MUNICIPALITY OF NORTH PERTH

SERVICING MASTER PLAN
FOR LISTOWEL AND ATWOOD

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MUNICIPALITY OF NORTH PERTH

SERVICING MASTER PLAN
FOR LISTOWEL AND ATWOOD

September 24, 2025

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MUNICIPALITY OF NORTH PERTH
SERVICING MASTER PLAN
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1.0 INTRODUCTION

1.1 Purpose of the Master Plan

The Municipality of North Perth initiated a Servicing Master Plan in July 2021 to identify infrastructure requirements for future growth associated with water supply, storage, and distribution systems; wastewater collection and treatment; and the stormwater management systems servicing the communities of Listowel and Atwood.

This Servicing Master Plan will establish infrastructure improvement and expansion needs to accommodate current and projected growth in these communities.

The Master Plan will become the basis for and used in support of, future 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).

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.

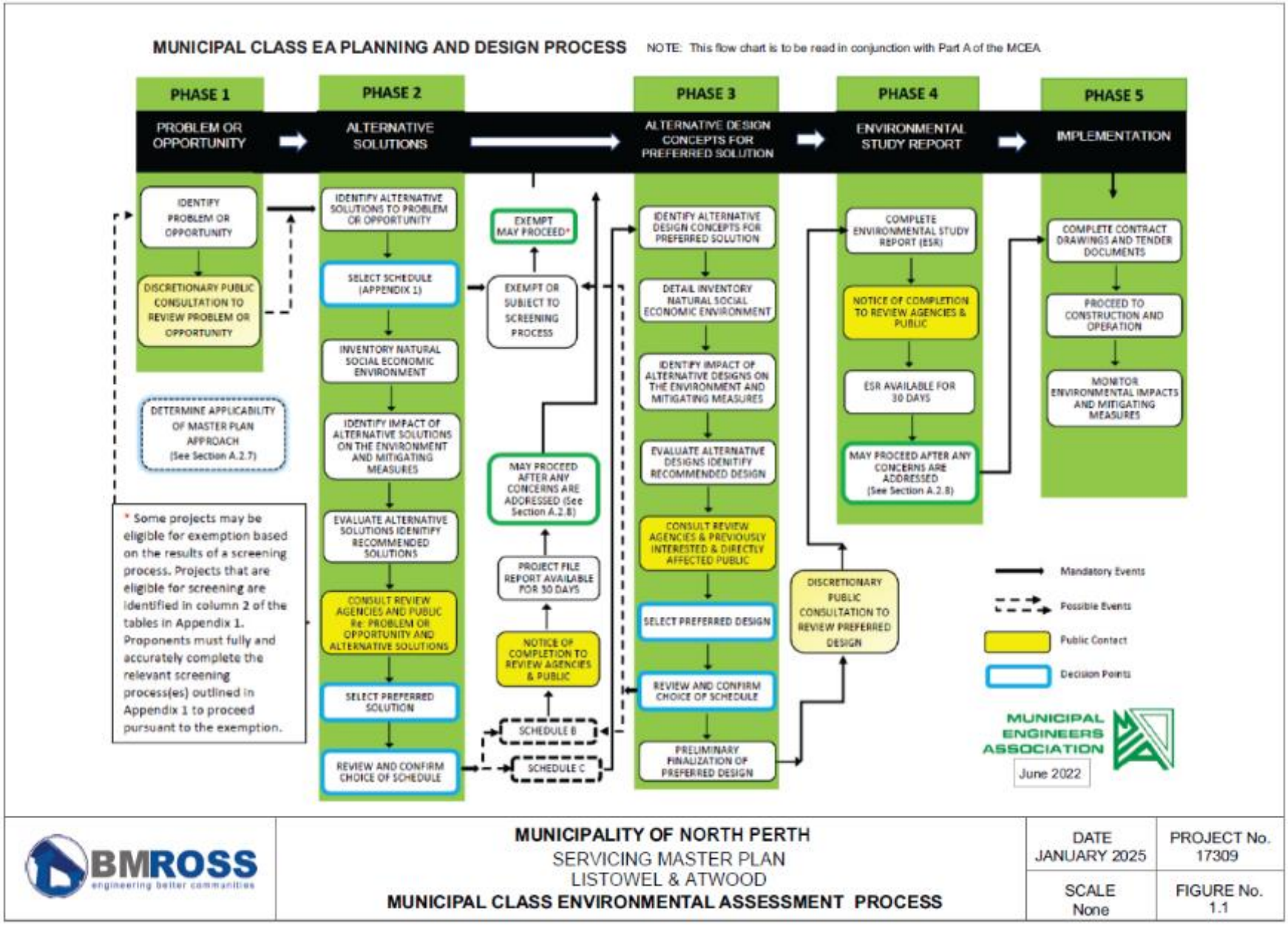
1.3.2 Classification of Project Schedules

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:

- Exempt – Projects are exempt from Environmental Assessment Act requirements;
- Eligible for Screening – Projects are eligible for exemption based on the results of the screening process(es);
- 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. Municipalities are expected to identify the appropriate level of environmental assessment based on the project they are considering.

Figure 1.1 Class EA Process



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 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.
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 the Servicing Master Plan, it was determined during the course of the investigation that Approach #1 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 will serve as a basis for additional infrastructure works associated with the implementation of project specific components. The level of consultation completed in conjunction with the Master Plan was sufficient to satisfy the MEA Class EA process associated with 'Exempt' Activities. The decision to apply Approach #1 for this Master Plan was based upon the following rationale:

- The level of review completed in conjunction with the Master Plan was not sufficient to satisfy the MEA Class EA process associated with Schedule B activities.
- The majority of the works identified through the Master Plan are 'Exempt' or pre-approved activities; therefore, the additional level of assessment was not warranted in conjunction with the study.
- There was insufficient detail associated with a future infrastructure needs (water storage facilities) to complete the level of assessment required for Schedule B activities.

Upon completion, the Master Plan will form the basis for additional assessment required to support projects identified as part of the preferred infrastructure plan.

1.4.3 Consideration of Climate Change

As part of this Master Plan, the impacts associated with climate change will be considered. Climate change phenomena 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.
- Changes in the geographic extent of species ranges and habitat.

1.4.4 Approval Requirements

The Master Plan is subject to approval from the Municipality of North Perth 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.

The Master Plan will be made available for public review and, subject to consideration of the proposed works and any comments received through consultation, the Master Plan will be approved by Municipal Council. Regulatory approvals will be required from federal and provincial review agencies for some components of the work and will be obtained once final engineering designs have been completed, prior to project implementation.

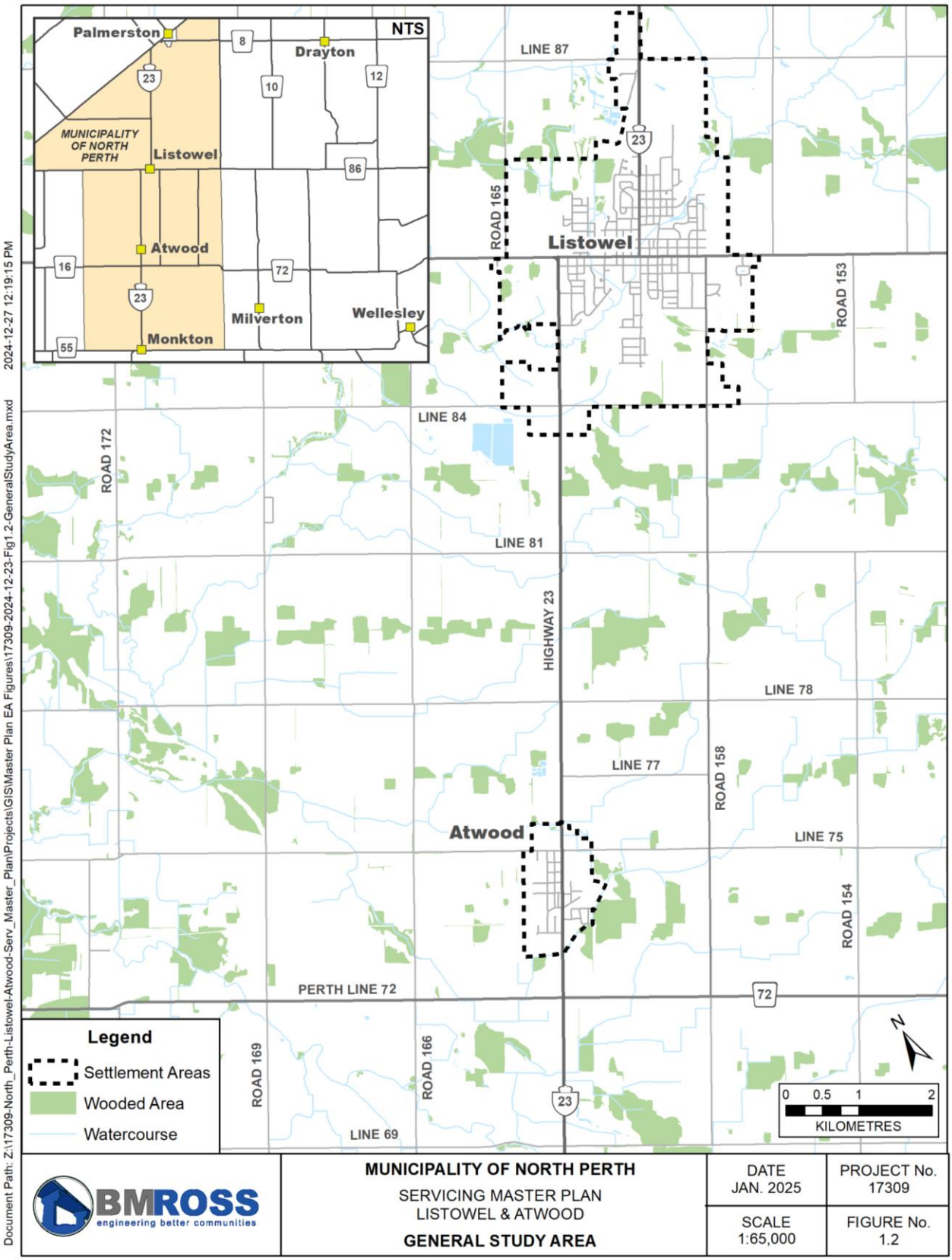
2.0 STUDY AREA AND EXISTING CONDITIONS

2.1 Study Area

In 1998, the Town of Listowel and the Townships of Elma and Wallace amalgamated to form the Municipality of North Perth. The Municipality is located approximately 40 kilometres north of Stratford in northern Perth County and, due to its location at the intersection of two major transportation corridors, Provincial Highway No. 23 (Highway No. 23) and Perth Line 86 (Perth County Road 86), has developed a diverse commercial and industrial base with an active manufacturing sector. The community of Listowel is located near the geographic centre of North Perth at the intersection of Highway No. 23 and Perth Line 86 while Atwood is located approximately 7km south of Listowel on Highway 23. Listowel serves as the largest urban settlement area within the Municipality with a population of approximately 9,500 residents and Atwood is second largest with an estimated population of 750.

Listowel is predominately a residential centre with an established commercial core and an expanding commercial/industrial sector at both the north and south limits, off of Highway No. 23. The settlement also provides a variety of facilities for local residents and the surrounding region, including an arena, community centre, fire hall, three elementary schools and a secondary school. The North Perth Municipal offices are located adjacent to the downtown core. The community is generally bisected by the Middle Maitland River, which meanders from east to west through the town including a significant portion of flood prone lands adjacent to the town centre. Figure 2.1 illustrates the general location of the Municipality of North Perth and the communities of Listowel and Atwood.

The focus of this Master Plan are the urban settlements of Listowel and Atwood, which have been identified as primary growth areas within the Municipality. These are also the only serviced urban areas within North Perth. Residential growth within Listowel has accelerated rapidly in recent years and the Municipality wants to ensure that planning for servicing of future growth areas keeps pace with expected population increases.



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LISTOWEL & ATWOOD
GENERAL STUDY AREA

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2.2 Infrastructure Inventory

Reviewing and confirming the inventory of existing water, sanitary and stormwater infrastructure was a critical component of this study and forms the basis of technical models. The location and size of watermains, hydrants, sanitary structures (maintenance holes), sanitary sewers, sanitary forcemains, stormwater management facilities (SWMFs), storm sewer structures (catchbasins, maintenance holes), and storm sewers were confirmed using geographic information system (GIS) databases. A thorough review was completed of available GIS databases, reports, drawings and development plans provided by the Municipality to fill in areas of new data, and address data gaps of historical information particularly storm and sanitary inverts and maintenance hole rim elevations. A global positioning system (GPS) survey was completed by BMROSS to further address data gaps and to resolve information discrepancies. The Provincial Digital Terrain Model (DTM), based on the 2024 LiDAR dataset, was used to establish maintenance hole/catch basin grate elevations.

BMROSS relied on third party information for completing this study, including storm sewer sizes, types and slopes. Where discrepancies were evident, a reasonable effort was made to try and resolve them. However, BMROSS takes no responsibility for any errors or omissions in the third-party information that was provided for this study.

2.3 General Description of Existing Water, Wastewater and Stormwater Facilities

The following provides a general description of water, wastewater and stormwater facilities. A more detailed description of the water, wastewater and stormwater facilities for each community is found in Section 4.0, Section 5.0 and Section 6.0 respectively.

2.3.1 Listowel Water Distribution System

The Listowel Drinking Water System (DWS) provides clean drinking water to more than 9,500 residents of Listowel. The DWS operates under Municipal Drinking Water License (MDWL) No. 091-103, Issue No. 5 and Drinking Water Works Permit (DWWP) No. 091-203, Issue No. 4.

The water supply for the system consists of three drilled wells that draw groundwater from an aquifer. Listowel Well Numbers 4, 5 and 6 were constructed in 1946, 1962 and 1989 and are 92.4 metres, 92.7 metres, and 118.6 metres deep, respectively. Two of the wells are located on the north side of Listowel and one is located on the southeast. System pressure is maintained by an elevated water tower located at 580 Main St. West, with a maximum capacity of 3,268 m^3. Predetermined water level set points automatically start and stop the well pumps.

2.3.2 Listowel Wastewater System

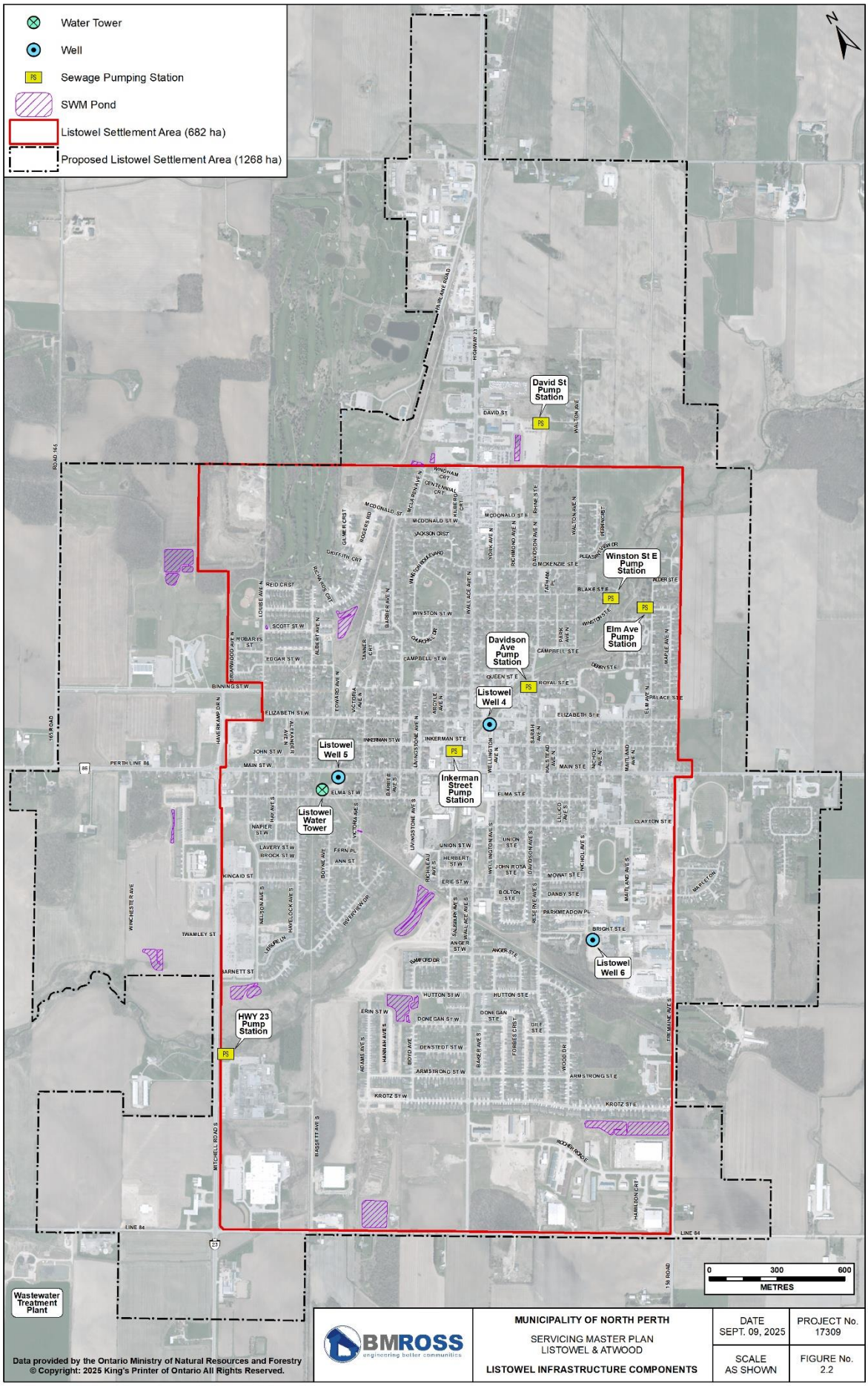
The community of Listowel is serviced by a communal sewage system consisting of collection sewers, six sewage pumping station (SPSs) and a wastewater treatment plant (WWTP) located at the southwest extent of the community off of Line 84. In general, sewage flows by gravity from the northeast extent of the settlement area to the southwest extent. The WWTP also receives sewage flows from the community of Atwood as well as septage waste from the surrounding areas. Treated effluent from the WWTP is discharged to the Maitland River.

2.3.3 Listowel Stormwater Management System

The existing urban area of Listowel is serviced by a network of storm sewers and end-of-pipe SWMFs. Most streets in Listowel have an urban road section (i.e. curbing and storm sewer). Stormwater is conveyed by several trunk storm sewers, open channel systems and municipal drains. For the Listowel storm sewer system, there are 33 sewersheds, which discharge to the Middle Maitland River and surrounding drains. The system includes 10 regional SWMFs, and almost 50,000 m of storm main providing drainage for the urban system.

Drainage within the community generally flows in a southwesterly direction to the Middle Maitland River, which is located within the jurisdiction of the MVCA.

Figure 2.2 illustrates the Listowel Settlement Area and shows the location of major components of the water, sanitary and stormwater systems.


Water Tower
Well
Sewage Pumping Station
SWM Pond
Listowel Settlement Area (682 ha)
Proposed Listowel Settlement Area (1268 ha)
David St Pump Station
Winston St E Pump Station
Elm Ave Pump Station
Davidson Ave Pump Station
Listowel Well 4
Listowel Well 5
Inkerman Street Pump Station
Listowel Water Tower
Listowel Well 6
HWY 23 Pump Station
Wastewater Treatment Plant
0 300 600
METRES
Data provided by the Ontario Ministry of Natural Resources and Forestry
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SERVICING MASTER PLAN
LISTOWEL & ATWOOD
LISTOWEL INFRASTRUCTURE COMPONENTS
DATE
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FIGURE No.
2.2

2.3.4 Atwood Water Distribution System

The Atwood DWS provides clean drinking water to more than 250 residents of Atwood. The DWS operates under Municipal Drinking Water License (MDWL) No. 091-101, Issue No. 4 and Drinking Water Works Permit (DWWP) No. 091-201, Issue No. 4.

The Atwood DWS obtains water from two wells that draw groundwater from an aquifer. Atwood Well 1 (Danbrook) is located adjacent to the Atwood Pumphouse and Well 2 (Smith) is located at 102 Parkview Crescent. All treatment of raw water from both sources takes place at the Atwood Pumphouse. Well 1 and 2 were constructed in 1997 and 2003 and are 24.4 metres and 49 metres deep, respectively. Both wells are located at the south end of Atwood and their corresponding Wellhead Protection Areas (WPAs) extend approximately 7.3 kilometres to the east. The treated water is discharged to a reservoir. Three high lift pumps deliver the treated water from the reservoir to the distribution system.

2.3.5 Atwood Sanitary System

Raw sewage from Atwood is conveyed through the Village's gravity sewage collection system to a SPS located at the northeast corner of Atwood. Sewage is then pumped through a dedicated forcemain to the headworks of the North Perth WWTP.

2.3.6 Atwood Stormwater Management System

Similar to Listowel, the community of Atwood is serviced by a network of storm sewers and end-of-pipe SWMFs. There is no large receiving watercourse in Atwood therefore stormwater is directed to several municipal drains, with drainage from the north half of the community generally flowing in a northerly direction to the Turnbull Municipal Drain and drainage from the south going to the southwest and southeast respectively Hana Municipal Drain. The receiving drains are also located within the jurisdiction of the Maitland Valley Conservation Authority (MVCA), ultimately discharging to the Middle Maitland River watershed east of Atwood.

Figure 2.3 illustrates the Atwood settlement area and key components of the water, sanitary and stormwater systems.

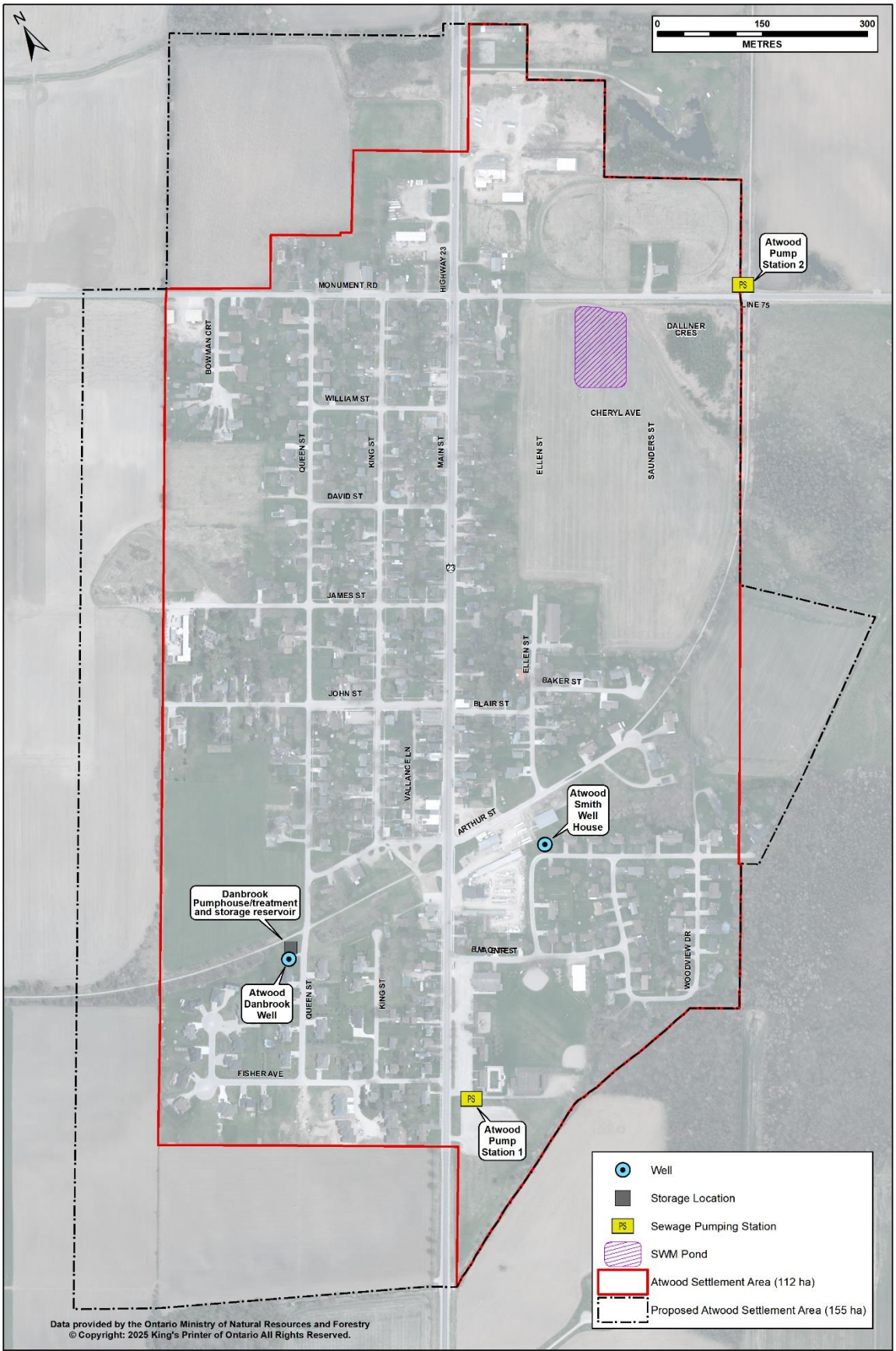
N
0
150
300
METRES
Atwood Pump Station 2
PS
MONUMENT RD
HIGHWAY 23
LINE 75
DALLINER CRES
BOWMAN CRT
WILLIAM ST
CHERYL AVE
QUEEN ST
KING ST
MAIN ST
ELLEN ST
SAUNDERS ST
DAVID ST
JAMES ST
JOHN ST
BAKER ST
BLAIR ST
VALLANCE LN
ARTHUR ST
Atwood Smith Well House
Danbrook Pumphouse/treatment and storage reservoir
Atwood Danbrook Well
ELMCREST
WOODVIEW DR
FISHER AVE
Atwood Pump Station 1
Well
Storage Location
Sewage Pumping Station
SWM Pond
Atwood Settlement Area (112 ha)
Proposed Atwood Settlement Area (155 ha)
Data provided by the Ontario Ministry of Natural Resources and Forestry
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FIGURE No.
2.3

2.4 Environmental Setting

2.4.1 General

The MCEA Master Plan process requires an inventory of the environmental setting. 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:

- MVCA, website and mapping.
- Government of Canada Species at Risk website.
- Ministry of Natural Resources (MNR) Natural Heritage Information Centre (NHIC) website.
- Existing files and reports completed by BMROSS.
- Ausable Bayfield Maitland Valley Source Protection Region reports.
- County of Perth reports and documents.
- Municipality of North Perth reports and documents.

2.4.2 General Physiography

Listowel and Atwood are 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 the 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 Listowel and Atwood area are characterized as being clay till with good drainage.

2.4.3 Significant Natural Features

(a) General

Listowel and Atwood are surrounded predominately by a rural landscape with a focus on agriculture as a primary use. The existing urban boundary is surrounded by scattered riparian forested habitat (see Figure 2.0). The Middle Maitland River flows through Listowel and a tributary of the Middle Maitland River flows through Atwood, providing habitat to aquatic species. Woodlands surrounding Listowel and Atwood appear relatively fragmented and disconnected based on historic and present agricultural land uses. Within the urban settlement boundary of Listowel and Atwood, there are relatively few natural features except for municipal parklands and the river valley corridors noted above.

(b) Watercourses

The Middle Maitland River flows through the centre of Listowel from the northeast to the southwest. The river continues in a southwest flow path after leaving the urban limits, eventually converging with the Little Maitland River, then discharging to the main channel of the Maitland River in Wingham. Tributaries of the Middle Maitland River can be found at the north and south ends of Atwood. The Middle Maitland River is regulated by the MVCA under O. Reg. 147/06. Based on a background review, there are records of Wavy-rayed Lampmussel and Rainbow Mussel, two species at risk mussels, and Northern Sunfish, a species at risk fish, within the Middle Maitland River downstream of Listowel and Atwood (Fisheries and Oceans Canada, 2022).

(c) Areas of Natural and Scientific Interest

The MNR 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 Listowel and Atwood, the 'Make a Map: Natural Heritage Areas' application was consulted (Ministry of Natural Resources, 2022). There is one ANSI located near Listowel; the Molesworth Woods. This feature is a Life Science ANSI, located approximately 5 km west of Listowel (Figure 2.4).

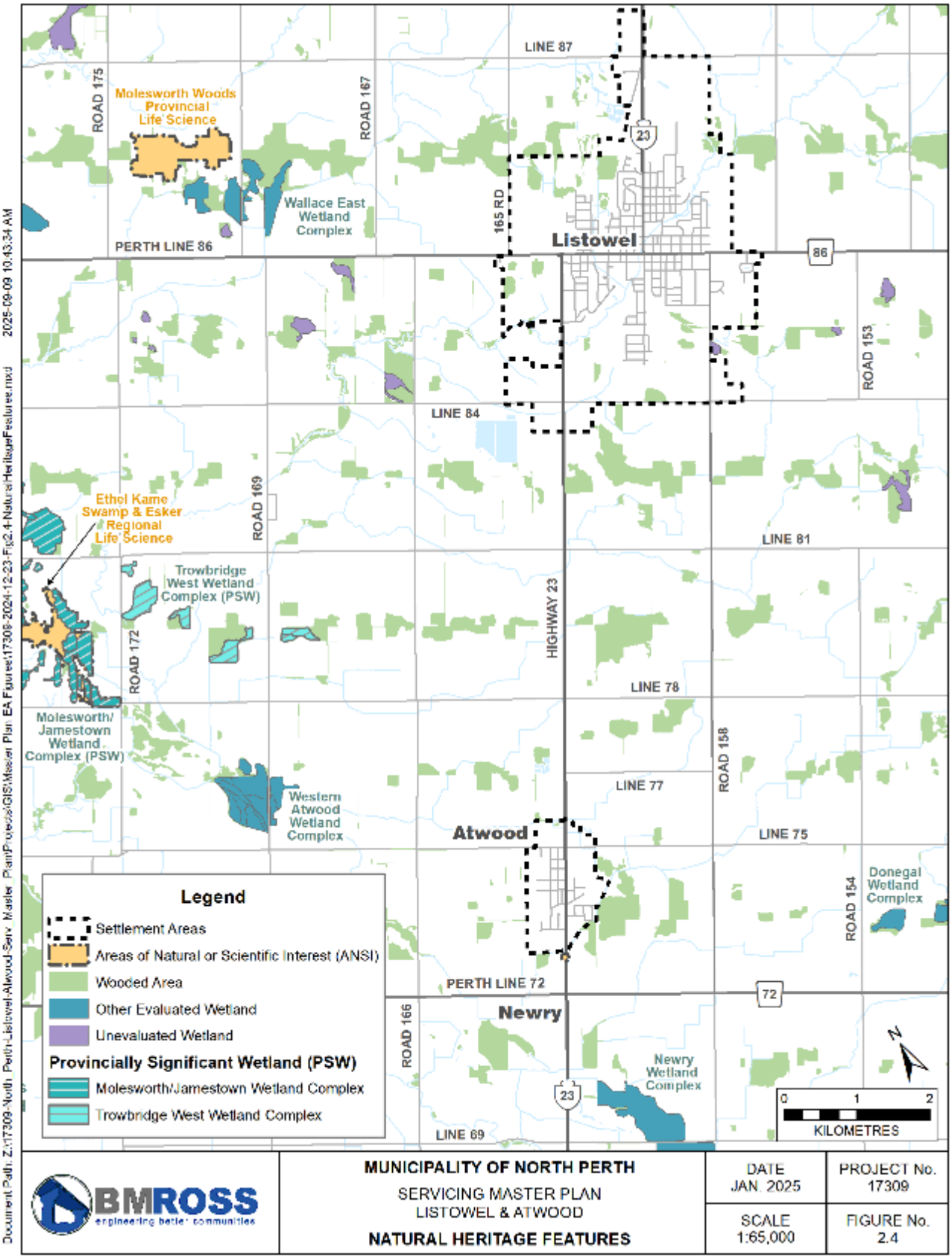
(d) Wetlands and Woodlands

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

Table 2.1 – Natural Areas within Proximity to Listowel and Atwood

Type	Name	Description
Natural Area	Newry Wetland Complex	Non-provincially significant wetland that has been evaluated approximately 2.4km south of Atwood
Natural Area	Western Atwood Complex	Non-provincially significant wetland that has been evaluated approximately 3.8km northwest of Atwood
Natural Area	Donegal Wetland Complex	Non-provincially significant wetland that has been evaluated approximately 3.9km southeast of Atwood
Natural Area	Molesworth Woods and Wallace East Wetland Complex	Non-provincially significant wetland that has been evaluated approximately 4km northwest of Listowel.

According to the County of Perth Official Plan (OP), the amount of natural features throughout the County is relatively small due to the clearing and draining of land for agricultural purposes (County of Perth, 2020). Natural features throughout the County consist of wetland areas, wooded areas, watercourses and valley lands. The County has a forest cover of approximately 9 per cent.


LINE 87
ROAD 175
Molesworth Woods Provincial Life Science
ROAD 167
Wallace East Wetland Complex
165 RD
Listowel
23
86
PERTH LINE 86
ROAD 153
LINE 84
ROAD 169
Ethel Kame Swamp & Esker Regional Life Science
LINE 81
Trowbridge West Wetland Complex (PSW)
HIGHWAY 23
ROAD 172
LINE 78
Molesworth/ Jamestown Wetland Complex (PSW)
ROAD 158
LINE 77
Western Atwood Wetland Complex
Atwood
LINE 75
Donegal Wetland Complex
ROAD 154
PERTH LINE 72
72
Newry
ROAD 166
Newry Wetland Complex
23
LINE 69
Legend
Settlement Areas
Areas of Natural or Scientific Interest (ANSI)
Wooded Area
Other Evaluated Wetland
Unevaluated Wetland
Provincially Significant Wetland (PSW)
Molesworth/Jamestown Wetland Complex
Trowbridge West Wetland Complex
N
0
1
2
KILOMETRES
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NATURAL HERITAGE FEATURES
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2.4
Document Path: Z:\17309-North Perth-Listowel-Atwood-Serv. Master Plan\Projects\GIS\Master Plan EA Figures\17308-2024-12-23-Fig2.4-NaturalHeritageFeatures.mxd
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2.4.4 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 Listowel and Atwood, the following sources were consulted:

- Natural Heritage Information Centre, Make a Heritage Map (Ministry of Natural Resources, 2022)
    - 1 km^2 squares 17MJ9834, 17MJ9734, 17NJ0342, 17NJ0442, 17NJ0543
- Environment Canada, Species at Risk Public Registry. SARA Schedule 1 Species List (Government of Canada, 2022)
- Ontario Reptile & Amphibian Atlas (Ontario Nature, 2022)
    - 10km squares 17NJ03, 17MJ93, and 17MJ04
- Ontario Species at Risk Website (Ministry of the Environment, Conservation, and Parks, 2022)
- Fisheries and Oceans Canada, Aquatic Species at Risk Online Mapping (Fisheries and Oceans Canada, 2022)
- Ontario Breeding Bird Atlas (Bird Studies Canada, 2009)
    - Region 6: Perth, 10km squares 17NJ04 and 17MJ93
- Atlas of the Mammals of Ontario (Federation of Ontario Naturalists, 1966)
- TEA Ontario Butterfly Atlas (Toronto Entomologists Association, 2022)
    - 10km squares 17MJ93 and 17NJ04

Table 2.2 – Potential Species at Risk within Listowel and Atwood Area

Species	Common Name	Scientific Name	Provincial Status	Federal Status
Turtle	Midland Painted Turtle	*Chrysemys picta marginata*	-	Special Concern
Turtle	Snapping Turtle	*Chelydra serpentina*	Special Concern	Special Concern
Bird	Bank Swallow	*Riparia riparia*	Threatened	Threatened
Bird	Barn Swallow	*Hirundo rustica*	Threatened	Threatened
Bird	Bobolink	*Dolichonyx oryzivorus*	Threatened	Threatened
Bird	Chimney Swift	*Chaetura pelagica*	Threatened	Threatened
Bird	Eastern Meadowlark	*Sturnella magna*	Threatened	Threatened
Bird	Eastern Wood-Pewee	*Contopus virens*	Special Concern	Special Concern
Bird	Northern Bobwhite	*Colinus virginianus*	Endangered	Endangered
Bird	Red-headed Woodpecker	*Melanerpes erythrocephalus*	Special Concern	Endangered
Bird	Wood Thrush	*Hylocichla mustelina*	Special Concern	Threatened
Insect	Gypsy Cuckoo Bumble Bee	*Bombus bohemicus*	Endangered	Endangered
Insect	Monarch	*Danaus plexippus*	Special Concern	Special Concern
Insect	Yellow-banded Bumble Bee	*Bombus terricola*	Special Concern	Special Concern

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.

2.4.5 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 Squares 17NJ04 and 17NJ93, in Region 6: Perth (Bird Studies Canada, 2009). Within that square, a total of 90 species were observed within the square. A total of 36 species of breeding birds were confirmed to have habitat within the area. In addition to the confirmed species, 22 species are considered to have probable and 32 possible breeding habitats in the area. The Barn Swallow *(Hirundo rustica),* a Threatened species in Ontario, and the Eastern Wood-Pewee *(Contopus virens),* a Special Concern species, are confirmed within the project study area. It is probable that the Bobolink *(Dolichonyx oryzivorus)* and Chimney Swift *(Chaetura pelagica)*, Threatened species in Ontario, and the Wood Thrush *(Hylocichla mustelina)*, a Special Concern species in Ontario, are found within the project study area.

The Bank Swallow *(Riparia riparia)* and Eastern Meadowlark *(Sturnella magna),* Threatened species in Ontario, and the Red-headed Woodpecker *(Melanerpes erythrocephalus)*, a Special Concern species in Ontario, are possibly found within the project study area.

2.4.6 Cultural Heritage and Archaeological Resources

The Listowel Ward OP outlines in Section 12 (Cultural Heritage Resources) that where appropriate, all cultural heritage resources (e.g. historic buildings, structures, and sites) shall be protected, conserved and preserved (Perth County Planning and Development Department, 2011). Development is encouraged to occur in harmony with cultural heritage resources and these resources are to be incorporated and utilized, where feasible. Furthermore, prior to development occurring, the Municipality requires the site to be assessed in order to verify the potential for archaeological resources.

(a) Cultural Heritage and Archaeological Resources

Based on input received from the Ministry of Citizenship and Multiculturalism (MCM) an assessment of potential impacts to archaeological resources, built heritage resources, and cultural heritage landscapes, must be undertaken in conjunction with the Class Environmental Assessment (Master Plan) process. To aid in this review, the Ministry provides screening tools to complete for each of these categories. Copies of the Screening Check Lists are included within Appendix A.

(b) Archaeological Resources

According to the Screening Checklist for Evaluating Archaeological Potential, the community of Listowel is identified as having archaeological potential due to historic transportation corridors and proximity (within 300 metres) to a watercourse. Therefore, prior to implementation of individual projects, a Stage 1-2 Archaeological Assessment (AA) may be required to assess potential impacts to archaeological resources.

(c) Built Heritage Resources

According to the Screening Checklist for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes, the study area has low potential for built heritage and cultural heritage landscapes. The completion of a Cultural Heritage Evaluation Report (CHER) and Heritage Impact Assessment (HIA) is therefore not likely required.

(d) Cultural Heritage Landscapes

A Cultural Heritage Landscape is defined within the 2024 Provincial Planning Statement (PPS) as: “a defined geographic area that may have been modified by human activity and is identified as having cultural heritage value or interest by a community, including an Indigenous community. The area may include features such as buildings, structures, spaces, views, archaeological sites or natural elements that are valued together for their interrelationship, meaning or association.” Section 4.6 of the PPS states that “Protected heritage property, which may contain built heritage resources or cultural heritage landscapes, shall be conserved.”

There are no designated Cultural Heritage Landscapes within the community of Listowel or Atwood however there are a number of Heritage properties. Therefore, prior to the implementation of individual projects, the project area will be assessed to ensure that significant heritage features are not located in proximity to the project work areas.

2.4.7 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.

2.5 Planning Policies

2.5.1 Provincial Planning Policies

The Provincial Planning Statement, 2024 (PPS) provides policy direction for land use planning and development across the province. Local planning policies and land use decisions must conform with the policies of the PPS. The PPS intends to promote long-

term prosperity, environmental health, public safety, and social well-being through efficient land use and development patterns (Ministry of Munical Affairs and Housing, 2024).

With respect to municipal infrastructure projects, there are a number of policies within the PPS that need to be considered. The first section of the PPS identifies policies directing land use to achieve efficient and resilient development and land use patterns.

The 2024 PPS provides planning for people and homes, stating the creation of a new OP and updating of subsequent versions of OP, sufficient land shall be made available to accommodate an appropriate range and mix of land uses to meet project needs for at least a 20-year planning horizon and a maximum of 30 years.

The PPS emphasizes the importance of ensuring an adequate and diverse housing supply to meet the needs of current and future residents in a regional market area. This involves two key components.

- 15 -Year Residential Growth Capacity - municipalities must maintain sufficient lands that are designated and available for residential growth for at least 15 years. This includes ensuring that these lands are appropriately planned for new development, such as through official plans and zoning.
- 3 -Year Immediate Supply - A minimum three-year supply of residential units must also be ensured. These units are to be appropriately zoned and served (or capable of being serviced) and part of draft-approved or registered plans of subdivision to facilitate prompt development.

This approach ensures that housing needs are met not only in the long term but also in the short term, supporting population growth, market demand, and economic sustainability. It also aligns with the broader objectives of the PPS to promote efficient land use and well-managed growth. Growth is to be concentrated in the settlement areas, and where applicable strategic growth areas, including major transit stations. Land use patterns within settlement areas should be based on densities and mix of land uses which efficiently use land and resources; optimize existing and planned infrastructure and public service facilities; support active transportation; transit and freight supportive

Section 3.1 of the PPS is dedicated to infrastructure and public services facilities. The policies in this section of the PPS promote the efficient provision of public infrastructure and service facilities to accommodate forecasted growth promptly, promote water and energy conservation, and accommodate future needs (3.6.1.a & 3.6.1.b). Planned infrastructure is to be financially viable over its life cycle and sufficient to meet existing and future needs. Additionally, infrastructure should support the effective and efficient delivery of emergency services and ensure public health and safety protection.

2.5.2 Local Planning Policies

The County of Perth OP is a long-term planning document that guides land use planning and development across the county. It establishes the framework for strategic growth, progressive development, and healthy community planning over a 25-year horizon. Several sections within the OP provide direction and insight into how lower-tier planning policy shall manage infrastructure and population growth. Growth within the County is directed toward Serviced Urban Areas of Listowel, Atwood, Mitchell, Milverton and

Shakespeare (S2.3) to maximize existing infrastructure and protect agricultural and natural lands. Within these areas, development is concentrated in Strategic Growth Areas, promoting compact, appropriately dense development patterns. Serviced Urban Areas must establish residential and employment intensification goals, fostering opportunities for intensification, infill and redevelopment. By offering a variety of available parcels, the county aims to attract new businesses and support sustainable economic growth (s.2.2) (The County of Perth, 2024).

The County OP projects Perth County's population to grow from 42,100 in 2021 to 62,900 by 2051(s.2.1). Lower-tier municipalities must provide infrastructure and public service facilities to support at least 15 years of anticipated growth, including water, wastewater, stormwater, power, transportation and waste management. They are also required to monitor and report annually on their capacity to accommodate growth. Additionally, municipalities must develop a Master Infrastructure Servicing Plan for a 25-year plan (The County of Perth, 2024).

Listowel is a fully serviced urban area with municipal water, sanitary and stormwater infrastructure (s.2.5.1) The County will collaborate with lower-tier municipalities to identify opportunities for infill and redevelopment on designated vacant or underutilized sites within serviced urban areas, ensuring adequate servicing and consideration of existing housing stock (s.5.1.1b). Additionally, the County will support municipalities in developing and implementing phasing policies for serviced urban areas to ensure the timely and contiguous expansion of infrastructure and public services adjacent to built-up settlement areas (s.5.1.1h) (The County of Perth, 2024).

Atwood is designated as a partially serviced urban area in the OP, with full municipal sanitary services and partial municipal water (s.2.5.1). Development should be directed to areas with existing municipal water and sewage services, considering the maximum build-out potential for future intensification (s.4.78c & d). Proponents of new private wells must demonstrate adequate water quality and quantity for the proposed development (The County of Perth, 2024)

The Listowel Ward OP (2011) incorporates local policies and implementation strategies based on the policy direction from the PPS and County OP. The purpose of the Listowel Ward OP is to provide direction on land use, development, resources, existing and future direction of settlement areas, specific to the existing conditions within the Listowel Ward. Section 3 of the OP provides the overall goals and objectives for the Listowel Ward in relation to future development needs. In Listowel, the primary residential land use is single-detached dwellings, but there are semi-detached and duplex units, townhouses and other forms of accommodations present within the settlement area.

The OP promotes the development of a wide range of housing types, styles and choices to accommodate the varying needs of the community. Sufficient residential land will be provided to accommodate growth for a minimum of 10 years to encourage residential development and redevelopment within the area (Municipality of North Perth, 2011). Appendix B provides excerpts from the referenced documents.

2.6 Clean Water Act (Source Water Protection)

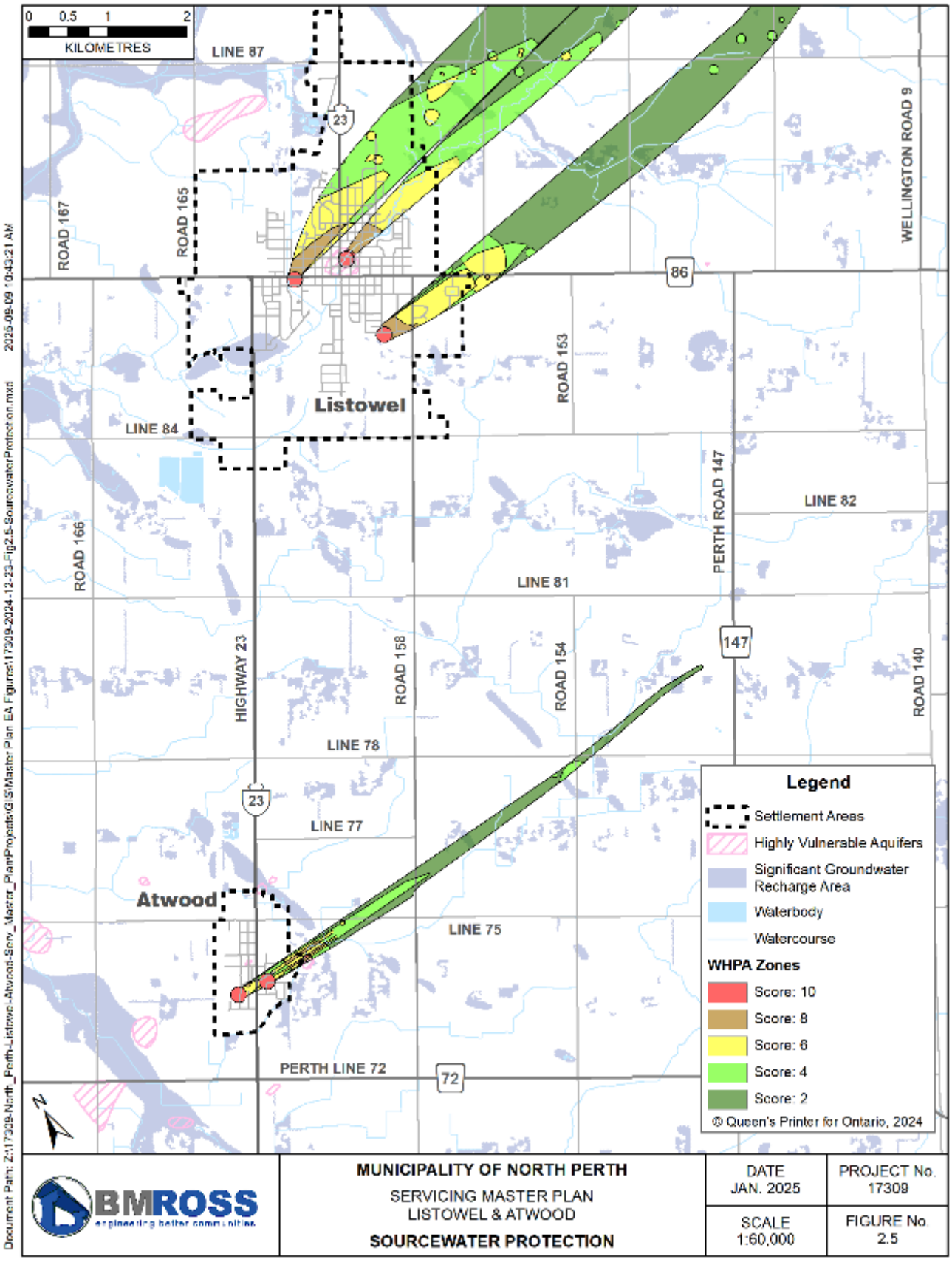
The Clean Water Act (CWA), 2006 intends to “protect existing and future drinking water” sources in Ontario. Under the Act, source protection areas and regions were established, giving conservation authorities the duties and power of a drinking water source protection authority. These duties focus on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

Listowel and Atwood are located with the Maitland Valley Source Protection Area (MVSPA). The Source Protection Plan (SPP) in this region came into effect in 2019 (Ausable Bayfield Maitland Valley Source Protection Region, 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 (Ausable Bayfield Maitland Valley Source Protection Region, 2019).

The Listowel DWS provides clean drinking water to more than 9,000 in Listowel. The Listowel system includes three drilled wells that draw groundwater from an aquifer. Listowel Wells 4, 5 and 6 were constructed in 1946, 1962 and 1989 respectively and are 92m, 92.7m, and 118.6m deep. Two of the wells are located on the north side of Listowel and one is located on the southeast. Their corresponding Wellhead Protection Areas (WHPA) extend to the northeast. WHPA-As have a vulnerability score of 10, WHPA-Bs have a vulnerability score of 8 or 6 and WHPA-Cs and WHPA-Ds have vulnerability scores of 6 or less. A highly vulnerable aquifer with a vulnerability score of 6 is present at the centre of Listowel, near Well 5. Drinking water threats within Listowel WHPAs were identified in the MVSPA Assessment Report. The drinking water threats include waste disposal sites, fuel handling or storage, and dense non-aqueous phase liquid handling or storage. No issues were identified with the wells or the condition of the wells based on past activities.

The Atwood DWS provides clean drinking water to more than 250 residents of Atwood. The Atwood system includes two drilled wells that draw groundwater from an aquifer. Atwood Wells 1 and 2 were constructed in 1997 and 2003 and are 24.4m and 49m deep, respectively. Both wells are located at the south end of Atwood and their corresponding WHPA’s extend approximately 7.3 kilometres to the east. WHPA-A has a vulnerability score of 10 and applies to residential land and a narrow strip of land east of Well 2. WHPA-B has a vulnerability score of 8 and applies to a small residential area within the hamlet, agricultural lands, and scrubland east of Atwood. WHPA-C has a vulnerability score of 6 or less. A highly vulnerable aquifer with a vulnerability score of 6 is present at the centre of Atwood.

Drinking water threats within Atwood WHPAs were identified in the MVSPA Assessment Report. Drinking water threats include waste disposal sites, sewage systems, pesticide application, fuel handling and storage, agricultural source material application, dense non-aqueous phase liquid handling and storage and grazing or pasturing livestock. No issues were identified with the wells or the condition of the wells based on past activities. Policies pertaining to drinking water threats within Listowel and Atwood can be found in the MVSPP. Projects completed as part of the Master Plan will follow these policies to prevent impacts to drinking water in Listowel and Atwood. Figure 2.1 shows the WHPAs and HVAs within Listowel and Atwood.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LINE 81
HIGHWAY 23
ROAD 158
ROAD 154
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ROAD 140
LINE 78
23
LINE 77
Atwood
LINE 75
PERTH LINE 72
72
N
Legend
Settlement Areas
Highly Vulnerable Aquifers
Significant Groundwater Recharge Area
Waterbody
Watercourse
WHPA Zones
Score: 10
Score: 8
Score: 6
Score: 4
Score: 2
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SERVICING MASTER PLAN
LISTOWEL & ATWOOD
SOURCEWATER PROTECTION
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3.0 POPULATION GROWTH AND FUTURE DEVELOPMENT

3.1 Information Sources

Population information for Listowel is available from the 2021 Census of Population from Statistics Canada (Government of Canada, 2021). The 2021 Census identifies Listowel 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.

The community of Atwood was never an incorporated Village; therefore, census data was not available for this settlement area. However, the urban area is relatively small, and it was possible to estimate the population based on the number of homes present within the urban boundary along with Municipal servicing information for sanitary and water servicing.

Municipal staff provided information on approved and proposed developments within and adjacent to each of the urban settlement areas. In addition to the proposed developments, recent population and housing projections completed by Watson and Associates Economists Ltd. (Watson) (Watson and Associates Economist Ltd, 2023) for the County of Perth and the lower-tier municipalities have been approved by the County Council. These 25-year forecasts were developed in conjunction with the review of the Perth County OP and provide a range of forecasts to assist municipalities with their growth-related planning policies.

This Master Plan intends 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 Municipality of North Perth is the 2021 Canada Census. In 2021, the population of North Perth was 15,538 residents, an increase of 2,408 persons from the 2016 count and 2,907 persons from the 2011 Census (Statistics Canada, 2021). The increase in population between 2016 and 2021 equates to an annual average growth rate of 3.10%. Over the last 10 years of census data, the annual average growth rate was 1.87%.

Population growth in North Perth occurred primarily within the community of Listowel, which increased in population from 7,530 persons in 2016 to 9,539 persons in 2021. This amounts to a 21% increase between 2016 and 2021. The Community of Listowel represents 61% of the population of North Perth and accounted for 83% of the growth in the Municipality in the prior 5 years. Table 3.1 summarizes the census population data for both Listowel and North Perth.

Table 3.1 – Census Population Counts, 1971-2021

Year	Listowel	Atwood	North Perth
1971	4,686	-	-
1976	5,126	-	-
1981	5026	-	-
1986	5107	-	-
1991	5,404	-	-
1996	5,467	-	11,808
2001	5,905	777	12,055
2006	6,303	790	12,254
2011	6,867	801	12,631
2016	7,530	814	13,130
2021	9,539	829	15,538
5-year population change	2,009	15	2,408
10-year population change	2,672	28	2,907
5-year AAGR[3] (%)	4.21%	.36%	3.10%
10-year AAGR[3] (%)	2.10%	.34	1.87%
5-year Population Change (%)	21.06%	1.8	15.5%
10-year population change (%)	28.01%	3.5	18.71%

Note: [1] Population derived from Census data.
[2] Population derived from Aerial Photography & Municipal Sources.
[3] AAGR: Average Annual Growth Rate.

Table 3.2 provides a summary of household growth based on Canada Census data for Listowel over the past 40 years. A total of 2,183 new residential units have been constructed since 1976. The average number of new households over the long, medium and short term is also shown. Over the long term (the past 30 years), there has been an average of 55 new residences constructed annually in Listowel. The average of the past 5 years shows that growth has increased, compared to the long-term average. Persons per household (PPHH), shown in the last column, compares population to the number of households. In Listowel, as in most similarly sized communities, the number of residents living in each residence, is declining.

Table 3.2 – Historic Households 1976-2021

Year	Listowel	Increase	PPHH[1]
1976	1,840		2.79
1981	1,925	+ 85	2.61
1986	2,010	+ 85	2.54
1991	2,136	+ 126	2.52
1996			
2001	2,450	+314	2.41
2006			
2011	2,975	+525	2.30
2016	3,304	+ 329	2.28
2021	4,023	+ 719	2.37
10-year Change	1,048		
30-year Change	1,887		
40-year Change	2,098		

Note: [1] PPHH – Persons per household

Table 3.3 displays historic household growth within the community of Listowel, Elma, Wallace, and North Perth based on historic building permit data provided by the Municipality. The numbers represent the average number of new homes built within the North Perth Wards over an annual 5-year period.

Table 3.3 – Building Permit Data (2018-2022) – Residential Dwellings

Year	Listowel	Elma	Wallace	North Perth
2018	209	10	13	232
2019	325	10	7	342
2020	224	11	6	241
2021	54	57	18	129
2022	24	83	10	117
Five Year Average	**167**	**34**	**11**	**212**

3.3 Growth Expressed as Equivalent Units

To assess capacity needs for major water and wastewater facilities the expected growth in households has been expressed in Equivalent Household Units (ERUs). A single detached residence is considered one ERU. Multi-family and apartment units are made equivalent using 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

For calculation purposes, it's assumed that for every residential unit built there will be a proportional increase in non-residential. The current customer count includes both residential and non-residential. Total flows include water supplied and wastewater

generated from both as well. For purposes of the reserve calculation, the historical "per customer flow", plus 10% to account for non-residential growth, is used as the flow for one ERU. This approach is expected to provide an over-estimate of future use (i.e., a factor of safety) for systems with little to no industrial, commercial, or institutional (ICI) use. Water demands and wastewater flows per ERU, including consideration of non-residential development, are calculated in later sections of this report.

3.4 Listowel Future Growth

3.4.1 Proposed Official Plan Settlement Boundary Expansion

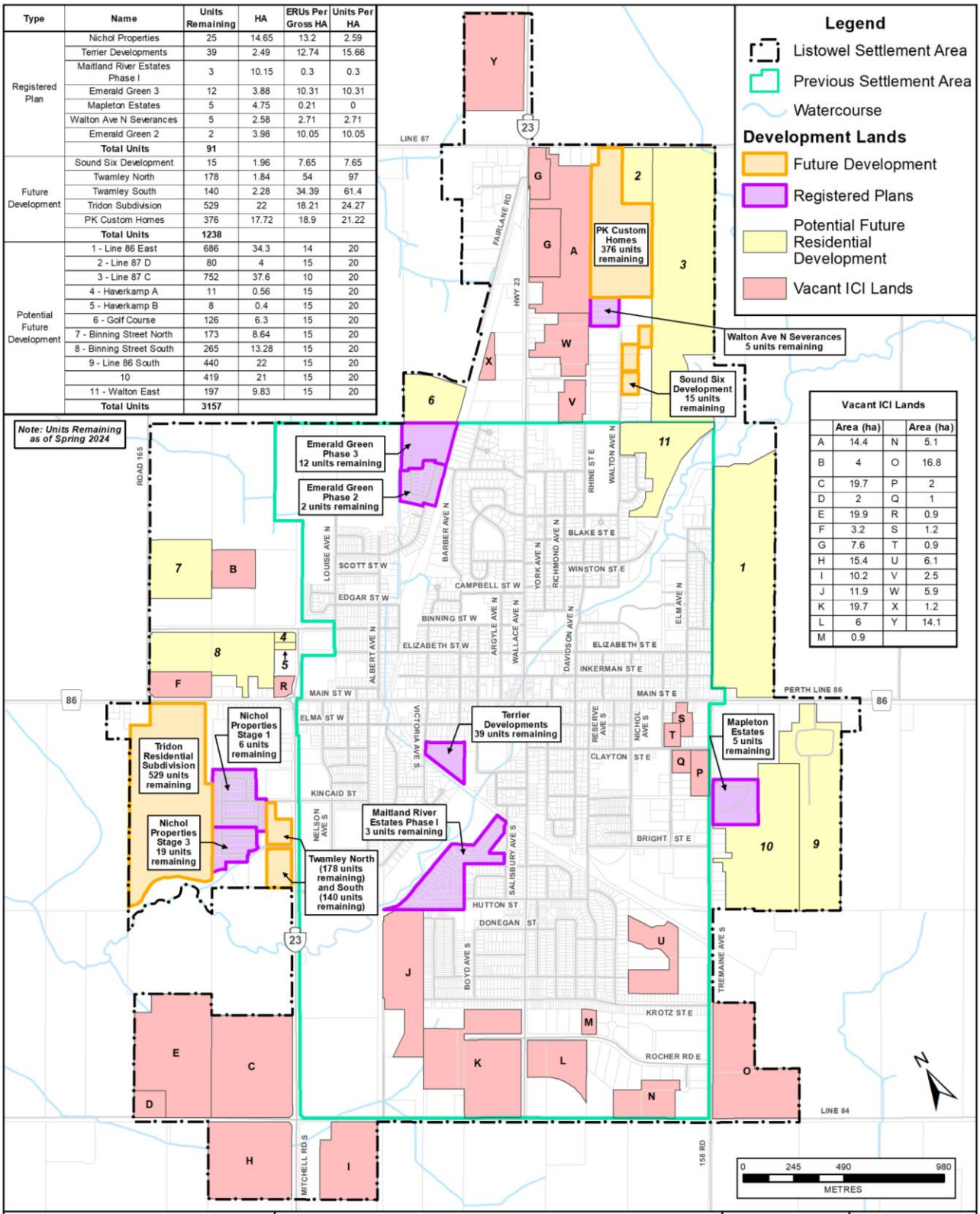
The 2024 County OP settlement boundary identified 11 Parcels as suitable for future residential growth and development within the 2024 Listowel urban boundary expansion area. Cumulatively these properties total 158 ha and have been summarized in Table 3.4. For each listed future development parcel, potential development units and population have been forecasted using an average household size of 2.37 persons per household (PPH) and an average density of 20 units per gross hectare. Figure 3.1 illustrates the location of the parcels.

Table 3.4 – Perth County Official Plan Future Residential Development Lands

Property Name	Area (ha)	Units	Future Population
1) Line 86 East	34	686	1,627
2) Line 87 D	4	80	190
3) Line 87 C	37.6	752	1,782
4) Haverkamp A	.56	11	26
5) Haverkamp B	.4	8	19
6) Golf Course	6.30	126	299
7) Binning Street North	8.64	173	410
8) Binning Street South	13.28	265	629.
9) Line 86 South	22	440	1,043
10) Tremain East	21	419	993
11) Walton East	9.83	197	467
Total	158	3,1567	7,485

Note: 1. Total Developable Area (Ha) is calculated as total developable lands, excluding estimated environmental protection areas and floodplain lands.

Type	Name	Units Remaining	HA	ERUs Per Gross HA	Units Per HA
Registered Plan	Nichol Properties	25	14.65	13.2	2.59
	Terrier Developments	39	2.49	12.74	15.66
	Maitland River Estates Phase I	3	10.15	0.3	0.3
	Emerald Green 3	12	3.88	10.31	10.31
	Mapleton Estates	5	4.75	0.21	0
	Walton Ave N Severances	5	2.58	2.71	2.71
	Emerald Green 2	2	3.98	10.05	10.05
	Total Units	**91**			
Future Development	Sound Six Development	15	1.96	7.65	7.65
	Twamley North	178	1.84	54	97
	Twamley South	140	2.28	34.39	61.4
	Tridon Subdivision	529	22	18.21	24.27
	PK Custom Homes	376	17.72	18.9	21.22
	Total Units	**1238**			
Potential Future Development	1 - Line 86 East	686	34.3	14	20
	2 - Line 87 D	80	4	15	20
	3 - Line 87 C	752	37.6	10	20
	4 - Haverkamp A	11	0.56	15	20
	5 - Haverkamp B	8	0.4	15	20
	6 - Golf Course	126	6.3	15	20
	7 - Binning Street North	173	8.64	15	20
	8 - Binning Street South	265	13.28	15	20
	9 - Line 86 South	440	22	15	20
	10	419	21	15	20
	11 - Walton East	197	9.83	15	20
	Total Units	**3157**			



BMROSS engineering better communities	**MUNICIPALITY OF NORTH PERTH** SERVICING MASTER PLAN LISTOWEL & ATWOOD **DEVELOPMENT LANDS - LISTOWEL**	DATE OCT. 23, 2024	PROJECT No. 17309
		SCALE AS SHOWN	FIGURE No. 3.1

3.4.2 North Perth Proposed Density

A proposed density of 20 units per gross hectare and 15 ERUs was calculated by averaging the number of units and unit densities of recent residential developments in Listowel. The following 11 properties were evaluated and averaged.

- Sugar Bush Town Houses
- Nichol Properties
- Twamley North
- Twamley Apartments
- Maitland River Estates I
- Maitland River Estates II
- Twamley South
- Tridon Residential Subdivision
- Emerald Green Phase II
- Emerald Green Phase III
- Terrier Development

The distribution of housing densities represented in the evaluated properties was the following:

- 36% Low Density (single and semi-detached dwellings),
- 14% Medium Density (duplex, townhouse, rise apartment),
- 49% High Density (apartments 3 or more floors) respectively, and
- 1% Residential Housing Blocks.

An average of 20 units per hectare was then multiplied by the available land parcel sizes, yielding the number of potential units in each future development land. An average household size of 2.37 PPH (2021 Canada Census Data) was then applied to determine the forecasted population growth for the identified parcels**. Appendix C** displays the average densities associated with each of the evaluated developments. The evaluated land densities ranged from a low of 6 units per hectare (Nichol Subdivision) to a high of 108 (Twamley North) units per hectare.

3.4.3 High Demand Scenario

As a result of discussions with North Perth staff it was suggested that anticipated future servicing requirements be assessed by examining recent higher-density developments (Tridon, Twamley North/South, Sugar Bush, and Makem Developments) to determine a ‘worst case’ demand scenario for servicing. The proposed high-density developments are depicted in Table 3.5. Densities associated with these higher-density developments equate to 28 units per hectare and 20 ERUs per hectare, with a density breakdown of:

- 22%, Low (single and semi-detached dwellings),
- 31 %, Medium (duplex, townhouse, rise apartment),
- 47%. High (apartments 3 or more floors)

Using the listed higher-density developments to calculate servicing demands will ensure that sufficient capacity will be available for similarly high development scenarios on lands designated for future development.

Table 3.5 – Ultimate Capacity Demand Scenario Developments

	Size (Ha)	Units	ERU	Units/ Hectare	ERU/ Hectare
Tridon Development (Approved)	22	534	400	24	18
Twamley North (Approved)	1.84	200	112	109	61
Twamley South (Approved)	2.28	140	78	61	34
Sugar Bush (Approved)	3.45	72	53	20	15
Makem Developments I (Draft Approved)	4.62	73	73	16	16
Makem Developments II (Draft Approved)	13.11	305	225	23	17
Total	**47.30**	**1,324**	**942**	**28**	**161**

3.4.4 Potential Institutional Uses

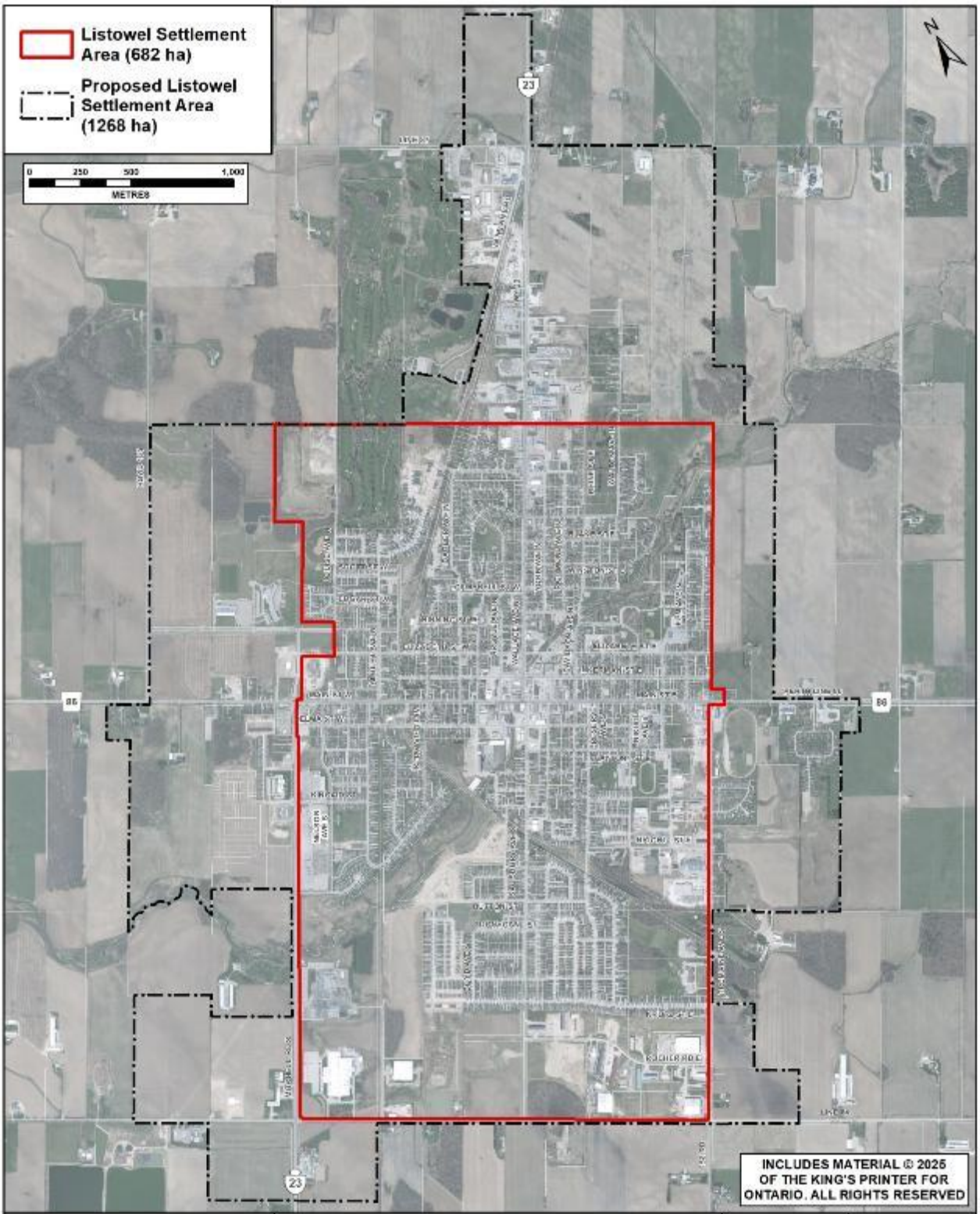
BMROSS staff met with North Perth on April 30th, 2024, via Zoom. This meeting provided updates regarding the use of Municipally owned lands located north and south of Binning Street West. A variety of potential institutional uses are anticipated for this area that would limit residential land uses. After the institutional uses are removed, the revised area yields 8.64 hectares north of Binning Street West and 13.28 south of Binning Street West for residential growth. This cumulative total of 21.92 hectares equates to 438 units [21.92* 20] of future residential development and a future population of 1,038 [438*2.37 PPH].

3.4.5 Perth County Growth Projections

The Perth County 2023 OP Comprehensive Review Report dated October 20, 2023, by Watsons, contained 25-year (2023-2048) growth projections for each municipality in Perth County. Figure 4-4 from the Watson report indicates the Municipality's urban serviced area long-term housing needs. Listowel's housing demand forecast from 2023-2048 is 4,870 housing units. The previous urban settlement boundary yielded an available housing supply of 710 residential units, leaving a deficit in the housing supply of 4,160 housing units to satisfy the comprehensive review demands. The existing supply in Atwood is 410 units, due to a recent development in the northeast part of the community. Forecasted growth is 490 units leaving a deficit of 80 units.

As part of the recently approved Perth County OP (2024) urban boundary expansions have been proposed for serviced settlement areas to accommodate growth forecasted in the Comprehensive Review conducted in 2023. Figures 3.2 and 3.3 illustrate the proposed settlement boundary expansions approved for Listowel and Atwood.

The revised 2024 Listowel settlement boundary accommodates 3,157 units (157.85*20) based on the projected densities calculated from recent Listowel developments. This leaves a deficit of -1,003 residential housing units (3,157-4,160) which equates to 50.15 hectares (1,003 /20) of additional residential land supply required to accommodate the 25-year comprehensive review growth forecasts.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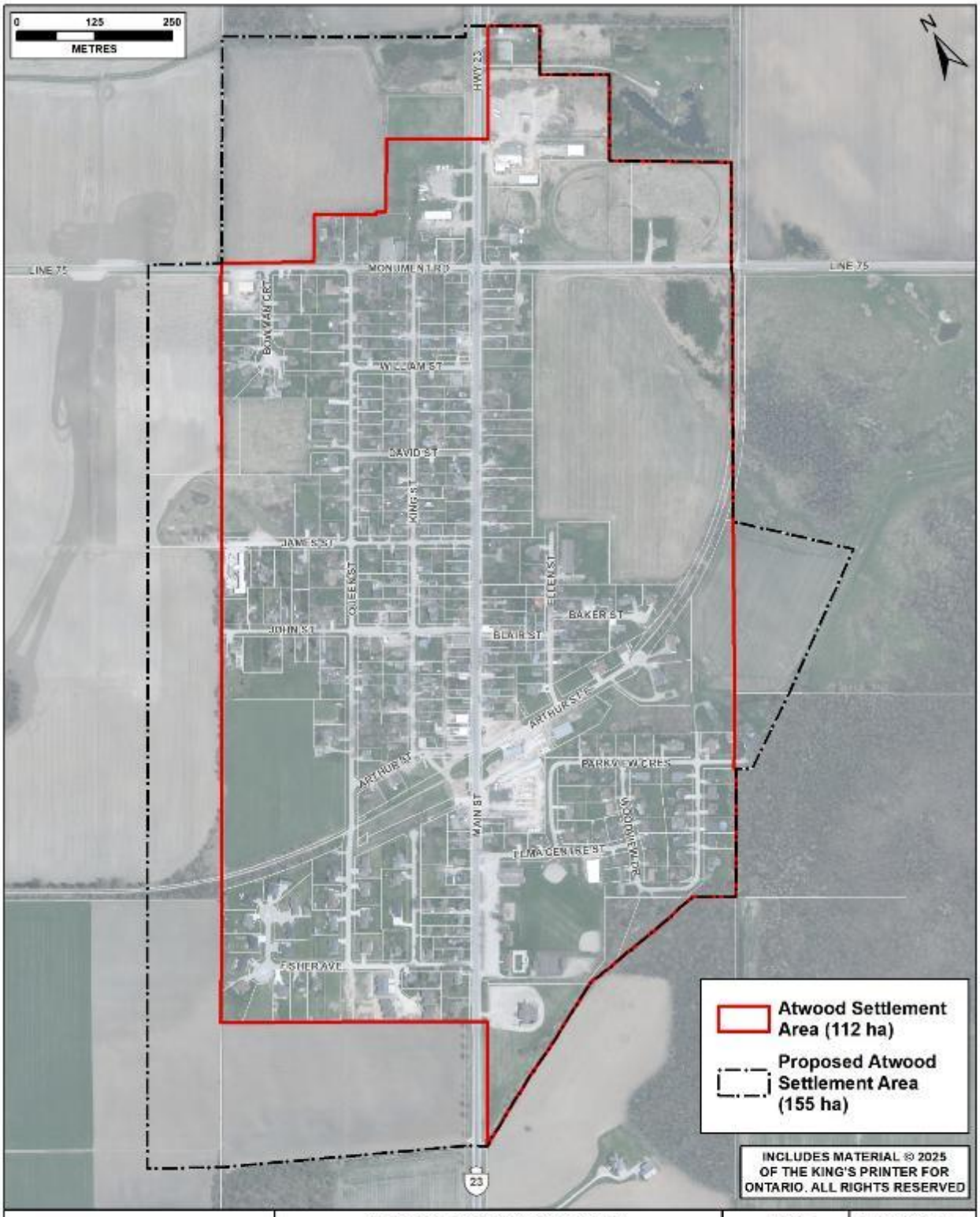
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Atwood Settlement Area (112 ha)
Proposed Atwood Settlement Area (155 ha)
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SERVICING MASTER PLAN
LISTOWEL & ATWOOD
EXISTING & PROPOSED SETTLEMENT AREA - ATWOOD
DATE
OCT. 29, 2024
PROJECT No.
17309
SCALE
AS SHOWN
FIGURE No.
3.3

3.4.6 County Official Plan Densities

The County of Perth OP Comprehensive Review (Watson 2023) projects a density of either, 11 low density units, 20 medium density units, or 49 high density units per gross ha. The medium density scenario is consistent with the density calculations used by North Perth for the Master Plan growth calculations.

3.4.7 Forecasted Growth

Future population growth was forecast for the Listowel settlement area based on historical growth in the community. A low, medium, and high growth rate of 1.39%, 2.43%, and 3.45% were calculated based on historic growth in Listowel during the past 10, 20, and 45 years. Table 3.6 summarizes the growth projections and residential housing unit needs.

Table 3.6 – Listowel Population Projections 2021 – 2046

Year	Low (1.39%)	Medium (2.43%)	High (3.45%)
2021	9,539	9,539	9,539
2026	10,226	10,740	11,220
2031	10,962	12,092	13,198
2036	11,751	13,615	15,524
2041	12,597	15,329	18,260
2046	13,504	17,258	21,479
Average Yearly Increase	793	1,544	2,388
Total Population Increase	3,965	7,719	11,940
Resulting Housing Units	1,673	3,257	5,038

Growth numbers contained within the County's OP assumed a future growth rate of approximately 3.22% (slightly less than the high growth scenario). The County's OP projects 4,864 additional units by 2046. This equates to an additional population of 11,528. When added to the current population of 9,539 (2021 Canada Census Data), this would result in a population of 21,067 by 2046, assuming an average household size of 2.37 PPH.

As noted in Section 3.4.5, the revised 2024 Listowel settlement boundary accommodates 3,157 units (157.5*20) based on the projected densities calculated from recent Listowel developments. This leaves a deficit of -1,003 residential housing units (3,157-4,160) which equates to 50.15 hectares (1,003 /20) of additional residential land supply required to accommodate the 25-year comprehensive review growth forecasts. At the high growth rate shown above, the expanded settlement boundary will achieve full build-out within 30 years.

3.4.8 Development Commitments

Table 3.7 and Figure 3.1 summarize existing development commitments for the Listowel settlement area.

Table 3.7– Listowel Development Commitments

Development Name	Hectare (ha)	Remaining (ERU)
Twamley South	2.28	78
Twamley North	1.84	100
Nichol Properties	14.65	23
Maitland River Estates Phase I	10.15	3
Sound Six	1.96	15
Tridon	22	401
Terrier	2.49	32
Mapleton	4.75	5
Emerald 2	3.88	2
Emerald 3	3.98	12
Walton Ave. N	2.58	5
PK Custom Homes	22	335
Total	**92.56**	**1,011**

Table 3.8 summarizes development potential for vacant lands within the expanded settlement area boundary. Figure 3.1 illustrates the location of the future development sites within the expanded settlement area.

Table 3.8 – Listowel Potential Development Commitments

Nu.	Name	Hectare (ha)	Potential (ERU)
1	Line 86 East	34.3	506
2	Line 87 D	4.00	59
3	Line 87 C	37.6	555
4	Haverkamp A	0.56	8
5	Haverkamp B	0.4	6
6	Golf Course	6.3	93
7	Binning St. North	8.64	128
8	Binning St. South	13.26	196
9	Line 86 South	22	325
10	Tremaine East	20.95	309
11	Walton East	9.83	145
	Total	**157.84**	**2,330**

3.5 Atwood Future Growth

3.5.1 Proposed Official Plan Settlement Boundary Expansion

Atwood's 2024 revised OP settlement boundary has 10 parcels identified as suitable for future residential growth and development. Cumulatively these properties total 44.5 ha and have been summarized in Table 3.9. For each of the listed future development parcels, potential development units and population have been forecasted using an average household size of 2.37 persons per household (PPH) and an average density of 20 units/ha. Figure 3.4 illustrates the location of the parcels.

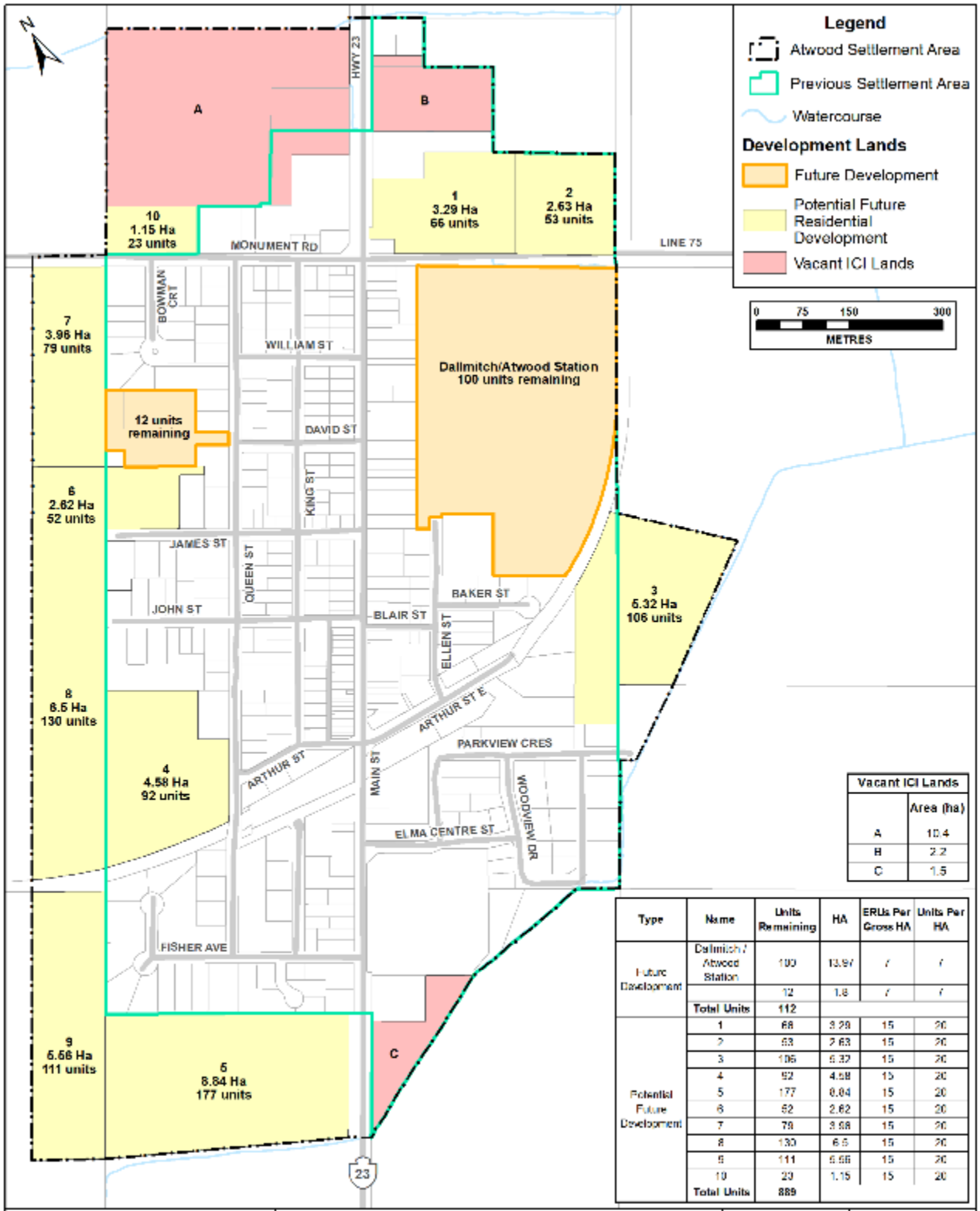
Table 3.9 – Perth County OP Residential Development Lands – Atwood

Parcel	Area (ha)	Units	Future Population
1)	3.29	66	829
2)	2.63	53	1,782
3)	5.32	106	1,896
4)	4.58	92	210
5)	8.84	177	419
6)	2.62	52	123
7)	3.96	79	187
8)	6.5	130	308
9)	5.56	111	263
10)	1.15	23	55
Total	44.55	889	6,072

Note: 1. Total Developable Area (Ha) is calculated as total developable lands, excluding estimated environmental protection areas and floodplain lands.

3.5.2 Forecasted Growth

For Atwood, which was never an incorporated settlement area, historic aerial photography was reviewed in conjunction with municipal building permit data to understand historic growth. The few developments that have occurred in the past 20 years, have filled in quickly. We believe that growth has been constrained, historically, by lack of available development lands, rather than a lack of demand. Therefore, we propose using growth rates based on historic development in Listowel, although slightly less aggressive. For the low growth rate, we suggest using a rate of 0.45% which is the Annual Average Growth Rate (AAGR) experienced in Atwood during the past 10 years. A medium growth rate of 1.39% would be based on growth in Listowel during the past 45 years, and a high growth rate would be based on the past 20 years of growth in Listowel, 2.43%. Table 3.10 displays population growth for the Atwood settlement area.


Legend
Atwood Settlement Area
Previous Settlement Area
Watercourse
Development Lands
Future Development
Potential Future Residential Development
Vacant ICI Lands
0 75 150 300
METRES
N
A
B
HWY 23
10
1.15 Ha
23 units
MONUMENT RD
1
3.29 Ha
66 units
2
2.63 Ha
53 units
LINE 75
7
3.96 Ha
79 units
BOWMAN CRT
WILLIAM ST
Dalimitch/Atwood Station
100 units remaining
12 units remaining
DAVID ST
6
2.62 Ha
52 units
KING ST
JAMES ST
QUEEN ST
JOHN ST
BAKER ST
BLAIR ST
ELLEN ST
3
6.32 Ha
106 units
8
6.5 Ha
130 units
ARTHUR ST E
PARKVIEW CRES
4
4.58 Ha
92 units
ARTHUR ST
MAIN ST
WOODVIEW DR
ELMA CENTRE ST
FISHER AVE
9
5.66 Ha
111 units
5
8.84 Ha
177 units
C
23
Vacant ICI Lands
Area (ha)
A 10.4
B 2.2
C 1.5
Type | Name | Units Remaining | HA | ERUs Per Gross HA | Units Per HA
Future Development | Dalimitch / Atwood Station | 100 | 13.97 | 7 | 7
12 | 1.8 | 7 | 7
Total Units 112
Potential Future Development
1 | 66 | 3.29 | 15 | 20
2 | 53 | 2.63 | 15 | 20
3 | 106 | 6.32 | 15 | 20
4 | 92 | 4.58 | 15 | 20
5 | 177 | 8.84 | 15 | 20
6 | 52 | 2.62 | 15 | 20
7 | 79 | 3.96 | 15 | 20
8 | 130 | 6.5 | 15 | 20
9 | 111 | 5.66 | 15 | 20
10 | 23 | 1.15 | 15 | 20
Total Units 889
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DEVELOPMENT LANDS - ATWOOD
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17309
SCALE
AS SHOWN
FIGURE No.
3.4

Table 3.10 – Atwood Population Projections 2021 – 2046

Year	Low (0.45%)	Medium (1.39%)	High (2.43%)
2021	829	829	829
2026	848	888	935
2031	867	952	1,054
2036	887	1,020	1,188
2041	907	1,093	1,340
2046	927	1,171	1,511
Avg. Yearly Increase	4	14	27
Total Increase	98	342	682

3.5.3 Household Growth

Over the same period, the number of households is expected to increase by 182 units based on the medium growth projection used to calculate population growth. The increase in households associated with the medium population projections are consistent with the number of average number of building permits issued for new dwelling units. The increase forecasted in the number of households is also consistent with demographic trends evident throughout Ontario (i.e., smaller households and sustained household growth). To reflect this change in household size, a decreasing PPHH ratio has been utilized. Table 3.12 shows expected household growth over the defined planning period for the low, medium and high growth rates.

Table 3.11– Atwood Household Projections 2021-2046

Year	Low (0.45%)	Medium (1.39%)	High (2.43%)	PPHH[1]
2021	338	338	338	2.50
2026	346	362	382	2.45
2031	361	397	439	2.40
2036	377	434	506	2.35
2041	394	475	583	2.30
2046	412	520	672	2.25
Avg. Yearly Increase	**3**	**7**	**13**	
Total Increase	**74**	**182**	**334**	

Note: [1] PPHH – Persons per household

3.6 Development Commitments – Atwood

Table 3.12 and Figure 3.4 summarize existing development commitments for the Atwood settlement area.

Table 3.12 – Atwood Development Commitments

Name	Hectare (ha)	Remaining ERU
Dallmitch /Atwood Station	13.97	91
Zyta	1.8	12
Total	**15.77**	**103**

Table 3.13 summarizes development potential for vacant lands within the expanded settlement area boundary. Potential development parcels are illustrated on Figure 3.4.

Table 3.13 – Atwood Proposed Development Commitments

Development Parcel	Parcel Size (ha)	Potential ERU
1	3.29	49
2	2.63	39
3	5.32	79
4	4.58	68
5	8.84	130
6	2.62	39
7	3.96	58
8	6.50	96
9	5.56	82
10	1.15	17
Total	**44.45**	**656**

4.0 WATER SERVICING

4.1 Listowel Drinking Water System

4.1.1 Supply and Storage Facilities

The community of Listowel is serviced by a DWS that takes water from three groundwater wells. The Listowel DWS operates under MDWL No. 091-103 Issue No. 6 and DWWP No. 091-203 Issue No. 5, both dated March 4, 2025. Wells 4 and 5 are located on the north side of Listowel and Well 6 is located on the southeast. System pressure is maintained and storage provided by an elevated tank (ET) located at 580 Main St. West, with a maximum capacity of 3,268 m^3. Predetermined water level set points in the ET automatically start and stop the well pumps.

Table 4.1 summarizes the approved water supply capacity for the Listowel DWS.

Table 4.1 – Listowel Water Facility Capacity

System Component	Capacity	Source
Combined Well System	9,819 m^3/day	DWWP / PTTW[1]
Well 4	3,273 m^3/day	DWWP / PTTW[1]
Well 5	3,273 m^3/day	DWWP / PTTW[1]
Well 6	3,273 m^3/day	DWWP / PTTW[1]
Treated Water Storage	Elevated Tank 3,268 m^3	DWWP

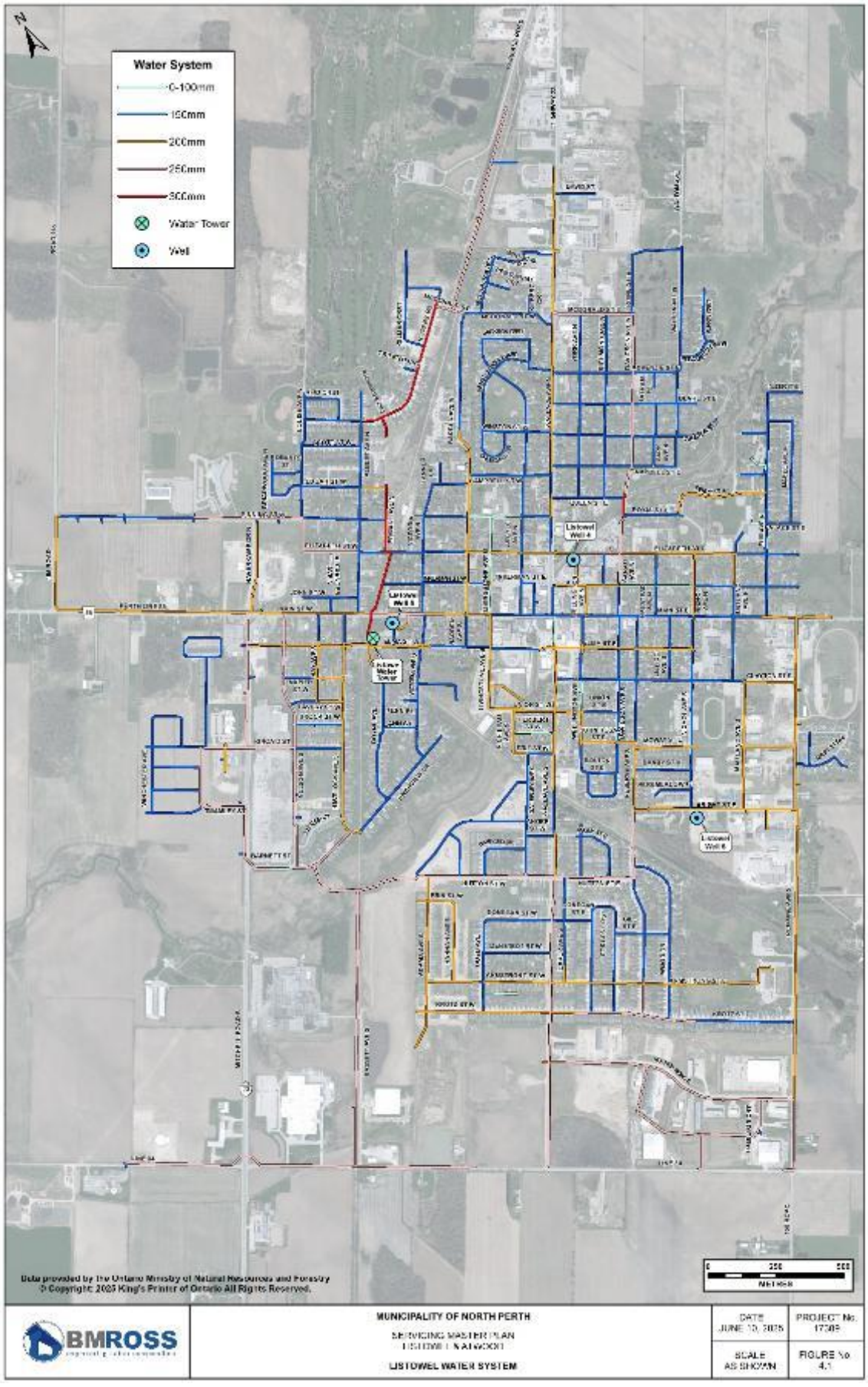
Notes:
1. PTTW refers to Permit to Take Water No. P-300-5141584896 Version 1.0.

The “firm capacity” of the Listowel DWS is established by assuming the largest well is out of service. Since each well has equal capacity, the firm (i.e., secure) capacity is the sum of approved capacity for two of the wells, which is 6,546 m^3/day.

4.1.2 Water Distribution System

The Listowel water distribution system is comprised of approximately 73 km of watermain based on GIS data provided by the municipality. This measurement includes watermain diameters of 50 mm to 300 mm. As of December 2024, there were approximately 4,400 customers.

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


Water System
0-100mm
150mm
200mm
250mm
300mm
Water Tower
Well
Listowel Well 4
Listowel Well 5
Listowel Water Tower
Listowel Well 6
Data provided by the Ontario Ministry of Natural Resources and Forestry
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0
250
500
Metres
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SERVICING MASTER PLAN
LISTOWEL & ATWOOD
LISTOWEL WATER SYSTEM
DATE
JUNE 10, 2025
PROJECT No.
17369
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AS SHOWN
FIGURE No.
4.1

4.1.3 Existing and Future Water Demands

4.1.3.1 Existing Average and Maximum Daily Flows

Water demands are recorded on a daily basis. Table 4.2 identifies the average day and maximum day demands for 2020-2023.

Table 4.2 – Listowel Treated Water Demands (2020 to 2023)

Year	Avg. Day (m^3/d)	Max. Day[1] (m^3/d)	Ratio (Max/Avg.)
2020	2,100	3,420	1.63
2021	2,184	3,366	1.54
2022	-	3,111	-
2023	2,390	3,850[2]	1.61
Average	2,225	-	1.59
Maximum	-	3,850	-

Notes:
1. Maximum day demands exclude the single high day each year related to hydrant flushing.
2. In 2023, there are multiple months where the maximum flow recorded is significantly higher than typical maximum day demands. For reserve calculations and modelling purposes, a maximum day demand of 3,850 m^3/d was assumed based on a typical system demand of 3,500 m^3/d plus an increase of 10%.

4.1.3.2 Unit Demands

As defined in Section 3.3, the demand per ERU is considered as the existing per customer demand plus 10% to account for non-residential growth. The maximum daily unit demand for Listowel is:

Demand per Customer = $\frac{3{,}850\ m^3/day}{4{,}400\ customers}$

= 0.88 m^3/day

Demand per ERU = 0.88 x 1.1 = **0.97 m^3/day**

4.1.4 Reserve Capacity for Supply

4.1.4.1 Total Reserve Capacity

As noted previously, the total reserve capacity is the difference between the supply from the three municipal wells and the existing maximum day demand for Listowel.

Total Well Supply = 9,819 m^3/day

Existing Max. Day = 3,850 m^3/day

Total Reserve = 5,969 m^3/day

4.1.4.2 Uncommitted Reserve Capacity

Table 3.7 and Figure 3.1 summarize existing development commitments for the Listowel settlement area. Based on these values, and a unit demand of 0.97 m^3/ERU·day, the uncommitted reserve is:

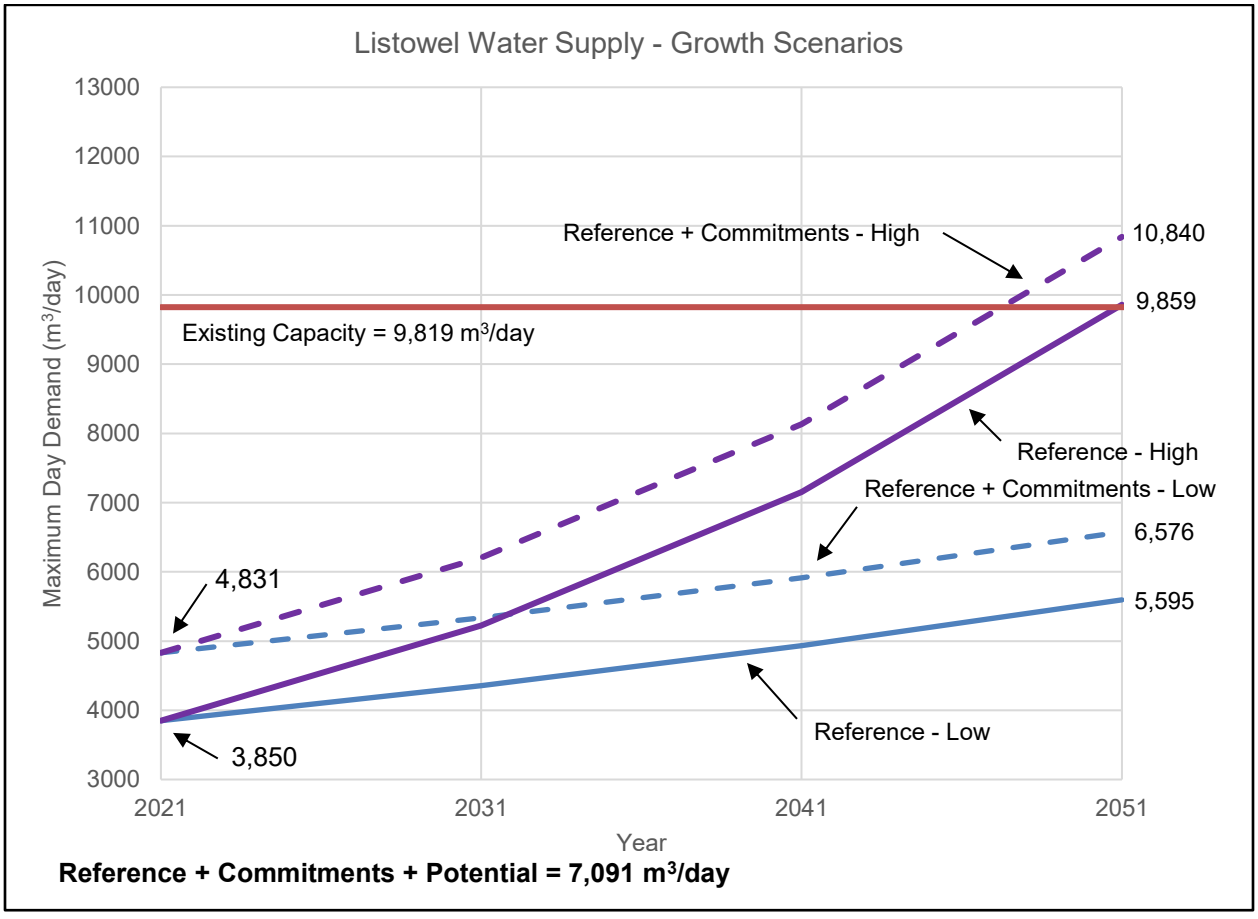
Total Reserve	= 5,969 m^3/day
Committed Reserve (1,011 ERUs x 0.97)	= 981 m^3/day
Uncommitted Reserve	= **4,988 m^3/day**

Table 3.8 summarizes development potential for vacant lands within the expanded Listowel settlement area boundary. The uncommitted reserve could supply an additional 5,142 ERUs, which exceeds the potential development sites within the existing urban boundary by 2,812 ERUs. Figure 3.4 illustrates the location of the potential development sites.

4.1.4.3 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 2051. The figure indicates that, at the highest growth rate the existing supply will be fully committed by approximately 2047.

Figure 4.2 – Growth Scenarios for Listowel Water Supply



4.1.5 Reserve Capacity for Storage

4.1.5.1 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)
Listowel Elevated Storage Tank	3,268	3,268

4.1.5.2 Basis of Assessment

The theoretical required storage is based on a formula in the Ministry of the Environment, Conservation and Parks (MECP) Design Guidelines for Drinking Water Systems. 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.

4.1.5.3 Required Water Storage

The Listowel ET has a total storage volume of 3,268 m^3. Table 4.4 summarizes the storage recommended for the individual components and total required storage volumes for Listowel.

Table 4.4 – Listowel Storage Summary

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	963	2,004	742	3,709
Existing + Commitments	1,208	2,297	876	4,381
Existing + Commitments + Proposals	1,773	3,912	1,421	7,106

Therefore, based on current rates of usage there is a deficit in available water storage relative to recommended volumes to accommodate existing conditions or development commitments. In our opinion, the magnitude of the deficit for the existing serviced population does not warrant immediate action but should be considered as development continues.

From Table 3.7, we note that the projected population for 2046 under the high growth scenario is 21,479 for the Listowel settlement area, an increase in population of 11,940. For 21,479 people the required storage volume will be 8,147 m^3 or 4,879 m^3 additional to existing.

4.1.6 Water Distribution System Modelling

4.1.6.1 Background

The Listowel 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 committed and future potential development areas.

4.1.6.2 Model Details

(a) Software

BMROSS used Bentley® WaterCAD® CONNECT Edition Update 4 for the water distribution system modelling. The model contains 355 pipes and 457 junctions for the existing Listowel network, which includes the supply provided by the three groundwater wells.

(b) Sources of Data

In order to produce a WaterCAD® model for the Listowel watermain network, several sources of information were used. In summary:

- The municipality provided watermain data from distribution system mapping (i.e., GIS files) which was used as a basis for creating the model.
- 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 Factor
150	100
200-250	110
300-600	120

- Elevation information was included in GIS data provided by North Perth. Where specific data was not available, particularly for future development areas, Google™ Earth imagery was used.
- Pump and storage characteristics were obtained from a combination of the 2018 GM Blue Plan water model, GIS data, the DWWP for the Listowel DWS, and information provided by staff.
- Water demand information was developed as part of this Master Plan.
- Assessments for fire protection capability were made using typical fire flow values including:
  - 40 to 50 L/s for residential areas.
  - 100 to 150 L/s for dispersed commercial development such as highway commercial.
  - 200 L/s for older, contiguous construction commercial area.

- All fire flows were assessed at 140 kPa minimum system residual pressure.

(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. For the existing Listowel model, the top six water customers by annual usage had the associated demand applied at the nearest model junction(s). The remaining water demand for the total system demand was divided by the total number of remaining model junctions in order to calculate the demand per junction. Appendix D contains a detailed summary of the demand allocation methodology.

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

4.1.6.3 Analyses Run

In general, the model was used to determine system pressures under peak demands and available fire flows under maximum day demands, for three scenarios: (1) existing, (2) existing plus committed development, and (3) future, which includes demands from existing, committed, and future potential development. Varying pump status (i.e., on/off) and water storage level in the ET were analyzed. A detailed list of all model scenarios includes:

- Existing and existing plus committed development demands (peak):
  - ET at operational initial level, no high-lift pumps (HLPs) on
- Future development demands (peak):
  - ET at operational initial level, no HLPs on
  - An additional ET at the north end of the community with the same water levels as the existing ET.

The scenarios listed above are anticipated to cover minimum pressures to be experienced at each junction during typical system operation.

- Existing and existing plus committed development demands (maximum day) plus fire flow:
  - ET at bottom of design fire storage, Well 6 HLP on
- Future development demands (maximum day) plus fire flow:
  - ET at bottom of design fire storage, Well 6 HLP on
  - An additional ET at the north end of the community with the same water levels as the existing ET.

The scenarios listed above are used to evaluate the range of fire flows anticipated from start to finish of a fire flow event.

4.1.6.4 Qualifications on Results

Results of the distribution system modelling are based on the system information as described above. Limited work was completed to calibrate/verify the model by way of comparison to actual field data. In the event that future distribution system modifications are to be based on the results of system modelling, it is recommended that a field testing program be carried out for the purpose of comparing actual field measurements to model predictions. The field testing can be limited to the general location of the system expansion being evaluated.

4.1.6.5 Results of Analysis

The results of the WaterCAD® analysis for each model scenario are presented in Table 4.5.

The watermain distribution system pipes modelled in each scenario are presented on figures in Appendix D.

4.1.6.5.1 Findings for Existing and Commitments Scenario

With reference to Table 4.5, the model predicts the following for the existing and commitments scenario:

- Operating pressures under peak demand conditions are predicted to be similar to the existing scenario (i.e. decreasing by 3 kPa on average, some junctions decrease by up to 5 kPa).
- Junctions near looped watermain extensions for developments experience an increase in available fire flow, in some locations up to the order of 100 L/s. Otherwise, junctions experience a nominal decrease in available fire flow.
- In general, servicing of development lands beyond the existing developed area will require suitably sized extensions and internal development looping, but allow for development without the need for upgrading any existing trunk watermain.
- Selection of new watermain locations 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.
- With reference to Table 4.4, additional storage is recommended to service committed developments, preferably in the north end of the community. The location, size, and style of storage would be confirmed through a Schedule B Class EA process.

Table 4.5 – Summary of WaterCAD® Analysis

Analysis[1,2,3,4] and Criteria[5]	Existing	Existing plus Commitments	Future
Peak Flow			
No. of junctions with kPa > 700	0	0	0
No. of junctions with kPa > 480 and <= 700	227	214	60
No. of junctions with kPa > 350 and <= 480	230	243	386
No. of junctions with kPa > 275 and <= 350	0	1	12
No. of junctions with kPa < 275	0	0	0
Fire Flows			
No. of junctions with Q < 31.5 L/s at 140 kPa	0	0	0
No. of junctions with Q > 31.5 and < 63 L/s at 140 kPa	13	8	10
No. of junctions with Q > 63 and < 94.6 L/s at 140 kPa	37	30	28
No. of junctions with Q > 94.6 L/s at 140 kPa	407	419	419

Notes:
1. For peak flow analysis, no pumps are operating.
2. For fire flow analysis, Well 6 is operating.
3. Existing plus commitments and future scenarios assume same pipe as existing model plus looping within and adjacent to development lands.
4. Future scenario assumes additional storage provided in the north part of Listowel.
5. Pressure criteria based 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

4.1.6.5.2 Findings for Future Scenario

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

- Operating pressures under peak demand conditions decrease significantly compared to the existing plus commitments scenario (i.e. approximately 50 kPa on average, some junctions decrease in the order of 130 kPa).
- Junctions near looped watermain extensions for developments and the assumed additional ET would experience an increase in available fire flow. Otherwise, most junctions experience a decrease in available fire flow, reflective of the increase in maximum day demand projected for the future.
- The same comments provided in the previous section regarding watermain trunk extensions and looping in development areas, and the need for additional water storage, apply here.

4.1.7 Climate Change Considerations

Climate change is predicted to result in more intense storms and potentially, periods of prolonged drought. The Listowel water supply comes from groundwater wells which, as a source of water, have a capacity far greater than the potential takings of Listowel. 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.

4.1.8 Problems and Opportunities for Water

4.1.8.1 General

For the Listowel 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 distribution. The existing storage system is effectively at capacity for the current customer base, and improvements are recommended to support developments.

4.1.8.2 Water Supply

Maximum day demands increased from previous years in 2023, assumed to be related to new growth. The 2023 maximum day demand was assumed to be 3,850 m^3/day, approximately 39% of the available supply which is 9,819 m^3/day.

Approved development is expected to increase the demand to 4,831 m^3/day. With reference to Figure 4.2, the existing water supply capacity will be adequate until approximately 2047 at the highest projected growth rate.

Approved development plus current known proposals will increase demands to 7,091 m^3/day, which is approximately 72% of the supply.

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

4.1.8.3 Water Storage

As the population increases so will the need for treated water storage. In Section 4.1.5 it was identified that the existing storage volume is slightly below the recommended value to accommodate existing customers. In our opinion, the magnitude of the deficit does not warrant immediate action for the existing serviced population, but additional storage is recommended to service committed developments as well as future potential developments. Future modelling scenarios assume additional storage in the north part of the community, with adequate trunk watermain connections. However, the actual location, size, and style of facility is subject to the location of watermain trunks, available land, and a Schedule B Class EA.

4.1.8.4 Distribution

Modelling of the existing, existing plus commitments, and future conditions for the water distribution system have identified the following:

- 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.

- Committed and future modelling scenarios assume additional watermain at suitable locations to provide looping for development. Locations used in modelling for this study are approximate and are for schematic purposes only. It is important to note that extensions to the water distribution system are dependent on the actual scale and sequence of development. Actual watermain locations and alignment are subject to rights-of-way, easements, etc.

4.1.9 Water Identified Projects – Listowel

The Master Plan has established the following potential projects to improve water servicing and water management for future development areas. Additional engineering investigations are recommended to confirm individual project scope.

Figure 4.3 identifies water projects for Listowel. Projects are noted as ‘L - #’ for Listowel projects. Several water projects have been identified for development lands and are dependant on timing of those developments. Future watermain and storage improvements have been highlighted as a future servicing need that needs to be addressed as part of future development planning.

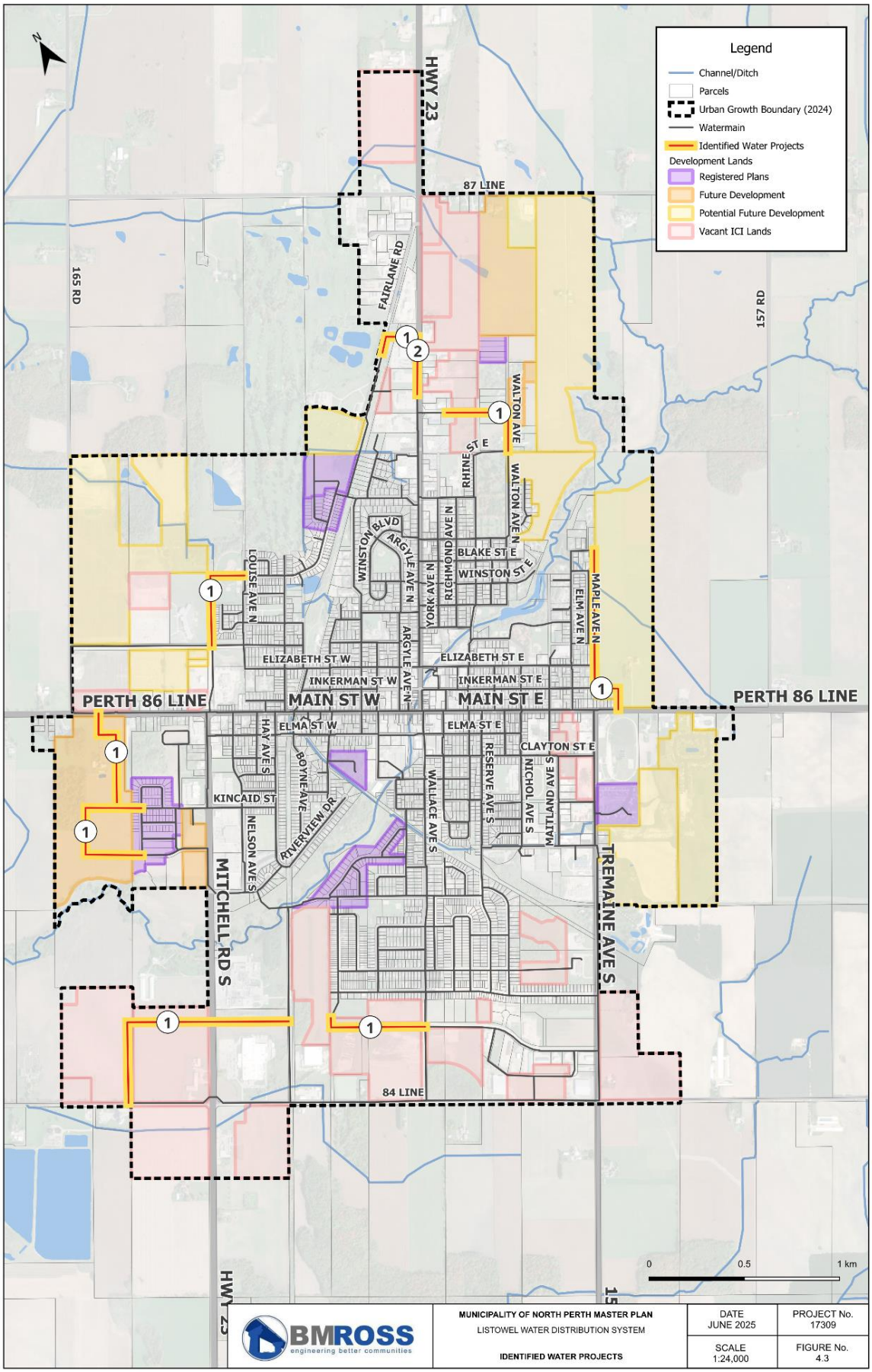
4.1.9.1 Development Servicing Needs

General Watermain Extensions and Looping for Future Development (L-1)

Watermain extensions and looping are recommended to service development lands, including distribution mains within development lands. Sizing and actual location subject to development layout.

Additional Storage (L-2)

Additional storage, preferably in north end of community. Subject to a Schedule B Class EA.


Legend
Channel/Ditch
Parcels
Urban Growth Boundary (2024)
Watermain
Identified Water Projects
Development Lands
Registered Plans
Future Development
Potential Future Development
Vacant ICI Lands
HWY 23
87 LINE
165 RD
157 RD
FAIRLANE RD
WALTON AVE
WALTON AVE N
RHINE ST E
WINSTON BLVD
ARGYLE AVE N
YORK AVE N
RICHMOND AVE N
BLAKE ST E
WINSTON ST E
LOUISE AVE N
ELM AVE N
MAPLE AVE N
ELIZABETH ST W
ELIZABETH ST E
INKERMAN ST W
INKERMAN ST E
PERTH 86 LINE
MAIN ST W
MAIN ST E
ELMA ST W
ELMA ST E
CLAYTON ST E
HAY AVE S
BOYNE AVE
RIVERVIEW DR
KINCAID ST
NELSON AVE S
WALLACE AVE S
RESERVE AVE S
NICHOL AVE S
WALTLAND AVE S
MITCHELL RD S
TREMAINE AVE S
84 LINE
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0
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1 km
BMROSS
engineering better communities
MUNICIPALITY OF NORTH PERTH MASTER PLAN
LISTOWEL WATER DISTRIBUTION SYSTEM
IDENTIFIED WATER PROJECTS
DATE
JUNE 2025
PROJECT No.
17309
SCALE
1:24,000
FIGURE No.
4.3

4.2 Atwood Drinking Water System

4.2.1 Supply and Storage Facilities

The community of Atwood is serviced by a DWS that takes water from two groundwater wells. The Atwood DWS operates under MDWL No. 091-101 Issue No. 5 and DWWP No. 091-201 Issue No. 5, both dated March 4, 2025.

The system obtains raw water from Well #1 (Danbrook) and Well #2 (Smith), both of which are located in the south part of Atwood. Water treatment for both wells occurs at the Danbrook Pumphouse, located adjacent to Well #1. Treated water is discharged to a reservoir equipped with three HLPs that deliver water to the watermain distribution network. Only some portions of the community of Atwood are serviced by the municipal water system, primarily in the south and northeast parts of the community. The MDWL is considered the limiting factor for supply purposes, with a maximum permitted daily treated water supply of 589 m^3/day.

Table 4.6 – Atwood Water Facility Capacity

System Component	Capacity	Source
Well System	589 m^3/day	MDWL / PTTW[1]
Well 1	327 m^3/day	MDWL / PTTW[1]
Well 2	262 m^3/day	MDWL / PTTW[1]
Treated Water Storage[2]	2 Cell Reservoir 125 m^3	DWWP

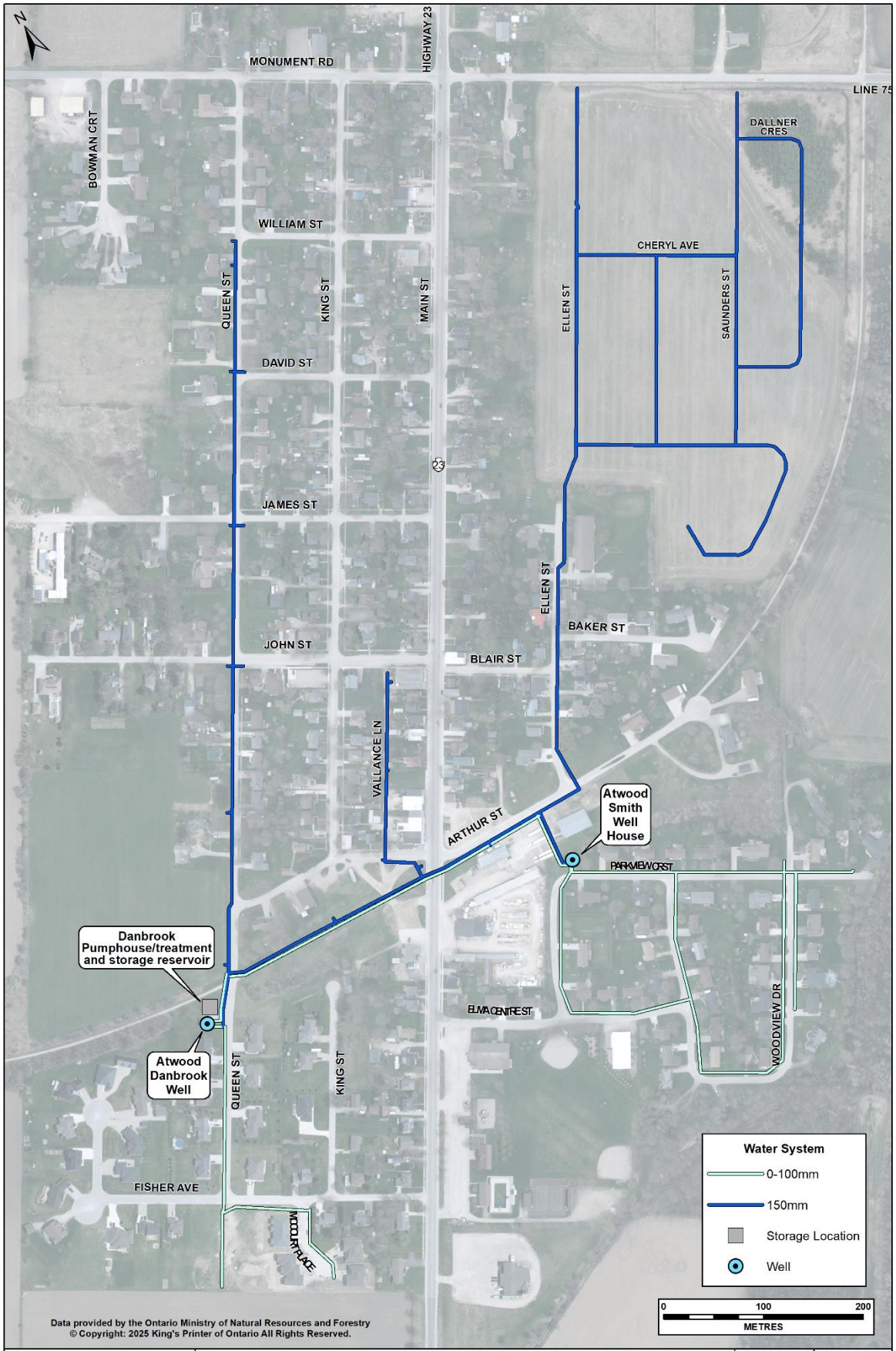
Notes:
1. PTTW refers to Permit to Take Water No. 2286-DCJMUJ.
2. The system also contains non-potable storage for fire protection, as described later in this report. Non-potable works are note included in the DWWP.

The “firm capacity” of the Atwood DWS is established by assuming the largest well (i.e., Well 1) is out of service. Therefore, the firm (i.e., secure) capacity is the approved capacity of Well 2, which is 262 m^3/day.

4.2.2 Water Distribution System

The Atwood water distribution system is comprised of approximately 7 km of watermain based on GIS data provided by the municipality. This measurement includes watermain diameters of 50 mm to 150 mm. As of December 2024, there were approximately 215 customers.

Figure 4.4 shows the locations of the watermains and major facilities associated with the Atwood water system.


N
MONUMENT RD
HIGHWAY 23
LINE 75
BOWMAN CRT
DALLNER CRES
WILLIAM ST
CHERYL AVE
QUEEN ST
KING ST
MAIN ST
ELLEN ST
SAUNDERS ST
DAVID ST
23
JAMES ST
ELLEN ST
BAKER ST
JOHN ST
BLAIR ST
VALLANCE LN
ARTHUR ST
Atwood Smith Well House
PARKVIEW CRST
Danbrook Pumphouse/treatment and storage reservoir
ELMA CENTRE ST
WOODVIEW DR
Atwood Danbrook Well
QUEEN ST
KING ST
FISHER AVE
MCCURTHAE
Water System
0-100mm
150mm
Storage Location
Well
0
100
200
METRES
Data provided by the Ontario Ministry of Natural Resources and Forestry
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LISTOWEL & ATWOOD
ATWOOD WATER SYSTEM
DATE
JUNE 10, 2025
PROJECT No.
17309
SCALE
AS SHOWN
FIGURE No.
4.4

4.2.3 Existing and Future Water Demands

4.2.3.1 Existing Average and Maximum Daily Flows

Water demands are recorded on a daily basis. Table 4.7 provides a summary of historical water supply values.

Table 4.7 – Atwood Treated Water Demands (2020 to 2023)[1]

Year	Avg. Day (m^3)	Max. Day (m^3)	Ratio (Max/Avg.)
2020	78	145	1.86
2021	67	100	1.49
2022	-	127	-
2023	87	180	2.07
Average	77	-	1.81
Maximum	-	180	-

Notes:
1. Maximum day demands exclude the single high day each year related to hydrant flushing.

4.2.3.2 Unit Demands

As defined in Section 3.3, the demand per ERU is considered as the existing per customer demand plus 10% to account for non-residential growth. The maximum daily unit demand for Atwood is:

Demand per Customer = $\frac{180 \text{ m}^3/\text{day}}{215 \text{ customers}}$

= 0.84 m^3/day

Demand per ERU = 0.84 x 1.1 = **0.92 m^3/day**

4.2.4 Reserve Capacity for Supply

4.2.4.1 Total Reserve Capacity

As noted previously, the total reserve capacity is the difference between the supply from the two municipal wells and the existing maximum day demand for Atwood.

Total Well Supply = 589 m^3/day

Existing Max. Day = 180 m^3/day

Total Reserve = **409 m^3/day**

4.2.4.2 Uncommitted Reserve Capacity

Table 3.12 and Figure 3.4 summarize existing development commitments for the Atwood settlement area. Based on these values, and a unit demand of 0.92 m^3/ERU·day, the uncommitted reserve is:

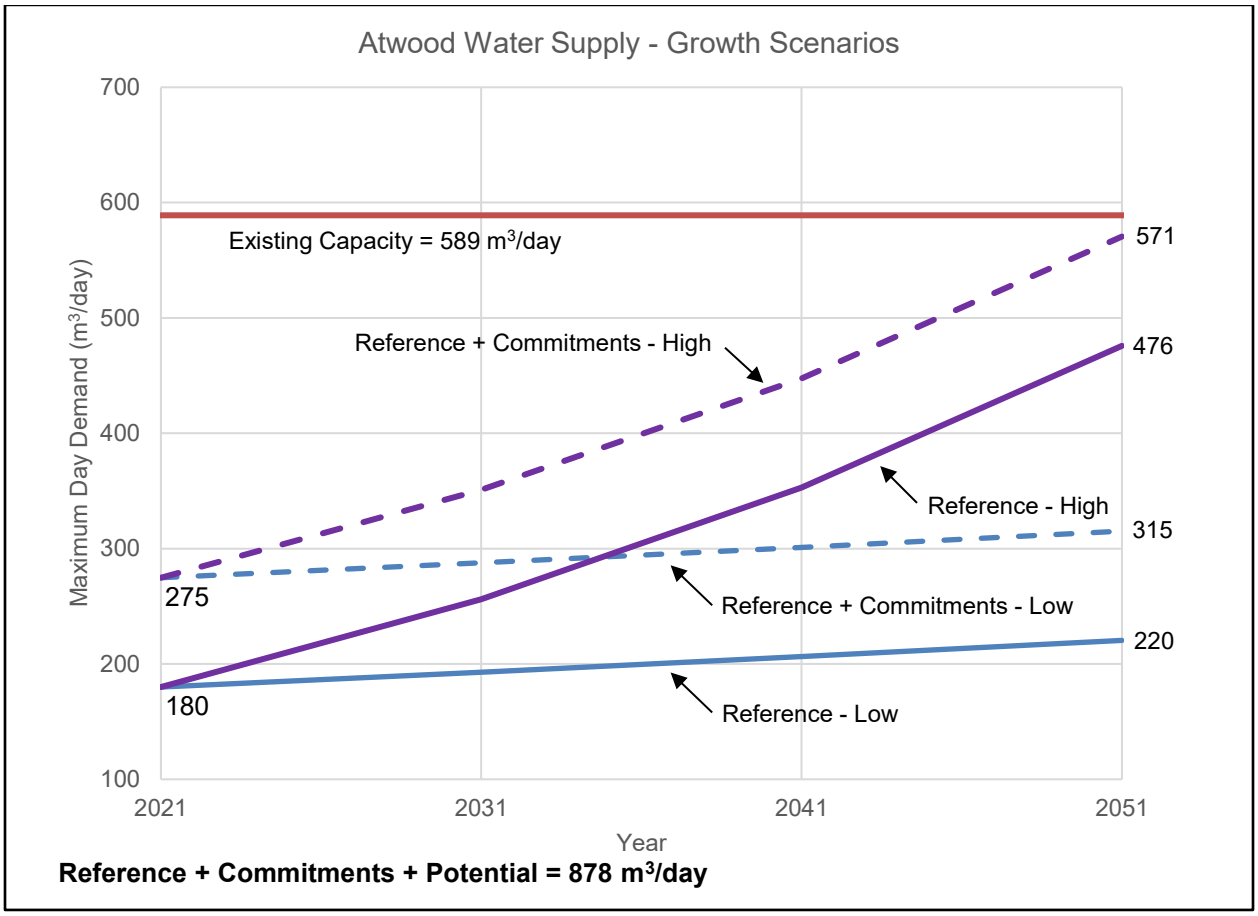
Total Reserve	=	409 m^3/day
Committed Reserve (103 ERUs x 0.92)	=	95 m^3/day
Uncommitted Reserve	=	**314 m^3/day**

Table 3.13 summarizes development potential for vacant lands within the expanded settlement area boundary. The uncommitted reserve could supply an additional 341 ERUs. There are potentially 656 ERUs available within the expanded urban boundary which leaves a supply deficit of 290 m^3/day should the entire area be developed.

4.2.4.3 Supply Capacity by Year

With reference to the growth projections presented in Section 3.5, Figure 4.5 shows the expected maximum day demand from 2021 to 2051. The figure indicates that, at the highest growth rate the existing supply will be adequate beyond 2051.

Figure 4.5: Growth Scenarios for Atwood Water Supply



4.2.5 Reserve Capacity for Storage

4.2.5.1 Existing Facilities

Table 4.8 identifies the existing storage facilities and their volumes.

Table 4.8 – Water Storage Facilities

Facility	Total Volume (m^3)	Effective Volume (m^3)
Atwood Reservoir	125	125
Atwood Fire Protection Reservoir[1]	295	295

Notes 1. This volume is non-potable; available for fire tanker truck use only.

4.2.5.2 Basis of Assessment

Refer to 4.1.5.2.

4.2.5.3 Required Water Storage

The Atwood reservoir has a total storage of 125 m^3. Atwood also has a non-potable fire protection reservoir with approximately 295 m^3 of total storage. Table 4.9 summarizes the storage required for the portions of the community serviced by municipal water.

Table 4.9 – Atwood Storage Summary

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	45	274	80	399
Existing + Commitments	69	484	138	691
Existing + Commitments + Proposals	220	780	250	1,250

Therefore, based on current rates of usage, there is not sufficient storage to accommodate development commitments or proposals, as existing conditions utilize 95% of the combined available potable and non-potable water storage.

From Table 3.6 we note that the projected population for 2046 under the high growth scenario is 1,511 for the Atwood settlement area, an increase in population of 682 from existing. For 1,511 people the recommended storage volume will be 843 m^3 or 423 m^3 additional to existing.

4.2.6 Water Distribution System Modelling

4.2.6.1 Background

The Atwood 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 committed and future potential development areas.

4.2.6.2 Model Details

(a) Software

BMROSS used Bentley® WaterCAD® CONNECT Edition Update 4 for the water distribution system modelling. The model contains 58 pipes and 48 junctions for the existing Atwood network, which includes the supply provided by the two groundwater wells.

(b) Sources of Data

In order to produce a WaterCAD® model for the Atwood watermain network, several sources of information were used. Refer to 4.1.6.2; similar notes apply here.

(c) Establishing Flows at Junctions

Refer to 4.1.6.2; similar notes apply here.

4.2.6.3 Analyses Run

In general, the model was used to determine system pressures under peak demands for three scenarios: (1) existing, (2) existing plus committed development, and (3) future, which includes demands from existing, committed, and future potential development. In Atwood, HLP operation is controlled by a pressure transmitter set to turn pumps on at 60 psi (415 kPa) and pumps off at 80 psi (550 kPa). Under peak demands, pumps were modelled as variable speed pumps with target pressures controlled by the junction directly downstream of the pumps. The model was also used to evaluate the level of fire flow available if a storage facility was added to the system in the future scenario and potential locations for an ET included two alternatives: (1) near the Danbrook Pumphouse and (2) north of the community, at Highway 23 and Monument Road. A detailed list of all model scenarios includes:

- Existing, existing plus committed development, and future demands (peak), pumps @ 60 psi (415 kPa):
    - Danbrook HLPs 1 and 2 on
- Existing, existing plus committed development, and future demands (peak), pumps @ 80 psi (550 kPa):
    - Danbrook HLPs 1 and 2 on

The scenarios listed above are anticipated to cover minimum and maximum pressures to be experienced at each junction during typical system operation.

- Future development demands (maximum day) plus fire flow, ET Option 1 and a 150 or 200 mm dia. watermain extension:
    - Potential ET near the Danbrook Pumphouse
    - ET at bottom of assumed fire storage, Danbrook HLP 3 on
    - 150 or 200 mm dia. watermain extension on Main St. to connect parts of the community that are not currently serviced, with looping

- Future development demands (maximum day) plus fire flow, ET Option 2 and a 150 or 200 mm dia. watermain extension:
    - Potential ET north of Atwood, at Highway 23 and Monument Rd.
    - ET at bottom of assumed fire storage, Danbrook HLP 3 on
    - 150 mm dia. watermain extension on Main St. to connect parts of the community that are not currently serviced, with looping

These scenarios are used to evaluate the range of fire flows anticipated from start to finish of a fire flow event if a storage facility was added to the Atwood DWS.

4.2.6.4 Qualifications on Results

Refer to 4.1.6.4; similar notes apply here.

4.2.6.5 Results of Analysis

The results of the WaterCAD® analysis for each model scenario are presented in Table 4.10.

Table 4.10 – Summary of WaterCAD® Analysis

Analysis[1,2,3,4,5] and Criteria[6]	Existing	Existing plus Commitments	Future
Peak Flow @ 60 psi (415 kPa)			
No. of junctions with kPa > 700	0	0	0
No. of junctions with kPa > 480 and <= 700	0	0	0
No. of junctions with kPa > 350 and <= 480	48	48	7
No. of junctions with kPa > 275 and <= 350	0	0	49
No. of junctions with kPa < 275	0	0	0
Peak Flow @ 80 psi (550 kPa)			
No. of junctions with kPa > 700	0	0	0
No. of junctions with kPa > 480 and <= 700	48	48	11
No. of junctions with kPa > 350 and <= 480	0	0	45
No. of junctions with kPa > 275 and <= 350	0	0	0
No. of junctions with kPa < 275	0	0	0
No. of junctions with kPa < 275	0	0	0

Analysis[1,2,3,4,5] and Criteria[6]	Existing	Existing plus Commitments	Future
Fire Flows: ET Option 1 a), 150 mm Extension			
No. of junctions with Q < 31.5 L/s at 140 kPa	-	-	11
No. of junctions with Q > 31.5 and < 63 L/s at 140 kPa	-	-	43
No. of junctions with Q > 63 and < 94.6 L/s at 140 kPa	-	-	0
No. of junctions with Q > 94.6 L/s at 140 kPa	-	-	2
Fire Flows: ET Option 2 a), 150 mm Extension			
No. of junctions with Q < 31.5 L/s at 140 kPa	-	-	7
No. of junctions with Q > 31.5 and < 63 L/s at 140 kPa	-	-	26
No. of junctions with Q > 63 and < 94.6 L/s at 140 kPa	-	-	23
No. of junctions with Q > 94.6 L/s at 140 kPa	-	-	0
Fire Flows: ET Option 1 b), 200 mm Extension			
No. of junctions with Q < 31.5 L/s at 140 kPa	-	-	11
No. of junctions with Q > 31.5 and < 63 L/s at 140 kPa	-	-	43
No. of junctions with Q > 63 and < 94.6 L/s at 140 kPa	-	-	0
No. of junctions with Q > 94.6 L/s at 140 kPa	-	-	2
Fire Flows: ET Option 2 b), 200 mm Extension			
No. of junctions with Q < 31.5 L/s at 140 kPa	-	-	5
No. of junctions with Q > 31.5 and < 63 L/s at 140 kPa	-	-	10
No. of junctions with Q > 63 and < 94.6 L/s at 140 kPa	-	-	21
No. of junctions with Q > 94.6 L/s at 140 kPa	-	-	20

Notes:
1. For peak flow analysis, Danbrook HLP 1 and 2 are operating.

2. Future scenario under peak demands assumes same pipe as existing model, looping within and adjacent to development lands, and a 150 mm watermain extension on Main St.
3. For future fire flow analysis, Danbrook HLP 3 is operating, and it was assumed that future supply will be increased to meet system demand. A design point of 20 L/s was assigned to each pump.
4. For future fire flow analysis, ET Option 1 assumes additional storage provided near Danbrook WTP. ET Option 2 assumes additional storage provided in the north part of Atwood at Highway 23 and Monument Road.
5. Future fire flow scenarios assume same pipe as existing model plus looping within and adjacent to development lands.
6. Pressure criteria based 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

The watermain distribution system pipes modelled in each scenario are presented on figures in Appendix D. For peak flow scenarios, figures are only provided for peak flow @ 60 psi (415 kPa), as it represents the lowest available junction pressures.

4.2.6.5.1 Findings for Existing Water Distribution System

The Atwood water distribution system obtains water from the current well supply. The WaterCAD® model identified the following conditions for the existing arrangement:

- There are no junctions with peak hour pressures greater than 700 or less than 275 kPa when pumps are targeting 60 or 80 psi (415 or 550 kPa).
- 100% of the model junctions are in the optimum pressure range (350 to 480 kPa) during peak flows when pumps are targeting 60 psi (415 kPa).
- 100% of the model junctions are in the acceptable pressure range (480 to 700 kPa) during peak flows when pumps are targeting 80 psi (550 kPa).

4.2.6.5.2 Findings for Existing and Commitments Scenario

With reference to Table 4.10, the model predicts the following for the existing and commitments scenario:

- Operating pressures under peak demand conditions are similar to the existing scenario (i.e., within 5 kPa) when pumps are targeting 60 and 80 psi (415 or 550 kPa).
- 100% of the model junctions are in the optimum pressure range (350 to 480 kPa) during peak flows when pumps are targeting 60 psi (415 kPa).
- 100% of the model junctions are in the acceptable pressure range (480 to 700 kPa) during peak flows when pumps are targeting 80 psi (550 kPa).
- 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.

- Selection of new watermain locations 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.
- With reference to Table 4.9, additional storage is needed to service committed developments, preferably in the north end of the community. The location, size, and style of storage would be confirmed through a Schedule B Class EA process.

4.2.6.5.3 Findings for Future Scenario

With reference to Table 4.10, the model predicts the following for the future scenario:

- Operating pressures under peak demand conditions decrease significantly compared to the existing plus commitments scenario (i.e. within approximately 90 kPa on average, and up to 110 kPa).
- With an ET near the Danbrook Pumphouse and a 150 mm diameter watermain extension on Main St, 20% of junctions have less than 31.5 L/s of available fire flow and 77% of junctions have between 31.5 L/s and 63 L/s of available fire flow. Upsizing the watermain on Main St to 200 mm slightly improves model results, increasing available fire flow by up to 5 L/s.
- With an ET at Highway 23 and Monument Rd, and a 150 mm diameter watermain extension on Main St, 13% of junctions have less than 31.5 L/s of available fire flow and 46% of junctions have between 31.5 L/s and 63 L/s of available fire flow. Upsizing the watermain on Main St to 200 mm results in 9% of junctions having less than 31.5 L/s of available fire flow and junctions overall experience an increase in available fire flow, some locations in the order of 80 L/s.
- The same comments provided in the previous section regarding watermain trunk extensions and looping in development areas, and the need for additional water storage, apply here.

4.2.7 Climate Change Considerations

Climate change is predicted to result in more intense storms and potentially, periods of prolonged drought. The Atwood water supply comes from groundwater wells which, as a source of water, have a capacity greater than forecasted growth to 2051 but less than projected to be required for the full scale of potential development lands identified. 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.

4.2.8 Problems and Opportunities for Water

4.2.8.1 General

For the Atwood DWS, problems and opportunities fall into three categories: supply, storage, and distribution. No short-term issues have been identified for either supply or distribution. Existing storage system issues are more significant, and improvements are recommended to support developments.

4.2.8.2 Water Supply

Maximum day demands increased significantly in 2023, probably related to new growth. The 2023 maximum day demand was 180 m^3/day which is approximately 31% of the available supply of 589 m^3/day.

Approved development is expected to increase the demand to 275 m^3/day. With reference to Figure 4.5, the existing water supply capacity will be adequate beyond 2051 at the highest projected growth rate. However, approved development plus current known proposals is projected to increase demands to 878 m^3/day, which is approximately 150% of the current supply. Additional well supply capacity, and upgrades of HLPs at the Danbrook Pumphouse, are required to meet future demands.

The supply capacity should be re-evaluated at a maximum interval of five years, given the significant impact that potential development lands could have. Detailed planning should begin no later than five years ahead of the actual need to increase supply.

4.2.8.3 Water Storage

As the population increases so will the need for treated water storage. In Section 4.2.5 it was identified that the existing combined potable and non-potable storage volume is 95% fully utilized. Additional storage is recommended to service committed developments as well as future potential developments. The preliminary preferred location for additional storage is in the north end of the community. Future modelling scenarios assume additional storage in the north part of the community. However, the actual location, size, and style is subject to the location of watermain trunks, available land, and a Schedule B Class EA.

4.2.8.4 Distribution

Modelling of the existing, existing plus commitments, and future conditions for the water distribution system have identified the following:

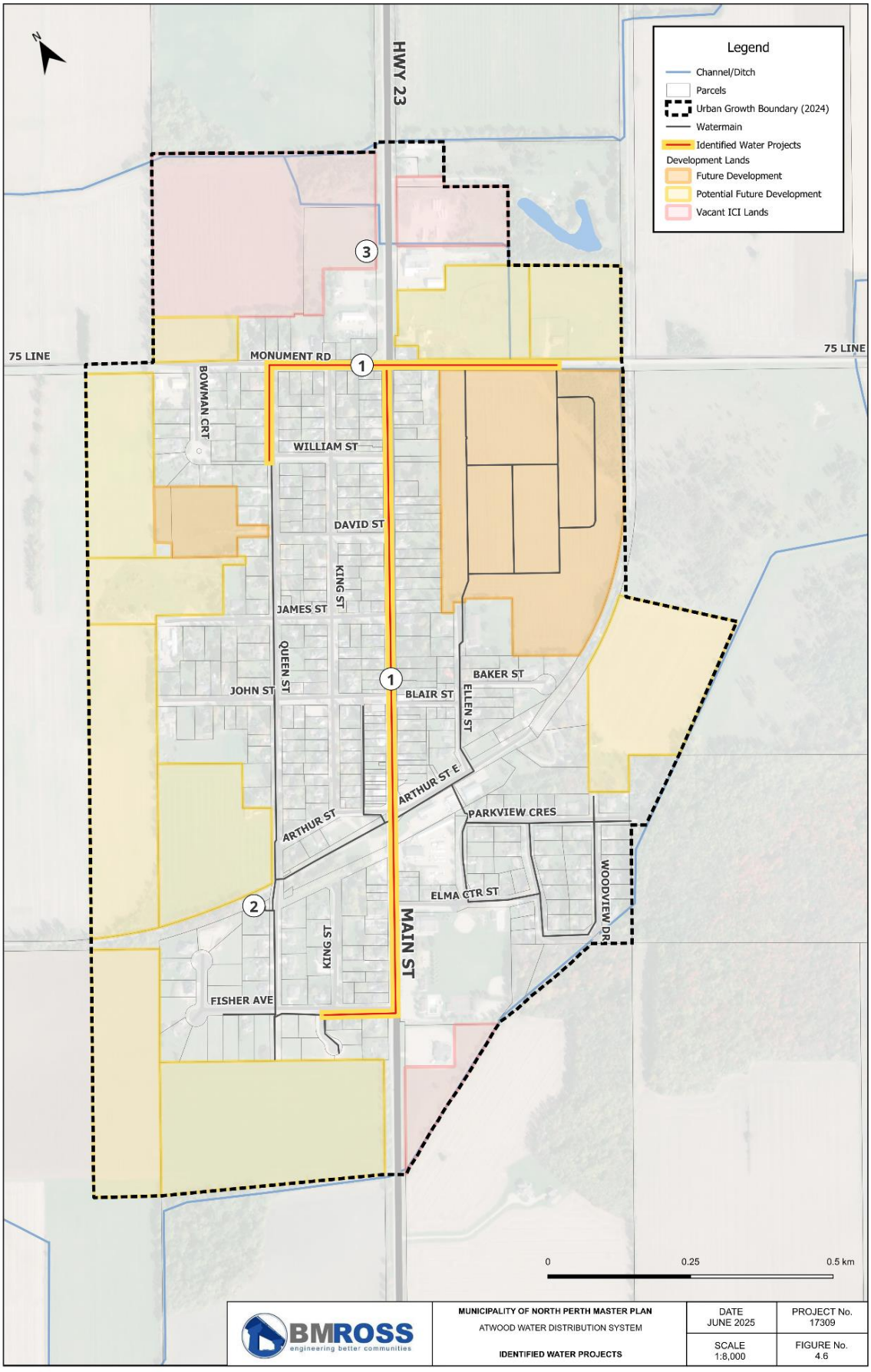
- In general, servicing of development lands beyond the existing developed area will require suitably sized extensions and internal development looping, without the need for upgrading any existing trunk watermain. Future modelling scenarios assume additional watermain at suitable locations to provide looping for developments. Locations are approximate and are for schematic purposes only. It is important to note that extensions to the water distribution system are dependent on the actual scale and sequence of development. Actual watermain locations and alignment are subject to right-of-ways, easements, etc.

- Watermain extension along Main Street and Monument Road is recommended to service developments and connect the remaining population currently serviced by private wells to the Atwood DWS.

4.2.9 Water Identified Projects – Atwood

The Master Plan has established the following potential projects to improve water servicing and water management for future development areas. Additional engineering investigations are recommended to confirm individual project scope.

Figure 4.6 identifies water projects for Atwood. Projects are noted as ‘A - #’ for Atwood projects. Several water projects have been identified for development lands and are dependant on timing of those developments. Future watermain, distribution, and storage improvements have been highlighted as a future servicing need that needs to be addressed as part of future development planning.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HWY 23
75 LINE
75 LINE
MONUMENT RD
BOWMAN CRT
WILLIAM ST
DAVID ST
KING ST
JAMES ST
QUEEN ST
JOHN ST
BLAIR ST
BAKER ST
ELLEN ST
ARTHUR ST E
ARTHUR ST
PARKVIEW CRES
WOODVIEW DR
ELMA CTR ST
KING ST
FISHER AVE
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IDENTIFIED WATER PROJECTS
DATE
JUNE 2025
PROJECT No.
17309
SCALE
1:8,000
FIGURE No.
4.6

4.2.9.1 Development Servicing Needs

Main Street/Monument Road Upgrades (A-1)

Watermain is recommended in these locations to service currently un-serviced existing development, improve watermain looping, and in preparation of servicing development lands. The following conceptual watermain upgrades are recommended:

- 170 m of 150 mm watermain along Queen Street from William Street to Monument Road.
- 510 m of 150 mm watermain along Monument Road, from Queen Street to Saunders Street.
- 1140 m of 150 mm watermain along Main Street, from Monument Road to Fisher Avenue.
- 130 m of 150 mm watermain along Fisher Avenue, from Main Street to King Street.

WTP Capacity Upgrade (A-2)

The current capacity of existing HLPs at the Danbrook WTP are limited relative to future development demand projections. Therefore, it is recommended to upgrade capacity of the pumps. For future potential buildout, an increase to the well supply capacity would also be required. It is recommended that HLP and well supply capacity increases be reviewed in conjunction with an assessment of additional water storage alternatives.

Additional Storage (A-3)

Additional storage is recommended. Subject to Schedule B Class EA.

4.3 Water Capital Costs

Capital costs for identified future development need projects have been estimated at a conceptual level for planning purposes and are summarized in Table 4.11. Refer to Sections 4.1.9 and 4.2.9 for detailed project descriptions for Listowel and Atwood respectively. Location of projects are shown on Figure 4.3 and 4.6 for Listowel and Atwood respectively. Costs for watermain projects are based on 2025 costs per meter and do not assume full urban reconstructions (i.e., cost shown is for individual asset type only). Cost saving could be incurred with coordination of water and storm replacements where applicable. Costs include 15% engineering and 20% contingencies.

For full urban street reconstructions, a cost of $5,000 per meter can be assumed for a “typical” street with 300 mm diameter storm, 200 mm diameter sanitary, and 150 mm diameter watermain (includes aforementioned engineering and contingency fees). As pipe diameters increase, the projected cost per meter increases as follows:

- $6,600 per meter if going to 750 mm diameter storm, 450 mm diameter sanitary, 300 mm diameter water.
- $8,000 per meter with 900 mm, 600 mm, and 400 mm diameters, respectively.

Table 4.11 – Water Project Costs

ID	Water Capital Project	Total Project Cost
Listowel – Development Servicing Needs		
L-1	**General Watermain Extensions and Looping for Future Development** o *Watermain extensions and looping to service development lands, including distribution mains within development lands. Sizing and actual location subject to development layout. Anticipated that development infrastructure to be paid for by developer.*	N/A
L-2	**Additional Storage** o *Additional storage, preferably in north end of community. Subject to Schedule B Class EA. Recommended to complete Class EA in conjunction with Atwood storage Class EA.*	$260,000 for Class EA in conjunction with Atwood Class EA activities. $10,000,000 order of magnitude for future storage facility.
Atwood – Development Servicing Needs		
A-1	**Main Street/Monument Road Upgrades** o *170 m of 150 mm watermain along Queen Street from William Street to Monument Road.* o *510 m of 150 mm watermain along Monument Road, from Queen Street to Saunders Street.* o *1440 m of 150 mm watermain along Main Street, from Monument Road to Fisher Avenue.* o *130 m of 150 mm watermain along Fisher Avenue, from Main Street to King Street.*	$2,528,300
A-2	**WTP Capacity Upgrade** o *Increase HLP capacity to service projected development needs.* o *Recommend establishing sizing and sequencing strategy in conjunction with well supply and storage Class EA*	$260,000 for Class EA in conjunction with Listowel and Atwood storage Class EA. $2,000,000 order of magnitude for additional well supply, treatment, and HLP upgrades.
A-3	**Additional Storage** o Additional storage, location TBD. Subject to Schedule B Class EA. Recommended to complete Class EA in conjunction with Listowel storage Class EA.	$260,000 for Class EA in conjunction with Listowel storage and other Atwood Class EA activities. $6,000,000 order of magnitude for future storage facility.

Note:

1. *Refer to Figure 4.3 and 4.6 for proposed project locations. Projects noted as 'L-#' for Listowel projects, and 'A-#' for Atwood projects.*
2. *Total project costs assumed based on 2025 watermain costs per meter, 15% Engineering and 20% Contingencies.*

5.0 LISTOWEL AND ATWOOD WASTEWATER SYSTEM

5.1 Description

Listowel and Atwood each have a separate sanitary sewage (i.e., wastewater) collection system. Wastewater from each community is pumped to a central wastewater treatment facility located adjacent to the southwest extent of Listowel.

5.1.1 Pumping and Treatment

The community of Listowel is serviced by a communal sewage system consisting of gravity sewers, six SPSs and a WWTP. The Highway 23 SPS discharges directly to the North Perth WWTP located at the southwest extent of the community off of Line 84. The other five stations are the Inkerman Street SPS, Davidson Avenue SPS, Elm Avenue North SPS, David St. SPS, and Winston Street SPS, each of which discharges to a location within the gravity collection system and eventually to the Highway #23 SPS.

Atwood, which is located approximately 6.5 km south of Listowel, is serviced by a collection system consisting of gravity sewers and two SPSs. SPS #2 is in the northeast extent of Atwood and is where wastewater from the community is pumped via forcemain to the WWTP near Listowel. The other station in Atwood, SPS #1, is in the southwest quadrant of the community, and discharges to gravity sewers within the SPS #2 catchment area.

All collection sewers and SPSs operate under Consolidated Linear Infrastructure (CLI) Environmental Compliance Approval (ECA) No. 091-W601, dated August 1, 2023.

The North Perth WWTP operates under amended ECA No. 0161-ALLQ8G dated May 31, 2017. The ECA establishes the hydraulic capacity of the WWTP as 9,030 m^3/day as an Annual Average Daily Flow (AADF), which includes flows from Listowel and Atwood, as well as septage. The plant provides tertiary level treatment and discharges continuously to the Maitland River.

As of 2024, there were approximately 4,400 sewage customers in Listowel and 375 sewage customers in Atwood.

Table 5.1 provides a summary of the capacity of the major facilities.

Table 5.1 – Listowel and Atwood Wastewater Facility Capacities

System Component	Capacity	Source Information
Listowel Facilities		
Wastewater Treatment Plant (WWTP)	9,030 m^3/day as an AADF 25,500 m^3/day as a Peak Flow	ECA
Inkerman SPS	3 pumps rated at 45 L/s at 16 m TDH	CLI ECA
Hwy. 23 SPS	3 pumps rated at 216 L/s at 24 m TDH, combined station capacity of 295 L/s at 30 m TDH	CLI ECA
Davidson Ave. SPS	2 pumps rated at 9.0 L/s at 9.8 m TDH	CLI ECA
Winston St. SPS	2 pumps rated at 0.85 L/s at 6.52 m TDH	CLI ECA
Elm Ave. N. SPS	2 pumps rated at 9.0 L/s at 9.8 m TDH	CLI ECA
David St. SPS	2 pumps rated at 16.2 L/s at 28.4 m TDH	CLI[1]
Atwood Facilities		
SPS #1	2 pumps rated at 29 L/s at 13.5 m TDH	CLI ECA
SPS #2	2 pumps rated at 48.45 L/s at 42.28 m TDH	CLI ECA

Notes:
1. The David St. SPS was recently constructed and CLI ECA No. 091-W601 Issue No. 1 is being amended to include the SPS. Capacity information was provided by the Municipality from a draft version of Issue No. 2.

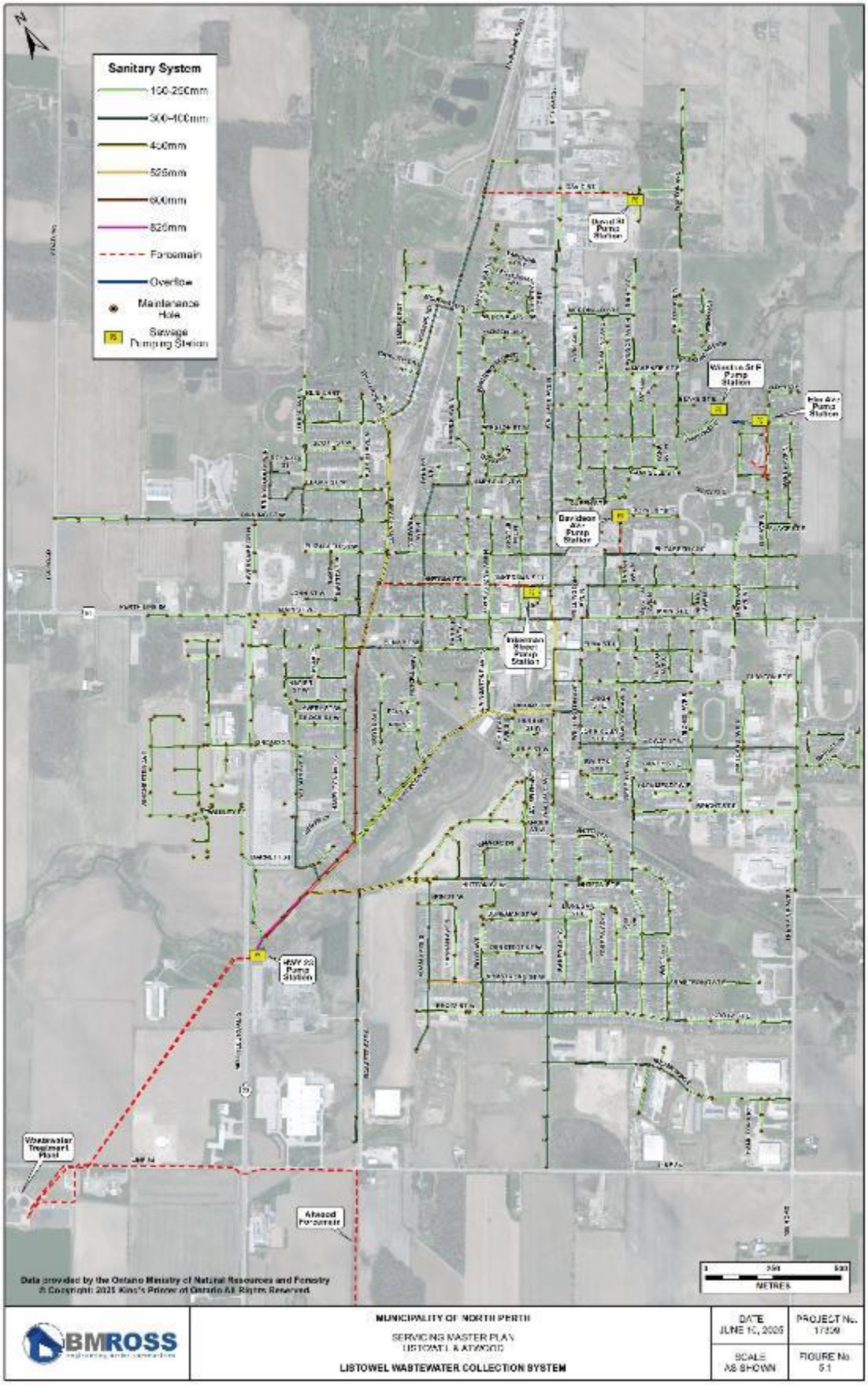
5.1.2 Collection Systems

The Listowel collection system has two primary drainage areas, and relatively small areas drain to the secondary pumping stations. The smaller secondary SPSs discharge to sewers within the Inkerman SPS catchment area, with the exception of the David St. SPS, which discharges within the Highway 23 SPS catchment area. The Inkerman SPS discharges to trunk sewers where Inkerman Street meets the Kinsmen Trail, then flows by gravity to the Highway 23 SPS.

Figure 5.1 illustrates the location of gravity sewers and forcemains serving the Listowel sanitary system, as well as the WWTP location. In total there are approximately 67 km of gravity sewers and 4.5 km of forcemain based on GIS data provided by the municipality. This measurement includes sewer diameters of 150 to 825 mm and forcemain diameters of 50 to 500 mm.

Through the Ministry of Infrastructure's Housing Enabling Water Systems Fund (HEWSF), the Government of Ontario is providing funding to the Municipality for the construction of a new SPS, the Fairlane Road SPS in Listowel, as identified in the Northeast Master Plan (Phase 2).

The Atwood collection system has two primary drainage areas. Flow from SPS #1 in Atwood discharges by forcemain to sewers on Main Street near Blair Street and then drain by gravity to SPS #2. Figure 5.2 shows the collection system in Atwood. Based on GIS data provided by the Municipality, there are approximately 9 kms of gravity sewer servicing the community and 8 kms of forcemain, including the forcemain from SPS #2 to the WWTP. This measurement includes sewer diameters of 200 to 300 mm and forcemain diameters of 200 and 300 mm.


Sanitary System
100-250mm
300-400mm
450mm
525mm
600mm
825mm
Forcemain
Overflow
Maintenance Hole
Sewage Pumping Station
Wastewater Treatment Plant
Atwood Forcemain
Data provided by the Ontario Ministry of Natural Resources and Forestry
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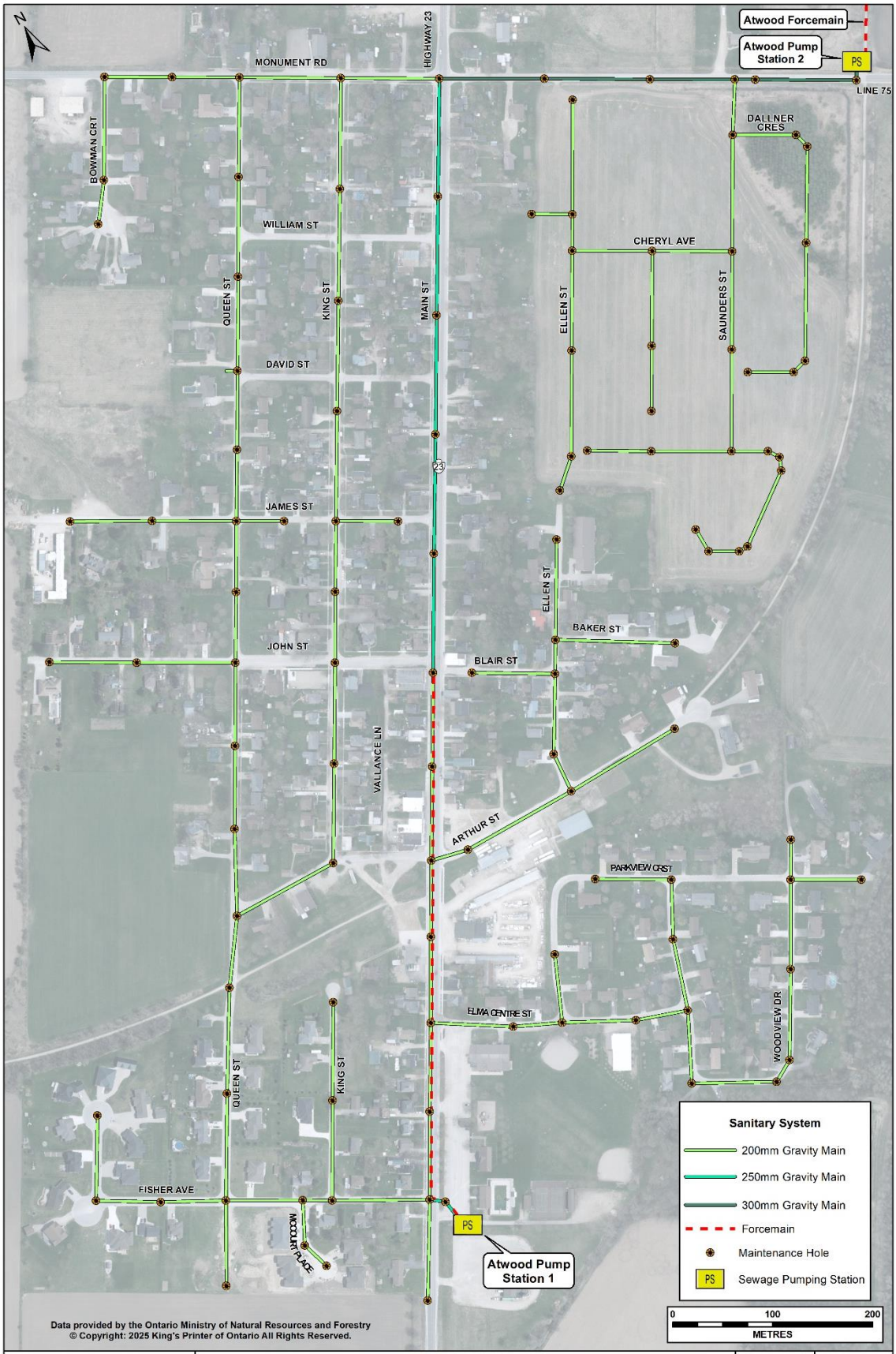
METRES
BMROSS
MUNICIPALITY OF NORTH PERTH
SERVICING MASTER PLAN
LISTOWEL & ATWOOD
LISTOWEL WASTEWATER COLLECTION SYSTEM
DATE
JUNE 10, 2025
PROJECT No.
17209
SCALE
AS SHOWN
FIGURE No.
5.1


Atwood Forcemain
Atwood Pump Station 2
PS
LINE 75
MONUMENT RD
HIGHWAY 23
DALLNER CRES
BOWMAN CRT
WILLIAM ST
CHERYL AVE
QUEEN ST
KING ST
MAIN ST
ELLEN ST
SAUNDERS ST
DAVID ST
23
JAMES ST
ELLEN ST
BAKER ST
JOHN ST
BLAIR ST
VALLANCE LN
ARTHUR ST
PARKVIEW CRST
ELMA CENTRE ST
WOODVIEW DR
QUEEN ST
KING ST
FISHER AVE
MCCOART PLACE
PS
Atwood Pump Station 1
Sanitary System
200mm Gravity Main
250mm Gravity Main
300mm Gravity Main
Forcemain
Maintenance Hole
PS
Sewage Pumping Station
0
100
200
METRES
Data provided by the Ontario Ministry of Natural Resources and Forestry
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SERVICING MASTER PLAN
LISTOWEL & ATWOOD
ATWOOD WASTEWATER COLLECTION SYSTEM
DATE
JUNE 10, 2025
PROJECT No.
17309
SCALE
AS SHOWN
FIGURE No.
5.2

5.2 Existing and Future Wastewater Flows

5.2.1 Existing Wastewater Flows

The following is a summary of recent historical wastewater flow information. The information is based on annual report data for the WWTP.

Table 5.2 – Listowel Historical Wastewater Flows

Year	AADF[1] (m^3/day)	Max. Single Day to WWTP (m^3)
2022	6,676	19,069
2023	7,469	24,126
2024	7,211	23,373
3 Year Average or Maximum	**7,119**	**24,126**

Notes:
1. AADF = Annual Average Daily Flow

5.2.2 Unit Sewage Flows

Wastewater flow can vary from year to year depending on environmental conditions and customer usage. As per the information above, flows are reasonably consistent in Listowel (i.e., highest and lowest year averages are within approximately 10% of the rolling average). The existing demand, for reserve capacity calculation purposes, is generally considered to be the average value for the previous three years. As defined in Section 3.3, the flow per ERU is considered as the existing per customer flow plus 10% to account for non-residential growth.

It is important to note that large industrial or commercial users (i.e., Erie Meats and Spinrite) as well as a septage receiving station at the WWTP account for nearly 2,200 m^3/day of AADF for the years reported in Table 5.2. This flow is deducted from the total plant flow in order to determine a typical customer flow that excludes large industrial, commercial, or institutional (ICI) uses.

$$\text{Total Non-ICI flow} = 7{,}119 - 2{,}200\ m^3/day$$
$$= 4{,}919\ m^3/day$$

$$\text{Flow per Customer} = \frac{4{,}919\ m^3/day}{4{,}775\ \text{customers}}$$
$$= 1.03\ m^3/day$$

$$\text{Flow per ERU} = 1.03 \times 1.1$$
$$= \mathbf{1.13\ m^3/day}$$

5.3 Reserve Treatment Capacity

5.3.1 North Perth WWTP Treatment Performance

5.3.1.1 Effluent Criteria

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

Table 5.3 – Treatment Objectives

Effluent Parameter	Concentration Objective
CBOD5	
From April 1 to November 30	5 mg/L
From December 1 to March 31	10 mg/L
Total Suspended Solids	
From April 1 to November 30	5 mg/L
From December 1 to March 31	10 mg/L
Total Phosphorus	
From April 1 to November 30	0.22 mg/L
From December 1 to March 31	0.58 mg/L
Total Ammonia Nitrogen	
From April 1 to November 30	1.5 mg/L
From December 1 to March 31	2.9 mg/L

The final effluent compliance criteria are set out in Table 2 of the ECA. Both the concentration and loading criteria are stipulated and are as follows:

Table 5.4 – Compliance Limits

Effluent Parameter	Concentration Objective	Average Waste Loading(kg/day)
CBOD5		
From April 1 to November 30	10 mg/L	90.4
From December 1 to March 31	15 mg/L	135.6
Total Suspended Solids		
From April 1 to November 30	10 mg/L	90.4
From December 1 to March 31	15 mg/L	135.6
Total Phosphorus		
From April 1 to November 30	0.36 mg/L	3.28
From December 1 to March 31	0.73 mg/L	6.56
Total Ammonia Nitrogen		
From April 1 to November 30	2.2 mg/L	20
From December 1 to March 31	3.62 mg/L	32.8
pH of the effluent maintained between 6.0 to 9.5, at all times		

5.3.1.2 Performance Review

A review of the 2024 Annual Report for the North Perth WWTP was undertaken. The review established that the WWTP met all performance criteria. The results are summarized below.

Table 5.5 – Compliance Results

Effluent Parameter	Annual Monthly Avg. Concentration mg/L	Annual Min. & Max. Results mg/L	Concentration Criteria mg/L Dec. 1 to March 31	Concentration Criteria mg/L April 1 to Nov. 30	Compliance
CBOD5	3.6	2.0-11.0	<15	<10	Monthly
Suspended Solids	4.49	1.30-8.60	<15	<10	Monthly
Total Phosphorus	0.19	0.07-0.33	<0.73	<0.36	Monthly
Ammonia & Ammonium	0.32	0.03-2.54	<3.62	<2.2	Monthly
Total Kjeidahl Nitrogen	2.7	1.19-4.73	N/A	N/A	Monthly
E. Coli	26.3	0-650	200 counts/100 mL	200 counts/100 mL	Monthly
pH	7.01-7.84	6.19-8.51	6.0-9.5	6.0-9.5	Monthly
Temperature	17.5	10.1-25.7			Monthly
Dissolved Oxygen	7.14	4.01-9.07	>5	>5	Monthly

The review of monthly effluent quality has established that the effluent criteria have generally been met. For most municipal WWTPs, it is our observation that use of the hydraulic annual average flow is the best and most reasonable approximation of reserve capacity, given that establishing reserve based on effluent criteria performance is not practical.

5.3.2 Listowel Total Reserve Capacity

The Total Reserve Capacity is equal to the rated plant capacity less existing flow.

$$\begin{aligned} \text{Total Reserve} &= \text{Rated Capacity} - \text{Existing AADF} \\ &= 9{,}030\ m^3/day - 7{,}211\ m^3/day \\ &= 1{,}819\ m^3/day \end{aligned}$$

At 1.13 m^3/ERU·day, approximately 1,609 ERUs can be served with the available reserve capacity.

5.3.3 Uncommitted Reserve

The Uncommitted Reserve Capacity is calculated by deducting the anticipated flow from development commitments from the Total Reserve Capacity.

From Tables 3.8 and 3.13, the combined number of committed ERUs for Listowel and Atwood is 1,114, therefore:

$$\begin{aligned} \text{Uncommitted Reserve} &= \text{Total Reserve} - \text{Commitments} \\ &= 1{,}819\ m^3/day - (1{,}114 \times 1.13\ m^3/day) \\ &= 560\ m^3/day \\ &= \mathbf{495\ ERUs} \end{aligned}$$

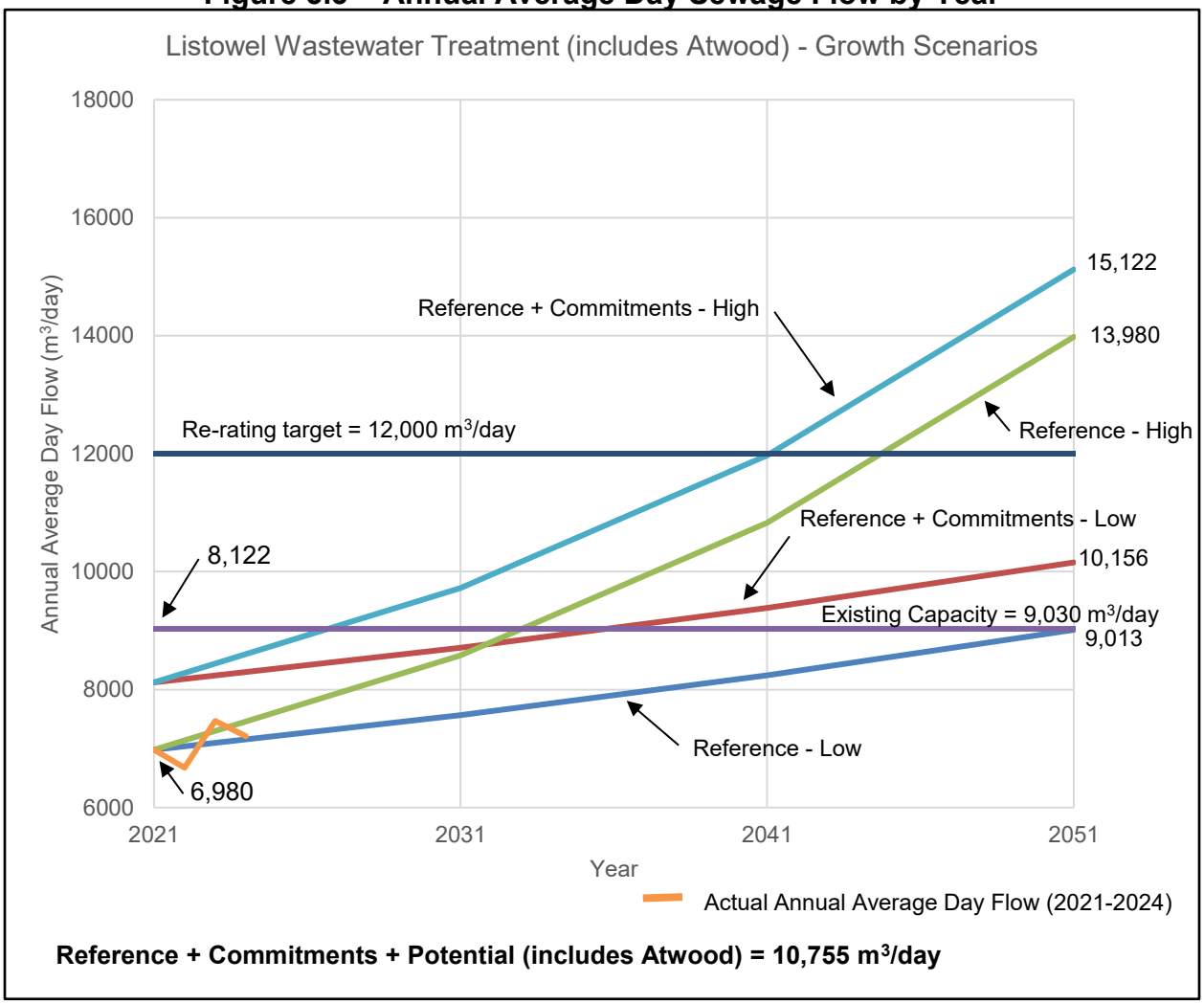
5.3.4 Treatment Capacity by Year

There is limited uncommitted reserve remaining at the Listowel WWTP (i.e., 495 ERU). It is noted that the Municipality is in the process of applying to have the WWTP re-rated to 12,000 m^3/day. If successful, an additional reserve of 2,970 m^3/day would result, which would be sufficient for an additional 2,628 ERUs.

With reference to the growth projections presented in Section 3.4, Figure 5.3 shows the expected annual average sewage flows from 2021 to 2051. The figure indicates that, at the highest growth rate, the existing treatment capacity will be adequate until approximately 2041, assuming that the Municipality is successful in re-rating the facility.

Tables 4.4 and 4.12 list potential residential developments that could be accommodated within the expanded urban settlement area identified in the 2024 Perth County OP. This represents a potential 2,330 ERUs in Listowel and 656 ERUs in Atwood, for a total of 2,986 ERUs. With the current estimated uncommitted reserve of 495 ERU, and assuming a successful re-rating to accommodate an equivalent additional 2,628 ERUs, the combined total of 495 + 2,628 = 3,123 ERUs would be marginally sufficient for the additional areas noted.

Figure 5.3 – Annual Average Day Sewage Flow by Year



5.4 Listowel Reserve Pumping Capacity

5.4.1 Highway 23 SPS

The Highway 23 SPS is the largest pumping station in North Perth. It collects all flow from Listowel and pumps to the North Perth WWTP. The SPS has three pumps (two duty, one standby), each with a rated capacity of 216 L/s when operating independently. The combined station capacity with two pumps in operation is 295 L/s.

Existing peak flows are estimated to be in the order of 320 L/s and additional peak design flows from committed and potential development within the urban boundaries of Listowel are estimated to be in the order of 400 L/s. Though existing peak flows are estimated to be greater than the rated SPS capacity, these values are based on theoretical peaking factors and are likely to be conservative. According to annual WWTP reports available and information from the Municipality, bypassing of the station occurred in the spring of 2025, though no bypasses or abnormal discharge events occurred from 2021 and 2024. Any increase to peak capacity of the SPS will need to

consider at least: physical pump size and ability to fit in the existing station, electrical service constraints, forcemain velocity and pressure constraints, and WWTP peak flow capacity.

In our opinion there is limited value in increasing the SPS peak capacity until the WWTP peak capacity is capable of handing the increased flow.

5.4.2 Inkerman Street SPS

The Inkerman Street SPS collects flow from the northeast section of Listowel. The station has three pumps (two duty, one standby) each with a rated capacity of 45 L/s. For modelling purposes, station rated capacity was assumed to be 56.3 L/s (1.25 x 45 L/s).

Existing peak flows are estimated to be in the order of 45 L/s and additional peak design flows from committed and potential development are estimated be in the order of 30 L/s. At this time, it is our opinion that flows to the station should continue to be monitored, and if development noticeably causes peak flows to increase (e.g., say in the order of 50 L/s total), planning for a station capacity increase should commence.

5.4.3 Davidson Avenue SPS

The Davidson Avenue SPS services approximately 15 properties in the North East of Listowel. The station has two pumps (one duty, one standby), each rated at 9 L/s. For modelling purposes, station rated capacity was assumed to be 9 L/s. As only trunk sewers were included in the model, this catchment area was not included in analyses. The catchment area for this SPS is not affected by development identified in Section 3.

5.4.4 Elm Avenue SPS

The Elm Avenue SPS services approximately 70 properties in the northeast of Listowel. The station has two pumps (one duty, one standby), each rated at 9 L/s. For modelling purposes, rated capacity of the station was assumed to be 9 L/s. As only trunk sewers were included in the model, this catchment area was not included in analyses. The catchment area for this SPS may be affected by a potential development commitment identified in Section 3, however the magnitude would depend on the location of future servicing connections to the existing system.

5.4.5 Winston Street SPS

The Winston Street SPS services five residential properties in the northeast of Listowel. The station has two pumps (one duty, one standby), each rated at 0.85 L/s. The rated capacity of the station was assumed to be 0.85 L/s, and was not included in model flows as the contribution to the collection system is considered to be negligible. As only trunk sewers were included in the model, this catchment area was not included in analyses. The catchment area for this SPS is not affected by development identified in Section 3.

5.4.6 David Street SPS

The David Street SPS recently constructed in 2023, and services the area around David St., Davidson Ave. N., and Walton Ave. in the northeast of Listowel (Phase 1 of the

Northeast Developments Lands). The station has two pumps (one duty, one standby, each rated at 16.2 L/s. For modelling purposes, rated capacity of the station was assumed to be 16.2 L/s. As only trunk sewers were included in the model, this catchment area was not included in analyses. The catchment area for this SPS may be affected by a potential development commitment identified in Section 3, however the magnitude would depend on the location of future servicing connections to the existing system.

5.5 Atwood Reserve Pumping Capacity

5.5.1 Atwood SPS #1

The Atwood SPS #1 receives flow from the south part of the Village and pumps to the north part of the village, where flow is collected by gravity sewers that flow to SPS #2. The station has two pumps (one duty, one standby), each rated at 29 L/s. For modelling purposes, rated capacity of the station was assumed to be 29 L/s.

Existing peak flows are estimated to be in the order of 20 L/s and additional peak design flows from committed and potential development are estimated to be in the order of 25 L/s. At this time, it is our opinion that flows to the station should continue to be monitored, and if development noticeably causes peak flows to increase (e.g., say in the order of 25 L/s total), planning for a station capacity increase should commence.

5.5.2 Atwood SPS #2

The Atwood SPS #2 receives all flow from the Village and pumps directly to the North Perth WWTP by forcemain. The station has two pumps (one duty, one standby), each rated at 48.45 L/s.

Existing peak flows are estimated to be in the order of 40 L/s and additional peak design flows from committed and potential development within the urban boundaries of Atwood are estimated to be in the order of 55 L/s. At this time, it is our opinion that flows to the station should continue to be monitored, and if development noticeably causes peak flows to increase (e.g., say in the order of 45 L/s total), planning for a station capacity increase should commence.

5.6 Listowel Wastewater Collection System Modelling

5.6.1 Background

The Listowel wastewater collection system was modelled using SewerCAD®. 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 focus of the model was to analyze trunk sewers, considered to be sewers equal to or larger than 250 mm diameter, or 200 mm diameter sewers that are either adjacent to and relevant to potential development areas or connect sections of larger diameter sewer.

5.6.2 Model Details

(a) Software

BMROSS used Bentley® SewerCAD® CONNECT Edition Update 3 for the wastewater collection system modelling. The model contains 372 pipes and 364 MHs for the existing Listowel system. Refer to Appendix E for model details.

(b) Sources of Data

In order to produce a SewerCAD® model for the sewer networks, several sources of information were used. In summary:

- Sanitary sewers and MH installation locations, elevations, and diameters were obtained from collection system mapping (i.e. GIS database), street As-Recorded drawings provided by the Municipality, and GIS data collected by BMROSS staff.
- Following creation of the model, data validation found several sources of error related to pipe and MH elevations. The model was corrected using additional BMROSS survey and other Municipal records, where available.
- A Manning's n value of 0.013 was used for all gravity sewer pipes.
- Wastewater flows for the collection system were developed as part of this Master Plan (refer to Appendix E).
- Assessments of sanitary sewer pipes were completed on the basis of comparing calculated peak flow estimates 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 at Maintenance Holes

Wastewater flows in the SewerCAD® model may be applied at MHs (i.e., point loads) or over the length of a sewer pipe (i.e., linear loads). For the existing Listowel model, the top six water customers by annual usage had the associated sanitary sewage peak flow applied at the nearest model MH, assuming 100% of facility water use was converted to sanitary flow. To calculate the flow per MH, the total catchment area wastewater flow, minus flow from large individual water users, was divided by the total number of MHs in the system. As only trunk sewers were evaluated, MHs upstream of modelled sewers were counted and flow was applied to the nearest MH in the model; the remaining flow was assigned to trunk sewer MHs proportionally and generally corresponds to dividing the total flow for the catchment area over the catchment area evenly. Appendix E contains a detailed summary of the demand allocation methodology.

For future development model scenarios, 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. Demands associated with each development area were applied to the nearest MH(s) 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.
- Existing plus committed development flow.
- Future flows, which includes flow from existing, committed, and future potential development.

5.6.4 Qualifications on Results

Results of the wastewater system modelling are based on the collection system information as described above. Although field measurements were used to verify sewer elevation data in key locations where available data sources did not appear to provide realistic information (e.g., wrong flow directions, slopes extremely flat or steep relative to typical design), not all sewer and MH elevation data was verified with field measurements. Peak flows were calculated based on the methodology described in Appendix E. 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 to confirm model accuracy and/or installing flow meters to determine actual flows.

5.6.5 Model Results

Table 5.6 summarizes the results of the analysis for the existing system, as well as the future scenarios. Full details are provided in Appendix E. Figures in Appendix E illustrate the sanitary collection system, highlighting sewer sections modelled that are approaching (>80% of capacity) or over capacity for each scenario.

Table 5.6 – Summary of Sewer Analysis

Analysis and Criteria	Existing	Existing plus Commitments	Future
Approximate No. of pipes with flow <80% design capacity	363	348	297
Approximate No. of pipes with flow >80% and <100% design capacity	3	14	26
Approximate No. of pipes with flow >100% design capacity	5	9	47

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 Atwood Wastewater Collection System Modelling

5.7.1 Background

Refer to 5.7.1 for Listowel. Similar comments apply to Atwood.

5.7.2 Model Details

(a) Software

BMROSS used Bentley® SewerCAD® CONNECT Edition Update 3 for the wastewater collection system modelling. The model contains 105 pipes and 105 MHs for the existing Atwood system. Refer to Appendix E for model details.

(b) Sources of Data

Refer to 5.8.2 (b) for Listowel. Similar comments apply to Atwood.

(c) Establishing Flows at Maintenance Holes

Refer to 5.8.2 (c) for Listowel. Similar comments apply to Atwood.

5.7.3 Analyses Run

Refer to 5.8.3 for Listowel. Similar comments apply to Atwood.

5.7.4 Qualifications on Results

Refer to 5.8.4 for Listowel. Similar comments apply to Atwood.

5.7.5 Model Results

Table 5.7 summarizes the results of the analysis for the existing system, as well as the future scenarios. Full details are provided in Appendix E. Figures in Appendix E illustrate the sanitary collection system, highlighting sewer sections modelled that are approaching (>80% of capacity) or over capacity for each scenario.

Table 5.7 – Summary of Sewer Analysis

Analysis and Criteria	Existing	Existing plus Commitments	Future
Approximate No. of pipes with flow <80% design capacity	102	102	92
Approximate No. of pipes with flow >80% and <100% design capacity	2	2	2
Approximate No. of pipes with flow >100% design capacity	1	1	11

The results indicate that there is one sewer segment currently theoretically over-committed in terms of capacity for the existing system conditions and existing plus committed development. With committed and future potential development, the number of sewer segments with constrained capacity increases.

5.8 Climate Change Considerations

Climate change is predicted to result in more intense storms and potentially, periods of prolonged drought. The Listowel and Atwood wastewater systems 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 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.

5.9 Problems and Opportunities

5.9.1 Wastewater Treatment

The following wastewater treatment issues have been identified:

- There is currently very limited un-committed reserve capacity available at the WWTP (i.e., 560 m^3/day or 495 ERUs). Potential development lands, not yet committed for servicing, have associated ERUs well beyond the current uncommitted reserve.

- The Municipality is in the process of applying to have the WWTP re-rated to 12,000 m^3/day. If successful, an additional reserve of 2,970 m^3/day would result, which would be sufficient for an additional 2,628 ERUs. The current uncommitted reserve, plus the additional reserve from a re-rating, would be sufficient for an estimated 3,123 ERUs. This is marginally greater than the 2,986 ERUs estimated for future potential development within Listowel and Atwood.

5.9.2 Wastewater Pumping

Comparing calculated future peak flow estimates to rated capacities of SPSs in Listowel and Atwood, the following stations are undersized for estimated future peak flows:

- Inkerman Street SPS (Listowel)
- Highway 23 SPS (Listowel)
- Atwood SPS #1
- Atwood SPS #2

Upgrades would be required to each of these stations to accommodate the future design peak flows that have been calculated. It is expected that capacity increases would require a combination of mechanical and electrical upgrades, and potentially forcemain paralleling or replacement depending on final design capacity. It is recommended that the Municipality continue to monitor flows to each identified SPS as developments proceed, and in the event that peak flows increase meaningfully, planning commence for station upgrades.

Increase to existing station capacity within the existing station building and site footprint is exempt from the formal Class EA process.

5.9.3 Wastewater Collection

The wastewater collection systems in Listowel and Atwood were analyzed on the basis of existing and future peak wastewater flow estimates in each trunk sewer pipe versus sewer pipe full-flow capacity.

Modelling results for Listowel 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. Table 5.8 and Figure 5.4 identify several proposed projects, including trunk sewer upgrades within the existing collection system, which are recommended to address future capacity requirements.

Results for Atwood indicate that there is one sewer segment that is currently theoretically over-committed in terms of capacity for the existing system conditions. With future development, the number of sewer segments with constrained capacity increases. Table 5.9 and Figure 5.5 identify several proposed projects, including trunk sewer upgrades within the existing collection system, which are recommended to address future capacity requirements.

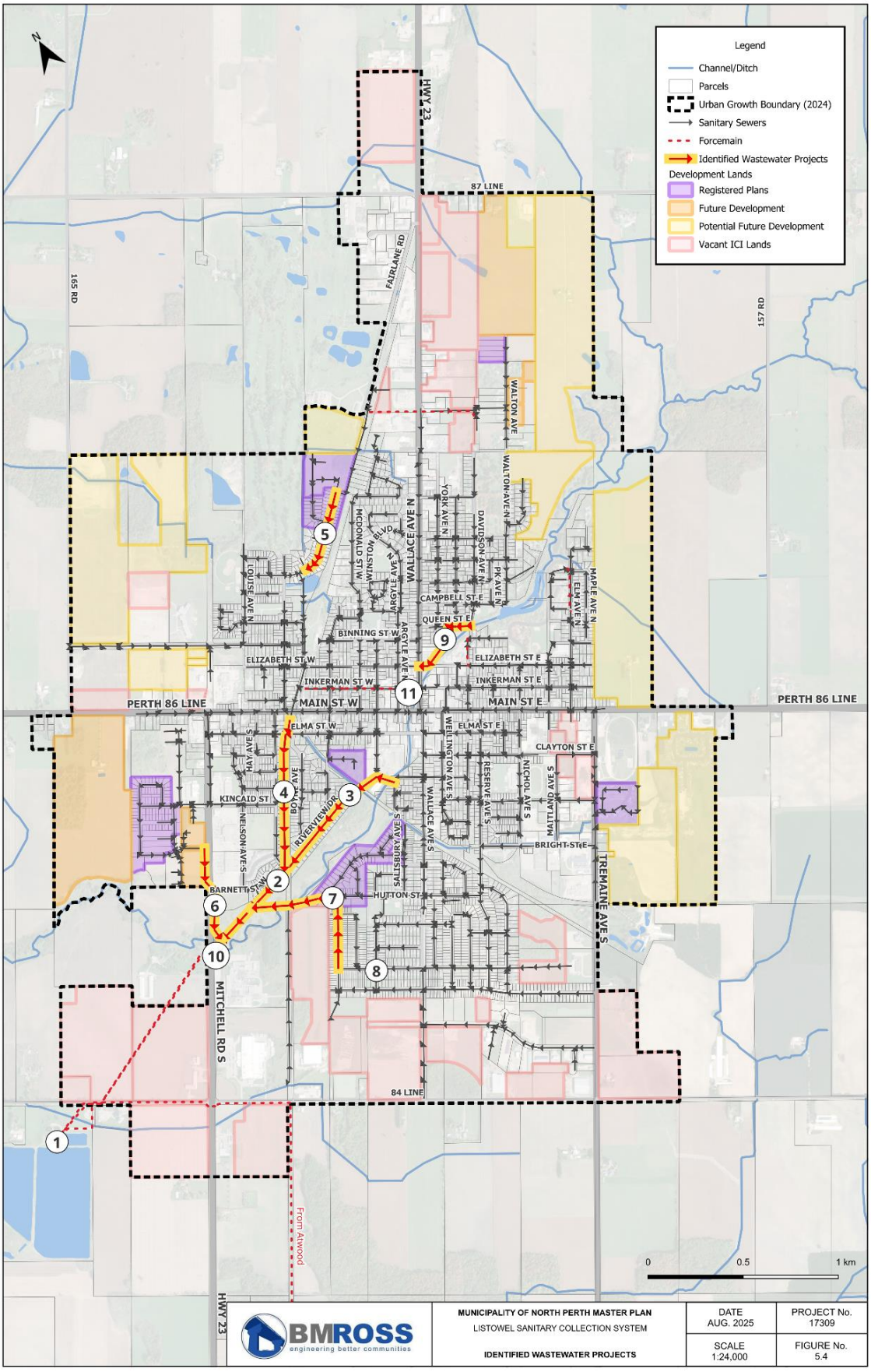
Given that theoretical values indicate constraints in the existing system, but there have not been reports or observances of capacity issues (i.e., surcharges, sewer backups), it is possible that the theoretical data over-estimates actual flows or that some sewer capacities are greater than calculated. 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.

5.10 Wastewater Identified Projects

The Master Plan has established the following potential projects to reduce sewer capacity utilization and improve overall sanitary servicing and wastewater management for existing infrastructure and future development areas. Additional engineering investigations are recommended to confirm individual project scope. Flow monitoring may be conducted for key problem areas for model verification and projected future peak flows.

Figure 5.4 and 5.5 identifies storm projects for Listowel and Atwood, respectively. Projects are noted as ‘L - #’ for Listowel projects, and ‘A - #’ for Atwood projects. Several sanitary projects have been identified for development lands and are dependant on timing of those developments. Future sanitary sewer and pumping station improvements have been highlighted as a future servicing need that needs to be addressed as part of future development planning.


Legend
Channel/Ditch
Parcels
Urban Growth Boundary (2024)
Sanitary Sewers
Forcemain
Identified Wastewater Projects
Development Lands
Registered Plans
Future Development
Potential Future Development
Vacant ICI Lands
HWY 23
87 LINE
165 RD
157 RD
FAIRLANE RD
WALTON AVE
WALTON AVE N
YORK AVE N
DAVIDSON AVE N
PK AVE N
MAPLE AVE N
ELM AVE N
MCDONALD ST W
WINSTON BLVD
WALLACE AVE N
ARGYLE AVE N
ARGYLE AVE S
LOUISE AVE N
CAMPBELL ST E
QUEEN ST E
BINNING ST W
ELIZABETH ST W
ELIZABETH ST E
INKERMAN ST W
INKERMAN ST E
PERTH 86 LINE
MAIN ST W
MAIN ST E
ELMA ST W
ELMA ST E
CLAYTON ST E
HAY AVE S
KINCAID ST
BOY AVE
RIVERVIEW DR
NELSON AVE S
WELLINGTON AVE S
RESERVE AVE S
NICHOL AVE S
WALLACE AVE S
SALISBURY AVE S
MATILDA AVE S
BRIGHT ST E
TREMAINE AVE S
BARNETT ST W
HUTTON ST
MITCHELL RD S
84 LINE
From Atwood
1
2
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4
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7
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9
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11
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0.5
1 km
BMROSS
engineering better communities
MUNICIPALITY OF NORTH PERTH MASTER PLAN
LISTOWEL SANITARY COLLECTION SYSTEM
IDENTIFIED WASTEWATER PROJECTS
DATE
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PROJECT No.
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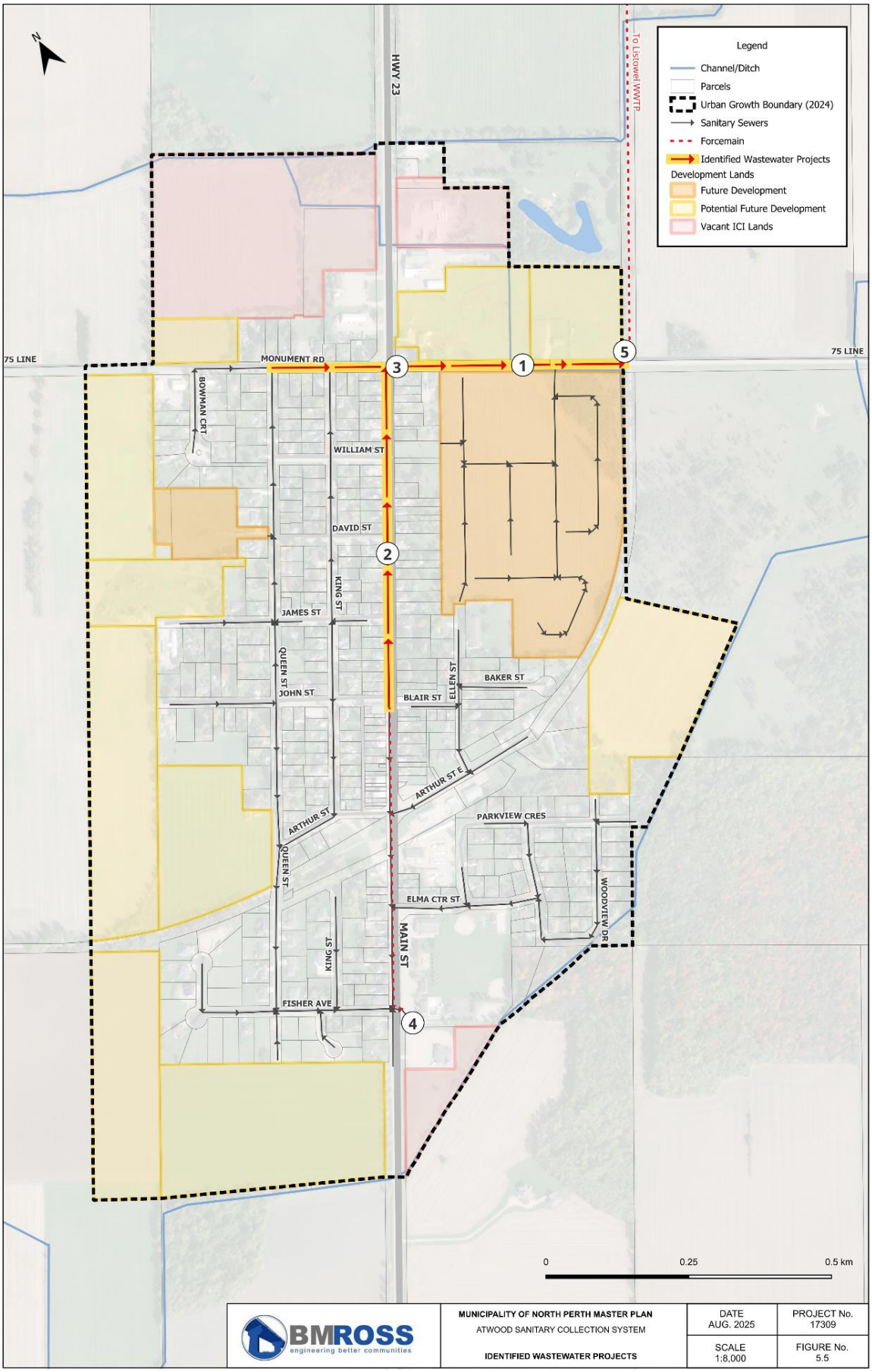
FIGURE No.
5.4


N
HWY 23
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Legend
Channel/Ditch
Parcels
Urban Growth Boundary (2024)
Sanitary Sewers
Forcemain
Identified Wastewater Projects
Development Lands
Future Development
Potential Future Development
Vacant ICI Lands
75 LINE
75 LINE
MONUMENT RD
BOWMAN CRT
WILLIAM ST
DAVID ST
KING ST
JAMES ST
QUEEN ST
JOHN ST
BLAIR ST
ELLEN ST
BAKER ST
ARTHUR ST E
ARTHUR ST
QUEEN ST
PARKVIEW CRES
WOODVIEW DR
ELMA CTR ST
KING ST
MAIN ST
FISHER AVE
1
2
3
4
5
0
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BMROSS
engineering better communities
MUNICIPALITY OF NORTH PERTH MASTER PLAN
ATWOOD SANITARY COLLECTION SYSTEM
IDENTIFIED WASTEWATER PROJECTS
DATE
AUG. 2025
PROJECT No.
17309
SCALE
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FIGURE No.
5.5

5.10.1 Listowel

The following projects have been identified for Listowel to address existing infrastructure needs and development related servicing. Refer to Figure 5.4 for locations.

5.10.1.1 Existing Infrastructure Needs

WWTP Capacity Upgrades/Expansion (L-1)

A capacity increase at the North Perth WWTP will be required to facilitate projected wastewater flows from growth. A target of 12,000 m^3/day as an AADF has been identified by Municipal staff and consultants in recent years, and the process to attempt that re-rating is underway by others.

Riverview Drive Flow Monitoring (L-2)

Model results indicate existing flow exceeds sewer capacity. However, estimated peak flows are theoretical and considered to be conservative. There has been no report of local surcharging. Therefore, to verify model results and determine if future upgrades are required, the following works are recommended:

Flow monitoring of:

- 450 mm sanitary sewers (two sections of sewer 215 m in total length) along Riverview Drive 75 m northeast of Boyne Avenue to Havelock Avenue S.
- 450 mm sanitary sewer (110 m section of sewer) 75 m southwest of Riverview Drive/Havelock Avenue S.

5.10.1.2 Development Servicing Needs

Riverview Drive Upgrades (L-3)

Limited capacity of existing sanitary sewers along Union Street W and Riverview Drive to the Highway 23 SPS to service future development flows. Therefore, to reduce potential for surcharging, the following conceptual sanitary sewer upgrades are recommended:

- 530 m of 600 mm sanitary sewer along Union Street W and Riverview Drive from Union Street W/Richileau Avenue S to 70 m east of Boyne Avenue. One section of sewer crosses under the Middle Maitland River.
- 540 m of 675 mm sanitary sewer from 70 m east of Boyne Avenue along Riverview Drive and through a backyard easement to 100 m south of Nelson Avenue S/ Barnett Street.
- 230 m of 750 mm sanitary sewer from 100 m south of Nelson Avenue S/Barnett Street through undeveloped land to 90 m northeast of Highway 23 SPS (north of the Middle Maitland River).
- 90 m of 900 mm sanitary sewer from the Middle Maitland River to Highway 23 SPS. Sewer crosses under the Middle Maitland River.

Kinsmen Trail S Upgrades (L-4)

Limited capacity of existing sanitary sewers along backyard easements from Main Street W to Havelock Avenue S to service future development flows. Therefore, to reduce potential for surcharging, the following conceptual sanitary sewer upgrades are recommended:

- 90 m of 675 mm sanitary sewer along backyard easements from 50 m south of Main Street W/Albert Avenue N to Elma Street W 40 m northwest of Boyne Avenue.
- 730 m of 750 mm sanitary sewer along backyard easements from Elma Street W 40 m northwest of Boyne Avenue to 30 m southwest of Havelock Ave S/Riverview Drive.

Kinsmen Trail N Upgrades (L-5)

Limited capacity of existing sanitary sewers along Rogers Road to service future development flows. Therefore, to reduce potential for surcharging, the following conceptual sanitary sewer upgrades are recommended:

- 450 m of 450 mm sanitary sewer along Rogers Road from McDonald Street to Richards Court.

Mitchell Road S Upgrades (L-6)

Limited capacity of existing sanitary sewers along Mitchell Road S to service future development flows. Therefore, to reduce potential for surcharging, the following conceptual sanitary sewer upgrades are recommended:

- 260 m of 300 mm sanitary sewer along Mitchell Road S from Twamley Street to Barnett Street 30 m southeast of Mitchell Road S.
- 260 m of 375 mm sanitary sewer from Barnett Street 30 m southeast of Mitchell Road S to 90 m northeast of Highway 23 SPS.

Adams Avenue S to Highway 23 SPS Upgrades (L7)

Limited capacity of existing sanitary sewers along Adams Avenue S and Hutton Street to sewers south of Barnett Street to service future development flows. Therefore, to reduce potential for surcharging, the following conceptual sanitary sewer upgrades are recommended:

- 380 m of 450 mm sanitary sewer along Adams Avenue S from Armstrong Street W to Hutton Street.
- 450 m of 600 mm sanitary sewer from Adams Avenue S/Hutton Street to 100 m south of Nelson Avenue S/Barnett Street. One section of sewer crosses under the Middle Maitland River.

Boyd Avenue S/Armstrong Street Weir Removal (L-8)

Limited capacity of existing sanitary sewers along Boyd Avenue S to service future development flows. Flow upstream of Boyd Avenue S/Armstrong Street W is directed down Boyd Avenue S by a fixed weir. However, sanitary sewers on Armstrong Street W have more available capacity and are adequately sized to accommodate future

development. Therefore, to reduce potential for surcharging, the following works are recommended:

- Removal of weir at Armstrong Street and Boyd Avenue S in 525 mm sanitary sewer flowing northwest along Armstrong Street.

Queen Street E/Elizabeth Street E Upgrades (L-9)

Limited capacity of existing sanitary sewers from Queen St E/Davidson Avenue to Elizabeth Street E/Wallace Avenue N to service future development flows. Therefore, to reduce potential for surcharging, the following conceptual sanitary sewer upgrades are recommended:

- 410 m of 375 mm sanitary sewer from Davidson Avenue N/Queen Street E to Wallace Avenue N/Elizabeth Street E.

Highway 23 SPS Capacity Upgrade (L-10)

It is recommended to closely monitor flows at the Highway 23 SPS, and when actual flows increase noticeably relative to station capacity, planning for a station capacity increase should commence.

Inkerman SPS Capacity Upgrade (L-11)

Similar recommendation to L-10.

5.10.2 Atwood

The following projects have been identified for Atwood to address existing infrastructure needs and development related servicing. Refer to Figure 5.5 for locations.

5.10.2.1 Existing Infrastructure Needs

Monument Road Flow Monitoring (A-1)

Model results indicate existing flow exceeds sewer capacity. However, estimated peak flows are theoretical and considered to be conservative. There has been no report of local surcharging. Therefore, to verify model results and determine if future upgrades are required, the following works are recommended:

- Flow monitoring of 300 mm sanitary sewer (85 m section of sewer) along Monument Road 90 m southeast of Ellen Street to Saunders Street.

5.10.2.1 Development Servicing Needs

Main Street Upgrades (A-2)

Limited capacity of existing sanitary sewers along Main Street to service future development flows and capacity upgrades to Atwood SPS #1, as the Atwood SPS #1 forcemain outlets to Main Street at Blair Street. Therefore, to reduce potential for surcharging, the following conceptual sanitary sewer upgrades are recommended:

<u>Option 1: Upgrades to Existing Sanitary Sewers</u>

- 600 m of 375 mm sanitary sewer along Main Street, from Blair Street to Monument Road.

Option 2: Realignment of Forcemain to Atwood SPS #2

- 990 m of 200 mm sanitary forcemain along Arthur Street and former railway right-of way, from Street/Arthur Street to Atwood SPS #2.
- Decommissioning section of forcemain along Main Street from Arthur Street E to Blair St.

Option 1 is recommended to be carried out in conjunction with extended watermain servicing along Main Street as part of Water Identified Project A-1, mentioned in Section 4.2.9. Alternatively, Option 2 would redirect flow from Atwood SPS #1 forcemain to directly discharge to Atwood SPS #2.

Monument Road Upgrades (A-3)

Limited capacity of existing sanitary sewers along Monument Road to service future development flows. Therefore, to reduce potential for surcharging, the following options for conceptual sanitary sewer upgrades are recommended:

- 200 m of 250 mm sanitary sewer along Monument Road, from Queen Street to Main Street.
- 440 m of 450 mm sanitary sewer along Monument Drive, from Main Street to Atwood SPS #2.

SPS #1 Capacity Upgrades (A-4)

Similar recommendation to L-10. It is noted that, for this station, any future capacity increase should compare continued use of the existing forcemain discharge location on Main Street versus a forcemain along the rail trail directly to SPS #2. Specifically, the impact to collection sewers on Main Street and Monument Road should be considered for the case of the existing SPS #1 forcemain discharge location.

SPS #2 Capacity Upgrades (A-5)

Similar recommendation to L-10.

5.11 Wastewater Capital Costs

Capital costs for identified existing infrastructure need and future development projects have been estimated at a conceptual level for planning purposes and are summarized in Table 5.8. Refer to Section 5.10 for detailed project descriptions. Location of projects are shown on Figure 5.4 and 5.5 for Listowel and Atwood respectively. Costs for sanitary sewer projects are based on 2025 costs per meter and do not assume full urban reconstructions (individual asset only). Cost saving could be incurred with coordination of water and storm replacements. Costs include 15% engineering fees and 20% contingencies.

For the assumed cost of full urban street reconstructions, see section 4.3.

Table 5.8 – Wastewater Project Costs

ID	Wastewater Capital Project	Total Project Cost
Listowel – Existing Infrastructure Needs		
L-1	**WWTP Capacity Upgrades/Expansion** o *Continue with process targeting a re-rating of 12,000 m^3/day AADF.*	TBD
L-2	**Riverview Drive Flow Monitoring** *Flow monitoring of:* o *450 mm sanitary sewers (two sections of sewer 215 m in total length) along Riverview Drive 75 m northeast of Boyne Avenue to Havelock Avenue S.* o *450 mm sanitary sewer (110 m section of sewer) 75 m southwest of Riverview Drive/Havelock Avenue S.*	$125,000 for a flow monitoring program targeting various locations in community including SPSs
Listowel – Development Servicing Needs		
L-3	**Riverview Drive Upgrades** o *530 m of 600 mm sanitary sewer along Union Street W and Riverview Drive from Union Street W/Richileau Avenue S to 70 m east of Boyne Avenue. One section of sewer crosses under the Middle Maitland River.* o *540 m of 675 mm sanitary sewer from 70 m east of Boyne Avenue along Riverview Drive and through a backyard easement to 100 m south of Nelson Avenue S/ Barnett Street.* o *230 m of 750 mm sanitary sewer from 100 m south of Nelson Avenue S/Barnett Street through undeveloped land to 90 m northeast of Highway 23 SPS (north of the Middle Maitland River).* o *90 m of 900 mm sanitary sewer from the Middle Maitland River to Highway 23 SPS. Sewer crosses under the Middle Maitland River.*	$4,267,600
L-4	**Kinsmen Trail S Upgrades** o *90 m of 675 mm sanitary sewer along backyard easements from 50 m south of Main Street W/Albert Avenue N to Elma Street W 40 m northwest of Boyne Avenue.* o *730 m of 750 mm sanitary sewer along backyard easements from Elma Street W 40 m northwest of Boyne Avenue to 30 m southwest of Havelock Ave S/Riverview Drive.*	$2,629,800
L-5	**Kinsmen Trail N Upgrades** o *450 m of 450 mm sanitary sewer along Rogers Road from McDonald Street to Richards Court.*	$855,000
L-6	**Mitchell Road S Upgrades** o *260 m of 300 mm sanitary sewer along Mitchell Road S from Twamley Street to Barnett Street 30 m southeast of Mitchell Road S.* o *260 m of 375 mm sanitary sewer from Barnett Street 30 m southeast of Mitchell Road S to 90 m northeast of Highway 23 SPS.*	$712,400
L-7	**Adams Avenue S to Highway 23 SPS Upgrades** o *380 m of 450 mm sanitary sewer along Adams Avenue S from Armstrong Street W to Hutton Street.* o *450 m of 600 mm sanitary sewer from Adams Avenue S/Hutton Street to 100 m south of Nelson Avenue S/Barnett Street. One section of sewer crosses under the Middle Maitland River.*	$ 2,014,500
L-8	**Boyd Avenue S/Armstrong Street Weir Removal** o *Removal of weir at Armstrong Street and Boyd Avenue S in 525 mm sanitary sewer flowing northwest along Armstrong Street.*	$75,000
L-9	**Queen Street E/Elizabeth Street E Upgrades** o *410 m of 375 mm sanitary sewer from Davidson Avenue N/Queen Street E to Wallace Avenue N/Elizabeth Street E.*	$606,800
L-10	**Highway 23 SPS Capacity Upgrade** o *Initially, monitor actual flows relative to theoretical estimates*	$125,000 for a flow monitoring program targeting various

ID	Wastewater Capital Project	Total Project Cost
	○ *Expand capacity for future design peak flows once impact from development warrants*	locations in community including SPSs $5,000,000 order of magnitude for future SPS capacity increase
L-11	**Inkerman SPS Capacity Upgrade** ○ *Initially, monitor actual flows relative to theoretical estimates* ○ *Expand capacity for future design peak flows once impact from development warrants*	$125,000 for a flow monitoring program targeting various locations in community including SPSs $1,500,000 order of magnitude for future SPS capacity increase
Atwood – Existing Infrastructure Needs		
A-1	**Monument Road Flow Monitoring** ○ *Flow monitoring of 300 mm sanitary sewer (85 m section of sewer) along Monument Road 90 m southeast of Ellen Street to Saunders Street.*	$125,000 for a flow monitoring program targeting various locations in community including SPSs
Atwood – Development Servicing Needs		
A-2	**Main Street Upgrades** **Option 1: Upgrades to Existing Sanitary Sewers** *600 m of 375 mm sanitary sewer along Main Street, from Blair Street to Monument Road.* **Option 2: Realignment of Forcemain to Atwood SPS #2** ○ *990 m of 200 mm sanitary forcemain along Arthur Street and former railway right-of way, from Street/Arthur Street to Atwood SPS #2.*	$888,000.00 $4,068,900.00
A-3	**Monument Road Upgrades** ○ *200 m of 250 mm sanitary sewer along Monument Road, from Queen Street to Main Street.* ○ *440 m of 450 mm sanitary sewer along Monument Drive, from Main Street to Atwood SPS #2.*	$1,056,000.00
A-4	**SPS #1 Capacity Upgrades** ○ *Initially, monitor actual flows relative to theoretical estimates* ○ *Expand capacity for future design peak flows once impact from development warrants*	$125,000 for a flow monitoring program targeting various locations in community including SPSs $1,000,000 order of magnitude for future SPS capacity increase
A-5	**SPS #2 Capacity Upgrades** ○ *Initially, monitor actual flows relative to theoretical estimates* ○ *Expand capacity for future design peak flows once impact from development warrants*	$125,000 for a flow monitoring program targeting various locations in

ID	Wastewater Capital Project	Total Project Cost
		community including SPSs $2,000,000 order of magnitude for future SPS capacity increase

Note:

1. *Refer to Figure 5.4 and 5.5 for proposed project locations. Projects noted as 'L-#' for Listowel projects, and 'A-#' for Atwood projects.*
2. *Total project costs assumed based on 2025 sanitary sewer costs per meter, 15% Engineering and 20% Contingencies.*

6.0 LISTOWEL AND ATWOOD STORMWATER MANAGEMENT SYSTEM

6.1 Description

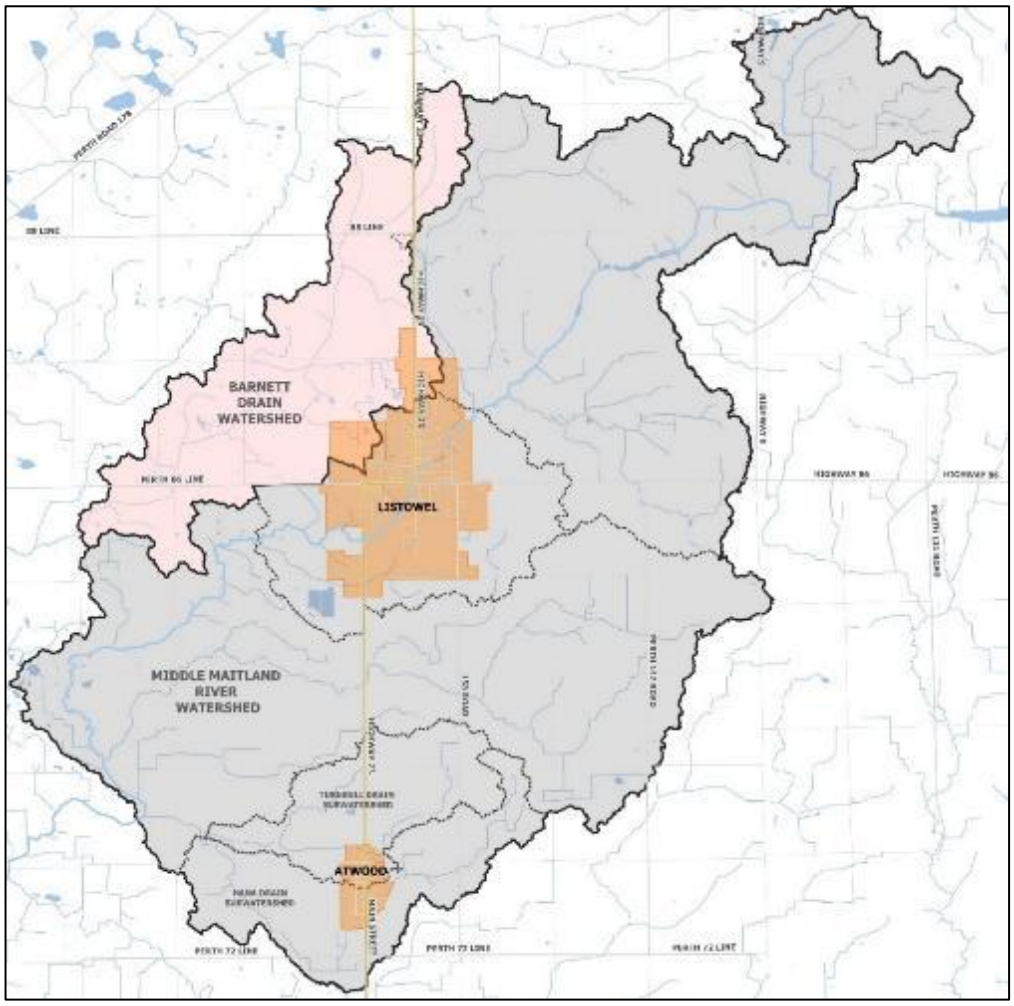
6.1.1 Watershed Overview

Listowel and Atwood are located within the Middle Maitland River Watershed, which is located within the jurisdiction of the MVCA, as generally shown in Figure 6.1 below.

Within Listowel, the Middle Maitland River transverses the community in a northeast to southeast direction. A majority of the built area of Listowel discharges to the Middle Maitland River via stormwater management facilities (SWMFs), storm sewer outfalls, watercourses, and municipal drains. The northwestern limit of Listowel is tributary to the Barnett Drain watershed, with ultimate discharge to the Little Maitland River approximately 20 km downstream to the west.

Atwood drains entirely to the Middle Maitland River through two main municipal drains, the Hana Drain to the south and the Turnball Drain to the north.

Figure 6.1: Watershed Overview



6.1.2 Listowel Storm System and Sewersheds

For the Listowel storm sewer system, there are 33 sewersheds, which discharge to the Middle Maitland River and surrounding drains. A illustrates the mosaic of the existing sewersheds and storm system. Figure 6.2B illustrates the anticipated full build-out sewershed for development planned to existing SWMF's. The system includes 10 regional SWMFs, and almost 50,000 m of storm main providing drainage for the urban system.

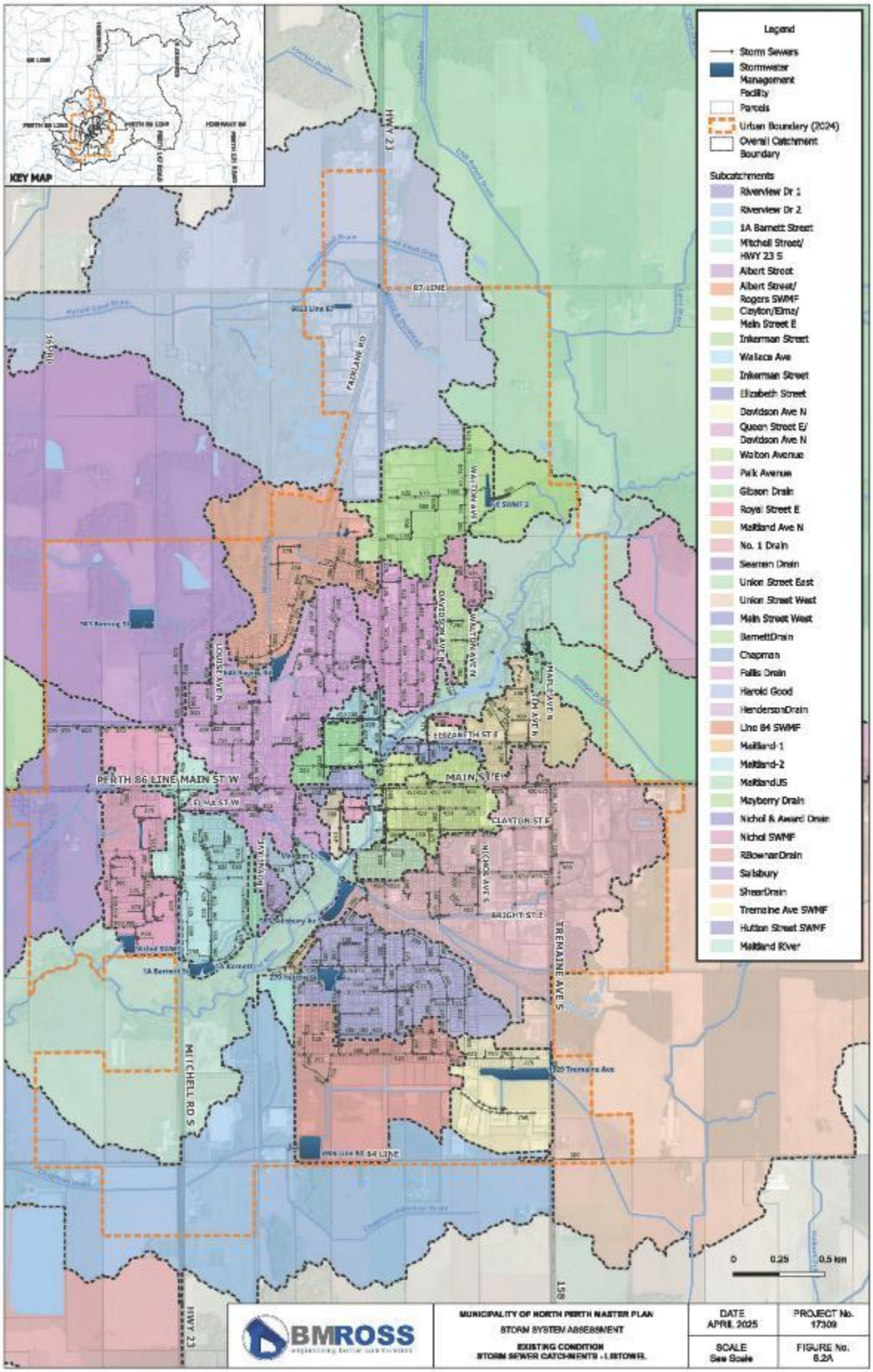
Catchment areas were established using GIS processing tools to automatically delineate watersheds based on the provincial LiDAR DTM, road network and storm sewer layout. The catchments were manually checked and refined based on field observations, aerial imagery, as well as available drawings, and reports. Table 6.1 provides a summary of the 33 major sewersheds for Listowel, and the respective outlets. External catchments beyond those shown on Figure 6.1 were not included in the evaluation model.

Table 6.1 – Summary of Major Sewersheds-Listowel

Catchment	Description/Outlet
No 1 Drain	The largest storm sewershed in Listowel, which includes drainage from the southeast quadrant from Main Street E and Tremaine Ave S, with storm servicing provided by a 1650 mm to 1950 mm trunk storm sewer along from Tremaine Ave along Mowat Street E, John Rosa Street E and Erie Street W and major flow channel from Tremaine Ave S generally along Bright Street and Reserve Ave, with discharge to the Salisbury Ave S SWMF for water quality control only. This catchment has been subject to historical investigations due to flooding and work as recommended from the "North Perth Drainage Project, South East Section of Listowel Ward" from 2002. A mix of landuse includes large industrial/commercial areas as well as residential areas south of Main Street E.
Hutton Street SWMF	Located in the southeast quadrant, the Hutton Street SWMF provides servicing for several relatively recent residential development area. The Hutton SWMF discharges to the 525 mm storm sewer on Hutton Street, with conveyance to the Maitland River
Line 84 SWMF	Located along the south boundary of Listowel, Line 84 SWMF provides servicing for both residential development and commercial/industrial areas. A combination of storm sewers from residential areas and open ditch systems within the industrial/commercial areas provide servicing with conveyance to the Line 84 SWMF for water quality and water quantity control.
Tremaine Ave SWMF	A mix of residential and industrial areas in the southeast corner of Listowel is serviced by the Tremaine Ave SWMF, with discharge to the Shear Drain. The Tremaine Ave SWMF includes two separate forebays to service the residential and commercial/industrial catchments. Outflow from the SWMF is constrained by capacity of the receiving Shear Drain

Catchment	Description/Outlet
Riverview Dr 1	Local residential catchment, along Riverview Drive and includes drainage of Boyne Ave, with discharge via 600 mm outlet directly to the Maitland River.
Riverview Dr 2	Local residential catchment, along Riverview Drive and includes drainage from Victoria Ave, and Ann St W with discharge via a 600 mm outlet directly to the Maitland River
1A Barnett Street	Residential and commercial areas generally east of HWY 23, south of Elma Street W and west of the rail trail discharge to the 1A Barnett Street SWMF for water quantity control and outlet directly to the Middle Maitland River to the south.
Mitchell Street/HWY 23 South	Relatively small catchment for the local road right-of-way of Hwy 23 from the Hwy 23/Line 86 round-about south, with discharge directly to the Maitland River via a 1200 x 900 mm culvert.
Nichol SWMF	New development area in the Southwest quadrant of Listowel, that includes drainage of the Nichol Subdivision, Sugar Bush Town House Development, Tim Horton's Plaza and drainage from the Nichol Drain Branch 4 of the existing wooded area, which is tributary to the Nichol SWMF, with direct discharge to the Middle Maitland River. Flows that exceed the capacity of the Nichol Branch 4 spill west at the wooded area to the Nichol and Award drain catchment.
Nichol and Award Drain	Southwest limit of Listowel is tributary to the Nichol Drain, and subject to future development north and south of Line 86, including the proposed Binning South SWMF. Nichol Drain upgrades were completed in 2018 generally along the historical drain alignment. Catchment south of Line 86 receives drainage spills from Nichol Branch 4 at the existing wooded area. Flows are conveyed to by the Nichol Drain to Middle Maitland River.
Seaman Drain	Northwest limit of Listowel, including area generally north of Binning St. including the Binning St West SWMF, tributary to the Seamans Drain, which ultimately discharges to the Barnett Drain to the northwest.
Albert Street/Rogers SWMF	Sewershed within the northwest quadrant of Listowel, receiving drainage from the Rogers Rd SWMF and servicing mainly residential areas along the Albert Street Corridor with discharge to the Albert Street Trunk storm sewer and open channel system along the old rail corridor, with discharge to the Maitland River south of Victoria Ave. Historically the catchment has been known to have restricted storm sewer capacity of the receiving trunk system. Recent upgrades completed in 2021 include a 5 year Albert Street trunk storm sewer to the open channel system. The downstream ditch and Victoria Ave crossing sized for 100 year.
Wallace Ave	Central Listowel, relatively small sewershed along Binning Street W and Wallace Avenue, discharging via 450 mm and 600 mm storm sewer to the Maitland River, immediately upstream of the river conduit.
Inkerman Street	Central Listowel, relatively small sewershed with discharge to Maitland River, along the river conduit.

Catchment	Description/Outlet
Main Street West	Central Listowel, sewershed along Main Street with a 600 mm storm sewer discharge to the river conduit
Elma Street West	Central Listowel, small sewershed along Elma Street with discharge to the Maitland River, immediately downstream of the river conduit.
Union Street West	Central Listowel, small sewershed along Union Street with discharge to Maitland River via 600 mm storm sewer.
Union Street East	Central Listowel, small sewershed along Union Street with discharge to Maitland River via 900 mm storm sewer
Clayton/Elma/ Main Street E	Combined sewersheds for sewer outfalls located at Clayton Street, Elma Street and Main Street East directly to the Maitland River.
Inkerman Street	Sewershed along Inkerman Street, with discharge directly to Maitland River. Upper section of Inkerman Street lacks storm infrastructure.
Elizabeth Street	Sewershed along Elizabeth Street E, with discharge directly to Maitland River via 750 mm storm sewer.
Royal Street E/ Davidson Ave N	Small local catchment, with discharge directly to Maitland River via 450 mm storm sewer.
Maitland Ave N	Combined sewershed of 3 storm outlets along Derby Street and Maitland Ave, providing servicing to lands in the vicinity of the Listowel Memorial Arena Park to the Maitland River.
Gibson Drain	Rural drainage along the east limit of Listowel tributary to Gibson Drain, which is conveyed by 900 mm storm sewer along Maple Ave N to the Maitland River. Upstream lands subject to potential future development.
Fallis Drain	Rural catchment at the east limit of Listowel, currently outside urban growth boundary
Queen Street E/ Davidson Ave N	Sewershed within the northeast quadrant of Listowel, receiving drainage from historically built areas bounded generally by Wallace Street to the west, McDonald Street to north and Davidson Ave N to the east, with discharge directly to the Maitland River at Queen Street and Davidson Ave N intersection to the south.
Palk Avenue	Small local catchment with direct discharge to Maitland River via 200 mm storm sewer.
Walton Avenue	Historical ad hoc storm infrastructure in the northeast quadrant along Walton Ave., with discharge to Maitland River via 300mm storm sewer.
Perkin Cresent	Small local catchment servicing potion of Walton Avenue and Perkins Cresent with discharge to the Maitland River via 450 mm storm sewer. Adjacent lands to east along river subject to potential development.
Mayberry Drain/NE SWMF 2	Sewershed in northeast quadrant tributary to Mayberry Drain. Includes drainage to the NE SWMF 2 east of Walton St. A major flow storm trunk is designed to provide 100 year major flow conveyance from the low-lying area at David St. and Davidson Ave. east to the NE SWMF 2.
Harold Good/NE Area	Sewershed in the northeast quadrant tributary to the Harold Good Drain and ultimately Little Maitland River. Includes drainage from future industrial park lands in NE quadrant and proposed NE SWMF 1.


KEY MAP
Legend
Storm Sewers
Stormwater Management Facility
Parcels
Urban Boundary (2024)
Overall Catchment Boundary
Subcatchments
Riverview Dr 1
Riverview Dr 2
1A Barnett Street
Mitchell Street/ HWY 23 S
Albert Street
Albert Street/ Rogers SWMF
Clayton/Elma/ Main Street E
Inkerman Street
Wallace Ave
Inkerman Street
Elizabeth Street
Davidson Ave N
Queen Street E/ Davidson Ave N
Walton Avenue
Park Avenue
Gibson Drain
Royal Street E
Maitland Ave N
No. 1 Drain
Seaman Drain
Union Street East
Union Street West
Main Street West
BarnettDrain
Chapman
Falls Drain
Harold Good
HendersonDrain
Line 84 SWMF
Maitland-1
Maitland-2
MaitlandJS
Mayberry Drain
Nichol & Award Drain
Nichol SWMF
RBowmanDrain
Salisbury
SheanDrain
Tremaine Ave SWMF
Hutton Street SWMF
Maitland River
HWY 23
87 LINE
FAIRLANE RD
WALTON AVE
DAVIDSON AVE N
LOUISE AVE N
MAPLE AVE N
ELIZABETH ST E
MAIN ST E
PERTH 86 LINE MAIN ST W
CLAYTON ST E
NICHOL AVE S
BRIGHT ST E
TREMAINE AVE S
MITCHELL RD S
HWY 23
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BMROSS
MUNICIPALITY OF NORTH PERTH MASTER PLAN
STORM SYSTEM ASSESSMENT
EXISTING CONDITION
STORM SEWER CATCHMENTS - LISTOWEL
DATE
APRIL 2025
PROJECT No.
17309
SCALE
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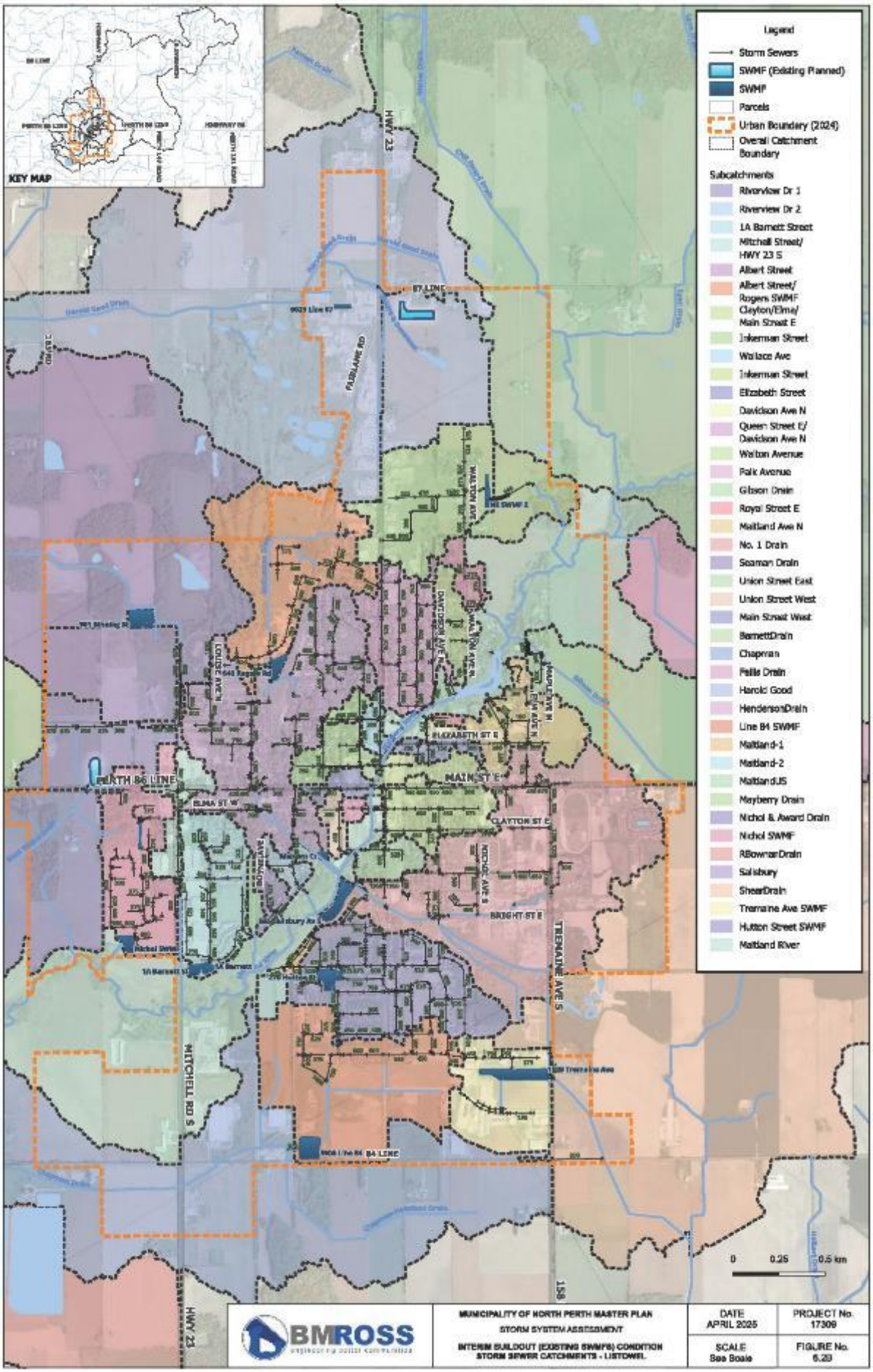
FIGURE No.
6.2A


KEY MAP
Legend
Storm Sewers
SWMF (Existing Planned)
SWMF
Parcels
Urban Boundary (2024)
Overall Catchment Boundary
Subcatchments
Riverview Dr 1
Riverview Dr 2
1A Barnett Street
Mitchell Street/ HWY 23 S
Albert Street
Albert Street/ Rogers SWMF
Clayton/Elma/ Main Street E
Inkerman Street
Wallace Ave
Inkerman Street
Elizabeth Street
Davidson Ave N
Queen Street E/ Davidson Ave N
Walton Avenue
Falk Avenue
Gibson Drain
Royal Street E
Maitland Ave N
No. 1 Drain
Seaman Drain
Union Street East
Union Street West
Main Street West
BarnettDrain
Chapman
Falls Drain
Harold Good
HendersonDrain
Line 84 SWMF
Maitland-1
Maitland-2
MaitlandJS
Meyberry Drain
Nichol & Award Drain
Nichol SWMF
RBowmarDrain
Salisbury
ShearDrain
Tremaine Ave SWMF
Hutton Street SWMF
Maitland River
HWY 23
MAIN ST E
NORTH 86 LINE
MITCHELL RD S
TREMAINE AVE S
0
0.25
0.5 km
BMROSS
MUNICIPALITY OF NORTH PERTH MASTER PLAN
STORM SYSTEM ASSESSMENT
INTERIM BUILDOUT (EXISTING SWMFS) CONDITION STORM SEWER CATCHMENTS - LISTOWEL
DATE APRIL 2025
PROJECT No. 17309
SCALE See Scale
FIGURE No. 6.20

6.1.3 Atwood Storm System and Sewersheds

For the Atwood drainage system, there are 11 sewersheds, discharging to the Turnbull Drain in the northwest, and the Hana Drain to the southwest. There is 1 relatively recent regional stormwater management facility, which services the Dalmitch Subdivision. The entire system includes approximately 8,300 m of storm main, servicing the urban area. Many of the existing storm sewers in older areas of Atwood have municipal drain status. Table 6.2 provides a summary of the 11 major sewersheds and their respective outlets. Figure 6.3 illustrates the sewersheds and associated outlets.

Table 6.2 – Summary of Major Sewersheds – Atwood

Catchment	Outlet
Dalmitch SWMF	Sewershed in the northeast quadrant of Atwood, includes the relatively recently constructed Atwood (Dalmitch) SWMF providing servicing to the Datmitch subdivision as well as some historical development areas east of Main Street, with discharge to the Hood Drain, and ultimately the Turnbull Drain to the north.
Arthur Street E	Small sewershed at east limit of existing built area, tributary to Hanna Drain via 450 mm outlet sewer, crossing future development lands.
Woodview	Small sewershed in the southeast quadrant of Atwood, servicing primarily residential areas, with some commercial drainage from properties on south side of Arthur Street. Spills from Arthur Street low point, east of Main Street are conveyed into the Parkview Cresent catchment. Discharge to the Hanna Drain via a 400 mm storm sewer.
Woodview 2	Small drainage area on the southeast limit of Atwood, discharging to the Hanna Drain via 250 mm storm sewer.
Parkview Cresent	Small sewershed with discharge to Hanna Drain via 375 storm sewer, across Atwood Lions Park.
Main Street South	A central sewershed, servicing Main Street (Hwy 23) from John Street/Blair St. south to the Hanna Drain via a 600 mm outlet sewer.
Queen Street (Lone Oak Drain)	Sewershed in the southwest quadrant providing drainage generally on Queen Street via a 750 mm outlet sewer (Lone Oak Drain).
Clark Drain	Drainage in the southwest quadrant provided to existing agricultural lands west of Queen Street, tributary to the Clark Drain and ultimately the Hanna Drain to the south.
Bowman Court (Queen Street Drain)	Sewershed in the northwest quadrant providing drainage to Bowman Court and overland flows from adjacent agricultural area subject to future development. Includes partial drainage for Queens Street/William Street low lying area serviced by both the Queen Street Drain, and the King and Queen Street Drain.

Catchment	Outlet
King Street (King and Queen Street Relief)	Sewershed in the northwest quadrant draining to King Street (Queen and King Street Relief Drain), with discharge north to the Hood Drain via a 600 mm outlet sewer, across potential future development lands, ultimately tributary to the Turnbull Drain to the north. Includes partial drainage for Queen Street/William Street low lying area serviced by both the Queen Street Drain, and the King and Queen Street Drain.
Main Street North	A central sewershed, servicing Main Street (Hwy 23) from John Street north to the Hood Drain via 750 outlet sewer, ultimately tributary to the Turnbull Drain to the north.

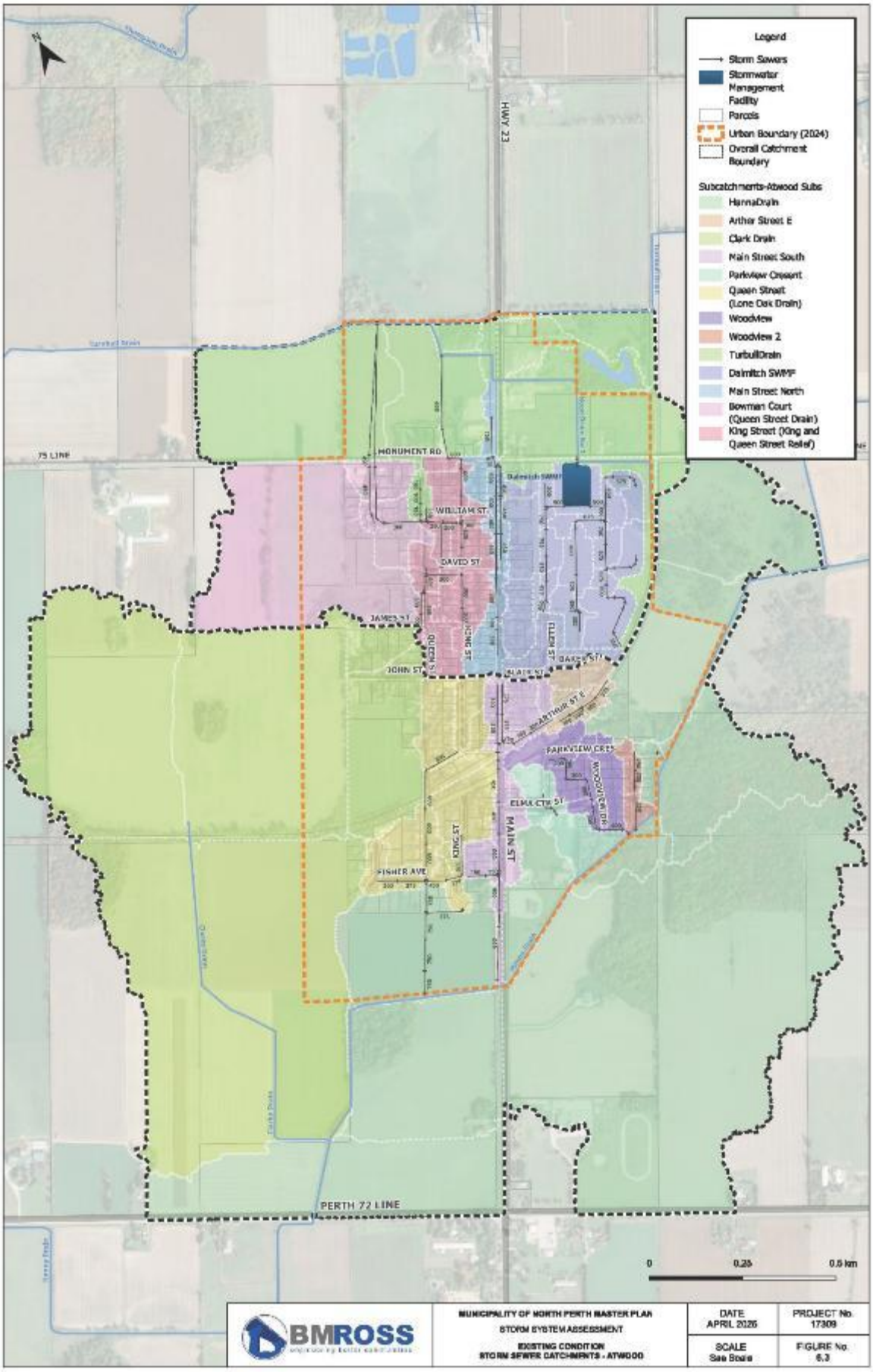
6.1.4 Inventory of Existing Stormwater Management Facilities

There are 10 regional SWMFs in Listowel and 1 regional SWMF in Atwood. Table 6.3 below summarizes details of the existing the regional SWMFs.

Table 6.3 – Summary of Existing Regional SWMF

SWMF	Facility Type (Wetpond, Wetland, Dry Pond, OGS, LID)	Level of Water Quality Treatment (ex. Basic 60%, Normal 70%, Enhanced 80% long term total suspended solids removal)	Level of Water Quantity Control Level	Total Catchment Area (Full Build-out)[1] (ha)
Listowel				
Tremaine Avenue SWMF	Wet Pond	Normal	100 year	25.5
1A Barnett Street SWMF	Dry Pond	Basic	100 year	40.3
Hutton Street West SWMF	Wet Pond	Enhanced	100 year	56.7
Salisbury Avenue South SWMF	Wetland	Normal	2 year	146.1
Line 84 SWMF	Wet Pond	Enhanced	100 year	70.3
Line 87 SWMF	Dry Pond	Basic (assumed)	--	7.8
Rogers Road SWMF	Wetland	Enhanced	100 year	57.0
Binning Street West SWMF (North)	Wetpond	Enhanced	100 year	34.1
NE SWMF 2	Wetland/Wetpond Hybrid	Normal	100 year	46.3
Nichol Subdivision SWMF	Wetland pond	Enhanced	100 year	35.2
Atwood				
Atwood (Dalmitch) SWMF	Wetland/Wetpond Hybrid	Enhanced	100 year	18.3

Note: 1. Catchment area established through master plan catchment delination, and reviewed against design catchment areas.


Legend
Storm Sewers
Stormwater Management Facility
Parcels
Urban Boundary (2024)
Overall Catchment Boundary
Subcatchments-Atwood Subs
HannaDrain
Arthur Street E
Clark Drain
Main Street South
Parkview Crescent
Queen Street (Lone Oak Drain)
WoodView
WoodView 2
TurbullDrain
Dalmitch SWMF
Main Street North
Bowman Court (Queen Street Drain)
King Street (King and Queen Street Relief)
HWY 23
75 LINE
MONUMENT RD
WILLIAM ST
DAVID ST
JAMES ST
JOHN ST
QUEEN ST
MAIN ST
ARTHUR ST E
PARKVIEW CRES
WOODVIEW RD
KING ST
FISHER AVE
PERTH 72 LINE
0
0.25
0.5 km
BMROSS
MUNICIPALITY OF NORTH PERTH MASTER PLAN
STORM SYSTEM ASSESSMENT
EXISTING CONDITION
STORM SEWER CATCHMENTS - ATWOOD
DATE
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SCALE
See Scale
FIGURE No.
6.3

Numerous private SWM facilities provide additional water quality and water quantity control across the study area. Large private SWM facilities or onsite SWM storage areas have been accounted for in the master plan and include:

- Sugar Bush SWMF
- Tim Horton's Plaza SWMF
- 575 Albert Avenue Private SWMF
- Catholic Church SWMF
- Evangelical Missionary Church SWMF
- St Marys Catholic School

6.1.5 Previous Stormwater Studies

As part of the Master Plan process, previous studies and relevant reports were reviewed. For the Listowel study area historical SWM studies in addition to development reports included the No 1 Drain Report (North Perth Drainage Project), South Master Servicing Plan, Class EA for Binning Street Extension and the Northeast Master Plan. Key elements from previous studies are summarized below.

North Perth Drainage Project – Southeast section of Listowel Ward, by Gamsby and Mannerow Limited (Sept 2002)

A class EA report was previously completed in 2002 on the No 1 Drain watershed, due to historical flooding at various locations, sporadic infill development and future development potential. In general, the study recommended a trunk storm sewer for the 5 year event, a designated major overland flow path, and a new stormwater management facility (Salisbury Avenue SWMF). A trunk storm sewer was recommended and constructed commencing from Main Street near Elm, running east to Tremaine Avenue where is turns south down to Mowat Street road allowance. At Mowat Street the trunk sewer turns west and eventually jogs south to the Salisbury Avenue SWMF, via John Rosa Street, Wellington Avenue and Erie Street West. Major flow recommendations in the upper reaches included maintaining major flow paths along private properties in the vicinity of the historical municipal drain, between Main Street, Clayton Street and Mowat Avenue road allowance. Ditch drainage from major flows route along Bright Street and the community trail provides a route for flows to the Salisbury Avenue SWMF.

Municipality of North Perth – Listowel South Master Servicing Plan, by Gambsy and Mannerow Limited (2006).

A Schedule B Class EA was conducted to coordinate servicing (water, sanitary and stormwater) for the southwest section of the community of Listowel. The preferred stormwater strategy included the development of three regional SWMFs (implemented as the Hutton Street West SWMF, Tremaine Avenue SWMF and Line 84 SWMF). The regional SWMFs service a majority of the area, with individual facilities (site controls) identified for industrial sites at the south/southeast limits due to grading constraints.

Class EA for Extension of Binning Street, by B M Ross and Associates (2014)

A Schedule B Class EA was completed for the extension of Binning Street, west from Louise Ave. N. to Road 165. It was anticipated that future development would occur

adjacent to the newly constructed road as well as a new Arena Facility and Elementary School. Two regional stormwater management facilities were proposed as part of the project. A north facility which was constructed as part of the road project and a facility in the southwest, adjacent to Perth Line 86, to service future development lands. The North facility has a permanent pool volume of 4661 m^3 and an extended detention volume of 1580 m^3. The south facility was designed with a permanent pool volume of 2599 m^3 and an extended detention volume of 920 m^3.

Northeast Master Plan Schedule B Class EA Environmental Study Report, by GM Blue Plan (2020)

To coordinate the municipal servicing (water, sanitary and stormwater) for the Northeast Area, a schedule B Class EA was conducted. The preferred SWM strategy recommended the development of two new municipally owned SWMFs, urban streets with curb and gutter, storm sewers, and major flow conveyance.

To date, the southern NE SWMF 2 (phase 1) has been constructed. Works completed have supported the decommissioning of the Mayberry Drain dry pond. The second recommended SWMF, NE SWMF 1 (Phase 2) is at a conceptual design phase.

6.2 Stormwater System Assessment

6.2.1 Model Details

To assess the hydraulic capacity of the existing drainage system and to support potential storm improvement projects, a PCSWMM model was generated for each community. PCSWMM is a GIS-based model and allows for both minor system (storm sewers, ditches, culverts) and major system (road overland flow) design. The purpose of the modeling was to assess the capacity of both the minor and major system, identify capacity restrictions, surface ponding depths, and confirm the function of existing stormwater management facilities.

The stormwater GIS inventory established for the Master Plan, as described in Section 2.2, formed the basis of the stormwater PCSWMM model. Schematics of the PCSWMM models, including the minor and major runoff links, nodes and catchments is provided in Appendix F.

6.2.2 Model Assumptions and Setup

The model and its hydrologic parameters were established based on the following:

- Catchments:
  - The major catchment areas for Listowel and Atwood (see Table 6.1 and 6.2) were subdivided into subcatchments using GIS processing tools to based on provincial 2022 LiDAR DTM, road network and storm sewer layout. Subcatchments were reviewed for consistency with available drainage plans, SWM reports and Municipal drain reports.
  - Catchment overland flow length for urban areas were set to a maximum of 50 m. For large undeveloped areas, overland flow lengths were assumed at maximum 150 m.

  - Overland flow slopes were derived using GIS processing tools to calculate average slopes based on the provincial DTM for each catchment area, using an averaged 20 m slope grid.
  - Percentage impervious was derived using GIS processing tools based on two scenarios: existing and full-build land use values. A land use shape file was established based on aerial imagery, parcel fabric, and Perth County OP mapping files. Existing condition impervious values represent 2024 development conditions.
  - Impervious Manning n = 0.015
  - Pervious Manning n = 0.25
  - Impervious Initial abstraction = 2 mm
  - Pervious Initial abstraction = 5 mm
  - Weighted Soil Curve Numbers (CN) were calculated based on land use and surficial soil types. Surficial soil types were established based on GIS dataset of the Soil Map of Perth County, Ontario, Soil Survey No. 15
- Established storm sewer GIS database (See Report Section 2.2)
  - Assumed existing sewers and culverts are being maintained and kept in good working condition.
  - Generally, CB laterals, were not included in the model. The model includes main storm sewers.
  - Number of catch basin inlets were added to adjacent model junctions as applicable. Catch basin inlet capacity based on Ministry of Transportation (MTO) Drainage Manual Design Charts (Marsalek, 1982) and research conducted by Townsend, Wisner, and Moss (1980), obtained from the City of Toronto Infoworks CS Basement Flooding Model Studies Guidelines (Draft, 2014).
  - Existing sewers assumed to be smooth interior wall piping, unless otherwise known (i.e. Manning's n=0.013).
- Ditches and culverts included in the model are based on GIS inventory and LiDAR surface.
- SWMFs depth-area rating curves were determined from 2022 LiDAR, and confirmed with SWM report design details. Outlet arrangements input as per SWM design report details.
- Model "storage" nodes were established at confined low points in roadways, or on properties that lie along overland flow routes. Stage-storage relationships were established for each of these storage nodes from the 2022 LiDAR.

A summary of hydrologic parameters used in the model are provided in Appendix F. Model files are provided electronically.

6.2.2.1 IDF Curve Data

As part of the stormwater assessment, a review of IDF curve data was completed. Various IDFs have been historically applied in the design of regional SWMFs. Design reports were reviewed and identified the following IDFs of being used in currently constructed regional SWMFs:

- Environment Canada Stratford WWTP IDF (4)
- City of Stratford Design Guidelines IDF (1)

- UTRCA - London IDF (1)
- UTRCA - Stratford IDF (1)
- Unknown (4)

In general, regional data from Stratford, including either the Environment Canada Stratford WWTP IDF station, UTRCA – Stratford IDF (2004) or the City of Stratford Guidelines has been used for most of the regional SWMFs in North Perth. An overview of the return period amount and IDF curve fitted returned period amounts are summarized in Table 6.4 for previously used IDF curves and other nearby stations.

Table 6.4 – IDF Curve Comparison

Environment Canada Guage Station	Years	# Years	IDF Return Period Amounts (mm)				IDF Fitted Curve Return Period Amount (mm)			
			5 yr.		100 yr.		5 yr.		100 yr.	
			6-hr	24-hr	6 hour	24 -hr	6-hr	24-hr	6 hour	24 -hr
Stratford WWTP	1966-2004	36	62.5	76.4	122.5	141.6	57.1	91.9	107.5	182.5
London CS	1943 - 2021	71	47.6	66.4	77	109.1	49.3	72.6	81.6	118.6
Mount Forest	1962-2020	43	55.1	68.3	97.1	117	51.2	80.8	87.2	143.2
Waterloo Wellington A	1971-2007	33	54.3	67	97.6	110.6	52.2	80.1	92.1	143.1
Glen Allan	1960 - 1970	10	66.3	75.5	129.6	134.8	58.6	82.7	129.1	152.4
Other Datasets										
UTRCA - Stratford IDF Data	(2004)	--	--	--	--	--	58.3	82.4	111.9	158.2
UTRCA - London IDF Data	(2004)	--	--	--	--	--	51.1	63.3	83.4	111.6
City of Stratford Design Guidelines	(2022)	--	--	--	--	--	58.3	82.0	112.3	157.1
Unknown[1]	--	--	--	--	--	--	56.9	81.4	102.9	150.3

Note: 1. Unknown IDF used in used in design of 640 Rogers Road, 1529 Tremaine Avenue, 585 Salisbury Avenue South SWMF, Binning Street SWMF. Referenced as Stratford gauge data, but does not match City of Stratford Design Guidelines or EC Stratford WWTP IDF

As identified in Table 6.4 above, the most conservative IDF for the region is the Environment Canada Stratford WWTP station. It is noted that two historical events in Stratford totaled rainfall amounts of 142.8 mm (1983) and 136 mm (2002) in 24 hours.

For the current stormwater assessment, the Environment Canada Stratford WWTP IDF return period data has been applied. The following distributions were run to determine the critical design event.

- 5 and 100-year 6-hour SCS Type II rainfall distribution
- 5 and 100-year 24-hour SCS Type II rainfall distribution
- 5 and 100-year 6-hour Chicago rainfall distribution
- 5 and 100-year AES 12 hour rainfall distribution

Based on model results, the 6-hour SCS Type II rainfall distribution produced the highest flows for the urban area and was carried forward in the analysis.

- *5 year 6-hour SCS Type II - 62.5 mm total rainfall*
- *100 year 6-hour SCS Type II – 122.5 m total rainfall*

6.2.2.2 Model Validation and Critical Storm Hydrographs

Results from the Listowel storm system model were reviewed at a high level against previous hydrologic modeling completed for the Maitland River for flood plain mapping purposes. Hydrographs were also assessed to distinguish impact of rural and urban flows on the Maitland River, and need for SWM quantity controls for future development lands.

Model Validation

The Listowel PCSWMM model included the upstream rural catchments allowing for comparison against anticipated Maitland River flows. Modeling did not include a detailed calibration to Maitland River flows, which was beyond the scope of this study.

Hydrographs and peak flows from the PCSWMM model were compared against recent hydrological modeling completed for the North Perth Flood Hazard Mapping Project by Aquafor Beach Limited (2023) for the MVCA. It is noted that the HEC-HMS model developed for the Flood Hazard project for the Listowel and upstream area included 11 basins and Green Ampt infiltration methods. The PCSWMM model for the master plan included 695 individual subcatchments and applied the SCS curve number infiltration method. The design storm applied in the Flood Hazard project was AES 12 hr 100 yr storm event based on IDF data from Glen Allan EC station. To compare model results, the same design storm was applied to the Listowel PCSWMM model. Table 6.5 below summarizes the comparison of model peak flow results for the 5 and 100 year AES 12 hr events.

Table 6.5 – Peak Flow Comparison to NP Flood Hazard Mapping Project Flows

Location	**HEC-HMS Model[1]** North Perth Flood Hazard Mapping Project		**Existing Condition** Master Plan PCSWMM Model	
	5-yr	**100-yr**	**5-yr**	**100-yr**
Upstream of Listowel	32.64	74.03	17.94	75.13
Downstream of Listowel	36.95	83.27	18.81	76.45

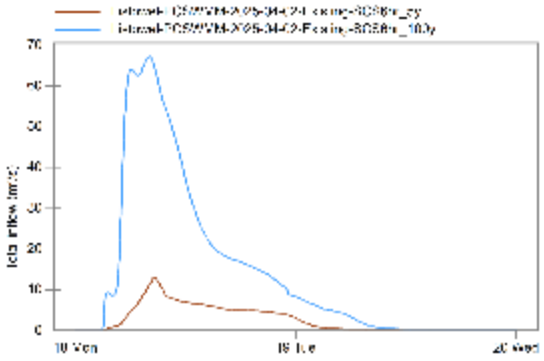
Note:

1. *Obtained from Table 4-8 in the NP Flood Hazard Mapping Project - Hydrological Modeling Report by Aquafor Beech (2023) Maitland Conservation Authority.*
2. *Peak flows for AES 12-hour Distribution Event. Rainfall from Glen Allan EC station.*

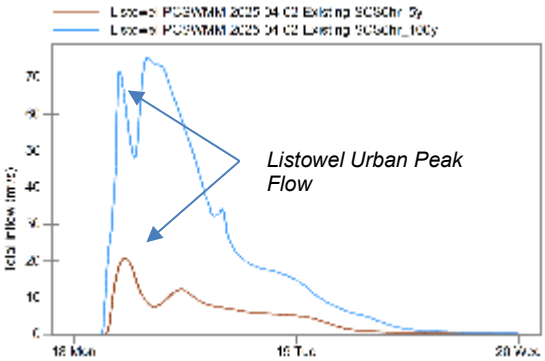
As summarized above, the 100 year AES flows are very similar between the HEC-HMS model completed for North Perth Flood Hazard Mapping project and the Master Plan storm water system modeling. The 5 year peak flow is estimated lower in the PCSWMM model. Overall agreement between the two models for the 100 year event provides confidence in modeling.

6.2.2.3 Critical Storm Hydrographs and Maitland Peak Flows

A review of PCSWMM result hydrographs and SWMF performance (max pond depths) confirmed the SCS type II 6 hour distribution as the critical event for urban hydrology across Listowel. A review of Maitland River modelled hydrographs also identified that the urban peak flows to the Maitland River tend to occur prior to the upstream rural area. For a 5 year SCS Type II 6 hour event, the urban peak flow is higher than the rural peak flow from the upstream catchment area.



Upstream of Listowel

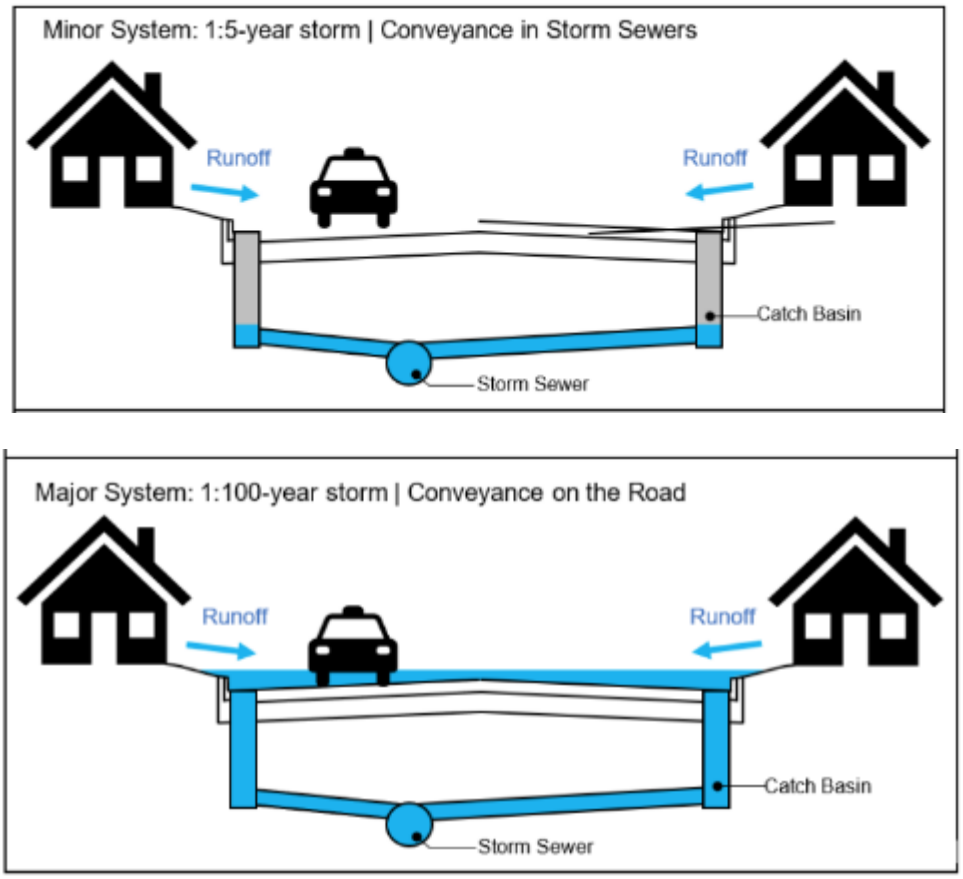


Downstream of Listowel

Within the last 20 years, some developments immediately adjacent to the Maitland River have been allowed to discharge without peak flow controls. A sensitivity analysis was conducted and confirmed additional uncontrolled runoff would increase peak flows along the Maitland for the 5 and 100 year event. Therefore peak flow controls are required for all future development with direct discharge to the Maitland River, for all events to maintain existing peak flows.

6.2.3 Results

PCSWMM models for each community have been used to verify the capacity of the major and minor system. Under a 5 year storm (a storm with 20% chance of occurring in any year) (referred to as a minor storm) sewers are typically designed to flow full, as shown in the schematic below, with minimal ponding on the road. The second scenario is the 100 year event (a storm with 1% chance of occurring in any year) (a major storm event) where the storm sewer system and the road/channel systems are designed to convey runoff. Key problems areas are highlighted under a 5 year event, if flows are ponding within the road way, typically greater than the curb height (150 mm). Under a major 100 year event, ponding up to 300 mm is typically considered acceptable within roadway areas so long as it does not spill and impact adjacent private property. Therefore, in some cases, ponding may only be acceptable at shallower depths (e.g. 150mm, where there is barrier curb or the adjacent private property is lower than the curb).



(Image Source: https://getinvolved.london.ca/carlingcreekmp/news_feed/background-information)

Model results are presented for the 5 year and 100 year event for Listowel in Figure 6.4 to 6.6, and Atwood in Figure 6.7 to 6.9. Combined minor and major system results are shown in Exhibits F.1 to F.4 in Appendix F for each community. It is noted that the "flow capacity" of the 5 year storm capacity results for Listowel and Atwood, shown on Figure 6.4 and 6.7, are based on the model's dynamic results and take into account backwater effects from downstream surcharged sewers, if applicable. Therefore, some sewer segments that are shown (in red) as operating at "100%" or more of their flow capacity may actually be an indication that the pipe is "full" only as a result of downstream surcharging. Therefore, if undersized downstream surcharged sewer segments are resolved to provide free discharge conditions, upstream sewer segments may have sufficient capacity contrary to what the red colour coding might otherwise indicate.

Results of major system (road network) are shown in Figure 6.5 and 6.6 for Listowel and Figure 6.8 and 6.9 for Atwood for the 5 and 100 year event respectively. Typically, the major system follows the path of the minor storm drainage system. However, there may be low point locations (bath tub topography) where the major system will spill from the road allowance to adjacent properties due to a lack of overland drainage or insufficient storm sewer capacity. Road sections indicated in green have minor flooding within the road, typically along the curbline. Yellow sections indicated flooding within road lanes, orange indicates areas with flooding above curb height but contained in the boulevard, and red would indicate flooding spilling to private lands.

6.2.3.1 Listowel Storm Model Results

Listowel model results are provided in Figure 6.4 to 6.6. Figure 6.4 illustrates a large portion of storm sewer network is flowing full or very close to full for a 5 year storm event, as designed. The key existing problem areas for a 5 year event can be identified by reviewing road sections where significant surface ponding is occurring during a 5 year event as shown in Figure 6.5.

Key potential flooding locations include:

- Binning Street, east of Louise Avenue North
- Walton Ave between Mckenzie Steet E and south the Maitland River
- Clayton Street, immediately east of Tremaine Avenue S
- McLaren Ave at Centennial Court
- Winston Blvd adjacent to Jackson Park
- Inkerman Street between Elm and Maitland Ave
- Victoria Street, north of Elizabeth

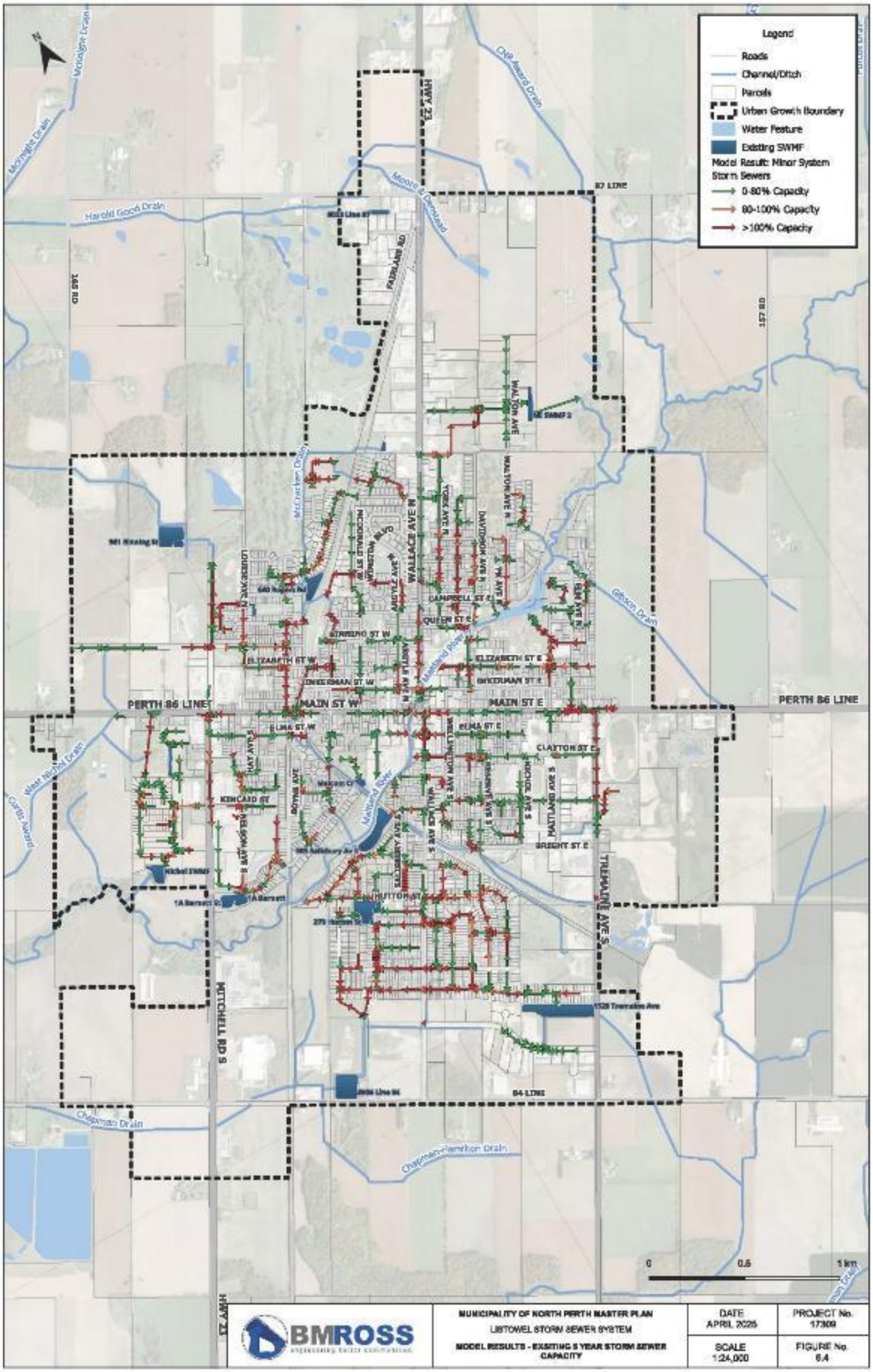
Areas of flooding in 5 year (Figure 6.5) show up more intense in the 100 year event results (Figure 6.6), with additional flooding expected throughout Listowel. It is noted a significant portion of the system is functioning well under a 100 year event. Flooding indicated is typically along corridors that have limited relief (bath tub topography), and flows are constraint by capacity of existing sewers and channels.

6.2.3.2 Atwood Storm Model Results

Atwood model results are shown in Figure 6.7 to 6.9. A large portion of the storm system flowing full or close to full for a 5 year storm event. Surface flooding is indicated throughout older portions of the community.

Key areas of interest include:

- Generally the Queen Street, William Street, King Street, and Bowman Court area, which is a low lying area (bath tub topography) serviced by the Queen Street drain on the west limit and the Queen and King Street relief drain west of Main Street, is subject to flooding.
- Surface ponding has been indicated along southern portion of Queen Street and Fisher Avenue as well as Wood Drive.
- The Dalmitch subdivision at the northeast quadrant performs well for both a 5 year and 100 year scenario.


Legend
Roads
Channel/Ditch
Parcels
Urban Growth Boundary
Water Feature
Existing SWMF
Model Result: Minor System Storm Sewers
0-80% Capacity
80-100% Capacity
>100% Capacity
HWY 23
87 LINE
PERTH 86 LINE
MAIN ST W
MAIN ST E
WALLACE AVE N
MITCHELL RD S
TREMAINE AVE S
84 LINE
Maitland River
Chapman Drain
Chapman-Hamilton Drain
Harold Good Drain
Moore & Dennstedt
Gibson Drain
0
0.5
1 km
MUNICIPALITY OF NORTH PERTH MASTER PLAN
LISTOWEL STORM SEWER SYSTEM
MODEL RESULTS - EXISTING 5 YEAR STORM SEWER CAPACITY
DATE
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PROJECT No.
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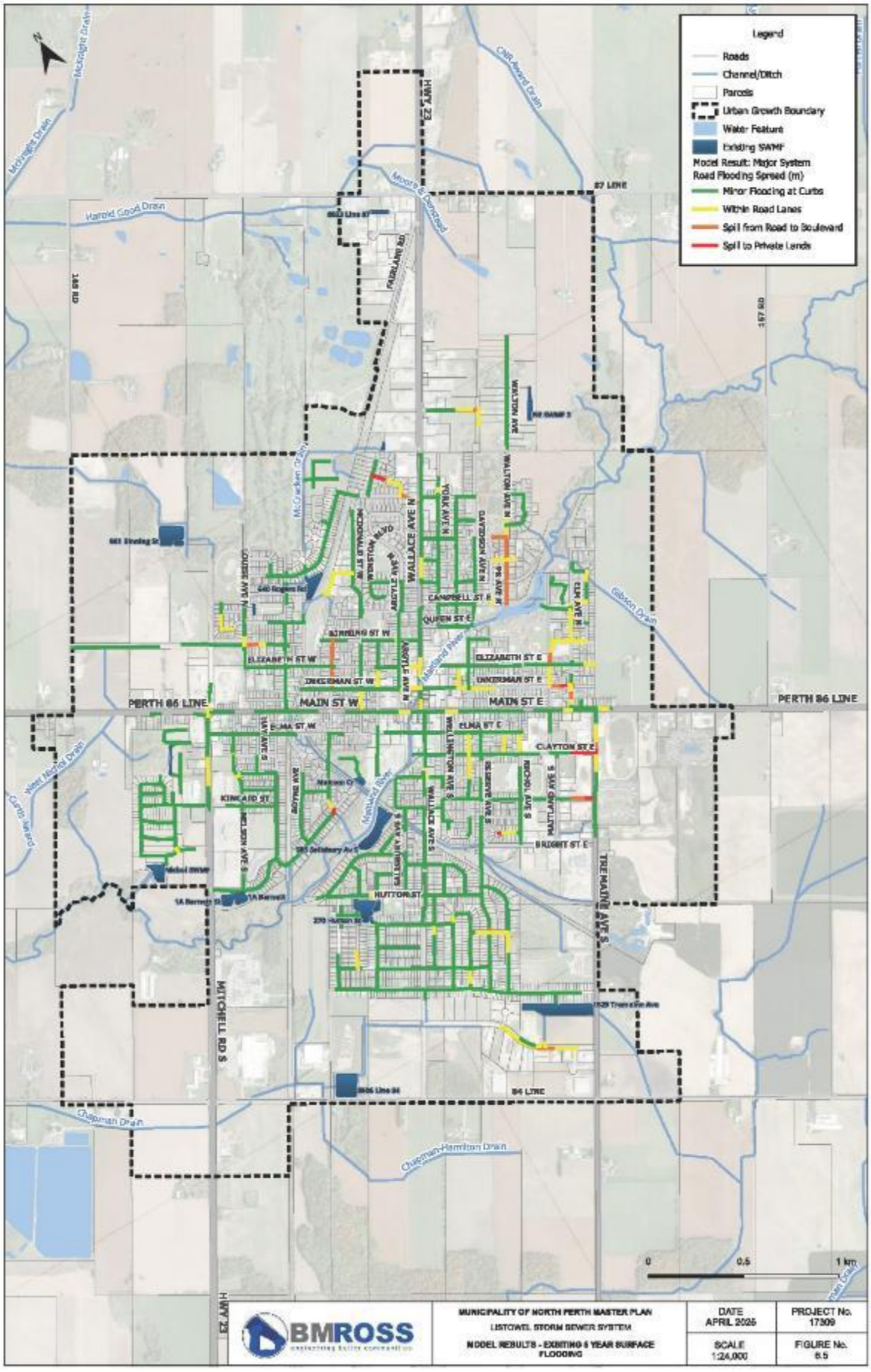
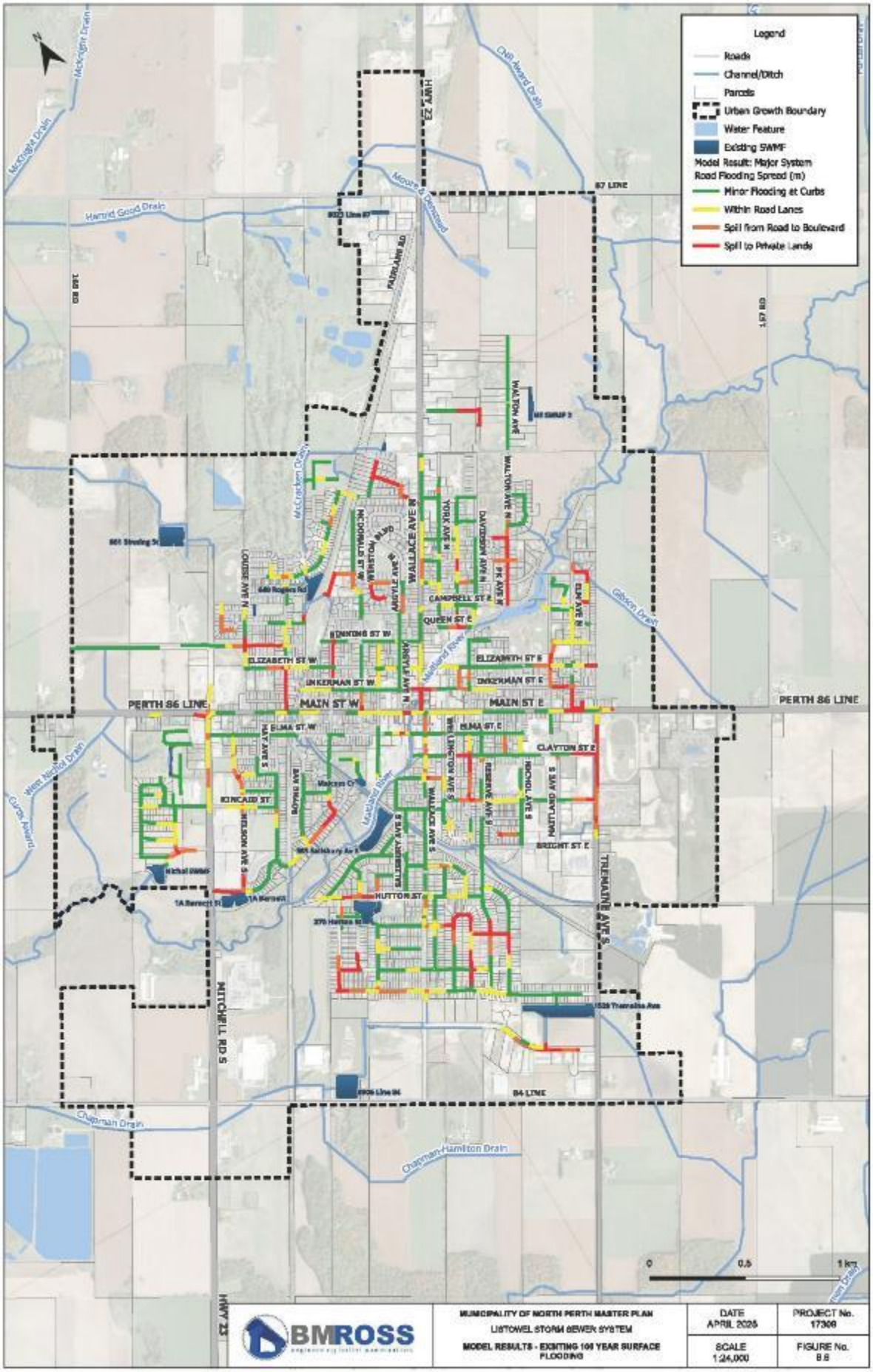
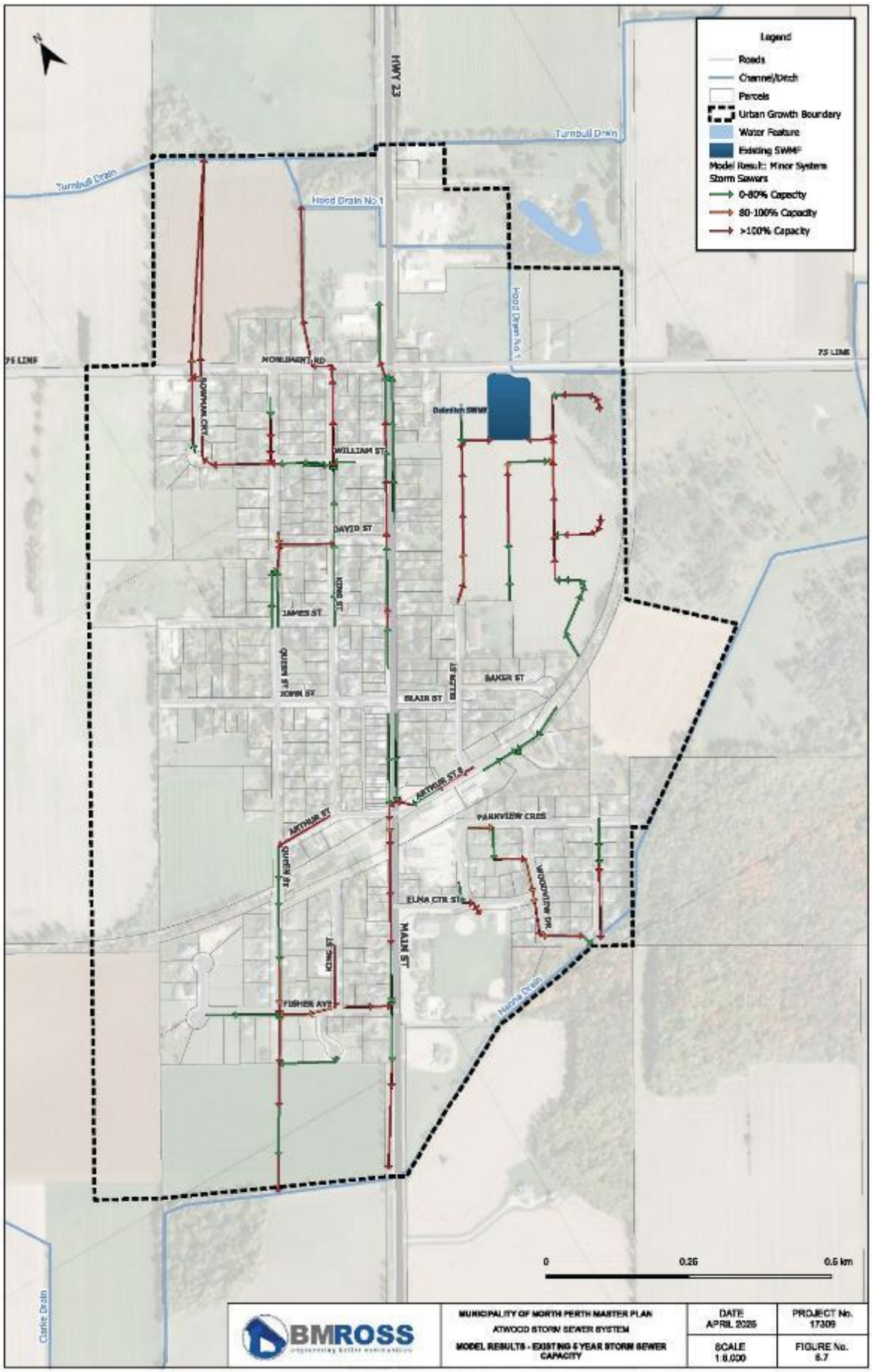
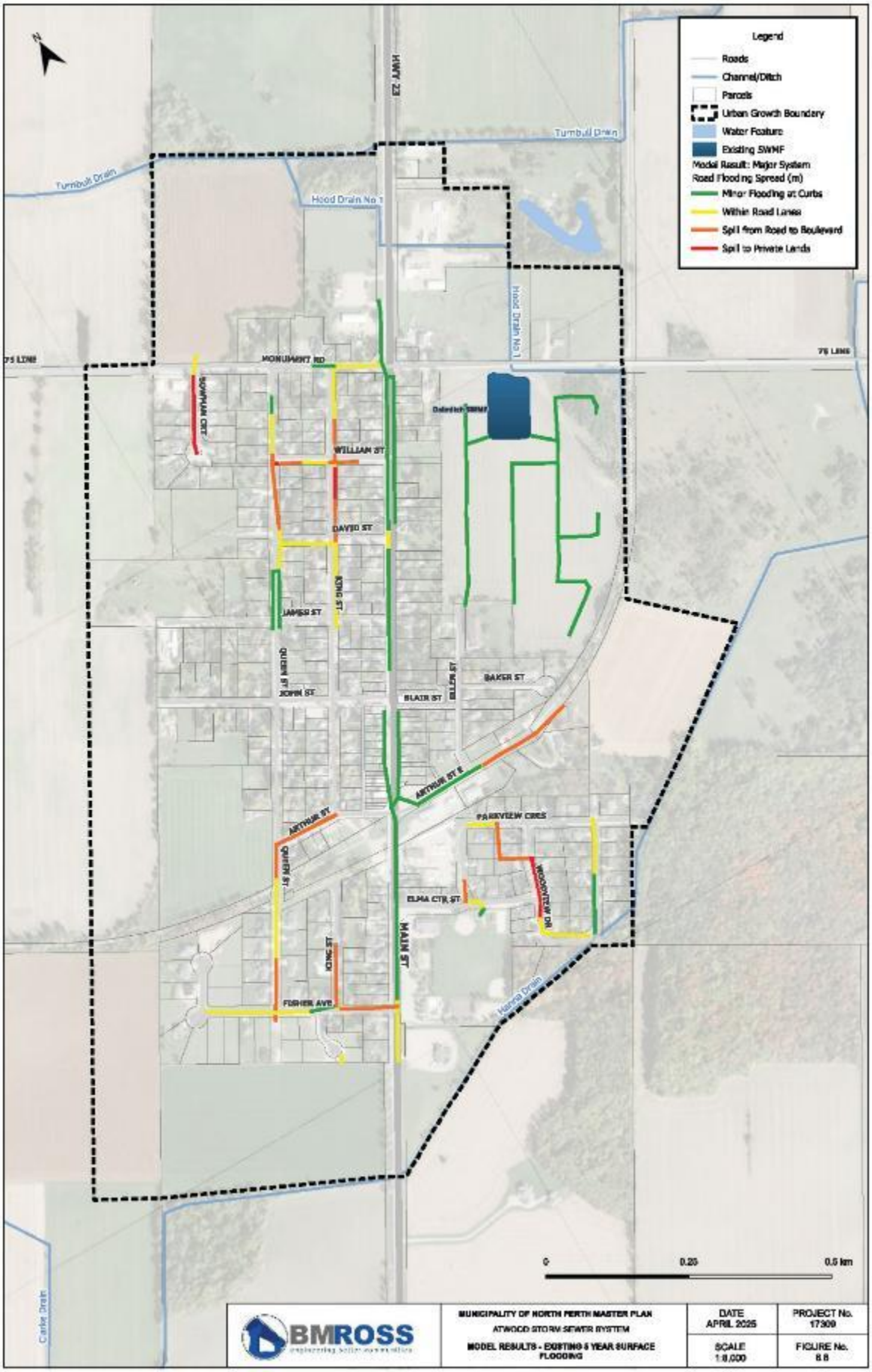
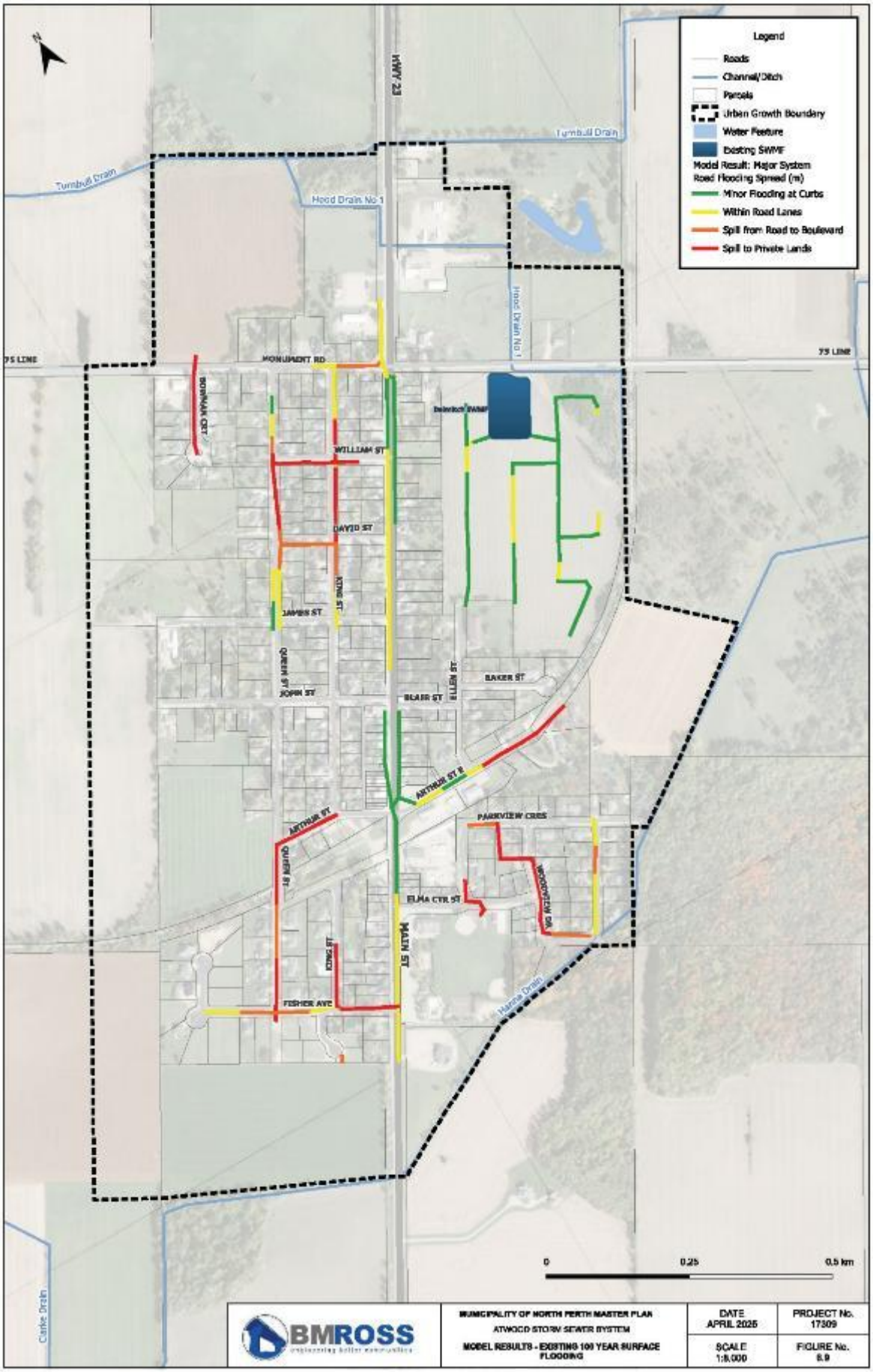
6.4


Legend
Roads
Channel/Ditch
Parcels
Urban Growth Boundary
Water Feature
Existing SWMF
Model Result: Major System Road Flooding Spread (m)
Minor Flooding at Curbs
Within Road Lanes
Spill from Road to Boulevard
Spill to Private Lands
PERTH 86 LINE
MAIN ST W
MAIN ST E
87 LINE
84 LINE
HWY 23
MITCHELL RD S
MUNICIPALITY OF NORTH PERTH MASTER PLAN
LISTOWEL STORM SEWER SYSTEM
MODEL RESULTS - EXISTING 5 YEAR SURFACE FLOODING
DATE APRIL 2025
PROJECT No. 17309
SCALE 1:24,000
FIGURE No. 6.5


Legend
Roads
Channel/Ditch
Parcels
Urban Growth Boundary
Water Feature
Existing SWMF
Model Result: Major System Road Flooding Spread (m)
Minor Flooding at Curbs
Within Road Lanes
Spill from Road to Boulevard
Spill to Private Lands
PERTH 86 LINE
MAIN ST W
MAIN ST E
WALLACE AVE N
WALLACE AVE S
MITCHELL RD S
HWY 23
84 LINE
87 LINE
Harrid Good Drain
McKnight Drain
Chapman Drain
Chapman-Hamilton Drain
Maitland River
Gibson Drain
West Nichol Drain
0
0.5
1 km
BMROSS
MUNICIPALITY OF NORTH PERTH MASTER PLAN
LISTOWEL STORM SEWER SYSTEM
MODEL RESULTS - EXISTING 100 YEAR SURFACE FLOODING
DATE APRIL 2025
PROJECT No. 17309
SCALE 1:24,000
FIGURE No. 8.8


Legend
Roads
Channel/Ditch
Parcels
Urban Growth Boundary
Water Feature
Existing SWMF
Model Result: Minor System Storm Sewers
0-80% Capacity
80-100% Capacity
>100% Capacity
HWY 23
Turnbull Drain
Hood Drain No 1
Hood Drain No 1
75 LINE
75 LINE
MONUMENT RD
BOWMAN CRT
Dalrich SWMF
WILLIAM ST
DAVID ST
JAMES ST
KING ST
QUEEN ST
JOHN ST
BLAIR ST
BLAIR ST
BAKER ST
ARTHUR ST S
ARTHUR ST
PARKVIEW CRES
QUEEN ST
ELMA CTR ST
MEADOW RD
MAIN ST
KING ST
FISHER AVE
Hanna Drain
Clarke Drain
0
0.25
0.5 km
BMROSS
MUNICIPALITY OF NORTH PERTH MASTER PLAN
ATWOOD STORM SEWER SYSTEM
MODEL RESULTS - EXISTING 5 YEAR STORM SEWER CAPACITY
DATE
APRIL 2025
PROJECT No.
17309
SCALE
1:8,000
FIGURE No.
6.7


Legend
Roads
Channel/Ditch
Parcels
Urban Growth Boundary
Water Feature
Existing SWMF
Model Result: Major System
Road Flooding Spread (m)
Minor Flooding at Curbs
Within Road Lanes
Spill from Road to Boulevard
Spill to Private Lands
HWY 23
Turnbull Drain
Hood Drain No 1
MONUMENT RD
WILLIAM ST
DAVID ST
KING ST
JAMES ST
QUEEN ST
JOHN ST
BLAIR ST
ELLEN ST
BAKER ST
ARTHUR ST E
ARTHUR ST
PARKVIEW CRES
WOODVIEW DR
ELMA CTR ST
MAIN ST
JESSICA ST
FISHER AVE
Henna Drain
Carke Drain
0
0.25
0.5 km
BMROSS
MUNICIPALITY OF NORTH PERTH MASTER PLAN
ATWOOD STORM SEWER SYSTEM
MODEL RESULTS - EXISTING 5 YEAR SURFACE FLOODING
DATE APRIL 2025
PROJECT No. 17309
SCALE 1:8,000
FIGURE No. 8.8


Legend
Roads
Channel/Ditch
Parcels
Urban Growth Boundary
Water Feature
Existing SWMF
Model Result: Major System
Road Flooding Spread (m)
Minor Flooding at Curbs
Within Road Lanes
Spill from Road to Boulevard
Spill to Private Lands
HWY 23
Turnbull Drain
Hood Drain No 1
75 LINE
MONUMENT RD
BOARMAN CRT
WILLIAM ST
DAVID ST
KING ST
JAMES ST
QUEEN ST
JOHN ST
BLAIR ST
ELLEN ST
BAKER ST
ARTHUR ST E
ARTHUR ST
PARKVIEW CRES
WOODSIDE DR
ELMA CTR ST
MAIN ST
FISHER AVE
Hanna Drain
Carke Drain
0
0.25
0.5 km
BMROSS
MUNICIPALITY OF NORTH PERTH MASTER PLAN
ATWOOD STORM SEWER SYSTEM
MODEL RESULTS - EXISTING 100 YEAR SURFACE FLOODING
DATE APRIL 2025
PROJECT No. 17309
SCALE 1:5,000
FIGURE No. 8.9

6.2.3.3 SWMF Quantity Control Performance

The performance of existing regional SWMFs were reviewed for the 100 year event for existing and anticipated full build-out conditions. Table 6.6 below summarizes anticipated max depths, activation of the emergency overflow weir and freeboard for each facility.

Table 6.6 – Existing SWMF Water Quantity Performance

	Modelled – Existing Conditions				Modelled – Full Build-out Conditions			
SWMF	Max HGL (m)	Max Depth (m)	Above Emg. Overflow (m)	Freeboard to Top of Berm (m)	Max HGL (m)	Max Depth (m)	Above Emg. Overflow (m)	Freeboard to Top of Berm (m)
Listowel								
Tremaine Ave SWMF	383.63	1.40	-0.29	0.50	383.66	1.43	-0.32	0.47
1A Barnett St SWMF	376.49	1.92	--	0.21	376.51	1.94	--	0.19
Hutton Street West SWMF	378.88	3.71	-0.03	-0.03	378.80	3.71	-0.03	-0.03
Salisbury Ave South SWMF	378.13	1.80	--	0.19	378.15	1.82	--	0.17
Line 84 SWMF	377.59	2.23	--	0.61	378.07	2.71	-0.07	0.13
Line 87 SWMF	--	--	--	--	--	--	--	--
Rogers Road SWMF	383.90	1.52	-0.31	-0.01	383.90	1.52	-0.31	-0.01
Binning St West SWMF	381.44	0.62	-0.14	0.26	381.94	1.12	-0.64	-0.24
NE SWMF 2 (Phase 1)	385.77	1.97	--	0.83	386.14	2.34	-0.04	0.46
Nichol SWMF	376.07	2.92	-0.12	-0.02	376.12	2.97	-0.17	-0.07
Malcom Crescent SWMF	378.84	0.82	-0.04	0.62	378.78	0.76	--	0.68
NE SWMF1 (Phase 2)	--	--	--	--	385.48	2.28	--	0.52
Atwood								
Atwood (Dalmitch) SWMF	364.33	1.68	-0.11	0.09		1.68	-0.11	0.09

Under existing conditions, existing SWMFs are generally functioning as anticipated for an extreme event. Emergency overflow weirs are anticipated to be activated for several facilities. It is noted that the performance of facilities may differ from original design documents due to refinements in total catchment impervious values, applied design storm events, and catchment delineation for minor and major system. Typically the 100 year should be contained below the emergency overflow weir elevation. However, most ponds are anticipated to contain the 100 year within the top of berm design elevations. At full anticipated build-out, some SWMF performance is anticipated to be impacted. Of note:

- The Hutton Street SWMF is constrained, with no overland spill from the facility. Increased potential for flooding at this facility. Maintenance should be prioritized on outlet structures.
- Binning Street West SWMF, under full build-out conditions, performance is anticipated to be impacted due to currently anticipated development impervious values. SWMF retrofits are anticipated for this facility to accommodate higher impervious levels.
- Roger's Road SWMF high water levels are anticipated to be contained to the SWM block with no impact to adjacent residential areas.
- Overflow of the Nichol SWMF is directed to the Maitland River.
- Line 87 SWMF has no design details. The dry pond is assumed to be undersized for Industrial land service area, providing minimal quantity control. Opportunity to increase the size of facility to be considered as development occurs in the area.

- NE SWMF 2 (Phase 1) emergency overflow is anticipated to be activated for full anticipated build-out conditions.

6.2.3.4 SWMF Quality Control Performance

The majority of North Perth's existing SWMFs have been designed as wet facilities (wet pond, wetland, or hybrid wetpond-wetland) with water quality controls provided through the provision of a permanent pool volume. Permanent pool volume requirements for wet facilities are based on design requirements from *MECP SWM Guidelines (2003), Table 3.2 Water Quality Storage Requirements based on Receiving Waters*. Each level of protection (enhanced, normal, and basic) is established based on the sensitivity of the receiving aquatic environment. Dry pond facilities are known to have limited water quality provision, and depends on the detention time of the facility (typically minimum 24 hours for basic treatment level).

Table 6.7 below summarizes for existing regional SWMFs, the facility type, water quality designed treatment level, catchment area and impervious ultimate build-out as assessed through the master plan, total permanent pool provided (as per available design report) and total permanent pool required.

Table 6.7 – Existing SWMF Water Quality Performance

SWMF	Facility Type	Level of Water Quality Treatment	Total Catchment Area (Full Build-out) (ha)	Full Build-out Impervious (%)	Provided Permanent Pool[1] (m^3)	Required Permanent Pool (m^3)
Tremaine Avenue SWMF	Wet Pond	Normal	25.5	61	2,839	1,946
1A Barnett Street SWMF	Dry Pond	Basic	40.3	62	--	--
Hutton Street West SWMF	Wet Pond	Enhanced	56.7	50	7,792	7,738
Salisbury Avenue South SWMF	Wetland	Normal	146.1	43	4,960	3,488
Line 84 SWMF	Wet Pond	Enhanced	70.3	52	11,000	9,961
Line 87 SWMF	Dry Pond	Basic (assumed)	7.8	62	--	--
Rogers Road SWMF	Wetland	Enhanced	57.0	24	1,631	1,475
Binning Street West SWMF (North)	Wetpond	Enhanced	34.1	65	12,840	5,111
NE SWMF 2	Wetland/Wetpond Hybrid	Normal	46.3	53	2,570	2,261
Nichol Subdivision SWMF	Wetland pond	Enhanced	35.2	50	2,343	2,057
Atwood (Dalmitch) SWMF	Wetland/Wetpond Hybrid	Enhanced	18.3	48	1,425	1,030

Note:

1. *Permanent Pool volumes obtained from SWMF design reports and as-record drawings, as available.*
2. *Required Permanent Pool, is the calculated permanent pool volume required as per the Full Build-out Catchment Area and assumed impervious established in the Master Plan.*

Based on the anticipated buildout to existing facilities, all existing SWMFs are providing sufficient volumes based on intended design. However, it is noted that water quality protection levels differ across facilities. Opportunities to streamline protection levels should be made in design of future SWMFs and any retrofit considerations. Specific water quality opportunities are noted:

- Tremaine Avenue SWMF is designed as a normal level wet pond. The facility includes a dry upper portion used for quantity control (no permanent pool). Opportunity to potentially increase the permanent pool volume if required to support future development at a higher impervious level or additional development area.
- Salisbury Avenue South SWMF is designed as a normal level wetland facility. Opportunity to retrofit facility in future to a wetpond with deeper permanent pool volumes to support higher impervious level or increase from normal to enhanced treatment level.
- Rogers Road SWMF is an enhanced level wetland facility. Opportunity exists to retrofit to a wetpond facility and treat additional upstream catchment through increased water quality volume by deepening permanent pool volumes within existing facility footprint. Upstream catchment areas would require separate water quantity controls.
- Binning Street West SWMF has surplus permanent pool volume. Opportunities exist to lower the permanent pool level, and increase the quantity (active) storage capacity of the facility to support higher density development.
- NE SWMF 2 (Phase 1) is designed as a hybrid wetpond-wetland type facility with normal treatment level. Opportunity to retrofit facility from a hybrid wetpond-wetland to a wet pond with deeper permanent pools to increase water quality to enhance level.
- Opportunity to improve water quality components of existing wetland and hybrid wetpond-wetland facility systems through planting strategies through SWM retrofits, or at the time of maintenance clean outs.

6.2.4 Problems and Opportunities for Stormwater

6.2.4.1 Listowel

The general opportunities and constraints have been identified for Listowel and are illustrated in Figure 6.10.

Key Constraints:

- Several locations are subject to flooding due to “bath tub” topography and limited storm sewer capacity including: Binning Street east of Louise Avenue, Albert Street north of Main Street, Clayton Street immediately east of Tremaine Avenue S, McLaren Ave at Centennial Court, and the Winston Boulevard/Jackson Park area.
- Walton Ave between Mckenzie Steet E and south of the Maitland River has limited storm capacity.

- Limited major flow inlet capacity for the 100 year major flow storm sewer at Davidson Avenue to NE SWMF 2 (Phase 1), causing potential for local flooding.
- Lack of storm infrastructure along Inkerman Street between Elm and Maitland Ave.
- Limited storm capacity along Maitland Avenue N, from Elizabeth Street to the Maitland River Outlet.
- Limited drain capacity identified for the Shear Drain, the West Nichol Drain, the Gibson Drain, and the Harold Good Drain.

Key Opportunities:

- Several regional facilities have capacity to be retrofitted to service additional area for water quality and water quantity controls, including: Binning St SWMF, Tremaine Ave SWMF, Salisbury Avenue South SWMF, NE SWMF 2 (Phase 1), and Rogers Road SWMF.
- SWM servicing for future development lands can improve overall servicing.

6.2.4.2 Atwood

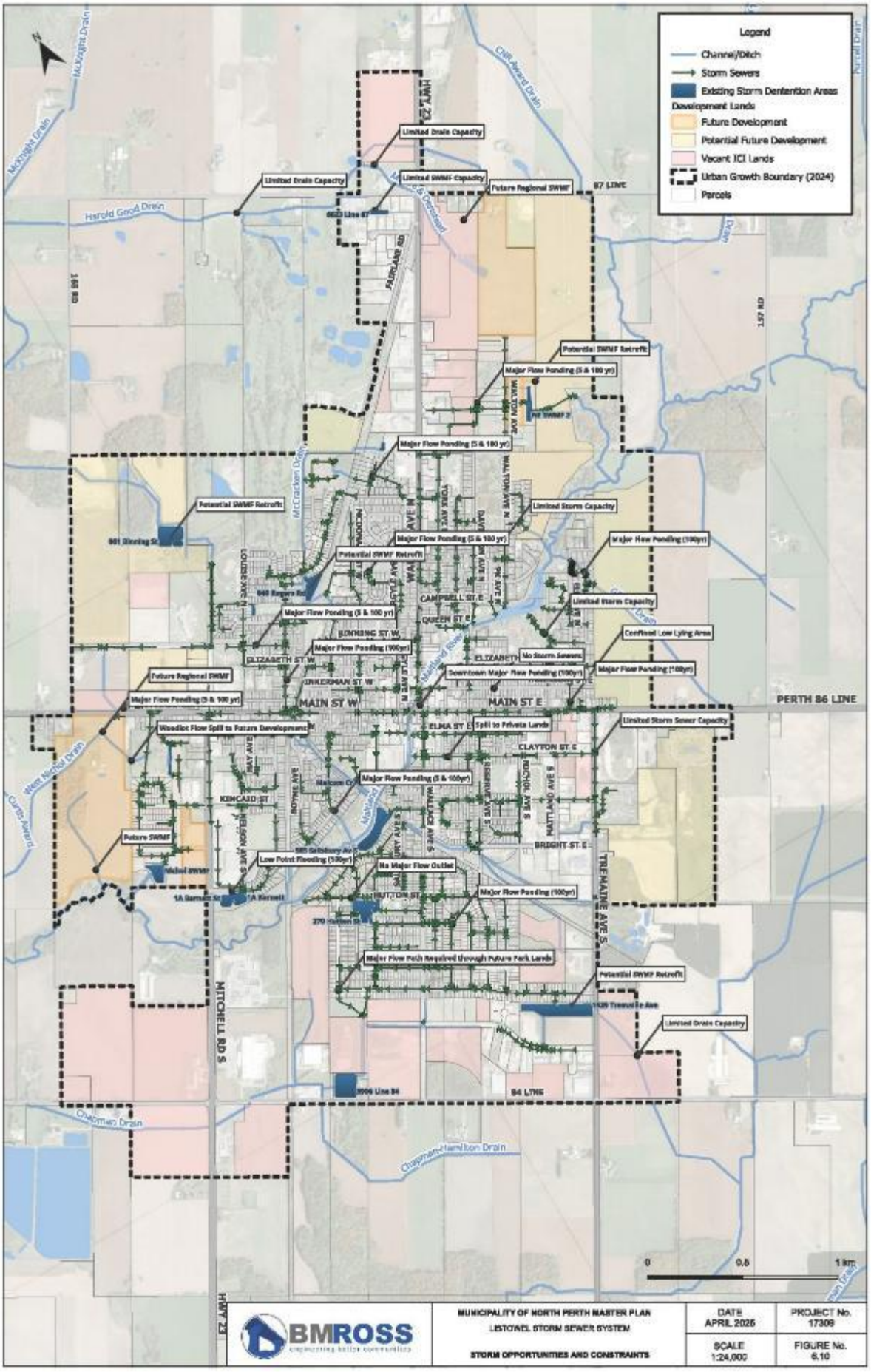
The following opportunities and constraints have been identified for Atwood and are illustrated in Figure 6.11.

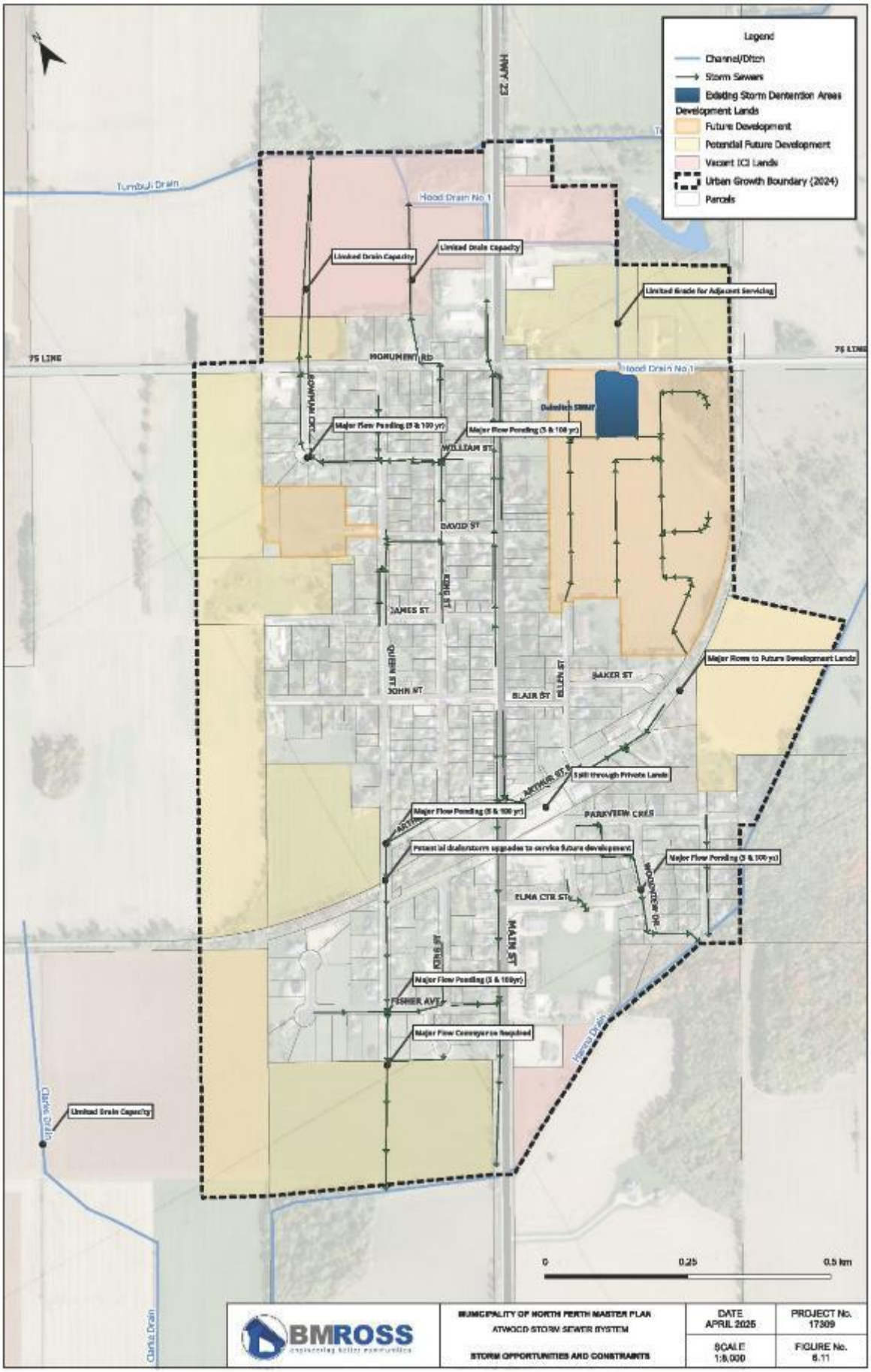
Key Constraints:

- Limited drain capacity identified in Queen Street Drain, Queen and King Relief Drain, and Clark Drain
- Several locations are subject to flooding due to “bath tub” topography and limited storm sewer capacity including: Queen Street, William Street, King Street, and Bowman Court area.
- Surface ponding has been indicated along southern portion of Queen Street and Fisher Avenue as well as Wood Drive.
- Limited servicing grade at north quadrant

Key Opportunities:

- SWM servicing for future development lands can improve overall servicing.


Legend
Channel/Ditch
Storm Sewers
Existing Storm Detention Areas
Development Lands
Future Development
Potential Future Development
Vacant ICI Lands
Urban Growth Boundary (2024)
Parcels
Limited Drain Capacity
Limited SWMF Capacity
Future Regional SWMF
Potential SWMF Retrofit
Major Flow Ponding (5 & 100 yr)
Limited Storm Capacity
Major Flow Ponding (100yr)
Confined Low Lying Area
No Storm Sewers
Downtown Major Flow Ponding (100yr)
Spill to Private Lands
Limited Storm Sewer Capacity
Major Flow Ponding (5 & 100yr)
Future SWMF
Low Point Flooding (100yr)
No Major Flow Outlet
Major Flow Path Required through Future Park Lands
MAIN ST W
MAIN ST E
PERTH 86 LINE
MITCHELL RD S
HWY 23
87 LINE
84 LINE
Harold Good Drain
McCracken Drain
Chapman-Hamilton Drain
0
0.5
1 km
BMROSS
MUNICIPALITY OF NORTH PERTH MASTER PLAN
LISTOWEL STORM SEWER SYSTEM
STORM OPPORTUNITIES AND CONSTRAINTS
DATE
APRIL 2025
PROJECT No.
17309
SCALE
1:24,000
FIGURE No.
6.10


Legend
Channel/Ditch
Storm Sewers
Existing Storm Detention Areas
Development Lands
Future Development
Potential Future Development
Vacant (C) Lands
Urban Growth Boundary (2024)
Parcels
HWY 23
Turnbull Drain
Hood Drain No 1
Limited Drain Capacity
Limited Drain Capacity
Limited Grade for Adjacent Servicing
7S LINE
MONUMENT Rd
BONHAM CRES
Major Flow Ponding (5 & 100 yr)
Major Flow Ponding (5 & 100 yr)
WILLIAM ST
DAVID ST
KING ST
JAMES ST
QUEEN ST
JOHN ST
BLAIR ST
ELLEN ST
BAKER ST
Major Flows to Future Development Lands
Still through Private Lands
ARTHUR ST
Major Flow Ponding (5 & 100 yr)
PARKVIEW CRES
Potential dealerstorm upgrades to service future development
Major Flow Ponding (5 & 100 yr)
ELMA CTR ST
MAIN ST
KING ST
Major Flow Ponding (5 & 100yr)
FISHER AVE
Major Flow Conveyance Required
Limited Drain Capacity
Clarks Drain
0
0.25
0.5 km
BMROSS
MUNICIPALITY OF NORTH PERTH MASTER PLAN
ATWOOD STORM SEWER SYSTEM
STORM OPPORTUNITIES AND CONSTRAINTS
DATE
APRIL 2025
PROJECT No.
17309
SCALE
1:8,000
FIGURE No.
6.11

6.3 Stormwater Alternatives

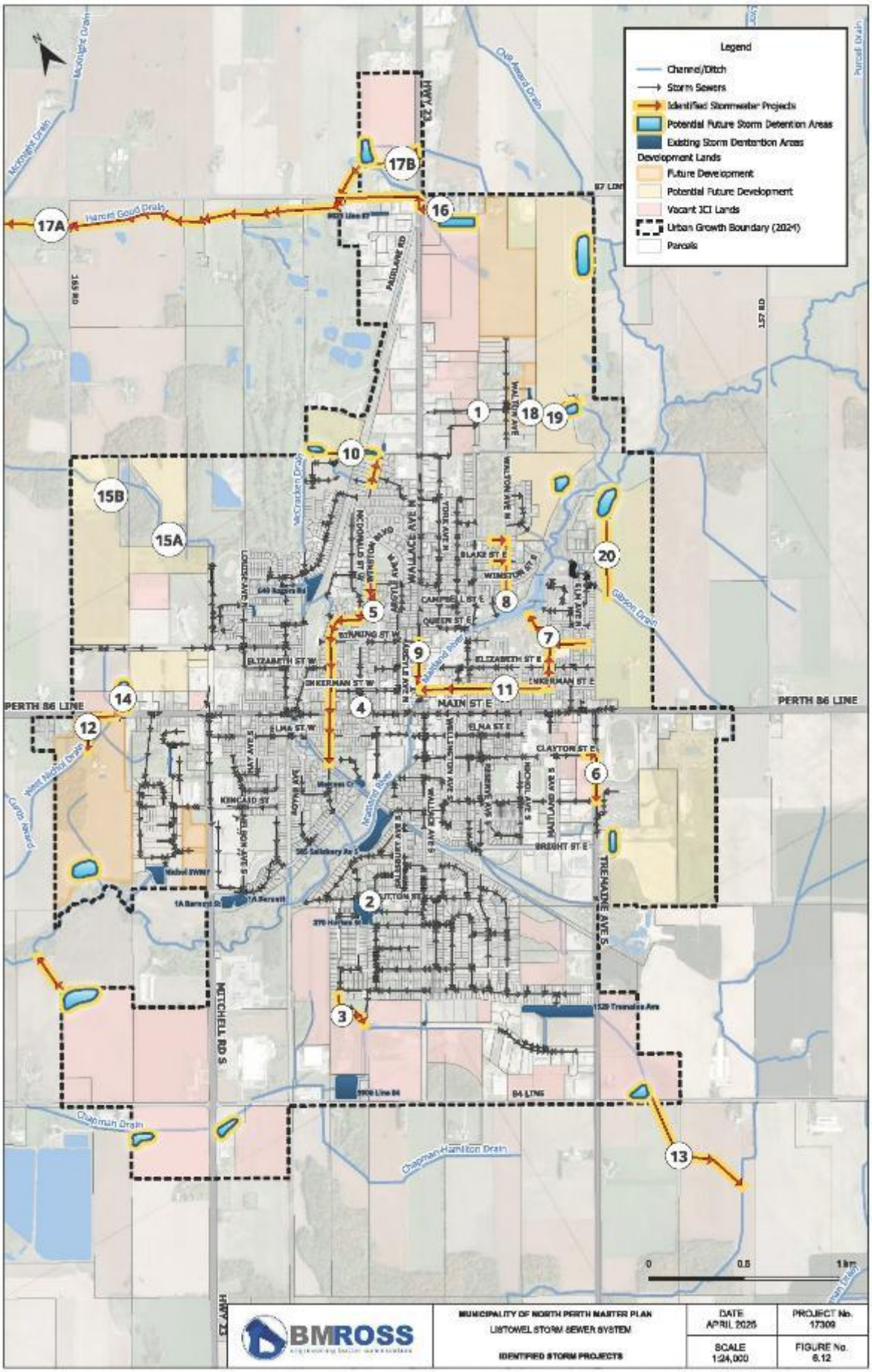
Based on the identified storm opportunities and constraints, several stormwater alternatives have been considered across the study area, including:

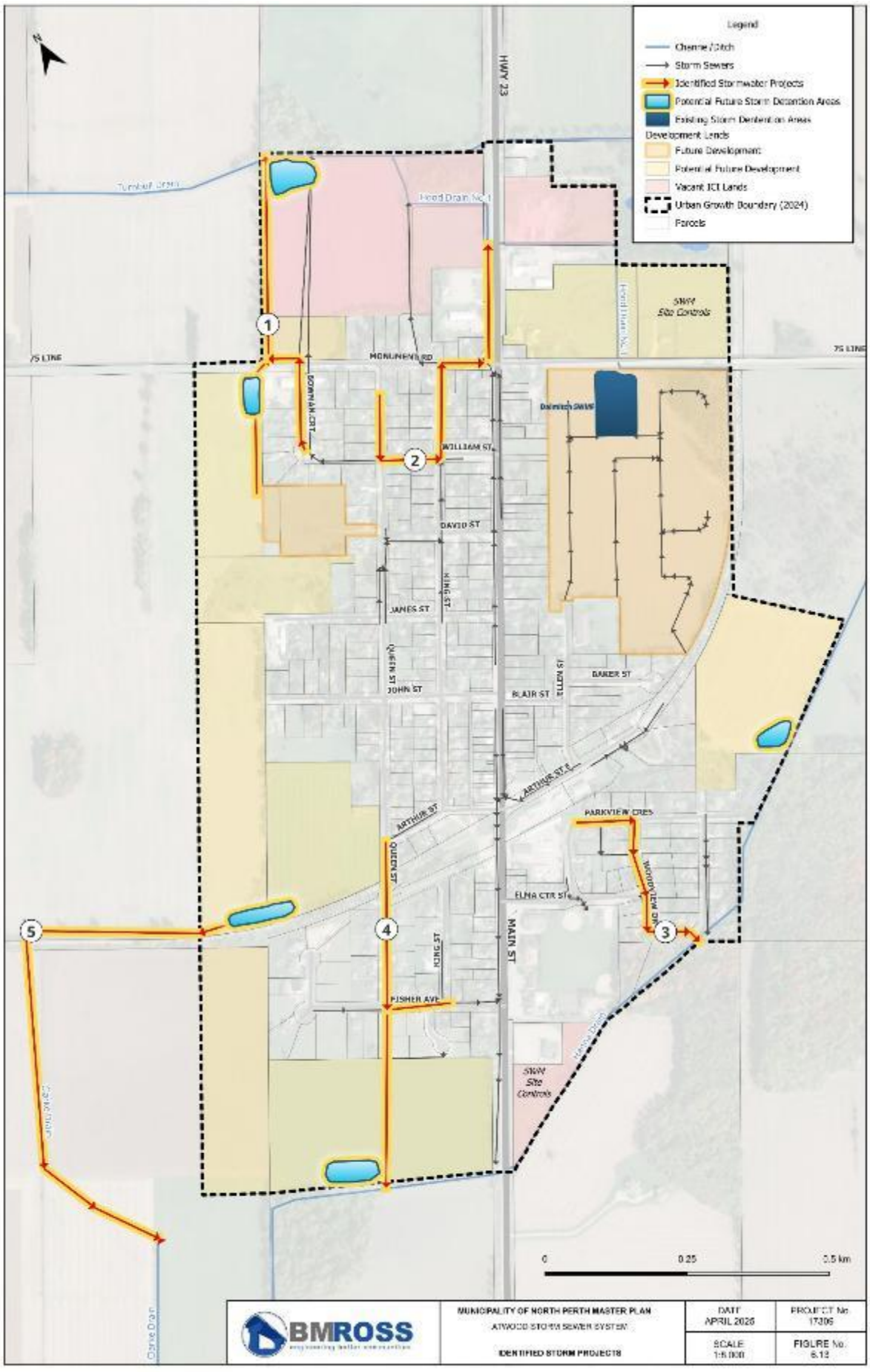
- Do nothing
- Storm sewer capacity increases to reduce flooding to acceptable limits
- Grading modifications within road ROW
- Grading modifications on private lands
- Off-line storage areas on public properties (parklands, etc.)
- On-site SWMF for private properties/future development lands
- Retrofit Existing SWMFs. Retrofit options may include increasing permanent pool volumes, enlargements and outlet changes.
- Super pipe storage
- Low impact developments (LIDs) and Best Management Practices (BMPs)
- Combination of the above

6.4 Storm Identified Projects

The Master Plan has established the following potential projects to reduce flooding and improve overall storm servicing and stormwater management for existing infrastructure and future development areas. Additional engineering investigations are recommended to confirm individual project scope. Flow monitoring may be conducted for key problem areas for model verification and calibration to heavy rain events.

Figure 6.12 and 6.13 identifies storm projects for Listowel and Atwood, respectively. Projects are noted as ‘L - #’ for Listowel projects, and ‘A - #’ for Atwood projects. Relative location of potential regional future SWMFs are indicated at a conceptual level. Several storm projects have been identified for the surrounding development lands and are dependant on timing of those developments. Future municipal drain realignments and improvements have been highlighted as a future servicing need that needs to be addressed as part of future development planning.


Legend
Channel/Ditch
Storm Sewers
Identified Stormwater Projects
Potential Future Storm Detention Areas
Existing Storm Detention Areas
Development Lands
Future Development
Potential Future Development
Vacant 3CI Lands
Urban Growth Boundary (2021)
Parcels
17A
17B
16
1
18
19
10
15B
15A
20
8
5
7
9
11
4
14
12
6
2
3
13
MAIN ST E
PERTH 86 LINE
MITCHELL RD S
ST ANN
0
0.5
1 km
BMROSS
MUNICIPALITY OF NORTH PERTH MASTER PLAN
LISTOWEL STORM SEWER SYSTEM
IDENTIFIED STORM PROJECTS
DATE
APRIL 2025
PROJECT No.
17309
SCALE
1:24,000
FIGURE No.
6.12


Legend
Channel / Ditch
Storm Sewers
Identified Stormwater Projects
Potential Future Storm Detention Areas
Existing Storm Detention Areas
Development Lands
Future Development
Potential Future Development
Vacant ICI Lands
Urban Growth Boundary (2024)
Parcels
HWY 23
Flood Drain No 1
SWM Site Controls
7S LINE
MONUMENT RD
BOWMAN CRT
WILLIAM ST
DAVID ST
JAMES ST
KING ST
QUEEN ST
JOHN ST
BLAIR ST
ELLEN ST
BAKER ST
ARTHUR ST E
ARTHUR ST
PARKVIEW CRES
WOODSIDE DR
ELMA CTR ST
MAIN ST
FISHER AVE
1
2
3
4
5
0
0.25
0.5 km
BMROSS
MUNICIPALITY OF NORTH PERTH MASTER PLAN
ATWOOD STORM SEWER SYSTEM
IDENTIFIED STORM PROJECTS
DATE
APRIL 2026
PROJECT No.
17309
SCALE
1:5,000
FIGURE No.
6.13

6.4.1 Listowel

The following projects have been identified for Listowel to address existing infrastructure needs and development related servicing. Refer to Figure 6.12 for locations.

6.4.1.1 Existing Infrastructure Needs

NE SWMF MJ Flow capture (L-1)

Model results indicate limited inlet capacity for the 100 year flow to enter the 100 year trunk storm system between Davidson Ave N and Walton Ave N, tributary to the NE SWMF 2 (Phase 1). High capacity inlets are recommended to be installed.

Hutton Street SWMF Relief/Spillway (L-2)

No major flow spillway into the Hutton Street facility exists, resulting in road surface ponding on Hutton Street. Recommend provision of a curb cut and spillway into the Hutton Street SWMF to reduce ponding on road during major events.

Hana Haven Subdivision (L-3)

Limited overland flow relief provided at east end of Krotz Street W. Recommend provision of major flow path when parklands are developed, to ensure flows are conveyed properly to the Line 84 Stormwater management facility.

Barber Street (L-4)

Limited capacity of existing storm sewers on Barbara Street causing surface ponding. Local storm sewer improvements recommended. At a conceptual level, 70m of 450mm storm sewer, connecting to Inkerman Street West outlet sewer.

Jackson Park Flood Relief/Victoria Ave Storm Trunk (L-5)

Flooding for the 5 year and 100 year event has been identified along Winston Boulevard in the vicinity of Jackson Park. This flooding area was confirmed with North Perth staff based on historical flooding complaints.

Currently drainage is tributary to the Albert Street trunk storm sewer. Flows are conveyed from the low point along Winston Boulevard east via a 600 mm storm sewer through private property discharging to the open channel immediately adjacent to the Roger SWMF. Flows are conveyed south by the Albert Street Trunk system and recent channel works to the Maitland River. The Albert Street Trunk system was recently reconstructed and was designed for the 5 year capacity, and downstream bridges for the 100 year.

Several conceptual solutions were investigated to address existing 5 year and 100 year flooding in the Jackson Park Area. Options considered included provision of storm storage within Jackson Park, upsized storm sewer/channel works truncating at the Albert Street Trunk sewer inlet at Edward Avenue North, potential expansion of Rogers SWMF, and a new trunk storm sewer system down Victoria Avenue (by-passing constraints along Albert Street trunk system).

A Victoria Avenue storm trunk system was determined to be the best option best option to elevate flooding in Jackson Park area and remove storm infrastructure crossing private lands. Additional storage in Jackson Park showed limited benefit to reducing trunk storm sizing, and is not anticipated to offset cost to provide storage in existing park lands. At a

conceptual level, the proposed Victoria Avenue Trunk sewer alignment could be provided along the following alignment:

- 230m of 1200mm storm sewer south along Winston Boulevard and Churchill Drive, to Cambell Street West. Use of the existing sanitary easement between Churchill Drive and Campbell Street W requires additional investigation.
- 70m of 1350mm storm sewer east along Campbell Street W to Barbara Avenue North
- 40m of 1350mm storm sewer south along Barbara Avenue North
- 110m of 1350mm storm sewer along Campbell Street W, from Barbara Avenue North to Victoria Avenue South
- 760m of 1350mm storm sewer along Victoria Avenue N, from Campbell Street to outlet location, south of Elma Street West.

The conceptual alignment of the Victoria Trunk sewer would also remove additional lands in the vicinity of Campbell Street and Tanner Court from discharging to the Albert Street Trunk system.

Tremaine Avenue Storm Upgrades/ Major Flow Conveyance (L-6)

Limited inlet capacity along Clayton Street is a cause for flooding at the confined low-lying area west of Tremaine Avenue South. Clayton Street East low point receives major flows from the north and east. Flooding can be mitigated by providing high catchbasin inlets along Clayton Street and Tremaine. To reduce sewer surcharging for the 5 year, storm upgrades would be required along Tremaine Avenue South from Clayton Street to Mowat Street. A major flow path through private lands to the south should be considered if infill development occurs between Clayton Street and Mowat Street. This recommendation is consistent with a major flow path requirement identified between Clayton and Mowat Street, as part of the previous No 1 Drain Class EA (*North Perth Drainage Project – Southeast section of Listowel Ward, by Gamsby and Mannerow Limited (Sept 2002)).*

Therefore to reduce potential for flooding, the following conceptual storm sewer upgrades are recommended:

- High inlet capacity catchbasins along Clayton Street low point and Tremaine Avenue South at Clayton Street
- 240m of 1650mm storm sewer on Tremaine Ave., from Clayton Street to Mowat Street.
- Major flow path to be provided as infill development occurs between Clayton Street and Mowat Street.

Maitland Ave/Palace Street Upgrades (L-7)

Recommended storm upgrades along Maitland Avenue North, from Inkerman Street North to the outlet at the Maitland River. At a conceptual level,

- 110m of 450mm storm sewer on Maitland Avenue N, from Inkerman Street to Elizabeth Street,

- 80m of 675mm storm sewer on Maitland Avenue N, from Elizabeth Street to 80 m north
- 290m of 750mm storm sewer on Maitland Avenue N, from 80 m north of Elizabeth to the outlet at the Maitland River.

Additional upgrades to storm sewer infrastructure along Palace Street East is also recommended.

- 70m of 375mm storm sewer on Palace Street, from Maple Avenue No to Elm Street North
- 110m of 450mm storm sewer on Palace Street, from Elm Street North to Maitland Avenue North.

Walton Ave N (L-8)

Limited storm sewer infrastructure exists along the Walton Street corridor. Road reconstruction and local storm sewer improvements are recommended. At a conceptual level,

- 370m of 600mm storm sewer along Walton Avenue is recommended between Mckenzie Street East and the outlet to the Maitland River south of Campbell Street East.
- Reconstruction of Winston Street E, Blake Street E and Mckenzie Street E should be considered for storm upgrades at the detailed design stage.

Wallace Ave N (L-9)

Storm upgrades are recommended for the Wallace Street storm trunk. At a conceptual level,

- 120m of 600mm storm sewer is recommended along Wallace Street, from Binning Street West to Elizabeth Street W, and
- 90m of 750mm storm sewer along Wallace from, Elizabeth Street West to the outlet with the Maitland River.

This work is recommended downstream of the recently reconstructed Binning Street West storm sewer work.

McLaren Ave (L-10)

The low point near the intersection of McLaren Avenue and Centennial Court has been identified as susceptible to 100 year flooding with limited major overland relief. The existing 525 mm outlet sewer from Mclaren Avenue Ave is also located along private property and discharges to the woodlot to the west, and is eventually picked up the by Gilmer Cresent storm sewer system. A potential future project has been identified to place storm infrastructure in a proper easement easement along future development lands to the north and to connect to the McCracken Drain for long-term maintenance and operation. At a conceptual level,

- a 900mm storm sewer approximately 270m long from the low point along McLaren Avenue at Centennial Court, north through future development lands to the

McCracken Drain has been sized to mitigate ponding levels up to the 100 year design storm.

Inkerman Street (L-11)

Inkerman Street corridor lacks stormwater infrastructure from Nichol Avenue North to Wellington Avenue. Introduction of storm sewers are recommended. At a conceptual level,

- 100m of 375mm storm sewer along Inkerman Street, from west of Nichol Street to Halstead Avenue North.
- 130m of 450mm storm sewer along Inkerman Street, from Halstead Avenue North to Davidson Avenue N.
- 120m of 600mm storm sewer along Inkerman Street, from Davidson Avenue North to 50m west of Wellington Avenue N.
- 130m of 900mm storm sewer along Inkerman Street, from Wellington Street to outlet with the Maitland River conduit at Wallace Avenue.

6.4.1.2 Development Servicing Needs

Development SWM servicing for lands surrounding Listowel has been reviewed, within the 2024 urban growth boundary. Refer to Figure 6.13.

Nichol Drain West Realignment and Residential Development South of Line 86 (L-12)

A future SWMF servicing the proposed residential development south of Line 86 (Tridon Development) is anticipated. Realignment the West Nichol Drain within future development lands south of Line 86 will be required. It is noted that the West Nichol Drain was recently upsized from a 300 mm drain to a 675 mm - 750 mm storm drain in 2018. It is acknowledged that a significant major flow ponding area is located within the future development areas immediately south of Line 86. It is recommended that the drain realignment consider existing condition flows from areas upstream of Line 86 tributary to the drain. Realignment of the tile drain and conveyance of existing conditions major flows for upstream areas will be required. Peak 5 year and 100 year flows from upstream areas are 0.63 m^3/s and 2.207 m^3/s respectively.

Shear Drain (L-13)

The Shear Drain has limited capacity to receive flows. Improvements to the Shear Drain are anticipated to support future industrial commercial development. Future drain upgrades must consider peak flows from Termaine Avenue SWMF and identify if changes are required to pond outlet structure. Major flow conveyance to be considered in design of any drain upgrade through future development lands.

Binning Street South Development Area SWMF (L-14)

The Binning Street South SWMF is required to service the proposed municipal development area generally bound by Binning Street to the north, Mitchell Street to the east, Line 86 to the south and 165th Road to the west. A conceptual design of the facility has been previously completed as part of the Binning Street Class EA, with a proposed

catchment area of 23 ha and composite impervious level of 40%. Refinement of SWMF sizing is required as future development is expected to include mix commercial and residential land use with an anticipated average impervious level of 65%. Sizing of the proposed SWMF is also dependent on the final design capacity of the Nichol Drain West realignment (L-11). If major flow conveyance is maintained through the future development lands to the south (Tridon Development), total SWM block sizing can be limited to approximately 0.7 ha. If no major flow conveyance is provided such that the proposed SWMF is required to overcontrol 100 year flows to approximately the 5 year flow drain capacity of 0.7 m^3/s, the total SWM block size will increase to 1.6 ha. The proposed facility is recommended to provide water quality control at an enhanced level (80% long-term suspended solids removal).

Binning Street North 1 SWMF Retrofits (L-15A)

Retrofits to Binning Street North SWMF are recommended to increase the capacity of the SWMF. The existing SWMF is designed to provide water quantity and enhanced water quality control for a 39.5 ha contributing area with an impervious level of 42%. The facility has been constructed but only a portion of the catchment has been developed to date for the Steve Kerr Memorial Complex and North Perth Westfield Elementary School. The remaining development area is anticipated to be a mix of institutional and residential use which an anticipated increase in the total catchment impervious of up to 65% to the facility. To accommodate anticipated increase in flood volume, retrofits are required. Opportunities within the existing facility exist to drop the permanent pool level to limit required increases in the SWMF footprint.

Retrofits are recommended to be investigated along with the recommended Binning Street North 2 SWMF.

It is recommended that the design of Binning Street North SWMF retrofits consider slightly overcontrolling flows such that lands north of the Seamon Drain Branch A do not require a SWMF for water quantity control. Additional site controls for water quality would be required for lands north Seamon Drain Branch A, and could be implemented through small site controls including LIDs or OGS units.

Binning Street North 2 SWMF (L-15B)

An additional SWMF is recommended for the future development area immediately adjacent to 165th Road, for a service area of approximately 7.5 ha. Due to grading constraints, the lands are not able to be directed to the existing Binning Street North 1 SWMF. A small SWMF is recommended to service potential mixed use of 65% impervious.

NE SWMF 1 (Phase 2) and Trunk Outlet to Harold Good Drain (L-16)

To support development in the northeast development area, a new regional SWMF is required.

A conceptual design has been completed for the NE SWMF 1 by GM Blue Plan (2023) as recommended in the NE Master Plan. The conceptual design of facility consists of a hybrid wetland facility providing normal water quality control, with discharge to a new 900 mm storm sewer trunk outlet from Highway 23 along Line 87 to the open portion of Harold Good Drain to the west.

It is recommended that water quality provided in the facility be increased from “normal level” to an “enhanced level” of protection providing 80% long-term S.S. removal for the facility. To achieved increased level of protection, the facility design could be implemented as a wetpond facility with deeper permanent pool volumes to provide additional water quality benefits. The outlet sewer is recommended to be upsized to approximately a 1050 mm storm sewer, providing capacity for the designed 100 year outflow for the SWMF. Servicing of adjacent Highway 23 and Line 87 for the 5 yr event should be considered in the sizing the final design of the proposed outlet storm sewer.

Improvements to the Harold Good Drain (L-17A) are required to support the proposed outlet. If constraints are identified in the detailed sizing of the Harold Good Drain, the proposed NE SWMF1 may be required to over control flows to ensure no increase in peak flows to the receiving system.

Harold Good Drain Improvements Phase 1 (L-17A)

Improvements to the Harold Good Drain are required to support future development of the NE Development Area, located generally west of Highway 23 and south of Line 87. The Harold Good Drain improvements have been identified in the preliminary design of the NE SWMF 1 completed by GM Blue Plan (2023). Drain upgrades have been identified to restore the municipal drain to the original trapezoidal cross-section with a bottom width of 1 m, side slope of 1.5:1 and average grade of 0.2% throughout.

At the detailed design, potential peak flow impacts of upstream development and floodplain considerations should be considered in the drain assessment. It is noted the total drainage area tributary to the Harold Good drain, at Line 86, is 178 ha. Typical limits for floodplain mapping by Ministry of Natural Resources’ (MNR’s) is 125 ha.

Harold Good Drain Improvements Phase 2 (L-17B)

Realignment of Harold Good Drain will be required to accommodate future development to the north of Line 87 and west of Hwy 23. Floodplain considerations may be required by MVCA in the drain realignment assessment.

NE SWMF 2 (Phase 1) Retrofit (L-18)

The service area for the NE SWMF 2 is anticipated to be expanded to service additional lands from the Makem Development, located north of the facility. The pond is currently designed to provide normal level of water quality.

Based on the anticipated full build-out catchment to the NE SWMF 2, overtopping of the emergency weir is anticipated for the 100 year event. Total storage volumes required to contain the 100 year flow to the design flow of 1.41 is estimated at 19,118 m^3. Total storage provided to the overflow weir and top of berm is 17,908 m^3 and 23,650 m^3 respectively.

Future work to be considered on pond may include raising the berm to retain higher volume of water and deepening permanent pool to achieve enhanced water quality treatment, inline with other recent SWMF facilities.

Mayberry Drain Realignment (L-19)

Realignment of Mayberry drain will be required to accommodate future development to the east. Any future drain realignment shall be designed to handle up to the 100 year flow

outflow from the NE SWMF 2. Major flow conveyance above the 100 year from the NE SWMF 2 is required.

Due to servicing grade constraints with the existing NE SWMF 2, an additional SWMF or SWM site controls will be required to service the southern portion of the future development area tributary to the Mayberry Drain.

Gibson Drain Realignment (L-20)

Realignment of the Gibson Drain will be required to accommodate future development along the east portion of the urban growth boundary, generally bound by Line 86 to the south and the Maitland River to the north. Under existing conditions, the Gibson Drain is conveyed through existing residential areas along Maple Avenue N and Elm Avenue North, prior to discharging to the Maitland River. The low point along Maple Avenue, immediately east of Elm Avenue has been identified as prone to flooding, and limited capacity existing in the drainage system.

Upon development of lands to the east, it is recommended that storm flows be directed north to a single regional SWMF, subject to site servicing and phases. Development lands will be required to convey upstream Gibson Drain rural flows.

Northeast (East of Walton Avenue)

A small residential development area, located east of Walton Avenue along the north side of Maitland River, is subject to potential future development. A single SWMF is anticipated to service this potential development, with no external areas.

Southeast Residential Area (No 1 Drain)

Residential area tributary to the No 1 Drain, generally east of Termaine Avenue will require a SWMF providing water quantity controls, with discharge to the Tremaine Avenue trunk storm sewer. Location of SWMF subject to subdivision phasing and servicing.

South Industrial Commercial Area

Several individual SWMFs will be required to service the industrial and commercial areas identified along Line 84, generally discharging to the Chapman Drain. SWMF locations are subject to site specific needs and servicing.

Servicing of the lands in the northwest corner of Mitchel Road S (Hwy 23) and Line 84 may be service directly to the Maitland River. An outlet may be obtained through the Drainage Act through private lands.

6.4.2 Atwood

Existing infrastructure needs and development servicing projects have been developed for Atwood as shown in Figure 6.13. Potential locations of future stormwater facilities in relation to development areas and infrastructure are shown.

6.4.2.1 Existing Infrastructure Needs

Projects to address existing infrastructure and urban flooding are summarized below. Some projects will also help address servicing of future development lands as noted.

Queen Street Drain/Bowman Court (A-1)

Upgrades are recommended to the Queen Street drain/Bowman Court storm drainage works. A new municipal drain alignment and extension is recommended to provide servicing to future development west of Bowman Court and alleviate flooding within the Bowman Court area. A future regional SWMF is recommended on the south side of Monument Road (Line 75), with discharge the new drain. Future residential and commercial/industrial development north of Monument Road should be considered in the location, design and capacity of drainage works. Design of the Bowman's Court storm sewer to be sized at the time of municipal drain works and development of adjacent lands. Major flow spills from Queen Street corridor are to be considered.

King Street/Willaim Street Storm (A-2)

Upgrades and realignment of King Street storm sewer (Queen-King Street Relief Drain) is recommended to alleviate potential flooding within the Queen Street, King Street, and William Street low lying areas, in combination with the Queen Street drain works, identified in A-1.

Both A-1 and A-3 projects will provide additional capacity and remove existing municipal drains from crossing the middle of future development lands to the north.

At a conceptual level the following is recommended,

- 120m of 300mm storm sewer along Queen Street, from south of Monument Road to David Street.
- 110m of 525mm storm sewer along William Street, from Queen Street to King Street
- 170m of 1050mm storm sewer along King Street, from William Street to Monument Road
- 100m of 1050mm storm sewer along Monument Road, from King Street to Main Street (Hwy 23).
- 200m of open channel along Main Street, from Monument Road north to Hood Drain No 1.

Wood Drive/Parkview Cresent Storm (A-3)

Storm sewer realignment and upgrades are recommended for Wood Drive and Parkview Cresent. Between Parkview Cresent and Wood Drive, the existing 300 mm storm sewer is located within private property. It is recommended to move infrastructure to the road allowances of Parkview Cresent and Wood Drive. It is also noted that Wood Drive receives drainage and spill from commercial areas along Arthur Street. Timing to be completed with other road improvement works.

At a conceptual level,

- 100m of 525mm storm sewer along Parkview Cresent, from 100 m west of Wood Drive to Wood Drive
- 50m of 525mm sewer along Wood Drive, from Parkview Cresent to 50 m south of Parkview Cresent.

- 60m of 600mm sewer along Wood Drive, from 50 m south of Parkview Cresent to Elma Centre Street
- 170m of 675mm seer along Wood Drive, from Elma Centre Street to outlet with Hana Drain south of Woodview Drive

Lone Oak (A-4)

Queen Street upgrades are required to mitigate existing capacity issues and improve servicing for future development. Servicing for future development is subject to development timing and sequencing. Refer to ***Southwest Atwood Servicing (north of Atwood Memorial Trail) (A-5A & A-5B)*** *as* discussed in the development servicing for Atwood Section 6.4.2.2.

At a conceptual level, if future development upstream of the rail trail discharges to the Loan Oak drain (Queen Street sewer), upgrades would be required. To allow a 5 year existing discharge rate for future development,

- 200m of 1200mm storm sewer on Queen Street, from Arthur Street to 200 m south of Arthur Street, and
- 400m of 1350mm on Queen Street, from 200 m south of Arthur Street to outlet location would be required.

If future development is diverted to the west via upgrades to the Clark Drain, subject to development sequencing and timing, upgrades are only required for existing capacity.

- 200m of 750mm Queen Street, from Arthur Street south to 200 m south.
- 90m of 825mm Queen Street, from 200 m south of Arthur Street to Fisher Ave.
- 310m of 900mm Queen Street from Fisher Ave to outlet at Hana Drain.

High capacity inlets are recommended at the low point of Queen and Fisher Street to capture flows and mitigate surface ponding.

6.4.2.2 Development Servicing

Development servicing for lands surrounding Atwood has been reviewed within the 2024 urban growth boundary, generally described below in the northwest, northeast, southeast and southwest quadrants. Refer to Figure 6.13.

Northwest Atwood Servicing

Two SWMFs are recommended servicing future residential and commercial/industrial development north and south of Monument Road. The proposed works A-1 and A-2 are recommended to replace the Queen Street Drain and Queen-King Street Relief Drain, and improve the servicing for the lands in the northwest corner of Atwood. Refer to A-1 and A-2 in Section 6.4.2.1 for more details.

Northeast Atwood Servicing (north of Monument Road)

In the northeast area of Atwood topographic relief is very limited. SWM servicing for future development will be subject to fill tolerances and likely require a combination of BMPs/LIDs and surface conveyance systems. Traditional storm sewers with and end-of-pipe controls is limited due to grade.

Southeast Atwood Servicing (south of Atwood Memorial Trail)

Future residential development south of the Atwood Memorial Trail and east of Arthur Street will require a SWM facility, adjacent to the Hana Drain. Future development to accommodate existing major flows from Arthur Street. Minor system flows. Location subject to potential development phasing.

Southwest Atwood Servicing (south of Atwood Memorial Trail)

A regional SWMF is recommended adjacent to the Hanna Drain to service future residential development. Major and minor flows from Arthur Street to be accommodated in future development servicing.

Future development of vacant ICI lands adjacent to Hanna Drain, along Main Street will require site controls.

Southwest Atwood Servicing (north of Atwood Memorial Trail) (A-5)

Servicing for lands north of the Atwood Memorial Trail were historically tributary to the Clark Drain, which was originally constructed in 1926, with a 250 mm (10 inch) tile and a 175 mm (7 inch) branch B up to Queen Street. In 1956, a 400 mm (16 inch) tile replaced the lower closed portion of the tile from the Clark Drain open channel to north of the old rail line, now the Atwood Memorial Trail. Over the history of the drain, numerous petitions have been made regarding concerns on lack of capacity and future development. Many petitions were incomplete or were unsuccessful due to anticipated costs. In 1998 a petition was made for the Lone Oak Drain, to service the Lone Oak Subdivision. A upsized drain consisting of a 600 mm storm drain from Arthur to Queen Street, and a lower 750 mm storm drain to Hanna Drain was approved and designed to take drainage from the north of the rail trail, historically tributary to the Clark Drain. Vacant lands allocated for future development, bounded between the Atwood Memorial Trail, Queen Street and John Street were given the right-of-drainage to the new Lone Oak Drain at Arthur and Queen Street. The 2000 Lone Oak Drain report states that flood flows would need to be detained or allowed to escape westerly.

Based on the current modeling results of the Lone Oak Drain under the Master Plan, capacity issues have been noted along the 600 mm and 750 mm drain for a 5 year event, as well as surface ponding. Upgrades to the Lone Oak Drain would be required not to only improve existing storm capacity but to properly service future lands.

It is acknowledged that the current OP boundary expansion on the west limit of Atwood is approximately 120 m in width, and would support a single road with residential lots on each side. The layout of the expansion does not align well with natural topography for placement of regional SWMFs. Therefore some flexibility is acknowledged on the layout of SWMFs for the west limit of Atwood pending development timing and sequence.

A regional SWM facility is recommended for servicing of new development lands north of the Memorial Trail, shown conceptually as A-5 on Figure 6.13.

The final location of the regional facility will depend on development phasing and could be located further west with discharge to an upgraded Clark Drain if development of the expansion lands proceeds first. This work would likely involve a drainage petition for upgrading the existing Clark Drain, for a suitable outlet. It is acknowledged that the entire Clark Drain would require replacement, as the upper reach is 1926 construction and

downstream of the trail is 1956. Location of the SWMF could also be placed across the property boundaries to allow for cost sharing and phasing, such that an interim pond could be constructed initially and expanded in future.

6.5 Storm Capital Costs

Capital costs for identified existing infrastructure need projects have been estimated at a conceptual level for planning purposes and are summarized in Table 6.8. Costs for development servicing projects, including identified municipal drain upgrades, are not included. Refer to Section 6.4 for detailed project descriptions. Location of projects are shown on Figure 6.12 and 6.13 for Listowel and Atwood respectively. Costs for storm water projects are based on 2024 reconstruction costs and assume full urban reconstructions (base course of asphalt). Cost saving could be incurred with coordination of water and sanitary replacements. Costs include 15% contingencies and 20% contingencies.

Table 6.8– SWM Project Costs – Existing Infrastructure Needs

ID	Storm Capital Project (Existing Infrastructure Needs)	Total Project Cost
Listowel		
L-1	**NE SWMF Major Flow Inlets** o *High Capacity Inlets*	$20,000
L-2	**Hutton Street SWMF Spillway** o *Boulevard spillway construction and restoration*	$14,000
L-4	**Barber Street Storm Replacement** o *70 m of 450 mm storm sewer, connecting to Inkerman Street West outlet sewer.*	$184,000
L-5	**Jackson Park Flood Relief/Victoria Ave Storm Trunk** o *230 m of 1200 mm storm sewer south along Winston Boulevard and Churchill Drive, to Cambell Street West. Use of the existing sanitary easement between Churchill Drive and Campbell Street W requires additional investigation.* o *70 m of 1350 mm storm sewer east along Campbell Street W to Barbara Street* o *40 m of 1350 mm storm sewer south along Barbara Street* o *110 m of 1350 mm storm sewer along Campbell Street W to Victoria Avenue South* o *760 m of 1350 mm storm sewer along Victoria Avenue N from Campbell Street to outlet location, south of Elma Street West.*	$5,324,000
L-6	**Tremaine Street Avenue Storm Upgrades/ Major Flow Conveyance** o *High inlet capacity inlets along Clayton Street low point and Termaine Avenue South at Clayton Street* o *240 m of 1650 mm storm sewer on Termaine Ave, from Clayton Street to Mowat St.*	$1,333,000
L-7	**Maitland Ave/Palace Street Upgrades** o *110 m of 450 mm storm sewer on Maitland Avenue N, from Inkerman Street to Elizabeth Street,* o *80 m of 675 mm storm sewer on Maitland Avenue N, from Elizabeth Street to 80 m north* o *290 m of 750 mm storm sewer on Maitland Avenue N, from 80 m north of Elizabeth to the outlet at the Maitland River.* o *70 m of 375 mm storm sewer on Palace Street, from Maple Avenue North to Elm Street North* o *110 m of 450 mm storm sewer on Palace Street, from Elm Street North to Maitland Avenue North.*	$1,924,000

ID	Storm Capital Project (Existing Infrastructure Needs)	Total Project Cost
L-8	**Walton Ave N Storm Replacement** o *370 m of 600 mm storm sewer along Walton Avenue* *****additional storm servicing recommended for Winston Street E, Blake Street and Mckenzie Street E	$1,077,000
L-9	**Wallace Avenue North Storm Replacement** o *120 m of 600 mm storm sewer is recommended along Wallace Street, from Binning Street West to Elizabeth Street W* o *90 m of 750 mm storm sewer along Wallace from, Elizabeth Street West to the outlet with the Maitland River.*	$630,000
L-10	**McLaren Ave Storm Realignment** o *900 mm storm sewer, 125 m long Road Restore* o *900 mm storm sewer 143 m long, boulevard Restore*	$477,000
L-11	**Inkerman Street Storm** o *100 m of 375 mm storm sewer along Inkerman Street, from west of Nichol Street to Halstead Avenue North.* o *130 m of 450 mm storm sewer along Inkerman Street, from Halstead Avenue North to Davidson Avenue North.* o *120 m of 600 mm storm sewer along Inkerman Street, from Davidson Avenue North to 50 m west of Wellington Avenue North.* o *130 m of 900 mm storm sewer along Inkerman Street, from Wellington Street to outlet with the Maitland River conduit at Wallace Avenue.*	$1,398,000
Atwood		
A-1	**Bowman Court (Queen Street Drain) Storm Upgrades** o *Bowman's Court storm sewer to be sized at the time of municipal drain works and development of adjacent lands.*	*Subject to Future Development and Municipal drain work*
A-2	**King Street Trunk Storm Upgrades and Realignment** o *120 m of 300 mm storm sewer along Queen Street, from south of Monument Road to David Street.* o *110 m of 525 mm storm sewer along William Street, from Queen Street to King Street* o *170 m of 1050 mm storm sewer along King Street, from William Street to Monument Road* o *100 m of 1050 mm storm sewer along Monument Road, from King Street to Main Street (Hwy 23).* o *200 m of open channel along Main Street, from Monument Road north to Hood Drain No 1.*	$1,650,000
A-3	**Wood Drive/Parkview Cresent Storm** o *100 m of 525 mm storm sewer along Parkview Cresent, from 100 m west of Wood Drive to Wood Drive* o *50 m of 525 mm sewer along Wood Drive, from Parkview Cresent to 50 m south of Parkview Cresent.* o *60 m of 600 mm sewer along Wood Drive, from 50 m south of Parkview Cresent to Elma Centre Street* o *170 m of 675 mm seer along Wood Drive, from Elma Centre Street to outlet with Hana Drain south of Woodview Drive*	$1,069,000
A-4	**Queen Street South (Loan Oak Drain) upgrades** **Existing and Future Development Servicing** o *200 m of 1200 mm storm sewer on Queen Street, from Arthur Street to 200 m south of Arthur Street, and* o *400 m of 1350 mm on Queen Street, from 200 m south of Arthur Street to outlet location would be required.* ***** Subject to development requirements and sequencing*** ***Existing Servicing Only***	$2,607,000 *(Existing & Development Servicing)* Or

ID	Storm Capital Project (Existing Infrastructure Needs)	Total Project Cost
	○ *200 m of 750 mm Queen Street, from Arthur Street south to 200 m south.* ○ *90 m of 825 mm Queen Street, from 200 m south of Arthur Street to Fisher Ave.* ○ *310 m of 900 mm Queen Street from Fisher Ave to outlet at Hana Drain.*	*(Existing Servicing only) $1,979,000*

Note:

3. *Refer to Figure 6.12 and 6.13 for proposed project locations. Projects noted as 'L-#' for Listowel projects, and 'A-#' for Atwood projects.*
4. *Total project costs assumed based on 2024 storm reconstruction costs, urban full reconstruction (base curse of asphalt), 15% Engineering and 20% Contingencies.*

6.6 Stormwater Management Design Criteria and Suggested Standards for Future Works

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 Municipality and the MVCA to review design criteria relative to the proposal and the current environmental conditions of the watershed.

A Stormwater Management Report setting out the existing and proposed drainage pattern shall be submitted to and approved by the Municipality, the MVCA 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, stormwater management requirements outlined within the "Design Criteria for Sanitary Sewers, Storm Sewers and Forcemains for Alterations Authorized under an Environmental Compliance Approval" (V.2.0 May 2023) and conditions outlined in Municipality of North Perth's Municipal Stormwater Management System Environmental Compliance Approval (CLI ECA) (ECA Number: 091-S701, Issue 1). General requirements are described in the following sections.

6.6.1 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 due to limited capacity of downstream receiving systems. IDF data from the Environment Canada Stratford WWTP IDF station should be applied. Additional IDF data may be applied as required by Perth County and MTO. The SCS Type II 6 hour distribution, as well as a suite of synthetic storms (100 year 6-hour Chicago, 100 year 12-hour AES, etc), should be applied to assess system performance. The most conservative results are to be used for the design basis for SWMF outlet design and storage requirements.

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 by the 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.

6.6.2 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.

Wet ponds are the most common end-of-pipe control in Ontario and are the least likely to be impacted by winter/spring ice conditions. The permanent pool for water quality is typically designed with deep water areas (1-2 m deep). Total depths of 3 m are typical.

Wetland and hybrid wetland facilities have lower volume requirements and are intended to be designed with portions of the facility with deep and shallow zones, complete with a planting plant to support bio. Wetland and hybrid wetland facilities are intended to operate at much shallower depths for permanent pool and active storage and are normally more land intensive than wet ponds (MECP, 2003). Maximum active storage depths of 1 m are recommended to support planting strategies.

For infill or retrofit sites, water quality controls may be provided by the use of oil-grit-separators (OGS) or Low Impact Development (LID) measures upon approval by the Municipality and the MVCA. The sizing of OGS units should limit cleanout requirements to once a year as feasible.

6.6.3 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.

6.6.4 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 100 year 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 grass 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 Municipality 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 Municipality, MVCA , 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 (MTO), respectively. MTO design standards and IDF values are to be considered for any projects along MTO corridors.
- 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.

6.6.5 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.

6.6.6 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 Municipality and MVCA prior to plan finalization.

6.6.7 Development Constraints for Hazard Land Areas

The OP and Zoning By-law identify hazard lands associated with the Maitland 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 'MVCA regulatory area' is restricted.

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.

6.6.8 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 Municipality.

LID measures located within municipal road ROWs or municipal property are to be owned and maintained by the Municipality. 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 clay loam and silty loam soil types. LIDs may be implemented in “tight soils” with adaptations such as underdrains and overflows with connections to downstream storm sewers/conveyance systems. Source Water Protection policies should be reviewed prior to implementation 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.

6.6.9 Climate Change and Resiliency

The impact of climate change should be considered in consultation with the Municipality and the MVCA. 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, the 100 year SCS Type II distribution, as well as a suite of synthetic storms (100 year 6-hour Chicago, 100 year 12-hour AES, etc), should be applied to assess system performance. IDF data from the Environment Canada Stratford WWTP IDF station should be applied. See Section 6.2.2.1. A minimum freeboard of 0.3 m should be provided in SWM facilities as a safety factor to the 100 year event and climate change resiliency.

6.6.10 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 Muncipality 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 for long-term replacement.

6.6.11 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.

6.6.12 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 Municipality 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 removal 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 Municipality for and considered for approval under the Municipal ECA CLI. 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.)

6.6.13 Municipal Drain Works

Many of the receiving outlets for proposed development areas 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 Municipality 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.

7.0 SERVICING ISSUES AND ALTERNATIVES

7.1 Summary of Servicing Issues

7.1.1 Water Supply

The existing major facilities for potable water supply include:

Listowel:

- Three groundwater well supplies with combined capacity of 9,819 m^3/day.

Atwood:

- Two groundwater well supplies with a combined capacity of 589 m^3/day.

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

Listowel:

- Approved development is expected to increase the maximum day demand to 4,831 m^3/day (3,850 + 981). Approved development plus potential development lands available within the expanded settlement boundary would increase demands to 7,091 m^3/day (4,831 + 2,260) which is approximately 72% of the current supply.
- At the highest projected growth rate, the existing water supply is projected to be fully committed by 2047. Therefore, there is no short-term issue identified with respect to the Listowel water supply.

Atwood:

- Approved development is expected to increase the maximum day demand to 275 m^3/day (180 + 95). Approved development plus potential development lands available within the expanded settlement boundary would increase demands to 878 m^3/day (275 + 603) which is approximately 149% of the current supply, exceeding the current supply capacity.
- At the highest projected growth rate, the existing water supply is projected to be fully committed after 2051. Therefore, even though potential development lands represent a sufficient number of ERUs to cause the existing water supply capacity

to be exceeded, the projected timeframe for that to occur is sufficiently far into the future that there is no short-term issue identified with respect to the Atwood water supply.

- The HLPs at the existing Danbrook reservoir are likely to require replacement with larger capacity units, prior to the need for an increase in the raw water supply.

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

To increase the supply in Atwood will likely involve adding an additional well to the supply system.

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

7.1.2.1 Listowel Water Storage

Treated water storage is provided in Listowel as follows:

- An elevated water tank in central Listowel with a capacity of 3,268 m^3.

The theoretical required storage is based on a formula in the MECP Design Guidelines for Drinking Water Systems. The Guidelines recommend storage be provided for peak flow equalization, fire flows and emergencies. The available water storage volume in Listowel is already less than the recommended volume for the current serviced population.

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 be initiated immediately to ensure that available storage matches the anticipated 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).

7.1.2.2 Atwood Water Storage

Water storage is provided in Atwood as follows:

- A two-cell reservoir for potable water in the south part of Atwood with a capacity of 125 m^3.
- Atwood has a non-potable fire protection reservoir with capacity of approximately 295 m^3 . This reservoir does not form part of the drinking water system.

Based on current rates of usage, there is not sufficient storage to accommodate development commitments or proposals, as the recommended volume for existing customers represents 95% of the combined available potable and non-potable water storage.

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 be initiated immediately to ensure that available storage matches the anticipated need. Within the study the following should be considered:

- Consideration of converting the existing non-potable fire protection reservoir to a potable storage facility.
- 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

There were no significant issues identified with the Listowel water distribution system. As development progresses, looping and sizing of watermain within development lands will need to be planned appropriately.

For Atwood, consideration should be given to extending the water distribution network along Main Street and Monument Drive to service additional growth and the remainder of the community, as well as improve looping of existing mains.

7.1.4 Wastewater Pumping and Treatment

The major facilities for wastewater pumping and treatment include:

Listowel:

Six SPSs, and the North Perth WWTP rated at:

- 9,030 m^3/day AADF.
- 25,500 m^3/day Peak Day Flow.

Atwood:

SPS #1 and SPS #2, which ultimately conveys sewage to the North Perth WWTP.

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

- It is noted that the Municipality is in the process of applying to have the WWTP re-rated from 9,030 to 12,000 m3/day.

- At the highest projected growth rate the AADF capacity of the WWTP will be adequate until approximately 2041, assuming that the Municipality is successful in rerating the facility.
- Potential residential developments that could be accommodated within the expanded urban settlement areas represent a potential 2,330 ERUs in Listowel and 656 ERUs in Atwood, for a total of 2,986 ERUs. With the current estimated uncommitted reserve of 495 ERU at the WWTP, and assuming a successful re-rating to accommodate an equivalent additional 2,628 ERUs, the combined total of 495 + 2,628 = 3,123 ERUs would be marginally sufficient for the additional areas noted.
- It is probable that the capacity of the Highway 23 SPS will have to be increased at some point in the future to accommodate projected growth, based on projected peak flows. According to annual reports available for the WWTP, no bypasses or abnormal discharge events occurred during recent years. Any increase to peak capacity of the SPS will need to consider at least: physical pump size and ability to fit in the existing station, electrical service constraints, forcemain velocity and pressure constraints, and WWTP peak flow capacity. In our opinion there is limited value in increasing the SPS peak capacity until the WWTP peak capacity can handle the increased flow.
- Flows to the Inkerman SPS should continue to be monitored, and if development noticeably causes peak flows to increase (e.g., say in the order of 50 L/s total), planning for a station capacity increase should commence.
- Flows to the Atwood SPS #1 should continue to be monitored, and if development noticeably causes peak flows to increase (e.g., say in the order of 25 L/s total), planning for a station capacity increase should commence.
- Flows to the Atwood SPS #2 should continue to be monitored, and if development noticeably causes peak flows to increase (e.g., say in the order of 45 L/s total), planning for a station capacity increase should commence.

7.1.5 Wastewater Collection

Listowel:

Table 5.6 and Figure 5.4 provide a summary of existing and potential future issues within the Listowel sanitary sewer collection system. Of 372 pipe sections in the system, eight are operating at 80% or greater of their capacity based on theoretical peak flow estimates. Five of these are at greater than 100%. After build-out of existing commitments and future growth within the expanded settlement area there will be 27 pipe sections at greater than 80% and 46 at greater than 100%.

Atwood:

Table 5.7 and Figure 5.5 provide a summary of existing and potential future issues within the Atwood sanitary sewer collection system. Of 105 pipe sections in the system, three are operating at 80% or greater of their theoretical capacity. One of these are at greater than 100%. After build-out of existing commitments and future growth within the

expanded settlement area there will be two pipe sections at greater than 80% and 11 at greater than 100%.

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.

7.1.6 Stormwater Management

Existing SWM constraints exist in both communities where existing infrastructure and topography result in localized flooding during extreme rainfall events.

Additional SWM facilities and conveyance infrastructure is required as Listowel and Atwood continue to experience growth. Historically SWM works were initiated using a piecemeal approach to serve individual developments. This approach was generally feasible in the past as new developments often resided adjacent to open watercourses. However higher densities anticipated with new growth is exceeding the capacity of many of these systems. 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 6.4 for a detailed list of problems and opportunities and servicing alternatives for subwatersheds in each community.

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 7.1, 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 Planning 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 7.1. What is presented is a preliminary list based on current information.

Table 7.1 – Preliminary Summary of Alternative Solutions

Service	Facility	Identified Issue	Timing	Alternative Solutions
Water Storage	New water storage facility required in Listowel	Need for additional capacity (See Section 4.1.5 and Figure 4.3)	Near future as current volume is less than recommended	• 1A - Reduce maximum day demand. • 1B – Modify the existing storage facilities • 1C – Construct additional storage To be evaluated through a Class EA
Water Storage	New or expanded water storage required in Atwood	Need for additional capacity (See Section 4.2.5 and Figure 4.4)	Near to intermediate future as current volume is only slightly greater than recommended	• 2A – Reduce maximum day demand • 2B – Modify the existing storage facilities • 2C – Construct additional storage To be evaluated through a Class EA
Water Distribution	Watermain Extension in Atwood	Need to service additional growth and the remainder of the community (See Section 4.2.8.4)	Generally in response to development. Trunk watermain in conjunction with storage.	• 3A – Extend watermain to service only development lands • 3B – Extend watermain to service developments and the remaining community
Wastewater Pumping	Hwy. 23 SPS Inkerman SPS SPS #1 & 2 (Atwood)	Need for increased capacity. Triggered by pace of growth. (See Section 5.4)	To coincide with increased flows to each facility associated with growth	• 4A - Reduce existing peak flows • 4B - Provide larger pumps in the SPS • 4C – Full SPS replacement
Wastewater Treatment	Listowel WWTP	Need for increase in rated capacity of the facility. A plant rerating is in progress. (See Section 5.3.4).	Near future for proposed re-rating. 2041 for a future capacity increase beyond the re-rating target of 12,000 m^3/day.	Increasing the rated capacity of an existing WWTP without physically expanding the facility is exempt from the formal Class EA process.

Service	Facility	Identified Issue	Timing	Alternative Solutions
Wastewater Collection	Listowel gravity sewers Atwood gravity sewers	Collection system improvements are required to address current issues and accommodate growth (See Section 5.6 (Listowel) and Section 5.7 (Atwood)).	Timing depends on further investigations and specific developments.	• 5A - Replace problem sewer sections with larger sewers • 5B – Monitor flows within affected sections to confirm pipe capacity • 5C – Divert flows • 5D – Reduce peak flows
Stormwater Management	Listowel and Atwood SWMFs and storm sewers	Need for improvements to SWM systems to minimize flooding in existing areas and to accommodate future development areas	Immediately within existing problem areas/ development-driven within growth areas	Section 6.4 outlines the alternative approaches which were examined in identified recommended approaches in both communities.

7.3 Preliminary Evaluation of Alternatives

7.3.1 Water Storage - Listowel

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

- Alternative 1A – Reduce Maximum Day water demands.
- Alternative 1B – Increase supply capacity.
- Alternative 1C – Construct additional storage facilities.

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

Alternative 1A – Demand Reduction

Opportunities for reducing maximum day demands are not considered to be feasible, given the rate of growth, existing development commitments, and already relatively low demand per ERU. This applies particularly to fire storage as capacity will need to increase proportional to population growth. Regardless, opportunities for demand reduction should be pursued where feasible.

Alternative 1B – Modify Existing Facilities

The existing storage facility in Listowel 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 1C – Construct Additional Storage

The exact nature of how additional storage would be provided is subject to more detailed design through a Schedule B Class Environmental Assessment. The following descriptions provide an outline of what will have to be considered.

Table 7.2 – Environmental Impacts Associated with the Water Storage Alternatives

Type of Impact	1A – Demand Reduction	1C – 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 decrease water consumption. -May limit future non-residential developments, depending on water usage needs -May limit future pop'n growth	-Will provide sufficient fire flow and emergency storage needs. -Will support continued growth and development -May require an archaeological assessment. - Aesthetic issues may need to be addressed when siting new facility.
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.
Economic	-Lower capital cost than 1C. -Would need to invest in water usage reduction and education program. -May result in 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.

7.3.2 Water Storage - Atwood

There is a long term need to increase treated water storage capacity in Atwood. 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 through a Schedule B Class EA. The following opinions are based on current information.

Alternative 2A – Demand Reduction

Opportunities for reducing maximum day demands are not considered to be feasible, given the rate of growth and existing development commitments. This applies particularly to fire storage as capacity will need to increase proportional to population growth. Regardless, opportunities for demand reduction should be pursued where feasible.

Alternative 2B – Modify Existing Facilities

The existing treated water storage facility in Atwood is a ground-level reservoir. There is also a non-potable fire storage reservoir, which could potentially be converted to a potable storage facility.

Alternative 2C – Construct Additional Storage

The exact nature of how additional storage would be provided is subject to more detailed design through 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	2B – Modify Existing Facilities	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. - Reservoir site has sufficient space to accommodate expansion.	-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. - Aesthetic issues may need to be addressed when siting the new facility.	-Will provide sufficient fire flow and emergency storage needs. -Will support continued growth and development -May require an archaeological assessment. - Aesthetic issues may need to be addressed when siting the new facility.
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.	-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	2B – Modify Existing Facilities	2C – Construct Additional Facilities
Economic	-Lower capital cost than Alternative 1C, 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.	- More costly than Alternative 1A but less expensive than 1C. - Will allow for continued growth and development in the community. - Costs may be recovered from future development through development charges.	- 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 Water Distribution - Atwood

There is a long term need to extend the water distribution system in Atwood to service future development lands and the remainder of the community. The identified alternative approaches to address this issue are:

- Alternative 3A – Extend watermains to Service future growth lands only.
- Alternative 3B – Extend watermains to Service future growth and the remainder of the community.

Alternative 3A – Extend Watermains to Service Growth Only

Watermains would be extended on Main Street and Monument Road to service anticipated growth areas in the community. Timing of construction would be coordinated with proposed developments and other infrastructure upgrades needed for the affected road sections.

Alternative 3B – Extend Watermains to Service Growth and the Community

Watermains would be extended on Main Street and Monument Road to service anticipated growth areas and the remainder of the community. Timing of construction would be coordinated with proposed developments and other infrastructure upgrades needed for the affected road sections.

Table 7.4 – Environmental Impacts Associated with the Water Storage Alternatives

Type of Impact	3A – Service Growth Only	3B – Service Growth and Community
Technical	-Watermains would be sized to service full build-out of development lands. -Would improve distribution system by looping the mains and removing dead-ends.	--Watermains would be sized to service full build-out of development lands and existing community. -Would improve distribution system by looping the mains and removing dead-ends.
Socio-cultural	-Would support additional growth in the community. -Would not provide municipal water supply to the existing community.	- Would support additional growth in the community. -Would provide municipal water supply to the existing community. - Would require residents to connect to the new municipal water supply.
Natural Environment	-No impacts anticipated.	-No Impacts anticipated.
Economic	-Lower capital cost than 1B. - Costs may be recovered from future development through development charges.. -Watermain construction could be coordinated with other infrastructure upgrades (road/sanitary/storm).	- More expensive Alternative. - Costs may be recovered from future development through development charges. - Watermain construction could be coordinated with other infrastructure upgrades (road/sanitary/storm).

7.3.4 Wastewater Pumping – Hwy. 23 SPS & Inkerman SPS, SPS #1 & #2 (Atwood)

Four SPSs were projected to have future peak flows in excess of current rated capacities. Such stations may require capacity increases in order to facilitate development within their respective catchment areas, or otherwise peak flows would have to be maintained at or below station capacity by way of peak flow reduction.

- **Alternative 4A** – Reduce existing peak flows.
- **Alternative 4B** – Provide larger pumps and associated upgrades

Alternative 4A – Reduce Existing Peak Flows

Listowel

Although existing peak flows at the Hwy. 23 SPS are estimated to be greater than the rated SPS capacity, these values are based on theoretical peaking factors and are conservative. According to annual WWTP reports available and information from the Municipality, bypassing of the station occurred in the spring of 2025, though no bypasses or abnormal discharge events occurred from 2021 and 2024.

To actually reduce peak flows arriving at the Hwy. 23 or Inkerman SPS would first 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 in Listowel would be in the order of $100,000 to $150,000. The investigations can proceed incrementally over several budget years.

The actual cost of reducing I-I, once locations are known, will vary based on the contributing issue. Based on experience in other communities, meaningful reducing in peak flows through I-I reduction may be difficult to achieve without significant capital investment in sewer repair and replacement.

Atwood

Similar to Listowel, recent growth in the community associated with the Dallmitch development in the northeast, would suggest that sanitary flows are unlikely to decrease. In addition, the expanded settlement boundary provides the possibility of significant growth in the community. Meaningful I-I reduction, to the point of allowing SPS capacity increases to be avoided, may be difficult.

Alternative 4B – Increase Pumping Capacity

Larger pumps can typically be placed in existing pumping stations, though are spatial and electrical constraints that will affect how large of a capacity increase can be warranted without other major station upgrades. 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 SPSs associated forcemains.

Tentatively, we expect the following upgrades would be required at the Hwy. 23 SPS. Similar upgrades would be required at the other SPS.

- Replacement of the existing sewage pumps with larger units.
- Replacement of the existing generator set to accommodate the larger pumps.
- Modification or replacement of the existing electrical systems (MCC).
- Increases in the station piping and forcemain capacity would be evaluated based on pump sizing.

The evaluation of the environmental impacts associated with the options being considered is summarized in Table 7.5:

Table 7.5 – Environmental Impacts Associated with the Wastewater Pumping Alternatives

Type of Impact	4A – Reduce Peak Flows	4B – 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 increased 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 growth.	-Will provide sufficient pumping capacity to support growth.
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 development.	- Will allow for continued growth and development in the community. -Costs may be recovered from future development through development charges

7.3.5 Wastewater Collection – Listowel and Atwood

Modeling of the Listowel wastewater collection system determined that there are several sewer segments that are currently theoretically over-committed in terms of capacity for existing system conditions. With further development, the number of sewer segments with constrained capacity increases. The identified alternative approaches to address this issue are:

- Alternative 5A - Replace problem sewer sections with larger sewers
- Alternative 5B – Monitor flows within affected sections to confirm pipe capacity
- Alternative 5C – Divert flows
- Alternative 5D – Reduce peak flows

Alternative 5A – Replace problem sewer sections with larger sewers

Where sanitary flows are known to exceed the capacity of a given section of sanitary piping, replacement with a larger capacity sewer could occur. Ideally the works would be coordinated with other infrastructure improvements (road/water/storm) and be sized to meet full build-out of the new settlement area boundary.

Alternative 5B – Monitor flows within affected sections to confirm pipe capacity

For sanitary piping where 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 to either confirm or disprove capacity issues.

Alternative 5C – Divert Flows

Where sanitary flows associated with future growth are expected to exceed the capacity of a given section of sanitary piping, consideration should be given to diverting flows to either a lesser utilized sewer that could accommodate the additional capacity or to a different sewer catchment area that can support the additional flows. Consideration would need to be given to SPS capacity and downstream capacity, as well as whether the topographical setting would allow for gravity flow to more than one outlet. The evaluation of the environmental impacts associated with the options being considered is summarized in Table 7.6:

Alternative 5D – Reduce Peak Flows

As noted previously, modeling of the Listowel and Atwood wastewater collection systems determined that there are several sewer segments that are currently theoretically over-committed in terms of capacity for existing system conditions. With further development, the number of sewer segments with constrained capacity increases. To reduce peak flows within the collection system would first require an infiltration and inflow (I-I) investigation of the collection system, given that peaks are anticipated to result from I-I rather than typical customer use generating true sewage. The typical approach is to undertake some combination of an investigation of existing flows by installing temporary flow meters within the collection system, and conducting a physical examination of MHs. Sewer sections suspected of problems can then be examined by CCTV. Actual reduction of peak flows due to I-I would then require physical repair or replacement of identified issues, which can be relatively costly depending on how widespread the issues are.

Table 7.6 – Environmental Impacts Associated with Wastewater Collection Alternatives

Type of Impact	5A – Replace Sewers	5B – Monitor Flows	5C – Divert Flows	5D – Reduce Peak Flows
Technical	-Need to ensure that new sanitary piping is sized to accommodate full build-out of the new settlement boundary -Downstream sewer segments need to be assessed to ensure sufficient capacity.	-Will determine actual, not theoretical, pipe flows -Will help determine required capacity for future replacements.	-May help to utilize under-capacity sewer sections. -May negatively impact other sections of the collection system, including SPS capacity.	- May identify significant I & I issues within the collection system. -Could be completed in conjunction with flow monitoring.
Socio-cultural	-Would require road reconstruction and temporary impacts to sanitary servicing during completion of the work.	- No impacts anticipated.	-No impacts anticipated.	- No impacts anticipated.
Natural Environment	-No impacts anticipated.	-No impacts anticipated.	-Impacts will depend on the location of the diversion piping. -No significant impacts are anticipated if work occurs within existing right of ways.	-No impacts anticipated.

Type of Impact	5A – Replace Sewers	5B – Monitor Flows	5C – Divert Flows	5D – Reduce Peak Flows
Economic	-Most expensive option. -Work should be coordinated with other infrastructure needs (road/water/storm) to minimize economic impacts. - Costs may be recovered from future development through development charges.	- Least expensive option initially. - Would delay timing of sewer work to allow better coordination with other infrastructure needs.	- Anticipated costs for diversion would need to be compared against costs of replacing the initial sewer section. - May result in unanticipated costs of diversion negatively impacts other sections of the sanitary collection system.	- Less expensive option initially for identification, but potentially costly to remediate. - Could delay timing of sewer work to allow better coordination with other infrastructure needs.

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 Storage - Listowel

In Section 4.1.5 it was identified that the existing storage volume is slightly below the recommended value to accommodate existing customers. Additional storage is recommended to service committed developments as well as future potential developments, preferably in the north end of the community. The existing storage facility cannot be expanded. A Schedule B Class EA process should be initiated immediately to ensure that sufficient storage is available to accommodate anticipated growth.

7.4.2 Water Storage - Atwood

In Section 4.2.5 it was identified that the existing combined potable and non-potable storage volume is 95% fully utilized. Additional storage is recommended to service committed developments as well as future potential developments, preferably in the north end of the community. The existing storage facility can potentially be expanded, however the current location may not be the most effective site to accommodate expected growth, which primarily is occurring in the northeast part of Atwood. A Schedule B Class EA process should be initiated immediately to ensure that sufficient storage is available to accommodate anticipated growth.

7.4.3 Water Distribution – Atwood

Section 4.2.8.4 recommends extending watermains along Main Street and Monument Road to service new developments and connect the remaining population to the Atwood DWS. This will add additional security to the DWS.

7.4.4 Wastewater Pumping – Hwy. 23/Inkerman/SPS #1 (Atwood)

Continued growth will drive the need to increase the capacity of several SPSs serving both Listowel and Atwood. The preferred approach is to continue to monitor flows within each station on an annual basis and then carry out station upgrades to increase capacity when existing flows exceed the identified threshold.

7.4.5 Wastewater Collection – Listowel and Atwood

Flow monitoring is recommended within existing areas of the community where modeling has indicated that the theoretical capacity of the gravity collection system has been exceeded. In future growth areas, pipe replacement may be warranted but should be coordinated with other infrastructure needs.

7.4.6 Stormwater Management

Section 6.4 of the Master Plan outlines recommended approaches for SWM infrastructure in both communities.

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 7.7– Summary of Preliminary Preferred Solutions

Service	Facility	Identified Issue	Timing	Preferred Solutions	Relative Priority	Class EA Schedule
Water Storage	Listowel elevated tank.	Need for additional storage in long-term	Class EA to be complete 2026	Construct additional storage facility. Requires Class EA which should begin immediately.	High	B
Water Storage	Atwood Potable & Non-Potable Reservoirs	Need for additional storage in long-term	Class EA to be complete 2026	Construct additional storage facility. Requires Class EA which should begin immediately.	High	B
Water Distribution	Atwood DWS	Need for additional watermain distribution	Coincident with community growth or other infrastructure needs	Extend watermain to service anticipated growth and the remainder of the community	Medium	Exempt
Wastewater Pumping	Hwy. 23/Inkerman/SPS #1 (Atwood)	Need for increased pumping capacity	Coincident with community growth	Monitor flows at each station and replace existing sewage pumps and related works.	Medium	Exempt
Wastewater Treatment	Listowel WWTP	Increase existing rated capacity	Is currently in progress.	Increase rated capacity of the Listowel WWTP.	High	Exempt
Wastewater Collection	Sanitary Sewer System	Improvements are required to accommodate development	Varies	Flow monitoring is recommended within existing developed portions of the community. Potential replacement is recommended within growth areas, coordinated with other infrastructure needs.	Medium	Exempt
Stormwater Management	Listowel SWMFs and storm sewers	Address problem areas and plan for growth	Immediately for problem areas/ Development driven	Refer to Section 6.4.1 for specific SWM recommendations	High/Low	TBD
Stormwater Management	Atwood SWMFs and storm sewers	Address problem areas and plan for growth	Immediately for problem areas/ Development driven	Refer to Section 6.4.2 for specific SWM recommendations	Medium/Low	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 July 29, 2021 and August 5th editions of the Listowel Banner. The Notice was also placed on the municipal website (http://www.northperth.ca). The notice was also directly mailed to local stakeholders who might have an interest in the Master Plan process. A copy of the Notice is included in Appendix G.

8.3 Stakeholder Consultation

At the outlet of the Master Plan, a stakeholder list of local developers working in Listowel and Atwood 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.

Two comments were received from project stakeholders in response to the Notice. The comments received and responses are summarized in Table 8.1.

Table 8.1 – Initial Public Comments Received

Resident	Comment	Response
Local Developer PK Custom Homes Inc. July 30, 2021 Via E-Mail	• Asked to continue to be circulated information related to the project.	• Will add to project circulation list.
Listowel Resident August 17, 2021 Via Phone	• Owns land in Listowel • Too old to develop it himself. Will probably sell. • Wants to stay informed and asked for presentation material to be sent to his mailing address.	• Information noted and filed.

8.4 Review Agency Consultation

Input into the study process was solicited from 9 review agencies by way of direct mail or email 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 July 29, 2021 and agencies were requested to forward comments on the project by September 1, 2021. A copy of the letter and a list of the agencies circulated is included in Appendix G. Table 8.2 includes a summary of the feedback received from review agencies as a result of the initial notification.

Table 8.2 – Review Agency Comments Received

Agency	Comments	Response
Patrick Huber-Kidby, MVCA August 3, 2021 Via E-Mail	• Thanks for the notification. • Advised of improvements to the Hood Municipal Drain in Atwood proposed/required by subdivision NP 18-03 (Dallmitch Holdings Ltd). • Offered to provide information MVCA might have to aid the study (typically hazard mapping and perhaps some smaller localized floodplain assessments). • Asked to be appraised of progress.	• Information noted and filed.
Mary Lynn MacDonald, Risk Management Official, DWSP August 4, 2021 Via E-Mail	• Asked about the timeline for the Master Plan. • Thought that North Perth might be planning for a new well in Listowel.	• Indicated that the MP process would take 10 months to a year to complete. • Said that if a new well was recommended, we would let SWP know well in advance.
Mark Badali, MECP August 9, 2021 Via E-Mail	• Received Notice of MP Initiation • Asked if the intention was to follow Approach 1 or 2 for the MP. • Advised on Aboriginal communities that should be contacted in conjunction with the Master Plan. • Provided additional information related to Species at Risk Screening.	• Said that it would likely be approach 1 but it may depend on what projects are recommended. • Will confirm as the process proceeds.
Ian Thornton, MNR Guelph August 12, 2021 Via E-mail	• Advised that the MNR contact had changed for the district. • Suggested we contact Karina Cerniavskaja and provided her email.	• Contact list updated to reflect the change.

Agency	Comments	Response
Karina Ceriavskaja, NDMNRF August 25, 2021 Via E-Mail	• Acknowledge receipt of the Notice • Provided a Natural Heritage and Species at Risk Guide to help with the identification of sensitive features. • Provided links to assist with finding Petroleum Wells & Oil, Gas and Salt Resource • Provided details related to the Public Lands Act & Lakes and Rivers Improvement Act.	• Information noted and filed.
Joseph Harvey, Ministry of Heritage Sport, Tourism & Culture Industries August 30, 2021 Via E-Mail	• Understands that the MP is a long range plan that is evaluating water, sanitary and stormwater infrastructure in Listowel and Atwood. • Suggests that the Master Plan include an evaluation of cultural features, including archaeological resources, built heritage resources, and cultural heritage landscapes. • Check-lists provided to help screen for potential features.	• Information noted and filed.

8.4.1 Project Update Letter

In conjunction with the Public Open House, an update letter was compiled for Review Agencies which summarized the progress completed to date and offered to forward the presentation material from the meeting. The information was forwarded to the 9 review agencies that were initially contacted in regards to the MP on November 13, 2023. A summary of feedback received from agencies as a result of the Update Letter is included in Table 8.3.

Table 8.3 – Summary of Agency Comments

Review Agency	Comments	Action Taken
Matthew Shakespeare Regional Lands Intern, MNRF November 14, 2023 Via E-Mail	• Acknowledge receipt of letter. • Provided Natural Heritage and Species at Risk information. • Provided links to assist with finding Petroleum Wells & Oil, Gas and Salt Resource - Provided details related to the Public Lands Act & Lakes and Rivers Improvement Act.	- Information noted and filed.

Review Agency	Comments	Action Taken
Joseph Harvey, Ministry of Citizenship and Multiculturalism December 22, 2023 Via E-Mail	• Thanks for providing the Notice. • Asked us to provide the Project Information Form (PIF) number associated with archaeological assessments completed. • Asked if the project had been screened for potential impacts to cultural heritage resources.	- Information noted and filed.

8.5 Aboriginal Consultation

8.5.1 Aboriginal Consultation Process

The Crown has a duty to consult with First Nation and Métis communities if there is a potential to impact on Aboriginal or treaty rights. This requirement is delegated to project proponents as part of the Class EA process, therefore the project proponent has a responsibility to conduct adequate and thorough consultation with Aboriginal communities as part of the Class EA consultation process. The project study area is located within the Thames River watershed, therefore Aboriginal communities living within the watershed were contacted as well as those situated within a general proximity to the study area.

8.5.2 Background Review

In order to identify Aboriginal communities potentially impacted by the project the Aboriginal and Treaty Rights Information System (ATRIS) was consulted. A search was conducted for Aboriginal communities, including their traditional territories, within a 50 km radius of the project study area. Utilizing this process, several communities and organizations were identified as follows:

- Munsee-Delaware Nation
- Oneida Nation of the Thames
- Aamjiwnaang First Nation
- Métis Nation of Ontario
- Bkejwanong Territory
- Six Nations of the Grand River
- Chippewas of the Thames First Nation
- Chippewas of Kettle and Stony Point First Nation
- Chippewas of Nawash Unceded First Nation
- Chippewas of Saugeen First Nation
- Haudenosaunee Confederacy Chiefs' Council
- Saugeen Ojibway Nation (SON)

Correspondence was subsequently forwarded to each community/organization detailing the Master Plan process and seeking their input. Table 8.4 summarizes the results of the initial consultation phase. Copies of all correspondence is included within Appendix G.

Table 8.4 – First Nation and Métis Consultation

First Nation or Métis Contact	Comments	Response
Chippewas of the Thames First Nation August 24, 2021 Via E-Mail	– Project is located within the McKee Treaty Area and the Big Bear Creek Additions to Reserve land selection area. – Advised that they have minimal concerns with the project at this time. – Suggested we consult with FN communities in closer proximity to North Perth.	– Information noted and filed.
Emily Martin Saugeen Ojibway Nation (SON)	– At this point, the Saugeen Ojibway Nation's Environment Office does not have the resources to engage in consultation on this project. – We have no further comments on this project. If at any point anything of archeological significance is revealed on site, please contact the SON Environment Office immediately.	– Information noted and filed.

8.5.3 Project Update Letter

In conjunction with the Public Open House, an update letter was compiled for Indigenous Communities which summarized the progress completed to date and offered to forward the presentation material from the meeting. The information was forwarded to the 11 communities that were initially contacted regarding the MP on November 13, 2023. A summary of feedback received from agencies as a result of the Update Letter is included in Table 8.5.

Table 8.5 – Summary of Agency Comments

Review Agency	Comments	Action Taken
Georgia McLay, Coordinator, Lands, Waters & Consultation Historic Saugeen Métis December 19, 2023 Via E-Mail	• Thanked us for including the Historic Saugeen Métis (HSM) in the NP Servicing MP consultation. • Listowel and Atwood are beyond the boundaries of the Traditional Harvesting Territory of the HSM community, and as such, they have no further interest in this project.	- Information noted and filed. - HSM removed from the consultation list.

Review Agency	Comments	Action Taken
Erna-Marie Leclair Chippewas of the Thames First Nation January 17, 2024 Via E-Mail	• Had received our update letter and asked for the presentation material to be provided through the NationsConnect platform.	- Information provided through NationsConnect.
Erna-Marie Leclair Chippewas of the Thames First Nation February 5, 2024 Letter via E-Mail	• Reviewed the presentation material and had moderate concerns related to impact to watercourses. • Asked to meet with project team to review information in detail.	- Zoom meeting arranged for February 20th, 2024. - No specific concerns indicated by COTTN after reviewing the project information in detail.

8.6 Public Information Centre

A Public Open House was held on November 15, 2023 from 4:30-6:30 p.m. in the North Perth Council Chambers. A notice advertising the meeting was placed in the Listowel Banner in advance of the meeting. The notice was also placed on the North Perth website and on social media. Copies were emailed to project stakeholders as well as agencies and Indigenous communities.

A series of information boards were mounted around the room which provided details related to the Class EA Master Plan process, the expected timelines for completion of the Master Plan, and information related to the existing water, sanitary and stormwater infrastructure for Listowel and Atwood. Comments were received from one member of the public, as shown in Table 8.6. Approximately 6 individuals attended the public open house.

Table 8.6 – Summary of Public/Adjacent Property Owner Comments

Member of Public	Comments	Action Taken
J. Harper (via comment sheet) October 29th, 2023	- Suggested re-routing water coming down Concession 4 versus tearing up PC drainage.	- Information noted and filed.

A copy of the PIC presentation material is included in Appendix G.

8.7 Notice of Study Completion

A Notice of Study completion was published for the project on September 24, 2025. The Notice provided a brief description of the Master Plan process and indicated the projects recommended for implementation through the Master Plan. The Notice was published in the Listowel Banner for two consecutive weeks, was posted on the municipal website, and was emailed or mailed to the list of review agencies and Indigenous communities identified at the start of the Class EA process as well as to project stakeholders.

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 B MCEA to investigate options for additional water storage capacity in both Listowel and Atwood. The Class EA process will be coordinated and will be initiated in 2025, with projected completion in 2026, 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:

- Increased capacity at the Hwy. 23 and Inkerman SPSs in Listowel
- Increased capacity at SPS #1 and #2 in Atwood
- Sanitary collection system upgrades in both communities
- Stormwater improvements and proposed regional facilities in both communities

The timing of these projects is dependent on where and when future development occurs. Given the need for these projects is driven by future growth, North Perth 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 Municipality of North Perth has a Development Charge By-law in place, and currently collects development charges related to road, water, and wastewater services among others. A number of projects identified through the Master Plan are currently included in the most recent version (2024) of the North Perth Development Charge By-Law.

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, North Perth 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 many of the recommendations in this Master Plan. The Master Plan should 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. Addressing existing problem areas can be initiated immediately, subject to funding. Phasing of development servicing needs will be 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 an 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 Storage

The Master Plan identified a need additional water storage in both Listowel and Atwood. It is recommended that this study be initiated immediately to ensure that sufficient storage is available to support continued growth in each community.

10.2.2 Wastewater Pumping

The Master Plan identified that two sewage pumping stations in Listowel and both SPSs in Atwood are approaching their theoretical capacity, based on the current pumping arrangement. Given this, it is recommended that North Perth continue to monitor sewage flows at each station so that larger pumps and associated appurtenances can be installed prior to flows associated with future growth exceeding the station capacity.

10.2.3 Wastewater Collection

With respect to the wastewater collection system, this Master Plan identified that gravity sewer sections in both communities are approaching or above their theoretical capacity, based on modeling data. Given this, it is recommended that North Perth undertake a sewer flow modeling study in the identified areas to verify flow conditions.

10.2.4 Ontario Heritage Act

If archaeological resources are impacted by EA project work, please notify MCM at archaeology@ontario.ca. All activities impacting archaeological resources must cease immediately, and a licensed archaeologist will carry out an archaeological assessment in accordance with the Ontario Heritage Act and the Standards and Guidelines for Consultant Archaeologists.

If human remains are encountered all activities must cease immediately and the local police and coroner be notified. In situations where human remains are associated with archaeological resources, MCM should also be notified to ensure that the site is not subject to unlicensed alterations which would be a contravention of the Ontario Heritage Act.

10.2.5 Stormwater Management

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 North Perth be included in future Asset Management Plan updates.

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 exempt from the formal Class EA process. If North Perth undertakes the construction of a 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.

10.3 Master Plan Approval

The Listowel and Atwood 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 North Perth. 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, will 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 Municipality 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 storage will be required for Listowel and Atwood in the future. It is recommended that a MCEA study be initiated immediately for water storage in both communities.
- That flow monitoring programs be initiated in both Listowel and Atwood to determine actual flows at identified sections of gravity sewers that are theoretically over-capacity.
- That intake flows at the Hwy. 23 SPS, Inkerman SPS and SPS #1 & SPS #2 (Atwood) be monitored to identify peak thresholds when pumping capacity will need to be increased in response to growth.
- That watermain extensions be considered along Main Street and Monument Road in Atwood to extend watermain servicing to development sites and the remainder of the community (work to coincide with potential sanitary upgrades along the same sections of road allowance).

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 Municipality of North Perth initiated a Servicing Master Plan to investigate infrastructure needs and requirements relating to water, wastewater and stormwater servicing within the communities of Listowel and Atwood. 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 1 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 Listowel and Atwood, 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 to establish reserve capacity. A WaterCAD® model was created and used to assess fire flows and pressures throughout the water distribution system. It was identified that additional water storage is recommended for both communities in the future.

For wastewater, the Master Plan assessed collection, pumping and treatment infrastructure. The assessment included an evaluation of reserve treatment capacity and SewerCAD® modelling for the collection sewers. From the assessment of existing infrastructure and projected future needs, it was identified that additional sewage treatment capacity is needed. It is understood that rerating of the WWTP is currently in progress. Modeling of sewer capacity identified sections of gravity sewers in both communities where capacity is theoretically overcommitted, and flow studies are recommended to verify model results in key locations. SPS capacities in both communities will also need to be monitored to ensure that pumping capacity is sufficient to address increased sanitary flows associated with growth.

A review of the existing stormwater infrastructure, municipal drains and subwatersheds was undertaken for this Master Plan. For each subwatershed within Listowel and Atwood, 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 storage in both communities.
- Increased wastewater treatment capacity.
- Increased capacity at the Hwy. 23 SPS, Inkerman SPS and SPS #1 & #2 (Atwood).
- Water distribution extension in Atwood.
- Sewer collection upgrades in both communities.
- Stormwater improvements to address problem areas and accommodate growth.

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

- Construct additional water storage facilities in each community.
- Monitor sewage flows at the four SPS’s and then replace existing sewage pumps and related works when upgrades are warranted.
- Undertake flow studies within identified sections of the sanitary collection system in each community.
- Extend watermain servicing in Atwood to service development lands and the remaining community.
- Coordinate stormwater management opportunities and constraints as identified for each community.

Based on the preferred solutions, the Master Plan recommends:

- Additional water storage will be required for Listowel and Atwood. It is recommended that North Perth undertake a Schedule B MCEA study immediately.
- That flow monitoring studies be initiated in both communities to confirm capacity within several gravity sewer sections and to confirm pumping capacity at four SPSs.
- That stormwater management improvements be undertaken immediately within existing developed areas of the community and implemented in conjunction with development applications within growth areas of each community.
- 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.

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

The Listowel and Atwood 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 Municipality of North Perth.

All of which is respectfully submitted.

B. M. ROSS AND ASSOCIATES LIMITED

Per _____
Andrew J. Garland, P. Eng.

Per _____
Kelly Vader, RPP, MCIP

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