

Region of Waterloo

**Baden and New Hamburg Water and
Wastewater Master Plan Update -
Master Plan Report
Volume 1: Summary Report (Final)**

Prepared by:

AECOM Canada Ltd.

50 Sportsworld Crossing Road, Suite 290

Kitchener, ON, Canada N2P 0A4

www.aecom.com

519.650.5313 tel

519.650.3424 fax

Project Number:

105507/60116643

Date:

June 16, 2011

Statement of Qualifications and Limitations

The attached Report (the “Report”) has been prepared by AECOM Canada Ltd. (“Consultant”) for the benefit of the client (“Client”) in accordance with the agreement between Consultant and Client, including the scope of work detailed therein (the “Agreement”).

The information, data, recommendations and conclusions contained in the Report (collectively, the “Information”):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the “Limitations”)
- represents Consultant’s professional judgement in light of the Limitations and industry standards for the preparation of similar reports
- may be based on information provided to Consultant which has not been independently verified
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued
- must be read as a whole and sections thereof should not be read out of such context
- was prepared for the specific purposes described in the Report and the Agreement

Consultant shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information. Consultant accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

Consultant agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but Consultant makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

The Report is to be treated as confidential and may not be used or relied upon by third parties, except:

- as agreed in writing by Consultant and Client
- as required by law
- for use by governmental reviewing agencies

Consultant accepts no responsibility, and denies any liability whatsoever, to parties other than Client who may obtain access to the Report or the Information for any injury, loss or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report or any of the Information (“improper use of the Report”), except to the extent those parties have obtained the prior written consent of Consultant to use and rely upon the Report and the Information. Any damages arising from improper use of the Report or parts thereof shall be borne by the party making such use.

This Statement of Qualifications and Limitations is attached to and forms part of the Report and any use of the Report is subject to the terms hereof.

Table of Contents

Statement of Qualifications and Limitations

	Page
1. INTRODUCTION AND BACKGROUND	1
1.1. OVERVIEW	1
1.2. BACKGROUND	1
1.3. POPULATION AND FLOW PROJECTIONS	2
1.3.1. <i>Population Projections</i>	2
1.3.2. <i>Flow Projections</i>	2
2. WASTEWATER SYSTEM	5
2.1. BACKGROUND	5
2.1.1. <i>Wastewater Treatment</i>	5
2.1.2. <i>Wastewater Collection System</i>	6
2.2. OPPORTUNITIES AND CONSTRAINTS	7
2.2.1. <i>Wastewater Treatment</i>	7
2.2.2. <i>Assimilative Capacity in Support of Wastewater Treatment Alternatives</i>	7
2.2.2.1. Update of Assimilative Capacity Study	7
2.2.2.2. Rural Water Quality Program	9
2.2.3. <i>Wastewater Collection</i>	10
2.3. EVALUATION OF WASTEWATER ALTERNATIVES	10
2.3.1. <i>Wastewater Treatment</i>	10
2.3.1.1. Liquids Treatment	10
2.3.1.2. Biosolids Management	12
2.3.2. <i>Wastewater Collection System</i>	12
2.4. WASTEWATER RECOMMENDATIONS	13
2.4.1. <i>Wastewater Treatment</i>	13
2.4.2. <i>Wastewater Collection</i>	14
3. WATER SYSTEM	17
3.1. BACKGROUND	17
3.2. OPPORTUNITIES AND CONSTRAINTS	18
3.2.1. <i>Water Supply and Treatment</i>	18
3.2.1.1. Wilmot Centre Wellfield (K50's)	18
3.2.1.2. Well NH3 and New Groundwater Supply Nearby	18
3.2.1.3. Baden Wells	18
3.2.2. <i>Water Storage and Distribution</i>	18
3.3. EVALUATION OF ALTERNATIVES	19
3.3.1. <i>Water Supply and Treatment</i>	19
3.3.2. <i>Water Distribution</i>	22
3.3.3. <i>Water Storage</i>	23
3.4. WATER RECOMMENDATIONS	24
4. PUBLIC CONSULTATION	26

1. Introduction and Background

1.1. Overview

The Region of Waterloo (the Region) initiated a study in 2008 to update the previous New Hamburg Baden Wastewater Treatment Class Environmental Assessment (Class EA), and the Baden New Hamburg Water Supply Master Plan Update completed in 1997 and 1996, respectively. The Baden and New Hamburg Water and Wastewater Master Plan update has addressed all requirements of Phases 1 and 2 of a 'Schedule C' process as prescribed by the Class EA for Municipal Water and Wastewater Projects.

Based on the Class EA requirements and incorporating the concerns of public comments, agency and municipality input, the Purpose Statement is defined as follows:

“The goal of this Master Plan Study is to update previous Master Plan and Class EA studies with recent works, revised population projections and policies, and changes in the environment. It identifies strategies that will optimize existing systems and increase capacities of the existing water supply/ treatment/ distribution/ storage and wastewater conveyance/ pumping/ treatment systems to provide servicing into the future. The strategies are to ensure that:

- *an adequate amount of water can be provided in a safe, reliable and cost-effective manner to satisfy current and long-term requirements;*
- *wastewater can be conveyed and treated in a safe, reliable and cost-effective manner to satisfy current and long-term requirements, with consideration for the receiving water's assimilative capacity.*

The study will have regard for established sustainability and environmental planning principles that properly consider potential impacts to sensitive land uses such as the natural environment and agriculture. Furthermore, the study will define and factor in the role of water conservation/ efficiency including decrease of water losses, inflow/ infiltration reduction measures, and innovative strategies which can extend the life of existing infrastructure along with future systems.”

The updated Baden-New Hamburg Water and Wastewater Master Plan provides an overall plan for the upgrade and expansion of facilities to ensure adequate water and wastewater capacity to protect human health and the natural environment, meet legislative requirements and future growth, and be fiscally responsible and sustainable.

This report summarizes the work undertaken to develop the Baden-New Hamburg Water and Wastewater Master Plan Update, consisting of the following volumes:

- Volume 1: Summary Report
- Volume 2: Wastewater Master Plan
- Volume 3: Water Master Plan
- Volume 4: Appendices

1.2. Background

The communities of Baden and New Hamburg are situated within the Township of Wilmot (the Township) in the Region. The water and wastewater systems in these communities are operated as a two tier system:

- The Region is responsible for two main raw wastewater pumping stations (Morningside and Baden), treatment, discharge and biosolids management; while the Township is responsible for wastewater collection and a secondary pumping station.
- The Region is responsible for water supply, treatment, storage and transmission mains while the Township is responsible for water distribution and water service connections.
- The Study Area, shown in **Figure 1**, is comprised of the Baden and New Hamburg water and wastewater servicing area, as well as the Foxboro Green wastewater servicing boundary. Although the Foxboro Green subdivision community is not currently a part of the Baden and New Hamburg system, it is included in this Study for future consideration.

1.3. Population and Flow Projections

1.3.1. Population Projections

For the purpose of evaluating future servicing alternatives, the population forecast scenarios in **Table 1** were used to provide a range of population growth that may occur in the planning period to 2041, and to develop servicing alternatives to satisfy the full range of potential growth, or determine constraints to this growth. Projections up to 2029 for the overall Township are documented in the Regional Official Plan (2009), from which forecasts for the communities of Baden and New Hamburg were provided by the Region's Planning, Housing and Community Services Department. Further, the 2041 low and high growth estimates are "unofficial" and were used for the sole purpose of evaluating the feasibility of various servicing alternatives within this Master Plan update.

Table 1: Baden / New Hamburg Population Serviced Growth Scenarios

Area	2016	2021	2026	2029	2041 Low*	2041 High*
Residential	14,760	16,800	19,340	20,800	21,500*	26,100*
Employment	4,900	5,800	6,570	7,050	7,340*	9,300*
Population Equivalent (PE)	19,660	22,600	25,910	27,850	28,840*	35,400*
* Unofficial projections						

1.3.2. Flow Projections

Applied to the population projections were per capita water demands and per capita wastewater generation rates to develop future servicing requirements, including water supply and wastewater treatment volumes.

The estimated population and flow projections used in the development of alternatives for wastewater treatment are summarized in **Table 2**.

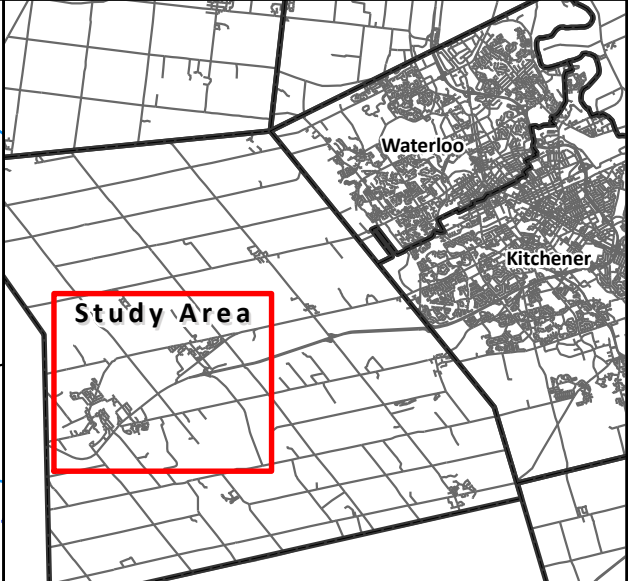
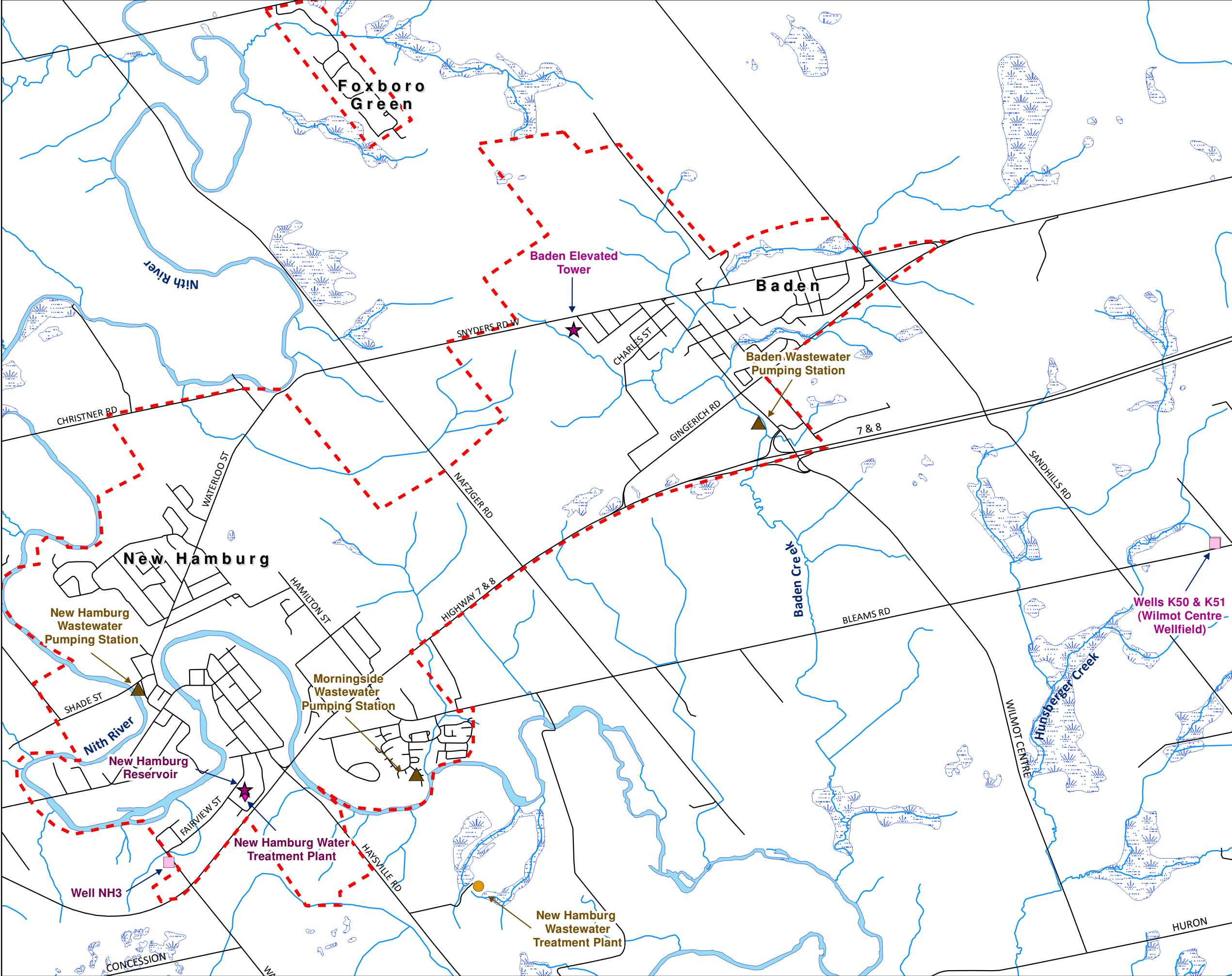
Table 2: Baden and New Hamburg Projected Wastewater Flows

	2008	2011	2016	2021	2026	2029	2041 (LOW)	2041 (HIGH)
New Hamburg WWTP PE Projection	15,220	16,740	19,660	22,600	25,910	27,850	28,840	35,400
Foxboro WWTP Service Area PE Projection	430	430	430	430	430	430	430	430
Total Raw Sewage PE	15,650	17,170	20,090	23,030	26,340	28,280	29,270	35,830
Flow (m³/day) ⁽²⁾	3,959	4,344	5,083	5,827	6,664	7,155	7,405	9,065
Peak Factors (max day) ⁽³⁾	2.50	2.50	2.50	2.50	2.50	2.51	2.49	2.41
Peak Flow (m³/day) ⁽³⁾	9,899	10,860	12,707	14,566	16,660	17,952	18,469	21,820
<i>Notes: (1) Population Equivalent (PE) wastewater generated= 253 L/capita/day and a max day peaking factor of 2.5 (2) Dry Weather Flow is the maximum flow resulting from daily diurnal flow fluctuations (3) Peak Wet Weather Flow is the maximum flow resulting from wet weather events (for example, rainfall).</i>								

The estimated population projections and demands used in the development of alternatives for water are summarized in **Table 3**.

Table 3: Baden and New Hamburg Projected Water Demand

	2008	2011	2016	2021	2026	2029	2041 (LOW)	2041 (HIGH)
Baden-New Hamburg PE Projection	15,220	16,740	19,660	22,600	25,910	27,850	28,840	35,400
Average Day Demand (m³/d) ¹	2,773	3,050	3,582	4,118	4,721	5,075	5,255	6,450
Maximum Day Demand (m³/d) ²	3,980	4,377	5,140	5,909	6,775	7,282	7,541	9,256
¹ Average Day Demand per Equivalent Capita = 182.22 L/capita/day ² Maximum Day Demand per Equivalent Capita = 261.47 L/capita/day								



Legend

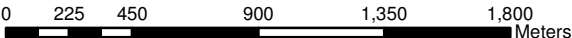
- Wastewater Treatment Plant
- ▲ Wastewater Pumping Station
- Water Wells
- ★ Reservoir & Elevated Water Tower
- ◆ Water Treatment Plant
- Roads
- Rivers
- Nith River
- Wetlands
- - - Study Area

Baden - New Hamburg Water & Wastewater Master Plan Update

**Figure 1:
Study Area**

Datum: NAD 83, Zone 17
Source: Region of Waterloo

June 2011



2. Wastewater System

In order to assess the wastewater system needs based on the projected flows in **Section 1**, review of the New Hamburg Wastewater Treatment Plant (WWTP) and wastewater collection infrastructure was required. Details are outlined herein leading to recommended alternatives for wastewater treatment and collection.

2.1. Background

As shown in **Figure 1**, the Baden and New Hamburg Wastewater System consists of the following infrastructure:

- New Hamburg Wastewater Treatment Plant (Region);
- Morningside Wastewater Pumping Station (Region);
- New Hamburg Wastewater Pumping Station No. 2 (Township);
- Baden Wastewater Pumping Station (Region); and
- Foxboro Green Wastewater Treatment Plant and Pumping Station (Region).

2.1.1. Wastewater Treatment

The New Hamburg WWTP, constructed in 2000, is a sequencing batch reactor (SBR) activated sludge facility that treats wastewater flows generated within the communities of Baden and New Hamburg. The plant consists of influent works (mechanical screens and grit removal), sequencing batch reactors (three SBRs in parallel); tertiary sand filters, ultraviolet (UV) effluent disinfection, aerobic sludge digestion and storage, and emergency storage as shown in **Figure 2**. Currently, aerobic sludge is processed from three other Region plants (Hespeler, Wellesley and St. Jacobs) at the New Hamburg WWTP. The New Hamburg WWTP discharges into the Nith River. The plant currently has an average rated capacity of 5,200 m³/d (60 L/s).

In addition, the New Hamburg WWTP influent includes sidestreams from the aerobic digesters when supernating and from the hauled waste holding lagoon. Hauled waste consists of septage and holding tank wastes typically from unserviced and rural communities and rural residents. The hauled waste is currently stored in the former Stabilized Sludge Storage Lagoon adjacent to the aerobic digesters. During wet weather events, influent is directed to the emergency storage lagoon and is returned to the treatment plant during dry periods.

A phased approach was adopted for the design of this facility. Phase 1 (completed in 2000) was to provide capacity to 2016. The Phase 2 Expansion was to be completed by 2016 to provide a design flow of 7,400 m³/day with capacity sufficient to 2041. As such, several features were incorporated into the Phase 1 design to either provide capacity beyond 2016 or flexibility to easily install additional tanks and equipment to provide additional capacity during the eventual Phase 2 expansion.

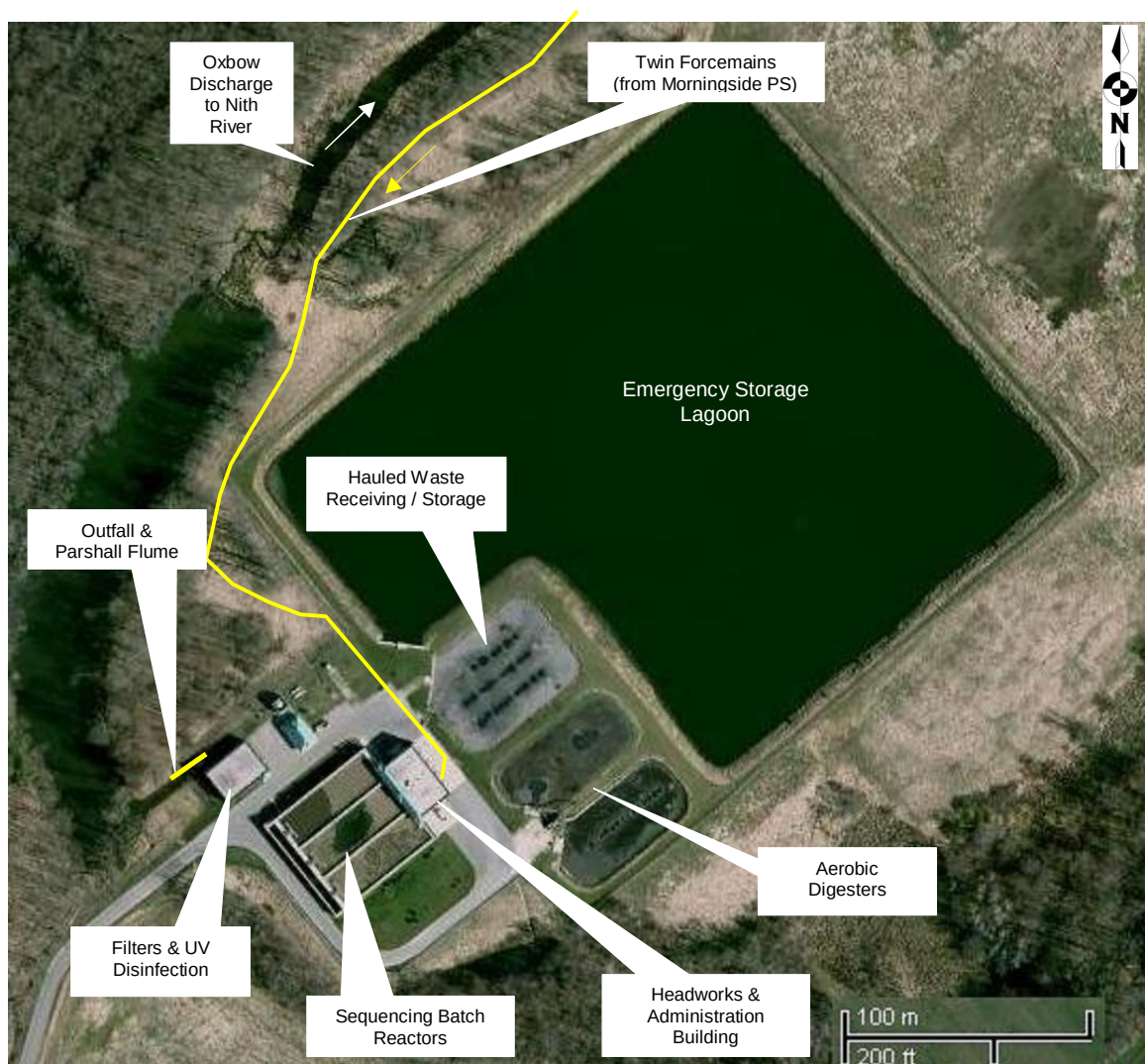


Figure 2: New Hamburg WWTP Aerial View

2.1.2. Wastewater Collection System

The sanitary sewer collection system for Baden, New Hamburg and Foxboro Green consists of the following main components:

- Baden – 5 catchment areas which combine through a gravity sewer system to the Baden Wastewater Pumping Station (WWPS). The Baden WWPS transfers wastewater to the New Hamburg sanitary collection system via force main.
- New Hamburg – 9 catchment areas: four of which combine via gravity sewer into the New Hamburg WWPS #2 (Township); combine with five additional catchment areas to the Morningside WWPS. In addition, the Baden forcemain feeds to the Morningside WWPS.
- Morningside Wastewater Pumping Station – conveys all wastewater to the New Hamburg Wastewater Treatment Plant. It collects all the wastewater from Baden and New Hamburg from two trunk sanitary sewers (Nith River Trunk Sewer and East Side Trunk Sewer).
- Foxboro Green Wastewater System – This system is divided in two sewage systems and serves approximately 430 people. Sewage System No. 1 consists of two rotating biological contactors (RBC No. 1 and No. 2) and one effluent pumping chamber. Sewage System No. 2 consists of one raw sewage lift station, one RBC (No. 3), and one effluent pumping chamber.

2.2. Opportunities and Constraints

The following opportunities and constraints within the Baden/New Hamburg wastewater system were identified.

2.2.1. Wastewater Treatment

To determine constraints and opportunities within the New Hamburg Wastewater Treatment Plant (WWTP), hydraulic and process bottlenecks were evaluated and opportunities for optimization through changes in operation identified. Based on the analysis, the three primary issues with New Hamburg WWTP are:

1. At a current rated capacity of 5,200 m³/d, the treatment capacity based on current operation and effluent requirements is limited.
2. No long term biosolids storage. Biosolids are stored in the aerobic digesters leads to poor quality decant which result in excess solids loading to the Sequencing Batch Reactors (SBRs).
3. SBR programming does not allow for peak diurnal or wet weather flows. As the plant approaches its design flows, a higher fraction of the plant return flows will be diverted to the emergency storage lagoon.

The last two issues cause solids to be caught in an internal loop that can result in a reduction of the SBRs treatment capacity.

A fourth possible issue is the efficiency of the SBR Decant Chamber. Decant equalization (i.e. by the SBR Decant Chamber) is required to prevent the sand filters and UV processes from being by-passed. Additional information (tank geometry and operational details) is required to undertake more thorough analysis of this constraint.

2.2.2. Assimilative Capacity in Support of Wastewater Treatment Alternatives

In order to develop wastewater treatment alternatives in subsequent sections, a review and update of the assimilative capacity assessment of the Nith River basin was required. The outputs of this work would form the basis for effluent requirements to which treatment alternatives would have service to.

2.2.2.1. Update of Assimilative Capacity Study

Assimilative capacity studies evaluate the effect of point and non-point contaminant sources on a natural body of water. These studies also assist in evaluating effluent quality requirements for wastewater treatment plants. As the communities of Baden and New Hamburg grow in the future, opportunities to increase the treatment capacity of the WWTP are potentially limited by the assimilative capacity of the Nith River. The New Hamburg WWTP discharges to an oxbow that subsequently discharges to the Nith River. Through completion of the Baden New Hamburg Master Plan update, one of the primary objectives was to update the assimilative capacity studies of the Nith River. As part of this effort, the following was undertaken to update the assimilative capacity studies:

1. Updates to background river water quality characteristics using hydrometric analysis, a review of water quality sampling and data collected since the completion of the last study and an evaluation of river water quality for trend analysis;
2. Development of a list of parameters of concern (POCs);

3. Dissolved oxygen modeling;
4. Mixing zone analysis;
5. Development of a framework for a Total Phosphorus Management Program;

Consultation with the MOE and GRCA regarding the approach to the above was carried out to confirm Regional Office interpretation of issues which formed the basis of the assimilative capacity study. The Region's approach to the assimilative capacity update was discussed and agreed upon by the MOE.

Parameters of Concern (POCs) typically are a long list of chemicals and physical parameters that are possible in WWTP discharge, or affect impacts in the receiving water. To this list can be added biological parameters (e.g. bacteria) and results of biological tests (toxicity tests). Those applicable are as follows:

- Total phosphorus (TP)
- Ammonia, Un-ionized ammonia, temperature and pH
- Nitrate
- Oxygen demanding substances (CBOD and NOD) and dissolved oxygen (DO)

The results of the DO modeling indicate that at low flows there is minimal impact from increased WWTP loadings. This is because the effluent is highly treated such that increased discharge causes little increase in the concentration of oxygen demanding substances. In addition, the Nith River is a relatively shallow stream with good re-aeration. There is however some concern with DO at the point of discharge from the oxbow at the Nith River (See Figure 2 later). Historic data indicates low DO concentrations at this point, however completely mixed concentrations are still well above the PWQO for warm water fisheries.

A model was developed for estimation of the initial mixing zone and was used to evaluate the mixing characteristics of the plume (i.e. the mixing length) for DO and unionized ammonia for three scenarios (from ROW WWTMP, 2007). These three scenarios, Baseline, Scenario A, and Scenario B, consist of seven consecutive days of low flow (during Summer) with a recurrence interval of twenty years (7Q20) with plant discharge of 5200 m³/day (current CofA rated capacity), 8810 m³/day (Approximately 2028), and 10200 m³/day (Beyond 2041), respectively. The findings of the mixing zone analysis are as follows:

- Under high river flow conditions the effluent plume was found to be well mixed at 50 metres downstream from the oxbow point of discharge at the Nith River;
- Under low river flow conditions, lateral well mixed conditions are expected to occur approximately 1000 metres downstream from the oxbow point of discharge at the Nith River;
- Under all scenarios, a zone of passage with dissolved concentrations (DO) above 5 mg/L is expected to be present in the left half of the river for 1 kilometre below the oxbow point of discharge at the Nith River; and
- Under all scenarios, the un-ionized ammonia concentrations are expected to remain below the PWQO within 1 kilometre from the oxbow point of discharge at the Nith River.

See **Volume 2 – Section 2** for details on the Assimilative Capacity Study.

Based on the findings of the above referenced Assimilative Capacity Studies, the following effluent objectives are recommended in developing alternative for New Hamburg WWTP configurations to accommodate future flows for planning purposes. Table 4 presents the current effluent objectives and compliance limits for comparison with the recommended effluent design objectives. These did not change from current with the exception of:

- **Maintaining current CofA's phosphorus loading requirements, notwithstanding increased flow which results in decreased objectives to comply with Policy 2 requirements to**

maintain current discharge levels (see next section on the Rural Water Quality Program); and

- Nitrate objectives may be established in the future.

Table 4: New Hamburg WWTP Recommended Effluent Objectives – for Planning Purposes

EFFLUENT PARAMETER	CURRENT		RECOMMENDED DESIGN OBJECTIVE
	EFFLUENT OBJECTIVE	COMPLIANCE LIMITS	
cBOD ₅	5 mg/L	10 mg/L ^(a) , 52 kg/day	5 mg/L
TSS	5 mg/L	10 mg/L ^(a) , 52 kg/day	5 mg/L
TP*	0.2 mg/L	0.3 mg/L ^(b) , 1.56 kg/day	0.2 mg/L, 1.56 kg/day*
TAN			
May 1 to Nov 30	0.4 mg/L	1.0 mg/L ^(b) , 5.1 kg/day	0.4 mg/L
Dec 1 to Apr 30	1.0 mg/L	2.0 mg/L ^(b) , 10.4 kg/day	1.0 mg/L
Nitrate – Nitrogen Option a) Option b)	No Nitrate Objective	No Nitrate Objective	No Nitrate Objective Nitrate Objective (TBD)
* Per Policy 2, maintaining current CofA loading objective results in decreased concentration objective with increased flow (^(a) Annual Average; (^(b) Monthly Average; TBD = to be determined)			

2.2.2.2. Rural Water Quality Program

Previous studies identified the high level of background phosphorus concentrations in the Nith River watershed to be primarily from non-point sources, (e.g. agricultural sources), compared to the relatively smaller loadings from point sources such as Regional wastewater treatment plants. With the goal of improving surface water quality through implementation of non-point sources abatement to reduce nutrient loadings, and the additional objective of protecting area groundwater, the Rural Water Quality (RWQ) Program commenced in 1998 as a collaborative effort between the Region and the Grand River Conservation Authority (GRCA). The GRCA administers the program and provides extensive services to the farming community to identify projects to be funded. Best management practices (BMPs) have been identified that have the best potential for protecting surface and groundwater, with specific algorithms (calculations) based on research for quantifying the amount of total phosphorus reduction expected for each project. See **Volume 2 – Section 2.6** for details on the RWQ Program.

Total phosphorus Policy 2 requirements for the New Hamburg Wastewater Treatment Plant discharges to the Nith River are to be met. Policy 2 refers to water quality which presently does not meet the Provincial Water Quality Objectives (PWQO) for a specific parameter, where further degradation is not acceptable and measures shall be taken to improve the water quality. The last expansion of the New Hamburg WWTP was approved by the Ministry of the Environment with a recommendation for a combination of a non-point source (NPS) control plan, as well as a minimum treatment level of BAT EA (Best Available Technology Economically Achievable) to meet this requirement. There was no direct offset calculation incorporated into the CofA. A review was done on the RWQP projects and it showed that RWQP projects continue to function as designed and significantly reduce the amount of phosphorous leaving the landscape.

2.2.3. Wastewater Collection

The Baden and New Hamburg wastewater collection systems were evaluated to identify opportunities and constraints of the Region's infrastructure based on the current installed capacity and 2041 flow requirements (Low and High Scenarios). The initial analysis compared the design flow with the projected 2041 (Low and High) flows for the current service areas. Additionally, the possibility of incorporating the Foxboro Green wastewater system into the Baden and New Hamburg System was evaluated. Opportunities and constraints for the wastewater collection system are summarized below:

- Optimization of the Baden WWPS and related equalization storage requirements to handle 2041 wet weather flows need to be confirmed as part of further work. Additional pumping capacity required along with storage to address wet weather flow impacts.
- Additional pumping capacity may be required necessitating replacement of the impellers and an additional pump at the Morningside WWPS for the 2041 (High) scenario;
- New trunk sewers and pumping stations by the Township would be required to discharge wastewater to the Morningside WWPS for areas to be developed;
- Possibility for converting the Foxboro Wastewater Treatment System to a pumping station with connection to the Baden - New Hamburg collection system.

2.3. Evaluation of Wastewater Alternatives

In accordance with the Class Environmental Assessment (Class EA) process, various alternatives solutions were identified and evaluated to accommodate the projected 2041 (low and high) wastewater flows.

2.3.1. Wastewater Treatment

2.3.1.1. Liquids Treatment

The following wastewater alternatives for the New Hamburg WWTP were developed, each considering population projections and possible effluent requirements. The alternatives were screened with respect to their ability to eliminate the deficiencies within the existing treatment plant, ability to accommodate future growth, and the flexibility to meet possible future effluent limits. **Table 5** provides a summary of the alternatives.

Table 5: Summary and Screening of Wastewater Alternatives

ALTERNATIVE	GENERAL EVALUATION
WW-1: Do Nothing	Summary: No upgrades or expansion activities would be carried out. Pros: No additional upgrades are required. Cons: Existing deficiencies would prevent the WWTP from accommodating flows up to the current design capacity of the plant and cannot accommodate future growth. Next Steps: Not recommended for further evaluation
WW-2: Limit Community Growth	Summary: Limit growth based on existing plant capacity. Pros: Minor capital expenditure required to address deficiencies. Cons: Would not accommodate projected population growth from the 2009 Regional Official Plan Next Steps: Not recommended for further evaluation
WW-3: Reduce Wastewater Flows	Summary: Measures would be taken to reduce wastewater flows through water efficiency efforts, and I/I mitigation.

ALTERNATIVE	GENERAL EVALUATION
	Pros: Moderate capital expenditure required to implement and maintain water efficiency and I/I mitigation efforts. Cons: I/I mitigation would be a Township responsibility. Storm flow mitigation at the WWTP is currently provided. Next Steps: This option will continue to be implemented by the Region and Township in conjunction with other alternatives.
WW-4: Optimize and Expand the existing WWTP per Phase 2 design	Summary: Existing deficiencies would be corrected, and optimization of unit processes would be carried out. Additional capacity would be provided per the original design intent of the facility. Pros: Additional capacity would be provided to accommodate the Regional Official Plan's 2029 population projection and, if required, <u>the 2041 low population projection</u>. Lower capital investment in short term. Changes in effluent quality limits may be accommodated. Cons: Capacity expansion via plant additions (or other means if enhanced treatment is required) to address the 2041 High Projection. Additional treatment processes may be required to meet more stringent effluent limits. Next Steps: This option is viable and was given further consideration. Confirmation of this alternative's ability to meet future effluent limits is required.
WW-5: Optimize and Expand the existing WWTP - modification to secondary process	Summary: The existing secondary treatment process would be converted to a flow through process by converting the SBRs to plug flow aeration tanks and constructing new secondary clarifiers in lieu of a fourth SBR. Pros: Capacity to accommodate future growth within the service area would be provided (2041 Low and High). In future, more stringent effluent limits could be planned for and met with certainty. Cons: Significant upgrades and in the long term (2029 and beyond) as capital expenditure would be required. Constructability issues. Next Steps: This option would be further investigated in the long term (2029 and beyond) as part of future Master Plan updates.

Based on the screening described above the following alternatives were developed in further detail:

- Alternative WW – 4: Optimize and expand the existing WWTP as per Phase 2 design;
- Alternative WW – 5: Optimize and expand the WWTP - modification to secondary process.

Both alternatives were further developed and evaluated for Natural Environment, Social/Cultural, Economic, Legal/Jurisdictional, and Technical criteria as per Class EA requirements (See **Volume 2 – Section 5** for details).

A summary of advantages and disadvantages of the shortlisted wastewater treatment alternatives is provided in **Table 3**.

Table 3: Wastewater Treatment Options Advantages vs. Disadvantages

ALTERNATIVE	ADVANTAGES	DISADVANTAGES
WW-4: Optimize and expand existing WWTP per Phase 2 design	- Additional capacity would be provided to accommodate the Regional Official Plan's 2029 population projection and, if required, the 2041 low population projection - Lower capital investment in short term - Changes in effluent quality limits may be accommodated	May require additional treatment processes in long term future or for more stringent effluent limits (2041 High Projection)
WW-5: Optimize and expand WWTP with modifications to secondary process	- Capacity to accommodate future growth within the service area would be provided (2041 Low and High) - Future, more stringent effluent limits could be planned for and met with certainty	- Significant upgrades and therefore significant capital expenditure would be required initially - Constructability issues

2.3.1.2. Biosolids Management

The Region of Waterloo is currently undertaking a Regional Biosolids Master Plan Update to assess its current biosolids management and disposal practices, and to recommend a preferred biosolids management strategy to the year 2041.

As the selected option for biosolids management at the New Hamburg WWTP is integral to the capacity of the liquid stream process (due to the loading impact of return flows from the biosolids handling process), and due to space requirements of the biosolids handling process, the direction of the Biosolids Master Plan Update is briefly described below.

The Biosolids Master Plan Update recommends use of the existing aerobic digesters for gravity thickening. Biosolids would then be hauled to the Region's Ayr WWTP for additional thickening and processing at a new auto-thermal thermophilic aerobic digestion system (ATAD). Haulage of biosolids from other plants to the New Hamburg WWTP will be discontinued. Hespeler biosolids will be hauled to the new ATAD facility while Wellesley and St. Jacobs biosolids will go to the Waterloo WWTP. As a future consideration, mechanical thickening could occur at the New Hamburg WWTP prior to haulage to the new ATAD facility. Further details will be provided in the Biosolids Master Plan Final Report.

2.3.2. Wastewater Collection System

As discussed earlier, the Baden and New Hamburg wastewater collection systems were examined to determine impacts to the Region's wastewater infrastructure (WWTP and 2 PSs) only based on future scenarios. Also, alternatives to evaluate the potential for connecting the Foxboro Green wastewater system to the Baden and New Hamburg collection system and how this impacts the Region's facilities, was also examined. Two wastewater collection system alternatives were considered:

- Wastewater Collection Option WWCS-1 – Six existing/new catchment areas and the floodplain area along the Nith River. This alternative assumed that a portion of the area northeast of Highway 8 would require pumping to the Morningside WWPS.

- Wastewater Collection Option WWCS-2 – Five existing/new catchment areas and the floodplain area along the Nith River. It was assumed that a portion of the area located northeast of Highway 8 would flow by gravity sewer to the Morningside WWPS.

As a subset of the above, three alternatives were developed to examine the potential to connect the Foxboro Green Wastewater Collection Systems to the Baden/New Hamburg system as follows:

- Alternative WW F-1 - Connect Foxboro Green WWPS to New Hamburg WWPS #2;
- Alternative WW F-2 – Connect Foxboro Green WWPS to New Hamburg East Side Trunk Sewer;
- Alternative WW F-3 – Connect Foxboro Green WWPS to Baden WWPS.

These shortlisted alternatives were evaluated according to the Natural/Environment, Social/Cultural, Economic/Financial, Legal/Jurisdictional, and Technical criteria as per Class EA requirements (See **Volume 2 – Section 5** for details).

2.4. Wastewater Recommendations

2.4.1. Wastewater Treatment

Based on the evaluation of wastewater treatment alternative solutions it is recommended that Alternative WW-4 be selected as the preferred alternative for wastewater treatment, as illustrated in **Figure 3**. While both Alternatives WW-4 and WW-5 will meet the needs of the service area in the short and long term, Alternative WW-5 requires a significantly greater initial investment.

Alternative WW-4 meets the treatment objectives of the WWTP and provides flexibility for future expansion and/or changes in regulatory requirements. This alternative also maximizes the use of existing infrastructure, and reduces expansion complexity as well as operational changes. Implementation of the preferred Alternative WW- 4 may be phased as follows:

- Phase 1 – Optimize New Hamburg WWTP and resolve existing SCADA programming issues in 2012 (no later 2016).
- Phase 2 – Upgrade/Expand as per Phase 2 of the 1996 MP expansion strategy as outlined herein in 2018;
- Re-evaluate the Master Plan update to confirm Phase 3 and 4 recommendations by approximately 2028;
- Phase 3 – Install a parallel package treatment plant when capacity of Phase 2 is reached to meet capacity and treatment needs – one parallel package plant to meet 2041 Low population projections. A larger or a second to meet 2041 High population projections in 2034;
- A possible Phase 4 – Should effluent TP requirements require enhanced filtration, install a second stage of tertiary filters as part of Phase 3 or later.

Figure 4 illustrates the timing of each required component of the preferred alternative based on estimated population growth and projected flows. Population is shown in terms of a Population Equivalents (PE) representing both residential and employment growth. Each Phase should be fully operational by the year indicated. This means that planning design, construction and approvals must be initiated in advance of this target date over a 2-3 year period. A summary of the estimated cost is shown in **Table 6**.

Table 6: Wastewater Treatment - Summary of Cost ⁽¹⁾

COMPONENT	COST ESTIMATE (C\$)
Phase 1: Optimization of Existing Process and resolve SCADA programming issues	\$ 85,000
Phase 2: Phase 2 Expansion	\$ 8,155,000
Phase 3: One Parallel Package Treatment System (Membranes contemplated) to meet 2041 – Low Population Projection	\$ 6,128,800
TOTAL - 2041 LOW	\$ 15,005,800
Phase 3: A second Parallel Package Treatment System (Membranes contemplated) to meet 2041- High Population Projection)	\$ 8,791,400
TOTAL - 2041 HIGH	\$ 17,668,400
A possible Phase: Second stage of tertiary filters (if enhanced filtration is required)	\$ 7,225,000

Notes: All costs are 2010 dollars and include 15% Engineering and 10% Contingency.

The preferred wastewater treatment alternative will have the following Municipal Class EA requirements:

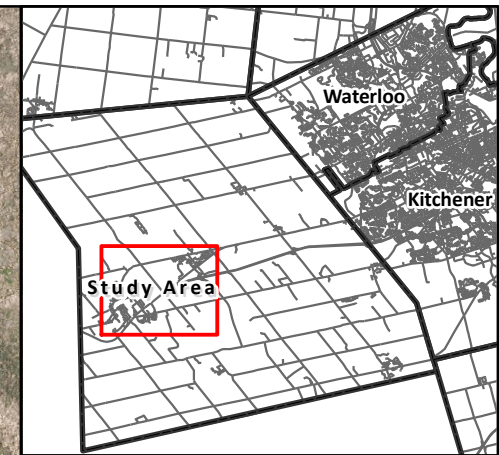
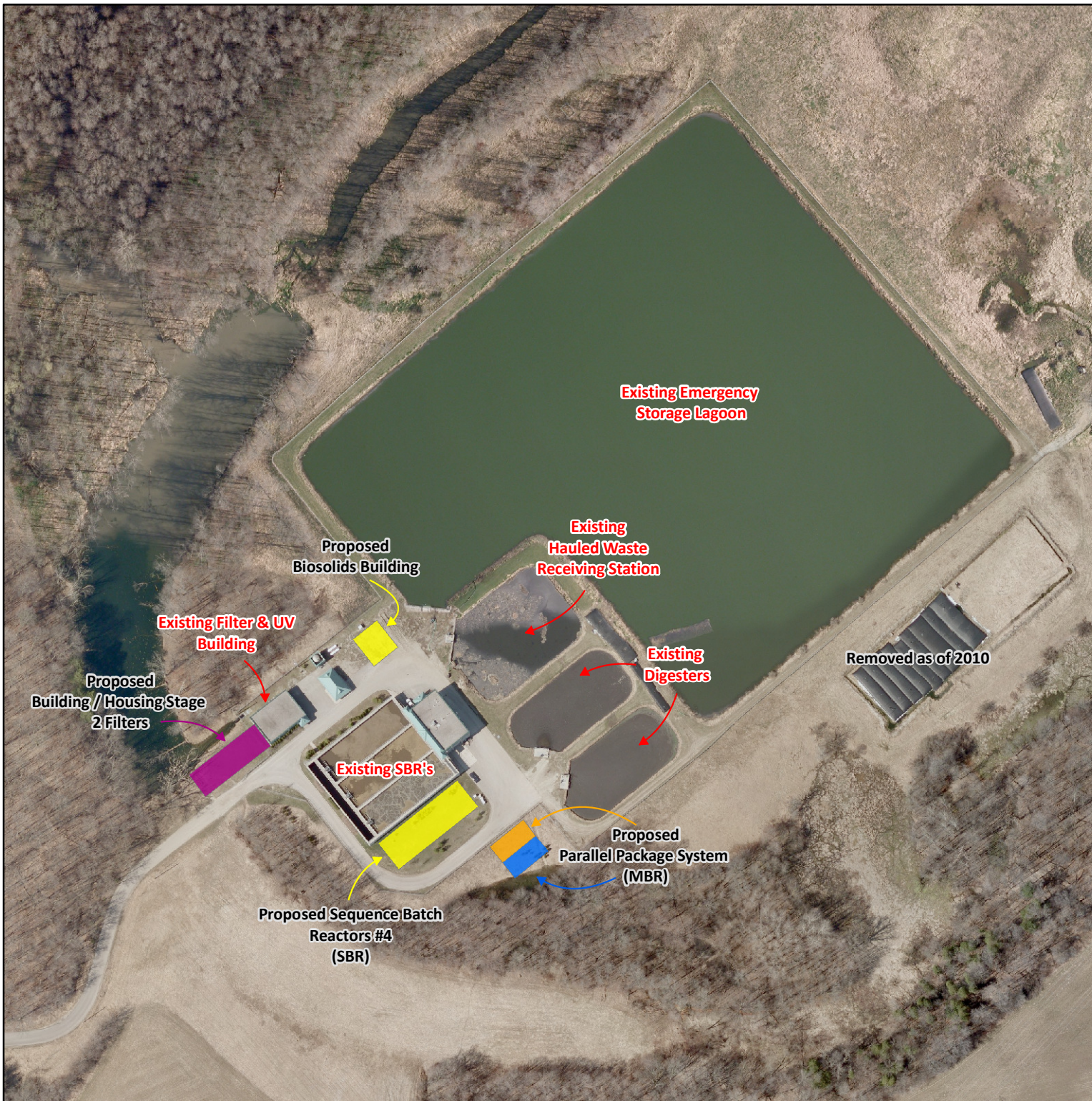
- Optimize existing process – Schedule A (improvement to operations without construction of works); and
- Expand per Phase 2 – Schedule C (Construction of new SBR results in the requirement for Schedule C).

2.4.2. Wastewater Collection

It is recommended that as lands are developed, a Wastewater Servicing Study be carried out by the Township of Wilmot to determine the optimal location of key trunk sewers and infrastructure based on the Region's and Township's growth spatial planning.

Based on the preliminary evaluation, Alternative WWCS-2 is the preferred alternative for wastewater collection. It has a lower capital cost and also reduces the complexity of the system by requiring one fewer pump station. Depending on the recommended Wastewater Servicing Study findings, the preferred wastewater collection option may change.

The preferred connection strategy for Foxboro Green is not anticipated until the long term and will depend on future spatial population distribution. Additionally, Foxboro Green wastewater flows can only be accommodated if additional capacity becomes available at the New Hamburg WWTP.



Legend

Development Time Line

- 2018
- 2028
- 2034 (2041 High Only)
- Advanced TP Removal

Baden - New Hamburg Water & Wastewater Master Plan Update

Figure 3:
New Hamburg Wastewater Treatment - Preferred Alternative (WW-4)

Datum: NAD 83, Zone 17
Source: Region of Waterloo

June 2011

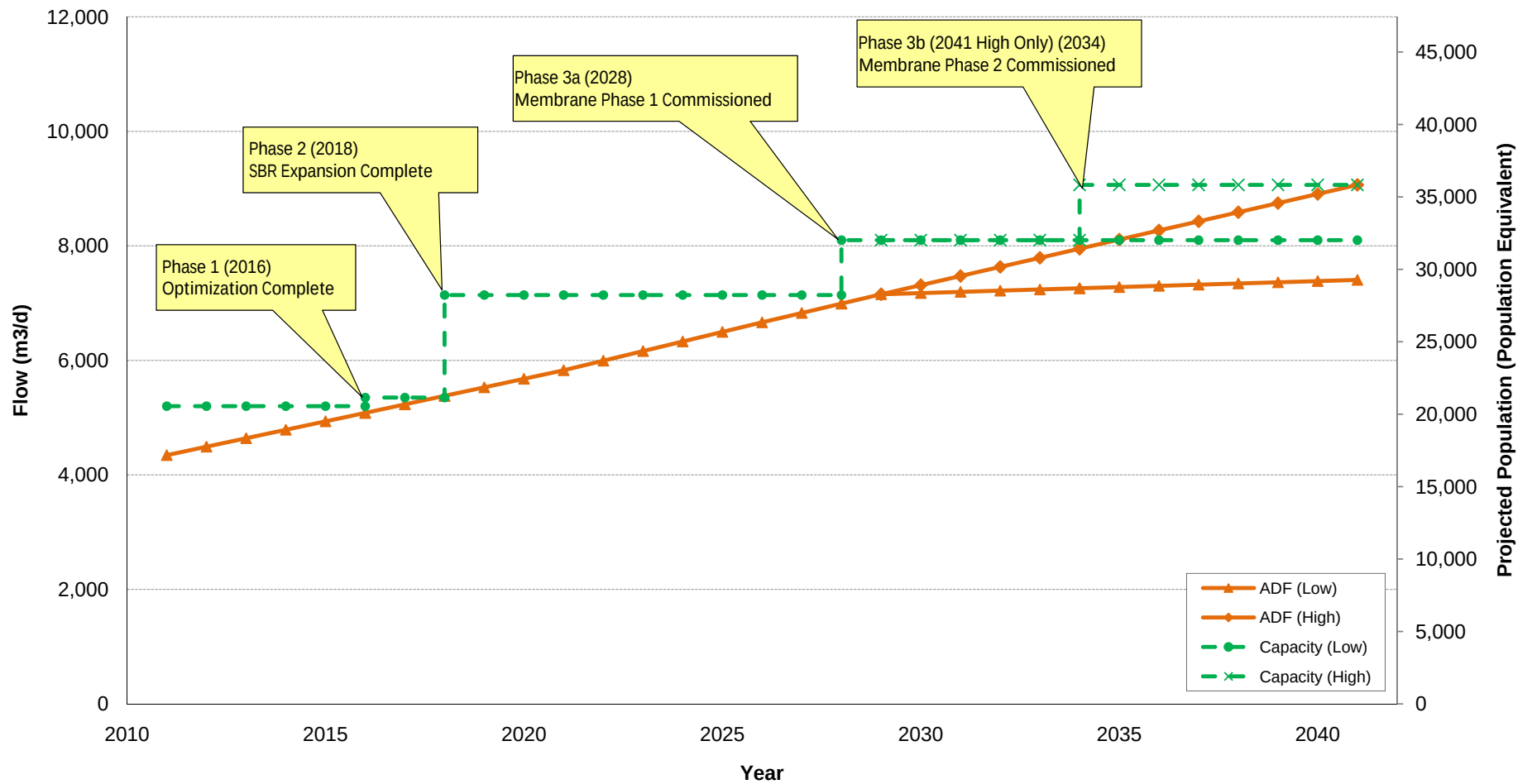


AECOM



0 15 30 60 90 120 Meters

Figure 4: New Hamburg WWTP - Proposed Phasing



3. Water System

In order to assess water system needs based on the projected water demands outlined in **Section 1**, review of the current water supply, treatment, storage and key transmission facilities was required. Details are outlined herein leading to recommended alternatives for supply, treatment and storage.

3.1. Background

As shown in **Figure 1**, the Baden-New Hamburg water supply and distribution system consists of the following infrastructure:

- New Hamburg Water Treatment Plant and Reservoir (NHWTP): The NHWTP is a package plant that provides treatment for iron and manganese reduction, with a rated capacity of 3,542 m³/d (41 L/s). The storage reservoir consists of a cast-in-place two cell concrete structure with a usable volume of 2,000 m³;
- Well NH3 (NH3): NH3 is constructed with a 300 mm (nominal) diameter casing in dolostone bedrock to a depth of approximately 58 m below ground surface (elevation 298 masl). NH3 currently operates under MOE Permit to Take Water (PTTW) No. 2101-6FTQM9, which allows for a maximum production rate of 3,542 m³/day (41 L/s).
- Baden Elevated Tower: The Baden Elevated Tower has a capacity to store 5,363 m³ when filled to its maximum level. However, it is currently being operated at 30% capacity to minimize high pressures problems in areas with low elevation;
- Baden Wells: Wells B1 and B2 were constructed with 300 mm diameter casings, in Aquifer 1 (between 310 and 350 metres above sea level generally comprised of coarse sand and gravel outwash deposits) separated by approximately 3 m. The Baden Wells have historically operated under MOE (PTTW) No. 94-P-2035, which allowed for a combined production rate of 6,550 m³/day (75.8 L/s) from either or both wells. The PTTW for the Baden Wells expired in 2004. No production pumping from the Baden Well Field has occurred since 2001 due to elevated nitrate concentrations and are therefore disconnected from the distribution system.
- Wilmot Centre Wellfield (K50s): The Wilmot Centre Wellfield consists of wells K50 and K51, separated by approximately 8 m and located within one pump house. Both wells are 400 mm (nominal) diameter in Aquifer 1. Wells K50 and K51 each have a capacity of 79 L/s, at a total dynamic head (TDH) of 71 m. This wellfield operates under MOE PTTW No. 0287-6WHQTY, which allows for a combined pumping rate of 13,651 m³/day (158 L/s) from the wellfield. This PTTW will expire on May 31, 2016. There is a historical agreement between the Region of Waterloo and the Township of Wilmot that diversion of pumped groundwater from the Wilmot Centre well field to the Integrated Urban System (IUS) would be maintained at or below the 1978 average annual rate of 7,517 m³/day (87 L/s), except under special circumstances. Additionally, 605 to 864 m³/day (7 to 10 L/s) is diverted to a local surface water pond (Gastmeier Ponds).

3.2. Opportunities and Constraints

The following opportunities and constraints within the Baden/New Hamburg water system were identified.

3.2.1. Water Supply and Treatment

3.2.1.1. Wilmot Centre Wellfield (K50's)

- Well NH3 and the K50 wells may provide sufficient supply capacity to year 2041 requirements, depending on outputs of the Long Term Wilmot Centre Monitoring Program (LTWCMP). The Wilmot Centre Monitoring Program is a long term program of stepped increases in pumping at the K50 well field up to its permitted capacity while monitoring impacts on the local environment;
- Potential concerns regarding the effects of increased pumping on local private wells;
- Additional water supply capacity is required when considering firm capacity and scenarios which involve taking individual supplies off-line; and
- Nitrate levels at K50 are maintained within the Ontario Drinking Water Standard (ODWS).

3.2.1.2. Well NH3 and New Groundwater Supply Nearby

- Potential to draw poor groundwater quality from the underlying Salina Formation;
- Potential effects on the Nith River;
- Determine the safe yield for additional groundwater supply in the vicinity of NH3;
- Additional treatment will be required to reduce iron levels at the NHWTP if a new well is added to the New Hamburg wellfield with similar water quality to NH3. Additional treatment capacity can be accommodated at the Water Treatment Plant (WTP) with some upgrades; and
- A comprehensive groundwater study would be required.

3.2.1.3. Baden Wells

- Use of the Baden Wells with the K50s to meet ODWS is a consideration. Based on the previous Master Plan, nitrate treatment would be needed.

3.2.2. Water Storage and Distribution

- Additional water storage within the Baden/New Hamburg Study Area will be required before 2021. The total water storage volume requirements for the study area to 2041 are presented in **Table 7**. Fire flow requirements were revised by interpolating MOE Suggested Fire Flows and Durations.
- There are areas at low elevations with high pressures within the existing distribution system (approaching 100 psi (691 kPa)) when the Baden Elevated Tower is at the top water level.
- New and/or upgraded watermain within the Township of Wilmot water distribution system are required to provide looping to address pressure and water quality constraints, and/or provide sufficient fire flows and service new growth areas.

Table 7: Storage Requirements

YEAR	EQUIVALENT POPULATION	FIRE FLOW (L/S)	DURATION (HRS)	TOTAL STORAGE REQUIRED (M³)	SURPLUS/DEFICIT (M³)
2008	15,220	236.7	3.6	5,213	2,150
2016	19,660	268.1	4.3	6,753	610
2021	22,600	299.9	4.5	7,963	- 600
2029	27,850	322.3	5.0	9,527	- 2,164
2041 (low)	28,840	327.2	5.0	9,718	- 2,355
2041 (high)	35,400	358.3	5.3	11,507	- 4,144
<i>Note: MOE fire flows and duration were interpolated</i> <i>Existing Total Storage: 7,363 m³</i>					

3.3. Evaluation of Alternatives

3.3.1. Water Supply and Treatment

The following alternative solutions were developed based on the Class EA process to address the constraints and opportunities summarized in **Section 3.2**, and the population projections described in **Section 1.3**. **Table 8** provides a summary of the alternative water solutions. The alternative solutions were screened with respect to their ability to satisfy constraints and opportunities within the existing water system and their ability to accommodate future growth.

Table 8: Summary and Screening of Water Supply Alternatives

ALTERNATIVE	GENERAL EVALUATION
W-1: Do Nothing	Summary: Continue with Wells NH3 and K50s as water supply sources at current rates. Pros: Minor capital investment Cons: Deterioration of existing system, no additional water to accommodate 2041 firm capacity requirements Next Steps: Not recommended for further evaluation.
W-2: Limit Community Growth	Summary: Limit growth based on existing water supply capacity Pros: Minor capital investment. Cons: Would not accommodate projected population growth from the 2009 Regional Official Plan Next Steps: Not recommended for further evaluation.
W-3: Water Conservation	Summary: Water conservation programs have been implemented since 1974. Pros: Reduction of water consumption can contribute to lower water demands. Cons: Would not accommodate the projected water demands to year 2041 as a stand-alone alternative. Next Steps: Water conservation practices will continue to be promoted in conjunction with other alternatives
W-4: Modify/ Expand Operation and Maintenance Practices	Summary: Modify operational practices to supply more water from the K50 wells to Baden/New Hamburg as required. Pros: The Baden/New Hamburg area would have the required firm capacity available for the projected 2041 water demand. Minor capital investment at Baden/New Hamburg. Cons: This option does not meet overall Regional requirements for servicing.

ALTERNATIVE	GENERAL EVALUATION
	Next Steps: Consider this strategy only as a means to provide water under emergency conditions to support firm capacity requirements.
W-5: Expand/Upgrade Existing Groundwater Supplies	Summary: Reactivate the Baden wells and provide nitrate treatment Pros: Wells exist with known production capacity, connected to the existing water distribution system. Cons: High capital and O&M cost for adding treatment to the Baden Wells. Next Steps: Recommended for further evaluation.
W-6: New Groundwater Supplies	Summary: New well at the New Hamburg Wellfield (NH4), and/or a new well at the Wilmot Centre Wellfield (K52). Pros: Well NH4 would provide additional capacity; well K52 could serve as a backup well. Cons: Iron/manganese treatment and land acquisition required for NH4. K52 moderate cost. Next Steps: Recommended for further evaluation.
Note: All alternatives (except W-1 Do Nothing) will require additional water storage and upgrades to the water distribution system.	

Based on the screening described above the following water alternatives were given further consideration:

- Alternative W-4: Modify Operation and Maintenance Practices
- Alternative W-5: Expand/Upgrade Existing Groundwater Supplies
- Alternative W-6: New Groundwater Supplies

Further strategic water supply options were developed for subsequent evaluation following a firm capacity approach based on combinations of Alternative Solutions W-4 to W-6 as shown by **Table 9**:

Table 9: Water Supply Strategic Options

SUPPLY STRATEGIC OPTION	WATER SUPPLY SOURCES	TOTAL CAPACITY TO BADEN/NEW HAMBURG, L/S ^{**3}	FIRM CAPACITY TO BADEN/ NEW HAMBURG, L/S ^{**3}
WS-1	NH3, K50s	112	41 to 107
WS-2	NH3, K50s, Baden Wells	167 to 178 ¹	107
WS-3	NH3, K50s, new NH well	131	60 to 107
WS-4	NH3, K50s, new K50 well ²	112	112
WS-5	NH3, K50s, Baden wells, new NH well	156	126
<i>Total Capacity = total capacity available with all wells; Firm Capacity: total capacity available with the largest well offline</i> <i>* Subtracting 87 L/s supplied to IUS, ** range depends on water supplied to IUS</i> <i>¹ Depending on type of treatment used; ² New K50 well as standby well only; ³ Includes water supplied to the Gastmeier Ponds</i>			

A summary of the advantages and disadvantages of the proposed water supply strategic options is provided in **Table 10**.

Table 10: Water Supply Strategic Options Advantages vs. Disadvantages

SUPPLY STRATEGIC OPTION	WELLS	CLASS EA SCHEDULE	ADVANTAGES	DISADVANTAGES
WS-1	K50/K51, NH3	-	Minor capital investment required	reduction in supply under firm capacity conditions
WS-2	K50/K51, NH3, B1/B2	C	- Firm capacity requirement achieved with ion exchange for nitrate removal at Baden Wells - Supply available to IUS - Land acquisition not required	High cost to reactivate Baden Wells
WS-3	K50/K51, NH3, NH4 (new)	C	- NHWTP could be expanded to provided additional iron/manganese treatment - Revised wellfield PTTW to include NH4	- Land acquisition and pipeline easement required - High capital cost investment - reduction in supply under firm capacity conditions - Uncertainty of environmental impacts
WS-4	K50/K51, K52 (new), NH3	A	- Firm capacity required achieved - Disinfection and standby power facilities already in place - Land acquisition not required	Moderate to high capital cost investment
WS-5	K50/K51, NH3, NH4 (new), B1/B2	C	- Firm capacity requirement achieved - Supply available to IUS	- Land acquisition required - Very high capital cost investment - Uncertainty of environmental impacts

These water supply strategic options were evaluated according to the Natural/Environment, Social/Cultural, Economic/Financial, Legal/Jurisdictional, and Technical criteria as per Class EA requirements (See **Volume 3 - Section 4** for details).

Most options will require water treatment, as nitrate removal is anticipated at the Baden Wells and iron removal at the new NH4 well. The water treatment options for nitrate removal at the Baden Wells include ion exchange or reverse osmosis; and the water treatment options for the new NH4 well consist of a new iron/manganese treatment system at the new site, or expansion of the existing water treatment system at the New Hamburg Water Treatment Plant. Both options would require a Schedule C Class EA and would therefore undergo further evaluation, should either be the preferred water supply strategic option.

A summary of the advantages and disadvantages of water treatment options is provided in **Table 11** for future reference.

Table 11: Treatment Options Advantages vs. Disadvantages

CHEMICAL OF INTEREST	TREATMENT OPTION	ADVANTAGES	DISADVANTAGES
Nitrate (Baden Wells)	WB-1 – Ion Exchange	- No post-treatment required - Lower capital and O&M Cost - Low waste volume generated - Several full-scale plants in operation in the US. - Similar to operational concept of water softeners.	New technology for the Region
	WB-2 – Reverse Osmosis	Pathogen free water	- May require post treatment - Higher capital and O&M Cost - High waste volume generated - Less popular for nitrate removal
Iron (New NH4 Well)	WNH 1 Expand NHWTP	- Lower capital cost - Less land required - No major changes in current O&M practices	Less flexibility (one pipe discharging to the NHWTP)
	WNH2 Treatment at new NH4 well site	- More operational flexibility (two pipes discharging to NHWTP) “standby” capability	- Higher capital cost - More land required - Additional O&M requirements

3.3.2. Water Distribution

Several new Township watermain will be required between Baden and New Hamburg to service new growth. Locations and pipe diameters depend on the population distribution; however, this has not been determined throughout Baden and New Hamburg. Therefore, future water distribution system requirements will need to be developed further with planning projections, development timing and water supply alternatives all being considered as they are dependent on the development of new water supply sources (e.g. alternative for new NH4 or reactivating Baden wells).

In addition to new watermain requirements, the south-western portion of New Hamburg experiences pressures approaching 100 psi due to existing topography. Three possible options were developed for the Township to address high pressure problem in these areas. A summary of the advantages and disadvantages of the high pressure solution options is provided in **Table 12**.

Table 12: High Pressure Solution Options Advantages vs. Disadvantages

ALTERNATIVE	CLASS EA SCHEDULE	ADVANTAGES	DISADVANTAGES
NHD-1 – Central Pressure Reducing Area	A	- Easier access for O&M - High public acceptance	- Higher capital cost - Some pipe work required
NHD-2 – Residential PRVs	n/a	- Lower capital cost - No O&M Cost, assuming homeowners would be responsible for O&M	- Low public acceptance - Difficult to maintain, and high O&M cost if Township responsible for maintenance
NHD-3 – Hybrid	A	Moderate public acceptance	- Moderate capital cost - Less pipe work required
<i>Schedule A to “install... appurtenances from existing water mains”, n/a = not applicable</i>			

3.3.3. Water Storage

The 2041 (Low and High) population scenarios require an additional storage capacity of approximately 2,500 and 4,200 m³, respectively. The storage options shown in **Table 13** were developed assuming existing storage will be at its full capacity in 2041.

These water storage options were evaluated according to Natural/Environment, Social/Cultural, Economic/Financial, Legal/Jurisdictional, and Technical criteria as per Class EA requirements (See **Volume 3 – Section 4** for details). These storage options should be developed further during the Design Concept Phase of a Water Storage Class EA. Depending on the preferred water supply alternative, some storage options may no longer be practical. A summary of the advantages and disadvantages of each option is provided in **Table 13**.

Table 13: Water Storage Advantages vs. Disadvantages

ALTERNATIVE	CLASS EA SCHEDULE	ADVANTAGES	DISADVANTAGES
Option S-1 Expand NHWTP Reservoir	B	- Land available on NHWTP site - No major changes to the current water distribution system - Storage would be split between Baden and New Hamburg	High lift pumping station would require upgrade/expansion to accommodate increased flow
Option S-2 Storage at Baden Wells Site	B	- Land available at Baden Wells site - No major changes to the current water distribution system	Most water storage would be in Baden resulting in greater reliance on transmission mains between the two communities
Option S-3 New Location	B*	Central location	- New high lift pumping would be required - May require land acquisition
Option S-4 Combination of Above	B*	- Operational flexibility - Smaller pipes may be required	- Higher cost - Land acquisition may required
<i>Schedule B is adequate to “establish new or expand/replace existing water storage facilities.”</i>			
<i>* Confirmation depends on site location</i>			

3.4. Water Recommendations

Water Supply and Treatment

It is recommended that the Region implement WS-4 as the preferred water supply strategic option. Details are as follows:

- Increase water taking from the K50s following the proposed stepped increases as outlined in the LTWCMP to the PTTW permitted flow;
- Maintain pumping from the NH3 well to the permitted flow;
- Install an additional well immediately (new K52 well), at the K50's site and connect it to the existing system to provide water supply capacity redundancy. The estimated cost is \$ 1.1 M, and would follow a Schedule A Class EA.
- Maximize the transfer of water to the IUS at 87 L/s at all times to ensure that the stepped increases are achieved through the additional Baden – New Hamburg demand
- Maximize the transfer of water to Baden and New Hamburg by operating the K50s at a constant rate, utilizing NH3 only to meet peaks in demand as required.

Figure 5 illustrates the proposed timing for stepped increases of the K50s water taking as per the LTWCMP. Confirmation of the preferred option is dependent on the WCMP results indicating minimal to no additional environmental impact with the increased water taking at the K50s Wells. This includes continuation of the Region's water level monitoring program and continued monitoring of nitrate levels.

A second option WS-2 (Contingent Option) is recommended as a backup should the preferred option not be realized due to non-mitigable environmental or hydrogeological constraints. This alternative consists of re-instating the Baden wells with treatment. See **Volume 3 – Section 5.1** for further details of this contingent option.

Water Storage

As outlined in **Section 3.3.3**, a Schedule B Class EA is required to further investigate water storage options which would then recommend a preferred water storage alternative. Based on the preferred water supply strategic option (W-4), it is recommended that the Region implement S-1 as the preliminary preferred water storage option:

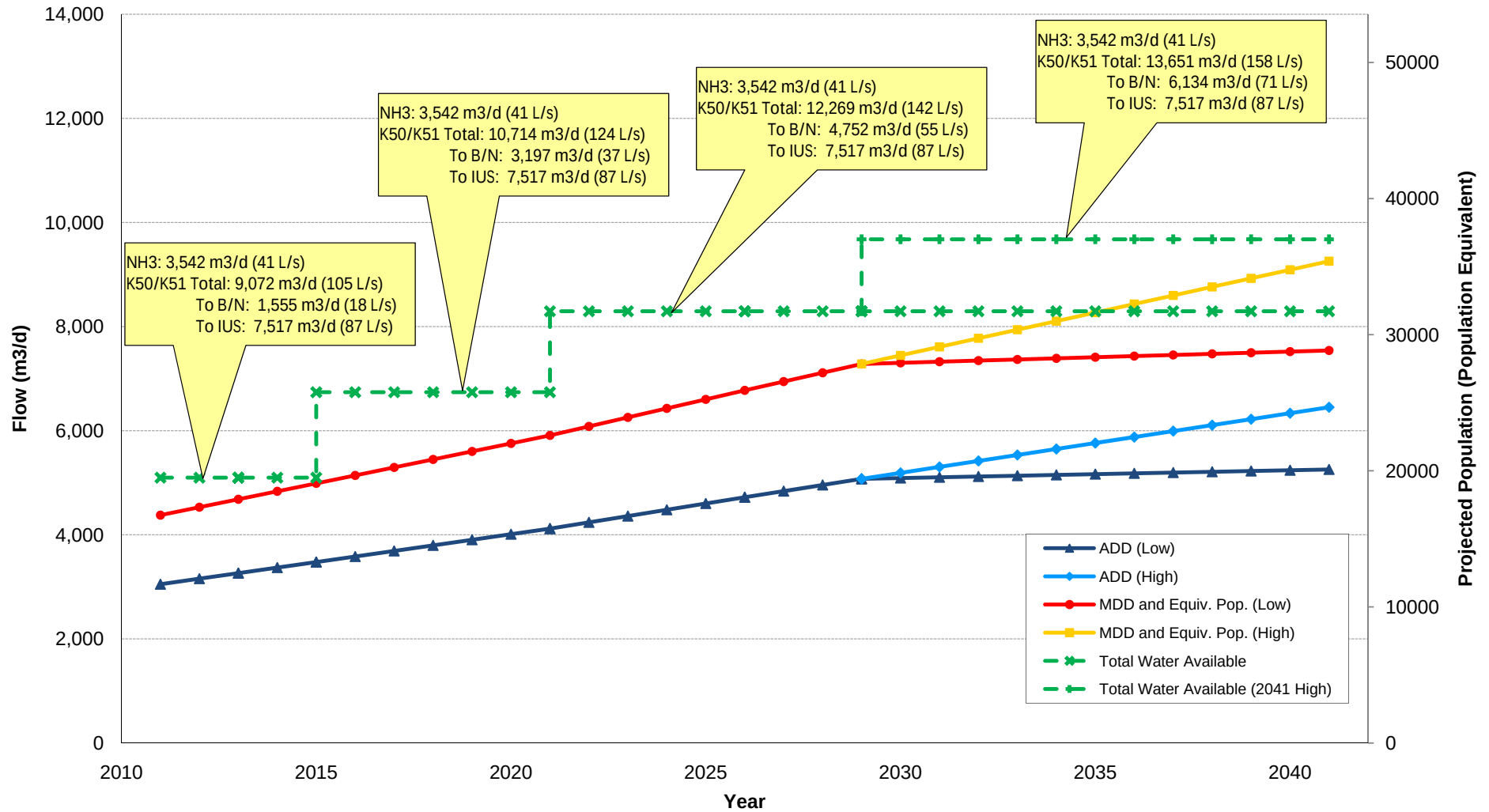
- Expand the storage at the New Hamburg Water Treatment Plant to meet 2041 fire flow requirements; and
- Upgrade the existing high lift pumping station at the New Hamburg Water Treatment Plant.

Depending on the preferred water supply alternative and the Schedule B Water Storage Class EA findings, the preferred water storage option may change.

Water Distribution

Recommendations for future water distribution system requirements will be developed further by the Township of Wilmot subject to the timing of growth, and the development of new water supply sources by the Region, if needed in the future. The more immediate Township requirement is to implement the necessary modifications in the distribution system piping and valving to address high pressure areas in New Hamburg.

Figure 5: Projected Water Supply Planning Phases (Preferred Option)



4. Public Consultation

Based on the work presented, and comments received from the public, agencies, and other stakeholders throughout project completion, and at the Public Information Centre (PIC) held in December 2010, preferred water and wastewater strategies to 2041 were identified.

The following is a chronology of the opportunities for public involvement during the Baden-New Hamburg Water and Wastewater Master Plan Update:

- **November 2008: Notice of Commencement**
Advertisements were placed in local newspapers informing the public of the commencement of this Master Plan Update. In addition, notification letters were mailed to local area municipalities, neighbouring Townships, provincial agencies, federal agencies, First Nations communities, and the Grand River Conservation Authority (GRCA).
- **Steering Committee Meetings**
The intent of the Steering Committee was to provide input and advice to the Project Team in the direction of the project at key stages. The Steering Committee consisted of the project consultant, assigned Regional and Township Councillors, representatives of the Region's Water Services Division, representatives of the Region's Planning Department, the Township of Wilmot, the GRCA, and the Ministry of Environment (MOE). A total of three Steering Committee Meetings were held throughout the project (October 2008, June 2009, and November 2010).
- **November 2010: Notice of Public Information Centre (PIC)**
Advertisements were placed in local newspapers informing the general public of the PIC. As well notification letters were mailed out to identified agencies and members of the public who had expressed an interest in this Master Plan.
- **December 2010: Public Information Centre**

The PIC was held at the Wilmot Township Office to present the preferred water and wastewater strategies and to request input from interested parties.

Region of Waterloo

**Baden and New Hamburg Water and
Wastewater Master Plan Update -
Master Plan Report
Volume 2: Wastewater (Final)**

Prepared by:

AECOM Canada Ltd.

50 Sportsworld Crossing Road, Suite 290

Kitchener, ON, Canada N2P 0A4

www.aecom.com

519.650.5313 tel

519.650.3424 fax

Project Number:

105507/60116643

Date:

June 16, 2011

Statement of Qualifications and Limitations

The attached Report (the “Report”) has been prepared by AECOM Canada Ltd. (“Consultant”) for the benefit of the client (“Client”) in accordance with the agreement between Consultant and Client, including the scope of work detailed therein (the “Agreement”).

The information, data, recommendations and conclusions contained in the Report (collectively, the “Information”):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the “Limitations”)
- represents Consultant’s professional judgement in light of the Limitations and industry standards for the preparation of similar reports
- may be based on information provided to Consultant which has not been independently verified
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued
- must be read as a whole and sections thereof should not be read out of such context
- was prepared for the specific purposes described in the Report and the Agreement
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time

Consultant shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information. Consultant accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

Consultant agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but Consultant makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

The Report is to be treated as confidential and may not be used or relied upon by third parties, except:

- as agreed in writing by Consultant and Client
- as required by law
- for use by governmental reviewing agencies

Consultant accepts no responsibility, and denies any liability whatsoever, to parties other than Client who may obtain access to the Report or the Information for any injury, loss or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report or any of the Information (“improper use of the Report”), except to the extent those parties have obtained the prior written consent of Consultant to use and rely upon the Report and the Information. Any damages arising from improper use of the Report or parts thereof shall be borne by the party making such use.

This Statement of Qualifications and Limitations is attached to and forms part of the Report and any use of the Report is subject to the terms hereof.

Table of Contents

Statement of Qualifications and Limitations

page

1.	Introduction and Background	1
1.1	EA and Related Preparatory Work	1
1.1.1	Master Plan Purpose and Approach	1
1.1.2	Purpose Statement.....	5
1.1.3	Master Planning Approach	6
1.1.4	Steering Committee.....	6
1.1.5	Stakeholder Contact List	7
1.1.6	Notice of Commencement.....	8
1.1.7	Public Information Centre	8
1.2	Previous Studies/Reports.....	8
1.2.1	New Hamburg Baden Wastewater Treatment Class Environmental Assessment (July 1997)	8
1.2.2	New Hamburg – Baden Wastewater Treatment and Conveyance Infrastructure – Preliminary Design Report (1998).....	9
1.2.3	New Hamburg Wastewater Treatment Plant – Design Brief (1999)	10
1.2.4	Region of Waterloo Wastewater Treatment Master Plan (2007)	10
1.2.5	Baden and New Hamburg Sanitary Sewer Inflow and Infiltration Study (2009), New Hamburg Sewage Collection Optimization Study (1998)	11
1.3	Study Area Background	12
1.3.1	Natural Environment.....	12
1.3.2	Socio-Economic Environment.....	18
1.3.2.1	Existing and Future Land Use Update	18
1.3.2.2	Heritage and Cultural Resources	22
1.3.2.3	Transportation	22
1.3.3	Existing Conditions.....	22
1.3.3.1	Wastewater Treatment.....	22
1.3.3.2	Collection System and Pumping Stations	27
1.4	Wastewater Forecast Update.....	32
1.4.1	Population Projections.....	32
1.4.2	Existing Wastewater Flows and Loadings.....	37
1.4.3	Future Wastewater Flows and Loadings	42
1.4.4	Hauled Waste and Septage.....	43
1.4.5	Foxboro Green WWTP – Flows and Loads.....	43
2.	Nith River Basin Characterization and Assimilative Capacity	46
2.1	Updates to Background Water Quality Characteristics.....	46
2.2	Parameters of Concern.....	47
2.3	Dissolved Oxygen Modeling.....	49
2.4	Mixing Zone Modeling.....	50
2.5	Approach to Un-ionized Ammonia.....	51
2.6	Approach to Total Phosphorus Management.....	51
2.6.1	Rural Water Quality Program.....	51
2.6.2	Framework for a Total Phosphorus Management (TPM) Program.....	52
2.7	Recommendations.....	53

2.7.1	Recommendations for WWTP Analysis	53
2.7.2	Recommendations for Future Nith River Monitoring	53
3.	Opportunities and Constraints of Existing System	54
3.1	Wastewater Treatment	54
3.1.1	Analysis Methodology	54
3.1.2	Emergency Storage Lagoon	56
3.1.2.1	Existing System	56
3.1.2.2	Analysis	56
3.1.3	Liquids Treatment Processes	56
3.1.3.1	Inlet Works (PU-1, PU-3, and PU-3)	56
3.1.3.2	Headworks – Screening and Grit Removal (PU-5, PU-6, PU-7)	59
3.1.3.3	Sequencing Batch Reactors (PU-6, PU-9, PU-19)	61
3.1.3.4	SBR Decant Chamber (PU-19)	65
3.1.3.5	Tertiary Filters – PU-10	66
3.1.3.6	Disinfection	68
3.1.4	Biosolids Handling	70
3.1.4.1	Existing System	70
3.1.4.2	Analysis	71
3.1.4.3	Summary	74
3.1.5	Evaluation Summary	75
3.2	Wastewater Collection System	75
3.2.1	Analysis Methodology	75
3.2.2	Baden WWPS (Region)	77
3.2.3	New Hamburg WWPS No. 2 (Township)	78
3.2.4	Morningside WWPS (Region)	78
3.2.5	Foxboro Green WWPS (Region)	79
3.2.6	Evaluation Summary	80
4.	Development of Wastewater Alternatives	81
4.1	Wastewater Treatment	81
4.1.1	Effluent Quality Requirements	82
4.1.2	Development of Long List of Alternatives for the New Hamburg WWTP (Liquids)	83
4.1.2.1	Alternative WW-1: Do Nothing	83
4.1.2.2	Alternative WW-2: Limit Community Growth	84
4.1.2.3	Alternative WW-3: Reduce Wastewater Flows	84
4.1.2.4	Alternative WW-4: Expand the Existing Treatment Plant per Phase 2 Expansion Plan	84
4.1.2.5	Alternative WW-5: Optimize and Expand Existing Wastewater Treatment Plant to Beyond 2029	85
4.1.2.6	Summary and Screening of Alternatives	86
4.1.3	Development of Screened Treatment Alternatives	87
4.1.3.1	Alternative WW-4 – Optimize and Expand WWTP SBR – Detailed Upgrade Strategy	87
4.1.3.2	Alternative WW-5 – Optimize and Expand WWTP with Conversion to a Flow-Through Process – Detailed Upgrade Strategy	104
4.1.4	Biosolids Management	115
4.2	Wastewater Collection System	115
4.2.1	Option WWCS-1: Six Catchment Areas and Floodplain	119
4.2.1.1	Wastewater Collection Option 1A	119
4.2.1.2	Wastewater Collection Option 1B	120
4.2.2	Option WWCS-2: Five Catchment Areas and Floodplain	125

4.2.2.1	Wastewater Collection Option 2A.....	125
4.2.2.2	Wastewater Collection Option 2B.....	126
4.2.3	Option WWF-1: Foxboro Green Wastewater Collection Options.....	129
4.2.3.1	Foxboro Wastewater Collection Option F1	129
4.2.3.2	Foxboro Wastewater Collection Option F2	129
4.2.3.3	Foxboro Wastewater Collection Option F3	129
4.2.4	Wastewater Collection System Estimated Conceptual Costs	131
5.	Evaluation Criteria and Approach	133
5.1	Class EA Master Plan Process and Evaluation Framework	133
5.2	Use of Descriptive Information and Qualitative Evaluation	133
5.3	Evaluation Criteria and Methodology	134
5.4	Evaluation.....	137
5.4.1	Public Consultation.....	137
5.4.2	New Hamburg WWTP – Evaluation of Alternatives	137
5.4.2.1	Alternative WW1 – Do Nothing.....	138
5.4.2.2	Alternative WW 4 – Expand Existing Facility Per Phase 2 Expansion Plan.....	138
5.4.2.3	Alternative WW 5 – Convert to a Flow Through Process.....	139
5.4.2.4	Summary of Evaluation– Wastewater Treatment.....	140
5.4.3	Baden/New Hamburg Wastewater Collection System– Evaluation of Alternatives.....	141
5.4.3.1	Alternative WWCS1 – Do Nothing.....	142
5.4.3.2	Alternative WWCS – 1 – Six Catchment Areas & Floodplain Area Along Nith River – Connect Baden WWPS to new PS#2	143
5.4.3.3	Alternative WWCS – 2 – Five Catchment Areas & Floodplain Area Along Nith River – Deep Sewer to Morningside WWPS from West Baden	144
5.4.3.4	Summary of Evaluation– Wastewater Collection – Baden/New Hamburg	144
5.4.3.5	Alternative “Do Nothing”.....	146
5.4.3.6	Alternative WWF – 1 – Connect Foxboro Green WWPS to New Hamburg PS#2	146
5.4.3.7	Alternative WWF – 2 – Connect Foxboro Green WWPS to New Hamburg East Side Trunk Sewer	147
5.4.3.8	Alternative WWF – 3 – Connect Foxboro Green WWPS to Baden WWPS.....	147
5.4.3.9	Summary of Evaluation– Wastewater Collection – Foxboro Green	148
6.	Wastewater Recommendations.....	150
6.1	Wastewater Treatment Plant.....	150
6.1.1	New Hamburg WWTP Phasing Plan.....	150
6.2	Baden/New Hamburg/Foxboro Wastewater Collection System.....	152
6.3	Recommendations for Future Monitoring.....	152
6.3.1	New Hamburg WWTP	152
6.3.2	Current ROW Surface Water Quality Monitoring Program	152
7.	References.....	154

List of Figures

Figure 1.1: Study Area	2
Figure 1.2: Class Environmental Assessment Master Plan Approach	4
Figure 1.3: Environmentally Sensitive Areas	15

Figure 1.4: Source Water Protection Areas	16
Figure 1.5: Mineral Aggregate Resource Areas	17
Figure 1.6: Changes to Planning Designations in New Hamburg	20
Figure 1.7: Changes to Planning Designations in Baden	21
Figure 1.8: Wastewater Treatment Schematic	23
Figure 1.9: New Hamburg WWTP Aerial View	25
Figure 1.10: Baden Catchment Areas and Sewer Schematic	29
Figure 1.11: New Hamburg Catchment Areas and Sewer Schematic	30
Figure 1.12: Population Growth Areas	33
Figure 1.13: Low Population Growth Scenario	36
Figure 1.14: High Population Growth Scenario	36
Figure 1.15: Flows to the WWTP from 2002 to 2007 by Day of the Year	39
Figure 1.16: Foxboro Green WWTP – 2008 Influent Flow Summary	44
Figure 3.1: WWTP Process Block Diagram (PBD)	55
Figure 3.2: Inlet Works - Excerpt from PBD	57
Figure 3.3: Headworks Process Block Diagram	60
Figure 3.4: Sequencing Batch Reactors – PBD Excerpt	63
Figure 3.5: SBR Decant Chamber – PBD Excerpt	66
Figure 3.6: Tertiary Filters – PBD Excerpt	67
Figure 3.7: Ultraviolet Disinfection – PBD Excerpt	69
Figure 3.8: Solids Handling Excerpt from Process Block Diagram	70
Figure 3.9: Sludge Stabilization Capacity for Each Option	74
Figure 3.10: Servicing Areas	76
Figure 4.1: Strategy for Determining Preferred Wastewater Treatment Alternative	81
Figure 4.2: Effluent Considerations in WW Alternatives	83
Figure 4.3: Phase 2 Upgrades – Liquid Train Process Flow	89
Figure 4.4: Alternative WW 4 A – Site Plan	91
Figure 4.5: MBR Package System Process Flow	97
Figure 4.6: Alternative WW-4-B	103
Figure 4.7: Alternative WW-5 – Simplified Process Configuration	105
Figure 4.8: Alternative WW-5-A	108
Figure 4.9: Alternative WW-5-B	112
Figure 4.10: Alternative WW-5-C	114
Figure 4.11: Study Area Topography	116
Figure 4.12: WW Collection Alternative 1A	123
Figure 4.13: WW Collection Alternative 1B	124
Figure 4.14: WW Collection Alternative 2A	127
Figure 4.15: WW Collection Alternative 2B	128
Figure 4.16: Foxboro Green WW Collection System Alternatives	130
Figure 6.1: New Hamburg WWTP – Proposed Implementation Plan	151

List of Tables

Table 1.1: Steering Committee Members	7
Table 1.2: Wastewater Class EA Recommendations and Status Update (1997)	8
Table 1.3: Baden - New Hamburg Wastewater Collection – Average Day Flows, L/s (m ³ /day)	9
Table 1.4: Inflow/Infiltration Recommendations (2009)	12
Table 1.5: Areas Added to Baden and New Hamburg Urban Development since 1997	19
Table 1.6: WWTPs C of A Info	22
Table 1.7: Description of Solids Handling Process Components	24
Table 1.8: Description of Liquids Handling Processes	24
Table 1.9: New Hamburg WWTP C of A Criteria	26
Table 1.10: Foxboro Green WWTP Effluent Objectives	27
Table 1.11: Baden WWPS Design Flows	28
Table 1.12: Morningside WWPS Design Flows.....	31
Table 1.13: Morningside Twin Forcemains Design Flows and Velocities.....	32
Table 1.14: Population Forecasts.....	34
Table 1.15: Population Forecasts for Serviced Urban Areas.....	34
Table 1.16: Baden / New Hamburg Population Serviced Growth Scenarios.....	35
Table 1.17: New Hamburg WWTP Per Capita Wastewater Flows.....	37
Table 1.18: Estimated Infiltration/Inflow Levels	38
Table 1.19: Wastewater Generation by Sector (Projected vs. Actual)	39
Table 1.20: New Hamburg WWTP Existing Wastewater Loadings.....	41
Table 1.21: Future Average Day Raw Wastewater Flows (m ³ /d).....	42
Table 1.22: Baden - New Hamburg per Capita Wastewater Contaminant Loads.....	42
Table 1.23: Hauled Waste and Septage Quantity Assumption.....	43
Table 1.24: Foxboro Green WWTP – Raw Wastewater Influent Quality	44
Table 1.25: Foxboro Green WWTP – Effluent Wastewater Quality	44
Table 1.26: Foxboro Green WWTP Loadings (2007)	45
Table 2.1: Dissolved Oxygen – Summary of Cases	49
Table 2.2: Minimum DO Concentration Results	50
Table 2.3: New Hamburg WWTP Recommended Effluent Objectives – for Planning Purposes.....	53
Table 3.1: Inlet Works – Design Flow Summary	58
Table 3.2: Description of Unit Process – Headworks	59
Table 3.3: Design Flow to Headworks (F6).....	60
Table 3.4: Description of Unit Processes - SBRs.....	62
Table 3.5: SBR Loading Capacity	63
Table 3.6: SBRs – Flow Summary.....	64
Table 3.7: SBR Capacity Comparison – Normal Operation Versus Overfill	64
Table 3.8: Tertiary Filters – Flow Summary	67
Table 3.9: Parameters in Solids Handling Analysis.....	72
Table 3.10: Sludge Stabilization Capacity Comparison.....	72
Table 3.11: Baden WWPS Design vs. Projected Flows	77
Table 3.12: New Hamburg WWPS No. 2 Installed vs. Projected Flows.....	78

Table 3.13: Morningside WWPS Design vs. Projected Flows.....	79
Table 4.1: New Hamburg WWTP Recommended Effluent Objectives – for Planning Purposes.....	82
Table 4.2: Population Projection Comparison.....	85
Table 4.3: Summary and Screening of Alternatives	86
Table 4.4: Summary of Optimized Capacity.....	89
Table 4.5: Alternative WW-4 – Screening Capacity	90
Table 4.6: Alternative WW-4 – Grit Removal Capacity.....	92
Table 4.7: Alternative WW-4 – Tertiary Filter Capacity.....	93
Table 4.8: Alternative WW-4 - SBRs	93
Table 4.9: Alternative WW – 4 – UV Disinfection	94
Table 4.10: Summary of Phase 2 Expansion Capacity	95
Table 4.11: Phase 2 Expansion – Estimated Cost	95
Table 4.12: Parallel Package Plant - Capacity Requirement	96
Table 4.13: Cost Estimate - MBR Package System – 2041 Low	98
Table 4.14: Cost Estimate – MBR Package System – 2041 High.....	99
Table 4.15: Summary of Cost – Alternative WW - 4.....	100
Table 4.16: Effluent TP Limits	101
Table 4.17: Cost Estimate – Stage 2 Filtration.....	102
Table 4.18: Summary of Optimized New Hamburg WWTP Capacity.....	105
Table 4.19: Headworks and UV Expansion Capacity.....	105
Table 4.20: Alternative WW-5 – Secondary Treatment	106
Table 4.21: Alternative WW-5 – Tertiary Filter Capacity.....	109
Table 4.22: Cost Estimate – Expand the Facility – Alternative WW-5.....	110
Table 4.23: Cost Estimate – Stage 2 Filtration.....	111
Table 4.24: Summary of Cost – Alternative WW - 5.....	113
Table 4.25: Option WWCS-1 - Estimated and Projected Flows per Catchment Area.....	118
Table 4.26: Option WWCS-2 - Estimated and Projected Flows.....	118
Table 4.27: Option WWCS- 1A - Estimated and Projected Flows.....	119
Table 4.28: Option WWCS-1B - Estimated and Projected Flows.....	121
Table 4.29: Option WWCS-2A - Estimated and Projected Flows.....	125
Table 4.30: Option WWCS-2B - Estimated and Projected Flows.....	126
Table 4.31: Wastewater Collection System Options Conceptual Cost.....	131
Table 5.1: Evaluation Components.....	134
Table 5.2: Evaluation Criteria for Water and Wastewater Alternatives.....	135
Table 5.3: Evaluation of Treatment Alternatives	141
Table 5.4: Summary of Alternatives – Baden/New Hamburg Collection System.....	145
Table 5.5: Summary of Alternatives – Foxboro Green Collection System.....	149

1. Introduction and Background

The communities of Baden and New Hamburg (Baden/NH) are situated within the Township of Wilmot (the Township) in the Regional Municipality of Waterloo (the Region). The water and wastewater systems in these communities are operated as a two tier system:

- The Region is responsible for water supply, treatment storage and trunk distribution while the Township is responsible for water distribution and water service connections.
- The Region is responsible for two main raw wastewater pumping stations, treatment, discharge and biosolids management while the Township is responsible for wastewater collection and a secondary pumping station.

The Study Area, shown in **Figure 1.1**, comprises of Baden and New Hamburg water and wastewater limits, as well as, the Foxboro Green wastewater services. Although the Foxboro Green subdivision community is not currently a part of the Baden and New Hamburg system, it is included in this Study for future consideration.

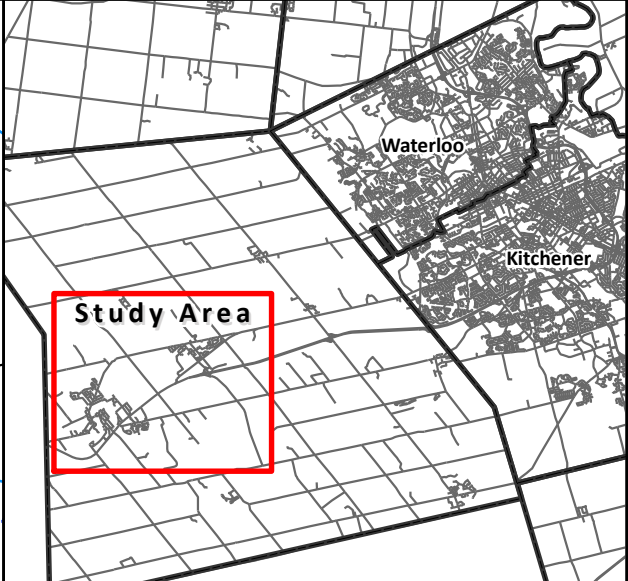
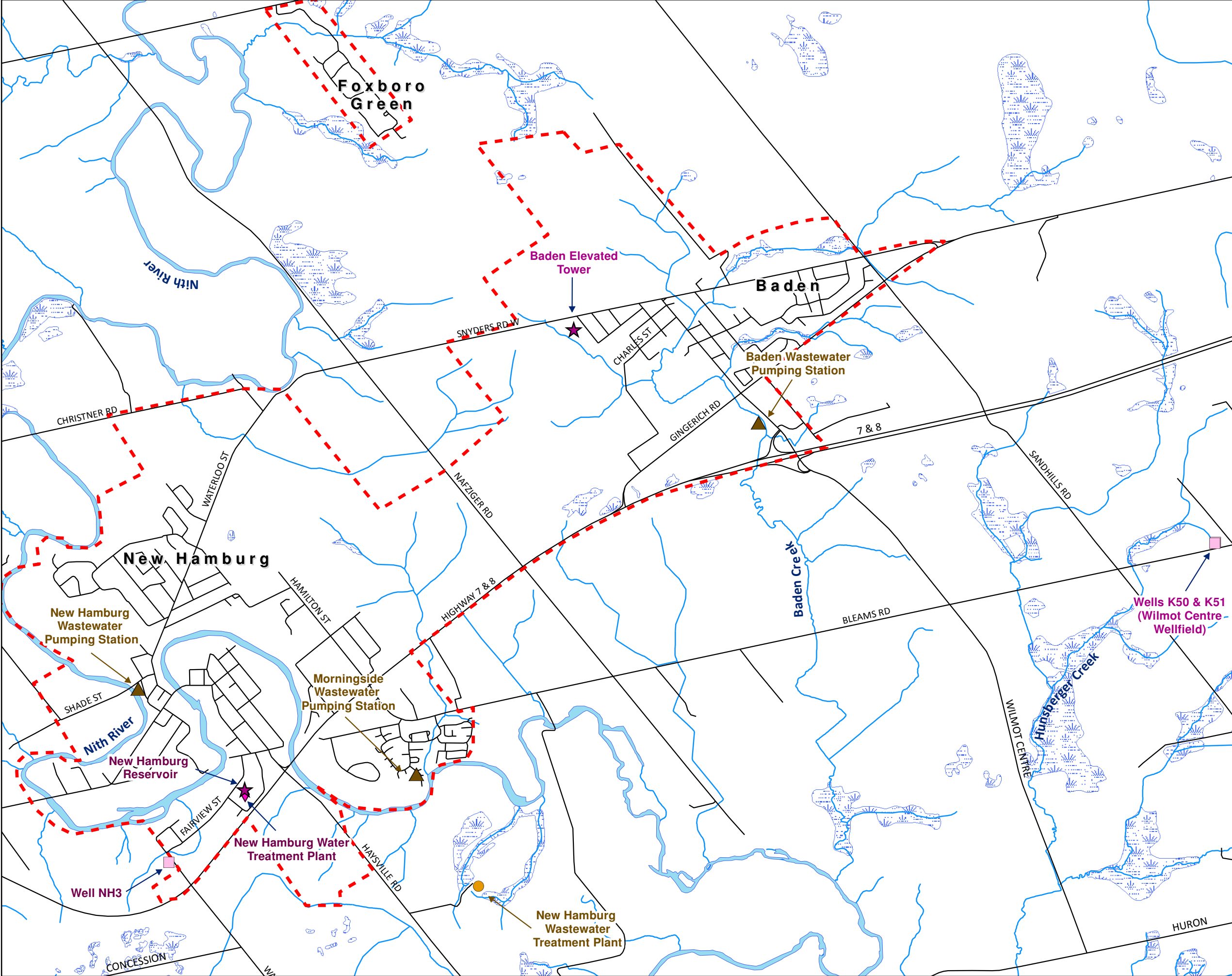
1.1 EA and Related Preparatory Work

1.1.1 Master Plan Purpose and Approach

Master Plans are long range plans which integrate infrastructure requirements for existing and future land use with environmental assessment planning principles. These plans examine an infrastructure system, or group of related projects, to outline a framework for planning for subsequent projects and/or developments. As a minimum, Master Plans should address Phases 1 and 2 of the Municipal Engineers Association (MEA) Class Environmental Assessment (Class EA) Master Plan Approach No. 1 (MEA Municipal Class EA Document, Appendix 4, October 2000 as amended in 2007). (See **Figure 1.2**)

Master planning provides a municipality with a broad framework through which the need and justification for specific projects can be established such that the environmental assessment process can be satisfied. Key features of a Master Plan include:

- Addressing the key principles of successful environmental planning.
- Addressing at least the first two phases of the Municipal Class EA to the extent possible.
- Allowing for an integrated process with other planning initiatives.
- Providing a strategic level assessment of various options to better address overall system needs and potential impacts and mitigation.
- Short and long-term planning.
- Taking a system wide approach to planning which relates infrastructure either geographically, or by function.
- Recommending an infrastructure master plan which can be implemented through separate projects.
- A description of specific projects (location, phased implementation plan, EA schedules and requirements).



Legend

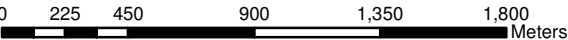
- Wastewater Treatment Plant
- ▲ Wastewater Pumping Station
- Water Wells
- ★ Reservoir & Elevated Water Tower
- ◆ Water Treatment Plant
- Roads
- Rivers
- Nith River
- Wetlands
- - - Study Area

Baden - New Hamburg Water & Wastewater Master Plan Update

Figure 1-1: Study Area

Datum: NAD 83, Zone 17
Source: Region of Waterloo

June 2011



Examples of Master Plans include: wastewater and water plans for entire or major portions of a municipality; wastewater treatment plans and water supply plans for a community or municipality; watershed/ subwatershed plans; transportation master plans; and infrastructure master plans.

The Baden – New Hamburg Water and Wastewater Master Plan update has addressed all requirements of Phases 1 and 2 of a 'Schedule C' process as prescribed by the Class EA for Municipal Water and Wastewater Projects. The Master Plan document will be made available for public comment. The Master Plan update is completed at a broad range level of assessment, requiring more detailed investigations at the project-specific level to fulfill Municipal Class EA documentation requirements for any specific Schedule B or C projects identified within the Master Plan. The Master Plan will therefore become the basis for, and be used in support of, future investigations for any specific Schedule B and C projects identified within.

Schedule B projects will require the completion of Phase 2 for those aspects specific to a particular project, and filing of the Project file for public review. Schedule C projects will have to complete Phase 2 as above, and fulfill Phases 3 and 4 of the process prior to filing an Environmental Study Report for public review.

The Water/Wastewater Master Plan should also be reviewed at a minimum frequency of every ten years (September 2007 Class EA amendment), to determine the need for a detailed formal review and/ or updating. Potential changes which may trigger the need for a detailed review include:

- Major changes to original assumptions;
- Major changes to components of the Master Plan;
- Significant new environmental effects;
- Major changes in the proposed timing and/or scope of projects recommended within the Master Plan.

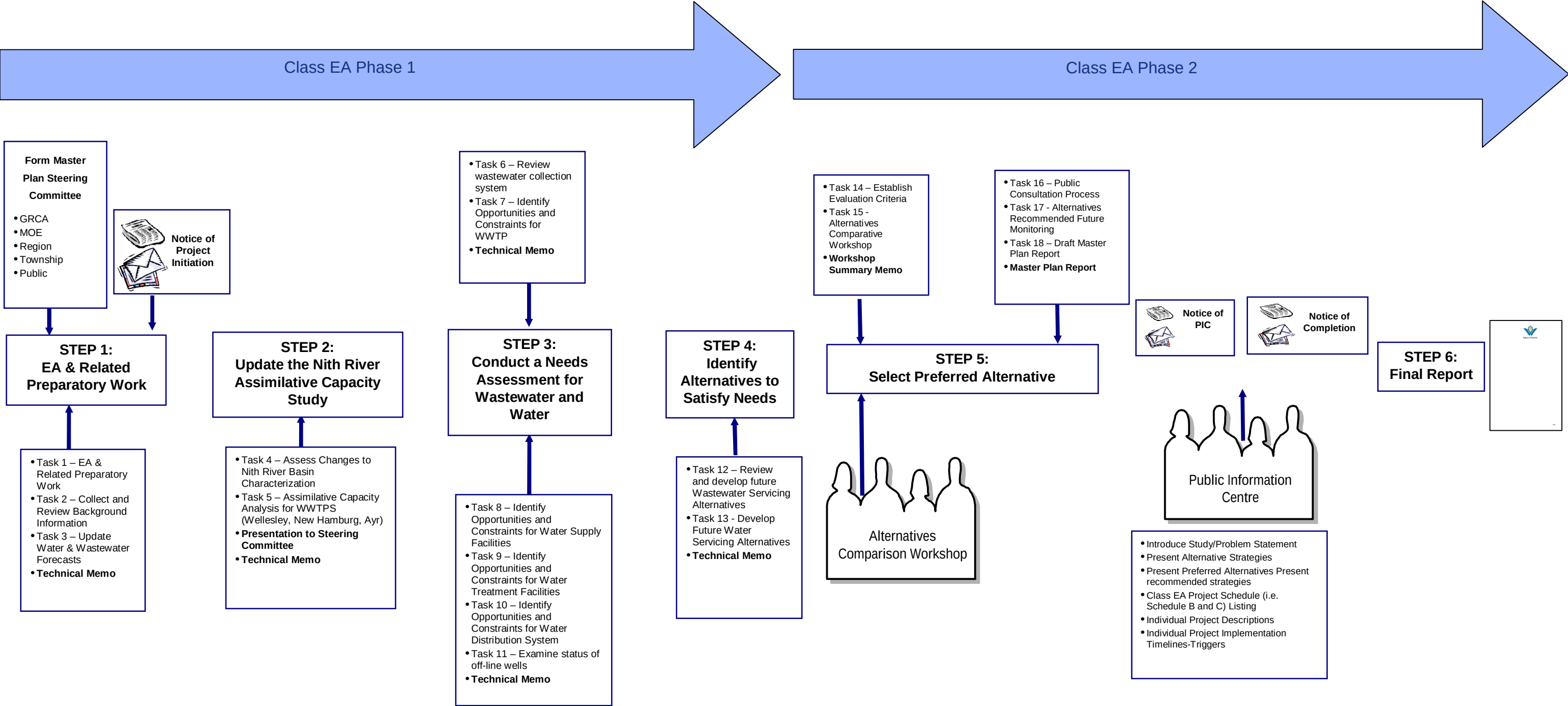


Figure 1.2: Class Environmental Assessment Master Plan Approach

1.1.2 Purpose Statement

Phase 1 of the Class EA planning process requires the proponent of an undertaking to first document factors leading to the conclusion that the improvement or change is needed, and ultimately, develop a clear statement of the identified problems, deficiencies or opportunities to be investigated. As such, the Purpose Statement is the principle starting point in the undertaking of a Class EA study and becomes the central theme and integrating element of the project. It also assists in setting the scope of the project.

In developing the Purpose Statement for the Baden – New Hamburg Water and Wastewater Master Plan, the following was considered:

- The Region of Waterloo and Township of Wilmot have the mandate to provide water/wastewater services in a safe, efficient and cost effective manner to meet the demands of the customers it serves. Customers include the residential, industrial, commercial and institutional (ICI) sectors.
- The Regional Official Plan and the Township of Wilmot Official Plan outline the future growth for Wilmot Township and for Baden - New Hamburg respectively.
- According to the Region of Waterloo's 2008 Water and Wastewater Monitoring Report, the communities have water supply capacity well beyond the anticipated demand in 2016. However, with the projected growth anticipated to 2016, the wastewater flows will be at or approaching the hydraulic design capacity of the New Hamburg WWTP.
- The 2007 Wastewater Treatment Master Plan outlined receiving water status for various parameters of concern, including total phosphorus as Policy 2, to be addressed through an updated assimilative capacity analysis for any re-rating or expansion of the existing wastewater treatment plant. Recognition is given to the possibility that future growth opportunities are impacted by the ability of the Nith River to assimilate treated effluent from the wastewater treatment facility.
- Consideration is to be given to recognition of historical and continued non-point source control for phosphorus in support of plans for expansion of the WWTP with Best Available Technology – Economically Achievable (BAT-EA).
- Increase in water supply from the Wilmot wellfield (K50/51) is subject to the Wilmot Water Taking Policy, a long standing agreement requiring on-going monitoring and review and consultation with the Public Liaison Committee, prior to implementation.
- Consideration is to be given to initiatives for water conservation and enhanced efficiency, education programs and reduced outside water use,
- Consideration is to be given to initiatives to implement reduction in high inflow and infiltration (I&I) rates currently experienced.
- Opportunities for review agency and public consultation are to be considered for study alternatives and recommendations.

Based on the above conditions and incorporating the concerns of public comments, agency and municipality input, the Purpose Statement is defined as follows:

“The goal of this Master Plan Study is to update previous Master Plan and Class EA studies with recent works, revised population projections and policies, and changes in the environment. It will identify strategies that will optimize existing systems and increase capacities of the existing water

supply/treatment/distribution/storage and wastewater conveyance/pumping/treatment systems to provide servicing into the future. The strategies are to ensure that:

- an adequate amount of water can be provided in a safe, reliable and cost-effective manner to satisfy current and long-term requirements;*
- wastewater can be conveyed and treated in a safe, reliable and cost-effective manner to satisfy current and long-term requirements, with consideration for the receiving water's assimilative capacity.*

The study will have regard for established sustainability and environmental planning principles that properly consider potential impacts to sensitive land uses such as the natural environment and agriculture. Furthermore, the study will define and factor in the role of water conservation/efficiency including decrease of water losses, inflow/infiltration reduction measures, and innovative strategies which can extend the life of existing infrastructure along with future systems.”

1.1.3 Master Planning Approach

The Master Plan approach is based on the requirements outlined in the Region's Request for Proposal (RFP) dated April 2008, a review of the background information outlined above for the project; and the Class EA Master Planning process; and on past Regional projects including the Wastewater Treatment Master Plan (2007) and the Baden – New Hamburg Water Supply Master Plan. Key aspects include:

- Problem Statement preparation;
- Public consultation;
- Confirming projected populations/demands;
- Evaluating existing water and wastewater system capacity and receiving water assimilative capacity;
- Identifying alternative water/wastewater solutions;
- Developing evaluation criteria and a process for alternative comparison/assessment;
- Incorporating public feedback;
- Evaluating alternatives;
- Preparation of a draft implementation plan; and
- Final reporting.

1.1.4 Steering Committee

In addition to the public consultation process planned for this study, it was determined that it would be most beneficial to involve the Township and surrounding communities, as well as key government review agencies to provide input into the project. The intent is for the Steering Committee to provide input and advice to the Project Team in the direction of the project at key stages. Membership of the Steering Committee is provided in **Table 1.1**.

Table 1.1: Steering Committee Members

Member	Association
Sandra Cooke	Grand River Conservation Authority
Barbara Slattery	MOE
Paul Odom	MOE
Grant Whittington	Township of Wilmot
Peter Roe	Township of Wilmot
Les Armstrong	Township of Wilmot
Gary Charbonneau	Township of Wilmot
Kaoru Yajima	Region of Waterloo
Jorge Cavalcante	Region of Waterloo
Khalid Mehmood	Region of Waterloo
Kevin Curtis	Region of Waterloo
Olga Vrentzos	Region of Waterloo
Margaret Parkin	Region of Waterloo
Eric Hodgins	Region of Waterloo
Jerry Borovicka	Region of Waterloo
Nancy Kodousek	Region of Waterloo
Thomas Schmidt	Region of Waterloo
Rachel Vaillancourt	Region of Waterloo

The first Steering Committee meeting was held on October 10, 2008 to introduce all to the project and its objectives, including an overview of background studies and previous Class EA projects related to water and wastewater in the communities of Baden and New Hamburg. The project team gave details on the scope of the project highlighting potential issues for community growth. Lastly, the Notice of Study Commencement was issued to the Steering Committee for review.

The second Steering Committee meeting was held on June 15, 2009 to review the population projections, the water distribution modeling, Nith River Assimilative Capacity, and the New Hamburg WWTP Process modeling.

The third Steering Committee meeting was held on November 20, 2010 to present the alternative solutions and the Public Information Centre (PIC) boards (PIC held on December 2, 2010).

1.1.5 Stakeholder Contact List

The stakeholder contact list was developed by including all those contacts confirmed through the recent (2007) Regional Wastewater Treatment Master Plan. Additional groups or individuals were added who were identified as potential stakeholders or who expressed interest in previous studies, through

consultation with the Township. This list was updated throughout the project with requests from the public and through identification of agencies or special interest groups that could be impacted or have interest in specific alternatives. The latest contact list as of December 16, 2010 is provided in **Volume 4: Appendix A**.

In addition, all correspondence is documented and responses tracked in accordance with the EA process.

1.1.6 Notice of Commencement

The Notice of Commencement was published in the Kitchener - Waterloo Record as well as the New Hamburg Independent. Copy of the Notice is provided in **Volume 4: Appendix A**.

1.1.7 Public Information Centre

The Notice of Public Information Centre (PIC) was published in the local newspapers the week of November 15 and 22, 2010. Copy of the notice of PIC and boards are provided in **Volume 4: Appendix F**.

The PIC was held on December 2, 2010 at the Township Office, from 4:30 to 7:30 pm.

1.2 Previous Studies/Reports

There has been an array of studies, reports, and projects undertaken and completed on the Baden and New Hamburg Area. A summary of these studies is presented in this section. Information pertinent to historical and existing condition is included in **Section 1.3.3**.

1.2.1 New Hamburg Baden Wastewater Treatment Class Environmental Assessment (July 1997)

This watershed characterization study provided critical input into development of alternatives for modifications and expansion to the wastewater collection and treatment system in Baden and New Hamburg up to the year 2016 with a view to the long term (2041) (Stanley, 1997). This Schedule C Class EA undertaking examined a number of wastewater treatment system configurations. The recommended alternatives and their updated status are provided in **Table 1.2**.

Table 1.2: Wastewater Class EA Recommendations and Status Update (1997)

Recommended	Status Update
Decommissioning of the Baden WWTP and conversion to a wastewater pumping station	Baden WWPS has a firm capacity of 4,234 m ³ /d (49 L/s) to the New Hamburg WWTP, and 1,400 m ³ equalization tank for storage
- Construction of the Morningside wastewater pumping station - Combining of the Baden and New Hamburg	Morningside WWPS has a firm capacity of 22,637 m ³ /d (262 L/s) to the New Hamburg WWTP

Recommended	Status Update
wastewater flows	
Decommissioning of the New Hamburg Pumping Station No. 1	New Hamburg Pumping Station No. 1 was decommissioned.
Installation of the necessary forcemains to the New Hamburg WWTP and gravity sewers to new WWPSs	Forcemains and gravity sewers were installed to service new WWPSs
Upgrading the New Hamburg WWTP using best available technology-economically achievable (BAT-EA) to reduce phosphorus loads (expanded to 2016 flow of 5200 m³/d with additional consideration of 2031 flow of 7200 m³/d). The preferred design alternative consisted of sequencing batch reactors (SBR) sized to provide full nitrification, with UV disinfection and sand filtration	New Hamburg WWTP was upgraded in 2001 to handle wastewater flow to the design year 2016, with a rated capacity of 5,200 m³/day, including: - Chemical phosphorus removal technology; - SBRs to provide full nitrification; - UV disinfection; - Sand filtration.

In addition to the above recommendations, the groundwork was set in place for implementation of the Region's Rural Water Quality Program (RWQ) to address non-point source nutrients to the Grand River watershed (including phosphorus) in collaboration with the Grand River Conservation Authority and other provincial agencies. Other recommendations included working with the Township to carry out infiltration and inflow (I&I) reduction programs and water efficiency efforts.

1.2.2 New Hamburg – Baden Wastewater Treatment and Conveyance Infrastructure – Preliminary Design Report (1998)

In carrying out the recommendations of the 1997 Schedule C Class Environmental Assessment, the Township of Wilmot retained Stanley Engineering to carry out the preliminary design of upgrades to the New Hamburg WWTP and Baden Pumping Station.

Prior to the expansion, the New Hamburg WWTP consisted of an aerated lagoon, facultative lagoons and intermittent sand filtration.

According to the Preliminary Design Report, the gravity trunk sewers and forcemain were designed to accommodate ultimate design flows (2041 flows) while the design of certain features of the Baden and Morningside sewage pump stations were staged, first for 2016 capacity, with additional capacity to be added later to provide for 2041 flows. A summary of the design average day wastewater flows used in the conveyance system upgrades is provided in **Table 1.3**.

Table 1.3: Baden - New Hamburg Wastewater Collection – Average Day Flows, L/s (m³/day)

Area	Year		
	1996	2016	2041
Baden	8.3 (715)	17.9 (1,550)	22.6 (1,950)
New Hamburg	20.5 (1,775)	41.1 (3,550)	63.1 (5,450)
Total	20.8 (2,490)	59.0 (5,100)	85.7 (7,400)

Pump station features that were designed for an interim (2016 flow include):

- Pumps;
- Pump motors;
- Electrical equipment;
- Standby generator.

Pump station features that were designed for an ultimate (2041) flow include:

- Structural features;
- Pipework (including forcemains);
- Equalization pumps designed for 2041 design flow.

1.2.3 New Hamburg Wastewater Treatment Plant – Design Brief (1999)

This document summarizes the specific process and hydraulic design components relating to the upgraded New Hamburg Wastewater Treatment Plant, including the Morningside Wastewater Pumping Station, and the interconnecting forcemain. Upgrades to the plant were carried out in 2000 including:

- Screening and Grit removal;
- Sequencing Batch Reactors (SBRs) for secondary treatment;
- Tertiary filtration, and
- Disinfection by UV irradiation.

The original design intent was to have biological phosphorus removal (BPR) accomplished in the SBRs, with a back up chemical dosing system to augment the BPR. The plant is not operating in a BPR mode and phosphorus removal is achieved through chemical addition (alum).

Further details regarding the WWTP are provided in **Section 1.3.3.1**.

1.2.4 Region of Waterloo Wastewater Treatment Master Plan (2007)

The Region completed a Wastewater Treatment Master Plan (WWTMP; 2007) for all of its existing Regional wastewater treatment plants (WWTPs), with consideration for servicing future growth areas. As it pertains to WWTPs discharging to the Nith River, it documented the following:

- The Nith River is MOE Policy 1 for un-ionized ammonia and Policy 2 for phosphorus;
- Continued tertiary treatment is recommended for phosphorus removal at all WWTPs for future flows while a reduction in effluent un-ionized ammonia (UIA) concentration may be required for New Hamburg WWTP effluent;

¹ Policy 1 refers to “water quality better than the Provincial Water Quality Objectives...” (MOE, 1994).

- The proposed strategy for the New Hamburg WWTP is to re-rate the existing plant to 7800 m³/d and further expand to 10,500 m³/d by 2041, pending assimilative capacity assessment of the Nith River.

1.2.5 Baden and New Hamburg Sanitary Sewer Inflow and Infiltration Study (2009), New Hamburg Sewage Collection Optimization Study (1998)

The Baden/New Hamburg Sanitary Sewer Inflow and Infiltration Study (CRA 2009), carried out by the Township, was initiated due to the higher than expected flows to the New Hamburg WWTP that was suspected to be caused by an increase in I/I in the collection system. This study identified inflow and infiltration (I/I) problem areas in sewer pipes installed prior to 1985 within the Study Area. Baseline parameters were established based on reviews of previous reports, including the 1998 New Hamburg Sewage Collection System Optimization Study (Stanley, 1998) and the 1994 Baden Sanitary Sewer System I/I Study.

In the determination of design flows, the findings of the 1994 Baden Sanitary Sewer System I/I Study and the 1997 New Hamburg Sewage Collection Optimization Study estimated that the Baden Average Dry Weather Flow (ADWF) included approximately 170 lpcd of I/I flow and the New Hamburg ADWF included approximately 105 lpcd of I/I. As future development was expected to have reduced I/I levels through the use of modern construction materials and practices, 90 lpcd of I/I was deemed to be appropriate for consideration in design flows.

The findings of the study are summarized as follows:

- Baden – There was a noted increase in dry weather flows attributed to the substantial increase in subdivision development over the study period. An increase in dry weather I/I was found in the Foundry and Snyder's Road West Catchments of 5.54 L/s and 0.02 L/s respectively. However no dry weather flow I/I increase was detected in the Snyder's Road East or Brewery Catchments. No wet weather I/I was found in any of the catchments. The measured increase in dry weather I/I flow represents approximately 21% of the total dry weather average flow in Baden during the monitoring period.
- New Hamburg – A dry weather flow I/I increase was detected in two of the four New Hamburg catchments (Catchment Areas 2 and 4). The increase in I/I to Catchment Area 2 was approximately 1.79 L/s and to Catchment Area 4 was 12.17 L/s. An increase in flows related to a wet weather flow response was noted in the New Hamburg Catchments 2, 3 and 4. The measured increase in dry weather I/I flow represents approximately 24% of the total dry weather average flow in New Hamburg during the monitoring period.

The I/I study stated the following conclusions:

- The Baden Award Drain was not found to be connected to the sanitary sewer;
- In New Hamburg's Catchment Area 3, no connection of downspouts and well overflows with sanitary sewer were found on Greenwood Drive;
- Substantial heavy calcite build-up was found in the sanitary sewer system that was obstructing flow and reducing capacity of sewers.

The recommended alternatives to minimize I/I problems are provided in **Table 1.4**.

Table 1.4: Inflow/Infiltration Recommendations (2009)

Location ¹	Recommended
B	Discharge pipe at 49 Elizabeth Street to be investigated to confirm whether an illegal connection exists or not.
B	Continued flow monitoring at Waterloo-Oxford Secondary School to be completed to confirm whether school's weeping tiles or groundwater wells are connected to the sanitary sewer.
B	Review pump station output level at Charlotta Street pump station to prevent peak flows from surcharging the sanitary trunk sewer.
B	Provide proper maintenance of sanitary trunk sewer along Charlotta and Foundry Street.
NH	Complete detailed investigation on both Riverside Drive and Harlew Court utilizing CCTV Surveys and by-pass sewer pumping to identify the source of groundwater infiltration.
NH	Raise the rim elevation at MH91 located in the south swale of Highway 7/8.
G	Ensure adequate inspection is maintained at new residential developments with respect to I/I control.
G	Consider the feasibility of creating a Township by-law requiring property owners to ensure there are no illegal connections to the public sewer as a condition of property sale.
G	Ensure all cases of moderate to heavy encrustation are scheduled to be cleared on a periodic basis to prevent obstruction of flow capacity.
Notes: 1) B - Baden; NH – New Hamburg; G – General Area (both Baden and New Hamburg)	

1.3 Study Area Background

1.3.1 Natural Environment

A detailed inventory of the natural and social environment of Baden and New Hamburg was completed in the Environmental Study Report for the WWTP expansion (Stanley and Paragon, 1997) as well as the Water Supply Master Plan (Paragon, 1996). This information is summarized herein and updated with more recent planning information provided by Wilmot Township.

The study area is located along the western edge of the physiographic region referred to as the Waterloo Moraine, or the Waterloo Sandhills. Topography within the area is hummocky to gently rolling, with a local relief of approximately 45 m near Baden. Ground surface elevations within the study area gently decrease in a southwesterly direction from a high of approximately 405 masl in the area around the Baden Hills to approximately 330 to 340 masl along the Nith River in New Hamburg. The topographic high near St. Agatha corresponds to the surface water divide that extends south between Baden and Petersburg, diverting water west to the Nith River and east to Alder Creek.

The area surrounding the New Hamburg WWTP consists of rural area, much of it being used for agricultural crops, with prime agricultural soils with no limitations in use for crops to moderately severe limitations reducing the choice of crops or requiring special conservation practices. There is also much woodland in the immediate vicinity of the WWTP and along the Nith River. Several high quality upland hardwood stands are noted in the vicinity of the WWTP, some of which are located on steep erodible slopes. These natural and semi-natural areas consist of a mixture of upland hardwood forest, hardwood swamp, marsh, successional lands (e.g. shrub land, brushy grassland and meadow) and hedgerows.

Active farm complex and residential dwellings are only found in the southern and eastern parts of the study area along township roads 12 and 13. An extra high voltage hydro transmission line runs north-east to south-west across the study area on agricultural land to the south of the WWTP.

The New Hamburg WWTP is surrounded by a mixture of swamp and marsh communities characterized by a wetland complex which lies within the oxbow of the Nith River. This area, which in the Environmental Study Report (ESR) study was called the New Hamburg Oxbow Wetland Complex, was evaluated in this study and determined to be a Class 4 Locally Significant Wetland. The presence of locally significant plant and wildlife species and its recreational and educational use by the local community were noted. Municipalities are encouraged to conserve these locally significant wetlands.

The area surrounding the Baden Wastewater pumping station (WWPS) is an urban fringe environment generally consisting of a mixture of active and idle agricultural land, residential, commercial and institutional uses. Natural areas including some woodland occur only in peripheral locations. The Baden Hills ESPA 13 occurs about 400 m east of the Baden WWPS. Generally the lands in the vicinity of the WWPS are disturbed, developed, successional or in agricultural production. There are no significant natural features noted in previous reports other than Baden Creek and one locally significant plant.

Greenlands Network

The 2009 Official Plan classifies the Region's Greenlands Network in landscape level systems and core environmental features. Landscape level systems include significant valleys, environmentally sensitive landscape, provincial greenbelt natural heritage system, and regional recharge areas and they do not affect agricultural uses and associated normal farm practices. Core environmental features include provincially significant wetlands, environmentally sensitive policy areas, regional forests, forests greater than 4 ha, and significant valley features that require maintenance, protection and enhancement of biodiversity and important ecological functions. As identified on **Figure 1.3** (2009 Regional Official Plan, Map 4), the Study Area has significant valleys (shown in light green) along the Nith River, and core environmental features (shown in dark green) between Baden and New Hamburg, as well as between Wellesley and New Hamburg. These features were identified in the Regional Official Policies Plan (2006) as the Phillipsburg Forest, Baden Hills, Spongy Lake, St. Agatha Forest, Nith River Valley, and Shantz Bush.

The 2009 Regional Official Plan does not list each feature, but the same areas are identified in **Figure 1.3**.

The Spongy Lake is considered to be a Provincially Significant Wetland within the study area. This resource as identified by the Ministry of Natural Resources consists of a small perched lake adjacent to the St. Agatha Forest.

Floodplains and other Watercourses

The Nith River generally flows from north to south through the Town of New Hamburg at the west limit of the study area. The Nith River Floodplain has been identified by the Grand River Conservation Authority and is controlled through their policies and guidelines. Land use designations are applied to areas within the floodplain. Activities within the floodplain are subject to the approval of the Grand River Conservation Authority and may be permitted within the floodplain in a one zone policy area or a floodway in a two zone

policy area. In addition to the Nith River, a number of other watercourses are located in the study area including the following:

- Baden Creek
- Hunsberger Creek
- Alder Creek
- Hofstetter Lake

Source Water Protection Areas

The Region has developed a water protection strategy to identify, protect, and conserve the Region's drinking-water resources. The 2009 Regional Official Plan has identified three Wellhead Protection Sensitivity Areas (WPSA) within the Study Area. *Area 1* is surrounding a well on Concession South of Erb Road, *Area 2* is surrounding a well on Walker Road, and *Area 3* is surrounding two wells on Bleams Road. Areas 1 and 2 are classified as WPSA-1 at the wellhead, WPSA-4 in the proximities of the wellhead, and WPSA-5 further from the wellhead locations. *Area 3* is classified as WPSA-1 at the wellhead, WPSA-6 in the proximities of the wellheads, and WPSA-7 further from the wellhead locations. WPSA-1 as defined in the 2009 Regional Official Plan "delineates areas within a 100 meter radius of each municipal drinking-water supply well and it represents the highest sensitivity area with respect to potential movement of disease causing organisms and groundwater infiltrations". WPSA-4 "delineates medium sensitivity areas found within the two year time of travel to a municipal drinking-water supply well". WPSA-5 "delineates medium sensitivity areas found outside of the two year, but within the ten year time of travel to a municipal drinking-water supply well." WPSA-6 "delineates low sensitivity areas found within the two year time of travel to a municipal drinking-water supply well." WPSA-7 "delineates low sensitivity areas found outside of the two year but within the ten year time of travel to a municipal drinking-water supply well." The subsurface geologic materials of these wells allow rapid movement of water and they contribute a large portion of the water supply to the Region. **Figure 1.4** (2009 Regional Official Plan, Map 6c) shows the location of both areas.

Mineral Aggregate Resources

A number of mineral aggregate resource areas have been designated by the 2009 Regional Official Plan within the study area. Mineral Aggregate Resource areas represent locations where there is high potential for mineral aggregate extraction due to the quantity of high quality mineral aggregate deposits. Area municipalities establish policies in their Official Plans and regulations in their zoning bylaws to protect these mineral aggregate resource areas from land uses which are not compatible with future extraction. These areas are shown in **Figure 1.5** (2009 Regional Official Plan, Map 8).

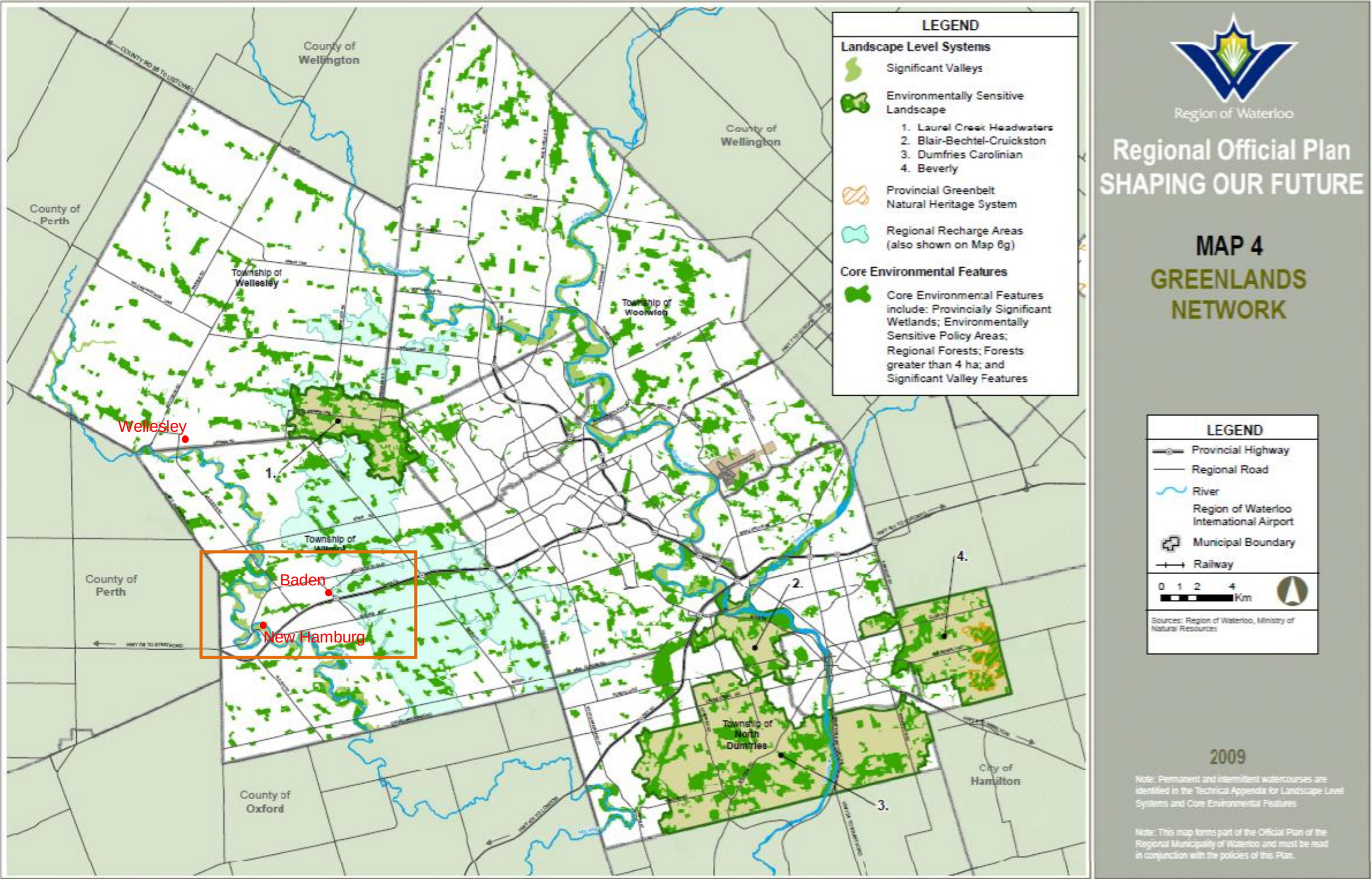


Figure 1.3: Environmentally Sensitive Areas

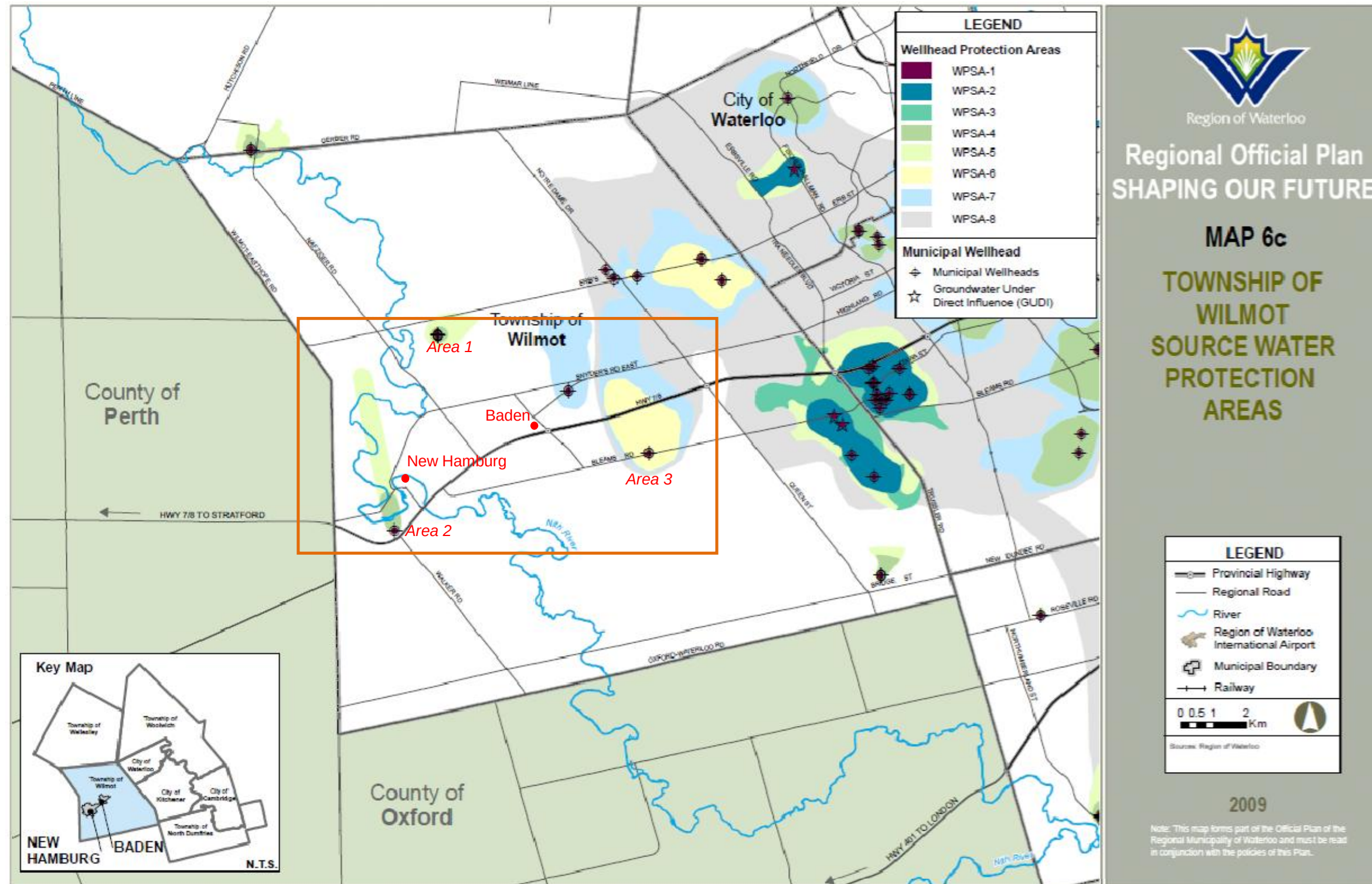


Figure 1.4: Source Water Protection Areas

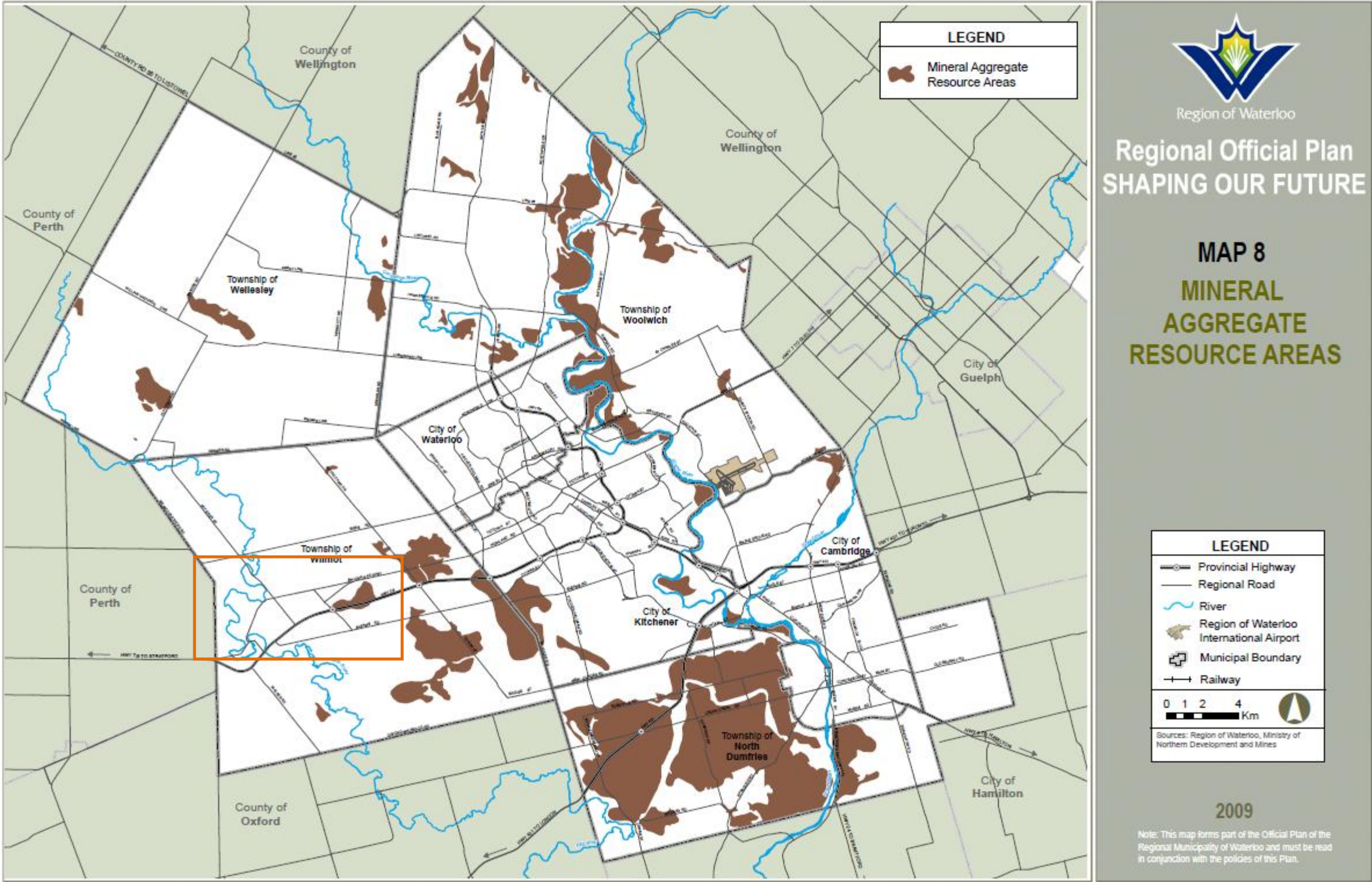


Figure 1.5: Mineral Aggregate Resource Areas

1.3.2 Socio-Economic Environment

1.3.2.1 *Existing and Future Land Use Update*

Baden and New Hamburg are designated as the two primary Township Urban Areas in the Regional Official Plan, as the majority of the population and household growth within the Township will occur in these settlement areas. According to the Township of Wilmot's 2008 Official Plan, the land use in Baden and New Hamburg is primarily Residential, Light Industrial, and Major Recreational. The areas surrounding Baden and New Hamburg are mainly prime agricultural. A number of areas with environmental constraints, such as protected areas designated as Locally Significant Natural Areas, follow the Nith River and its tributaries through both communities.

In general, since the 1996 Master Plan, the Township of Wilmot's Official Plan was updated which altered future growth patterns from an 'outward' development concept to an 'in-filling' development concept, i.e. between the two communities.

The Township of Wilmot Planning Department provided **Figure 1.6** and **Figure 1.7** along with a description of changes in planning designations to illustrate the changes from the pre-1998 Settlement Boundary to the post-1997 Urban Area Boundary in New Hamburg and Baden, respectively. Also shown are the land use designations per the current Township Official Plan. In May 1994 the Regional Council had adopted a designation of approximately 704 gross hectares of land surrounding Baden/NW as "Township Urban Area"; however, it was subsequently deferred by the Ministry in November 1995 (Region, 2004). In general, since the work completed in 1996 on the Water Supply Master Plan and the Wastewater WWTP Class EA, 322 hectares have been added to the urban areas of Baden and New Hamburg with the majority of this area occurring between the two communities. Of this additional land, almost half (151 hectares) is designated as urban residential, with a small fraction environmentally constrained. Another 96 hectares is designated as general and light industrial, in areas just east of New Hamburg. The following **Table 1.5** summarizes the land added (in hectares) to the urban area since 1997. In addition, there are approximately 35 hectares in the northeast corner of New Hamburg just outside the Urban Area Boundary which does not currently have an urban area designation, but will be the first area considered when additional lands are designated as part of the new Regional Official Plan process. The Township Urban Area for the year 2041 is projected in 1,124 hectares.

Table 1.5: Areas Added to Baden and New Hamburg Urban Development since 1997

Area No.	Urban residential	Environmentally constrained ¹	Open space	General industrial	Light industrial	Major recreation	Future urban area
1	12.1	1.2					
2	7.3		10.5				
3			23.5	63.5	19.8		
4				3.6			
5	46.9						
6	9.3						
7	1.6	1.0					
8	63.9						
9	10.1						
10			21.0	6.5		19.4	
11		1.2			2.8		
Future land use							35.2
Total (ha)	151.4		55.0	73.7	22.7	19.4	35.2
Total area added since 1996 (ha)						322.1	
Notes: 1) Area included in Urban industrial							

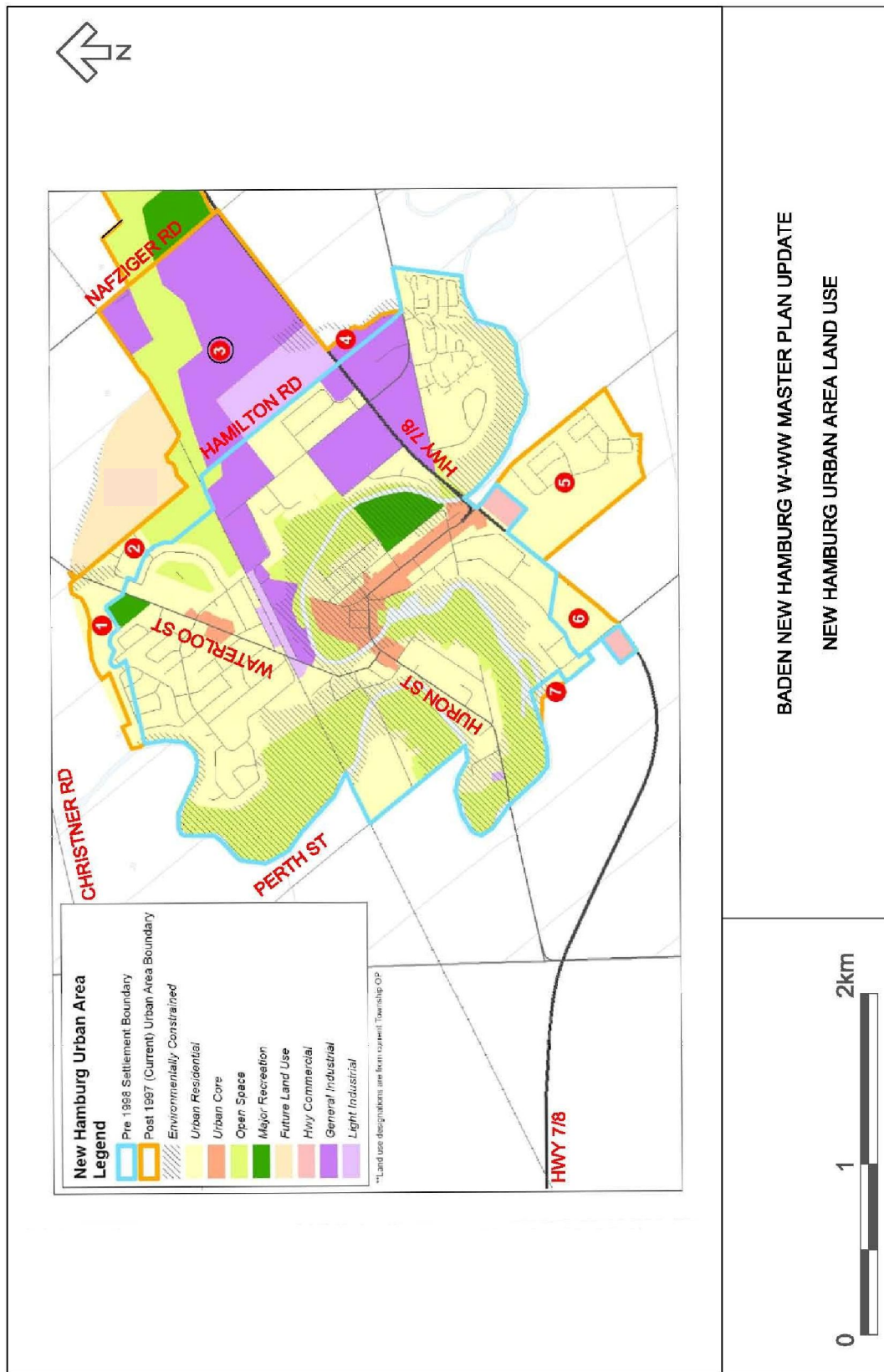


Figure 1.6: Changes to Planning Designations in New Hamburg

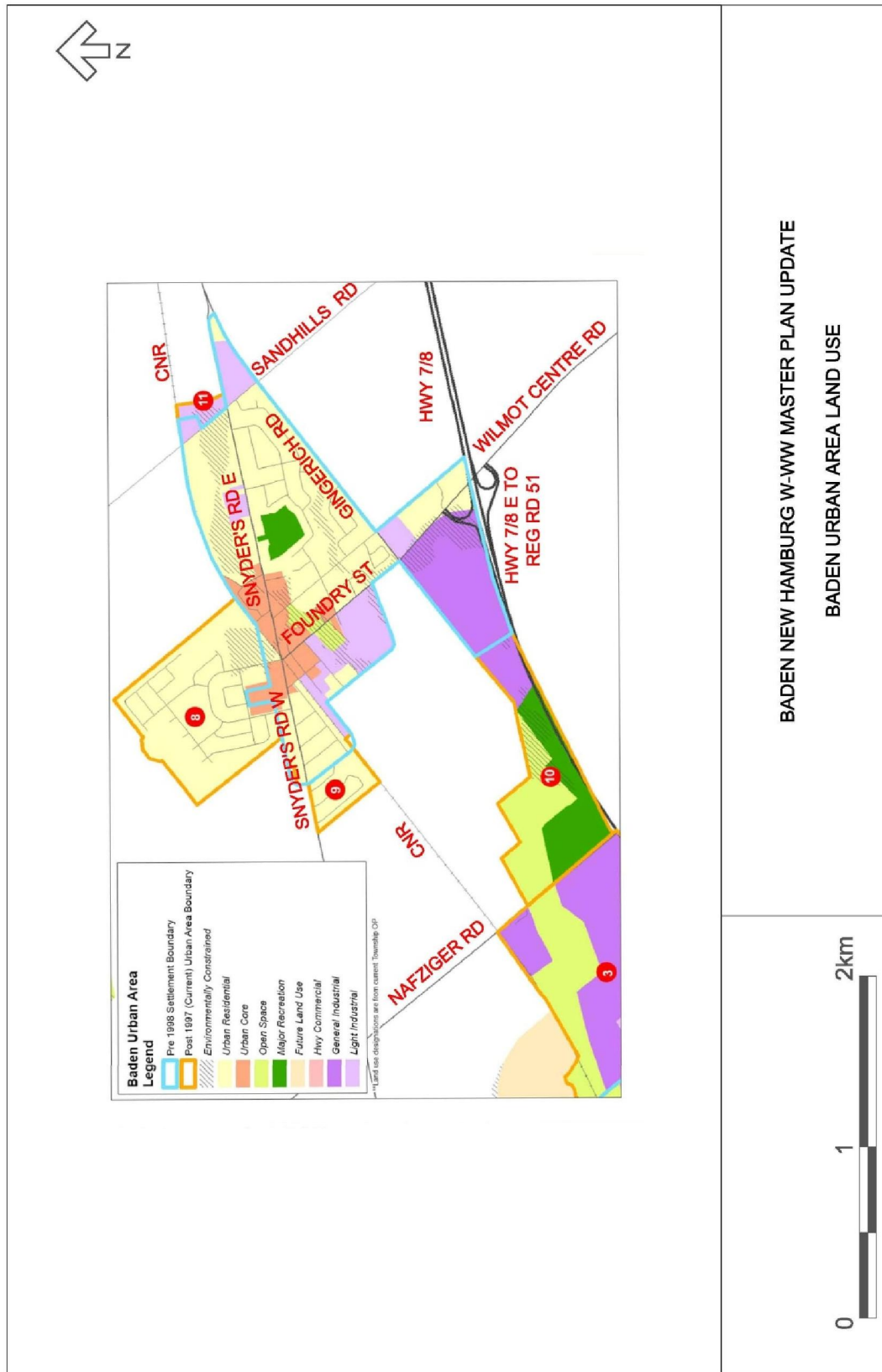


Figure 1.7: Changes to Planning Designations in Baden

In addition to lands added to the urban area, other major changes in land use since the 1996 Master Plan include:

- Additional build up of residential areas in the western areas of New Hamburg;
- Conversion of open space to institutional in the southwest area of Baden; and,
- Conversion of commercial areas to residential areas in the eastern portion of Baden.

As the communities of Baden and New Hamburg grow in the future, opportunities to increase the treatment capacity of the WWTP are potentially limited by the assimilative capacity of the Nith River.

1.3.2.2 *Heritage and Cultural Resources*

The study area is primarily agricultural, and also includes a number of heritage and cultural features located in urbanized areas. Cultural facilities within the study area include a number of public schools, Waterloo-Oxford District Secondary School and several churches. A new JK to grade 6 school located on Snyders Road West was slated to open in 2010.

1.3.2.3 *Transportation*

The existing transportation network includes Provincial Highway 7/8 which bisects the study area in an east-west direction. The remaining roads within the study area are under the jurisdiction of either the Region of Waterloo or the Township of Wilmot. A major CN Rail line bisects the area in an east-west direction, running north and parallel to Highway 7/8. Based on the ESR, the contemplated GO Transit expansion to Kitchener-Waterloo is considering a station and layover in Baden near Nafziger Road and the CN right of way.

1.3.3 Existing Conditions

1.3.3.1 *Wastewater Treatment*

Currently wastewater from the Baden and New Hamburg service areas are conveyed to the New Hamburg Wastewater Treatment Plant (WWTP) for tertiary treatment and subsequently discharged into the Nith River. Foxboro Green wastewater is treated at the Foxboro Green WWTP with biological treatment and denitrification followed by discharge to a leaching bed. **Table 1.6** presents the Certificate of Approval (C of A) flows for both WWTPs. These WWTPs are further described in this section.

Table 1.6: WWTPs C of A Info

Description	New Hamburg	Foxboro Green
Average Daily Flow (m3/d)*	5,200	150
C of A No.	9330-6G9K5B	8151-6MXJE3
C of A Last Amendment Date	Nov 22, 2005	April 3, 2008
Notes: * Average Daily Flow = Rated Capacity		

1.3.3.1.1 New Hamburg WWTP

The New Hamburg WWTP is a sequencing batch reactor (SBR) activated sludge facility that treats the wastewater flows generated within the communities of Baden and New Hamburg. The plant consists of influent works (mechanical screens and grit removal), sequencing batch reactors (3 SBRs in parallel); tertiary sand filters, ultraviolet (UV) effluent disinfection and sludge digestion and storage, as shown in **Figure 1.9**. The New Hamburg WWTP discharges into the Nith River. The plant currently has an average rated capacity of 5200 m³/d (60 l/s).

The flows directed to the New Hamburg WWTP are measured at the Morningside Pump Station. However, depending on the instantaneous flow conveyed to the WWTP a portion of these may be diverted to the Emergency Storage Lagoons (ESL) for equalization and pumped to the SBRs when flows are lower. This ensures that the flow to the SBRs never exceeds 167 L/s (14,428 m³/day).

In addition the WWTP influent includes sidestreams from the aerobic digesters when supernating and from the hauled waste holding lagoon. Hauled waste consists of septage and holding tank wastes typically from unserved and rural communities and rural residents. The hauled waste is currently stored in the former Stabilized Sludge Storage Lagoon adjacent to the aerobic digesters. **Figure 1.8** illustrates a simplified schematic of the wastewater, biosolids and hauled waste flows serviced at the New Hamburg WWTP.

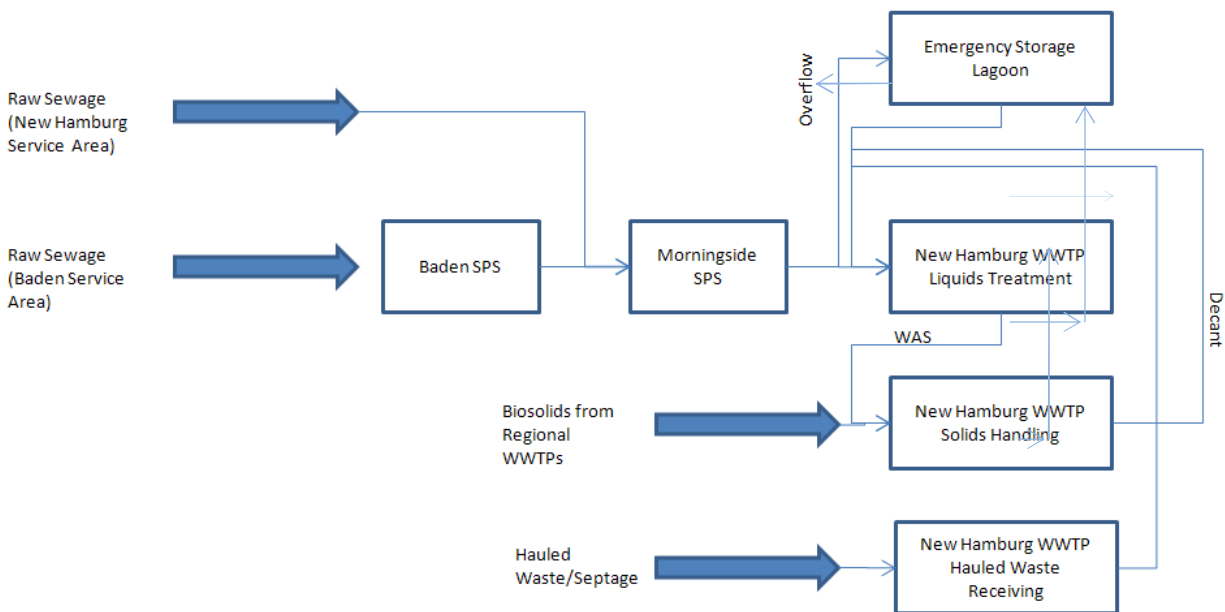


Figure 1.8: Wastewater Treatment Schematic

Figure 1.9 shows an aerial view of the New Hamburg WWTP.

Each process component of the facility is summarized in **Table 1.7** and **Table 1.8**.

Table 1.7: Description of Solids Handling Process Components

Process	Receive Flow From	Quantity	Volume	Additional components
Aerobic Digestion	New Hamburg WWTP SBRs St. Jacobs WWTP Wellesley WWTP Hespeler WWTP	2 digesters	3265 m ³ /digester	Mixing by jet aeration, blowers, submersible pumps for sludge transfer between reactors, submersible pumps for decant transfer or sludge loading to trucks.
Emergency Storage Lagoon (ESL)	Plant Bypass Hauled Waste Decant Sludge Overflow from Digesters	1 ESL	99,000 m ³	Pumps for transfer to headworks (22 L/s)
Note: New Hamburg WWTP Process Description per CofA # 9330-6G9K5B, and 5450-57PQGT				

Table 1.8: Description of Liquids Handling Processes

Process	Components	Quantity	Size	Total Capacity ²	Additional Components
Headworks	Screens (manual/automatic),	1 duty unit , 1 standby unit	6mm fine screens	222 l/s	Dewatering screw conveyor, transport screw conveyor, bagging system, disposal bin
	Vortex Grit Removal	2 units	2.1 m diameter/each	222 l/s	One common grit classifier
Secondary Treatment	Sequencing Batch Reactors (SBR)	3 tanks	L = 45 m W = 15 m SWD = 5 m	98 l/s	Fine bubble diffusers, submersible mixers, motorized effluent decanters, positive displacement (PD) blowers
Tertiary Filtration	Continuous Sand Filters	3 filters	each filter cell has four modules	180 l/s	Compressors, submersible solids handling pumps
Disinfection	UV Disinfection	2 channels		222 l/s	Low pressure UV lamps
Hauled Liquid Waste Receiving	Aerated pre-treatment Cell	1 holding tank (lagoon)	6000 m ³	6000 m ³	45 fine bubble diffusers, 4 wind powered mixers, submersible pump (decant return)
Phosphorus Removal	Alum Addition	1 storage tank , 6 metering pumps	27000 L Chemical storage tank		2 dosing points (headworks effluent and pre filtration)
Note: - New Hamburg WWTP Process Description per CofA # 9330-6G9K5B, and 5450-57PQGT - Headworks, Filtration, and Disinfection are designed for peak flows whereas the SBR is designed for average day flows in accordance with MOE Design Guidelines.					



Figure 1.9: New Hamburg WWTP Aerial View

1.3.3.1.2 Septage and Hauled Waste

In response to a need for a hauled waste receiving centre, a storage tank at the New Hamburg WWTP originally intended for long term stabilized sludge storage was converted to meet this need. Acceptance of hauled waste at the New Hamburg WWTP was made as a result of limitations on direct land application from changes to the Nutrient Management Act. Prior to this, hauled waste and septage was land applied by haulers without treatment.

The New Hamburg WWTP was selected as the receiving centre because the New Hamburg WWTP solids handling facility was operating well below its rated capacity. Thus the use of the long term sludge storage basin for hauled waste receiving was feasible on a short term basis. The New Hamburg WWTP receiving centre was intended to be a short term solution until the hauled waste and septage demand was sufficient to warrant a permanent facility. As noted in the Region of Waterloo, Report # E-02-018.1

(December 3, 2002), as demand increases, the New Hamburg WWTP would not be the ideal receiving facility.

To accommodate the hauled waste, screening was installed and aeration added to the storage tank. Hauled waste could then be screened and held in the storage tank and slowly returned to the plant headworks for full treatment. It has been estimated that hauled waste and septage comprise approximately 10% of the total contaminant load, and 1% of the total hydraulic load to the New Hamburg WWTP.

1.3.3.1.3 New Hamburg Effluent Objectives and Non-Compliance Criteria

The New Hamburg WWTP effluent objectives and compliance limits (Certificate of Approval No. 9330-6G9K5B dated November 22, 2005) are presented in **Table 1.9**.

Table 1.9: New Hamburg WWTP C of A Criteria

Effluent Parameter	C of A Criteria	
	Design Objective	Compliance Limits
cBOD ₅	5 mg/L	10 mg/L ^(a) , 52 kg/day
TSS	5 mg/L	10 mg/L ^(a) , 52 kg/day
TP	0.2 mg/L	0.3 mg/L ^(b) , 1.56 kg/day
TAN	0.4 mg/L (May 1 to Nov 30) 1.0 mg/L (Dec 1 to Apr 30)	1.0 mg/L ^(b) , 5.1 kg/day (May 1 to Nov 30) 2.0 mg/L ^(b) , 10.4 kg/day (Dec 1 to Apr 30)
pH	6.5-8.5	
E. coli		200/100 mL ^(c)
Notes: (a) – annual average (b) – monthly average (c) - monthly geometric mean density		

In addition to regulating the effluent quality, the CofA stipulates the following:

- Bypasses are prohibited except for to avoid loss of life, injury, danger to public health and property damage, essential maintenance, or regional directed given prior written acknowledgement of by-pass;
- If bypass occurs, one grab sample must be analysed for compliance, and a log book must be maintained to record all bypasses;
- Hauled sewage from outside works can be brought to the facility for treatment but cannot exceed 64 m³/day. No more than 20% of this hauled sewage brought in can be comprised of septage;
- Sludge from Regional facilities can be brought to the plant for stabilization; however, the sludge received plus sludge generated should not exceed capacity of the digesters based on a min solids residence time (SRT) of 45 days or the requirement of land application (whichever is greater).

1.3.3.1.4 Foxboro Green Wastewater Treatment Plant

According to the Certificate of Approval No. 8151-6MXJE3, issued on November 3, 2006, the Foxboro Green WWTP system has a combined total rated capacity of 150 m³/day and services a population of 430. This system is divided in two sewage systems. Sewage System No. 1 consists of two rotating biological contactors (RBC No. 1 and No. 2) and one effluent pumping chamber. Sewage System No. 2 consists of one raw sewage lift station, one RBC (No. 3), and one effluent pumping chamber. Each RBC consists of a primary settling tank, a rotating contactor, a denitrification chamber and a final clarifier. Effluent is released to leaching beds. The effluent requirements are stated as objectives only as summarized in **Table 1.10**.

Table 1.10: Foxboro Green WWTP Effluent Objectives

Parameter	Objective (mg/l)
CBOD5	<20
TSS	<20
TAN	<10

1. Notes: Objective are in accordance with CofA #8151-6MXJE3

1.3.3.2 Collection System and Pumping Stations

As described in **Section 1**, the Region is responsible for the main raw wastewater pumping stations including the Baden and Morningside Wastewater Pumping Stations, while the Township is responsible for wastewater collection and local pumping stations. The sanitary sewer collection system for Baden, New Hamburg and Foxboro Green consists of the following main components:

- Baden – 5 catchment areas which combine through a gravity system to the Baden Wastewater Pumping Station; outlets to the New Hamburg Sanitary Sewer System via a 200mm forcemain
- New Hamburg – 9 catchment areas: four of which combine via gravity into the New Hamburg Wastewater Pumping Station #2; combines with five additional catchment areas to a 600 mm sewer to the Morningside Wastewater Pumping Station; in addition, the Baden Sanitary forcemain feeds into a manhole and a gravity 450mm sewer to the Morningside Wastewater Pumping Station
- Morningside Wastewater Pumping Station – conveys all wastewater to the New Hamburg Wastewater Treatment Plant
- Foxboro Green Wastewater Pumping Station – conveys one third of the wastewater from Foxboro Green to RBC No. 3.

The sanitary collection systems, catchment areas, and pipe sizes are depicted in **Figure 1.10** and **Figure 1.11** which are excerpts from the recent Sanitary Sewer Inflow/Infiltration Study (CRA, 2009). The following sections provide background on the design parameters for the trunk sewers, pumping stations and forcemains.

1.3.3.2.1 Baden Wastewater Pumping Station (Region)

The Baden WWPS is located on Foundry Street, between Gingerich Rd and Highway 8. A 450 diameter inlet sewer feeds the Baden Wastewater Pump Station. According to the Preliminary Design Brief (Stanley, 1998), the Baden WWPS has three forcemain pumps to transfer wastewater to the New Hamburg sanitary collection system. The Baden WWPS forcemain pumps have a current installed average day and peak dry weather capacity of 18 L/s (1,555 m³/d) and 49 L/s (4,233 m³/d), respectively.

The outlet forcemain (referred to as the Highway 7/8 forcemain) is 200 mm in diameter (dashed red line in **Figure 1.10** and **Figure 1.11**) and sized for the ultimate (2041) dry weather peak flow of 60 L/s (5,184 m³/d), without redundancy. In the event of flows above the peak dry weather flows, the pump station wet well contains three 47 L/s submersible pumps that are activated if the duty pumps are not sufficient. Flows above peak dry weather flows are transferred to an equalization tank for storage (1,400 m³). The equalization tank has a 200 mm drain line from the fill line header connected to the wet well. The equalization tank also has a 450 mm diameter overflow to Baden Creek for use during extreme storm events. During the large storm event that occurred between January 6 and January 10, 2008 when water levels in the Baden Creek were elevated, the creek surcharged through the existing overflow at the Baden Pump Station into the retention tank and the sanitary sewer main.

This resulted in flows exceeding the pumping station capacity such that trucks were required to transport excess flows to the New Hamburg Wastewater Treatment Plant.

Reportedly on other occasions during high precipitation events, operators are required to transfer large volumes of wastewater to the NH WWTP by tanker truck to avoid bypasses occurring at the Baden WWPS.

Table 1.11 summarizes the Baden WWPS design flows.

Table 1.11: Baden WWPS Design Flows

Year	Average Day L/s (m ³ /d)	Peak Dry Weather L/s (m ³ /d)	Peak Wet Weather to FM L/s (m ³ /d)	Peak Wet Weather to Storage L/s (m ³ /d)
Current	18 (1,555)	49 (4,233)	49 (4,233)	140 (12,096)
2041*	22.6 (1,953)	60 (5,184)	60 (5,184)	140 (12,096)
Source: Preliminary Design Report (Stanley, 1998)				

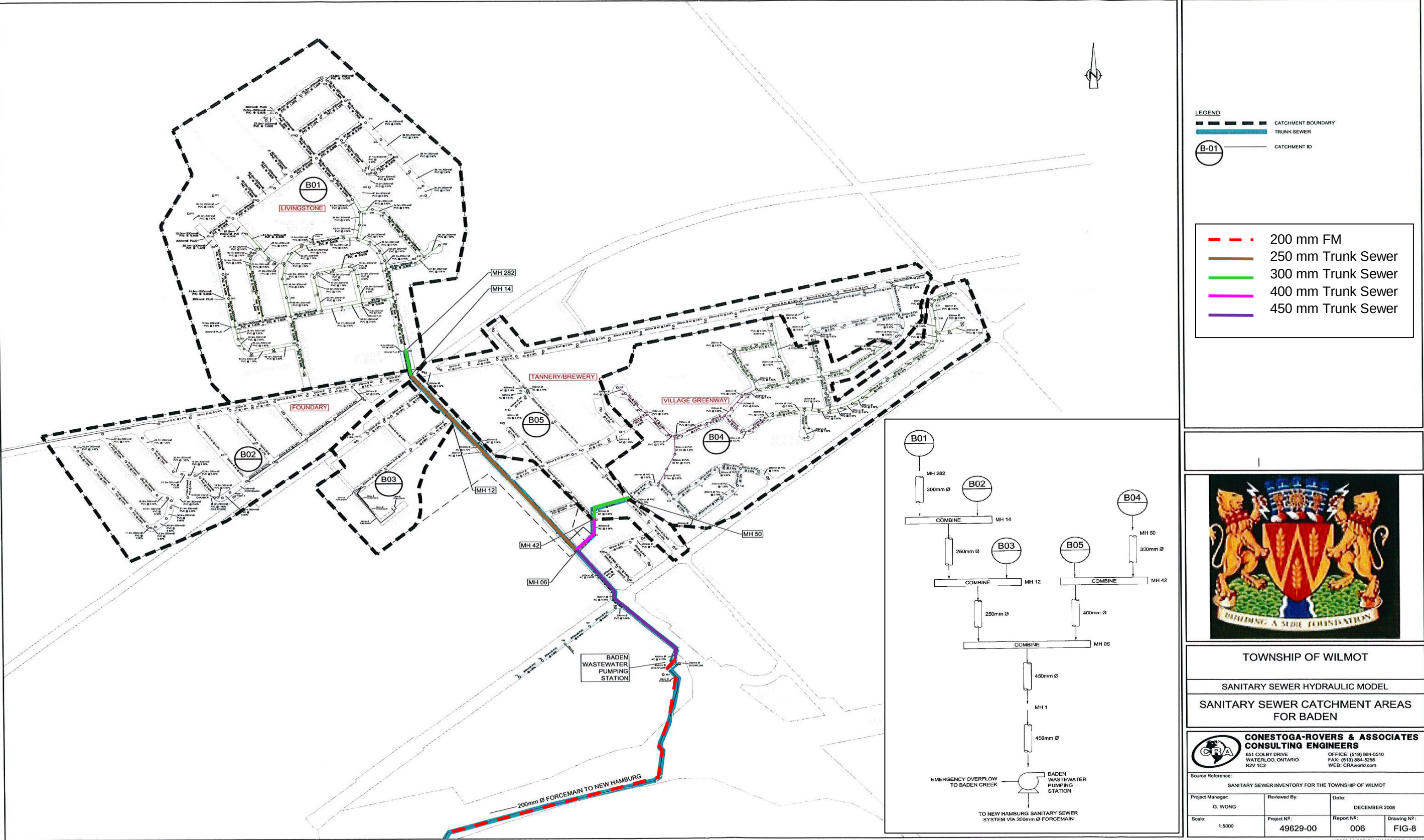


Figure 1.10: Baden Catchment Areas and Sewer Schematic

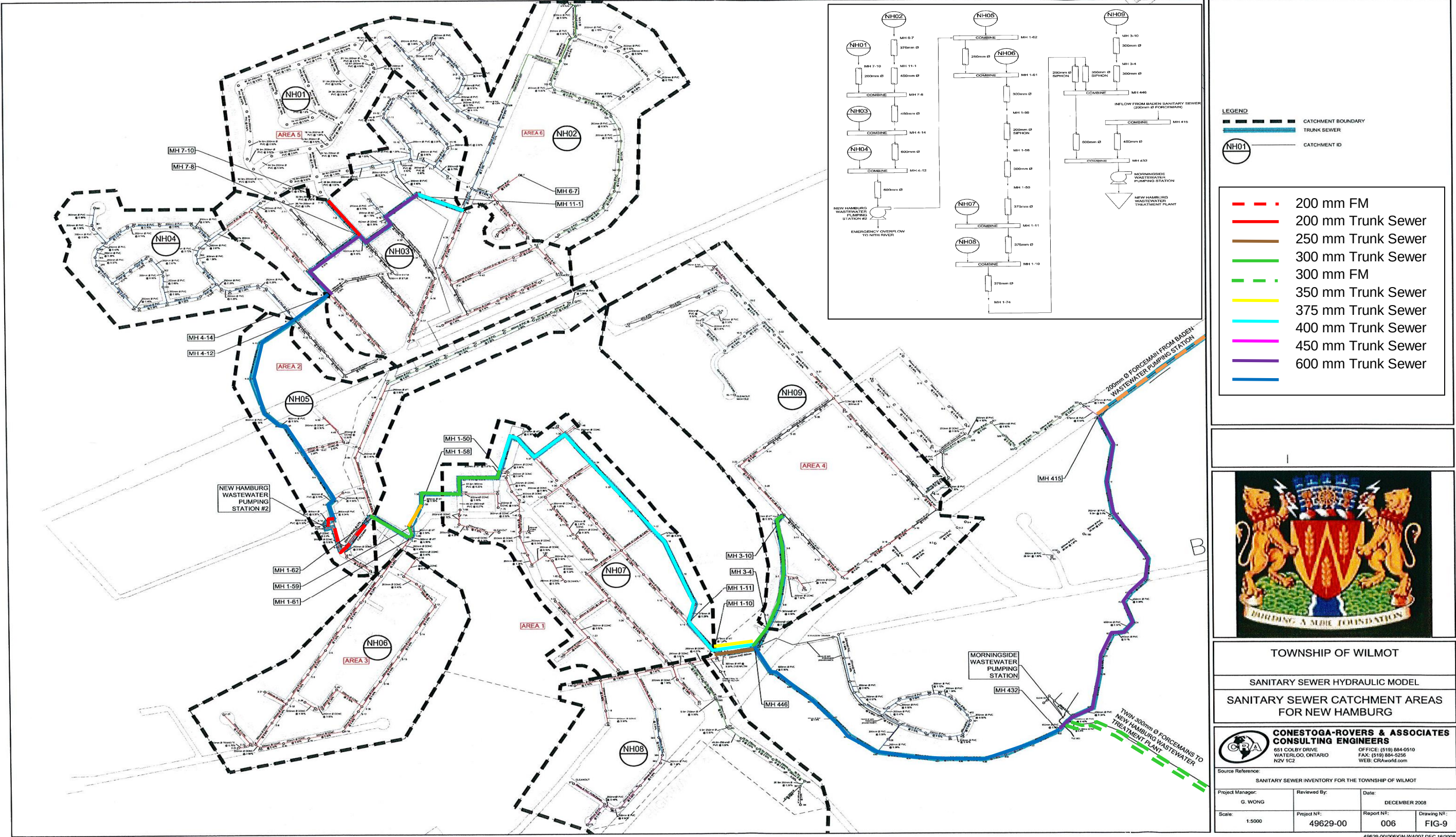


Figure 1.11: New Hamburg Catchment Areas and Sewer Schematic

1.3.3.2.2 New Hamburg Wastewater pumping station #2 (Township)

The New Hamburg Wastewater Pumping Station 2 is owned and operated by the Township. It is located at the intersection of Milton and Shade Street. The New Hamburg WWPS 2 has a 2.4 m diameter wet well with two pumps each with installed capacity of 34 L/s (2,938 m³/d) and a combined installed pumping rate of 45 L/s (3,888 m³/d). The outlet forcemain discharges to a 300 mm gravity sewer pipe on Waterloo Street (dashed red line connecting to a green line in **Figure 1.11**).

This pumping station has two equalization tanks. When the inflow rate exceeds the capacity of the main pumping chamber, excess flow is diverted into a separate pumping chamber where it is pumped to the first equalization basin which has a storage volume of approximately 270 m³. Three pumps with capabilities of 19 L/s (1,642 m³/d), 38 L/s (3,283 m³/d) and 190 L/s (16,416 m³/d) are available to pump wastewater from the pumping chamber to the equalization basin. Another 1,300 m³ equalization basin is connected to the smaller equalization basin via a 600 mm overflow gravity pipe from the smaller equalization basin. A 600 mm overflow to the Nith River is provided from the second equalization basin for extreme events.

1.3.3.2.3 Morningside Wastewater Pumping Station (Region)

The Morningside Wastewater Pumping Station (WWPS) is situated within the Morningside Retirement Community located southeast of Morningside Circle West. It collects all the wastewater from Baden and New Hamburg from two trunk sanitary sewers (dashed red line in **Figure 1.10** and dashed red and purple lines in **Figure 1.11**) including:

- Nith River Trunk Sewer – a 600 mm diameter sewer that services lands currently drained to the New Hamburg WWPS#2 as well as future development to the west of New Hamburg. The Nith River Trunk Sewer is approximately 1,125 m long, and it was designed for a peak wet weather flow of 280 L/s (24,192 m³/d).
- East Side Trunk Sewer – a 450 mm diameter sewer that services areas to the East of New Hamburg and receives wastewater from the Baden WWPS. The East Side Trunk Sewer is approximately 1,150 m long, and it was designed for a peak wet weather flow of 145 L/s (12,528 m³/d).

The Morningside WWPS is equipped with four pumps (3 duty and 1 standby) with a current installed average day capacity of 59 L/s (5,098 m³/d), and dry and peak wet weather installed capacities of 165 L/s (14,256 m³/d) and 262 L/s (22,637 m³/d), respectively. According to the Design Brief (Stantec, 1999), this WWPS is rated to pump up to 323 L/s (27,907 m³/d) with the replacement of the existing impellers. **Table 1.12** summarizes the Morningside WWPS design flows.

Table 1.12: Morningside WWPS Design Flows

Year	Average Day L/s (m ³ /d)	Peak Dry Weather L/s (m ³ /d)	Peak Wet Weather L/s (m ³ /d)
Current	59 (5,098)	165 (14,256)	262 (22,637)
2041*	86 (7,405)	214 (18,490)	323 (27,907)
* based on existing impellers replacement Source: Preliminary Design Report (Stanley, 1998)			

These pumps are connected to a common discharge header, before splitting to two forcemains. The twin 300 mm forcemains are approximately 1,300 meters in length and discharge the wastewater to the New Hamburg WWTP. According to the Design Brief, one forcemain will handle average day to peak hour dry weather conditions and the second forcemain will be used during peak wet weather conditions, as presented in **Table 1.13** (Stantec, 1999).

Table 1.13: Morningside Twin Forcemains Design Flows and Velocities

<i>Minimum (in one FM)</i>		<i>Maximum (in two FMs)</i>	
Flow, L/s (m³/d)	Velocity, m/s	Flow, L/s (m³/d)	Velocity, m/s
56 (4,838)	0.77	323 (27,907)	2.29

1.3.3.2.4 Foxboro Wastewater Pumping Station

The Foxboro Green WWPS is located within the Foxboro Green Retirement Community, 25 m southwest of RBC No. 3. It is equipped with two raw sewage submersible pumps, each pump rated at approximately 2.61 L/s (225.5 m³/d) at TDH of 2.52 m collecting raw sewage from residences via a collection system and discharging to RBC No. 3. The Foxboro Green WWPS was designed for an average daily flow of 50 m³/d, serving one-third of the community.

1.4 Wastewater Forecast Update

1.4.1 Population Projections

The communities of Baden and New Hamburg are located in the Township of Wilmot, one of seven local area municipalities which comprise the Regional Municipality of Waterloo, west of the City of Kitchener.

Land use and population growth in Baden and New Hamburg are governed by the policies and principles outlined in the 2009 Regional Official Plan (ROP) and the Township Official Plan. Since completion of the previous Master Plan in 1996, the Township of Wilmot's Official Plan (TWOP) was consolidated in November 2006. The TWOP outlines long term direction related to growth management to 2016 and beyond, to guide future development within the Township initiated by both the public and private sectors; the plan recognizes that long range decisions must be made well beyond the horizon year planning period. For the purpose of Master Planning, the year 2041 was selected as the planning period for long term consideration. However, population projections are also developed for the 2031 timeframe for the purposes of evaluating wastewater treatment and discharge requirements, as the Ministry of the Environment prefers to review a 20 year time period for approvals for wastewater-related infrastructure. All proposed public works must be in conformity with the 2009 Regional Official Plan.

New Hamburg and Baden are both designated as Township Urban Areas within the 2009 Regional Official Plan. As such, these areas have been allocated to accommodate the population and household growth identified in the Regional Population Household Forecast for the Township of Wilmot. According to the 2009 Regional Regional Official Plan, the development occurring in some of these areas require

planning in order to provide a development pattern including road network that supports the integration of transit services, a municipal drinking water supply system and a municipal wastewater system, among others. **Figure 1.12** shows the township urban area boundary and the built-up area. The built-up area consists of land that has been developed.

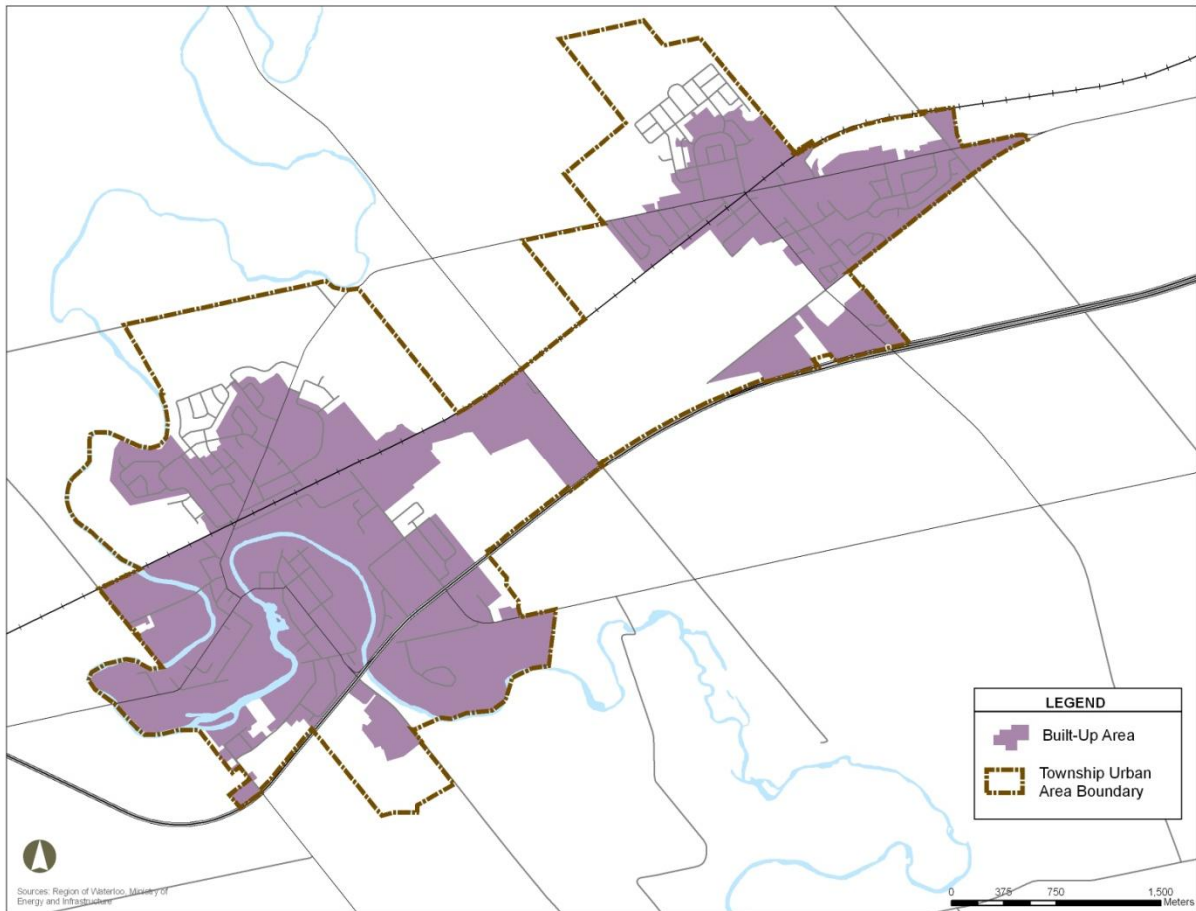


Figure 1.12: Population Growth Areas

Population and household forecasts from the TWOP and the 2009 Regional Official Plan are contained in **Table 1.14**. The 2009 Regional Official Plan indicates a total Township population forecast of 28,500 in 2029.

Table 1.14: Population Forecasts

Study Description	2016	2029
Township of Wilmot Official Plan (2006)	22,300	-
Region of Waterloo Regional Official Plan (2009)		
➤ Wilmot Population	-	28,500
➤ Wilmot Employment	-	9,700

Population forecasts for the serviced urban areas of Baden and New Hamburg have been documented in recent study reports and are summarized in **Table 1.15**. The current population (2007 year-end) of these communities is 10,245 including temporary university and college students.

Table 1.15: Population Forecasts for Serviced Urban Areas

Study Description	2016	2041
Baden and New Hamburg Water Supply Master Plan (1994)		
Land-Base Method	14,950	22,995
Long-Term Water Strategy	15,100	21,100
Baden and New Hamburg Wastewater Class EA (1997)		
Baden	3,750	4,800
New Hamburg	10,070	15,600
Total Baden and New Hamburg – Residential	13,820	20,400
New Hamburg and Baden Water Distribution Study – Final Report (2004)		
Baden – Residential	3,951	6,899
New Hamburg - Residential	10,748	16,183
ICI Equivalent (Total)	6,240	9,631
Total – Residential	14,699	23,082
ICI Equivalent (Total)	20,939	32,713
Region of Waterloo Wastewater Master Plan (2007)		
Baden and New Hamburg – Residential	13,037	25,307
Baden and New Hamburg – Employment	5,581	8,577

The objective of the Master Plan is to develop a plan for water and wastewater infrastructure to meet the needs of these urban communities. However, the Township and Region are cognizant of the constraints pertaining to each with respect to water supply via groundwater, and wastewater treatment, specifically the assimilative capacity of the Nith River. For the purposes of evaluating future alternatives, population forecast scenarios were proposed to provide a range of population growth that may occur in the planning

period to 2041 (and beyond the forecasts provided by the Region's Planning Department up to 2029) and develop alternatives to satisfy the full range of potential growth or determine constraints to this growth.

For the purposes of this Master Plan update, the Region developed 5-year forecasts as shown in **Table 1.16**. While 2029 projections for the Township are documented in the ROP (2009), the 2041 low and high growth estimates are “unofficial” and to be used for the sole purpose of evaluating the feasibility of various alternatives within this Master Plan update. These growth scenarios are subsequently applied to per capita water demands and per capita wastewater generation rates to develop future requirements, including water supply and wastewater treatment, with particular attention to potential constraints.

Table 1.16: Baden / New Hamburg Population Serviced Growth Scenarios

Area	2016	2021	2026	2029	2041 Low*	2041 High*
Residential	14,760	16,800	19,340	20,800	21,500*	26,100*
Employment	4,900	5,800	6,570	7,050	7,340*	9,300*
Equivalent Population	19,660	22,600	25,910	27,850	28,840*	35,400*
<i>* Unofficial projections</i>						

Figure 1.13 shows the projected population growth from 2006 to 2041 considering a plateau projection from 2029 to 2041 (low population projection). **Figure 1.14** shows the projected population growth from 2006 to 2041 considering a straight line extension from 2029 to 2041 (high population projection). It is noted that the high 2041 population scenario is comparable to that applied in the ROW WWTMP (2007) for both residential and employment projections.

Furthermore, consideration will be given to providing municipal wastewater services to the Foxboro community. The population for this residential community is expected to remain stable at approximately 430 persons.

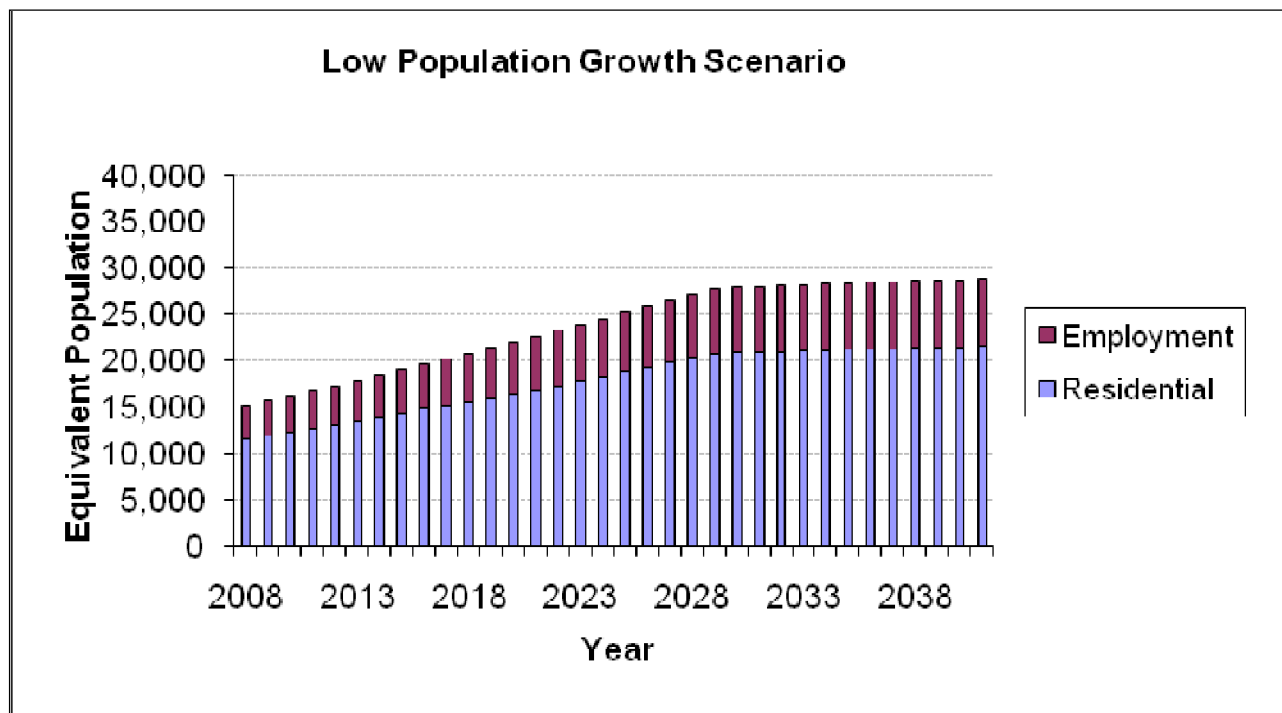


Figure 1.13: Low Population Growth Scenario

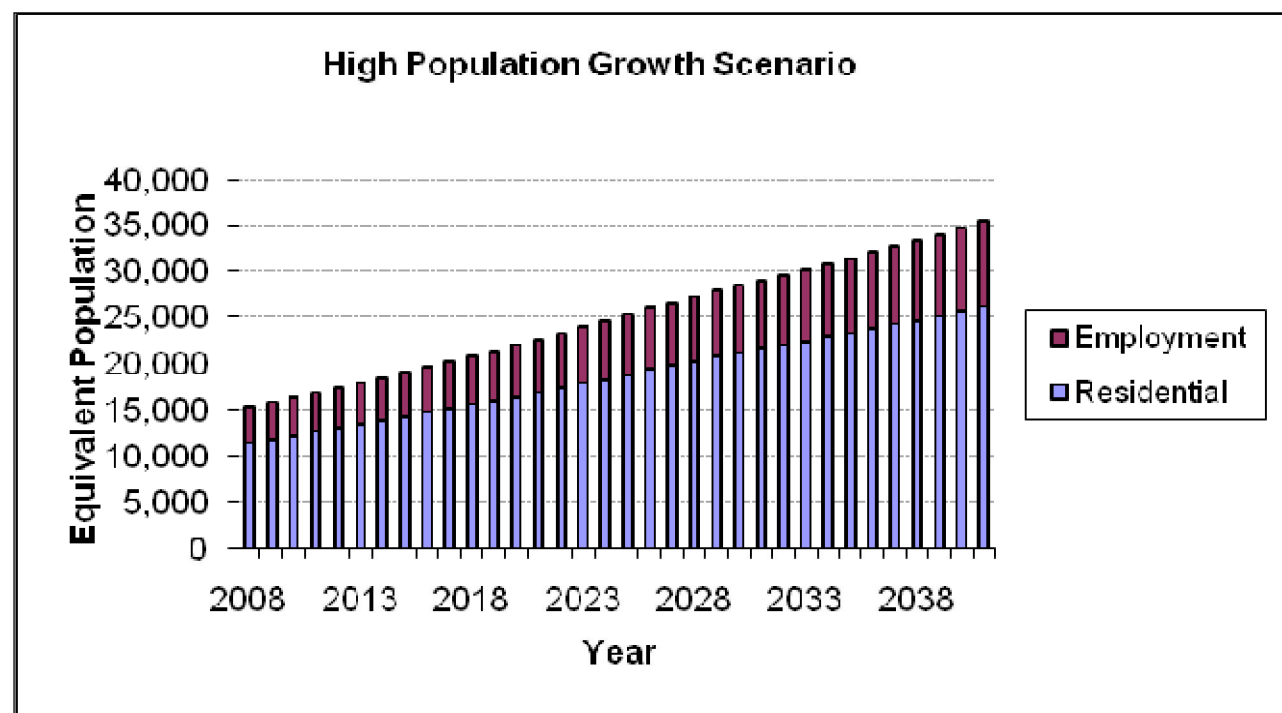


Figure 1.14: High Population Growth Scenario

1.4.2 Existing Wastewater Flows and Loadings

The historical wastewater flows to the New Hamburg WWTP since its commissioning, for the years 2002 to 2007, are provided in **Table 1.17**. The flow records are based on monitoring data at the WWTP. Based on the existing and historical population and wastewater flow data, the per capita wastewater flows were calculated based on residential-only population as well as on total equivalent population.

Table 1.17: New Hamburg WWTP Per Capita Wastewater Flows

Parameter	Units	Year					
		2002	2003	2004	2005	2006	2007
Residential Population		7,150	7,912	8,648	9,083	9,804	10,319
Employment Population		3,648	3,767	3,886	4,005	4,124	4,243
Equivalent Population		10,798	11,679	12,534	13,088	13,928	14,562
Flow							
Average Annual Flow	m3/d	2,855	3,058	3,122	3,039	3,620	3,252
Maximum Day Flow	m3/d	6,943	8,743	11,439	9,782	10,392	10,265
95th Percentile Flow	m3/d	4,202	5,092	5,334	4,584	6,043	4,675
Average per Capita (residential) Flow	L/cap/d	399.3	386.5	361.0	334.6	369.2	315.1
Average per Capita (equiv. pop) Flow	L/cap/d	264.4	261.8	249.1	232.2	259.9	223.3
Residential Population and Average Flow Source: 2009 Water and Wastewater Monitoring Report, Page B-20							
Employment Population Source: Interpolated from 2003 Water and Wastewater Monitoring Report							
Max and 95th Percentile Flow Source: Actual Data							

It should be noted that total per capita flows include domestic flow from the residential sector as well as the infiltration/inflow (I/I) component and Institutional/Commercial/Industrial (ICI) discharges. Therefore, high per capita flows indicate the possibility of high I/I and/or significant amounts of ICI discharge.

As was done in the previous New Hamburg WWTP Class EA, total wastewater flows have been split into the following three components:

- Domestic (residential and ICI) flow;
- Special dischargers;
- Infiltration/Inflow.

Domestic flow is assumed to consist mostly of the residential discharges, together with flows from minor industrial, commercial and institutional (ICI) establishments. It will be further assumed that the minor ICI development is generally related to the residential population. This includes institutional, commercial and recreational establishments which are identified as having high water consumption such as retirement homes, restaurant chains, community pool, etc. which would likely increase with population growth.

A review of the residential to ICI ratio for existing and future populations indicated a slight decrease in the projected ICI fraction (from 30 to 25% of the total population). At the current split, the residential sector accounts for 75% of water demands. Therefore, projecting future flows on this basis should continue to reflect the overall consumption and wastewater flows.

Special dischargers are larger industrial establishments with high water demands which would likely remain relatively constant; any change in wastewater production from special users would be independent of population growth. Special users identified from 2007-08 water billings data for the purpose of this study had a total average day consumption of 275 m³/day (8.7% of the 2007 average plant flow). While these industries do not contribute a large fraction of hydraulic loading, they are considered separately to evaluate their organic loadings to the plant independent of the general domestic and ICI wastewater.

Other industries that maintain separate treatment plants and discharge directly to the Nith River or its tributaries are not included in these flow projections.

The I/I levels for future development are expected to be lower than the existing levels. This is largely due to new plumbing codes that prohibit the connection of the foundation drains to the sanitary system, as well as modern sewer piping that is comparatively leak tight.

I/I levels were estimated in the 1997 Class EA using historical per capita water consumption and wastewater generation data, the 1995 Water & Wastewater Monitoring Report, and the 1994 Baden Sanitary Sewer System I/I Study, as shown in **Table 1.18**. At that time, as future development was expected to have reduced I/I levels through the use of modern construction materials and practices, 90 Lpcd (residential) of I/I was deemed to be appropriate for consideration in design flows.

Table 1.18: Estimated Infiltration/Inflow Levels

Estimated Existing Infiltration/inflow Levels			
Parameter	I/I Percentage of the Total WWTP Flow (%)	Average Day I/I Flow (m ³ /d)	Per Capita I/I Flow (Lpcd)
Baden	35%	241	158
New Hamburg	30%	502	105

A review of the more recent I/I study completed in 2009 does not provide any additional data to that provided above. In fact, increases in the portion of dry weather I/I was documented in catchment areas in both Baden (increase of 5.54 L/s in the Foundry Catchment) and New Hamburg (increase of 12.17 L/s in Catchment Area 4). Wet weather flow response increases were also detected in New Hamburg. A detailed list of repairs is provided; however a correlated decrease in I/I is not provided.

A comment regarding calibration of the sewer model using Storm Water Management Model (SWMM) indicates a pattern in fluctuations of average dry weather flow with season, likely a result of the relatively high water table within Baden and New Hamburg (CRA, 2009). To demonstrate this finding, **Figure 1.15** plots the flows to the WWTP from 2002 to 2007 by day of the year showing higher flows during the snow melt period (around day 100) and during the beginning/end of year (around day 340).

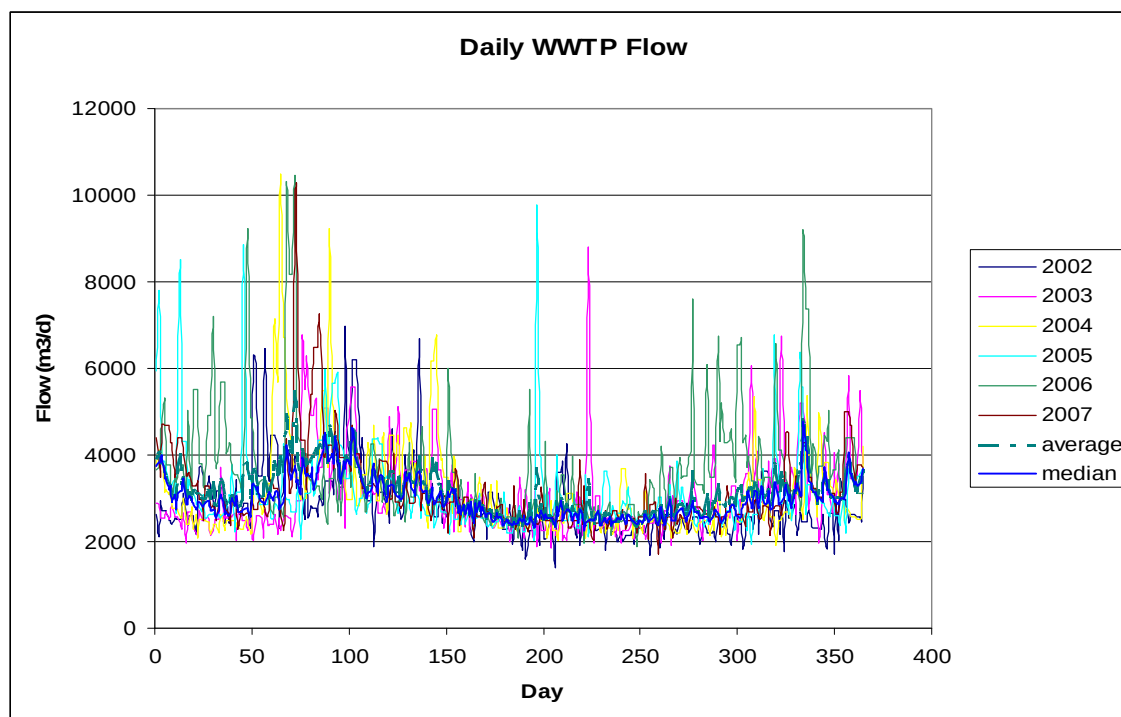


Figure 1.15: Flows to the WWTP from 2002 to 2007 by Day of the Year

A comparison of the existing wastewater flows versus the projected wastewater flows for 2009 is shown in **Table 1.19**. The domestic flow includes both residential discharge as well as minor ICI flows and is calculated as the difference between the total flow and the sum of special users discharge and I/I flows.

Table 1.19: Wastewater Generation by Sector (Projected vs. Actual)

	Average Day I/I Flow	Special Users Discharge	Domestic Flow	Total WWTP Flow	Population	Per Capita Domestic Flow (Res. pop)	Per Capita Domestic Flow (Equiv. pop)
	m ³ /d	m ³ /d	m ³ /d	m ³ /d	person	Lpcd	Lpcd
update 2009*	743	275	2133	3148	9077	235	163
2009 Projection**	1164	276	2812	4303	11430	250	NA
* Source: Actual data (2002 to 2007 average)							
** Source: Stanley and Paragon, 1997 (2009 numbers interpolated from 1994 and 2016)							

Comparison of the 2009 update to the 1994 Class EA for 2009 projection indicates that the actual wastewater generated is lower than earlier estimate. This can be attributed to decreased per capita water demand in recent years.

Table 1.20 summarizes the historical wastewater loadings to the plant for the period of 2002 to 2007. It is of note that loadings are based on flow rates and influent concentration; however, flows to the plant are recorded as pumped flow from Morningside wastewater pumping station. During high flow events, some of the flows are diverted to the storage lagoons on site and then pumped back into the plant at a later date. The influent characterization is based on samples collected of the raw wastewater to the WWTP. Therefore, loadings could be overestimated during some periods based on higher than actual flows being treated; during periods when the equalization lagoons are pumped back to the plant, this would result in the raw wastewater being diluted.

Loadings for Foxboro Green WWTP are presented later in **Table 1.26** for examining options such as integrating with the New Hamburg WWTP.

It should be noted that total per capita flows include domestic flow from the residential sector as well as the infiltration/inflow (I/I) component and Institutional/Commercial/Industrial (ICI) discharges. The I/I component is based on findings reported in previous I/I studies and is consistent with MOE Design Guidelines.

Table 1.20: New Hamburg WWTP Existing Wastewater Loadings

Parameter	Units	Year					
		2002	2003	2004	2005	2006	2007
Residential Population	person	7,150	7,912	8,648	9,083	9,804	10,319
Employment Population	person	3,648	3,767	3,886	4,005	4,124	4,243
Equivalent Population	person	10,798	11,679	12,534	13,088	13,928	14,562
Flow							
Average Annual Flow	m ³ /d	2,855	3,058	3,122	3,039	3,620	3,252
Maximum Day Flow	m ³ /d	6,943	8,743	11,439	9,782	10,392	10,265
95th Percentile Flow	m ³ /d	4,202	5,092	5,334	4,584	6,043	4,675
Average per Capita (residential) Flow	L/capita/d	399.3	386.5	361.0	334.6	369.2	315.1
Average per Capita (equivalent pop) Flow	L/capita/d	264.4	261.8	249.1	232.2	259.9	223.3
cBOD5							
Average Concentration	mg/L	157	131	130	122	104	106
Average Daily Load	kg/d	448	402	405	370	378	345
Maximum Daily Load (95th Percentile)	kg/d	612	619	608	612	647	458
Maximum Day PF	Ratio	1.4	1.5	1.5	1.7	1.7	1.3
Average Per Capita Loading	g/capita/d	41.5	34.4	32.3	28.3	27.2	23.7
TSS							
Average Concentration	mg/L	172	145	142	145	169	190
Average Daily Load	kg/d	491	444	444	442	612	617
Maximum Daily Load (95th Percentile)	kg/d	794	621	650	692	1397	958
Maximum Day PF	Ratio	1.6	1.4	1.5	1.6	2.3	1.6
Average Per Capita Loading	g/capita/d	45.4	38.0	35.4	33.8	44.0	42.3
TKN							
Average Concentration	mg/L	38.9	30.6	30.6	33.1	33.3	45.6
Average Daily Load	kg/d	111.0	93.5	95.4	100.7	120.7	148.2
Maximum Daily Load (95th Percentile)	kg/d	165.7	129.1	108.5	167.7	191.2	182.5
Maximum Day PF	Ratio	1.5	1.4	1.1	1.7	1.6	1.2
Average Per Capita Loading	g/capita/d	10.3	8.0	7.6	7.7	8.7	10.2
TP							
Average Concentration	mg/L	5.9	4.9	5.5	4.9	5.2	5.9
Average Daily Load	kg/d	16.9	15.1	17.1	14.8	18.8	19.1
Maximum Daily Load (95th Percentile)	kg/d	27.2	25.2	22.8	29.0	33.1	25.5
Maximum Day PF	Ratio	1.6	1.7	1.3	2.0	1.8	1.3
Average Per Capita Loading	g/capita/d	1.6	1.3	1.4	1.1	1.4	1.3

1.4.3 Future Wastewater Flows and Loadings

Wastewater flow projections are developed on a serviced population basis. Such wastewater flow projections must consider historical flow information as well as future long term changes in per capita wastewater flow rates. Using the existing and historical population and wastewater flow data, the per capita wastewater flows were calculated based on residential-only population as well as on total equivalent population. These flows have been used to determine future wastewater requirements.

Table 1.21 provides a summary of the predicted wastewater flows, including the 2041 high and low population scenarios. Comparison of these projections to those developed in the design of conveyance system upgrades indicate they are in the same order.

Table 1.21: Future Average Day Raw Wastewater Flows (m³/d)

Population/flow	2008	2011	2016	2021	2026	2029	2041 (Low)	2041 (High)
Residential	11,480	12,620	14,760	16,800	19,340	20,800	21,500	26,100
Employment	3,740	4,120	4,900	5,800	6,570	7,050	7,340	9,300
Total Equivalent Population	15,220	16,740	19,660	22,600	25,910	27,850	28,840	35,400
B-NH Average Flow, m3/d (L/s)	3,789 (43.9)	4,139 (47.9)	4,808 (55.6)	5,471 (63.3)	6,239 (72.2)	6,687 (77.4)	6,911 (80.0)	8,394 (97.1)
Foxboro Average Flow, m3/d (L/s)	112 (1.3)	112 (1.3)	112 (1.3)	112 (1.3)	112 (1.3)	112 (1.3)	112 (1.3)	112 (1.3)
Total Average Flow, m3/d (L/s)	3,901 (45.2)	4,251 (49.2)	4,920 (56.9)	5,583 (64.6)	6,351 (73.5)	6,799 (78.7)	7,023 (81.3)	8,506 (98.4)
<i>References:</i> Dry weather I/I allowance = 90 L/c/d (for residential population) High discharges = 275 m ³ /d (daily allowance) ADWF Per Capita (Equivalent Population) = 163 L/c/d								

The historical data was used to estimate future contaminant loads as summarized in **Table 1.22**.

Table 1.22: Baden - New Hamburg per Capita Wastewater Contaminant Loads

Parameter	Load (g/capita/ day)
Design BOD Load	27.01
Design TSS Load	36.74
Design TKN Load	8.48
Design TP Load	1.22
<i>Note: Design contaminant loads are provided on an Equivalent Population Basis and as such are lower than the expected loads from a typical domestic sewage.</i>	

The influent characterization does not include the return loadings from sidestream processes (digester decant, filter backwash etc) as it is discharged downstream of the sampler. Hauled waste is reportedly added upstream of the sampler.

1.4.4 Hauled Waste and Septage

The existing New Hamburg WWTP CofA allows for a maximum of 64 m³/day of septage and hauled waste to be brought to the plant. Of this, no more than 20% of the total flow can be comprised of septage. For the purposes of reviewing opportunities and constraints of the existing system, the CofA allowed hauled waste values were used in this evaluation as they reflect a worst case allowance (**Table 1.23**).

Table 1.23: Hauled Waste and Septage Quantity Assumption

Parameter	Value	Units
Hauled Waste Flow	51	m ³ /day
Hauled Waste BOD ¹	300	mg/l
Septage Flow	12.8	m ³ /day
Septage BOD ¹	6100	mg/l
Total Flow	64	m ³ /day
Total BOD Load	93	kg/day
% of Total Flow to New Hamburg WWTP ²	1%	
% of Total BOD Load to New Hamburg WWTP ²	14%	
Notes: 1) Septage and Hauled Waste BOD estimated based on typical values. 2) New Hamburg WWTP Flow is equal to design capacity of 5200 m ³ /day, New Hamburg WWTP BOD load based on average historical raw sewage BOD concentration		

1.4.5 Foxboro Green WWTP – Flows and Loads

The Foxboro Green WWTP has a capacity of 150 m³/day and can service a population of 430. In 2008, the Foxboro WWTP treated an average flow of 112 m³/day. The month to month variation in flows is illustrated in **Figure 1.16**.

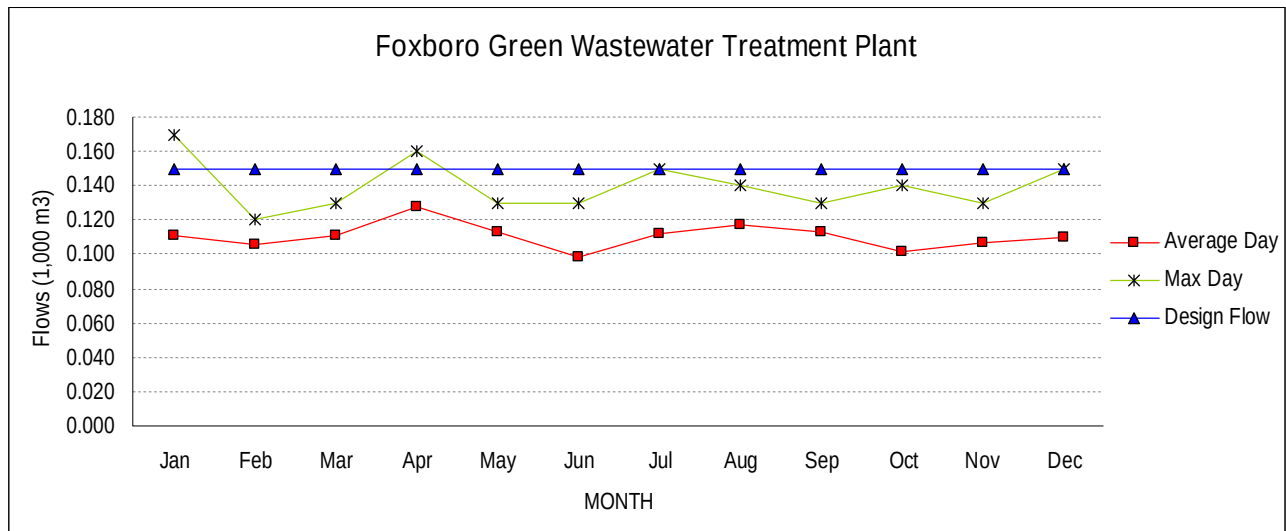


Figure 1.16: Foxboro Green WWTP – 2008 Influent Flow Summary

Average raw wastewater influent quality for 2008 is summarized in **Table 1.24** and average effluent quality is summarized in **Table 1.25**.

Table 1.24: Foxboro Green WWTP – Raw Wastewater Influent Quality

2008	CBOD ¹	TSS	TP	TKN	TAN	Nitrate	Nitrite	pH	Temp
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		C
Average	134.25	116.75	5.73	40.825	18.21	0.168	0.1658	7.62	13.33

Note: 1) Carbonaceous Biochemical Oxygen Demand (cBOD)

Table 1.25: Foxboro Green WWTP – Effluent Wastewater Quality

2008	CBOD	TSS	TP	TAN	TKN	Mean E.coli
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(cfu/100ml)
Average	3.05	6.31	4.17	1.32	2.85	6,640.13

Foxboro Green WWTP loadings are presented in **Table 1.26** for mass balance calculations and for examining options such as integrating with the New Hamburg WWTP.

Table 1.26: Foxboro Green WWTP Loadings (2007)

Parameter	Units	Foxboro Green
Residential Population	Person	415
Employment Population	Person	0
Equivalent Population	Person	415
Flow		
Average Daily Flow	m ³ /d	112
cBOD5		
Average Concentration	mg/L	113
Average Daily Load	kg/d	12.6
Average Per Capita Loading	g/capita/d	30.4
TSS		
Average Concentration	mg/L	95
Average Daily Load	kg/d	10.6
Average Per Capita Loading	g/capita/d	25.5
TKN		
Average Concentration	mg/L	35.98
Average Daily Load	kg/d	4.0
Average Per Capita Loading	g/capita/d	9.7
TP		
Average Concentration	mg/L	5.96
Average Daily Load	kg/d	0.7
Average Per Capita Loading	g/capita/d	1.6

2. Nith River Basin Characterization and Assimilative Capacity

Assimilative capacity studies evaluate the effect of point and non point contaminant sources on a natural body of water. These studies assist in evaluating the effluent quality requirements of a wastewater treatment plants. Through the completion of the Baden New Hamburg Master Plan update, one of the primary objectives was to update the assimilative capacity studies of the Nith River.

Prior to construction of the existing New Hamburg Wastewater Treatment Plant (WWTP) in 2000, and as part of the New Hamburg Wastewater Treatment Class EA, a comprehensive assimilative capacity study was undertaken to establish the assimilative capacity of the Nith River in 1996. This study considered the impact of point and non-point sources located along the Nith River. As the communities of Baden and New Hamburg grow in the future, opportunities to increase the treatment capacity of the WWTP are potentially limited by the assimilative capacity of the Nith River.

As part of the Baden/New Hamburg Master Plan update, the following was undertaken to update the assimilative capacity studies:

1. Updates to background water quality characteristics using hydrometric analysis, a review of water quality sampling and data collected since the completion of the last study and an evaluation of surface water quality for trend analysis;
2. Development of a list of parameters of concern (POCs);
3. Dissolved oxygen modeling was carried out to assess downstream impacts of WWTP on DO levels in the River;
4. Mixing zone analysis carried out to assess downstream impacts of WWTP on DO levels in the River and the downstream concentrations of unionized ammonia for a number of flow scenarios at the existing ammonia design objective of 0.4 mg/l;
5. Development of a framework for a Total Phosphorus Management Program, including two scenarios considered in evaluating WWTP alternatives:
 - a. Meet Policy 2 designation – existing CofA load maintained for future increases in flow (i.e. reduce effluent TP concentration limit);
 - b. Implement Rural Water Quality (RWQ) Program – existing CofA concentration maintained for future flow increases (i.e. increase effluent TP load limit). The framework for a TP Management, and RWQ programs are further discussed in **Section 2.6**.
6. Recommendations for future monitoring;

Consultation with the MOE and GRCA regarding the approach was carried out to confirm Regional Office interpretation of issues which form the basis of the assimilative capacity study. The Regions approach to the assimilative capacity update was agreed upon with the MOE. Documentation of this consultation has been included in Volume 4, Appendix B.

2.1 Updates to Background Water Quality Characteristics

The update to the background water quality characteristics are documented and discussed in detail in **Volume 4 Appendix B**.

2.2 Parameters of Concern

Parameters of Concern (POCs) typically are a long list of chemicals and physical parameters that are possible in the WWTP discharge or affect the impact in the receiving water. To this can be added biological parameters (e.g. bacteria, benthic invertebrates) and results of biological tests (toxicity tests). The parameters assist in the understanding of the impact of discharge, including modelling.

The POCs are determined by consideration of the characteristics of the effluent and the receiving water. In the case of an existing WWTP like New Hamburg, effluent characteristics can be evaluated by reviewing existing data, augmented by additional sampling for metals and organic chemicals if warranted. In-stream characteristics can be evaluated by comparing historical levels with the Provincial Water Quality Objectives. Those that exceed the Provincial Water Quality Objectives (PWQO) can be classified as Policy 2² parameters, and will receive specific attention in the review.

The issue of effluent acute toxicity can be considered directly with effluent concentrations set based on standard acute toxicity targets (e.g. chlorine residual and un-ionized ammonia). Some POCs can be considered relatively simplistically with mass balance calculations, such as total phosphorus and nitrates. Other issues need to be addressed in the mixing zone, just downstream of the outfall compared to chronic targets - PWQOs (e.g. unionized ammonia and chlorine residual). Effluent toxicity and in-stream toxicity for unionized ammonia has an additional complexity as this parameter is affected by temperature and pH, which are often different in the effluent and in-stream, and vary significantly throughout the year.

Assimilative capacity studies also typically address dissolved oxygen relationships downstream. This will necessitate a consideration of the parameters directly affecting DO such as carbonaceous biological oxygen demand (CBOD) and nitrogenous oxygen demand (NOD). The DO regime is often affected by algal and plant growth dynamics which is governed by a complex interaction between physical-chemical, meteorological and nutrient input factors.

The wastewater generated by the communities of the Baden New Hamburg is primarily domestic. There is a small ICI component, with the larger industries present consisting mainly of food processing companies. There are two existing surcharge agreements both for food industries, for BOD loadings which exceed the Sewer Use By-law limits.

An intensive river sediment sampling and analysis program was completed in 1995 as part of the previous assimilative capacity study. Sediment samples were collected downstream of the Baden and New Hamburg WWTPs as well as industrial outfalls such as Stanley Industries in New Hamburg (this plant ceased production in 1996). The ICAP metal SCAN was completed for each sample and results compared to Provincial Sediment Quality Guidelines for the nine metals: cadmium, chromium, copper, lead, manganese, zinc, nickel and phosphorus. No sediment samples violated the Provincial Guidelines for either the low or severe effect level.

Since the Class EA for the New Hamburg WWTP Expansion was completed in 1997, the type of industry in Baden New Hamburg remains unchanged. Although the WWTP liquid stream is not sampled for non-conventional parameters, the aerobically digested biosolids are analyzed for metals concentration as they are applied to agricultural land. A review of this data indicates all samples are well within the aerobic sludge guidelines for all metals except selenium. As inorganic and organic selenides either are insoluble

² Policy 2 refers to "water quality which presently does not meet the Provincial Water Quality Objectives..." (MOE, 1994).

or rapidly decompose under aerobic conditions to form elemental selenium which is insoluble in water, it is anticipated that it would not be found in the liquid stream in any significant concentration (Canadian Water Quality Guidelines). In addition, dissolved selenium species in the aquatic environment have an affinity for iron and aluminum sesquioxides forming insoluble selenites.

It is not expected that the ratio of domestic to ICI population will change over time.

The proposed approach to approach to POC status of relevant parameters is summarized as follows:

- **Total phosphorus (TP)** – This parameter was examined in the May 2009 AECOM Report *Baden-New Hamburg Water and Wastewater Master Plan Update, Status Report - Task 4 and 5 Activities – Nith River Basin Characterization and Assimilative Capacity Approach*, where it was noted that the Nith River is a Policy 2 receiver for total phosphorus. As part of the Rural Water Quality Program, total phosphorus loading in the Nith River has been reduced since 1998, however, it is hard to quantify the volume of nutrients kept out of streams and rivers. It was recommended that participation in this program continue. Further, a Best Available Technology Economically Achievable (BAT EA) total phosphorus limit of 0.3 mg/L was approved for the expanded New Hamburg WWTP. Due to the Policy 2 designation, TP is a parameter of concern. The analysis considered upgrading treatment levels to maintain reduced loadings of TP. Alternatively, additional further reductions of TP have been proposed as part of the Rural Water Quality program.
- **Ammonia, Un-ionized ammonia, temperature and pH** – The temperature, pH and ammonia parameters were considered as POC's because of their relationship to un-ionized ammonia. A simple analysis procedure was used in previous studies consisting of assuming a zone-of-passage of 25% of the river at 7Q20 flows, and evaluation of meeting the PWQO in this volume assuming complete mixing. This analysis confirmed that this approach results in continued provision of a zone-of-passage with existing treatment levels for ammonia for the expanded WWTP. In order to determine the full extent of the mixing zone, a mixing zone model was applied as described in Section 2.4.
- **Chloride** – While chlorides have been noted to be increasing in the Nith River, the observed concentrations have not exceeded guideline levels. Chlorides were not considered as a POC in this study.
- **Nitrate** - The Canadian Water Quality Guideline for nitrate is 13 mg/L. For the New Hamburg WWTP it is proposed that it be evaluated and consideration given to the feasibility, benefit and cost of adding denitrification in the future. Each WWTP alternative was developed for scenarios with and without denitrification.
- **Oxygen demanding substances (CBOD and NOD) and dissolved oxygen (DO)** - While DO is currently Policy 1; carbonaceous biological oxygen demand CBOD will continue to be a POC as it is an effluent control parameter. Nitrogenous oxygen demand (NOD) is controlled by the treatment objectives for ammonia and the monitoring requirement for TKN. DO modeling was carried out to further examine this as summarized in the following Section and detailed in Volume 4 Appendix B.
- **Metals** – During the previous assimilative capacity study completed in 1996 (Stanley-Paragon, 1996) an extensive sediment sampling program for metals concentrations was carried out downstream of wastewater treatment plants' outfalls in the Nith River. "It is concluded that

river bed sediments in the Nith River System meet Provincial Sediment Quality Guidelines." (ibid, p 4-60). Accordingly, metals were not considered parameters of concern, (however, see below regarding monitoring).

- Other industrial chemicals - While no new industries that might contribute metals or other industrial chemicals are contributing wastewater to the New Hamburg WWTP it is not know what specific industries might propose to locate in the serviced industrial zoned lands. However, the ROW has a Sewer Use By-law that would apply to any new discharges. The by-law is actively enforced by ROW staff with a monitoring program.

2.3 Dissolved Oxygen Modeling

During the 1996 Assimilative Capacity Study (Stanley, 1996), a fishery assessment was carried out that found bass species to be the primary sports fish. Based on this, the Nith River was considered a warm water fishery. Accordingly, the dissolved oxygen PWQO for the temperature range of 20 C to 25 C is 4 mg/l.

A dissolved oxygen model was set up for the Nith River from upstream of the discharge of the New Hamburg WWTP and downstream for 10 km. The model is steady-state and accounts for the impact of oxygen demanding substances from the treatment wastewater sediment oxygen demand and reaeration from the atmosphere.

Oxygen demanding substances include carbonaceous sources (BOD5), nitrogenous sources (TKN) and sediment (SOD).

Six cases, including the calibration case, were modeled as shown in **Table 2.1** below.

Table 2.1: Dissolved Oxygen – Summary of Cases

Case	WWTP Flow	River Flow	Effluent Quality	Comment
1	Average 2001-2008	Sept 20, 2008	75 th percentile observed	Calibration to minimum DO at Haysville.
2	Rated Capacity (5200 m ³ /day)	Sept 20, 2008	CofA Objective	Rated capacity, normal flow
3	Rated Capacity (5200 m ³ /day)	7Q20	CofA Objective	Rated Capacity, Annual Low Flow
4	Scenario A*	7Q20	CofA Objective	Expansion Scenario1, 8,800 m ³ /day – low flow
5	Scenario B*	7Q20	CofA Objective	Expansion Scenario 2, 10,200 m ³ /day- low flow
5	Scenario C*	7Q20	CofA Objective	Expansion Scenario 2, 10,200 m ³ /day- low flow – improved DO at WWTP Outlet
* Expansion scenarios from ROW WWTMP (2007)				

The results of the DO modeling indicate that at low flows there is minimal impact from the increased WWTP loadings. This is because the effluent is highly treated such that increased discharge causes little increase in the concentration of oxygen demanding substances. In addition, the Nith River is a relatively shallow stream with good reaeration. Dissolved oxygen minimums resulting from this analysis are summarized in the Table to follow.

Table 2.2: Minimum DO Concentration Results

Case	DO (mg/l) at discharge from Oxbow	DO (mg/l) Downstream
1	6.30	6.39
2	5.86	6.21
3	5.78	6.63
4	5.10	6.51
5	4.90	6.46
6	5.85	6.46

There is some concern with the dissolved oxygen at the point of discharge from the oxbow. Historic data indicates low dissolved oxygen concentrations at this point however, completely mixed concentrations are still well above the PWQO for warm water fisheries of 4 mg/l. A mixing zone analysis was also carried out to examine any impact that may be caused by low DO immediately below the discharge. The results of this are discussed as follows.

Volume 4 Appendix B includes the “Dissolved Oxygen Modelling of the Nith River Downstream of New Hamburg” that provides additional information on the dissolved oxygen modelling.

2.4 Mixing Zone Modeling

In order to properly assess downstream impacts of expanding the wastewater treatment facility, the assimilative capacity of the Nith River was estimated. This also required an understanding of the return frequency low flows in the Nith River and the mixing characteristics of the river. The mixing zone analysis was also used to assess the DO conditions in the river below the discharge point and to estimate the downstream concentrations of unionized ammonia. The complete analysis is detailed in Volume 4 – Appendix B and is summarized as follows.

Flow measurements and field water quality parameters were collected along the Nith River, from the outfall of the New Hamburg WWTP to Holland Mills Road in Wilmot. A flow measurement at the WWTP outfall, and four cross sections were taken along a 1 km stretch. Depths, flow velocities, pH, conductivity and temperature were collected at each station. An upstream measurement of conductivity, pH and temperature were also collected. The depth profile, flow regime and velocities at the discharge channel were determined. Additionally, four flow cross sections were measured between the Outfall and Holland Mills Road and measurements were taken at the footbridge in New Hamburg to provide an indication of water quality.

Available data was used to carry out a flow analysis using Hydrotec software to determine 7Q20 flows. Flow regimes were evaluated and lateral mixing lengths determined.

A 2D Guassian Plume model was then developed for estimation of the initial mixing zone. The model was used to evaluate the mixing characteristics of the plume (ie the mixing length) for dissolved oxygen and unionized ammonia for the following scenarios (from ROW WWTMP, 2007):

1. Baseline: Summer low flow conditions (7Q20) with the existing permitted discharge of 5200 m³/day;
2. Scenario A: Summer low flow conditions (7Q20) with the plant discharge increased to 8810 m³/day;
3. Scenario B: Summer low flow conditions (7Q20) with the plant discharge increased to 10200 m³/day.

The findings of the mixing zone analysis are as follows:

- Under high surface flow conditions the effluent plume was found to be well mixed at 50 m downstream;
- Under low surface flow conditions, lateral well mixed conditions are expected to occur approximately 1000 m downstream from the discharge
- Under all scenarios, a zone of passage with dissolved oxygen concentrations above 5 mg/l is expected to be present in the left half of the river for 1 km below the outfall
- Under all scenarios, the un-ionized ammonia concentrations are expected to remain below the PWQO within 1 km of the discharge.

Volume 4 Appendix B includes the “Mixing Zone Analysis for New Hamburg Waste Water Treatment Plan” that provides additional information on the mixing zone analysis.

2.5 Approach to Un-ionized Ammonia

The Nith River is a Policy 1 receiver for un-ionized ammonia. Ammonia is regulated by the effluent limits specified in the WWTP's Certificate of Approval, and historical effluent quality shows that the C of A objectives and limits are consistently being met. Ammonia and un-ionized ammonia were examined in both the May 2009 AECOM Report and the October 2010 Golder Associates report *Mixing Zone Analysis for New Hamburg Waste Water Treatment Plant*. The reports showed that un-ionized ammonia concentrations were not acutely toxic in the effluent (end of pipe), and were below PWQO in the Nith River downstream of the WWTP discharge (including within the mixing zone).

2.6 Approach to Total Phosphorus Management

2.6.1 Rural Water Quality Program

Two studies identified the high level of phosphorus loadings from agricultural sources. Draper and Weatherbe (1995) noted that agricultural sources of phosphorus accounted for 68% of the total loading of phosphorus to the Grand River from within the ROW boundaries compared to 16% from Regional wastewater treatment plants. The report recommended that the Region develop a control program to control rural non-point sources.

The Nith River Assimilation Study (Stanley-Paragon, 1996) estimated that 96% of the total phosphorus annual loadings in the Nith River at Paris were from anthropogenic (man's activities involved) non-point sources with only 0.5% from point sources. This report also recommended that the ROW should be

involved in a non-point sources abatement program to reduce nutrient loadings to the Nith River. The report noted that the combined Baden and New Hamburg discharges would require Best Available Technology Technically Achievable (BAT-TA) treatment to meet total phosphorus river concentrations and meet Policy 2 requirements. However, a combination of a non-point source (NPS) control plan as well as a minimum treatment level of BAT-EA was recommended. The treatment objectives for the two levels considered are as follows:

BAT EA – 0.2 mg/L

BAT TA – 0.1 mg/L

The Ontario Ministry of the Environment accepted this recommendation and the construction of the new New Hamburg WWTP, which treats the combined wastewater flows of Baden and New Hamburg, was approved with the BAT EA effluent objective. It should be noted that the BAT EA level of treatment was an improvement over the pre-existing level and that the loadings of TP were reduced from 380 kg/yr for the Baden and New Hamburg plants to 280 kg/yr for the combined plant even with the increased flow. There was no direct offset calculation made and any reference to the NPS control program explicitly avoids the use of the term “trading.”

The Rural Water Quality Program commenced in 1998 as a collaborative effort between the ROW and the Grand River Conservation Authority. The initial source of funding is from the ROW, although all three levels of government, private foundations and stewardship organizations have provided funding to the program.

The program is carried out by the Grand River Conservation Authority as the agent for the Region. They provide extension services to the farming community and identify projects to be funded. For a farm to be eligible for funding an Environmental Farm Plan must be completed. Best management practices (BMPs) have been identified that have the best potential for protecting surface and groundwater, with specific algorithms (calculations) based on research for quantifying the amount of total phosphorus reduction expected for each project (Allaway, 2003).

The program is managed by a steering committee with representation from Regional of Waterloo, Grand River Conservation Authority, Ontario Ministry of Environment, Ontario Ministry of Agriculture and Food and Rural Affairs, Township of Wellesley, and several provincial and local agricultural organizations. The committee and subcommittees help identify suitable best management practices, aid in education of the agricultural community, and help resolve disputes.

Other benefits are realized through the program such as reduction in soil erosion, reduced bacterial pathogen levels, reduced nitrogen parameter loads to both surface and groundwater, and reduced pesticide releases to surface water.

Volume 4 Appendix B includes the “Waterloo Rural Water Quality Program – Nith River Watershed Review” that expands on the program objectives and status.

2.6.2 Framework for a Total Phosphorus Management (TPM) Program

Recognizing that phosphorus is a Policy 2 parameter in the Nith River, and that the source of phosphorus is primarily from non-point sources (agriculturally based), it is important to note that the WWTP currently provides tertiary treatment for phosphorus reduction and that the effluent loading from all WWTPs accounts for less than 1% of the overall contribution to the river. Therefore, consideration has been given

to alternatives for future wastewater requirements which include formalization of the existing Rural Water Quality Program as a mechanism for phosphorus reduction in the Nith River watershed which offsets increases in wastewater treatment loadings at the New Hamburg.

Ontario precedents of successful implementation of such programs are readily available in communities in the South Nation River watershed and others. The basis for offset ratios established in these programs has been documented and will be put forward for consideration here.

As a basis for establishing an offset ratio, the GRCA has evaluated the rate of success of the Rural Water Quality Program, by auditing a representative sample of projects to determine if the funded measures are still in place and functioning to reduce TP loadings. This evaluation is documented in Volume 4, Appendix B.

2.7 Recommendations

2.7.1 Recommendations for WWTP Analysis

In developing alternative New Hamburg WWTP configurations to accommodate future flows, the following effluent quality should be used.

Table 2.3: New Hamburg WWTP Recommended Effluent Objectives – for Planning Purposes

EFFLUENT PARAMETER	CURRENT		RECOMMENDED DESIGN OBJECTIVE
	EFFLUENT OBJECTIVE	COMPLIANCE LIMITS	
cBOD ₅	5 mg/L	10 mg/L ^(a) , 52 kg/day	5 mg/L
TSS	5 mg/L	10 mg/L ^(a) , 52 kg/day	5 mg/L
TP*	0.2 mg/L	0.3 mg/L ^(b) , 1.56 kg/day	0.2 mg/L, 1.56 kg/day*
TAN			
May 1 to Nov 30	0.4 mg/L	1.0 mg/L ^(b) , 5.1 kg/day	0.4 mg/L
Dec 1 to Apr 30	1.0 mg/L	2.0 mg/L ^(b) , 10.4 kg/day	1.0 mg/L
Nitrate – Nitrogen	No Nitrate Objective	No Nitrate Objective	No Nitrate Objective
Option a)			Nitrate Objective
Option b)			
* Per Policy 2, maintaining current CofA loading objective results in decreased concentration objective with increased flow			
^(a) Annual Average; ^(b) Monthly Average			

2.7.2 Recommendations for Future Nith River Monitoring

Additional monitoring on the Nith River is recommended in order to supplement the information gathered through the existing ROW monitoring program. The additional monitoring would consist of the following:

- 48-hour dissolved oxygen study during summer low flow conditions; and
- Dye tracer study during high flow conditions (spring) and low flow conditions (summer) (first year only).

The recommendations for future monitoring are detailed in **Section 6.3**.

3. Opportunities and Constraints of Existing System

3.1 Wastewater Treatment

3.1.1 Analysis Methodology

To determine constraints within the New Hamburg Wastewater Treatment Plant (NHWWTP) and the opportunity for optimization the following was carried out:

- Review of available data and literature including:
 - New Hamburg WWTP Amended Certificate of Approval No 9330-6G9K5B and 5450-57PQGT;
 - New Hamburg – Baden Wastewater Treatment and Conveyance Infrastructure – Preliminary Design Report, July 1998;
 - Region of Waterloo Hauled Liquid Waste Pilot Project Update (Report E02-018.1), December 3, 2002;
 - Draft New Hamburg Wastewater Treatment Plant Process Narrative, September 28, 2006;
 - New Hamburg WWTP Sequencing Batch Reactor (SBR) SCADA Evaluation, March 14, 2007;
 - New Hamburg Wastewater Treatment Plant Design Brief, March 1998;
 - Region of Waterloo, Digester Upgrade Assessment, Technical Memorandum, AECOM, February 2009.
- Discussion with WWTP Operations Staff.
- Review of WWTP data – Data from routine sampling and flow monitoring records.
- Wastewater Characterization Study – Detailed in the “New Hamburg WWTP Data and Model Calibration Summary – Draft” (Hydromantis, January 2010).

A number of discrepancies were noted in the above documents which should be resolved before progressing with any changes to the plant operation or design. The above noted information was used in the configuration of a Process Block Diagram (**Figure 3.1**). This diagram provides a visual representation of:

- Major unit process design capacity;
- Pump sizes;
- Incoming average, minimum, maximum day and peak flows including all sidestreams;
- Overflow or by-pass locations;
- Process flow paths under normal, minimum, maximum day, peak flow, and stand-by conditions.

Hydraulic and process bottlenecks were then identified along with opportunities for optimization through changes in operation. It should be noted that unit process sizing and capacity is based on Stantec design documents and requires on-site confirmation. A summary of the findings of this analysis is noted in the paragraphs to follow. **Figure 3.1** shows the WWTP process block diagram (PBD). Reference to this Figure will be made throughout this analysis.



55

3.1.2 Emergency Storage Lagoon

3.1.2.1 Existing System

The emergency storage lagoon (ESL) is a 99,000 m³ earth lagoon intended to serve as temporary storage for plant overflows during wet weather conditions. Sewage is later returned to the plant influent chamber.

Flows enter the ESL by the following:

- Influent Chamber Overflow (PU-4, F38);
- SBR Feed Channel Overflow (PU-8, F40);
- Overflow from the Stabilized Sludge (Hauled Waste) Holding Tank (PU-13, F59).

Flows from the ESL are pumped back to the main stream WWTP for treatment by PU-16 at a constant flow rate of 22 l/s (1,900 m³/day) when manually initiated by the operator. The operator may initiate this pump at any time. PU-16 pumps ESL flows to the main stream WWTP via the influent chamber (PU-4). The ESL also has an overflow weir that can send flows directly to the plant effluent (by-passing disinfection). This overflow has no indication (other than visual) to alert operators if an overflow occurs.

3.1.2.2 Analysis

As will be illustrated throughout this analysis, the ESL is emptied by pumping flows to the main stream process via the influent chamber. Pumping of flows from the ESL during high flow periods can create hydraulic bottlenecks within the main stream WWTP. The main stream WWTP process components have provisions (overflow weirs etc.) that direct flows in excess of unit process capacities to the ESL. Returning flows from the ESL to the main stream during high flow conditions can therefore simply result in circling flows back to the ESL. To prevent this, flows from the ESL should be returned to the mainstream process for treatment during low raw sewage flow periods.

The aerobic digester is being used to store biosolids which results in creating a poor quality decant (high solids concentration) and consequently a high solids loading to the SBRs when decant is returned. Discussion with operations staff has also indicated that due to capacity issues within the biosolids handling process, sludge from the aerobic digesters must be periodically sent to the ESL and subsequently back into the plant.

These issues are elaborated on further in the following sections.

3.1.3 Liquids Treatment Processes

3.1.3.1 Inlet Works (PU-1, PU-3, and PU-3)

3.1.3.1.1 Existing Conditions

The review of the impacts of flow variation on the New Hamburg WWTP starts with review of capacity of the WWPSs to handle I/I flows. Sewage from New Hamburg is collected and directed to the Morningside Pumping Station (F1). Flows from Baden are directed first to the Baden PS (F2) then pumped to Morningside Pump Station. Together both the Baden and New Hamburg raw sewage flows are pumped to the Inlet Works at the New Hamburg WWTP to begin treatment.

An equalization basin has been provided at the Baden PS for the management of wet weather flows. Operations staff have indicated that periodically depths in the equalization basin reach high levels which cannot be managed by the existing pumps and forcemain and need to be trucked to the NHHWTP (F30). This occurs under high rainfall events. **Figure 3.2** portrays the origin of flows to the WWTP influent chamber including sidestream flows.

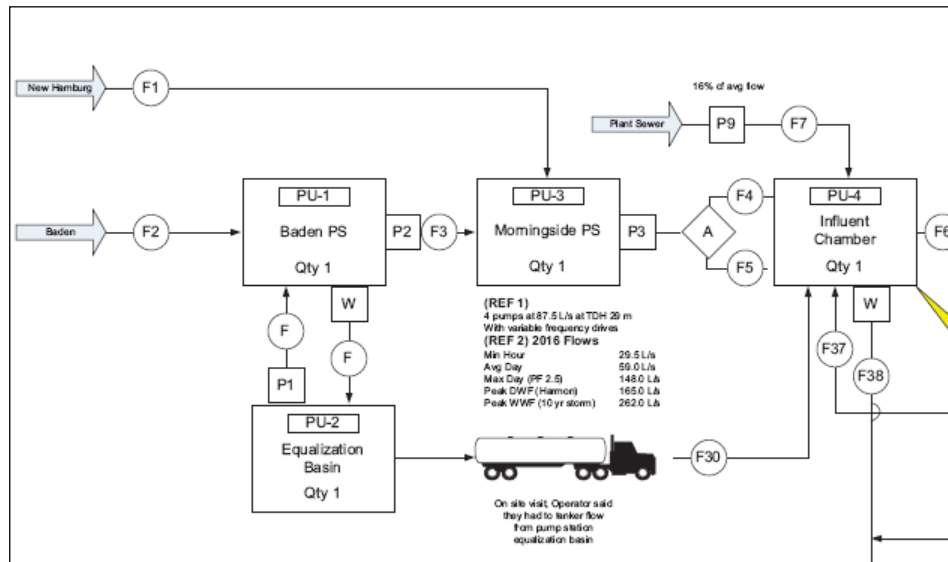


Figure 3.2: Inlet Works - Excerpt from PBD

Once at the WWTP Influent Chamber (PU-4), raw sewage is joined by sewage pumped (P6) from the ESL (F38), Septage/Hauled Waste Storage (F37) and flow from the plant sewer (F7). The plant sewer returns wastewater generated at the plant and does not include process return flows (filter backwash etc). Additionally, the downstream SBR Feed Channel overflow (F40) is also sent back to the Influent Chamber.

An overflow weir is located in the Influent Chamber. This overflow weir will send any flows greater than 166.7 l/s to the ESL (F38).

3.1.3.1.2 Analysis

Table 3.1 summarizes design flows to the Inlet Works during minimum, peak dry weather, average daily and peak instantaneous design flows.

Table 3.1: Inlet Works – Design Flow Summary

	Raw Sewage From Morningside SPS (F5 and F4)	Tanker Flow from pump Station (F30) ¹	Plant Sewer ³ (F7)	Emergency Storage Lagoon/Hauled Waste Feed (F37)	Overflow From SBR Feed Channel (PU-8)	Total Flow to Headworks (F6)	Resulting Overflow to Emergency Storage (F38)
		Instantaneous Flow (l/s)					
Peak Instantaneous ⁴	262	0.0	9.7	22.2	126.6	167	253.5
Peak DWF Hourly	165	0.0	0	22.2	104	167	124.2
Average Daily	59	0.0	0	0.0	0	59	0.0
Minimum Hourly	29.5	0.0	0	0.0	0	29.5	0.0
Min Instantaneous	0						
1) Operator indicated that in high flow periods, they had to transport flow from the Baden PS to the New Hamburg WWTP by tanker truck							
2) Based on pumping rate of pump transporting flow from emergency storage lagoon back to headworks (P6)							
3) Plant Sewer Flow is estimated as 16% of the Average Daily Raw Sewage Flow.							
4) Peak instantaneous flows refers to the condition where the total flow = peak instantaneous raw sewage + plant sewer flow + emergency storage lagoon feed are simultaneously sent to the plant headworks							

Flows in excess of 166.7 l/s overflow the weir and are directed to the ESL. In the event that the ESL/Hauled Waste is pumped back to the influent chamber during peak instantaneous or dry weather flow, flows in excess of 166.7 l/s will simply overflow back to the emergency storage lagoon. This results in re-pumping flows as well as directing higher strength wastes to the ESL.

However if ESL/Hauled Waste is pumped to the Influent Chamber during average or minimum flow periods, overflows should not occur. In the current operation of the plant, flows from the emergency storage lagoon and the plant sewer can be pumped to the influent chamber at any time. This can be mitigated by timing returns from the emergency storage lagoon/hauled sewage and plant sewer to coincide with low raw sewage flow periods. In addition, using a lower capacity pump (i.e. less than 22 L/s) can be used to dampen the instantaneous load from the ESL to the headworks.

3.1.3.1.3 Summary

Inlet Works Constraint:

- Flows from Pump Chamber 2 (PU-16) can be pumped to the influent chamber at any time and may result in overflows at the influent chamber (PU-4) if pumped during high flow periods.

Inlet Works Opportunity:

- If flows from PU-16 are properly managed to return flows during low flow periods only, there is hydraulic capacity to treat the flows without the risk of by-passing;
- Energy savings from avoiding re-pumping;
- Avoid storage of higher strength wastes in lagoons (intended for equalization of low BOD I/I flows).

3.1.3.2 Headworks – Screening and Grit Removal (PU-5, PU-6, PU-7)

3.1.3.2.1 Existing Conditions

The plant headworks consists of an automatic fine screen, a manually raked screen and two vortex grit removal units.



Photograph 1 ↑

New Hamburg WWTP – Screenings Washer



Photograph 2 ↑

New Hamburg WWTP – Screenings Conveyor

Table 3.2: Description of Unit Process – Headworks

Process Name	Number	Description	Design Capacity	Duty/Standby
Automatic Screens	1	6 mm fine screens	166 L/s to 222 l/s	Duty
Manual Screens	1	6 mm fine screens	167 L/s	Standby
Vortex Grit Removal	2	Hydraulic vortex centrifugal force settler	214 to 261 l/s	Duty

Under normal operation, flow from the Influent Chamber flows to the Automatic Screen, then to the Vortex Grit removal units. If the Automatic Screen is offline, the flow can be directed to the Manual Screen.

Operations staff have indicated that they are generally satisfied with the operation of both the screen and vortex grit removal units.

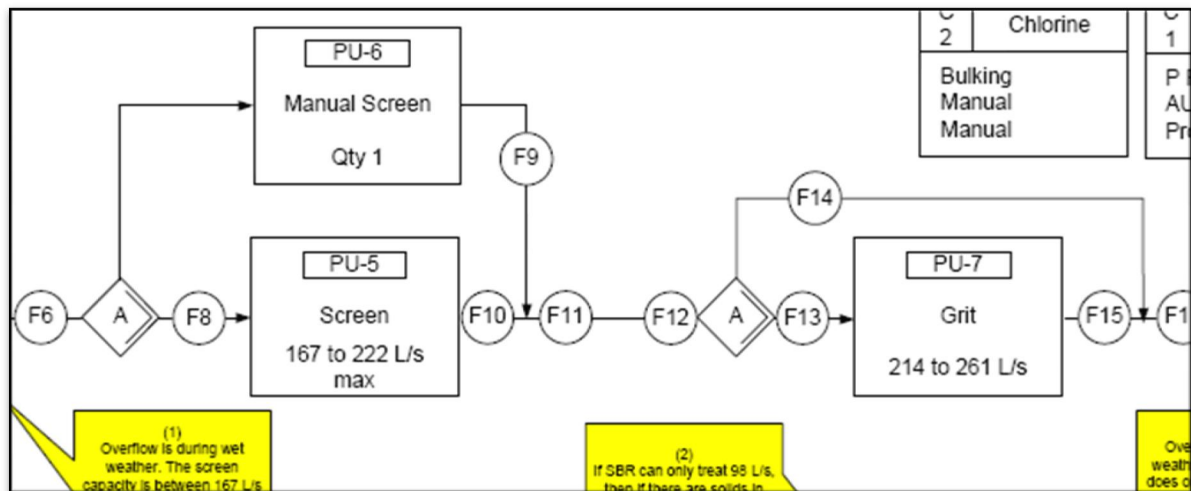


Figure 3.3: Headworks Process Block Diagram

3.1.3.2.2 Analysis

The plant headworks receives flows from the influent chamber (PU-4). The overflow weir in the influent chamber limits the flow (F6) nominally to 166.7 l/s. **Table 3.3** summarizes the design instantaneous flow rates to the plant headworks.

Table 3.3: Design Flow to Headworks (F6)

Flow From Influent Chamber (F6)	
Peak Instantaneous	167 (l/s)
Peak DWF Hourly	167 (l/s)
Average Daily	59 (l/s)
Minimum Hourly	30 (l/s)
<i>Notes: Flow rates noted are at design capacity conditions</i>	

The screens have a nominal capacity of 167 l/s to a maximum of 222 l/s. Literature review regarding the grit removal capacity indicates that this equipment is sized to accommodate flows between 241 and 261 L/s.

3.1.3.2.3 Summary

Headworks Constraint:

- No constraints – the existing headworks system is sufficient to beyond the design capacity of the plant.

Headworks Opportunity:

- Screen and grit removal units can accommodate raw sewage flows of up to 222 l/s (19,181 m³/day).

3.1.3.3 Sequencing Batch Reactors (PU-6, PU-9, PU-19)

3.1.3.3.1 Existing Conditions

Secondary Treatment at the New Hamburg WWTP is provided by three parallel, true batch Sequencing Batch Reactors (SBRs). Each is equipped with fine bubble diffusers, submersible mixers, motorized effluent decanters and positive displacement (PD) blowers. There is no interruption in the feed because the cycle is set up such that one SBR is always in feed/react mode.



Photograph 1 ↑
New Hamburg WWTP SBR



Photograph 2 ↑
SBR Decant Arm

Table 3.4: Description of Unit Processes - SBRs

Parameter	Value
Number	3
Dimensions	L = 45 m W = 15 m SWD ¹ = 5 m
Volume	3375 m ³ (each SBR) 10125 m ³ (total)
Design Capacity	98 l/s (each SBR)
Operating Conditions	SRT = 27 days MLSS= 2800 mg/l
<i>Notes:</i> Design reports indicated that SBR can be filled to 5.4 m, however operator has indicated that the SBR is filled to 5 m under all conditions	

The hydraulic capacity of the SBR is determined by the cycle time. The designer's intent was to operate the plant on an 8 hour cycle, allowing the SBR to overfill during peak diurnal flows. In the event of a high wet weather flow, there was to be flexibility in the programming to provide a 2.4 hour SBR storm cycle (Stantec, 1999a). The Process Control Narrative (Stantec, 2006) speaks of 4 cycle times and no over filling. The cycle times were to be 18 h, 12 h, 4.5 h and 8 h when the plant is in manual mode.

Notwithstanding the designer's intent, at present the operator has one cycle time (8 hours). The other cycle times were not programmed into the control system.

The SBR operating sequence is as follows:

- Fill – 160 minutes
- Aerated – 200 minutes
- Settle – 60 minutes
- Decant – 60 minutes
- Total Cycle Time – 480 minutes.

Screened and dewatered sewage (F16) flows first to the SBR feed channel where it is combined with digester decant (F41); filter backwash (F42) and alum (FC1 and FC3). The combined flow then enters the SBRs.

Each SBR is filled to a depth of 5 metres, then aerated, settled and decanted. Secondary treated flow (F72) then proceeds to the SBR decant chamber and WAS (F29) is sent to the aerobic digesters. The SBR decanter removes the active volume of the SBRs over a period of 2.86 hours.

The SBR feed channel is also equipped with an overflow weir. Under high flow conditions excess flow is sent over the weir to the plant influent chamber upstream of the headworks.

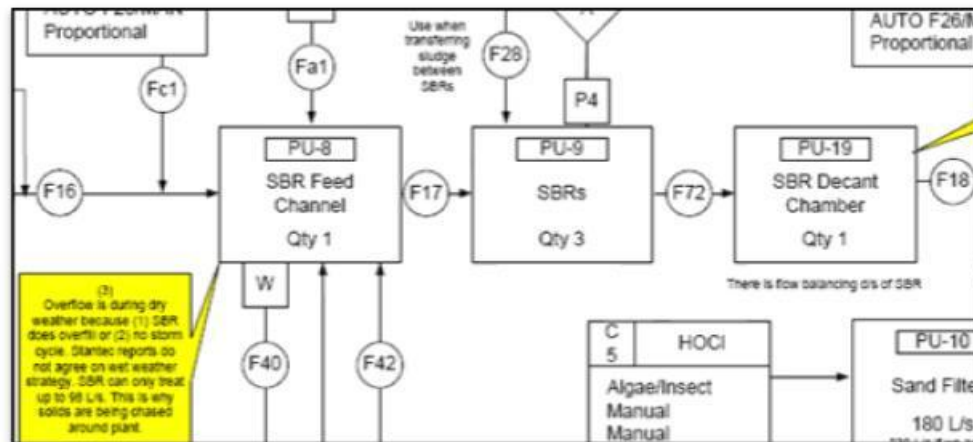


Figure 3.4: Sequencing Batch Reactors – PBD Excerpt

3.1.3.3.2 Analysis

The SBRs were evaluated for both hydraulic and loading constraints. An analysis of loading SBR design loads is shown in **Table 3.5**. For comparison purposes, the capacity for each was developed on the basis of population equivalents (PE)³.

Table 3.5: SBR Loading Capacity

Parameter	Value
Design BOD Load ¹	27.0 g BOD/PE/day
Design TSS Load ¹	36.7 g TSS/capita/day
Design TP Load ¹	1.2 g TP /PE/day
WAS Yield ²	1.3 kg WAS/Kg BOD Load
Sludge Capacity Required ³	0.95 kg/PE
Total Capacity Available ⁴	28,350 kg
Loading Capacity	29,906 PE Total, 10,000 PE per SBR
Notes; 1) Based on historical BOD Loads 2) WAS Yield accounts for sludge generated by alum addition 3) Based on 0.027 kgBOD/PE.d x 1.3kg WAS/Kg BOD x SRT(27 day) 4) Volume at Top Water Level is 10125 m3, MLSS = 2.8 kg/m3	

While design reports discuss the capability for various operating modes (normal, high flow, storm flow, manual flow) discussion with plant operations staff indicate that the SBRs can only be operated in manual flows. As a result the hydraulic throughput is limited to 98 l/s.

³ PE = Population Equivalent, refer to Section 1.4.1.

Table 3.6: SBRs – Flow Summary

Parameter	Screened/Degritted Sewage (F16)	Digester Decant ¹ (F41)	Sand Filter Backwash ² (F42)	Total Instantaneous Flow to SBR Feed Channel	Flow to SBRs (F7)	Resulting Overflow (F40)
	Instantaneous Flow Rate (l/s)					
Peak Instantaneous	167	44	14	225	98	127
Peak DWF Hourly	167	22	14	203	98	104
Average Daily	59	0	14	73	73	0
Minimum Hourly	29	0	0	29	29	0
Min Instantaneous	0	0	0	0	0	0
Notes: 1) Flow rate is based on pump capacity 2) Flow rate is based on 23% of average daily flow						

Table 3.6 summarizes all flows to the SBR Feed Channel. It can be noted that while both the screened and degritted sewage and the sand filter backwash are continuously flowing, the digester decant flow is pumped and timing controlled manually by the operator. The table indicates that under average daily flows, the SBRs can accommodate the sewage and filter backwash flows. If the digester was also decanted at this time, the total flow to the SBRs would be 95 l/s and could also be accommodated by the SBRs. **Table 3.6** also indicates that during peak dry weather flow, the sewage and filter backwash flows would partially overflow to the Influent Chamber (PU-4).

The 1998 Design Brief notes that the SBRs are designed to fill to a level of 5.4 m during peak day flows; however operations staff indicates that the SBRs are only filled to a consistent level of 5.0 m. Increasing the fill level increases the active volume and thus the total capacity of the SBR. This is shown in Table 3.7 below.

Table 3.7: SBR Capacity Comparison – Normal Operation Versus Overfill

	Current Practice	Design Basis	Unit
Top water level	5.0	5.4	m
Bottom water level	3.6	3.6	m
Max decant depth	1.4	1.8	m
Active volume	945	1215	m ³
Cycle time	8	8	hours
Active volume	945	1215	m ³ /SBR
Number of Cycles	3	3	

	Current Practice	Design Basis	Unit
Number of SBRs	3	3	
Flow per day	8505	10935	m ³ /d
SBR Capacity	98	127	L/s

3.1.3.3.3 Summary

SBRs Constraint:

- Hydraulic constraint resulting in overflow during dry weather because SBRs are limited in current operation to fill to depth of 5 m under all flow conditions;
- Hydraulic constraint resulting overflow during wet weather as there is no storm cycle.

SBRs Opportunity:

- SBRs have additional available hydraulic loading capacity;
- Reprogramming the SBR's to allow for storm cycles will mitigate the need for by-passing during wet weather periods;
- Management of decant return flows during low flow periods only will assist in preventing overflows;
- Allowing the SBR to fill to a depth of 5.4 m during peaks provides an additional 29 l/s of capacity, sufficient to mitigate dry weather overflows;
- All of the above changes will require new programming of the SBR operation.

3.1.3.4 SBR Decant Chamber (PU-19)

3.1.3.4.1 Existing Conditions

The SBR decant chamber is located downstream of the SBR. The intent of the SBR decant chamber is to balance flows leaving the SBR so as to not over flow the filters and UV during the decant cycle.

3.1.3.4.2 Analysis

During the decant cycle of the SBR, decant leaves the SBR at an instantaneous rate of 262 l/s. If decant was to flow directly to the tertiary filters it would exceed the filter and UV capacity resulting in a bypass. The decant chamber avoids this by equalizing flows (ie preventing large flow spikes) to the downstream processes.

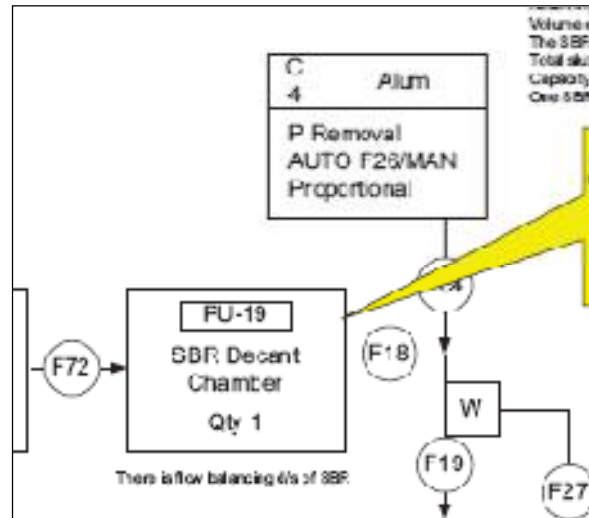


Figure 3.5: SBR Decant Chamber – PBD Excerpt

3.1.3.4.3 Summary

The efficiency of the SBR decant chamber is critical in mitigating filter and UV by-passes. Details regarding the geometry and general operation are not available in the existing literature (C of A or historical reports) and as such further investigation, including hydraulic analysis and a detailed operational review, is required into the operation and efficiency of this chamber.

3.1.3.5 Tertiary Filters – PU-10

3.1.3.5.1 Existing Conditions

Tertiary filtration is provided by three continuous flow sand filters each with four modules. The sand filters have a total capacity of 180 L/s. Alum can be dosed upstream of the sand filters for polishing the SBR effluent. Hypochlorite can also be added to the filters for algae and insect control.



Photograph 1 ↑

New Hamburg WWTP Tertiary Filters



Photograph 2 ↑

New Hamburg WWTP Tertiary Filters

An overflow weir is located between the SBR decant chamber (F18) and the sand filters that allows flows to by-pass the filters in the event that the filters fail or are taken offline. Filter backwash (F42) is returned to the SBR feed channel.

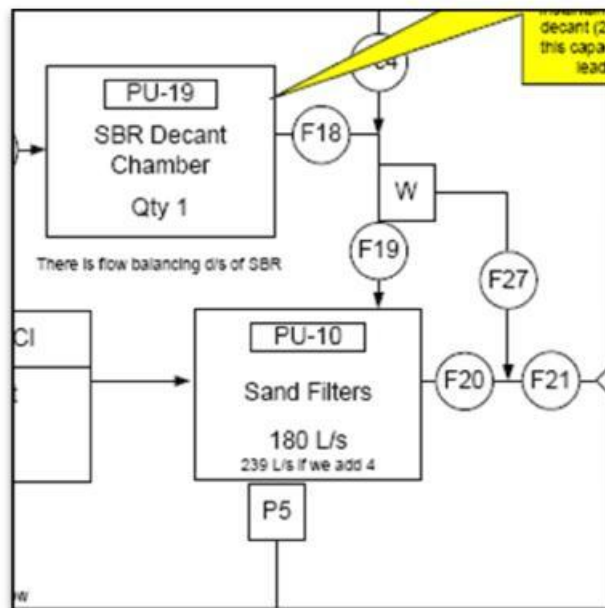


Figure 3.6: Tertiary Filters – PBD Excerpt

3.1.3.5.2 Analysis

The tertiary filters receive flows from the SBR decant and as a result are directly affected by the operation of the SBR. **Table 3.8** illustrates the effect of the operating mode of the SBR on the flow to the filters and UV disinfection.

Table 3.8: Tertiary Filters – Flow Summary

SBR Operating Mode	SBR Decant Time (hours)	SBR Fill Depth (m)	Flow to the Filters/UV (l/s)
Normal Operation ¹	2.67	5	98
Overfilling	2.67	5.4	125
Storm Mode	0.8	5	328
<i>Normal operation represents the present day mode of operation</i>			

The flow to the filters is dictated by the SBR decanter. Under present day operation when the SBR is filled to 5 m, the flow to the filters is 98 L/s as shown in the table above. However, if the SBR is allowed to overfill, decant will flow to the filters at a rate of 125 L/s. By implementing a storm mode, the SBR decanting time period would be shortened resulting in flows leaving the SBRs at a rate of 328 l/s. If decant was to be sent directly to the filters at this flow rate, a filter by-pass would occur. The purpose of the decant chamber (PU-19) is to act as intermediate equalization between the SBRs and the filters to

mitigate high instantaneous flows to the filters during a storm mode. The decant chamber receives SBR decant and releases it to the downstream at a lower, more manageable rate, over a longer period of time. It is unknown how well this is working at present.

At present the sand filters have a capacity of 180 l/s. With the addition of a fourth filter (with 4 modules) this capacity can be increased to 239 l/s.

3.1.3.5.3 Summary

Tertiary Filters Constraint:

- The filters are limited to a flow rate of 180 l/s. This is sufficient to allow for the current decanter flow rate of 98.4 l/s at 5 m of depth and 125 l/s at 5.4 m of depth. Should a storm mode be implemented in the SBR, the filter capacity would be insufficient unless the decant chamber is used to manage peak instantaneous flows.

Tertiary Filters Opportunity:

- The filters are sufficient to the design capacity of the plant;
- There is space for the addition of another filter bank for four more filters to accommodate flows beyond the design capacity.

3.1.3.6 Disinfection

3.1.3.6.1 Existing System

Disinfection is provided by UV irradiation. At present there are two UV channels, one with two banks of low pressure UV lamps and a rated capacity of 222 L/s (F23). The other channel does not currently contain UV lamps (F24). There is also a bypass channel (F70).

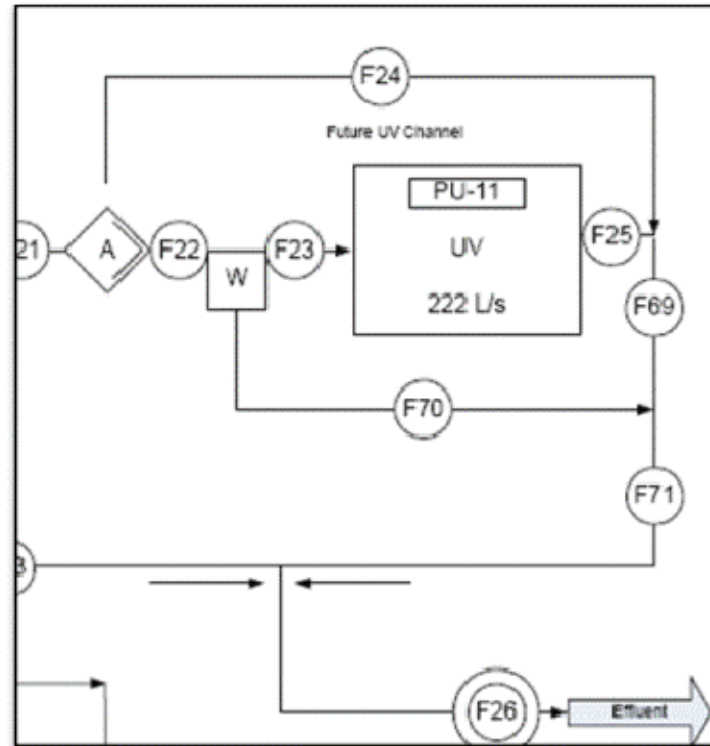


Figure 3.7: Ultraviolet Disinfection – PBD Excerpt

3.1.3.6.2 Analysis

Following tertiary filtration, filtered effluent (F22) or filter by-pass flows (in the event of filter failure) (F24) are directed to the UV channels for disinfection. An overflow weir allows flows to bypass disinfection. Similar to the tertiary filters, flow to the UV channels is impacted by the operation of the SBR (see **Table 3.8**).

An item of note is the location of the effluent sampler. The effluent is sampled at F71 which is downstream of UV disinfection but upstream of the emergency storage lagoon overflow to the outfall.

3.1.3.6.3 Summary

Disinfection Constraint:

- The UV system is limited to a flow rate of 222 l/s. This is sufficient to allow for the current decanter flow rate of 98.4 l/s at 5 m of depth and 125 l/s at 5.4 m of depth. Should a storm mode be implemented in the SBR, the UV capacity would be insufficient unless flows are managed by an SBR decant chamber.

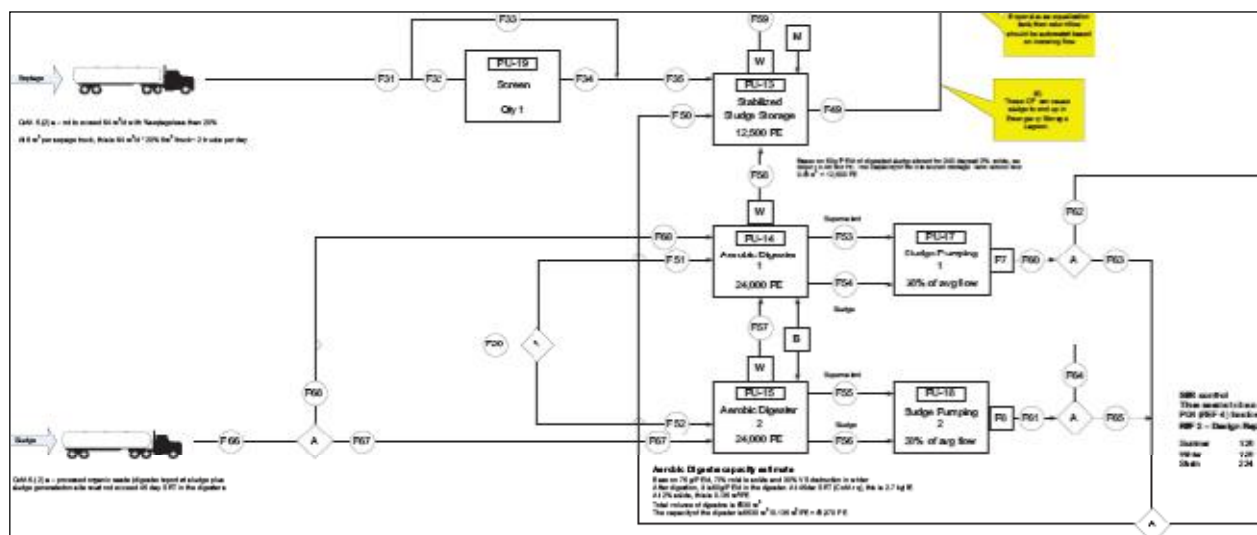
Disinfection Opportunity:

- The UV system is sufficient to the design capacity of the plant;
- There is space for the provision of additional UV capacity for flows beyond the design capacity;
- The effluent sampler should be moved to include emergency storage lagoon overflows.

3.1.4 Biosolids Handling

3.1.4.1 Existing System

The New Hamburg WWTP provides sludge stabilization for WAS generated at the New Hamburg WWTP, St. Jacobs WWTP, Wellesley WWTP and Hespeler WWTP. The solids handling system at the New Hamburg WWTP is shown in the excerpt from **Figure 3.1** (Process Block Diagram) below. In the original design, Aerobic digestion was to be provided by a two cell aerobic digestion system (PU-14 and PU-15). Digested sludge was then to be sent to the Stabilized Sludge Storage Lagoon (PU-13) for long term storage. Pumps (P6 and P7) are used to both pump supernatant to headworks and sludge to biosolids loading trucks as required.



**Photograph 1 ↑**

New Hamburg WWTP Emergency Storage Lagoon

**Photograph 2 ↑**

New Hamburg WWTP – Aerobic Digester

Operations staff have noted that dual use of the aerobic digesters for digestion and storage has resulted in a serious bottleneck at the plant. To mitigate limited capacity, once the aerobic digesters are full, the digesters are decanted and supernatant is sent to headworks for further processing. Once the tanks have been decanted as much as possible (i.e. no additional supernatant exists) and the digesters are full of sludge, additional sludge is sent to the ESL.

Because there are overflow weirs from the digesters, to the stabilized sludge storage (now used as hauled waste storage), and between the hauled waste storage and the emergency storage lagoon, it is also possible that sludge can overflow to the ESL.

3.1.4.2 Analysis

In the analysis of the opportunities and constraints with the biosolids handling system at the New Hamburg WWTP a number of potential options to resolve capacity limitations were evaluated in terms of capacity including:

- Option 1 (current operation) – Both digesters act as both digestion and storage units;
- Option 2 – The one digester provides digestion, digested sludge is mechanically thickened and long term storage is provided by the second digester;
- Option 3 – the primary and secondary digesters provide digestion, long term storage is provided by the stabilized sludge lagoon and an alternate hauled waste facility is constructed;
- Option 4 – Option 3 with the addition of mechanical thickening prior to long term storage;
- Option 5 – construct a new long term storage tank and continue the use of existing hauled waste receiving station;
- Option 6 – construct new digesters and use existing digesters for sludge storage and continue the use of the existing hauled waste receiving station;
- Option 7 – Use existing digesters for digestion, continue the use of existing hauled waste receiving station and store sludge at an alternate off-site location.

Table 3.9 outlines the assumptions used in this analysis.

Table 3.9: Parameters in Solids Handling Analysis

Parameter	Value	Units
Number of Digester Cells (PU-14 & PU-15)	2	
Volume/Cell	3265	m ³
Total Digestion Volume	6530	m ³
Required SRT (DIGESTION)	45	days
Required SRT (LONG TERM STORAGE)	240	days
Stabilized Sludge Storage Lagoon (PU-13) Volume	6000	m ³
Sludge Produced per Population Equivalent ¹		
Waste Activated Sludge	37	g/PE/day
Digested sludge	29	g/PE/day
WAS Volatile Solids Concentration	70%	(VSS/TSS)
Winter VSS Destruction in Digester	30%	(of VSS)
Digested Solids Concentration		
Before Decanting	10	kg/m ³
After Decanting	20	kg/m ³
After Thickening	60	kg/m ³
<i>1)Based on 1.3 kg WAS/kg BOD Load</i>		

Table 3.10 summarizes the results of the analysis. As the biosolids handling facility receives sludge from a number of Regional WWTPs, capacity in this table is shown in terms of population equivalents (PE).

Table 3.10: Sludge Stabilization Capacity Comparison

Option	Capacity (PE)
Option 1	
Digestion and Storage	18,451
Option 2	
Digestion	49,202
Storage	27,676
Option 3	
Digestion	98,405
Storage	16,953
Option 4	
Digestion	98,405

Option	Capacity (PE)
Storage	50,860
Option 5	
Digestion	98,405
Storage	Build to Requirements
Option 6	
Digestion	Build to Requirements
Storage	9069
Option 7	
Digestion	98,405
Storage	Not Applicable (no onsite storage)
Assumes:	
1. 70 g undigested sludge produced/PE/day, 60 g digested sludge produced/PE/day	
2. Sludge concentration is 1% before decanting, 2% after decanting and 6% after thickening	

In the above Table, the impact of using the aerobic digesters for digestion and storage can be clearly seen by comparing Options 1 and 2. When the need for storage in the aerobic digesters is removed, the capacity of the digesters is substantially increased. This indicates that the issues experienced with biosolids handling at the New Hamburg WWTP are not due to the digester capacity. In actuality the lack of available aerobic biosolids storage has resulted in the inability of the WWTP biosolids facility to operate as intended. The design intent of the digesters was to provide digestion and sludge thickening. By adding storage, not only is digester volume taken up but the addition of storage results in diminishing the thickening capacity of the digester.

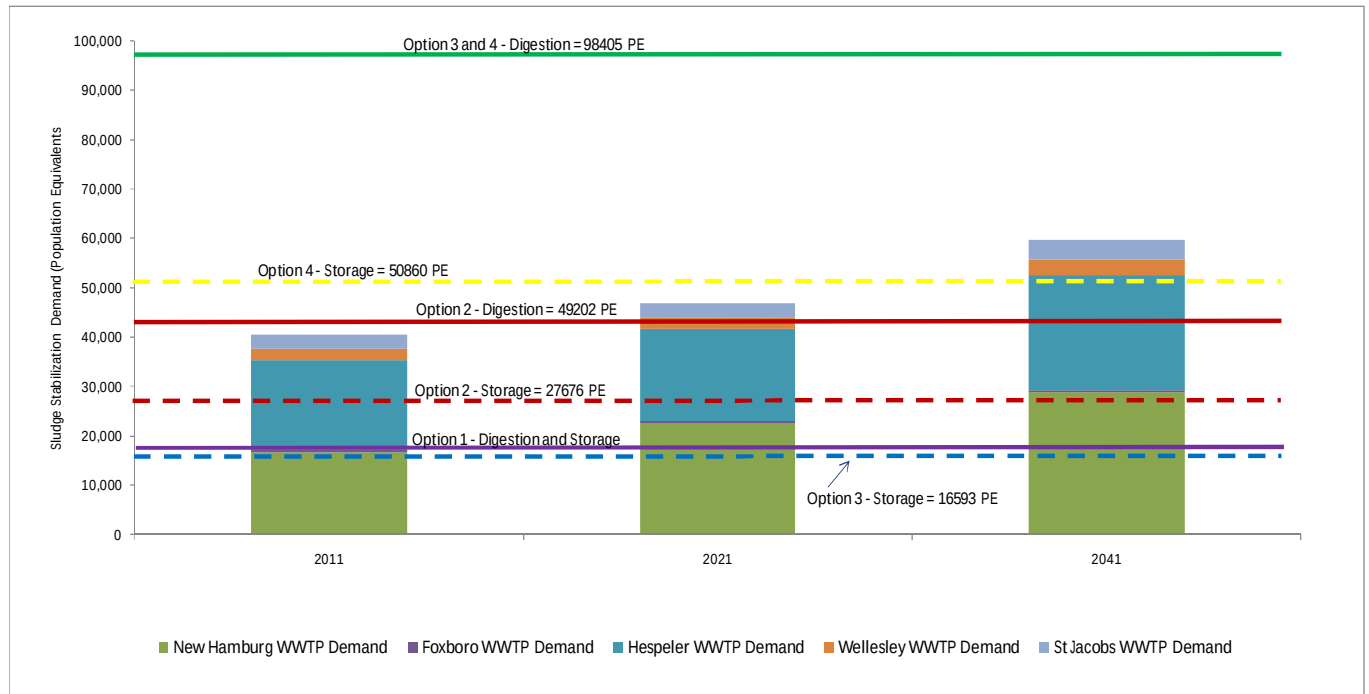


Figure 3.9: Sludge Stabilization Capacity for Each Option

Figure 3.9 above summarizes the aerobic biosolids digestion and storage requirements of each of the New Hamburg, Hespeler, Wellesley and St. Jacobs WWTPs and the capacity that would be provided by each option. Aerobic biosolids digestion and storage requirements of the Foxboro WWTP have also been shown.

3.1.4.3 Summary

Biosolids Handling Constraints:

- Under the current strategy of using the existing digesters for both digestion and storage, the capacity of the digesters is insufficient for future loads – even with no outside biosolids.

Biosolids Handling Opportunities:

- Option 2 will provide enough digestion capacity for all contributing WWTPs to 2011. If Hespeler WWTP biosolids are directed elsewhere, this option is sufficient for digestion through 2041. However additional storage is required beyond 2011.
- Option 4 will provide digestion and storage capacity to beyond 2021 with Hespeler WWTP included and to beyond 2041 without Hespeler included in the total volume.
- There may be other opportunities identified under the Region's on-going Biosolids Master Plan Update.

3.1.5 Evaluation Summary

Based on the above analysis the two primary issues with New Hamburg WWTP are:

1. No long term biosolids storage. Biosolids are being stored in the aerobic digesters leading to poor quality decant results in excess solids loading to the SBRs.
2. SBR programming does not allow for peak diurnal or wet weather flows. As the plant approaches its design flows, a higher fraction of the plant return flows will be diverted to the emergency storage lagoon.

These two deficiencies cause solids to be caught in an internal loop that can result a reduction in the SBRs treatment capacity.

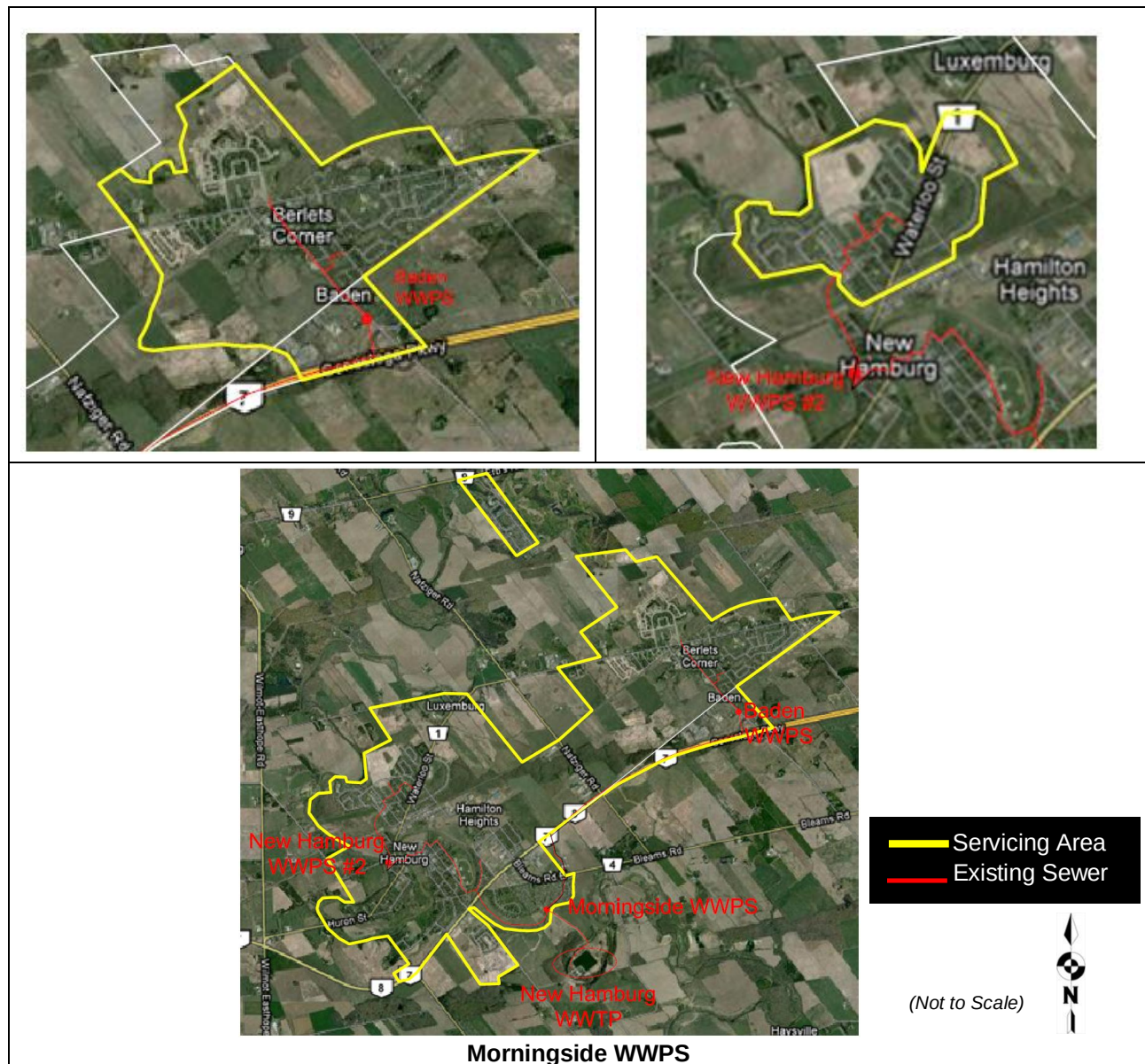
A third possible issue is the efficiency of the SBR Decant Chamber. Decant equalization (ie by the SBR Decant Chamber) is required to prevent the sand filters and UV processes from being by-passed. Insufficient information (tank geometry and operational details) is available to undertake a more thorough review of this constraint.

3.2 Wastewater Collection System

The Baden, New Hamburg, and Foxboro Green wastewater collection systems were evaluated to identify opportunities and constraints based on the current installed capacity and 2041 flow requirements (Low and High Scenarios) for the Region's wastewater collection infrastructure only. Interim flows were not included in the wastewater collection system evaluation as the planned population growth spatial distribution over time was not available during this study.

3.2.1 Analysis Methodology

The initial analysis compared the design flow with the projected 2041 (Low and High) flows for the current servicing areas. The servicing areas per existing wastewater pumping stations considered in this analysis are shown in yellow in **Figure 3.10**. Red line indicates existing sewer lines.



3.2.2 Baden WWPS (Region)

The projected flows for the 2041 Low and High Scenarios were compared to the Baden WWPS design flows. As shown in **Table 3.11**, the 2041 Low Scenario flows are very similar to the 2041 Design flows presented in the Preliminary Design Report (Stanley, 1998). However, the 2041 High Scenario flows are higher than the 2041 Design flows.

Table 3.11: Baden WWPS Design vs. Projected Flows

Year	Average Day, L/s (m3/d)	Peak Dry Weather, L/s (m3/d)	Peak Wet Weather to FM, L/s (m3/d)	Peak Wet Weather to Storage, L/s (m3/d)	Force Main (mm)
Installed*	18 (1,555)	49 (4,233)	49 (4,233)	140 (12,096)	1 X 200
2041 Design*	22.6 (1,953)	60 (5,184)	60 (5,184)	140 (12,096)	1 X 200
2041 (Low)**	20 (1,694)	60 (5,226)	200 (17,247)		Ok for dry weather
2041 (High)**	24 (2,029)	70 (6,101)	233 (20,134)		
* From Preliminary Design Report (Stanley, 1998)					
** Unofficial Projection					

The Baden WWPS is currently capable of pumping 2016 peak dry weather flows; however, the pumping station can be upgraded to 2041 peak dry weather design flows. There is storage available on site for wet weather flows, with a total capacity of 1,400 m³. As mentioned in **Section 1.2.5**, the estimated Baden Average Dry Weather Flow includes approximately 170 lpcd of I/I flow, with reduced I/I levels of 90 lpcd in new developed areas. Refer to **Section 1.3.3.2.1** for additional information on the existing equalization tank.

The following constraints and opportunities are identified for the Baden WWPS:

Baden WWPS Constraint:

- Not sufficient pumping capacity and equalization storage capacity to handle current I/I issues. Excess flows have been trucked directly to the WWTP on occasion.
- Baden forcemain (200 mm) to Morningside WWPS: designed for dry weather flow from Baden WWPS (2041). No redundancy.
- Peak Dry Weather Flow for the 2041 High Scenario is higher than the current design flow.

Baden WWPS Opportunity:

- Alternative B1: Reduce I/I
- Alternative B2: Provide additional equalization storage at Baden WWPS in order to continue discharging peak dry weather flow to Morningside WWPS.
- Alternative B3: Increase capacity of Baden WWPS and forcemain. Would have implications downstream:

- o Provide Morningside WWPS equalization and/or increase pumping capacity to peak wet weather flows
- o Increase New Hamburg WWTP equalization storage capacity.

3.2.3 New Hamburg WWPS No. 2 (Township)

The projected flows for the 2041 Low and High Scenarios were compared to the New Hamburg WWPS No. 2 installed capacity. As shown in **Table 3.12**, the 2041 Low Scenario flow is very similar to the 2041 Design flows. However, the 2041 High Scenario flow is approximately 15% higher than the 2041 Design flows. Current wet weather capacity was not available.

Table 3.12: New Hamburg WWPS No. 2 Installed vs. Projected Flows

Year	Average Day, L/s (m3/d)	Peak Dry Weather, L/s (m3/d)	Pump Capacity to Storage, L/s (m3/d)	Force Main (mm)
Installed*	-	45 (3,888)	19 (1,642) 38 (3,283) 190 (16,416)	1 X 300
2041 (Low)**	14 (1,224)	47 (3,942)	same	1 X 300
2041 (High)**	16 (1,405)	51 (4,442)	same	1 X 300
* From "Sanitary Sewer Inflow/Infiltration Study" (CRA, 2009)				
** Unofficial Projection				

There is storage available on site for a volume of 1,570 m³. The 200 mm FM discharges to a 300 mm gravity sewer pipe on Waterloo Street.

The following constraints and opportunities are identified for the New Hamburg WWPS No. 2:

New Hamburg WWPS No. 2 Constraint:

- Peak Dry Weather Flow for the 2041 High Scenario is higher than the WWPS installed capacity.

New Hamburg WWPS No. 2 Opportunity:

- Increase capacity of New Hamburg WWPS No. 2 for the 2041 High Scenario.

3.2.4 Morningside WWPS (Region)

The projected flows for the 2041 Low and High Scenarios were compared to the Morningside WWPS design flows. The existing pumps are rated to handle 2041 design flows with replacement of the pump impellers. As shown in **Table 3.13**, the 2041 Low Scenario flow is slightly lower than to the 2041 design flows. However, the 2041 High Scenario flows are significantly higher than the 2041 design flows.

Table 3.13: Morningside WWPS Design vs. Projected Flows

Year	Average Day, L/s (m3/d)	Peak Dry Weather, L/s (m3/d)	Peak Wet Weather, L/s (m3/d)	Force Main (mm)
Installed*	59 (5,098)	165 (14,256)	262 (22,637)	2 X 300
2041 Design*	86 (7,405)	214 (18,490)	323 (27,907)	2 X 300
2041 (Low)**	81 (7,023)	202 (17,473)	303 (26,209)	2 X 300
2041 (High)**	98 (8,506)	236 (20,433)	355 (30,650)	2 X 300
* From Preliminary Design Report (Stanley, 1998)				
** Unofficial Projection				

As mentioned in **Section 1.2.5**, the estimated New Hamburg Average Dry Weather Flow includes approximately 105 lpcd of I/I flow, with reduced I/I levels of 90 lpcd of I/I in new developed areas.

Morningside WWPS Constraint:

- Peak Dry Weather Flow for the 2041 High Scenario is higher than the current design flow.
- East Side Trunk Sewer Capacity (145 L/s) may not be sufficient depending on the alternatives presented below.
- I/I issue difficult to address without knowledge of the source

Morningside WWPS Opportunity:

- Address I/I issue.
- New sewer trunks required to discharge wastewater to Morningside WWPS
- Replacement of the impellers and an additional pump may be required at the Morningside WWPS for the 2041 (High) scenario.

3.2.5 Foxboro Green WWPS (Region)

As mentioned above, the Foxboro Green Retirement Community has its own wastewater treatment process; however, the Region expressed an interest in reviewing feasibility of pumping the wastewater from Foxboro Green to the Baden - New Hamburg collection system for treatment at the New Hamburg WWTP.

Foxboro Green WWPS Constraint:

- There is no connection between the Foxboro Green wastewater collection system with the Baden/New Hamburg System.

Foxboro Green WWPS Opportunity:

- Upgrade the existing Foxboro Green Wastewater System to pump the wastewater to the New Hamburg WWTP.
- Connect the Foxboro Green wastewater collection system to the Baden/New Hamburg system.

3.2.6 Evaluation Summary

Opportunities and constraints for the wastewater collection system are summarized below:

- I/I issue difficult to address without identifying the source
- Some areas currently not serviced will require new pumping stations
- New sewer trunks are required to discharge wastewater to Morningside WWPS
- Baden WWPS and equalization storage need to be evaluated
- Replacement of the impellers and an additional pump may be required at the Morningside WWPS for the 2041 (High) scenario.
- Upgrade the Foxboro WWTP to a pumping station and connect to the Baden - New Hamburg collection system.

4. Development of Wastewater Alternatives

4.1 Wastewater Treatment

In accordance with the Class Environmental Assessment (Class EA) process, various alternatives solutions were identified to accommodate the projected 2041 (low and high) wastewater flows. The Ontario Ministry of the Environment (MOE) stipulates that a 20 year horizon should be used in planning for wastewater treatment infrastructure. The Region of Waterloo's Regional Official Plan (ROP) provides population forecasts through to 2029 and as such the alternatives developed for the New Hamburg WWTP reflect the 2029 horizon. However, this Master Plan includes long term planning alternatives to address 2041 requirements to meet estimated high and low population projections.

The following approach has been adopted for developing wastewater treatment alternatives at the New Hamburg WWTP:

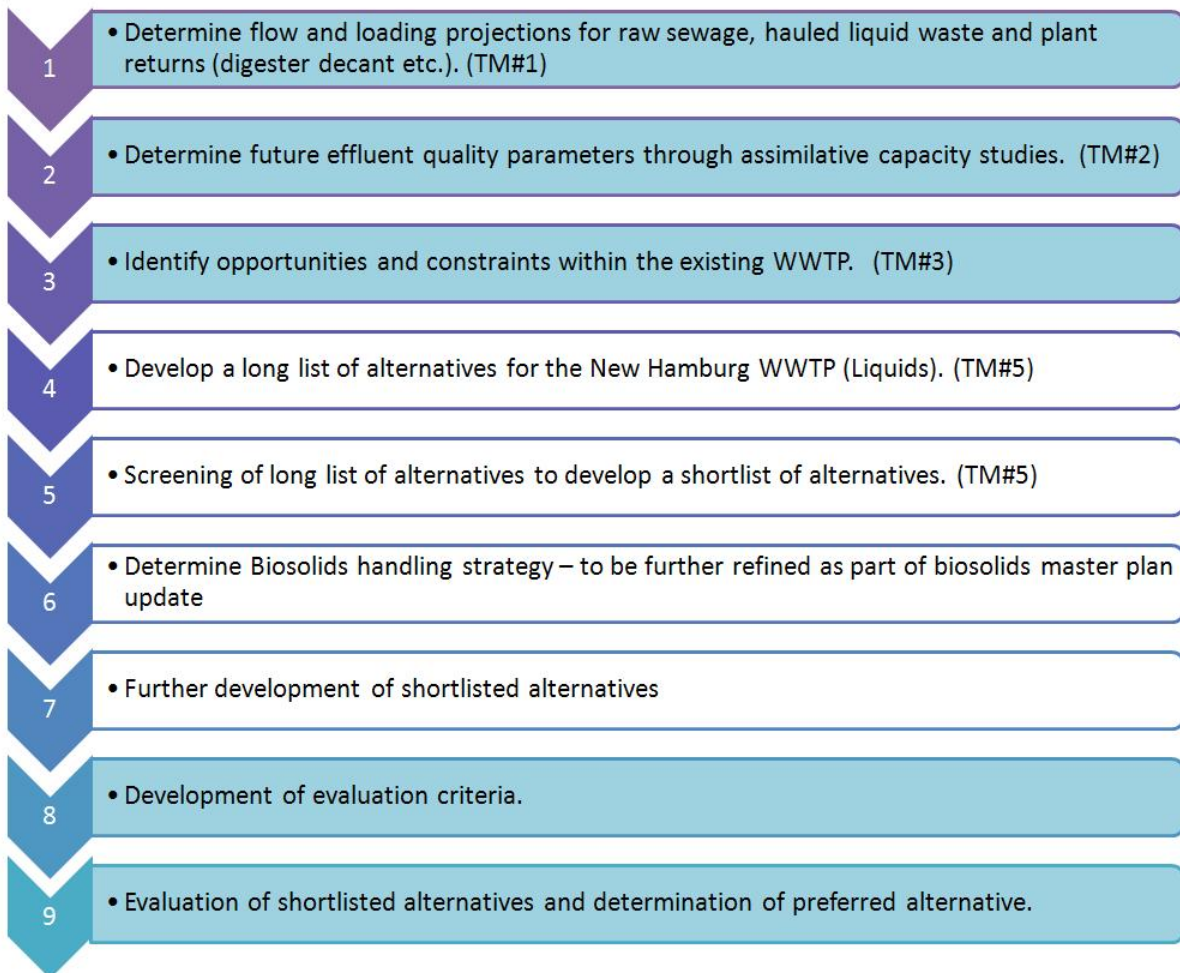


Figure 4.1: Strategy for Determining Preferred Wastewater Treatment Alternative

Given the future growth, effluent quality requirements, constraints and opportunities identified in Section 3, this Section addresses strategies for the New Hamburg WWTP (Steps 4 through 7).

The New Hamburg WWTP provides wastewater treatment for the communities of Baden and New Hamburg. The New Hamburg WWTP biosolids management process provides biosolids stabilization for aerobic biosolids generated at the Hespeler WWTP, Wellesley WWTP, and St Jacobs WWTP in addition to the biosolids produced at the New Hamburg WWTP. Digester supernatant from the solids handling process is returned to the New Hamburg WWTP headworks. As such the return flows from the biosolids handling process (decant) comprises a larger component of the liquids stream than a biosolids handling process that services one treatment plant.

4.1.1 Effluent Quality Requirements

Modifications to the existing WWTP to accommodate increases in raw sewage flow require consideration of possible changes to the existing effluent limits. Per the recommendations stemming from the assimilative capacity update (see **Section 2**), the following effluent criteria have been used in the development of wastewater treatment alternatives for the New Hamburg WWTP.

Table 4.1: New Hamburg WWTP Recommended Effluent Objectives – for Planning Purposes

EFFLUENT PARAMETER	CURRENT		RECOMMENDED DESIGN OBJECTIVE
	EFFLUENT OBJECTIVE	COMPLIANCE LIMITS	
cBOD ₅	5 mg/L	10 mg/L ^(a) , 52 kg/day	5 mg/L
TSS	5 mg/L	10 mg/L ^(a) , 52 kg/day	5 mg/L
TP*	0.2 mg/L	0.3 mg/L ^(b) , 1.56 kg/day	0.2 mg/L, 1.56 kg/day*
TAN			
May 1 to Nov 30	0.4 mg/L	1.0 mg/L ^(b) , 5.1 kg/day	0.4 mg/L
Dec 1 to Apr 30	1.0 mg/L	2.0 mg/L ^(b) , 10.4 kg/day	1.0 mg/L
Nitrate – Nitrogen Option a) Option b)	No Nitrate Objective	No Nitrate Objective	No Nitrate Objective Nitrate Objective
* Per Policy 2, maintaining current CofA loading objective results in decreased concentration objective with increased flow (a) Annual Average; (b) Monthly Average			

Thus each treatment alternative required consideration of these possible future effluent limits as shown in **Figure 4.2**.

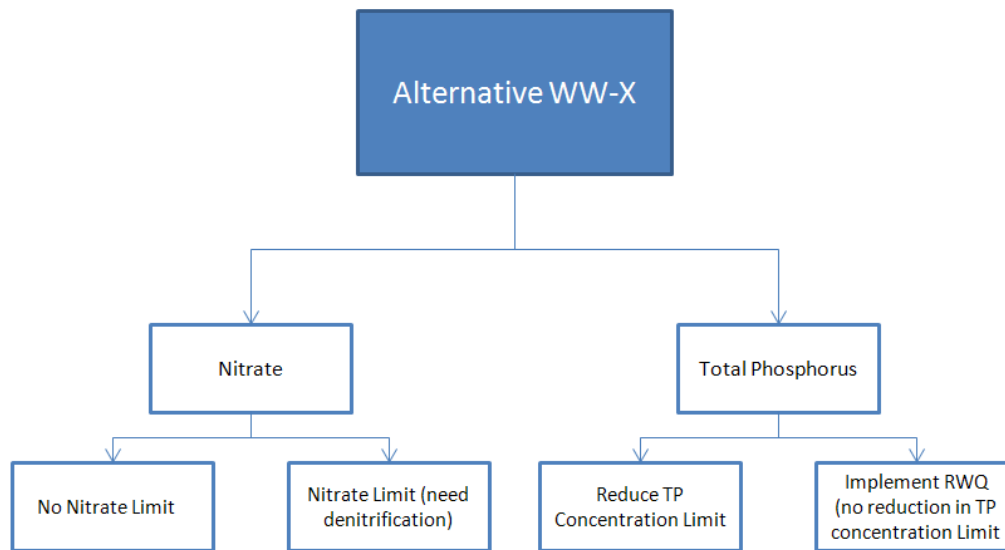


Figure 4.2: Effluent Considerations in WW Alternatives

4.1.2 Development of Long List of Alternatives for the New Hamburg WWTP (Liquids)

Several alternatives for the New Hamburg WWTP were developed, each considering population projections, possible effluent alternatives and the assumptions regarding the preferred biosolids handling strategy (discussed in later in this document). Each alternative is listed below and discussed in the following paragraphs.

Alternative WW-1: **“Do Nothing”**

Alternative WW-2: **Limit Community Growth**

Alternative WW-3: **Reduce Wastewater Generated**

Alternative WW-4: **Optimize and Expand Existing WWTP per Phase 2 Expansion Plan**

Alternative WW-5: **Optimize and Expand Existing WWTP by Conversion to a Flow Through Process**

4.1.2.1 *Alternative WW-1: Do Nothing*

In the “Do Nothing” alternative no changes to the existing wastewater treatment plant will be made. The plant will continue to operate with no modification to infrastructure or operational practices.

At present there are several constraints within the existing wastewater treatment plant that require correction to ensure treatment objectives are met through to the rated capacity of the plant and this alternative does not allow for this.

As a result the “Do Nothing” alternative is not considered a viable option.

4.1.2.2 *Alternative WW-2: Limit Community Growth*

Alternative WW-2 assumes that growth within the New Hamburg WWTP service area is limited to the existing CofA design capacity of 5,200 m³/day. Alternative WW-2 would not include additional infrastructure, but would include minor modifications to operation of the WWTP to correct existing deficiencies such that the treatment objectives of the WWTP can be met to the current design capacity of the system. As reported in the Region's 2010 Water and Wastewater Monitoring Report, the existing flow plus committed flow is 5,162 m³/day which leaves 38 m³/day of available capacity or servicing for 102 Population Equivalents (PE).

The 2009 Regional Official Plan documents a plan to accommodate the residential commercial and industrial needs of the Township through to 2029.

Limiting growth to the design capacity of the WWTP will not meet the growth rates specified in the ROP to 2029 and does not meet the Purpose Statement of this Master Plan study.

4.1.2.3 *Alternative WW-3: Reduce Wastewater Flows*

Water efficiency efforts such as toilet replacement programs and changes to the plumbing code may further reduce water consumption and wastewater flows. As well, I/I studies of the Baden/New Hamburg area suggest repairs to the collection system may assist in mitigating dry weather I/I, although no confirmed correlation to the decrease in I/I is presently available.

The MOE design guidelines for sewage treatment works stipulate that projected wastewater flows for the design of sewage treatment works must use historical per capita flows as a basis for future growth, and thus possible future reductions in flow should not be considered.

Additionally, the per capita average sewage flow used in the projection of future flows to the wastewater treatment facility is 253 l/capita/day which is at the low end of the MOE Design Guidelines for Sewage Treatment Works recommended range of 225-450 l/capita/day. While some reduction in flows may be achieved through water efficiency efforts and correction of dry weather I/I flows, this is expected to be minimal.

As such Alternative WW-3 is recommended to continue under any preferred management strategy; however, in and of itself, it does not meet the future requirements for wastewater treatment capacity.

4.1.2.4 *Alternative WW-4: Expand the Existing Treatment Plant per Phase 2 Expansion Plan*

The New Hamburg WWTP was constructed in 2000. A phased approach was taken in the design of this facility. The Phase 1 (completed in 2000) was to provide capacity to 2016. Phase 2 was to be completed in 2016 to provide a design flow of 7,400 m³/day with capacity sufficient to 2041. As such several features were incorporated into the Phase 1 design to either provide capacity beyond the 2016 or flexibility to easily install additional tanks and equipment to provide additional capacity during the eventual Phase 2 expansion.

This alternative (Alternative WW-4), proposes to carry out an expansion according to the Phase 2 expansion plan. The deficiencies within the existing treatment plant would be first corrected and where

possible, optimization of the existing unit processes would be carried out. Upgrades would then be carried out according to the Phase 2 expansion plan to provide capacity beyond the capability of the existing system.

The WWTP will be upgraded in accordance with the phasing plan documented in the July 1998 *New Hamburg – Baden Wastewater Treatment and Conveyance Infrastructure, Preliminary Design Report*. The benefit of this approach is its compatibility with the existing configuration of the treatment plant. Upgrades could be installed that are cohesive to the existing plant layout, with minimal disruption to the plant hydraulics, minimal need for additional buildings/structural modification, and maximizes the utilization of existing infrastructure.

The primary drawback of this approach is that the projected wastewater flows used as basis for the Phasing schedule used in the July, 1998 preliminary design was based on the population projections documented in the Regional Official Policies Plan published in 1996. The 2009 Regional Official Plan has updated population projections that are significantly higher than the 1996 ROPP. Comparisons between the 1996 ROPP and the 2009 ROP are shown in **Table 4.2**.

Table 4.2: Population Projection Comparison

Official Plan	Equivalent Population (2016)	Equivalent Population (2041)
1996 ROPP	13,820	20,400
2009 ROP	20,090	29,270 (low projection) 35,830 (high projection)
<i>Note: The population and employment forecasts provided by Regional staff have been prepared specifically to meet the data requirements of this engineering study. Use of the forecasts does not mean or imply that Regional staff or Regional Council endorse potential planned development commensurate with the forecasts. Consideration of planned development anywhere within the Region must occur in the context of the population and employment forecasts contained in the Regional Official Plan as approved by the Province of Ontario.</i>		

As shown, the Phase 2 design equivalent population was significantly lower than the updated projections noted in the 2009 ROP. While opportunities for optimization of the infrastructure do exist, an expansion according to the 2000 design is not expected to meet the needs of the updated population projections. While the existing infrastructure does provide for space within the existing buildings and simplistic tie ins for expansion to the Phase 2 capacity, expansion beyond this capacity would require significant structural modifications and extensive evaluation (including a detailed hydraulic analysis) and modification to the intended hydraulics of the facility. As such, a parallel process would be required to provide treatment beyond the capability of the expanded facility. A parallel MBR package plant would achieve the necessary process objectives with a small footprint and no need for additional buildings.

4.1.2.5 *Alternative WW-5: Optimize and Expand Existing Wastewater Treatment Plant to Beyond 2029*

As discussed, the evaluation of the existing WWTP noted several deficiencies within the existing treatment plant as well as opportunities for optimization. As with Alternative WW 4 these deficiencies will be corrected, and where possible, unit processes will be optimized.

The facility would then be expanded to accommodate future growth. Alternative WW 5 consists of conversion of the SBR secondary treatment system to a conventional flow-through process. Instead of the addition of a fourth SBR proposed in Alternative WW-4, the existing three SBRs would be converted to plug flow aeration tanks. In addition two new secondary clarifiers and a RAS/WAS pump station would be constructed. This configuration is less sensitive to peak flows and is more operator friendly. In addition, the process can be easily modified for changing effluent requirements (for example, seasonal SRT changes, anoxic zone easily incorporated for denitrification cycles etc.) Two additional cells, and therefore an expansion of the existing filter building would be required.

The headworks, UV disinfection systems would be upgraded per the original Phase 2 design discussed for Alternative WW-4.

4.1.2.6 Summary and Screening of Alternatives

Table 4.3 provides a summary of the alternatives discussed above. The alternatives were screened with respect to their ability to satisfy the deficiencies within the existing treatment plant, ability to accommodate future growth, and the flexibility to meet possible future effluent limits.

Table 4.3: Summary and Screening of Alternatives

Alternative	General Evaluation
WW – 1, Do Nothing	Summary: No upgrades or expansion activities will be carried out. Pros: No additional upgrades are required. Cons: There are deficiencies within the existing system that will prevent the WWTP from accommodating flows up to the design capacity of the plant. Next Steps: The “Do Nothing” alternative is not considered acceptable and therefore will not be given further consideration.
WW – 2, Limit Community Growth	Summary: Limit growth based on existing plant capacity Pros: No additional capital expenditure is required. Cons: Future growth has been identified in the Regional Official Plan. This alternative does not meet the purpose statement of this Master Plan study. Next Steps: The “Limit Growth” option is not considered acceptable and will therefore not be given further consideration.
WW – 3, Reduce Wastewater Flows	Summary: Measures will be taken to reduce wastewater flows through water efficiency efforts, and I/I mitigation. Pros: No additional capital expenditure is required. Cons: Per capita sewage flows are at present at the low end of the MOE suggested range. MOE design guidelines indicate future planning should be based on historical flows and not potential future reduction efforts. Additionally storm flow mitigation at the WWTP is currently provided. Next Steps: This option will continue to be implemented by the Region and Township as part of any proposed strategy moving forward to maintain existing low wastewater flows. Further reductions will result in the deferral of the need for planned expansions.

WW – 4, Optimize and Expand the existing WWTP per Phase 2 design	Summary: Deficiencies within the existing treatment plant would be corrected, and optimization of unit processes would be carried out. Additional capacity would be provided per the original design intent of the facility. Pros: Additional capacity will be provided that may be sufficient to the Regional Official Plan Population Horizon. Changes in effluent quality limits may be accommodated. Cons: The Phase 2 expansion plan was based on out-dated population projections. The capacity of the Phase 2 expansion will be limited by the provisions made previously. A parallel process will be required to meet long term capacity needs. Significant upgrades and therefore significant capital expenditure would be required. Next Steps: This option is viable and therefore will be given further consideration. Confirmation of this alternative's ability to meet future effluent limits is required.
WW - 5, Optimize and Expand the existing WWTP - modification to secondary process	Summary: The existing secondary treatment process will be converted to a flow through process by converting the SBRs to plug flow aeration tanks and constructing new secondary clarifiers in lieu of a fourth SBR. Pros: Capacity to accommodate future growth within the service area would be provided. Future, more stringent effluent limits could be planned for and met with certainty. Cons: Significant upgrades and therefore significant capital expenditure would be required. Next Steps: This option will be further investigated.

Based on the screening described above the following alternatives will be developed in further detail:

- Alternative WW – 4: Optimize and expand the existing WWTP per Phase 2 design;
- Alternative WW – 5: Optimize and expand the WWTP - modification to secondary process.

4.1.3 Development of Screened Treatment Alternatives

On the basis of the preliminary screening, further development of Alternatives WW-4 and WW-5 is provided in the following paragraphs.

4.1.3.1 Alternative WW-4 – Optimize and Expand WWTP SBR – Detailed Upgrade Strategy

In Alternative WW-4, the deficiencies within the existing treatment plant would be corrected and where possible, optimization of the existing unit processes would be carried out. Upgrades would then be carried out according to the Phase 2 expansion plan to provide capacity beyond the capability of the existing system. Several features were incorporated in the Phase 1 expansion in planning for future expansion including:

- Twin screenings channels sized to provide capacity through to 2041. A mechanical screen was installed in one channel, with the capacity for peak flows to 2016. A manual screen was installed in the second channel as a standby unit. The manual screen was to be removed and replaced with a mechanical screen to serve as a second duty screen as part of the Phase 2 expansion.
- Two grit removal units were installed to provide capacity up to 2041 peak dry weather flows.
- The SBRs were designed to be operated in both conventional treatment mode and biological phosphorous removal (BPR) mode. The three SBRs were sized to provide treatment to 2041 if operated in a conventional mode. Should the SBRs be operated in BPR mode, space was provided for the addition of a fourth SBR. Simplistic tie-ins were provided for future sludge withdrawal pumps.

- Four tertiary filter cells were constructed, each to be fitted with four filter modules sized to provide capacity to 2041. Filter modules were installed in three of the four cells as part of the Phase 1 expansion with the intent to add four additional filters in the empty cell as part of the Phase 2 expansion.
- Two parallel UV disinfection channels were constructed in the UV/Filter building. UV equipment was installed in one of the two UV channels in the Phase 1 expansion and the second channel was to be fitted with UV equipment as part of the Phase 2 expansion.

Alternative WW-4 includes the following:

1. Correct deficiencies within the existing treatment plant;
2. Optimize current treatment plant;
3. Upgrade and Expand WWTP per Phase 2 expansion strategy;
4. Install package parallel treatment plant to treat flows in excess of Phase 2 expansion capacity.

Each component is discussed in detail as follows:

4.1.3.1.1 Correct deficiencies within the existing treatment plant

As the first step in Alternative WW-4 the deficiencies in existing WWTP would be corrected including:

- Reprogramming of the SBR to allow for storm cycles;
- Control timing of return flows (digester supernatant, hauled waste/septage and emergency overflow lagoon) to ensure that flows are not returned during peak periods;
- Consider diverting biosolids from the Hespeler WWTP to another Regional facility for stabilization until a long term biosolids handling strategy can be implemented.

Estimated Cost: \$35,000

4.1.3.1.2 Optimize existing process

As discussed in **Section 3.1.3.2** there is an opportunity to re-rate the screening and grit removal equipment as follows:

- Mechanical Screens - CofA rated capacity is 167 L/s – re-rate to 222 L/s;
- Vortex Grit Removal – CofA rated capacity is 214 L/s – re-rate to 261 L/s.

Stress testing of the headworks equipment is recommended to confirm the re-rated capacities.

Estimated Cost: \$50,000

Table 4.4 summarizes the additional capacity that could be gained through correcting the existing deficiencies and optimizing where possible.

Table 4.4: Summary of Optimized Capacity

Major Unit Process	PE (with optimization)	Year Capacity is Reached
Screening	28,900	2029
Grit Removal	n/a	
SBRs	21,100	2017
Filters	21,100	2017
UV	27,000	2027
<i>Note: above capacity assume the inclusion of Foxboro flows.</i>		

The capacity of the optimized facility is limited to the SBRs and filters which are limited to 21,100 PE or an approximate average day raw sewage flow of 5,300 m³/day (61 l/s).

4.1.3.1.3 Upgrade and Expand WWTP per Phase 2 design

The Phase 2 upgrades are shown diagrammatically in **Figure 4.3** and a proposed site layout is shown in

Figure 4.4. Existing process units are shown in grey and new process units in blue.

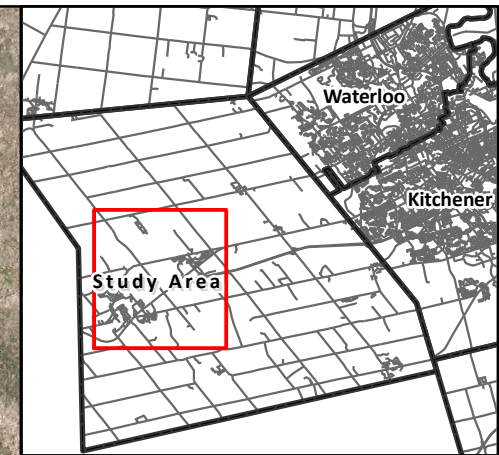
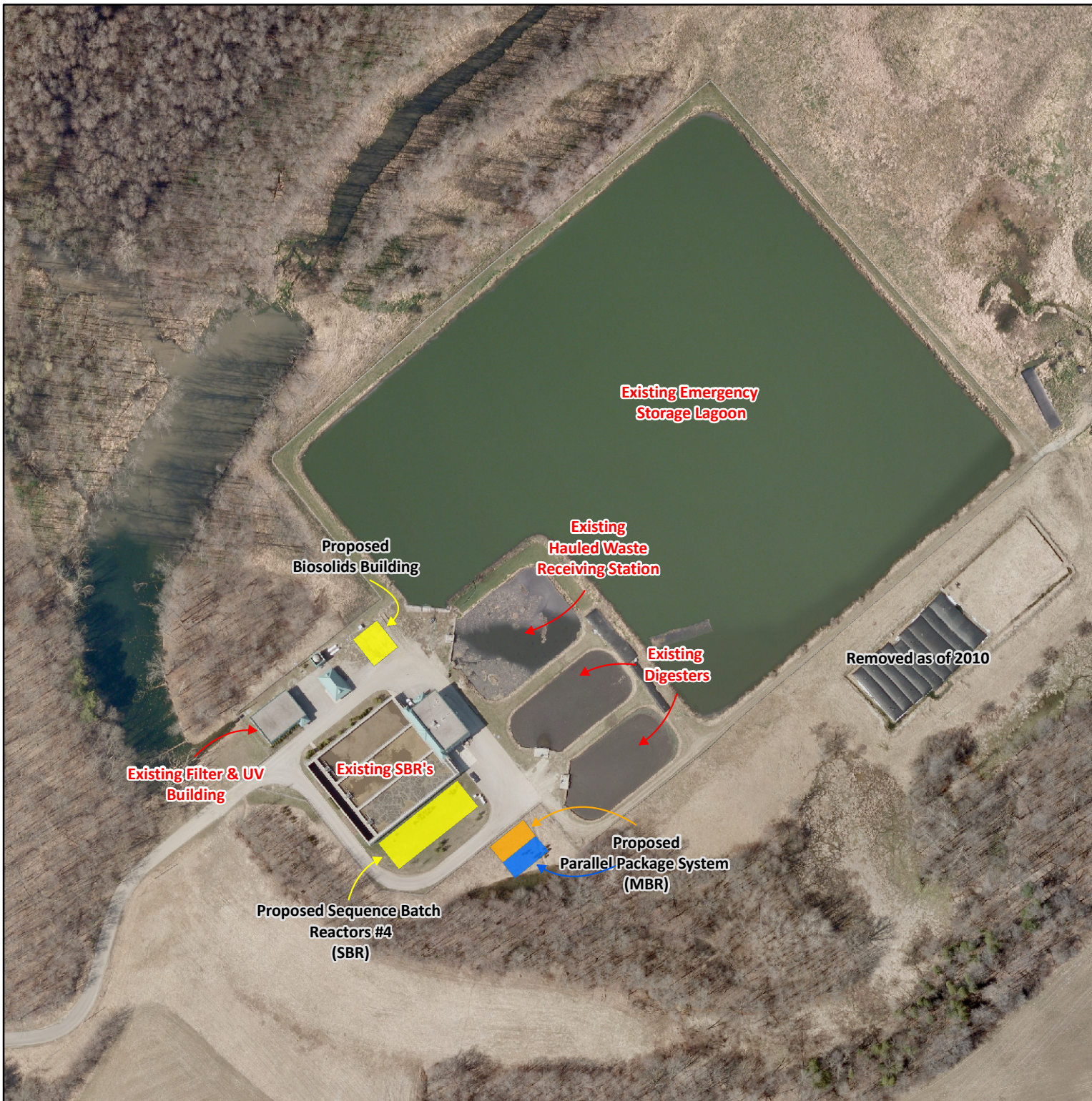
**Figure 4.3: Phase 2 Upgrades – Liquid Train Process Flow**

Headworks - Screens

The existing manual screen will be replaced with a mechanical screen of similar capacity as the existing installed mechanical screen. Headworks facilities are designed for peak flows. A peak factor of 2.5 has been used in this analysis. At an optimized capacity of 222 L/s/screen, per Alternative WW-4, the resulting total capacity of the screens is 444 L/s. At 2041 high flows, return flows from the hauled waste receiving station and the plant sewer amount to 16.5 L/s resulting in a raw sewage capacity of 427 L/s.

Table 4.5: Alternative WW-4 – Screening Capacity

Parameter	Units	Existing	Phase 2 Expansion
Return Flows			
Plant Sewer flows	l/s	9.6	15.8 ²
Hauled Liquid Waste	l/s	0.74	0.74
Total Return Flows	l/s	10.4	16.5
Rated Capacity	l/s	222	444
Total Raw Sewage Capacity	l/s	211	427
Total Raw Sewage Capacity	PE ¹	28,900	58,400
Headworks Screens Capacity	PE	28,900	58,400
Year (with Foxboro) ³		2029	Beyond 2041 high
Year (w/o Foxboro) ³		2041 (low)	Beyond 2041 high
1) Population Equivalent = 253 L/capita/day and a PF of 2.5 2) Plant sewer calculated at 2041 high estimated ADF 3) Phase 2 expansion capacity indicates year that capacity is reached (i.e. further expansion should be in place by this time)			



Legend

Development Time Line

- 2018
- 2028
- 2034 (2041 High Only)

Baden - New Hamburg Water &
Wastewater Master Plan
Update

Figure 4-4:
New Hamburg Wastewater Treatment -
Alternative Review
Alternative WW-4 Option A

Datum: NAD 83, Zone 17
Source: Region of Waterloo

June 2011



AECOM



0 15 30 60 90 120
Meters

Headworks – Grit Removal

The Phase 2 expansion strategy did not provide for an additional grit removal unit to be added to the process. Optimization, per Alternative WW-4, will result in a total grit removal capacity of 261 L/s. At 2041 high flows, return flows from the hauled waste receiving station and the plant sewer amount to 16.5 L/s resulting in a raw sewage capacity of 244 L/s.

Table 4.6: Alternative WW-4 – Grit Removal Capacity

Parameter	Units	Phase 2 Expansion
Return Flows		
Plant Sewer	l/s	15.8 ²
Hauled Liquid Waste	l/s	0.74
Total Return Flows	l/s	16.5
Rated Capacity	l/s	261
Total Raw Sewage Capacity	l/s	244
Total Raw Sewage Capacity	PE ¹	35,600
Headworks Grit Removal Capacity	PE	35,600
Year (with Foxboro) ³		2041 high
Year (w/o Foxboro) ³		2041 (high)
1) Population Equivalent = 253 L/capita/day and a PF of 2.5 2) Plant sewer calculated at 2041 high estimated ADF 3) Phase 2 expansion capacity indicates year that capacity is reached (i.e. further expansion should be in place by this time)		

Secondary Treatment – Sequencing Biological Reactors, and Tertiary Filtration

The capacity of the tertiary filters and the SBRs were analyzed together as the capacity of the SBRs depends on the flow that the downstream tertiary filters can accept. The filter capacity is the limiting factor and as such will be discussed first.

Provision was made in the existing filter/UV building for an additional filter module (four additional filters) to be added. With the addition of the new filters the total capacity of the tertiary filtration system is 239 L/s. At 2041 high flows the expected return flows from the hauled waste receiving station, plant sewer and filter backwash amount to 24 L/s (assuming digester supernatant will be returned during off peak times). The raw sewage capacity of the filters is then 205 L/s. The existing and expanded capacity of the tertiary filters is summarized in **Table 4.7**.

Table 4.7: Alternative WW-4 – Tertiary Filter Capacity

Parameter	Units	Existing	Phase 2 Expansion ²
Return Flows			
Plant Sewer	l/s	9.6	15.8 ²
Digester Decant	l/s	22.0	22.0
Filter Backwash	l/s	14.0	18.7
Hauled Liquid Waste	l/s	0.7	0.7
Total Return Flows	l/s	24.4	32.2
Filter Capacity	l/s/cell	60	60
Number of cells	cells	3	4
Total Capacity	l/s	179	239
Total Raw Sewage Capacity	l/s	155	205
Total Raw Sewage Capacity	PE ¹	21,100	28,200
Tertiary Filter Capacity	PE	21,100	28,200
Year (with Foxboro)		2017	2028
Year (w/o Foxboro)		2019	2031
1)Population Equivalent = 253 L/capita/day and a PF of 2.5 2)Plant sewer calculated at 2041 high estimated ADF 3)Phase 2 expansion capacity indicates year that capacity is reached (i.e. further expansion should be in place by this time).			

Both the biological and hydraulic capacities of the SBR were evaluated. As shown in the previous table, the peak loading capacity of the filters during the SBR storm mode is 205 L/s or 131 L/s during average day flows. This equates to the addition of a fourth SBR identical to the existing SBRs (15 m width, 45 m length and 5 m SWD).

Table 4.8: Alternative WW-4 - SBRs

Parameter	Units	Existing	Phase 2 Expansion
Return Flows			
Plant Sewer ³	l/s	10	16
Digester Decant ¹	l/s	22	22
Filter Backwash	l/s	14	19
Hauled Liquid Waste	l/s	0.7	0.7
Total Return Flows	l/s	24	35
Total BOD Load ¹	kg/day	93	93
Hydraulic Capacity			
Storm Flow Capacity	l/s	179	205
Peak day Flow	l/s	98	131
Average daily Raw Sewage Capacity flow	l/s	62	83
Average daily Raw Sewage Capacity flow	PE ²	21,100	28,200

Parameter	Units	Existing	Phase 2 Expansion
Biological Capacity			
BOD Capacity	kg/day	1,300	1,800
BOD Capacity – Raw Sewage	PE	49,600	66,300
SBR Capacity	PE	21,100	28,200
Year (with Foxboro)		2017	2028
Year (w/o Foxboro)		2019	2031
1) BOD load from return flows is assumed due to hauled waste and septage returns. Digester decant is expected to occur during off peak hours and BOD load from all other return flows is assumed negligible. 2) Population Equivalent = 253 L/capita/day (Per TM#1) and a PF of 2.5 3) Plant sewer calculated at 2041 high estimated ADF 4) Phase 2 expansion capacity indicates year that capacity will be reached (i.e. further expansion should be operational by this time).			

Ultraviolet Disinfection

Two parallel UV channels were installed as part of the Phase 1 expansion. One of the two channels was fitted with UV lamps. UV lamps were to be installed in the second UV channel as part of the Phase 2 expansion doubling the capacity of the disinfection system. The resulting raw sewage capacity is 409 L/s.

Table 4.9: Alternative WW – 4 – UV Disinfection

Parameter	Units	Existing	Phase 2 Expansion
Return Flows			
Plant Sewer	l/s	9.6	15.8
Digester Decant	l/s	22.0	22.0
Filter Backwash	l/s	14.0	18.7
Hauled Liquid Waste	l/s	0.7	0.7
Total Return Flows	l/s	24	34
Number of UV Channels		2	2
Number of Channels with lamps		1	2
Number of banks per channel		2	2
Design Capacity of installed lamps	l/s	222	444
Raw Sewage Capacity	l/s	198	409
UV Capacity	PE	27,000	55,800
Year (with Foxboro)		2027	beyond 2041 high
Year (w/o Foxboro)		2028	beyond 2041 high

SUMMARY – Phase 2 Expansion Capacity

In Phase 2 expansion of the New Hamburg WWTP, the lowest capacity of each unit process discussed above will dictate the capacity of the liquids process. The capacity of each unit process is summarized in **Table 4.10**.

Table 4.10: Summary of Phase 2 Expansion Capacity

Major Unit Process	PE (existing)	Year	PE (with Phase 2 Expansion)	Year
Screening	28,900	2029	58,400	beyond 2041 high
Grit Removal	n/a		35,600	2041 high
SBRs	21,100	2017	28,200	2028
Filters	21,100	2017	28,200	2028
UV	27,000	2027	55,800	beyond 2041 high
<i>Note: above capacity assume the inclusion of Foxboro flows.</i>				

As shown in the above Table the Phase 2 expansion will provide sufficient capacity to just before 2029 with Foxboro flows and just past 2029 without Foxboro Flows. This equates to a PE of 28,200 limited by filtration and SBR capacity.

Cost Estimation

The estimated cost of implementing the Phase 2 upgrades is summarized in **Table 4.11**.

Table 4.11: Phase 2 Expansion – Estimated Cost

Component	Value
Structural	
SBR Tanks (15m x 45m x 5 m)	\$ 1,168,000
Process Mechanical¹	
Headworks – New Mechanical Screens	\$ 395,000
SBR – Decanter/Blowers/Mixers/Diffusers	\$ 1,403,000
Filters – New Filter Cell	\$ 198,000
UV - Add UV Equipment in an existing Channel	\$ 325,000
Pumps (allowance)	\$ 78,000
Pipes and fittings	\$ 390,000
Sub-Total Process Mechanical	\$ 2,789,000
Other	
Electrical	\$ 395,700

Component	Value
Instrumentation & Control	\$ 712,300
Site Servicing	\$ 197,900
Building Mechanical	\$ 197,900
TOTALS	
Sub-total Equipment and Construction	\$ 5,461,000
Contractor Profit and Overhead	\$ 546,000
Estimating contingency (30%)	\$ 1,638,000
Sub-total With Contingencies and Contractor Fees	\$ 7,645,000
Engineering and Contract Administration	\$ 1,147,000
TOTAL - Phase 2 Expansion	\$ 8,792,000
1)Equipment costs include installation	
2)All costs are shown in present day (2010) dollars	

4.1.3.1.4 Install Parallel MBR Package Plant

According to the capacity assessment discussed in the above paragraphs a parallel package system would be required at approximately 2028. The capacity requirements of the parallel package system are summarized in **Table 4.12**.

Table 4.12: Parallel Package Plant - Capacity Requirement

Year	Capacity Required with Foxboro Flows (PE)	Capacity Required with Foxboro Flows (m ³ /day)	Capacity Required without Foxboro Flows (PE)	Capacity Required without Foxboro Flows (m ³ /day)
2029	53	33	0	0
2041 (low)	1,042	659	613	387
2041 (high)	7,602	4,809	7,172	4,537

The initial capacity requirements are relatively low, and would warrant a very small unit installed initially and a larger unit installed later. Instead a more appropriate phasing approach could be used where a slightly oversized MBR unit could be installed initially, and a second module installed later to meet 2041 (high) requirements

A fixed flow would be directed to the MBR plant with flow fluctuations being managed by the main stream plant. Since excess disinfection capacity is available through the mainstream process, flows from the MBR plant will join main stream plant flows upstream of the disinfection system as shown in **Figure 4.5**.

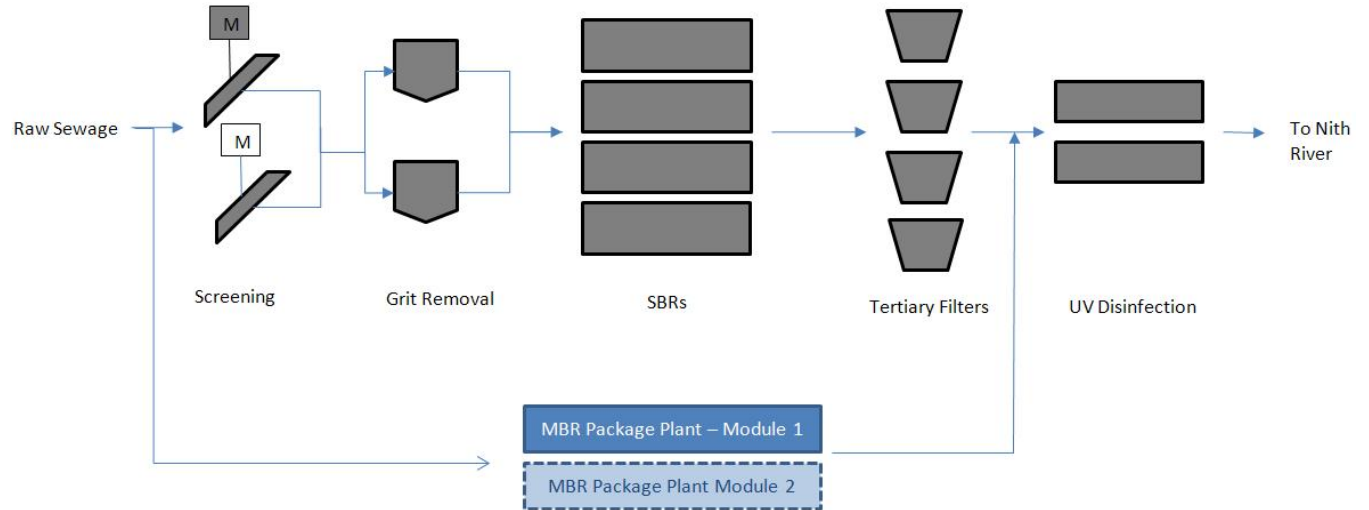


Figure 4.5: MBR Package System Process Flow

Cost Estimation

The cost estimations for both the 2041 low and high population projections are shown in the following tables.

Table 4.13: Cost Estimate - MBR Package System – 2041 Low

Component	Cost
Process Mechanical	
Membrane Package System - Phase 1 - Installed 2025	\$ 1,253,000
Pumps (allowance)	\$ 78,000
Pipes and fittings	\$ 390,000
Sub-Total Process Mechanical	\$ 2,974,000
Other	
Instrumentation & Control	\$ 535,320
Site Servicing	\$ 148,700
Building Mechanical	\$ 148,700
Totals	
Sub-total Equipment and Construction	\$ 3,806,700
Contractor Profit and Overhead	\$ 380,700
Estimating contingency (30%)	\$ 1,142,000
Sub-total With Contingencies and Contractor Fees	\$ 5,329,400
Engineering and Contract Administration	\$ 799,400
TOTAL - Membrane Package System - 2041 Low	\$ 6,128,800
1)Based on a GE/Zenon ZeeWeed 500 Membrane Package System	
2)All costs provided in 2010 dollars	

Table 4.14: Cost Estimate – MBR Package System – 2041 High

Component	Cost
Process Mechanical	
Membrane Package System - Phase 1 - Installed 2025	\$ 1,253,000
Membrane Package System - Phase 2 - Installed 2041 (high)	\$ 2,506,000
Pumps (allowance)	\$ 117,000
Pipes and fittings	\$ 390,000
Sub-Total Process Mechanical	\$ 4,266,000
Other	
Instrumentation & Control	\$ 767,880
Site Servicing	\$ 213,300
Building Mechanical	\$ 213,300
TOTALS	
Sub-total Equipment and Construction	\$ 5,460,500
Contractor Profit and Overhead	\$ 546,048
Estimating contingency (30%)	\$ 1,638,144
Sub-total With Contingencies and Contractor Fees	\$ 7,644,700
Engineering and Contract Administration	\$ 1,146,701
TOTAL - Membrane Package System – 2041high	\$ 8,791,400
1)Based on a GE/Zenon ZeeWeed 500 Membrane Package System	
2)All costs provided in 2010 dollars	

4.1.3.1.5 Summary Cost Estimate – Alternative WW - 4

A summary of the estimated cost to carry out Alternative WW-4 is noted in the following table.

Table 4.15: Summary of Cost – Alternative WW - 4

Component	Cost estimate
Correction of Existing Deficiencies	\$ 35,000
Optimization of Existing Process	\$ 50,000
Phase 2 Expansion	\$ 8,155,000
Membrane Package System 2041 - Low	\$ 6,128,800
TOTAL - 2041 LOW	\$ 15,005,800
Membrane Package System 2041- High	\$ 8,791,400
TOTAL - 2041 HIGH	\$ 17,668,400
Estimated Present Worth of O&M Cost (for comparison purposes) ¹	\$ 9,800,000
Notes:1) Estimated O&M Cost based on 2004 National Benchmarking Initiative data escalated at 2% per year with a 30% increase in O&M when membrane package plant is installed. Uses 5% interest rate over 31 years.	

4.1.3.1.6 Effluent Quality Changes - Nitrate

Addition of denitrification (nitrate removal) typically requires approximately 25 to 30% more SBR capacity to allow for an increase in cycle time for the same volume treated. For the alternative WW-4, the approach would be to de-rate the expanded SBR process capacity (including Phase 2 expansion) by 25 to 30% and divert more flows to the parallel package system.

However, since the existing plant currently denitrifies and the package system is oversized, the requirement for denitrification is not expected to result in a significant increase to overall capacity or cost.

4.1.3.1.7 Effluent Quality Changes – Total Phosphorus

Two options are available regarding effluent phosphorus including:

- A. Reduce effluent TP concentrations limits with increasing flow to maintain loadings within the existing C of A limits.
- B. Maintain effluent TP concentrations at the current C of A levels, and provide reductions of TP loadings to the Nith River watershed through the Rural Water Quality program.

Alternative WW-4 Option A

- The effluent TP limits that would be required to maintain the existing C of A TP load limits are summarized in **Table 4.16**.

Table 4.16: Effluent TP Limits

Parameter	Average Day Flow	Allowable effluent TP
	m ³ /day	mg/l
Present Day Flow	3789	0.30 ¹
Existing - Design (approx. 2020)	5200	0.30 ²
2029	6687	0.23 ²
2041 Low	6911	0.23 ²
2041 High	8394	0.19 ²
1)Per CofA concentration limit		
2)Per CofA loading limit		

As shown, under the Option A, an effluent TP limit of 0.19 to 0.23 mg/l is required to meet Policy 2 effluent requirements for TP, i.e. not to exceed the current allowable loadings. Experience indicates that this level of TP removal with tertiary filtration systems is feasible but it is at the boundary of the traditional limit of this technology. Although the current effluent TP concentrations are consistently in this range, the plant is presently underloaded and therefore, it is not known how the tertiary filters will perform under higher loadings. Advances in polymer dosing practices with tertiary filtration systems and recent pilot studies have indicated very low effluent TP concentrations can be achieved. As such the Option A approach to address increasing TP loadings is as follows:

- 1) Monitor – monitor the performance of the existing tertiary filters with respect to effluent TP concentration;
- 2) Optimize – optimize polymer dosing practices to improve filter performance;
- 3) Construct – in the event that Items 1 and 2 do not achieve the desired TP concentrations, an advanced tertiary treatment process would be required.

Several advanced tertiary treatment technologies are available that are capable of achieving effluent TP limits less than 0.1 mg/L. Two widely used technologies for high levels of TP removal are:

- **Ultrafiltration membranes** – modular units fitted with thousands of membrane fibres. Secondary treated effluent is filtered by applying a slight vacuum to the end of each fibre to draw wastewater through the pores. The pores form a physical barrier that allows clean water to pass through while blocking unwanted material such as suspended solids, bacteria, pathogens and certain viruses. The particles that are rejected by the membrane pores remain in the process tank and are periodically removed during backwashing. Contaminants that exist in dissolved form, or are smaller than the pore size of the membrane, can be removed by the membranes if they are first transformed into insoluble species or larger particles. Treatment processes commonly coupled to accomplish such conversions include enhanced coagulation and oxidation. The resulting treated effluent achieve TSS and TP concentrations at non-detect levels. *Example System* – GE/Zenon ZeeWeed 1000 Ultrafiltration
- **Dual Filtration** – in this technology, two deep bed upflow continuous backwash filters are used in series. The first filter is of a larger diameter to reduce filter clogging and allow for an increased

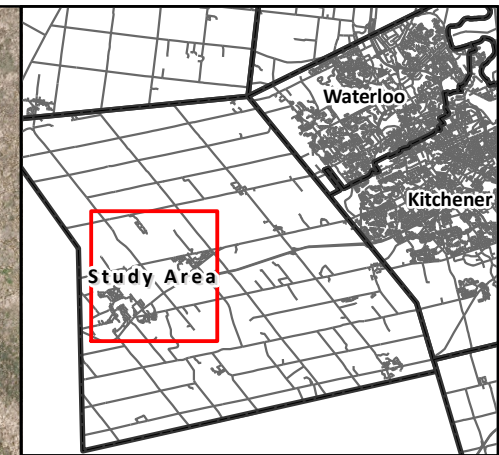
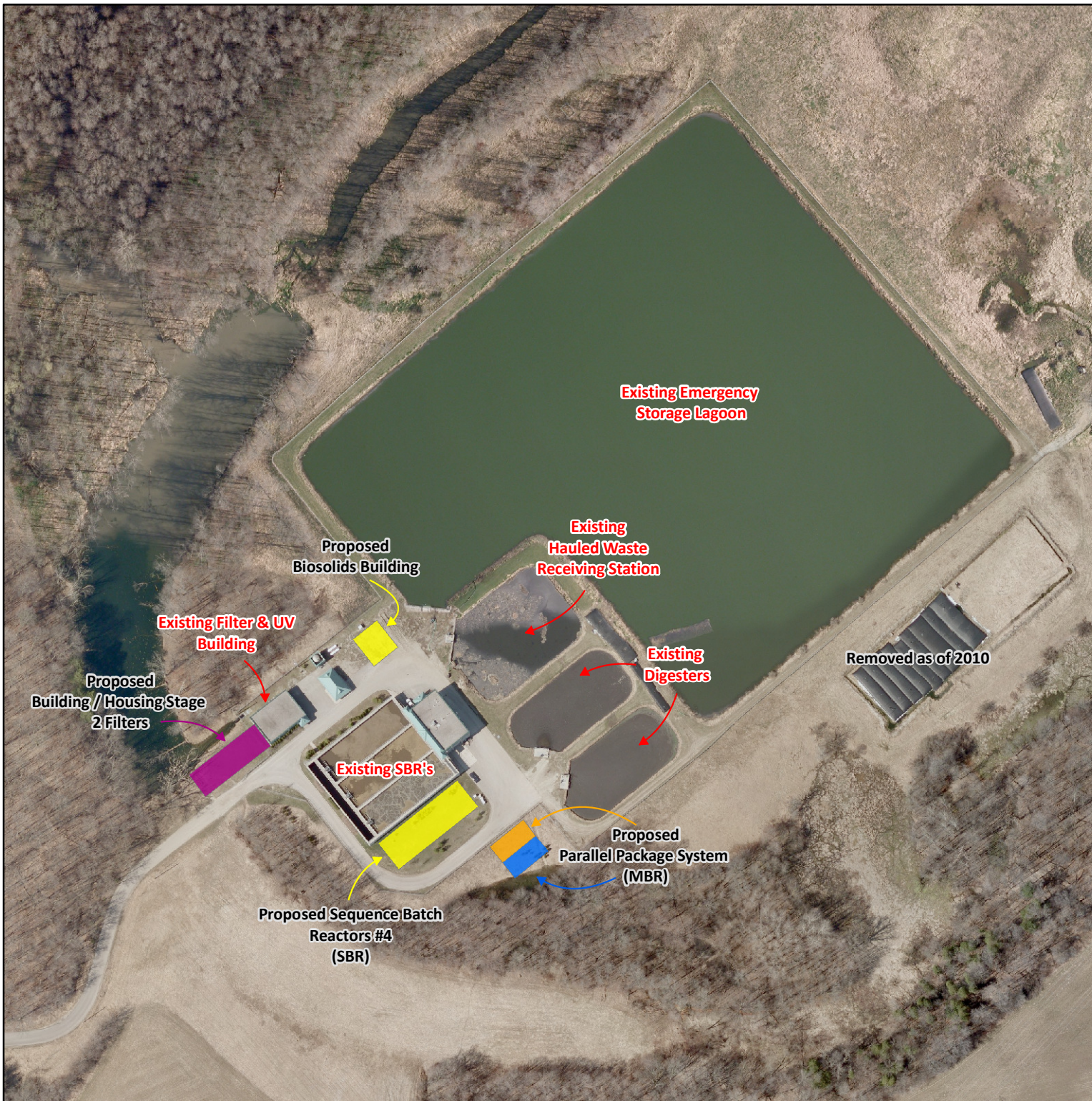
contact time and the second is a smaller diameter filter to remove particles not extracted in the first stage. Effluent TP concentrations at full scale installations have been recorded at or below 0.02 mg/l. *Example System – Parkson Dynasand D2 System*

A dual filtration technology would utilize the existing filtration system as the Stage 1 filters and new Stage 2 filters would be installed. This approach has been assumed for planning purposes.

Table 4.17: Cost Estimate – Stage 2 Filtration

Component	Estimated Cost
Structural	\$ 2,608,000
Process Mechanical	\$ 898,000
Allowance for I&C	\$ 631,000
Allowance for Yard Piping	\$ 175,000
Allowance for HVAC	\$ 175,000
Sub-total Equipment and Construction	\$ 4,488,000
Contractor Profit and Overhead	\$ 448,800
Estimating contingency (30%)	\$ 1,346,000
Sub-total With Contingencies and Contractor Fees	\$ 6,283,000
Engineering and Contract Administration	\$ 942,000
TOTAL - Dual Filtration System - Addition of New Filters	\$ 7,225,000

A proposed site layout with the installation of Dual Filtration is shown on the Figure to follow.



Legend

Development Time Line

- 2018
- 2028
- 2034 (2041 High Only)
- Advanced TP Removal

Baden - New Hamburg Water &
Wastewater Master Plan
Update

Figure 4-6:
New Hamburg Wastewater Treatment
- Alternative Review
Alternative WW-4 Option B

Datum: NAD 83, Zone 17
Source: Region of Waterloo

June 2011



AECOM



0 15 30 60 90 120 Meters

Alternative WW-4 Option B

Managing increasing effluent TP loadings over time through the Rural Water Quality Program has been shown to be a viable alternative for the Nith River watershed. An audit of previously implemented projects under this program provided evidence that these initiatives have been maintained and continue to be effective as a means to reduce phosphorus contributions to surface water along with other nutrients and contaminants. In addition, it has been estimated that there are sufficient remaining projects within the Regional boundary of the Nith River watershed to ensure that continuation of this program would have significant benefits.

It is envisioned that the Region will continue to support and manage the RWQ program due to its greater benefits to both groundwater and surface water protection, no additional cost has been applied to this Option. However depending on whether the increase in effluent phosphorus loadings is directly tied to support of the RWQ program management and monitoring (or specific reduction targets), it is probable that there would be at a minimum, added administrative costs associated with this Option.

4.1.3.1.8 Class EA Requirements

The Municipal Class EA requirements of Alternative WW-4 are as follows:

- Correct deficiencies and optimize existing process – Schedule A (improvement to operations without construction of works)
- Expand per Phase 2 – Schedule C (Construction of new SBR results in requirement for Schedule C)

4.1.3.2 Alternative WW-5 – Optimize and Expand WWTP with Conversion to a Flow-Through Process – Detailed Upgrade Strategy

Alternative WW-5 consists of conversion of the SBR secondary treatment system to a conventional flow-through process. Instead of the addition of a fourth SBR proposed in Alternative WW-4, the existing three SBRs would be converted to plug flow aeration tanks, and two new secondary clarifiers would be constructed.

Alternative WW-5 includes the following:

1. Correct deficiencies within the existing treatment plant;
2. Optimize current treatment plant;
3. Expand plant.

In this alternative the plant would be expanded to meet the long term capacity requirements without the need for a parallel package system. As with Alternative WW-4, the deficiencies within the existing system would be corrected and where possible, optimization of unit processes would be carried out. Following these steps the expected capacity of the existing system was determined as follows:

Table 4.18: Summary of Optimized New Hamburg WWTP Capacity

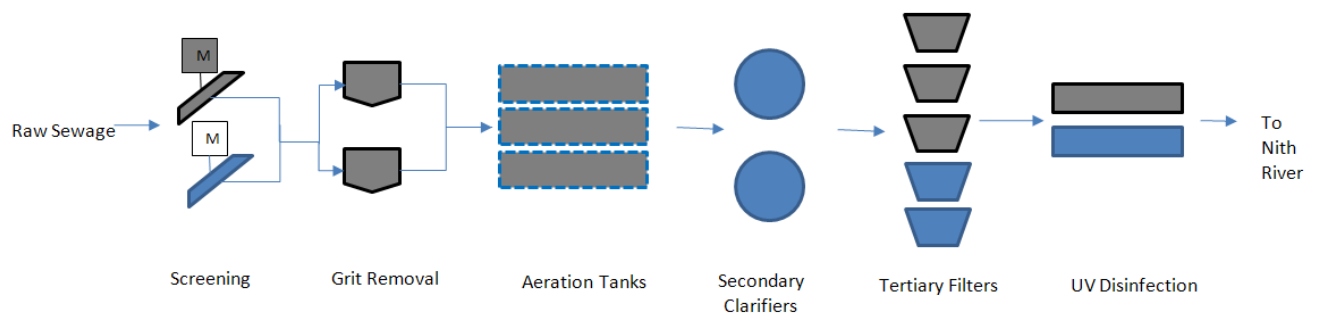
Major Unit Process	PE (existing)	Year
Screening	28,900	2029
Grit Removal	35,600	2041 high
SBRs	21,100	2017
Filters	21,100	2017
UV	27,000	2027
<i>Note: above capacity assume the inclusion of Foxboro flows.</i>		

Based on the above, the capacity of the existing system would be reached at approximately 2017. Similar to Alternative WW-4, Alternative WW-5 consists of upgrades consistent with the Phase 2 expansion plan to the Headworks, and UV processes. The analysis conducted for Alternative WW-4 indicates this would provide screening, grit removal and disinfection capacity to the 2041 high population projections as indicated in the Table below.

Table 4.19: Headworks and UV Expansion Capacity

Major Unit Process	PE (existing)	Year	PE (with Phase 2 Expansion)	Year
Screening	28,900	2029	58,400	beyond 2041 high
Grit Removal	n/a		35,600	2041 high
UV	27,000	2027	55,800	beyond 2041 high
<i>Note: above capacity assume the inclusion of Foxboro flows.</i>				

In Alternative WW-5, the existing SBRs will be converted to 3 plug flow aeration tanks, and two secondary clarifiers will be added to convert the process to a conventional activated sludge process. As the addition of a fourth filter will provide capacity to a peak raw sewage flow of 205 L/s or capacity to 2028, additional filtration capacity will also be added. In Alternative WW-5, the filter building will be expanded to allow for the installation of a fifth filter to provide capacity through to 2041.

**Figure 4.7: Alternative WW-5 – Simplified Process Configuration**

The following variations to Alternative 5 were considered:

Alternative 5A: Existing effluent objectives

Alternative 5B: Lower effluent Total Phosphorous objective

Alternative 5C: Addition of Total Nitrogen limit

The proposed Alternative WW-5 simplified process configuration is shown in **Figure 4.7** and a proposed site layout is shown in

Figure 4.8 . The secondary and tertiary treatment processes are discussed in detail as follows.

4.1.3.2.1 Secondary Treatment

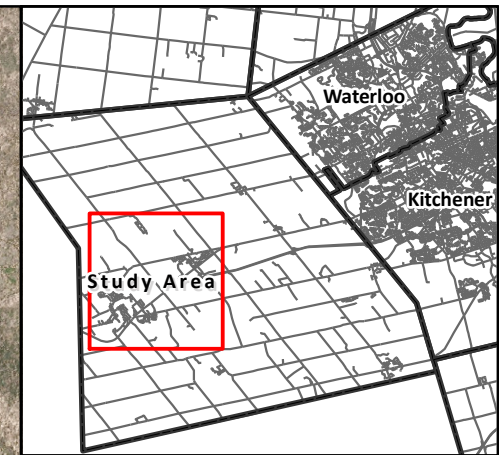
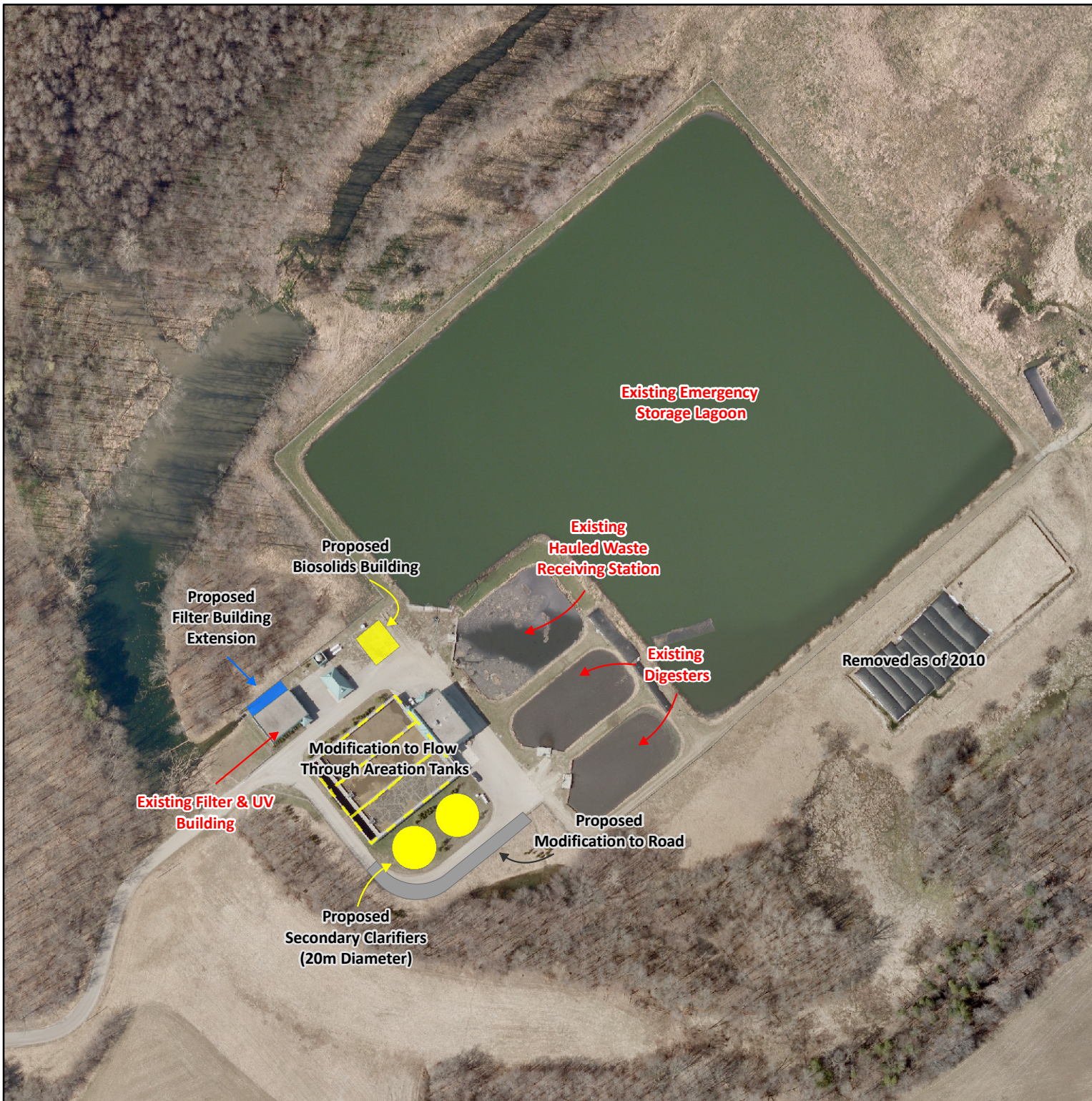
The three existing SBR tanks will be converted to plug flow reactors by modifications to the feed channels, the addition of baffles within the tanks, and effluent weirs. The SBR tanks are already fitted with a fine bubble diffuser system and sufficient blower capacity.

Two circular secondary clarifiers will be added downstream of the aeration tanks and upstream of the tertiary filters, sized to provide peak flow capacity to 2041. A new RAS/WAS pumping station will also be added. **Table 4.20** summarizes the design parameters of the proposed secondary treatment process.

Table 4.20: Alternative WW-5 – Secondary Treatment

Parameter	Value	Units
Aeration Tanks		
Return Flows		
Plant Sewer	15.5	l/s
Digester Decant	22	l/s
Filter Backwash	18.66	l/s
Hauled Liquid Waste	0.74	l/s
Existing Tank Dimensions		
length	45	m
width	15	m
depth	5	m
Number of SBRs	3	m
Total Volume	10125	m ³
Biological Capacity		
Assumed Yield	1.1	kg TSS Produced/kg BOD Removed
Operating MLSS	3.5	kg/m ³
Aerobic HRT	6	hours
Total SRT	15	days
WAS produced	2,400	kg WAS/day
BOD Load Capacity	2,150	kg/day BOD capacity
Total Capacity (Biological)	79,500	PE

Parameter	Value	Units
Capacity Used by HLW (Biological)	147	PE
Raw Sewage Capacity (Biological)	79,400	PE
Hydraulic Capacity		
Minimum HRT ¹	6	hours
Available Volume	10125	m ³
Maximum Average Day Flow	1690	m ³ /hour
Hydraulic Capacity¹	160,000	PE
Aeration Tank CAPACITY	79,400	PE
Secondary Clarifiers		
Raw Sewage Flow (average)	8544	m ³ /day
Raw Sewage Flow (peak)	21360	m ³ /day
Raw Sewage Flow (peak)	247	l/s
Return Flows		
Plant Sewer	15.8	l/s
Digester Decant	22	l/s
Filter Backwash	24.8	l/s
Hauled Liquid Waste	0.74	l/s
Total Flow	288	l/s
RAS Rate (100% RAS)	8544	m ³ /day
SOR ⁴	40	m ³ /m ² /day
SLR ⁵	170	kg/m ² /day
Design SA	623	m ²
No Clarifiers	2	
Diameter	20	m / secondary clarifier
Secondary Clarifier Capacity	33,770	PE
1) Min HRT per MOE design guidelines for conventional activated sludge aeration tanks with nitrification 2) Hydraulic capacity based on PE = 253 L/capita/day 3) Plant sewer flow calculated at 2041 high estimated ADF 4) Surface Overflow Rate Per MOE Design Guidelines for a Nitrifying activated sludge system 5) Solids Loading Rate Per MOE Design Guidelines for a Nitrifying activated sludge system		



Legend

- Road Modification
- 2018
- 2041
- Modification Area

Baden - New Hamburg Water &
Wastewater Master Plan
Update

Figure 4-8:
New Hamburg Wastewater Treatment -
Alternative Review
Alternative WW-5 Option A

Datum: NAD 83, Zone 17
Source: Region of Waterloo

June 2011



AECOM



0 15 30 60 90 120
Meters

As summarized above, when converted to conventional plug flow aeration tanks, the existing SBRs will provide sufficient capacity well beyond the design horizon of the facility. The secondary clarifiers have therefore been sized to accommodate flows to 2041 high projections, with the inclusion of Foxboro. Based on this, two 20 metre diameter circular clarifiers will be required.

A new RAS/WAS pumping station will be required to maintain biological activity within the aeration tanks, and to remove waste solids from the activated sludge system as needed.

4.1.3.2.2 Tertiary Filters

To meet the capacity needs through 2041 high population projections, two additional filter cells would be required. This would provide a total filtration capacity of 257 L/s. With 41 L/s of recycle flows, capacity for 257 L/s of raw sewage or 35,000 PE would be provided. This is summarized in **Table 4.21**.

Table 4.21: Alternative WW-5 – Tertiary Filter Capacity

Parameter	Units	Existing	Expanded
Return Flows			
Plant Sewer	l/s	9.6	15.8 ²
Digester Decant	l/s	22.0	22.0
Filter Backwash	l/s	14.	18.7
Hauled Liquid Waste	l/s	0.7	0.7
Filter Capacity	l/s/cell	60	60
Number of cells	cells	3	5
Total Capacity	l/s	179	299
Total Raw Sewage Capacity	l/s	155	257
Total Raw Sewage Capacity	PE ¹	21,100	35,100
Tertiary Filter Capacity	PE	21,100	35,100
Year (with Foxboro)		2017	2041 high
Year (wo Foxboro)		2019	2041 high
1) Population Equivalent = 253 L/capita/day (Per TM#1) and a PF of 2.5			
2) Plant sewer calculated at 2041 high estimated ADF			

The existing filter building only provides space for one additional filter cell. The existing building would therefore be expanded to accommodate a fifth filter cell.

4.1.3.2.3 Cost Estimate

The estimated cost of expanding the facility per Alternative WW-5 is summarized in **Table 4.22**.

Table 4.22: Cost Estimate – Expand the Facility – Alternative WW-5

Component	Estimated Cost
Structural	
Modifications to convert existing SBR to Plug Flow Reactors	\$ 1,500,000
Secondary Clarifiers	\$ -
Base Slab	\$ 237,000
Walls	\$ 280,000
RAS/WAS Pump Station	\$ 325,000
Filter Building Expansion	\$ 780,000
Sub-Total Structural	\$ 1,737,000
Process Mechanical	
Headworks - Screens	\$ 395,000
Secondary Clarifier Scum/Sludge Removal (motorized)	\$ 1,040,000
Filters - Add two new filter cells	\$ 397,000
UV - Add UV Equipment in an Existing Channel	\$ 325,000
Pumps (allowance)	\$ 137,000
Pipes and fittings	\$ 845,000
Sub-Total Process Mechanical	\$ 3,139,000
Sub-Total Process Mechanical/Structural	\$ 4,876,000
Other	
Allowance for Electrical Upgrades	\$ 487,600
Allowance for I&C	\$ 877,680
Allowance for Yard Piping	\$ 243,800
Allowance for HVAC	\$ 243,800
TOTALS	
Sub-total Equipment and Construction	\$ 6,729,000
Contractor Profit and Overhead	\$ 673,000
Estimating contingency (30%)	\$ 2,019,000
Sub-total With Contingencies and Contractor Fees	\$ 9,420,000
Engineering and Contract Administration	\$ 1,413,000
TOTAL - Alternative WW-5	\$ 10,833,000

4.1.3.2.4 Effluent Quality Changes - Nitrate

Addition of denitrification typically requires approximately 25 to 30% more SBR capacity to allow for an increase in cycle time for the same volume treated. For the alternative WW-5, the approach would be to the capacity of the aeration tanks would be de-rated by approximately 30%. Alternatively an anoxic

zone, approximately 25 to 30% of the total aeration tank volume could be constructed and the secondary treatment process would be operated as a Modified Ludzack-Ettinger (MLE) process.

4.1.3.2.5 Effluent Quality Changes – Total Phosphorus

Similar to Alternative WW-4, there are two Options to address the TP Policy 2 requirement to maintain or reduce current total phosphorus loadings:

- Option B Reduce effluent TP concentrations limits with increasing flow to maintain loadings within the existing C of A limits.
- Option C Maintain effluent TP concentrations at the current C of A levels, and provide reductions of TP loadings to the Nith River watershed through the Rural Water Quality program.

Alternative WW-5 Option B

The proposed approach for Option B consists of:

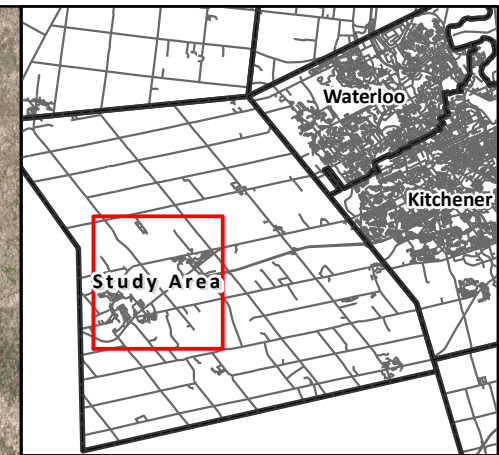
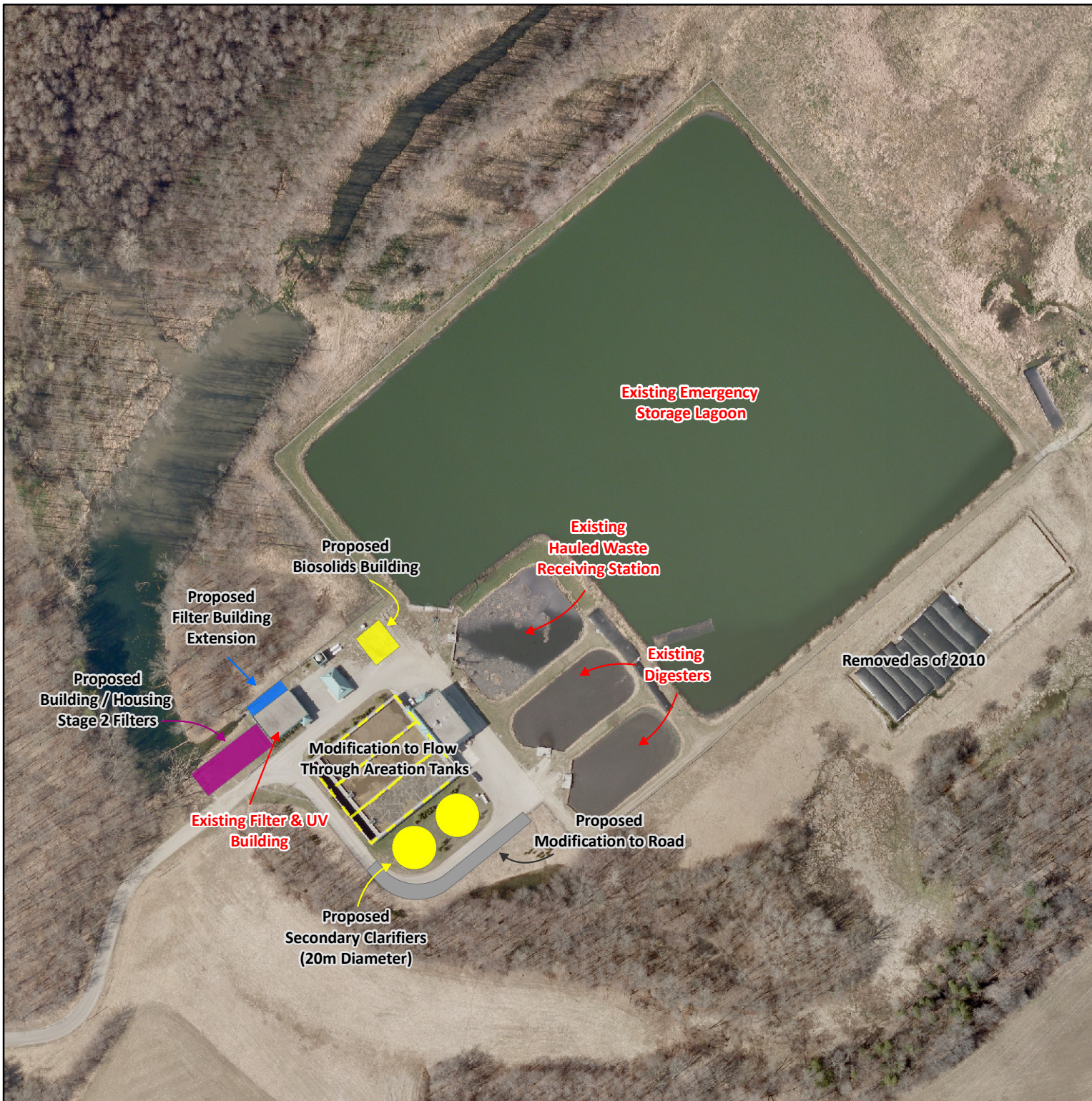
- 1) Monitor – monitor the performance of the existing tertiary filters with respect to effluent TP concentration;
- 2) Optimize – optimize polymer dosing practices to improve filter performance;
- 3) Construct – in the event that Items 1 and 2 do not achieve the desired TP concentrations, an advanced tertiary treatment process would be required.

In Alternative WW 4, only flow directed through the main stream plant required consideration of an advanced treatment process for high levels of TP removal, as the parallel package system would be capable of high levels of TP removal. Alternative WW-5 would require that all flows be treated by the second stage of filters. A proposed modified site layout is shown in **Figure 4.9**.

The estimated cost of this system is summarized in the Table below.

Table 4.23: Cost Estimate – Stage 2 Filtration

Component	Estimated Cost
Structural	\$ 2,768,000
Process Mechanical	\$ 974,000
Allowance for Electrical	\$ 374,000
Allowance for I&C	\$ 674,000
Allowance for Yard Piping	\$ 187,000
Allowance for HVAC	\$ 187,000
Sub-total Equipment and Construction	\$ 5,164,000
Contractor Profit and Overhead	\$ 516,000
Estimating contingency (30%)	\$ 1,549,000
Sub-total With Contingencies and Contractor Fees	\$ 7,230,000
Engineering and Contract Administration	\$ 1,084,000
TOTAL - Dual Filtration System - Addition of New Filters	\$ 8,314,000



Legend

- Road Modification
- 2018
- 2041
- Modification Area
- Advanced TP Removal

Baden - New Hamburg Water &
Wastewater Master Plan
Update

Figure 4-9:
New Hamburg Wastewater Treatment -
Alternative Review
Alternative WW-5 Option B

Datum: NAD 83, Zone 17
Source: Region of Waterloo

June 2011



AECOM



0 15 30 60 90 120
Meters

Alternative WW-5 Option C

Managing increasing effluent TP loadings over time through the Rural Water Quality Program has been shown to be a viable alternative for the Nith River watershed. An audit of previously implemented projects under this program provided evidence that these initiatives have been maintained and continue to be effective as a means to reduce phosphorus contributions to surface water along with other nutrients and contaminants. In addition, it has been estimated that there are sufficient remaining projects within the Regional boundary of the Nith River watershed to ensure that continuation of this program would have significant benefits.

It is envisioned that the Region will continue to support and manage the RWQ program due to its greater benefits to both groundwater and surface water protection, no additional cost has been applied to this Option. However depending on whether the increase in effluent phosphorus loadings is directly tied to support of the RWQ program management and monitoring (or specific reduction targets), it is probable that there would be at a minimum, added administrative costs associated with this Option.

A proposed modified site layout is shown in **Figure 4.10**.

4.1.3.2.6 Summary

The estimated cost of implementing Alternative WW-5 is summarized in **Table 4.24**.

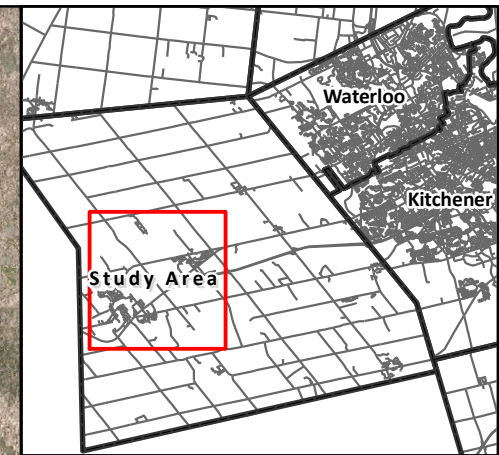
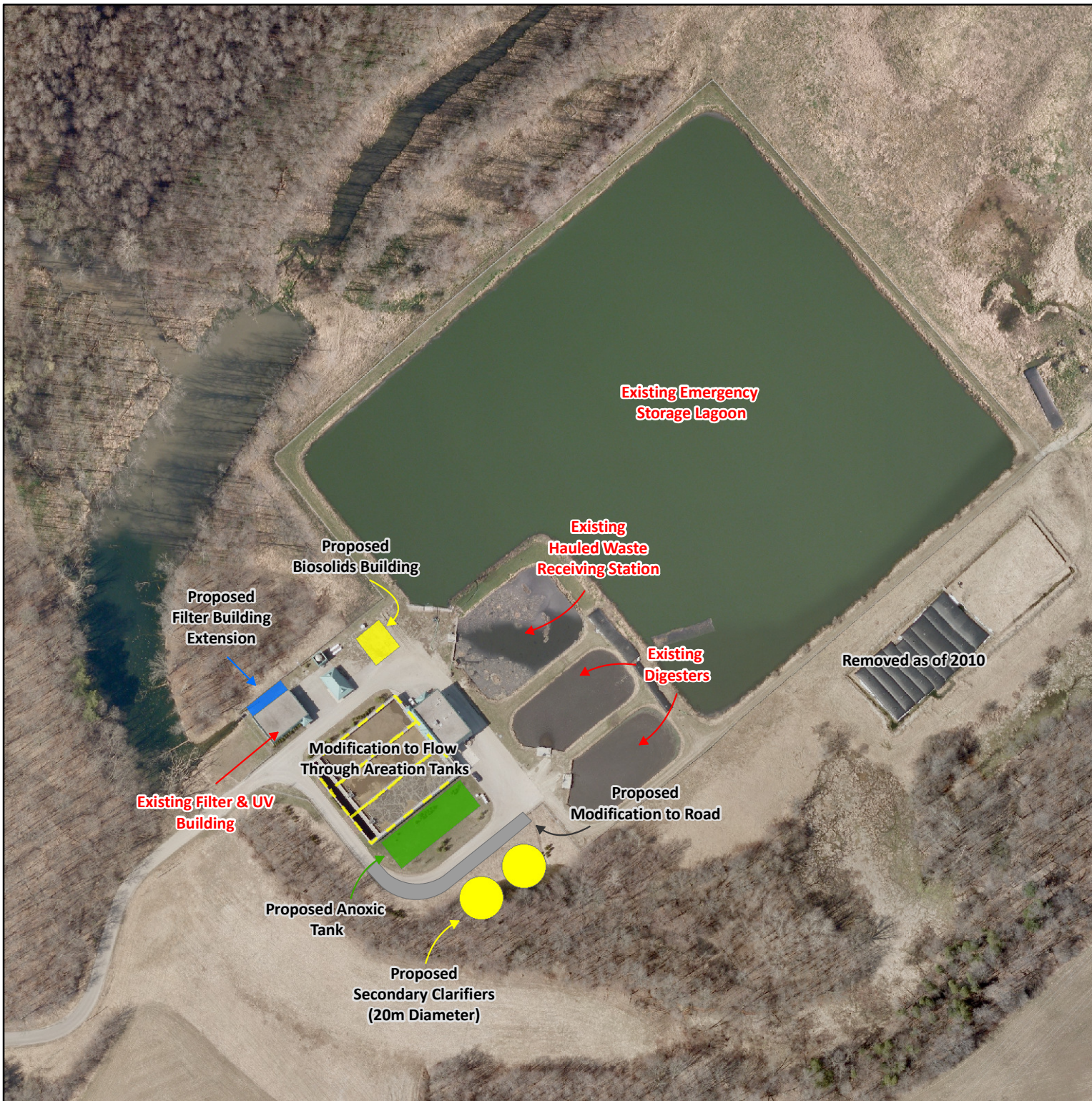
Table 4.24: Summary of Cost – Alternative WW - 5

Component	Cost estimate
Correction of Existing Deficiencies	\$ 35,000
Optimization of Existing Process	\$ 50,000
Expand the Facility	\$ 10,833,000
TOTAL	\$ 10,918,000

4.1.3.2.7 Class EA Requirements

The Municipal Class EA requirements of Alternative WW – 5 are as follows:

- Correct deficiencies and optimize existing process – Schedule A (improvement to operations without construction of works).
- Modify facility to a flow through process – Schedule C (Construction of new works results in requirement for Schedule C).



Legend

- Road Modification
- 2018
- 2041
- Modification Area
- Denitrification Strategy

Baden - New Hamburg Water &
Wastewater Master Plan
Update

Figure 4-10:
New Hamburg Wastewater Treatment -
Alternative Review
Alternative WW-5 Option C

Datum: NAD 83, Zone 17
Source: Region of Waterloo

June 2011



AECOM



0 15 30 60 90 120
Meters

4.1.4 Biosolids Management

The Region of Waterloo has recently commenced work on a Regional Biosolids Master Plan Update to assess the status of its biosolids management and disposal facilities and to reconfirm or develop a preferred biosolids management strategy to the year 2041.

As the selected option for biosolids management at the New Hamburg WWTP is integral to the capacity of the liquid stream process (due to the loading impact of return flows from the biosolids handling process) and due to space requirements of the biosolids handling process.

The Biosolids Master Plan Update recommends the use of the existing aerobic digesters for gravity thickening. Biosolids would then be hauled to the Region's Ayr WWTP for additional thickening and processing at a New Auto-Thermal, Thermophilic, Aerobic Digestion System (ATAD). Haulage of biosolids from other plants to the New Hamburg WWTP will be discontinued; Hespeler biosolids will be hauled to the new ATAD facility while Wellesley and St. Jacobs biosolids will go to Waterloo. As a future consideration, mechanical thickening could occur at the New Hamburg WWTP prior to haulage to the new ATAD facility. Further details can be found in the final Regional Biosolids Master Plan Update Report.

4.2 Wastewater Collection System

The Baden, New Hamburg, Foxboro Green Study Area is divided in three sub-catchment areas. As shown in **Figure 4.11**, some of the areas from northern Baden, most of New Hamburg, and Foxboro Green tend to flow away from the Morningside Wastewater Pumping Station (WWPS) due to existing grades.

The Baden and New Hamburg wastewater collection system alternatives, with focus on the Region's infrastructure, are presented in this Section. As mentioned earlier, alternatives to evaluate the potential for connecting Foxboro Green wastewater to the Baden and New Hamburg collection system are also presented.

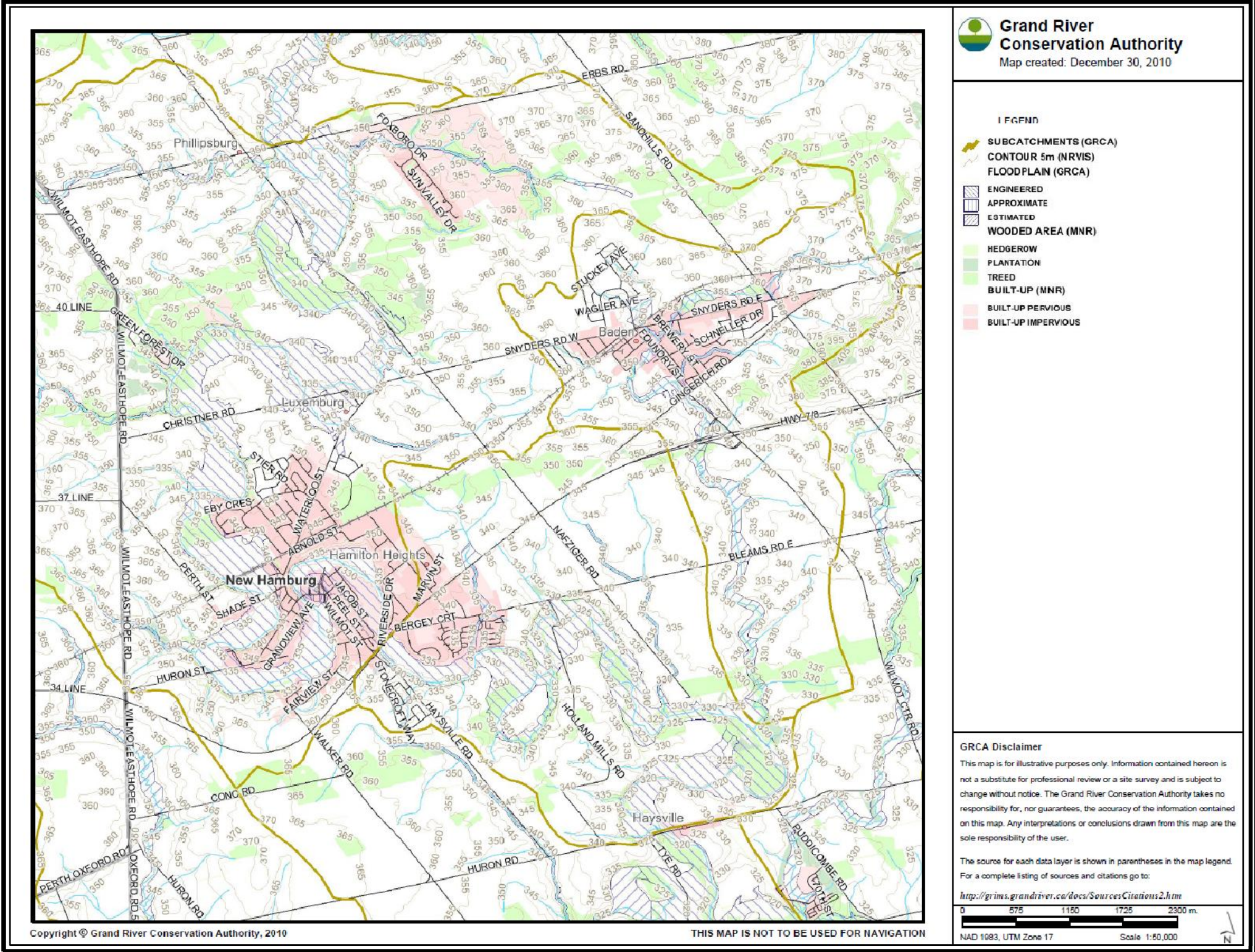


Figure 4.11: Study Area Topography

The following two wastewater collection system alternatives were formulated taking the topographical features, the existing collection system, and the 2041 (Low and High) projected flows into consideration. Additionally, various sewer routes are proposed from Foxboro Green to the B-NH collection system. Scenarios presented herein are solely for the purposes of capacity planning of Regional wastewater infrastructure and they do not imply future development plans by the Township.

- Wastewater Collection Option WWCS-1 (**Figure 4.12** and **Figure 4.13**) consists of six catchment areas and the floodplain area along the Nith River. It was assumed that a portion of the area located northeast of Highway 8 would require pumping to the Morningside WWPS.
- Wastewater Collection Option WWCS-2 (**Figure 4.14** and **Figure 4.15**): consists of five catchment areas and the floodplain area along the Nith River. It was assumed that a portion of the area located northeast of Highway 8 would flow by gravity to the Morningside WWPS.
- Foxboro Green Collection Options WWF-1 (**Figure 4.16**): three alternatives to connect the Foxboro Green wastewater collection systems to Baden/New Hamburg wastewater system are presented.

Table 4.26 and **Table 4.27** present a summary of projected flows by wastewater pumping station catchment area and the two main trunk sewers for Options WWCS-1 and WWCS-2, respectively. Projected flows were calculated based on growth projections within each catchment area. It is important to note that these flows are susceptible to changes depending on projected spatial distribution growth throughout Baden and New Hamburg. Combinations of flows are not included in these tables, as they depend on each alternative's variation and are presented below.

Table 4.25: Option WWCS-1 - Estimated and Projected Flows per Catchment Area

Catchment Area	Installed Capacity, m ³ /d	Projected Equiv. Pop.		Average Daily Flow, m ³ /d		Peak Dry Weather Flow, m ³ /d ¹		Peak Wet Weather Flow, m ³ /d ²	
		2041 (low)	2041 (high)	2041 (low)	2041 (high)	2041 (low)	2041 (high)	2041 (low)	2041 (high)
Baden PS ³	16,329	7,206	8,846	1,653	2,029	5,114	6,101	16,878	20,134
NH PS#2	3,888	4,721	5,795	1,083	1,329	3,539	4,233	5,308	6,350
New PS#1	-	3,031	3,721	695	853	2,390	2,868	3,586	4,302
New PS#2	-	1,110	1,363	255	313	960	1,160	1,440	1,739
Foxboro PS	-	962	1,086	237	266	905	1,004	1,357	1,507
Nith River Trunk Sewer (Gravity to Morningside) ⁴	24,192	8,557	10,503	2,155	2,601	6,512	7,631	9,768	11,447
East Side Trunk Sewer (Gravity to Morningside) ⁴	12,528	3,667	4,501	924	1,115	3,110	3,665	4,664	5,497
Morningside PS	22,637	29,255	35,815	7,002	8,506	17,420	20,433	26,130	30,650
¹ Harmon Peaking Factor = $1+(14/(4+(P/1000)^5))$ ² Peaking Factor from Stanley, 1998 ³ Flow to Morningside WWPS = 4,233 m ³ /d (49L/s). Flow to Storage = 12,096 m ³ /d (140 L/s) ⁴ Gravity flows, excluding discharges from other PSs – depend on alternatives variation									

Table 4.26: Option WWCS-2 - Estimated and Projected Flows

Catchment Area	Installed Capacity, m ³ /d	Projected Equiv. Pop.		Average Daily Flow, m ³ /d		Peak Dry Weather Flow, m ³ /d ¹		Peak Wet Weather Flow, m ³ /d ²	
		2041 (low)	2041 (high)	2041 (low)	2041 (high)	2041 (low)	2041 (high)	2041 (low)	2041 (high)
Baden PS ³	16,329	7,206	8,846	1,653	2,029	5,114	6,101	16,878	20,134
NH PS#2	3,888	4,721	5,795	1,083	1,329	3,539	4,233	5,308	6,350
New PS#1	-	3,031	3,721	695	853	2,390	2,868	3,586	4,302
Foxboro PS	-	962	1,086	237	266	905	1,004	1,357	1,507
Nith River Trunk Sewer (Gravity to Morningside) ⁴	24,192	9,334	11,457	2,333	2,820	6,964	8,167	10,445	12,251
East Side Trunk Sewer (Gravity to Morningside) ⁴	12,528	4,000	4,910	1,000	1,209	3,333	3,931	5,000	5,897
Morningside PS	22,637	29,255	35,815	7,002	8,506	17,420	20,433	26,130	30,650
¹ Harmon Peaking Factor = $1+(14/(4+(P/1000)^5))$ ² Peaking Factor from Stanley, 1998 ³ Flow to Morningside WWPS = 4,233 m ³ /d (49L/s). Flow to Storage = 12,096 m ³ /d (140 L/s) ⁴ Gravity flows, excluding discharges from other PSs – depend on alternatives variation									

4.2.1 Option WWCS-1: Six Catchment Areas and Floodplain

A portion of the area located northeast of Highway 8 would require pumping to the Morningside WWPS. Variations presented below indicate different routes for the new sewer lines.

4.2.1.1 Wastewater Collection Option 1A

Wastewater Collection Option 1A is illustrated in **Figure 4.12**. Option 1A would mainly consist of connecting Baden WWPS to the new PS#2, and connecting the new PS#1 to NHPS#2. Flows from north Baden would be collected by the upgraded Foxboro WWPS, and discharged to one of the WWPSs. Gravity and pumping station flows would discharge to the Morningside Pumping Station. **Table 4.27** presents a summary of projected flows by wastewater pumping station for Option 1A, including the Nith River and the East Side Trunk Sewers, excluding flows from Foxboro WWPS. The projected flows may change depending on the Foxboro WWPS preferred route.

Table 4.27: Option WWCS- 1A - Estimated and Projected Flows

Catchment Area	Installed Capacity, m ³ /d	Projected Equiv. Pop.		Average Daily Flow, m ³ /d		Peak Dry Weather Flow, m ³ /d ¹		Peak Wet Weather Flow, m ³ /d ²	
		2041 (low)	2041 (high)	2041 (low)	2041 (high)	2041 (low)	2041 (high)	2041 (low)	2041 (high)
Baden PS³	16,329	7,206	8,846	1,653	2,029	5,114	6,101	16,878	20,134
New PS#2 (+ Baden PS)	-	8,317	10,209	1,907	2,341	5,787	6,897	19,097	22,761
New PS#1	-	3,031	3,721	695	853	2,390	2,868	3,586	4,302
NH PS#2 (+ New PS#1)	3,888	7,752	9,516	1,778	2,182	5,447	6,495	8,171	9,743
Foxboro PS	-	962	1,086	237	266	905	1,004	1,357	1,507
Nith River Trunk Sewer (gravity flows + NH PS#2 + New PS#1)⁴	24,192	16,309	20,019	3,933	4,784	10,783	12,687	16,175	19,031
East Side Trunk Sewer (gravity flows + New PS#2 + Baden PS)⁴	12,528	11,984	14,710	2,831	3,456	8,143	9,632	12,214	14,448
Morningside PS	22,637	29,255	35,815	7,002	8,506	17,420	20,433	26,130	30,650
¹ Harmon Peaking Factor = $1+(14/(4+(P/1000)^5))$ ² Peaking Factor from Stanley, 1998 ³ Flow to Morningside WWPS = 4,233 m ³ /d (49L/s). Flow to Storage = 12,096 m ³ /d (140 L/s) ⁴ Gravity flows, excluding discharges from other PSs – depend on alternatives variation Red indicates flows higher than the existing capacity.									

The following improvements would be required for Option WWCS-1A:

- New pumping facilities:
 - o New wastewater pumping station PS#1 serving north areas of New Hamburg. New PS#1 2041 (low) average daily and wet weather capacity of 700 m³/d and 3,600 m³/d, respectively. New PS#1 2041 (high) average daily and wet weather capacity of 860 m³/d and 4,300 m³/d, respectively.
 - o New wastewater pumping station PS#2 serving southwest areas of Baden. New PS#2 2041 (low) average daily and wet weather capacity of 2,000 m³/d and 19,100 m³/d, respectively. New PS#2 2041 (high) average daily and wet weather capacity of 2,400 m³/d and 22,800 m³/d, respectively.
- New force mains:
 - o 150-mm force main from New PS#1 to Trunk Sewer connected to NH WWPS#2 (~ 1.8 km)
 - o 100-mm force main from Foxboro WWPS to Various Alternatives (from 3.5 to 7 km)
 - o 250-mm force main from New PS#2 to East Side Trunk Sewer (~ 0.9 km)
- Upgrade existing pumping facilities:
 - o Baden WWPS
2041 Low: Require additional pumping capacity (550 m³/d);
2041 High: Require additional pumping capacity (3,800 m³/d).
 - o NH WWPS#2
2041 Low and High: Require additional pumping capacity (2041 low: 4,238 m³/d; 2041 high: 5,855 m³/d)
 - o Morningside WWPS
2041 Low and High: Require additional pumping capacity (2041 low: 3,500 m³/d; 2041 high: 8,000 m³/d)
 - o Foxboro WWPS – convert from WWTP (2041 low: 1,360 m³/d; 2041 high: 1,510 m³/d)
- Upgrade existing force mains:
 - o 200 mm force main connecting the NH WWPS #2 to the sewer system would require upgrade to 250 mm (~ 0.4 km)
- Upgrade existing trunk sewers:
 - o 450 mm East Side Trunk Sewer would require to be upgraded (~1.2 km)
 - o Thorough evaluation of the existing sewers would be required to determine upgrades required.

4.2.1.2 Wastewater Collection Option 1B

Wastewater Collection Option 1B is illustrated in **Figure 4.13**. Option 1B is similar to Option 1A with an exception that the flow from the New PS#1 would be directly connected to the East Side Sewer Trunk.

Table 4.28 presents a summary of projected flows by wastewater pumping station for Option 1B, including the Nith River and the East Side Trunk Sewers, excluding flows from Foxboro WWPS. The projected flows may change depending on the Foxboro WWPS preferred route.

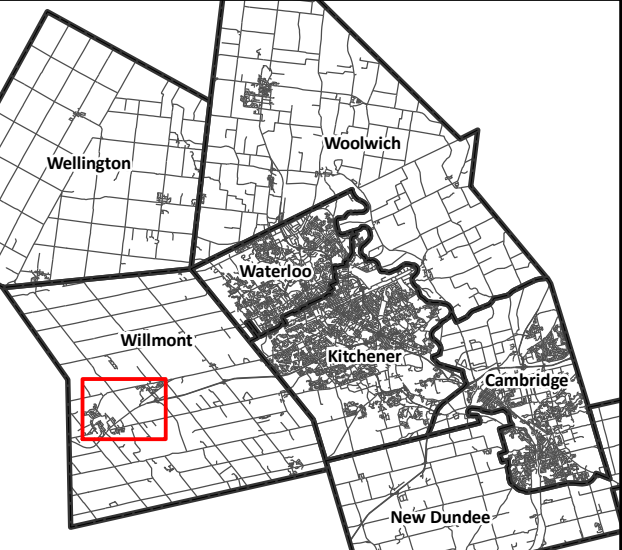
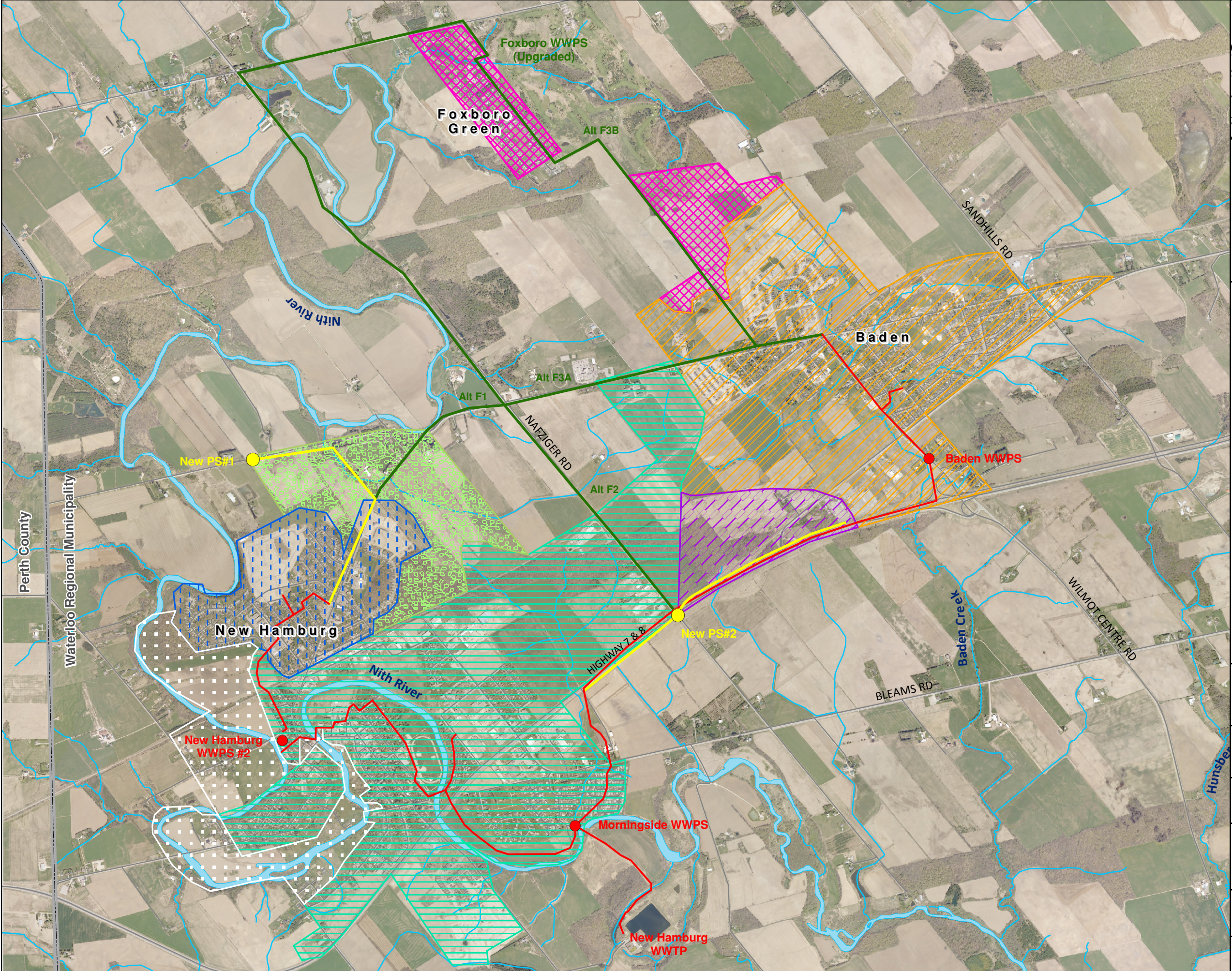
Table 4.28: Option WWCS-1B - Estimated and Projected Flows

Catchment Area	Installed Capacity, m ³ /d	Projected Equiv. Pop.		Average Daily Flow, m ³ /d		Peak Dry Weather Flow, m ³ /d ¹		Peak Wet Weather Flow, m ³ /d ²	
		2041 (low)	2041 (high)	2041 (low)	2041 (high)	2041 (low)	2041 (high)	2041 (low)	2041 (high)
Baden PS³	16,329	7,206	8,846	1,653	2,029	5,114	6,101	16,878	20,134
New PS#2 (+ Baden PS)	-	8,317	10,209	1,907	2,341	5,787	6,897	19,097	22,761
New PS#1	-	3,031	3,721	695	853	2,390	2,868	3,586	4,302
NH PS#2	3,888	4,721	5,795	1,083	1,329	3,539	4,233	5,308	6,350
Foxboro PS	-	962	1,086	237	266	905	1,004	1,357	1,507
Nith River Trunk Sewer (gravity flows + NH PS#2)⁴	24,192	13,278	16,298	3,079	3,931	8,828	10,777	13,243	16,166
East Side Trunk Sewer (gravity flows + New PS#2 + Baden PS + New PS#1)⁴	12,528	15,015	18,430	3,526	4,310	9,795	11,585	14,693	17,377
Morningside PS	22,637	29,255	35,815	7,002	8,506	17,420	20,433	26,130	30,650
¹ Harmon Peaking Factor = $1+(14/(4+(P/1000)^5))$ ² Peaking Factor from Stanley, 1998 ³ Flow to Morningside WWPS = 4,233 m ³ /d (49L/s). Flow to Storage = 12,096 m ³ /d (140 L/s) ⁴ Gravity flows, excluding discharges from other PSs – depend on alternatives variation Red indicates flows higher than the existing capacity.									

The following improvements would be required for Option WWCS-1B:

- New PS#1 and PS#2, as described in Option WWCS-1A.
- New force mains:
 - o 150-mm force main from New PS#1 to East Side Trunk Sewer (~ 3.3 km)
 - o 100-mm force main from Foxboro WWPS to Various Alternatives (from 3.5 to 7 km)
 - o 250-mm force main from New PS#2 to East Side Trunk Sewer (~ 0.9 km)
- Upgrade existing pumping facilities:
 - o Baden WWPS
2041 Low: Require additional pumping capacity (550 m³/d);
2041 High: Require additional pumping capacity (3,800 m³/d).

- o NH WWPS#2
2041 Low and High: Require additional pumping capacity (2041 low: 1,420 m³/d; 2041 high: 2,462 m³/d)
 - o Morningside WWPS
2041 Low and High: Require additional pumping capacity (2041 low: 3,500 m³/d; 2041 high: 8,000 m³/d)
 - o Foxboro WWPS – convert from WWTP (2041 low: 1,360 m³/d; 2041 high: 1,510 m³/d)
- Upgrade existing trunk sewers:
 - o 450 mm East Side Trunk Sewer would require to be upgraded (~1.2 km)
 - o Thorough evaluation of the existing sewers would be required to determine upgrades required.



Legend

- Existing Pumping Station
- New Pumping Station
- Existing Trunk Sewer
- New Trunk Sewer
- New Trunk Sewer (From /To Foxboro)
- Roads
- Rivers
- Nith River
- To Baden PS
- Floodplain
- To Foxboro PS
- Gravity to Morningside PS
- To NH PS#2
- To New PS#1
- To New PS#2
- Municipality Boundary

Baden - New Hamburg Water & Wastewater Master Plan Update

Figure 4-12:
Proposed Sewer System Alternative 1A

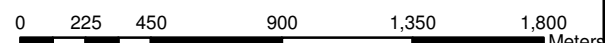
Datum: NAD 83, Zone 17 Source: Region of Waterloo	June 2011
--	-----------

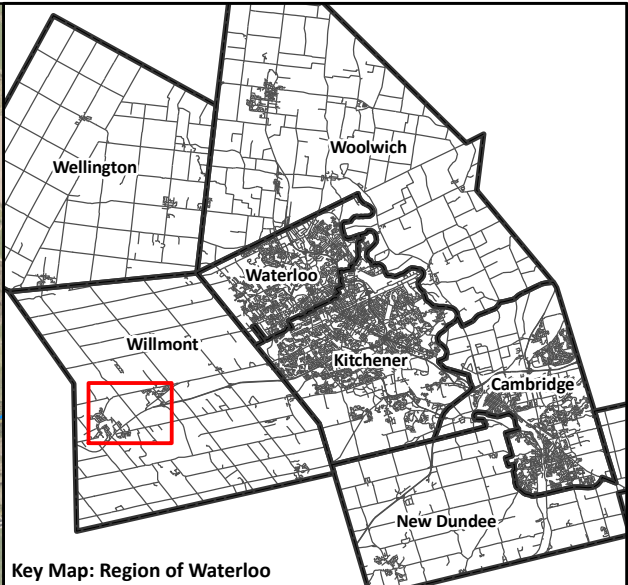
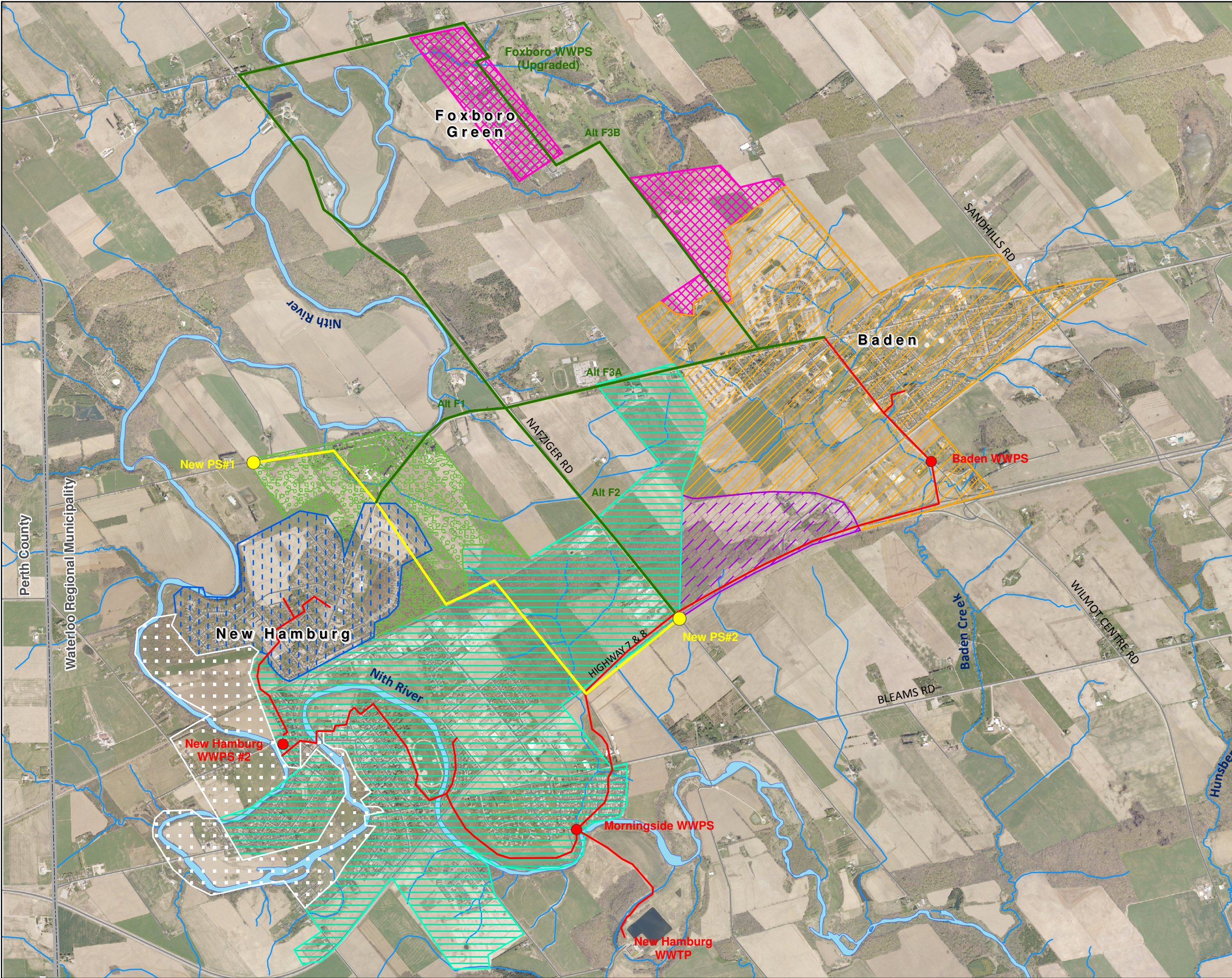


Region of Waterloo









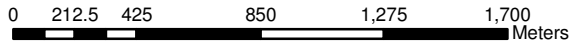
Legend

- Existing Pumping Station
- New Pumping Station
- Existing Trunk Sewer
- New Trunk Sewer
- New Trunk Sewer (From /To Foxboro)
- Roads
- Rivers
- Nith River
- To Baden PS
- Floodplain
- To Foxboro PS
- Gravity to Morningside PS
- To NH PS#2
- To New PS#1
- To New PS#2
- Municipality Boundary

Baden - New Hamburg Water & Wastewater Master Plan Update

Figure 4-13:
Proposed Sewer System Alternative 1B

Datum: NAD 83, Zone 17 Source: Region of Waterloo	June 2011
--	-----------

 Region of Waterloo	
	
	

4.2.2 Option WWCS-2: Five Catchment Areas and Floodplain

It was assumed that a portion of the area located northeast of Highway 8 would flow by gravity to the Morningside WWPS. Deeper sewer lines would be required to accommodate this assumption.

4.2.2.1 Wastewater Collection Option 2A

Wastewater Collection Option 2A is illustrated in **Figure 4.14**. Option 2A is similar to Option 1A with one less pumping station (New WWP#2), and a deeper sewer line connecting the excess flow from southwest Baden to Morningside WWPS. **Table 4.29** presents a summary of projected flows by wastewater pumping station for Option 2A, including the Nith River and the East Side Trunk Sewers, excluding flows from Foxboro WWPS. The projected flows may change depending on the Foxboro WWPS preferred route.

Table 4.29: Option WWCS-2A - Estimated and Projected Flows

Catchment Area	Installed Capacity, m ³ /d	Projected Equiv. Pop.		Average Daily Flow, m ³ /d		Peak Dry Weather Flow, m ³ /d ¹		Peak Wet Weather Flow, m ³ /d ²	
		2041 (low)	2041 (high)	2041 (low)	2041 (high)	2041 (low)	2041 (high)	2041 (low)	2041 (high)
Baden PS³	16,329	7,206	8,846	1,653	2,029	5,114	6,101	16,878	20,134
New PS#1	-	3,031	3,721	695	853	2,390	2,868	3,586	4,302
NH PS#2 (+ New PS#1)	3,888	7,752	9,516	1,778	2,182	5,447	6,495	8,171	9,743
Foxboro PS	-	962	1,086	237	266	905	1,004	1,357	1,507
Nith River Trunk Sewer (gravity flows + NH PS#2 + New PS#1)⁴	24,192	16,309	20,019	3,933	4,784	10,783	12,687	16,175	19,031
East Side Trunk Sewer (gravity flows + Baden PS)⁴	12,528		14,710		3,456		9,632		14,448
Morningside PS	22,637	29,255	35,815	7,002	8,506	17,420	20,433	26,130	30,650
¹ Harmon Peaking Factor = $1+(14/(4+(P/1000)^5))$ ² Peaking Factor from Stanley, 1998 ³ Flow to Morningside WWPS = 4,233 m ³ /d (49L/s). Flow to Storage = 12,096 m ³ /d (140 L/s) ⁴ Gravity flows, excluding discharges from other PSs – depend on alternatives variation Red indicates flows higher than the existing capacity.									

The same improvements stated in Option WWCS-1A are required for Option WWCS-2A, with the following changes:

- No New PS#2
- New trunk sewer connecting southwest Baden to the East Side Trunk Sewer.

4.2.2.2 Wastewater Collection Option 2B

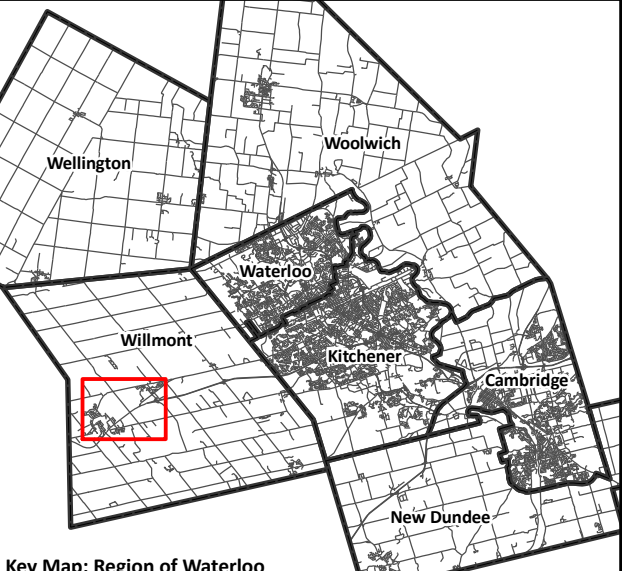
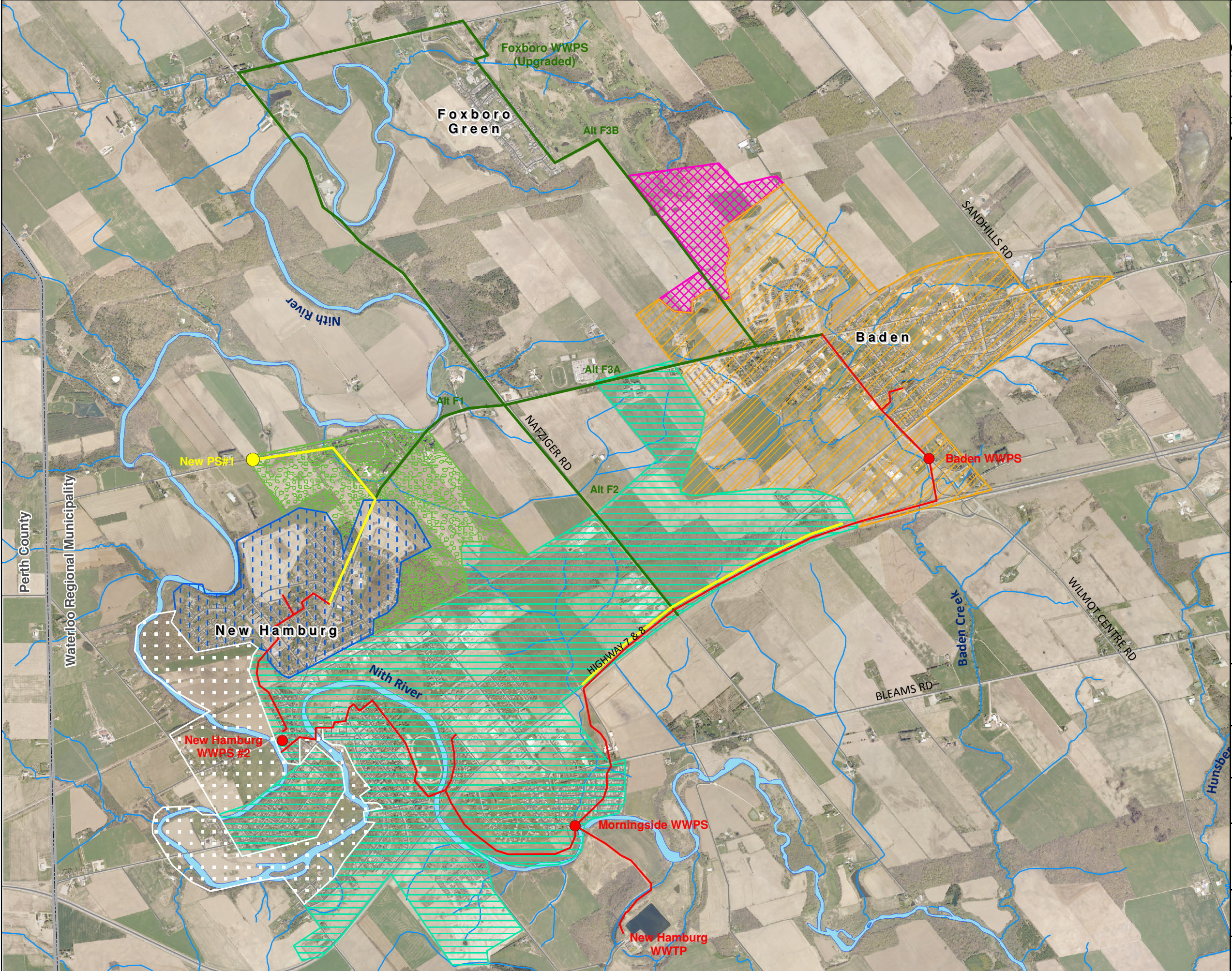
Wastewater Collection Option 2B is illustrated in **Figure 4.15**. Option 2B is similar to Option 1B with one less pumping station (New WWP#2), and a deeper sewer line connecting the excess flow from southwest Baden to Morningside WWPS. **Table 4.30** presents a summary of projected flows by wastewater pumping station for Option 2B, including the Nith River and the East Side Trunk Sewers, excluding flows from Foxboro WWPS. The projected flows may change depending on the Foxboro WWPS preferred route.

Table 4.30: Option WWCS-2B - Estimated and Projected Flows

Catchment Area	Installed Capacity, m ³ /d	Projected Equiv. Pop.		Average Daily Flow, m ³ /d		Peak Dry Weather Flow, m ³ /d ¹		Peak Wet Weather Flow, m ³ /d ²	
		2041 (low)	2041 (high)	2041 (low)	2041 (high)	2041 (low)	2041 (high)	2041 (low)	2041 (high)
Baden PS³	16,329	7,206	8,846	1,653	2,029	5,114	6,101	16,878	20,134
New PS#1	-	3,031	3,721	695	853	2,390	2,868	3,586	4,302
NH PS#2	3,888	4,721	5,795	1,083	1,329	3,539	4,233	5,308	6,350
Foxboro PS	-	962	1,086	237	266	905	1,004	1,357	1,507
Nith River Trunk Sewer (gravity flows + NH PS#2)⁴	24,192	13,278	16,298	3,079	3,931	8,828	10,777	13,243	16,166
East Side Trunk Sewer (gravity flows + Baden PS + New PS#1)⁴	12,528		18,430		4,310		11,585		17,377
Morningside PS	22,637	29,255	35,815	7,002	8,506	17,420	20,433	26,130	30,650
¹ Harmon Peaking Factor = $1+(14/(4+(P/1000)^5))$ ² Peaking Factor from Stanley, 1998 ³ Flow to Morningside WWPS = 4,233 m ³ /d (49L/s). Flow to Storage = 12,096 m ³ /d (140 L/s) ⁴ Gravity flows, excluding discharges Red indicates flows higher than the existing capacity.									

The same improvements stated in Option WWCS-1B are required for Option WWCS-2B, with the following changes:

- No New WWPS#2
- New trunk sewer connecting southwest Baden to the East Side Trunk Sewer.



Legend

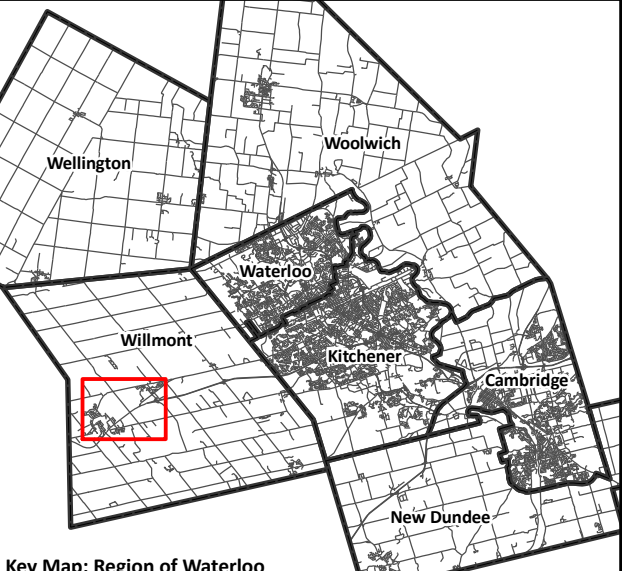
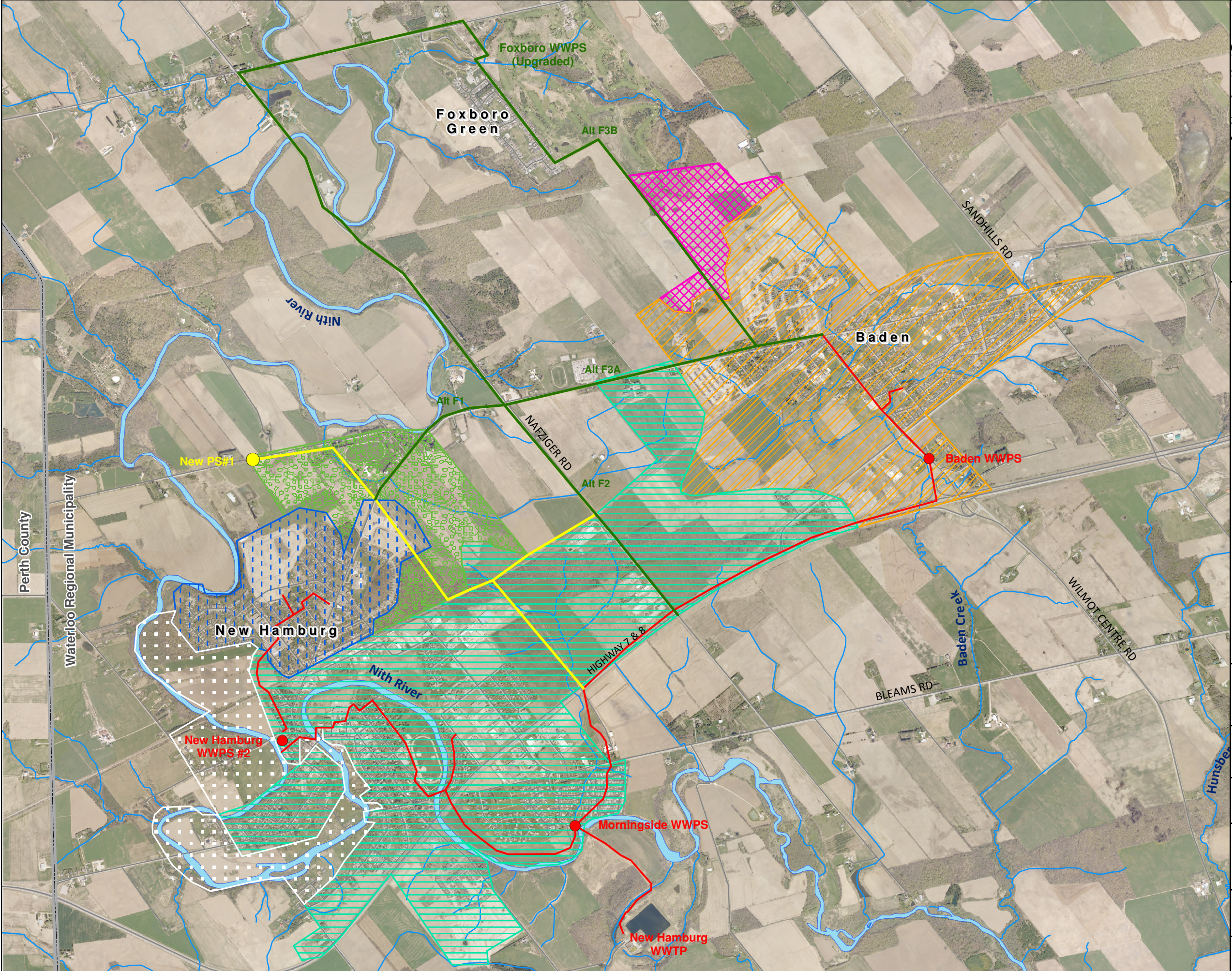
- Existing Pumping Station
- New Pumping Station
- Existing Trunk Sewer
- New Trunk Sewer
- New Trunk Sewer (From/To Foxboro)
- Roads
- Rivers
- Nith River
- To Baden PS
- Floodplain
- To Foxboro PS
- Gravity to Morningside PS
- To NH PS#2
- To New PS#1
- Municipality Boundary

Baden - New Hamburg Water & Wastewater Master Plan Update

Figure 4-14:
Proposed Sewer System Alternative 2A

Datum: NAD 83, Zone 17
Source: Region of Waterloo

June 2011



Legend

- Existing Pumping Station
- New Pumping Station
- Existing Trunk Sewer
- New Trunk Sewer
- New Trunk Sewer (From/To Foxboro)
- Roads
- Rivers
- Nith River
- To Baden PS
- Floodplain
- To Foxboro PS
- Gravity to Morningside PS
- To NH PS#2
- To New PS#1
- Municipality Boundary

Baden - New Hamburg Water & Wastewater Master Plan Update

Figure 4-15:
Proposed Sewer System Alternative 2B

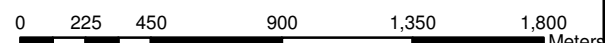
Datum: NAD 83, Zone 17 Source: Region of Waterloo	June 2011
--	-----------



Region of Waterloo







4.2.3 Option WWF-1: Foxboro Green Wastewater Collection Options

As shown in **Figure 4.16**, three alternatives to connect the Foxboro Green wastewater collection system to the Baden/New Hamburg wastewater system are proposed for consideration. The projected flows below include the northern portion of Baden as well.

4.2.3.1 Foxboro Wastewater Collection Option F1

Option F1 would consist of connecting the Foxboro Green Wastewater System to the New Hamburg WWPS #2 catchment area.

The following improvements would be required for Option F1:

- New 100-mm force main from Foxboro WWPS to NH WWPS#2 trunk sewer (~ 7 km)
- Convert Foxboro RBC No. 1 and No. 2 to WWPS (2041 low: 1,360 m³/d; 2041 high: 1,510 m³/d), and connect the existing raw sewage lift station (RBC No. 3) to the converted WWPS.
- Additional capacity at NH WWTP #2
- Existing sewer trunk system review

4.2.3.2 Foxboro Wastewater Collection Option F2

Option F2 would consist of connecting the Foxboro Green Wastewater System to the New Hamburg East Side Trunk Sewer.

The following improvements would be required for Option F2:

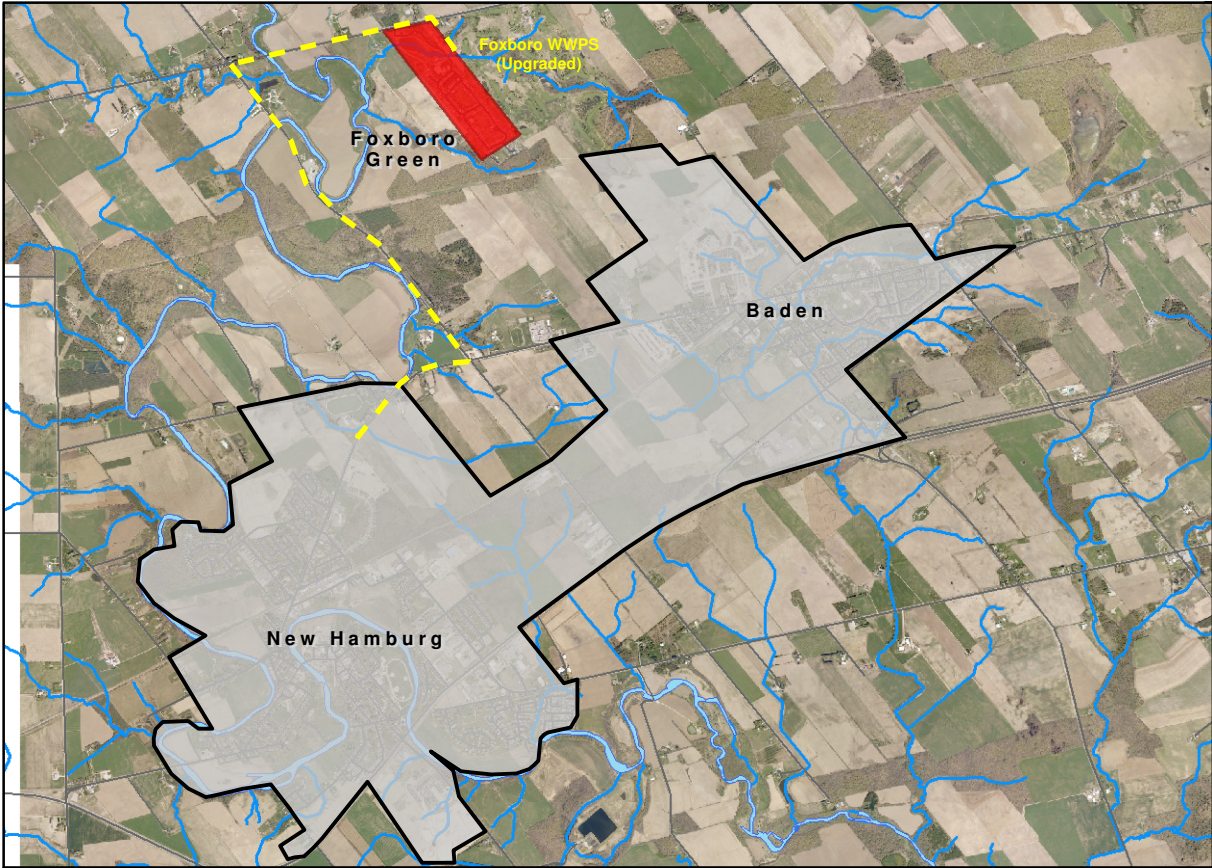
- New 100-mm force main from Foxboro WWPS to the East Side trunk sewer (~ 7.5 km).
- Convert Foxboro RBC No. 1 and No. 2 to WWPS (2041 low: 1,360 m³/d; 2041 high: 1,510 m³/d), and connect the existing raw sewage lift station (RBC No. 3) to the converted WWPS.
- Additional capacity at East Side Sewer Trunk.
- Existing sewer trunk system review.

4.2.3.3 Foxboro Wastewater Collection Option F3

Option F3 would consist of connecting the Foxboro Green Wastewater System to the Baden WWPS catchment area. This connection could be implemented by either crossing the country side (shorter route) or along major roads.

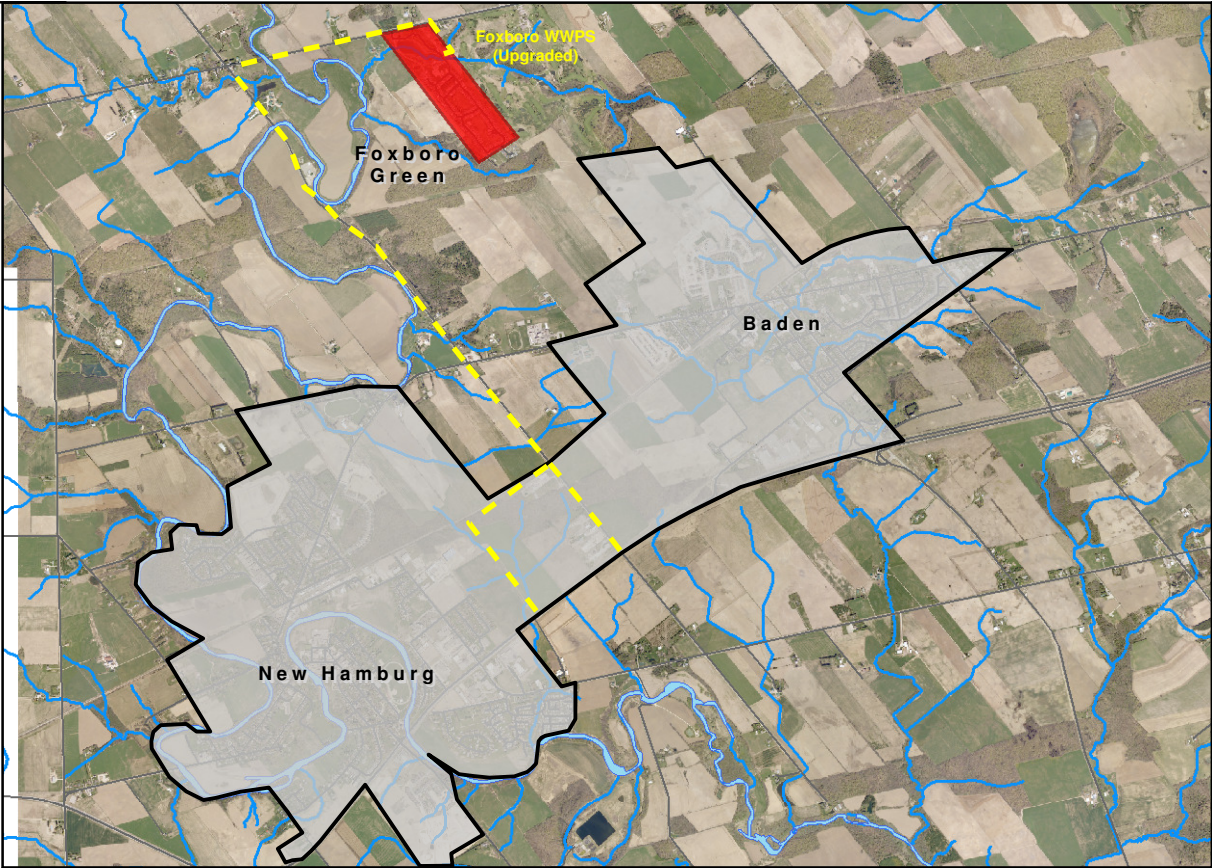
The following improvements would be required for Option F3:

- New 100-mm force main from Foxboro WWPS to Baden WWPS (A: ~ 7 km; B: ~ 3.5 km);
- Convert Foxboro RBC No. 1 and No. 2 to WWPS (2041 low: 1,360 m³/d; 2041 high: 1,510 m³/d), and connect the existing raw sewage lift station (RBC No. 3) to the converted WWPS;
- Additional capacity at East Side Sewer Trunk;
- Additional capacity at the Baden WWPS;
- Existing sewer trunk system review.



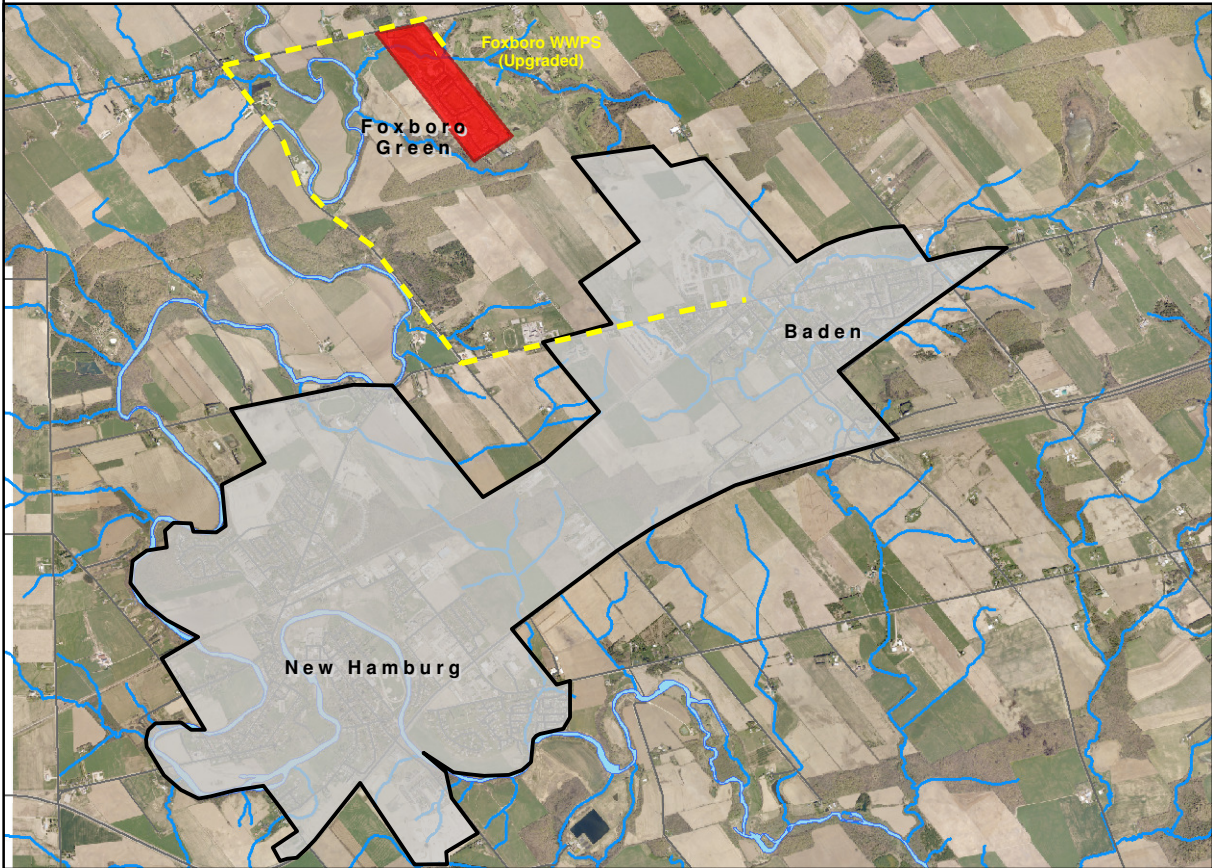
Option F1

Force Main to NH North (~7 km) Additional Flow to NH WWPS#2



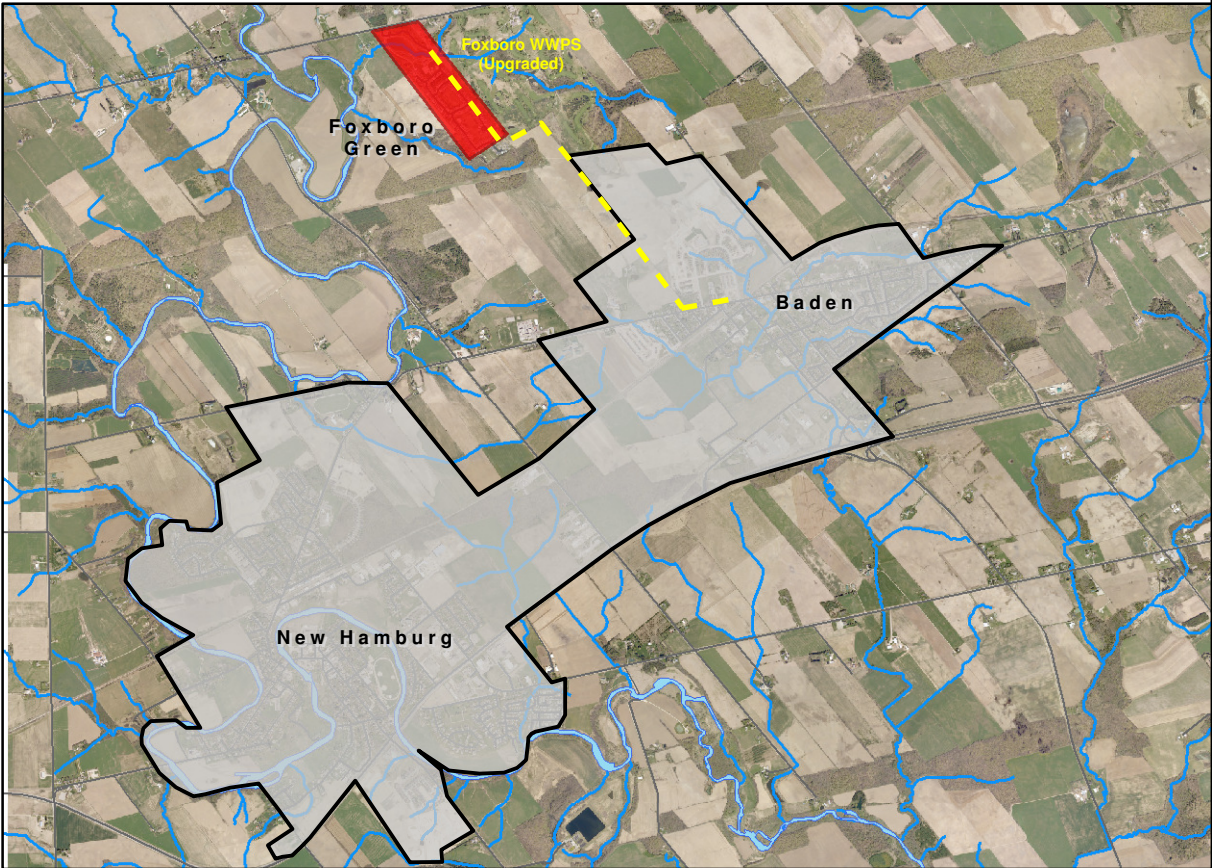
Option F2

Force Main to NH East Side Trunk Sewer (~7.5 km)



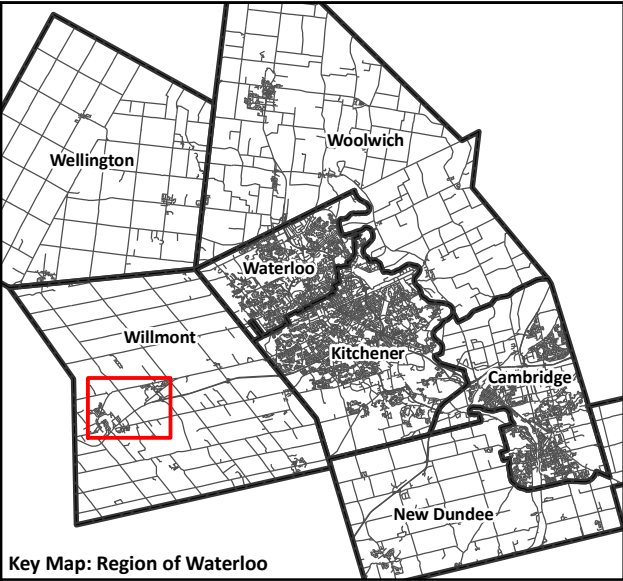
Option F3A

Force Main to Baden (~7 km) Additional Flow to Baden WWPS



Option F3B

Force Main to Baden (~3.5 km) Additional Flow to Baden WWPS



Legend

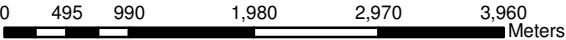
- New Trunk Sewer
- Roads
- Rivers
- Study Area
- Nith River
- Foxboro PS

Baden - New Hamburg Water & Wastewater
Master Plan Update

**Figure 4-16:
Foxboro Green WW Collection System
Alternatives**

Datum: NAD 83, Zone 17
Source: Region of Waterloo

June 2011



4.2.4 Wastewater Collection System Estimated Conceptual Costs

Table 4.31 presents the conceptual cost for each wastewater collection system alternative.

Table 4.31: Wastewater Collection System Options Conceptual Cost

Strategic Option	Variation	Description	Conceptual Cost Estimate (C\$)
WWCS1	1A	- New PS#1 (Capacity: 4,300 m³/d) - New PS#2 (Capacity: 22,800 m³/d) - New 150 mm FM from New PS#1 (~1.8 km) - New 250-mm FM from New PS#2 (~ 0.9 km) - Upgrade Baden WWPS (Additional 3,800 m³/d) - Upgrade NH WWPS#2 (Additional 5,855 m³/d) - Upgrade Morningside WWPS (Additional 8,000 m³/d) - Convert Foxboro Wastewater System (1,510 m³/d) - Upgrade NH WWPS#2 FM to 250 mm (~ 0.4 km) - Upgrade East Side Trunk Sewer to 600 mm (~1.2 km) WWCS-1A TOTAL	1.94 M 5.29 M 0.63 M 0.41 M 1.80 M 2.34 M 2.82 M 1.54 M 0.18 M 0.90 M 17.85 M
	1B	- New PS#1 (Capacity: 4,300 m³/d) - New PS#2 (Capacity: 22,800 m³/d) - New 150 mm FM from New PS#1 (~3.3 km) - New 250-mm FM from New PS#2 (~ 0.9 km) - Upgrade Baden WWPS (Additional 3,800 m³/d) - Upgrade NH WWPS#2 (Additional 2,462 m³/d) - Upgrade Morningside WWPS (Additional 8,000 m³/d) - Convert Foxboro Wastewater System (1,510 m³/d) - Upgrade East Side Trunk Sewer to 600 m (~1.2 km) WWCS-1B TOTAL	1.94 M 5.29 M 1.16 M 0.41 M 1.80 M 1.39 M 2.82 M 1.54 M 0.90 M 17.24 M
WWCS2	2A	- New PS#1 (Capacity: 4,300 m³/d) - New 150 mm FM from New PS#1 (~1.8 km) - New 250-mm Sewer Trunk from SW Baden (~0.9 km) - Upgrade Baden WWPS (Additional 3,800 m³/d) - Upgrade NH WWPS#2 (Additional 5,855 m³/d) - Upgrade Morningside WWPS (Additional 8,000 m³/d) - Convert Foxboro Wastewater System (1,510 m³/d) - Upgrade NH WWPS#2 FM to 250 mm (~ 0.4 km) - Upgrade East Side Trunk Sewer to 600 mm (~2.1 km) WWCS-2A TOTAL	1.94 M 0.63 M 0.41 M 1.80 M 2.34 M 2.82 M 1.54 M 0.18 M 2.10 M 13.76 M

	2B	- New PS#1 (Capacity: 4,300 m³/d) - New 150 mm FM from New PS#1 (~3.3 km) - New 250-mm FM from New PS#2 (~ 0.9 km) - New 250-mm Sewer Trunk from SW Baden (~ 0.9 km) - Upgrade Baden WWPS (Additional 3,800 m³/d) - Upgrade NH WWPS#2 (Additional 2,462 m³/d) - Upgrade Morningside WWPS (Additional 8,000 m³/d) - Convert Foxboro Wastewater System to WWPS (1,510 m³/d) - Upgrade East Side Trunk Sewer to 600 mm (~2.1 km) WWCS-2B TOTAL	1.94 M 1.16 M 0.41 M 0.41 M 1.80 M 1.39 M 2.82 M 1.54 M 2.10 M 13.56 M
WWCSF	F1	- New 100 mm FM from Foxboro WWPS (~ 7 km) - Additional capacity at NH WWTP #2 (1,510 m³/d) WWCS-F1 TOTAL	2.10 M 1.04 M 3.14 M
	F2	New 100 mm FM from Foxboro WWPS (~ 7.5 km) WWCS-F2 TOTAL	2.25 M 2.25 M
	F3A	- New 100 mm FM from Foxboro WWPS (~ 7 km) - Additional capacity at Baden WWPS (1,510 m³/d) WWCS-F3A TOTAL	2.10 M 1.04 M 3.14 M
	F3B	- New 100 mm FM from Foxboro WWPS (~ 3.5 km) - Additional capacity at Baden WWPS (1,510 m³/d) WWCS-F3B TOTAL	1.05 M 1.04 M 2.09 M

5. Evaluation Criteria and Approach

5.1 Class EA Master Plan Process and Evaluation Framework

The objective of the Baden-New Hamburg Water and Wastewater Master Plan is to clearly define a “broad” long-range plan which will consist of a “suite” of projects required to implement the plan over the planning period (2041). Various individual projects may also be combined to form a specific strategy. The master plan addresses Phase 1 (Purpose Statement) and Phase 2 (Identify and Evaluate Alternative Solutions) of the MEA Class EA document to the extent possible, and provides a listing of individual sewage collection and treatment, and water supply and distribution projects. The listing includes:

- Project description/location;
- Phased-implementation schedule (triggers);
- Recommended Class EA Planning Schedule (i.e. Schedule B or Schedule C or Individual EA); and,
- An overview of how each project relates to the Study Area environmental features which will be addressed in each future Class EA projects.

This approach involved the preparation of a Master plan document at the conclusion of Phases 1 and 2 of the Municipal Class EA process. The Master Plan document is made available for public comment prior to being approved by the municipality.

The Master Plan was completed at a broad level of assessment thereby requiring more detailed investigations at the project-specific level to fulfill Municipal Class EA documentation requirements for any specific Schedule B and C projects identified within the Master Plan.

The Master Plan is therefore the basis for, and be used in support of future investigations for the specific Schedule B and C projects identified within it. Schedule B projects would require the filing of the Project File or Environmental Screening Document for public review while Schedule C projects would have to fulfill Phases 3 and 4 prior to filing an Environmental Study Report (ESR) for public review.

Over the planning period Class EA approvals for all Schedule “B” and “C” projects can then be easily secured by using the Master Plan as a starting point and completing remaining Class EA requirements (i.e. alternative route/site/technology evaluations, site specific investigations, notification, consultation and filing of individual Class EA project documents).

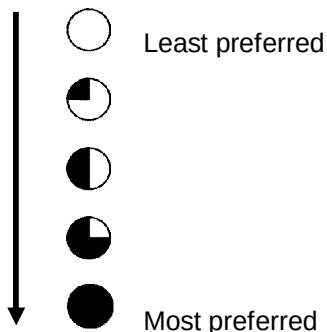
5.2 Use of Descriptive Information and Qualitative Evaluation

The evaluation is not based on a numerical ranking system. Such an approach would have to strictly adhere to statistical methods that are often difficult to apply in a multi-faceted issue such as a Class EA. For example, considerable time and resources can be spent on agreeing on evaluation category weightings (e.g. disagreement on weighting or importance given to a specific category or criteria).

Instead, a descriptive or qualitative evaluation is used to consider the suitability of alternative solutions/strategies and to identify significant advantages and disadvantages with respect to the evaluation criteria. In this respect, comparisons and trade-offs are made between alternatives which is described in the text of the Class EA master plan report and forms the rationale for the identification of a preferred solution or strategy. Trade-offs involve forfeiting an advantage or accepting a disadvantage to address a higher priority consideration. For information purposes only, the alternatives are ranked in

order of preference (based on advantages/disadvantages) under the discussion with respect to each aspect of the environment.

For the evaluation summary, the following rating symbols are applied to each alternative solution and evaluation criteria:



The evaluation of alternative solutions are captured in a matrix format to allow direct comparison between alternatives.

5.3 Evaluation Criteria and Methodology

A detailed evaluation of each alternative solution and wastewater treatment have been completed based on the impact to the following components (**Table 5.1**).

Table 5.1: Evaluation Components

Evaluation Component	Description
Natural Environment	Component having regard for protecting significant natural and physical elements of the environment (i.e. air, land, water and biota) including natural heritage-environmentally sensitive policy areas.
Social/ Cultural	Component that evaluates potential effects on residents, neighbourhoods, businesses, community character, social cohesion, community features and historical/archaeological and heritage components in addition to municipal and provincial development objectives.
Economic/ Financial	Component that addresses the potential effect on infrastructure capital and O&M costs.
Legal/ Jurisdictional	Component that considers regulatory and land requirements for each alternative.
Technical	Component that considers technical suitability and other engineering aspects of the strategy.

Based on the above the following table has been prepared which provides a detailed list of considerations under each main component. It is important to note that the criteria as presented in **Table 5.2** reflects those applied in previous Regional Master Plans which incorporated public, agency and stakeholder comment.

Table 5.2: Evaluation Criteria for Water and Wastewater Alternatives

Natural Environment Considerations
Potential effects on surface waters
Nith River watershed
Provincially Significant Wetlands
Potential effects on groundwater
Source water protection
interference with private or municipal wells
Potential effects on terrestrial environmental biota, trees and vegetation
trees and vegetation
number and significance o trees removed and/or disturbed
extent of loss/disturbance to grass/vegetation
sensitive species habitat (e.g. vulnerable/threatened endangered or locally/regionally rare amphibians, birds and other wildlife)
Planning considerations - potential effects
environmental management planning considerations (e.g. GMS)
Potential effects on Natural Heritage features
natural heritage features, including provincially significant wetlands (PSWs), environmentally significant areas (ESAs), Areas of Natural and Scientific Interest (ANSIs), and sensitive species habitat
Public Health and Safety Considerations
Potential land use impacts (i.e. displacement or disruption) and siting considerations including:
temporary disruption during construction (i.e. dust, noise, vibrations, traffic management, and pedestrian movement, detours, access to property and maintain existing services;
potential impacts to sensitive land uses
First Nations considerations
archaeological/heritage resources/cultural landscape features
tourist/recreational resources
agricultural resources
potential for disturbing or altering existing community character or structure
potential for displacing/disturbing existing residences, business and/or community, institutional and recreational facilities
Potential effects to Public Health & Safety
proximity to roadways – impact of spills, road salt on groundwater
water quality – public acceptance of treatment technology required
air quality
Ability of Alternative to meet provincial water quality standards and security requirements, having regard to the long-term storage needs and emergency requirements

Social and Cultural Considerations
Planning considerations - potential effects
Short term and long-term community growth including conformity with municipal and provincial planning policies.
Ability to meet municipal and provincial growth targets.
Social costs and benefits
applicability for education program for consumers including Public education of water conservation
ability to meet “Triple bottom line” test (collectively consider social, economic and environmental impacts and ability to achieve a balanced outcome)
Economic and Financial Considerations
Estimated capital and operating costs.
best use of existing infrastructure
cost impacts to municipal finances (i.e. Water/Sewer Rates and DC's)
ability to avoid or minimize tax increase for residents
impacts to agricultural operations
complexity of approvals considering current and future regulatory environment
land acquisition requirements
location inside vs. outside Regional and Township boundaries and associated jurisdictional issues
Technical Considerations
Ability of alternative to meet short and long-term municipal requirements:
impact to system operations
ability to provide reliable and secure service
flexibility
Ease of Implementation/time to implement; flexibility for scheduling
difficulty of construction - water crossings - tunnels and shafts - deep open cut sections - construction in limited area - protection of utilities, trees, structures
maintaining operation during construction
minimizing disruptions/ downtime
constructability
schedule and timing
Infrastructure, utility and energy requirements necessary to implement alternative.
optimization of existing capacity (technical perspective);
Innovation and use of relevant/new technology
operational and maintenance complexity

5.4 Evaluation

The alternatives developed in Section 4 have been evaluated according to the methodology and criteria described above. The results of this evaluation assisted determining the preferred solution for wastewater servicing in the Baden/New Hamburg service area.

5.4.1 Public Consultation

A Public Information Center (PIC) was held in December 2010 to present the wastewater preferred alternatives and receive feedback from the public. The following represents a summary of the comments received related to wastewater:

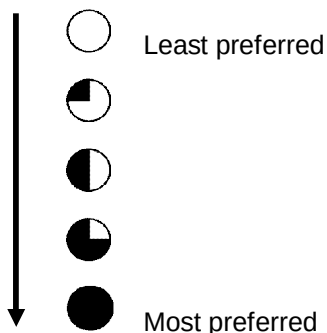
- Request that the final Class EA solution to be deferred until approval of the ROP and the completion of the Township's Official Plan.
- Alternatives to the trucking of sludge and hauled waste should be investigated. Trucking is disruptive and has an environmental impact.
- It is requested that the Wilmot Centre Monitoring Program Public Liaison Committee be kept apprised of issues pertaining to this Master Plan.

Responses to the above comments were sent to their authors and they were included in the evaluation of alternatives presented in the previous section.

5.4.2 New Hamburg WWTP – Evaluation of Alternatives

As discussed earlier in this document, five alternative solutions were reviewed for implementation at the New Hamburg WWTP. Of these, two alternatives; Alternative WW-4 (Expand WWTP per Phase 2 Expansion Plan) and Alternative WW-5 (Convert WWTP to Flow Through Process), were determined to be viable options while Alternatives WW-1 to WW-3 were screened from further consideration. Alternative WW-4 and Alternative WW-5 were further developed to assist in determining which of these two shortlisted alternatives was preferred. The two shortlisted alternatives were evaluated according to the criteria noted in Table 3.2. Alternative WW-1 (Do Nothing) was also included in this evaluation for comparison purposes.

The evaluation of each alternative, for each criteria is described in the following paragraphs. For each alternative a qualitative score has been allocated for respective criteria according to the following:



5.4.2.1 Alternative WW1 – Do Nothing

This alternative proposes that no action be taken to upgrade, modify or expand the New Hamburg WWTP. The evaluation of this alternative for each criteria is noted as follows.

- **Natural Environment** – in this alternative the flows to the WWTP and the Nith River will continue to increase. Without improvement of deficiencies within the WWTP processes, effluent quality may deteriorate, resulting in harmful effects to the Nith River. Additionally the continued use of the emergency storage lagoons for storage of process flows (i.e., rather than the intended purpose of wet weather flows) may result in an environmental spill.

Impact on Natural Environment: Moderate to High

- **Social / Cultural** – The “Do Nothing Alternative” will not meet the short and long term growth requirements of the Region and the Township. The potential for environmental spills result in Public Health and Safety concern. Additionally this option does not comply with the triple bottom line test.

Impact on Social/Cultural Criteria: High

- **Economic/Financial** – The “Do Nothing Alternative” provides no opportunity for future growth and new tax revenues. Any required upgrades to the WWTP will be at the expense of existing customers.

Impact on Economic/Financial Criteria: Moderate to High

- **Legal/Jurisdictional** – no impact

Impact on Legal/Jurisdiction Criteria: Lowest Impact

- **Technical** – As discussed the facility has a number of ongoing operational deficiencies that need to be addressed immediately to meet short term needs. Without an expansion, the WWTP cannot accommodate an increase in flows. Therefore this alternative does not meet short or long term operational and infrastructure requirements.

Impact on Technical Criteria: Moderate to High

5.4.2.2 Alternative WW 4 – Expand Existing Facility Per Phase 2 Expansion Plan

- **Natural Environment** –The upgrades proposed in Alternative WW-4 include upgrading and expanding the WWTP to meet effluent requirements with respect to non-toxicity and PWQO limits. This alternative provides options for the future reductions in TP limits through implementation of advanced filtration technology at the WWTP or by addressing non-point sources of phosphorus through the Rural Water Quality (RWQ) program. The support of the RWQ provides added benefits to source water protection for ground and surface water. While flexibility has been provided for future changes in TP limits, there is limited flexibility for other future effluent limit changes (i.e. ammonia, nitrate, etc). As all proposed construction work is within the existing site, there will be minimal to no impacts on the terrestrial environment or natural heritage features.

Impact on Natural Environment: Low to Moderate

- **Social / Cultural** – This alternative will meet the short term growth targets in conformance with planning policies and public health and safety parameters. Long term targets can be met through installation of a parallel package plant.

As previously mentioned, all work proposed in this alternative will be contained on the existing site and as such, minimal to no impact to the social or cultural environment is expected. Additionally, as this is a remote location, there will be minimal disruption to neighbouring residences during construction.

This alternative complies with the triple bottom line test.

Impact on Social/Cultural Criteria: Low

- **Economic/Financial** – Alternative WW4 requires an initial investment of approximately \$8 M for completion of the expansion per the Phase 2 expansion plan. According to current growth forecasts, this provides capacity to approximately 2028. Once the capacity of the expanded plant is reached, a parallel process may be required at a substantial capital and operational cost. The future treatment requirements are highly dependent on population growth and the future regulatory environment with respect to effluent quality, both of which are uncertain at this time. These uncertainties are typical and as such, the MOE recommends that a relatively short 20 year planning horizon be used in planning wastewater treatment upgrades.

Impact on Economic/Financial Criteria: Moderate

- **Legal/Jurisdictional** – An amendment to the New Hamburg WWTP Certificate of Approval will be required for the implementation of Alternative WW-4. No land acquisition will be required and all upgrades are located within the Regional/Township boundaries.

Impact on Legal/Jurisdiction Criteria: Low to Moderate

- **Technical** – Alternative WW-4 includes the optimization of the existing facility and the correction of deficiencies within the process resulting in improved operation and reliability. The proposed Phase 2 upgrades were planned in the original design concept of the facility and therefore, this option has the greatest ease of implementation. These upgrades optimize use of the existing infrastructure and the process is familiar to operations staff. However, should a future parallel package process be needed once the capacity of the Phase 2 expansion is exceeded, operational complexity would increase substantially. A future parallel package process results in two separate processes with differing operational requirements.

Impact on Technical Criteria: Moderate

5.4.2.3 Alternative WW 5 – Convert to a Flow Through Process

- **Natural Environment** – As with Alternative WW-4 the upgrades proposed in Alternative WW-5 include upgrading and expanding the plant to meet effluent requirements and provides options for the future reductions in TP limits through implementation of advanced filtration technology at the WWTP or by addressing non-point sources of phosphorus through the Rural Water Quality (RWQ) program.

Alternative WW-5 provides added flexibility for future changes in effluent limits (i.e., ammonia, nitrate etc). As all proposed construction work is within the existing site, there will be minimal to no impacts on the terrestrial environment or natural heritage features.

Impact on Natural Environment: Lowest Impact

- **Social / Cultural** – This alternative will meet the short and long term growth targets in conformance with planning policies and public health and safety parameters.

As previously mentioned, all work proposed in this alternative will be contained on the existing site and as such minimal to no impact to the social or cultural environment is expected. Additionally, as this is a remote location, there will be minimal disruption to neighbouring residences during construction.

This alternative complies with the triple bottom line test.

Impact on Social/Cultural Criteria: Low to Moderate.

- **Economic/Financial** – Alternative WW5 requires an initial investment of approximately \$11 M for completion of the expansion and will provide capacity beyond the 2041 high growth forecasts. In comparison to Alternative WW-4, this alternative requires a greater upfront investment; however, it provides for long term growth and effluent quality changes.

Future treatment capacity requirements are highly dependent on population growth and the future regulatory environment with respect to effluent quality, both of which are uncertain at this time. These uncertainties are typical with as such, the MOE recommends a 20 year planning horizon be used in planning wastewater treatment upgrades.

Impact on Economic/Financial Criteria: Moderate to High

- **Legal/Jurisdictional** – An amendment of the New Hamburg WWTP Certificate of Approval will be required for the implementation of Alternative WW-5. No land acquisition will be required and all upgrades are located within the Regional/Township boundaries.

Impact on Legal/Jurisdiction Criteria: Low to Moderate

- **Technical** – Alternative WW-5 includes the optimization of the existing facility and the correction of deficiencies within the process resulting in improved operation and reliability. Several aspects of the proposed upgrades will utilize existing infrastructure and take advantage of upgrades planned for in the original installation. The conversion to a flow through process adds complexity to the design and construction of the upgrade, and also requires the addition of new infrastructure that was not part of the original design intent of the facility. The operation of the plant will also change significantly and while the proposed system is familiar to the Region, it may not be familiar to existing operations staff.

Impact on Technical Criteria: Moderate

5.4.2.4 Summary of Evaluation– Wastewater Treatment

The following Table summarizes the evaluation of Wastewater Treatment Alternatives.

Table 5.3: Evaluation of Treatment Alternatives

Evaluation Criteria	Alternative WW-1 “Do Nothing”	Alternative WW-4 – Expand Existing WWTP per Phase 2 Expansion Plan	Alternative WW 5 – Convert WWTP to Flow Through Process
Natural Environment	Risk of deteriorated effluent quality	Future effluent TP requirements will be met. Limited flexibility for other future effluent limit changes.	Future effluent TP requirements will be met. Added flexibility for other future effluent limit changes.
	Impact: Moderate to High	Impact: Low to Moderate	Impact: Low to Moderate
			
Social/Cultural	Does not meet short/long term requirements. Risk of adverse effluent quality and thus Public Health and Safety	Short and long term growth requirements can be met, however long term requirements requires additional package plant. Minimal to no impact on surrounding areas.	Short and long term growth requirements can be met. Minimal to no impact on surrounding areas.
	Impact: High	Impact: Low	Impact: Low
			
Economic/Financial	No new tax revenues	Requires an initial investment of \$8 M. Future (2028) package plant will require and additional \$6-9 M if dictated by growth needs.	Requires an initial investment of \$11 M.
	Impact: High	Impact: Moderate	Impact: Moderate to High
			
Legal/Jurisdictional	No Impact	CofA Amendment required.	CofA Amendment required.
	Impact: Lowest Impact	Impact: Low to Moderate	Impact: Low to Moderate
			
Technical	Does not meet WWTP treatment objectives.	Initial upgrades compatible with existing system. Future package plant increases operational complexity.	Initial upgrades require complex modification and significant changes to plant operation.
	Impact: Moderate to High	Impact: Moderate	Impact: Moderate to High
			

5.4.3 Baden/New Hamburg Wastewater Collection System– Evaluation of Alternatives

As discussed earlier in this document, the Baden, New Hamburg and Foxboro Green wastewater collection systems were reviewed to determine the most suitable strategy for wastewater collection in the area. Two wastewater collection system alternatives were taken into consideration including:

- Wastewater Collection Option WWCS-1 – Six catchment areas and the floodplain area along the Nith River. This alternative assumed that a portion of the area northeast of Highway 8 would require pumping to the Morningside WWPS.

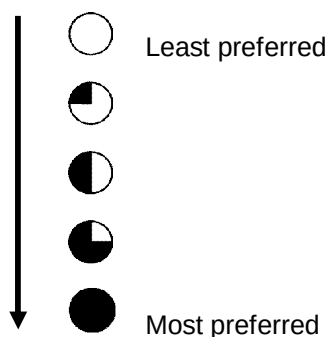
- Wastewater Collection Option WWCS-2 – Five catchment areas and the flood plain area along the Nith River. It was assumed that a portion of the area located northeast of Highway 8 would flow by gravity to the Morningside WWPS.

In addition to the two collection alternatives, three alternatives were developed to connect the Foxboro Green Wastewater Collection Systems to the Baden/New Hamburg system as follows:

- Alternative WW F-1 - Connect Foxboro Green WWPS to New Hamburg WWPS #2
- Alternative WW F-2 – Connect Foxboro Green WWPS to New Hamburg East Side Trunk Sewer
- Alternative WW F-3 – Connect Foxboro Green WWPS to Baden WWPS

These shortlisted alternatives were evaluated according to the criteria noted in **Table 3.2**. Alternative WW-1 (Do Nothing) was also included in this evaluation for comparison purposes.

The evaluation of each alternative, for each criteria is described in the following paragraphs. For each alternative a qualitative score has been allocated for respective criteria according to the following:



5.4.3.1 Alternative WWCS1 – Do Nothing

This alternative proposes that no action be taken to upgrade, modify or expand the Baden/New Hamburg Collection System. The evaluation of this alternative for each criteria is noted as follows.

- **Natural Environment** – in this alternative the wastewater flows would continue to increase and the current operation may result in continued or increased emergency discharges to Baden Creek.

Impact on Natural Environment: Low to Moderate

- **Social / Cultural** – The “Do Nothing Alternative” will not meet the short and long term growth requirements of the Region and the Township. The potential emergency discharges to Baden Creek which may have an effect on water quality and thus Public Health and Safety. Additionally this option does not comply with the triple bottom line test.

Impact on Social/Cultural Criteria: High

- **Economic/Financial** – The “Do Nothing Alternative” provides no opportunity for future growth and new tax revenues. Additionally, higher O&M costs may be incurred to address high flow events.

Impact on Economic/Financial Criteria: Moderate to High

- **Legal/Jurisdictional** – no impact

Impact on Legal/Jurisdiction Criteria: Lowest Impact

- **Technical** – The existing wastewater collection system does not meet the future requirements of the service area.

Impact on Technical Criteria: Moderate to High

5.4.3.2 *Alternative WWCS – 1 – Six Catchment Areas & Floodplain Area Along Nith River – Connect Baden WWPS to new PS#2*

- **Natural Environment** – With the implementation of Alternative WWCS-1, occasional emergency discharges to Baden Creek may continue. Additionally the proposed construction will have some impact on terrestrial environment during construction. Minimal impact on natural heritage features are expected as the work is not located in sensitive areas.

Impact on Natural Environment: Moderate

- **Social / Cultural** – This alternative will meet the short and long term growth targets in conformance with planning policies. The proposed wastewater pumping station may be located in a major recreational area and as such, a high impact to the area's recreational resources is expected. Moderate disruption to neighbours during construction will occur, and would require mitigation.

This alternative complies with the triple bottom line test

Impact on Social/Cultural Criteria: Low to moderate.

- **Economic/Financial** – Alternative WWCS – 1 has an estimated capital cost of \$16.8 to \$17.4 M. An increase in O&M cost is expected with the new sewage pump stations. The required upgrades can be financed by new consumers.

Impact on Economic/Financial Criteria: Moderate

- **Legal/Jurisdictional** – A Schedule B Class EA will be required as part of the preliminary design of this upgrade. A Certificate of Approval will be required for new or expanded pump stations, sewers and forcemains outside existing utility corridors. Land acquisition is required for the two proposed wastewater pump stations.

Impact on Legal/Jurisdiction Criteria: Moderate

- **Technical** – The proposed upgrades would provide added reliability in the collection system and could be phased to meet growth. However, while the proposed upgrades would accommodate 2041 low flows, 2041 high flows could not be accommodated. This alternative also proposes added complexity as three new pump stations would be required.

Impact on Technical Criteria: Moderate

5.4.3.3 *Alternative WWCS – 2 – Five Catchment Areas & Floodplain Area Along Nith River – Deep Sewer to Morningside WWPS from West Baden*

- **Natural Environment** – With the implementation of Alternative WWCS-2, occasional emergency discharges to Baden Creek may continue. Additionally the proposed construction will have some impact on terrestrial environment during construction. Minimal impact on natural heritage features are expected as the work is not located in sensitive areas.

Impact on Natural Environment: Moderate

- **Social / Cultural** – This alternative will meet the short and long term growth targets in conformance with planning policies. Moderate disruption to neighbours during construction will occur, and would require mitigation.

This alternative complies with the triple bottom line test

Impact on Social/Cultural Criteria: Low

- **Economic/Financial** – Alternative WWCS – 2 has an estimated capital cost of \$13 to \$13.3 M. A moderate increase in O&M cost is expected with the new sewage pump station, however this increase will be less than Alternative WWCS-1 as one less wastewater pump station is required. The required upgrades can be financed by new customer.

Impact on Economic/Financial Criteria: Moderate to Low

- **Legal/Jurisdictional** – A Schedule B Class EA will be required as part of the preliminary design of this upgrade. A Certificate of Approval will be required for one new pump station, as well as proposed sewers and forcemains outside existing utility corridors. Land acquisition is required for the two proposed new wastewater pump stations.

Impact on Legal/Jurisdiction Criteria: Moderate to low

- **Technical** – The proposed upgrades would provide added reliability in the collection system. All proposed upgrades will be built to capacity initially. However, while the proposed upgrades could accommodate 2041 low flows, 2041 high flows could not be accommodated. This alternative also proposes less complexity than Alternative WWCS-1 as one less new pumping station is required.

Impact on Technical Criteria: Moderate to low

5.4.3.4 *Summary of Evaluation– Wastewater Collection – Baden/New Hamburg*

The following Table summarizes the evaluation of Wastewater Collection System Alternatives for Baden/New Hamburg.

Table 5.4: Summary of Alternatives – Baden/New Hamburg Collection System

Evaluation Criteria	Alternative “Do Nothing”	Alternative WWCS-1 – 6 Catchments Connect Baden WWPS to new PS#2	Alternative WWCS-1 – 5 Catchments, deep sewer to Morningside WWPS
Natural Environment	Frequent spills to Baden Creek Possible Impact: Low to Moderate	Occasional spills to Baden Creek possible. Terrestrial impacts during construction. Impact: Moderate	Occasional spills to Baden Creek possible. Terrestrial impacts during construction. Impact: Moderate
			
Social/Cultural	Does not meet short/long term requirements. Risk of emergency discharges to Baden Creek. Does not meet triple bottom line test. Impact: High	Short and long term requirements met. High impact on recreation areas. Meets triple bottom line test. Impact: Low to Moderate	Short and long term growth requirements can be met. Minimal to impact on surrounding areas. Impact: Low
			
Economic/Financial	No new tax revenues. Increased O&M Cost to address high flow events. Impact: Moderate to High	\$16.8 to \$17.4 M Higher O&M cost for additional WWPS. All upgrades at the cost of new consumers. Impact: Moderate	\$13 to \$13.3 M. Higher O&M cost for additional WWPS however less than WWCS-1. All upgrades at the cost of new consumers. Impact: Low to Moderate
			
Legal /Jurisdictional	No Impact Impact: Lowest Impact	CofA Amendment required (2 new WWPS). Schedule B Class EA required. Impact: Moderate	CofA Amendment required (1 new WWPS). Schedule B Class EA required. Impact: Low to Moderate
			
Technical	Does not meet future requirements. Impact: Moderate to High	Meets requirements. Added O&M complexity Impact: Moderate	Meets requirements. Added O&M complexity but less than WWCS-1 Impact: Low to Moderate
			

In addition to the alternatives for the Baden/New Hamburg Collection system, several alternatives were developed for the connection of the Foxboro Green service area to the Baden/New Hamburg system. Shortlisted alternatives include:

- Do Nothing;
- Alternative WWF-1 – Connect Foxboro Green WWPS to New Hamburg WWPS#2;
- Alternative WWF-2 – Connect Foxboro Green WWPS to The New Hamburg East Side Trunk Sewer;
- Alternative WWF-3 – Connect Foxboro Green WWPS to Baden WWPS.

5.4.3.5 Alternative “Do Nothing”

This alternative proposes that no action be taken to upgrade or connect the Foxboro Green WWPS to the Baden/New Hamburg system. The evaluation of this alternative for each criterion is noted as follows.

- **Natural Environment** – in this alternative the current treatment system may impact the quality of shallow groundwater MOE could require more stringent effluent limits which may or may not be met with the existing system.

Impact on Natural Environment: Low to Moderate

- **Social / Cultural** – The “Do Nothing Alternative” will meet the short term requirements; however the current operation has the risk of failure in the long term. This option does not comply with the triple bottom line test on a long term basis.

Impact on Social/Cultural Criteria: High

- **Economic/Financial** – The “Do Nothing Alternative” will require no capital cost and has no impact on municipal finances as there are no plans for future growth. Higher O&M costs may be incurred to ensure the current system can meet effluent requirements.

Impact on Economic/Financial Criteria: Moderate to High

- **Legal/Jurisdictional** – no impact

Impact on Legal/Jurisdiction Criteria: Lowest Impact

- **Technical** – The existing Foxboro WWTP will continue to be kept operational.

Impact on Technical Criteria: Moderate to High

5.4.3.6 Alternative WWF – 1 – Connect Foxboro Green WWPS to New Hamburg PS#2

- **Natural Environment** – With the implementation of Alternative WWF-1, a moderate impact on the terrestrial environment is expected during construction of the forcemain/sewer. Additionally the proposed construction will have some impact on sensitive areas (PSWs, ESAs, ANSIs, sensitive species habitat) as portions of the proposed construction would occur within these sensitive areas.

Impact on Natural Environment: Moderate

- **Social / Cultural** – This alternative will meet the short and long term growth targets in conformance with planning policies. While a moderate disruption to neighbours during construction will occur, the proposed work will meet all provincial requirements.

This alternative complies with the triple bottom line test.

Impact on Social/Cultural Criteria: Moderate.

- **Economic/Financial** – Alternative WWF – 1 has an estimated capital cost of \$3.1M. This work will be financed by existing consumers and growth within Baden/New Hamburg.

Impact on Economic/Financial Criteria: Moderate

- **Legal/Jurisdictional** – A Schedule A+ Class EA will be required as part of the preliminary design of this upgrade. A Certificate of Approval will be required for new or expanded pump stations,

sewers and forcemains outside existing utility corridors. All proposed work is located within Regional and Township boundaries.

Impact on Legal/Jurisdiction Criteria: Moderate to high

- **Technical** – The proposed upgrades would provide added reliability and compliance with regulatory agencies. The New Hamburg WWPS#2 would require additional capacity as well as the sewer system. Flow from Foxboro would be double pumped. The existing WWTP could be retrofitted to a pumping station.

Impact on Technical Criteria: Moderate to High

5.4.3.7 Alternative WWF – 2 – Connect Foxboro Green WWPS to New Hamburg East Side Trunk Sewer

- **Natural Environment** – With the implementation of Alternative WWF-2, a moderate impact on the terrestrial environment is expected during construction. Additionally the proposed construction will have some impact on sensitive areas (PSWs, ESAs, ANSIs, sensitive species habitat) as portions of the proposed work would occur within sensitive areas.

Impact on Natural Environment: Moderate to High

Social / Cultural – This alternative will meet the short and long term growth targets in conformance with planning policies. While a moderate disruption to neighbours during construction will occur, the proposed work will meet all provincial requirements. This alternative complies with the triple bottom line test.

Impact on Social/Cultural Criteria: Moderate

- **Economic/Financial** – Alternative WWF – 2 has an estimated capital cost of \$2.2M. This work will be financed by existing consumers and growth within Baden/New Hamburg.

Impact on Economic/Financial Criteria: Moderate to Low

- **Legal/Jurisdictional** – A Schedule A+ Class EA will be required as part of the preliminary design of this upgrade. A Certificate of Approval will be required for new or expanded pump stations, sewers and forcemains outside existing utility corridors. All proposed work is located within Regional and Township boundaries.

Impact on Legal/Jurisdiction Criteria: Low to Moderate

- **Technical** – The proposed upgrades would provide added reliability and compliance with regulatory agencies. The East Side trunk sewer would require additional capacity as well as the sewer system. Flow from Foxboro would not be double pumped, as is required by Alternative WWF-1. The existing WWTP could be retrofitted to a pumping station.

Impact on Technical Criteria: Low to Moderate

5.4.3.8 Alternative WWF – 3 – Connect Foxboro Green WWPS to Baden WWPS

- **Natural Environment** – With the implementation of Alternative WWF-3, a moderate impact on the terrestrial environment is expected during construction. Additionally the proposed

construction will have some impact on sensitive areas (PSWs, ESAs, ANSIs, sensitive species habitat) as portions of the proposed work would occur within sensitive areas. Unlike Alternatives WWF-2 and 3, Alternative WWF-3 may result in occasional emergency discharges to Baden Creek.

Impact on Natural Environment: Moderate

Social / Cultural – This alternative will meet the short and long term growth targets in conformance with planning policies. While a moderate disruption to neighbours during construction will occur, the proposed work will meet all provincial requirements. This alternative complies with the triple bottom line test.

Impact on Social/Cultural Criteria: Moderate

- **Economic/Financial** – Alternative WWF – 3 has an estimated capital cost of \$2 to \$3.1 M. This work will be financed by existing consumers and growth within Baden/New Hamburg.

Impact on Economic/Financial Criteria: Moderate

- **Legal/Jurisdictional** – A Schedule B Class EA will be required as part of the preliminary design of this upgrade. A Certificate of Approval will be required for new or expanded pump stations, and proposed sewers and forcemains outside existing utility corridors. All proposed work is located within Regional and Township boundaries.

Impact on Legal/Jurisdiction Criteria: Moderate

- **Technical** – The proposed upgrades would provide added reliability and compliance with regulatory agencies. The Baden WWPS as well as the sewer system would require additional capacity. Flow from Foxboro would be double pumped. Option 3B would have a shorter route however the sewer would be installed in “green lands”. The existing WWTP could be retrofitted to a pumping station.

Impact on Technical Criteria: Moderate

5.4.3.9 Summary of Evaluation– Wastewater Collection – Foxboro Green

The following Table summarizes the evaluation of Wastewater Collection System Alternatives for Foxboro Green.

Table 5.5: Summary of Alternatives – Foxboro Green Collection System

Evaluation Criteria	Alternative “Do Nothing”	Alternative WWF-1: Connect Foxboro Green WWPS to New Hamburg WWPS#2	Alternative WWF-2: Connect Foxboro Green WWPS to New Hamburg east Side Trunk Sewer	Alternative WWF-3: Connect Foxboro Green WWPS to Baden WWPS
Natural Environment	Shallow groundwater impact	Moderate impact on terrestrial environment and natural heritage features during construction.	Moderate impact on terrestrial environment and natural heritage features during construction.	Moderate impact on terrestrial environment and natural heritage features during construction.
	Impact: Low to Moderate	Impact: Moderate	Impact: Moderate	Impact: Moderate
				
Social/Cultural	Potential for operational failure Does not meet triple bottom line test	Short and long term requirements met. Moderate disruption to neighbours during construction. Meets triple bottom line test.	Short and long term growth requirements can be met. Minimal to impact on surrounding areas.	Short and long term growth requirements can be met. Minimal to impact on surrounding areas.
	Impact: High	Impact: Moderate	Impact: Moderate	Impact: Moderate
				
Economic/Financial	Increased O&M Cost in the event of failure. No capital cost	\$3.1 M capital.	\$2.2 M capital.	\$2M to \$3.1M capital.
	Impact: Moderate to High	Impact: Moderate	Impact: Low to Moderate	Impact: Moderate
				
Legal /Jurisdictional	No Impact	CofA Amendment for new/expanded PS. Schedule A+ Class EA required.	CofA Amendment for new/expanded PS. Schedule A+ Class EA required.	CofA Amendment for new/expanded PS. Schedule B Class EA required.
	Impact: Lowest Impact	Impact: Low to Moderate	Impact: Low to Moderate	Impact: Moderate
				
Technical	Foxboro WWTP to remain on line.	New Hamburg WWPS#2 and sewer requires additional capacity. Flow from Foxboro double pumped.	The East Side Trunk Sewer would require additional capacity. Flow from Foxboro not double pumped.	The Baden WWPS would require additional capacity. Flow from Foxboro double pumped.
	Impact: Moderate to High	Impact: Low to Moderate	Impact: Low to Moderate	Impact: Moderate
				

6. Wastewater Recommendations

6.1 Wastewater Treatment Plant

It is recommended that Alternative WW-4 be selected as the preferred alternative for wastewater treatment based on the evaluation in **Section 5.4.2**. While both Alternatives WW-4 and WW 5 will meet the needs of the service area in the short and long term, Alternative WW-5 requires a significantly greater initial investment.

Alternative WW-4 meets the treatment objectives of the WWTP and provides flexibility for future expansion and/or changes in regulatory requirements. This alternative also maximizes the use of the existing infrastructure, and reduces expansion complexity as well as operational changes.

6.1.1 New Hamburg WWTP Phasing Plan

Implementation of the preferred Alternative WW- 4 may be phased as follows:

- Part 1 – Optimize New Hamburg WWTP and correct existing deficiencies;
- Part 2 – Upgrade/Expand per Phase 2 expansion strategy;
- Part 3 – Install parallel package treatment plant when capacity of Step 2 is reached
- Part 4 – Should effluent TP requirements require enhanced filtration, install a second stage of tertiary filters.

Figure 6.1 illustrates the timing of each required component of the preferred alternative based on estimated population growth. Population is shown in terms of a Population Equivalents (PE) representing both residential and employment growth. Each Part should be fully operational by the year indicated. This means that design, construction and approvals must be planned for in advance of this target date.

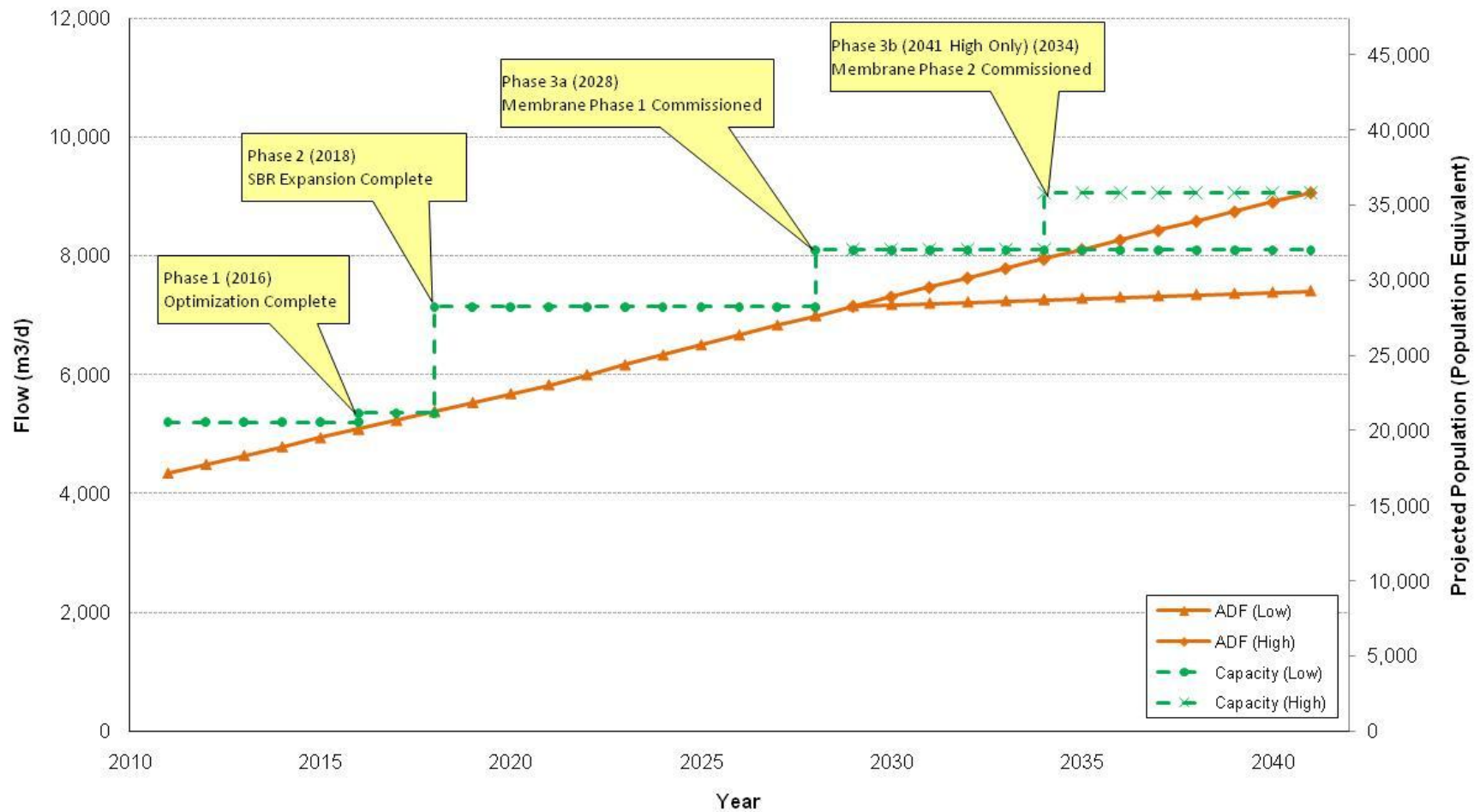


Figure 6.1: New Hamburg WWTP – Proposed Implementation Plan

6.2 Baden/New Hamburg/Foxboro Wastewater Collection System

We recommend that as lands are developed, a Wastewater Servicing Study to be performed to determine the optimal location of loading key trunk sewers and infrastructure based on the Region's and Township's growth spatial planning.

Based on the preliminary evaluation Alternative WWCS-2 is selected as the preferred alternative for wastewater collection. While both Alternatives WWCS-1 and WWCS-2 meet the needs of the service area, Alternative WWCS-2 has a lower capital and also reduces the complexity of the system by requiring one fewer pump station. Additionally, Alternative WWCS-1 has a high impact on recreational resources as the proposed pump station may be located in a major recreational area. This is not the case for Alternative WWCS-2.

As mentioned above, depending on the recommended Wastewater Servicing Study findings, the preferred wastewater collection option may change.

The preferred connection strategy for Foxboro Green, should it be pursued, will also depend on the future spatial population distribution and timing. Phasing will depend on growth and regulatory requirements. Additionally, Foxboro Green wastewater flows can only be accommodated if additional capacity becomes available at the New Hamburg WWTP.

6.3 Recommendations for Future Monitoring

6.3.1 New Hamburg WWTP

Inter-process monitoring: It is recommended that analyses be conducted for COD and TKN along with the routine measurements of BOD₅, VSS and TSS in raw and effluent samples. Additionally, grab samples from the hauled waste, and aerobic digester decant would assist in accurately assessing the impact of return flows on the mainstream plant process. Monitoring the quality of the water in the emergency storage lagoon will also assist in this effort.

6.3.2 Current ROW Surface Water Quality Monitoring Program

Currently, the Region carries out an extensive surface water monitoring program of the Grand, Speed, and Nith Rivers upstream and downstream of the Waterloo, Kitchener, Hespeler, Preston, Galt, Wellesley, New Hamburg, and Ayr Wastewater Treatment Plants (WWTPs).

The current monitoring program carried out by the Region includes surface water quality sampling and analysis, benthic macroinvertebrate and fisheries assessments, and longitudinal river surveys of dissolved oxygen and specific conductivity. Water quality samples are collected on the Nith River upstream and two downstream locations of the New Hamburg WWTP discharge six (6) times per season, for a total of twenty-four (24) times per year.

The surface water samples collected at each stations are a composite of grab samples taken from the right bank, center, and left bank of the Nith River. The composite samples are analyzed for biochemical oxygen demand (BOD), total suspended solids (TSS), total Kjeldahl nitrogen (TKN), total ammonia

nitrogen (TAN), nitrate, nitrite, total phosphorus (TP), orthophosphate, and chlorides. In addition, *in situ* water quality measurements of pH, conductivity, temperature and dissolved oxygen are collected at each station.

Benthic macroinvertebrate and fish studies were carried out on the Nith River in 2009, and will be carried out again in 2012. As part of the benthic macroinvertebrate study, one station upstream of the WWTP discharge location and two downstream stations were established. Surficial sediment quality monitoring was also carried out.

7. References

AECOM, 2009. “Region of Waterloo, Digester Upgrade Assessment, Technical Memorandum”. February 2009.

AECOM, 2011. “Baden – New Hamburg Water and Wastewater Master Plan Update – Technical Memorandum 1 – Tasks 1, 2, and 3 (Final)”. January 2011.

Allaway, Chris, January 2003, Phosphorus Loading Algorithms for the South Nation River, South Nation River Conservation Authority.

Burnside, 2009. “2008 Annual Monitoring Report – Wilmot Centre Monitoring Program – Region of Waterloo – Wilmot Centre.” March 2009.

Conservation Ontario, May 2003, Watershed Economic Incentives Through Phosphorus Trading and Water Quality.

Cooke, Sandra, March 2006, Water Quality in the Grand River: A Summary of Current Conditions (2000-2004) and Long Term Trends, Grand River Conservation Authority

CRA, 2009. Conestoga-Rovers & Associates (CRA). “Sanitary Sewer Inflow/Infiltration Study – Baden and New Hamburg - Volume 1 of 2 and Volume 2 of 2”. February 2009.

D. W. Draper Associates, Donald G. Weatherbe Associates, Review of Surface Water Quality Protection Measures, for Region of Waterloo, July 25, 1995

Earth Tech. “Wastewater Treatment Master Plan – Final Report”. Prepared for the Region of Waterloo. August 2007.

Greenland Engineering Group, Concord Ontario Hydrotec Software, 1997.

Hipel, K.W., and A. I. McLeod, 1994, Time Series Modelling of Water Resources and Environmental System, Elsevier, Amsterdam.

Hydromantis, 2010. “Wastewater Characterization Study – Detailed in the “New Hamburg WWTP Data and Model Calibration Summary – Draft”. January 2010.

MOE. Certificate of Approval No. 5450-57PQGT.

MOE. Certificate of Approval No. 9330-6G9K5B. November 22, 2005.

MOE. Certificate of Approval No. 8151-6MXJE3. November 3, 2006.

MOE. “Design Guidelines for Sewage Works”. PIBS 6879. 2008.

MOE. Deriving Receiving Water Based, Point-Source Effluent Requirements for Ontario Waters. Procedure B-1-5 PIBS# 3302. July 1994.

Municipal Engineers Association, 2007. “Municipal Class Environmental Assessment”. October 2000, as amended in 2007.

Ontario Ministry of the Environment, 1989 A Report on Low Flow Characteristics in Ontario,

Ontario Ministry of the Environment, 1994b, Water Management, Policies, Guidelines, Provincial Water Quality Objectives.

Paragon Engineering Ltd, 1996. "Regional Municipality of Waterloo – Baden-New Hamburg Water Supply Master Plan and Project – Class Environmental Assessment – Environmental Study Report". Volumes 1 and 2. March, 1996.

Region of Waterloo, Planning, Housing and Community Services. "Proposed Regional Official Policies Plan Amendment, Township Urban Area Expansions, Baden and New Hamburg, Township of Wilmot." Report P-04-017. File Code D16-40/TUAE. February 17, 2004.

Region of Waterloo. "Council-Adopted Regional Official Plan". June 16, 2009.

Region of Waterloo. "2007 Water and Wastewater Monitoring Report." October 2007.

Region of Waterloo. "2009 Water and Wastewater Monitoring Report." April 2009.

Sanitas Technologies, 2007, WQStat Plus User's Guide, Copyright 1998 - 2007

Stanley Associates, Paragon Engineering, 1996, "The Nith River Assimilation Study New Hamburg-Baden Wastewater Treatment Class Environmental Assessment" for Region of Waterloo.

Stanley Associates, Paragon Engineering, 1997, "New Hamburg Baden Wastewater Treatment Class Environmental Assessment – Environmental Study Report - V" for Region of Waterloo. July 1997.

Stanley Associates, Paragon Engineering, 1998, "New Hamburg Sewage Collection System Optimization Study." 1998.

Stanley Associates, Paragon Engineering, 1998. "New Hamburg – Baden Wastewater Treatment and Conveyance Infrastructure – Preliminary Design Report". 1998.

Stantec Consulting Ltd. "New Hamburg Wastewater Treatment Plant – Process Control Narrative". 2006

Stanley Associates, Paragon Engineering, 1996, "The Nith River Assimilation Study New Hamburg-Baden Wastewater Treatment Class Environmental Assessment" for Region of Waterloo.

Stantec Consulting Ltd, 1999a. "New Hamburg Wastewater Treatment Plant – Design Brief". March 1999.

Stantec Consulting Ltd, 1999b. "Morningside Wastewater Pumping Station – Design Brief". Prepared for the Regional Municipality of Waterloo. 1999.

Stantec Consulting Ltd, 2011. "Final Baseline Monitoring Report Wilmot Centre Well Field". Prepared for the Regional Municipality of Waterloo. November 2001.

Stantec Consulting Ltd., 2004a. "Baden/New Hamburg Watermain Distribution System Study – Final Report". Prepared for the Township of Wilmot. August 2004.

Stantec Consulting Ltd., 2004b. "Community of Baden – Elevated Water Storage Tower – Preliminary Design Report". Prepared for the Regional Municipality of Waterloo. August 2004.

Stantec Consulting Ltda. and Waterloo Hydrogeologic Inc., Nitrate Migration Control Feasibility Study, April 1999.

Township of Wilmot Development Services. "Township of Wilmot Official Plan". November 2006 Consolidation.

Tukey, J.W., 1977. Exploratory Data Analysis, Addison-Wesley, Reading, Massachusetts.

Region of Waterloo

**Baden and New Hamburg Water and
Wastewater Master Plan Update -
Master Plan Report (Final)
Volume 3: Water**

Prepared by:

AECOM Canada Ltd.

50 Sportsworld Crossing Road, Suite 290

Kitchener, ON, Canada N2P 0A4

www.aecom.com

519.650.5313 tel

519.650.3424 fax

Project Number:

105507/60116643

Date:

June 16, 2011

Statement of Qualifications and Limitations

The attached Report (the “Report”) has been prepared by AECOM Canada Ltd. (“Consultant”) for the benefit of the client (“Client”) in accordance with the agreement between Consultant and Client, including the scope of work detailed therein (the “Agreement”).

The information, data, recommendations and conclusions contained in the Report (collectively, the “Information”):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the “Limitations”)
- represents Consultant’s professional judgement in light of the Limitations and industry standards for the preparation of similar reports
- may be based on information provided to Consultant which has not been independently verified
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued
- must be read as a whole and sections thereof should not be read out of such context
- was prepared for the specific purposes described in the Report and the Agreement
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time

Consultant shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information. Consultant accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

Consultant agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but Consultant makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

The Report is to be treated as confidential and may not be used or relied upon by third parties, except:

- as agreed in writing by Consultant and Client
- as required by law
- for use by governmental reviewing agencies

Consultant accepts no responsibility, and denies any liability whatsoever, to parties other than Client who may obtain access to the Report or the Information for any injury, loss or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report or any of the Information (“improper use of the Report”), except to the extent those parties have obtained the prior written consent of Consultant to use and rely upon the Report and the Information. Any damages arising from improper use of the Report or parts thereof shall be borne by the party making such use.

This Statement of Qualifications and Limitations is attached to and forms part of the Report and any use of the Report is subject to the terms hereof.

Table of Contents

Statement of Qualifications and Limitations

	page
1 Introduction and Background	1
1.1 EA and Related Preparatory Work	1
1.1.1 Master Plan Purpose and Approach	1
1.1.2 Purpose Statement.....	4
1.1.3 Master Planning Approach	6
1.1.4 Steering Committee.....	6
1.1.5 Stakeholder Contact List	7
1.1.6 Notice of Commencement	7
1.1.7 Public Information Centre	8
1.2 Previous Studies/Reports.....	8
1.2.1 Baden – New Hamburg Water Supply Master Plan and Update (May 1996)	8
1.2.2 New Hamburg Water Treatment Plant Upgrades – Operation and Maintenance Manual (November 1999).....	10
1.2.3 Baseline Monitoring Report – Wilmot Centre Well Field (2001)	10
1.2.4 Baden/New Hamburg Watermain Distribution System Study (August 2004).....	11
1.2.5 Community of Baden Elevated Water Storage Tower – Preliminary Design Report (August 2004)	11
1.2.6 Wilmot Industrial Trunk Watermain – Final Report (September 2005) and Environmental Assessment File (April 2007).....	11
1.2.7 Condition Assessment and Region of Waterloo Water Supply Facilities Replacement Update Project (2007)	12
1.2.8 Water and Wastewater Monitoring Report (April 2009).....	13
1.2.9 2008 Annual Report for the Wilmot Centre Monitoring Program (2009)	13
1.3 Study Area Background	14
1.3.1 Natural Environment.....	14
1.3.2 Socio-Economic Environment.....	20
1.3.3 Existing Conditions.....	24
1.4 Population Projection and Water Demand Forecast	39
1.4.1 Population Projections.....	39
1.4.2 Historical Water Consumption	43
1.4.3 Current Water Consumption	45
1.4.4 Significant Water Users	48
1.4.5 Water Demand Forecast	48
2 Opportunities and Constraints of Existing System	50
2.1 Water Supply	50
2.2 Water Treatment.....	51
2.3 Water Storage	52
2.4 Water Distribution	56
3 Development of Water Alternatives	59
3.1 Water Supply Alternative Solutions	59
3.1.1 Alternative W-1: Do Nothing	59
3.1.2 Alternative W-2: Limit Community Growth.....	60

3.1.3	Alternative W-3: Water Conservation.....	60
3.1.4	Alternative W-4: Modify/Expand Operational and Maintenance Practices.....	60
3.1.5	Alternative W-5: Expand/Upgrade Existing Groundwater Supplies	61
3.1.6	Alternative W-6: New Groundwater Supplies	61
3.1.7	Screening of Water Supply Alternative.....	61
3.2	Strategic Water Supply Options	63
3.2.1	Option WS-1: Wilmot Centre Wells (K50 and K51) plus Well NH3.....	63
3.2.2	Option WS-2: Wilmot Centre Wells (K50 and K51) plus Well NH3 plus Baden Wells	65
3.2.3	Option WS-3: Wilmot Centre Wells (K50 and K51) plus Well NH3 and new Well NH4	66
3.2.4	Option WS-4: Wilmot Centre Wells (K50 and K51) plus Well NH3 and new Wilmot Centre well (K52)	67
3.2.5	Option WS-5: Wilmot Centre Wells K50 and K51 (at reduced yield) plus Well NH3 plus Baden wells plus Well NH4	67
3.2.6	Water Supply Options Estimated Conceptual Life Cycle	69
3.2.7	Summary of Water Supply Options Advantages and Disadvantages.....	71
3.2.8	Further Investigation.....	71
3.3	Water Treatment Alternatives.....	72
3.3.1	Baden Wells.....	72
3.3.2	New NH4 Well.....	74
3.3.3	Summary of Water Treatment Options Advantages and Disadvantages.....	76
3.4	Water Storage Alternatives	77
3.5	Water Distribution Needs	81
3.5.1	High Pressure Areas	81
4	Evaluation Criteria and Approach.....	85
4.1	Class EA Master Plan Process and Evaluation Framework	85
4.2	Public Consultation	85
4.3	Use of Descriptive Information and Qualitative Evaluation	86
4.4	Evaluation Criteria and Methodology.....	86
4.5	Evaluation of Strategic Water Supply Options	89
4.6	Evaluation of Water Treatment.....	93
4.7	Evaluation of Water Distribution	93
4.8	Evaluation of Water Storage	96
4.8.1	Do Nothing Option.....	96
4.8.2	Option S-1: Expand New Hamburg Water Treatment Plant (NHWTP) Reservoir	96
4.8.3	Option S-2: New Storage at the Baden Wells.....	97
4.8.4	Option S-3: New Storage in a New Location	97
4.8.5	Option S-4: Combination of Above.....	98
5	Water System Recommendations.....	99
5.1	Water Supply and Treatment	99
5.2	Water Distribution	103
5.3	Water Storage	103
5.4	Summary	103
5.5	Recommendations for Future Monitoring and/or Further Hydrogeological Investigation	105
5.5.1	Wilmot Centre Wells (K50 and K51 well).....	105
5.5.2	Baden Wellfield	105
5.5.3	New Hamburg Wellfield	105
6	References	106

List of Figures

Figure 1-1: Study Area.....	2
Figure 1-2: Class Environmental Assessment Master Plan Approach	3
Figure 1-3: Environmentally Sensitive Areas	17
Figure 1-4: Source Water Protection Areas	18
Figure 1-5: Mineral Aggregate Resource Areas.....	19
Figure 1-6: Changes to Planning Designations in New Hamburg.....	22
Figure 1-7: Changes to Planning Designations in Baden	23
Figure 1-8: Historical pumping records from Regional Wells K50s.....	26
Figure 1-9: Baden/New Hamburg Existing Wells Location	28
Figure 1-10: B/NH Wells Manganese Concentrations.....	32
Figure 1-11: B/NH Wells Water Quality	33
Figure 1-12: NHWTP Site Aerial View.....	35
Figure 1-13: NHWTP Filter Photo.....	35
Figure 1-14: Baden/NH Water Storage Facilities Location	37
Figure 1-15: Existing and Proposed Water Mains.....	38
Figure 1-16: Population Growth Areas.....	40
Figure 1-17: Low Population Growth Scenario.....	42
Figure 1-18: High Population Growth Scenario.....	42
Figure 1-19: Historic Water Demands	44
Figure 1-20: Average Day Demand per Capita.....	44
Figure 1-21: Diurnal Demand Pattern for Baden-New Hamburg Water System used for Calibration.....	46
Figure 1-22: Demand Patterns	47
Figure 1-23: Water Demands by Sector (2007)	47
Figure 2-1: Demand vs. Supply Curve.....	50
Figure 2-2: New Hamburg 2041 (High) Fire Flows.....	57
Figure 2-3: Baden 2041 (High) Fire Flows	58
Figure 3-1: Wilmot Centre Wellfield Site	68
Figure 3-2: Baden Wells Water Treatment Options.....	73
Figure 3-3: New NH4 Well Water Treatment Options.....	75
Figure 3-4: Storage Options Locations	79
Figure 3-5: Reservoir Expansion at NHWTP Site.....	80
Figure 3-6: New Hamburg High Pressure Area - Option NHD-1 (Central PRVs)	82
Figure 3-7: New Hamburg High Pressure Area - Option NHD-2 (Residential PRVs)	82
Figure 3-8: Water Distribution Water Mains (Existing and Proposed)	84
Figure 5-1: Projected Water Supply Planning Phases (Preferred Option).....	101
Figure 5-2: Projected Water Supply Planning Phases (Contingent Option)	102
Figure 5-3: Existing and Proposed Water Infrastructure.....	104

List of Tables

Table 1-1: Steering Committee Members	6
Table 1-2: Water Supply Master Plan (1996) and Status Update	8
Table 1-3: Watermain Distribution Study Recommendations (2004)	11
Table 1-4: Areas Added to Baden and New Hamburg Urban Development since 1997	21
Table 1-5: Wells Summary	34
Table 1-6: Existing Storage Capacity	36
Table 1-7: Population Forecasts	40
Table 1-8: Population Forecasts for Serviced Urban Areas	41
Table 1-9: Baden / New Hamburg Population Serviced Growth Scenarios	41
Table 1-10: Historical Water Consumption	43
Table 1-11: Baden/New Hamburg Water System Consumption and Pumping Summary in 2007	45
Table 1-12: 2007 Water Consumption Data by Sector	46
Table 1-13: High and Special Water Users	48
Table 1-14: Summary of historical water demand on a per capita basis	49
Table 1-15: Projected Water Demands for Low and High Population Scenarios	49
Table 2-1: Water Quality and ODWS Requirements	51
Table 2-2: System-wide Calculation of Available Storage for the year 2008 (Current Condition)	53
Table 2-3: Calculation of Available Storage for the year 2016	53
Table 2-4: Calculation of Available Storage for the year 2021	54
Table 2-5: Calculation of Available Storage for the year 2029	54
Table 2-6: Calculation of Available Storage for the year 2041 (Low)	54
Table 2-7: Calculation of Available Storage for the year 2041 (High)	55
Table 2-8: Summary of Storage Analysis	55
Table 3-1: Screening of Water Supply Alternative Solutions	62
Table 3-2: Water Supply Strategic Options	64
Table 3-3: Water Supply Strategic Options Conceptual Life Cycle Cost (20 years)	70
Table 3-4: Water Supply Strategic Options Advantages vs. Disadvantages	71
Table 3-5: Treatment Options Advantages vs. Disadvantages	76
Table 3-6: Storage Requirements	77
Table 3-7: Water Storage Advantages vs. Disadvantages	78
Table 3-8: High Pressure Solution Options Advantages vs. Disadvantages	83
Table 4-1: Evaluation Components	87
Table 4-2: Evaluation Criteria for Water Alternatives	87
Table 4-3: Evaluation of Water Supply Strategic Options	94
Table 4-4: Evaluation of Storage Options	95

1 Introduction and Background

The communities of Baden and New Hamburg (Baden/NH) are situated within the Township of Wilmot (the Township) in the Regional Municipality of Waterloo (the Region). The water and wastewater systems in these communities are operated as a two tier system:

- The Region is responsible for water supply, treatment storage and trunk distribution while the Township is responsible for water distribution and water service connections.
- The Region is responsible for two main raw wastewater pumping stations, treatment, discharge and biosolids management while the Township is responsible for wastewater collection and a secondary pumping station.

The Study Area, shown in **Figure 1-1**, is comprised of Baden and New Hamburg water and wastewater limits, as well as, the Foxboro Green wastewater services. Although the Foxboro Green subdivision community is not currently a part of the Baden and New Hamburg system, it is included in this Study for future consideration.

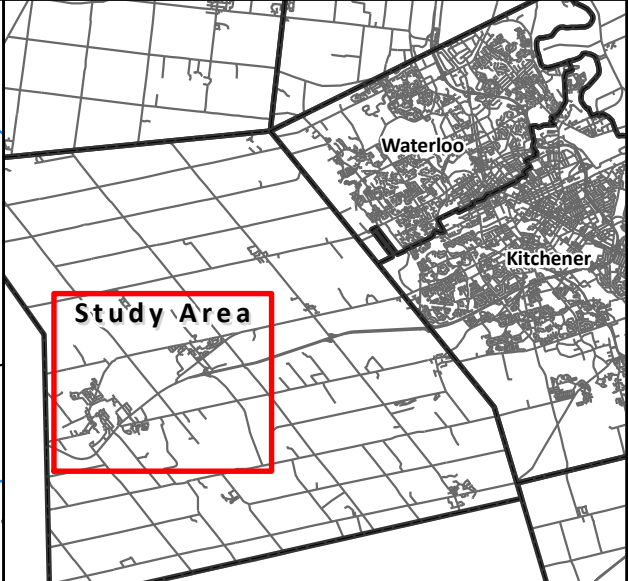
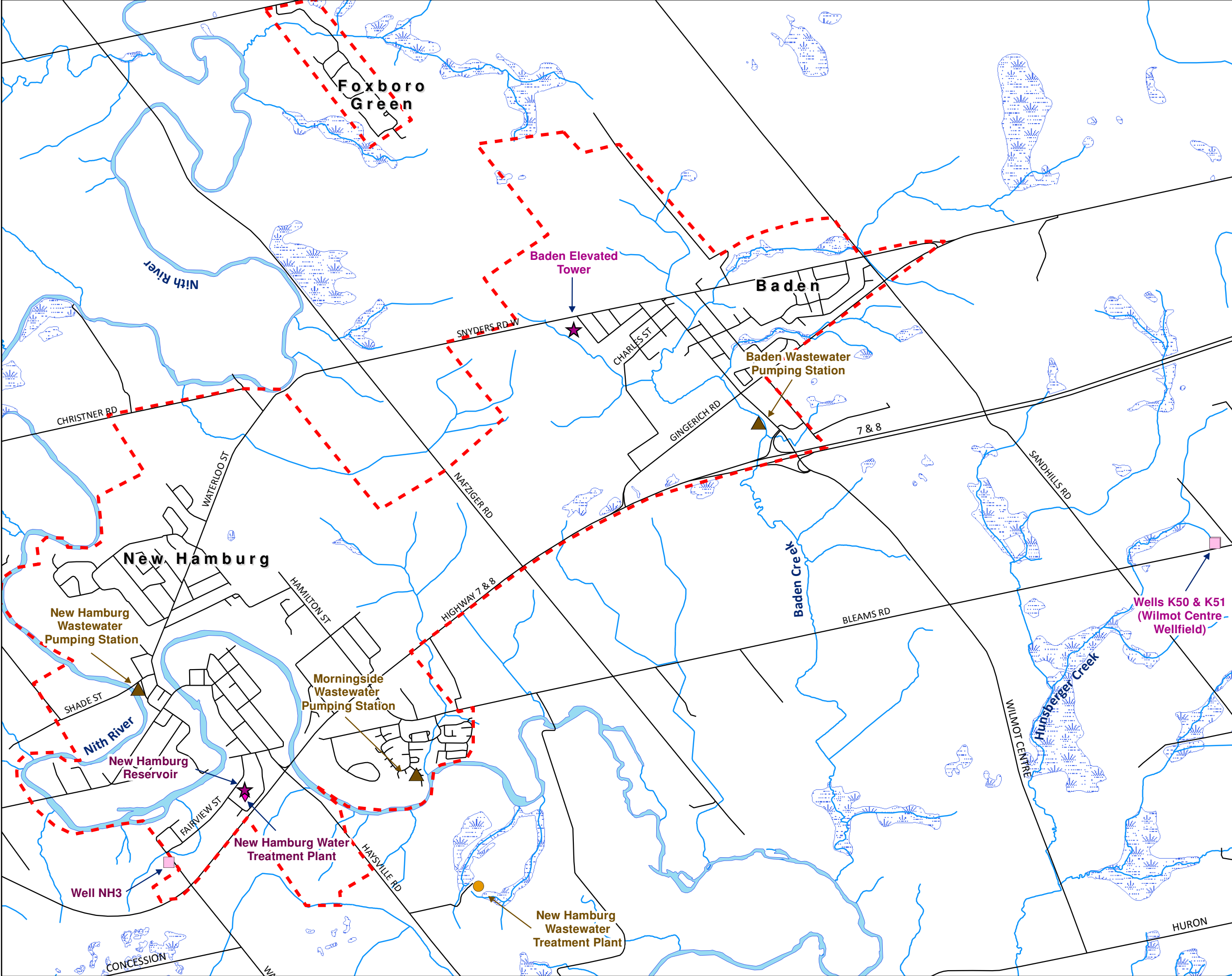
1.1 EA and Related Preparatory Work

1.1.1 Master Plan Purpose and Approach

Master Plans are long range plans which integrate infrastructure requirements for existing and future land use with environmental assessment planning principles. These plans examine an infrastructure system, or group of related projects, to outline a framework for planning for subsequent projects and/or developments. As a minimum, Master Plans should address Phases 1 and 2 of the Municipal Engineers Association (MEA) Class Environmental Assessment (Class EA) Master Plan Approach No. 1 (MEA Municipal Class EA Document, Appendix 4, October 2000 as amended in 2007). (See **Figure 1-2**)

Master planning provides a municipality with a broad framework through which the need and justification for specific projects can be established such that the environmental assessment process can be satisfied. Key features of a Master Plan include:

- Addressing the key principles of successful environmental planning.
- Addressing at least the first two phases of the Municipal Class EA to the extent possible.
- Allowing for an integrated process with other planning initiatives.
- Providing a strategic level assessment of various options to better address overall system needs and potential impacts and mitigation.
- Short and long-term planning.
- Taking a system wide approach to planning which relates infrastructure either geographically, or by function.
- Recommending an infrastructure master plan which can be implemented through separate projects.
- A description of specific projects (location, phased implementation plan, EA schedules and requirements).



Legend

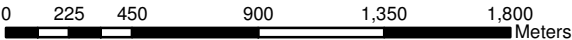
- Wastewater Treatment Plant
- ▲ Wastewater Pumping Station
- Water Wells
- ★ Reservoir & Elevated Water Tower
- ◆ Water Treatment Plant
- Roads
- Rivers
- Nith River
- Wetlands
- - - Study Area

Baden - New Hamburg Water & Wastewater Master Plan Update

Figure 1-1: Study Area

Datum: NAD 83, Zone 17
Source: Region of Waterloo

June 2011



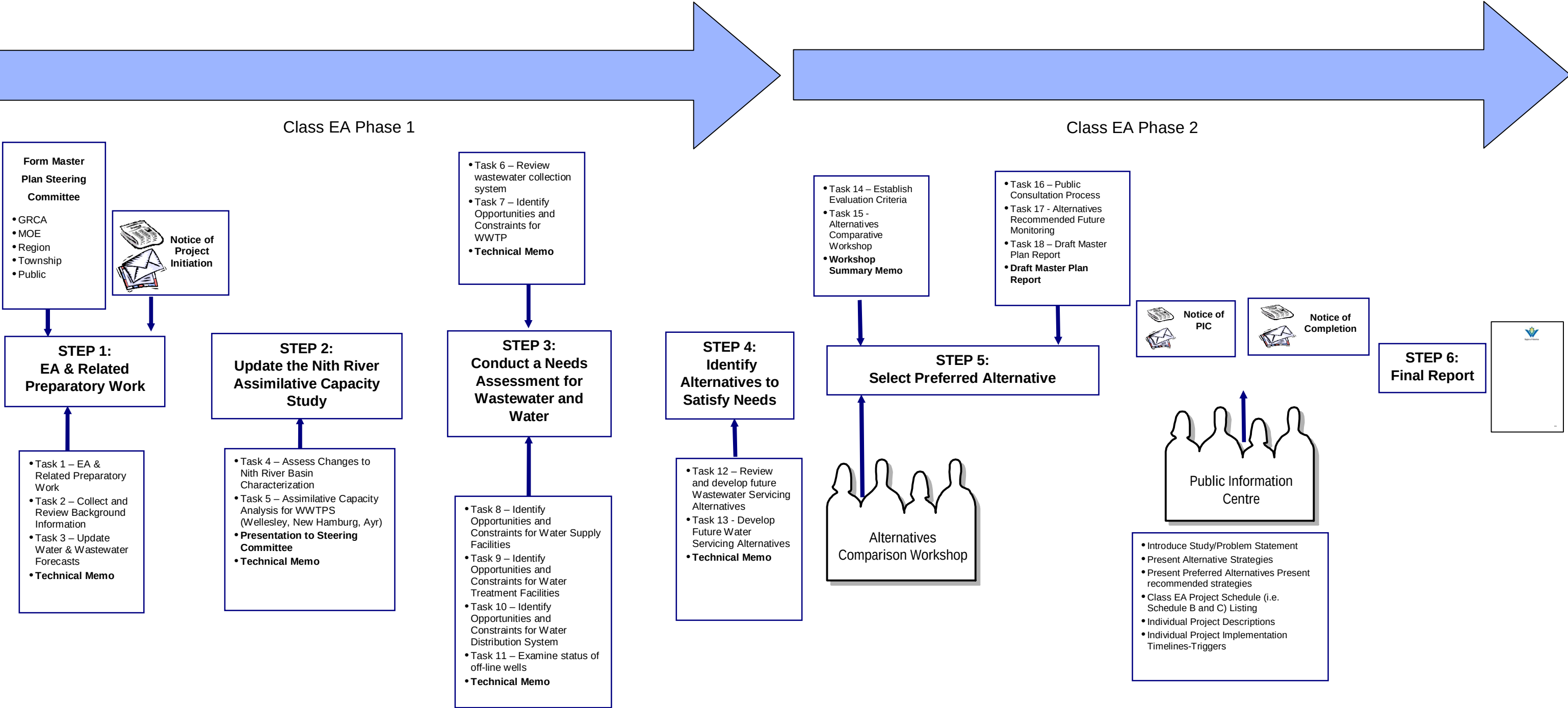


Figure 1-2: Class Environmental Assessment Master Plan Approach

Examples of Master Plans include: wastewater and water plans for entire or major portions of a municipality; wastewater treatment plans and water supply plans for a community or municipality; watershed/ subwatershed plans; transportation master plans; and infrastructure master plans.

The Baden – New Hamburg Water and Wastewater Master Plan update has addressed all requirements of Phases 1 and 2 of a 'Schedule C' process as prescribed by the Class EA for Municipal Water and Wastewater Projects. The Master Plan document will be made available for public comment. The Master Plan update is completed at a broad range level of assessment, requiring more detailed investigations at the project-specific level to fulfill Municipal Class EA documentation requirements for any specific Schedule B or C projects identified within the Master Plan. The Master Plan will therefore become the basis for, and be used in support of, future investigations for any specific Schedule B and C projects identified within.

Schedule B projects will require the completion of Phase 2 for those aspects specific to a particular project, and filing of the Project file for public review. Schedule C projects will have to complete Phase 2 as above, and fulfill Phases 3 and 4 of the process prior to filing an Environmental Study Report for public review.

The Water/Wastewater Master Plan should also be reviewed at a minimum frequency of every ten years (September 2007 Class EA amendment), to determine the need for a detailed formal review and/ or updating. Potential changes which may trigger the need for a detailed review include:

- major changes to original assumptions;
- major changes to components of the Master Plan;
- significant new environmental effects;
- major changes in the proposed timing and/or scope of projects recommended within the Master Plan.

1.1.2 Purpose Statement

Phase 1 of the Class EA planning process requires the proponent of an undertaking to first document factors leading to the conclusion that the improvement or change is needed, and ultimately, develop a clear statement of the identified problems, deficiencies or opportunities to be investigated. As such, the Purpose Statement is the principle starting point in the undertaking of a Class EA study and becomes the central theme and integrating element of the project. It also assists in setting the scope of the project.

In developing the Purpose Statement for the Baden – New Hamburg Water and Wastewater Master Plan, the following was considered:

- The Region of Waterloo and Township of Wilmot have the mandate to provide water/wastewater services in a safe, efficient and cost effective manner to meet the demands of the customers it serves. Customers include the residential, industrial, commercial and institutional (ICI) sectors.
- The Regional Official Plan and the Township of Wilmot Official Plan outline the future growth for Wilmot Township and for Baden – New Hamburg respectively.
- According to the Region of Waterloo's 2008 Water and Wastewater Monitoring Report, the communities have water supply capacity well beyond the anticipated demand in 2016. However, with

the projected growth anticipated to 2016, the wastewater flows will be at or approaching the hydraulic design capacity of the New Hamburg WWTP.

- The 2007 Wastewater Treatment Master Plan outlined receiving water status for various parameters of concern, including total phosphorus as Policy 2, to be addressed through an updated assimilative capacity analysis for any re-rating or expansion of the existing wastewater treatment plant. Recognition is given to the possibility that future growth opportunities are impacted by the ability of the Nith River to assimilate treated effluent from the wastewater treatment facility.
- Consideration is to be given to recognition of historical and continued non-point source control for phosphorus in support of plans for expansion of the WWTP with Best Available Technology – Economically Achievable (BAT-EA).
- Increase in water supply from the Wilmot wellfield (K50/51) is subject to the Wilmot Water Taking Policy, a long standing agreement requiring on-going monitoring and review and consultation with the Public Liaison Committee, prior to implementation.
- Consideration is to be given to initiatives for water conservation and enhanced efficiency, education programs and reduced outside water use,
- Consideration is to be given to initiatives to implement reduction in high inflow and infiltration (I&I) rates currently experienced.
- Opportunities for review agency and public consultation are to be considered for study alternatives and recommendations.

Based on the above conditions and incorporating the concerns of public comments, agency and municipality input, the Purpose Statement is defined as follows:

“The goal of this Master Plan Study is to update previous Master Plan and Class EA studies with recent works, revised population projections and policies, and changes in the environment. It will identify strategies that will optimize existing systems and increase capacities of the existing water supply/treatment/distribution/storage and wastewater conveyance/pumping/treatment systems to provide servicing into the future. The strategies are to ensure that:

- *an adequate amount of water can be provided in a safe, reliable and cost-effective manner to satisfy current and long-term requirements;*
- *wastewater can be conveyed and treated in a safe, reliable and cost-effective manner to satisfy current and long-term requirements, with consideration for the receiving water’s assimilative capacity.*

The study will have regard for established sustainability and environmental planning principles that properly consider potential impacts to sensitive land uses such as the natural environment and agriculture. Furthermore, the study will define and factor in the role of water conservation/efficiency including decrease of water losses, inflow/infiltration reduction measures, and innovative strategies which can extend the life of existing infrastructure along with future systems.”

1.1.3 Master Planning Approach

The Master Plan approach is based on the requirements outlined in the Region's Request for Proposal (RFP) dated April 2008, a review of the background information outlined above for the project; and the Class EA Master Planning process; and on past Regional projects including the Wastewater Treatment Master Plan (2007) and the Baden – New Hamburg Water Supply Master Plan. Key aspects include:

- Problem Statement preparation;
- Public consultation;
- Confirming projected populations/demands;
- Evaluating existing water and wastewater system capacity and receiving water assimilative capacity;
- Identifying alternative water/wastewater solutions;
- Developing evaluation criteria and a process for alternative comparison/assessment;
- Incorporating public feedback;
- Evaluating alternatives;
- Preparation of a draft implementation plan; and
- Final reporting.

1.1.4 Steering Committee

In addition to the public consultation process planned for this study, it was determined that it would be most beneficial to involve the Township and surrounding communities, as well as key government review agencies to provide input into the project. The intent is for the Steering Committee to provide input and advice to the Project Team in the direction of the project at key stages. Membership of the Steering Committee is provided in **Table 1-1**.

Table 1-1: Steering Committee Members

Member	Association
Sandra Cooke	Grand River Conservation Authority
Barbara Slattery	MOE
Paul Odom	MOE
Grant Whittington	Township of Wilmot
Peter Roe	Township of Wilmot
Les Armstrong	Township of Wilmot
Gary Charbonneau	Township of Wilmot
Kaoru Yajima	Region of Waterloo
Jorge Cavalcante	Region of Waterloo

Member	Association
Khalid Mehmood	Region of Waterloo
Kevin Curtis	Region of Waterloo
Olga Vrentzos	Region of Waterloo
Margaret Parkin	Region of Waterloo
Eric Hodgins	Region of Waterloo
Jerry Borovicka	Region of Waterloo
Nancy Kodousek	Region of Waterloo
Thomas Schmidt	Region of Waterloo
Rachel Vaillancourt	Region of Waterloo

The first Steering Committee meeting was held on October 10, 2008 to introduce all to the project and its objectives, including an overview of background studies and previous Class EA projects related to water and wastewater in the communities of Baden and New Hamburg. The project team gave details on the scope of the project highlighting potential issues for community growth. Lastly, the Notice of Study Commencement was issued to the Steering Committee for review.

The second Steering Committee meeting was held on June 15, 2009 to review the population projections, the water distribution modeling, Nith River Assimilative Capacity, and the New Hamburg WWTP Process modeling.

The third Steering Committee meeting was held on November 20, 2010 to present the alternative solutions and the Public Information Centre (PIC) boards (PIC held on December 2, 2010).

1.1.5 Stakeholder Contact List

The stakeholder contact list was developed by including all those contacts confirmed through the recent (2007) Regional Wastewater Treatment Master Plan. Additional groups or individuals were added who were identified as potential stakeholders or who expressed interest in previous studies, through consultation with the Township. This list was updated throughout the project with requests from the public and through identification of agencies or special interest groups that could be impacted or have interest in specific servicing alternatives. The latest contact list as of December 16, 2010 is provided in **Volume 4 Appendix A**.

In addition, all correspondence is documented and responses tracked in accordance with the EA process.

1.1.6 Notice of Commencement

The Notice of Commencement was published in the Kitchener - Waterloo Record as well as the New Hamburg Independent. Copy of the Notice is provided in **Volume 4: Appendix A**.

1.1.7 Public Information Centre

The Notice of Public Information Centre (PIC) was published in the local newspapers the week of November 15 and 22, 2010. Copy of the notice of PIC and boards are provided in **Volume 4: Appendix F**. Identified agencies and members of the public who had expressed an interest in this Master Plan were notified by individual mailings.

The PIC was held on December 2, 2010 at the Township Office, from 4:30 to 7:30 pm. Boards were presented consisting of maps, drawings, text and flow charts documenting existing conditions and a preliminary evaluation of alternatives Strategic Supply Options, treatment, distribution and storage. The PIC had 10 people signing the attendance register. Those attending the PIC were encouraged to complete a comment sheet providing their feedback on the alternatives. Members of the Project Team, including the Region of Waterloo, the Township of Wilmot and the Consultant Team were in attendance to answer questions. Comments are summarized in **Section 4.2** and copies of the comments are included in **Volume 4: Appendix F**.

1.2 Previous Studies/Reports

There has been an array of studies, reports, and projects undertaken and completed on the Baden and New Hamburg Water Supply System. A summary of these studies is presented in this section. Information pertinent to historical and existing condition is included in **Section 1.3.3**.

1.2.1 Baden – New Hamburg Water Supply Master Plan and Update (May 1996)

The Baden-New Hamburg Water Supply Master Plan (WSMP) was completed as a Schedule C Class Environmental Assessment (Paragon, 1996). Historical water demands were reviewed to develop future demand forecasts and storage requirements. This study examined the status of source, treatment, storage and trunk distribution of water to identify the preferred alternative up to 2016 and 2041. Many of the components in the preferred alternative have been implemented by the Region through subsequent study and construction. The WSMP recommendations and their updated status are provided in **Table 1-2**.

Table 1-2: Water Supply Master Plan (1996) and Status Update

Related Area	Recommended	Status Update
Supply	Maintain existing Wells K50/K51 in the Wilmot Centre Well Field and construct a new standby well for redundancy	Wells K50 and K51 continue to operate; no standby well constructed to date
	Construct additional wells in the Wilmot Centre Well Field in accordance with the long term monitoring program	Not completed. Depending on long term monitoring program results.
	Maintain existing Wells B1/B2 or alternative purge wells within the Baden Aquifer to prevent the migration of nitrates to the Wilmot Centre Well Field and ultimately effect a clean-up of the Baden Aquifer. Discharge from the purge well system should be to an environmentally	Wells B1 and B2 no longer in operation

Related Area	Recommended	Status Update
	safe location that may include the existing watercourse and/or a constructed wetland	
	Maintain existing Well NH3 in the deep aquifer south of New Hamburg and interconnect potential future wells in the deep aquifer south of New Hamburg, should a reduction in pumping rate of NH3 be required to address long term water quality issues	Well NH3 in operation; no additional wells to date
	Implement Water conservation measures	Regional program implemented
	Develop a comprehensive long term monitoring program for the Wilmot Centre Well Field	Long term monitoring is ongoing
Storage	Replacement of the water storage standpipe in Baden with a new elevated storage tank to provide fire flows and to solve pressure deficiencies	New 5.4 ML elevated storage tank in Baden was constructed in 2007.
	New Elevated Storage Facility in New Hamburg, north of Highway 7/8 and west of Township Road 11A	Not implemented as the water demand has historically decreased, and additional storage not required yet.
Trunk Infrastructure	Construction of a 450 mm diameter trunk watermain along Regional Road 4 and Township Road 16 to interconnect the Wilmot Centre Well Field with Baden at Regional Road 6	Completed
	Reinforcement of the existing trunk system between Baden and New Hamburg through the construction of a 500 mm diameter trunk watermain from Township Road 16 along Regional Road 1, Regional Road 5, and along the future Boullee Street extension to interconnect with the existing 400 mm diameter watermain on Fairview Avenue	Partially completed in 2009 with a 450 mm water main between the Baden Tower and Nafziger Road
	Construction of a 500 mm diameter trunk watermain from the existing 400 mm diameter watermain adjacent to the New Hamburg Reservoir to interconnect with the future elevated storage facility west of Township Road 11A and north of Highway 7/8	Not completed. New elevated storage facility in New Hamburg was not built.
Local Distribution System	Upgrading of the existing watermain along Huron Street from Waterloo Street to Stone Street through the construction of a 250 mm diameter watermain	Completed with 200 mm watermain in 2008
	Upgrading of the existing watermain on Regional Road 4 (250 mm diameter) from the 400 mm diameter watermain on Fairview Avenue to the future 250 mm diameter watermain	completed
Treatment	Construction of manganese treatment facilities for wells in the Wilmot Centre Well Field, as required	Not implemented, as manganese level remained below ODWS.
	Construction of an iron treatment facility adjacent to the New Hamburg Reservoir for Well NH3 and any future wells in the deep aquifer south of Highway 7/8	NHWTP constructed in 1999

1.2.2 New Hamburg Water Treatment Plant Upgrades – Operation and Maintenance Manual (November 1999)

This manual describes the New Hamburg Water Treatment Plant, and provides the design parameters, including the major components, an overall site plan, and a process and instrumentation diagram. It also provides detailed information on the operation, control, and maintenance of each component (Stantec, 1999).

1.2.3 Baseline Monitoring Report – Wilmot Centre Well Field (2001)

The 1996 WSMP recommended that the rate of pumping from the Wilmot Centre well field be pumped at rates comparable to 1978 between 1998 and 2000 in order to allow for collection of baseline monitoring data. Provided no significant environmental impacts were identified, the pumping rate was to be gradually increased from 87 to 142 L/s. The 1996 WSMP suggested that if significant impacts were identified, mitigation measures or reduced pumping could be considered.

To support the increased taking from the Wilmot Centre well field, a detailed long term monitoring program was developed in conjunction with key stakeholders in the area (e.g., the Wilmot Public Liaison Committee, PLC) (Stantec, 2001). The monitoring program comprised of the following three stages:

- Stage 1: Design of Baseline Monitoring Program and Instrumentation (1997);
- Stage 2: Installation of Monitoring Instrumentation (August 1998);
- Stage 3a: Baseline Monitoring Program Implementation (August 1998 to July 2000); and
- Stage 3b: Long Term Monitoring Program Implementation (July 2000 to present)

At the conclusion of Stage 3a, Stantec (2001) recommended the Long Term Monitoring Program (Stage 3b). Stage 3b consists of increasing pumping from the Wilmot Centre well field using a 3-step approach implementation, each step encompassing five years until the horizon period is reached in 2016. During each time-step, the average pumping rate will be increased from the existing 87 L/s to 105 L/s, to 124 L/s and finally to 142 L/s. This would allow for approximately 5 years of monitoring at each pumping rate. However, pumping rates have not increased and continued to decline to the end of 2008. The 3-step pumping has not been implemented due to the ability of well NH3 to meet the supply needs of Baden/NH. The Region's water operations group have also minimized the use of the K50s to Baden/New Hamburg due to the effects of mixing the different disinfection residuals used at each source. However, recently (December 2009) the use of ammonia at the NH WTP was discontinued such that all potable water in the distribution system has a free chlorine residual.

During the baseline period from 1998 to 2000, wells K50 and K51 were pumped at a combined annual average rate of 87 L/s (1978 policy) and groundwater and surface water showed natural level variations (e.g. Hunsberger Creek) levels. Accordingly a recommendation to increase the pumping rate to 105 L/s from 2001 to 2006 was made to Regional Council. However, recent pumping rates from the Wilmot Centre wells have been less than the 1978 average annual rate and therefore, does not allow for assessment of proposed increase in water taking.

1.2.4 Baden/New Hamburg Watermain Distribution System Study (August 2004)

This report comprises a complete review and analysis of the Baden/New Hamburg watermain distribution system, including recommendations for system improvements and capital planning (Stantec, 2004). The recommended new watermains are provided in **Table 1-3**. The Township has completed some of the works and the remainder are included in the 10-year capital program. These new water mains are included in the updated water distribution model.

Table 1-3: Watermain Distribution Study Recommendations (2004)

Recommended	Status Update
250 mm on Forrest Avenue, from East of Hincks St to East of William St (290 m)	Completed in 2005
150 mm on William Street, from Forrest Avenue to Blowoff (120 m)	Not completed
150 mm on Conestoga Road, from Forrest Avenue to Blowoff (60 m)	Completed in 2005
150 mm on Old Haysville Road, from end to end (40 m)	250 mm completed in 2002
150 mm on Milton/Byron, from Milton End x2 to Byron end (120 m)	Not completed
150 mm on Hannah, from end to Milton St (40 m)	Not completed
150 mm on Astor Crescent, from Forrest Avenue to Valve V-126 (60 m)	Completed in 2005
150 mm on Burns Street, from Union St End to Burns St End (60 m)	200 mm completed in 2006
150 mm on Church Street, from end to Peel Street (15 m)	Not completed

In addition to the new pipes listed above, an additional transmission main between Baden and New Hamburg was recommended in the future as development proceeds, as well as replacement of several pipes due to condition assessment (age, size, history of breaks, etc).

1.2.5 Community of Baden Elevated Water Storage Tower – Preliminary Design Report (August 2004)

This document identifies all design parameters for the Baden Elevated Water Storage Tower, provides site layout, type of construction, describes the tower operation, and summarizes all tower accessories. Modeling and geotechnical investigation are provided as well (Stantec, 2004A).

1.2.6 Wilmot Industrial Trunk Watermain – Final Report (September 2005) and Environmental Assessment File (April 2007)

The Final Report recommended the preferred alternative for the new trunk watermain to service lands between Baden and New Hamburg, including the water use demand projections, alternative watermain

routes, modeling and evaluation of the alternatives (R.V. Anderson, 2005). The construction of this watermain had three phases. Phase 1 of the Wilmot Industrial Trunk main was completed in 2008 consisting of the section on Gingerich Rd, west of the Baden Creek crossing, between the Foundry St and Nafziger Road. Phase 2 was completed in 2009, connecting the Baden water tower and Gingerich Rd. Phase 3 will be completed when the proposed industrial lands west of Nafziger Rd are developed. In order to comply with the Schedule B Class EA requirements, a project file was prepared summarizing the public consultation feedback regarding the two creek crossings within Phase 2 of this project (R.V. Anderson, 2007).

1.2.7 Condition Assessment and Region of Waterloo Water Supply Facilities Replacement Update Project (2007)

The Region provided a summary of the condition assessment of the major water facilities within the study area completed in 2007 by AECOM (former KMK). Detailed equipment information is provided on these condition assessments.

- New Hamburg Well NH3 (July 11, 2007): the process piping was reported to be in poor condition. Well pumps, chlorine pumps, and electrical panel were reported to be in good condition. The assessment also reported that the ventilation direction needs to be reversed to exhaust the chlorine instead of pulling the chlorine air across the room.
- New Hamburg Water Treatment Plant (July 11, 2007): the process piping was reported as in fair condition with some surface rusting. Most equipment was in good condition during the condition assessment. Backflow preventers are required on the in-house service potable water piping. The ammonium sulphate containment tank requires secondary containment.
- Well K-50 (May 17, 2007): most equipment and structure was in good condition during the condition assessment. The west wall at floor level was in fair condition. Electric heaters are old and will require replacement. The study noted a missing bird screen on the exhaust fan. There are issues with the roof exhaust and exhaust piping, as well as, with the indoor fuel capacity and vent connections.
- Well K-51 (May 17, 2007): most equipment and structure was in good condition during the condition assessment. The well, structure walls, foundation, and in ground concrete valve chamber south of pump house were reported in fair condition.

The following facilities were not inspected as part of this review:

- Baden Elevated Tank – this facility is new having been commissioned in July 2008; during the construction maintenance period, some deficiencies which require taking the tank off-line to correct.
- New Hamburg Reservoir
- Baden Wells

The Region of Waterloo Water Supply Facilities Replacement Update Project provides projection of the upgrades or replacements requirements for the water supply system within the Region up to the year 2030. A summary of the dollar value estimated for every 10 years is presented as follows:

Facility	2008-2010	2011-2020	2021-2030
New Hamburg (WTP and NH3)	\$ 0	\$ 1,261,800	\$ 1,330,100
K50	\$ 450,000	\$ 574,700	\$ 427,500
K51	\$ 550,000	\$ 540,200	\$ 177,500

1.2.8 Water and Wastewater Monitoring Report (April 2009)

This report documents the actual water use and provides a basis for water use forecasts. It also summarizes the water production capacity within the Region (Region, 2009) and is updated annually. Data from this report is presented in **Section 1.4**.

1.2.9 2008 Annual Report for the Wilmot Centre Monitoring Program (2009)

The 2008 Annual Report for the Wilmot Centre Monitoring Program (WCMP) provides a summary of the monitoring results until the end of 2008. Since no increases in pumping have occurred, all data collected to date is considered to represent an extension of the baseline conditions (Burnside, 2009).

The original intent of the monitoring program was to identify potential environmental impacts from staged increases of the Wilmot Centre well field pumping rate from 87 to 142 L/s between 2000 and 2005. While the combined pumping rate was increased to approximately 150 L/s for extended periods of time prior to July 2003 (e.g. approximately 1 month period), the average-annual daily pumping rate ranged from 78.0 L/s (2008) to 100.8 L/s (2001). It is noted that the combined pumping rate at K50/51 has continued to decline as of the end of 2008.

Key conclusions of the monitoring Wilmot Centre monitoring program (Burnside, 2009) included:

- Water levels in the perched aquifer and beneath surface water features (i.e., streambed piezometers) showed water level fluctuations that are primarily related to changes in precipitation. No clear response to pumping was observed.
- Surface water flow measurements showed no response to changes in pumping but appeared to be sensitive to changes in precipitation;
- Nitrate concentrations in groundwater show significant variation throughout the study area and also varied with depth with highest concentrations typically found in shallow wells. Nitrate concentrations at most locations have remained steady or increased slightly over time.
- The 2008 trout spawning surveys indicated natural variations in spawning activity which is unrelated to pumping.

Identification of potential long term impacts, can only be identified through gradually increasing the average annual combined flow rate as recommended in the Baseline Monitoring Program (Stantec, 2001).

1.3 Study Area Background

1.3.1 Natural Environment

A detailed inventory of the natural and social environment of Baden and New Hamburg was completed in the Environmental Study Report for the WWTP expansion (Stanley and Paragon, 1997) as well as the Water Supply Master Plan (Paragon, 1996). This information is summarized herein and updated with more recent planning information provided by Wilmot Township.

The study area is located along the western edge of the physiographic region referred to as the Waterloo Moraine, or the Waterloo Sandhills. Topography within the area is hummocky to gently rolling, with a local relief of approximately 45 m near Baden. Ground surface elevations within the study area gently decrease in a southwesterly direction from a high of approximately 405 masl in the area around the Baden Hills to approximately 330 to 340 masl along the Nith River in New Hamburg. The topographic high near St. Agatha corresponds to the surface water divide that extends south between Baden and Petersburg, diverting water west to the Nith River and east to Alder Creek.

The area surrounding the New Hamburg WWTP consists of rural area, much of it being used for agricultural crops, with prime agricultural soils with no limitations in use for crops to moderately severe limitations reducing the choice of crops or requiring special conservation practices. There is also much woodland in the immediate vicinity of the WWTP and along the Nith River. Several high quality upland hardwood stands are noted in the vicinity of the WWTP, some of which are located on steep erodible slopes. These natural and semi-natural areas consist of a mixture of upland hardwood forest, hardwood swamp, marsh, successional lands (e.g. shrub land, brushy grassland and meadow) and hedgerows. Active farm complex and residential dwellings are only found in the southern and eastern parts of the study area along township roads 12 and 13. An extra high voltage hydro transmission line runs north-east to south-west across the study area on agricultural land to the south of the WWTP.

The New Hamburg WWTP is surrounded by a mixture of swamp and marsh communities characterized by a wetland complex which lies within the oxbow of the Nith River. This area, which in the Environmental Study Report (ESR) study was called the New Hamburg Oxbow Wetland Complex, was evaluated in this study and determined to be a Class 4 Locally Significant Wetland. The presence of locally significant plant and wildlife species and its recreational and educational use by the local community were noted. Municipalities are encouraged to conserve these locally significant wetlands.

The area surrounding the Baden Wastewater pumping station (WWPS) is an urban fringe environment generally consisting of a mixture of active and idle agricultural land, residential, commercial and institutional uses. Natural areas including some woodland occur only in peripheral locations. The Baden Hills ESPA 13 occurs about 400 m east of the Baden WWPS. Generally the lands in the vicinity of the WWPS are disturbed, developed, successional or in agricultural production. There are no significant natural features noted in previous reports other than Baden Creek and one locally significant plant.

Greenlands Network

The 2009 Regional Official Plan classifies the Region's Greenlands Network in landscape level systems and core environmental features. Landscape level systems include significant valleys, environmentally sensitive landscape, provincial greenbelt natural heritage system, and regional recharge areas and they do not affect agricultural uses and associated normal farm practices. Core environmental features

include provincially significant wetlands, environmentally sensitive policy areas, regional forests, forests greater than 4 ha, and significant valley features that require maintenance, protection and enhancement of biodiversity and important ecological functions. As identified on **Figure 1-3** (2009 Regional Official Plan, Map 4), the Study Area has significant valleys (shown in light green) along the Nith River, and core environmental features (shown in dark green) between Baden and New Hamburg, as well as between Wellesley and New Hamburg. These features were identified in the Regional Official Policies Plan (2006) as the Phillipsburg Forest, Baden Hills, Spongy Lake, St. Agatha Forest, Nith River Valley, and Shantz Bush.

The 2009 Regional Official Plan does not list each feature, but the same areas are identified in **Figure 1-3**.

The Spongy Lake is considered to be a Provincially Significant Wetland within the study area. This resource as identified by the Ministry of Natural Resources consists of a small perched lake adjacent to the St. Agatha Forest.

Floodplains and other Watercourses

The Nith River generally flows from north to south through the Town of New Hamburg at the west limit of the study area. The Nith River Floodplain has been identified by the Grand River Conservation Authority and is controlled through their policies and guidelines. Land use designations are applied to areas within the floodplain. Activities within the floodplain are subject to the approval of the Grand River Conservation Authority and may be permitted within the floodplain in a one zone policy area or a floodway in a two zone policy area. In addition to the Nith River, a number of other watercourses are located in the study area including the following:

- Baden Creek
- Hunsberger Creek
- Alder Creek
- Hofstetter Lake

Source Water Protection Areas

The Region has developed a water protection strategy to identify, protect, and conserve the Region's drinking-water resources. The 2009 Regional Official Plan has identified three Wellhead Protection Sensitivity Areas (WPSA) within the Study Area. Area 1 is surrounding the Foxboro Green well field on Concession South of Erb Road, Area 2 is surrounding Well NH3 on Walker Road, and Area 3 is surrounding the Wilmot Centre Wells (K50s). Areas 1 and 2 are classified as WPSA-1 at the wellhead, WPSA-4 in the proximities of the wellhead, and WPSA-5 further from the wellhead locations. Area 3 is classified as WPSA-1 at the wellhead, WPSA-6 in the proximities of the wellheads, and WPSA-7 further from the wellhead locations. WPSA-1 as defined in the 2009 Regional Official Plan "delineates areas within a 100 meter radius of each municipal drinking-water supply well and it represents the highest sensitivity area with respect to potential movement of disease causing organisms and groundwater infiltrations. WPSA-4 "delineates medium sensitivity areas found within the two year time of travel to a

municipal drinking-water supply well” and WPSA-5 “delineates medium sensitivity areas found outside of the two year, but within the ten year time of travel to a municipal drinking-water supply well.” WPSA-6 “delineates low sensitivity areas found within the two year time of travel to a municipal drinking-water supply well.” WPSA-7 “delineates low sensitivity areas found outside of the two year but within the ten year time of travel to a municipal drinking-water supply well.” The subsurface geologic materials of these wells allow rapid movement of water and they contribute a large portion of the water supply to the Region. **Figure 1-4** (2009 Regional Official Plan, Map 6c) shows the location of both areas.

Mineral Aggregate Resources

A number of mineral aggregate resource areas have been designated by the 2009 Regional Official Plan within the study area. Mineral Aggregate Resource areas represent locations where there is high potential for mineral aggregate extraction due to the quantity of high quality mineral aggregate deposits. Area municipalities establish policies in their Official Plans and regulations in their zoning bylaws to protect these mineral aggregate resource areas from land uses which are not compatible with future extraction. These areas are shown in **Figure 1-5** (2009 Regional Official Plan, Map 8).

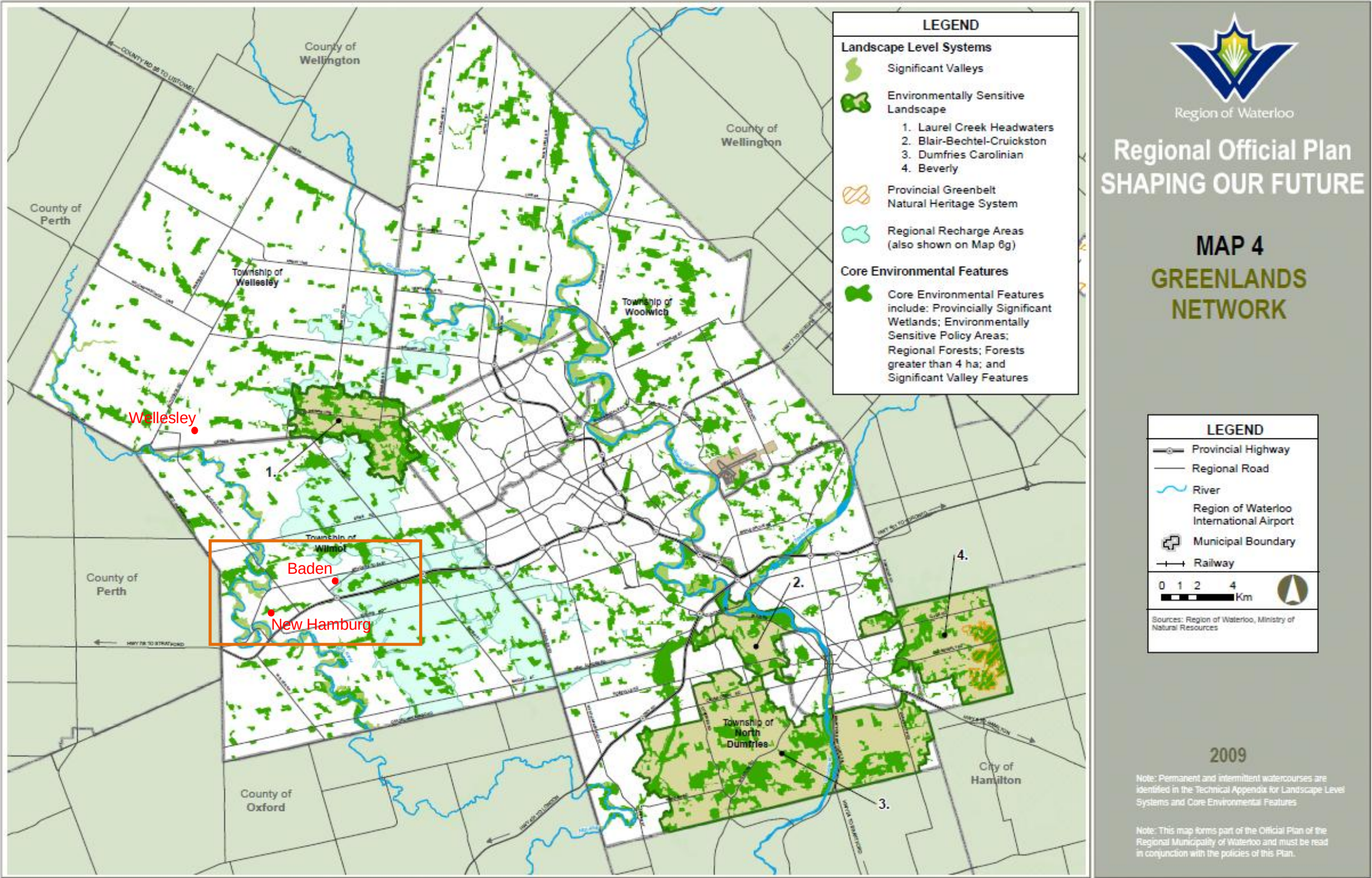


Figure 1-3: Environmentally Sensitive Areas

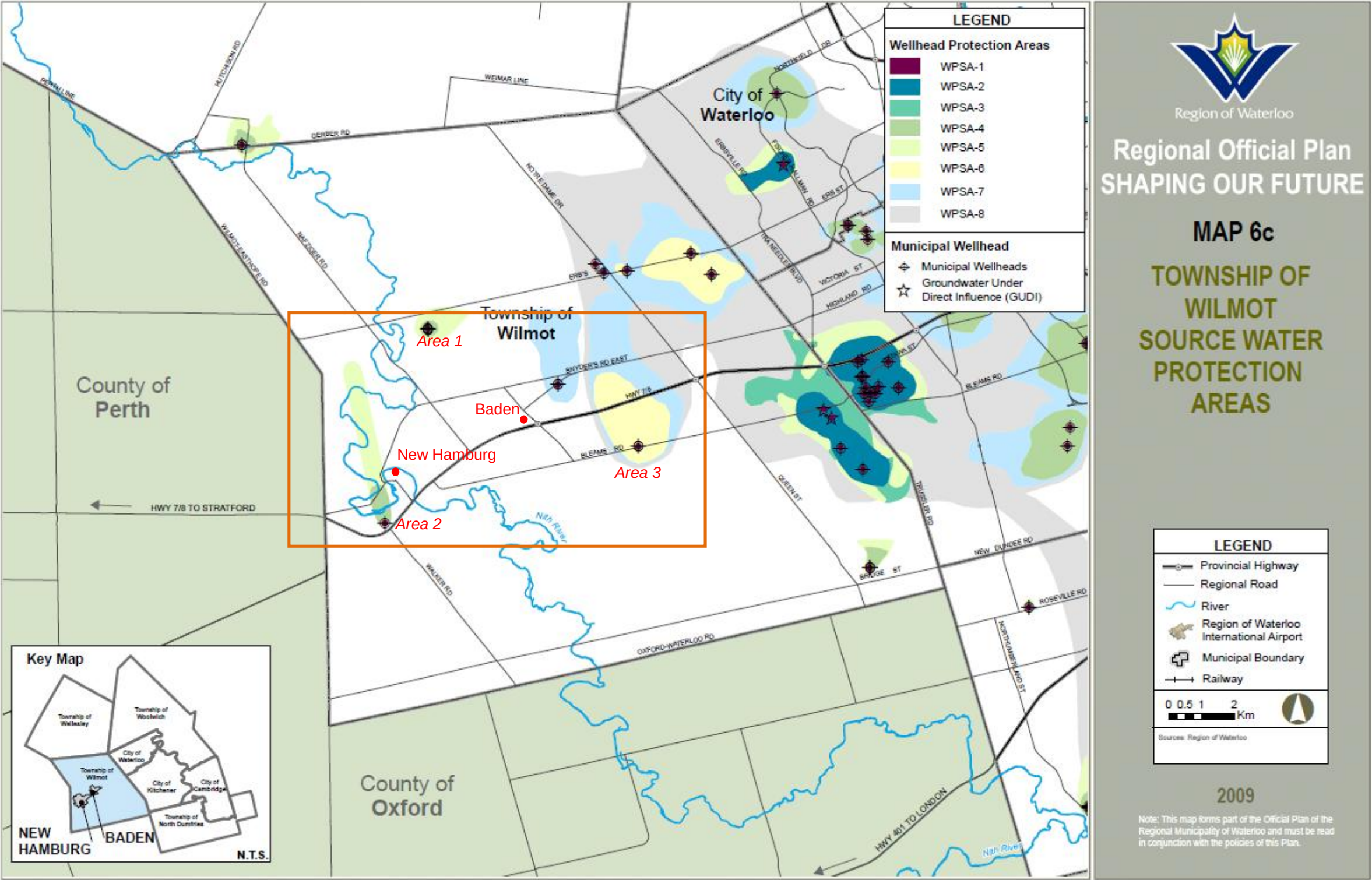


Figure 1-4: Source Water Protection Areas

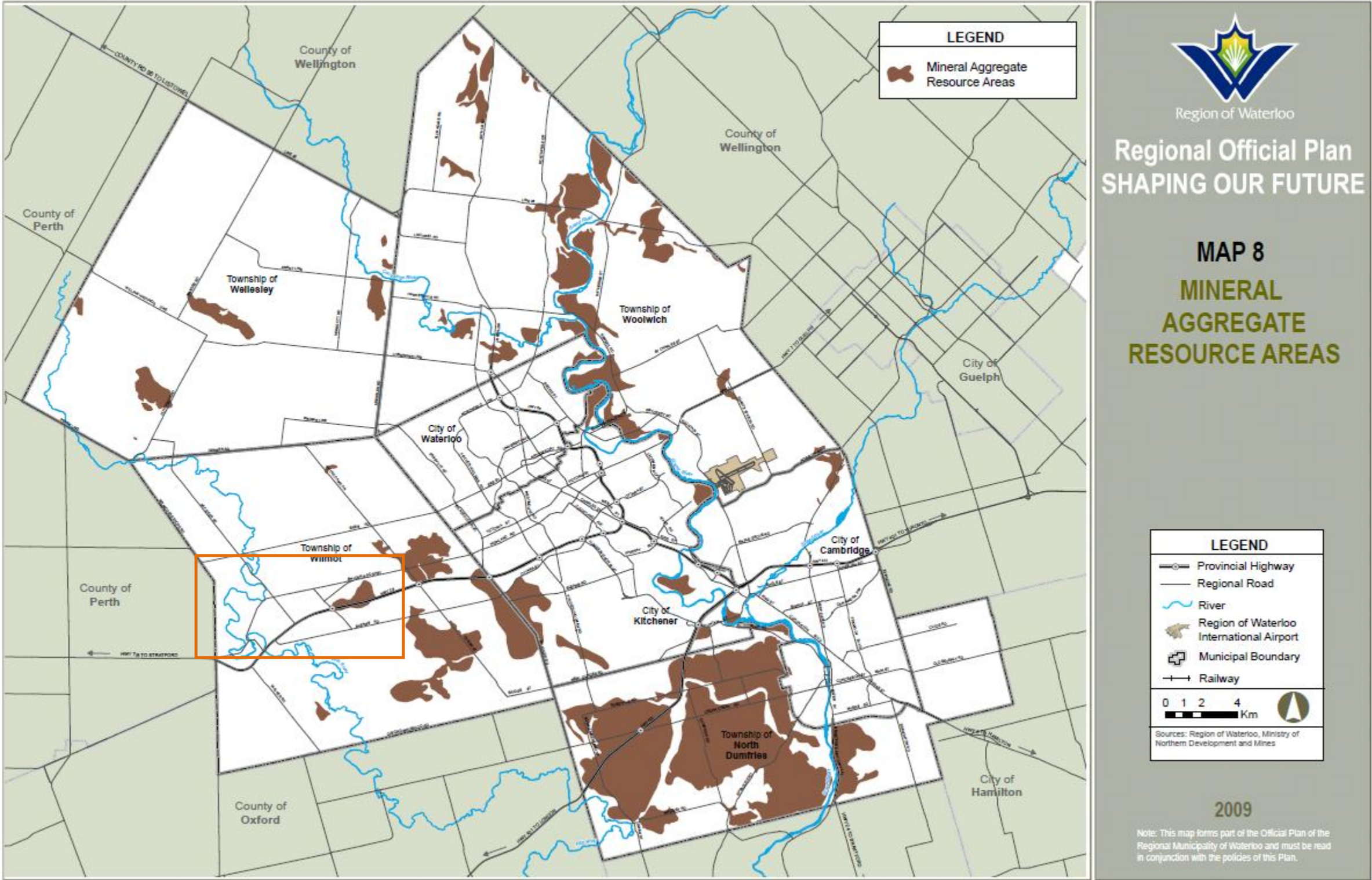


Figure 1-5: Mineral Aggregate Resource Areas

1.3.2 Socio-Economic Environment

1.3.2.1 Existing and Future Land Use Update

Baden and New Hamburg are designated as the two primary Township Urban Areas in the Regional Official Policies Plan, as the majority of the population and household growth within the Township will occur in these settlement areas. According to the Township of Wilmot's 2008 Official Plan, the land use in Baden and New Hamburg is primarily Residential, Light Industrial, and Major Recreational. The areas surrounding Baden and New Hamburg are mainly prime agricultural. A number of areas with environmental constraints, such as protected areas designated as Locally Significant Natural Areas, follow the Nith River and its tributaries through both communities.

In general, since the 1996 Master Plan, the Township of Wilmot's Official Plan was updated which altered future growth patterns from an 'outward' development concept to an 'in-filling' development concept, i.e. between the two communities.

The Township of Wilmot Planning Department provided **Figure 1-6** and **Figure 1-7** along with a description of changes in planning designations to illustrate the changes from the pre-1998 Settlement Boundary to the post-1997 Urban Area Boundary in New Hamburg and Baden, respectively. Also shown are the land use designations per the current Township Official Plan. In May 1994 the Regional Council had adopted a designation of approximately 704 gross hectares of land surrounding Baden/NW as "Township Urban Area", however, it was subsequently deferred by the Ministry in November 1995 (Region, 2004). In general, since the work completed in 1996 on the Water Supply Master Plan and the Wastewater WWTP Class EA, 322 hectares have been added to the urban areas of Baden and New Hamburg with the majority of this area occurring between the two communities. Of this additional land, almost half (151 hectares) is designated as urban residential, with a small fraction environmentally constrained. Another 96 hectares is designated as general and light industrial, in areas just east of New Hamburg. The following **Table 1-4** summarizes the land added (in hectares) to the urban area since 1997. In addition, there are approximately 35 hectares in the northeast corner of New Hamburg just outside the Urban Area Boundary which does not currently have an urban area designation, but will be the first area considered when additional lands are designated as part of the new Regional Official Plan process. The Township Urban Area for the year 2041 is projected in 1,124 hectares.

Table 1-4: Areas Added to Baden and New Hamburg Urban Development since 1997

Area No.	Urban Resid.	Environ-mentally Constrained ¹	Open Space	General Indust.	Light Indust.	Major Recreation	Future Urban Area
1	12.1	1.2					
2	7.3		10.5				
3			23.5	63.5	19.8		
4				3.6			
5	46.9						
6	9.3						
7	1.6	1.0					
8	63.9						
9	10.1						
10			21.0	6.5		19.4	
11		1.2			2.8		
Future Land Use							35.2
Total (ha)	151.4		55.0	73.7	22.7	19.4	35.2
Total Area added since 1996 (ha)							322.1
<i>Notes:</i>							
¹ Area included in Urban Residential							

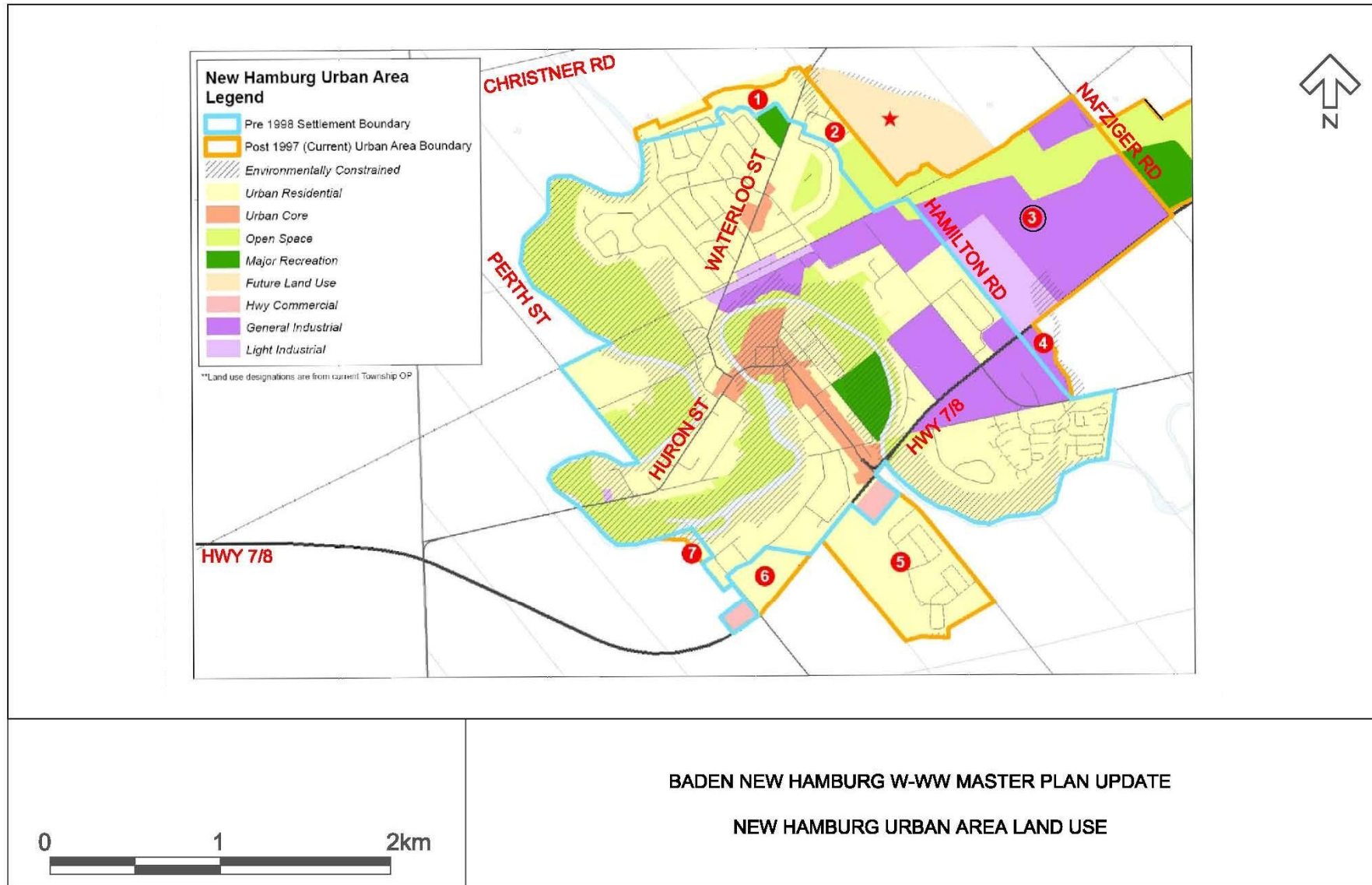


Figure 1-6: Changes to Planning Designations in New Hamburg

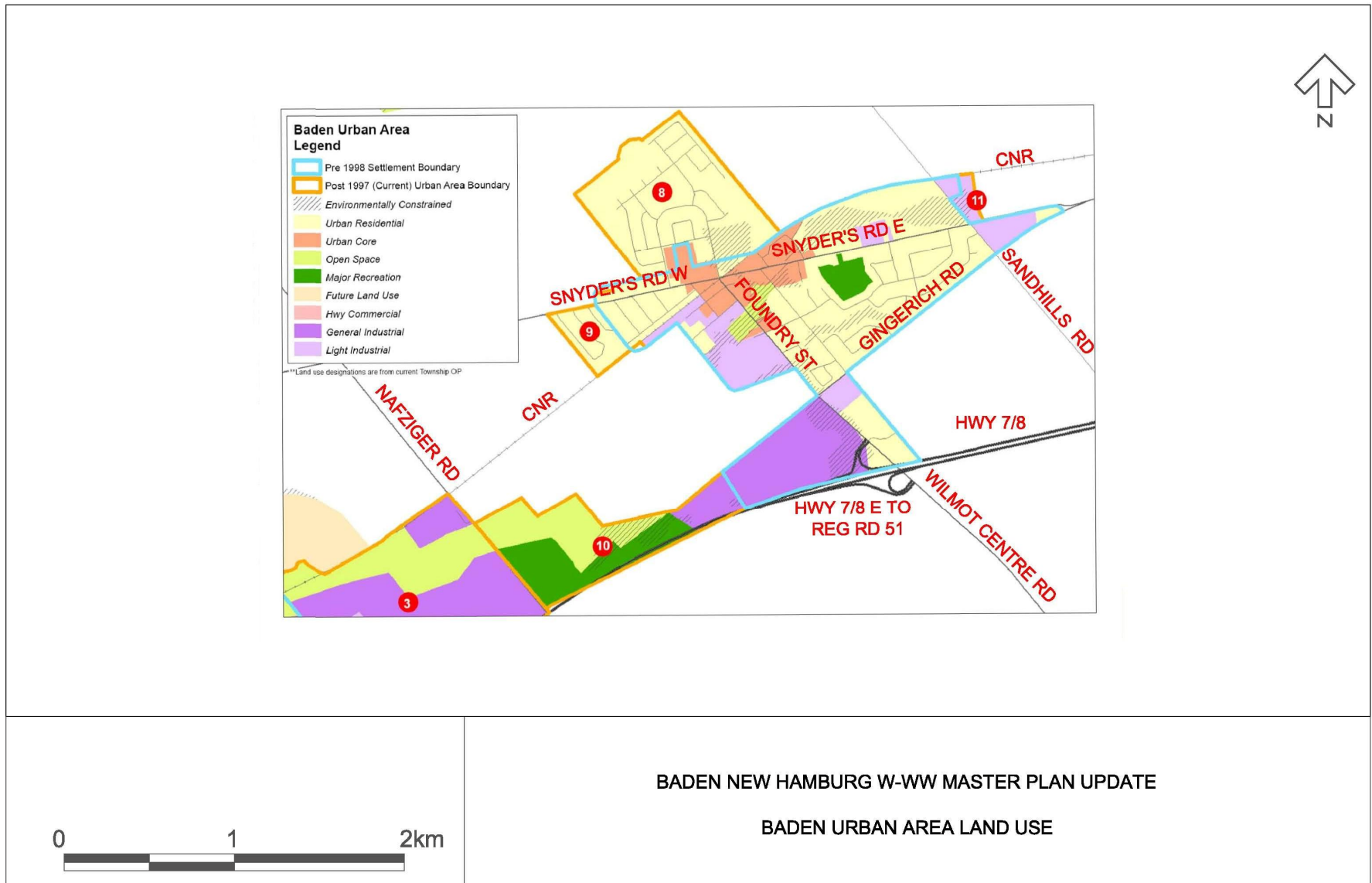


Figure 1-7: Changes to Planning Designations in Baden

In addition to lands added to the urban area, other major changes in land use since the 1996 Master Plan include:

- Additional build up of residential areas in the western areas of New Hamburg;
- Conversion of open space to institutional in the southwest area of Baden; and,
- Conversion of commercial areas to residential areas in the eastern portion of Baden.

As the communities of Baden and New Hamburg grow in the future, opportunities to increase the treatment capacity of the WWTP are potentially limited by the assimilative capacity of the Nith River.

1.3.2.2 Heritage and Cultural Resources

The study area is primarily agricultural, and also includes a number of heritage and cultural features located in urbanized areas. Cultural facilities within the study area include a number of public schools, Waterloo-Oxford District Secondary School and several churches. A new JK to grade 6 school located on Snyders Road West is slated to open in 2010.

1.3.2.3 Transportation

The existing transportation network includes Provincial Highway 7/8 which bisects the study area in an east-west direction. The remaining roads within the study area are under the jurisdiction of either the Region of Waterloo or the Township of Wilmot. A major CN Rail line bisects the area in an east-west direction, running north and parallel to Highway 7/8. Based on the ESR, the contemplated GO Transit expansion to Kitchener-Waterloo is considering a station and layover in Baden near Nafziger Road and the CN right of way.

1.3.3 Existing Conditions

1.3.3.1 Hydrogeological Monitoring

The results of monitoring data collected in the environmental monitoring programs in the Baden/ New Hamburg study area since the Baden – New Hamburg Water and Wastewater Master Plan Update (1996 WMP) are summarized as follows:

Background

In 1970, the Kitchener Water Commission installed and tested the Wilmot Centre wells (K50 and K51) and obtained an Ontario Ministry of Environment Permit to Take Water for a combined production rate of 159 L/s from the well field. There is a historical understanding between the Region of Waterloo and the Township of Wilmot that pumping from the Wilmot Centre well field to Integrated Urban System (IUS) would be maintained at or below the 1978 average annual rate of 87 L/s except under special circumstances.

The communities of Baden and New Hamburg have historically obtained their water supply from four municipal wells: the Baden well field (Wells B1 and B2) that represented the primary supply source,

supplemented by groundwater wells in New Hamburg (NH-1 and NH-2). During the mid-1990's, water quality concerns from the Baden and New Hamburg well fields became an issue for consideration in the Baden-New Hamburg Water Supply Master Plan (Paragon, 1996). As part of the 1996 WSMP, Paragon Engineering Limited (Paragon) and Terraqua Investigations Ltd. (Terraqua) carried out extensive hydrogeologic studies to evaluate groundwater (quantity and quality) issues within the study area and assessed the viability of potential water sources based on projected water demand. Numerous alternatives for the water supply system as a whole were developed and presented to the public for consideration. The preferred alternative was use of the Wilmot Centre well field (K50 & K51) together with a new bedrock well (NH3), to meet the long-term water supply demands for Baden/New Hamburg.

Additional background information is provided in the following sections.

Monitoring Program Methodology and Results

To support the increased taking from the Wilmot Centre well field, a detailed long term monitoring program was developed in conjunction with key stakeholders in the area (e.g., the Wilmot Public Liaison Committee, PLC). The monitoring program comprised of the following three stages (Stantec 2001):

- Stage 1: Design of Baseline Monitoring Program and Instrumentation (1997);
- Stage 2: Installation of Monitoring Instrumentation (August 1998);
- Stage 3a: Baseline Monitoring Program Implementation (August 1998 to July 2000); and
- Stage 3b: Long Term Monitoring Program Implementation (July 2000 to present)

The 1996 WSMP recommended that the rate of pumping from the Wilmot Centre well field be pumped at rates comparable to 1978 between 1998 and 2000 in order to allow for collected of baseline monitoring data. Provided no significant environmental impacts were identified, the pumping rate was to be gradually increased from 87 to 142 L/s. The 1996 WSMP suggested that if significant impacts were identified, mitigation measures or reduced pumping could be considered.

At the conclusion of Stage 3a, Stantec (2001) recommended the Long Term Monitoring Program (Stage 3b). Stage 3b would consist of increasing pumping from the Wilmot Centre well field using a 3-step approach implementation, each step encompassing five years until the horizon period is reached in 2016. During each time-step, the average pumping rate will be increased from the existing 87 L/s to 105 L/s, 124 L/s and finally 142 L/s. This would allow for approximately 5 years of monitoring at each pumping rate. However, pumping rates have not increased and continued to decline to the end of 2008. The 3-step pumping has not been implemented due to the ability of well NH3 to meet the supply needs of Baden/NH. The Region's water operations group have also minimized the use of the K50s due to the effects of mixing the different disinfection residuals used at each source. However, recently (2010) the use of ammonia at the NH WTP was discontinued such that all potable water in the distribution system has free chlorine residual.

A summary of the monitoring results until the end of 2008 are provided in the 2008 Annual Report for the Wilmot Centre Monitoring Program. Since no increases in pumping have occurred, all data collected to date is considered to represent an extension of the baseline conditions (Burnside, 2009).

A summary of the Wilmot Centre well field combined production rate between 1998 and 2008 is provided in **Figure 1-8**. As described above, the original intent of the monitoring program was to identify potential

environmental impacts from staged increases of the Wilmot Centre well field pumping rate from 87 to 142 L/s between 2000 and 2005. While the combined pumping rate was increased to approximately 150 L/s for extended periods of time prior to July 2003 (e.g. approximately 1 month periods), the average-annual daily pumping rate ranged from 78.0 L/s (2008) to 100.8 L/s (2001). It is noted that the combined pumping rate at K50/51 has continued to decline as of the end of 2008.

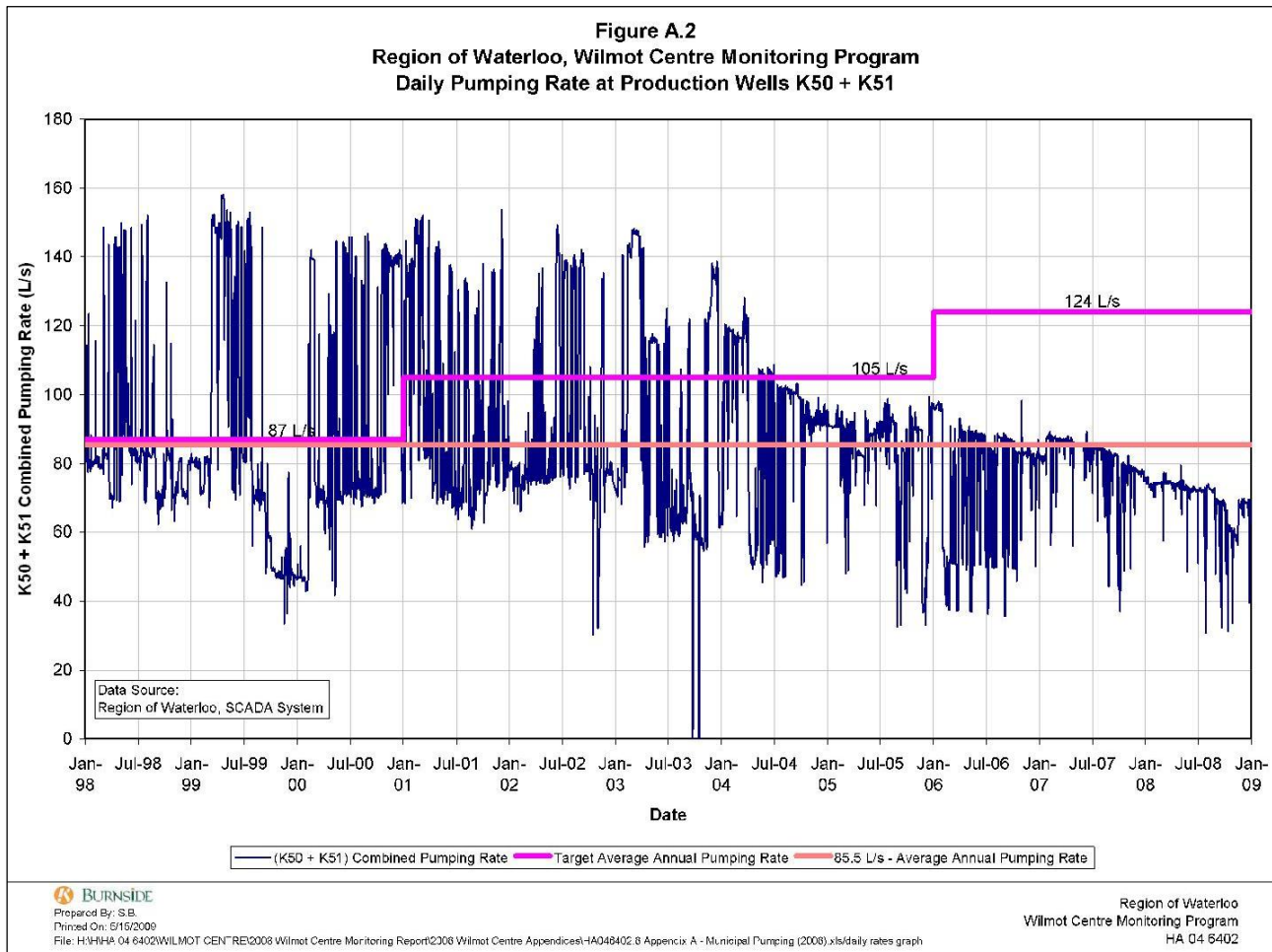


Figure 1-8: Historical pumping records from Regional Wells K50s

Key conclusions of the Wilmot Centre monitoring program (Burnside, 2009) included:

- Water levels in the perched aquifer and beneath surface water features (i.e., streambed piezometers) showed water level fluctuations that are primarily related to changes in precipitation. No clear response to pumping was observed.
- Surface water flow measurements showed no response to changes in pumping but appeared to be sensitive to changes in precipitation;

- Nitrate concentrations in groundwater show significant variation throughout the study area and also vary with depth with highest concentrations typically found in shallow wells. Nitrate concentrations at most locations have remained steady or increased slightly over time.
- The 2008 trout spawning surveys indicated natural variations in spawning activity which is unrelated to pumping.
- The benthic invertebrate survey concluded that a healthy invertebrate community will exist with or without the contribution of ground water upwelling's.

Potential long term impacts, can only be identified through gradually increasing the average annual combined flow rate as recommended in the Baseline Monitoring Program (Stantec, 2001).

1.3.3.2 Water Supply Facilities

Since the completion of the WSMP, the communities of Baden and New Hamburg have obtained their water supply from three municipal sources, (**Figure 1-9**):

- The Baden Well Field (Wells B1 and B2). Well B2 was pumped to waste from December 1994 to November 2002. Well B1 was turned off December 1994. The Baden Well Field was turned off and disconnected in November 2002.
- The Wilmot Centre Well Field (Wells K50 and K51), which is a primary water supply source;
- A municipal well in New Hamburg (Well NH3), which is a primary water supply source.

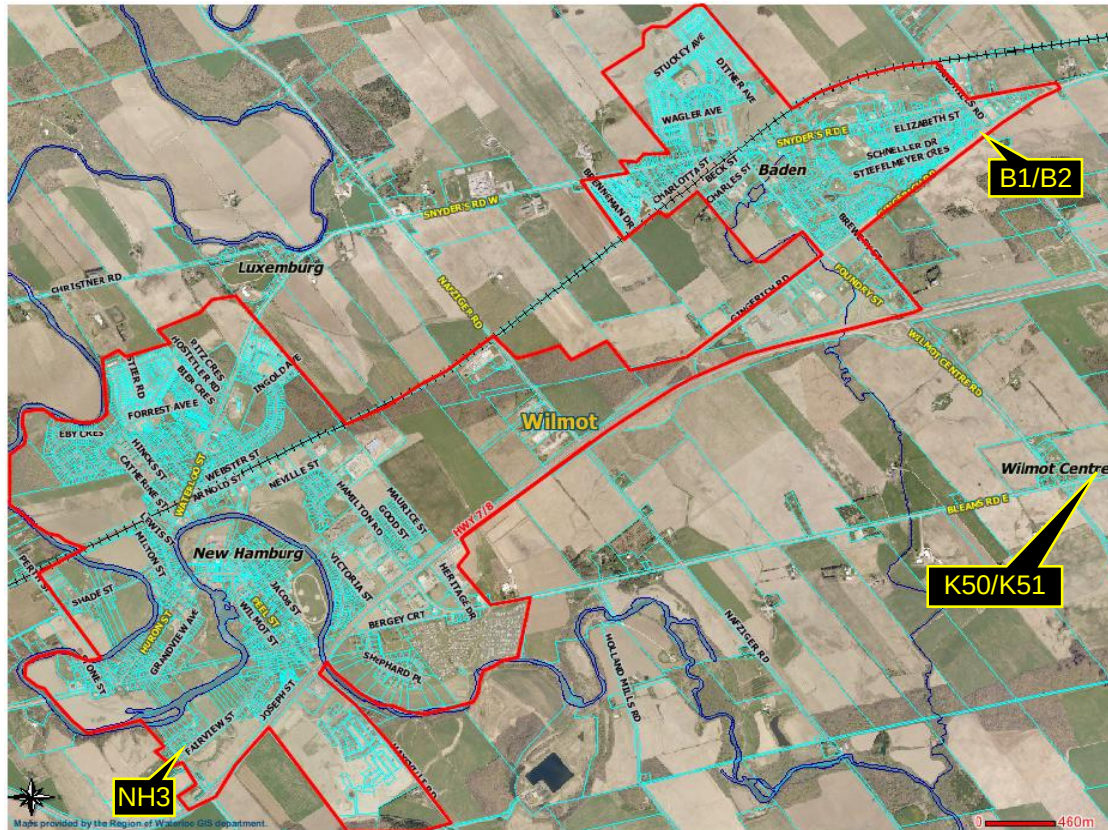


Figure 1-9: Baden/New Hamburg Existing Wells Location

1.3.3.2.1 Baden Well Field (Wells B1/B2)

The Baden Well Field (B1/B2), as shown in **Figure 1-9**, is located on the southwest corner of Sandhills Road (Township Road 16) and Gingerich Road (Region Road No. 6), approximately 500 east of Baden. The Well Field was constructed in 1973 by International Water Supply (IWS) on behalf of the Ontario Water Resources Commission (now Ontario Ministry of Environment).

Production wells B1 and B2 are separated by approximately 3 m. Well B2 is located within the control building, while Well B1 is located outside in a small wood frame, metal clad shed. Both wells were constructed with 300 mm diameter casings, with screen lengths of approximately 6.3 and 6.4 m with total well depths of approximately 42 m below ground surface. The Baden Wells have historically operated under MOE Permit to Take Water (PTTW) No. 94-P-2035, which allowed for a combined production rate of 6,550 m³/day (75.8 L/s) from either or both wells. The PTTW for the Baden Wells expired in 2004.

From 1977 through to 1993, the average daily pumping rates for each of the Baden Wells ranged from approximately 1,500 to 2,500 m³/day. In 1994, the individual pumping rate of the wells increased to approximately 3,000 m³/day. The nitrate concentration in groundwater pumped from B1 and B2 generally ranged from approximately 8 to 12 mg/L during this period of increased pumping. Due to the elevated nitrate concentration, groundwater from B2 Well was pumped to waste to prevent nitrate migration to the Wilmot Centre Well Field from December 1994 on (and B1 Well was turned off). No production pumping from the Baden Well Field has occurred since 2001 and the Baden Well Field was turned off in November

2002. For additional information refer to the Baden-New Hamburg Hydrogeological Report (Golder, 2011).

The groundwater elevation in Aquifer 1 (in the vicinity of the Baden Wells) is at approximate elevation 355 masl. The pumping level in the Baden wells generally fluctuated from elevation 351 to 347 masl (when individual pumping rates vary from 2,000 to 3,000 m³/day). These results indicate that groundwater drawdown in the Baden production wells was less than 10 m.

Key findings of the Water Supply Master Plan (Paragon, 1996), relating to the Baden Well Field (B1/B2) can be summarized as follows:

- Wells B1 and B2 may be capable of sustaining yields of 3,024 m³/day (35 L/s) and 3,715 m³/day (43 L/s), respectively.
- A 56-day pumping test (carried out during the summer of 1994) at the Baden Well Field determined that combined pumping at approximately 6,000 m³/day from B1 and B2 resulted in a small amount of water table drawdown (i.e., approximately 1 m drawdown at a distance of 6 m from the B1 and B2) in the vicinity of the Baden Well Field. As such, long term operation of the Baden Wells should not affect the operation of local private wells.

The concentration of key groundwater quality parameters (e.g., chloride, nitrate, sodium and iron) with respect to time are shown on **Figure 1-11**. Prior to 2001, groundwater quality from the Baden Well Field met all health related parameters within the current Ontario Drinking Water Standards (MOE, 2006) with the exception of nitrate. Between 1985 and 1991, nitrate concentrations at B1 and B2 ranged between 6.0 and 8.5 mg/L. Nitrate concentrations decreased slightly to a low of 5.3 mg/L in 1992 and subsequently increased to a range of 8.5 to 15 mg/L. No water quality data are available since 2000.

Nitrate mass balance modelling carried out in support of the 1995 WSMP predicted that nitrate concentrations at the Baden Well Field (with a combined production total of 5,962 m³/day or 69 L/s) would likely remain between 8.0 to 10.0 mg/L on average.

1.3.3.2.2 Wilmot Centre Well Field (K50/51)

The Wilmot Centre Well Field consists of wells K50 and K51 on the north side of Bleams Road, approximately 800 m east of Sandhills Road (Township Road No.16) (**Figure 1-9**). The wells are separated by approximately 8 m and are located within the pump house. Both wells are 400 mm (nominal) diameter wells, completed in Aquifer 1 with 9 m long screens (from approximately Elevation 329 m to 320 m). The wells are used to service existing residents along Regional Road 4 and the Shingletown settlement through a 150mm diameter local watermain. K50 and K51 wells supply water to the town of Baden via a valve located in a valve chamber located just outside the wellhouse. Wells K50 and K51 each have a capacity of 79L/s, at a total dynamic head (TDH) of 71m. Sodium hypochlorite is used for the disinfection of the water.

This well field operates under MOE PTTW No. 0287-6WHQTY, which allows for a combined pumping rate of 13,651 m³/day (158 L/s) from the well field. This PTTW will expire on May 31, 2016. There is a historical agreement between the Region of Waterloo and the Township of Wilmot that diversion of pumped groundwater from the Wilmot Centre well field to the Integrated Urban System (IUS) would be maintained at or below the 1978 average annual rate of 7,517 m³/day (87 L/s) except under special circumstances.

The combined pumping rate has shown significant variation both in the short term (i.e., daily) and long term (i.e., from 1985 to present). Based on an analysis of the hydrograph trends, the following observations are presented:

- From 1985 through to 2004, the (combined) maximum and minimum pumping rates have consistently ranged from approximately 13,000 to 6,050 m³/day (150 to 70 L/s);
- Since 2004, the maximum pumping rate has gradually been reduced from 9,500 to 6,050 m³/day (110 to 70 L/s), with a minimum pumping rate of approximately 4,320 m³/day (50 L/s); and
- Groundwater pumping from Wilmot Centre has varied from a peak annual average of approximately 12,100 m³/day (140 L/s) in 1988 to 6,739 m³/day (78 L/s) in 2008 and 6,048 m³/day (70 L/s) in 2009.

It is noted that approximately 80 to 90% of pumped groundwater from Wilmot Centre is diverted to the IUS, with the remainder diverted to a local surface water pond (5 to 10% to Gastmeier Ponds) and 3 to 5% to the Baden New Hamburg distribution system (Burnside, 2009).

Three aquifer tests have been carried out at the Wilmot Centre Well Field in order to determine the sustainable pumping rate of K50's as well as local water table response. These tests include:

- An 18-day test (April 20 to May 7, 1970) at a combined rate of 13,651 m³/day (158 L/s);
- A 30-day test (January 11 to February 10, 1994) at a combined rate of 13,262 m³/day (153.5 L/s); and
- A 55-day test (June 15 to August 9, 1995) at a combined rate of approximately 14,000 m³/day (162 L/s).

In response to the operation of the wells at the permitted rate, groundwater levels in nearby monitoring wells (e.g., OW9-67, located approximately 25 m from the K50s) were lowered approximately 2 m. In general, less than 0.5 m of drawdown was observed in monitoring wells (completed within Aquifer 1) at distances of 2 km from the well field.

Prior to 1995, most of the private wells in the vicinity of the Wilmot Centre Well Field (i.e., residents of Shingletown) were dug wells, which were completed in the Perched Aquifer. Between 1981 and 1995, approximately 14 well interference complaints were received by the Region of Waterloo. These complaints were generally addressed by well replacements (installation of drilled wells into Aquifer 1) or connecting complainants to the municipal water service from Wilmot Centre Well Field.

A summary of key water quality parameters (e.g., chloride, nitrate, sodium and iron) with respect to time are provided on **Figure 1-11**. Groundwater quality from the well field meets all Ontario Drinking Water Standards for health related parameters. Since 2000, increasing concentrations of sodium (from 10 mg/L in 2000 to 20 mg/L in 2009) and chloride (20 mg/L in 2000 to 40 mg/L in 2009) have been noted. The concentration of nitrate in groundwater pumped from K51 has remained less than 3 mg/L since 1985. The concentration of nitrate in groundwater pumped from K50 has shown a steady increasing trend (from 3 mg/L in 1999 to 6 mg/L in 2009). The 1996 WSMP identified that manganese concentrations in Well K50 had historically been slightly above the ODWO of 0.05 mg/L. However, during the testing at that time, manganese concentrations were approximately 0.05 mg/L in Well K50 and 0.03 mg/L in Well K51. For this reason, the 1996 WSMP had recommended to “construct manganese treatment as required”. As shown in **Figure 1-10**, since 2003 manganese concentrations remain below the ODWO of 0.05 mg/L; therefore, provision for manganese treatment is not required at this time.

1.3.3.2.1 Wilmot Centre Monitoring Program

The purpose of the Long Term Monitoring Program is to confirm that each step of the proposed increase is sustainable with respect to groundwater resources, surface water features and aquatic habitat. If significant environmental impacts were identified during any step, then mitigation measures could be undertaken or pumping volumes could be reduced. The Long Term Monitoring program was initiated by the Region in 1998 and has continued to present. As discussed in **Section 1.2.3**, the step increases in Wilmot Centre pumping has not been realized. In fact, the average annual pumping rate from Wilmot Centre well field had decreased to approximately 78 L/s in 2008 and 70 L/s in 2009.

1.3.3.2.3 *Well NH3*

As part of the 1996 WSMP, NH3 was installed on the west side of Walker Road (Regional Road No. 3) approximately 250 m north of Highway 7 & 8, in the southwestern portion of New Hamburg (**Figure 1-9**).

NH3 is constructed with a 300 mm (nominal) diameter casing and is completed in dolostone bedrock at a depth of approximately 58 m below ground surface (elevation 298 masl). Below the casing depth, NH3 is an open borehole to a depth of approximately 76.2 m below ground surface (elevation 279.8 masl). The base of the open borehole is interpreted to be completed in the top of the Salina Formation. NH3 currently operates under MOE PTTW No. 2101-6FTQM9, which allows for a maximum production rate of 3,542 m³/day (41 L/s).

Since the commissioning of NH3 in 1996, the production rate of the well has typically ranged from 1,990 to 2,500 m³/day (23 to 29 L/s). During dry (i.e., summer) periods, the pumping rate typically increases to approximately 3,250 m³/day (37.6 L/s). The static groundwater elevation in the bedrock (in the vicinity of NH3) is at an approximate elevation of 331 masl. Groundwater levels (under pumping conditions) generally range from elevation 325 masl at NH3 to elevation 330 masl at distant monitoring wells. Based on these results, groundwater level drawdown (in the bedrock aquifer) ranges from approximately 2 to 4m within a 50 m radius of NH3 to approximately 1 m at a distance of 800 m from NH3.

There is approximately 30 m of overburden in southwestern New Hamburg. Considering a casing depth of 30 m, normal operation at NH3 (approximately 23 to 29 L/s) only utilizes approximately 15% of its available drawdown. These results indicate that the stress on the groundwater quantity within the bedrock aquifer is relatively low. As discussed in the Hydrogeological Report (Golder, 2011), an inherent concern is that even a moderate stress may cause poor quality water from the Salina Formation to enter the overlying Bass Island Formation and NH3. Further study has been recommended by Golder to determine the optimized pumping rate that may be realized in southwest New Hamburg without drawing groundwater from the Salina Formation and to determine the effects on local private wells.

As part of the WSMP studies in 1994, a bedrock test well was tested at 19.3 L/s and the potential yield of the bedrock aquifer was estimated at 38 L/s at this location (on Reg. Road 3, south of Highway 7). Using the method of superposition, potential drawdown from the operation of multiple wells can be estimated based on the response to a single well (in this case well NH3). Based on the interpreted drawdown versus distance, groundwater level drawdown from cumulative pumping at NH3 and a new well (for a combined pumping rate of 60 L/s) would result in approximately 6 to 8 m of groundwater drawdown at each of the pumping wells and about 3 to 4 m drawdown in the bedrock locally. Based on this analysis, the bedrock aquifer should be capable of sustaining an additional 30 L/s near NH3, in southwestern New Hamburg.

Groundwater quality at NH3 is good; meeting all health related Ontario Drinking Water Standards except for iron. As shown on **Figure 1-11**, the concentration of iron in NH3 has remained relatively stable at 0.4 mg/L since 1996. The concentration of sulphate remains below 100 mg/L.

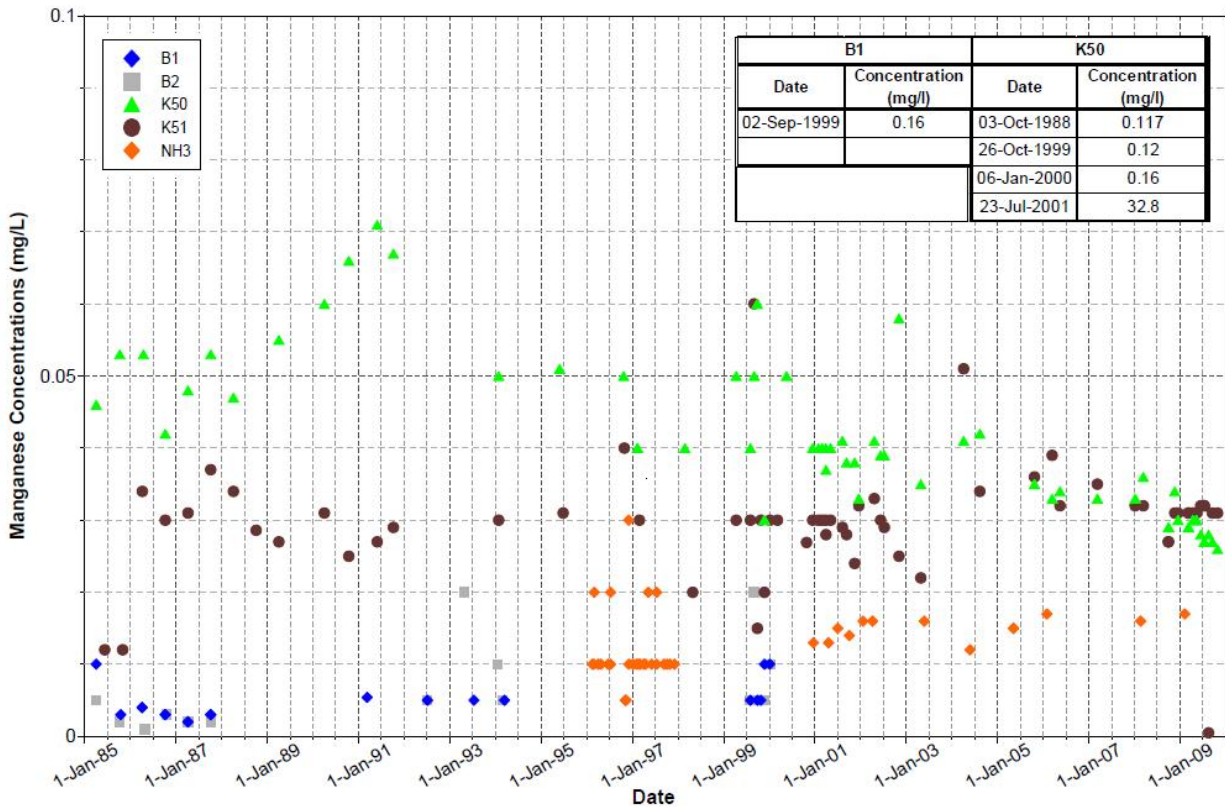
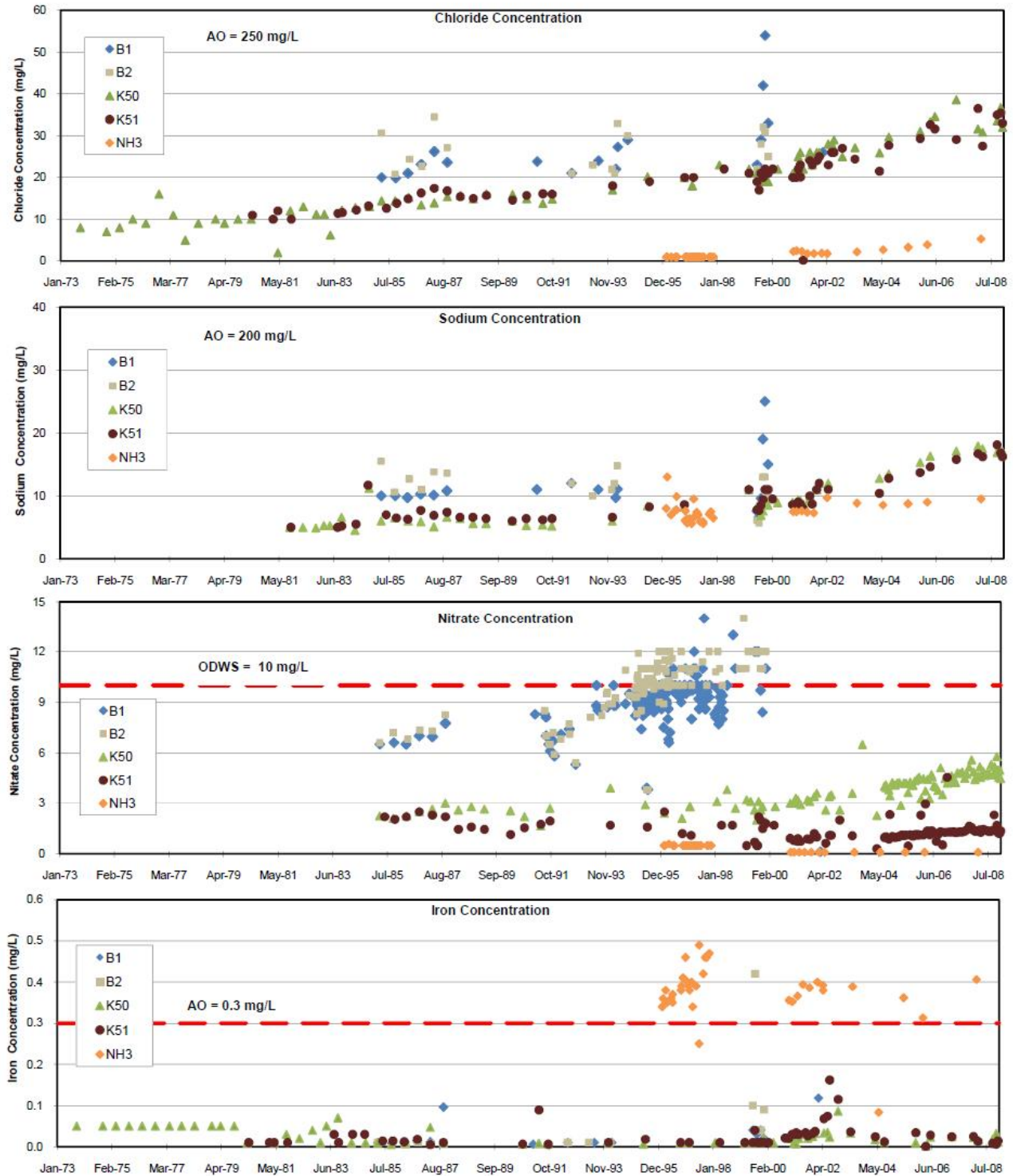


Figure 1-10: B/NH Wells Manganese Concentrations

1.3.3.2.4 Wells Summary

Table 1-5 presents a summary of each well field based on the sections above. Detailed information of the existing wells is provided in the “Preliminary Hydrogeological Draft Report” prepared by Golder Associated in January 2011 (Golder, 2011) included in **Volume 4 – Appendix E**.



Notes:
Water quality data obtained from Regional Municipality of Waterloo database.

Source: Golder, 2011

Figure 1-11: B/NH Wells Water Quality

Table 1-5: Wells Summary

Well	Description
Baden Well Field	• Sustainable Yield: ⊕ B1 = 3,024 m³/day (35 L/s) and ⊕ B2 = 3,715 m³/day (43 L/s). • Groundwater pumping from B1/B2 results in a small amount of drawdown locally (i.e., approximately 1 m drawdown at a distance of 6 m from the B1 and B2). • Baden well field was turned off in November 2002. B1 was turned off in 1994 and B2 was pumped to waste from 1994 to 2002. • An MOE PTTW and upgrades/maintenance would be required for future operation of B1/B2. PTTW expired in 2004. • Water Quality: Elevated nitrate concentrations at B1 and B2 (8 to 12 mg/L).
Wilmot Centre Well Field	• Permitted Rate = 13,651 m³/day (158 L/s) combined. • Production capacity of individual wells are limited by the pump. • Average annual pumping rate at Wilmot Centre has varied from 12,100 m³/day (140 L/s) in 1988 to 6,739 m³/day (78 L/s) in 2008. • Relatively consistent average annual production totals have been observed between 1997 and 2007, ranging from 7,800 to 8,600 m³/day (90 to 100 L/s): ⊕ 80 to 85 L/s to IUS ⊕ 7 to 10 L/s to Gastmeier Pond ⊕ 3 to 5 L/s to B-NH • Long term monitoring program was developed following the WSMP in order to identify potential effects on local water resources from the staged increase of Wilmot Centre Pumping. • Monitoring is on-going however, the proposed staged increase has not been implemented • Water Quality: Nitrate concentration at K50 (currently 6 mg/L). No detectable VOC's or PAH's to date
New Hamburg Well Field	• Permitted Rate = 3,542 m³/day (41 L/s). • Since the commissioning in 1996, the production rate typically ranges from 1,990 to 2,500 m³/day (23 to 29 L/s). • During dry (i.e., summer) periods, the pumping rate typically increases to approximately 3,250 m³/day (37.6 L/s). • Depth of casing = 298 masl • Pumping level in NH3 (at 23 to 29 L/s) is typically 325 masl. • Groundwater elevation in nearby monitoring wells is approximately 330 masl. • Potential for additional groundwater supply from the Bass Island Formation. • Hydrogeological study is required to determine effects of pumping increases from NH3 well field: ⊕ Drawing poor quality groundwater from Salina Formation and; ⊕ Effects on local private wells. • Water Quality: ⊕ Manganese concentration at NH3 ranges from 0.01 to 0.02 mg/L (MOE Guideline: 0.05 mg/L). ⊕ Iron concentration at NH3 ranges from 0.1 to 0.5 mg/L (MOE Guideline: 0.3 mg/L). ⊕ No detectable VOCs or PAHs to date.

1.3.3.3 Water Treatment Facilities

The original New Hamburg Reservoir and Pumping Station facility was constructed in 1983 for additional storage capacity to the former Baden Standpipe. It is located on a 1.1 ha site on the south side of Fairview Street, 0.2 km southwest of the intersection of Bleams Road in New Hamburg. The storage reservoir consists of a cast-in-place two cell concrete structure with a usable volume of 2,000 m³.

In 1999 the new Hamburg WTP was upgraded to provide treatment for iron and manganese reduction. The New Hamburg Water Treatment Plant (NHWTP) is located on a 1.1 ha site on the south side of Fairview Street, 0.2 km southwest of the intersection of Bleams Road in New Hamburg. **Figure 1-12** shows the site aerial view. The NHWTP is a package plant (Model FVT-08 Electromedia 1 System, supplied by Filtronics (**Figure 1-13**) with a rated capacity of 3,542 m³/d (41 L/s). The Electromedia 1 System is comprised of three pressure filter units, associated pipes and valves, air compressor, and a control panel. Each filter contains proprietary catalytic media adequate for iron and manganese removal, as well as to trap precipitated floc (Stantec, 1999).



Figure 1-12: NHWTP Site Aerial View



Figure 1-13: NHWTP Filter Photo

The backwash sequence for each filter consists of a four minute backwash cycle followed by a one minute purge cycle, after each filter run. Filter effluent is discharged to waste during the purge cycle. A cast-in-place backwash settling tank was constructed beneath the filtration room to allow the media to settle prior to returning the filter to normal service. Precipitated iron and manganese accumulate near the bottom and the supernatant (stored backwash water) is discharged directly into the raw water heater upstream of the WTP, which allows for blending of the supernatant with the raw water from Well NH3. There is a backwash tank sampling pump that continuously collects sample of the backwash water storage tank and passes it through a turbidity analyzer. Excessive turbidity will signal the need for sludge removal from the backwash/reclaim and/or the need for extending the settling. Due to the reclaim capability, the waste generated during the backwash process is minimal.

The storage reservoir at the WTP consists of a cast-in-place two-cell concrete structure with a usable volume of $\pm 2000 \text{ m}^3$. The cells have the capability of being isolated draining down one cell and maintaining operation of another. The 150mm diameter outlet line from the package WTP is distributed to the twin reservoir via a 150mm fill line. Water is discharged into the east cell and is drawn from the west cell. The main purpose of this reservoir is to provide storage for flow equalization and for sufficient disinfection contact time along with the provision of fire flow storage.

A revised pumping system has been completed to handle peak instantaneous water demands. Two new vertical centrifugal split case pumps were added along with the existing horizontal centrifugal fire pump; all pumps directing flow to the existing 400mm diameter water main.

The electrical distribution system consists of a 13 kVA primary transformer, a new service entrance main switch, meter cabinet, and a motor control centre (MCC) for branch distribution to the pumps in the building loads. A branch feeder is also provided to supply a 25 kVA step-down transformer for servicing the 120/208 volt loads of the new filtration addition.

A programmable remote processing unit (RPU1) provides control of the water transport and interfaces to the filter package system. The RPU1 contains a communication interface, via a dedicated telephone line, that allows two-way data transfer between the treatment plant and the Region's SCADA System at the Mannheim Treatment Centre in Kitchener.

1.3.3.4 Water Distribution and Storage

As described in **Section 1**, the Region is responsible for trunk distribution while the Township is responsible for water distribution and water service connections. High lift pumps located at the NHWTP pump the finished water into the Baden/New Hamburg System. In addition, a 450 mm diameter watermain from the Wilmot Centre wellfield feeds the Baden distribution system. The New Hamburg-Baden water distribution system contains a network of approximately 455 pipes having a total length of approximately 88 km. Watermains locations are shown in **Figure 1-15** (red lines are proposed pipes).

There are two water storage facilities (**Figure 1-14**) servicing the Baden/New Hamburg Water System. The reservoir located at the New Hamburg Water Treatment Plant (NHWTP) has a usable volume of approximately $2,000 \text{ m}^3$. The Baden Elevated Tower has a capacity to store $5,363 \text{ m}^3$ when filled to its maximum level; however it is currently being operated at its 30% capacity to minimize high pressures problems in areas with low elevation (**Figure 1-15**). **Table 1-6** summarizes the available storage capacity in the Baden/New Hamburg Study Area based on full capacities.

Table 1-6: Existing Storage Capacity

Description	Water Storage Capacity, m^3
NHWTP Reservoir	2,000
Baden Elevated Tower*	5,363
Total Water Storage Available	7,363
* Based on high pressure issue solved	

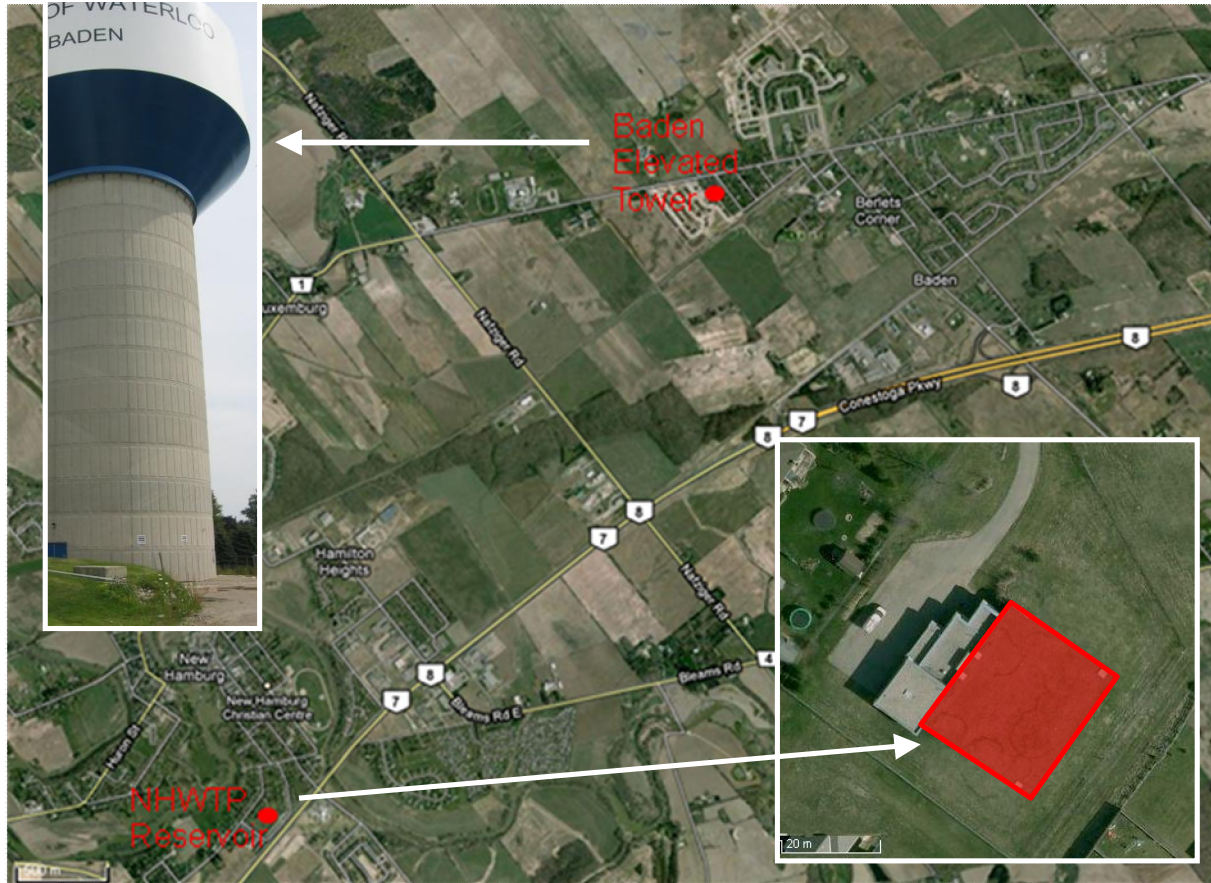
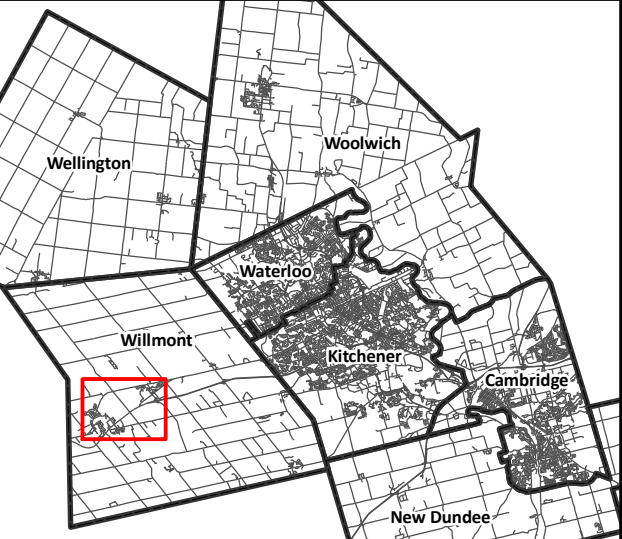
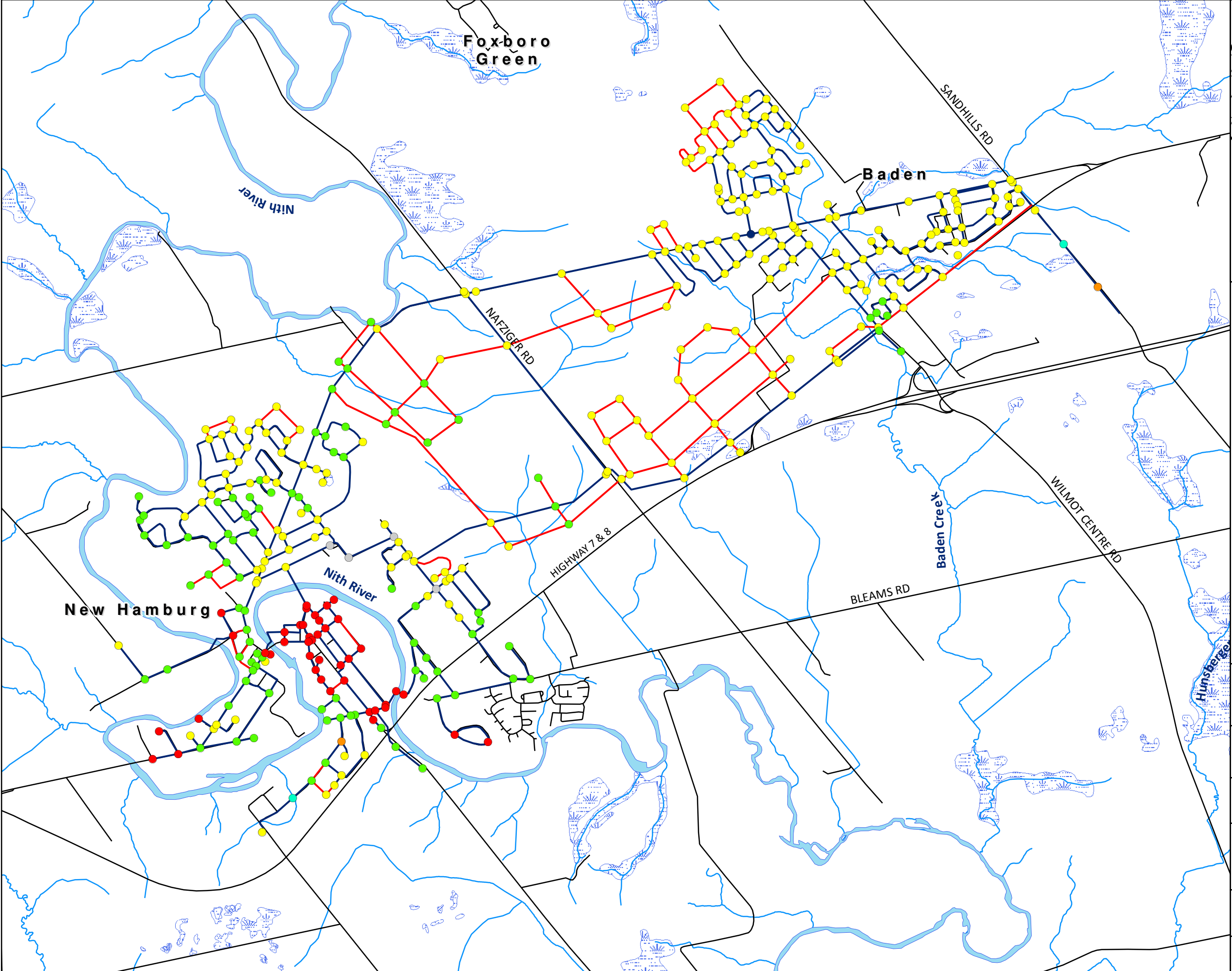


Figure 1-14: Baden/NH Water Storage Facilities Location



2041 (HIGH) MDD

Legend

Maximum Pressure (Psi)

- < 20
- 20 ~ 40
- 40 ~ 50
- 50 ~ 80
- 80 ~ 90
- > 90

Existing Pipes

Proposed Pipes

Roads

Rivers

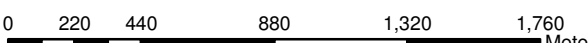
Nith River

Wetlands

Baden - New Hamburg Water & Wastewater Master Plan Update

Figure 1-15:
High Pressure Areas with Pipe Improvements

Datum: NAD 83, Zone 17 Source: Region of Waterloo	June 2011
--	-----------

 Region of Waterloo	
	
	

1.4 Population Projection and Water Demand Forecast

1.4.1 Population Projections

The communities of Baden and New Hamburg are located in the Township of Wilmot, one of seven local area municipalities which comprise the Regional Municipality of Waterloo, west of the City of Kitchener.

Land use and population growth in Baden and New Hamburg are governed by the policies and principles outlined in the 2009 Regional Official Plan (ROP) and the Township Official Plan. Since completion of the previous Master Plan in 1996, the Township of Wilmot's Official Plan (TWOP) was consolidated in November 2006. The TWOP outlines long term direction related to growth management to 2016 and beyond, to guide future development within the Township initiated by both the public and private sectors; the plan recognizes that long range decisions must be made well beyond the horizon year planning period. For the purpose of Master Planning, the year 2041 was selected as the planning period for long term consideration. However, population projections are also developed for the 2031 timeframe for the purposes of evaluating wastewater treatment and discharge requirements, as the Ministry of the Environment prefers to review a 20 year time period for approvals for wastewater-related infrastructure. All proposed public works must be in conformity with the 2009 Regional Official Plan.

New Hamburg and Baden are both designated as Township Urban Areas within the 2009 Regional Official Plan. As such, these areas have been allocated to accommodate the population and household growth identified in the Regional Population Household Forecast for the Township of Wilmot. According to the 2009 Regional Official Plan, the development occurring in some of these areas require planning in order to provide a development pattern including road network that supports the integration of transit services, a municipal drinking water supply system and a municipal wastewater system, among others. **Figure 1-16** shows the township urban area boundary and the built-up area. The built-up area consists of land that has been developed.

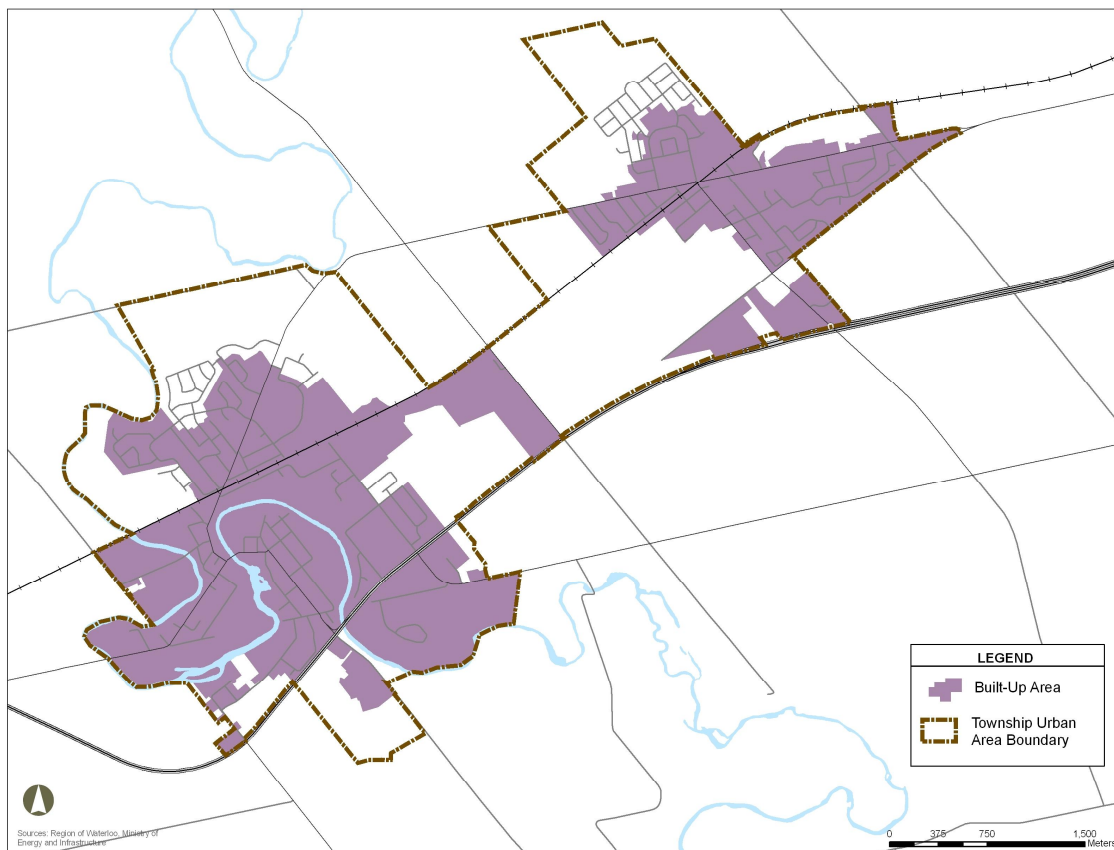


Figure 1-16: Population Growth Areas

Population and household forecasts from the TWOP and the 2009 Regional Official Plan are contained in **Table 1-7**. The 2009 Regional Official Plan indicates a total Township population forecast of 28,500 in 2029.

Table 1-7: Population Forecasts

Study Description	2016	2029
Township of Wilmot Official Plan (2006)	22,300	-
Region of Waterloo Regional Official Plan (2009)		
➤ Wilmot Population	-	28,500
➤ Wilmot Employment	-	9,700

Population forecasts for the serviced urban areas of Baden and New Hamburg have been documented in recent study reports and are summarized in **Table 1-8**. The current population (2007 year-end) of these communities is 10,245 including temporary university and college students.

Table 1-8: Population Forecasts for Serviced Urban Areas

Study Description	2016	2041
Baden – New Hamburg Water Supply MP (1994)		
Land-Base Method	14,950	22,995
Long-Term Water Strategy	15,100	21,100
Baden – New Hamburg WW Class EA (1997)		
Baden	3,750	4,800
New Hamburg	10,070	15,600
Total Baden/New Hamburg – Residential	13,820	20,400
New Hamburg/Baden Watermain Distribution Study – Final Report (2004)		
Baden – residential	3,951	6,899
New Hamburg – residential	10,748	16,183
ICI Equivalent (Total)	6,240	9,631
Total – Residential	14,699	23,082
ICI Equivalent (Total)	20,939	32,713
Region of Waterloo WW Master Plan (2007)		
Baden/New Hamburg – Residential	13,037	25,307
Baden/New Hamburg - Employment	5,581	8,577

The objective of the Master Plan is to develop a servicing plan for water and wastewater infrastructure to meet the needs of these urban communities. However, the Township and Region are cognizant of the constraints pertaining to each with respect to water supply via groundwater, and wastewater treatment, specifically the assimilative capacity of the Nith River. For the purposes of evaluating future servicing alternatives, population forecast scenarios were proposed to provide a range of population growth that may occur in the planning period to 2041 (and beyond the forecasts provided by the Region's Planning Department up to 2029) and develop servicing alternatives to satisfy the full range of potential growth or determine constraints to this growth.

For the purposes of this Master Plan update, the Region developed 5-year forecasts as shown in **Table 1-9**. While 2029 projections for the Township are documented in the ROP (2009), the 2041 low and high growth estimates are “unofficial” and to be used for the sole purpose of evaluating the feasibility of various servicing alternatives within this Master Plan update. These growth scenarios are subsequently applied to per capita water demands and per capita wastewater generation rates to develop future servicing requirements, including water supply and wastewater treatment, with particular attention to potential constraints.

Table 1-9: Baden / New Hamburg Population Serviced Growth Scenarios

Area	2016	2021	2026	2029	2041 Low*	2041 High*
Residential	14,760	16,800	19,340	20,800	21,500*	26,100*
Employment	4,900	5,800	6,570	7,050	7,340*	9,300*
Equivalent Population	19,660	22,600	25,910	27,850	28,840*	35,400*
<i>* Unofficial projections</i>						

Figure 1-17 shows the projected population growth from 2006 to 2041 considering a plateau projection from 2029 to 2041 (low population projection). **Figure 1-18** shows the projected population growth from 2006 to 2041 considering a straight line extension from 2029 to 2041 (high population projection).

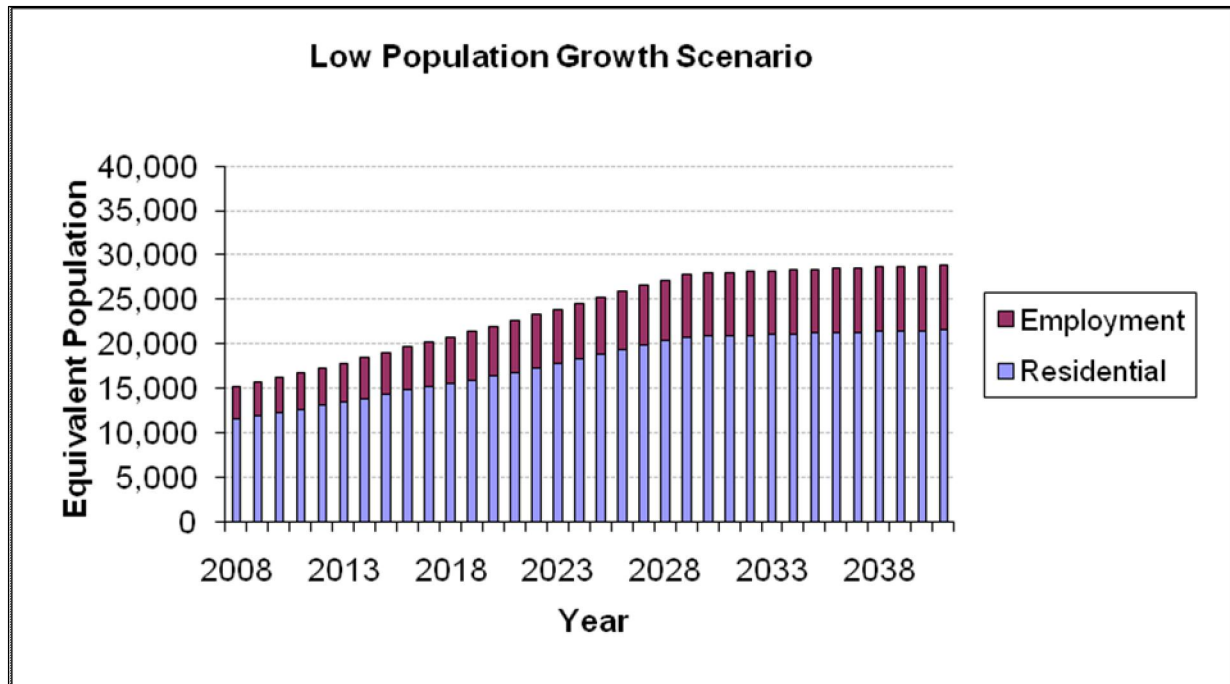


Figure 1-17: Low Population Growth Scenario

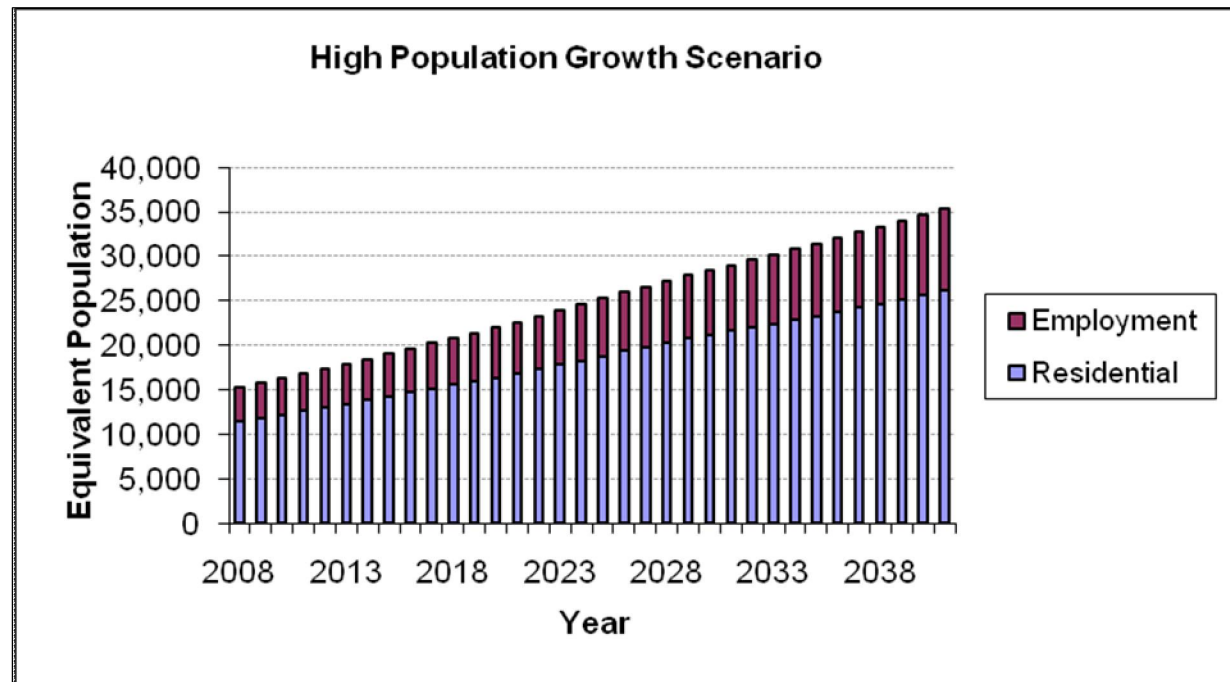


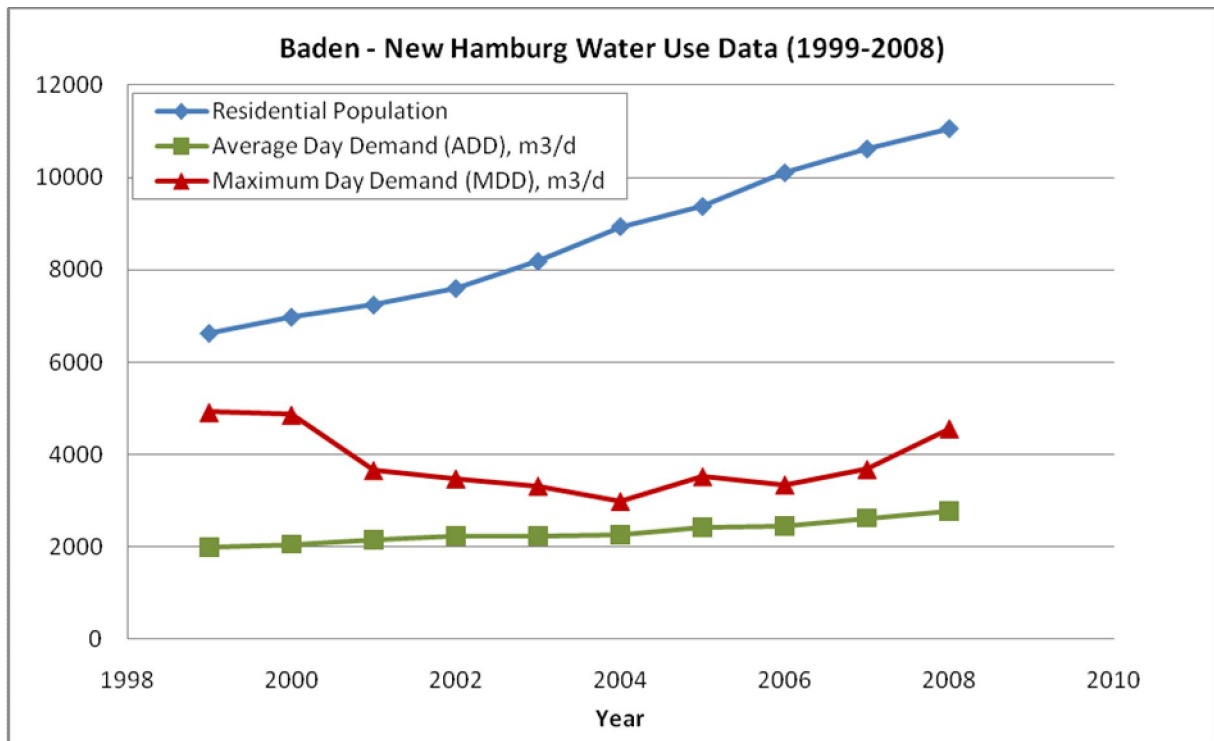
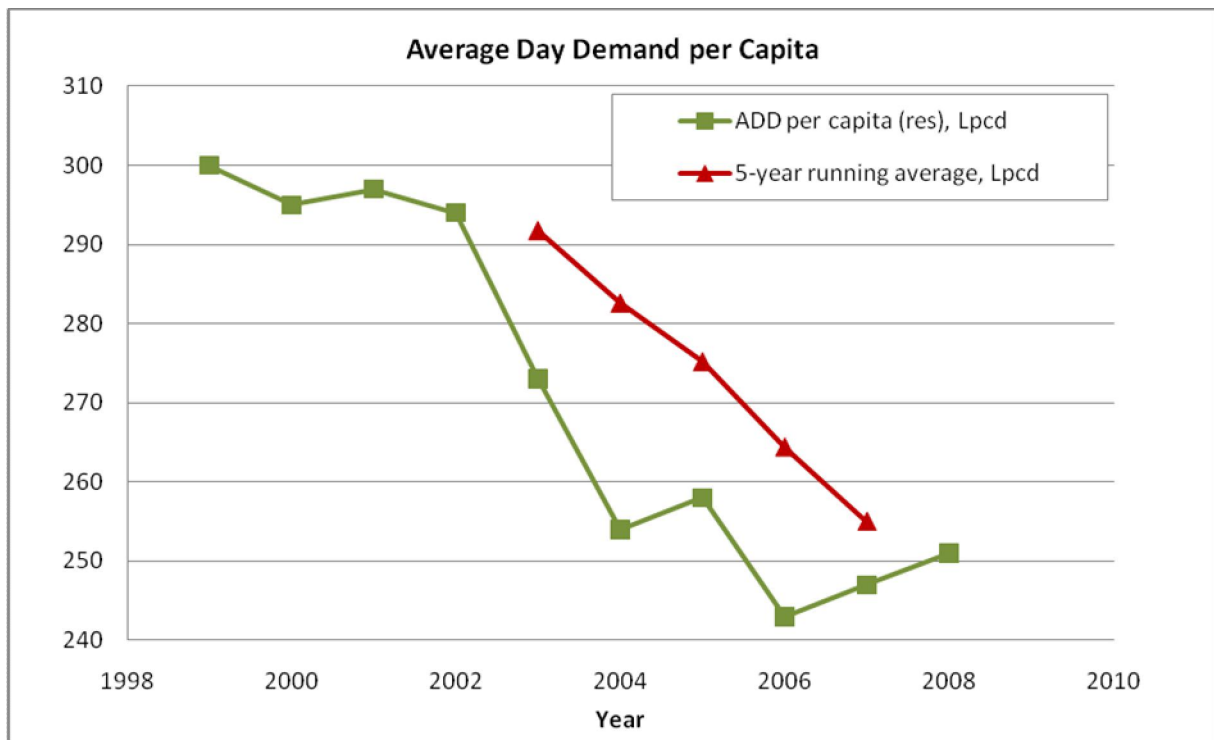
Figure 1-18: High Population Growth Scenario

1.4.2 Historical Water Consumption

The historical water consumption within the Baden/New Hamburg area from 1999 to 2008 is provided in **Table 1-10**. The water consumption records are based on actual water use data, presented in the 2009 Water and Wastewater Monitoring Report (Region of Waterloo, 2009). Based on the existing and historical population and water consumption data, the residential-only average day demand (ADD) per capita was calculated.

Table 1-10: Historical Water Consumption

Year	Residential Population	Average Day Demand (ADD), m ³ /d	Maximum Day Demand (MDD), m ³ /d	ADD per capita (res), Lpcd
1999	6,630	1,992	4,925	300
2000	6,980	2,057	4,866	295
2001	7,240	2,150	3,664	297
2002	7,600	2,238	3,483	294
2003	8,185	2,234	3,328	273
2004	8,936	2,269	2,991	254
2005	9,373	2,422	3,528	258
2006	10,100	2,459	3,351	243
2007	10,616	2,623	3,687	247
2008	11,056	2,772	4,569	251
<i>Source: 2009 Water and Wastewater Monitoring Report, Appendix C, Table 2</i>				

**Figure 1-19: Historic Water Demands****Figure 1-20: Average Day Demand per Capita**

1.4.3 Current Water Consumption

The Region of Waterloo provided AECOM with the water billing records as well as pumping records for the year 2007. The 2007 total water consumption (based on billing information) was 29 L/s (2,506 m³/d). New Hamburg water demand is approximately 65 percent (19 L/s) and Baden water demand is around 35 percent (10 L/s). The billing consumption figures were assigned in the water distribution model (See **Section 1.3.3.4** for a brief description) based on land use information as follows:

Water billing records for the year 2007 were compared to the pumping records to estimate the unaccounted for water (UFW) and maximum day peaking factor (MDD). This information is summarized in **Table 1-11**. The average daily demand (ADD) from billing records in 2007 was estimated to be approximately 29 L/s (2,506 m³/d) and the ADD presented in the 2009 Water and Wastewater Monitoring Report for 2007 is 30.4 L/s (2,623 m³/d), including UFW losses. Since the ADD from the 2009 Monitoring Report is a more conservative number, the ADD of 30.4 L/s (2,623 m³/d) was used in this analysis. The 2009 Water and Wastewater Monitoring Report defines ADD as the “total water used in a service area during a period of time as per wholesale billing records, divided by the number of days in the period” and MDD as “the highest daily consumption of water in a service area during a year. Daily consumption is defined as the total amount of water pumped into the water system plus or minus the change in storage in the system during the 24 hour period”. The ADD should be used for analysis of the distribution system for this type of average demand conditions. One year of records is considered sufficient to estimate the water consumption patterns and water quantity for planning purposes.

According to the 2009 Water and Wastewater Monitoring Report, the MDD numbers are based on water pumped and change in storage, which already take into consideration the UFW losses.

Table 1-11: Baden/New Hamburg Water System Consumption and Pumping Summary in 2007

Consumption and Pumping Summary Year 2007	Value
Average day demand (actual data from billing records)	29L/s (2,506 m ³ /d)
Average water used (2009 W/WW Monitoring Report)	30.4L/s (2,623 m ³ /d)
Maximum day demand (from pumping records)	45L/s (3,888 m ³ /d)
Maximum day peaking factor	1.35
Unaccounted for water	4 L/s (12.12%)

The diurnal pattern for the day of model calibration was calculated based on a hydraulic water balance (Demand = Water pumped to system – Difference in storage) for September 26, 2009. This date was chosen based on two criteria: (1) the day on which the highest pressures occurred during the monitoring period and (2) a day on which there was a large variation in the system pressures. **Figure 1-21** shows the diurnal pattern entered into the model and used in the model calibration.

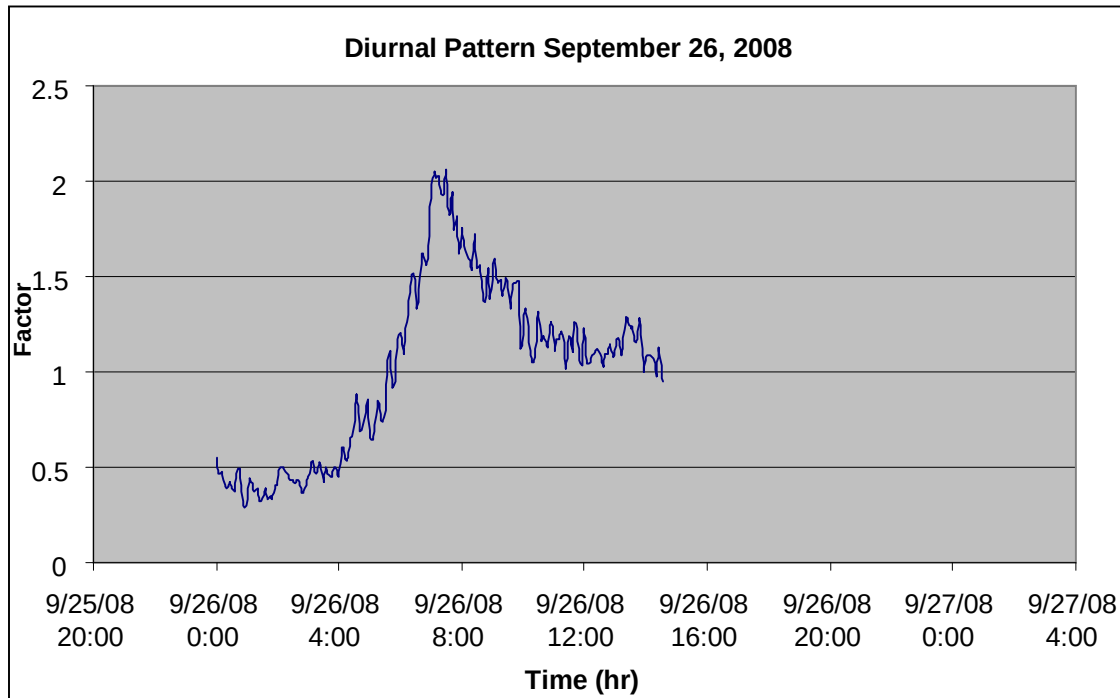


Figure 1-21: Diurnal Demand Pattern for Baden-New Hamburg Water System used for Calibration

In the hydraulic model, a demand pattern was developed from the SCADA/pumping records, water balance. The Region's model contained six separate demand patterns; however there were only demands associated with the demand patterns shown in the following figure. The actual overall demand pattern is similar to that shown for residential since it constitutes such a large percentage of total demand.

Water demands by sector are summarized in **Table 1-12** and **Figure 1-22**. The majority of demand is residential at 78 % of the total demand, excluding unaccounted for water (UFW). If taking UFW into consideration, the residential demand is at 68% of the total demand.

Table 1-12: 2007 Water Consumption Data by Sector

Sector	Baden (L/s)	New Hamburg (L/s)	Total (L/s)	Total (m ³ /d)	Total (m ³ /y)
Residential	7.48	14.95	22.43	1938	707,262
Commercial	0.21	1.28	1.49	129	46,988
Industrial	1.82	1.23	3.05	263	96,085
Institutional	0.48	1.43	1.92	166	60,491
UFW	1.34	2.64	3.98	344	125,503
Total	11.33	21.53	32.86	2840	1,036,329

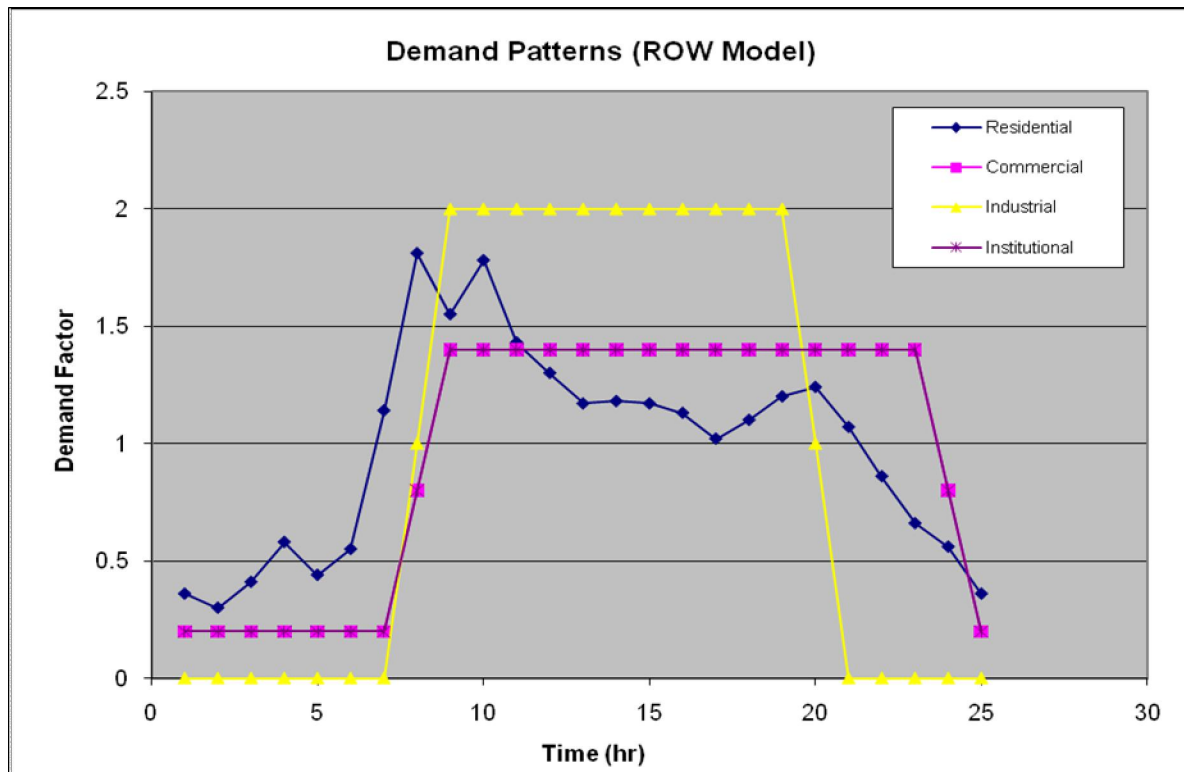


Figure 1-22: Demand Patterns

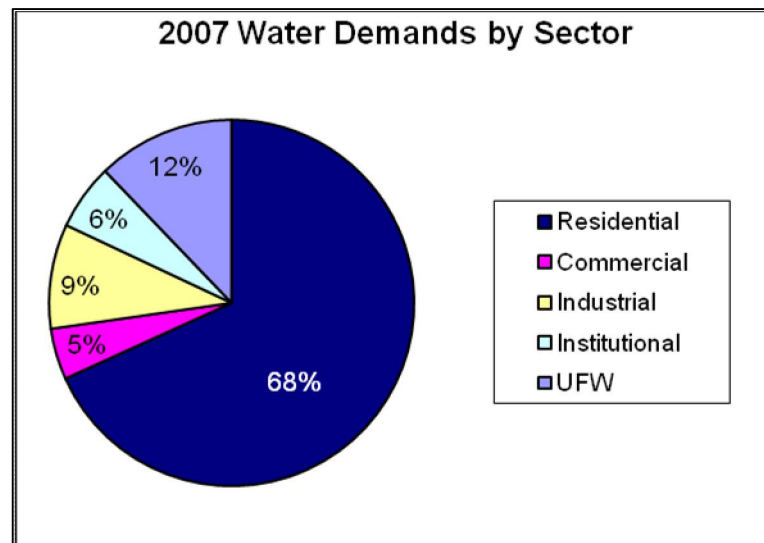


Figure 1-23: Water Demands by Sector (2007)

1.4.4 Significant Water Users

The high water users were identified in the review of water consumption data for 2007 billing records, and are presented in **Table 1-13**. While they represent the highest users by total volume, none of them are a large fraction of total water demand and therefore, were not considered as “large consumers” for the purposes of distribution modeling or for projecting future demands. The highest individual consumer at 165 m³/d represents 5.6% of the total estimated 2007 average day demand.

Table 1-13: High and Special Water Users

User ID	Consumption (m ³)	Avg Day (m ³ /day)	User ID	Consumption (m ³)	Avg Day (m ³ /day)
Residential 1	7,768.00	24.58	Commercial 1	24,495.00	77.52
Residential 2	2,588.00	8.19	Commercial 2	3,233.00	10.23
Residential 3	1,663.00	5.26	Commercial 3	2,435.00	7.71
Total Residential		38.03	Total Commercial		95.45
Industrial 1	52,300.00	165.51	Institutional 1	28,163.00	89.12
Industrial 2	19,242.00	60.89	Institutional 2	37,383.00	118.30
Industrial 3	14,960.00	47.34	Institutional 3	7,706.00	24.39
Total Industrial		273.74	Total Institutional		207.42
Other 1	4,141.00	13.10	Note: (05/30/07 to 04/11/08 = 316 Days)		
Other 2	1,816.00	5.75			
Other 3	1,371.00	4.34			
Total Other		23.19			

1.4.5 Water Demand Forecast

The water demand from 2002 to 2007 extracted from the Region of Waterloo 2009 Water and Wastewater Monitoring Report for Baden and New Hamburg was summarized and reported in terms of average (ADD) and maximum day demands (MDD) per capita, both on a residential population basis and a total equivalent population basis, as shown in **Table 1-14**.

Table 1-14: Summary of historical water demand on a per capita basis

Year	Resid. Pop.	Empl.	Total Equiv.	ADD, m ³ /d	MDD, m ³ /d	ADD per capita (res) Lpcd	ADD per capita (equiv) Lpcd	MDD per capita (res) Lpcd	MDD per capita (equiv) Lpcd	MD Factor
2002	7,600	3,648	11,248	2,238	3,483	294	199	458	310	1.56
2003	8,185	3,767	11,952	2,234	3,328	273	187	407	278	1.49
2004	8,936	3,886	12,822	2,269	2,991	254	177	335	233	1.32
2005	9,373	4,005	13,378	2,422	3,528	258	181	376	264	1.46
2006	10,100	4,124	14,224	2,459	3,351	243	173	332	236	1.36
2007	10,616	4,243	14,859	2,623	3,687	247	177	347	248	1.41
Average						262	182	376	261	1.43

These average values are then applied to the future population projections developed earlier to project future water demands. Since the ADD from the 2009 Water and Wastewater Monitoring Report reflected only the billing records, 12% was added to the ADD to account to UFW losses. As stated above, MDD from 2009 Water and Wastewater Monitoring Report is based on water pumped and change in storage, already taking into consideration the UFW losses, therefore, UFW losses were not added to the MDD.

Table 1-15 shows the projected water demands.

Table 1-15: Projected Water Demands for Low and High Population Scenarios

Population/Flow	2016	2029	2041 (Low)	2041 High
Residential	14,760	20,800	21,500	26,100
Employment	4,900	7,050	7,340	9,300
Total Equivalent Population	19,660	27,850	28,840	35,400
ADD (m³/d)¹	3,582	5,075	5,255	6,450
MDD (m³/d)²	5,140	7,282	7,541	9,256
¹ ADD=Total Equiv. Pop.*Average ADD per capita (equiv.)/1000				
² MDD=Total Equiv. Pop.*Average MDD per capita (equiv.)/1000				

Comparison of these projections to those developed in the previous Water Supply Master Plan (1996) indicates that they are 40 to 60% lower than earlier estimates. The 1996 Master Plan projected ADD for 2016 and 2041 were 6,728 and 10,348 m³/d respectively, as opposed to the current ADD projections of 4,012 and 5,886 (Low) or 7,224 m³/d (High) respectively. The 1996 Master Plan projected MDD for 2016 and 2041 were 12,110 and 18,626 m³/d respectively, as opposed to the current MDD projections of 5,140 and 7,541 (Low) or 9,256 (High) m³/d respectively. This can be attributed to decreased per capita demands in recent years.

2 Opportunities and Constraints of Existing System

This section describes the opportunities and/or constraints of the Baden/New Hamburg water system based on existing conditions and projected demand.

2.1 Water Supply

Based on review of the available hydrogeological field studies in the vicinity of Baden and New Hamburg and on the projected water demand to 2041 (low and high scenarios), the current system is capable of supplying the required demand, without any redundancy, according to the PTTW for NH3 and K50's, as shown in **Figure 2-1** (this review of maximum day capacity does not allow for any diversion of supply to the Gastmeier Ponds under maximum day conditions). If any of these wells require maintenance, or reduces its production, the water supply in Baden/New Hamburg may be compromised.

While this depiction would indicate that with NH3 and the Wilmot wells, there is sufficient capacity the Region must also consider firm capacity and scenarios which involve taking individual supplies off-line.

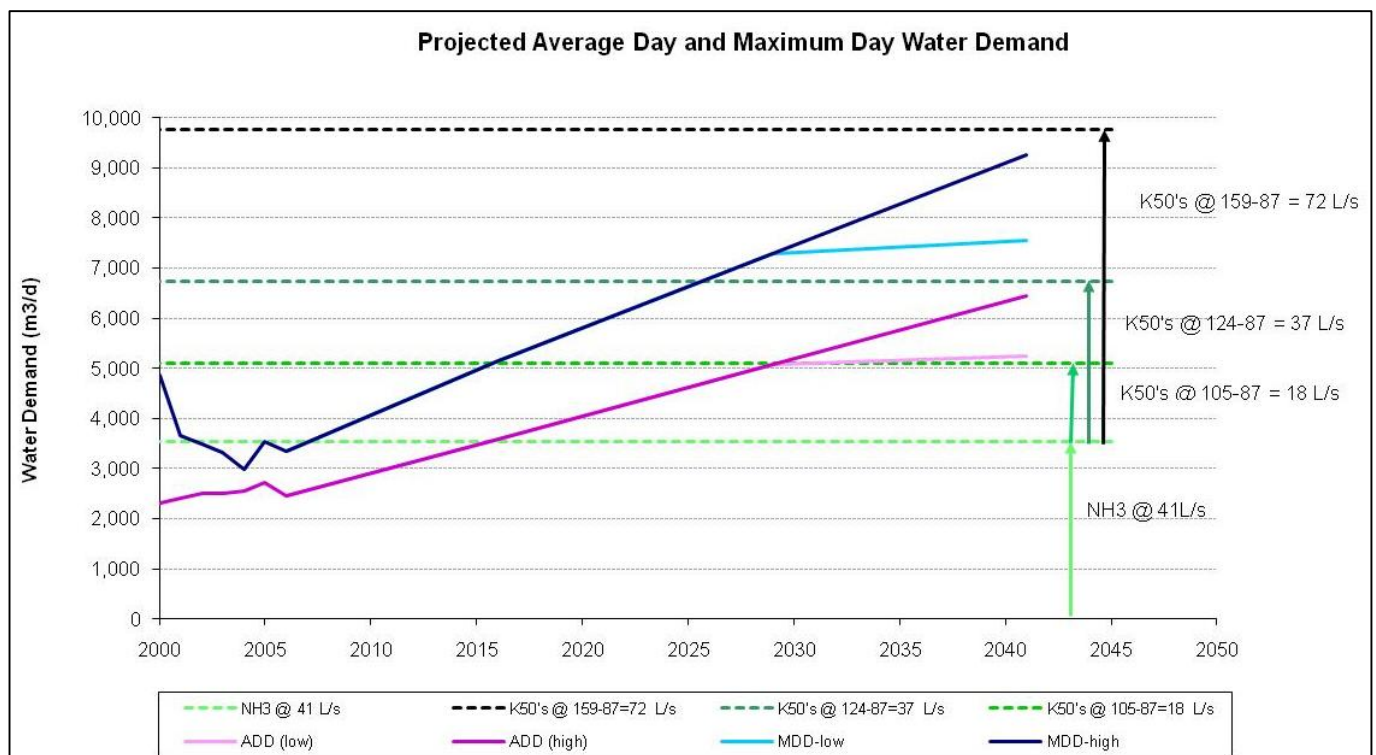


Figure 2-1: Demand vs. Supply Curve

The following opportunities and constraints were identified for water supply facilities:

Water Supply Constraints:

- Optimization of the Wilmot Centre Well Field is subject to successful completion of the Long Term Wilmot Centre Monitoring Program to evaluate potential effects on local water resources from the staged increase of Wilmot Centre Pumping.
- Potential concerns of increased pumping at NH3 are the effects on local private wells, potential to draw poor groundwater quality from the underlying Salina Formation; and potential effects on the Nith River. To address these concerns, a comprehensive groundwater supply study (which includes long term performance testing and monitoring) should be carried out to determine the safe yield for additional groundwater supply from the vicinity of NH3.
- Upgrade, maintenance and treatment (nitrate) will be required if B1/B2 are to be used for municipal groundwater supply. During the 1996 WSMP, this alternative had a low public acceptance due to water quality (nitrate concentration) and treatment requirements.

Water Supply Opportunities:

- Optimize Wilmot Centre Well Field. Staged increased should be carried out to determine sustainability of supply. Installation of a new production well within the current property boundary, nearby to provide supply redundancy is possible; however, this would require acquisition of nearby land. Nitrate treatment may be required in future based on current upward trend in K50.
- Additional groundwater supply in the vicinity of Well NH3. Possibly as much as 30 L/s of additional water supply may be available from Bass Island Formation. Promising results from test wells south of Highway 7/8 indicate feasibility; however it is likely that water quality would be similar to well NH3 with elevated iron concentrations.
- Re-activate the Baden Well Field (Wells B1/B2) and provide treatment for nitrate.

2.2 Water Treatment

Table 2-1 presents the concentrations of the chemical of interest that are either above or are approaching the Ontario Drinking Water Standard requirements.

Table 2-1: Water Quality and ODWS Requirements

Water Source	Chemical of Interest	Concentration	ODWS	Notes
K50	Nitrate	Currently 6 mg/L	10 mg/L*	
K51	Nitrate	< 3 mg/L	10 mg/L	
NH3	Manganese Iron	0.01 to 0.02 mg/L 0.1 to 0.5 mg/L	0.05 mg/L** 0.3 mg/L**	NHWTP rated capacity = 3,542 m ³ /d (41 L/s)
B1/B2	Nitrate	8 to 12 mg/L	10 mg/L*	
<i>Note: no detectable VOC's or PAH's to date at any of the B-NH well fields</i> * MAC = Maximum Acceptable Concentration ** AO = Aesthetic Objective				

The following opportunities and constraints were identified for Water Treatment Facilities:

Water Treatment Constraints:

- Nitrate removal systems are complex and expensive, with high O&M cost
- The NHWTP current capacity is equivalent to the current Well NH3 PTTW. Depending on the treatment location, land acquisition may be required.

Water Treatment Opportunities:

- Increasing nitrate levels at K50 (K50: up to 6 mg/L; K51: < 3mg/L) maintained within ODWS.
- Treatment for high nitrate levels at Baden Wells (8 to 12 mg-N/L) is achievable through proven technologies. However, this technology is complex and has high operation and maintenance costs.
- Additional treatment will be required to reduce iron levels at the NHWTP if a new well is added to the New Hamburg Well Field. Additional treatment capacity can be accommodated at the NHWTP with some upgrades.

2.3 Water Storage

According to the Ministry of Environment (MOE) Design Guidelines for Drinking-Water Systems (2008 Design Guidelines), “treated water storage facilities should be designed to allow maintenance of adequate flows and pressures in the distribution system during peak hour water demand, and to meet critical water demands during fire flow and emergency conditions”.

System-wide storage needs for the years 2008, 2016, 2021, 2029, 2041 (low), and 2041 (high) were calculated for current and future projected population scenarios.

The existing storage capacity is based on the volume available in one reservoir at the New Hamburg Water Treatment Plant (NHWP) with a usable volume of approximately 2,000 m³ and the Baden Elevated Tower with a capacity to store 5,363 m³ when filled to its maximum level. It is important to note that presently the tank is only filled 30% due to high pressures measured in the low-lying area of the distribution system.

The storage needs of the system were determined by comparing the storage requirement with the available storage. The water storage requirement (excluding any storage needed for the operation of the water treatment plant) for the Baden/New Hamburg System was calculated using the interpolated values from the MOE guidelines for “Sizing Treated Water Storage for Systems Providing Fire Protection” from the 2008 Design Guidelines, summarized by the following equation:

$$\text{Total Treated Water Storage Requirement} = A + B + C$$

- A) Fire Storage: This is the maximum needed fire flow rate times the expected fire duration as per Table 8-1 in the MOE 2008 Design Guidelines, using interpolated values based on equivalent population. The MOE 2008 Design Guidelines for Fire Flow Requirements has been used for small municipalities in Ontario, otherwise, the Fire Underwriters survey document entitled “Water Supply for Public Fire Protection” is recommended.

- B) Equalization Storage: equals 25 percent of the Maximum Day Demand (MDD) based on equivalent population demands. The MDDs have been determined to be 1.43 times the Average Day Demand (ADD), based on the actual flows from 2002 to 2007.
- C) Emergency Storage: equals 25% of A + B.

Table 2-2 presents the existing vs. required water storage for the entire Baden/New Hamburg system for 2008.

Table 2-2: System-wide Calculation of Available Storage for the year 2008 (Current Condition)

2008 Equivalent Population	15,220	
2008 ADD	2,772	m ³ /d
2008 MDD	4,569	m ³ /d
A = Fire Storage	$= (0.237 \text{ m}^3/\text{s} * 60 \text{ s}/\text{min} * 60 \text{ min}/\text{hr} * 3.6 \text{ hr}) =$	3,029
B = Equalization Storage (25% MDD)	$= 0.25 * \text{MDD} =$	1,142
C = Emergency Storage (25% of A+B)	$= 0.25 * (A+B) =$	1,043
Total Storage Required		5,214
Available Storage		7,363
Surplus/Deficit (if "+" = surplus, if "-" = deficit)		2,149

The storage calculations for the five future scenarios are shown in the following tables.

Table 2-3 summarizes the results of storage analysis for the year 2016. Based on current conditions, there will be a surplus in storage of approximately 600 m³.

Table 2-3: Calculation of Available Storage for the year 2016

2016 Equivalent Population	19,660	
2016 ADD	3,582	m ³ /d
2016 MDD	5,140	m ³ /d
A = Fire Storage	$= (0.2681 \text{ m}^3/\text{s} * 60 \text{ s}/\text{min} * 60 \text{ min}/\text{hr} * 4.3 \text{ hr}) =$	4,117 m ³
B = Equalization Storage (25% MDD)	$= 0.25 * \text{MDD} =$	1,285 m ³
C = Emergency Storage (25% of A+B)	$= 0.25 * (A+B) =$	1,351 m ³
Total Storage Required		6,753 m³
Available Storage		7,363 m³
Surplus/Deficit (if "+" = surplus, if "-" = deficit)		610 m³

Table 2-4 summarizes the results of storage analysis for the year 2021. Based on current conditions, there will be a deficit in storage of approximately 600 m³.

Table 2-4: Calculation of Available Storage for the year 2021

2021 Equivalent Population	22,600	
2021 ADD	4,118	m ³ /d
2021 MDD	5,909	m ³ /d
A = Fire Storage	$= (0.2999 \text{ m}^3/\text{s} * 60 \text{ s}/\text{min} * 60 \text{ min}/\text{hr} * 4.5 \text{ hr}) =$	4,893 m ³
B = Equalization Storage (25% MDD)	$= 0.25 * \text{MDD} =$	1,477 m ³
C = Emergency Storage (25% of A+B)	$= 0.25 * (A+B) =$	1,593 m ³
Total Storage Required		7,963 m³
Available Storage		7,363 m³
Surplus/Deficit (if "+" = surplus, if "-" = deficit)		-600 m³

Table 2-5 summarizes the results of storage analysis for the year 2029. Based on current conditions, there will be a deficiency in storage of approximately 2,200 m³.

Table 2-5: Calculation of Available Storage for the year 2029

2029 Equivalent Population	27,850	
2029 ADD	5,075	m ³ /d
2029 MDD	7,282	m ³ /d
A = Fire Storage	$= (0.3223 \text{ m}^3/\text{s} * 60 \text{ s}/\text{min} * 60 \text{ min}/\text{hr} * 5 \text{ hr}) =$	5,801 m ³
B = Equalization Storage (25% MDD)	$= 0.25 * \text{MDD} =$	1,821 m ³
C = Emergency Storage (25% of A+B)	$= 0.25 * (A+B) =$	1,905 m ³
Total Storage Required		9,526 m³
Available Storage		7,363 m³
Surplus/Deficit (if "+" = surplus, if "-" = deficit)		-2,163 m³

Table 2-6 summarizes the results of storage analysis for the year 2041 (low). Based on current conditions, there will a deficiency in storage of approximately 2,500 m³.

Table 2-6: Calculation of Available Storage for the year 2041 (Low)

2041 (low) Equivalent Population	28,840	
2041 (low) ADD	5,255	m ³ /d
2041 (low) MDD	7,541	m ³ /d
A = Fire Storage	$= (0.3272 \text{ m}^3/\text{s} * 60 \text{ s}/\text{min} * 60 \text{ min}/\text{hr} * 5 \text{ hr}) =$	5,890 m ³
B = Equalization Storage (25% MDD)	$= 0.25 * \text{MDD} =$	1,885 m ³
C = Emergency Storage (25% of A+B)	$= 0.25 * (A+B) =$	1,944 m ³
Total Storage Required		9,719 m³
Available Storage		7,363 m³
Surplus/Deficit (if "+" = surplus, if "-" = deficit)		-2,356 m³

Table 2-7 summarizes the results of storage analysis for the year 2041 (high). Based on current conditions, there would be a deficiency in storage of approximately 4,200 m³.

Table 2-7: Calculation of Available Storage for the year 2041 (High)

2041 (high) Equivalent Population	35,400	
2041 (high) ADD	6,450	m ³ /d
2041 (high) MDD	9,256	m ³ /d
A = Fire Storage	$= (0.3583 \text{ m}^3/\text{s} * 60 \text{ s}/\text{min} * 60 \text{ min}/\text{hr} * 5.34 \text{ hr}) =$	6,891 m ³
B = Equalization Storage (25% MDD)	$= 0.25 * \text{MDD} =$	2,314 m ³
C = Emergency Storage (25% of A+B)	$= 0.25 * (A+B) =$	2,301 m ³
Total Storage Required		11,507 m³
Available Storage		7,363 m³
Surplus/Deficit (if "+" = surplus, if "-" = deficit)		-4,144 m³

Table 2-8 presents a summary of the storage needs for the system.

Table 2-8: Summary of Storage Analysis

Year	Excess Storage (if +)/ Storage Deficit (if -), m ³
2008	+2,150
2016	+610
2021	-600
2029	-2,164
2041 (low)	-2,355
2041 (high)	-4,144

Storage Constraints:

- Currently there are high pressure areas in New Hamburg when operating the NHWTP high lift pumps with the Baden Elevated Tower more than 30% full.
- With the above pressure problem resolved and the Baden Elevated Tower at its full capacity, there will be water storage deficiencies before 2016 to meet critical water demands during fire flow and emergency conditions.

Storage Opportunities:

- Additional storage within the Baden/New Hamburg Study Area will be required before 2021, with an ultimate requirement of 2,500 m³ for the 2041 (Low) scenario, and 4,200 m³ for the 2041 (High) scenario.
- There is available area at the NH WTP for expansion to reservoir storage volume to accommodate the required volumes to the 2041 projections (High and Low).

2.4 Water Distribution

The Region of Waterloo provided AECOM the H2OMap hydraulic model as part of the current master plan update to be reviewed, updated as necessary, and hydraulically calibrated. AECOM used InfoWater model to carry out the updates and required analyses.

The model was updated with all recent upgrades in the distribution system and calibrated. In addition, a water quality component was added to the model and calibrated based on field work completed by the Township and Region in October 2008. This addition allows for evaluation of system residuals when modifying method of disinfection. The model was run under current demands with several scenarios including maximum day, and maximum day + fire. Under a fire scenario (residential plus industrial/institutional fire), the model output represents the fire flow achievable at a minimum pressure of 20psi.

A population distribution was assumed for the 2041 high scenario with applicable demand applied to zones spatially to facilitate running the distribution model under future conditions. The same scenarios as above were modelled with the estimated 2041 (high) demands applied.

Other assumptions applied in the model under future demands include:

- Required additional volume for storage was provided at the NH WTP
- Supply scenarios included:
 - o NH3 well plus the balance of flow from the K50s to meet maximum day requirements
 - o NH3 plus an additional well in the NH well field plus the balance of flow from the K50s to meet maximum day requirements
 - o Future areas were serviced with added loops and nodes with demands

Figure 2-2 and **Figure 2-3** include a fire scenario under 2041 (high) demand conditions, which indicates flow contours at 20psi. It is evident that high fire flows will be available in the central core (commercial and industrial area) with the infrastructure proposed. Minimum fire flow requirements for residential areas are available with the exception of dead ends and small diameter piping (indicated in **Figure 2-2** with the red arrow). Fires in these areas would likely need to be addressed with water from more than one location (i.e. hydrant) to provide sufficient flow.

Water Distribution Constraints:

- Due to existing topography of the study area, there are areas in New Hamburg at low elevations which will experience high pressure (approaching 100 psi) once the Baden Elevated Storage Tank is filled to its maximum level even with improved distribution. These could be resolved locally through individual or central pressure reducing valves.
- The existing system has a number of dead ends and sections of low diameter piping which indicate insufficient fire flows in the model. These dead ends also create operation and maintenance requirements as they need to be flushed periodically to maintain residual concentrations.

Water Distribution Opportunities:

- As infrastructure in older areas is upgraded, the Township may use the opportunity to increase watermain diameters and provide looping to address both pressure and water quality constraints.
- New watermains are proposed in future (included in Township budgets) including Phase 3 Wilmot industrial trunk watermain and associated connections north and west to connect to existing mains. This will help resolve the current problem with excessive pressures in the low elevation areas in New Hamburg which results from NHWTP pumps running up the pump curve when filling the Baden tower with existing watermains. This can be partially improved with increased dependence on the K50s to fill the Tank. However as noted above, due to topography, these pressures may still approach 100 psi which can stress and cause failure in older plumbing systems. This may need to be addressed through installation of individual PRVs or an area with one PRV; it is estimated that this area consists of approximately 420 units.

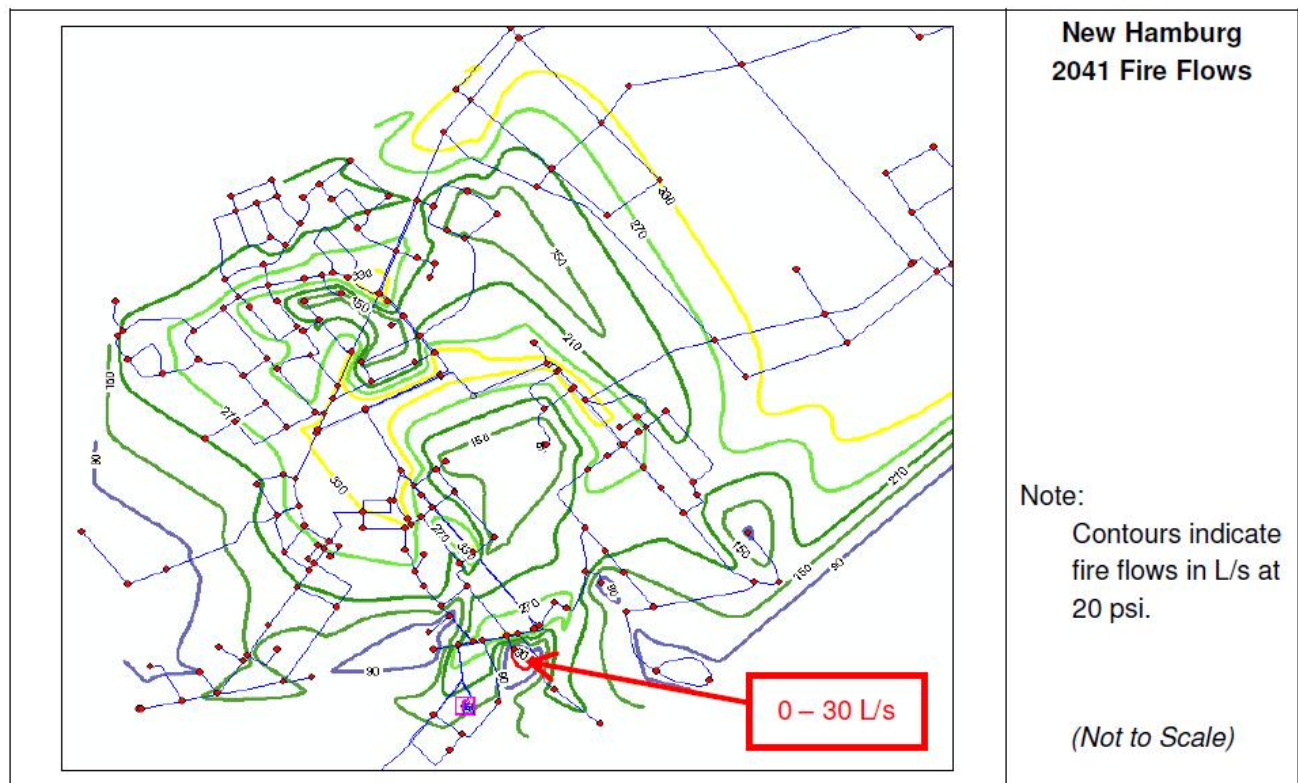
**Figure 2-2: New Hamburg 2041 (High) Fire Flows**



Figure 2-3: Baden 2041 (High) Fire Flows

3 Development of Water Alternatives

In accordance with the Class Environmental Assessment (Class EA) Master Plan process, various alternatives were identified to accommodate the projected 2041 (low and high) water demands. Alternative solutions were initially screened for the ability to meet the projected 2041 (low and high) requirements. The remaining alternative solutions were developed further within alternative strategic water supply options.

3.1 Water Supply Alternative Solutions

The following alternative solutions were formulated based on the Class EA process to address the deficiencies summarized in **Section 2**.

Alternative W-1:	“Do Nothing”
Alternative W-2:	Limit Community Growth
Alternative W-3:	Water Conservation
Alternative W-4:	Modify/Expand Operational and Maintenance Practices
Alternative W-5:	Expand/Upgrade Existing Groundwater Supplies
Alternative W-6:	New Groundwater Supplies

Alternative Solutions were evaluated considering that the Wilmot Centre Monitoring Program will be completed, and will confirm a sustainable capacity of 13,738 m³/d (158 L/s) at the Wilmot Centre Wells (which is the current permitted capacity). If the sustainable capacity at the Wilmot Centre Wells is found to be lower than the permitted capacity, one or more additional water sources will be necessary to supply the required projected water demand. Additional water storage and upgrades to the water distribution system will be required to meet the 2041 demands for all of the water alternatives (except Alternative W-1 – Do Nothing).

3.1.1 Alternative W-1: Do Nothing

The “Do Nothing” alternative (Alternative W-1) would consist of maintaining current operational practices and current maintenance activities, without implementing any new infrastructure requirements. Well NH3 and the Wilmot Centre Wellfield (K50s) would continue as the only water supply sources for Baden/New Hamburg areas.

Since 2004, the maximum pumping rate from the K50s has gradually been reduced from 9,500 to 6,050 m³/day (110 to 70 L/s). It is noted that approximately 80 to 90% of pumped groundwater from the K50s is diverted to the Integrated Urban System (IUS), with the remainder diverted to a local surface water pond (Gastmeier Ponds) and the Baden/New Hamburg distribution system (Burnside, 2009). Since the commissioning of NH3 in 1996, the production rate of the well has typically ranged from 1,990 to 2,500 m³/day (23 to 29 L/s). Baden/New Hamburg area historical demand is 2,940 m³/d (34 L/s). Wells NH3

and K50s have 9,677 m³/d (112 L/s) available for Baden/New Hamburg, assuming maximum taking from K50 wells (to be confirmed during monitoring program), which meets the 2041 high water demand requirements. In order to meet required demand however, it is assumed that under maximum day demands, the flow diverted to the Gastmeier Pond would be limited to 432 m³/d (5 L/s). If the maximum combined taking of 9,112 m³/d (112 L/s) is not confirmed to be sustainable during the Wilmot Centre Monitoring Program, the total available flow would be 4,666 m³/d (54 L/s) (including 3,542 m³/d (41 L/s) from the NH3 well), which would not be sufficient based on the projected future water demand.

Moreover, this scenario does not address the need for a firm water supply capacity to Baden/New Hamburg. If one of the K50 wells failed or was scheduled to be offline for maintenance, Baden/New Hamburg would be provided with only 3,540 m³/d (41 L/s), which would be enough for up to 2012 demands.

Based on the above, while the “Do Nothing” alternative appears to accommodate the 2041 demand through existing supplies, this alternative solution does not address two considerations:

- Security of supply and firm capacity (firm capacity refers to the capacity with the largest pump out of service at a pump station), and
- Contingency in the event that the long term monitoring program does not support additional Wilmot Centre takings.

Therefore, alternative W-1 (“Do Nothing”) will not be carried forward.

3.1.2 Alternative W-2: Limit Community Growth

Alternative W-2 consists of limiting growth such that the total demand would not exceed the current water supply firm capacity. This alternative does not meet the Master Plan purpose statement to provide long term water supply capacity.

3.1.3 Alternative W-3: Water Conservation

The Region has been actively promoting and implementing water efficiency programs since 1974. Several programs have successfully been implemented to support water conservation. The Region updated its 1998 Water Efficiency Master Plan 2007-2015 in July 2006 which recommended a nine-year program focused on the general public education, outdoor water use reduction, efficient toilet replacements, industrial, commercial, and institutional efficiencies, municipal leak reduction, and research and development. According to the Water Efficiency Master Plan, water conservation practices are estimated to have a cumulative water savings over 8,000 m³/d between the years 2007 and 2015.

A reduction in water demands through conservation alone will not be sufficient to supply water to the 2041 projected population. Water conservation programs are recommended as a complement of any preferred alternative solution.

3.1.4 Alternative W-4: Modify/Expand Operational and Maintenance Practices

The Region and the Township regularly undertake routine maintenance of the system through rehabilitation of existing wells, flushing of the water distribution system, and general maintenance of

pumping facilities. Expanding the current operational practices and maintenance would not significantly increase the volume of water supplied daily.

An option would be to modify the historical agreement between the Region and the Township that involves diverting 7,517 m³/d (87 L/s) of water from the Wilmot Centre Wellfield to the Integrated Urban System (IUS). This modification would involve setting Baden/New Hamburg as the primary customers of the Wilmot Centre Wellfield, and the IUS would receive only the excess water (less than the current set flow).

This alternative is not supported in a Regional water supply context as it creates a deficiency in another part of the system. It does not result in increased capacity to support overall Regional population growth.

3.1.5 Alternative W-5: Expand/Upgrade Existing Groundwater Supplies

The existing water supply system consists of the active NH3 and K50s wells, as well as wells which are currently offline including wells B1 and B2 located in Baden. The use of these wells was discontinued in the mid-1990s due to increasing nitrate concentration levels.

This alternative would consist of reactivating these wells by implementing nitrate treatment. According to the 1996 WSMP, Wells B1 and B2 are capable of sustaining yields of 3,024 m³/d (35 L/s) and 3,715 m³/d (43 L/s), respectively, with an estimated combined capacity of 6,000 m³/d (69 L/s). This alternative will be considered for further evaluation.

3.1.6 Alternative W-6: New Groundwater Supplies

Confirmation of the feasibility of new production wells within the Study Area is dependent on the results of future hydrogeological investigations; however based on existing information new supply facilities may include:

New well (NH4) within the New Hamburg Wellfield – this new well could be located south of Bleams Road, close to the NH3 Well site.

New well (K52) at the Wilmot Centre Wellfield – this well could be located near the existing K50s Wells. It would function as a backup well, which would be operated only if one of the existing K50s were offline. The 1996 Class EA indicated a possible trend of increasing manganese concentration in these wells; however, manganese levels still remain below the acceptable levels. Therefore, a treatment for manganese reduction is not included in this alternative.

Both new wells will be considered for further evaluation.

3.1.7 Screening of Water Supply Alternative

Table 3-1 provides a summary of the water supply alternative solutions discussed above. The alternative solutions were screened with respect to their ability to satisfy the deficiencies within the existing system and ability to accommodate future growth.

Table 3-1: Screening of Water Supply Alternative Solutions

Alternative	General Evaluation
W-1: Do nothing	Summary: Continue with Wells NH3 and K50s as water supply sources at current rates. Pros: No capital investment Cons: Deterioration of existing system, no additional water to accommodate 2041 firm capacity requirements Next Steps: Not recommended for further evaluation.
W-2: Limit Community Growth	Summary: Limit growth based on existing water supply capacity Pros: No major capital investment. Cons: Would not accommodate the projected population growth from the 2009 Regional Official Plan Next Steps: Not recommended for further evaluation.
W-3: Water Conservation	Summary: Water conservation programs have been implemented since 1974. Pros: Reduction of water consumption can contribute to lower water demands. Cons: Would not accommodate the projected water demands to year 2041 as a stand-alone alternative. Next Steps: Water conservation practices will continue to be promoted in conjunction with other alternatives
W-4: Modify/Expand Operation and Maintenance Practices	Summary: Modify operational practices to supply more water from the K50s wells to Baden/New Hamburg as required. Pros: Baden/New Hamburg area would have the required firm capacity available for the projected 2041 water demand. No major capital investment at Baden/New Hamburg. Cons: This option does not meet overall Regional requirements for servicing. Next Steps: Consider this strategy only as a means to provide water under emergency conditions to support firm capacity requirements.
W-5: Expand/Upgrade Existing Groundwater Supplies	Summary: Reactivate Baden wells and provide nitrate treatment Pros: Wells are existing with known production capacity, connected to the existing distribution system. Cons: High capital and O&M cost for adding treatment to the Baden Wells. Next Steps: Recommended for further evaluation.
W-6: New Groundwater Supplies	Summary: New well at the New Hamburg Wellfield (NH4), and/or a new well at the Wilmot Centre Wellfield (K52). Pros: Well NH4 would provide additional capacity; well K52 could serve as a backup well. Cons: Iron/manganese treatment and land acquisition required for NH4. K52 moderate cost. Next Steps: Recommended for further evaluation.
Note: All alternatives (except W-1 Do Nothing) will require additional water storage and upgrades to the water distribution system.	

Based on the screening described above the following water supply alternatives will be given further consideration:

- Alternative W-4: Modify Operation and Maintenance Practices
- Alternative W-5: Expand/Upgrade Existing Groundwater Supplies
- Alternative W-6: New Groundwater Supplies

Alternatives W-1 and W-2 do not address the 2041 water demand requirements and identified deficiencies, therefore, will not be considered in any further evaluation. Water conservation practices (Alternative W-3), combined with the recommended alternative solution, will continue to be supported by the Region on a regular basis.

3.2 Strategic Water Supply Options

Strategic water supply options, presented in **Table 3-2**, were developed for further evaluation following a firm capacity approach based on combinations of Alternative Solutions W-4 to W-6:

Option WS-1: Wilmot Centre Wells K50 and K51 plus Well NH3

Option WS-2: Wilmot Centre Wells K50 and K51 plus Well NH3 plus Baden Wells

Option WS-3: Wilmot Centre Wells K50 and K51 plus Well NH3 plus new NH4 Well

Option WS-4: Wilmot Centre Wells K50 and K51 plus Well NH3 plus new K52 Wilmot Centre Well

Option WS-5: Wilmot Centre Wells K50 and K51 (at reduced yield) plus Well NH3 plus Baden Wells plus new NH4 Well

The total capacity of all options appears to satisfy projected demand; however, with the largest source removed (firm capacity approach), not all options will meet the projected 2041 (high) maximum day demand of 9,256 m³/d (107 L/s).

Associated upgrades to the distribution system and storage are presented in **Sections 3.4** and **3.5**.

3.2.1 Option WS-1: Wilmot Centre Wells (K50 and K51) plus Well NH3

Strategic Supply Option WS-1 represents continued use of the existing water supply sources (Wells NH3 and K50s), with increased capacity available from the Wilmot Centre Wellfield per the current strategy for water takings over time. Well NH3 has a capacity to supply 3,542 m³/d (41 L/s) and each Wilmot Centre Well (K50 and K51) can supply 6,826 m³/d (79 L/s). The total combined available flow is 17,194 m³/d (199 L/s), with 9,677 m³/d (112 L/s) available to Baden/New Hamburg and the Gastmeier Ponds and 7,517 m³/d (87 L/s) supplied to the IUS, assuming maximum taking from K50 wells of 13,651 m³/d (158 L/s) are confirmed during the Wilmot Centre Monitoring Program).

It is anticipated during future max day demand requirements for Baden-New Hamburg; the flow diverted to the Gastmeier Ponds could be limited to 432 m³/d (5 L/s). The total available capacity to Baden/New Hamburg servicing area meets the projected 2041 high maximum day demand when all wells are in operation; however if one Wilmot Centre well were offline, neither Baden/New Hamburg nor the IUS would be supplied with the required flows. The water supplied to the IUS if one Wilmot Centre well were off-line would be limited by one Wilmot Centre well capacity which is 6,826 m³/d (79 L/s). Sub-options WS-1A to WS-1C provide variations of supply flows to the IUS.

Table 3-2: Water Supply Strategic Options

Strategic Water Supply Option	Water Supply Sources					Total Capacity		Firm Capacity		
	NH3	K50 & K51 (less IUS)	B1 & B2	NH4 (new)	K52 (standby)	Q to B-NH		Q to B-NH		Q to IUS
	(41 L/s)	(158-87 L/s)	(35 + 43) L/s)	(30 L/s)	(80 L/s)	(L/s)	(m3/d)	(L/s)	(m3/d)	(L/s)
WS-1A	41	71				112	9,677	41	3,542	79
WS-1B	41	71				112	9,677	87	7,517	33
WS-1C	41	71				112	9,677	107	9,254	13
WS-2A	41	71	66			178	15,400	107	9,266	79
WS-2B	41	71	55			167	14,386	107	9,202	68
WS-3A	30	71		30		131	11,318	60	5,184	79
WS-3B	30	71		30		131	11,318	87	7,517	52
WS-3C	30	71		30		131	11,318	107	9,256	32
WS-4	41	71			79	112	9,677	112	9,677	87
WS-5	30	37	59	30		156	13,478	126	10,886	87

Assumptions:

1. capacity of one K50 well = 79 L/s
2. capacity of NH3 + NH4(new) = 60 L/s
3. No loss with iron and manganese treatment of NH3 water at the NHWTP
4. IUS capacity used only for redundancy in Firm Capacity
5. B wells capacity 69 L/s less 4 to 21% loss for treatment residuals
6. Alt 5 assumes max capacity of K50s limited to 124 L/s
7. Flow diverted to Gastmeier Ponds would be limited to 432 m3/d (5L/s) in Options 1C and 4B.

Option WS-1A: If one Wilmot Centre well were offline, Baden/New Hamburg would be supplied only by well NH3 with 3,542 m³/d (41 L/s) and the IUS would be supplied with the maximum capacity of one Wilmot Centre well which is 6,826 m³/d (79 L/s). This sub-option would not provide the required firm capacity for the projected 2041 (low and high) water demands; therefore, it will not be further evaluated.

Option WS-1B (2041 low MDD): in this scenario, if one Wilmot Centre well were offline, the remaining Wilmot well would supply the IUS with a reduced flow to provide firm capacity as required. Baden/New Hamburg would be supplied with the projected 2041 (low) maximum day demand of 7,541 m³/d (87 L/s) and the IUS would be supplied with 2,851 m³/d (33 L/s) instead of 6,826 m³/d (79 L/s).

Option WS-1C (2041 high MDD): in this scenario, if one Wilmot Centre well were offline, the remaining Wilmot well would supply the IUS with a reduced flow to provide firm capacity as required. Baden/New Hamburg would be supplied with the projected 2041 (high) maximum day demand of 9,256 m³/d (107 L/s) and the IUS would be supplied with 1,123 m³/d (13 L/s) instead of 6,826 m³/d (79 L/s).

Pros: No capital investment required at Baden/New Hamburg.

Cons: The Region would need to consider potential impacts of less water available from the K50 wells to the IUS if one supply well is out of operation (maintenance or emergency condition). If the maximum combined taking from the K50s is not confirmed to be sustainable during the Wilmot Centre Monitoring Program, the total available flow would be 4,666 m³/d (54 L/s) (including 3,542 m³/d (41 L/s) from the NH3 well), which would not be sufficient based on the projected future water demand.

Class EA Schedule: A Class EA would not be required for Baden/New Hamburg for this water supply option; however, a Class EA may be required for the alternative water source for IUS.

3.2.2 Option WS-2: Wilmot Centre Wells (K50 and K51) plus Well NH3 plus Baden Wells

This alternative includes the existing water supply sources (NH3 and K50s) plus re-activating the Baden wells. The Baden Wells have a combined capacity of 5,960 m³/d (69 L/s). However, the Baden wells would require treatment to remove nitrate, resulting in a combined finished water capacity ranging from 4,750 to 5,700 m³/d (from 55 to 66 L/s), due to loss with water treatment residuals depending on the treatment technology used. Total available capacity, with ion exchange system for nitrate removal at the Baden Wells, meets 2041 high maximum day demand and firm capacity with one Wilmot Centre well off-line (Option WS-2A); however to meet the 2041 high MDD with reverse osmosis for nitrate removal and one Wilmot Centre Well off-line, the flow to the IUS would be reduced to 5,875 m³/d (68 L/s) instead of 6,826 m³/d (79 L/s). Treatment alternatives for nitrate removal are presented in **Section 3.3.1**.

Needs: Provide treatment for nitrate removal at the Baden wells site. New MOE PTTW and Drinking Water Permit. Rehabilitation and condition survey of both Baden Wells would be required for their re-activation.

Pros: 2041 high MDD with firm capacity would be achieved with Ion Exchange for nitrate removal without compromising the quantity of water supplied to IUS. Land acquisition is not required.

Cons: High capital investment for nitrate removal system. The Region would need to consider potential impacts of less water available from the K50 wells to the IUS if one supply well is out of operation (maintenance or emergency condition). In addition, there is the possibility that there may be public opposition to supply Baden-New Hamburg with these wells.

Class EA Schedule: Completion of a Schedule C Class EA Study is required for implementation of treatment facilities at the Baden wells.

3.2.3 Option WS-3: Wilmot Centre Wells (K50 and K51) plus Well NH3 and new Well NH4

This alternative includes the existing water supply sources (Well NH3 and K50s) plus an additional well in the New Hamburg well field (NH4). Results from test wells located south of Highway 7/8 indicated that a second well near NH3 could have a yield of 30 L/s, resulting in a combined well field capacity from the two New Hamburg wells of 60 L/s, allowing for interference effects (i.e. reduction in NH3 from 41 to 30 L/s). Total available capacity meets 2041 high maximum day demand; however, under a firm capacity scenario (i.e. one Wilmot Centre well off-line), both the high and low 2041 MDD would require reduction in flow from K50s to the IUS. Development of additional groundwater supply in the Bass Island Formation in south-western New Hamburg would require a comprehensive groundwater supply study to determine the sustainable yield. It is anticipated that new treatment facilities for iron/manganese removal or an upgrade to the existing New Hamburg Water Treatment plant would be required for the additional flow as the groundwater is expected to have similar water quality as well NH3. Treatment alternatives for iron/manganese removal are presented in **Section 3.3.2**. Sub-options WS-3A to WS-3C provide variations of supply flows to the IUS.

Option WS-3A: If one Wilmot Centre well was offline, Baden/New Hamburg would be supplied by wells NH3 and new NH4 with 5,184 m³/d (60 L/s) and flow to the IUS from the K50s would be limited to one well at 6,826 m³/d (79 L/s). This sub-option would not provide the required firm capacity for the projected 2041 (low and high) water demands; therefore, it will not be further evaluated.

Option WS-3B (2041 low MDD): In this scenario the Wilmot wells would supply the IUS with a reduced flow to provide firm capacity as required: 7,541 m³/d (87 L/s) to B-NH and 4,493 m³/d (52 L/s) to IUS.

Option WS-3C (2041 high MDD): In this scenario the Wilmot wells would supply the IUS with a reduced flow to provide firm capacity as required: 9,256 m³/d (107 L/s) to B-NH and 2,765 m³/d (32 L/s) to IUS.

Needs: Provide treatment for iron/manganese removal for additional flow. A new wellfield MOE PTTW to include a new well would be required. New watermain to connect the new NH4 to either the New Hamburg Reservoir located at the New Hamburg Water Treatment Plant or to well NH3.

Pros: Public did not oppose to new wells at the New Hamburg Wellfield during the 1996 WSMP. New NH4 well would be located nearby well NH3.

Cons: High capital investment for iron/manganese removal system and acquisition of land south of Highway 7/8 (to locate the new well NH4). The Region would need to consider potential impacts of less water available from the K50 wells to the IUS if one supply well is out of operation (maintenance or emergency condition).

Class EA Schedule: Construction of a new well requiring treatment would require completion of a Schedule C Class EA.

3.2.4 Option WS-4: Wilmot Centre Wells (K50 and K51) plus Well NH3 and new Wilmot Centre well (K52)

This alternative includes the existing water supply sources (Well NH3 and K50s), as shown in **Figure 3-1**, plus a new well in the Wilmot Centre Wellfield (Well K52). The new K52 well would function as a standby well. A backup well in the Wilmot Centre wellfield with the same pumping capacity of the existing wells would ensure that firm capacity is always provided with one of the K50s wells out of service. However, this would not address the condition where NH3 well is out of service. If NH3 well were offline, the firm capacity would require a reduced flow to the IUS of 4,493 m³/d (52 L/s) for the 2041 (High) 2041 MDD scenario.

Needs: New well at the K50s site. Connect new K52 well to the distribution system.

Pros: Disinfection and standby power facilities already in place. Land acquisition not required as there is space available within the existing site limits.

Cons: High capital investment with new well house and acquisition of land by the K50's site. The Region would need to consider potential impacts of less water available from the K50 wells to the IUS or a new water source if one supply well is out of operation (maintenance or emergency condition) or if the maximum combined taking from the K50s is not confirmed to be sustainable during the Wilmot Centre Monitoring Program.

Class EA Schedule: Schedule A is recommended to install new wells at an existing municipal well site, where the existing rated yield will not be exceeded.

3.2.5 Option WS-5: Wilmot Centre Wells K50 and K51 (at reduced yield) plus Well NH3 plus Baden wells plus Well NH4

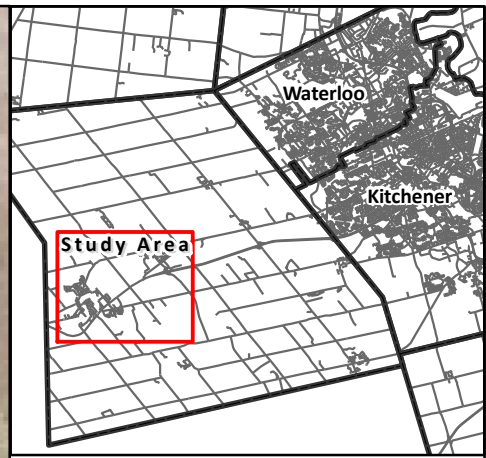
This alternative includes all possible options (K50s, NH3, NH4, and Baden Wells) in the event that the pumping capacity of the Wilmot Centre wells is capped at 124 L/s based on future results of the long term monitoring program. This alternative would exceed the 2041 high demand requirements even with the largest producing well was off-line (firm capacity approach).

Needs: Provide treatment for nitrate removal at Baden wells, and install a new well at the New Hamburg Wellfield including treatment for iron/manganese removal.

Pros: 2041 high demands would meet the firm capacity requirements.

Cons: High capital cost. Land acquisition required for new NH4 well. MOE PTTWs and Drinking water Permit amendments required.

Class EA Schedule: Schedule C is recommended to construct a new water treatment plant or expand existing treatment plant beyond existing rated capacity.



Legend

- Wells K50 & K51 (Willmont Centre)
- Rivers
- Roads
- Land owned by Region

Baden - New Hamburg Water & Wastewater Master Plan Update

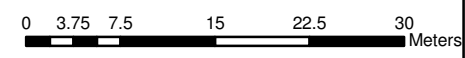
Figure 3-1:
Wilmot Centre Wells Site (K50s)

Datum: NAD 83, Zone 17
Source: Region of Waterloo

June 2011



AECOM



3.2.6 Water Supply Options Estimated Conceptual Life Cycle

A conceptual level 20-year life cycle cost estimate for each strategic option is presented in **Table 3-3**. All costing has been developed for planning purposes based on a conceptual level of design with 35% contingency. All pricing is based on 2010 dollars with no consideration for escalation. Engineering and construction services are estimated at 15% of capital cost. Allowance for land acquisition is not included.

The design concepts for site development have been established with minimal geotechnical and site survey information. Field investigations during subsequent phases of this project will more accurately define subsurface conditions and elevations throughout the site.

The following assumptions were made regarding each well service life, rehabilitation frequency and cost:

- Well service life is dependent on well rehabilitation. If proper maintenance is done and well is in compliance with regulatory agencies, a well will be in service indeterminately.
- Well rehabilitation may be required every 5 to 10 years. For costing purposes, it was assumed each well would be rehabilitated every 5 years. The rehabilitation cost will vary from \$50,000 to \$80,000 per well, depending on the well depth.

Table 3-3: Water Supply Strategic Options Conceptual Life Cycle Cost (20 years)

Water Supply Strategic Option	Description	New Finished Water Produced, m ³ /d (L/s)	Conceptual Capital Cost (C\$) ¹	Additional Annual O&M Cost (\$/yr)	Cost per additional cubic meter water produced (\$/m ³) ³
WS-1	K50s and NH3	0	\$ 0	\$ 0	\$ 0
WS-2	K50s, NH3, and Baden Wells (ion exchange)	5700 (66)	\$ 1.4 M to \$ 1.8 M	\$ 0.3 M	\$ 0.18 - \$ 0.19
	K50s, NH3, and Baden Wells (reverse osmosis)	4750 (55)	\$ 2.2 M	\$ 1.0 M	\$ 0.66
WS-3	K50s, NH3, New NH4 Well (expand NHWTP)	1,728 (20)	\$ 2.1 M*	\$ 0.1 M	\$ 0.34
	K50s, NH3, New NH4 Well (treatment at NH4 site)	1,728 (20)	\$ 3.3 M*	\$ 0.1 M	\$ 0.44
WS-4	K50s, NH3, and New K52 Well	0 ²	\$ 1.1 M*	\$ 0	-
WS-5	K50s, NH3, Baden Wells, New NH4 Well (reverse osmosis, expand NHWTP)	6478 (75)	\$ 4.3 M*	\$ 1.1	\$ 0.57
	K50s, NH3, Baden Wells, New NH4 Well (reverse osmosis, treatment at NH4 site)	6478 (75)	\$ 5.5 M*	\$ 1.1	\$ 0.60
	K50s, NH3, Baden Wells, New NH4 Well (ion exchange, expand NHWTP)	7428 (86)	\$ 3.5 M to \$ 3.9 M*	\$ 0.4	\$ 0.22 to \$ 0.23
	K50s, NH3, Baden Wells, New NH4 Well (ion exchange, treatment at NH4 site)	7428 (86)	\$ 5 M to \$ 5.5 M*	\$ 0.4	\$ 0.25 to \$ 0.26
¹ Cost for new water produced; ² with standby capability. ³ including rehabilitation of new wells every 5 years* Land acquisition cost not included.					

3.2.7 Summary of Water Supply Options Advantages and Disadvantages

A summary of advantages and disadvantages of the proposed water supply options is provided in **Table 3-4**.

Table 3-4: Water Supply Strategic Options Advantages vs. Disadvantages

Water Supply Strategic Option	Wells	Class EA Schedule	Advantages	Disadvantages
WS-1	K50/K51, NH3	-	No capital investment required	reduction in supply under firm capacity conditions
WS-2	K50/K51, NH3, B1/B2	C	- Firm capacity requirement achieved with ion exchange for nitrate removal at Baden Wells - Supply available to IUS - Land acquisition not required	High cost to reactivate Baden Wells
WS-3	K50/K51, NH3, NH4 (new)	C	- NHWTP could be expanded to provide additional iron/manganese treatment - revised wellfield PTTW to include NH4	- Land acquisition and pipeline easement required - High capital cost investment - reduction in supply to IUS under firm capacity conditions - Uncertainty of environmental impacts
WS-4	K50/K51, K52 (new), NH3	A	- Firm capacity required achieved - Disinfection and standby power facilities already in place - Land acquisition not required	- Moderate capital cost investment - reduction in supply to IUS under firm capacity conditions
WS-5	K50/K51, NH3, NH4 (new), B1/B2	C	- Firm capacity requirement achieved - Supply available to IUS	- Land acquisition required - Very high capital cost investment - Uncertainty of environmental impacts

3.2.8 Further Investigation

The following items require further investigation for a better evaluation of the above water supply strategic options:

- The Region must consider the impact of reduced supply from K50s to the IUS in a future firm capacity scenario (one supply well out of service) in Baden - New Hamburg.
- Availability and cost of land nearby the Wilmot Centre Wells and south of Highway 7/8 (by well NH3) for installation of new wells.
- Hydrogeological investigations to support additional groundwater supply options.

3.3 Water Treatment Alternatives

Treatment requirements are anticipated at the Baden Wells (nitrate removal), and at the new NH4 well (iron removal) should they be part of the preferred alternative. Water treatment options are presented below for further evaluation.

3.3.1 Baden Wells

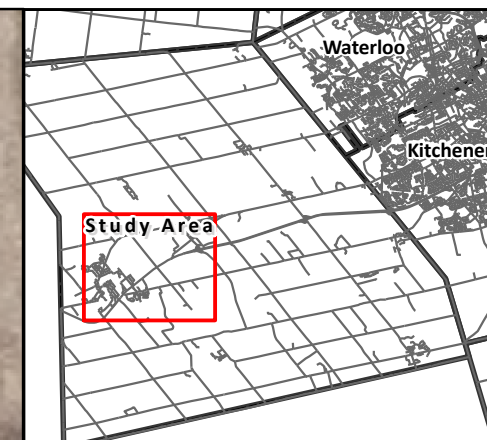
Between 1985 and 1991, nitrate concentrations at B1 and B2 ranged between 6.0 and 8.5 mg/L. Nitrate concentrations decreased slightly to a low of 5.3 mg/L in 1992 and subsequently increased to a range of 8.5 to 15 mg/L. No water quality data is available since 2000. It was anticipated in the 1996 WSMP that nitrate concentrations will likely not exceed 15 mg/L on a long term basis. The maximum acceptable concentration of nitrates in drinking water per the Ontario Drinking Water Standard (ODWS) is 10 mg/L as nitrogen. Therefore, treatment for nitrate removal would be required to utilize the Baden Wells. Based on historical pumping information and monitoring, it is anticipated that the wells can readily achieve a sustainable rate of 5,962 m³/d (69 L/s).

The 1996 WSMP evaluated five different treatment technologies for nitrate removal (chemical reduction, reverse osmosis, electrodialysis, biological denitrification, and ion exchange), and recommended ion exchange as the most appropriate treatment technology. Ion exchange and reverse osmosis systems are most commonly used for nitrate removal; therefore, both systems were re-evaluated as treatment options for the Baden well supply in order to fully evaluate this source relative to the other alternatives.

Option WB-1 Ion Exchange: The ion exchange process for the removal of nitrates operates similar to the process that is used in water softeners, with an ion exchange type of resin instead of a softening resin. The process uses a strong base anion exchange resin, which is regenerated with common salt. The waste generated depends on the ion exchange system and manufacturer, ranging from 0.1% to 4%, which would result in product water flows at the Baden wells of no less than 5,702 m³/d (66 L/s). The required footprint also varies depending on the manufacturer, ranging from 70 to 110 m². The estimated conceptual cost to add an ion exchange system to the Baden wells site ranges from \$1.3 M to \$1.4 M. Operation and maintenance (O&M) costs are estimated to be approximately \$0.03 per cubic metre treated. A pilot study is recommended to size the ion exchange properly, and to determine the loading of the waste generated.

Option WB-2 Reverse Osmosis (RO): A semi-permeable membrane is used to remove various inorganic matter from the water by applying pressure to force the water through the membrane, leaving the particles behind (contaminants and minerals), including nitrates. RO systems typically reduce nitrate concentrations by 80%. RO systems waste a high volume of water, ranging from 20 to 25%, which would result in product water flows at the Baden wells between 4,406 m³/d (51 L/s) and 4,752 m³/d (55 L/s). The RO required footprint ranges from 60 to 150 m². The estimated conceptual cost to provide an RO system at the Baden wells site would be about \$1.8 M. Operation and maintenance (O&M) cost is estimated to be approximately \$0.15 per cubic metre treated.

As shown in **Figure 3-2**, the Baden wells site has area available for either treatment system.



Legend

- Roads
- Existing Watermains
- Proposed Watermain
- Baden Building Additions**
 - Option 1 (WB-1)
 - Option 2 (WB-2)
 - Well B1 & B2 (Existing)

Baden - New Hamburg Water &
Wastewater Master Plan
Update

Figure 3-2:
Baden Wells Water Treatment Options

Datum: NAD 83, Zone 17
Source: Region of Waterloo

June 2011



AECOM



0 2 4 8 12 16 Meters

Nitrate Treatment Technology Performance Summary

Ion exchange and RO have been approved by the United States Environmental Protection Agency as Best Available Technologies for nitrate removal. There are numerous studies that investigated the feasibility of ion exchange for nitrate removal, and several full-scale plants have been built (mostly in the U.S.). One of the first ion exchange systems for nitrate removal (44 L/s capacity) was built in 1983 in California, which achieves a nitrate reduction of approximately 84% (Lauch and Guter, 1986). Ion exchange systems are supplied by several manufacturers, such as, ORICA, TONKA, Siemens, Dow, among others. RO systems for nitrate removal are not as common as ion exchange systems.

A recent study was conducted by the University of Waterloo assessing ion exchange and RO systems for nitrate removal. This study consisted of bench tests using water samples prepared in the lab and groundwater collected from the GW1 and GW2 Region's sites. GW1 and GW1 groundwater has elevated nitrate concentrations, as well as, high sulphate and chlorides that may compete during the treatment process. This study concluded that both treatments can successfully remove nitrate at or below the required levels. Ion exchange systems do not require any post treatment, as opposed to RO that may require post treatment since the water may potentially be corrosive by the removal of all ions. The author recommended the use of ion exchange systems with caution as the presence of other anions in the water, such as high sulphate, may interfere with the effectiveness of the treatment (Shams, 2010).

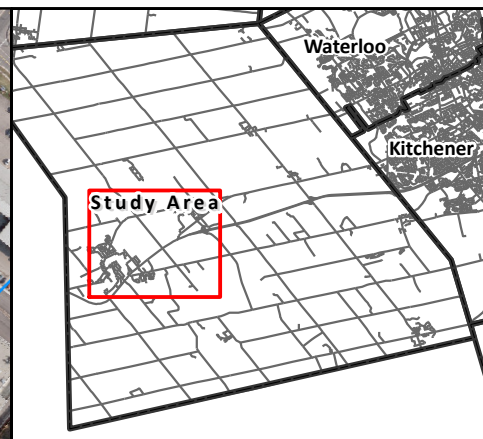
3.3.2 New NH₄ Well

Assuming the water at the proposed NH₄ well will have similar concentrations as well NH₃, the expected iron concentration would range from 0.4 to 0.5 mg/L. The MOE guideline for iron concentration in drinking water is 0.3 mg/L.

There are two options for providing iron treatment for the additional water from the new NH₄ well (

Figure 3-3):

- Option WNH-1: Expansion to NHWTP
- Option WNH-2: Treatment at new NH₄ well site.



Legend

- Existing Pipe Network
- Option WNH - 1
- Option WNH - 2
- Nith River

Baden - New Hamburg Water & Wastewater Master Plan Update

Figure 3-3: New Hamburg New NH4 Well Water Treatment Options

Datum: NAD 83, Zone 17
Source: Region of Waterloo

June 2011



AECOM



0 30 60 120 180 240 Meters

Option WNH-1 Expand NHWTP: The water from well NH3 is treated at the New Hamburg Water Treatment Plant (NHWTP), which has a maximum capacity to treat 3,542 m³/d (41 L/s). Since the combined flow of well NH3 and new NH4 well is estimated to be 5,184 m³/d (60 L/s), additional iron treatment capacity would be required. This option would consist of increasing the NHWTP capacity in 1,642 m³/d (19 L/s), by adding a new Electromedia 1 filter vessel within the NHWTP building. Additional piping, valves, and a panel would also be required at the NHWTP. The new NH4 well would be placed in new 48 m² well house, provided with a sodium hypochlorite system for chlorination. Contact time would be provided at the NHWTP Reservoir. The raw chlorinated water from the new NH4 well would be discharged to the existing 250 mm pipe that connects well NH3 to the NHWTP, via a new 200 mm pipe (approximately 500 m). Since the recommended site is located on the south side of Highway 7/8 and the service area is on the north side (as well as Well NH3 and NHWTP), directional drilling may be required to install the new 200 mm pipe segment. The estimated conceptual cost to expand NHWTP, install a new NH4 well, and connect to the distribution system, excluding land acquisition, would be approximately \$2.1 M.

Option WNH-2 Treatment at new NH4 well site: this option would have a new iron removal treatment system at the new NH4 well site with a capacity of 2,592 m³/d (30 L/s), including a complete Electromedia 1 treatment package for iron removal. This option would provide operational flexibility, as the new NH4 well would operate independently from well NH3 (except from withdrawal influences). The new NH4 well and iron treatment would be placed in a 120 m² building, provided with a sodium hypochlorite system for chlorination. Contact time would be provided at the NHWTP Reservoir. The product chlorinated water from the new NH4 well would be discharged directly to the NHWTP Reservoir via a new 200 mm pipe (approximately 1,500 m). Since the recommended site is located on the south side of Highway 7/8 and the service area is on the north side (as well as the NHWTP), directional drilling may be required to install the new 200 mm pipe segment. The estimated conceptual cost to expand NHWTP, install new NH4 well, and connect to the NHWTP Reservoir, excluding land acquisition, would be approximately \$3.3 M.

3.3.3 Summary of Water Treatment Options Advantages and Disadvantages

A summary of advantages and disadvantages of water treatment options is provided in **Table 3-5**.

Table 3-5: Treatment Options Advantages vs. Disadvantages

Chemical of Interest	Treatment Option	Advantages	Disadvantages
Nitrate (Baden Wells)	WB-1 – Ion Exchange	- No post-treatment required - Lower capital and O&M Cost - Low waste volume generated - Several full-scale plants in operation - Similar operational concept of water softeners.	New technology for the Region
	WB-2 – Reverse Osmosis	Pathogen free water	- May require post treatment - Higher capital and O&M Cost - High waste volume generated - Less popular for nitrate removal
Iron (New NH4 Well)	WNH 1 Expand NHWTP	- Lower capital cost - Less land required - No major changes in current O&M practices	Less flexibility (one pipe discharging to the NHWTP)
	WNH2 Treatment at new NH4 well site	- More operational flexibility (two pipes discharging to NHWTP) “standby” capability	- Higher capital cost - More land required - Additional O&M requirements

3.4 Water Storage Alternatives

The total water storage volume requirements for the study area to 2041 are presented in **Table 3-6**. Fire flows requirements were revised by interpolating MOE Suggested Fire Flows and Durations. The results indicate that Baden/New Hamburg area will require additional storage capacity by 2021 as anticipated in the 1996 WSMP.

Table 3-6: Storage Requirements

Year	Equivalent Population	Fire Flow (L/s)	Duration (hrs)	Total Storage Required (m ³)	Surplus/Deficit (m ³)
2008	15,220	236.7	3.6	5,213	2,150
2016	19,660	268.1	4.3	6,753	610
2021	22,600	299.9	4.5	7,963	- 600
2029	27,850	322.3	5.0	9,527	- 2,164
2041 (low)	28,840	327.2	5.0	9,718	- 2,355
2041 (high)	35,400	358.3	5.3	11,507	- 4,144
<i>Note: MOE fire flows and duration were extrapolated</i> <i>Existing Total Storage: 7,363 m³</i>					

The 2041 (Low and High) scenarios require an additional storage capacity of approximately 2,500 and 4,200 m³, respectively. Storage options were formulated assuming the existing storage will be at its full capacity in 2041. It is important to note that the Baden elevated tower currently can only be filled to up to 30% due to high pressures encountered in the low-lying area of the distribution system, near the Nith River. Solution to the high pressure problems are presented in **Section 3.5.1**.

Figure 3-4 shows the proposed storage locations for Options S-1 to S-3. Any of the options below would be able to accommodate the required volumes for the 2041 scenarios (Low and High).

Option S-1 – Expand NHWTP Reservoir: the existing NHWTP Reservoir could be expanded on the existing site. The existing high lift pumping station would be upgraded/expanded as well. As shown in

Figure 3-5, the NHWTP site has area available for additional storage.

Option S-2 – New storage at the Baden Wells: a new reservoir would be located within the Baden Wells site.

Option S-3 – New storage in a new location: a new reservoir located in an area between Baden and New Hamburg (**Figure 1-14**). Additional investigation is required to determine the best location, as well as, the feasibility based on the current distribution system. Land acquisition could be required depending on the site location.

Option S-4 – Combination of above: If the alternatives above are considered feasible, and recommended for further evaluation, combination of storage alternatives will be evaluated.

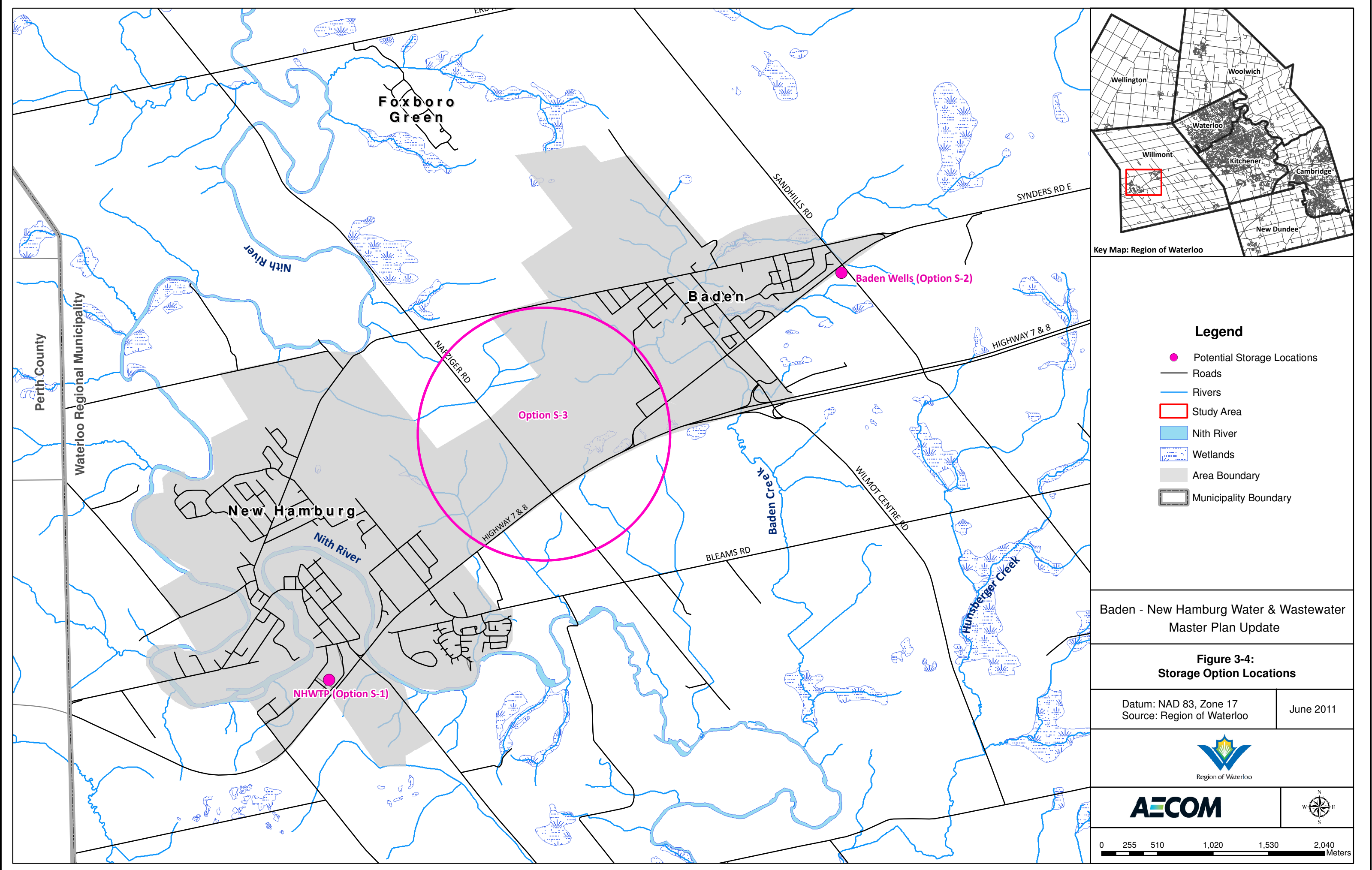
These storage options will be developed further during the Design Concept Phase of the Storage Class EA. Depending on the preferred water supply alternative, some storage options would no longer be feasible.

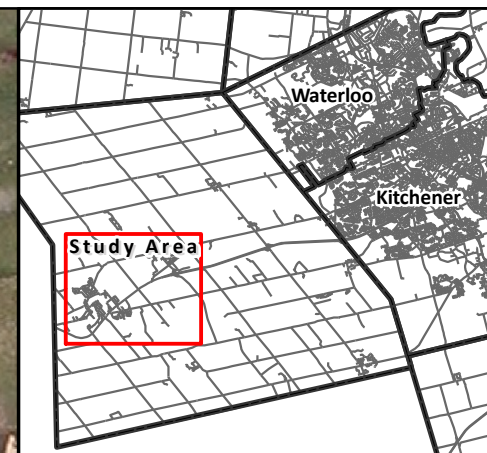
3.4.1.1 Summary of Storage Options Advantages and Disadvantages

A summary of advantages and disadvantages of options is provided in **Table 3-7**.

Table 3-7: Water Storage Advantages vs. Disadvantages

Storage Option	Class EA Schedule	Advantages	Disadvantages
Option S-1 Expand NHWTP Reservoir	B	- Land available on NHWTP site - No major changes to the current distribution system - Storage would be split between Baden and New Hamburg	High lift pumping station would require upgrade/expansion
Option S-2 Storage at Baden Wells Site	B	- Land available on Baden Wells site - No major changes to the current distribution system	Most water storage would be in Baden resulting in greater reliance on transmission mains between the communities
Option S-3 New Location	B*	Central location	- New high lift pumping would required - May require land acquisition
Option S-4 Combination of Above	B*	- Operational flexibility - Smaller pipes may be required	- Higher cost - Land acquisition may required
Schedule B is adequate to “establish new or expand/replace existing water storage facilities.”			
* Confirmation depends on site location			





Legend

- Roads
- New Hamburg Existing Pipe
- Existing Reservoir
- High Lift Pumping Station Expansion
- Reservoir Expansion Area

Baden - New Hamburg Water &
Wastewater Master Plan
Update

Figure 3-5:
Reservoir Expansion at NHWP Site

Datum: NAD 83, Zone 17
Source: Region of Waterloo

June 2011



AECOM



0 4 8 16 24 32 Meters

3.5 Water Distribution Needs

Several new watermains will be required between Baden and New Hamburg to service new growth. Locations and pipe diameters depend on the population distribution; however, this has not been determined throughout Baden and New Hamburg. Therefore, tentative locations of proposed watermains and their respective diameters are shown in

Figure 3-8 (proposed pipes are shown in orange). Depending on the planned population spatial distribution, these proposed watermains sizes and locations may change significantly.

Future water distribution system requirements will need to be developed further with planning projections, development timing and water supply alternatives all being considered as they are dependent on the development of new water supply sources (e.g. alternative for new NH4 or re-activating Baden wells).

3.5.1 High Pressure Areas

The existing distribution system has high pressures in the low-lying areas when the Baden Elevated Tower is more than 30% full. Based on hydraulic modeling results, the low lying areas with excessively high pressures (approaching 100 psi) will be resolved in most locations by the addition of new pipes as proposed in

Figure 3-8 (orange lines) and improved transmission between the WTP and elevated storage.

The south-western side of New Hamburg, as illustrated in **Figure 1-15** (red nodes); will still encounter pressures approaching 100 psi due to the existing topography. The following three possible options are developed to address the high pressure problem in areas with high pressures.

Option NHD-1 – Central Pressure Reducing System: This option would consist of building five pressure reducing chambers with pressure reducing valves (PRVs) in strategic locations to reduce high pressures within the low elevation areas (**Figure 3-6**). Communications to the Region/Township SCADA system would be required for operation and maintenance purposes. Further hydraulic modeling is recommended to confirm the number of chambers required and proposed system operation. The estimated capital cost of implementing this option is approximately \$1.1 M, much higher than Option NHD-2.

Option NHD-2 – Residential Pressure Reducing Valves: Approximately 420 units of residential PRVs would be provided to the customers located within the high pressure zones as shown within the orange circled areas (**Figure 3-7**). Maintenance and replacement of these individual PRVs on a regular basis would be responsibility of the homeowner. This would have a low capital cost of approximately \$0.3 M and no O&M cost to the Region/Township.

Option NHD-3 – Hybrid – Central Pressure Reducing Areas and Residential Pressure Reducing Valves in Remote Areas: This alternative is a combination of Alternatives 1 and 2, which would involve four central pressure reducing systems, and approximately 30 residential PRVs installed in remote locations. Further hydraulic investigation is recommended to confirm the number of chambers required and how the system would be operated. The estimated capital cost of this option of \$0.9 M is less than Option NHD-1.

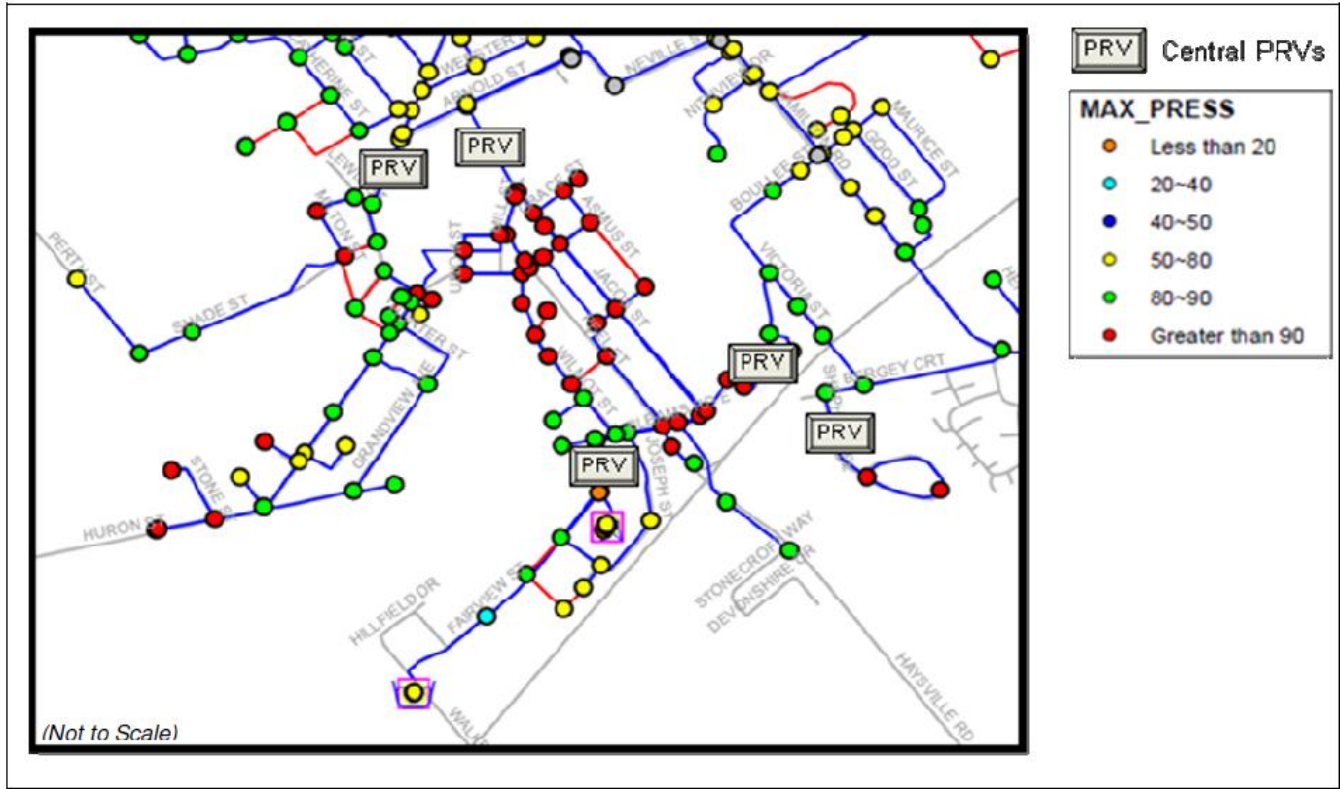


Figure 3-6: New Hamburg High Pressure Area - Option NHD-1 (Central PRVs)

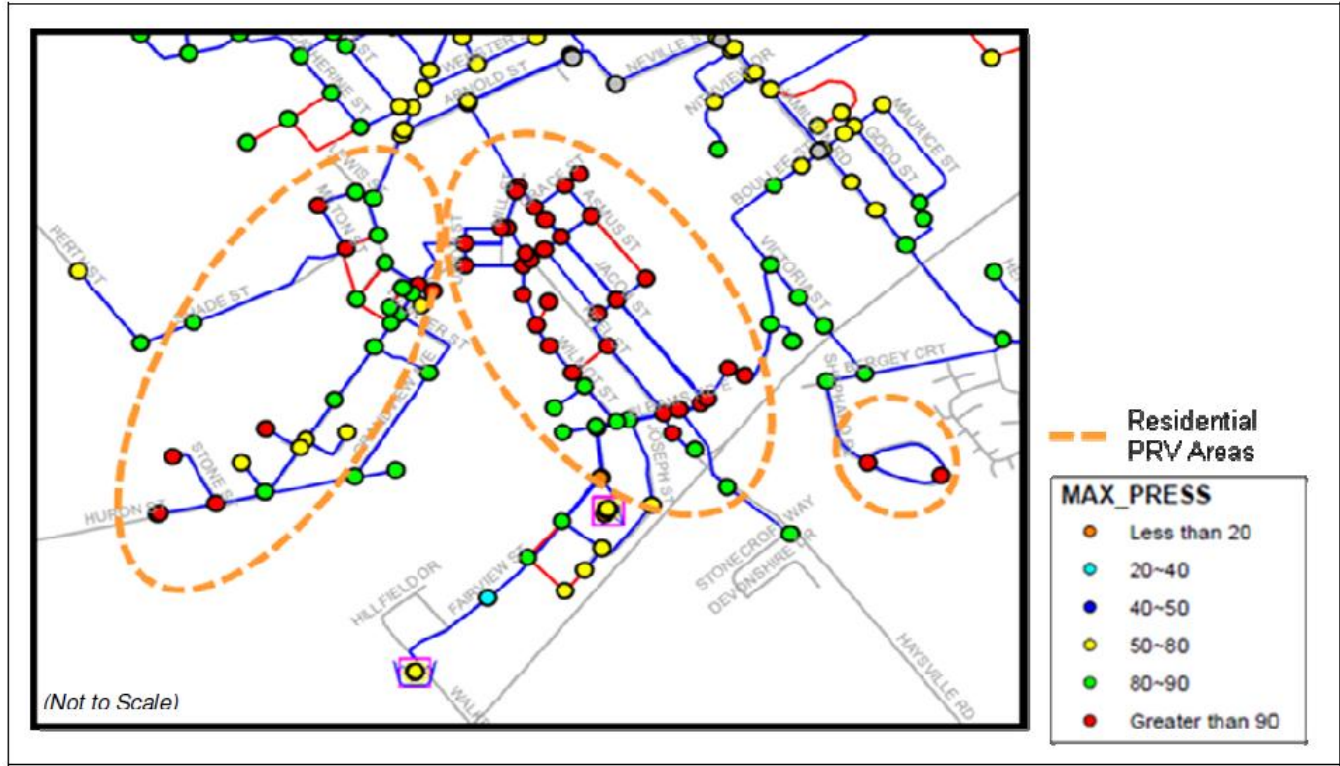


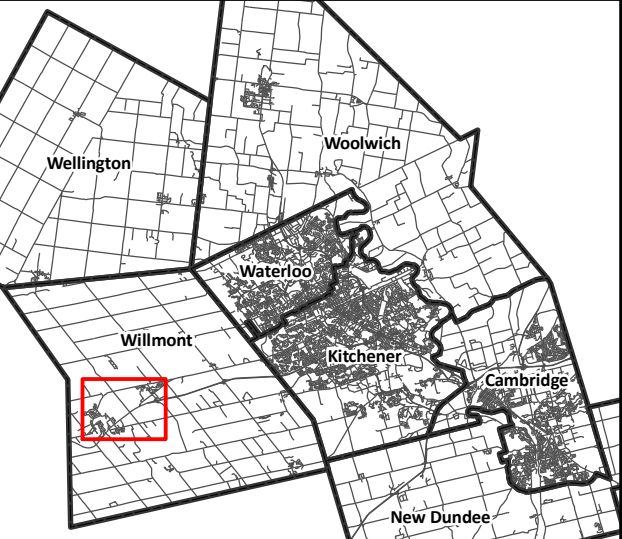
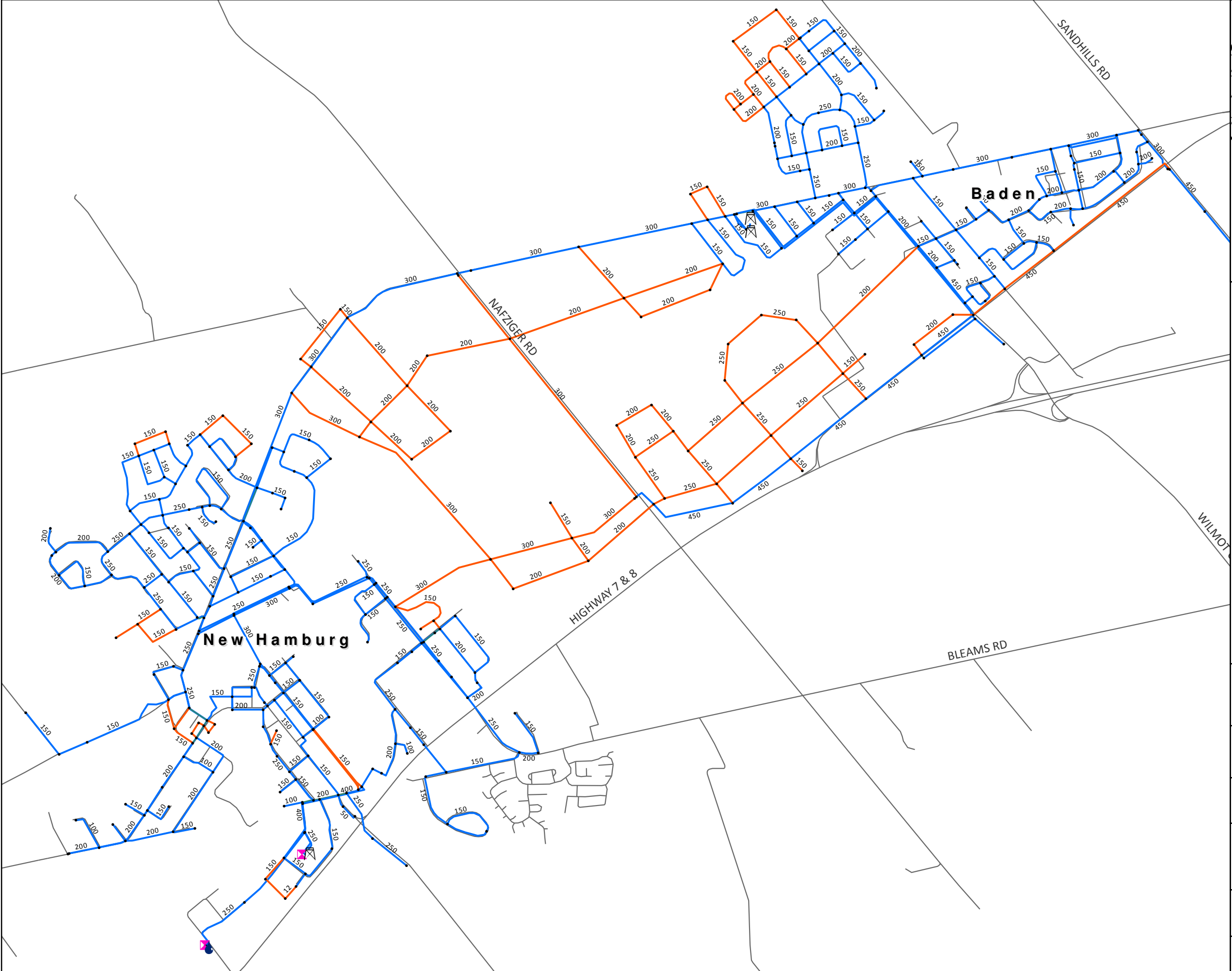
Figure 3-7: New Hamburg High Pressure Area - Option NHD-2 (Residential PRVs)

High Pressure Area Option	Description	Conceptual Cost Estimate (C\$)
NHD-1: Central Pressure Reducing Area (100%)	• Site Works, asphalt repair, etc	250,000
	• Pre-Cast Concrete Chamber (2.4X3m) (including installation) (5 units)	250,000
	• Pressure Reducing Valve (parts and installation)	200,000
	• Communications to Region/Township SCADA system/Electrical (20%)	140,000
	• Estimating Contingency (30%)	252,000
	NHD-1 TOTAL	1,092,000
NHD-2: Residential PRVs	• Plumbing and Parts (421 units)	105,250
	• Installation	105,250
	• Estimating Contingency (30%)	63,150
	NHD-2 TOTAL	273,650
NHD-3: Hybrid - Central Pressuring Reducing Area and Residential PRVs in Remote Locations	• Site Works, asphalt repair, etc.	200,000
	• Pre-Cast Concrete Chamber (2.4X3m) (including installation) (4 units)	200,000
	• Pressure Reducing Valve (parts and installation)	160,000
	• Residential PRVs (plumbing parts, and installation) for remote areas (29 units)	14,500
	• Communications to Region/Township SCADA system/Electrical (20%)	114,900
	• Estimating Contingency (30%)	206,820
	NHD-3 TOTAL	896,220

A summary of advantages and disadvantages of high pressure solution options is provided in **Table 3-8**.

Table 3-8: High Pressure Solution Options Advantages vs. Disadvantages

High Pressure Area Options	Class EA Schedule	Advantages	Disadvantages
NHD-1 – Central Pressure Reducing Area	A	- Easier access for O&M - High public acceptance	- Higher capital cost - Some pipe work required
NHD-2 – Residential PRVs	n/a	- Lower capital cost - No O&M Cost, assuming homeowners would be responsible for O&M	- Low public acceptance - Difficult to maintain, and high O&M cost if Region/Township responsible for maintenance
NHD-3 – Hybrid	A	Moderate public acceptance	- Moderate capital cost - Less pipe work required
<i>Schedule A to “install... appurtenances from existing water mains”, n/a = not applicable</i>			



Key Map: Region of Waterloo

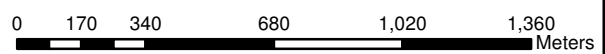
Legend

- Tanks / Reservoir
- Wells
- Pumps
- Junctions
- Existing Pipes (Diameters in mm)
- Proposed Pipes (Diameters in mm)
- Roads

Baden - New Hamburg Water & Wastewater Master Plan Update

**Figure 3-8:
Diameters for Existing and Proposed Pipes**

Datum: NAD 83, Zone 17 Source: Region of Waterloo	June 2011
--	-----------



4 Evaluation Criteria and Approach

4.1 Class EA Master Plan Process and Evaluation Framework

The objective of the Baden-New Hamburg Water and Wastewater Master Plan is to clearly define a “broad” long-range plan which will consist of a “suite” of projects required to implement the plan over the planning period (2041). Various individual projects may also be combined to form a specific strategy. The **Master Plan Volume 3** addresses Phase 1 (Purpose Statement) and Phase 2 (Identify and Evaluate Alternative Solutions) of the MEA Class EA document, and provides a recommendation for future water supply, treatment, storage and distribution projects. The recommendation includes:

- Project description/location;
- Phased-implementation schedule (triggers);
- Recommended Class EA Planning Schedule (i.e. Schedule B or Schedule C or Individual EA); and,
- An overview of how each project relates to the Study Area environmental features which will be addressed in each future Class EA projects.

This approach involves the preparation of a Master plan document at the conclusion of Phases 1 and 2 of the Municipal Class EA process. This Master Plan document will be made available for public comment prior to being approved by the municipality.

The Master Plan was completed at a broad level of assessment thereby requiring more detailed investigations at the project-specific level to fulfill Municipal Class EA documentation requirements for any specific Schedule B and C projects identified within the Master Plan.

The Master Plan will therefore become the basis for, and be used in support of future investigations for the specific Schedule B and C projects identified within it. Schedule B projects would require the filing of the Project File or Environmental Screening Document for public review while Schedule C projects would have to fulfill Phases 3 and 4 prior to filing an Environmental Study Report (ESR) for public review.

Over the planning period Class EA approvals for all Schedule “B” and “C” projects can then be easily secured by using the Master Plan as a starting point and completing remaining Class EA requirements (i.e. alternative route/site/technology evaluations, site specific investigations, notification, consultation and filing of individual Class EA project documents).

4.2 Public Consultation

As stated in Section 1.1.7, a PIC was held in December 2010 to present the water supply preferred alternative and receive feedback from the public. The following represents a summary of the comments received related to the water system:

- Request that the final Class EA solution to be deferred until approval of the ROP and the completion of the Township's Official Plan.
- Need additional details on how potential environmental impacts on the water takings affected the evaluation.
- The proposed staged increase as outlined in the Wilmot Centre Monitoring Program has not been implemented and, therefore, there is no data to support any increase of pumping from the K50s as

sustainable from an environmental perspective. Recommendation of takings from the K50s to be limited at 100 L/s, until sustainability is confirmed with the monitoring program.

- Requested additional information on Baden Wells

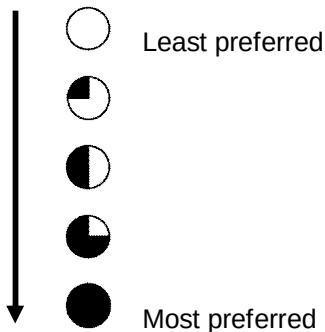
Responses to the above comments were sent to their authors and they were included in the evaluation of alternatives presented in the previous section.

4.3 Use of Descriptive Information and Qualitative Evaluation

The evaluation was not based on a numerical ranking system. Such an approach would have to strictly adhere to statistical methods that are often difficult to apply in a multi-faceted issue such as a Class EA. For example, considerable time and resources can be spent on agreeing on evaluation category weightings (e.g. disagreement on weighting or importance given to a specific category or criteria).

Instead, a descriptive or qualitative evaluation was used to consider the suitability of alternative solutions/strategies and to identify significant advantages and disadvantages with respect to the evaluation criteria. In this respect, comparisons and trade-offs are made between alternatives which are described herein and form the rationale for the identification of a preferred solution or servicing strategy. Trade-offs involve forfeiting an advantage or accepting a disadvantage to address a higher priority consideration. For information purposes only, the alternatives were ranked in order of preference (based on advantages/disadvantages) under the discussion with respect to each aspect of the environment.

For the evaluation summary, the following rating symbols were applied to each alternative solution and evaluation criteria:



The evaluation of alternative solutions was captured in a matrix format to allow direct comparison between alternatives.

4.4 Evaluation Criteria and Methodology

A detailed evaluation of each alternative solution and water supply strategic options were completed based on the impact to the following environmental components (**Table 4-1**) and related evaluation criteria. Water treatment, distribution and storage alternatives will be further evaluated during the implementation stage.

Table 4-1: Evaluation Components

Evaluation Component	Description
Natural Environmental	Component having regard for protecting significant natural and physical elements of the environment (i.e. air, land, water and biota) including natural heritage-environmentally sensitive policy areas.
Social/ Cultural	Component that evaluates potential effects on residents, neighbourhoods, businesses, community character, social cohesion, community features and historical/archaeological and heritage components in addition to municipal and provincial development objectives.
Economic/ Financial	Component that addresses the potential effect on infrastructure capital and O&M costs.
Legal/ Jurisdictional	Component that considers regulatory and land requirements for each alternative.
Technical	Component that considers technical suitability and other engineering aspects of the servicing strategy.

Based on the above the following table has been prepared which provides a detailed list of considerations under each main environmental component. It is important to note that the criteria as presented in **Table 4-2** reflects those applied in previous Regional Master Plans which incorporated public, agency and stakeholder comment.

Table 4-2: Evaluation Criteria for Water Alternatives

Natural Environment Considerations
Potential effects on surface waters
Nith River watershed
Potential effects on groundwater
Source water protection
interference with private or municipal wells
Potential effects on terrestrial environmental biota, trees and vegetation
trees and vegetation
number and significance of trees removed and/or disturbed
extent of loss/disturbance to grass/vegetation
sensitive species habitat (e.g. vulnerable/threatened endangered or locally/regionally rare amphibians, birds and other wildlife)
Planning considerations - potential effects
environmental management planning considerations (e.g. GMS)
Potential effects on Natural Heritage features
natural heritage features, including provincially significant wetlands (PSWs), environmentally significant areas (ESAs), Areas of Natural and Scientific Interest (ANSIs), and sensitive species habitat

Social Cultural Considerations
Planning considerations - potential effects
Short term and long-term community growth including conformity with municipal and provincial planning policies.
Ability to meet municipal and provincial growth targets.
Potential land use impacts (i.e. displacement or disruption) and siting considerations including:
temporary disruption during construction (i.e. dust, noise, vibrations, traffic management, and pedestrian movement, detours, access to property and maintain existing services;
potential impacts to sensitive land uses
First Nations considerations
archaeological/heritage resources/cultural landscape features
tourist/recreational resources
agricultural resources
potential for disturbing or altering existing community character or structure
potential for displacing/disturbing existing residences, business and/or community, institutional and recreational facilities
Potential effects to Public Health & Safety
proximity to roadways – impact of spills, road salt on groundwater
water quality – public acceptance of treatment technology required
air quality
Ability of Alternative to meet provincial water quality standards and security requirements, having regard to the long-term storage needs and emergency servicing requirements (e.g. fire flows and pressures).
Social costs and benefits
applicability for education program for consumers including Public education of water conservation
ability to meet “Triple bottom line” test (collectively consider social, economic and environmental impacts and ability to achieve a balanced outcome
Economic/Financial Considerations
Estimated capital and operating costs.
best use of existing infrastructure
cost impacts to municipal finances (i.e. Water/Sewer Rates and DC's)
ability to avoid or minimize tax increase for residents
impacts to agricultural operations
Legal/Jurisdictional Considerations
complexity of approvals considering current and future regulatory environment
land acquisition requirements
location inside vs. outside Regional and Township boundaries and associated jurisdictional issues

Technical Considerations
Ability of alternative to meet short and long-term municipal servicing requirements:
impact to system operations
ability to provide reliable and secure service
flexibility
Ease of Implementation/time to implement; flexibility for scheduling
difficulty of construction - water crossings - deep open cut sections - construction in limited area - protection of utilities, trees, structures
maintaining operation during construction
minimizing disruptions/ downtime
constructability
schedule and timing
Infrastructure, utility and energy requirements necessary to implement alternative.
optimization of existing capacity (technical perspective);
Innovation and use of relevant/new technology
operational and maintenance complexity

4.5 Evaluation of Strategic Water Supply Options

The Strategic Water Supply Options developed in **Section 3** have been evaluated according to the methodology and criteria described above. The results of this evaluation will assist in determining the preferred solution for water supply in the Baden/New Hamburg service area.

As discussed earlier in this document, six water supply alternative solutions were reviewed. Of these, three alternatives; Alternative W-4 (Modify Operation and Maintenance Practices), Alternative W-5 (Expand/Upgrade Existing Groundwater Supplies) and Alternative W-6 (New Groundwater Supplies), were determined to be viable alternatives while Alternative W-3 (Water Conservation) will continue to be supported by the Region and Township. Combinations of Alternative W-4 to Alternative W-6 were further developed as strategic water supply options to determine the preferred water supply option. Five strategic water supply options were evaluated according to the criteria noted in **Table 4-2**. The “Do Nothing” Option was also included in this evaluation for comparison purposes.

4.5.1.1 Do Nothing Option

This alternative proposes that no action be taken to upgrade, modify or expand the current Baden/New Hamburg Water Supply System. The evaluation of this alternative for each criteria is noted as follows.

- **Natural Environment** – no impact
Impact on Natural Environment: Lowest Impact
- **Social / Cultural** – The “Do Nothing Option” would not meet the short and long term growth requirements of the Region and the Township and would not provide servicing during emergency conditions. Moreover, this option does not comply with the triple bottom line test (people, profit, planning).
Impact on Social/Cultural Criteria: Highest Impact

- **Economic/Financial** – The “Do Nothing Option” would provide no opportunity for future growth and new tax revenues. Any required upgrade would be at the expense of existing consumers.

Impact on Economic/Financial Criteria: Highest Impact

- **Legal/Jurisdictional** – no impact

Impact on Legal/Jurisdiction Criteria: Lowest Impact

- **Technical** – Even though the existing supplies meet current demand, they do not address the security of supply and firm capacity should one or more wells be off-line for servicing or in an emergency situation.

Impact on Technical Criteria: High Impact

4.5.1.2 Option WS-1: Wilmot Centre Wells K50 and K51 plus Well NH3

- **Natural Environment** – This option would involve withdrawing the current permitted flow of 13,651 m³/d (158 L/s) from the K50s to match demand over time in order to maintain the agreement of supplying 7,517 m³/d (87 L/s) to the IUS. As the maximum taking from the K50s has been much lower than the permitted taking, potential effects on surface waters and groundwater will be evaluated during each staged increase as proposed in the Wilmot Centre Monitoring Program.

Impact on Natural Environment: Low to Moderate

- **Social / Cultural** – Assuming the Wilmot Centre Monitoring Program (WCMP) establishes minimal to no impact on the natural environment for the maximum permitted taking, this option would meet long term requirements with less water supplied to the IUS during an emergency condition as the firm capacity would not be sufficient. This option would meet the short and long term targets in conformity with planning policies, except during an emergency condition.

Impact on Social/Cultural Criteria: Low to Moderate

- **Economic/Financial** – Depending on the WCMP findings, this option would require minimal capital cost investment (i.e.: for pump replacement) and would not involve any significant additional O&M cost. As the firm capacity would not be sufficient to supply water to both Baden/New Hamburg and the IUS during emergency conditions, opportunity for future growth as well as new tax revenue could be compromised.

Impact on Economic/Financial Criteria: Low to Moderate

- **Legal/Jurisdictional** – No approval required as this option would maintain the current taking approved in the PTTW. No land acquisition would be required.

Impact on Legal/Jurisdiction Criteria: Lowest Impact

- **Technical** – As mentioned above, this option would depend on the Wilmot Centre Monitoring Program (WCMP) results confirming a maximum wellfield taking as per the PTTW. Firm capacity could be met assuming it would be acceptable to supply less water to the IUS under these conditions. With increase in pumping rate, this option would involve minor modifications to the existing K50s wells pumps.

Impact on Technical Criteria: Moderate

4.5.1.3 Option WS-2: Wilmot Centre Wells K50 and K51 plus Well NH3 plus Baden Wells with Nitrate Treatment

- **Natural Environment** – Same as Option W-1 regarding the K50s and NH3. As the proposed construction work for re-instating the Baden wells with treatment would be within the existing well field site, there would be minimal to no anticipated impacts on the natural environment with the re-activation of the Baden Wells. Depending on the preferred technology, the treatment process for nitrate reduction would produce some residual by-products for disposal.

Impact on Natural Environment: Low to Moderate

- **Social / Cultural** – Same as Option WS-1 regarding the K50s and NH3, except that the flows to the IUS would be maintained at 6,826 m³/d (79 L/s) during an emergency condition. This option would meet the short and long term targets in conformity with planning policies, even during an emergency condition.

Impact on Social/Cultural Criteria: Lowest Impact

- **Economic/Financial** – Same as Option WS-1 regarding the K50s and NH3. The Baden Wells re-activation would require an initial capital investment ranging between \$1.4M and \$2.2M, depending on the type of treatment chosen. The cost of new water produced would range between \$0.18 and \$0.66 per cubic. The cost for required upgrades to provide new water supply capacity would be applicable to new consumers.

Impact on Economic/Financial Criteria: Lowest Impact

- **Legal/Jurisdictional** – An amendment to the drinking water license and a new PTTW would be required. Completion of a Schedule C Class EA Study is required for implementation of treatment facilities at the Baden wells.

Impact on Legal/Jurisdiction Criteria: Moderate

- **Technical** – Same as Option WS-1 regarding K50s and NH3. This option would require a new treatment for nitrate removal at the Baden Wells, which would involve an operation of a new technology by Regional staff (e.g.: ion exchange, reverse osmosis).

Impact on Technical Criteria: Low to Moderate

4.5.1.4 Option WS-3: Wilmot Centre Wells K50 and K51 plus Well NH3 plus new NH4 Well with Iron/Manganese Treatment

- **Natural Environment** – Same as Option WS-1 regarding the K50s and NH3. It is anticipated that the new NH4 Well would be located on agricultural lands. If raw water is conveyed to the existing treatment plant (expanded) then a dedicated raw water supply line would be required crossing the highway from south to north.

Impact on Natural Environment: Low to Moderate

- **Social / Cultural** – Same as Option WS-1 regarding the K50s and NH3. This option would meet long term requirements with less water supplied to the IUS during an emergency condition as the firm capacity would not be sufficient. This option would meet the short and long term targets in conformity with planning policies, except during an emergency condition.

Impact on Social/Cultural Criteria: Low to Moderate

- **Economic/Financial** – Same as Option WS-1 regarding the K50s and NH3. The new NH4 well, including iron/manganese treatment, would require an initial capital investment ranging between \$2.1M and \$3.3M, depending on the location of the treatment. The cost of new water produced would range between \$0.34 and \$0.44 per cubic metre. The cost for required upgrades to provide new water supply capacity would be applicable to new consumers.

Impact on Economic/Financial Criteria: Low to Moderate

- **Legal/Jurisdictional** – An amendment of the drinking water license and a PTTW revision would be required. Completion of a Schedule C Class EA Study is required for installation of a new well and construction or expansion of existing water treatment plant beyond existing rated capacity. Land acquisition would be required for the construction of NH4 and treatment facilities (if local to well) plus connecting raw or finished watermain.

Impact on Legal/Jurisdiction Criteria: Moderate

- **Technical** – Same as Option WS-1 regarding K50s and NH3. This option would require a new well near well NH3, which would require land acquisition and expansion of the existing water treatment plant for iron removal. Current O&M practices would be maintained with a larger system.

Impact on Technical Criteria: Moderate

4.5.1.5 Option WS-4: Wilmot Centre Wells K50 and K51 plus Well NH3 plus new K52 Wilmot Centre Well

- **Natural Environment** – Same as Option WS-1 regarding the K50s and NH3. It is anticipated that the new K52 well would be located in close proximity to the existing K50 wells, within the property limit. Depending on the outputs of an initial investigation, if the proposed K52 well is to be located outside of the property boundary, it would be placed within agricultural lands.

Impact on Natural Environment: Low to Moderate

- **Social / Cultural** – Same as Option WS-1 regarding the K50s and NH3, except that the flows to the IUS would be lower during an emergency condition if Well NH3 were offline.

Impact on Social/Cultural Criteria: Lowest Impact

- **Economic/Financial** – Same as Option WS-1 regarding the K50s and NH3. The new K52 well would provide redundancy as the three wells could only be operated up to the maximum allowed by the PTTW and staged approach. The estimated initial capital cost for this third well is approximately \$1.1M plus land acquisition (if required). O&M cost would slightly increase with the addition of this new well.

Impact on Economic/Financial Criteria: Lowest Impact

- **Legal/Jurisdictional** – An amendment of the drinking water license, a PTTW revision, and completion of a Schedule A or B Class EA Study would be required, depending on land acquisition requirement.

Impact on Legal/Jurisdiction Criteria: Low to Moderate

- **Technical** – Same as Option WS-1 regarding K50s and NH3. This option would require a new well in close proximity to the existing K50s within the same well field, with all work within the wellhead protection area. Current O&M practices would be maintained.

Impact on Technical Criteria: Low to Moderate

4.5.1.6 Option WS-5: Wilmot Centre Wells K50 and K51 (at reduced yield) plus Well NH3 plus Baden Wells plus new NH4 Well

- **Natural Environment** – Combination of Options WS-2 and WS-3.

Impact on Natural Environment: Low to Moderate

- **Social / Cultural** – Combination of Options WS-2 and WS-3.

Impact on Social/Cultural Criteria: Lowest Impact

- **Economic/Financial** – Combination of Options WS-2 and WS-3.

Impact on Economic/Financial Criteria: Moderate

- **Legal/Jurisdictional** – Combination of Options WS-2 and WS-3.

Impact on Legal/Jurisdiction Criteria: Moderate

- **Technical** – Combination of Options WS-2 and WS-3.

Impact on Technical Criteria: Moderate to High

4.5.1.7 Summary of Evaluation – Water Supply

Table 4-3 summarizes the evaluation of Water Supply Strategic Options.

4.6 Evaluation of Water Treatment

Further evaluation (if required) will be developed after the results from the Wilmot Centre Monitoring Program during the implementation of the water supply preferred option as water treatment is directly related to the water supply.

4.7 Evaluation of Water Distribution

As stated in **Section 1.1**, several new watermains will be required between Baden and New Hamburg to service new growth. Location and pipe diameters depend on the population distribution; however, the population distribution throughout Baden and New Hamburg has not yet been determined. Therefore, tentative locations of proposed watermains and their respective diameters are shown in

Figure 3-8 (proposed pipes are shown in orange). Depending on the planned population spatial distribution, these proposed watermains sizes and locations may change significantly.

In order to address the inability to fill the Baden Tower at its full capacity, the high pressure issues in the New Hamburg lower areas will require a solution as presented in **Section 3.5.1**. Further evaluation will be performed during the storage Class EA as any solution would be a Schedule A undertaking at most.

Future water distribution system requirements will be developed further together with the planning department and the water supply alternatives as they are interdependent on the development of new water supply sources (e.g. NH4 and Baden wells).

Table 4-3: Evaluation of Water Supply Strategic Options

Evaluation Criteria		“Do Nothing” Option	W-1: K50/K51 & NH3	W-2: K50/K51, NH3 & B1/B2	W-3: K50/K51, NH3, new NH4	W-4: K50/K51, NH3 & New K52	W-5: K50/K51 (reduced), NH3, B1/B2, new NH4
Natural Environment	<u>Potential Effects on Surface Waters:</u> Nith River Watershed	None	Impacts to be confirmed during the Wilmot Centre Monitoring Program (WCMP)	Impacts to be confirmed during WCMP	Impacts to be confirmed during WCMP, adding monitoring for NH Wellfield	Impacts to be confirmed during WCMP	Impacts to be confirmed during WCMP, adding monitoring for NH Wellfield
	<u>Potential Effects on Groundwater:</u> Interference with private or municipal wells; source water protection	None	Impacts to be confirmed during the WCMP	Impacts to be confirmed during WCMP	Impacts to be confirmed during WCMP, adding monitor for NH Wellfield	Impacts to be confirmed during WCMP	Impacts to be confirmed during WCMP, adding monitoring for NH Wellfield
	<u>Potential Effects on Terrestrial Environmental Biota, Trees and Vegetation:</u> Number & significance of trees removed or disturbed; extent of loss of vegetation; sensitive species habitat	None	None	None	Minor loss of agricultural land	Minor loss of agricultural land	Minor loss of agricultural land
	<u>Planning Considerations – Potential Effects:</u> Environmental management planning considerations	None	Similar impacts	Similar impacts	Similar impacts	Similar impacts	Similar impacts
	<u>Potential Effects on Natural Heritage Features:</u> PSWs, ESAs, ANSIs, sensitive species habitat	None	None	None	None	None	None
Natural Environment Summary							
Social / Cultural	<u>Potential Effects on Growth:</u> Short & long-term growth; conformity with planning policies; ability to meet growth targets	Would not meet short and long term requirements	Would meet long term requirements, with less water supplied to IUS during an emergency condition	Would meet long term requirements	Would meet long term requirements, with less water supplied to IUS during an emergency condition	Would meet long term requirements	Would meet long term requirements
	<u>Potential Land Use Impacts:</u> Disruption during construction; First Nations considerations; archaeological / heritage resources / cultural / tourist / recreational / agricultural resources	None	None	New building at the Baden Wells site. No social/cultural impact anticipated	New well at a site near NH3. No social/cultural impact anticipated	New well at a site near K50s site. No social/cultural impact anticipated	No social/cultural impact anticipated
	<u>Potential Effects to Public Health & Safety:</u> Water quality; air quality; ability to meet provincial standards; emergency servicing requirements	No emergency servicing	Firm capacity would limit the water supply to IUS during an emergency condition	Firm capacity would be met	Firm capacity would limit the water supply to IUS during an emergency condition	Firm capacity would be met	Firm capacity would be met
	<u>Social Cost & Benefits:</u> Education potential; triple bottom line test (people, profit, planning)	Would not comply with the triple bottom line test	Would comply with the triple bottom line test	Would comply with the triple bottom line test	Would comply with the triple bottom line test	Would comply with the triple bottom line test	Would comply with the triple bottom line test
Social / Cultural Summary							
Economic / Financial	<u>Engineering Cost Estimate</u> - Capital cost - Operating & Maintenance	\$ 0 - Current O&M Practices	\$ 0.1 M - Current O&M Practices	\$ 1.4 to \$ 2.2 M - Additional O&M for wells and new treatment system \$ 0.18 to \$ 0.66 - All required upgrades on new consumers	\$ 2.1 to 3.3 M - Additional O&M for new well, and upgraded iron treatment system \$ 0.34 to \$ 0.44 - All required upgrades on new consumers	\$ 1.1 M - Additional O&M for new well - - All required upgrades on new consumers	\$ 3.5 to \$ 5.5 M - Additional O&M for new wells and treatment facilities \$ 0.22 to \$ 0.60 - All required upgrades on consumers
	- Life Cycle Cost per m³ of new water - Cost impacts to municipal finances	\$ 0 - No opportunity for future growth and new tax revenue	\$ 0 - No opportunity for future growth and new tax revenue				
Economic / Financial Summary							
Legal / Jurisdiction	<u>Requirements for Implementation</u> - Complexity of approvals - Land acquisition - Location within Regional / Township boundaries	- None - None - Yes	- No approvals required - None - Yes	- Schedule C Class EA, PTTW, amendment to drinking water license - None - Yes	- Schedule C Class EA, revised PTTW, amendment to drinking water license - Yes - Yes	- Schedule A or B Class EA, revised PTTW, amendment to drinking water license - Yes - Yes	- Schedule B Class EA, PTTW, amendment to drinking water license - Yes - Yes
Legal / Jurisdictional Summary							
Technical	<u>Ability to meet short & long-term servicing requirements:</u> Impacts to system operations; security and reliability of service; flexibility	Existing water supply does not meet future requirements for a firm capacity approach	Depends on the WCMP results to confirm available capacity. Firm capacity would be possible with less water supplied to IUS	Depends on WCMP results to confirm available capacity. Supply available to IUS	Depends on WCMP results to confirm available capacity. NHWTP could be expanded to provide additional iron/manganese treatment	Depends on WCMP results to confirm available capacity. Disinfection and standby power facilities already in place. Less flow to IUS during an emergency event.	Firm capacity requirement achieved even if the WCMP recommends a lower flow than the expected
	<u>Ease of Implementation; Flexibility:</u> Difficulty of construction; barriers; maintaining operation; minimizing disruptions; constructability; schedule & timing	n/a	Higher flows to be confirmed by the WCMP. No construction required	Wells currently offline due to high nitrate concentrations	Treatment for iron removal required	Increasing trend in nitrate levels within ODWS.	Treatment for nitrate removal required at Baden Wells, and iron removal at the new NH4 well
	<u>Need for added infrastructure: utilities & energy:</u> Optimization of existing capacity	n/a	To be confirmed by the WCMP. Firm capacity would be possible with less water supplied to IUS				
	<u>Innovation and use of new technology:</u> Operational and maintenance complexity	n/a	No modification to current O&M Practices	New treatment required for nitrate removal. Ion exchange would be a new technology implemented for the Region	Iron treatment upgrade required at the NHWTP. Current O&M practices would be maintained, with a bigger system.	Current O&M activities would be maintained. Nitrate treatment may be required over time.	Treatment required for nitrate removal at the Baden Wells using ion exchange or RO (new technology). Iron treatment upgrade required at the NHWTP to treat the new NH4 water for iron removal
Technical Summary							
TOTAL / FINAL EVALUATION							
LEGEND: Lowest Impact (Most Preferred) Low to Moderate Moderate Moderate to High High (Least Preferred)							

Table 4-4: Evaluation of Storage Options

Evaluation Criteria		“Do Nothing” Option	S-1: Expand NHWTP Reservoir	S-2: Storage at Baden Wells Site	S-3: Storage at New Location	S-4: Combination of S-1 to S-3
Natural Environment	<u>Potential Effects on Surface Waters and Groundwater:</u> Nith River Watershed, Interference with private or municipal wells; source water protection	None	Minor interference with groundwater during construction	Minor interference with groundwater during construction	Minor interference with groundwater during construction	Some interference with groundwater during construction
	<u>Potential Effects on Terrestrial Environmental Biota, Trees and Vegetation:</u> Number & significance of trees removed or disturbed; extent of loss of vegetation; sensitive species habitat	None	Minor removal of vegetation at the existing NHWTP site	Minor removal of vegetation at the existing Baden Wells Site	Possible removal of vegetation at the new site; proposed location may be in a sensitive area	Some removal of vegetation at the proposed sites; proposed location may be in a sensitive area
	<u>Planning Considerations – Potential Effects:</u> Environmental management planning considerations	None	None	None	Depends on the proposed location	Depends on the proposed location
	<u>Potential Effects on Natural Heritage Features:</u> PSWs, ESAs, ANSIs, sensitive species habitat	None	None	None	Depends on the proposed location	Depends on the proposed location
Natural Environment Summary						
Social / Cultural	<u>Potential Effects on Growth:</u> Short & long-term growth; conformity with planning policies; ability to meet growth targets	Would not meet long term requirements	Would meet long term requirements	Would meet long term requirements	Would meet long term requirements	Would meet long term requirements
	<u>Potential Land Use Impacts:</u> Disruption during construction; First Nations considerations; archaeological / heritage resources / cultural / tourist / recreational / agricultural resources	None	None, as expansion would be within the existing NHWTP site	None, as expansion would be within the existing Baden Wells site	Depends on the proposed location	Depends on the proposed location
	<u>Potential Effects to Public Health & Safety:</u> Water quality; air quality; ability to meet provincial standards; emergency servicing requirements	Would not meet long term fire flow requirement	- Would meet long term fire flow requirement - Storage would be split between Baden and New Hamburg	- Would meet long term fire flow requirement - Most water storage would be in Baden resulting in greater reliance on transmission mains	Would meet long term fire flow requirement	Would meet long term fire flow requirement
	<u>Social Cost & Benefits:</u> Education potential; triple bottom line test (people, profit, planning)	Would not comply with the triple bottom line test	Would comply with triple bottom line test	Would comply with triple bottom line test	Would comply with triple bottom line test	Would comply with triple bottom line test
Social / Cultural Summary						
Economic / Financial	<u>Engineering Cost Estimate</u> - Capital cost - Operating & Maintenance - Cost impacts to municipal finances	- None - Higher over time as deterioration would occur - No opportunity for future growth and new tax revenue	- Moderate cost - slightly higher than current - All required upgrades on new consumers	- Moderate cost - Higher than S-1 - All required upgrades on new consumers	- Higher cost - Higher than S-1, similar to S-2 - All required upgrades on new consumers	- Highest cost - Highest - All required upgrades on new consumers
	Economic / Financial Summary					
Legal / Jurisdictional	<u>Requirements for Implementation</u> - Complexity of approvals - Land acquisition - Location within Regional / Township boundaries	- None - None - Yes	- Schedule B Class EA - Land available on NHWTP site - Yes	- Schedule B Class EA - Land available on site - Yes	- Schedule B or C Class EA, depending on the site - Land acquisition likely required - Yes	- Schedule B or C Class EA, depending on new site location - Land acquisition likely required - Yes
	Legal / Jurisdictional Summary					
Technical	<u>Ability to meet short & long-term servicing requirements:</u> Impacts to system operations; security and reliability of service; flexibility	Would not meet long term requirements for fire flow	Would meet long term requirements	Would meet long term requirements	Would meet long term requirements	Would meet long term requirements
	<u>Ease of Implementation: Flexibility:</u> Difficulty of construction; barriers; maintaining operation; minimizing disruptions; constructability; schedule & timing	n/a	No major changes to the current distribution system	No major changes to the current distribution system	Some changes to the current distribution system depending on location of site	Some changes to the current distribution system depending on location of site
	<u>Need for added infrastructure: utilities & energy:</u> Optimization of existing capacity	n/a	Expand reservoir and high lift pumping station	New reservoir and lift pumping station	New reservoir and lift station	New reservoirs and lift stations
Technical Summary						
TOTAL / FINAL EVALUATION						
LEGEND: Lowest Impact (Most Preferred) Low to Moderate Moderate Moderate to High High (Least Preferred)						

4.8 Evaluation of Water Storage

As presented in **Section 2.3**, Baden-New Hamburg will require additional storage capacity by 2021 with a 2041 (Low and High) requirement of 2,500 and 4,200 m³, respectively. Four storage options were presented in **Section 3.4** and are evaluated herein according to the criteria noted in **Table 4-2**. The “Do Nothing” Option was also included in this evaluation for comparison purposes.

4.8.1 Do Nothing Option

This option proposes that no action be taken to upgrade, modify or expand the current Baden/New Hamburg Water Storage. The evaluation of this option for each criteria is noted as follows.

- **Natural Environment** – no impact

Impact on Natural Environment: Lowest Impact

- **Social / Cultural** – The “Do Nothing Option” would not meet long term growth requirements of the Region and the Township. Moreover, this option does not comply with the triple bottom line test (people, profit, planning).

Impact on Social/Cultural Criteria: Highest Impact

- **Economic/Financial** – The “Do Nothing Option” would provide no opportunity for future growth and new tax revenues. Any required upgrades would be at the expense of existing consumers.

Impact on Economic/Financial Criteria: Highest Impact

- **Legal/Jurisdictional** – no impact

Impact on Legal/Jurisdiction Criteria: Lowest Impact

- **Technical** – This option would not address fire flow requirements starting in year 2021.

Impact on Technical Criteria: Highest Impact

4.8.2 Option S-1: Expand New Hamburg Water Treatment Plant (NHWTP) Reservoir

- **Natural Environment** – As this option would involve construction within the NHWTP site limits, minor effect on groundwater and minor removal of vegetation during construction would occur. Effect on groundwater would occur during the dewatering phase of the construction.

Impact on Natural Environment: Low to Moderate

- **Social / Cultural** – This option would meet fire flow long term requirements for the projected population. No potential impact on land use as the proposed storage reservoir would be located within the NHWTP site limits. This option would comply with the triple bottom line test.

Impact on Social/Cultural Criteria: Lowest Impact

- **Economic/Financial** – This option would have a moderate capital cost and the O&M cost would be slightly higher than the current O&M practices. The cost for required upgrades to provide new water storage capacity would be applicable to new consumers.

Impact on Economic/Financial Criteria: Moderate Impact

- **Legal/Jurisdictional** – Land acquisition would not be required as the proposed expansion would be located within the existing NHWTP site limits. Completion of a Schedule B Class EA Study would be required.

Impact on Legal/Jurisdiction Criteria: Low to Moderate

- **Technical** – This option would meet fire flows requirements for long term projections. Expansion of the existing reservoir and upgrade to the existing high lift pumping station would be required. No major changes to the current distribution system would be required.

Impact on Technical Criteria: Low to Moderate

4.8.3 Option S-2: New Storage at the Baden Wells

- **Natural Environment** – Similar to S-2, within the Baden Wells site.

Impact on Natural Environment: Low to Moderate

- **Social / Cultural** – This option would meet fire flow long term requirements for the projected population. No potential impact on land use as the proposed storage reservoir would be located within the Baden Wells site limits. Most water storage would be in Baden resulting in greater reliance on transmission mains. This option would comply with the triple bottom line test.

Impact on Social/Cultural Criteria: Low to Moderate

- **Economic/Financial** – Similar to S-2, with higher capital cost and higher O&M requirements.

Impact on Economic/Financial Criteria: Moderate

- **Legal/Jurisdictional** – Similar to S-2, within the Baden Wells site.

Impact on Legal/Jurisdiction Criteria: Low to Moderate

- **Technical** – This option would meet fire flows requirements for long term projections. A new reservoir and a new high lift pumping station would be required. No major changes to the current distribution system would be required.

Impact on Technical Criteria: Moderate

4.8.4 Option S-3: New Storage in a New Location

- **Natural Environment** – The natural environmental impacts would highly depend on the location of this proposed new storage. As a general rule, minor interference with groundwater would occur during construction, as well as removal of vegetation.

Impact on Natural Environment: Moderate to High

- **Social / Cultural** – This option would meet fire flow long term requirements for the projected population. Some potential impact on land use depending on the location of the proposed site. This option would comply with the triple bottom line test.

Impact on Social/Cultural Criteria: Moderate

- **Economic/Financial** – Higher capital cost as land acquisition would be required. Similar O&M requirements as S-3.

Impact on Economic/Financial Criteria: Highest Impact

- **Legal/Jurisdictional** – Land acquisition may be required depending on the location of the proposed site. Completion of a Schedule B or C Class EA Study would be required depending on the location of the site.

Impact on Legal/Jurisdiction Criteria: Moderate to High

- **Technical** – This option would meet fire flows requirements for long term projections. A new reservoir and a new high lift pumping station would be required. Some changes to the current distribution system would be required depending on the location of the site.

Impact on Technical Criteria: Moderate to High

4.8.5 Option S-4: Combination of Above

- **Natural Environment** – Combination of S-1 to S-3

Impact on Natural Environment: Moderate to High

- **Social / Cultural** – Combination of S-1 to S-3

Impact on Social/Cultural Criteria: Moderate to High

- **Economic/Financial** – Combination of S-1 to S-3

Impact on Economic/Financial Criteria: Highest Impact

- **Legal/Jurisdictional** – Combination of S-1 to S-3

Impact on Legal/Jurisdiction Criteria: Moderate to High

- **Technical** – Combination of S-1 to S-3

Impact on Technical Criteria: Moderate to High

4.8.5.1 Summary of Evaluation – Water Storage

Table 4-4 summarizes the evaluation of Water Storage Options.

5 Water System Recommendations

Based upon the evaluation and public/agency feedback received, this section presents the water system recommendations.

5.1 Water Supply and Treatment

It is recommended that Strategic Option WS-4 be selected as the preferred option for water supply based on the evaluation discussed in the above section. The preferred option consists of the following:

- Increase the takings from the K50s following the stepped increases as outlined in the WCMP to the maximum flow of 142 L/s as allowed by the WCMP to meet 2041 (Low) demand and further to the PTTW permitted flow (158 L/s) to meet 2041 (High) if required;
- Increase pumping from the NH3 well to permitted flow (41 L/s);
- Install an additional well (new K52 well) at the K50's site and connect it to the existing system to provide water supply capacity redundancy.

Figure 5-1 illustrates the proposed timing for stepped increases of the K50s takings per the WCMP. In order to ensure sufficient long term supply to match future demands, it is critical to implement the phasing at the five year intervals allowed pending concurrence in direction from the monitoring report and recommendations. In order to do this, the Region must change its operational strategy as follows:

- Maximize the transfer of water to the IUS at 87 L/s at all times
- Maximize the transfer of water to Baden and New Hamburg by operating the K50s at a constant rate and utilizing NH3 only to meet peaks in demand as required.

By following this protocol, the Region will be able to confirm the sustainable water taking from the Wilmot wellfield, and if not feasible from a monitoring perspective (i.e. cannot mitigate environmental impacts), then the acceptable sustainable K50s taking will be identified and the long term water supply strategy modified accordingly. In the interim, the use of NH3 can be increased to supplement K50s to match demands.

The WCMP identifies stepped increases to 142 L/s. If this is found to be sustainable, this combined with NH3 at 41 L/s can meet the long term needs of the low 2041 growth scenario. If population is increasing in accordance with the high 2041 growth scenario, the WCMP can be revisited to consider a further increase to 158 L/s which is available in the Wilmot well field PTTW. This value is currently supported by hydrogeological data, but would also require review of impacts through environmental monitoring.

Provision of the new K52 well should be implemented immediately to provide firm capacity to Baden-New Hamburg. Its operation will also enable the Region to sustain pumping at the rates set out in the WCMP to ensure targets are met for evaluation and the monitoring program.

Confirmation of the preferred option is dependent on the WCMP results and on-going assessment of additional environmental impact with the increased taking at the K50s Wells. This includes continuation of the Region's water level monitoring program and continued monitoring of nitrate levels. Since the success of this approach cannot be guaranteed, a contingency plan is required to ensure that water supply will continue to satisfy the needs of planned population increases in Baden and New Hamburg. Through the evaluation process, it was determined that the second preferred option is Strategic Option WS-2 (Contingent Option): re-instating the Baden wells with treatment.

Due to timing constraints in the short term, (i.e. the projected maximum day demand in five years is equal to the supply available by pumping K50s at the allowable 105 L/s plus NH₃, as indicated in **Figure 5-1**), it is critical to undertake three strategies immediately:

- The K50s well field pump rate must be increased to 105 L/s and sustained commencing in 2011 and monitoring results reviewed on an annual basis and evaluated to determine the likelihood that at the end of the five year period, it will be acceptable to increase the pumping rate to the next proposed step of 124 L/s.
- Install K52 to ensure that the proposed water taking from the Wilmot well field can always be sustained at the planned pump rate.
- Review the requirements for Strategic Option WS-2 should that become the preferred strategy and implement preliminary investigations which would allow fast-tracking of this alternative if required.

Further to the last point, the following **Figure 5-2** illustrates the schedule for implementation of Contingent Strategic Option WS-2 to meet demand, assuming that the water takings from the K50s is limited to 105 L/s. As shown, if this is found to be the case, the Baden wells would be required in 2015, and therefore, much of the work required to ensure the Baden wells are operational at this time would be required in advance of this date.

It is recommended that the Region undertake the following studies commencing in 2011:

- preliminary investigation/ treatability study for nitrate treatment alternatives (i.e. feasibility study);
- hydrogeological investigations to confirm well rehabilitation requirements;
- hydrogeological review/testing program (if required) to support PTTW application;
- on-going water quality monitoring (confirm design requirements and identify trends);
- Schedule C Class EA project for Baden Well treatment;
- apply for PTTW
- complete design of proposed undertaking and apply for approvals; and finally;
- initiate construction of the treatment system.

The above process could be scheduled over the next five years and fast tracked if indications are that the Wilmot wells cannot be sustained at 105 L/s.

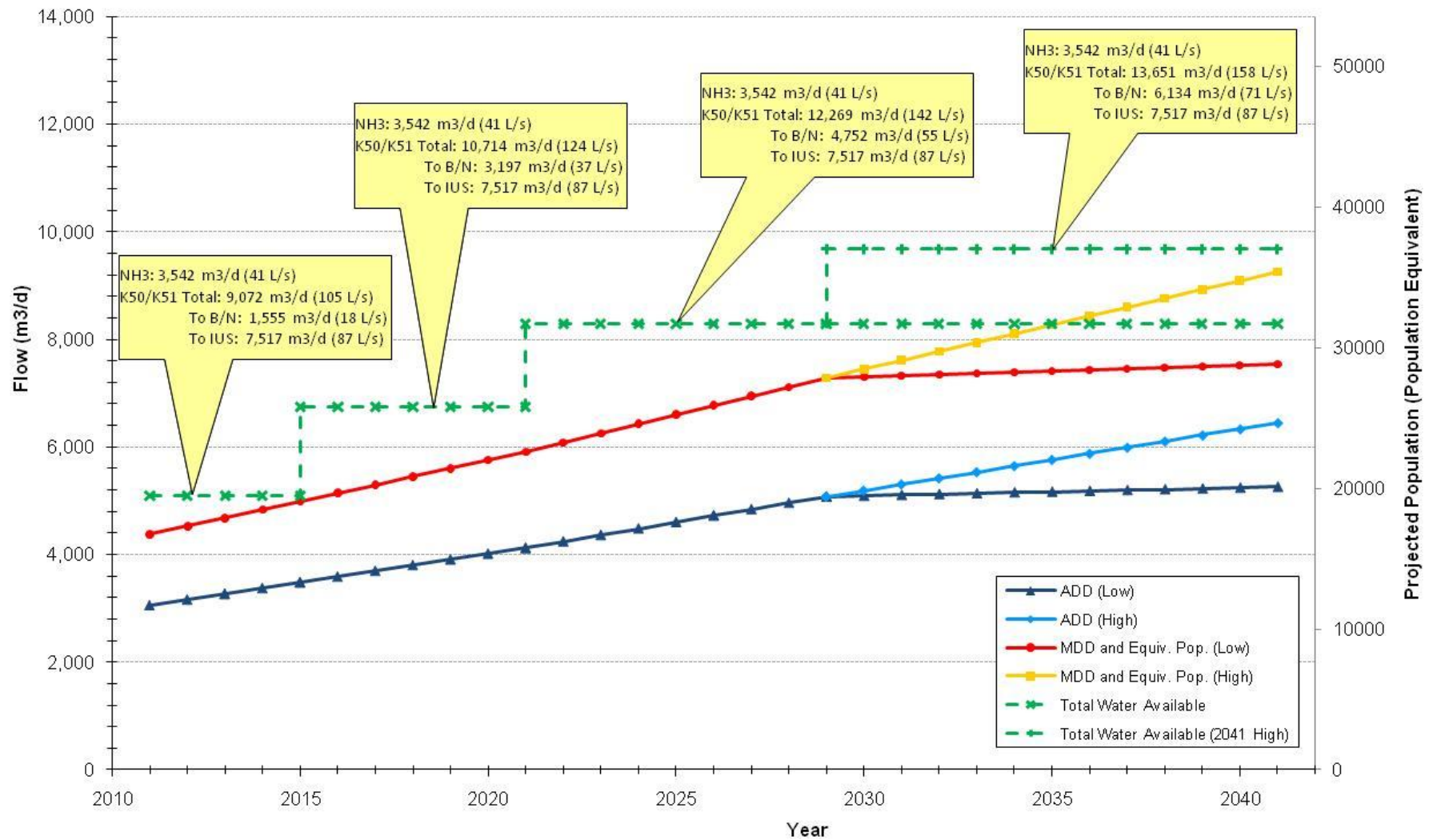


Figure 5-1: Projected Water Supply Planning Phases (Preferred Option)

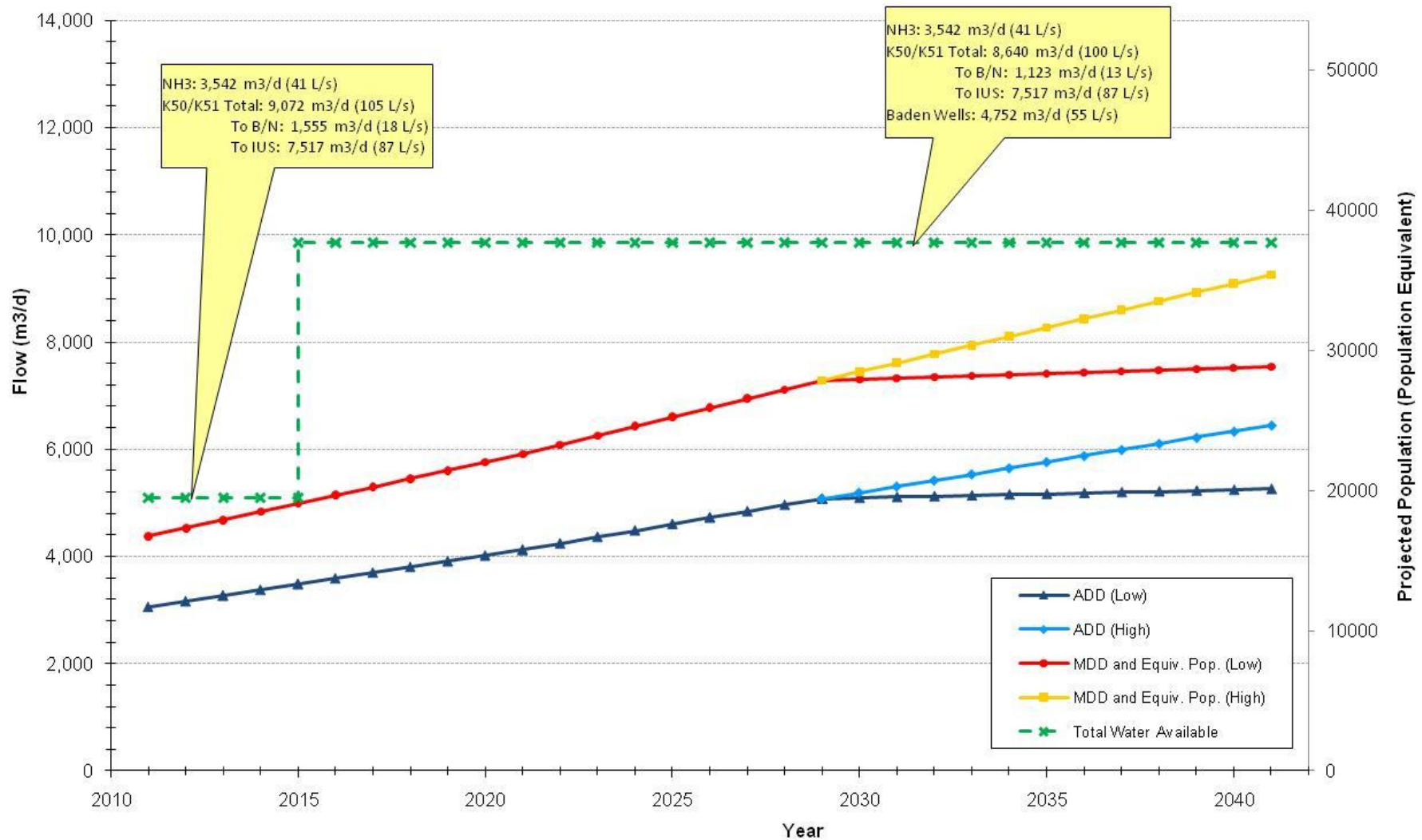


Figure 5-2: Projected Water Supply Planning Phases (Contingent Option)

5.2 Water Distribution

Recommendations for future water distribution system requirements will be developed further by the Township of Wilmot subject to the timing of growth, and the development of new water supply sources by the Region, if needed in the future.

A more immediate requirement is to implement the necessary modifications in the distribution system piping and valving to address high pressure areas in New Hamburg.

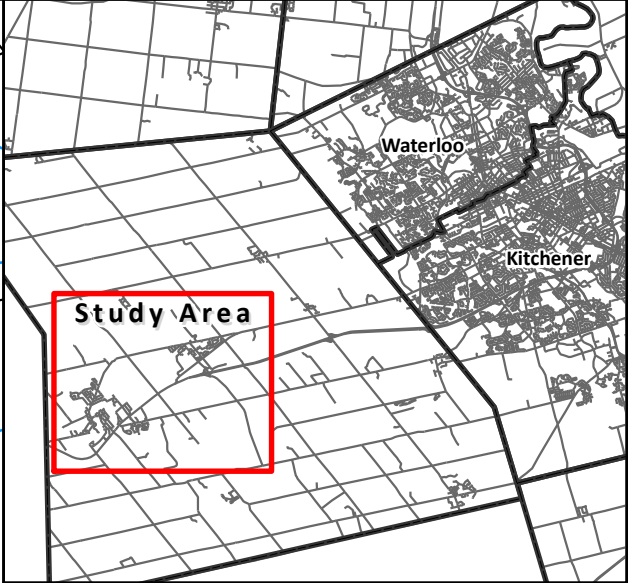
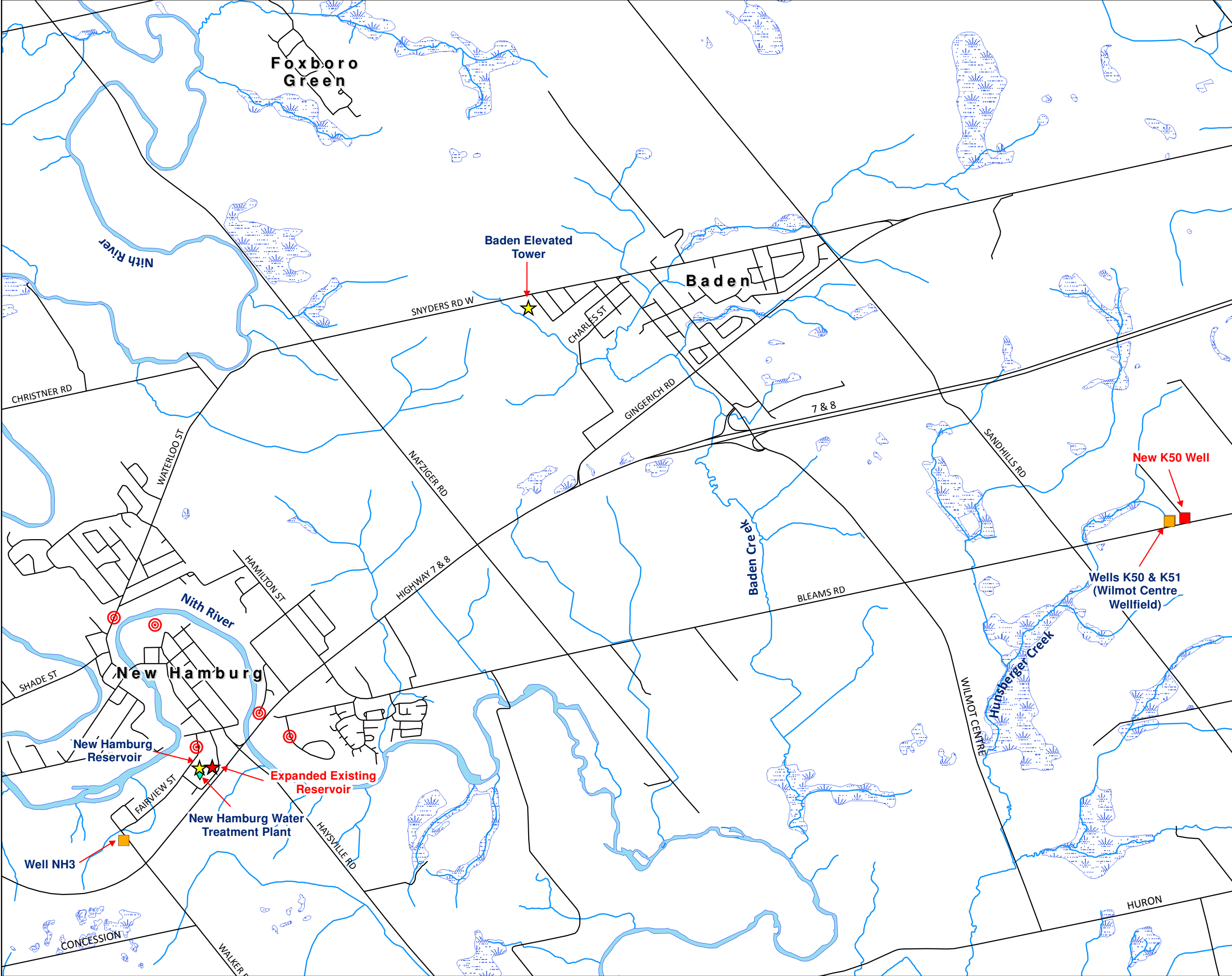
5.3 Water Storage

It is recommended that Storage Option S-1 be selected as the preferred option for water storage based on the evaluation discussed in the above section. The preferred option consists of the following:

- Expand storage at the New Hamburg Water Treatment Plant to meet 2041 fire flow requirements;
- Upgrade high lift pumping station.

5.4 Summary

Figure 5-3 illustrates the existing and proposed improvements for Baden-New Hamburg Water System based on the above evaluation.



Legend

Wells

Proposed New K50 Well

Reservoir & Elevated Tower

Proposed Reservoir

Proposed Central PRV

Water Treatment Plant

Roads

Rivers

Nith River

Wetlands

Baden - New Hamburg Water & Wastewater Master Plan Update

Figure 5-3:
Existing and Proposed Water Infrastructure

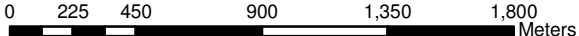
Datum: NAD 83, Zone 17
Source: Region of Waterloo

June 2011


Region of Waterloo







5.5 Recommendations for Future Monitoring and/or Further Hydrogeological Investigation

5.5.1 Wilmot Centre Wells (K50 and K51 well)

The Wilmot Centre Monitoring Program began in 1999 and proposed stepped increases of the pumping rate while comprehensive monitoring was undertaken. While the monitoring has been on-going since 1999, the stepped increases have not been implemented (in fact the pumping rate has decreased to 85 L/s or less since 2006). Since no monitoring data (representing K50/51 pumping at 105 L/s) is available, there is insufficient information to support increasing the pumping rate above 105 L/s. It is recommended that the Region implement the stepped increases of the Wilmot Centre Monitoring program as soon as possible and make changes in the operational strategy to ensure that this pumping rate be sustained. In this way there will be sufficient information available by 2015 to 2016 to support increasing the pumping rate above 105 L/s to match demand.

5.5.2 Baden Wellfield

A new PTTW will be required for renewed operation of the Baden wells. Applying for a new PTTW will require a supporting hydrogeological report which includes an impact assessment of B1 and B2 pumping on local environmental features. It is possible that the Ministry of Environment (MOE) may accept a supporting report that uses interpreted historical data for development of the impact assessment. Under this scenario, the cost for preparing a PTTW application would be relatively minor (less than \$50,000).

If, however, MOE expresses concerns regarding the effects of B1/B2 pumping on local groundwater and surface water resources, new field studies may be required to support a PTTW application. The new field studies would need to include a comprehensive monitoring program (similar to that of Wilmot Centre) while B1/B2 is test pumped for an extended period of time. Under this scenario, the cost for the field studies and preparing a PTTW application could be on the order of \$200,000.

5.5.3 New Hamburg Wellfield

Should the Region wish to further investigate the feasibility of additional water supply in the New Hamburg area, it is recommended that a hydrogeological feasibility study be undertaken to confirm that the bedrock aquifer (Bass Island Formation) can sustain increased pumping. This would include the installation of test production wells, long term performance testing and monitoring of groundwater elevation and quality in the Bass Island Formation. Cost of this program could range from \$250,000 to \$500,000.

6 References

Burnside, 2009. “2008 Annual Monitoring Report – Wilmot Centre Monitoring Program – Region of Waterloo – Wilmot Centre.” March 2009.

Conestoga-Rovers & Associates. “Sanitary Sewer Inflow/Infiltration Study – Baden and New Hamburg – Volumes 1 and 2.” Prepared for The Township of Wilmot. February 2009.

Earth Tech. “Wastewater Treatment Master Plan – Final Report”. Prepared for the Region of Waterloo. August 2007.

Golder, 2011. “Baden-New Hamburg Water Supply Master Plan Update – Final Hydrogeological Report.” January 7, 2011.

MOE. Deriving Receiving Water Based, Point-Source Effluent Requirements for Ontario Waters. Procedure B-1-5 PIBS# 3302. July 1994.

Municipal Engineers Association, 2007. “Municipal Class Environmental Assessment”. October 2000, as amended in 2007.

Paragon Engineering Ltd, 1996. “Regional Municipality of Waterloo – Baden-New Hamburg Water Supply Master Plan and Project – Class Environmental Assessment – Environmental Study Report”. Volumes 1 and 2. March, 1996.

Region of Waterloo, Planning, Housing and Community Services. “Proposed Regional Official Policies Plan Amendment, Township Urban Area Expansions, Baden and New Hamburg, Township of Wilmot.” Report P-04-017. File Code D16-40/TUAE. February 17, 2004.

Region of Waterloo. “2007 Water and Wastewater Monitoring Report.” October 2007.

Region of Waterloo. “2009 Water and Wastewater Monitoring Report.” April 2009.

Region of Waterloo, 2009b. “Council-Adopted Regional Official Plan”. June 16, 2009.

R.V. Anderson Associates Ltd. “Region of Waterloo Wilmot Industrial Trunk Watermain Final Report.” September 2005.

R.V. Anderson Associates Ltd. “Region of Waterloo Wilmot Industrial Trunk Watermain Environmental Assessment File.” April 2007

Stanley Associates, Paragon Engineering, 1996, “The Nith River Assimilation Study New Hamburg-Baden Wastewater Treatment Class Environmental Assessment” for Region of Waterloo.

Stanley Associates and Paragon Engineering Ltd. “New Hamburg Baden Wastewater Treatment Class Environmental Assessment – Environmental Study Report.” July 1997.

Stantec Consulting Ltd. and Waterloo Hydrogeologic Inc., “Nitrate Migration Control Feasibility Study”, April 1999.

Stantec Consulting Ltd. “Morningside Wastewater Pumping Station – Design Brief”. Prepared for the Regional Municipality of Waterloo. 1999b.

Stantec, 1999. “New Hamburg Water Treatment Plant Upgrades – Operation and Maintenance Manual.” Prepared for the Regional Municipality of Waterloo under contract no. 98031. November 1999.

Stantec Consulting Ltd. “Final Baseline Monitoring Report Wilmot Centre Well Field”. Prepared for the Regional Municipality of Waterloo. November 2001.

Stantec Consulting Ltd., 2004. “Baden/New Hamburg Watermain Distribution System Study – Final Report”. Prepared for the Township of Wilmot. August 2004.

Stantec Consulting Ltd., 2004b. “Community of Baden – Elevated Water Storage Tower – Preliminary Design Report”. Prepared for the Regional Municipality of Waterloo. August 2004.

Township of Wilmot Development Services. “Township of Wilmot Official Plan”. November 2006