTP EA Study.	A+
Wastewater Treatment	Lucan WWTP	Increase existing Headworks' capacity	Required now but timing is linked to WWTP expansion.	Replace existing facility with a new Headworks.	$2,200,000	Part of WWTP Expansion – Schedule C.
Wastewater Treatment	Lucan WWTP	Need for increase In AADF rated capacity	2029	To be determined through a Class EA process	$170,000 for Class EA	C

Service	Facility	Identified Issue	Required by Year	Preferred Solutions	Probable Cost (2021$)	Class EA Schedule
Wastewater Treatment	Lucan WWTP	Increase biosolids treatment and storage capacity	Required now but timing is linked to WWTP expansion	To be determined through a Class EA process	TBD through WWTP EA Study.	Part of WWTP Expansion – Schedule C
Wastewater Collection	Sanitary Sewer System	Improvements are required to accommodate development	Varies	Improvements are dependent on the timing of specific developments. Costs are dependent on what other work (e.g. street reconstruction) is completed simultaneously.	TBD	A
Stormwater Management	Lucan SWMFs and storm sewers	Need for SWM for future development areas.	Development driven	Coordinate stormwater management planning on a subwatershed basis	TBD	TBD

8.0 Consultation

8.1 General

Public consultation represents an integral part of the master planning process. During this study, a consultation program was implemented to obtain input on key study issues from the general public, government review agencies, and key stakeholders. Information gathered through this process was incorporated into the analysis of future servicing needs and the evaluation of alternatives. The following subsections summarize the consultation program.

8.2 Initial Public Consultation

Initial comments were solicited from local residents by way of a public notice issued in the local newspaper. The Notice of Project Commencement summarized the purpose and intent of the Master Plan study and requested comments from interested persons. The notice was issued in the December 9, 2020 and December 16 editions of the Lakeshore Advance and Middlesex Banner. The Notice was also placed on the municipal website (http://www.lucanbiddulph.on.ca). A copy of the Notice is included in Appendix G.

One comment was received from the public in response to the Notice. The comment received and response is summarized in Table 8.1.

Table 8.1 – Initial Public Comments Received

Comment	Comment	Response
Resident, December 9, 2020	• Request further information regarding impacts on municipal drain (Austin Drain) through property	• Study is primarily focusing on infrastructure within Lucan urban settlement area. • Study is just starting, do not have any specific information to provide on the Austin Drain at present. • Will add to project circulation list.

8.3 Review Agency Consultation

Input into the study process was solicited from 8 review agencies by way of direct mail correspondence. Agencies were sent a general project summary, which provided background information on the study, outlined the Master Plan process and the scope of the investigations. The information was circulated on December 9, 2020 and agencies were requested to forward comments on the project by January 7, 2021. A copy of the letter and a list of the agencies circulated is included in Appendix G.

A response to the initial letter was received from MECP, on April 19, 2021. The comments from MECP identified initial requirements for Class EA/Master Plan studies. The letter also delegated responsibility to consult with First Nation and Métis communities to the Township.

The study team held a meeting with Ausable Bayfield Conservation Authority (ABCA) staff on May 28, 2021 to discuss the findings and recommendations of the Master Plan. ABCA staff provided comments and clarification on ABCA stormwater policies that were incorporated into the Master Plan. A copy of the meeting notes is included in Appendix G.

8.4 First Nation and Métis Consultation

To identify First Nations and Métis communities that may have an interest in the Master Plan, federal and provincial agencies were consulted. The following communities were sent a letter outlining the project (included in Appendix G) The letter was mailed December 9, 2020 to the following communities:

- Chippewas of the Thames First Nation
- Munsee-Delaware Nation
- Oneida Nation of the Thames
- Delaware Nation
- Métis Nation of Ontario
- Bkejwanong Territory
- Caldwell First Nation
- Chippewas of Kettle and Stony Point First Nation
- Aamjiwnaang First Nation

The letter included information regarding the proposed Master Plan. A log of correspondence with First Nation and Métis communities is provided in Table 8.2. Copies of all correspondence sent are included within Appendix G.

Table 8.2 – First Nation and Métis Community Correspondence Log

First Nation or Métis Contact	Date	Type of Contact	Details/Response
Chippewas of Thames First Nation	December 9, 2020	Letter sent by BMROSS	Project initiation letter • Response received March 24, 2021
Munsee-Delaware Nation	December 9, 2020	Letter sent by BMROSS	Project initiation letter • No response received
Oneida Nation of the Thames	December 9, 2020	Letter sent by BMROSS	Project initiation letter • No response received
Delaware Nation	December 9, 2020	Letter sent by BMROSS	Project initiation letter • No response received
Métis Nation of Ontario	December 9, 2020	Letter sent by BMROSS	Project initiation letter • No response received
Bkejwanong Territory	December 9, 2020	Letter sent by BMROSS	Project initiation letter • No response received
Caldwell First Nation	December 9, 2020	Letter sent by BMROSS	Project initiation letter • No response received
Chippewas of Kettle and Stony Point First Nation	December 9, 2020	Letter sent by BMROSS	Project initiation letter • No response received
Aamjiwnaang First Nation	December 9, 2020	Letter sent by BMROSS	Project initiation letter • No response received
Chippewas of the Thames First Nation (COTFN)	March 24, 2021	Letter sent by COTFN	No concerns with project. If there are any substantive changes, please send notification to consultation@cottfn.com

8.5 Stakeholder Consultation

At the outlet of the Master Plan, a stakeholder list of local developers working in Lucan Biddulph was developed. The developer stakeholders were sent a copy of the Notice of Commencement to solicit any initial input on the Master Plan. Following this, the study team met with three of the developers who were contacted to discuss the Master Plan. The meetings were an opportunity to discuss future servicing needs and potential servicing options in relation to the Master Plan.

8.6 Public Information Centre

A virtual Public Information Centre (PIC) was held on July 29, 2021 at 6:30 via Zoom. A notice advertising the meeting was placed in the Exeter Lakeshore Times-Advance and Middlesex Banner for two weeks ahead of the meeting. The notice was also placed on the Township of Lucan Biddulph website. Copies were emailed to local stakeholders.

At the PIC, the study team provided an overview of the intent of the Master Plan and summarized the projected growth and development, and major findings related to water supply, storage and distribution, wastewater pumping and treatment, and stormwater management for the community of Lucan.

The following summarizes the questions and comments received from attendees:

- Question - Note that flow monitoring is being recommended. What is the timeline for completing that work and will it be incorporated into the Master Plan and then used for future discussions around the expansion of the urban boundary?
    - Response – The flow monitoring work will start shortly. The monitors will need to be installed for 3-4 months with time for analysis afterwards. It is anticipated that the flow monitoring work will be completed as a follow-up study to the finalized Master Plan.
- Comment – It is hoped the flow monitoring data can be shared when completed.
- Question – Is the EA for the wastewater treatment plant looking at growth to the 2046 planning horizon?
    - Response – The EA is looking at population forecasts to 2046. A Public Information Session will be held in August for the WWTP EA.
- Question – Wastewater conveyance is not looked at beyond the existing boundary in the Master Plan. Why was conveyance not considered out to the 2046 planning horizon?
    - Response – The scope of the Master Plan was to find the conveyance constraints within the existing urban boundary. Given that the location of future development areas outside the boundary are unknown, it is not possible to identify which sewers would be utilized by future development.
- Comment – Can a copy of the slideshow presentation be provided?
    - Response – Yes. The Township will provide a copy.
- Comment – Recommended undertaking flow monitoring as soon as possible. Noted that the findings of the flow monitoring will impact sewer capacities.
- Question – Should flow monitoring be completed regardless of the Master Plan?
    - Response (from Township staff) – Staff are currently working on bringing information to Council regarding the scope and cost of flow monitoring.
- Question – Has the increase in hard surfaces (roads, driveways) been considered as part of the stormwater portion of the Master Plan?
    - Response – The increase in hard surfaces results in the need to consider stormwater quantity and quality controls and criteria. It was also noted that LIDs can be used, where appropriate to help reduce flows.
- Question – Would it be beneficial to reduce water usage?

- Response – It is beneficial to reduce water usage, however it is not likely that water usage can be reduced enough for the purposes of increasing capacity.
- Question – Stormwater ponds often collect pollutants, are there natural remediation methods?
    - Response – Often pollutants settle out into the sediment at the bottom of the pond and that sediment eventually needs cleaned out or removed. The sediment is tested and then depending on the results, it may be land applied. Often it is landfilled.
- Question – How does the growth in the past correlate to the County population forecasts?
    - Response – Recent growth in Lucan corresponds with the high growth forecast.
- Question – Where is the best place to put growth? Do we need to decide on a preliminary location to allow growth and then go back and look at if suitable for growth?
    - Response – Infrastructure is only one consideration when examining potential future growth areas.
- Question – How can LID facilities be encouraged?
    - Response – LIDs can be encouraged through urban design engineering standards. It is also important to bring it up during pre-consultation with developers.
- Question – Has the Master Plan been contemplated in light of the Asset Management Plan?
    - Response – No, but the Master Plan recommendations can be incorporated into AMP life cycle information.
- Question – The Master Plan includes stormwater management criteria. How are these applied?
    - Response – The stormwater management criteria can be included in engineering design standards or staff can refer developers directly to the Master Plan.

A copy of the PIC presentation and notes are included in Appendix G. Following the presentation there were two comments submitted to the Township. The following table summarizes the comments received following the public meeting.

Table 8.3 Comments Received Following PIC

Commentor	Comments	Action
Resident Comment (received August 26, 2021)	• Expressed concern regarding additional expenses related to growth on taxpayers, water and sewage rates. • Noted that developers should be bearing a significant portion of development-related costs. • Expressed concern how the east side of Saintsbury will serviced with sewage services. • Noted the Van Duesen drain is not shown on the maps.	• Concerns noted.
Strik Baldinelli Moniz on behalf of Westdell Development Corp. (received August 27, 2021)	• Provided a number of technical questions related to sanitary sewage capacities and flow values used. • Asked for confirmation of capacity and target usage of lagoons.	• Township provided response.

9.0 Costs and Financing

9.1 Funding of Future Projects Alternatives

9.1.1 General

This Master Plan identifies an immediate need to proceed with a Schedule C MCEA to investigate options for additional treatment capacity at the Lucan Wastewater Treatment Plant. This project was initiated in March 2020 and will be funded through development charges collected from future development. The costs associated with completing the EA are currently included in the existing development charges background report and by-law.

A number of projects have been identified based on the progression of growth and future needs. These projects include:

- Additional water supply capacity
- Additional water storage
- Watermain improvements in the area of the Industrial Park and northwest portion of Main Street
- Increased capacity at the Chestnut St. SPS
- Sewer upgrades
- Stormwater controls and increased capacity

The timing of these projects is dependent on where and when future development occurs. Given that the need for these projects is driven by future growth, the Township may consider financing these projects through development charges or through the Municipal Act.

9.1.2 Development Charges

The future projects identified in the Master Plan are driven by growth and will significantly benefit future growth. Municipalities have the ability to collect for the growth-related costs of capital works projects through the Development Charges Act. The Act allows municipalities to collect development charges against future development for the costs associated with the provision of infrastructure and services that benefit growth. The Township of Lucan Biddulph has a Development Charge By-law in place, and currently collect development charges related to road, water, and wastewater services among others.

In the future, should the Township need to undertake the above-noted projects, the portion of project costs that benefit growth can be collected through development charges.

9.1.3 Municipal Act

Part XII of the Municipal Act provides municipalities with broad powers to impose fees and charges via passage of a by-law. The powers, as presented in S. 391(1) of the Municipal Act authorize a municipality to impose fees or charges for:

- Services or activities provided or done by or on behalf of it.
- Costs payable by it for services or activities provided or done by or on behalf of any other municipality of local boards; and
- The use of its property, including property under its control.

Municipalities use the authority of the Municipal Act to collect capital charges from water and sewage projects. Under the Act, municipalities can charge an immediate benefit to those properties who will receive a benefit at a future time. Under the Act, municipalities are permitted to pass a by-law requiring mandatory connections to the system and mandatory pay by-laws.

There are many methods available to assess and calculate a capital cost recovery rate for a project, including:

- By metres of frontage of the property,
- An area rate based on hectares,
- A fixed charge for each parcel (flat rate) or
- Any other method Council considers fair.

9.1.4 Stormwater Infrastructure Financing

Costs associated with servicing future development lands and benefitting properties may be financed using the following options.

- Designed and financed by the development community. Where proposed SWM works serve multiple properties an agreement for shared servicing costs can be formed between parties and the township as appropriate. A coordinated approach to stormwater planning should not result in additional costs to developers and may result in efficiencies.
- Designed and financed by the Township, and costs recovered through an area rated by-law, future development charges, or the municipal drainage act process as appropriate. It is noted that some components (conveyance, outlet improvements) of the projects may be implemented by the Township initially to support future development.

10.0 Implementation

10.1 General

This Master Plan identifies a number of future requirements for water, wastewater and stormwater infrastructure. Upon approval of the Master Plan, the Township of Lucan Biddulph may initiate the associated studies or steps associated with the identified preliminary preferred solutions. Given that many of the identified problems/opportunities are based on future need, the progression of development will determine the timing of implementing the recommendations in this Master Plan. It is recommended that the Master Plan be reviewed on a regular basis to evaluate the accuracy of key assumptions (e.g. the rate of growth) and to confirm the suitability of the preferred solutions. The Master Plan should be modified as required to address any changes in the environmental setting and/or local conditions.

Implementation of SWM infrastructure will be subject to the receipt of all necessary approvals. Phasing is dependent upon the anticipated schedule for future development lands and the development of individual parcels within each catchment. Generally, the SWM facility proposed adjacent to the outlet must be constructed prior to development occurring on lands within the basin. It may be possible to stage the construction of facilities if only portions of the service area are initially developed, however a suitable staging plan would need to be developed and approved in conjunction with the initial development, before moving ahead with construction. Sites with onsite controls may proceed if adequate capacity is present in the receiving storm sewer, or municipal drain.

10.2 Additional Studies Required

10.2.1 Water Supply and Storage

The Master Plan identified a need to monitor water supply capacity going forward. It is recommended that the supply capacity be evaluated on a 5-year basis.

It was also identified that additional water storage will be required in the future. To assess the need and appropriate type and location of water storage, it is recommended that the Township undertake a Schedule B MCEA within the next 5 years.

10.2.2 Wastewater Treatment

The Master Plan identified the need for additional wastewater treatment capacity in the immediate future. It was recommended that a Schedule C MCEA be undertaken to investigation options regarding an expansion of the Lucan WWTP. This EA was initiated in March 2021. It is anticipated this EA will also address related treatment issues identified in this Master Plan, including biosolid treatment and storage, peak flow constraints relating to the headworks, and pumping capacity at the Chestnut Street SPS.

10.2.3 Wastewater Collection

With respect to the wastewater collection system, this Master Plan identified that some sections of sewer are approaching or above their theoretical capacity, based on modeling data. Given this, it is recommended that the Township undertake a sewer flow modeling study to verify flow conditions.

10.2.4 Stormwater Management

Stormwater Asset Inventory

It is recommended that the Township complete an inventory of the storm sewer network, including length, diameter, slope, and inverts. The inventory should also verify inlet and outlet information for existing SWM facilities and OGS units. A GIS database is recommended. It is acknowledged that detailed as-constructed drawings for the historical settlement area may be limited. An inventory is recommended to be completed by GPS ground survey, with reference to existing GIS databases. As part of the inventory, the Township should gather all available ECAs for existing SWM infrastructure and outlets.

A complete inventory will be key to future capacity assessments, condition assessments, and asset management. A system inventory will also assist in the Township's forthcoming application for the MECPs proposed **Consolidated Linear Infrastructure Permissions Approach (CLI)**, which is the new system wide approval for storm and sewage systems to replace the current ECA process (similar to Water Distribution Systems). Based on information provided by the MECP, this process is anticipated to take place by Spring 2022.

Asset Management

It is recommended that the SWM facilities, Oil-grit-separators (OGS) units and any future low impact development infrastructure that is owned and maintained by the Township be included in future Asset Management Plan updates. It was noted that 2018 AMP did not include the cost to maintain SWM facilities.

Regional SWMFs Studies

To support recommended regional SWM facilities, detailed stormwater management plans or a subwatershed study will be required. If the design of SWM facilities is undertaken as part of plan of subdivision, the works are considered a Schedule A Class EA. If the Township undertakes the construction of the regional SWMF, the works will be considered a Schedule B Class EA project.

Future studies and assessments on receiving watercourses may identify the need for higher erosion control measures. A site specific geomorphological/fluvial assessment may be required to establish additional erosion control requirements.

Floodplain Assessments

Additional Floodplain Assessment studies are required for proposed SWM facilities and developments located adjacent to or potentially within flood hazard lands. Floodplain studies must address impacts to flood elevation, conveyance, storage, erosion, ecological resources and performance of planned works to the satisfaction of the Township and ABCA (refer to Section 6.4.7 for details).

Due to ongoing development pressures, the ABCA and Township may consider updating the 1994 floodplain mapping for the community of Lucan. Updated floodplain mapping would confirm the existing condition floodplain and assist in the review process of current and future developments near flood hazard lands.

Currently, updates to the floodplain mapping, including areas not included in the original 1994 Lucan Two Zone Study have been a conducted as part of engineering studies for future development lands. This may lead to longer approval timelines for developments due to additional consultation with ABCA and the Township to confirm existing conditions.

10.3 Master Plan Approval

The Lucan Urban Servicing Master Plan was developed following an approved Master Plan process, as set out in the MCEA document. For this study, the Master Plan process incorporated the completion of Phases 1 and 2 of the Class EA process.

The Master Plan will be approved for implementation subject to adoption by the Council of Township of Lucan Biddulph. This Master Plan identifies future projects that will need to be considered based on where and when growth proceeds. Some projects, such as the need for additional water storage, may require a MCEA study to evaluate site-specific impacts and alternatives.

10.4 Requirements for Master Plan Completion

The following activities are required in order to complete the formal MCEA process:

- Issue a Notice of Study Completion.
- Make the Master Plan Report available for public review in conjunction with the Notice of Completion.
- Obtain feedback from the public, stakeholders and agencies.
- Address any outstanding issues resulting from the Notice of Completion.
- Advise the Township and Ministry of Environment, Conservation and Parks (MECP) when the process is complete.

10.5 Final Public Consultation

Upon completion of the Master Plan, a Notice of Study Completion will be circulated to stakeholders, review agencies, and placed in local papers. The notice will summarize the projects identified in the Master Plan and indicated the approval process associated with moving forward with implementation.

10.6 Master Plan Recommendations

The following represents the key study recommendations, developed following the evaluation of alternatives as part of the Master Plan process:

- Additional water supply capacity will be needed in the future. The Township should undertake an engineering study to expand the supply capacity no later than 2036. The supply capacity should be re-evaluated at 5-year intervals going forward.

- Additional water storage will be required for Lucan in the future. It is recommended that the Township undertake a MCEA study by 2030.

- That stormwater management planning be coordinated with development proposals on a subwatershed level.

The Master Plan should be reviewed on a regular basis to evaluate the accuracy of key assumptions (e.g. the progression and rate of growth). The Master Plan should be modified as required to address changes to the environmental setting and local conditions.

11.0 Summary

The Township of Lucan Biddulph initiated a Master Plan to investigate infrastructure needs and requirements relating to water, wastewater and stormwater servicing within the community of Lucan. The intent of this Master Plan is to serve as the basis for and support future infrastructure projects as identified through the study. The Master Plan followed the MCEA process, such that the requirements of Master Plan Approach 2 are met, including an inventory of existing environmental conditions, identification of problems or opportunities and the evaluation of alternative solutions.

The Master Plan summarizes the existing environmental conditions within Lucan, as well as the existing water, wastewater and stormwater infrastructure. An analysis of existing population and projected future growth, based on proposed developments, was also undertaken to understand future infrastructure requirements.

To assess water infrastructure needs, the Master Plan study included a review of the existing water supply, storage and distribution infrastructure. This included an examination of existing water demands and potential future water demands and reserve capacity. An existing WaterCAD® model was updated and reviewed to assess fire flows and pressures throughout the water distribution system. It was identified that additional water supply and storage will be required in the future. The modeling also identified the need for additional fire flows in the industrial area adjacent to Saintsbury and Fallon Drives and in the northwest area of Lucan.

For wastewater, the Master Plan assessed pumping, treatment and collection infrastructure. The assessment included an evaluation of reserve capacity and desktop modelling of sewer capacities. From the assessment of existing infrastructure and projected future needs, it was identified that additional sewage treatment capacity is needed. Additionally, the headworks of the sewage treatment plant is approaching the end of its useful life and the biosolids and storage treatment components are undersized. Modeling of sewer capacity identified sections where capacity is theoretically overcommitted.

A review of the existing stormwater infrastructure, municipal drains and subwatersheds was undertaken for this Master Plan. For each subwatershed within the Lucan area, the opportunities and constraints related to stormwater management and servicing were identified. Municipal design criteria for stormwater management were also examined. From the analysis of the subwatersheds, the need for stormwater controls for future development areas and increased capacity in response to development was identified.

A series of alternative solutions for the identified problems were evaluated. The identified problems or opportunities, based on the progression of growth and future needs include:

- Additional water supply capacity.
- Additional water storage.
- Watermain improvements in the area of the Industrial Park and northwest portion of Main Street.
- Increased wastewater treatment capacity.

- Increased capacity at the Chestnut St. SPS.
- Sewer upgrades.
- Stormwater controls and increased capacity.

Alternative solutions to the above-noted problems and opportunities were evaluated. Based on the evaluations undertaken, the following solutions were recommended:

- Expand water supply facilities.
- Construct an additional water storage facility.
- Replace the existing sewage pumps at the Chestnut SPS and related works.
- Replace existing headworks at the Lucan WWTP.
- Undertake a Class EA for expansion of the Lucan WWTP.
- Coordinate stormwater management planning on a subwatershed basis.

Based on the preferred solutions, the Master Plan recommends:

- Additional water supply capacity will be needed in the future. The Township should undertake an engineering study to expand the supply capacity no later than 2036. The supply capacity should be re-evaluated at 5-year intervals going forward.

- Additional water storage will be required for Lucan in the future. It is recommended that the Township undertake a MCEA study by 2030.

- That stormwater management planning be coordinated with development proposals on a subwatershed level.

- The Master Plan should be reviewed on a regular basis to evaluate the accuracy of key assumptions (e.g. the progression and rate of growth). The Master Plan should be modified as required to address changes to the environmental setting and local conditions.

We note that the Township has initiated a Schedule C Environmental Assessment for the expansion of the Lucan WWTP.

A consultation program was developed for this Master Plan was directed towards stakeholders, the pubic and provincial review agencies. Relatively few comments were received during the study.

The Lucan Urban Servicing Master Plan has been completed in accordance with the planning and design process of the MCEA. For this study, the Master Plan process incorporated the completion of Phases 1 and 2 of the MCEA process. The Master Plan will be approved for implementation subject to adoption by the Council of the Township of Lucan Biddulph.

All of which is respectfully submitted.

B. M. ROSS AND ASSOCIATES LIMITED

Per ______________________________

Andrew J. Garland, P. Eng.

Per ______________________________

Lisa J. Courtney, RPP, MCIP

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Appendix A

Species at Risk List – Middlesex County

Appendix B

Screening Checklists for Archaeological Resources and Built Heritage Resources, and Cultural Heritage Landscapes

Appendix C

WaterCAD® Modelling Information

Appendix D

Wastewater Modelling Details

Appendix E

Lucan Two Zone Flood Policy (1993)

Appendix F

ABCA Guidelines for Locating SWMFs within Riverine Floodplains

Appendix G

Consultation Materials