COUNTY OF FRONTENAC

COMMUNAL SERVICES STUDY

JUNE 2019

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EXECUTIVE SUMMARY

The County of Frontenac's permanent and seasonal populations are projected to grow over the next 20 years. With population growth comes development pressures and the need to consider where and how development can be accommodated and serviced, while maintaining and enhancing the vitality and livability of the County's villages and hamlets as rural community hubs with a distinct sense of place.

Existing approaches to water and wastewater servicing constrain the County's potential for growth. The cost of providing or expanding municipal water and wastewater services to all rural areas is not a fiscal reality for most municipalities. Development on private individual on-site services inherently results in lower forms of density, due to the spatial requirements associated with well and septic treatment systems, and associated separation distances.

Continued development in the County on private services has the potential to result in inefficient use of land, and threaten the long-term viability of the County's villages and hamlets, especially their mainstreets. Without innovative approaches to servicing, the County and developers are limited in their ability to respond to community needs in the provision of diverse housing types along the housing spectrum to enable residents to age in place. Development on smaller lot sizes could assist in addressing increasing concerns related to rural housing affordability and accessibility. Private servicing also limits the revitalization of village and hamlet mainstreets and commercial cores to be vibrant, walkable, and compact, and able to accommodate new commercial and mixed-use development.

Communal services are systems that provide water and wastewater treatment to clusters of residences or businesses. They can be a less expensive alternative to centralized municipal services and a more environmentally-friendly alternative to private on-site services. However, perceived obstacles have slowed the implementation of communal services in many jurisdictions. A key benefit of communal services is that they represent alternative water and wastewater servicing approaches that can provide the County and Townships with the innovative technology and flexibility to accommodate growth and achieve planning, environmental, and economic development objectives.

The fundamental purpose of this Communal Servicing Study ("the Study") is to demonstrate that the perceived obstacles are just that, and to equip the County of Frontenac with the planning, engineering, and economic development tools necessary to enable redevelopment and new development on the basis of communal services. Communal water and wastewater servicing offers the potential to enable new development and infill across the County, including on village and hamlet mainstreets, addressing some of the challenges associated with centralized municipal services and with private on-site services. Most importantly, communal servicing has the potential to support more compact, land-efficient development than is possible with private

servicing, at a lower cost than is possible with centralized municipal services, and enable revitalization of the County's communities.

The type of communal services treatment and disposal system that is chosen to service a development depends on many factors, including site soil characteristics, the presence of surface water features close to the site, design sewage flows, raw sewage strength, and effluent requirements. This Study includes Engineering Best Practices that provide a guideline for the planning, selection, and design of a communal on-site sewage treatment and disposal system, as well as best practices for installation, operation, and maintenance. These best practices are not intended to be all-inclusive and require professional judgement in their use. For all sewage systems, appropriate government approvals will be required prior to construction and/or use of the system.

An Excel-based cashflow Financial Model was developed to be used by the County as a tool for estimating appropriate charges to cover anticipated annualized costs and mitigate financial risk associated with communal services. The Model was built as a high-level 'what-if' tool, enabling the user to input costs, development size, and other parameters, in order to understand the funding required to reach steady-state (i.e., stable) annual charges. Two funding sources were identified and incorporated into the Model: a utility fee levied upon residential and commercial customers of the planned communal system; and a property tax increase levied upon all property owners in the County. Modelled cost-recovery options include:

- **Option 1:** Utility fee covers all costs
- **Option 2:** Property tax covers catastrophe costs; utility fee covers remainder
- **Option 3:** Property tax covers catastrophe and capital replacement costs; utility fee covers all other costs
- **Option 4:** Property tax covers all costs

The Model allows for calculation and allocation of costs associated with construction of residential and/or commercial units. Additionally, the Model estimates risk-adjusted costs associated with unexpected, catastrophic failure of one or more communal water/wastewater systems in the County, based on user-defined risk tolerances and failure rates. 'Catastrophe' costs are those which are not planned for as part of routine Operation and Maintenance (O&M), rehabilitation, or capital replacement, nor covered by typical water/wastewater facility insurance policies.

There are examples of communal servicing projects in Ontario and Canada that clearly demonstrate its benefits. This Study identifies solutions to perceived barriers to communal servicing, demonstrates the benefits of communal servicing, and sets out a framework for the County of Frontenac to encourage development on the basis of communal servicing.

COMMUNAL SERVICING WORKS FOR THE COUNTY

Communal servicing enables:

- Increased development potential, growing the tax base;
- More water-sensitive design and other approaches to meet sustainability objectives;
- A broader range of housing typologies and commercial development to allow for complete communities;
- Reduced municipal service delivery costs to residents (e.g. garbage collection, snow removal); and
- A new approach to managing risk.

COMMUNAL SERVICING WORKS FOR DEVELOPERS

Through communal servicing, developers have more:

- Flexibility to address different market segments;
- Feasible servicing approaches for developments in hard-to-service areas; and
- Guidance and certainty on servicing.

COMMUNAL SERVICING WORKS FOR RESIDENTS

Residents on communal servicing can:

- Be confident in their water and wastewater treatment systems;
- Have a wider choice of housing options, allowing for aging in place; and
- Be confident that water resources are being appropriately stewarded.

1 INTRODUCTION

The County of Frontenac ("the County") is a rural upper-tier municipality located in Eastern Ontario, extending from the islands south of the City of Kingston to north of Highway 7, with a total area of 3,200 km^2. The County boasts a stunning and varied natural landscape, a strong culture of environmental conservation, a strategic location relative to urban centres, and a historic pattern of villages and hamlets. Residents enjoy a high quality of life, and Frontenac welcomes residents and visitors to enjoy its natural and cultural heritage.

According to the 2016 Census, the County's total population is approximately 26,677 persons,[1] with an additional significant seasonal population, spread across historic villages, small towns, and hamlets in four Townships: North Frontenac, Central Frontenac, South Frontenac, and Frontenac Islands, as illustrated in **Figure 1-1**.

According to the Population, Housing and Employment Projections for the Frontenacs, prepared by Watson & Associates in 2014, the County's permanent population is projected to grow from 27,900 persons in 2011 to 33,200 persons in 2036, an increase of 5,300.[2] The County's seasonal population is projected to grow from 29,600 persons in 2011 to 31,000 persons in 2036, an increase of 1,400.[3] Together, the total permanent and seasonal population for the County is forecast to reach a total of 64,200 persons by 2036, representing an increase of approximately 6,700 persons from 2011.[4]

With population growth comes development pressures and the need to consider where and how development can be accommodated and serviced, while maintaining and enhancing the vitality and livability of the County's villages and hamlets as rural community hubs with a distinct sense of place. Alternative water and wastewater servicing approaches can provide the County and its Townships with the innovative technology and flexibility to accommodate growth and achieve planning and economic development objectives.

[1] Statistics Canada, Census Profile, 2016 Census, Frontenac, County, Ontario.
[2] Watson & Associates Economists Ltd., 2014. Population, Housing and Employment Projections for the Frontenacs, pg. 10-2.
[3] Ibid., Table F-6.
[4] Ibid., pg. 10-2.

Figure 1-1: County of Frontenac Key Map

The County retained WSP to prepare a regional Communal Services Study ("the Study"), with the following goals:

1) Ensure land use planning criteria can be created to allow and promote new development on communal services;

2) Establish a financial model(s) that will reduce / eliminate the fiscal risk to the County and/or Townships to support new development on communal services;

3) Create planning policy that can be incorporated into the County and Township Official Plans to allow for consideration of communal services development; and

4) Provide options (planning, legal, servicing infrastructure) to permit new communal servicing infrastructure for existing buildings and infill development on mainstreets.

This Communal Servicing Study ("the Study") demonstrates how these goals can be achieved and identifies solutions for the County of Frontenac to enable redevelopment and new development on the basis of communal services. Communal water and wastewater servicing offers the potential to enable new development and infill across the county, including on village and hamlet mainstreets, addressing some of the challenges associated with centralized municipal services and with private on-site services. Most importantly, communal servicing has the potential to support more compact, land-efficient development than is possible with private servicing, at a lower cost than is possible with centralized municipal services, and enable revitalization of the County's communities.

1.1 THE SERVICING PROBLEM

Existing approaches to water and wastewater servicing constrain the County's potential for growth. The cost of providing or expanding municipal water and wastewater services to all rural areas is not a fiscal reality for most municipalities. The Provincial Policy Statement, 2014 (PPS) discourages partial servicing. Development on private individual on-site services inherently results in lower forms of density, due to the spatial requirements associated with well and septic treatment systems, and associated separation distances.

Continued development on private services alone has the potential to result in inefficient use of land, and to threaten the long-term viability of the County's villages and hamlets, especially their commercial cores and mainstreets. It limits the ability of the County and developers to respond to market trends, accommodate diverse housing types and needs and infill development on smaller lot sizes, which could assist in addressing increasing concerns related to rural housing affordability and accessibility. Reliance on private services also limits the ability to create mainstreets and commercial cores that are vibrant, walkable, and compact, and revitalize them through new commercial and mixed-use development, as well as conversions of uses. This may ultimately lead to declines in social and economic activity in village and hamlet cores by both residents and visitors, and a loss of sense of place.

The implementation of communal services has the potential to address many of these issues and assist the County and Townships in achieving their planning and economic development objectives and supporting thriving rural communities. However, perceived obstacles have slowed the implementation of communal services in many jurisdictions. The intent of this Study is to provide the County and its Townships with the knowledge, context, and tools to confidently enable implementation of communal services. There are several important areas to address to facilitate smooth implementation of communal services. Foremost among these is the Provincial requirement for Municipal Responsibility Agreements (MRAs) between developers of private communal systems and municipalities. It is critical to understand how best to mitigate and share financial responsibility and risk. County and Township Councils and staff need the tools to confidently understand, negotiate, and approve communal servicing projects.

1.2 WHAT ARE COMMUNAL SERVICES?

The existing conventional options for wastewater treatment are municipal centralized services and private individual on-site services. In a centralized municipal system, water is distributed to and wastewater is collected from a large service area through an extensive piped collection / distribution infrastructure. The water / wastewater is treated at a municipally-owned plant which is generally over-sized for current needs to account for future growth. By contrast, private individual on-site services generally refer to well water and septic treatment systems which serve one dwelling, a cluster of dwellings on one lot, or a commercial or recreational facility.

Communal servicing refers to communal drinking water systems and communal sewage systems that provide water and wastewater treatment to clusters of residences and businesses. They are an alternative to conventional municipal services and private individual on-site services. Communal systems are also sometimes called “decentralized systems” or “cluster systems.” While operating on the same basic principles as conventional municipal services, communal services are not connected to a single central facility. Instead, ‘right-sized’ facilities treat water and wastewater close to where it is needed or created.

The three types of systems are shown schematically in **Figure 1-2**.

Many different options exist within the broad category of communal servicing. Systems may be municipally- or privately-owned, using several different ownership and operation models. While many communal servicing systems use similar technical approaches, there is a growing range of treatment technologies that can be used. The distinguishing feature is that communal services treat water and wastewater close to where it is needed, reducing the need to pipe water or wastewater over long distances.

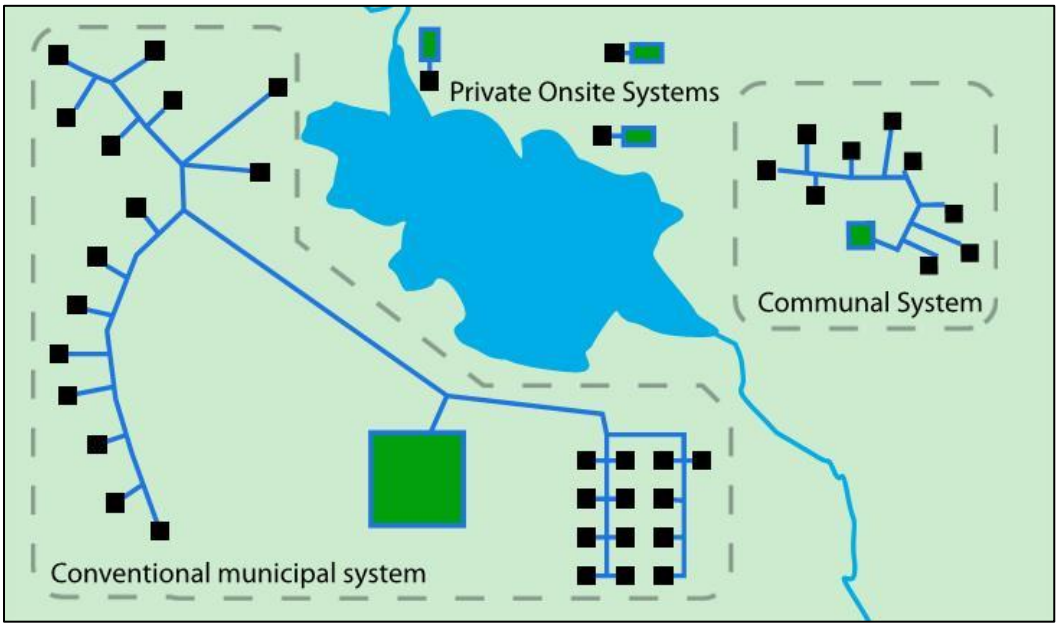

Figure 1-2: Different types of servicing systems

Communal servicing examples include:

Shadowridge Estates, Greely, Ottawa, Ontario (2011)

- Subdivision of 45 single-detached houses and 113 semi-detached units;
- Municipally-owned water and wastewater systems;
- Wastewater treated through peat bed;
- Drinking water extracted from well and treated through compact plant.

Fieldstone Development, Township of Mono, Ontario (2014)

- 340-unit subdivision of detached freehold homes;
- Municipally-owned wells;
- Conventional sewer collection system discharging to a Rotating Biological Contactor (RBC) Treatment Unit;
- Ultimate discharge of treated sewage is subsurface via area bed disposal systems;
- Municipally-owned well field (five wells) using groundwater to service approximately 600 connections in the area.

St-Joseph-de-Kamouraska, Quebec (2001)

- 80 existing residential units;
- Municipally-owned wastewater system;

- Wastewater from each residence is treated by an individual EcoFlo Advanced Treatment Unit;
- Treated effluent from these units discharges via gravity sewers into one of five communal dosing stations; treated wastewater is discharged into Rivière du Loup.

1.3 WHY ARE COMMUNAL SERVICES THE RIGHT FIT FOR THE COUNTY OF FRONTENAC?

Implementing communal services can assist the County and Townships in achieving their planning and economic development objectives. Communal water and wastewater servicing can enable new development and infill across the County, addressing some of the challenges associated with centralized municipal servicing and private on-site services. Communal servicing has the potential to enable more compact, land-efficient development than is possible with private servicing, at a lower cost than is possible with cent ralized municipal services.

The majority of population growth is forecasted in the County's rural areas, which is further evidenced by the location of active plans of subdivision across the County, and recent residential lot creation activity.[5] While some growth and development in the County's rural areas may be appropriate, haphazard rural development has the potential for negative impacts on the County's natural heritage resources and the character of rural areas.

Installing innovative, cost-effective communal water and wastewater facilities across the County would assist in reducing haphazard development, allowing for diverse housing types, and creating a sense of place in the County's settlement areas, particularly for the mainstreets and commercial cores of the County's villages and hamlets.

FULL MUNICIPAL SERVICES:

Systems that connect many houses in a large settlement area with a central municipally-owned treatment plant.

PRIVATE ON-SITE SERVICES:

Provide water or treat/dispose wastewater on the same lot as it is used/generated. Private wells and septic systems are the most common form of on-site treatment. These are regulated through **Part 8** of the **Ontario Building Code**.

COMMUNAL SERVICES:

Systems that provide water and wastewater treatment to clusters of development, close to where it is needed, using a growing range of treatment technologies.

[5] Watson & Associates Economists Ltd., 2014. Population, Housing and Employment Projections for the Frontenacs, pg. 10-2.

The County and its consultant, WSP, in consultation with local developers, have identified designated settlement areas, traditional mainstreets in settlement areas, and waterfront lands as priority areas for communal servicing approaches. Regional coordination for communal services in the County will provide an advantage, as it will help to ensure that a consistent approach is applied across municipal jurisdictions in the Townships.

The successful installation and operation of these communal systems will also assist the County in meeting the policy directions set out in the 2014 Provincial Policy Statement (PPS), such as:

- Promoting efficient development and land use patterns, to minimize land consumption and servicing costs;
- Focusing growth and development in settlement areas, to promote their vitality and regeneration;
- Accommodating a mix of densities and land uses;
- Encouraging opportunities for intensification and redevelopment;
- Providing for a range and mix of housing types and densities required to meet the needs of current and future residents, such as affordable housing, aging in place, and denser development on smaller lot sizes that is located in proximity to community services;
- Protecting natural heritage and the environment, by reducing potential nutrient loading impacts on lakes and waterbodies which are critical to the County's economy, quality of life, and protection of fish habitat and species; and

  Increasing public health and safety by developing and implementing a regular inspection and reporting system for the public.

In the County, communal servicing systems can facilitate:

- New development on smaller lot sizes that are a better 'fit' into the existing fabric of a village or hamlet;
- Developments within settlement areas that are dense enough to promote walkability, lower-carbon lifestyles, and efficient use of other municipal services and infrastructure;
- More housing within walking distance of mainstreets and commercial cores, to assist in strengthening the local economy;
- Commercial or industrial development and possible creation of a business park;
- Infilling and redevelopment along mainstreets, to promote vibrant community hubs, and on brownfield sites;
- Development of a broader range of housing types in the County, such as seniors' homes and outdoor lifestyle communities;
- Increased opportunities for mixed-use development, and for home-based businesses; and
- Rural and waterfront development that protects the County's water quality and natural heritage.

Some communities in Ontario already rely on communal water and wastewater servicing, including Indigenous communities and RV parks. Interest in communal servicing tends to be greater in rural and lower-density communities, due to the following potential benefits:

1) MORE EFFICIENT LAND USE

Communal servicing allows more efficient land use as compared to private on-site servicing. In many rural communities and smaller centres, centralized servicing is often not resource-effective. By contrast, communal servicing can support densities up to those supported by centralized municipal services, in targeted areas at relatively low cost.

Figure 1-3 illustrates an actual residential development in the County with private on-site services. **Figure 1-4** conceptually illustrates the additional density and development potential which could be enabled through the implementation of communal services for that same subdivision. The 28-hectare subdivision accommodates a total of 16 lots for single-detached dwellings, with each lot being serviced by private on-site water and wastewater systems. If the subdivision was developed on communal services, for example, it could accommodate a total of 62 units, including 41 lots for single-detached dwellings, 9 lots for townhouse dwellings, and an apartment complex with 12 units, representing almost 4 times the density. This would have financial implications from an increased tax revenue perspective, and be a more fiscally responsible outcome for the development and the community as a whole. This is described in detail in the Financial Model, as discussed in **Section 7**.

2) REDUCED FINANCIAL BURDEN

Numerous studies have shown that communal servicing infrastructure can be cost-effective as compared to centralized infrastructure, for the following reasons:

- Municipal systems are designed for over-capacity to accommodate growing populations. Modular communal systems permit expansion as needed.[6]
- Communal systems reduce the need for expansive collection and distribution infrastructure, which are a substantial component of project costs.
- Where actual costs are similar over 50+ years, the cost of financing the large capital expenditures for municipal systems make communal systems cheaper.[7]

Communal servicing compares favourably with private servicing, and appropriate financing structures can help distribute the burden to individual property owners.

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[6] G. Tjandraatmadja, S. Burn, M. McLaughlin et al, “Rethinking urban water systems - Revisiting concepts in urban wastewater collection and treatment to ensure infrastructure sustainability,” Water Science and Technology: Water Supply 5 no.2 (2005).
[7] R.D. Pinkham, J. Magliaro, J. and M. Kinsley. Case Studies of Economic Analysis and Community Decision Making for Decentralized Wastewater Systems. (Snowmass, CO, USA: Rocky Mountain Institute, 2004).

3) ENVIRONMENTAL BENEFITS

Communal servicing systems inherently offer some environmental benefits. Smart choices throughout the planning and design process can yield even greater environmental benefits. Most communal servicing projects achieve environmental benefits:

- Water is returned to the environment close to where it was withdrawn;
- Higher water and wastewater treatment standards can be expected than for private services;
- Environmental and social costs of large distribution/collection networks are avoided; and
- Monitoring inspection programs can ensure that the systems are always operating at a quality standard.

Broader environmental benefits can be achieved with thoughtful design:

- Reductions in water consumption:
  - Demand management permits smaller treatment systems,
  - Built-in financial incentive to invest in water-efficient design,
  - In-building treatment and reuse systems (e.g. greywater recycling systems) offer the strongest potential environmental benefits.[8]

- Greater adaptability and resilience in the face of climate change:
  - Better control of inflow / infiltration reduces risk of catastrophic flooding,[9]
  - Many smaller systems significantly reduce the risk of catastrophic failure.[10]

- Innovative technology, including resource recovery, can be implemented. For example, the following approaches offer specific benefits:
  - In-Building Treatment Systems allow reuse of water, reducing water use.
  - Advanced Treatment Units and Package Treatment Plants, like the Ecoflo and the Waterloo Biofilter achieve extremely high treatment quality with little land consumption, making them appropriate for mainstreet and infill-type development. Installation and maintenance information for these systems are included in **Appendix E**.

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[8] Mark Snider, Mike Dwyer, Brittany Mulhern and Roddy Bolivar, A Fresh Look – Alternative Servicing Models for Ontario's Villages, (Township of Rideau Lakes, ON: McIntosh Perry CE, Twp. of Rideau Lakes, Bolivar~Phillips, 2016).
[9] A. G. Capodaglio, A. Callegari, D. Cecconet and D. Molognoni, "Sustainability of decentralized wastewater treatment technologies," Water Practice and Technology, Vol 12 No. 2 (2017): 463-477.
[10] L. Chelleri, T. Schuetze and L. Salvati, "Integrating resilience with urban sustainability in neglected neighbourhoods: Challenges and opportunities of transitioning to decentralized water management in Mexico City." Habitat International, 48 (2015), 122-130.

- Constructed wetlands require little energy, and can function as habitat.[11]

- Careful attention must be paid to separate projects located on the same aquifer, to ensure that well interference is minimized and sustainable yields are maintained.

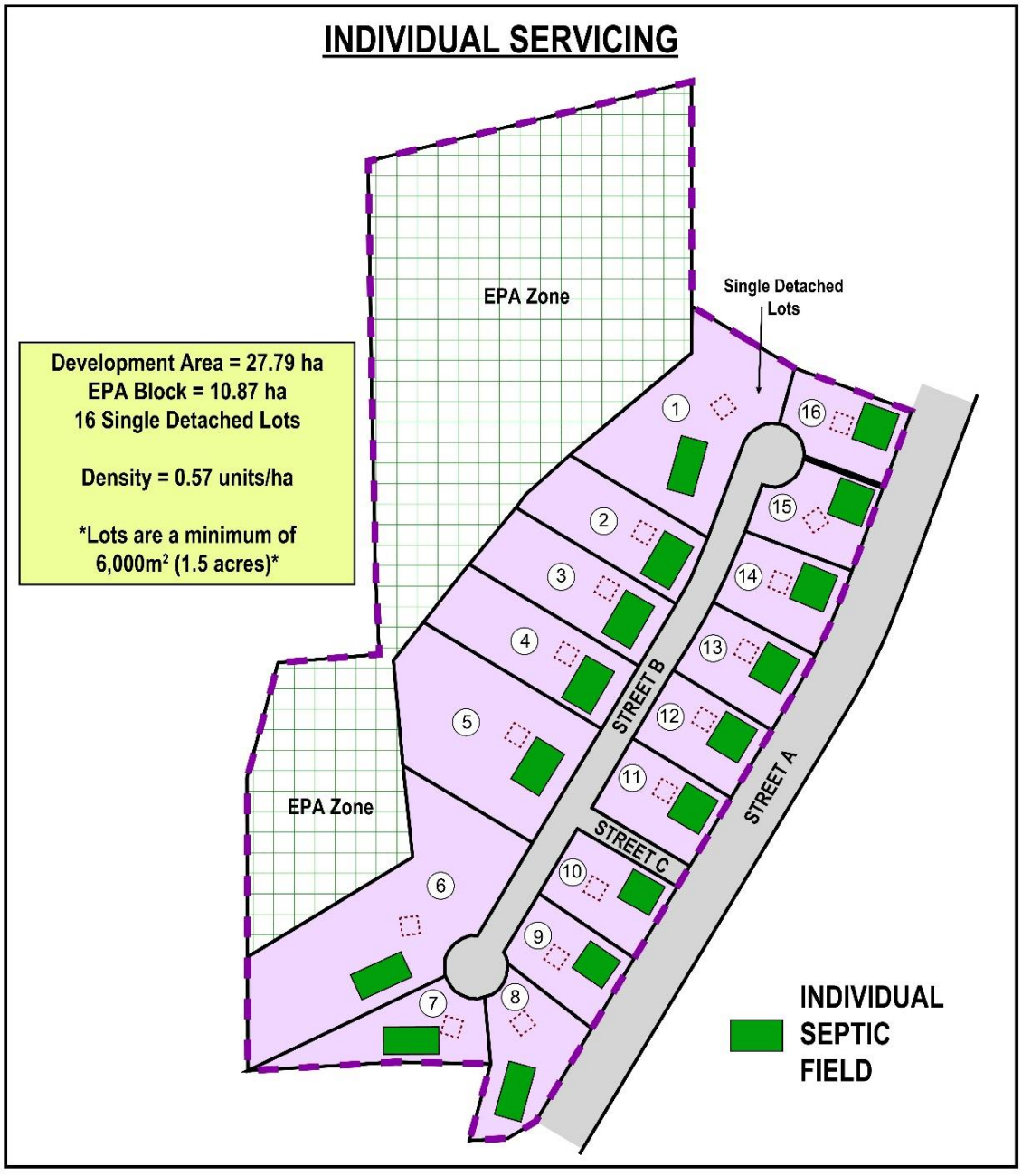

Figure 1-3: Subdivision Development Potential on Individual Servicing

[11] Yates, "Developing and Understanding for Wastewater Treatment in Remote Communities in Nunavut, Canada."

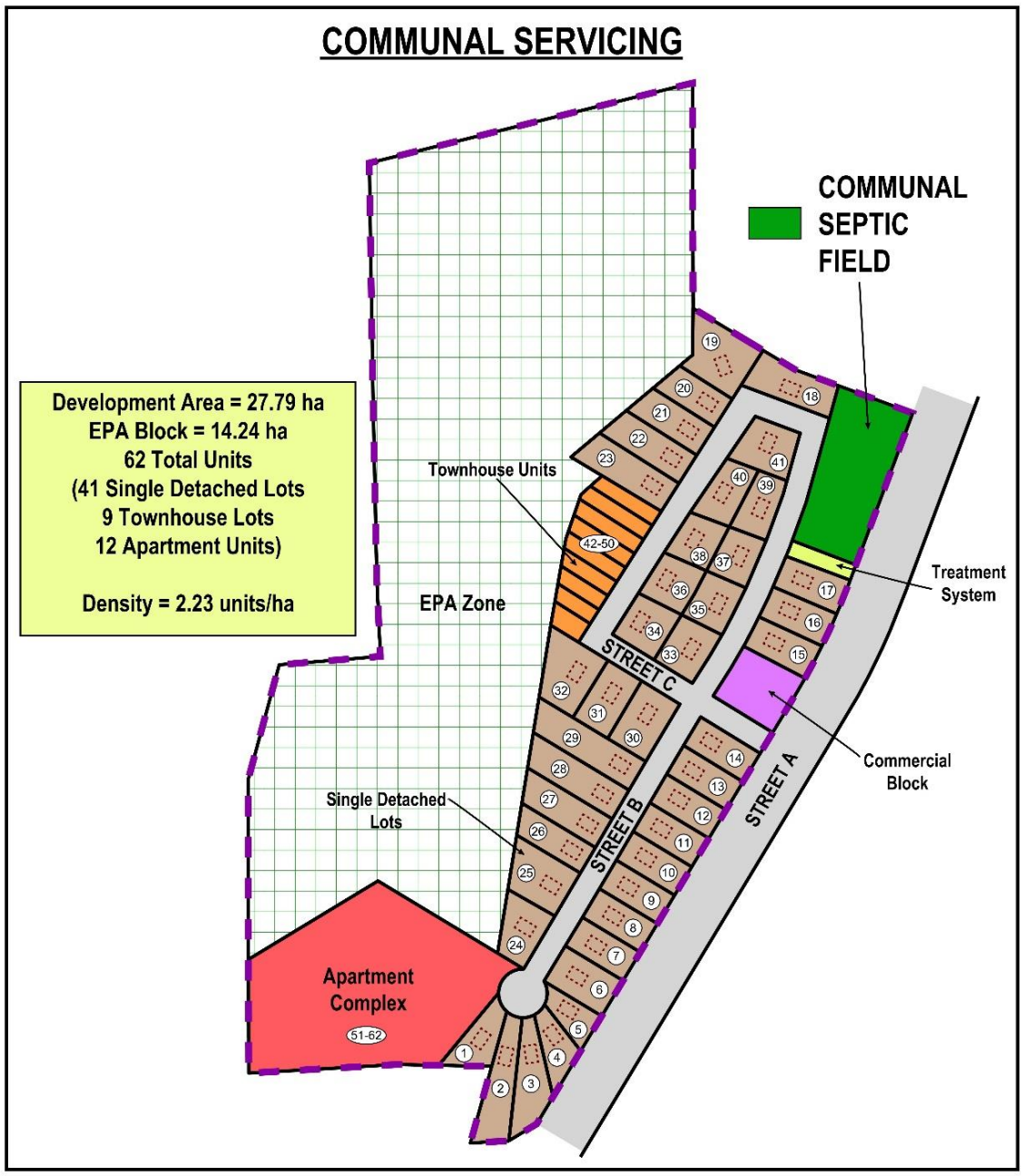

Figure 1-4: Subdivision Development Potential on Communal Servicing

1.4 STUDY PURPOSE

In undertaking this Study, the County is responding proactively to emerging opportunities for water and wastewater servicing in its four Townships. The fundamental purpose of the Study is to equip the County with the planning, engineering, and economic development tools necessary to enable redevelopment and new development on the basis of communal services.

This Study also identifies the existing regulatory and planning framework for communal servicing, as well as critical engineering and financial considerations. In doing so, the Study identifies regulatory and planning hurdles and risks for projects using communal servicing.

The Communal Services Study will empower the County and its Townships to manage the complexity inherent in water and wastewater servicing questions, with the objective to facilitate development on communal services. The key outputs of the overall Study include:

- Criteria-based Official Plan policies to encourage new development on communal services, as well as for commercial mainstreet redevelopment;
    - A planning rationale for consideration of development on partial services (i.e. communal septic, individual wells) within the context of the PPS;
    - Legal tools and processes available under the Planning Act and the Condominium Act that can be applied, and those scenarios where such tools could be considered for use;
    - 'Templates' of such tools that can be used by the municipalities;
- Engineering best practices, including a monitoring approach for communal systems; and
- A Financial Model to reduce the risk for the municipalities and developers associated with entering into Municipal Responsibility Agreements.

The measure of success for this Study will be the initiation of a project on communal services within 18 months of Council approval of the Study.

2 COMMUNITY OVERVIEW

2.1 DEMOGRAPHIC TRENDS

Growth projections prepared in 2014 for the County of Frontenac by Watson & Associates Economists Ltd. forecast that the County's permanent population is projected to grow from

27,900 persons in 2011, to 33,200 persons in 2036, which represents an increase of 5,300.[12] The majority of this population growth, approximately 67%, is anticipated to occur in the Township of South Frontenac, largely due to its proximity to the City of Kingston, employment opportunities for commuters, as well as continued local employment growth.[13] The Township of Central Frontenac is anticipated to accommodate the next largest fraction of the growth (17%), followed by the Township of Frontenac Islands (9%), and the Township of North Frontenac (7%), as illustrated in **Figure 2-1**.

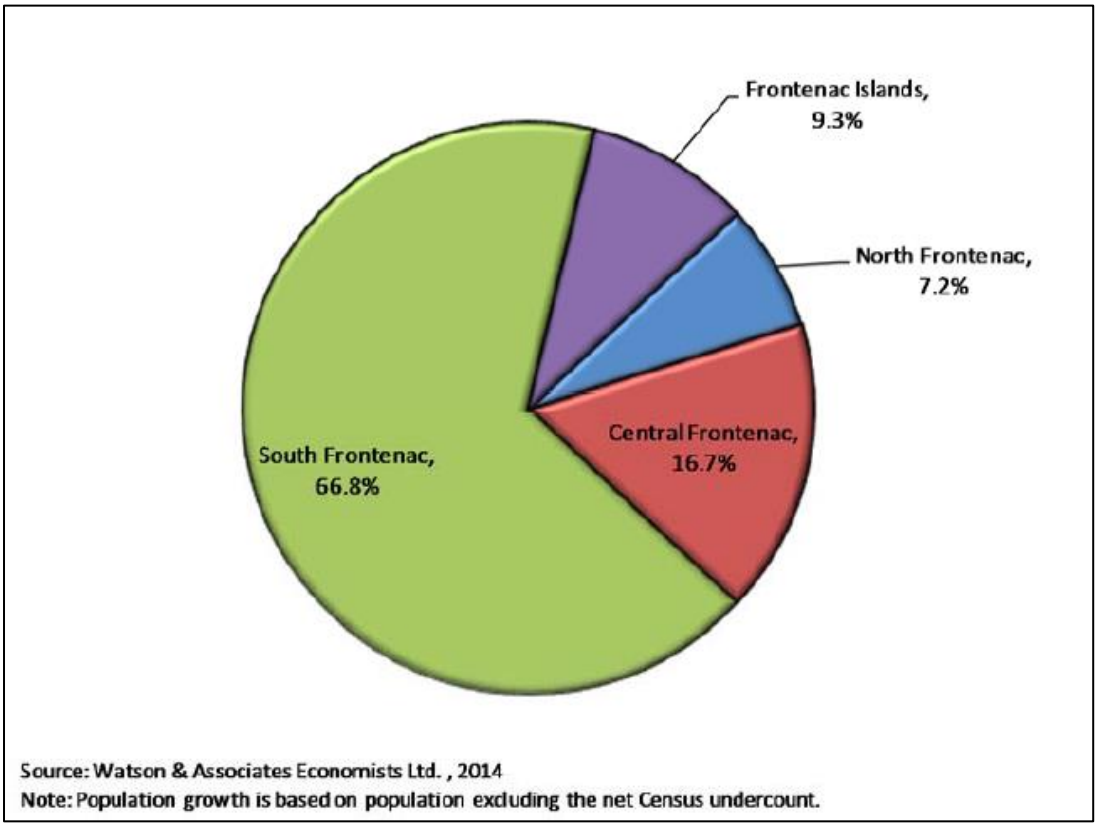

Figure 2-1: Allocation of Permanent Population Growth in the County of Frontenac by Municipality, 2011-2036

The population growth trends in the County are likely to be impacted by significant decisions in the neighbouring City of Kingston. The City has made the planning decision to maintain the City's current urban boundary, and accommodate the majority of future growth through intensification. Further, the addition of a second ferry between Wolfe Island and downtown Kingston proposed by the Ministry of Transportation (MTO), anticipated in 2021, will double existing capacity and will likely result in growth pressures on Wolfe Island. The Township of Frontenac Islands is expected to commence a secondary planning study for the Village of

[12] Watson & Associates Economists Ltd., 2014. Population, Housing and Employment Projections for the Frontenacs, pg. 10-2.
[13] Ibid., pg. 10-2.

Marysville on Wolfe Island in mid-2019, which will include a review of future servicing options. As such, Frontenac Islands may experience an increase in population and employment, and potentially the opportunity for establishment or confirmation of new settlement areas.

The County of Frontenac has a high and increasing proportion of seniors.[14] This is due to aging-in-place of current residents, recent retirees who are 'moving home,' retiring urbanites wishing to move to a smaller community and a more rural lifestyle, and the out-migration of younger adults. This older demographic has unique housing needs. In particular, seniors and older adults may need greater community support and infrastructure than is compatible with dispersed development.

The County of Frontenac is also seeing an increase in the number of seasonal residents. This includes summer cottagers as well as tourists who are attracted by the County's natural and cultural heritage. Tourism is a significant potential source of economic growth for the County, and the County must develop solutions to ensure adequate short-term and seasonal accommodations for this market. The tourism market is also distributed well throughout the County, with North, South and Central Frontenac Townships each supporting approximately 30% of the County's existing stock of short-term accommodations. Frontenac Islands has the potential to expand its tourist market, particularly in the agri-tourism sector. Ensuring appropriate servicing approaches will help enable growth of this sector without undermining the County's natural beauty and rustic atmosphere.[15]

2.2 LAND USE

The land use structure of the County follows important historical patterns. The County's hamlets and villages have historically served as economic centres for rural agricultural, resource-extraction and recreational communities, and are increasingly serving an important residential use. While economic trends are shifting, the rural character of the County, and its strong agricultural and recreational economies, are central to the County's continued success. **Figure 2-2** shows the distribution of settlement areas in the County of Frontenac.

[14] City of Kingston and County of Frontenac, 10-Year Housing and Homelessness Plan, 2013. https://www.frontenaccounty.ca/en/corporate/resources/10_Year_Housing_Homelssness_Plan_Kingston_and_Frontenac.pdf

[15] MDB Insight, "County of Frontenac Accommodation Review and Strategy for Growth," Report for the County of Frontenac, July 2017. https://www.infrontenac.ca/en/invest-in-frontenac/resources/Documents/Frontenac-Accommodation-Review-and-Strategy-for-Growth.pdf

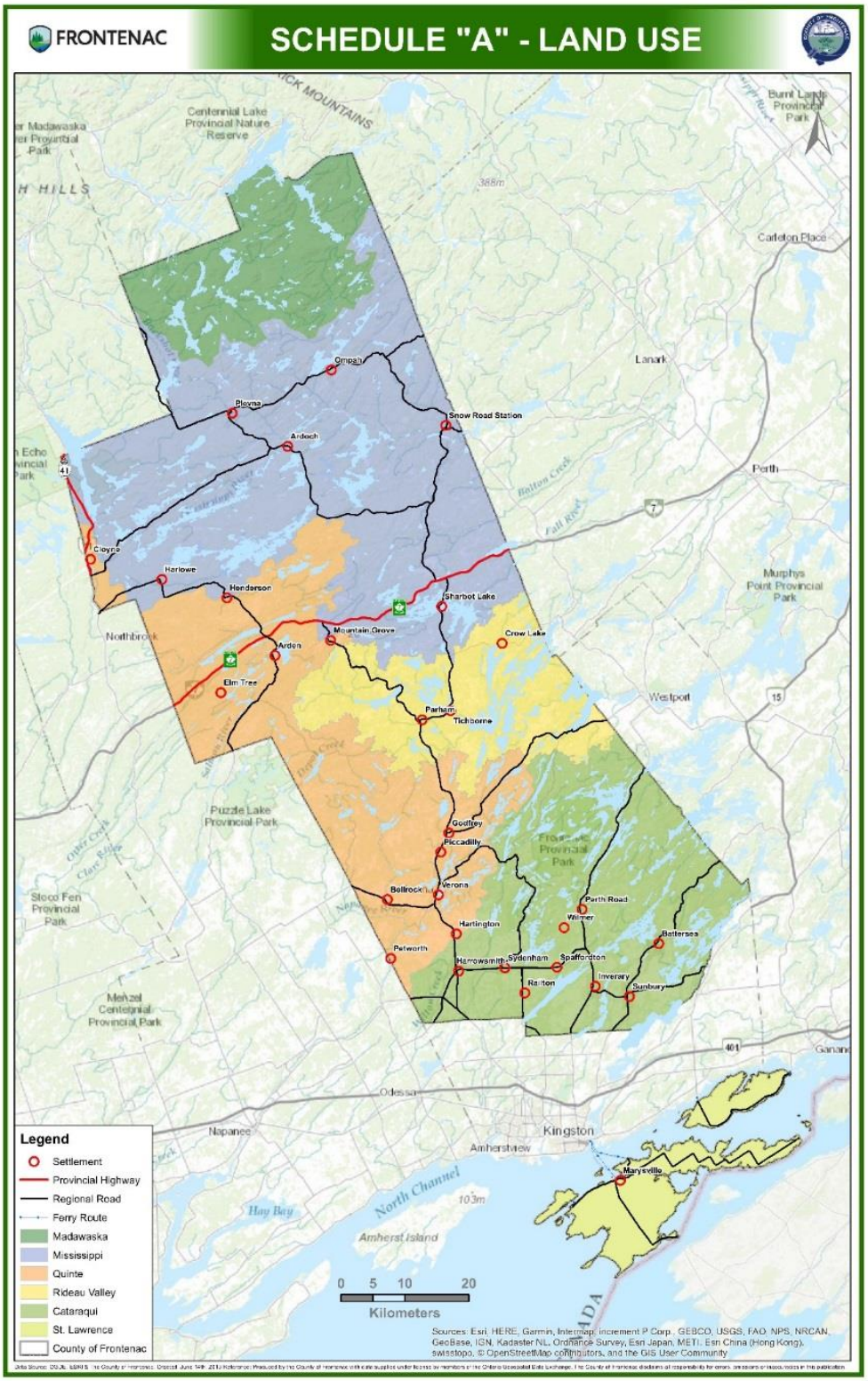

Figure 2-2: Settlement Areas in the County of Frontenac

The unique community characteristics are described and designated in the County and Township Official Plans. The policies included therein aim to provide a balanced and sensible protection of waterbodies and waterfront, agricultural lands and natural heritage features with rural residential and commercial development. Development of waterfront residential properties – whether seasonal or year-round – has long been an important land use within the County. Balancing new growth in waterfront areas with protection for natural features is a critical challenge facing the county.

The southern areas of the County of Frontenac are historically agricultural communities. However, they are increasingly experiencing more development pressures, largely due to in-migration, Kingston's fixed urban boundary, the desire for larger lots / rural living, and a desire for rural affordability. The dynamics in the County's southern areas will permit different approaches to development on communal servicing as compared to the County's more forested and remote northern areas, which have more seasonal residential waterfront development and larger rural lots.

In the current planning and policy framework, the County's growth is focused on 36 Settlement Areas distributed throughout the County. The largest of these are villages with 200-300 homes, and the smallest consist of a handful of homes and buildings clustered around a crossroads (see **Figure 2-3** for examples). As noted in Section 3.1 of the County of Frontenac Official Plan, some of these smaller Settlement Areas likely do not meet the definition of Settlement Areas in the 2014 Provincial Policy Statement. At the same time, servicing limitations constrain growth and redevelopment in the County's larger Settlement Areas.

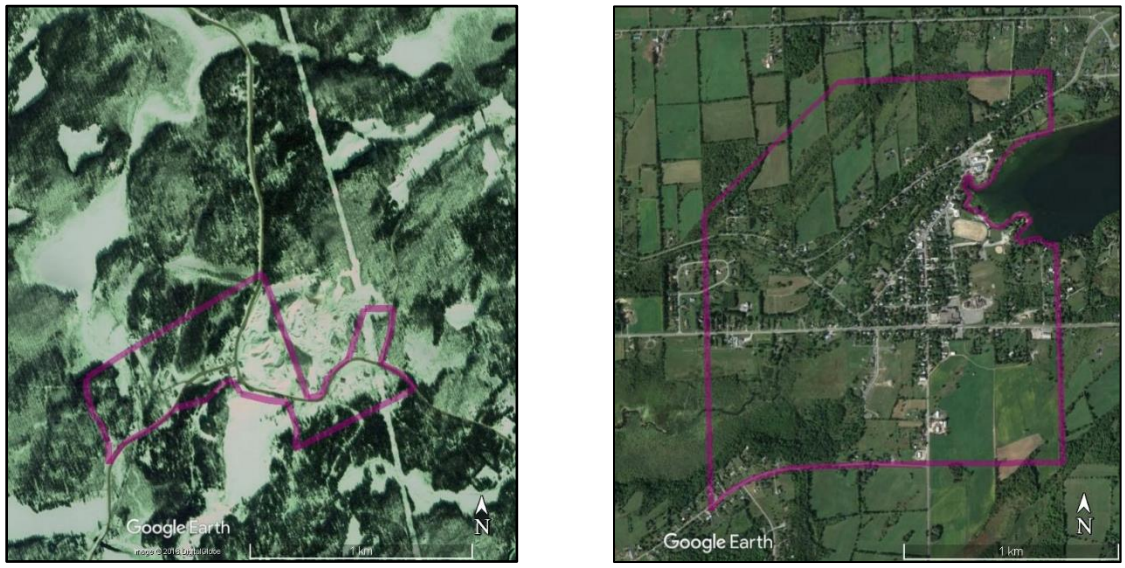

Figure 2-3: Approximate boundaries for Snow Road Station Settlement Area in North Frontenac (left) and Sydenham Settlement Area in South Frontenac (right)

The County has expressed interest in rationalizing the Settlement Areas on the basis of further study. This would represent excellent growth management practice. As the Environmental Commissioner of Ontario has noted, municipalities often assess and plan for infrastructure capability after growth areas have been delineated, to great economic and ecological cost.[16] Appropriate servicing approaches implemented on the basis of this Study, would substantially upgrade the development potential of many settlement areas, as will broader trends influencing the County including economic spinoff from the Third Crossing Bridge and increases in eco- and agri-tourism in the County. Therefore, the outcomes of this Study should inform any changes made to Settlement Areas including potential boundary expansions at the time of Comprehensive Official Plan review by the County and Townships. It must be noted that the Algonquins of Ontario must be consulted as part of this process.

2.3 HISTORIC VILLAGES AND MAINSTREETS

The County of Frontenac is made up of dozens of historical settlements, connected by country highways. While each hamlet, village and cross-roads community has a unique character, shaped by its history and location within the County, all share a settlement typology. These communities, from Marysville to Ompah, are oriented around mainstreets. Traditionally, mainstreets acted as economic centres for the surrounding rural region, and were the places that people came to shop, meet friends, and attend community events. **Figure 2-4** shows Verona's mainstreet in the 1930s – a successful community and retail centre despite the Great Depression.

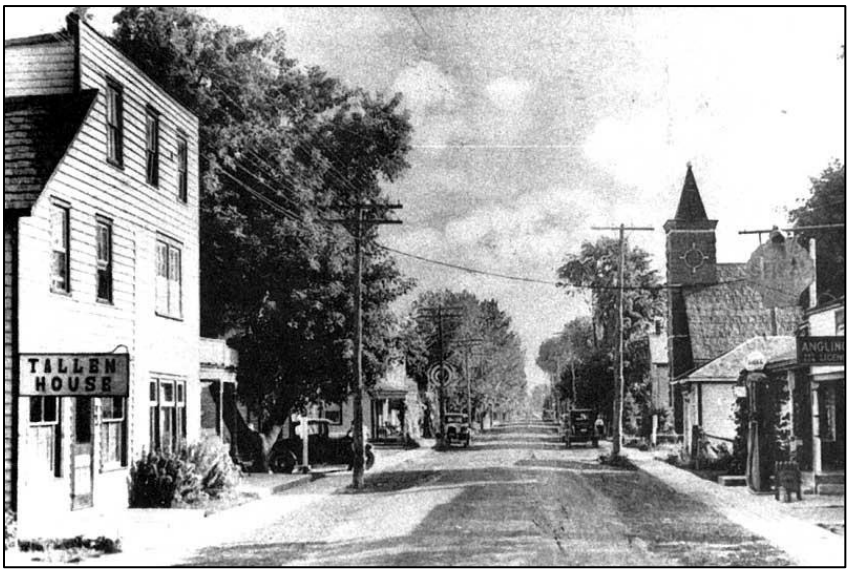

Figure 2-4: Verona Mainstreet, circa 1930 (Jeff Green, Frontenac News, 2015)

[16] Environmental Commissioner of Ontario, "Losing Our Touch", (ECO 2011/2012 Annual Report, Part 2, Toronto, ON: Environmental Commissioner of Ontario, 2012).

Economic trends since the mid 20th century have changed the role of the County's communities and their mainstreets. Many retail functions have been amalgamated in larger population centres resulting in a diminished role for mainstreets, and now the residential role of these communities is just as important as their economic one. Unfortunately, existing approaches to servicing limit the ability of these communities to capitalize on their potential to house new community members, and to enhance their historic role as local centres of economic activity. Additionally, many lots in the hearts of these communities are undersized relative to modern standards for private servicing, prohibiting redevelopment and resulting in potential environmental risks. New development within these communities happens on the basis of lot sizes optimized for private servicing, not for densities which promote walkability, neighbourliness, and a village feel. Fortunately, communal servicing would enable added density in existing settlement areas, including intensification and mixed-use redevelopment along mainstreets, and residential development that is sufficiently dense to promote active transportation, environmental sustainability, and the viability of local community institutions and businesses.

2.4 HOUSING

The majority of the County's housing is in the form of single-detached homes. As compared to the Province, the County has a high level of home ownership, and overall good housing affordability. In 2013, the County committed to ensuring housing quality and affordability by implementing the updated Municipal Housing Strategy and the 10-Year Municipal Housing & Homelessness Plan, in concert with the City of Kingston. This Plan identified increasing home prices in the County as a potential threat to affordability.[17]

The majority of new development, whether it is waterfront-oriented or not, is intended for year-round habitation, and relies on private water and sewage systems. Another important housing trend observed in the County is the conversion of seasonal waterfront and recreational dwellings to year-round residences. Based on recent MPAC data, 7,897 out of 29,002 parcels in the County are considered seasonal.[18]

Housing affordability for renters and seniors is more constrained due to limited rental stock. Additionally, housing stock in the County of Frontenac is older as compared to Kingston, so the costs of maintaining and upgrading properties – including on-site servicing – can strain the budgets of homeowners.[19]

[17] City of Kingston and County of Frontenac, 10-Year Municipal Housing & Homelessness Plan.
[18] MPAC Information provided by the County of Frontenac, April 12, 2019.
[19] Ibid.

2.5 ENVIRONMENT AND NATURAL HERITAGE

Protection of the County's ecologically rich and aesthetically stunning natural environment is critical. The County's growing recreational economy, as well as its traditional agricultural and resource-extractive industries, rely on a healthy environment. South Frontenac contains part of the "Frontenac Arch" – the curved portion of the Canadian Shield that links to the Adirondacks Mountains in the United States through South Frontenac. This ecologically-rich system has been recognized by the community through the UNESCO World Biosphere Reserve program.[20] The County also has an extensive area of Crown land in its northern region: the Township of North Frontenac is comprised of 64% Crown Land, and the Township of Central Frontenac is comprised of 17% Crown Land, as illustrated in **Figure 2-5**.

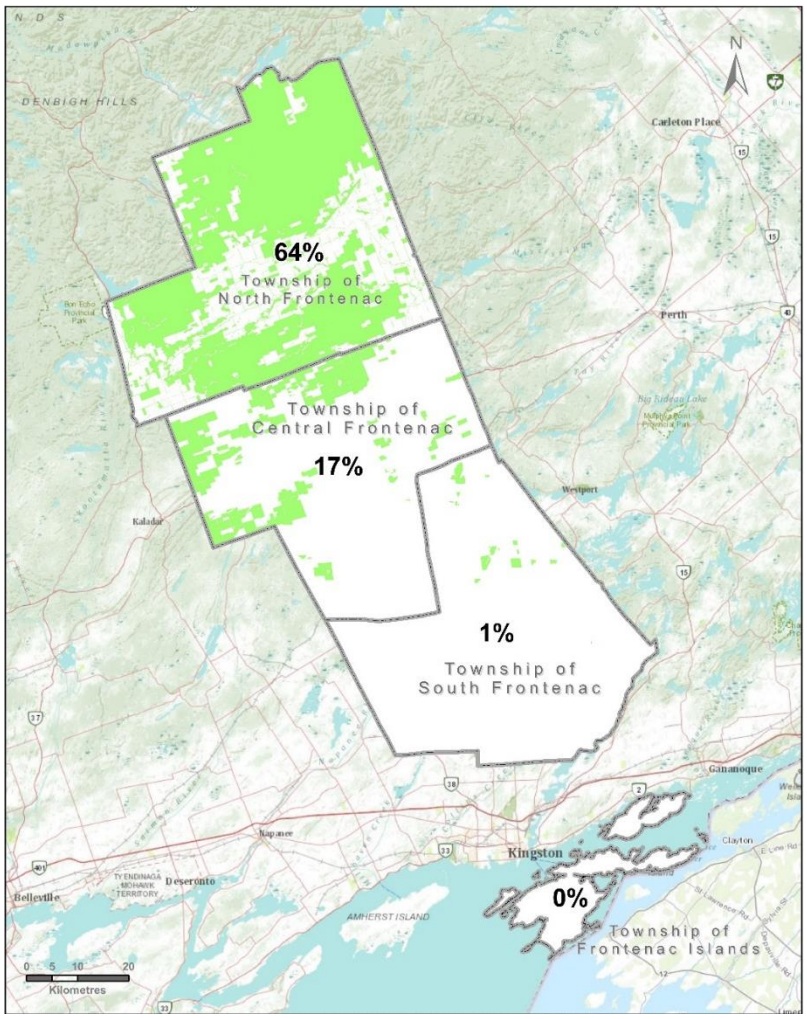

Figure 2-5: County of Frontenac Crown Land, Figure #2 Crown Land, County of Frontenac Official Plan, 2016

[20] The Frontenac Arch Biosphere Network, "What is the Frontenac Arch Biosphere?", http://www.frontenacarchbiosphere.ca/.

The County's water resources must be protected through safe and clean water and wastewater servicing. One source of risk for human health in the areas geology has been identified – most of the County is underlain by Precambrian Shield, which is prone to cracking and seepage, increasing the risk of septic movement.[21] Local developers have identified the rockier ground in the north of the County as a particular challenge to installing adequately sized septic beds. South Frontenac, with the greatest development potential, is also shaped by important water resources: its land area is 17% lakes, and 12% wetland.[22] The other Townships also have significant lake and wetland resources. The County has identified lakes which support Lake Trout populations as a conservation priority, such as Big Salmon Lake, illustrated in **Figure 2-6**. The County of Frontenac Official Plan ensures their protection through limits on development. Adequate water and sewer servicing is critical to the health of the County's Trout Lakes and all its aquatic ecosystems.

Figure 2-6: Big Salmon Lake in Frontenac Provincial Park (CC 2.0 Ted Goldring, 2006)

2.6 CLIMATE CHANGE AND RISK

Climate change has already begun to impact the County. Extreme hot days, as well as extreme precipitation events have increased.[23] Understanding the types of risks to water and wastewater servicing that are exacerbated by climate change is critical. These include:

- Extreme storm events increasing inflow/infiltration, overwhelming treatment capacity;

[21] County of Frontenac, Official Plan (2016 Consolidation), Subsection 4.2.1.4.1 "Special Policies: Future Villages Services Planning," p 42.
[22] County of Frontenac Mapping, http://www.frontenacmaps.ca/mapgallery.html
[23] Adam Fenech, "Climate Change at Frontenac Arch Biosphere Reserve: Preliminary Results," Presentation, Climate Lab at the University of Toronto. Environment Canada, August 28, 2010.

- Extreme weather, including rain on frozen ground, may flood infrastructure[24]; and
- Extended droughts reduce flow in receiving water bodies, limiting assimilative capacity.

Risk management for communal wastewater systems is critical. In fact, risk in communal and small-scale systems may be easier to manage than in larger municipal systems, due to their smaller scale.[25] Communal systems may also represent a smaller risk of contamination as opposed to multiple individual private wells, and issues would likely be easier and more cost effective to respond to if, for example, a deeper well is required. Communal systems and new technologies also offer the opportunity to reduce the carbon footprint of wastewater treatment.[26]

3 REGULATORY FRAMEWORK

The Federal government, the Government of Ontario, and local municipalities all play a role in planning, regulating and approving all water and wastewater servicing. Ontario's Ministry of Environment, Conservation and Parks (MECP) plays a lead role in ensuring that water and sewage projects are safe for the environment and people. Upper- and lower-tier municipal governments also play a key role in implementing Provincial and local policy. While Conservation Authorities do not have a direct regulatory or approvals role in most cases, they are important partners for municipalities and the Province. A full review of the relevant Federal and Provincial policies, legislation, and guidelines is available in **Appendix A**.

FEDERAL GOVERNMENT

- Sets minimum environmental standards for sewage effluent through the **Canada Wastewater Systems Effluent Regulations, SOR/2012-138 Fisheries Act**.
- Guidelines for Canadian Drinking Water Quality are used by Provinces to develop drinking water quality guidelines.
- There is no direct involvement of the Federal government in most water and wastewater treatment projects, because the Federal government is not directly responsible for water and wastewater planning or approvals, and Ontario standards for water and wastewater quality meet or exceed Federal requirements.

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[24] R Sandford and K. Freek, *Flood Forecast: Climate Risk and Resiliency in Canada* [e-book] (Victoria, British Columbia: Rocky Mountain Books; 2014).
[25] AECOM and C40 Cities, "C40 Infrastructure Interdependencies + Climate Risks," Report, C40 Infrastructure Interdependencies and Cascading Climate Impacts Study, April 2017. https://unfccc.int/sites/default/files/report_c40_interdependencies_.pdf.
[26] ECO, *Every Drop Counts: Reducing the Energy and Climate Footprint of Ontario's Water Use* (ECO 2016/2017 Annual Report, Toronto, ON: Environmental Commissioner of Ontario, 2017).

PROVINCE OF ONTARIO

- Under the **2014 Provincial Policy Statement** and the **Planning Act, RSO 1990, c. P.13, Section 2**, the Province sets directions for sewage and water planning that municipalities must be consistent with and conform to.
- Regulates effluent being discharged into the environment by requiring **Environmental Compliance Approvals (ECA)** for most sewage projects, including communal wastewater treatment projects. The need for an ECA is triggered by **Section 9.1 of the Environmental Protection Act, RSO 1990, c. E.19** or **Section 53 of the Ontario Water Resources Act, RSO 1990, c. O.40.**
  - The ECA process ensures that new wastewater treatment projects will not lower the quality of Ontario waterbodies below the Provincial Water Quality Objectives, outlined in **Water Management: Policies, Guidelines Provincial Water Quality Guidelines, 1994**.
- Regulates small drinking water systems, under the **Health Protection and Promotion Act, RSO 1990, c. H.7, O. Reg. 319/08**.
- Institutes source protection in the **Safe Drinking Water Act (SDWA), 2002**, as amended. Effective July 1, 2018, drinking water suppliers must undertake technical source protection work which must be reviewed by the local Conservation Authority (if applicable) and approved by the MECP.
- Approves projects that trigger an Environmental Assessment, (**Section 3 of the Environmental Assessment Act, 1990**, and **O-Reg 345/93**).
- Publishes D-5 Planning for Water and Sewage Service Guidelines, which are used by the province to evaluate and approve wastewater projects.
  - **D-5-2 Application of Municipal Responsibility for Communal Water and Sewage Service** only contemplates municipal operation and ownership, or communal servicing for condominiums – a major constraint for communal servicing projects.

2014 PROVINCIAL POLICY STATEMENT IN FOCUS:

Sections 1.6.6.2 to 1.6.6.5 of the PPS set out preferred options for servicing. This is referred to as the "servicing hierarchy" for water and wastewater:

1. Full municipal services,
2. Private communal services.
3. Private on-site services
4. Partial services (only allowed in case of failure)

The "servicing hierarchy" seems to discourage communal services. In fact, communal services will help the County of Frontenac and its Townships be consistent with the PPS: Communal servicing will allow more efficient land use and development – a central goal of the PPS.

MUNICIPALITIES

- Responsible under the **Planning Act** for ensuring consistency of local planning policy and development approvals with the **Provincial Policy Statement, 2014** (PPS).
- Power under the **Planning Act** to plan for water and wastewater services, and to ensure development only occurs where adequate water and wastewater servicing is possible.
- Responsible for reviewing development applications to ensure that servicing plans will be safe, healthy and environmentally responsible.
- Through **Municipal Responsibility Agreements (MRAs)**, must take responsibility for failed communal systems.

As the County of Frontenac embraces the potential of communal servicing, it is critical that municipal councils and staff, developers and interested residents understand how communal servicing projects are affected by this regulatory and approvals framework. **Figure 3-1** illustrates how a hypothetical communal wastewater system would pass through the approvals process. This hypothetical project discharges more than 10,000 L/day (about 20 houses). Wastewater treatment systems that treat less than 10,000 L/day might not trigger the need for an Environmental Assessment (EA) or Environmental Compliance Approval (ECA), although the same principles and standards would apply.

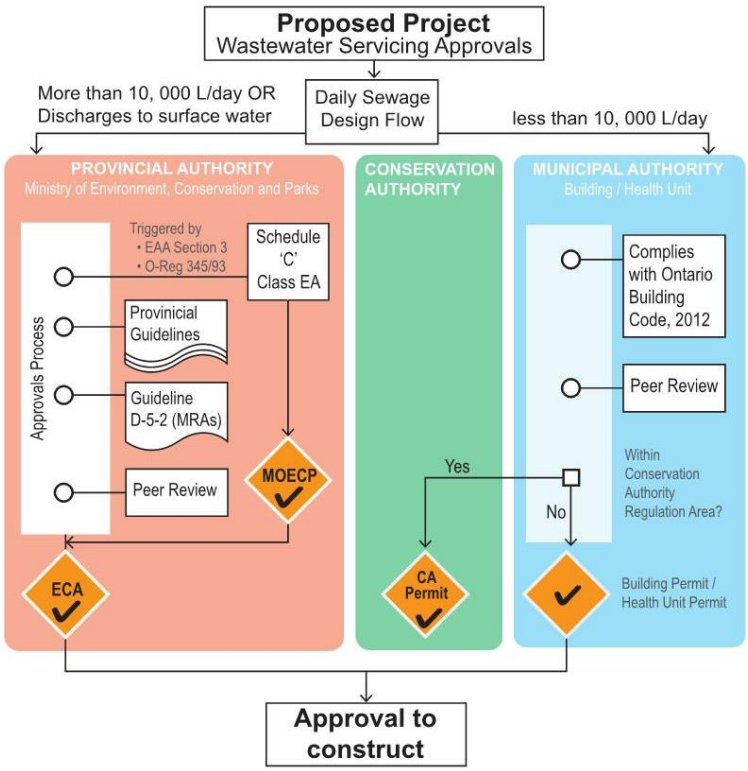

Figure 3-1: Regulatory approvals process for a hypothetical communal wastewater system

3.1 LEGISLATIVE AND REGULATORY IMPLICATIONS FOR COMMUNAL SERVICING

The Federal and Provincial legislative and regulatory parameters have historically been oriented towards centralized municipal services. The legislative and regulatory review undertaken for the Study highlights how the proponent of a communal servicing project can navigate the existing regulatory framework. Importantly, the responsibility is on the proponent to establish the proposed system's technical feasibility, approach to managing risk, and the environmental benefits of the system. Other important implications for municipalities and private proponents interested in communal servicing approaches are as follows:

1) Communal servicing systems can support the broad objectives of the PPS towards intensification, efficient land use, the need to address rural affordability, settlement area growth, preservation of agricultural land, increased active transportation, efficient infrastructure, and economic development by allowing denser development in small settlement areas.

2) The servicing hierarchy expressed in Sections 1.6.6.2-5 of the PPS and reinforced in other legislation, regulations and guidelines, distinguishes between municipally-owned services and private communal services, but does not define the type of municipal service. Therefore, municipally-owned or operated communal servicing would not be in the 'second tier' of servicing options.

3) Proponents and/or municipalities are liable for failures in servicing infrastructure. The legislative language is oriented towards protection of the environment and public health.

4) Provincial policy, legislation and regulation refer to efficient use of resources, conservation and protection of the natural environment. However, beyond regulating discharge of pollutants into waterbodies, the regulatory framework offers little guidance as to how servicing infrastructure can support these goals.

5) Guideline D-5-2 Application of Municipal Responsibility for Communal Water and Sewage Service structures the relationship between private communal services and the municipality by requiring an MRA in many situations. However, it is anticipated that an MRA would likely not be required for a commercial-only mainstreet servicing project, nor for seasonal/recreational projects. MRAs apply to permanent and primary residences. In the case of commercial-only uses or seasonal residences and failure of communal services, the MECP has the authority to shut services down until they are repaired.

6) A critical question remains regarding the appropriate sizing of communal services. Guideline D-5 Planning for Sewage and Water Services is clear that sufficient capacity to support growth must be present before development, but does not provide a specific formula for determining the appropriate capacity of new water and wastewater servicing systems. Planning for centralized services may rely on industry common practice or

comparisons to nearby servicing areas. However, centralized systems must consider the following factors:

- Extremely high cost to expand treatment and distribution capacity after-the fact;
- Limited ability to predict impact of water demand management programs; and
- Significant potential for inflow and infiltration over the infrastructure's lifespan.

By contrast, developers who look to install communal services for a specific development may be able to better control these factors. Determining appropriate servicing capacity is critical for managing risk, but where servicing capacity can safely be assumed to be smaller, project proponents can save on infrastructure costs.[27]

4 EXISTING LOCAL PLANNING CONTEXT

4.1 THE ROLE OF CONSERVATION AUTHORITIES

Conservation Authorities are an important resource and partner for water and sewer works, and are often responsible for working with Province to monitor water quality and flow of waterbodies within their area. The data they provide is used by the MECP to help define the effluent quantity and quality that may be discharged under an ECA. Conservation Authorities may also be involved in source water protection.

Four (4) Conservation Authorities have authority within the County. Conservation Authorities' jurisdictions follow watershed boundaries rather than political ones, so careful coordination between the County, the applicable Township, the relevant Conservation Authority, and the project proponent is important.

The Ontario Low Water Response Program was established in 2009 to help Ontario prepare for drought conditions. Under this program, Conservation Authorities are encouraged to

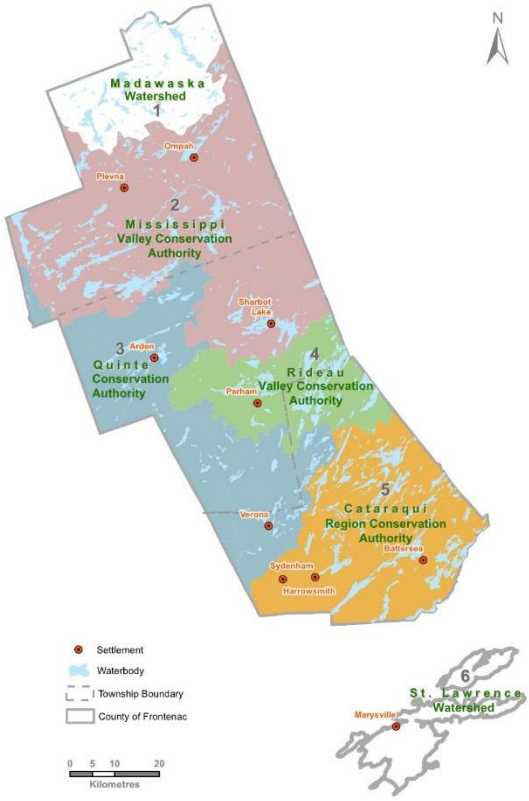

Figure 4-1: Key Map of Conservation Authorities within County of Frontenac

[27] M. Binstock, *Moving toward a soft path approach? A case study of water management in Guelph, Ontario* (Toronto, ON: Canadian Institute for Environmental Law and Policy, 2010).

establish minimum flow thresholds for aquatic ecosystem health, considering the impact of wastewater effluent in low water conditions.[28] They may also address groundwater conditions. Conservation Authorities have water conservation and demand management programs, as described below.

Cataraqui Region Conservation Authority

- Monitors water quantity on eight (8) streams.
- Monitors water quality through MECP's Provincial Water Quality Monitoring Network.
- Low water response plan partner.

Mississippi Valley Conservation Authority

- Monitors the effect of development and land use to assess watershed conditions through field monitoring, remote sensing and gathering and interpreting information on the status of water and water related natural resources on an ongoing basis.
- Has Low Water Response Plan to coordinate responses between agencies.
- Has a septic re-inspection program.

Rideau Valley Conservation Authority

- Administers Part 8 of the Ontario Building Code on behalf of the City of Ottawa and Tay Valley Township by reviewing and issuing Building Permits for construction, enlargement and/or alteration of sewage disposal (i.e. private) systems.
- Has a septic re-inspection program.
- Monitors and maps water quality and flow levels.

Quinte Conservation Authority

- Has developed Low Water Response and monitors flow thresholds.
- Part of the Ontario Provincial Groundwater Monitoring Network and the Ontario Provincial Water Quality Monitoring Network which provides data to the MECP on water quality.

4.2 OFFICIAL PLAN REVIEW

At the time of this report, the following Official Plans and Draft Official Plans were reviewed:

- County of Frontenac Official Plan (2016);
- Township of Frontenac Islands Official Plan (2013);

[28] ECO, Losing our Touch.

- Township of South Frontenac Official Plan (2003);
- Township of Central Frontenac Official Plan (2008);
- Township of Central Frontenac Draft Official Plan (2018); and
- Township of North Frontenac Official Plan (2017).

It should be noted that the Township of South Frontenac is anticipated to undertake the development of a new Official Plan, beginning in mid-2019.

Policies related to water and wastewater servicing varied significantly across the County and Townships. Each of the Official Plans contain strong policy directions supporting infill of settlement areas and revitalization of traditional villages and main streets. As previously noted, perceived barriers to communal servicing have constrained the availability of appropriate water and wastewater services in the County. There is a strong opportunity for the County and its Townships to encourage development and revitalization by adopting policies that are supportive of communal servicing options.

4.2.1 COUNTY OF FRONTENAC OFFICIAL PLAN, ADOPTED OCTOBER 15, 2014, MMAH APPROVAL JANUARY 11, 2016

The Official Plan for the County of Frontenac ("County OP") was adopted by Council on Wednesday October 29, 2014 and was approved by the Ministry of Municipal Affairs and Housing on January 11, 2016. The County OP is in full force and effect.

The County OP provides over-arching policy direction on matters of provincial and County-wide significance. The County OP directs growth management and land use decisions by providing upper-tier land use planning guidance for the County's member municipalities. Detailed land use planning and local decision making is managed and administered locally through the local municipal Official Plans.

There are a number of community priorities that are identified in the County OP that can be more effectivity delivered from a planning and economic development perspective through the implementation of communal services across the County and Townships. For example, Section 2.2.2 – Tourism in the County OP contains policies to promote tourism and leisure activities which include lakes and rivers, which could benefit from development on communal systems, while protecting the environment.

In addition, there are several types of land uses that would benefit from development on communal systems to enable more development, smaller lot sizes, and better overall

management of lands, such as business parks (Section 2.2.3), rural lands (Section 3.3), and waterfront areas which have special policies as identified in Section 3.3.3.4 in the County OP. As stated in Section 3.1.2 in the County OP, another community priority is the importance of ensuring the housing supply can meet growth projections, as well as providing a diversity of housing types to enable County residents to age in place. This would be enhanced by allowing development on communal services. It would offer residents choice, and it would offer developers an option to develop with increased densities and smaller lot sizes, serviced by a communal system.

Section 3, "Growth Management," contains policies to encourage intensification and redevelopment of the County's traditional villages, mainstreets and settlement areas. It also acknowledges that existing servicing approaches are constraining smart growth in the County. In fact, the County OP's policies in Section 4.2.1.5 Private Services constrain potential development in Settlement Areas – they state that private services may only be used for infilling and minor rounding out but municipal services are unlikely to be available to support intensification.

Section 3 Growth Management
3.1(c): "The lack of full municipal water and wastewater services in any of the hamlets or villages of the County will constrain the ability to increase the density of these areas, and may impact the ability to focus new development within these settlement areas; […]"

The County OP identifies the opportunity to rationalize Settlement Areas, including on the basis of water and wastewater servicing potential.

The County OP also provides direction to the Townships:

- Section 3.3.3: Townships should coordinate with each other to ensure that development within the same watershed is environmentally appropriate.
- Section: 3.3.3(2)(d): Townships should work with the County to investigate new technologies and communal servicing options.
- Section 3.3.3(2)(e): Townships should establish minimum lot size based on local conditions.

Several policies of the County OP that explicitly discourage communal servicing must be amended. These are identified in **Appendix B**. Section 4.2.1.4.1 Special Policies: Future Village Services Planning contains a range of policy options to investigate/promote the development of full municipal services. Given the potential benefits of communal servicing over municipal services to achieve the goals of the County OP, the tools and approaches in this section may be amended to support communal services rather than municipal services. This would also assist in providing an opportunity for local businesses and/or landowners of vacant properties to redevelop, expand, and to potentially apply for a community improvement grant.

Furthermore, the County's lakes and river systems are important as established through the preparation of Lake Management Plans (LMPs), as described in Section 7.1.4.13 in the County OP. The preparation of the LMPs identify and protect the physical and environmental values and can result in a vision for the lake community, and land use policies and direction for stewardship. LMPs and the lake capacity assessment to determine carrying capacity for development and opportunities to improve water quality.

4.2.2 TOWNSHIP OF FRONTENAC ISLANDS OFFICIAL PLAN, JULY 2013 CONSOLIDATED VERSION

The Township of Frontenac Islands Official Plan (July 2013 Consolidation) states that the preferred servicing option for its Settlement Areas is full municipal services. However, in the event that full municipal services are not feasible, it identifies communal services as the preferred means of servicing.

The Official Plan has strong support for communal servicing; however, additional policies outlining options and criteria for communal servicing may help to support implementation of the Township's existing policies.

Section 3.2.4.1 Communal Water Supply
This policy indicates that new residential development of 6 residential units or more will be served by communal water supply systems except where it is demonstrated to the satisfaction of the Township that a communal system is not feasible or practical. In terms of administration and management, all new communal water supply systems designed to serve more than 5 residential lots/units shall be assumed by the municipality for administration and maintenance purposes and an annual review of all municipal water supply systems shall be required.

4.2.3 TOWNSHIP OF SOUTH FRONTENAC OFFICIAL PLAN, MARCH 2003, TEXT AMENDMENTS APPROVED BY MMAH MAY 23, 2013

Section 4.8 Servicing Objectives
"(vi) To prohibit private communal systems in the Township."

The development policies for settlement areas in the Township of South Frontenac Official Plan (2003, 2013) which is in full force and effect, are broadly permissive to encourage enough building of appropriate stock to support affordability and elasticity in the residential and non-residential market. However, given current servicing approaches, this goal is constrained by the need to provide safe and adequate services. Nevertheless, many policies in the Township's Official Plan explicitly discourage communal servicing and innovative servicing options.

On May 27, 2019, Township Council repealed an Official Plan Amendment (OPA 23), which was adopted on September 15, 2015, as the OPA was never approved by the County and is now out of date. The Township of South Frontenac will be undertaking the development of a new Official Plan, anticipated to begin in mid-2019. Future communal servicing options and appropriate policies will be considered as part of the new Official Plan. As such, a review of the Township's existing Official Plan policies is not included in **Appendix B**.

4.2.4 TOWNSHIP OF CENTRAL FRONTENAC OFFICIAL PLAN, APPROVED WITH MODIFICATIONS JUNE 18, 2008 (IN FORCE AT TIME OF STUDY PUBLICATION)

The Township of Frontenac Official Plan which is currently in full force and effect discourages smaller lots and higher densities in settlement areas, hamlets and the Village of Sharbot Lake on the basis of servicing constraints. Policies in Section 4.2 of the Plan are intended to discourage any development that might demand centralized services. Nevertheless, the Official Plan does contemplate the potential of communal services for multiple lot development in Section 4.2.4.

4.2.5 TOWNSHIP OF CENTRAL FRONTENAC OFFICIAL PLAN, FIRST DRAFT MAY 15, 2018

The Draft Official Plan for the Township of Central Frontenac contains many progressive policies that explicitly and implicitly support communal servicing. These policy directions include:

- Consideration of climate change impacts, in Section 2.2.
- Support for efficient development patterns, in Section 2.3.2 and 2.3.5.
- Strong support for sustainable practices, including conservation of water resources, actions that improve or restore ecological functions, and the use of adaptive technologies that reduce consumptive practices, in Section 2.3.17.

The Official Plan establishes the criteria for evaluating communal servicing proposals in Section 3.17.3. Nevertheless, policies of the Draft Official Plan could be amended to strengthen support for communal servicing.

4.2.6 TOWNSHIP OF NORTH FRONTENAC OFFICIAL PLAN, APPROVED BY COUNTY COUNCIL SEPTEMBER 20, 2017

Section 3.17 Provisions for Water Supply and Sewage Disposal in the Township of North Frontenac Official Plan states, "Servicing will be on the basis of individual on-site sewage services and individual on-site water services. This reflects the character of the area as well as the intent to avoid densities, which may necessitate the installation of piped services." While recognizing the lower-density character of North Frontenac, stronger support for communal servicing should be considered during the next Official Plan Review.

Currently the Official Plan policies that offer support for development on communal servicing include:

- Section 3.17 acknowledges the need for private communal services for larger-scale permanent residential developments, RV park developments, and tourist and recreational developments.
- Subsection 3.17.3 Communal Services outlines the criteria for evaluating communal servicing proposals.
- Section 4.2.3 Hamlet Principles promotes intensification for hamlets.

Several policies of the Official Plan that explicitly discourage communal servicing must be amended. These are identified in **Appendix B**.

4.3 SUMMARY

Generally, the policies in the County of Frontenac's current Official Plan, similar to those of its Townships, are permissive of communal servicing, within the existing provincial regulatory requirements. However, they tend to prioritize private on-site servicing.

A stronger policy framework at the County level and in the Townships' Official Plans will need to be developed to provide landowners with the option for development on communal servicing. This framework will identify how this servicing can be implemented from land use planning, engineering and financial perspectives.

Appendix C contains draft policies to be considered for inclusion in the County and Township Official Plans, including new policy additions and revisions to existing policies to better direct development on communal services and facilitate progressive growth management in the County.

PARKLAND DEDICATION

One potential issue noted by a local developer expert is the question of parkland dedications and communal septic beds. Each Township Official Plan has parkland dedication policies allowing the Township to request that up to 5% of the area of a residential subdivision or condominium development be conveyed to the Township for parkland purposes. South Frontenac, Central Frontenac and Frontenac Islands also qualify that land must be suitable for parkland. The relevant policy excerpts can be found in **Appendix B**.

This is relevant to communal servicing, since most communal servicing technologies require an area of land that is used for sub-surface disposal, the surface of which may be covered by turf. Although this surface might seem ideal for passive recreational uses, and thus appropriate for parkland dedication purposes, because the land is encumbered, municipalities are not obligated

to accept it. Municipalities with a higher population density (i.e. in the GTA) have struggled with the question of encumbered land. The risk is that if the sub-surface facilities need upgrades the surface parkland will need to be restored. The question of who should pay for this – the municipality, the current occupiers (e.g. a condo corporation) or the original developers – is a source of uncertainty. Parkland for stormwater ponds/facilities is generally not accepted as part of the 5% parkland dedication.

If the Townships were to permit conveyance of the land above subsurface disposal beds for parkland dedication, they would reduce cost barriers to development. Some potential options are:

1) Privately-owned public space (POPS): The municipality could enter into an agreement with the developer at the plan of subdivision stage to waive the parkland dedication requirement, and instead require development of the land above the dispersal system into a publicly accessible, but privately owned and maintained parkette. In this case, a clause would have to be included that the condo corporation (or, in the case of a residential facility like a nursing home, the owner/management company) would be responsible for rehabilitating the parkland in the case of subsurface repairs;
2) The municipality could accept the encumbered land, and accept the risk/responsibility for repairing the parkland in the case of subsurface repairs; and/or
3) The municipality could reduce or waive the parkland requirement which may act as another incentive for a developer to build using communal services.

5 COMMUNAL SERVICES BEST PRACTICES

Attention to communal servicing has increased dramatically in the past several years. Despite the significant positive benefits of alternative approaches to water and wastewater servicing, relatively few Ontario examples exist. Attention to alternative servicing models comes from a few professional sources. One of these is “A Fresh Look: Alternative Servicing Models for Ontario’s Villages” (2016), prepared by McIntosh Perry Consulting for the Township of Rideau Lakes. “A Fresh Look” outlines alternative servicing models for Ontario villages, with a contextual focus on the Township of Rideau Lakes.

As outlined in “A Fresh Look,” multiple levels must be considered when planning servicing:

1) Technological – the technologies used to treat drinking water and wastewater
2) Planning – the structure and scale of the system
3) Management – ownership, financing and operations questions

A number of evolving technical options are available that provide possibilities for alternative servicing models. Advanced treatment units (ATUs) and package treatment plants are modular

systems that allow advanced treatment at an on-site and communal scale. ATUs are scaled down mechanical and chemical treatment processes which can be added to a conventional septic system. Improvements in technology and new technologies such as membrane filters have resulted in the capability to incorporate all of the processes of a conventional large-scale treatment plant into a package that is easily transported and efficient to operate.

A wide variety of modular type treatment options are available, which are cost-effective to purchase, can be installed quickly, and can easily be adapted to changing environmental regulations. Waterloo Biofilter, located in Guelph, and Premier Tech Aqua, in Riviere-du-Loup, are two local companies that provide these solutions. Further information on these technologies can be found in **Appendix E**. Communal systems connect a small number of users together to address their local needs and leverage their local servicing attributes. One of the strongest attributes of communal and decentralized servicing is its flexibility. Communal servicing is well suited to a range of development types, but installation of a communal servicing in one part of a Settlement Area or municipality does not preclude private on-site services in other areas where such an approach may be adequate.

A range of financing, ownership and management models are appropriate for communal servicing systems, some of which are more suitable than others dependent on local factors. Private ownership and operation of communal servicing systems is an option that works well in many cases. County of Frontenac may prefer to take over ownership and operations of a communal system after it has been constructed by a private proponent.

Communal systems can also be financed through various models. The authors of “A Fresh Look” recommend considering a range of options. They suggest that establishment of communal servicing can be considered a type of economic development program, and thus economic development tools like funding from the general property tax levy or the application of Community Improvement Plan tools like the Tax Increment Equivalent may be appropriate. Private pay-per-use financing models have worked for the Fetherstone Park development in North Grenville, while Oxford County has established a Community Servicing Assistance program where property owners who have obtained the benefit from municipal servicing pay into a fund to support new systems for only $10 per year.

POTENTIAL FOR RESOURCE RECOVERY

Conventional wastewater management systems often reuse the biological sludge generated by the treatment process as an agricultural soil supplement. By and large, however, conventional wastewater management is based on the assumption that wastewater is only waste.[29] Many alternative and innovative wastewater management approaches, by contrast, incorporate some

[29] Gunilla Öberg, Maria G. Merlinzky, Alicia Lavalle, Margaret Morales and Melina M. Tobias, “The Notion of Sewage as a Waste,” *Ecology and Society* 19, no.2 (2014). doi: 10.5751/ES-06531-190219

level of resource recovery, which can lessen environmental impact.[30] For example, recovering biogas from digesting waste generates energy and converts stronger greenhouse gasses into the less potent CO_2.[31] Systems that reuse greywater reduce water consumption and may lessen energy costs because less treatment is needed.[32] Resources, like ammonia and fertilizer can be sold to offset treatment costs and can be used within the local economy. [33]

LANDSCAPE-BASED

Landscape-based solutions for wastewater treatment are a form of green infrastructure. Like other forms of green infrastructure, landscape-based wastewater treatment can be multifunctional, integrated, adaptable, resilient, and a producer of social, economic and ecological benefits.[34] Some treatment approaches can realize direct ecological benefits by mimicking natural systems.[35] That is, some landscape-based treatment approaches, like constructed wetlands, can add habitat, ecosystem function and diversity back into the landscape.[36] Biological and landscape-based systems can also have lower energy costs.[37] Advocates for these types of approaches argue that using biological processes, building in redundancy, and scaling-down systems have many benefits, from decreasing capital and operating costs, to re-engaging residents at the community level.

Figure 5-1: Example of emerging wastewater treatment technologies, PhytoLinksTM Modular Floating Treatment Wetland System for stormwater and wastewater applications (TerrapinWater)

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[30] T. Taylor and R. Goldstein, *Sustainable Water Resources Management, Volume 3: Case Studies on New Water Paradigm,* (Report, Palo Alto, CA: Electric Power Research Institute, 2010).
[31] S. Tilmans, A. Diax-Hernandex, E. Nyman and J. Davis, "The potential for financing small-scale wastewater treatment through resource recovery: experience from Bocas del Toro, Panama," *Journal of Water, Sanitation and Hygiene for Development* 4 no,3 (2014): 457.
[32] Tjadraatmadja et al., "Rethinking urban water systems."
[33] T. A. Nanninga et al., "Discussion on Sustainable Water Technologies for Peri-Urban Areas of Mexico City: Balancing Urbanization and Environmental Conservation," *Water* no.4 (2012)
[34] R. Hansen and S. Pauleit, "From Multifunctionality to Multiple Ecosystem Services? A Conceptual Framework for Multifunctionality in Green Infrastructure Planning for Urban Areas," *Ambio* 43 (2014).
[35] D'Amato, V. E. Clerico, E. Dietzmann, E. Striano and M.K. Clark. *Distributed Water Infrastructure for Sustainable Communities: A Guide for Decision Makers.* (WERF Stock No. DEC3R06, Decentralized Water Resources Collaborative, http://www.ndwrcdp.org/): p5.
[36] W. Thomas, "From waste to wetlands (Arcata, California)," *Ecodecision,* no.14 (1994).
[37] D'Amato et al., "Distributed Water Infrastructure."

6 ENGINEERING BEST PRACTICES

On-site sewage servicing is required when municipal sewage servicing is not available. The type of on-site sewage system can vary greatly, from a conventional sewage system (i.e. septic tank) to an advanced treatment system with membrane bioreactor technology. Discharge of sewage effluent to the natural environment can either be via surface disposal to a water body or ditch, or can be via subsurface disposal to the shallow groundwater regime beneath the site. The type of treatment and disposal system that is chosen to service a development will depend on many factors, including site soil characteristics, the presence of surface water features close to the site, design sewage flows, raw sewage strength, and effluent requirements.

Appendix D includes Engineering Best Practices that provide a guideline for the planning, selection, and design of a communal on-site sewage treatment and disposal system. Best practices for installation, operation, and maintenance are also discussed. It should be noted that these best practices are not intended to be all-inclusive and require professional judgement in their use. For all sewage systems, appropriate government approvals will be required prior to construction and/or use of the system.

More detailed information on the following engineering considerations is included in **Appendix D**:

- Site evaluation;
- Soil evaluation;
- Planning and design of communal sewage systems, including daily design sewage flows, flow balancing, and the approvals process;
- Peer review;
- Wastewater strength;
- Determining the treatment and disposal method;
- Surface discharge;
- Subsurface disposal systems;
- Installation and commissioning of communal sewage systems; and
- Monitoring, operation, and maintenance considerations.

7 FINANCIAL MODEL AND RISK MITIGATION

In the context of ongoing regional and local municipal development, the County must balance its desire to encourage installation of innovative, cost-effective communal water and wastewater facilities with the need to ensure all communal services are maintained in a serviceable

condition. Specifically, residential and commercial units relying upon communal services must be safe to inhabit at all times, in accordance with the Ontario Ministry of the Environment, Conservation and Parks (MECP) Guideline D-5-2.

WSP developed an Excel-based cashflow Financial Model to be used by the County as a tool for estimating appropriate charges to cover anticipated annualized costs and mitigate financial risk associated with communal services. The Model was built as a high-level 'what-if' tool, enabling the user to input costs, development size, and other parameters, in order to understand the funding required to reach steady-state (i.e., stable) annual charges. The Model was structured to assess the following annualized costs as a function of a user-input initial capital cost, service type, and development phasing:

- Operations and Maintenance (O&M) costs;
- Rehabilitation costs;
- Eventual capital replacement costs;
- Insurance costs; and
- 'Catastrophe costs' related to unplanned and unexpected major expenses not covered by insurance.

The Model allows for an evaluation period of up to 30 years, on the basis that most water and wastewater equipment has a lifecycle of 30 years or less. Two funding sources were identified and incorporated into the Model: a utility fee levied upon residential and commercial customers of the planned communal system; and a property tax increase levied upon all property owners in the County. Modelled cost-recovery options include:

- **Option 1:** Utility fee covers all costs;
- **Option 2:** Property tax covers catastrophe costs; utility fee covers remainder;
- **Option 3:** Property tax covers catastrophe and capital replacement costs; utility fee covers all other costs; or
- **Option 4:** Property tax covers all costs.

The Model allows for calculation and allocation of costs associated with construction of residential and/or commercial units.

7.1 ASSUMPTIONS

The Model makes the following assumptions:

- The Model evaluates costs associated with a single development (i.e. one communal system) and allows for up to eight (8) phases of development;

- Initial construction capital costs are paid upfront by the developer or the County, or some combination therein as stipulated by the Model user. However, depending on the Model Option selected, there is an option to have unit owners bear responsibility for initial construction costs through repayment of a loan;

- It was assumed that the County of Frontenac, rather than the Townships, would be responsible for appropriate communal system operation, and property tax calculations were estimated at the County (rather than Township) level;

- In the Model, the user is enabled to input a period of time (e.g. five (5) years), during which the developer is assumed to provide surety (bonding) for the communal system. This indicates that the County would have a period of time at the commencement of operations of a new development during which any system failures would be addressed by the developer at no cost to the County, or, in the event that the developer fails to meet its obligations, the developer's bonding agency. This allows for a period during which revenues held against catastrophic system failures can accrue before any risk of system failure is imposed upon the County;

- The Model assumes that O&M costs associated with the communal system are paid by the developer from the time operation begins, until development occupancy (i.e. number of units sold) reaches a user-defined threshold (e.g. 70% of units). However, O&M fees are still levied upon residential and commercial property owners during these early years. In essence, developer-paid O&M costs simply lower the lifecycle cost obligations of residential and commercial property owners, as well as the County-wide property tax base;

- Long-term ownership of a communal system will be held by either a condominium corporation or the County. In the event that the system is owned by a condominium corporation, it is assumed that the County will create a by-law requiring O&M activities to be conducted by a qualified third-party system operator in perpetuity;

- Units sold are assumed to be sold and occupied on January 1st of any given year;

- Failure rates are assumed to be the same for every development, and the same for every year of operation; and

- All calculations are conducted and expressed in real 2017 dollars (CAD). Summary results are also provided in year-of-expenditure dollars (CAD).

7.2 METHODOLOGY

Fundamentally, the Model enables the user to input parameters ('one-time' inputs) specific to a hypothetical or planned communal water/wastewater system, and to select one of the four cost-

recovery options described herein. The Model then runs these user inputs through a series of calculations to estimate communal system annualized lifecycle costs, and allocate payment responsibility.

The steps in the modelling process are described below.

STEP 1: USER INPUT

The first step in the modelling process requires the user to enter an array of 'one-time' inputs, such as an estimated inflation rate, as well as time-series inputs, such as estimated development occupancy rates by year. User inputs required to run the Model are shown in **Table 7-1**.

Table 7-1: Financial Model User Inputs Required

USER INPUTS
• Model (fee) scenario selection • Inflation rate • Interest rate • Capital costs • Likelihood of failure • Annualized costs as a function of capital costs • Construction dates and capital costs associated with other developments using communal systems in the County of Frontenac • Risk tolerance (likelihood of having sufficient funding available to address any unexpected catastrophic failures not covered by insurance) • Property area per typical existing residential unit (i.e. for conventional well/septic construction) • Estimated revenue leakage rates • Development construction dates • Development area and number of residential and commercial units • Anticipated water usage (flow) rates • Occupancy rates and dates • Property values and property tax rates • Surface vs. subsurface operation • Communal system 'seed' funding (i.e. an initial borrow to enable minimum, stabilized annual fees while achieving required minimum reserve fund balance)

USER INPUTS
• Construction dates and capital costs associated with other developments using communal systems in the County of Frontenac • Property value per typical existing residential unit (i.e. for conventional well/septic construction) • Initial hookup fee per unit

STEP 2: CATASTROPHE COST CALCULATION

This step estimates risk-adjusted costs associated with unexpected, catastrophic failure of one or more communal water/wastewater systems in the County. As described in **Section 7**, 'Catastrophe' costs are those which are not planned for as part of routine O&M, rehabilitation, or capital replacement, nor covered by typical water / wastewater facility insurance policies.

Based on a user-defined annualized likelihood of failure of a 'typical' communal system, the probability of catastrophic failure ('failure') is calculated for up to 20 communal systems in the County, where one of the systems is the hypothetical communal system under consideration in the Model, and the other systems (as few as zero, or as many as 19) are existing communal systems in other developments in the County. The calculation of expected Catastrophe costs incorporates consideration of other communal systems in the County on the basis that the incremental reserve funding needed to protect against failure is reduced for every successive communal system. In other words, Catastrophe cost reserve fund obligations are closer to logarithmic than linear with respect to the number of communal systems in operation.

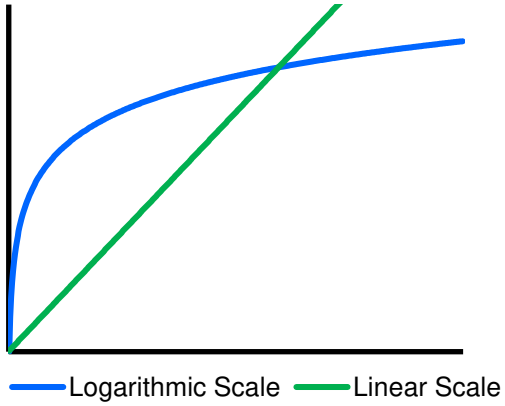

Figure 7-1: Logarithmic vs. Linear Scale

The Model assumes that failure events are independent of one another (i.e. failure of a communal system at one development is assumed to be irrelevant with respect to likelihood of failure at another development). Failure events are also assumed to be independent of facility age, on the basis that proper O&M is assumed throughout the full lifecycle of the system being

proposed, regardless of the duration of that lifecycle. Based on user-defined construction dates for each development, the likelihood of having one or more failures during each year in the Model evaluation period is calculated.

The number of communal system failures in the Model evaluation period is then compared against a user-input risk-tolerance level to determine how many failures should be budgeted for during the evaluation period. The risk-tolerance level is intended to represent the certainty of the County having sufficient funding set aside based on the anticipated number of failures during the Model evaluation period. An example is shown in **Table 7-2**.

Table 7-2: Example Communal System Catastrophic Failure Likelihood and Risk Tolerance

RISK-TOLERANCE LEVEL	LIKELIHOOD THROUGHOUT MODEL EVALUATION PERIOD
User-defined risk tolerance	99%
Likelihood of 0 Communal System Failures	4%
Likelihood of 1 or fewer Communal System Failures	88%
Likelihood of 2 or fewer Communal System Failures	99.7%
Likelihood of 3 or fewer Communal System Failures	99.99%

In the above example, the County would budget for two communal system failures, on the basis that:

- There is an 88% chance of having no more than one failure.
- There is a 99.7% chance of having no more than two failures.
- The risk tolerance is set at 99%, indicating a desire to have a 99% chance of having enough funding available to account for anticipated failures. Budgeting for one failure is anticipated to have only an 88% chance of ensuring that sufficient funding is set aside. Budgeting for two failures indicates the likelihood of having sufficient funding set aside is 99.7%.

Once an appropriate number of failures to budget for has been determined by the County, the Model determines the cost associated with a given failure.

The Model builds in a cost-recovery mechanism to fund eventual communal system replacement at the end of service life, as discussed herein. As such, to understand the direct

financial liability associated with catastrophic failure,[38] the Model computes the outstanding, or unfunded, capital cost to replace each communal system (i.e. the hypothetical system being modelled, as well as any other existing communal systems defined by the user). This *outstanding* capital cost is based on *total* capital replacement costs, as defined by the user, an assumed replacement-cost recovery rate.[39]

The Model then ranks each communal system, from highest to lowest, based on its outstanding capital replacement cost. To provide a conservative estimate of the required catastrophic failure budget, the Model assumes that failures occur at the systems with the largest outstanding replacement costs. A budget to cover catastrophic failures is then calculated for use during later steps in the Model.

STEP 3: FLOW RATE CALCULATION

This step calculates expected annual water use (volume) for residential and commercial units, based on user-defined anticipated occupancy rates, unit sizes, and daily flow rates. Total annual water use is calculated, as is the percentage of total annual water attributed to residential units vs. commercial units.

STEP 4: PROPERTY VALUE CALCULATION

This step calculates residential and commercial property values in the modelled development to understand the implications for the County's total real estate valuation, and annual property tax revenue.

STEP 5: CAPITAL, O&M, REHABILITATION, AND INSURANCE COST CALCULATION

Based on user-defined capital costs for the hypothetical development's communal system, O&M costs, major rehabilitation costs, insurance costs, and eventual system replacement costs are estimated. O&M, rehabilitation, insurance, and eventual replacement costs are defined as a fixed percentage of initial capital costs, and O&M costs are scaled to reflect occupancy rates estimated by the Model user. The Model user is able to adjust the fixed percentages within the Model parameter input process.

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[38] The Model budgets only for costs associated with replacement of the existing communal system. The Model does *not* budget for any legal or indirect financial liability associated with catastrophic failure, including damage to property, property market values, environmental damage, harm to residents, etc.

[39] The replacement-cost recovery rate is predicated on stabilized fees throughout the lifecycle of each communal system, indicating that a portion of fees collected annually from system users is held in reserve to apply against eventual communal system replacement costs. For example, if a communal system were to fail on its first day of operation, it is assumed that 100% of its eventual replacement cost is outstanding, whereas a communal system failing halfway through its anticipated lifespan would be expected to have only 50% of its replacement cost outstanding.

Each cost category is calculated and presented as a set of annualized values and a total lifecycle cost.

STEP 6: RAW RESERVE FUND CALCULATION

Once costs and flow rates are established, the Model calculates raw (i.e. unstabilized) annualized reserve fund contributions required to sustain the hypothetical communal system. It is assumed that all costs associated with the communal system are paid for out of a development-specific reserve fund (apart from initial capital costs which are not considered in the Model, as discussed in **Section 7.1**). All Utility Fees and Property Tax funds which go to supporting the modelled communal system are thus treated as contributions to the reserve fund.

Cost obligations are apportioned as dictated by whichever Model Funding Option is selected by the user (refer to earlier in this section for discussion of funding options). At this step in the Model, cost obligations are split into:

- Developer obligations (in the early years of the development, before the user-defined critical occupancy level has been reached, as discussed in **Section 7.1**);
- Utility Fee obligations; and
- Property Tax obligations.

Because reserve fund contributions are not stabilized, annual reserve fund contributions are set to match anticipated annual expenditures, creating substantial variation in fees/rates paid per year. This is addressed in the following steps.

STEP 7: STABILIZED UTILITY FEE AND PROPERTY TAX CALCULATIONS

Using the cost obligations and annual expenditures summarized under Step 6, stabilized Utility Fees and Property Tax increases are established. Fees / taxes are set such that rates are consistent throughout the Model evaluation period, the reserve fund balance always meets or exceeds the minimum required balance, and the reserve fund balance at the end of the Model evaluation period is equal to the minimum required balance.

Stabilization has two primary benefits. First, stabilization enables the communal system owner to charge users a consistent unit rate[40] throughout the lifespan of the asset, providing property owners with a predictable and equitable rate. Second, notwithstanding the need to generate and reserve capital to cover potential Catastrophe costs as described above, stabilization facilitates slow, steady accumulation of rehabilitation and eventual replacement funds. This increases the likelihood that the communal system owner will successfully collect the required user fees and

[40] Notwithstanding inflation, which is generally not reflected in this Model (units are presented in 2017 dollars (CAD)).

property taxes in a given year, and reduces the likelihood and magnitude of revenue leakage (i.e. non-payment).

The need to maintain a minimum reserve fund balance to address potential system failures (Catastrophe costs) tends to place significant cost obligations early in the communal system lifecycle. The most efficient and equitable means of overcoming this initial cost obligation is to provide the reserve fund with 'seed' funding – a one-time, up-front contribution of funds – borrowed from another funding source, whether that source is a bank, another County account, or similar.

STEP 8: INDUCED PROPERTY TAX REVENUE CALCULATION

One of the primary benefits of communal system implementation rather than conventional well / septic implementation is the opportunity to increase development density. This step of the Model calculates induced property tax revenue based on the expectation that the County's property tax net revenue will increase on a per-area basis as development density increases.

Induced property tax revenue for a given land area was therefore calculated as the difference between tax revenue anticipated under a communal system scenario, which assumes a user-defined density of units, and tax revenue anticipated under a user-defined conventional well / septic development density.

This calculation assumes property tax rates are equal under the communal system and conventional scenarios.

STEP 9: SUMMARY

The final step in the modelling process is to summarize the results in a series of tables and charts.

Sample outputs from the model, as well as a Basic User Guide, are included in **Appendix F**.

8 CONCLUSION

This Study has affirmed the major potential benefits of communal servicing approaches for the County, developers and residents. To reiterate:

COMMUNAL SERVICING WORKS FOR THE COUNTY BY ENABLING:

- Increased development potential, growing the tax base;
- More water-sensitive design and other approaches to meet sustainability objectives;

- A broader range of housing typologies and commercial development to allow for complete communities;
- Reduced municipal service delivery costs to residents (e.g. garbage collection, snow removal); and
- A new approach to managing risk.

COMMUNAL SERVICING WORKS FOR DEVELOPERS BY INCREASING:

- Flexibility to address different market segments;
- Range of feasible servicing approaches for hard-to-service areas; and
- Guidance and certainty.

COMMUNAL SERVICING WORKS FOR RESIDENTS BY ENSURING THAT RESIDENTS:

- Can be confident in their water and wastewater treatment systems;
- Have a wider choice of housing options, allowing aging in place; and
- Can be confident that water resources are being appropriately stewarded.

The Study also identifies engineering best practices for designing communal wastewater systems, responding to regulatory and legislative requirements for such systems. General considerations and design principles set the framework for how such systems must be designed and how approvals must be sought. Within this framework, each individual system must be designed based on site characteristics, intended development, and local objectives. Appropriate and thoughtful design at the planning and design phase will ensure that water conservation is maximised, environmental impact is minimised and that the system is durable and efficient. Given the complexity and technical nature of wastewater treatment systems, the County can ensure good design by instituting a peer review process.

The Study's Financial Model provides a high-level 'what-if' tool enabling the user to estimate the funding required to reach steady-state (i.e. stable) annual charges to cover anticipated annualized costs and mitigate financial risk associated with communal services. As such, there are no system- or development-specific conclusions to be drawn. However, the following general trends were observed when testing hypothetical developments using the Model:

- Catastrophe cost reserve fund obligations are closer to logarithmic than linear with respect to the number of communal systems in operation. This indicates that the amount of funding which needs to be held in reserve in case of system failure is expected to drop sharply on a per-system basis when the number of systems in operation rises;

- Annual property tax increases are non-existent under Option 1, and are minimal under Options 2 and 3, increasing between $1 to $10 per unit per year, depending on the size of the development; and
- User fees of ~$100 per month ($1,200 per year) are likely feasible under Options 2 and 3, depending on the scale, cost, and development parameters.

With population growth comes development pressures and the need to consider where and how development can be accommodated and serviced, while maintaining and enhancing the vitality and livability of the County's villages and hamlets as rural community hubs with a distinct sense of place. The implementation of communal services can position the County and Townships as leaders in accommodating growth, providing a diversity of housing options to meet community needs, and revitalizing village and hamlet mainstreets towards achieving planning and economic development objectives.

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APPENDIX

A FEDERAL AND PROVINCIAL REGULATORY FRAMEWORK

FEDERAL

CANADA WASTEWATER SYSTEMS EFFLUENT REGULATIONS, SOR/2012-139 FISHERIES ACT

These regulations set limits on effluent for a number of deleterious substances, including carbonaceous biochemical oxygen demand (CBOD), total suspended solids (TSS), residual chlorine, and un-ionized ammonia. However, Ontario had already published minimum standards in 1983 that were equivalent to or exceeded the more recent federal requirements.[41]

PROVINCIAL

PLANNING ACT

The Planning Act establishes the rules for land use planning in Ontario and describes how land uses may be controlled in the province's communities. The Planning Act gives Ontario municipalities the power to make certain decisions about water and wastewater servicing. However, **Section 2, "Provincial Interest"**, excerpted below, also identifies sewage and water systems as a matter of provincial interest.

> "[…] the Minister, the council of a municipality, a local board, a planning board and the Tribunal, in carrying out their responsibilities under this Act, shall have regard to, among other matters, matters of provincial interest such as […] **(h)** the adequate provision and efficient use of […] sewage and water [...] systems."

Subsection (5) "Prohibition of use of land, etc., availability of municipal services" of **Section 34 "Zoning Bylaws",** excerpted below, empowers municipalities to ensure that development occurs only after the municipality is confident in the water and wastewater servicing is adequate:

> "A by-law passed under paragraph 1 or 2 of subsection (1) or a predecessor of that paragraph may prohibit the use of land or the erection or use of buildings or structures unless such municipal services as may be set out in the by-law are available to service the land, buildings or structures, as the case may be."

[41] ECO, *Redefining Conservation,* (ECO 2009/2010 Annual Report, Toronto, ON: Environmental Commissioner of Ontario, 2010).

More generally, **Section 70.3, "Regulations re sewage and water services,"** and associated regulations permit municipalities to pass bylaws governing the allocation of water and sewer services for plans of subdivision. This section states:

> "The Lieutenant Governor in Council may by regulation authorize municipalities to pass by-laws establishing a system for allocating sewage and water services to land that is the subject of an application under section 51 upon such conditions as may be set out in the regulation."

PROVINCIAL POLICY STATEMENT, 2014

Under Section 3 "Policy Statements," of the Planning Act, the Province may issue policy statements on matters of provincial interest. The most recent Provincial Policy Statement (PPS) came into effect on April 30, 2014 and provides policy directions regarding intensification, rural land, settlement areas and environmental sustainability that are directly relevant to communal servicing and its implications.

The PPS directs that future growth and development be focused within designated settlement areas, defined in the Definitions section as:

> "[…] urban areas and rural settlement areas within municipalities (such as cities, towns, villages and hamlets) that are:
>
> a) built up areas where development is concentrated and which have a mix of land uses; and
> b) lands which have been designated in an official plan for development over the long term planning horizon provided for in policy 1.1.2. In cases where land in designated growth areas is not available, the settlement area may be no larger than the area where development is concentrated."

In Section 1.2 Coordination, policy 1.2.1, excerpted below directs that the vitality and regeneration of rural settlement areas shall be promoted.

> "A coordinated, integrated and comprehensive approach should be used when dealing with planning matters within municipalities, across lower, single and/or upper-tier municipal boundaries, and with other orders of government, agencies and boards including:
>
> d) infrastructure […] and waste management systems;
> e) ecosystem, shoreline, watershed, and Great Lakes related issues; […]"

One of the significant challenges to implementing communal servicing is the implicit and explicit servicing hierarchy set out in Sections 1.6, “Infrastructure and Public Service Facilities,” policies 1.6.6.2, 1.6.6.3, 1.6.6.4, and 1.6.6.5. Municipal services are preferred, and intensification and redevelopment on those services is preferable. Where these don’t exist, private communal services are acceptable. Individual on-site systems are permitted where municipal or communal services are not provided, subject to adequate site conditions. Finally, partial services are only permitted to address failed on-site services, or for infilling or rounding out of existing development.

The distinction between municipal services and private communal services is particularly important for this Study. It is often assumed that municipal services are conventional centralized systems and not communal systems that serve individual developments. However, the definition of municipal services is not provided. The Growth Plan for the Greater Golden Horseshoe, which does *not* apply to the County of Frontenac, defines municipal wastewater systems as “any sewage works owned or operated by a municipality.” Therefore, it is important to consider that communal services owned or operated by the municipality, that help to achieve the other objectives of the PPS, are not in conflict with the hierarchy set out in Sections 1.6.6. These policies are:

> 1.6.6.2 “Municipal sewage services and municipal water services are the preferred form of servicing for settlement areas. Intensification and redevelopment within settlement areas on existing municipal sewage services and municipal water services should be promoted, wherever feasible.”
>
> 1.6.6.3 “Where municipal sewage services and municipal water services are not provided, municipalities may allow the use of private communal sewage services and private communal water services.”
>
> 1.6.6.4 “Where municipal sewage services and municipal water services or private communal sewage services and private communal water servicesare not provided, individual on-site sewage services and individual on-site water services may be used provided that site conditions are suitable for the long-term provision of such services with no negative impacts. In settlement areas, these services may only be used for infilling and minor rounding out of existing development.”
>
> 1.6.6.5 “Partial services shall only be permitted in the following circumstances:
>
> a) where they are necessary to address failed individual on-site sewage services and individual on-site water services in existing development; or
> b) within settlement areas, to allow for infilling and minor rounding out of existing development on partial services provided that site conditions are suitable for the long-term provision of such services with no negative impacts.”

The most important goals for sewage and water services are sustainability, feasibility and safety. Integration of servicing, land-use policy and development are critical to properly achieve these goals. These priorities are highlighted in policy 1.6.6.1, excerpted below:

> "Planning for sewage and water services shall: […]
> (b) ensure that these systems are provided in a manner that:
> 1. can be sustained by the water resources upon which such services rely;
> 2. is feasible, financially viable and complies with all regulatory requirements; and
> 3. protects human health and the natural environment;
> (c) promote water conservation and water use efficiency;
> (d) integrate servicing and land use considerations at all stages of the planning process; and,
> (e) be in accordance with the servicing hierarchy outlined through policies 1.6.6.2, 1.6.6.3, 1.6.6.4 and 1.6.6.5."

Approaches to determining adequate wastewater treatment capacity for a development are not legislated – instead, design guidelines and the professional opinion of the engineers are used. Nevertheless, policy 1.6.6.6 emphasizes the importance of ensuring adequate treatment capacity:

> "Subject to the hierarchy of services provided in policies 1.6.6.2, 1.6.6.3, 1.6.6.4 and 1.6.6.5 planning authorities may allow lot creation only if there is confirmation of sufficient reserve sewage system capacity and reserve water system capacity within municipal sewage services and municipal water services or private communal sewage services and private communal water services. The determination of sufficient reserve sewage system capacity shall include treatment capacity for hauled sewage from private communal sewage services and individual on-site sewage services."

Protection of water resources and aquatic ecosystems is a significant goal of the PPS. In particular, water quantity and quality should be protected using a watershed-level scale for long-term planning. Municipalities should also use planning to encourage water conservation, and long-term sustainable use of water resources, as directed by policy 2.2.1, under Section 2.2 "Water".

> "Planning authorities shall protect, improve or restore the quality and quantity of water by:
> a) using the watershed as the ecologically meaningful scale for integrated and long-term planning, which can be a foundation for considering cumulative impacts of development;

b) minimizing potential negative impacts, including cross-jurisdictional and cross-watershed impacts; […]

f) planning for efficient and sustainable use of water resources, through practices for water conservation and sustaining water quality[.]"

Policies related to efficient land use (1.1.1) in settlement areas (1.1.3) and rural lands (1.1.4) have general applicability to communal servicing. Development should use land efficiently to minimize the conversion of agricultural or natural heritage land. In particular, infill and redevelopment of vacant land within settlement areas should be promoted. The mix of densities and land uses in settlement areas should make efficient use of infrastructure and support active transportation.

The PPS directs that future growth and development be focused within designated settlement areas, and that the vitality and regeneration of rural settlement areas shall be promoted. Within the County, the rural settlement areas and waterfront areas do not have municipal water and wastewater services, with the exception of the Village of Sydenham in the Township of South Frontenac which has municipal water supply. Consequently, development under the current planning framework must usually proceed on private services, resulting in limited potential for intensification in the settlement areas due to the minimum lot sizes required to support private services and low-density forms of development. Communal servicing, which allows higher lot densities and potential for infill in settlement areas, would help to achieve the broad and specific goals of the PPS, particularly as outlined in Sections 1.1.1, 1.1.3 and 1.1.4.

ENVIRONMENTAL PROTECTION ACT, CONSOLIDATED MARCH 2018

The purpose of this Act is to provide for the protection and conservation of the natural environment, as outlined in Section 3 of Part I of the Act. It applies to this Study in numerous ways. Most directly, through Section 9 (1) "Approval, plant or production process", the Environmental Protection Act requires that any activity that discharges waste to the environment must receive an Environmental Compliance Approval (ECA), issued by the Ministry of the Environment and Climate Change. This text reads as follows:

"No person shall, except under and in accordance with an environmental compliance approval,

(a) use, operate, construct, alter, extend or replace any plant, structure, equipment, apparatus, mechanism or thing that may discharge or from which may be discharged a contaminant into any part of the natural environment other than water; or

(b) alter a process or rate of production with the result that a contaminant may be discharged into any part of the natural environment other than water or the rate or

manner of discharge of a contaminant into any part of the natural environment other than water may be altered. 2010, c. 16, Sched. 7, s. 2 (4)."

Further clarification on the need for approval is included in Part II, Section 20.2 "Application for Approval, cited below:

> (1) "A person may apply to the Director for approval to engage in an activity mentioned in subsection 9 (1) or 27 (1) of this Act or subsection 53 (1) of the Ontario Water Resources Act if the activity has not been prescribed by the regulations for the purposes of subsection 20.21 (1). 2010, c. 16, Sched. 7, s. 2 (15)."
>
> (7) Sewage works "If a person applies for approval to use, operate, establish, alter, extend or replace a sewage works, the application may also be for approval to engage in any activity that is mentioned in subsection 9 (1) or 27 (1) that is related to the sewage works unless the Director requires otherwise. 2010, c. 16, Sched. 7, s. 2 (15)."

The need for an ECA is equally triggered by **Section 53** of the **Ontario Water Resources Act**, **"Approval, sewage works,**" as described in Section 3.5 of this Study. The ECA process itself is reviewed in a subsequent section.

Additionally, the Ministry of Environment, Conservation and Parks, through the Act, is given the power to conduct research related to pollution, environmental quality and innovative waste disposal systems. Specifically:

> Part I Section 4 "The Minister has the power to:
> - Investigate pollution and waste management problems,
> - Conduct research related to contaminants, pollution, waste management and waste disposal,
> - Conduct studies of the quality of the natural environment and monitoring programs;
> - Make grants and loans for research and training related to pollution; planning, operating, developing, improving and enlarging waste management systems; and, programs to encourage the reduction of waste;
> - (h) Establish and operate demonstration and experimental sewage systems under Part VIII."

The general regulatory powers outlined in **Section 175.1** allow the Lieutenant Governor in council to exempt, prohibit, govern and require the payment of fees to the Crown in regards to sewage systems, among others.

Part V of the Environmental Protection Act requires an approval for land application of untreated septage. This is an important factor for municipal management of biosolids.

ONTARIO WATER RESOURCES ACT, CONSOLIDATED APRIL 2018

The Ontario Water Resources Act provides for the conservation, protection and management of Ontario's water and for their efficient and sustainable use, in order to promote Ontario's long-term environmental, social and economic well-being.

The **Definitions** section gives the following definitions:

> " 'sewage' includes drainage, storm water, commercial wastes and industrial wastes and such other matter or substance as is specified by the regulations; ("eaux d'égout")"
>
> " 'sewage works' means any works for the collection, transmission, treatment and disposal of sewage or any part of such works, but does not include plumbing to which the Building Code Act, 1992 applies; […]"

One of the major sources of risk for municipalities is contained in Section 16, "Order by provincial officer: contraventions," of the Act. The OWRA grants the Minister (Director) significant powers to intervene in sewage works that it deems unsafe or failed. Following Section 16, a provincial officer may issue an order to a person in contravention of a provision of the Act or regulations. Under subsection (3), "What order may require," the order may require:

> "(d) the repair, maintenance or operation of water works or sewage works in such manner and with such facilities as are specified in the order;
> (e) the removal of sewage or any thing contaminated by sewage;
> (f) sampling, analysis or reporting with respect to the quality or quantity of any waters;
> (g) where the contravention has caused damage to or endangered or is likely to cause damage to or endanger existing water supplies, providing temporary or permanent alternate water supplies;"

The Director also has powers to require repair or rehabilitation to environmental resources that were damaged by wastewater treatment failure.

> Section 32 "Where, in the opinion of a Director, it is in the public interest to do so, the Director, by order, may require a person who owns, manages or has control of a sewage works, water works or other facility which may discharge material into a water or watercourse that may impair the quality of the water, to do any one or more of the following:
>
> 1. To have available at all times, or during the periods specified in the order, the equipment, material and personnel specified in the order at the locations specified in the order to prevent, reduce or alleviate any impairment of the quality of the water or the effects of any impairment of the quality of the water.

2. To obtain, construct and install or modify the devices, equipment and facilities specified in the order at the locations and in the manner specified in the order.
3. To implement the procedures specified in the order.
4. To take all steps necessary to ensure that the procedures specified in the order will be implemented in the event that a water or watercourse becomes impaired or may become impaired.
5. To monitor and record the quality and quantity of any water specified in the order and to report thereon to the Director.
6. To study and to report to the Director upon,
    i. measures to control the discharge into a water or watercourse of a material specified in the order,
    ii. the effects of the discharge into a water or watercourse of a material specified in the order,
    iii. the water or watercourse into which a material specified in the order may be discharged."

Environmental Compliance Approval

Section 53, "Approval, sewage works" of the Act triggers the need for ECA, just as the Environmental Protection Act does. Part (I) of this section reads:

> "Subject to section 47.3 of the Environmental Protection Act, no person shall use, operate, establish, alter, extend or replace new or existing sewage works except under and in accordance with an environmental compliance approval."

Section 53, subsection (6), "Exceptions" provides more detailed information on the type of works which do not require an ECA. While all communal sewage works would require an ECA, there are some potentially relevant exceptions that may allow more flexible approaches to communal servicing. One potentially relevant exception is in clause (b):

> "A privately-owned sewage works designed for the partial treatment of sewage that is to drain or be discharged into a sanitary sewer;"

This could potentially ease the regulatory complexity of a greywater or partial treatment system intended to discharge into a communal system, as only an ECA for the communal system would be necessary.

Appeals to the Local Planning Appeals Tribunal (LPAT) are addressed in Section 55 "Sewage works established or extended within a municipality". The relevant subsections read as follows:

"Application to L.P.A.T." (4) "If a registration under Part II.2 of the Environmental Protection Act is in effect or an environmental compliance approval has been issued in respect of the establishment or extension of a sewage treatment works by a person, other than a municipality, of sewage treatment works within a municipality the Local Planning Appeal Tribunal may, on application by the person undertaking the establishment or extension, order the amendment of any by-law for prohibiting or regulating the use of land or structures for dumping or disposing of garbage, refuse or domestic or industrial waste passed under the Municipal Act, 2001, the City of Toronto Act, 2006 or a predecessor of those Acts or any by-law passed under section 34 of the Planning Act or any official plan to permit the use of land for the establishment or extension."

"Powers of L.P.A.T." (5) "The Local Planning Appeal Tribunal, as a condition of making an order under subsection (4), may impose such restrictions, limitations and conditions respecting the use of land for the establishment or extension of the sewage treatment works not inconsistent with the regulations made for the purposes of Part II.2 of the Environmental Protection Act or the terms and conditions in the environmental compliance approval, as to the Local Planning Appeal Tribunal may appear necessary or expedient."

Section 62 "Report by Director, water or sewage works," of the Ontario Water Resources Act has great relevance for communal servicing, because it must be referenced in any Municipal Responsibility Agreement. It states:

62 (1) "Where a Director reports in writing to the clerk of a municipality that he or she is of the opinion that it is necessary in the public interest that water works or sewage works or any part thereof be established, maintained, operated, improved, extended, enlarged, altered, repaired or replaced, the municipality shall forthwith do every act and thing in its power to implement the report of the Director."

(2) If the municipality fails to do everything in its power to implement the report forthwith after receiving it, and the time for taking an appeal has passed or there has been a final disposition of an appeal confirming or altering the report, the Director, with the approval of the Local Planning Appeal Tribunal, may direct that whatever is necessary to implement the report or the report as confirmed or altered be done at the expense of the municipality, and may arrange for the Agency to do it."

(3) The Minister or the Agency may recover the expense incurred in implementing the report, with costs, by action in a court of competent jurisdiction, as a debt due to the Crown or the Agency, as the case may be, by the municipality[.]"

ENVIRONMENTAL ASSESSMENT ACT, 1990

The Environmental Assessment Act generally only applies to public bodies. Municipalities constructing or expanding municipal servicing must generally undertake a Schedule "C" Municipal Class Environmental Assessment (Class EA). Class EAs offer standardized processes to follow when planning and designing a project. With respect to wastewater projects, this process is often combined with application for an ECA, and can give the proponent peace of mind that due diligence has been done.

Section 5, "Approval for Undertaking," of the Act applies to Provincial agencies or bodies and to municipalities. However, it also still may apply to private developers, as per subsection (b) and (c), below.

> Section 3 "Application of Act" "This Act Applies to,
>
> (a) enterprises or activities or proposals, plans or programs in respect of enterprises or activities by or on behalf of Her Majesty in right of Ontario or by a public body or public bodies or by a municipality or municipalities;
>
> (b) major commercial or business enterprises or activities or proposals, plans or programs in respect of major commercial or business enterprises or activities of a person or persons, other than a person referred to in clause (a), designated by the regulations[.]
>
> (c) an enterprise or activity or a proposal, plan or program in respect of an enterprise or activity of a person or persons, other than a person or persons referred to in clause (a), if an agreement is entered into under section 3.0.1 in respect of the enterprise, activity, proposal, plan or program."

Section 3.0.1 allows non-public bodies to enter into a written agreement with the Minister (MECP) to follow the applicable Class EA. **O. Reg 345/93** (below) specifies how private proponents are to proceed under the Act.

> O. Reg. 345/93: Environmental Assessment Act – Designation and Exemption—Private Sector Developers
>
> "1. In this Regulation, "private sector developer" means a developer of land other than land belonging to Her Majesty in right of Ontario, a public body or a municipality.
>
> 2. (1) An enterprise or activity by a private sector developer is defined as a major commercial or business enterprise or activity and is designated as an undertaking to which the Act applies if it is,
>
> (a) of a type listed in Schedule C of the Municipal Class Environmental Assessment that was approved on October 4, 2000 under section 9 of the Act; and
>
> (b) a project provided for residents of a municipality for roads, water or wastewater.

(2) An undertaking designated under subsection (1) is exempt from section 5 of the Act if,
(a) no other environmental assessment has been submitted to the Minister; and
(b) the procedure for the undertaking is set out in the Municipal Class Environmental Assessment and its approval does not require a further approval under section 5 of the Act. […]"

Essentially, this regulation means that private sector proponents who plan to construct water or wastewater project either on their own behalf (private communal services) or for a municipality (the municipality will assume ownership/operation) must follow the Schedule 'C' Municipal Class EA.[42] An exception is if the project would be a Schedule "A" project under the MEA process, or a Schedule "B" project, or a project that is subject to approvals under the Planning Act.[43]

NUTRIENT MANAGEMENT ACT, 2002

The Nutrient Management Act provides for the management of materials containing nutrients in ways that will enhance protection of the natural environment and provide a sustainable future for agricultural operations and rural development. Specifically, the Act sets out provisions for the management of materials containing nutrients and regulations respecting farm animals, such as standards respecting the management of materials containing nutrients used by, and on agricultural operations or used for other uses.

Specifically, O. Reg. 267/03 prohibits land application of untreated septage (biosolids) in accordance with approval issued under Part V of the Environmental Protection Act.

SUSTAINABLE WATER AND SEWAGE SYSTEMS ACT, 2002

This Act applies only to municipally-owned systems. Its intent is to support full-cost accounting and full-cost recovery for Ontario's publicly owned water systems. It requires that municipalities develop a financial plan for any owned water works to inform the setting of municipal water rates, and encourages the same for wastewater systems.

MECP DESIGN GUIDELINES FOR SEWAGE WORKS, 2008

The MECP's Design Guidelines for Sewage Works outlines specific design guidelines and/or procedures in the design of sewage works and in the engineering review of applications for

[42] Municipal Engineers Association, "Part A – Class EA Planning Process, A.3.3 Proponency," in Municipal Class Environmental Assessment, 2015. http://www.municipalclassea.ca/manual/page5.html
[43] Municipal Engineers Association, Municipal Class Environmental Assessment – Companion Guide (rev01), September 2017. https://www.ogra.org/files/MCEA%20Companion%20Guide%202017.pdf

approval of such systems. However, legislation, including legislated standards and regulations, takes precedence over the Design Guidelines and must be followed.

Preliminary Design Studies for New/Experimental Systems
"Where the proposed system incorporates processes for which established guidelines are not available, or include equipment and materials where no reliable data from full scale operation are available (e.g., processes that are new or in development - Section 3.9 -Technology Development), the following information may also be needed depending on the scope and risks involved in the project:

- All available data pertaining to the proposed process, equipment, or material;
- Results of any testing programs which have been undertaken by independent testing agencies, research foundations and universities;
- Identification of any known full-scale applications of the proposed process/equipment/material, including a description of the type of application and the name and address of the person who could be contacted for technical information on the application;
- Discussion of the impact of the potential failure of the proposed process/equipment/material and identification of the measures proposed
- to be undertaken to prevent or remedy any health hazard or noncompliance as a result of such failure; proposed contingencies to modify or replace the proposed process, equipment or material in case of their failure and liabilities associated with the proposal;
- Description of the monitoring, testing and reporting program proposed to be undertaken during the experimental period; and
- The proposed duration of the experimental period."

Determination of Capacity

Section 2.3 Stage 2 Documents
"Documentation of the extent, nature and anticipated population of the area to be serviced, facilities proposed to serve the area and provisions for future expansion of the sewage works to include additional service areas and/or population growth; Itemization and discussion of present and future domestic sewage production figures, industrial, commercial and institutional sewage production, infiltration and wet weather inflows used in sizing various components of the sewage collection and/or treatment works."

2.4.1.2 Design Brief – Major Facilities
"[…] Basic data on the estimated sewage generation rates from the population and area to be served, including:

- Design period;

- Design service population and area and population density;
- Design industrial, commercial and institutional sewage flows;
- Wet weather flow; and
- Design flows (average, peak daily and peak hourly)."

MECP GUIDELINE D-5-2 APPLICATION OF MUNICIPAL RESPONSIBILITY FOR COMMUNAL WATER AND SEWAGE SERVICES, MARCH 1995

This brief Guideline institutes the requirement for a Municipal Responsibility Agreement (MRA). It applies to all works that require an ECA. It is the Ministry's opinion that private communal systems are more likely to fail, due to poor management practices and insufficient funds for needed repairs. It therefore requires that for all privately-owned communal systems, municipalities take on the responsibility for repairing systems that fail, through an MRA with the developer. It requires municipalities to ensure that communal water and wastewater facilities are maintained in serviceable condition, such that the units relying upon decentralized services are safe to inhabit and operate at all times. In situations where communal water or wastewater facilities become inoperable or otherwise unsafe, the local municipality is obliged to intervene and fund repairs or replacements ("repairs"), up to and including full system replacement, as required to return the services to safe operation.

This guideline is a considerable source of risk for municipalities.

WATER MANAGEMENT: POLICIES, GUIDELINES, PROVINCIAL WATER QUALITY OBJECTIVES GUIDELINES, 1994

Effluent quality in Ontario is not governed primarily by absolute standards, but with regard to the specific assimilative capacity of the local watershed. The effluent itself must meet certain basic standards imposed by the MECP,[44] and by the Federal Wastewater Systems Effluent Regulations.[45] However, higher standards are imposed on a context-specific basis, with reference to the local receiving waterbody and the Provincial Water Quality Objectives.

Using monitoring data, often from Conservation Authorities, Ministry staff from the Regional Office will be able to determine what standards the effluent must meet in order to not bring water quality in the receiving body below the Provincial Water Quality Objectives, published in Table 2 of the Guideline:

[44] ECO, Redefining Conservation.
[45] Wastewater Systems Effluent Regulations, (SOR/2012-139), Fisheries Act.

Provincial Water Quality Objectives (2.0) “are intended to provide guidance in making water quality management decisions such as the designation of the surface waters of the Province which should not be further degraded. They are often used as the starting point in deriving waste effluent requirements included in Certificates of Approval and other instruments issued to regulate effluent discharges.”

APPENDIX

B

COUNTY AND TOWNSHIPS PLANNING CONTEXT

B.1 COUNTY OF FRONTENAC, OFFICIAL PLAN, JANUARY 2016

The Official Plan for the County of Frontenac ("County OP") was adopted by Council on Wednesday October 29, 2014 and was approved by the Ministry of Municipal Affairs on January 11, 2016.

The County OP provides over-arching policy direction on matters of provincial and County-wide significance. The OP directs growth management and land use decisions by providing upper-tier land use planning guidance for the County's member municipalities. Detailed land use planning and local decision making is managed and administered locally through the local municipal Official Plans.

Section 3 Growth Management contains policies related to growth patterns that would be shaped by a water and wastewater servicing strategy. Relevant subsections are excerpted here:

> Section 3 (c): "The lack of full municipal water and wastewater services in any of the hamlets or villages of the County will constrain the ability to increase the density of these areas, and may impact the ability to focus new development within these settlement areas;"
>
> Section 3 (f): "Settlement areas are identified in the Provincial Policy Statement (PPS), 2014 as villages and hamlets where development is concentrated and which have a mix of land uses. It is recognized that some of the historical settlement areas identified on Schedule 'A' of this Plan may not meet this definition and are better described as crossroad. As a result, the County will undertake a settlement area study to examine and rationalize settlement areas identified on Schedule 'A' in order to determine where growth shall be focused over the long term planning horizon."
>
> Section 3.2.2 Settlement Area Policies: "Efficient development patterns and road connections will be encouraged in Settlement Areas to optimize public services and to make the most efficient use of land and resources."
>
> Section 3.2.2.2: "Because none of the settlement areas in the Frontenacs have municipal services, a settlement area capability study (comprehensive review) is required by the Official Plan for any boundary expansion to determine:
>
> (a) That the Settlement Area can adequately accommodate new development without having a negative impact on groundwater used for drinking purposes and/or the ability of the soils in the area to assimilate effluent;
>
> (b) An analysis of alternatives that may be considered to settlement expansion, including redevelopment and infill; and

(c) A review to determine compliance with the Minimum Distance Separation (MDS) formulae."

In terms of long-range planning for municipal services, as stated, provisions of municipal infrastructure such as roads, street lighting, and municipal water is necessary to support long term viability of the communities located in the County. Moreover, the County recognizes the importance of providing municipal infrastructure in a timely fashion and that the maintenance and sustainability of existing infrastructure assets is fundamental to the continued variety and growth of settlement areas across the County. The following sections outline the County's policy:

Section 3.3 Rural Lands: "Low density residential development […] is desirable, provided it is appropriately located. […] Permitted uses are: […] Residential development of a limited scale."

Section 3.3.3 Policies:

(1) "In recognition of the potential impacts that new growth and development may have on entire watershed systems, the County encourages communication between the local Townships within the same watershed area when a new development proposal is considered to have a potential impact on the quality and function of the watershed.

(2) a. Lot creation should take place either through Plan of Subdivision, Plan of Condominium, or Consent.

(2) d. It is recognized that the majority of existing and new rural residential development will be serviced by private wells and septic tanks; however, the County and the Townships may be interested in the investigation of new technologies and communal servicing options where it is deemed feasible for such areas and is supported by the Ministry of the Environment and Climate Change (MOECC).

(2) e. In determining the location and suitability of any proposed residential plan of subdivision, the following criteria shall be considered by both the County and the Townships:

i. the design of the subdivision should provide for a range of lot sizes directly related to the site's topography, vegetation and soil and drainage characteristics;

ii. based on the varying topography across the County, the Local Official Plans should establish a base minimum lot size;

iii. the minimum area of lot sizes should be determined by a hydrogeological study and a terrain analysis;

iv. Lots need to be of adequate size to provide for proper installation of private services; […]"

4.2 Servicing:
4.2.1.2 Goal: “To ensure that there is adequate provision of services and utilities consistent with the environmental, cultural, and economic goals of the County.”

4.2.1.3 Objectives
“To encourage the provision of adequate municipal services to achieve and facilitate orderly growth.
To improve the natural environment and maintain a clean and healthy level of water quality based on a watershed approach.
To ensure that citizens of Frontenac County have access to potable drinking water.
To promote waste reduction and waste management as per Section 4.3. […]
To accommodate growth in an organized manner to minimize capital and operating costs for the Townships.”

Section 4.2.1.4 Policies: “All new development within Settlement Areas will be provided with appropriate services to sustain permanent occupancy.
The County supports and can work with the Townships to coordinate infrastructure and public service facilities such as potential municipal water and sewage, and will ensure that such facilities are strategically located to support effective and efficient delivery of services across Township boundaries.”

Further, the County acknowledges new technologies and “Both the County and the Townships will monitor new technologies – in areas such as broadband, water treatment, and septic systems – that would be beneficial to residents and businesses and which would best be coordinated across municipal boundaries and will work together to develop strategies to ensure that optimal services can be provided in a timely and efficient manner.” The following sections outline the County’s policy:

Section 4.2.1.4.1 Special Policies: Future Village Services Planning
“With the exception of the village of Sydenham, not one of the villages and hamlets in Frontenac County has a municipal water supply. Villages such as Sharbot Lake, Marysville, Verona, Plevna and Harrowsmith are historical settlements that date back to the mid-nineteenth century in development. Many of the building lots in the village cores are too small relative to today’s health and safety standards with regard to the minimum lot size of approximately 1 hectares (2 acres) to ensure a long term potable water supply on private well and septic systems. […]

To help ensure these villages can sustain commercial and residential use and remain a valuable part of sustaining rural living, the County supports long-term planning for potential municipal services in villages. The planning shall include the following:

- Facilitate the preparation, implementation and monitoring of the Source Water Protection Plans;

- Work with the Townships to investigate and analyze lands adjacent to a village that could be purchased by the County or the Townships for the future site of a municipal well; and further, if necessary, work with the Townships to apply land use controls to surrounding properties to ensure long-term protection of the water source.
- Prepare a region-wide review of villages and hamlets which could require municipal services in the future and develop a priority list for local government investment.
- Establishment of a County reserve fund for drinking water protection that can be used in the investment of municipal infrastructure for water systems when required.
- Work with provincial and federal governments to seek funding to invest in municipal services.
- Partial services shall only be permitted in the following circumstances:
  - Where they are necessary to address failed individual on-site sewage services and individual on-site water services in existing development; or
  - Within settlement areas, to allow for infilling and minor rounding out of existing development on partial services provided that site conditions are suitable for the long-term provision of such services with no negative impacts."

4.2.1.5 Private Services: "Where municipal sewage services and municipal water services or private communal sewage services and private communal water services are not provided, individual on-site sewage services sand individual on-site water services may be used provided that site conditions are suitable for the long-term provision of such services with no negative impacts. In settlement areas, these services may only be used for infilling and minor rounding out of existing development.

Negative Impacts shall be defined for the purposes of this section and Section 4.2.1.5 as degradation to the quality and quantity of water, sensitive surface water features and sensitive groundwater features, and their related hydrologic functions, due to single, multiple or successive development. Negative Impacts should be assessed through environmental studies including hydrogeological or water quality impact assessments, in accordance with provincial standards."

Policies in Section 4.2 Servicing, Subsection 4.2.2 Storm Water Management Planning, address stormwater management planning, which states that stormwater management plans shall be prepared in accordance with the Ontario Ministry of the Environment and Climate Change (MOECC) Guideline, Stormwater Management Planning and Design Manual, 2003.

Housing affordability, addressed in Section 5.2.2 Affordable Housing Policies is also indirectly impacted by servicing. This policy is cited below:

"The local Townships will, where appropriate, promote intensification in settlement areas through their planning documents. Examples include: allowing for the conversion of single detached houses into multiple units and permitting land severances on large

underutilized properties which will allow for new residential development on the vacant severed parcel."

Section 7.2.1 Source Water Protection is relevant to the provision of communal water and wastewater servicing, as water intake zones must be planned for and protected.

> Section 7.2.1 Source Water Protection Plans:
> "The County shall […] Prohibit the establishment of new […] wastewater treatment plants in the Sydenham intake protection zones 1 and 2 (As identified in the Cataraqui Source Protection Plan) [and] Contribute and promote a culture of conservation among all public, private, community groups and local citizens and aim to reduce water use in all sectors; [and] Establish sector-specific targets for water use reductions".

B.2 TOWNSHIP OF NORTH FRONTENAC OFFICIAL PLAN, 2017

The Township of North Frontenac Official Plan addresses water supply and sewage disposal in Section 3.17 Provisions for water supply and sewage disposal, which states:

> "Notwithstanding the servicing hierarchy in the PPS, "is the intent of Council, in having regard for this statement, to balance the servicing needs of the area with the character of development. Servicing will be on the basis of individual on-site sewage services and individual on-site water services. This reflects the character of the area as well as the intent to avoid densities, which may necessitate the installation of piped services. This may not preclude the need for private communal sewage and water services for larger scale permanent residential (condominium or tenured ownership), developments, commercial developments such as recreational vehicle park, tourist commercial operation etc."

Communal services are specifically addressed in Subsection 3.17.3 Communal Services, as described below:

> "Council may consider private sewage and private water communal services for multiple lot/unit development (more than five lots/units). Prior to considering the need for a communal service, Council shall be satisfied that the following criteria are considered:
>
> (a) That the proposed density of the development is essential to the viability of the project and that other development or servicing options have been thoroughly considered (i.e. different location, method of servicing, acquisition of a larger land holding, etc.), and that as a result, the only reasonable or economical alternative is a communal service.

(b) That the potential for remedial measures has been adequately investigated with respect to health related matters (i.e. well contamination, nutrient management), and that no reasonable or economical alternative exists for resolving such health concerns that to install a communal service.

(c) That the Ministry of the Environment and Climate Change has issued an order under the “Ontario Water Resources Act” requiring the installation of a communal system and/or the proposed communal service qualifies for Certificate of Approval from the Ministry.

(d) That the proposed owner/operator has prepared an appropriate business plan to establish an appropriate cost structure for the installation and operation of the communal services.

(e) That the financial security can be established (e.g. trust fund and/or insurance policy), to offset potential capital or operational costs arising from the default of the operator.

(f) Where such a service is deemed to be necessary based on the above criteria and is approved, Council will assume ownership and operation after the issuance of a Environmental Compliance Approval where a private communal sewage service and or a private communal water service are required for permanent freehold residential development. Where a private communal sewage service(s) is required for permanent residential development, the Municipality shall be responsible for the service(s) should the system fail or the maintenance be neglected. Where a private communal service is required a responsibility agreement shall be required between the Municipality and the proponent or developer. A responsibility agreement will not be required for a mobile home park or recreational vehicle park for non-permanent residential development.

(Note: a private communal water service may include a Permit to Take Water under the Ontario Water Resources Act.) The responsibility agreement shall set out the requirements for the operation and maintenance of the system on a private basis subject to the approval of the Ministry of Environment. The legal agreement shall contain financial assurance provisions which will ensure funds for operation and routine maintenance as well as a secured fund for capital improvements should repair or replacement of the facility become necessary. In addition, the legal agreement shall set out the following:

i. Operating and Maintenance Standards.

ii. A definition of Default.

iii. An outline of remedial action.

iv. Registration on title of the subject property.

v. Easements, where required.

Council will assume ownership/operation for the private communal sewage and/or water service should the system fail or should the operator fail to operate or maintain the system according to the agreement and will utilize the financial security as needs to be in the operation/repair of the communal sewage service(s).

For the purposes of this Plan, private communal services means a sewage works within the meaning of Section 1 of the Ontario Water Resources Act that serves six or more lots or private residences and is not owned by a Municipality. Private communal water services means a non-municipal drinking water system within the meaning of Section 2 of the Safe Drinking Water Act, 2002 that serves six or more lots of private residences.

It is recognized that Frontenac County will be preparing a regional communal servicing study in 2017 that may result in Amendments to this Plan."

Under Section 3.17.4, it is Council's policy that storm water management shall be required as a preventative approach, rather than relying solely on end-of-pipe quality control, to protecting the quality and quantity of water resources.

Section 3.18 Co-ordination of Services of the Official Plan states that Council intends to monitor population, employment and housing development having regard to trends across the County of Frontenac and their impact on growth management in North Frontenac.

The following are broad growth management and land use principles addressed in Section 4:

4.2.3 Hamlet Principles:

"G. Opportunities for intensification and redevelopment shall also be promoted where it can be accommodated in the Hamlets through existing building stock, infill, on existing lots of record and through the rehabilitation and redevelopment of brownfields. Consideration for such initiatives shall recognize the long-term sustainability of development on private water and sewage services or the serving option selected for a hamlet or part thereof. Council shall establish and implement targets for intensification and redevelopment recognizing local servicing limitations."

Section 4.3.2 Rural Planning Principles

"A. […] Lot sizes for rural residential development or waterfront residential development shall be no less than 0.8 ha (2 acres). In determining whether there is a suitable building envelope, all required yard setbacks, steep slopes, rocks bluffs, wetlands, etc. must be subtracted from the overall lot size (see Section 3.15.2 D).

Lot sizes may be reduced in developments created by Plan of Subdivision or for multiple unit projects (fractional ownership, condominium, and time share).

Lot sizes or density may only be reduced where the risk assessment arising out of the study clearly indicates that there will be no reduction in water quality in a ground or surface water supply, that the quantity is sustainable for the intended use without the drawdown or well interference with adjacent wells and that other design standards criteria are generally exceeded. The study shall be undertaken by a professional (team) competent in the field of hydrology, hydrogeology and ecology subject to terms of reference approved by the Municipality. The study shall be subject to a peer review at the cost of the applicant for development. The study shall also recommend measures to restore or improve sensitive surface water features, sensitive groundwater features and their hydrologic functions."

B. Residential development shall be adequately serviced with on-site water and sewage disposal services (see Section 3.18 – Water Supply and Sewage Disposal). Council will require a servicing options report as a means to determine the most appropriate option for servicing for large-scale development such as a Plan of Subdivision or for multiple unit projects (fractional ownership, condominium, time share).

D. Energy efficient and sustainable design will be promoted for all development. Council may establish performance standards through conditional zoning, site plan control and other means."

4.7 Tourist Commercial Uses
4.7.2 Planning Principles:
"C. All tourist commercial uses requiring servicing shall be located on a lot that can be adequately serviced with water supply and sewage disposal (see Section 3.17 - Water Supply and Sewage Disposal)."

4.10 Waterfront Area
4.10.3 Basis and Principles:
"C. Development should be promoted in locations where demands on public services will be minimized, and where this development will most effectively utilize – or help pay for – existing services."

4.10.5 Objectives
"G. To ensure that development does not unduly contribute to a demand for utilities or services which are uneconomical to provide, improve, or maintain."

4.18 Energy, Air Quality and Sustainability
4.18.2 Planning Principles
"D. Energy efficient and sustainable design will be promoted for all development. Council may establish performance standards through conditional zoning, site plan control and other means; and […]"

6.9.7. Holding Zone – Section 36

"In order to show a future zoning designation while retaining control of the timing of development, a "holding" designation may be used, in the form of a symbol "H" as a suffix to the zone designation. As long as the "H" is retained, the use of the land shall be limited.

A. Rationale for the Use of Holding by-laws

Holding by-laws may be used where the principle of development has been established under the Planning Act. A Holding By-law may be used under the following circumstances:

i. To hold development until water and sewage services are provided, or, studies have been undertaken to prove that servicing is possible on the site and the servicing has been included in the Municipal budget or provided for through a Subdivision Agreement or other acceptable means with a developer; […]".

B. Conditions to be met for Removal of the Holding Symbol

The Holding "H" may be removed by by-law when the above circumstances have been satisfied and the following conditions met: (i) Approval of servicing the site /area is given or servicing of adequate standards is provided on the site[.]"

The possibility to impose parkland dedication requirements for Plans of Subdivision or Condominium is set out in Section 3.15.2.

Section 3.15.2 Consents

"S. Conditions may be imposed by Council in the granting of severances, which may include but not be limited to the following: […]

(iii) The dedication of land or cash-in-lieu of parkland; […]"

Overall parkland dedication requirements are set out in Section 6.9.11.

6.9.11. Parkland Dedication or Cash-in-Lieu – Section 42

"It is Council's policy to require the conveyance of parkland or the cash-in-lieu equivalent for residential and non-residential development as a means to implementing the policies for parks and open space areas of this Plan. The land or cash to be conveyed shall not exceed two per cent (2 %) of the value of the land to be developed for commercial or industrial uses or five per cent (5 %) for residential uses. Where Council requests cash-in-lieu, the value of the land shall be determined on the day before the day the building permit is issued."

B.3 TOWNSHIP OF CENTRAL FRONTENAC OFFICIAL PLAN, 2008 (CURRENTLY IN FORCE)

Water supply and sewage disposal provisions are outlined in Section 4.2. It is the intent of Council to be consistent with the Provincial Policy Statement's provision, which identifies a servicing hierarchy where full municipal servicing needs of the area with the character of development.

Traditionally low densities in the village of Sharbot Lake, hamlets and cross road settlements have not necessitated full municipal services. The intent of the Plan is to conserve this character by requiring larger lot sizes which will not require costly services. Further, Section 3.5 provides provisions for village, hamlet and cross road settlement area development concept. It states that none of the communities categorized are serviced or intended to be serviced with piped municipal services or communal services. Consequently, lot sizes for all new development must be adequate to support on-site water and sewage disposal systems.

Policy overview under Section 4.2.1 states that, in the Rural Area, low density development will continue to prevail and on-site (private) services will continue to be the basis for servicing. The exception will be larger scale commercial developments, such as recreational vehicle park or campground, where communal services may be required.

Section 4.2.2 explicitly states that it is the policy of Council to ensure that the density of development within the Planning Area does not result in the need for piped water and sewer services and in the review of planning applications, it is Council's intent to ensure that lot sizes are sufficiently large to make them self-sustaining for the purposes of water supply and the disposal of sewage.

Individual on-site sewage disposal systems are permitted under Section 4.2.3, subject to the outlined approval requirements.

Council may consider communal services, as per Section 4.2.4, for multiple lot development (six or more lot/units). For the purposes of this plan, communal services means sewage works and sewage systems and water works that provide for the distribution, collection or treatment of sewage or water, but which are not connected to full municipal sewage and water services; are for the common use of six or more residential or non-residential lots or units; and are owned, operated, and managed by the municipality, another public body, a condominium corporation or single owner under an agreement pursuant to the Planning Act.

If a system is approved, Council will assume responsibility or ownership after the issuance of a Certificate of Approval. Moreover, Council may choose to operate the system or consider entering into a legal agreement for the operation and maintenance of the system on a private

basis subject to the approval of the Ministry of Environment. Should the system fail or operator fail to operate or maintain the system in accordance with the agreement, Council will assume responsibility for the communal system.

Under Section 4.3, “Storm Water Management and Drainage”, it states that it is Council’s policy that storm water management shall be required for all urban settlement areas as a preventative measure (rather than relying solely on end-of-pipe quality control) to protecting water resources (quality and quantity) and outside of urban settlement areas where deemed appropriate. This section also features principles which Council intends to utilize in its approach to storm water management.

Parkland Dedications are addressed under the following policies:

> 3.5.1 Residential District
> 3. Public Service Uses
> “D. Council may elect to utilize the Planning Act to require the dedication of park land or the cash-in-lieu equivalent as a means to providing additional parkland or improving recreational facilities within existing parks […].”

Constraints on what parkland can by accepted by the Township are set out in Section 8.1.1 Policies – Flood Plains:

> “7. Where new development is proposed on a site, part of which has physical or environmental constraints, such land shall not necessarily be acceptable for parkland dedication under Section 43 of the Planning Act. All lands conveyed to the municipality shall be in a physical condition satisfactory to Council.”

The Parkland Dedication requirements are contained in Section 10.11.11 Parkland Dedication or Cash-in-Lieu – Section 42:

> “It is Council’s policy to require the conveyance of parkland or the cash-in-lieu equivalent for residential and non-residential development as a means to implementing the policies for parks and open space areas of this Plan. The land or cash to be conveyed shall not exceed two per cent (2 %) of the value of the land to be developed for commercial or industrial uses or five per cent (5 %) for residential uses. Where Council requests cash-in-lieu, the value of the land shall be determined on the day before the day the building permit is issued.”

B.4 TOWNSHIP OF CENTRAL FRONTENAC OFFICIAL PLAN, (DRAFT, MAY 2018)

Section 2.2 Vision and Context establishes five areas of focus, including:

- Infrastructure
- Protection and Health of Natural Environment

The Official Plan also recognizes the impacts of climate change on land-use, particularly unpredictable water levels in rivers, lakes and groundwater during droughts and floods.

General objectives are outlined in Section 2.3 Objectives of the Plan. Subsections applicable to the Study are as follows:

> Section 2.3.2 "To promote efficient development patterns that optimize the use of land, resources and public investment, and to promote a strong liveable and healthy community that enhances social well-being and is economically and environmentally sound. […]"
>
> Section 2.3.5 "To provide for a low-density settlement pattern which can be efficiently serviced, but which will avoid densities that will require the need for piped municipal services. Development will be encouraged in locations where services (e.g., snow plowing, school bussing, fire protection, ambulance service and waste disposal) are available or can be made available at a reasonable cost."
>
> Section 2.3.17. "To encourage sustainable practices in the planning, design and development of the community through such measures as reducing energy consumption; improve or restore ecological functions; conserving or promoting biodiversity; recycling, harvesting and conserving water resources including waste water; […] promoting the use of environmentally friendly building materials and building systems; conducting energy and lifecycle audits; and promoting adaptive technologies that reduce consumptive practices."

This section also makes reference to protecting the financial status of the Township with regard to infrastructure planning.

Section 3.17 Water Supply and Sewage Disposal addresses the servicing hierarchy in the PPS. However, the Plan states that:

> "Servicing will be on the basis of individual on-site sewage services and individual on-site water services."

Nevertheless, provisions for private communal water and sewage services are made for residential developments with 5 or more lots, and for commercial developments like RV parks and tourist operations. This is addressed in Section 3.17.3:

> "Prior to considering the need for a communal service Council shall be satisfied that the following criteria are considered:
>
> A. That the proposed density of development is essential to the viability of the project and that other development or servicing options have been thoroughly considered (i.e. different location, method of servicing, acquisition of a larger land holding etc.), and that as a result, the only reasonable or economical alternative is a communal service.
>
> B. That the potential for remedial measures has been adequately investigated with respect to health related matters (i.e. well contamination, nutrient management, and that no reasonable or economical alternative exits for resolving such health concerns than to install a communal service.
>
> C. That the Ministry of the Environment and Climate Change has issued an order under the "Ontario Water Resources Act" requiring the installation of a communal system and/or the proposed communal service qualifies for Certificate of Approval from the Ministry.
>
> D. That the proposed owner/operator has prepared an appropriate business plan to establish an appropriate cost structure for the installation and operation of the communal services(s).
>
> E. That a financial security can be established (e.g. trust fund and/or insurance policy), to offset potential capital or operational costs arising from the default of the operator.
>
> F. Where such a service is deemed to be necessary based on the above criteria and is approved, Council will assume ownership and operation after the issuance of a Environmental Compliance Approval where a private communal sewage service and or a private communal water service are required for permanent freehold residential development. Where a private communal sewage service(s) is required for permanent residential development, the Municipality shall be responsible for the service(s) should the system fail or the maintenance be neglected. Where a private communal service is required a responsibility agreement shall be required between the Municipality and the proponent or developer. A responsibility agreement will not be required for a mobile home park or recreational vehicle park for non-permanent residential development. (Note: a private communal water service may include a Permit to Take Water under the Ontario Water Resources Act.) The responsibility agreement shall set out the

requirements for the operation and maintenance of the system on a private basis subject to the approval of the Ministry of Environment. The legal agreement shall contain financial assurance provisions which will ensure funds for operation and routine maintenance as well as a secured fund for capital improvements should repair or replacement of the facility become necessary. In addition, the legal agreement shall set out the following:

i. Operating and Maintenance Standards.
ii. A definition of Default.
iii. An outline of remedial action.
iv. Registration on title of the subject property.
v. Easements, where required.

Council will assume ownership/operation for the private communal sewage and/or water service should the system fail or should the operator fail to operate or maintain the system according to the agreement and will utilize the financial security as needs to be in the operation/repair of the communal sewage service(s).

For the purposes of this Plan, private communal services means a sewage works within the meaning of Section 1 of the Ontario Water Resources Act that serves six or more lots or private residences and is not owned by a Municipality. Private communal water services means a non-municipal drinking water system within the meaning of Section 2 of the Safe Drinking Water Act, 2002 that serves six or more lots of private residences.

G. It is recognized that Frontenac County will be preparing a regional communal servicing study in 2018 that may result in Amendments to this Plan."

Beyond the direct discussion of communal servicing in Section 3.17.3, the Plan's treatment of land use has relevance for questions of communal servicing. Hamlet Settlement Area policies, addressed in Section 4.1 Hamlet Settlement Areas are intended to encourage residential development, considering the limitations posed by on-site water and sewer service.

Section 4.1.3 Hamlet Planning Principles
B. "Ensuring that the lot can be adequately serviced with water supply and sewage disposal."

H. "Council will encourage development to occur on existing approved lots before considering new development. Opportunities for intensification and redevelopment shall also be promoted where it can be accommodated in the Hamlets through existing building stock, infill, on existing lots of record and through the rehabilitation and redevelopment of brownfields. Consideration for such initiatives shall recognize the long-

term sustainability of development on private water and sewage services or the serving option selected for a hamlet or part thereof. Council shall establish and implement targets for intensification and redevelopment recognizing local servicing limitations."

Preferred servicing is outlined in Section 4.2.1:

> 4.2.1 Rural Area General
> "New development will be on the basis of on-site (private) water and sewage disposal systems, or communal systems, where necessary."

Rural lot development must occur on lots greater than 0.8 ha, not including natural heritage features and yard setbacks. However, under Section 4.3.2 Planning Principles:

> A. […] "Lot sizes may be reduced in developments created by Plan of Subdivision or for multiple unit projects (fractional ownership, condominium, and time share).[…]"

> B. "Residential development shall be adequately serviced with on-site water and sewage disposal services (see Section 3.18 – Water Supply and Sewage Disposal). Council may require a servicing options report as a means to determine the most appropriate option for servicing for large-scale development such as a Plan of Subdivision or for multiple unit projects (fractional ownership, condominium, time share)."

Rural Recreational Uses are also permitted where designated. As per Section 4.5.2 "Planning Principles":

> F. "All rural recreational uses requiring servicing shall be located on a lot that can be adequately serviced with water supply and sewage disposal."

This requirement is repeated verbatim in Section 4.6 Tourist Commercial Uses, subsection 4.6.2 B. of the Draft OP.

Policy outlining the servicing requirements for Recreational Commercial Vehicle parks incorporates greater flexibility, as per Section 4.7.3 Recreational Vehicle Parks and Campgrounds:

> "Where a number of new recreational vehicles are permitted, such as in a designated Recreational Vehicle Park and the aggregate sewage effluent discharge is greater than 10,000 liters per day, the approval of the Ministry of the Environment and Climate Change shall be required as set out in the Ontario Water Resources Act. Communal services shall be the preferred means of servicing multiple units. (see also Section 3.17 – Water Supply and Sewage Disposal). This policy shall not be deemed to exempt any

existing recreational vehicles from compliance with the Building Code Act or Ontario Water Resources Act, respectively, where a compliance order is issued."

Additionally, Section 4.7.6 Development Criteria for Recreational Parks and Campground, subsection G indicates what factors should be included in capacity calculations:

> "The proposed water supply and sewage disposal systems shall comply with Section 3.17 – Water Supply and Sewage Disposal of the Plan. Water usage and sewage disposal shall take into consideration provisions for shower, rest room and laundry facilities[.]"

Section 4.8 as a whole addresses Waterfront Areas. This section intends to address the conservation of water quality and ecosystem health (by regulating land use in areas within 150 metres of the waterfront, subject to a number of qualifications. Generally, the goals and objectives aim to achieve this by limiting waterfront development densities and ensuring that development is compatible with the natural surroundings. Specific reference to communal servicing is made in the discussion of Special Policy Area 1 – Garrison Shores under Section 4.9.5:

> D. Sewage and Water Services
>
> "The intent of this Plan is to provide for the progressive improvement of sewage and water services for existing development and to ensure that no new development is permitted unless it is clearly demonstrated that the site conditions for sewage and water services are suitable for the long-term provision of such services. Sewage and water systems may include individual on-site services or private communal sewage and water service systems or a mix of both types of systems.
>
> Prior to the approval of any of the following development or redevelopment applications, the procedures set out in Guidelines D-5-4 and D-5-5 of the Ministry of the Environment shall be satisfied in terms of water supply and impact assessment. A planning application shall be supported by a report that addresses the requirements of the Guidelines. In addition, Council may use the provisions of the Safe Drinking Water Act, the Clean Water Act or any other applicable legislation to ensure that malfunctioning sewage disposal systems are rectified and that water wells are properly maintained. Planning applications requiring an assessment include:
>
> — An application to develop a vacant unit or parcel for a residential dwelling or recreational vehicle;
> — An application to expand an existing recreational/residential use that creates the demand for water or sewage disposal (i.e. adding a bedroom);
> — An application to convert a seasonal dwelling to a permanent year-round dwelling; and

- An application to install a new water and/or sewage disposal system even if there is no change to the principal use;
- An application to change an existing use from a recreational vehicle to a residential dwelling.

The assessment of sewage and water services shall apply to a specific development cluster, except where in the opinion of a qualified professional, consideration has to be given to lands within an adjacent development cluster. Any subsequent applications shall take into consideration the findings and recommendations of a previous assessment.

Sewage disposal systems and water wells may be located outside of a prescribed Recreational/Residential Unit where permitted by the Condominium declaration, provided the overall density of the Development Cluster for which the service is provided is not exceeded.

In no case, will development or redevelopment be permitted which is not environmentally sustainable nor which exceeds the density standards for a development cluster.

The performance of sewage disposal systems may be monitored by Council through a septic tank re-inspection program to ensure that systems are properly maintained. Council will require that property owners and/or the condominium corporation make provision with a licensed sewage hauler for the pump-out of septic tanks on a regular basis."

As per Section 4.9.6 Waterfront Protection Policy, waterfront areas are subject to Site Plan Control, which can apply to the siting of sewage disposal and water supply system components. The Draft Official Plan's policies with regards to energy efficiency and sustainability also have applicability to the question of communal servicing. In particular, the Draft OP would commit to the following Planning Principles as listed in Section 4.15 Energy, Air Quality and Sustainability:

Section 4.15.2 Planning Principles
"[…] B. Council will encourage the installation of: energy efficient solid fuel burning appliances; proper, energy efficient insulation; water conserving fixtures, etc.; […]

D. Energy efficient and sustainable design will be promoted for all development. Council may establish performance standards through conditional zoning, site plan control and other means."

Also of potential relevance to communal water and wastewater systems is the question of parkland dedications, under Section 42 of the Planning Act. The draft Plan allows the

municipality to impose parkland dedication requirements for draft plans of subdivision or condominium, as cited in Section 3.15.2 Consents:

> "S. Conditions may be imposed by Council in the granting of severances, which may include but not be limited to the following:
> […] (iii) The dedication of land or cash-in-lieu of parkland; […]"

In Section 6.9 Planning Act, the Official Plan describes what form this condition would take:

> Section 6.9.11 Parkland Dedication or Cash-in-Lieu – Section 42:
> "It is Council's policy to require the conveyance of parkland or the cash-in-lieu equivalent for residential and non-residential development as a means to implementing the policies for parks and open space areas of this Plan. The land or cash to be conveyed shall not exceed two per cent (2 %) of the value of the land to be developed for commercial or industrial uses or five per cent (5 %) for residential uses. Where Council requests cash-in-lieu, the value of the land shall be determined on the day before the day the building permit is issued."

B.5 TOWNSHIP OF FRONTENAC ISLANDS OFFICIAL PLAN, CONSOLIDATED 2013

The goals and objectives of the Township, as specified in Section 2.2, states that, for infrastructure goals, full municipal sewage and water services are the preferred form of servicing for urban and settlement areas. Therefore, Council's objective is to complete a study on the feasibility of installing a municipal water service for Marysville. In areas serviced by full municipal sewage and water services, lot creation will be permitted only if sufficient reserve water and sewage system capacity will be available to accommodate it. If full municipal services are unavailable or cannot be provided, communal services are the preferred means of servicing multiple lot/units provided site conditions are suitable.

Lot/unit creation may be serviced by individual on-site sewage and water systems where the use of communal systems is not feasible. Moreover, partial services may be permitted where necessary to address failed on-site sewage and water systems in existing development.

Section 3 details community structure and development policies. Water supply is outlined in Section 3.2.4 Water Supply. It states that the municipality does not currently operate any municipal water supplies and relies on individual water supplies taken from ground water sources or adjacent water bodies. Except for those areas where new communal water supplies can be established such as within the urban settlement area of Marysville, it is expected that new development in these areas will continue to rely on ground water and surface sources.

Communal water supply is further outlined in Policy 3.2.4.1 Communal Water Supply, which indicates that new residential development of 6 residential units or more will be served by communal water supply systems except where it is demonstrated to the satisfaction of the Township that a communal system is not feasible or practical. In terms of administration and management, all new communal water supply systems designed to serve more than 5 residential lots/units shall be assumed by the municipality for administration and maintenance purposes and an annual review of all municipal water supply systems shall be required.

Section 3.2.4.2 Private Communal Piped Water Supply permits the continuation of existing private supply. New private communal services will be subject to municipal review where planning and building approvals are required.

For individual water supplies, such as wells, the applicant should be required to prove the adequacy of the available water supply to provide a dependable, safe source of water over extended periods without negatively impacting on other water sources for adjacent uses, as indicated in Policy 3.2.4.3 Individual Water Supply.

Policies for sewage disposal are outlined in Section 3.2.5 Sewage Disposal, which states there are no municipal sewage collection or disposal systems in the Township. Instead, development is served by individual sewage disposal systems, which consist primarily of septic tanks and tile fields. New development will continue to rely on either communal or individual sewage disposal systems. The Official Plan may designate those areas where new development will only be permitted on the basis of a communal sewage disposal system as per Section 3.2.5.1 Public Sewage Disposal Systems. No areas have been designated at this time.

For private communal sewage disposal, as per Section 3.2.5.2 Private Communal Sewage Disposal, where a private communal sewage disposal system exists, it may continue to provide service to the existing uses it has been serving. New communal services will be subject to municipal review where planning and building approvals are required. Subject to the Ministry of the Environment review, an existing system may be extended as a private communal system. New private communal systems shall be subject to review in accordance with the Ministry of the Environment legislation and guidelines.

Parkland dedication requirements are set out in Section 3.5.1 General Policies. The specific provisions of the OP are as follows:

> "1. It is intended that the provisions of Sections 42, 51, and 53 of the Planning Act, R.S.O. 1990, as amended, shall apply to all new plans of subdivision and consents to land severance, development or redevelopment. In accordance with these provisions, land and/or cash-in-lieu thereof shall be conveyed to the municipality as a condition to approval of the Plan of Subdivision, consent to land severance, development or redevelopment.

2. It is intended that lands conveyed to the municipality in accordance with the above provisions shall be suitable for development as a public recreational area and that lands subject to physical limitations such as flooding, steep slopes, erosion or other similar limitations will not necessarily be accepted for park purposes. All lands dedicated to the municipality shall be conveyed in a physical condition satisfactory to the municipality and the municipality may require certain improvements such as grading, planting of grass seed and other vegetation, fencing, etc."

APPENDIX

C

DRAFT OFFICIAL PLAN POLICIES

This Appendix includes draft policy recommendations to be considered by the County and the Townships to implement the findings of this Study in the policies of the respective County and Township Official Plans.

C.1 COUNTY OF FRONTENAC OFFICIAL PLAN, ADOPTED OCTOBER 15, 2014, MMAH APPROVAL JANUARY 11, 2016

1. Page 9, Section 1 – Introduction, Context of the Plan, add a new paragraph to read:

   "Moving forward, the County intends to become a leader in the use of communal servicing to encourage growth and development in these villages to promote historic revitalization, mainstreet development, and community building."

2. Page 24, Section 3.1 – Growth Projections for Frontenac County, delete (c) and replace with:

   "Development opportunities on communal servicing shall be encouraged to direct growth and redevelopment in Settlement Areas."

3. Page 24, Section 3.2 – Settlement Areas, Section 3.2.1 – Introduction, add to the end of the existing paragraph:

   "Over time, Settlement Areas may change and new ones may be created. The County shall encourage development on communal services in Settlement Areas to allow growth and revitalization to these areas and mainstreets."

4. Page 25, Section 3.2 – Settlement Areas, Section 3.2.1 – Introduction, add the following text to the end of the second paragraph:

   "…the County supports new development in both the settlement areas as well as in rural locations, **and encourages such development to occur on communal services as per Section 4.2.1.6 of the Plan**." (recommended text in bold)

5. Page 28, Section 3.3.3 Policies (in Rural Lands Section), delete Policy 2 (d) and replace with:

   "The County and the Townships shall encourage communal servicing as an alternative to private wells and septic tanks, where it is deemed feasible, and is supported by the Ministry of the Environment, Conservation and Parks (MECP)."

6. Page 31, Section 3.3.3.4.4 Policies (in the Special Policies – Waterfront Areas Section), the following policy should be added:

   "In order to reduce environmental impacts on a waterbody, Council supports the use of communal services for new development or redevelopment adjacent to a waterfront."

7. Page 42, Section 4.2.1.4.1 Special Policies: Future Village Services Planning (in the Servicing Section), the following policy should be added:

   "Development on communal services, as per Section 4.2.1.6, shall be encouraged within these villages. The priority shall be for residential development on communal servicing to be implemented through plans of subdivision.

8. Page 42, Section 4.2.1.4.1 Special Policies: Future Village Services Planning (in the Servicing Section), the following policy should be deleted:

   "Within settlement areas, to allow for infilling and minor rounding out of existing development on partial services provided that site conditions are suitable for the long-term provision of such services with no negative impacts."

9. Page 43, a new Section 4.2.1.6 Communal Services, including the following subsections and policies, should be added:

   "4.2.1.6.1 Introduction
   Communal services (also known as 'decentralized services') provide water and wastewater treatment to cluster of residences or businesses. They can be a less expensive alternative to centralized municipal services and a more environmentally-friendly alternative to private on-site services.

   The County completed a regional 'Communal Servicing Study' in 2019 to equip Frontenac with the planning, engineering, and economic development tools necessary to enable redevelopment and new development using communal services.

   4.2.1.6.2 Policies
   The County supports the use of communal sewage and water services as a form of infrastructure that can support new development within settlement areas, waterfront development, redevelopment of main streets, improved environmental protection and protection of public health.

   County Council further supports communal services as a means to support the broad objectives of sustainability of this Plan and the implementation of the Provincial Policy Statement, including:

   - intensification;
   - efficient land use;
   - rural affordability;
   - growth in Settlement Areas;
   - preservation of agricultural land;
   - increase active transportation; and
   - efficient use of infrastructure by allowing denser development in small settlement areas and creating a sense of place.

All development within the County may be developed on the basis of communal systems, subject to the proponent fully satisfying all financial, technical, and other requirements of the County and/or the Townships, and other relevant approval authorities. Any such system will have to meet the requirements of this Plan, the Local Official Plans, the Ministry of Environment, Conservation and Parks (MECP), and the approval processes under the Environmental Assessment Act, the Ontario Water Resources Act, the Safe Drinking Water Act, and the Planning Act.

The County and/or the Townships shall require a Municipal Responsibility Agreement to be established between the proponent and the County/Township. In approving any communal system, the County and/or Township may require a peer review of the proposed communal system, and shall require financial securities, and may impose a utility rate, to ensure that all operational, maintenance and administration costs associated with communal services will not create an unacceptable financial burden for the County and/or Townships, in the event of default by the owner-operator of the system.

The County will work to develop a financial model to reduce the risk of entering into a Municipal Responsibility Agreement for the County and/or Townships, and to reduce the cost of such agreements to a proponent in order to enable communal service development. In order to ensure all future communal serviced development is meeting public health and safety standards, the County will consider the creation of a public utility that will:

- inspect and monitor communal systems and ensure that such test reporting is made public;
- ensure that any maintenance requirements are addressed in a timely manner subject to municipal and provincial approvals; and
- establish fees for the purpose of managing communal systems.

C.2 TOWNSHIP OF NORTH FRONTENAC OFFICIAL PLAN, ADOPTED BY THE COUNCIL OF THE TOWNSHIP OF NORTH FRONTENAC: MAY 19, 2017, APPROVED BY THE COUNCIL OF THE COUNTY OF FRONTENAC: SEPTEMBER 20, 2017

1. Page 14, Section 2.3.19 – Economic Development, add the following policy:

   "The Township shall encourage growth and development in the Settlement Areas, including mainstreets, and rural development to occur on communal systems to revitalize the historic hamlets, while fostering rural affordability."

2. Page 28, Section 3.15.1 – Plans of Subdivision and Condominium, add a new paragraph:

"F: Communal Services: shall be encouraged for waterfront development that is accessed by private roads, and implemented through plans of condominium, which are subject to County approval."

3. Pages 38 to 40, Section 3.17.3 – Communal Services, the following changes and additions are recommended:

   - In the first paragraph, delete "[…] (more than five lots/units)".
   - Add a policy to state that, "Council shall balance the servicing needs and the fiscal reality of achieving rural affordability."
   - Delete the second paragraph, and replace with: "Development on communal services shall be in keeping with the following policies:"
   - Delete policies A, B, C, E and replace with:

     A. "The Township Council shall encourage communal servicing as an alternative to private wells and septic tanks, where it is deemed feasible, and is supported by the Ministry of the Environment, Conservation and Parks (MECP)".

     B. "Development on communal services shall be encouraged within settlement areas. In settlement areas, the priority shall be for residential development on communal servicing shall be implemented through plans of subdivision."

     C. "The Township shall require a Municipal Responsibility Agreement to be established between the proponent and the Township. In approving any communal system, the County and/or the Township may require a peer review of the proposed communal system, and shall require financial securities, and may impose a utility rate, to ensure that all operational, maintenance and administration costs associated with the private communal services will not create an unacceptable financial burden for the County and/or the Township, in the event of default by the owner-operator of the system."
   - D. Delete "That the proposed owner/operator has prepared an appropriate business plan […]", and replace with: "The proposed owner/operator shall be required to prepare an appropriate business plan […]"
   - F. Delete "Where such a service is deemed to be necessary based on the above criteria and is approved […]", and replace with: "Where communal services are deemed to be necessary and are approved […]"
   - F. In the first paragraph, last sentence, delete "non-permanent residential development" and replace with "seasonal residential development."
   - F. In the second last paragraph, delete references to "six or more lots."
   - F. Delete the last paragraph: "It is recognized that Frontenac County will be preparing a regional communal servicing study in 2017 that may result in Amendments to this Plan."

4. Page 40, the last paragraph in Policy F should be deleted.

5. Page 46, Section 4.1.3 – Hamlet Planning Principles, the following new policy should be added:

   L. “The Township shall encourage growth and development in the Settlement Areas, including mainstreets, to occur on communal systems to revitalize the historic hamlets and provide opportunities for increased density and a mix of uses.”

6. Page 78, Servicing, revise the policies as follows:

   – Revise “T” to read, “Development in the Waterfront Area designation that is accessed by a private road shall be encouraged to be on communal services, where feasible, and implemented through a plan of condominium, subject to approval. Where such development cannot occur, development may be serviced by private individual on-site sewage and water systems.”
   – Delete “V” and replace with:

     “The Township supports and encourages new development on communal services in both the settlement areas as well as in rural locations.”

C.3 TOWNSHIP OF CENTRAL FRONTENAC OFFICIAL PLAN, WITH MODIFICATIONS JUNE 18, 2008

A preliminary review of the Official Plan was conducted, but since a Draft OP has been prepared, the focus on potential policy changes has been focused on the Draft OP. It is anticipated that a Revised Draft OP will be presented to Township Council in Spring 2019.

C.4 TOWNSHIP OF CENTRAL FRONTENAC OFFICIAL PLAN, FIRST DRAFT, MAY 15, 2018

1. Page 14, Policy 2.3.5 under Section 2.3 – Objectives of the Plan:

   – Move “Development will be encouraged in locations […]” since this is covered in Policy 2.3.16.
   – Add to Policy 2.3.5, “Development will be encouraged in locations where communal systems are feasible.”

2. Page 17, move last paragraph to Policy 2.3.19, “For example […] development will be encouraged where it takes advantage of alternative forms of servicing such as communal servicing and existing infrastructure […]”

3. Page 32, Section 3.15.1 – Plans of Subdivision and Condominium, add a new F: “Infrastructure: Development on communal services shall be considered for a plan of subdivision or plan of condominium.”

4. Pages 42 to 44, Section 3.17.3 – Communal Services, the following changes and additions are recommended:

   - In the first paragraph, delete "[…] (more than five lots/units)".
   - Add a policy to state that, "Council shall balance the servicing needs and the fiscal reality of achieving rural affordability."
   - Delete the second paragraph, and replace with: "Development on communal services shall be in keeping with the following policies:"
   - Delete policies A, B, C, E and replace with:

     A. "The Township Council shall encourage communal servicing as an alternative to private wells and septic tanks, where it is deemed feasible, and is supported by the Ministry of the Environment, Conservation and Parks (MECP)".

     B. "Development on communal services shall be encouraged within settlement areas. In settlement areas, the priority shall be for residential development on communal servicing shall be implemented through plans of subdivision."

     C. "The Township shall require a Municipal Responsibility Agreement to be established between the proponent and the Township. In approving any communal system, the County and/or the Township may require a peer review of the proposed communal system, and shall require financial securities, and may impose a utility rate, to ensure that all operational, maintenance and administration costs associated with the private communal services will not create an unacceptable financial burden for the County and/or the Township, in the event of default by the owner-operator of the system."
   - D. Delete "That the proposed owner/operator has prepared an appropriate business plan […]", and replace with: "The proposed owner/operator shall be required to prepare an appropriate business plan […]"
   - F. Delete "Where such a service is deemed to be necessary based on the above criteria and is approved […]", and replace with: "Where communal services are deemed to be necessary and are approved […]"
   - F. In the first paragraph, last sentence, delete "non-permanent residential development" and replace with "seasonal residential development."
   - F. In the last paragraph, delete references to "six or more lots."
   - Delete policy G: "It is recognized that Frontenac County will be preparing a regional communal servicing study in 2018 that may result in Amendments to this Plan."

7. Page 57, Section 4.1.3 – Hamlet Planning Principles, the following new policy should be added:

M. “The Township shall encourage growth and development in the Settlement Areas, including mainstreets, to occur on communal systems to revitalize the historic hamlets and provide opportunities for increased density and a mix of uses.”

5. Page 58, Section 4.1.4 – Special Policy Area – Sharbot Lake: The County is currently preparing a new section with special policies to recognize the village as a regional hub, the importance of the future design of Highway 7, and a potential new VIA Rail station. The section will also include special policies specific to communal servicing to provide a framework for future municipal capital investment.

6. Page 71, Section 4.7.3 – Recreational Vehicle Parks and Campgrounds – draft policy stating, “Communal services shall be the preferred means of servicing multiple units.” This policy should remain.

7. Page 136, Appendix 1 – Definitions. Consider adding a definition for “communal services” and consider clarification and revisions to other existing terms currently used in the draft OP for “municipal services”, “public services”, “infrastructure”.

C.5 TOWNSHIP OF FRONTENAC ISLANDS OFFICIAL PLAN, JULY 2013 CONSOLIDATED VERSION

1. Page 12, Section 3.2:
   - Move the following text from Section 3.2.1 “Background” to a new preamble: “The land use designations of Schedule “A” require differing levels of supporting services. These services are provided by a number of service providers, many on a communal basis.”
   - Delete Section 3.2.1 “Background” in its entirety, and renumber the subsequent Sections.

2. Page 14, Section 3.2.3 – Water Supply and Sewage Disposal, delete “more than 5 residential lots/units or other […]”.

3. Page 14, Section 3.2.4.1, subsection 1. New Public Systems, i – New Development, delete “of 6 residential units or more”.

4. Page 15, Section 3.2.4.1, subsection 1. New Public Systems, iv – Administration and Management, delete “designed to serve more than 5 residential lots/units” and delete “shall be assumed” and replace with “may be assumed”.

5. Page 17, Section 3.2.5.2 – Private Communal Sewage Disposal, first paragraph, “New communal services will be subject to municipal review **and a peer review**…” (recommended text in bold to be added)

6. Page 65, Section 5.5.1 – General Principles for Village Areas, last paragraph, policy to be added, "…commercial and community services **on communal systems** […]" (recommended text in bold to be added)

APPENDIX

D ENGINEERING BEST PRACTICES

D.1 INTRODUCTION

The following Engineering Best Practices provide a guideline for the planning, selection, and design of a communal on-site sewage treatment and disposal system. Best practices for installation, operation, and maintenance are also discussed. It should be noted that this is not intended to be an all-inclusive document and requires professional judgement in its use. For all sewage systems, appropriate government approvals will be required prior to construction and/or use of the system.

D.2 SITE EVALUATION

D.2.1 EVALUATION OF SITE CHARACTERISTICS

Once the development site has been confirmed, a background review of site characteristics should be undertaken in order to plan for communal sewage servicing. Site characteristics may play a significant factor in the type of disposal (i.e. surface or subsurface), effluent requirements for the treatment system, and the type of treatment technology that will be chosen. The type of sewage system will also depend on other factors such as raw sewage quality and design sewage flows.

Site characteristics that should be reviewed prior to choosing a method of communal sewage servicing should include, but are not limited to, the following:

- Site location
- Surrounding land uses
- Physiography of the site, including:
  - Shallow soils
  - Topography
  - Bedrock topography and formations
    - The majority of the County of Frontenac is underlain by Precambrian metamorphic and igneous rock of the Canadian Shield. The southwest part of the County, including Wolfe Island and Howe Island, is underlain by Paleozoic sandstone, dolostone, limestone, and shale.[46] The Precambrian Shield is prone to cracking and seepage.[47]
  - Hydrostratigraphy
  - Local water well locations

[46] Ontario Geological Survey. 2012. Aggregate Resources Inventory of the County of Frontenac, Southern Ontario, pg.15.
[47] County of Frontenac Official Plan, 2016, pg. 42.

- Local surface water features

Information for the above items can be sourced from GIS mapping of the development site, the MECP's Water Well Record database, and on-site investigations. Other sources may have to be consulted, depending on site conditions.

D.2.2 SOIL EVALUATION

Field investigations should be undertaken following the background review to confirm the site characteristics. For subsurface disposal, an intrusive on-site shallow hydrogeological investigation would be required. The investigation would include test pits or boreholes to be completed within the proposed tank and leaching bed area to determine the following:

- Depth to bedrock or primary restricting layer (bedrock, groundwater table, impermeable soil);
- Evidence of high groundwater table;
- Soil conditions that may influence the design of the sewage system, such as smearing, compaction, presence of fill, etc.); and
- Infiltration rate of the soils.

Test pit or borehole logs should be completed according to standard practices. An adequate number of test pits should be excavated and analyzed to provide sufficient information to characterize the site.

According to the Ontario Building Code ("OBC") (2012), infiltration rates or percolation times that are used in the design of the sewage system can be determined via percolation test or soil classification. The methods are described in more detail in Section 8.2.1.2 of the OBC. For large subsurface disposal systems, the OBC method can be followed or Table 22-1 of the MECP's Design Guidelines for Sewage Works 2008 provides suggested hydraulic and organic loading rates.

D.2.3 SOILS OF FRONTENAC COUNTY

Specific to the County of Frontenac, there is a major division in the bedrock formations occurring between the Precambrian and Ordovician rocks. In the northern part of the County, the Precambrian rocks are composed of igneous and metamorphosed sedimentary rocks. Granite, granitic gneiss, and limestone are found in the area. Ordovician limestones occur in the southern part of the County. The Black River group forms the bedrock in the south, with the exception of the southern part of Wolfe Island where the bedrock belongs to the Trenton group.

The greatest area of the County is covered by till. This material varies greatly from the northern part of the county to the southern part, depending upon the nature of the underlying bedrock noted above. The till soils overlying the Precambrian Shield (northern part) are generally thin, and the nature of the relief reflects the bedrock relief. Most of the till soils overlying the Black River limestone (southern part) are also thin.

The soil materials along the southern border of the County consist of stone-free calcareous clay deposits broken in places by numerous outcrops of Precambrian rock. Silt-textured lacustrine materials cover an area from Kingston to Battersea, enclosed by limestone escarpments on the west and by Precambrian rock to the north and east. Coarse-textured soils, sands, and gravels are found in small areas scattered over the county, many of which may be shorelines of Lake Frontenac or Lake Champlain.[48]

D.3 PLANNING AND DESIGN OF COMMUNAL SEWAGE SYSTEMS

D.3.1 DAILY DESIGN SEWAGE FLOW

The theoretical total daily design sewage flow for a site should be calculated based on the theoretical sewage flows for the proposed use of the development. If there are multiple uses on the site, the theoretical daily design sewage flow for the site should be based on the combined theoretical sewage flows for the individual occupancy uses.

Theoretical sewage flows for residential type occupancies are provided in Table 8.2.1.3.A. of the OBC (2012), and Table 8.2.1.3.B for other types of occupancies. It should be noted that the theoretical sewage flows represent the peak maximum daily sewage flows for most developments.

As this list in the OBC is not comprehensive, other documents that can be referenced to determine theoretical sewage flows include:

- Appendix 9.3.1, Manual of Policy, Procedures and Guidelines for Onsite Sewage Systems, Ministry of the Environment, Conservation and Parks (1982); and
- Onsite Wastewater Treatment Systems Manual, U.S. Environmental Protection Agency.

Water conservation techniques may also be employed at new developments, including the use of high efficiency appliances and fixtures within residential and commercial/office units, that may reduce the daily design sewage flow from theoretical values. The designer should take this into consideration when determining the design sewage flow for the system; however, consideration should be given to the resulting increase in sewage strength that may result from these changes.

D.3.2 DAILY DESIGN SEWAGE FLOWS FOR LARGE SYSTEMS

Communal sewage systems servicing a larger development will see smaller peaks in generated sewage flows than smaller systems that service only a few houses. For smaller systems, the theoretical daily design sewage flow should be used to calculate the design flow for the system. For larger communal systems, a value lower than the peak daily design flow may be more

[48] Ontario Soil Survey. 1966. Soil Survey of Frontenac County.

representative due to the buffering capacity of the system. Reduction of peak flows to more representative values should be completed with professional judgement, in consultation with the MECP.

It is noted that for commercial developments the theoretical daily design sewage flow should be used unless reliable sewage flow data is available. The MECP may allow the use of recorded flow data to determine sewage design flows for an existing site, where reliable flow data exists and has been collected for a minimum of three (3) years. This would be decided on a case-by-case basis.

Extraneous flows from inflow and infiltration should also be accounted for. This includes possible sources such as leakage of groundwater into sewers and building sewer connections, leakage through manhole covers, foundation drains, downspouts, etc. In general, the longer the collection system, the higher possibility for inflow and infiltration to the sewage system. Attention must be paid during design and construction of the collection system in order to reduce these extraneous flows to the sewage works significantly. For example, foundation drains and downspouts must be connected to the surface or stormwater system and should not be connected to the sanitary collection system. Leak testing on the collection system should also be performed as part of the commissioning process.

D.3.3 FLOW BALANCING

Flow balancing should be considered for all communal sewage systems. Flow balancing provides useable storage to buffer the downstream treatment system from peak flows, provides a consistent flow rate to the treatment system, and prevents the subsequent treatment processes from hydraulic overloading.

The type of treatment being used will determine the requirement for flow balancing. For example, if a lagoon system is being used for sewage treatment, flow balancing would not specifically be required as lagoons are less susceptible to variations in flow. If a trickling filter is being used, the filter media has a specific loading rate that must be followed to meet performance standards, and thus balancing of flow would be much more important.

The need for flow balancing will also depend on the use or occupancy of the development. The flow characteristics of the development's occupancy must be considered during design. For example, schools would see the majority of sewage flow during the day on weekdays while residential sites would experience peaks during the morning and evening throughout the week.

D.3.4 APPROVALS PROCESS

Approvals for on-site sewage and disposal systems are governed by the local municipality or the MECP, and are generally reliant on the theoretical daily design sewage flows for the site. As stated in Chapter 22 of the MECP's 2008 guidelines, the Ontario Building Code governs small individual or multiple sewage systems that have a daily design sewage flow of less than 10,000

L/day and where both the system and the buildings they serve are completely within a single lot. These systems are reviewed and approved by the local municipality or health unit.

Sewage systems with a design flow of greater than 10,000 L/day require an Environmental Compliance Approval (ECA) from the MECP, and are governed under Section #53 of the Ontario Water Resources Act (R.S.O. 1990). The system is considered an OWRA sewage works under these additional scenarios:

- If a single property contains several small systems (each rated at less than 10,000 L/day) but the combined rated capacity of the systems exceeds 10,000 L/day.
- If the system is not entirely within the property of the building it serves, regardless of the capacity of the system.

The approval for each scenario will have different requirements. **Table D-1** below summarizes the requirements and other details for each approvals process in the province of Ontario.

Table D-1: Approvals Process for Sewage System Designs in Ontario

	DAILY DESIGN SEWAGE FLOW FOR SEWAGE SYSTEM	
	< 10,000 L/DAY	**> 10,000 L/DAY *OR* SURFACE DISCHARGE (ANY FLOW)**
Approval Document	Building Permit issued by the local municipality or health unit	Environmental Compliance Approval (ECA) issued by the Ministry of the Environment, Conservation and Parks (MECP)
Guidelines	Ontario Building Code (2012), Ministry of Municipal Affairs and Housing Other local municipal guidelines such as planning policy and by-laws	Design Guidelines for Sewage Works 2008, MECP Ontario Building Code (2012), Ministry of Municipal Affairs and Housing
Studies Required	Site Investigation Sewage System Design Drawings Building Permit Application Other requirements of the municipality	Pre-consultation with the MECP and/or Municipality as applicable Site Investigation Sewage System Design Report & Drawings Hydrogeological study including effluent Impact Study (subsurface disposal), or Assimilative Capacity Study and Mixing Zone Analysis (surface disposal) Municipal Class Environmental Assessment (MCEA, if required)

	DAILY DESIGN SEWAGE FLOW FOR SEWAGE SYSTEM	
	< 10,000 L/DAY	**> 10,000 L/DAY *OR* SURFACE DISCHARGE (ANY FLOW)**
		Indigenous Engagement (if required) Other requirements outlined in Guideline to Applying for an Environmental Compliance Approval, MECP
Fees	Building Permit Application fee (varies by municipality)	Varies, based on the site-specific information Fees outlined in the Minister's Requirements for Fees – Application Fees for ECA under the Environmental Protection Act
Time to Process (once application has submitted to approving body)	10 days	Up to 1 year

Other studies or approvals that are not listed may be required for sewage system construction. This includes approval from the local Conservation Authority and Ministry of Natural Resources and Forestry, Fisheries and Oceans Canada, and other requirements such as archaeological studies and land development studies (D-5-4 studies, D-5-4 studies). Other studies may be required.

D.3.5 PEER REVIEW

It is recommended that the County/ municipality have a peer review process in place for the engineering review of all communal sewage system designs within the County. Peer review is necessary to provide a thorough engineering review of a design submission as the Municipality will not have the requisite in-house expertise to review the adequacy of the design. This will promote good engineering practices in the design process, and limit the potential for system failure due to incomplete or inadequate design drawings. The MECP does not typically review designs for technical competency as their focus tends to be more aligned with discharge permitting (i.e. maximum permissible parameter concentrations), as such this peer review should be completed at the municipal level.

The technical peer review should take place prior to submission to the MECP for an ECA application, and should be conducted by a qualified engineer. The qualified engineer should be

licensed by Professional Engineers Ontario (PEO) and should have significant and recent expertise in the design and approval of large on-site sewage treatment and disposal systems.

D.3.6 WASTEWATER STRENGTH

The strength or quality of the raw sewage will influence the sewage system design. Consideration should be given to the source of the wastewater including domestic, commercial, process, etc. If the site is developed with multiple uses, the raw sewage quality should be based on the combined quality from the individual occupancy uses, similar to the calculation of sewage design flows.

Information on raw sewage quality can be found in the following documents:

- Table 19-2 – Comparison of Contaminant Concentrations in Septage and Sewage, Design Guidelines for Sewage Works 2008, MECP
- Chapter 3: Establishing Treatment System Performance Requirements, Onsite Wastewater Treatment Systems Manual, U.S. Environmental Protection Agency

Special consideration should be given to processes that could alter the strength of the wastewater coming into the treatment system, such as the following:

- Restaurant waste, which would be higher in organic matter and fats/oils/greases;
- Process wastewater flows; and
- Chemicals or other substances entering the sewage works that could inhibit or change the biological processes that occur in the sewage treatment works.

D.3.7 EVALUATION OF DISPOSAL METHODS

Given the established design parameters and site characteristics for a proposed development, the treatment and disposal method must be determined. As previously noted, there are two (2) main methods of disposal:

- Surface discharge; and
- Subsurface discharge.

The following considerations should be made when determining a treatment and disposal method and include, but are not limited to, the following:

- Available land area;
- Soils;
- Hydrogeology;
- Future capacity and expansion requirements;
- Location of surface water features or discharge points;
- Capital, Operations and Maintenance, and replacement costs;
- Environmental sensitivity;

- Desired system complexity;
- Design flows; and
- Raw sewage quality.

Once a disposal method has been determined, the effluent criteria for the treatment system and the treatment system process prior to disposal can be chosen. The treatment process will differ based on the chosen method of disposal. The design process for each disposal type is described further in the following sections.

D.3.8 EVALUATION OF ALTERNATIVE TREATMENT OPTIONS

Along with disposal system alternatives, there are various treatment system alternatives that should be considered when undergoing the design process for a communal sewage treatment plant. Examples of alternative treatment methods include the following:

- Membrane Bioreactor (MBR);
- Extended Aeration;
- Sequencing Batch Reactor (SBR);
- Lagoon (Facultative and/or Aerated);
- Rotating Biological Contactor (RBC); and
- Trickling Filter.

The evaluation of alternative treatment methods must be conducted on a case-by-case basis, and should be evaluated based on technical, social, natural, and financial criteria by a qualified professional.

The US Environmental Protection Agency (EPA) has produced numerous fact sheets on various treatment technologies, which are continually being updated as technologies change or new ones emerge. The “Wastewater Technology Fact Sheet Package Plants” by the US EPA provides technical information on package plants commonly used in small communities, including a description of the technology, benefits and limitations, design criteria, performance, and costing information. The Fact Sheet is included in **Appendix E**. As technology is continually changing and advancing, the designer of a communal wastewater treatment system should evaluate current information on wastewater treatment technologies from third party sources such as the MECP and the US EPA during the design process.

D.3.9 SURFACE DISCHARGE

Disposal of sewage effluent to surface water requires an MECP ECA, regardless of the design sewage flow of the system. Surface disposal of effluent may become cost-prohibitive for smaller-scale developments due to ongoing operations and maintenance costs associated with the operator and sampling requirements, however may be advantageous for larger developments due to the reduced land requirements.

In general, the design and approvals process for a treatment system with surface disposal requires the following (although the order may vary):

1) Complete background work and determine the preferred receiver.
2) Pre-consultation with the MECP.
3) Complete an Assimilative Capacity Study (ACS) of the receiver and, if required, a Mixing Zone Analysis.[49]
4) Complete a Municipal Class Environmental Assessment (MCEA), if the project fits the criteria.
5) Determine effluent requirements.
6) Complete the detailed engineering designs for the contemplated treatment system and associated structures/systems.
7) Municipal peer review.
8) Apply to the MECP for an ECA.

Effluent requirements are determined in accordance with the following:

- MECP's Design Guidelines for Sewage Works 2008
- Dry-ditch criteria from Procedure B-1-5 Deriving Receiving-Water Based, Point-Source Effluent Requirements for Ontario Waters
- Provincial Water Quality Objectives (1994)

The ACS will assess the receiver's capacity to accept discharge from the proposed treatment plant in accordance with provincial guidelines.

D.3.10 SUBSURFACE DISPOSAL SYSTEMS

Subsurface disposal systems discharge effluent to the subsurface soils beneath the leaching bed. Subsurface disposal systems can be designed for small or larger-scale developments.

SMALL SUBSURFACE DISPOSAL SYSTEMS (< 10,000 L/DAY)

Small subsurface disposal systems have daily design flows of less than 10,000 L/day and are governed under the Ontario Building Code (OBC, 2012). The overall design flow for the site must be less than 10,000 L/day, and the sewage system must be located entirely within the property boundary of lot the building of which it serves is situated on.

[49] A Mixing Zone Analysis is a study to define an acceptable area around a surface water discharge outfall to mix and dilute the sewage to acceptable levels in the receiving water body. This analysis is important as it helps to define what the acceptable sewage concentration will be exiting the sewage treatment plant.

The design and sizing requirements for small subsurface disposal systems is provided in Part 8 of the OBC. Setback guidelines to structures, wells, water bodies, etc. are provided in Section 8.2.1.6.A. of the OBC.

As per Section 8.7.7 of the OBC, Level IV treatment units must meet effluent requirements outlined in Columns 2 and 3 of Table 8.6.2.2., or 10 mg/L for both carbonaceous biochemical oxygen demand ($CBOD_5$) and total suspended solids (TSS). Treatment units must comply with Section 8.6.2.2. of the OBC, and have been certified to CAN/BNQ 3680-600, "Onsite Residential Wastewater Treatment Technologies". It should be noted that this applies to residential uses and may not apply to mixed-use developments that include commercial use. While wastewater from office and light retail uses tends to be similar in sewage strength to residential uses, the sewage produced by restaurant and heavier commercial uses is different in character. Determination of appropriate systems and standards must be undertaken on a case-by-case basis.

Table D-2 presents engineering best practices that should be considered during the design of small systems.

Table D-2: Considerations during Small System Design

ITEM	CONSIDERATIONS AND BEST PRACTICES
Location and Orientation of Tankage and Leaching Bed	Treatment tanks and leaching bed should be located in an area with adequate drainage; not to be located within a depressed area. The distribution pipes should be orientated perpendicular to the direction of effluent flow. The mantle is to be extended in any direction in which the effluent entering the soil or leaching bed moves horizontally.
Bed Design	In order to improve effluent distribution within the leaching bed, tied header and footer pipes are recommended. False headers or distribution boxes on the leaching bed are also recommended.
Tank and Pipe Insulation	Tankage to be insulated to frost depth. All sanitary pipes and forcemains to be insulated under roadways and walkways at a great enough depth to ensure protection from frost and crushing.

ITEM	CONSIDERATIONS AND BEST PRACTICES
Tank Access	Tankage to have adequate access over all inlet/outlet pipes, pumps, effluent filter, and other sewage system components that require maintenance. This would include risers to finished grade and lockable, tamper-proof lids.
Sealing Inlets/Outlets	All tankage outlets and inlets to be sealed with non-shrinking grout from the interior and exterior.
Waterproofing	If groundwater is encountered during the tank excavation, all tank seams shall be waterproofed with an exterior waterproof membrane (e.g. Blueskin).
Tank Bedding	Tanks to be installed on 50 mm of loose sand fill spread evenly over minimum 200 mm of compacted gravel or crushed stone.
Tank Burial	Tanks to be installed at an appropriate depth. Precast concrete tanks typically have a maximum burial depth of 1.0 m in non-traffic areas. Additional reinforcement is required for traffic areas and/or deep burial.
Reserve Capacity	Consideration to be given for future design flows and expansion at a site, specifically to future area requirements for tankage and leaching bed.
Buffering Capacity	Flow balancing provides useable storage to buffer the downstream treatment system from peak flows, provides a consistent flow rate to the treatment system, and prevents the subsequent treatment processes from hydraulic overloading.
Electrical Connections	All electrical connections to be installed by an electrician qualified by the Electrical Safety Authority in accordance with current regulations.
Pump Settings	Pump settings to dose via either demand-dosing or timer-dosing.
Pump Sizing	Pump sizing calculations to be conducted to determine ideal pump model for specific total dynamic head (TDH) and flow rating.
Pump Connections	Pumps should be installed with a quick disconnect so that they can be removed easily for servicing. Drain holes on the outlet pipe should be considered to

ITEM	CONSIDERATIONS AND BEST PRACTICES
	allow the pipe to drain freely and prevent freezing if burial depth is a concern.
Additional Sources of Effluent	The building sump, water softener, water treatment system, furnace condensate discharge, and eavestrough downspouts shall not be connected to the sewage system. All such flows to approved outlets located away from the tank and leaching bed areas.

LARGE SUBSURFACE DISPOSAL SYSTEMS (> 10,000 L/DAY)

Large subsurface disposal systems have a daily design flow of greater than 10,000 L/day and are regulated by the MECP, and are subject to the requirements of Section 53 of the Ontario Water Resources Act (RSO 1990).

Design guidelines for large systems are provided in Chapter 22 of the Design Guidelines for Sewage Works 2008. These guidelines state that "The designer of the large subsurface sewage disposal system is advised to consider, where appropriate and applicable, the design standards for small subsurface disposal systems contained in Part 8, Division B, of the Building Code". This means that, in general, sizing standards should adhere to, at minimum, those given in the OBC. Setback requirements can be generally based on those given in the OBC but are required to be determined on a case-by-case basis.

Table D-3 presents engineering best practices that should be considered during the design of large systems. These should be considered in addition to the best practices for small systems described in **Table D-2**.

Table D-3: Considerations during Large System Design

ITEM	CONSIDERATIONS AND BEST PRACTICES
Pump Stations	Optimal pump type (e.g. grinder, vortex, submersible, sewage, effluent, etc.) to be determined based on wastewater characterization. Pump and forcemain sizing calculations to be conducted to determine ideal pump model for specific Total Dynamic Head (TDH) and flow rating. Adequate venting to be provided, including carbon filters and insect/vermin screens.

ITEM	CONSIDERATIONS AND BEST PRACTICES
	Adequate access to pumps, floats, and other controls to be provided from grade, or adequate access equipment if entry to the pump station is required. Consideration for bar screens, pump screens or similar to catch large objects within the wastewater stream.
Control Room and Operator Work Areas	A central control room and operator work area may be provided to contain controls, chemical storage (if required), manuals, logbooks, etc. Ensure there is adequate indoor space for the operator (if required), including consideration for heating and ventilation.
Chemical Storage	Determine the requirements for chemical addition for the treatment system. Common chemicals used in the wastewater treatment process include metal coagulants, soda ash, chlorine, carbon addition, etc. Consideration should be made for explosion-proofing, secondary containment, heating, and venting of the chemical storage facility. The relative location of the chemical storage facility to the treatment tankage should be considered.
PLCs and SCADA Systems	The PLCs and/or SCADA will require an internet connection to allow for remote monitoring. The systems should be accessible and manageable if the Municipality is required to take over operation of the system.
Sampling Access / Monitoring	Access to monitoring for required points within the treatment system should be provided, including raw sewage, treated effluent, groundwater, etc. Flow data for raw sewage and treated effluent should be accessible and downloadable.
Groundwater Mounding and Monitoring	Mounding calculations should be conducted for subsurface disposal systems to ensure that adequate separation distance is provided as per OBC requirements. Groundwater monitoring ports should be installed within the leaching bed in order to monitor real-time mounding within the bed.
Municipal Requirements	Other requirements of the Municipality should be considered if the system will ultimately be taken over by the municipality. This would include aesthetics of the plant, product and specification grade, and other standards.
Back-up Power Supply and Back-up Equipment	Back-up power should be considered. Generators should be adequately sized to ensure operation of the treatment plant.

ITEM	CONSIDERATIONS AND BEST PRACTICES
	Back up equipment (pumps, blowers, etc.) should be on hand for quick replacement in case of failure.

D.4 INSTALLATION OF COMMUNAL SEWAGE SYSTEMS

D.4.1 SCHEDULE

Installation of the communal sewage system can occur following the receipt of a Building Permit from the municipality or ECA from the MECP.

Construction of on-site sewage systems typically occurs during the spring to fall season as frozen ground conditions are not conducive to successful installation of subsurface disposal systems. Construction during the winter is nevertheless possible if certain precautions are taken. The construction schedule will depend on the scope of work and complexity or size of the project.

D.4.2 INSTALLATION INFORMATION

Construction of the system should be supervised by a Professional Engineer licenced by Professional Engineers Ontario, for any communal sewage system being constructed.

SUBSURFACE DISPOSAL SYSTEM INSTALLATION

A subsurface disposal system is generally comprised of distribution piping within a stone trench, stone layer, or chamber system, installed in native soils or fill material. The distribution piping is often perforated 75 mm (3”) or 100 mm (4”) diameter PVC piping, surrounded by clean stone. Filter cloth is laid on top of the stone layer to prevent fine particles from entering the spaces in between the stone. The distribution piping or laterals are connected to a header pipe and footer pipe.

The most likely causes of concern during installation of a subsurface disposal system are the following:

- Improper base cut preparation, including the base cut being prepared on topsoil or inappropriate fill material;
- Importation of inappropriate fill materials (sand, stone, etc.) for the leaching bed, which can lead to premature failure of the bed;
- Settling of piping within the leaching bed, which can lead to uneven distribution within the bed; and
- Swales around the leaching bed area are not installed, or surface drainage is not directed away from the leaching bed area which can lead to oversaturation of the bed.

With proper construction management and inspections these concerns can be mitigated. The following is a typical scope of work for the installation of a subsurface disposal system:

- Installation of perimeter siltation fencing (downgradient of leaching bed and surrounding bed area, to prevent erosion of sediment);
- Remove and dispose of (off-site) any trees within 6 m of the proposed leaching bed;
- Inspection and testing of the native soils prior to installation of the leaching bed to ensure conformance with the design specification;
- Preparation of an appropriate base cut, including removal of existing topsoil and fill inappropriate fill material and scarification of the base soils;
- Provide and place imported septic sand meeting the design specifications (if required). The imported material should be inspected and tested prior to installation to ensure conformance with the design specification;
- Provide and install the specified stone and pipe areas for the distribution trenches. The imported stone material should be inspected and tested prior to installation to ensure conformance with the design specification. If a chambered system is being used, ensure that the chambers adhere to design specifications;
- Provide and install PVC headers, split headers, leader pipes, tied ends and tracer wire for each distribution cell;
- Provide and install permeable geotextile fabric over the stone layer;
- Supply and install sand fill above the sand layer or trenches;
- Provide and install HDPE polytube forcemains from the final pumping chamber to each header;
- A licensed well contractor should install required monitoring wells (if applicable), complete with well screens and steel lockable casings;
- Provide and place additional topsoil as needed to meet design requirements, re-installing stockpiled topsoil where available and of adequate quality, and fine grading of topsoil;
- Construct swales alongside of the leaching bed area as designed;
- Sod any slopes steeper than 4:1;
- Hydroseed or sod the leaching bed upon completion of the fine grading. The hydroseed should be maintained (watered) until substantial grow in has occurred;
- Removal of silt fencing and repair any areas affected by the construction of the leaching bed back to their pre-construction state.

SEWAGE TREATMENT SYSTEM INSTALLATION

The sewage treatment system is generally comprised of a series of tanks, typically installed in the following sequence: flow equalization tank, treatment tanks, effluent pump tank. The number, orientation, and sequence of tanks will be site-specific. Some considerations that need

to be made during tank installation include, but are not limited to, waterproofing, tank access, insulation, and burial depth.

The most likely causes of concern during installation of a treatment system are the following:

- Settling of tanks which can lead to improper flow between tanks;
- Inadequate installation of waterproofing that can lead to groundwater infiltration into tanks;
- Inadequate installation of insulation over tanks which can lead to pipe freezing and a reduction in treatment capabilities; and
- Swales around the tank area are not installed, or surface drainage is not directed away from the tank area which can lead to infiltration into the tanks.

The following is a typical scope of work for the installation of a (buried) sewage treatment system:

- Excavation of appropriate areas for placement of the tanks;
- Preparation of the base of the excavation, including the placement of bedding, for level tank installation;
- Supply and installation of all sewage treatment and conveyance tanks;
- Supply and install all plumbing connection between tanks;
- Supply and install of insulation on forcemains where less than 1.5 m of cover and on gravity piping where less than 1.2 m cover;
- Supply and install all access covers, vents, risers, etc. where required;
- If high groundwater conditions exist at the site, tanks with dynamic water levels should be anchored. Anchoring should be designed by a Professional Engineer. Tank seams affected by high groundwater elevations should be waterproofed with an exterior membrane;
- Supply and install insulation to 1.2 m below ground level (or frost depth) on top and sides of treatment tanks;
- Supply and install all inner workings of the sewage treatment system;
- Supply and install all electrical connections within and from the tanks to the control area and from the control area to the available on-site power supply (typically subcontracted by an electrician);
- Supply and install the required control panels;
- Backfill and properly grade the treatment tank area. Apron swale should be constructed around tankage to shed water from the proposed tank area;
- Test and support the commissioning of the system;

- Train the owner as per the use and general maintenance of the system.

Figure D-1: Installation of a communal wastewater treatment system

D.4.3 INSTALLATION INSPECTIONS

It is recommended that a Professional Engineer complete periodic inspection of the sewage works during installation to assess whether the installation completed by the contractor adheres to the approved design.

A typical inspection schedule for the installation of a sewage system with subsurface disposal is noted below. The requirements for inspections would be scaled depending on the size and complexity of the project:

1) PRE-CONSTRUCTION SITE MEETING

a) Discuss installation, site access, installation schedule and other pertinent information.

b) Samples of the septic stone and the sand fill should be provided to the Engineer for analysis prior to installation in order to help ensure material is appropriate and meets the design requirements prior to installation.

2) BASE GRADE INSPECTION

a) The length and width of the leaching bed excavation is as per specification.

b) Base soils are as per design.

c) Based on the excavation is scarified and free of topsoil.

d) Elevation of the excavation is accurate, or is within standards of good engineering practice. Elevations have been confirmed via survey equipment.

3) SAND FILL, STONE AND PIPE, AND TANK INSPECTION

a) The sand fill and stone material is consistent with preliminary testing results based on a visual inspection and review of pit receipt obtained from installer/supplier (if available).

b) The thickness of the sand fill is appropriate.

c) The number of distribution pipe runs installed is as designed.

d) The length of the distribution pipe is as designed.

e) The spacing of the pipes, centre to centre, is appropriate.

f) The elevation and elevation change across the distribution runs is appropriate.

g) The thickness of the stone trenches is appropriate.

h) The trenches are covered with permeable geotextile fabric.

i) Tracer wire (or other means of detection) is located around the stone area.

j) The sewage tanks are appropriately sized and CSA approved.

k) The sewage tanks are installed in the proposed location as per the design.

l) The inner workings of the treatment system are installed as per the design, including treatment media, chemical dosing, recirculation pumps, piping, etc.

m) The gravity connections have sufficient fall.

4) PUMPS, ALARMS AND FINAL GRADING INSPECTION

a) The pump(s) are installed properly and are functional.

b) The pump discharge rate meets the design dosage volume based on float settings.

c) The high-level alarm (visible/audible) is present and functional.

d) The trenches have been backfilled with appropriate material in accordance with the design.

e) The thickness of the cover on the leaching bed is appropriate.

f) The topsoil on the leaching bed is good quality and is the appropriate thickness.

g) Confirmation that there is high quality sand fill between the stone layer and topsoil as specified.

h) The leaching bed has been sodded/seeded to prevent erosion.

i) The final grading on the leaching beds has been completed as designed and in a manner that will shed water from the surface of the leaching bed.

j) Grading around the sewage tanks is appropriate and sheds water away from tank lids.

k) Swales around the leaching bed and tanks have been installed in accordance with the design.

Once the sewage system has been inspected and properly installed a Certification Letter should be prepared and signed by the Professional Engineer; typically, a requirement of the MECP. A start-up notification should also be prepared once the system has been commissioned in order to notify approving authorities that the system is in use.

D.5 COMMISSIONING INFORMATION

D.5.1 COMMISSIONING OF THE SYSTEM

Once the sewage system has been installed, including the completion of all plumbing and electrical connections, the system can be commissioned and started up. The treatment system manufacturer/supplier will typically have a technician on site to commission the treatment system. The contractor must also be present on site for commissioning. There should be clean water in the system in order for commissioning to take place.

D.5.2 OPERATIONS AND MAINTENANCE MANUAL

An Operations and Maintenance (O&M) manual must be produced for the sewage system that includes a general overview of the sewage system components, operational and maintenance procedures, contingency procedures, and outline the inspection program for the sewage system. The O&M manual should be kept on site at all times for reference.

Important information that should be contained in the O&M manual includes, but is not limited to, the following:

- System overview
- Approval document (e.g. ECA)
- Construction certification letter
- As-built drawings
- Operation procedures and system maintenance
- Inspection program
- Contingency procedures
- Complaint procedures
- Operation log reports

- Maintenance contracts (if available)

The treatment unit supplier should also provide maintenance information specific to the specific system.

D.6 MONITORING, OPERATION, AND MAINTENANCE OF THE COMMUNAL SEWAGE SYSTEM

Ongoing monitoring and maintenance of the sewage system is critical to ensure proper operation of the system, to extend the lifespan of the system, and to minimize impacts to the surrounding environment.

Table D-4 presents engineering best practices that should be considered for monitoring of communal sewage systems. These should be considered in addition to monitoring that is required as part of the ECA.

Table D-4: Considerations for Environmental Monitoring

ITEM	CONSIDERATIONS AND BEST PRACTICES
Monitoring Locations	ECAs will typically define the minimum monitoring required for sewage systems. In order to properly assess treatment performance of a system, it is often recommended to monitor at multiple points within a treatment system and for a range of parameters. At minimum, the raw sewage entering the treatment system and treated effluent prior to disposal should be monitored. Additional sampling points within the treatment system can be added depending on the complexity of the treatment process.
Monitoring Parameters	Similar to monitoring locations, ECAs will typically outline the minimum required monitoring parameters. It is recommended to more fully characterize the sewage so that system optimization and troubleshooting is possible. For raw sewage, the minimum recommended parameters are: 5-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), total Kjeldahl nitrogen (TKN), total ammonia nitrogen (TAN), nitrate, nitrite, total phosphorus (TP), alkalinity, pH. For treated effluent, the minimum parameters are: 5-day carbonaceous biochemical oxygen demand, TSS, TP TKN, TAN, nitrite, nitrite, alkalinity, pH.

ITEM	CONSIDERATIONS AND BEST PRACTICES
	Field pH, conductivity, and temperature should also be measured for all samples. Microbiology should be considered for certain sites.
Groundwater Monitoring	For applications with subsurface disposal, groundwater monitoring may be recommended to monitor off-site impacts as a result of the sewage system. Parameters of concern are typically the following: nitrite, nitrate, total phosphorus (TP), chloride (Cl).
Groundwater Mounding Monitoring	Groundwater mounding within the leaching bed can be measured through the installation of groundwater monitoring wells within the leaching bed area. The monitoring wells should be positioned to capture the highest groundwater mound conditions in the bed.
Surface Water Monitoring	For applications with surface water disposal, or subsurface disposal that is expected to impact surface waters, surface water monitoring may be recommended. Parameters of concern are typically the following: 5-day carbonaceous biochemical oxygen demand (BOD_5), total suspended solids (TSS), total ammonia nitrogen (TAN), total phosphorus (TP), microbiology, pH, temperature.
Sample Collection and Analysis	Samples should be collected in general accordance with the methods and protocols outlined in the MECP's Procedure F-10-1 "Procedure for Sampling and Analysis Requirements for Municipal and Private Sewage Treatment Works (Liquid Waste Streams Only)". Samples should be collected in pre-cleaned, laboratory supplied sample containers. After collection, samples should be placed within a clean cooler containing ice to ensure cold transport to the laboratory.
Flow Monitoring	Sewage flows to the sewage system should be monitored and recorded on a daily basis.

D.6.1 MAINTENANCE CONSIDERATIONS

Ongoing maintenance activities will differ based on the type of treatment and disposal method in the sewage system.

Maintenance and operation documents for select systems approved for use in Ontario have been included in **Appendix E**. It should be noted that these documents apply to residential units

and have been included to provide insight into maintenance activities that can be expected for sewage treatment systems. The maintenance programs for communal systems would typically be more comprehensive.

Table D-5 summarizes maintenance considerations for typical treatment and disposal systems (surface and subsurface).

Table D-5: Typical Maintenance Items for Sewage Treatment and Disposal Systems

COMPONENT	SUBCOMPONENT	MAINTENANCE ITEM	FREQUENCY
Treatment System	Sludge Storage Tanks	Pump sludge storage or septic tanks	Once every 3 to 5 years, or when the solids exceed 1/3rd of the tank volume
		Clean inlet tee and outlet baffle of debris	Monthly
		Clean effluent filter	Annually or more frequent (as needed)
	Flow Equalization, Effluent Pump Systems	Pump replacement	As needed, typically every 2 to 5 years
		Floats, wiring replacement	As needed
	Treatment Media	Replace treatment system media (e.g. foam, peat moss, etc.)	As needed, typically every 15 to 30 years
	Blowers, Sludge Return Pumps	Blower/sludge return pump replacement	As needed, typically every 2 to 5 years
	Chemical Dosing System	Fill chemical dosing tanks	As needed, typically every 3 to 6 months
		Chemical pump replacement	Every 2 to 5 years
	Control Panel	Check for alarms or errors	Daily

COMPONENT	SUBCOMPONENT	MAINTENANCE ITEM	FREQUENCY
Subsurface Disposal System	Leaching Bed	Maintain short, manicured grass	Weekly
		Walk leaching bed area and check for break-outs, soft spots, erosion, etc.	Weekly
		Ensure swales are intact and drainage is directed away from leaching bed	Monthly
Surface Disposal	Outlet Structure	Clean outlet pipe and/or structure free of debris and blockages	Annually

D.7 FAILURE RATES, REHABILITATION COSTS, AND INSURANCE RATES IN ONTARIO COMMUNITIES

The County had requested information regarding failure rates and rehabilitation costs for decentralized systems in other municipalities, similar to what is expected to be installed in the County of Frontenac. WSP was unable to obtain this information, as it is anticipated that the communal systems proposed in the County will be significantly smaller than many existing communal wastewater treatment plants, and that failure rates, capital costs, insurance rates, etc. would not be directly comparable. The anticipated smaller design flow rates for future communal services in the County will lead itself to less complex mechanical systems, and decreased instances of significant failure.

Therefore, WSP has based the failure rates and rehabilitation costs on our experience with hundreds of other similar-sized on-site sewage systems that have been completed for residential, commercial, and institutional developments. Flows for these systems can range from 8,000 L/day (approximately 5 homes) to 100,000 L/day (approximately 100 homes). It is expected that these systems would be more representative of what would be installed in the County of Frontenac in terms of size and sewage design flow. The mechanical workings of these systems, failure rates, and rehabilitation costs are well understood by WSP and have been used to support the creation of the financial model.

D.8 FURTHER REFERENCES

The following documents (or their successor documents) can be referenced when considering communal sewage servicing within Ontario:

- Design Guidelines for Sewage Works (2008), Ministry of the Environment, Conservation and Parks;
- Ontario Building Code (2012), Ministry of Municipal Affairs and Housing

- Onsite Wastewater Treatment Systems Manual (2012), U.S. Environmental Protection Agency;
- Provincial Water Quality Objectives (1994), Ministry of the Environment, Conservation and Parks;
- Manual of Policy, Procedures and Guidelines for Onsite Sewage Systems, Ministry of the Environment, Conservation and Parks (1982); and
- Procedure B-1-5 Deriving Receiving-Water Based, Point-Source Effluent Requirements for Ontario Waters.

APPENDIX

E

ENGINEERING BEST PRACTICES - ATTACHMENTS

Ecoflo Biofilter

Residential Owner's Manual – CAN/USA

*Congratulations on your purchase of an **Ecoflo® Biofilter** system from **Premier Tech Aqua (PTA)**. With the **Ecoflo® Biofilter** system, you have wisely chosen to protect your health as well as the environment. This manual contains information on the operation, operating guidelines, maintenance and warranties of the **Ecoflo® Biofilter**. For additional information, contact our customer service at **1 800 632-6356** or visit our website at **PREMIERTECHAQUA.COM.***

Operating Principle

Onsite wastewater treatment systems must respect applicable local rules and regulations. These systems are specifically designed to treat residential wastewater to such a level that treated effluent can be safely returned to the environment. Typically, an onsite wastewater treatment system is composed of 2 to 3 main treatment steps depending on site constraints: primary treatment, treatment system and if required, polishing treatment.

① Primary treatment

The primary/septic tank is the primary treatment. It clarifies wastewater by letting suspended solids settle to the bottom and retaining floating matter to prevent premature clogging of the treatment system. It is strongly recommended that the primary/septic tank be equipped with an effluent filter. Every primary/septic tank and effluent filter shall be installed according to the local regulations.

For more information on the operation, operating guidelines, maintenance and warranties of PTA's primary/septic tanks with effluent filter, please refer to the primary/septic tanks Owner's Manuals which can be found at PREMIERTECHAQUA.COM.

② Treatment system

Once wastewater has passed through the primary/septic tank, it then flows towards the Ecoflo® Biofilter. Inside the biofilter, a tipping bucket equally disperses the wastewater on specially designed plates which evenly distribute the wastewater on top of the filtering media. The wastewater then trickles through the natural filtering media. The treated effluent can then be discharged to the environment through an appropriate dispersal/disposal mean in accordance to local regulations.

The Ecoflo® Biofilter's operating principle allows the system to be used continuously or intermittently without requiring any special precaution or having any impact on the quality of the treatment. In most cases, no specific action from the owner is required to start the system.

The model and the number of Ecoflo® Biofilter are determined by the domestic wastewater flow per day. The selection of the model also depends on the available surface area, the topography of the lot, as well as the type, permeability and depth of the natural soil on site.

③ Polishing treatment

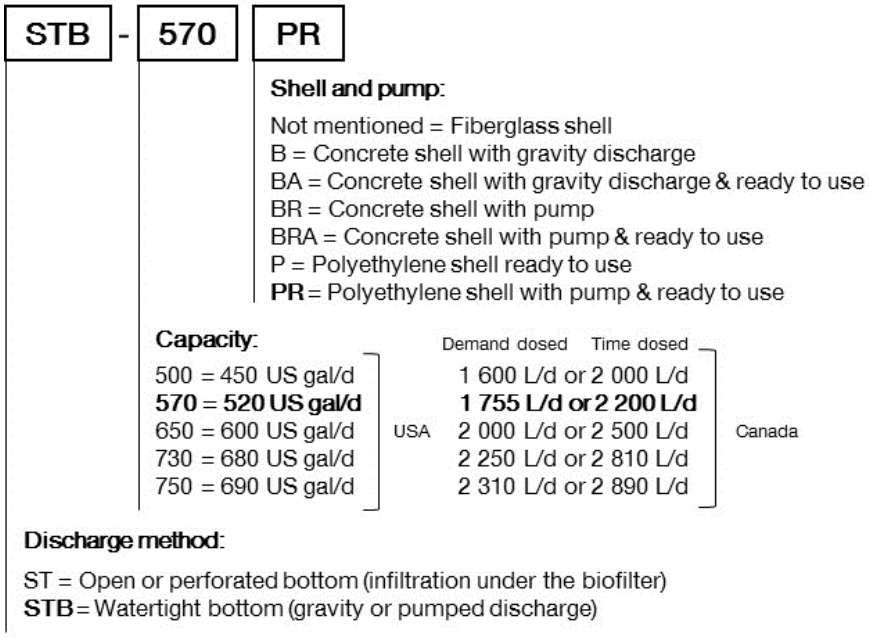
When required, the Ecoflo® Biofilter can be combined with PTA's disinfection filter (FDi), a UV disinfection unit (DiUV) or a phosphorus removal unit (DpEC) to reduce respectively pathogen concentrations or phosphorus.

For more information on the operation, operating guidelines, maintenance, and warranties of PTA's FDi, DiUV or DpEC, please refer to the products' Owner's Manuals, which can be found at PREMIERTECHAQUA.COM.

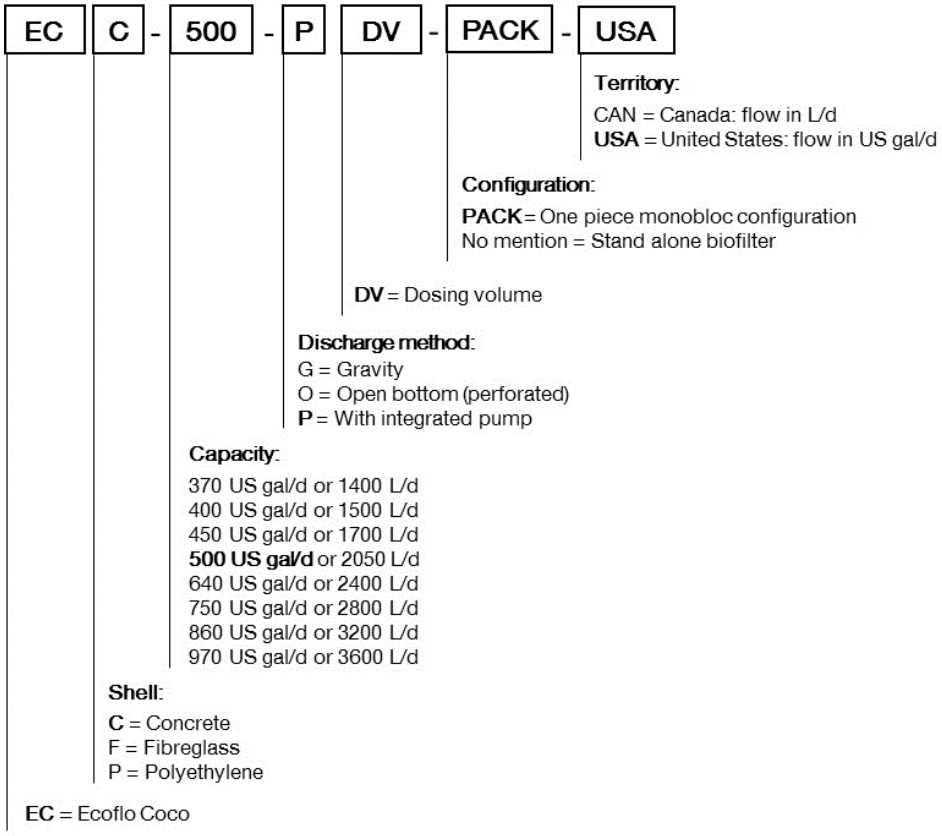
Ecoflo® Biofilter Models

The Ecoflo® Biofilter can be found in different model series, which are ST, STB, EC, EC5 and EC7 and each has different characteristics. The model number of the Ecoflo® Biofilter relates to its characteristics, as presented in the following table. **NOTE:** Some model series may not be approved in your area.

ST and STB model series:



EC5 model series (maximum applicable HLR 500 L/m²d or 12.25 gal/ft²d)



EC7 model series (maximum applicable HLR 700 L/m²d or 17.2 gal/ft²d)

EC7 - 600 - P - P - DV - PACK - USA

Territory:
CAN = Canada: flow in L/d
USA = United States: flow in US gal/d

Configuration:
PACK = One piece monobloc configuration
No mention = Stand alone biofilter

DV = Dosing volume

Discharge method:
G = Gravity
O = Open bottom (perforated)
P = With integrated pump

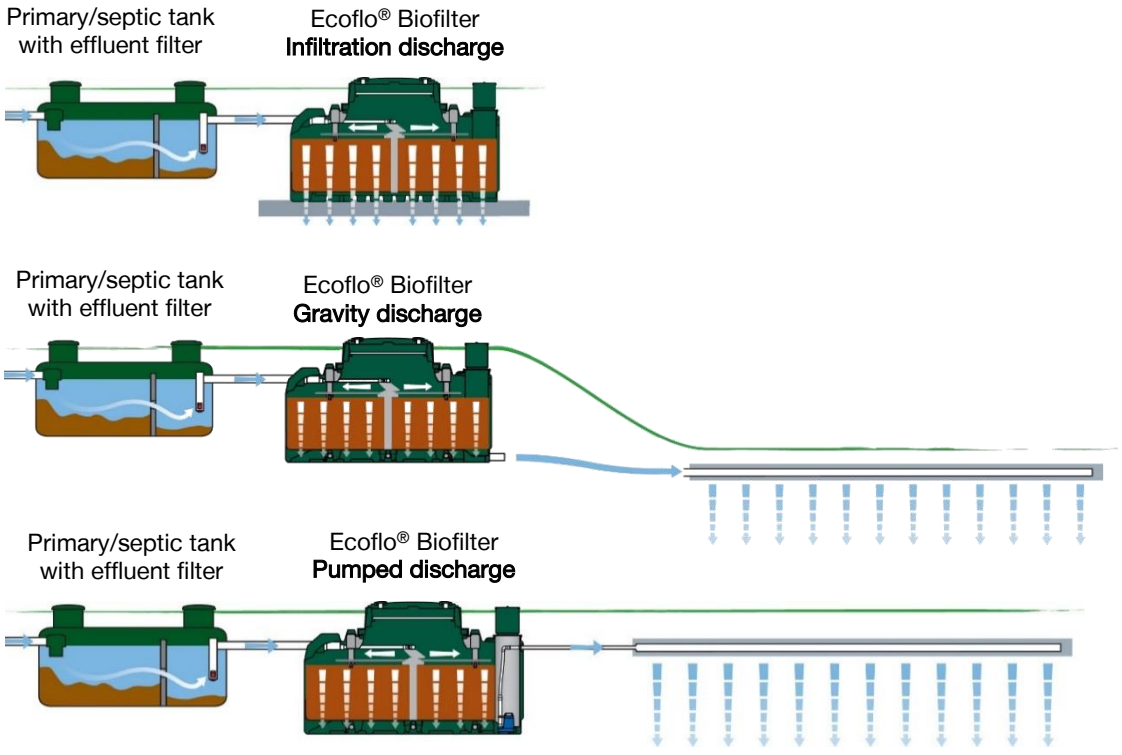
Shell:
C = Concrete
F = Fibreglass
P = Polyethylene

Capacity:
500 US gal/d or 1900 L/d
600 US gal/d or 2200 L/d
750 US gal/d or 2800 L/d
800 US gal/d or 3000 L/d
900 US gal/d or 3400 L/d
1050 US gal/d or 4000 L/d
1200 US gal/d or 4500 L/d
1350 US gal/d or 5000 L/d

EC = Ecoflo Coco

Installation Diagrams

NOTE: The installation diagrams below show the Ecoflo® Biofilter with polyethylene shells.



Operating Guidelines

Type of wastewater that can be treated by an Ecoflo® Biofilter:

Domestic wastewater (for example: wastewater from isolated dwellings).

It is NOT RECOMMENDED to discharge any of the following substances into the septic system:

- Oil and grease (motor oil, cooking oil, etc.);
- Wax and resins;
- Paints and solvents;
- Any kind of petroleum product;
- Any kind of pesticide;
- Any kind of septic tank additive;
- Any kind of toxic substance;
- Anything not easily biodegradable (for example, coffee beans, cigarette butts, sanitary napkins, tampons, condoms, cotton swab, etc.).

AND

- **NEVER open or go inside the primary/septic tank or the Ecoflo® Biofilter.**
- **Keep all lids of the septic system accessible at all times. NEVER cover them with mulch, dirt or any permanent structure (patio, swing, shed, etc.).**
- **NEVER connect a drain pipe, roof gutter, sump pump or air conditioner drain to the septic system.**
- **NEVER discharge content or water from a water softener backwash, a spa or pool in your septic system.**
- **NEVER discharge wastewater from a recreation vehicle (camping trailer, caravan, etc.) into any of the components of your septic system.**
- **NEVER use automatic toilet bowl cleaners**
- **Make sure all lids of the septic system are at least 50 mm (2") above the surface of the landscaped lot.**
- **NEVER install a riser on an open bottom fibreglass Ecoflo® Biofilter.**
- **NEVER install a riser on polyethylene Ecoflo® Biofilter with a separate pumping vault access.**
- **NEVER install more than one (1) extra 150 mm (6") riser on polyethylene Ecoflo® Biofilter with only a main access.**
- **NEVER install more than ONE (1) RISER on a concrete Ecoflo® Biofilter.**
- **Use only PTA products.**
- **NEVER plant trees within 6 m (20') of the Ecoflo® Biofilter lid and within 2 m (6' 6") of the absorption bed.**
- **ALWAYS maintain the surface of the lid of the Ecoflo® Biofilter free of any accumulated material or too close to blown snow, backfill, landscaping material, rocks, the bottom of a slope, an embankment or a retaining wall, etc. Minimum distances to respect are 5 m (16' 5") for a fiberglass shell Ecoflo® unit, 4 m (13' 1") for a polyethylene unit and 3 m (9' 10") for a concrete unit.**

By respecting these guidelines, you contribute to the proper operation of your septic system and help prolong the life of your Ecoflo® Biofilter filtering media. Failure to abide by these guidelines may, at Premier Tech Aqua's discretion, render the warranty invalid.

Owner's responsibility

The owner must respect all existing laws and regulations regarding the system's effluent quality and its discharge into the environment. The owner of the wastewater treatment system is responsible for its installation, operation and maintenance.

The system's warranty begins upon purchase. Should the start-up be delayed, it is the customer's responsibility to inform Premier Tech Aqua about it so the first maintenance, which is included in the purchase price, is postponed. If the first maintenance has been performed prior to the client's call, Premier Tech Aqua reserves the right to decide whether another maintenance, free of charge or not, will be carried out the following year. No request for delayed start-up will be accepted any later than one (1) year after the purchase date without it affecting the product's warranties.

Keep heavy objects off your septic system

Never drive a vehicle or place objects weighing more than 225 kg (500 lb) too close of the lid of your Ecoflo® Biofilter. **Minimum distances to respect are 5 m (16' 5") for a fiberglass shell Ecoflo® unit, 4 m (13' 1") for a polyethylene unit and 3 m (9' 10") for a concrete unit.** If you are planning any kind of landscaping or any other type of work on the property (i.e.: snow removal, lawn mowing, excavation, etc.), **make sure you advise all those involved,** so they do not damage your septic system. It is recommended to note where your septic system elements are located.

About your home

Your home must be equipped with an air vent that is in proper working order and all plumbing must comply with the applicable standards of the building code in your location. Every septic tank must be ventilated by an air duct with a diameter of at least 100 mm (4") or be connected to the air vent of the isolated dwelling being served. Premier Tech Aqua strongly recommends using a pipe with a diameter of 100 mm (4") for the air vent.

Any change in the use of your home or any modification to your Ecoflo® Biofilter must be authorized by the local authorities, and Premier Tech Aqua must be advised. If this requirement is not fully met, the warranty for your Ecoflo® Biofilter will be null and void.

Maintenance

Primary/septic tank

Empty your primary/septic tank every two to four years or if the level of sludge measured exceed the 2/3 of the total height of water in the tank. This helps to keep your septic system in proper working order. Every primary/septic tank and effluent filter shall be inspected and maintained as prescribed by local regulations.

If your home is equipped with a garbage disposal or a sewage pump, we strongly recommend emptying your primary/septic tank more frequently than the frequency noted above. Using this kind of equipment increases the amount of sludge in the primary/septic tank.

To have complete records of the maintenance performed on your septic system, we recommend that you to keep the proof of maintenance (invoice) with this Owner's Manual.

IMPORTANT: Primary/septic tanks can be emptied in several ways that can be classified into two categories: **complete emptying and selective emptying.** Complete emptying, the most common, consists of completely pumping the contents of the primary/septic tank. It's easy to check if the work was properly done because the primary/septic tank will be completely empty when the vacuum truck leaves the site. Selective emptying is divided into two sub-categories: with a filter (or recycled) or without a filter. The method with a filter requires a truck that has been adapted for this type of emptying, that is, one that separates and retains the solids from the wastewater. The mechanically clarified water is then returned to the primary/septic tank. The selective method without a filter allows the solids to settle while in the truck before the water is returned to the primary/septic tank. As such, in an effort to ensure the Ecoflo® Biofilter continues to perform optimally, **it is very important that you ensure than the water that is returned to the primary/septic tank has been properly clarified and does not contain or contains very few suspended solids**. We also recommend you to call one of the members of PTA's local partners. He will assist and verify if the work is done according to your specific needs to best protect your Ecoflo® Biofilter system.

Effluent filter

Under normal operating conditions, as described in this manual, an effluent filter that complies with local regulations should operate efficiently for many years. It must be cleaned every time the primary/septic tank is emptied, as established or recommended by local authorities.

Ecoflo® Biofilter

The owner of a biofiltration system **shall follow the manufacturer's recommendations regarding the maintenance of the system.** For that purpose, he must at all times have a valid contract with the manufacturer or its local representative and, depending on the local regulations, **a copy of the contract may have to be filed to the authorities**.

Annual maintenance is important to ensure optimal performance of your **Ecoflo® Biofilter** and essential to maintain its warranty. Therefore, your biofilter must be serviced annually for the duration of its useful life. According to local regulations, more than 1 visit per year may be required.

The maintenance of your Ecoflo® Biofilter shall be carried out by one of our duly trained service providers. This service includes a visual inspection of all components and a verification of the operation, as well as maintenance of the filtering media. **For maintenance purposes and to replace the filtering media, you must ensure that your system's lid is easily accessible.** Never cover or bury the lid of the Ecoflo® Biofilter. After each inspection, you will be given a maintenance record. Keep it with this manual in a safe place.

At the end of its normal life span (ten (10) years for EC, EC5 and EC7 model series and eight (8) years for ST and STB model series), the filtering media is analyzed by one of our authorized agents. Under normal usage, if the filtering media has not been abused and the operating guidelines have been respected, the filtering media might not have to be replaced and can be used for some additional years. **However, your Ecoflo® Biofilter's filtering media must be replaced before the system's treatment capacity and performance begins to deteriorate.** The filtering media is easily pumped out using a truck adapted to emptying primary/septic tanks. The new filtering media is then installed by an authorized agent or the pumper.

To know more about the maintenance of your Ecoflo® Biofilter, refer to your Maintenance Agreement. If you need help or more information, please call our Customer Service Department at **1 800 632-6356** or visit our website at **PREMIERTECHAQUA.COM**.

Ecoflo® Biofilter with Pump

Some Ecoflo Biofilters have an integrated pumping station (other situations may require a separate pumping station), that directs the treated effluent to an appropriate disposal mean according to local regulations. The electro-mechanical components are included in this system. Here are some of the details.

Visual and audio alarm system

The pumping station is equipped with a high-water-level float connected to an alarm system. This alarm system must be installed inside the residence (home) so it can be heard when it is activated. The following information describes how this system works.

Alarm box

A red indicator lights up and an audible alarm is heard when the water level in the Ecoflo® Biofilter is unusually high. If an alarm is activated, contact Premier Tech Aqua's After-Sales Service Department because the incident has to be checked. To silence the alarm, press the "**SILENCE**" button.

The **"TEST"** button lets you check if the alarm system is working properly. During a test, the red indicator should light up and an audio alarm should be heard.

In the event of a power failure, the alarm system continues to function on an emergency 9-volt alkaline battery (not supplied). Using a rechargeable battery is not recommended.

NOTE: Replace the emergency battery every 12 months, each time the alarm is activated or whenever there is a power failure. If the battery is weak, the system will beep once every minute. When this occurs, replace the battery immediately.

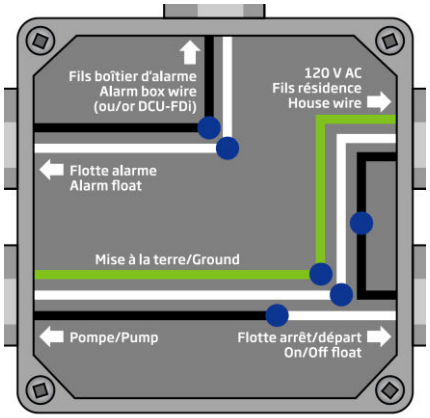
To replace the 9-volt battery:

- Disconnect the alarm box and remove it from the wall (the battery must be inserted on the side of the box).
- Open the cover of the 9-volt battery compartment and replace the battery with a 9-volt alkaline battery.
- Close the cover, reinstall the box on the wall and reconnect it.
- If the alarm is activated, press the "**RESET/TEST**" button to initialize it.

Electrical connections

All electrical connections must be done by a **certified electrician** and using seal connectors is mandatory. Premier Tech Aqua recommends installing the power box on top of the pumping station's insulating board to avoid humidity problems.

Use two (2) separate circuit-breakers, one to operate the pump and the other to connect the alarm box. Do not connect anything else to these circuit-breakers (for example, a household appliance). They must be used exclusively for the pump and the alarm box.



What to do in case of...

An activated alarm

If an alarm is activated, unrelated to a power failure, contact Premier Tech Aqua's After-Sales Service Department so the problem can be identified and corrected.

A prolonged power failure

If a power failure that occurs during winter is prolonged, protect the components of your septic system against freezing. If you have any questions to restart your system, contact Premier Tech Aqua's After-Sales Service Department.

Flooding

Certain sites are prone to flooding or to rises in groundwater levels. This can lead to a malfunction in your septic system or alter the performance of your Ecoflo® Biofilter. If this happens, contact Premier Tech Aqua's After-Sales Service Department.

Backflow

Backflow rarely occurs. But if it does happen, the primary/septic tank is usually the cause. Your primary/septic tank installer or primary/septic tank pumper can generally take care of the situation.

Odours

All septic systems are apt to generate gases and odours. The position of the air vent, as well as other factors unrelated to the Ecoflo® Biofilter itself, can prevent septic gases from dispersing properly and lead to odours. If this happens, contact Premier Tech Aqua's After-Sales Service Department.

If you have any questions or comments, do not hesitate to contact Premier Tech Aqua at 1 800 632-6356.

PREMIER TECH AQUA

1 800 632-6356
418 862-6642
pta@premiertech.com
PREMIERTECHAQUA.COM

Certificate of Warranty for Ecoflo® Biofilter

1. PREAMBLE

Premier Tech Technologies Ltd. (hereinafter called "Premier Tech") is proud to provide its customers with an exclusive wastewater treatment system guaranteed by an innovative Warranty.

For the application and interpretation of this Warranty, "Customer" shall mean the person who has purchased an Ecoflo® Biofilter (hereinafter called "Initial Purchaser"), for a residential installation, as well as any subsequent purchaser (hereinafter called "Subsequent Purchaser(s)"), in accordance with the provisions of section 8 of this Warranty. "Successor(s)" shall mean any other person entitled to exercise the same rights as the Customer under the law.

2. NATURE OF THE WARRANTY

2.1. Ecoflo® Biofilter

Premier Tech warrants to the Customer that the filtering media of the Ecoflo® Biofilter shall function properly for a period of ten (10) years for EC, EC5, EC7, ST and STB model series (except ST and STB models with 100% peat filtering media that shall function properly for eight (8) years) from the date of purchase by the Initial Purchaser (proof of purchase required).

Except as provided in sections 2.2 and 2.3 below, Premier Tech also warrants all parts of the Ecoflo® Biofilter components against any manufacturing defect for a period of ten (10) years from the date of purchase by the Initial Purchaser (proof of purchase required). The first two years of the warranty also cover the labour.

2.2. Concrete

Premier Tech does not offer any additional Warranty on the shell of the concrete Ecoflo® Biofilter. Accordingly, the Customer shall rely on the local concrete manufacturer's Warranty policy.

2.3. Pump, floats, alarm box and junction box

The pump, floats, alarm box and junction box included with the Ecoflo® Biofilter are guaranteed for two (2) years (parts only), from the date of purchase by the Initial Purchaser (proof of purchase required). The first year of the warranty also covers the labour.

Premier Tech's conventional Warranty is expressly limited to the text of this Certificate and valid provided the Ecoflo® Biofilter was installed in accordance with applicable regulations and with the manufacturer's recommendations.

3. NOTICE

For this Warranty to be valid, the Customer must notify Premier Tech in writing immediately upon the appearance of any indication of an anomaly or irregularity in the Ecoflo® Biofilter.

Such notice shall be mailed to Premier Tech's Head Office at 1, avenue Premier, Rivière-du-Loup, Québec, G5R 6C1, CANADA or by facsimile at (418) 862-6642.

Upon receipt of this notice, Premier Tech shall examine the situation and, if necessary, take appropriate corrective measures in accordance with the terms of this Warranty.

4. GENERAL EXCLUSIONS

The following damages or problems are excluded from the Warranty:

(a) Any damage or problem caused by a fortuitous event or "force majeure", such as, without limiting the generality of the foregoing, an earthquake, a flood, frost, hurricane, landslide, explosion or dynamiting;
(b) Any damage or problem caused by the fault or act of a third party including, without limiting the generality of the foregoing, the execution of landscaping work;
(c) Any damage or problem arising from a defective installation carried out by a person trained by Premier Tech, or any installation, modification, correction or addition carried out by a person not trained by Premier Tech;
(d) Any damage or problem arising from any installation, modification, correction or addition to the treatment system carried out after installation of the Ecoflo® Biofilter without prior written approval from Premier Tech;
(e) Any damage or problem caused by the use of a septic tank that does not comply with the applicable regulations and/or with Premier Tech's specifications, as described in the Owner's Manual;
(f) Any damage or problem, if it is shown that the usage of the Ecoflo® Biofilter was not in accordance with the instructions and guidelines described in the Owner's Manual;
(g) Any damage or problem, if the maintenance of the Ecoflo® Biofilter was not carried out by a person authorized by Premier Tech, in accordance with the Maintenance Agreement;
(h) Any damage or problem caused by an omission or act of the Customer or the Customer's Successors including, without limiting the generality of the foregoing, refusal to allow access to the system for maintenance;
(i) Any damage or problem, if it is found that the Customer or the Customer's Successors have modified or changed the use of the property serviced by the Ecoflo® Biofilter resulting in the alteration of the nature or quality of wastewater being treated and/or that constitutes a violation of the applicable regulations;
(j) Any damage or problem caused by and/or resulting from the work carried out to access to the Ecoflo® Biofilter, including, without limiting the generality of the foregoing, excavation, snow removal or demolition;
(k) Any damage or problem resulting from the condition of the site or of the soil and not reported or not properly reported to Premier Tech by the Customer or the person undertaking the site investigation.

5. PARTICULAR EXCLUSIONS

It is further expressly understood that the Customer may not carry out or cause to be carried out any repair or verification of the Ecoflo® Biofilter sold to him, or attempt to carry out any work or to apply any corrective measures whatsoever to said work, before notifying Premier Tech in accordance with the provisions of section 3 of this Warranty and before Premier Tech has visited the site, within a reasonable time following receipt of said notice, to assess the situation.

If the Customer carries out or causes to be carried out repairs, or attempts to repair or to apply corrective measures of any kind whatsoever to the Ecoflo® Biofilter sold to him without prior authorization by Premier Tech, this Warranty shall be considered null and void and Premier Tech shall be considered completely discharged from any and all of its obligations under this Warranty.

Certificate of Warranty for Ecoflo® Biofilter

6. INDEMNITIES AND DAMAGES

Subject to the application of the provisions and exclusions provided for in this Warranty, Premier Tech's liability and obligations regarding any corrective measure carried out or any attempt to correct an indicated problem shall be limited to replacing the filtering media and/or one or several components of the Ecoflo® Biofilter and to supplying the required labour, if applicable.

7. LIMITATION OF LIABILITY

Premier Tech's compensation or indemnification obligation shall be limited to the provisions of section 6 of this Certificate of Warranty and Premier Tech shall not be held liable for any other damage or loss that may have been suffered or incurred by the Customer or any third party in connection with the Ecoflo® Biofilter, its parts and/or components which originate thereof.

No additional warranty, express or implied, hence excluding any direct or indirect consequential damages (not limited to but including third parties loss) concerning the design, sale or use of the Ecoflo® Biofilter and/or services provided by Premier Tech is hereby granted. Premier Tech's liability under its warranty obligation shall in no case exceed the cost of the Ecoflo® Biofilter.

8. TRANSFER OF OWNERSHIP

In the event of transfer of ownership, sale, assignment or disposal in any way whatsoever of the Customer's property to a third party, this Warranty shall continue to apply if and only if the Subsequent Purchaser or the Successor confirms, by forwarding the attached "Notice of New Property Owner" to Premier Tech within a reasonable delay, that he/she is the new owner of the property, he/she understands and is aware of the content of this Certificate of Warranty and accepts its terms and conditions.

The person who proceeds with the transfer, sale, assignment or disposal of any way whatsoever of the property undertakes to hand over to the Subsequent Purchaser or the Successor the Certificate of Warranty provided upon completion of the work, as well as the Owner's Manual and, if applicable, the Maintenance and Environmental Monitoring Program for the Ecoflo® Biofilter.

Failure to abide by the terms and conditions of section 8 of this Certificate of Warranty may, at Premier Tech's discretion, render it invalid or to be rejected.

9. INSPECTION

The Customer and/or the Customer's Successors shall allow Premier Tech or its duly authorized representatives to carry out all necessary monitoring and inspections, as required, for implementation of this Warranty.

If the Customer and/or the Customer's Successors notify Premier Tech of an alleged defect or malfunction of the Ecoflo® Biofilter and that, after inspection, it is found that no such defect or malfunction exists or that such defect or malfunction is excluded from or does not apply to the Warranty, a minimum charge of $200.00 plus direct expenses shall be paid by the Customer and/or the Customer's Successors for the cost of the inspection.

10. INTERPRETATION

The terms and conditions of this Warranty shall be interpreted according to and governed by the provisions of this Warranty and the legislation in effect in the Province of Quebec.

11. PRIORITY OF THE CERTIFICATE OF WARRANTY

This Warranty supersedes any contract or understanding, written or verbal, entered into between the Customer and Premier Tech. In the event of contradiction between this Warranty and any other documents and/or contracts entered into between the Customer and Premier Tech, this Warranty shall prevail.

12. PURCHASERS AND SUCCESSORS

Subject to the provisions of this Warranty and especially those of section 8, this Warranty shall continue to be valid for Subsequent Purchasers and Successors and shall continue to have full effect until the end of the agreed Warranty period provided for in section 2 of this Certificate.

Notice of New Property Owner

Send a copy to Premier Tech Aqua.

Name of previous the owner:_____

I, the undersigned,_____ hereby declare that I have acquired the property located at

_____

Civic Number Street City Province or State

_____ (___)_____

ZIP or Postal Code Phone number

I have read and I understand the Warranty provided by Premier Tech Technologies Ltd for the Ecoflo® Biofilter. I wish to benefit from this Warranty for the remaining period, if any, and from the date of the transfer of ownership, that is,_____. I accept to be bound by this Warranty and by any and all of the sections, undertakings and conditions set forth therein. I have had the opportunity to examine the Ecoflo® Biofilter and declare myself satisfied with it at the time of this transfer. I ask Premier Tech Technologies Ltd. to take note of this transfer of ownership.

Signature: _____ Date: _____

Name of new owner: _____
(block letters)

Language preference: ❑ English ❑ French New owner's e-mail address: _____

Throughout the year

- After-sales service 7 days a week
- Customer service from Monday to Friday, 8 A.M. to 5 P.M.
- Technical support for the whole treatment chain (septic tank, pump, control panel, treatment system, etc.)
- Access to wastewater treatment professionals – wastewater is our specialty!
- Access to a network of local partners for service and emergency calls
- Access to a network of authorized and certified installers

Advantages of joining the Annual Inspection Program

- Annual maintenance service contract is automatically renewed upon reception of payment
- Copy of the contract to be provided to the municipality is sent to the homeowner (upon request)
- No charges to transfer contract to a new owner

ECO FRIENDLY

Annual Inspection Program validating your warranty

It is recommended that the owner of an advanced treatment system (or unit) [redacted] This annual inspection ensures the proper functioning of the system, the validity of its warranty and the respect of all regulatory norms in effect.

Please complete the Registration Form in your Owner's Manual to make sure a WALTER Service Professional will perform the 15-point yearly inspection on your Ecoflo biofilter.

This inspection includes the following steps:

- Inspection of the tipping bucket, distribution plates and all other internal components
- Inspection of the inner surfaces
- Scarification of the filtering media on its whole surface
- Verifation of the proper discharge of the treated water
- Photographs (filtering media and discharge area)

Thanks to the 15-point inspection performed by one of our qualified service partners every year, your Ecoflo® will offer exceptional performances and continue to protect your environment for years to come. For real peace of mind!

PREMIER TECH AQUA

2015

ECOFLOBIOFILTER.COM | 1 800 632 6356
maintenance@askforwalter.com

peace of mind

Annual Inspection Ecoflo® Septic System

Protect your investment

Your Ecoflo® septic system is a very important investment – for your property and the environment. Because it is underground and usually away from the main entrance of the residence, it is often forgotten. However, a well-planned preventive follow up will ensure optimal treatment performances for years to come.

A network of qualified professionals

Premier Tech Aqua (PTA) is committed to helping you protect that investment. This is why we developed a network of qualified professionals who offer an outstanding preventive service. With PTA s network of local partners – now known as WALTER – you will benefit from an unparalleled technical support and true peace of mind.

Walter™
WASTEWATER TREATMENT SERVICES

Before the visit 1

- WALTER professionals receive an extensive training that certifies they master the strict inspection procedures required
- PTA proceeds to the maintenance service contract renewal from its clients
- The homeowner makes the required payment in order to renew his/her service contract
- The homeowner makes sure that all his/her septic system lids are free of any obstacles and accessible at all times for the professional who will carry out the inspection between April and November

Annual inspection visit* 2

The annual visit is carried out between April and November by a WALTER professional who performs a 15-point inspection on the Ecoflo® filtering media and internal components. The homeowners do not need to be present since a proof of maintenance is left on the door handle to inform them.

* It is recommended that the owner of an advanced treatment system (or unit) **have a valid annual maintenance contract with a qualified service provider duly trained by the system manufacturer or its representative**.

Peace of mind for the homeowner 4

Thanks to the inspection visit, the homeowner knows the condition of his/her Ecoflo® septic system year after year.

- Data are analyzed by wastewater treatment specialists
- Maintenance reports are provided within 48 hours upon request
- Treatment performances are validated, which protects property value
- Technical support is provided by professionals
- Simple and accessible files make real estate transactions easier when property is sold
- Follow-up is approved by most governmental authorities

Protect your investment with

Walter™

WASTEWATER TREATMENT SERVICES

After the visit 3

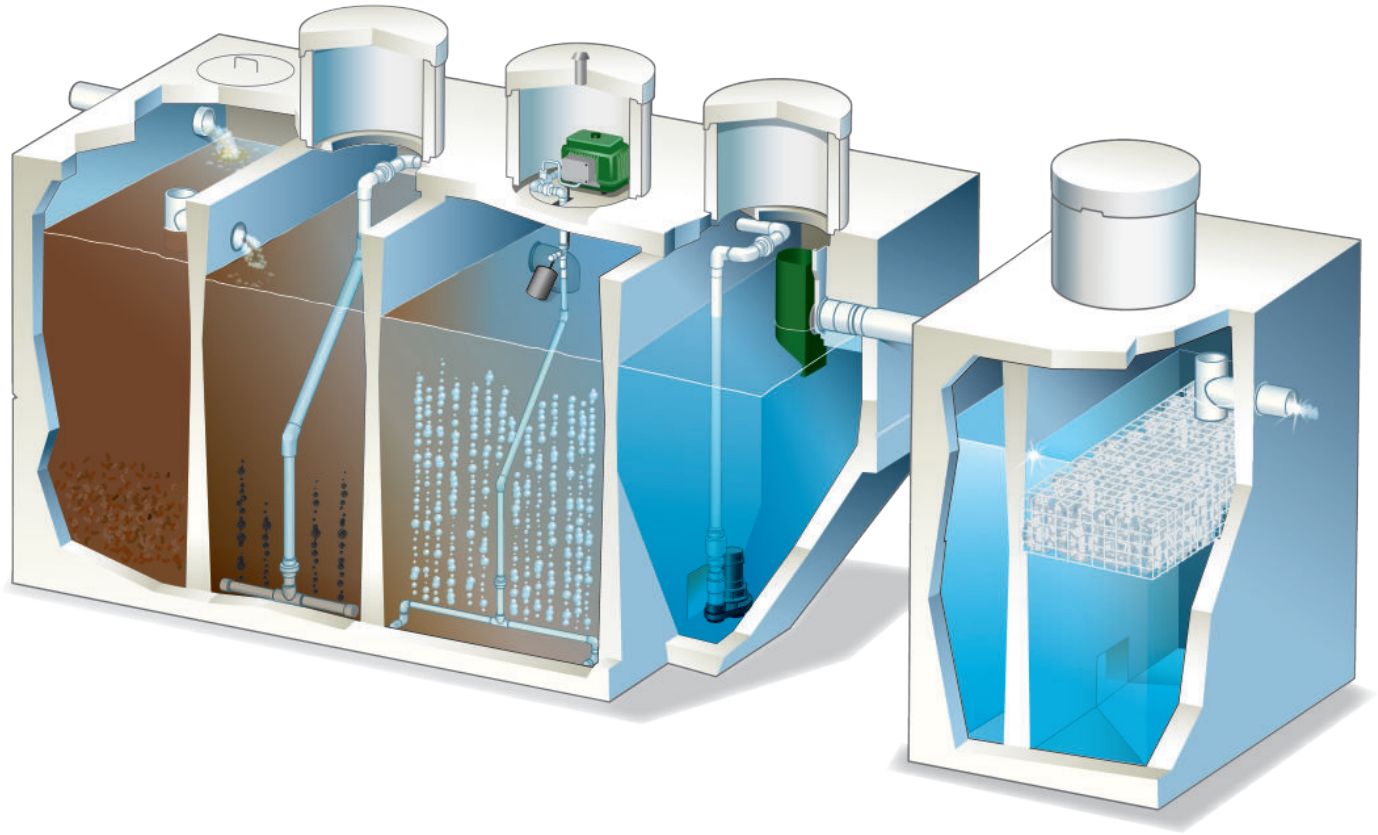
The WALTER professional provides PTA with all the information collected at the inspection visit.

- Information is entered in a high-performance data management system specially designed for septic installations
- Pictures taken onsite are downloaded
- Data are sent to PTA's main server to be analyzed and archived

norweco®

HYDRO-KINETIC®

WASTEWATER TREATMENT SYSTEM
MODELS 1260L THROUGH 3020L



INSTALLATION AND OPERATION MANUAL

Hydro-Kinetic® Installation and Operation Instructions

Wastewater enters the pretreatment chamber to precondition the waste before it flows into the anoxic chamber. Once in the anoxic chamber, facultative anaerobes digest organic matter. Flow then enters the aeration chamber where aerobic bacteria biologically convert the waste into stable substances and oxidize ammonia into nitrite and nitrate. Following aeration, liquids flow to the clarification chamber where gravity settles out biologically active material. A recirculation pump in the clarifier transfers a portion of the wastewater back to the anoxic chamber where nitrogen compounds are converted to harmless nitrogen gas. From the clarifier, treated liquids pass through the flow equalization device and into the disposal system. Effluent passes through the Bio-Film Reactor for final treatment.

The Hydro-Kinetic system is certified to BNQ Standard 3680-600 Class B-IV, D-I, N-I and BNQ Standard 3680-910 Class III, averaging effluent quality of 3.0 mg/L CBOD, 2.0 mg/L TSS, 67% Nitrogen removal and 2,200 CFU/100 ml fecal coliform. The Hydro-Kinetic system with Phos-4-Fade filter is certified to BNQ Standard 3680-600 Class B-IV, D-I, N-I, P-II and BNQ Standard 3680-910 Class IV, averaging effluent quality of 3.0 mg/L CBOD, 2.0 mg/L TSS, 67% Nitrogen removal, 0.14 mg/L Total Phosphorus and 2,200 CFU/100 ml fecal coliform. The Hydro-Kinetic system with UV disinfection is certified to BNQ Standard 3680-600 Class B-IV, D-III, N-I and BNQ Standard 3680-910 Class V, averaging effluent quality of 3.0 mg/L CBOD, 2.0 mg/L TSS, 67% Nitrogen removal and 2 CFU/100 ml fecal coliform. The Hydro-Kinetic system with Phos-4-Fade filter and UV disinfection is certified to BNQ Standard 3680-600 Class B-IV, D-III, N-I, P-II and BNQ Standard 3680-910 Class IV & V, averaging effluent quality of 3.0 mg/L CBOD, 2.0 mg/L TSS, 67% Nitrogen removal, 0.14 mg/L Total Phosphorus and 2 CFU/100 ml fecal coliform.

Before You Start

Installation procedures, equipment and personnel should always comply with applicable safety regulations as well as all federal, state and local codes. The Hydro-Kinetic system must be installed by an authorized representative of Norweco according to these instructions to insure safe, reliable and efficient operation. Carefully unpack and inspect the system components. Make sure you have received all components in good condition. Read all instructions before beginning installation. The Hydro-Kinetic system components include:

1. Service Pro Model 801P Control Center
2. Model A100/A150 Air Pump (with power wire junction box)
3. Alarm Float (with alarm wire junction box)
4. Flow Equalization Device
5. Primary Recirculation Assembly
6. Model SD102/SD103 Recirculation Pump
7. Intermediate Recirculation Assembly
8. Diffuser
9. Mixing Bar
10. Mixing Bar Drop Pipe Assembly
11. Diffuser Drop Pipe Assembly
12. Primary Air Assembly

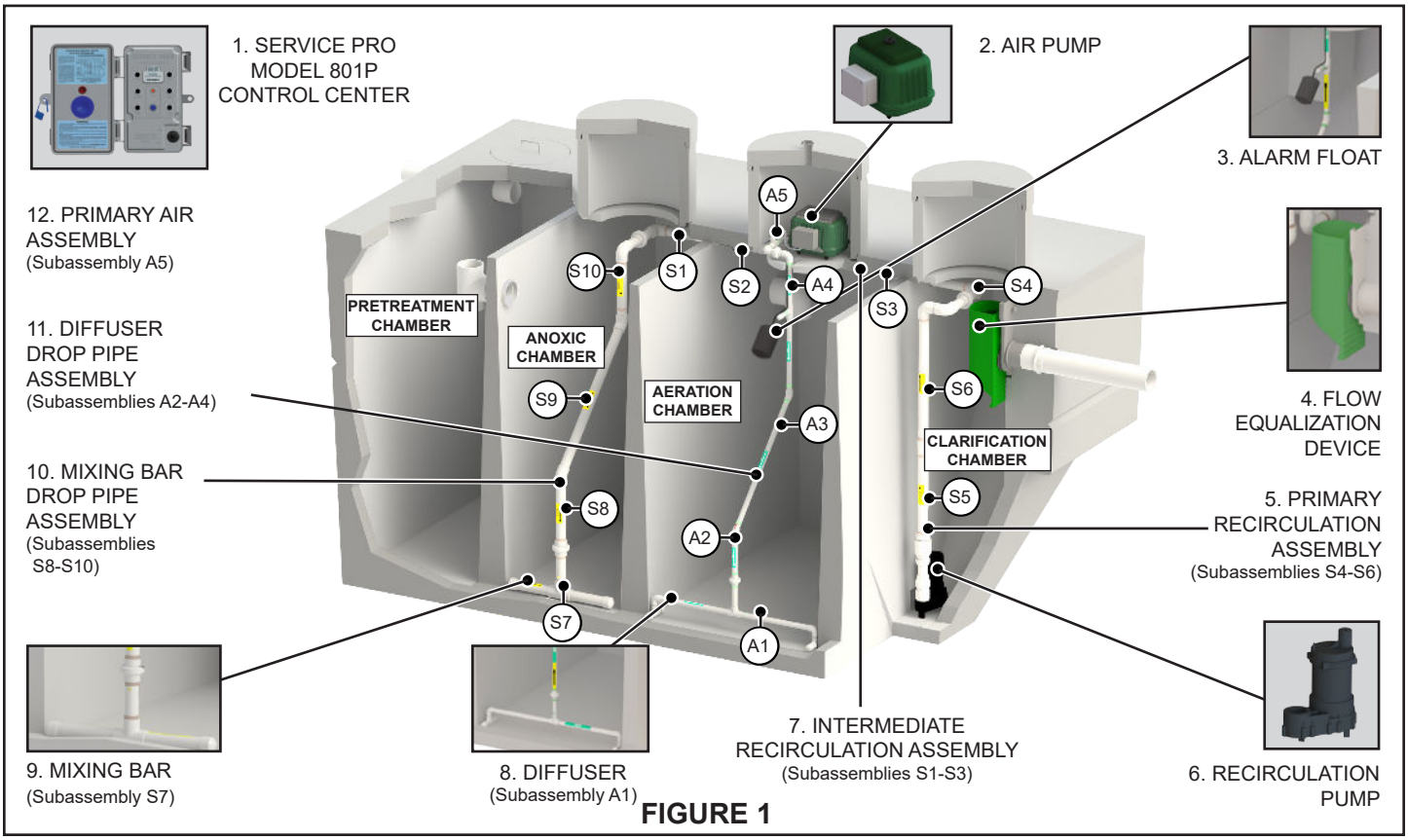


FIGURE 1

Pre-Delivery Tank Preparation

The Hydro-Kinetic tank equipment package contains some components that are cast-in the tank during the manufacturing process, and other components that are installed after the casting process is complete. In the standard two-piece tank, the only component that needs to be installed prior to delivery is the intermediate recirculation assembly. In a one-piece tank, the distributor will need to provide a pretreatment outlet tee, an aeration chamber inlet elbow and a Bio-Film Reactor outlet tee. Norweco recommends assembling all of these components, as well as the Bio-Film Reactor elements, before the tank is delivered to the installation site. Install components according to the following steps:

1. For a one-piece tank, solvent weld the 4" Schedule 40 PVC pretreatment outlet tee to the coupling that was cast-in the outlet of the pretreatment chamber (distributor to provide). Solvent weld the 4" Schedule 40 PVC aeration chamber transfer elbow into the coupling cast-in the inlet of the aeration chamber (distributor to provide).

2. For all systems, begin in the anoxic chamber and solvent weld subassembly S1 into the coupling that was cast-in the wall between the anoxic and aeration chambers. The elbow should be oriented as shown in Figure 2, with the short stub of pipe parallel to the floor and ceiling of the tank.

3. Solvent weld subassembly S2 into the aeration chamber side of the same cast-in coupling. See Figure 2.

4. Starting in the aeration chamber, pass subassembly S3 through the wall into the clarification chamber. Solvent weld the coupling on subassembly S2 to subassembly S3. See Figure 2.

5. Place the Bio-Film Reactor elements into the Bio-Film Reactor tank. They will rest on the support rib cast into the outlet chamber. The Bio-Film Reactor elements should be installed with the media service hatch oriented toward the middle of the tank and facing up. See Figure 3.

6. Using the universal tool, rotate the two slide locks on each Bio-Film Reactor element so that they lock into the recesses cast into the tank.

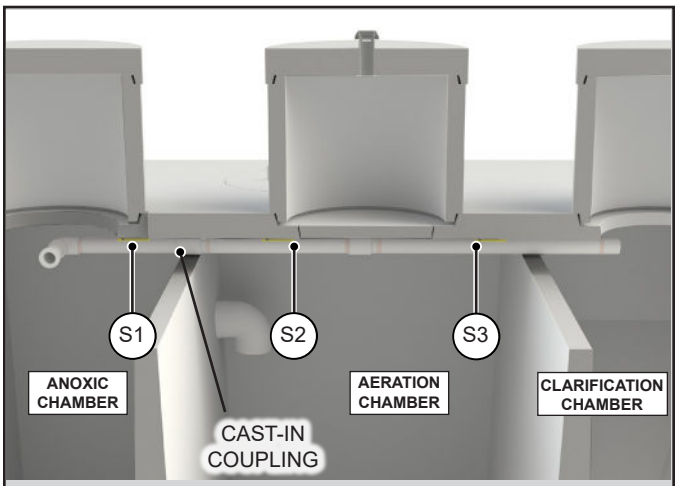


FIGURE 2

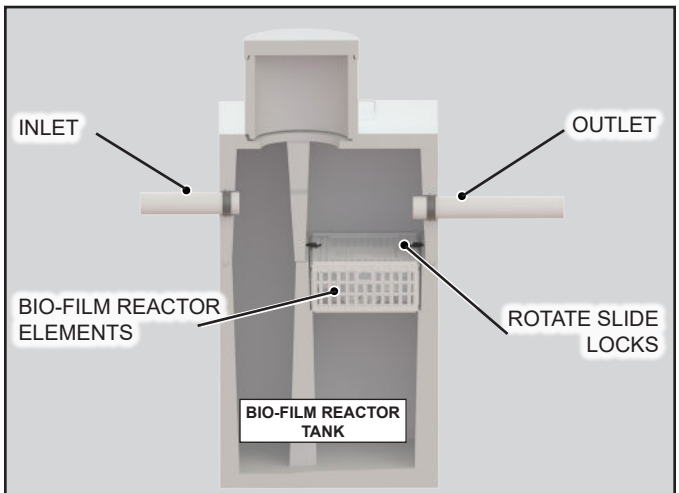


FIGURE 3

Tank Delivery and Setting

1. When installing a Hydro-Kinetic system, first check the length, width and depth of the excavation. Insure the excavation is long enough to allow at least 2' between the treatment tank and the Bio-Film Reactor for installation of the interconnect plumbing and backfill between the tanks. Cut a 4" Schedule 40 PVC pipe (distributor to provide) 6" longer than the distance between the tanks for the interconnect plumbing. Insert the interconnect pipe into the inlet of the Bio-Film Reactor tank prior to tank placement. This allows the interconnect pipe to be backed straight out, and solvent welded into the cast-in outlet coupling of the clarification chamber when the tank is set. The excavation should have sufficient overdig to allow for a minimum of 6" clearance around the entire perimeter of the system. Additional overdig will be required on deep installations or where unstable soil conditions exist. Safe working conditions must be established and maintained during the entire installation procedure.

2. Prepare the excavation to the appropriate depth based on the elevation of the building sewer line. Concrete systems should have a maximum burial depth of 42" below grade. HDPE systems should have a maximum burial depth of 36½" below grade. Allow ⅛" of fall per foot from the building to the system. Fall through the system is 5" from inlet invert to outlet invert. Therefore, the outlet line from the system must be installed 5" lower than the inlet sewer line. The bottom of the excavation must be level and smooth. A 4" layer of gravel, sand or fine crushed stone should be installed and leveled to within ¼" from side to side and end to end.

3. Using extreme caution, place the treatment tank into the excavation. Place the Bio-Film Reactor in the excavation allowing at least 2' between the treatment tank and the Bio-Film Reactor tank. Insure tanks are installed square and level.

4. Connect the building sewer line to the pretreatment chamber inlet. The inlet line must be laid continuously and unspliced from the tank to undisturbed earth beyond the limits of the tank excavation.

5. Back the interconnect pipe out of the Bio-Film Reactor tank and solvent weld the pipe to the outlet coupling of the clarification chamber. Then, connect the discharge sewer line to the Bio-Film Reactor tank outlet continuously and unspliced from the tank to undisturbed earth beyond the limits of the tank excavation. If using a one-piece tank, insert discharge sewer line through tank outlet seal, leaving 4" to 6" protruding inside the tank. Solvent weld the 4" Schedule 40 PVC outlet tee (distributor to provide) to the discharge sewer line.

6. Install risers as required to bring the access covers to grade.

Plant Wiring and Control Center Installation

1. Electrical work must be performed in accordance with the latest edition of the National Electrical Code as well as applicable local codes.

2. All electrical service cable used with the Hydro-Kinetic system must be UL and CSA approved, type UF, #14/2 AWG minimum and must have a full-size center ground. Larger cable is required if the length of the underground service is greater than 80 feet. Consult your electrician for details.

3. An approved cable must be installed from the air pump to the junction box provided for connection to the control center. If installing the air pump in a location other than the aeration chamber riser, insure the air line is no more than 75' in length and the air pump is protected from the elements in a clean, dry, well-ventilated area and proceed to step 6.

4. Inspect the power cable entrance in the side of the aeration riser. Remove any sharp edges or flash. Insert the free end of the power cable through a pre-formed ½" conduit ell (2' by 1'), then into the power cable entrance of the aeration riser. Guide the power cable into the riser. Pull enough cable through the riser to reach 36" above the riser top. Coil and secure the cable in the aeration riser so that it will not hang down into the tank.

5. Lay the conduit ell with cable directly across the top and down the tank side. Do not allow the power cable to be laid across the end of the tank or any removable access cover. Seal the connection between the conduit and the aeration riser with mortar or approved sealant.

6. A second underground cable must be installed unspliced from the Service Pro control center into the clarification chamber riser to supply power to the recirculation pump.

7. Inspect the power cable entrance in the side of the concrete clarification riser. Remove any sharp edges or flash. Insert the free end of the power cable through a pre-formed ½" conduit ell (2' by 1'), then into the power cable entrance of the clarification riser. Guide the power cable into the riser. Pull enough cable through the riser to reach 36" above the riser top. Coil and secure the cable in the clarification riser so that it will not hang down into the tank.

8. Lay the conduit ell with cable directly across the top and down the tank side. Do not allow the power cable to be laid across the end of the tank or any removable access cover. Seal the connection between the conduit and the clarification riser with mortar or approved sealant.

9. Two alarm leads must be installed from the air pump pressure switch to the Service Pro control center. The alarm leads should be #16 AWG minimum and installed in conduit where contact with concrete may occur. IMPORTANT: Alarm leads and power leads must always be installed in separate conduits.

10. Two alarm leads must be installed from the high water float switch to the Service Pro control center. The alarm leads should be #16 AWG minimum and installed in conduit where contact with concrete may occur. IMPORTANT: Alarm leads and power leads must always be installed in separate conduits. If the air pump will be installed in the aeration riser, the high water and air pump alarm leads should be installed in the same conduit. Properly seal the conduit opening in the riser with mortar or approved sealant.

11. Check the excavation and sewer line trenches to be sure they are free of debris, rocks and any sharp or abrasive objects that could damage electrical cables or alarm leads during backfill or settling.

12. Uncoil the electrical service cables and alarm leads into the excavation and influent sewer line trench. Leave sufficient slack in the cables so they will not be stressed or pulled tight during backfill or settling.

13. Always encase the electrical cables and alarm leads in conduit any time they are above finished grade. Route the conduits and cables as directly as possible to the control center mounting location.

Required Prior to Backfilling

1. For installations where the air pump will not be located in the aeration riser, install a ¾" Schedule 40 PVC air line from the air pump to the system. The air line should be buried in a trench at a recommended depth of at least 12 inches. Protect the air line in a casing pipe if heavy loading is anticipated. The air line must be run into the aeration riser and the opening in the riser sealed with mortar or approved sealant.

2. On the Bio-Film Reactor elements, use the universal tool to insure each of the slide locks are rotated until they are in the furthest extension point possible.

Backfilling

1. The system should be backfilled immediately after sewer lines and underground electrical cables are installed. Fine, loose earth should be used to backfill the tank excavation and sewer line trenches. Be sure it is completely free of rocks, large clumps of earth and construction debris. Use fine granular material when backfilling around electrical cables and conduits. The underground electrical cables should have at least 2' of earth cover. If the proposed finished grade will not permit this coverage, the cables should be installed in approved conduit from the tank to the building foundation. Backfill evenly around the entire perimeter of the tank rather than all at once on each side. Take care to completely fill in the cavity beneath the slanted clarifier end wall.

2. Final grading should be 6" below the top of each access cover and should slope away from the tank so surface runoff will drain away from the treatment system. Use extreme care in backfilling. Do not allow dirt or mud to enter any part of the treatment system or sewer lines. If dirt or mud enters any portion of the system, it must be removed to insure proper system operation. Removing the dirt or mud may require repeated flushing and tank pumping.

3. Immediately after backfilling, fill each chamber of the treatment system with water to the outlet invert. The water must be free of leaves, mud, grit or any other materials that might interfere with system operation.

Air Pump and Piping Installation

1. Remove all packaging from the plumbing assemblies labeled "AIR". Attach diffuser bar A1 to subassembly A2 at union as shown in Figure 4. Securely tighten union by hand.

2. Solvent weld subassembly A2 to subassembly A3 as shown in Figure 4. Insure red arrows are aligned.

3. Solvent weld subassembly A3 to subassembly A4 as shown in Figure 4. Insure blue arrows are aligned.

4. Install this entire assembly into aeration chamber by bending the flexible tubing. Lower assembly into the tank until the diffuser bar contacts both the floor and side wall of the tank as shown in Figure 4.

5. Remove air pump and components from carton. If the air pump will be installed in the aeration chamber riser, install a concrete support base for air pump.

6. Install the air pump in the aeration chamber riser on the support base (or in a clean, dry, well-ventilated area protected from the elements no more than 75' from the tank). Attach subassembly A4 to subassembly A5 at union as shown in Figure 4. Securely tighten union by hand.

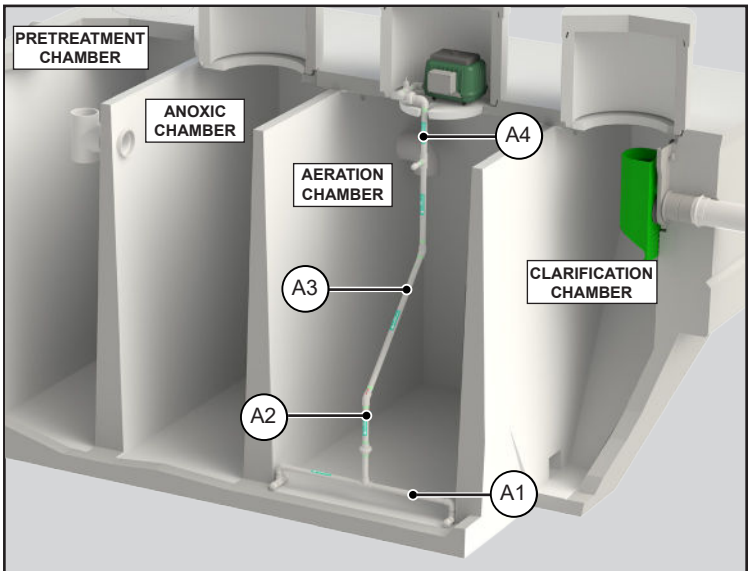


FIGURE 4

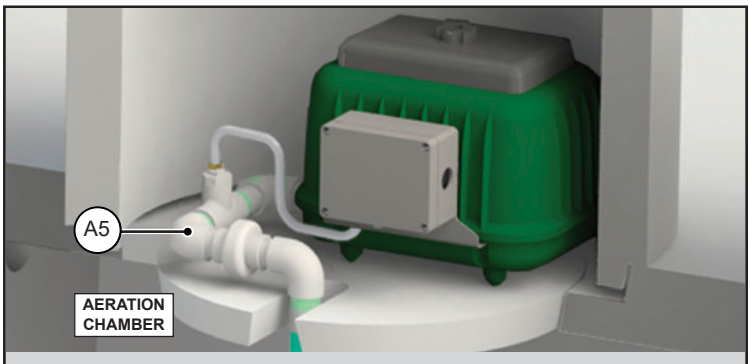


FIGURE 5

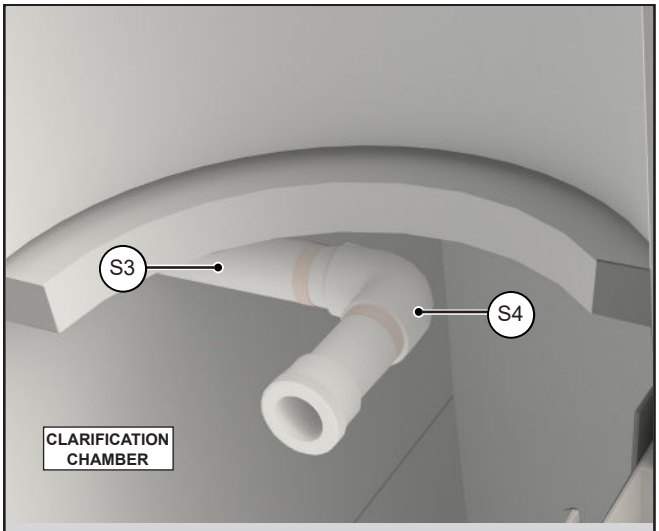


FIGURE 6

7. To wire the air pump female electrical connector, unscrew the three captive stainless steel screws from the face of the female connector. They will stay in the body of the receptacle. Lift out the rigid internal receptacle body. Unscrew the compression nut on the strain relief connector. Insert the electrical service cable through the compression nut, compression ring and neoprene grommet. Strip the outer insulation back 1¼" on the underground electrical service cable and expose the three individual leads. Use extreme care to be sure the insulation jackets on the individual black and white leads are not scarred or damaged while stripping the outer jacket.

8. Strip off the insulation jackets 7/16" from the ends of the individual black and white leads. Insert the black lead into the hole adjacent to the brass-colored screw and tighten the screw securely. Insert the white lead into the hole adjacent to the silver-colored screw and tighten the screw securely. Insert the bare copper ground lead into the hole that is adjacent to the green-colored screw and tighten the screw securely. Align the insert key on the receptacle body with the keyway molded into the rubber sleeve. Press the receptacle body into the sleeve and tighten the three stainless steel screws on the face of the connector. Press the grommet into the electrical connector and tighten the compression nut.

Recirculation Pump and Piping Installation

In the clarification chamber:

1. Remove all packaging from the plumbing assemblies labeled "SLUDGE". Solvent weld subassembly S3 to subassembly S4 in the clarification chamber (S3 was installed with the Tank Equipment Package). Be sure the union is facing horizontally as shown in Figure 6.

2. Thread subassembly S5 into the pump discharge as shown in Figure 7.

3. Solvent weld the coupling on subassembly S5 to subassembly S6. See Figure 7.

4. Attach pump cord to pump discharge assembly (S5-S6) using cable ties provided.

5. Use discharge assembly to lower pump into the clarification chamber until pump rests on the floor of the hopper as shown in Figure 7. Attach subassembly S4 to subassembly S6 at union. Securely tighten union by hand.

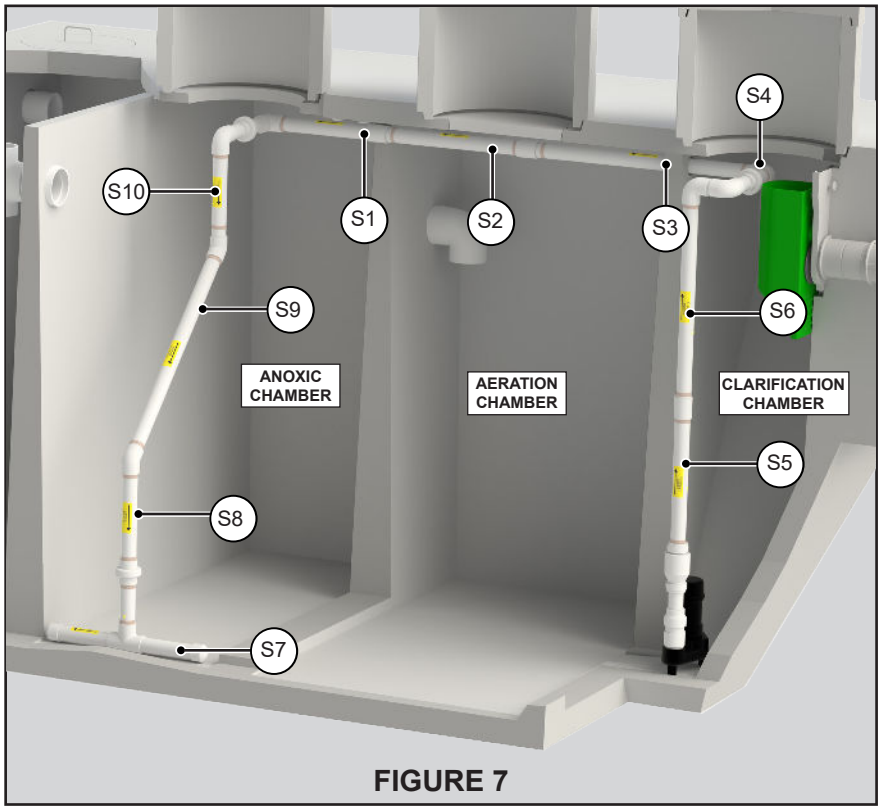


FIGURE 7

In the anoxic chamber:

6. Attach subassembly S7 to subassembly S8 at union as shown in Figure 7. Securely tighten union by hand.

7. Solvent weld subassembly S8 to subassembly S9 as shown in Figure 7. Insure yellow arrows are aligned.

8. Solvent weld subassembly S9 to subassembly S10 as shown in Figure 7. Insure green arrows are aligned.

9. Bend mixing bar assembly at flexible tubing and lower into anoxic chamber until mixing bar is positioned as shown in Figure 7. Attach subassembly S10 to subassembly S1 at union. Securely tighten union by hand.

10. Wire the recirculation pump female electrical connector. Unscrew the three captive stainless steel screws from the face of the female connector. They will stay in the body of the receptacle. Lift out the rigid internal receptacle body. Unscrew the compression nut on the strain relief connector. Insert the electrical service cable through the compression nut, compression ring and neoprene grommet. Strip the outer insulation back 1¼" on the underground electrical service cable and expose the three individual leads. Use extreme care to insure the insulation jackets on the individual black and white leads are not scarred or damaged while stripping the outer jacket.

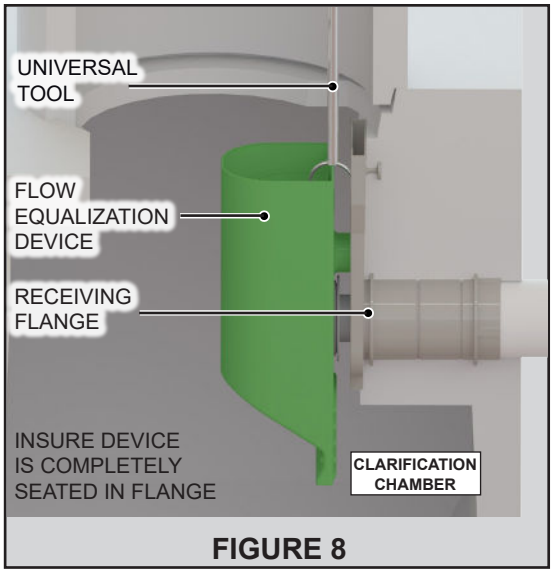


FIGURE 8

11. Strip off the insulation jackets 7/16" from the ends of the individual black and white leads. Insert the black lead into the hole adjacent to the brass-colored screw and tighten the screw securely. Insert the white lead into the hole adjacent to the silver-colored screw and tighten the screw securely. Insert the bare copper ground lead into the hole that is adjacent to the green-colored screw and tighten the screw securely. Align the insert key on the receptacle body with the keyway molded into the rubber sleeve. Press the receptacle body into the sleeve and tighten the three stainless steel screws on the face of the connector. Press the neoprene grommet into the electrical connector and tighten the compression nut.

12. Plug the male connector on the recirculation pump power cord into the female connector.

13. Install the flow equalization device by sliding it into the tank receiving flange in the clarification chamber as shown in Figure 8. Use the universal tool to insure the device is completely seated in the flange.

Completing the Installation

1. The control center should be wired for operation when the tank and underground electrical cables are installed. The control center should be located so that the red warning light can be seen and the audible alarm heard. The mounting location should minimize exposure to direct sunlight, freezing rain or conditions that might prevent routine inspection or access. The control center should always be mounted out of the reach of children.

2. Remove the cover from the alarm wire junction box connected to the float switch. Solvent weld the junction box to the conduit containing the alarm leads, located in the aeration chamber riser.

3. Reference Figure 9 for all wiring instructions. The black and white alarm wires contained in the junction box are provided to connect the float switch to the control center. Connect the black wire in the junction box to either alarm lead from the panel, and secure with a wire nut connector. Connect the white wire in the junction box to the remaining alarm lead from the panel, and secure with a wire nut connector.

4. If the air pump is installed in the aeration chamber riser, solvent weld the conduit connection for the pressure switch alarm cable to the junction box. Connect the black wire in the pressure switch cable to either alarm lead from the panel, and secure with a wire nut connector. Connect the white wire in the pressure switch cable to the remaining alarm lead from the panel, and secure with a wire nut connector.

5. Reinstall and secure the cover on the alarm wire junction box. Plug any unused junction box openings.

6. Proceed to the control center. Detach the cover from the control center enclosure and remove the insert from the mounting posts. Set the control center insert aside. Remove the knockouts in the bottom of the enclosure and install a sealed conduit connector (distributor to provide) in each opening. Exposed wiring to or from the control center should always be encased in conduit. Mount the control center securely using masonry nails, wood screws or common nails as appropriate.

7. Use a dedicated 115 VAC, single-phase circuit at the main electrical service panel. A 15 amp circuit breaker is recommended (10 amp minimum). **CAUTION: MAKE SURE THIS CIRCUIT IS DE-ENERGIZED. CHECK IT WITH AN ELECTRICIAN'S TEST LIGHT BEFORE PROCEEDING. REMEMBER THAT OTHER CIRCUITS IN THE SERVICE PANEL MAY REMAIN ENERGIZED AS YOU ARE WORKING. USE ONLY TOOLS WITH INSULATED HANDLES, STAND IN A DRY LOCATION AND WORK WITH EXTREME CARE.**

8. Open the black electrical insulator on the back of the control center insert for access to power and alarm wiring connections.

9. Install a #14/2 AWG minimum cable with full-size center ground from the control center to the power wire junction box provided for connection to the control center.

10. Wire from the dedicated circuit breaker in the main service panel to the power wire junction box. Use at least #14 AWG black copper wire. Connect the black wire from the main service panel to the black wire in the air pump power cable and the black wire to the control center. Secure with a wire nut connector.

11. Wire from the neutral in the main service panel to the junction box. Use at least #14 AWG white copper wire. Connect the white wire from the main service panel to the white wire from the air pump power cable and the white wire to the control center. Secure with a wire nut connector.

12. Connect the ground wire from the main electrical service panel to the non-insulated ground lead from the air pump and the ground wire to the control center. Secure with a wire nut connector. IMPORTANT: Never allow the white neutral leads and the ground leads to be spliced together.

13. Install the cover on the junction box and proceed to the control center.

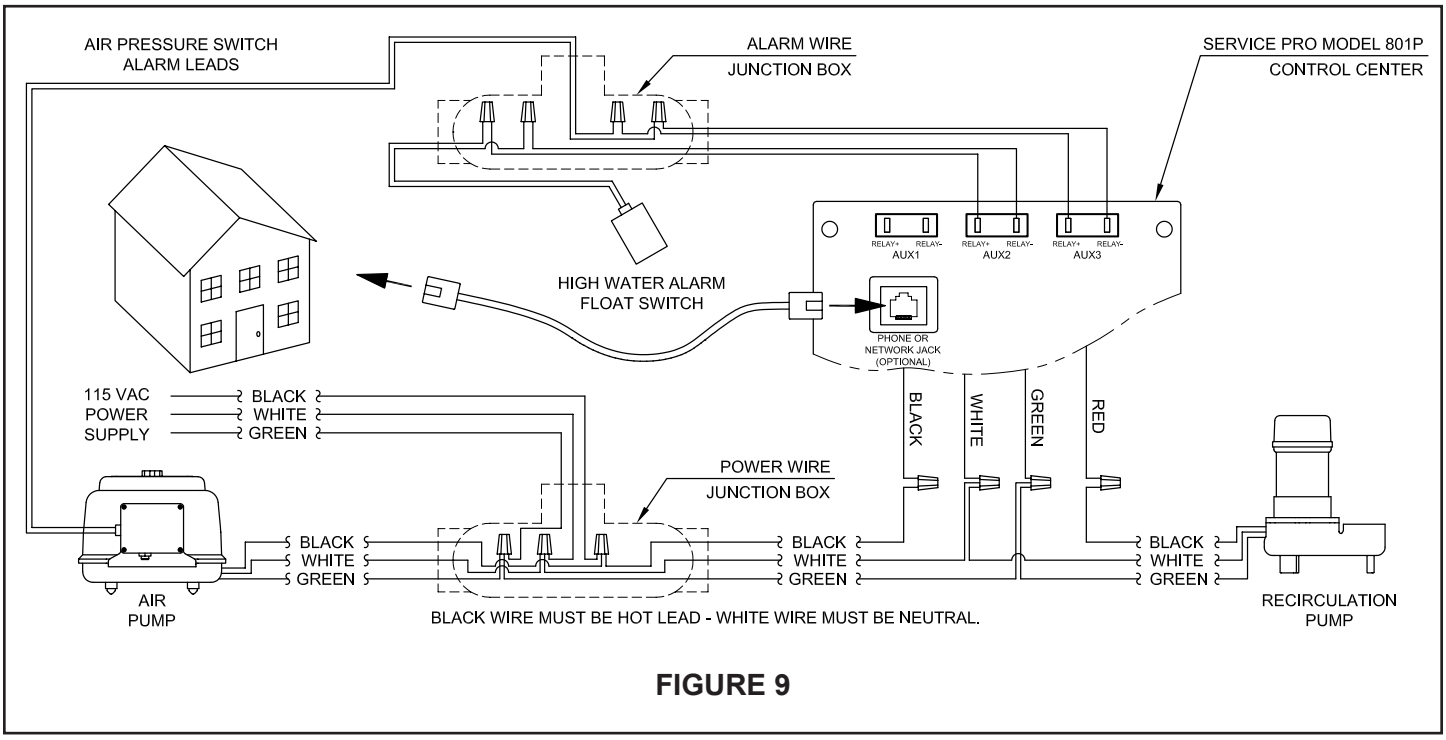


FIGURE 9

14. Connect the black wire from the junction box to the black wire on the control center. Secure with a wire nut connector.

15. Connect the black lead of the underground electrical cable from the recirculation pump to the red wire on the control center. Secure with a wire nut connector.

16. Connect the white wire from the junction box to the white wire from the recirculation pump and white wire on the control center. Secure with a wire nut connector.

17. Connect the ground wire from the junction box to the non-insulated ground lead from the recirculation pump and the green wire on the control center. Secure with a wire nut connector. IMPORTANT: Never allow the white neutral leads and the ground leads to be spliced together.

18. An auxiliary alarm input (AUX1) is available for connection of optional equipment such as an ultraviolet disinfection system, chemical detection system or effluent pump system. Refer to the Alarm Input section in the Service Pro Model 801P Installation and Operation Instructions for details regarding the connection of auxiliary equipment.

19. Connect the alarm leads from the high water float switch to the AUX2 RELAY terminals on the control center.

20. Connect the alarm leads from the air pump pressure switch to the AUX3 RELAY terminals on the control center.

21. If the remote monitoring features of the control center will be utilized, run the telephone or network cable to the bottom of the control center enclosure. IMPORTANT: Never install the communication cable in a conduit with power lines.

22. Place the communication cable in the electrical grommet provided. The grommet snaps into the control center enclosure. Crimp the appropriate phone or network connector on the end of the communication cable. Plug the connector into the jack on the control center insert. Connect the other end to the telephone or network system.

23. Carefully form all wiring neatly into the lower part of the control center. Do not allow the wires to make contact with other electrical components in the control center. The conduit openings in the enclosure must now be sealed using expanding foam sealant (available from Norweco).

24. Close the black electrical insulator and snap the control center insert into position. Reinstall and close the control center cover. Secure it with the Norweco tamper evident seal.

25. Clearly label the dedicated circuit used for the Hydro-Kinetic system on the door of the main service panel. Replace the service panel deadfront and enclosure cover.

Final Check and System Startup

1. Place the dedicated circuit breaker for the Hydro-Kinetic system in the main service panel in the "on" position.

2. To commission the telemetry system, first insure the phone/network cable is properly installed. Place the control center power switch in the "off" position. While holding in the reset button, place the power switch in the "on" position. Continue to hold the reset button for 5 seconds. Release the reset button and allow the telemetry system up to 60 seconds to call out and complete the commissioning process. The phone/network light will illuminate during the call out process. If commissioning is successful, the alarm light will flash 5 short flashes and stop as verification. If commissioning is unsuccessful, refer to the Service Pro Model 801P Installation and Operation Instructions.

3. If no telemetry system is installed, press and hold the RESET button on the control center for 5 seconds. The audible alarm should sound and the alarm light should illuminate.

4. The system is operational once all installation and startup steps have been completed to this point. It will take 2 to 6 weeks for the system to reach biological maturity, depending upon system loading. **DANGER: Make sure the system access covers are in good condition and securely installed on the mounting castings. Never allow access risers to be left uncovered or partially covered. Failure to secure access covers and safety nets could result in bodily injury, illness or death. Riser safety nets are available from Norweco for concrete or plastic risers.**

Routine Maintenance

The following should be performed every 12 months (or as required by your local governing regulations) by a qualified service technician:

1. If applicable, inspect the effluent discharge point to make sure there are no restrictions to the effluent flow. If restrictions are present, perform service as needed.

2. If effluent sampling is required, it is recommended that a proper sampling port be installed downstream of the system.

3. Inspect the vent cap, perimeter vent and air pump for objects, plants, insects or debris that could impede the air intake. Remove these items if present.

4. Check the air pump for proper operation. Check the air filter and clean or replace as required. Check the aeration chamber for odor. A musty odor indicates the presence of aerobic conditions essential for proper treatment. A septic odor indicates inadequate aeration, suggesting that the delivery of air into the aeration chamber has been restricted.

5. Check the aeration chamber and insure the diffuser assembly is creating a rolling motion of the chamber contents. If a rolling motion is not visible, verify air pump operation. Remove and clean diffuser assembly if necessary.

6. Check the anoxic chamber and insure the mixing bar is operational. The recirculation pump operates on a pre-programmed on/off cycle, so press the reset button if necessary to verify operation.

7. Inspect the flow equalization device. Rinse the design flow, sustained flow and peak flow ports with a garden hose and insure they are free of debris. Clean the flow ports with a brush if necessary.

8. Use the hopper scraping tool to gently scrape all surfaces of the clarification chamber hopper.

9. The settled solids should be pumped from the Bio-Film Reactor tank to the pretreatment chamber. With the flow equalization device securely in place, install the outlet blocking tool into the clarifier outlet coupling prior to pumping. Place the intake of the service pump at the bottom of the influent chamber. Pump the contents from the bottom of the Bio-Film Reactor tank until the accumulated solids are withdrawn and the water level is below the bottom of the Bio-Film Reactor elements. Approximately 150 gallons will be removed during service. Rinse the media with a hose during tank pumping. After pumping, remove the outlet blocking tool and allow the Bio-Film Reactor tank to refill to normal operating level. Never leave the Bio-Film Reactor tank empty after pumping.

10. Inspect the system to determine if complete pumping may be required. See "System Pumping" section of this document.

11. Upon completion of the inspection, insure that all access covers are properly reinstalled. Any missing or damaged access covers should be immediately replaced. **DANGER: Make sure the system access covers are in good condition and securely installed on the mounting castings. Never allow access risers to be left uncovered or partially covered. Failure to secure access covers and safety nets could result in bodily injury, illness or death. Riser safety nets are available from Norweco for concrete or plastic risers.**

12. Approved replacement parts are available from the authorized system dealer listed on the control center cover.

System Pumping

1. The Hydro-Kinetic system is a biological treatment device and will not require pumping as often as a septic tank. Pumping of the system will likely be required at 3 to 5 year intervals depending upon system usage, loading and treatment requirements. If pumping is required more frequently than every 2 years, there is an operational problem with the system and it should be evaluated in greater detail.

2. If the service technician suspects that the system may require pumping, a settleable solids test should be performed on a sample from the aeration chamber. The air pump must be removed from the aeration chamber riser to perform this test.

3. Immediately after removing air pump, dip a graduated cone or other clear container into the aeration chamber to a depth of 2½ feet. Set the container on a level surface and then allow the solids to settle for 30 minutes while you complete the service inspection. Do not disturb the container during the test.

4. After 30 minutes, read the level of solids and compare it with the total liquid volume in the container. Calculate the percentage of settled solids volume (i.e. ½ full of solids equals 50%). If the settled material contains large pockets of clear liquid, estimate the volume of these pockets and reduce the settled solids reading by that amount. A settled solids reading of up to 80% indicates no adjustments are necessary. A settled solids level greater than 80% in the aeration chamber indicates excessive solids and that the system should be pumped.

5. If it is determined that pumping is required, contact a tank pumping service licensed by the local regulatory agency. The septage or biosolids from the system must be removed and disposed of in a manner consistent with federal, state and local regulations. Advise the pumping service that they will be pumping approximately 1,500 gallons.

6. Turn off the air pump and recirculation pump before tank pumping.

7. Remove the access cover from the aeration and clarification chambers. Unplug the air pump and disassemble the union located on the primary air connection. Remove the air pump, primary air connection and support base from the aeration riser. Use the universal tool to bend flexible diffuser tubing and remove the diffuser drop pipe assembly. Connect the suction hose to the pump being used to evacuate the chamber.

8. Activate the pump and remove the aeration chamber contents. Pump the aeration chamber from the top down, to remove biologically inactive material. Feed the hose down as the liquid is being evacuated from the aeration chamber. It is not necessary to wash down the sidewalls or tank bottom. Pump only 75% of the volume out of the aeration chamber to facilitate plant re-start. Replace the diffuser drop pipe assembly. Reinstall the support base, primary air connection and air pump. Reassemble the union in the primary air connection and plug in the air pump. Replace the access cover.

9. The Bio-Film Reactor tank should be pumped after the aeration chamber. Remove the Bio-Film Reactor tank access cover. Lower the hose into the influent chamber until it contacts the bottom of the tank. Withdraw the hose approximately 2 inches. Completely pump 100% of the contents from the chamber and rinse the media with a hose during tank pumping. Replace the Bio-Film Reactor tank access cover.

10. Next, pump the anoxic chamber. Remove the anoxic chamber access cover. Use the universal tool to bend flexible mixing bar tubing and remove the mixing bar drop pipe to allow access for the suction hose. Lower the hose until it contacts the bottom of the tank. Withdraw the hose approximately 2 inches. Completely pump 100% of the contents from the chamber. Reinstall the mixing bar drop pipe assembly and replace the access cover.

11. The final chamber to pump is the pretreatment chamber. Remove the pretreatment chamber access cover. Break up the scum mat to facilitate pumping. Lower the hose until it contacts the bottom of the tank. Withdraw the hose approximately 2 inches. Activate the pump and remove 100% of the chamber contents. It is not necessary to wash down the sidewalls or tank bottom. If solids are so concentrated that the suction hose cannot withdraw them, tank contents may be backflushed to break up the solid matter. Replace the pretreatment chamber access cover.

12. After pumping, refill all chambers to capacity with clean water. Return all plumbing and equipment to its properly installed location. Replace any access covers that were removed. Turn on power to the air pump and the recirculation

pump. Check for proper operation of all equipment. **DANGER: Make sure the system access covers are in good condition and securely installed on the mounting castings. Never allow access risers to be left uncovered or partially covered. Failure to secure access covers and safety nets could result in bodily injury, illness or death. Riser safety nets are available from Norweco for concrete or plastic risers.**

Troubleshooting

This troubleshooting section provides solutions to the most common problems encountered in the operation of the system.

Control Center Alarming

1. **Liquid in tank at level of high water alarm float:** system is flooded due to an obstruction in the flow equalization device, outlet, effluent line or disposal field. Determine cause and remove obstruction, or make repairs as required. Be sure to check effluent disposal system for proper operation.

2. **No rolling action in aeration chamber:**
   - Air pump is pumping air but there is an obstruction in the line between the air pump and diffuser: disassemble air line and remove obstruction.
   - Diffuser is plugged: remove and clean diffuser.
   - Air pump is not running: check power supply to air pump.
   - Air is escaping through a leak in the plumbing assembly between air pump and diffuser: identify and repair air leak. If necessary, remove the diffuser, diffuser drop pipe assembly, and primary air assembly from the aeration chamber and use a soapy water solution to thoroughly coat the plumbing and check for bubbles. Repair any leaking air pipe or fitting and retest.

3. **Air pump is running but does not pump air:** clean or replace air filter. Internal components are worn and the air pump is failing. Rebuild or replace the air pump. Contact the authorized Norweco representative for replacement components.

4. **No mixing action in anoxic chamber:**
   - Recirculation pump is operating but there is an obstruction in the line between the recirculation pump and mixing bar: disassemble mixing bar plumbing and remove obstruction.
   - Recirculation pump is not operating. Pump needs replaced. Contact the authorized Norweco representative for replacement components.
   - Mixing bar is plugged: remove and clean mixing bar.
   - Check valve is stuck in closed position: repair or replace check valve.

Septic Odor from System

1. **No power to air pump:** check air pump for proper operation. Insure the breaker is in the "on" position, the air pump is plugged in and power is present (check with test light from Tool Kaddy)

2. **Insufficient air delivery to aeration chamber:** see “Control Center Alarming”

3. **Incomplete treatment due to hydraulic overloading:** see “Hydraulic Overloading of System”

4. **Water softener backwash discharging into system:** notify owner to remove backwash line from system

5. **Excessive solids in aeration chamber:** evaluate chamber and pump if necessary

6. **Excessive solids in anoxic chamber:** evaluate chamber and pump if necessary

Hydraulic Overloading of System

1. **Ground water entering tank through defective inlet or outlet seal:** excavate and repair seal

2. **Ground water entering system through crack in tank:** excavate and repair crack with hydraulic cement

3. **Ground water entering system through joint between riser and tank:** excavate and reseal joint with non-shrink grout or mastic

4. **Roofing down spouts, footer drains or floor drains tied into system:** notify owner to relocate connection downstream of system

5. **Check valve is stuck in closed position:** repair or replace check valve

Sampling

Proper sampling techniques are important to ensure that the results are representative of system performance. To ensure an accurate sample is collected, Norweco recommends that a sample port be installed immediately downstream of the treatment system. The sample ports should allow a free falling sample to be collected. Sample ports should be cleaned before attempting to collect a sample.

If a sample port has not been provided, effluent from the Bio-Film Reactor should be evaluated by collecting a sample from the liquid above the Reactor Elements. The sample should be collected from 2-3" below the liquid surface to avoid collection of any floating solids that could interfere with results.

If a sample port has not been provided, effluent from the Phos-4-Fade filter should be evaluated by collecting a sample from the liquid above the Phos-4-Fade media. The sample should be collected from 2-3" below the liquid surface to avoid collection of any floating solids that could interfere with results.

Samples of the UV system effluent must be collected from a sample port installed downstream of the UV disinfection system.

If an influent sample is required, the influent sample should be collected from the pretreatment chamber.

For Additional Information, Please Contact:

Waterloo Biofilter Systems Inc.
143 Dennis Street, PO Box 400
Rockwood ON N0B 2K0
T: 519-856-0757 F: 519-856-0759
www.waterloo-biofilter.com

Homeowner Manual

Waterloo Biofilter® Residential
Wastewater Treatment System

Waterloo Baskets Model: AD-BAXX

This product is certified to CAN/BNQ 3680-600 Class B-IV and respects the requirements thereof.

Serial No.: BI-XXXXXX
Capacity: X,XXX litres per day

Waterloo Biofilter Systems Inc.
143 Dennis Street, PO Box 400
Rockwood ON N0B 2K0
T: 519-856-0757 F: 519-856-0759
www.waterloo-biofilter.com

DANGER!

There are pipes and electrical wires buried near your Waterloo Biofilter® system. Please contact your installer or maintenance provider before attempting any excavation in the area surrounding your system. Failure to do so may result in damage and could cause serious electrical shock!

DANGER!

DO NOT attempt to service any component of the Waterloo Biofilter® system yourself and DO NOT enter any of the tanks associated with your system! You risk serious injury or death by doing so!

Your Waterloo Biofilter leaching bed is designed and constructed for your unique site. Please contact your installer or maintenance provider before carrying out any landscaping or re-grading in the area surrounding your system.

Please ensure that there is easy access at all times to the lids of your anaerobic digester and treatment unit tanks. This will facilitate system inspection and maintenance.

Your Waterloo Biofilter® sewage treatment system is a biological system and its proper function is dependent on the characteristics of your wastewater. DO NOT pour anything down your drains/toilets/sinks that will not biodegrade or that will harm bacterial populations. Keep the following out of your system to ensure the best system performance:

- water softener backwash
- sump pump discharge
- paints; solvents
- strong acids & bases
- pesticides
- industrial cleaners
- toilet bleach pucks
- prescription drugs
- cooking oil & grease
- detergent with bleach
- antibacterial products
- cigarette butts
- paper towels
- condoms
- garburator discharge
- coffee grounds
- diapers & wipes
- tea tree oil
- disinfectants
- feminine hygiene products
- medicated shampoo

DIRECTORS, OR AGENTS BE LIABLE FOR ANY DIRECT LOSSES, COSTS, OR DAMAGES THAT EXCEED THE PURCHASE PRICE OF THE PRODUCT. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO THE PURCHASER.

Governing Law and Attornment

This Limited Warranty is governed by and will be construed in accordance with the laws of the Province of Ontario and the laws of Canada applicable therein. Waterloo Biofilter and the owner hereby attorns to the jurisdiction of the courts of Wellington County in the Province of Ontario with respect to any dispute arising under this Limited Warranty.

This Limited Warranty gives you certain specific legal rights, and you may also have other rights which vary from state to state or province to province.

Filter Medium Biodegradation

For the purposes of this Limited Warranty, biodegradation is defined as the decomposition of the filter medium by the action of microorganisms such as bacteria that are naturally present in sewage. Damage to the foam filter media caused by means other than biodegradation as defined above is excluded from this Limited Warranty.

Causes of damage excluded under this Limited Warranty include but are not limited to: paints, harsh cleaners or chemicals, water softener backwash, solvents, strong acids, strong bases, insects, animals, excessive flow rates and ultraviolet light.

Transfer of Ownership

If there is a change in ownership of the property where the product is installed, this Limited Warranty may be transferred once under the terms and conditions of this Limited Warranty to the new property owner, provided that:

- Waterloo Biofilter is notified of the transfer of ownership in writing within 90 days of the closing of the property sale, AND
- the new owner's complete name, mailing address and valid phone number is provided in said notification, AND
- the new owner accepts the terms and conditions set out in this Limited Warranty

The effective date of warranty coverage will remain the date of shipment of the original purchase by the original property owner or their agent. If the new property owner fails to provide Waterloo Biofilter with a written notification as stated above this Limited Warranty shall be considered null and void. This Limited Warranty cannot be transferred again.

Making a Claim

If the product is defective you should immediately notify the system installer or maintenance provider. If it is found that the problem is caused by a manufacturing defect notify Waterloo Biofilter immediately and an inspection in regards to the warranty claim will be performed by us or our authorized representative.

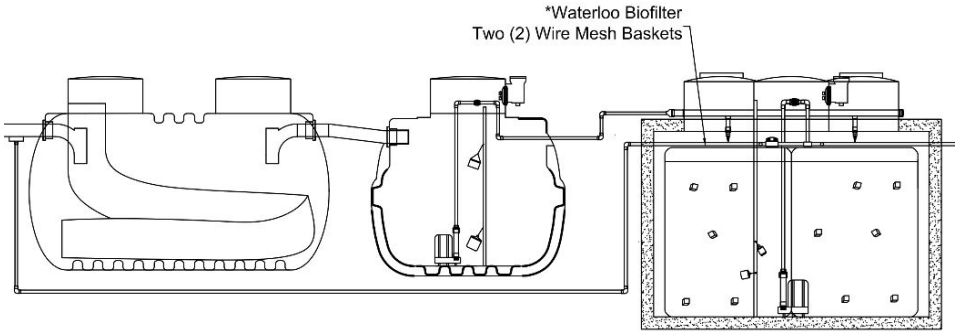
Access to the property and all system components must be granted for inspection purposes. If it is found through this inspection that the product is performing in accordance to the specifications herein, or that the problem is not a result of manufacturer's defect, a charge of $100 plus direct expenses will be invoiced to the owner. If it is found that the product is not performing as specified herein no charge will be applied.

Limitation of Liability

This Limited Warranty is the only warranty given by Waterloo Biofilter. No one is authorized to make other warranties on Waterloo Biofilter's behalf. IN NO EVENT WILL WATERLOO BIOFILTER, OR ITS DIRECTORS, OFFICERS, OR AGENTS, BE LIABLE TO THE PURCHASER OR ANY THIRD PARTY, WHETHER IN CONTRACT, IN TORT, OR ON ANY OTHER BASIS, FOR ANY INDIRECT, SPECIAL, PUNITIVE, EXEMPLARY, CONSEQUENTIAL, OR INCIDENTAL LOSS, COST, OR DAMAGE ARISING OUT OF OR IN CONNECTION WITH THE SALE, MAINTENANCE, USE, OR INABILITY TO USE THE PRODUCT, EVEN IF WATERLOO BIOFILTER, OR ITS DIRECTORS, OFFICERS, OR AGENTS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH LOSSES, COSTS OR DAMAGES, OR IF SUCH LOSSES, COSTS, OR DAMAGES ARE FORESEEABLE. IN NO EVENT WILL WATERLOO BIOFILTER, OR ITS OFFICERS,

How Your Waterloo Biofilter® System Works

Your Waterloo Biofilter is an attached growth biological trickling filter designed for residential wastewater only. Sewage is pre-treated by an anaerobic digester then distributed over the Waterloo Biofilter filter medium. The wastewater is absorbed into the medium where it is oxidized and degraded by naturally occurring bacteria. Treated Biofilter effluent is recirculated back to the anaerobic digester for additional treatment and discharged to a leaching bed where it is dispersed into the ground.



Schematic overview of the Waterloo Basket configuration

- **Control Panel** - located in your yard against your house to control the effluent pumps.
  DO NOT attempt to access the control panel yourself.
- **Anaerobic Digester** - provides digestion and settling of solids. The tank must be pumped when sludge occupies 1/3 of the total volume.
  Keep tank risers accessible for pumping and maintenance.
- **Pump Tank** - houses an effluent pump and float controls to dose the Biofilter.
  Keep pump tank riser accessible for maintenance.
- **Biofilter Treatment Unit** - houses the Biofilter Baskets for aerobic treatment and an effluent pump and float controls for recirculation and dispersal.
  Keep Biofilter tank lid accessible for maintenance.
- **Leaching Bed** - disperses treated water into the ground.
  DO NOT drive heavy vehicles over the leaching bed.

In the Event of an Alarm

Your control panel is equipped with audible and visual alarms. When the alarm goes off you will hear a loud buzzer sound and the red light on top of the control panel will turn on. It is unlikely for an alarm to go off when no one is home because the system only operates when water is being used.

Why is the Alarm Going Off?
The alarm indicates that the water level in either the pump tank or Basket Biofilter tank is too high.

What Should You Do?
You should call your maintenance provider immediately. Limit water use until the problem has been corrected.

How Do I Silence the Alarm?
Flip the black switch labeled *'SILENCE/TEST'* located on the side of your control panel. Remember that this does NOT mean the problem has been solved.

When contacting your maintenance provider please mention the specifications appearing on your Biofilter's nameplate to facilitate quick service.

Indicators of Problems

The key to high treatment levels and problem-free operation is a healthy bacterial population in your anaerobic digester. It is the homeowner's responsibility to respect the laws and regulations in terms of effluent quality discharged to the environment from this certified product. Remember that what you put into the system affects what comes out. Anything that degrades slowly or is harmful to bacteria should not be put into your system.

If any of these occur you should call your maintenance provider immediately.

- Sewage odour around the system; however, odour coming from the vent pipe on the roof is normal and can down-draft into windows etc.
- Standing water around the leaching bed
- Subsiding or very wet soil in the leaching bed
- Very slow draining or backstopped toilets or fixtures

the Warranty Period. This Limited Warranty does not cover any travel time or other labour costs. This Limited Warranty does not cover any shipping costs to or from Waterloo Biofilter's dock, to or from the designated service provider, and to or from the installation site.

Warranty Exclusions
This Limited Warranty does **NOT** apply;

1. if any portion of the product invoice issued by Waterloo Biofilter is outstanding, even if the product owner has paid in full their purchaser, installer, or agent for said product
2. to any component not supplied by Waterloo Biofilter including, but not limited to, anaerobic digester(s), pump tank(s), other concrete tanks(s), electrical wiring, plumbing, drainage or effluent disposal system
3. to any damage caused by improper transportation, handling, installation or maintenance of the product
4. to any damage or problem caused by act of God
5. to any damage or problem caused by the fault or act of a third party
6. to any damage or problem arising from any installation, modification, correction or addition carried out, or attempted to be carried out, on the product by a person not authorized by Waterloo Biofilter
7. to any damage or problem caused by the fault or action of the owner, or the owner's successors, including but not limited to refusing system access for maintenance, tampering with the system, altering control panel settings, or any other attempt to repair, maintain, access or inspect the Waterloo Biofilter system
8. to any damage or problem if it is demonstrated that the Waterloo Biofilter treatment unit was used outside of its designed use or rated flow capacity, or was not used and maintained in compliance with the terms and conditions outlined in the Owner's Manual
9. to any damage or problems resulting from heavy machinery or vehicles parked on or driven over the product
10. to any damage or problem caused by excavation, demolition, landscaping, snow removal, re-grading or construction to the product installation area
11. to any damage or problem resulting from errors in design specifications provided by the purchaser or its agents
12. to cosmetic damage such as scratches, scrapes, minor dents, or fading of stains, sealants or colourings.

Particular Exclusions

Maintenance Requirements
Under the Ontario Building Code all advanced wastewater treatment units are required by law to be serviced and maintained by an authorized maintenance provider. Failure by the system owner to maintain a current maintenance agreement with such a maintenance provider authorized by Waterloo Biofilter will void this Limited Warranty, and Waterloo Biofilter shall be considered completely discharged from all obligations under this Limited Warranty. Annual and complete maintenance records must be presented to Waterloo Biofilter upon request. Failure to present annual maintenance records will void this Limited Warranty.

Failure by the system owner to take preventative and corrective maintenance actions recommended by the maintenance provider in a timely fashion, including but not limited to periodic pumping of the anaerobic digester, will void this Limited Warranty.

LIMITED WARRANTY

Residential Models: 11 to 100 inclusive

This Limited Warranty is applicable to the above noted models of wastewater treatment units invoiced by Waterloo Biofilter Systems Inc. (Waterloo Biofilter) after March 1, 2009. This Limited Warranty shall only become effective upon receipt by Waterloo Biofilter of the Warranty Registration Card within 90 days of the date of product invoice issued by Waterloo Biofilter. Failure to send in the Warranty Registration Card to Waterloo Biofilter within this time frame means that Waterloo Biofilter may not be required to fulfill any of the obligations contained in this Limited Warranty.

Limited Warranty Coverage

Components manufactured by Waterloo Biofilter are warranted to be free from defects in materials and workmanship for the Warranty Period described below from the date of product shipment from our dock:

- Mesh Basket Enclosure – three (3) year limited warranty

Under this Limited Warranty, Waterloo Biofilter will, at its sole discretion, repair or furnish a replacement for such defective parts at no charge to the owner. Repaired or replacement parts will be warranted for the remaining portion of the original Warranty Period from the date of original product shipment.

Filter Medium

Waterloo Biofilter warrants that the foam filter medium will not biodegrade, under normal and expected operating conditions, to a point where it can no longer absorb wastewater, for a period of twenty (20) years from the date of shipment from our dock.

Under this Limited Warranty, Waterloo Biofilter will replace at no charge to the owner the portion of foam filter medium that is determined by Waterloo Biofilter to be defective. Replacement filter medium will be warranted for the remaining portion of the original Warranty Period from the date of original product shipment.

Other Components

All other components supplied by Waterloo Biofilter carry the original manufacturer's warranty and are not covered under this Limited Warranty offered by Waterloo Biofilter. The original manufacturer's applicable Warranty Periods are outlined below. Full copies of the original manufacturer's product warranties are available upon request.

- Effluent pumps – two (2) year limited warranty
- Control panels – three (3) year limited warranty
- Float switches – three (3) year limited warranty

Extended Warranty

Residential Models: 11 to 100 inclusive. If purchased at the time of order, the Extended Warranty increases the duration of the Warranty Period to five (5) years on electrical components including pump(s), control panel, and float tree(s). All other terms and conditions contained in the Limited Warranty apply.

Shipping and Labour Costs

Under this Limited Warranty, Waterloo Biofilter will not pay labour costs for installation or removal of product for repairs or replacements covered by this Limited Warranty which are performed by a Waterloo Biofilter designated service provider or others during

Maintenance Contracts

Homeowners with advanced sewage treatment systems are required by law to have a maintenance contract with an authorized provider. It is the responsibility of the homeowner to keep the contract up to date. Failure to maintain a current maintenance contract with an authorized provider voids the Limited Warranty offered by Waterloo Biofilter.

Preventative Maintenance Saves Money

Regular maintenance ensures that the system functions properly and remains operational for a long time. Regular maintenance helps to prevent and solve problems before they become larger issues that may require costly excavation or replacements.

Authorized Maintenance Providers

Waterloo Biofilter is the main authorized service provider for systems in Ontario and will contact you to setup up the agreement. If you have not heard from Waterloo Biofilter regarding your maintenance, please call us at 1-866-366-4329 x 277 or email us at service@waterloo-biofilter.com.

Importance of Warranty Registration Card

Please take the time to fully complete and send in the Warranty Registration Card accompanying this Homeowner Manual as soon as it is received. This allows us to keep track of our systems and readily provide you with product and troubleshooting support if required. The Warranty Registration Card must be received within 90 days of the date of invoice by Waterloo Biofilter in order to make any claim against the Limited Warranty offered on your system.

My Maintenance Provider Is

Company: _____

Phone: _____

Address: _____

_____

Maintenance Records

Date	Notes	Signature

FAQ

What is the protocol for vacations or seasonal homes?

You do not need to do anything to the system when you leave it unattended for a long period of time. The pumps will remain inactive so long as no wastewater is being generated at the site.

What do I do if the power goes out?

The pumps will not function and the pump tank and anaerobic digester will start to fill up. Limit water use until the power returns.

Solutions to Common Problems

Problem	Consequence	Solutions
Disinfectants • bleach • chlorine	Kills the bacteria in anaerobic digester preventing proper treatment	Limit use of anti-bacterial products and disinfectants; use chlorine-free cleaning products
Chemicals • pesticides • prescription drugs	Kills bacteria; may contaminate ground water or wells	Don't pour chemicals down the drain; direct water softener backwash away from the system
Paints • paints • solvents	Kills bacteria; clogs pipes and disposal field	Don't pour paints or solvents down the drain
Hydraulic Overload • too much water flowing into system at one time	Flushes solids out of anaerobic digester without a chance to be broken down	Wash only full loads of clothes or dishes; fix leaky toilets; don't connect sump pumps or RV waste to system
Food /Grease • garburator discharge • fats, oils & grease	Difficult for bacteria to breakdown; clogs pipes and disposal field	Don't use an in-sink garbage disposal; don't pour fats down the drain; scrape food off dishes before washing
Landscaping • heavy objects • re-grading • paving	May damage system; may cause water to pond; prevents necessary evaporation	Don't drive heavy equipment over system; consult installer/service provider before re-grading; don't pave leaching bed

143 Dennis Street, PO Box 400
Rockwood ON N0B 2K0
Tel: 519-856-0757 Fax: 519-856-0759
www.waterloo-biofilter.com

Waterloo Biofilter Residential Maintenance Checklist

Installer: _____ Phone: _____

Owner: _____ Address: _____

Phone: _____ E-Mail: _____

☐ OK ☒ No – See Notes ■ Not Applicable

Anaerobic Digester	Notes:
☐ Inlet pipe enters InnerTube and is free of debris ☐ InnerTube secure ☐ InnerTube ends in 1st third of tank ☐ Water level in tank compared to inlet ☐ Fermentation present ☐ No evidence of FOGs ☐ Normal odour ☐ Organic material is breaking down ☐ No evidence of nonorganic material ☐ Pictures Sludge Measurements:_____	

Internal Pump Chamber or External Pump Tank		Notes:
☐ Pumps & floats working ☐ Forcemain free-draining ☐ Inline filter clean ☐ Splice box cord connectors are secured ☐ Splice box is free of standing water ☐ Pump ropes properly secured ☐ Pump and float wiring properly secured ☐ Float tree in correct position ☐ Pictures		

Waterloo Biofilter Treatment Unit ☐ SH ☐ BA ☐ FB ☐ BFHD ☐ BFCN		Notes:
☐ Effluent is healthy ☐ No odour ☐ Passive air vent(s) clear Charcoal replacement needed ☐ yes ☐ no ☐ Nozzles clean ☐ Foam height appropriate ☐ Spray distribution even ☐ Foam colour normal ☐ Pumps & floats working	☐ Forcemains free-draining ☐ Recirculation ratio 50% ☐ Splice box cord connectors are secured ☐ Splice box is free of standing water ☐ Pictures	
Control Panel		Notes:
☐ Control panel operating ☐ Control panel timer setting correct ☐ Control panel alarms working ☐ Control panel sealed and free of corrosion ☐ Pictures	Pump Amps:	
Leaching Bed		Notes:
☐ Bed is dry ☐ Access hatches secure ☐ Healthy grass cover ☐ Proper grading ☐ SBT spray height > 600 mm ☐ Pictures		
Installation		Notes:
☐ Install looks good ☐ No construction debris found in system ☐ Electrical is correct ☐ Pictures		
Homeowner		Notes:
Review of best practices needed ☐ yes ☐ no ☐ other		
Recomendations		
Next Visit: ☐ 6 month ☐ 12 month		

Technician's Signature _____ Date _____ Time _____

WSB® clean: Operator, Service & Maintenance Manual

Models:

WSB 400	WSB 1250
WSB 500	WSB 1500
WSB 600	WSB 1600
WSB 750	WSB 1800
WSB 1000	

RES-WSB-OSM
Version 1.0

TABLE OF CONTENTS

1 INTRODUCTION

This manual covers the operation and maintenance for all residential WSB® clean models. It is important that you read through this entire manual before providing any service on the system. If you have any questions after reading this document or if you need any further information, please contact a customer service representative at (519) 648-3475

RH2O North America Inc.
268 Woolwich St. S
Breslau, Ontario, Canada
N0B 1M0

Phone: (519) 648-3475
Fax: (519) 648-3585
info@rh2o.com
www.rh2o.com

This manual provides maintenance and service guidelines to ensure proper operation of your WSB® clean system. It does not provide any maintenance/service information on any other components of your treatment system (i.e. disposal bed) or outline any local regulatory requirements.

It is important that you read this manual in it's entirety to ensure that all requirements and details are clearly understood. If there is anything that is unclear or missing contact the manufacturer for clarification before proceeding.

Note: Please ensure that the system has been filled with clear water before starting the system.

Electrical cables and plastic piping are buried close to your treatment system. Please contact your installation contractor or RH2O North America prior to any digging or excavation work in the area surrounding your treatment system. Failure to do so may result in electrical shock causing death or serious bodily injury in addition to expenses to repair any damaged pipes/electrical damage.

2 SAFETY INFORMATION

Please read and follow the precautions listed below, as well as those found throughout this document. If you have any questions regarding the safety or operation of the WSB® clean wastewater treatment system, please contact us at: (519) 648-3475.

➔ **DANGER:**	Always turn off the power to the system before servicing any components. Failure to do so may result in electrical shock causing serious bodily injury or death. All work must conform to local electrical, plumbing and building codes.
➔ **DANGER:**	Electrical equipment in flooded areas presents an electrical hazard. Do not enter a flooded area. Entering a flooded area may result in electrical shock causing death or serious bodily injury.

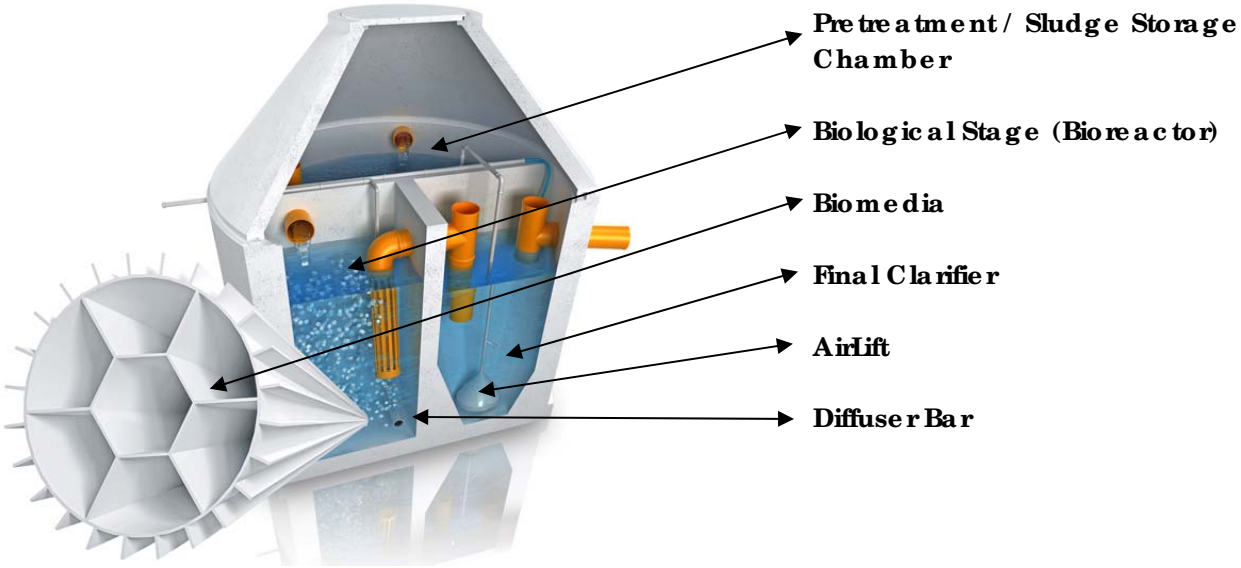
If contact with wastewater occurs, please remove any contaminated clothing and thoroughly wash all body areas and clothing exposed to wastewater with soap and water. To minimize any risk of illness, consult a physician.

Only authorized service personnel are to remove access covers on the WSB® system. Removal by unauthorized personnel may result in death or bodily injury from potentially hazardous gases and waste matter. Please ensure easy access to covers at all times for inspection and/or emergency purposes.

The use of this system when the air blower is not functioning can result in serious problems (i.e. clogging of your disposal bed/abnormal smells) and/or cancellation of the warranty.

3 WSB® CLEAN SYSTEM OPERATION

WSB® Clean is a fully biological wastewater treatment plant designed to treat domestic wastewater. Please refer to the Illustration and details below.



3.1 Pre-Treatment / Sludge Storage Chamber

Incoming wastewater travels by gravity into the pre-treatment tank where coarse particles settle and are stored here along with return sludge from the final clarifier.

3.2 Biological Chamber (Bioreactor)

Pre-processed wastewater from the Pre-Treatment / Sludge Storage chamber is now fed into the biological stage which contains the specially designed plastic carrier media. Microorganisms settle on the media and consume the organic material in the wastewater. Oxygen is needed for the biological cleaning process and is supplied by an air blower and distributed by fine bubble diffusers.

3.3 Final Clarifier

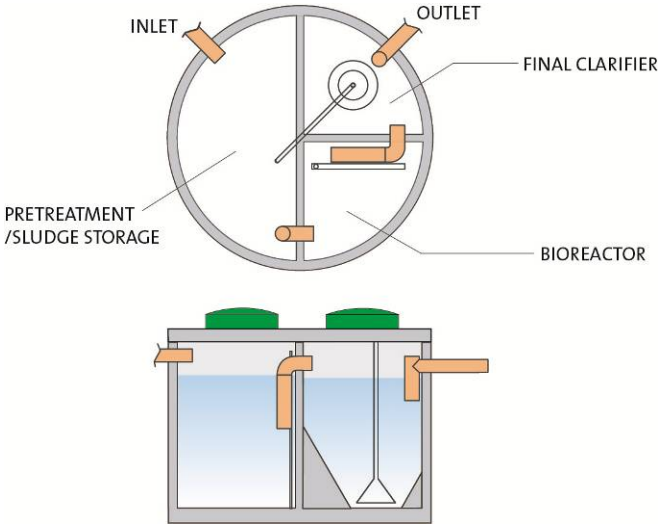
The final clarifier consists of a cone or sloped area in order to collect and transfer any secondary sludge back to the sludge storage. Sludge Return will be accomplished by either an air lift or pump. From the clarifier, the biologically cleaned wastewater is ready to be discharged back into the environment either via gravity flow, or via a pump tank.

3.4 Pump Tank (Optional)

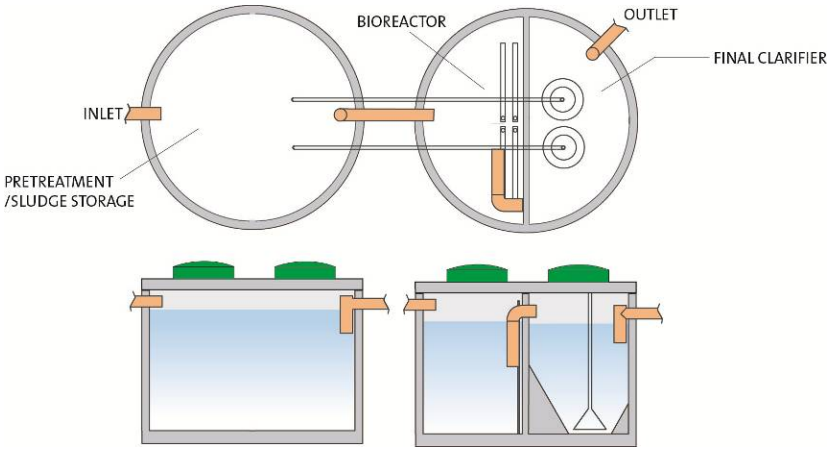
Depending on the type of disposal bed, you may have a pump tank to pressurize the treated effluent or lift the effluent to the bed. The pump tank stores treated effluent from the final clarifier and pumps it to the disposal bed at intervals based on the controller dosing pump settings. The dosing rate for the disposal bed should be determined by the designer of the disposal bed.

3.5 WSB® clean Wastewater Treatment System Layout

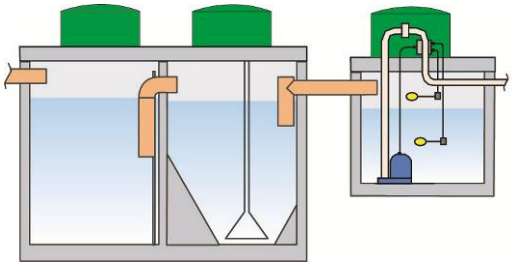
3.5.1 WSB 400 - 1000 – Single Tank Installation



3.5.2 WSB-1250-1800 – Two Tank Installation



3.5.3 Pump Tank – Example Installation



3.6 WSB® System Model Designation

Model Designation	Daily Capacity (L)	Number of Tanks	Pretreatment Capacity	NSF/ANSI 40 Classification
WSB 400	1600	1	2450 L	Class I
WSB 500	2000	1	2450 L	Class I
WSB 600	2500	1	2970 L	Class I
WSB 750	3000	1	2970 L	Class I
WSB 1000	3800	1	3490 L	Class I
WSB 1250	5000	2	5950 L	Class I
WSB 1500	5678	2	6950 L	Class I
WSB 1600	6300	2	6950 L	N/A
WSB 1800	7000	2	6950 L	N/A

Note: Please refer to the system data plate located on the control panel to identify which model you have.

3.7 System Classification

All WSB® Clean models meet the requirements of NSF/ANSI 40 and are certified as Class I treatment systems. Models with design flows larger then 5700 L/day (1500 Gallons/day) do not fall under the NSF/ ANSI 40 scope of work but have been verified by NSF as meeting the same design criteria.

3.8 Identification Plate

The identification plate is found on the WSB® control panel. The information on this plate identifies the size of the system and it may be required for responding to any alarms or issues with the system. If an identification plate is not on the control panel, please contact RH2O immediately.

4 WSB® COMPONENT FUNCTIONS / SETTINGS

4.1 Flow Equalization (EQ) / Balancing Pumps (optional)

Flow equalization (balancing) pumps are used only on systems that require a lift station, or flow equalization tanks. The flow EQ pumps are configured to dose the system with the appropriate flows on a daily basis based on the system design criteria.

The flow EQ pumps should be set to evenly deliver/pump the systems rated total daily design flow over a 24 hour period. For example: A system with a total daily design flow of 2400L and a pump with a flow rate of 100L/min, would be set for 1 minute pulse (ON) every 59 minute pause (OFF) cycle. This would evenly distribute the total flows across a 24 hour period.

4.2 Blowers

The blowers function in the WSB® process is to ensure that the floating media is mixed within the bioreactor and to maintain the appropriate dissolved oxygen levels required to sustain the proper bacterial growth on the media.

The minimum dissolved oxygen level at the end of the pause cycle should be 2mg/L

The default settings for most WSB® home units is 9min ON / 6 Min off during the day and 5 min on/ 25min off during the night. These settings may have to be adjusted based on the size of the system, homeowner water usage and habits, and blower size.

4.3 Sludge Return Pumps

Sludge return pumps are located in the final clarifier(s) and are used to return any sludge build up that may occur within the final clarifier to the pre-treatment / sludge storage chamber. In some systems a sludge return air lift may be used in place of a sludge return pump. The sludge return pumps must remove the sludge at a rate to prevent sludge accumulation from taking place in the clarifier.

For information on runtime settings please see section 17

4.4 Sludge Return Air Lift

The sludge return air lift is an alternate sludge return mechanism that instead of using a physical pump uses air flow and the resulting vacuum to suck any sludge that may have accumulated on the bottom of the final clarifier back to the pre-treatment / sludge storage chamber.

For information on runtime settings please see section 17

4.5 Disposal Bed (Final Effluent) Pumps

In applications where it is not possible for the effluent to flow from the final chamber to the bed via gravity (or due to other regulatory requirements) a pump tank is used. The disposal pumps are located in the pump tank and will pump, based on runtime settings specific to the system design flows and the dosing pump flow rates, the final effluent to the disposal bed. A pump tank actually provides many advantages including more complete dosing of the bed.

The disposal pump settings are based on the total system daily design flow and the size and type of disposal bed receiving the effluent. The actual runtime settings for the disposal bed pumps will be determined by the local regulations, and the engineering design report for the specific site and bed type.

5 MAINTENANCE SCHEDULES

NSF requires that all systems are serviced twice a year for the first 2 years. In addition to the NSF requirements your local regulatory agency may have additional service/maintenance requirements. The WSB® system itself is designed to operate normally with only annual servicing.

IMPORTANT: It is your responsibility as the maintenance provider to ensure compliance with local regulations.

6 MAINTENANCE PROCEDURE

During regular, or unscheduled maintenance, any system changes, observations, and measurements taken shall be recorded by the service provider on the service card or similar document.

6.1 Maintenance Equipment Checklist

Equipment required for inspection and maintenance on a system are:

- Protective Gloves
- Eye protection
- Dissolved oxygen meter
- Sludge Measuring Device (i.e. Sludge Judge®)
- Robertson #2 screw driver
- CFM meter
- Sampler and bottles
- Filters for air blower

6.2 Home/System Owner Inspections

The treatment plant must be checked regularly to ensure that the system is operating properly. The system owner (homeowner), as outlined in the owner's manual, is responsible for performing exterior system visual inspections on a weekly basis and reporting any controller alarm conditions immediately. It is recommended that the system/home owner check for alarms daily.

6.3 Site Inspection

As part of the regular maintenance procedure the following sections outline the site evaluation/inspection that should be performed on a WSB® clean system.

6.3.1 Inspect Lids

Before service begins check all access openings for damage and ensure that the lids are properly sealed/secured onto the tank access opening.

6.3.2 Settled Ground

When entering the site area do a visual scan for any settled ground around the treatment plant. Make sure there is no ground water ponding around the treatment plant area, and make sure proper grading is maintained to direct surface water away from treatment plant.

If it is identified that the ground has settled around the treatment plant or that ponding is evident the homeowner should be instructed to improve the grade around the treatment plant to correct and level the settled areas. This will ensure proper surface water flow away from the treatment plant area and to prevent future ponding.

NOTE: This is a good time to take a smell test to see if there are any odors coming from the treatment plant.

6.4 Gather Effluent Sample

Samples should always be gathered prior to doing any maintenance work on the system. Effluent samples may be taken if required by local regulations, or due to a desire to verify effluent quality.

For detailed instructions on gathering samples see section 8.2

6.5 Bioreactor Inspection

6.5.1 Odors

Before and after removing the lids to the bio-reactor you should do a smell check to tell if the system is working properly. At most you should notice a "mild musty smell". A septic smell will mean the system is not operating properly and changes must be made.

6.5.2 Media Color

After the start up period, the media will turn a light to dark brown colour. This is the bio-film growth and shows a healthy system. On heavier loaded systems it will turn a dark colour and a lighter colour for systems that have a lighter organic load.

NOTE: During start-up, the bio-reactors may foam.

6.5.3 Media Rollover

It will take approximately 2 weeks for the media to properly rollover completely in the bio-reactor. It should be a gentle rollover and cover the complete reactor area. To fast of a rollover will result in a higher suspended solids count in the final clarifier, A slow rollover will not provide the proper cleaning of the media and may leave dead spots in the reactor.

If you notice issues with media rollover refer to section 7.3.

6.5.4 Dissolved Oxygen Level Check

Dissolved Oxygen levels should be measured at the end of a run cycle and at the beginning of a run cycle. Dissolved oxygen should never be below 2 mg/l. A Dissolved Oxygen meter is a tool that shall be used for these measurements.

6.5.5 Blower Pressure / CFM Check

Take the air hose off the blower and attach the cfm meter to see if the blower is working within the blowers design cfm flow rate. Check hose connections and inspect blowers for any external damage or wear.

Check filter (must be replaced at least once per year).

6.5.6 Water/Effluent Color/Texture

When blower is off water should look clear on top of media and there should be a slightly mild musty odor.

6.5.7 Liquid Level

Make sure that liquid levels are at proper levels and that there are no obstructions in the transfer pipes. The water level should under normal operation be at the bottom of the outlet. If it is higher or lower please refer to the trouble shooting guide.

6.6 Final Clarifier Inspection

6.6.1 Odors

The clarifier should have a mild musty odour at most. If the odor is strong please see section 7.2 for trouble shooting procedures.

6.6.2 Floating Sludge

If there is floating sludge in the final clarifier you must check the thickness to see how much is present. If it is very thick and dark brown/black then the sludge return rate should be increased. Atmospheric and temperature changes will cause floatables from time to time and does not necessarily indicate a system problem.

If the floating sludge is very thick and dark brown/black it maybe necessary to schedule more frequent visits to check for increasing float sludge. If you notice that from visit to visit

the floating sludge blanket is increasing in thickness then this is an indication of improper sludge return/removal configuration.

6.6.3 Sludge Level Check

If during the floating sludge check you notice significant levels of floating sludge a sludge level check should also be performed, as below, to check sludge levels on the bottom of the clarifier. A sludge judge® tool should be used for this check.

Sludge levels need to be recorded and checked before the sludge return run cycle, and again at the end of the run cycle. This will determine if the sludge return run cycle is long enough to remove the settled sludge that has accumulated between each run cycle. If there is excessive sludge in the system the sludge return pump or suction airlift run time should be increased to ensure that adequate sludge return is achieved.

For more information on troubleshooting excessive sludge see section 7.2

6.6.4 Water/Effluent Color/Texture

Should generally be clear in color and little to no odor. If this is not the case please refer to the troubleshooting section.

6.6.5 Liquid Level Check

Check to make sure that the water level in the clarifier is at or just below the outlet. This is the proper depth of water during normal operation. If the water level is high or low please refer to the troubleshooting section for possible causes.

6.6.6 High Level Warning Float Check

High warning switch should be checked for proper level and that it is in working order. For details on testing floats please see section 7.2

6.6.7 Electrical Cords

Check any electrical cords for any apparent damage and that they are properly fastened. Any damaged electrical cords should be repaired immediately.

6.6.8 Media Transfer

Make sure no media has transferred from the bio-reactor into the clarifier. If any media has transferred it must be removed and put back into the bio-reactor.

If you identify media transfer please see section 7.2 for possible causes and remedies.

6.7 Pre-Treatment / Sludge Storage Tank Check

6.7.1 Water/Effluent Color/Texture

Normally water in the pre-treatment tank will have a septic smell with a possible scum layer.

6.7.2 Liquid Level Check

Check to make sure liquid levels are at a proper depth and that the inlet from the house has no debris left in the pipe. Under normal operation, water levels should be at the bottom of the outlet from the sludge storage tank.

6.7.3 Sludge Level Check

Using a Sludge Judge device, measure the level of sludge in this section of the tank. Once the level of sludge reaches a 60% depth the homeowner must be notified that this compartment must be emptied, and only this section of the tank is to be pumped.

Generally a system would require pumping from the pre-treatment/sludge storage chamber every 1-3 years.

IMPORTANT: The removal of solids from the pre-treatment / sludge storage chamber must be carried out by a specialized firm. The WSB® system has been designed so that only the pre-treatment chamber requires periodic sludge removal. Sludge levels will be monitored as part of the maintenance agreement and homeowners will be notified when pumping is required. It is the homeowner's responsibility to ensure sludge removal is performed by a certified professional, and in compliance with local regulations, and that all records of service are kept for future reference.

6.7.4 Media Transfer Check

If media has transferred back into this chamber it must be removed and placed back into the bio-reactor. Usually this only happens if flooding occurs in the disposal bed or a blocked pipe to the disposal and liquid backs up into the system.

If you identify media transfer please see section 7.2 for possible causes and remedies.

6.8 Pump Tank Check

6.8.1 High Level Alarm Float Check

High warning switch should be checked for proper level and that it is in working order. The alarm trigger level should be set to allow ample time after alarm the goes off to have a service technician be able to arrive and fix the problem before a back up occurs in the house.

For details on testing floats please see section 7.2

6.8.2 Low Level Pump Float Check

Check the low level float for proper adjustment and that it is in working order. This float switch should be set that it will shut the timer control off while keeping the pump totally submerged under effluent. To check if the float is working pull the float out of the liquid, put it in the inactive position (down), and see if the timer for the pump tank stops running.

6.8.3 Inspect Electrical Cords

Make sure all cords are free from damage and securely fastened. Any damaged cords should be repaired immediately.

6.9 Control Panel Check

6.9.1 Error Reports Check

Read the error reports on the panel and download them or record them manually in a book for record keeping. Review the error reports that occurred since the last maintenance visit and assess their potential causes. Any errors which could be a result of improper use of the system (i.e. flooding alarms, system power loss etc.) should be discussed with the system/home owner and included on the maintenance report.

6.9.2 Settings Check

Check all settings for the system with a laptop computer or manually to ensure they are correct.

6.9.3 Function Test

Run panel through the function test to make sure all equipment is in proper working order.

See section 10.2.3 for details on the function test.

6.9.4 Control Panel Alarms

The Control Panel should be checked for any alarms that may be present during maintenance. Any alarm conditions should be assessed and addressed before maintenance is complete.

6.10 Final Inspection

Before leaving check to make sure all lids are properly sealed and fastened down and leave a service report/indicator for the homeowner.

7 TROUBLESHOOTING

7.1 Effluent Water Quality Targets

When quality of treated effluent is not meeting the criteria as outlined in section 8.1, there are 4 major areas to look for problems.

Possible cause	Possible remedy
Check dissolved oxygen levels to insure they are at least 2 mg/l at the end of the pause cycle.	You may have to adjust the blower run time to insure adequate dissolved oxygen is achieved for each run cycle to sustain it through the off cycle to above 2 mg/l. Caution should be taken not to make the pulse ("ON") cycle too long which may cause too much stripping of the bio-film on the media. It may be more effective to reduce the pause ("off")_time to allow for more frequent addition of dissolved oxygen.
Check media roll over when blower is running to insure that adequate pressure is coming from blower.	If too little roll over of media is observed then the likely cause is low pressure from the blower. You should first check your blower filter to make sure it is clean and free from obstructions. You should also check the blower for CFM levels to insure blower is performing within it's specifications. Conduct a filling degree test as per section 7.4
Check the sludge level in the pretreatment sludge storage, and see if there is any unusual grease build up or chemical odours.	If sludge level is greater than 60% of total volume in pretreatment tank it maybe entering the bio-reactor causing problems with the treatment. The homeowner must be advised to call a local pumping company to evacuate the pretreatment/sludge storage compartment. You may also need to test it for fats, oils and greases (F.O.G.) or harmful chemicals if they are detected and have the compartment evacuated to

	remove these. If there is continuous incoming flow maybe there is ground water infiltrating the system and/or water running constantly from house. The homeowner must be notified to check on these issues.
Check to make sure sludge return pump or suction air-lift is operating properly.	If sludge return pump has failed or is plugged it will cause sludge to build up in final clarifier and contaminate the final effluent. A check should be made to insure they are operating properly. If they are operating properly an adjustment of the pulse (ON) and pause (OFF) times may need to be done to get proper removal of settled sludge. See section 7.2
Improper Homeowner Use	See section 11

7.2 Media Transfer

If you observe media in any tanks other than the bio-reactor the following table will help you to identify and address possible causes:

Clarifier	Damaged outlet from bio-reactor	Check the outlet pipe and slotted media filter in the bio-reactor and replace if damaged
Pre-Treatment	High water/ flooding	Check swing check valve between the pre-treatment sludge storage chamber and the bio-reactor to make sure it is operating properly

7.3 Media Rollover

The following table lists the likely causes of media rollover issues.

Condition	Possible cause	Possible remedy
Insufficient rollover	Blower not running	Verify blower is functioning properly and that no blower lines are clogged or disconnected
	Diffusers blocked or blower line blocked	If the blower is operating within specifications but there is insufficient media rollover, the blower lines are blocked or the diffusers are clogged – check/clean/replace lines and/or diffusers
	Too much media in bio-reactor	Conduct a filling degree test as per section 7.4
Excessive rollover	Too little media in bio-reactor	Conduct a filling degree test as per section 7.4
	Broken airline from diffuser manifold	Check lines and manifold for leaks and repair or replace as necessary
	Incorrectly sized blower	Check blower to ensure it is a proper blower as per the WSB® System suppliers specifications

7.4 Filling Degree Check

To conduct a filling degree test follow the instructions below:

While the blower is running dip a 1L open jar down into the moving media and allow it to fill. Check to see what the percentage of media is versus liquid level. It should be between 40% and 65% filled with media.

If the filling degree is lower or higher than the levels specified please contact the system manufacturer/supplier.

7.5 Excessive sludge

If during the maintenance / inspection tests it is identified that there is excessive sludge, before increasing the pump run times verify that the sludge return pumps are not clogged or restricted and/or that the suction airlift is operating correctly.

Sludge levels need to be recorded and checked before the sludge return run cycle. At the end of the run cycle it should be measured again to insure all sludge has been removed. If not the run time may need to be increased.

If you notice that sludge seems to be floating up prior to the scheduled sludge return pulse (ON) time commencing then shorten the pause (OFF) time as this indicates air has been used up in the sludge and wild denitrification is taking place.

7.5.1 Troubleshooting Sludge Return Pump

To verify the sludge return pump is operating properly:
From the Series 2 Control panel run the function test (see section 10.2.3) and monitor the current draw on the sludge return output to ensure it is within normal operating range.
Check the sludge return line at the pre-treatment tank to ensure appropriate water flow levels when the sludge return pump is on

7.5.2 Troubleshooting Suction Air Lift

If the blower is working properly and the airline is not plugged on a sludge return air-lift device, the solenoid should be checked to see if it is opening properly.

1. Disconnect the airline going to the airlift at the solenoid output
2. Enable the solenoid valve via the series 2 control panel (turn on appropriate output) and ensure that there is airflow through the solenoid.

   If there is no airflow through the solenoid the table below outlines some possible causes and remedies:

Possible cause	Possible remedy
Blower not running	Verify blower is on when the solenoid valve output is on
Hose to inlet of solenoid clogged	Disconnect inlet to solenoid, turn on solenoid and verify airflow
Solenoid failed	If you have verified the blower is running, the output to the solenoid is on, and there is air pressure at the inlet of the solenoid, the solenoid itself may have failed. Replace Solenoid and retest

If there is airflow through the solenoid verify that the sludge return lines are not plugged.

7.6 High Level and Low Level Floats

If during inspection/test or during normal operation it is determined that a float is not operating properly the float needs to be tested. Below are troubleshooting instructions that should be followed in order to verify float operation.

7.6.1 Audible Alarm Float Check:

1. First ensure that the float is connected to the control panel.
2. Ensure that the control panel is configured to alarm on active high or active low condition for the float.
3. Hold the float in the active state; Up is on (active), down is off (inactive) on all floats in the WSB® system.
4. After 10 seconds in the active state the controller should begin to alarm. If you hear an alarm then the float is operating properly.

   NOTE: it is important to make sure the controller is powered and that the alarm buzzer is connected and/or the internal audible alarm is enabled in the controller menu.

5. If you don't hear any alarm after 10-15 seconds it doesn't necessarily mean the float is not working. You must first check the controller to see if an alarm condition is being displayed on the controller interface screen. If you see that an alarm is present on the controller interface screen the float is working. If you did not hear an alarm you need to check the alarm configuration settings.

7.6.2 Continuity Test Float Check:

If the float is not causing an alarm and you have ensured that the controller is configured to detect the alarm you can check the float with a continuity meter.

1. Disconnect the float from the controller input.
2. Place the float in the active state; up is on, and down is off for all floats
3. Place the continuity meter probes across the 2 terminals of the float.
4. If the float is working properly there should be continuity between the terminals when the float is in the active state.
5. Move the float to the inactive state and connect the continuity meter across the terminals again. There should be no continuity with the float in the inactive state.
6. If both of these tests pass the float is working properly and should be reconnected to the controller.
7. If you are not getting an alarm during the Audible Alarm Float Check double check your alarm configuration to make sure that it is setup properly.

   NOTE: If there is a junction box between the controller and the float it may be that there is a connection issue within the junction box. Please check these connections above if the alarm and continuity tests both fail.

7.7 Odors

Insufficient oxygen will result in odours and improper treatment. If you are detecting odours please review the blower configuration settings and test the Dissolved Oxygen levels as per section 6.5.4.

Possible cause	Possible remedy
Hydraulic overloads	Check all toilets for leaks and ensure all taps are turned off
	Check for eaves or sump pumps connected to system or ground water infiltration
Insufficient pressure on blower	Check air filter first, then check the

	blower CFM output to insure it is adequate.
Chemical contaminates	Talk with homeowner about the do's and don'ts and sample incoming for contaminates. If you are unsure but believe the issue is related to chemical contaminants then a test sample should be taken to check for contaminants. See section 11 for do's and don'ts
Fat's Oils and greases	Sample for Fats Oils and Grease and talk with homeowner about proper system operations.
Insufficient Dissolved Oxygen	You may have to adjust the blower run time to insure adequate dissolved oxygen is achieved for each run cycle to sustain it thru the off cycle to above 2 mg/l. Caution should be taken not to make the on cycle too long which may cause too much stripping of the bio-film on the media. It may be more effective to reduce the off time to allow for more frequent addition of dissolved oxygen.

7.8 Controller Alarms

7.8.1 Flooding

Flooding Alarms will occur when the water level in the specific chamber increases above the normal operating level. Causes can vary depending on the chamber of the system in which the flooding alarm is being identified.

Possible cause	**Possible remedy**
Excessive flow to system	Check all toilets for leaks and ensure all taps are turned off. Check Water Softeners and other similar appliances.
Failed pump in pump tank (for systems with a pump tank only)	Replace pump
Failed or saturated bed	Call service provider
Ground/surface water Infiltration	Check for eaves or sump pumps connected to system

7.8.2 Overcurrent Alarm

On residential systems all pumps except the Disposal Bed pump (current sense optional) have integrated current monitoring. The current sense allows for early detection of pump failure that can lead to flooding alarms, or other issues with proper system operation.

Possible cause	**Possible remedy**
Failed Pump / Blower	Replace Pump / Blower

Jammed or clogged pump	Inspect pump and impeller for possible obstructions
Blower hose break or connection loss	Inspect blower lines and connections
Max Current Alarm Level on controller set too low.	While the pump / blower is in operation check the current reading on the controller screen. If the pump/blower is operating within its rated specifications for current draw it might be that the max current setting for the output in question was set too low and needs to be adjusted.

7.8.3 Undercurrent Alarm

On residential systems all pumps except the Disposal Bed pump (current sense optional) have integrated current monitoring. The current sense allows for early detection of pump failure that can lead to flooding alarms, or other issues with proper system operation.

Possible cause	Possible remedy
Failed Pump / Blower	Replace Pump / Blower
Breaker or fuse blown	If the pump has a separate fuse or breaker ensure that it has not blown/tripped and that the pump/blower is getting power.
Wiring issue	With all power to the system turned off, inspect electrical wires for the pump at the controller and any junction boxes to ensure no connections have come loose or corroded.
Plugged/clogged diffusers on bio-reactor blower TH	Inspect blower lines for obstructions and change diffuser if they are plugged.
Min Current Alarm Level on controller set too high	While the pump / blower is in operation check the current reading on the controller screen. If the pump/blower is operating within its rated specifications for current draw it might be that the min current setting for the output in question was set too high and needs to be adjusted.

7.8.4 Fuse Failure Alarm

All outputs on the WSB® controller are fused. If there is an overcurrent condition for too long the fuse may blow and result in a fuse blown alarm. Under normal conditions the high current alarm check should prevent the fuse from blowing but there are some conditions in which the fuse may still blow.

Possible cause	Possible remedy
Failed Pump / Blower causing excessive current draw	Replace Pump / Blower
Short circuit	With power off inspect the wiring to the pump to ensure there are no short circuits. This can also be done with a multimeter set to measure resistance (ohms).

7.8.5 Air Pressure Sensor Alarm

WSB® systems with a suction air lift for sludge return are equipped with a solenoid valve to control the air flow to the suction lift. An air pressure sensor line is installed after the solenoid that runs back to the controller to ensure that when the suction air lift is supposed to operate that air flow is present and within acceptable ranges.

Possible cause	Possible remedy
Blower Line rupture or disconnect	Check all air lines to the solenoid and suction air lift
Failed Blower	Verify blower is operating correctly and replace if it has failed
Failed solenoid	Check to ensure that the solenoid is operating correctly and replace if failed
Incorrect Min/Max pressure settings for air pressure sensor	Verify the min and max air pressure sensor settings are set correctly in the controller for the specified blower

8 WATER QUALITY TESTING

8.1 Water Quality Targets

The WSB® clean system has been designed to treat wastewater under normal operating conditions to meet the following effluent criteria:

Parameter	Standard
BOD5	< 15 mg/L
CBOD5	< 10 mg/L
TSS	<10 mg/L

8.2 Water Quality Sampling

It is critical that appropriate procedures are followed when gathering a sample to ensure that accurate water quality testing can be conducted that is truly representative of the treatment plants operation.

Sampling must be taken by a person trained and certified by RH2O North America to ensure the sample gives accurate results in regards to how the system is performing.

8.2.1 Sampling with a Pump Tank

Always use adequately sized sampling containers. Sampling containers must be prepared and sterilized prior to collection at sampling site.

Create flow through the system by one of the following:

1. Turn on fixtures in home
2. Add water to the pre-treatment tank by using a garden hose or
3. Pumping water back from the pump tank (if applicable)
4. Locate the effluent pipe feeding from the WSB® clean system to the pump tank (in the event of no pump tank being present refer to section below regarding sampling without a pump tank).
5. Carefully place mouth of sampling bottle into the free falling stream of effluent, do not allow the mouth of the sampling bottle to touch the pipe or the wall of the pump tank, depending on how far the pipe protrudes into the chamber

6. Fill sample bottle almost to the top, ensure there is some room for 5-10% expansion during transport

7. Make sure that the lid of the sample jar is not contaminated and that no dust or debris gets inside the sample. If something gets inside, a new sample bottle must be used and another sample taken
8. Cap and label sample.
9. Samples must be stored in a cooler with ice during transport
10. The samples should be dropped off at the accredited laboratory immediately and any necessary paperwork must also be filled (e.g. Chain of Custody).
11. Check with your local laboratory to ensure proper size and labelling of samples are being met to ensure accurate sampling results.

NOTE: The sample should be taken to the laboratory within 24hrs, ideally sooner.

8.2.2 Sampling without a Pump Tank

1. Always use adequately sized sampling containers. Sampling containers must be prepared and sterilized prior to collection at sampling site.
2. Locate the Clarifier section of the WSB® model to be sampled, specifically where the outlet pipe is located.

3. Carefully place the end of the suction hose into the 6" outlet pipe just below the surface of the effluent and make sure the walls of the pipe are not brushed with the hose. Place the other end of the hose in the sample jar and turn on the pump (supplied by RH2O) to suck water from the Clarifier to the sample jar.

NOTE: The sampling pump and hose should be cleaned with a cleaning solution each morning prior to taking samples.

4. Fill sample bottle almost to the top, ensure there is some room for 5-10% expansion during transport

5. Make sure that the lid of the sample jar is not contaminated and that no dust or debris gets inside the sample. If something gets inside, a new sample bottle must be used and another sample taken
6. Cap and label sample.
7. Samples must be stored in a cooler with ice during transport
8. The samples should be dropped off at the accredited laboratory immediately and any necessary paperwork must also be filled (e.g. Chain of Custody).
9. Check with your local laboratory to ensure proper size and labelling of samples are being met to ensure accurate sampling results.

8.3 Lab Test Requirements

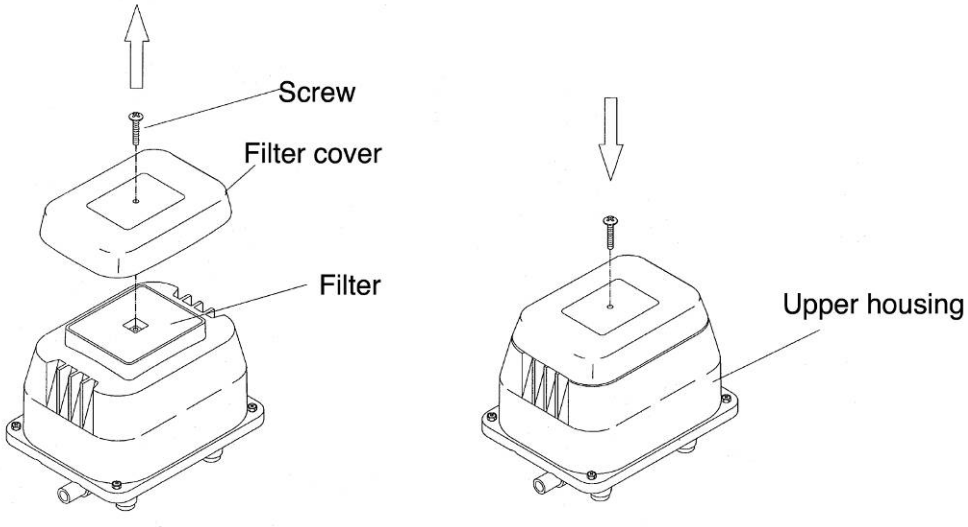
All samples must be tested by an authorized laboratory as per local regulatory requirements.

9 SERVICE PROCEDURES

IMPORTANT: If any equipment or parts are replaced the serial number and model number of the new component must be recorded on the service record and provided to RH2O North America.

9.1 Blower Filter Replacement

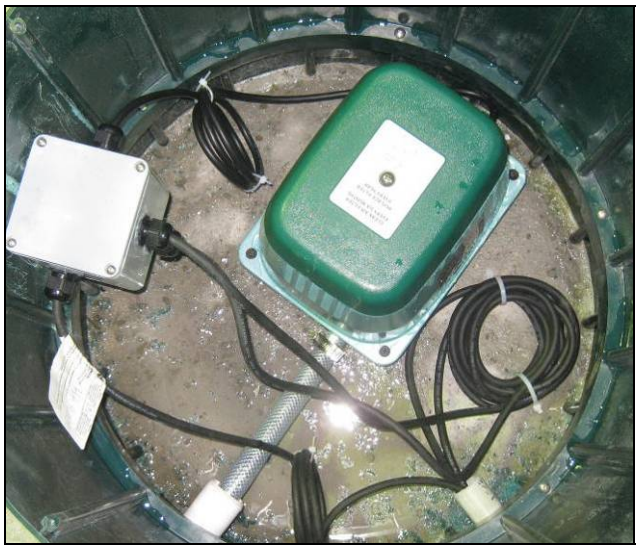
1. Lock out and tag controller power source.
2. Undo the cover screw securing the cover to the pump housing.
3. Remove the cover and filter pad
4. Replace filter pad and cover
5. Secure the cover with the cover screw
6. Restore power and test to assure it is functioning properly.



9.2 Blower Replacement

1. Lock out and tag controller power source
2. Remove airline and power cord and install new approved blower
3. Hook up electrical and airline
4. Restore power and test to assure it is functioning properly

WSB-400 – WSB-1000 (with Airlift)



WSB-1250-WSB-1800 (with sludge return pumps)

9.3 Sludge Return Pump Replacement

1. Lock out and tag controller power source.
2. Undo union and pull out pump via pvc pipe.

   IMPORTANT Do not lift the pump via the electrical cord.
3. Disconnect the old pump electrical cord from junction box connection and pull through conduit.
4. Feed new pump electrical cord through the conduit from the clarifier to the junction box.
5. Connect electrical in junction box
6. Remove outlet fitting and union from the old pump and put it on the new pump outlet.
7. Put pump back into chamber via the PVC pipe.

   IMPORTANT Do not lower the pump via the electrical cord.
8. Connect the union on the sludge return pump outlet to the sludge return pump line and connect.
9. Turn on power and test pump for proper operation.
10. Make sure union does not leak.

9.4 Sludge Return Air Lift Replacement

1. Lockout and tag controller power source.

2. Undo union and remove air lift from clarifier.
3. Remove airline connection from old air lift and connect to new air lift.
4. Place new air lift into clarifier.
5. Restore power and test to assure it is functioning properly.
6. Make sure union does not leak while it is operating.

For procedures on testing the sludge return air lift see section 7.5.2

9.5 Sludge Return Air Lift Solenoid Replacement

1. Lockout and tag controller power source.
2. Disconnect inlet and outlet air lines from the solenoid.
3. Remove fittings from old solenoid and do not discard.
4. Install old fittings removed in step above, to the new solenoid.
5. Connect inlet and outlet air lines to new solenoid.
6. Connect new solenoid to AC power
7. Restore power and test to assure it is functioning properly.
8. Make sure air line does not leak while it is operating.

9.6 Pump Tank Disposal Pump Replacement

1. Lockout and tag power source.
2. Undo union connecting pump to disposal bed.
3. Remove existing pump.

   IMPORTANT: Care must be taken to never lift pump by electrical cord or damage to watertightness of cord may happen
4. Remove outlet pipe and union from old pump
5. Install output pipe and union from old pump onto the replacement pump.

   IMPORTANT: If using a different approved replacement pump you must ensure that the outlet pipe/union and new pump result in the same height for proper connection to the existing plumbing when placed in the tank.

6. Place new pump into tank and ensure outlet pipe union mates appropriately with internal pipe union.
7. Restore power and test to assure it is functioning properly.
8. Make sure union has no leaks.

9.7 Float Replacement

1. Lock out and tag power source
2. Remove existing float
3. Take note of location of float weight as it is critical to ensure the weight is located at the exact same position on the new float.
4. Put float weight on new float and install new float in tank
5. Make sure to turn back on power and check float for proper operation.

IMPORTANT: Make sure the float weight is installed at the exact same location as it was on the old float that was just removed. Ensure an excess float cord is wrapped and not left floating in the tank.

9.8 Diffuser Replacement

If a diffuser becomes plugged or damaged it will need replacement. To replace the diffusers:

1. Lock out and tag power source
2. Disconnect the air line from the air drop pipe. This drop pipe is connected to the diffuser air divider.
3. Pull up the air divider with the drop pipe and then remove the damaged air diffuser
4. Replace the diffuser with a new approved diffuser.
5. Place air divider back into proper position
6. Re-attach air line from blower to the air drop pipe
7. Restore power and test to assure it is functioning properly.

NOTE: If the manufacturer of the diffusers recommends cleaning, follow cleaning steps as per their instructions.

9.9 Flow EQ Pump Replacement

1. Lock out and tag power source.
2. Undo union connecting pump to pre-treatment chamber.
3. Remove existing pump.

   IMPORTANT: Care must be taken to never lift pump by electrical cord or damage to watertightness of cord may happen
4. Remove outlet pipe and union from old pump
5. Install output pipe and union from old pup onto the replacement pump.

   IMPORTANT: If using a different approved replacement pump you must ensure that the outlet pipe/union and new pump result in the same height for proper connection to the existing plumbing when placed in the tank.
6. Place new pump into tank and ensure outlet pipe union mates appropriately with internal pipe union.
7. Restore power and test to assure it is functioning properly.
8. Make sure union has no leaks

9.10 Controller Replacement

If controller needs replacement a qualified licensed electrician will need to be called to make this change.

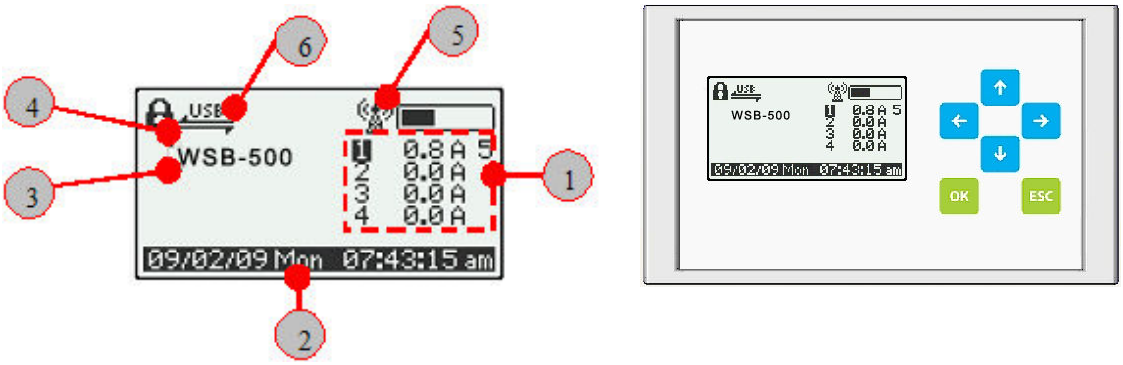
10 CONTROL PANEL OVERVIEW

Installation may only be carried out by a qualified electrician!

The WSB® clean control panel is preconfigured for standard operation of your wastewater treatment system. The panel comes equipped with a visual and audible alarm to notify you of any mechanical or high water conditions should problems ever arise. The Control panel operates all of the mechanical components of the WSB® system.

The control panel must be protected by a dedicated breaker in the in-house or building as per the installation manual.

10.1 Controller Interface Overview



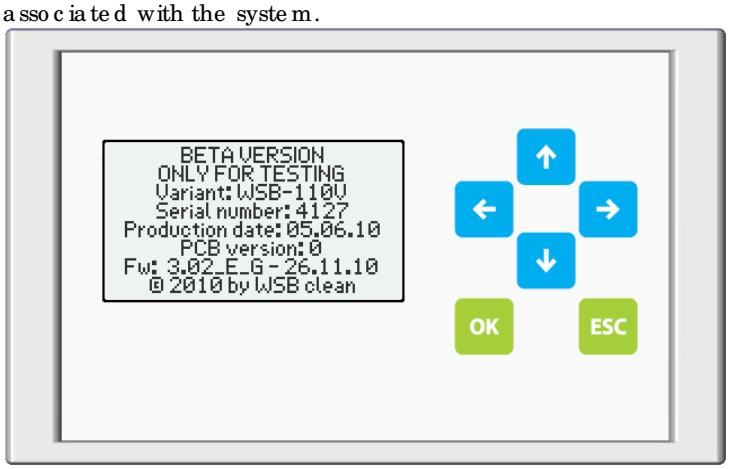
1 Status display of the outputs; display of the actual current consumption of the system
2 Display of the system time and date
3 Display of the operating mode
4 Display showing when the service menu is locked
5 Display of the GSM status with signal strength (remote monitoring)
6 Display showing when the control is connected to a read out device

10.2 The Customer Menu

The Customer Menu is called up by pressing either of the arrow keys . Navigation in the customer menu is also carried out using these keys. The customer menu provides access to the basic information a customer may require access to and is not protected by the system password.

10.2.1 Device Information

The Device Information screen provides an overview of all the revision information associated with the system.

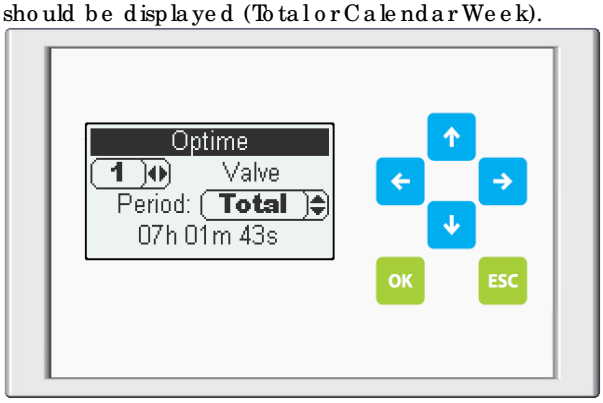


10.2.2 Optime

The optime view allows you to see the operating times for each of the outputs. You can select whether to view the Total operating time for the specified output or the Calendar Week (CW) for each output. Along with each output the Pump Type is also displayed.

The left/right arrow keys allow you to select the output to view.

The up/down arrow keys allow you to set the period in which the operating hours should be displayed (Total or Calendar Week).



10.2.3 Function Test

The function test verifies proper operation of all outputs and also does a battery backup test to determine if the batteries need to be replaced.

The function test will turn on each output separately regardless of the operation time settings or day/night settings etc.

Parameters	Description
Test start	Press OK to initiate the function test
Start delay	Specifies the start delay between actual function testing and pressing the Test Start option.
Pulse duration	Specifies how long each output will be pulsed during testing

10.2.4 Time/ Date

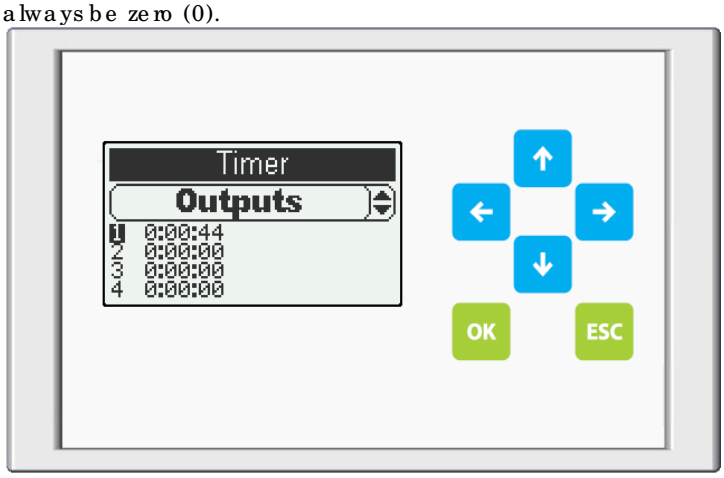
Date/time systems adjustments can be made in this menu point.

Parameters	Description
Date	Allows you to set the current date
Time Format	12 or 24hr format
Time	Allows you to set the current time
Summer Time	Daylight Savings Time enable/disabled

10.2.5 Timer (Display of Output Counters)

Displays the run time counters for all current output configurations. This view allows you to see the state of all outputs (on/off) as well as the pulse/pause counter values for each output.

NOTE: if the output is not configured to use a timer (i.e. Pulse/Pause) the timer value will always be zero (0).



10.2.6 Sludge Removal

The sludge removal maintenance setting allows you to log a sludge removal event into the Error Report. You can select how many days the system will be shut-down for sludge removal and how long Output 3 will subsequently be turned OFF during this process.

10.2.7 Maintenance Menu / Service Menu

The maintenance menu is launched on the OK or ESC key. This menu is protected by a password and may be accessed only by RH2O or its duly authorized representative.

10.2.8 Error Signals and Power Outage Warnings (Alarms)

If an error signal appears on the display and the display blinks, the signal can be cancelled by depressing the **ESC** key for 5 seconds. If the power is out or disconnected, a warning signal will sound after one minute. This signal can also be cancelled by depressing the **ESC key** for 5 seconds. The warning signal will sound for 2 seconds every 2 seconds in the first 10 minutes. After 10 minutes it will sound for 5 seconds every minute. After 1 hour it will sound for 20 seconds every 30 minutes. This is a set timed program and cannot be changed unless accessed remotely by RH2O. The control panel documents and logs all error messages.

10.3 Vacations and extended periods with limited usage

The WSB® clean system has been designed to continue operating properly even with limited or extended periods of no usage. The power can be left on for a vacation and the performance of

the system will not be impacted, even with little or no flow to the system. If the property is only used seasonally, (a winter lodge or only for summer months) and if the time that there would be no flows exceeds 4 consecutive weeks, the power can be shut down to the panel and blower. Once the property is lived in again, the power should be immediately turned back on.

10.4 Controller Specifications & Dimensions

Supply to KL8:	115V AC 60Hz
Input protection:	500mA slow 230V class H
Protection for output 1,2,4:	5A slow/230V class H
Protection for output 3,5:	2,5A slow/230V class H
Output voltage at output 1-5:	115V AC 60Hz
Output voltage at KL1+KL2:	5V/DC
Max. current per 5V output:	100mA
Input voltage to KL1+KL2:	5V/DC
Protection class:	Only for indoor use
Height:	185 mm
Width:	215 mm
Depth:	95 mm
Weight:	ca. 1kg

11 CONTROL PANEL CONFIGURATION

The Main Menu is called up by pressing the OK button while on the main status home screen. The main menu is a controlled area of the Series 2 controller and requires a password to enable access (see section 11.5.4). Each of the options in the Main Menu lead to submenus as outlined below.

11.1 "Parameter" Menu

11.1.1 Device Settings

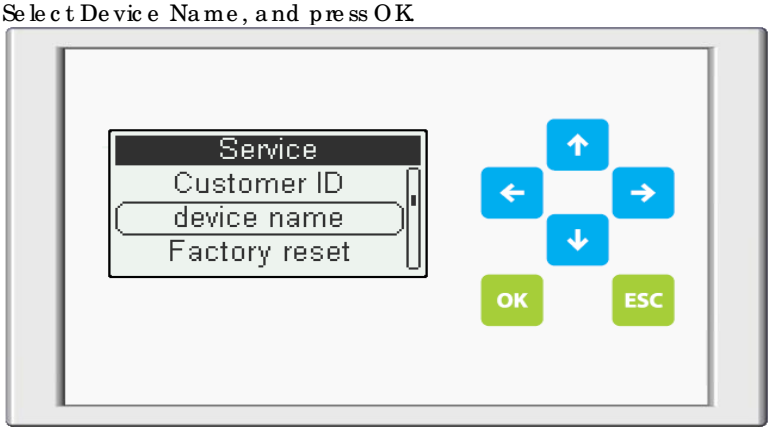
11.1.1.1 Device Name

The Device Name is set by the manufacturer of the system to reflect a specific configuration that is programmed into the Series 2 controller, thus giving it a specific application behavior. If the Device Name is not set by the manufacturer the Device Name displayed on the front panel will be the specific Class type that this controller was designed for at the factory (i.e. Class C/N). However, if the Device Name is programmed even once, the device name displayed will always be based on the Device Name field (even if it is programmed with all blanks = no name).

Below are instructions on how to set the Device Name:

1. From the main status menu press OK to enter the Main Menu.
2. Then select Service and Press OK to enter the Service Menu.

3. Select Device Name, and press OK.



4. Set a unique Device Name using the up and down arrows to scroll through the available characters and symbols and by using the left and right arrows to select the character location. When you are finished press OK.

NOTE: The Device Name can be a maximum of 13 alpha numeric characters.

11.1.1.2 Mode

The mode allows for selection of the available class types for the controller (i.e. Class C/N, Class C/N + P etc). The default setting is Class C/N for carbon removal and nitrification and is the mode in which the water quality targets are met as per section 8.1.

11.1.1.3 I/O Module

Allows for enabling / disabling of the I/O module. The I/O module is not used on standard residential WSB® clean systems.

NOTE: The I/O module is connected to the Series 2 controller via the Series 2 DB9 serial port, and connector X4 on the I/O module.

11.1.1.4 Expansion Module

Allows you to select and enable the various available expansion modules for use with the Series 2 controller. These include, but are not limited too, GSM, GPRS, LAN, Bluetooth etc.

NOTE: if you enable the GSM or GPRS module additional sub menu items will be available and require configuration.

11.1.2 Outputs

The outputs sub menu allows you to select outputs for configuration (outputs 1-8) as well as settings for redundancy. This is where you would adjust the settings for blowers, pumps, valves etc. that are controlled by the Series 2 controller.

For detailed information on configuration of output parameters please refer to section 12 Series 2 Controller Outputs.

11.1.3 Inputs

The inputs sub menu allows you to configure output independent alarms conditions for a given input. The configuration for a high level alarm in a pump tank, for example, would require that you set the mode to "Flooding" and specify the signal level as "Active High".

This would cause a controller alarm in the pump tank for the corresponding input if the float is high.

Unlike a cut-off alarm in an output Pulse/Pause configuration the Input menu is where inputs are configured for generic alarm indications that are not specific to any output. Care should be taken not to configure an input in this menu which has also been configured as a cut-off in an output configuration unless you are certain this is the behavior you want.

These inputs only cause an external visual and audible alarm via output 5 as well as an error to be placed into the error log as per the selected Mode. Additionally, if the controller has a GPRS, Ethernet, or similar remote monitoring device and email, or SMS message (or appropriate remote communications mechanism) will be used to provide a remote notification of the alarm condition.

Mode	Select the desired mode. See section 11.1.3.1
Signal Level	Specifies the signal condition that must be met by the input for the specified Mode to be recognized and an alarm generated.

NOTE: you cannot set more than one input with the same input alarm mode.

11.1.3.1 Input Modes

The following table explains the available Input Modes and there behaviors:

Off	Input monitoring is off
Tank Monitoring / Tank Empty	Causes a tank monitoring error to be written to the error log. The specific condition for Tank Monitoring is dependant on the specific installation and configuration.
Flooding 1	Causes a flooding error to be written to the error log. Flooding errors are typically used to indicate a high water level in a specific tank.
Motor Safety Switch	Causes a motor safety swtich error to be written to the error log.
Flooding 2	Causes a flooding error to be written to the error log. Flooding errors are typically used to indicate a high water level in a specific tank.

IMPORTANT: Do not set more than one input to the same "Mode" as they will conflict with each other.

For additional information on inputs please refer to section 14 Series 2 Controller Inputs.

11.1.4 Other Settings

The other settings sub menu allows access to a number of additional sub menu's for advanced operation of the Series 2 controller.

11.1.4.1 Function Test

Allows for configuration of the Function Test features. See section 10.2.3 for more information.

11.1.4.2 Error Report – Acoustic Output (Audible Internal Alarm)

Allows for enabling / disabling of the audible alarm which will sound each time an error occurs on the series 2 controllers. If the acoustic output is off the controller will still generate an audible alarm if the controller loses power (as long as the external battery is connected and has power). The on/off control of the acoustic output is only for alarm fault conditions.

NOTE: This does not disable the external alarm output (output 5). If an error condition is present on the controller output 5 will always pulse to cause an audible/visual alarm if connected.

11.1.4.3 Air Pressure

Allows you to specify the minimum and maximum air pressure readings for the onboard air pressure sensor. You are also able to configure the reference output associated with the air pressure sensor.

For more information see section 16

11.1.4.4 Valve Output Reference

The valve output reference specifies the output on the series 2 controller that will turn on when the valve turns. The valve output reference can be configured to any available output on the series 2 controller. As an example, this feature would be used to turn on a blower connected to output 1 for a sludge return air lift operating on output 3.

For more information see section 12.4.1

11.1.4.5 Run Bit

The Series 2 Controller has a configurable parameter called the Run Bit. The Run Bit allows the user to start and stop the output logic state machine by setting it to either ON (FW running) or OFF (firmware not running). The purpose of the Run Bit is to allow the user to stop the FW output logic state machine thus allowing multiple changes to the output configuration settings to be made using the Series 2 interface panel without having each minor change take effect as each parameter is set individually. This way you can configure all outputs and all associated parameters, based on the Mode selected for each output without having the settings take effect immediately. When you have completed setting all the output and input settings if you turn the Run Bit back ON the FW will start all outputs just as would occur on a system start-up.

NOTE: If you set the Run Bit to OFF all timers are reset and all outputs are turned off. This prevents any outputs which may have been on at the time the Run Bit was set to OFF, from staying on.

IMPORTANT: The run bit will NOT reset itself if you forget to turn it back on. You must either cycle power on the controller or manually turn the run bit back on to ensure the controller is once again running.

11.2 "Optime" (Operation Time) Menu

The optime menu provides access to additional operation time features not available in the customer menu. These include:

Parameters	Description
Show	Same as the optime view available in the customer menu. See section 10.2.2
Delete (Total)	Allows you to delete all optime information
Delete (CW)	Allows you to delete the Current Week (CW) optime information

11.3 "Reports" Menu

The reports menu allows you to view and/or delete all report information stored on the series 2 controller. This information is very valuable in detecting issues and tracking errors that have occurred on the controller.

11.4 "Service" Menu

The service menu contains a number of sub menus providing access to more advanced service features not available via the customer menu as outlined in the following sections.

11.4.1 Device Information

See section 10.2.1

11.4.2 Customer ID

The Customer ID field allows for a way to uniquely identify a controller installation with a specific customer. This is set by the manufacturer and should never be changed.

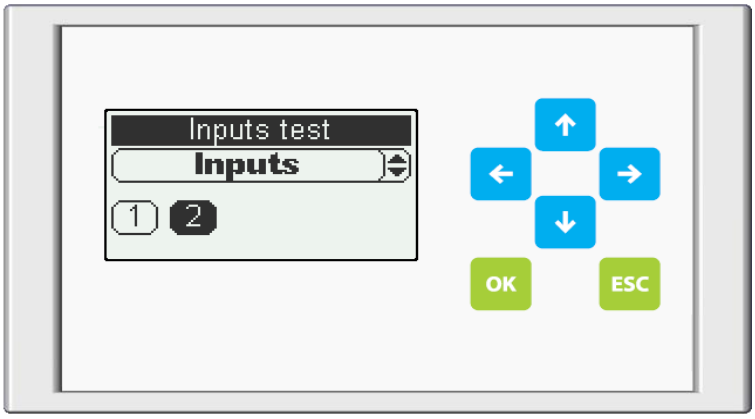
If the Customer ID is set, it will be included in all Email and SMS messages sent by the controller GPRS/GSM remote monitoring features to further assist in identifying the controller that generated the SMS or Email message

11.4.3 Factory Reset

Allows you to reset the controller to factory defaults.

11.4.4 Input Test

The input test allows you to view the status of the various inputs on the series 2 controller. You can activate and deactivate the inputs connected to the controller and confirm proper operation of these triggers by visually monitoring the graphics available.



In addition by using the up and down arrow keys you can view the state of all fuses (black background = Fuse OK), as well as the current reading on the air pressure sensor.

11.4.5 Function Test

See section 10.2.3

11.4.6 Timer

See section 10.2.5

11.5 "Settings" Menu

The settings menu provides access to advanced settings not available through the customer menu.

11.5.1 Language

Allows you to specify the display language.

11.5.2 Date / Time

See section 10.2.4

11.5.3 Display

Allows for configuration of various display features such as the illumination/backlight triggers, brightness control and contrast control.

11.5.4 Password

The password submenu allows you to change the access password required to enter the advanced configuration menu options available for the series 2 controller. Essentially, the password protects all configuration options except those available from the Customer Menu.

CAUTION: Setting a password of 000000 will disable password access and allow anyone to access all configuration parameters. This should be used with extreme caution.

IMPORTANT: Write your new password down and keep it in a safe place so you don't loose it.

11.5.4.1 Forgot The Password?

If you forget the password for a controller the password can be reset. Please contact RH2O.

11.5.4.2 Locking the Controller

If you have entered your password and do not want to leave the interface unlocked until the automatic internal password lock time expires and requires password entry again hold the ESC key for 2 seconds to force password protection and lock the controller interface.

12 SERIES 2 CONTROLLER OUTPUTS

The following sections provide detailed technical and configuration information on the inputs and outputs available on the Series 2 controller.

12.1 Outputs 1-4

The series 2 controller has 4 primary AC outputs; Outputs 1, 2, 3, and 4.

The outputs are designed for control of 115V power as supplied on the main controller input connector. The controller has a maximum total current rating of 20A.

The output current ratings are identified in the table below:

Output	Max Current (A)	Voltage
1	5	115V
2	5	115V
3	2.5	115V
4	5	115V

12.2 Output 5 – Alarm Output

The Alarm Output allows for connection of 115V buzzers and lights which will pulse when an alarm condition is present on the Series 2 controller.

The alarm output rating is identified below:

Output	Max Current (A)	Voltage
5	2.5A	115V

12.3 Output Modes

12.3.1 Off

Specified output is off.

NOTE: If another output is configured as a "Valve" and references this output it will turn on when the valve is on regardless of output mode setting.

12.3.2 Pulse/Pause

Pulse/Pause mode allows the user to configure ON (pulse) and OFF (pause) times for the specified output. The pulse/pause mode allows you to specify a daytime period and a nighttime period so that different pulse/pause settings can be used based on expected changes during the daytime and/or nighttime. In addition a cutoff signal source can be used as protection for the output so that if, for example, the water level is too low the current pulse/pause cycle will be stopped and reset and will only re-start when the cutoff signal source has indicated the input condition that stopped the cycle is no longer present.

NOTE: If another output is configured as a "Valve" and references this output it will turn on when the valve is on regardless of output mode setting.

Parameters	Description
Pump Type	See section 12.4
Min Current	Sets the minimum current alarm level for the output
Max Current	Sets the maximum current alarm level for the output
	If set to 0 the max current monitoring is disabled
	When setting current for Contactor 50A the current value increment is 1A. There are no decimal values for the 50A contactor setting.
Day Start	Specifies the daytime period start time **NOTE:** Set Day Start = Day Stop and no daytime operation period exists so the day pulse and pause settings do not execute
Day Stop	Specifies the daytime period end time **NOTE:** Set Day Start = Day Stop and no daytime operation period exists so the day pulse and pause settings do not execute
Day Pulse	Specifies the daytime pulse/ON period
Day Pause	Specifies the daytime pause/OFF period
Night Start	Specifies the night time period start time **NOTE:** Set Night Start = Night Stop and no night time operation period exists so the day pulse and pause settings do not execute
Night Stop	Specifies the night time period end time **NOTE:** Set Night Start = Night Stop and no night time operation period exists so the day pulse and pause settings do not execute
Night Pulse	Specifies the night time pulse/ON period
Night Pause	Specifies the night time pause/OFF period
Week Program	Specifies the days of the week the Pulse/Pause program is active. This allows you to turn off the pulse/pause program (both daytime and night time periods)
Initial State	The initial state parameter allows you to specify if a cycle should start in the pulse or pause state.
Cutoff Source	Allows you to specify an input source as an override to the existing pulse/pause configuration. NOTE: if the Cutoff Source is activated the pulse/pause cycle is stopped, the pulse/pause times reset, and will restart when the cut-off source deactivates
Cutoff Level	Specifies if the cut-off source is activated by a high level or a low level on the Cutoff Source input.

PerCycle Duplex	Output reference for per cycle duplex configuration with redundancy

NOTE: Daytime settings will override nighttime settings if they overlap.

12.3.2.1 Pulse/Pause PerCycle Duplex with Redundancy

In some applications it is important to have duplex/alternating outputs that operate on a per cycle basis. If this is required it can be configured very easily by simply selecting the second output, from the "Duplex Output" parameter list, to be used as the duplex slave output to the currently configured pulse/pause output. When using per cycle duplex redundancy is automatically built in, therefore, it is not necessary for you to setup master/slave redundancy from the menu as you would if using per day cycling.

12.3.3 Permanent On

The specified output is always on.

12.4 Pump Types

The pump types selection allows you to select common pump types from a list. If the pump you are using is available within the list the min and max current settings will automatically be set for that specific pump model.

NOTE: It is still recommended to verify the min and max current settings even when selecting a pump from the list. Sometimes the manufacturer may change pump designs which can affect actual current ratings.

12.4.1 Valve

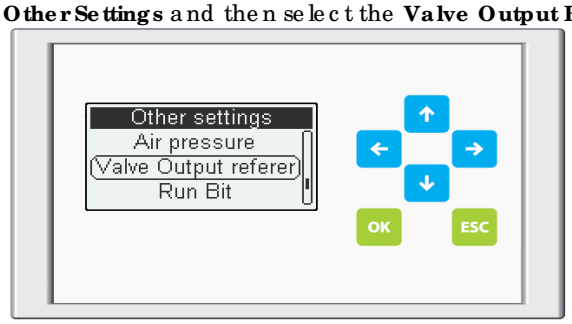
Valve is a special pump type that is most commonly selected when a solenoid valve is used to control flow to an output. This might be for the purpose of controlling either the flow of air or water.

NOTE: In all Series 2 FW versions 3.00 and earlier when a valve turns on output 1 is also automatically turned on. This behavior is fixed and cannot be changed. The assumption is made that if you are using a solenoid it is to control flow and that output 1 has the primary pump (air or water) that will cause the flow to occur.

12.4.1.1 Valve Behavior

The reference output that is turned on when a valve turns on can be configured to any available output on the series 2 controller. It is not longer fixed to only control output 1.

To change the Valve Output Reference from the Main Menu select **Parameter**, then select **Other Settings** and then select the **Valve Output Reference** option:



From the list you can select any available Series 2 output as the reference output. In addition to this outputs individual settings (i.e. pulse/pause, parallel relay, etc.) this output will turn on if any output configured with a Mode Type of Valve is also on.

NOTE: To maintain compatibility in FW upgrades to existing controllers the default setting is always output 1.

Add contactor pump types

12.5 Min. Current and Max. Current

The min. and max current fields allow you to specify the current draw range for a given output. If the current load is less than the min current or greater than the max current an alarm error will be generated.

13 OUTPUT DUPLEX / REDUNDANCY FEATURES

It is often desirable to have more than one pump available for critical pumping/supply applications. For example: If you have a single dosing pump and it fails the water level will continue to rise in the tank until someone is able to fix the pump or water supply to the tank can be stopped. In some situations it is impossible to get onsite quick enough (i.e. remote installations) and/or stop the flow of water to the system (i.e. multi-unit residential environments).

As a result it is possible to use redundancy to setup a duplex pump configuration if you are using the Pulse/Pause mode.

There are 2 ways in which you can configure a duplex system in the Pulse/Pause modes.

13.1 Per Day Duplex Cycling with Redundancy

In a duplex configuration most commonly you configure 2 outputs for 2 identical pumps. You then configure each pump with the same configuration settings (i.e. mode, pulse/pause settings etc.) and then configure the weekday settings so that the 2 pumps alternate on a daily basis.

For example: pump 1 is on Monday, Wednesday, Friday, and Sunday and pump 2 is on Tuesday, Thursday, and Saturday.

Then from the Redundancy menu you select the Master pump (i.e. output 1, or whatever output the primary pump is on) and the Slave pump (i.e. output 2, or whatever output the secondary pump is on).

If either of the pumps fail due to a blown fuse or an over/under current error the controller will automatically use the remaining good pump on all days activated in both the pumps weekday settings. Continuing with our example if pump 2 failed then pump 1 would run the pulse/pause cycles on all days of the week until pump 2 could be fixed and the error condition eliminated.

13.2 Per Cycle Duplex with Redundancy

Sometimes cycling pumps on a daily basis does not meet some of the requirements of a given application. Take for example a treatment system in which there are two beds. The duplex pumps, each one connected to a separate bed, should dose each bed evenly each day. It is not desirable that one pump operates on one day and the other pump on the next because only one bed will be dosed each day.

In this case it is more desirable to have per cycle duplex in which the pumps alternate on every pulse/pause cycle. In this configuration both beds are dosed evenly through-out the day, every day.

To configure per cycle duplex is very simple. In the pulse pause settings for the first output to be used in the duplex configuration set the Duplex Output parameter to the output to be used for the 2nd pump and save the settings. Then confirm the pump type, min current, max current etc. are properly configured for both outputs and you are done. There is no need to setup the Redundancy as was done in the per day duplex configuration. Redundancy is automatically built into the per cycle duplex functionality.

For more information see section 12.3.2.1

14 SERIES 2 CONTROLLER INPUTS

14.1 Inputs 1 and 2

The Series 2 controller has 2 digital inputs which can be used for floats or any digital switch compatible with the 5V operating level provided by the input terminals.

Name	Input Type	Connector Terminals	Description
Input 1	Digital	KL2-1	5VDC Output
		KL2-2	5VDC Input
Input 2	Digital	KL1-1	5VDC Output
		KL1-2	5VDC Input

15 ERROR CODES

Error Code	Description	Error Code	Description
0	iNo Reports	39	eFC error
1	ePower breakdown	40	eSecurity Time High Load
2	eOutput 1: Fuse defective	41	eDry run filtration phase
3	eOutput 2: Fuse defective	42	eMax. pressure exceeded
4	eOutput 3: Fuse defective	43	eMax. temperature exceeded
5	eOutput 4: Fuse defective	44	eExt. EEPROM defective
6	eOutput 5: Fuse defective	45	eMax. depression exceeded
7	eOutput 6: Fuse defective	46	eGSM module error
8	eOutput 7: Fuse defective	47	iSystem startup
9	eOutput 8: Fuse defective	48	eMax filling time exceeded
10	eOutput 1: Undercurrent	49 - 64	Reserved
11	eOutput 2: Undercurrent	65	eReserved
12	eOutput 3: Undercurrent	66	iReports deleted
13	eOutput 4: Undercurrent	67	iFirmware updated
14	eOutput 5: Undercurrent	68	wWDTerror
15	eOutput 6: Undercurrent	69	wDate/Time not set
16	eOutput 7: Undercurrent	70	iFactory reset
17	eOutput 8: Undercurrent	71	iDaylight saving time on
18	eOutput 1: Overcurrent	72	iDaylight saving time off

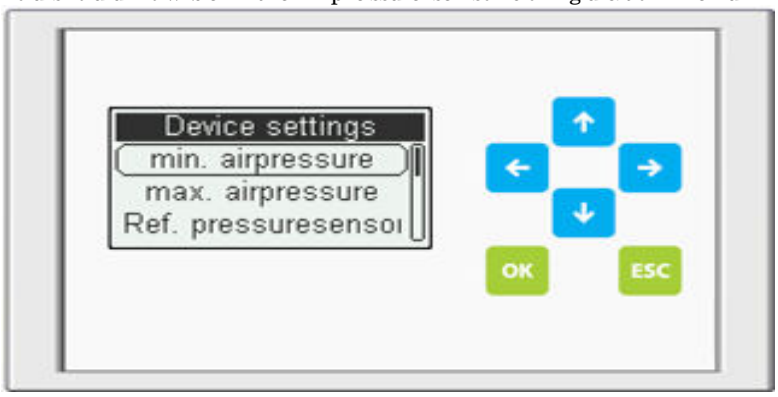
19	eOutput 2: Overcurrent	73	iClass D enabled
20	eOutput 3: Overcurrent	74	iClass D disabled
21	eOutput 4: Overcurrent	75	iMan. vacation mode enabled
22	eOutput 5: Overcurrent	76	iMan. vacation mode disabled
23	eOutput 6: Overcurrent	77	iMan. vacation mode started
24	eOutput 7: Overcurrent	78	iMan. vacation mode stopped
25	eOutput 8: Overcurrent	79	iAut. vacation mode started
26	eRTC defective	80	iAut. vacation mode stopped
27	eInt. EEPROM defective	81	iADAB started
28	eTank is empty	82	iClass HP enabled
29	eFlooding	83	iClass HP disabled
30	eMotor protection switch	84	wDry run backflush phase
31	eWrong polarity	85	iService mode (Manual)
32	eNo SIM-Card	86	iService mode (USB)
33	eSIM-Card locked	87	iService mode (Remote)
34	ePIN invalid	88	iInitiation mode started
35	eGSM module not available	89	iInitiation mode stopped
36	eGSM send error	90	iSludge removal started
37	eIO module not available	91	iSludge removal stopped
38	eFC not running	92	iError eliminated

16 CONFIGURING THE AIR PRESSURE SENSOR OUTPUT ERROR

The onboard air pressure sensor can be used to detect possible failures on air pressure lines from blowers and/or from valves connected to blowers. In this way it is possible to detect failures of the blower and/or any valves after which the air pressure sensor is connected.

To configure the air pressure sensor:

From the Main Menu select: Parameter, OK, Other Settings, OK, Air Pressure, OK.
You should now be in the Airpressure sensor configuration menu



Select the Min. Airpressure setting and click OK to set the minimum air pressure that is acceptable.

IMPORTANT: The air pressure values are in mbar, not PSI. To convert mbar to PSI just multiple the mBar number by 0.0145037738.

IMPORTANT: If the Min. Air pressure value is very large you can press the up arrow button to reset the parameter to zero (0).

IMPORTANT: The onboard air pressue sensor has a max pressure capability of 500 mbar (7.25PSI).

Select Max. Air pressure seting and click OK to set the maximum air pressure that is acceptable.

IMPORTANT: The air pressure values are in mbar, not PSI. To convert mbar to PSI just multiple the mBar number by 0.0145037738.

IMPORTANT: If the Max. Air pressure value is very large you can press the up arrow button to reset the parameter to zero (0).

IMPORTANT: The onboard air pressue sensor has a max pressure capability of 500 mbar (7.25PSI).

Select Ref. Pressure sensor to select the output which is associated with the min/max pressure levels being monitoring by the onboard pressure sensor. This reference output will be turned off if the min or max air pressure settings are exceeded. This behavior is identical to the min/max current parameters you have used for output current error detection.

17 WSB® SYSTEM RUNTIME PARAMETER SETTING GUIDELINES

The total desired flow rates, and operation times are provided below for some common blower models and sludge return pump flows. The WSB® system settings must be adapted to the specific blowers and/or pumps used on any given installation. However, the settings below are provided as an example to illustrate the required aeration and sludge removal requirements for the various WSB® models. If a different blower or pump is used calculations must be performed to ensure that the required aeration or sludge return flows are met based on the specific blower/pump specifications.

17.1 Blower Settings (Output 1)

Model	Litres Per Day (L/day)	output 1						
		aeration		day operation		night operation		operation
				06:00 -	23:59	00:00	05:59	per week
		Blower	Qty	pulse	pause	pulse	pause	
		[type]	[-]	[Min]	[Min]	[Min]	[Min]	[h]
WSB 400	1600	HP-100	1	8.8	6.3	7.5	22.5	84
WSB 500	2000	HP-100	1	9.5	5.5	7.5	22.5	90
WSB 600	2500	HP-120	1	8.0	7.0	7.5	22.5	78
WSB 750	3000	HP-120	1	9.0	5.5	8.0	22.5	89
WSB 1000	3800	HP-150	1	9.0	6.0	7.5	22.5	86
WSB 1250	5000	HP-200	1	9.5	5.5	7.5	22.5	90
WSB 1500	5678	HP-150	2	7.5	7.5	7.5	22.5	74
WSB 1600	6300	HP-150	2	7.5	7.5	7.5	22.5	74
WSB 1800	7000	HP-150	2	8.0	7.0	8.0	23.0	78

17.2 Sludge Return Settings (Output 2)

Model	Litres Per Day (L/day)	output 2 - PUMP					output 2 - AIR LIFT				
		Sludge Removal		operation time		Removal	Sludge Removal		operation time		Removal
				6:00	23:59	per day			6:00	23:59	per day
		Pump	Qty	pulse	pause		valve	Qty	pulse	pause	
		[L/min]	[-]	[sec]	[Min]	[L/d]	[L/min]	[-]	[sec]	[Min]	[L/d]
WSB 400	1600	144	1	7	60	315	12	1	22	15	317
WSB 500	2000	144	1	9	60	379	12	1	26	15	374
WSB 600	2500	144	1	12	60	505	12	1	35	15	504
WSB 750	3000	144	1	13	60	568	12	1	39	15	562
WSB 1000	3800	144	1	18	60	757	12	1	53	15	763
WSB 1250	5000	144	1	11.0	60.0	475	n/a	n/a	n/a	n/a	n/a
WSB 1500	5678	144	1	13.0	60.0	562	n/a	n/a	n/a	n/a	n/a
WSB 1600	6300	144	1	13.0	60.0	562	n/a	n/a	n/a	n/a	n/a
WSB 1800	7000	144	1	11.5	60.0	497	n/a	n/a	n/a	n/a	n/a

17.3 Sludge Return Settings (Output 4)

Model	Litres Per Day (L/day)	Output 4 - Pump				
		Sludge Removal		operation time		Removal
				6:00	23:59	per day
		Pump	Qty	pulse	pause	
		[L/min]	[-]	[sec]	[Min]	[L/d]
WSB 400	1600	n/a	n/a	n/a	n/a	n/a
WSB 500	2000	n/a	n/a	n/a	n/a	n/a
WSB 600	2500	n/a	n/a	n/a	n/a	n/a
WSB 750	3000	n/a	n/a	n/a	n/a	n/a
WSB 1000	3800	n/a	n/a	n/a	n/a	n/a
WSB 1250	5000	144	1	11.0	60.0	475
WSB 1500	5678	144	1	13.0	60.0	562
WSB 1600	6300	144	1	13.0	60.0	562
WSB 1800	7000	144	1	11.5	60.0	497

17.4 WSB® Phosphorus Precipitation Parameter Settings

For systems which require phosphorus precipitation the followings settings provide the guideline for desired daily dosing. Again, the specific pump model must be considered to ensure the daily dosing is achieved based on each chemical pump models stroke and flow characteristics.

NOTE: These numbers assume that the pump is operating in automatic mode (not controlled by external pulse logic) and the stroke length and ml/Stroke and Stroke Length configuration has been set to achieve the desired total daily dosing as outlined below.

Model	phosphorus precipitation		operation time		Dosing
			06:00 -	23:59	per day
	Chem Pump	Qty	pulse	pause	
	[type]	[-]	[sec]	[Min]	[mL/d]
WSB 400	Concept plus	1	11	30	134
WSB 500	Concept plus	1	13	30	161
WSB 600	Concept plus	1	18	30	214
WSB 750	Concept plus	1	20	30	241
WSB 1000	Concept plus	1	27	30	321
WSB 1250	Concept plus	1	33	30	401
WSB 1500	Concept plus	1	40	30	482
WSB 1600	Concept plus	1	47	30	562
WSB 1800	Concept plus	1	54	30	642

18 IMPORTANT OPERATING INSTRUCTIONS

To ensure the best performance of your WSB® clean wastewater treatment system:
We recommend the following Do's and Don'ts

18.1 Harmful Chemicals

Do Not: Use or discard any of the following products in the sinks or toilets of your residence:

- Caustic products used to unclog pipes (Mr. Plummer™, Dr. Plummer™, Drano Liquid™, etc.)
- Petroleum based products, paints, solvents etc.
- Pesticides
- Back Wash of a water softener system
- Large quantities of bleaching products
- Oil and grease (engine, cooking, etc.)
- Wax and resins
- Septic tank treatment products
- All non-biodegradable objects (cigarette buts, sanitary napkins, pads etc.)

18.2 Do Not

Please respect manufacturer's recommendations for usage of domestic cleaning products and follow the do's and don'ts outlined below to ensure proper operation of your system.

Failure to follow these guidelines can result in failure of your system:

- Do not use automatic toilet cleaners
- Do not use a waste disposal unit in the sink (in-sink-erator)
- Do not connect downspouts or storm drains or allow surface water to drain into the system
- Do not enter an access riser – gases can be deadly and lack of oxygen could be fatal
- Do not use special additives designed to 'increase the performance of your system'
- Do not plant trees or shrubs too close to the system lids or disposal bed
- Do not leave interior faucets on to reduce chances of freezing – use insulation to ensure freezing cannot occur
- Do not bury your access openings (lids)
- Do not drive over or near your system or bed

➔ **WARNING:**	Only authorized service personnel are to remove access covers on the WSB® system. Removal by unauthorized personnel may result in death or bodily injury from potentially hazardous gases and waste matter. Please ensure easy access to covers at all times for inspection and/or emergency

18.3 Best Practices

The following Best Practices are very important to ensuring proper operation of your system. Following these requirements will help to ensure years of hastle free operation of your WSB System

DO:

- Familiarize yourself with the location of your system and controls
- As a reference, keep a copy of the layout of your system
- Ensure water is diverted away from your disposal bed
- Budget to pump your tank on a regular basis (recommended between 2-5 years)
- Repair any leaking plumbing fixtures as soon as possible
- Replace old toilets with low flush or dual flush toilets
- Clean the lint filter on the washing machine on a regular basis
- Keep the access lids accessible and brought to grade at all times
- File the system maintenance cards (and service calls) to help keep accurate records
- Try to reduce the amount of wastewater that your system needs to treat (install high efficiency water saving products wherever possible)
- Use your garbage can to dispose of substances that can be harmful to your treatment system
- Collect grease in a container and dispose with your trash
- Conserve water and repair leaky toilets in order to not hydraulically overload your system

19 WSB® CLEAN SYSTEM SERVICE POLICY

All WSB® clean NSF/ANSI Standard 40, Class 1 certified wastewater treatment systems have an initial 2 year service agreement (two calls per year) included with the system's initial purchase price. To find out who the service provider for your system is please refer to the labels on the main control panel.

19.1 Extended Service Policy

An Extended Service Policy is available and may be purchased through RH2O North America. The extended service policy will provide you with the same piece of mind as the initial service policy included with the system and will ensure that your system is properly maintained and serviced in the event of a failure.

20 LIMITED WARRANTY

1. Preamble
RH2O North America Inc. (hereinafter called "RH2O") is proud to offer its customers with the following warranty. For the purposes of this Warranty Certificate, the term "Customer" shall mean the person(s) who are the owner(s) of the property where a WSB® clean system is installed and the term "Successors" means any other person entitled to exercise the customer's rights.

2. Nature of the Warranty
The purchase of a WSB® clean system includes a free inspection of all components during the first year following installation by an authorized representative of RH2O. All of the WSB® clean system components are warranted for a period of two years from the installation date. RH2O warrants the non-deterioration of its media for a period of twenty years, from the installation date. Components repaired or replaced under the two year warranty will be covered under warranty up to the end of the original two year warranty period.

3. Notification Obligations
The WSB® clean system includes an alarm system which works in conjunction with the control panel for the system. The control panel detects any problems related to the system and will sound the alarm. If the alarm goes off, the customer must immediately contact RH2O by written notification. The customer must also notify RH2O of any apparent anomaly, irregularity, and/or malfunction of the WSB® clean system. Failure to due do so within a reasonable timeframe may result in this Warranty Certificate becoming null and void. The Customer must provide access to the system at all times to RH2O or its representative.

4. Exclusions
The following damages or problems are excluded from the Warranty:

(a) Any damage or problem caused by an unexpected event or "Act-of-God", such as, and without limiting the generality of the foregoing: earthquakes, floods, hurricanes, landslides, explosions
(b) Any damage or problem caused by the fault or act of a third party;
(c) Any damage or problem arising from any modification, correction or addition carried out by a person not authorized by RH2O or without its approval;
(d) Any damage or problem, if it is proven that the WSB® clean system was not used according to the terms and conditions stipulated in the Owners Manual;
(e) Any damage or problem, if it is proven that the system was not used and maintained in compliance with the existing regulations;
(f) Any damage or problem, caused by fault or action of the Customer or the Customer's Successors including, but without limiting the generality of the foregoing, refusal to allow access to the system for inspection purposes.

5. Particular Exclusions
It is further expressly understood that the Customer may not carry out or cause to be carried out any repair, maintenance and/or verification of the purchased WSB® clean system, or attempt to carry out any work whatsoever or to apply any corrective measures whatsoever to the aforementioned systems (except for periodic pumping of the sludge) without written consent from RH2O. Failure to do so

may result in this warranty becoming null and void.

6. Indemnities and Damages
The liability and obligations of RH2O under this Warranty Certificate for corrective measures and/or means of correcting any problems, of which it is duly advised, shall be limited to the replacement of any component of the WSB® clean system, in compliance with sections 3 and 4 herein.

7. Damage Limitations
RH2O may in no way be held liable for any other damage sustained by the Customer. RH2O compensation or indemnification obligation shall be limited to the provisions under section 6 of this Warranty Certificate. RH2O does not assume any liability for personal injury or property damage caused by the use or misuse of the WSB® clean system. RH2O shall not, in any event, be liable for special, incidental, indirect, or consequential damages. RH2O liability shall, in all instances, be limited to the provisions under section 6 of this Warranty Certificate and will end upon expiration of the applicable Warranty Certification period.

8. Ownership Transfer
In the event of transfer of ownership, sale, reassignment or disposition in any other way of the Customer's property to a third party, this Warranty Certificate shall continue to apply on the express condition that the new owner confirms in writing to RH2O that he is the new owner of the property, is cognizant of the Warranty Certificate and accepts its terms and conditions. The Customer agrees to forward, to the buyer or the buyers successors, the Warranty Certificate, as well as the Owner's Manual. The Customer's Successors must complete the Ownership

Transfer Form and return it to RH2O in order for the ownership transfer to be complete and the Warranty Certificate to be valid.

9. Inspection
The Customer or the Customer's Successors shall allow RH2O or its duly authorized representative to perform all necessary monitoring and/or inspection measures, when deemed necessary, for the assessment and validly of this Warranty Certificate. If the Customer or Customers Successors notify RH2O of an alleged defect or malfunction of the WSB® clean and that after inspection, it is found that no such defect or malfunction is revealed, or, that the warranty is excluded or doesn't apply, a minimum charge of $100.00 plus direct expenses will be invoiced for the cost of such inspection.

10. Interpretation
The terms of this Warranty Certificate shall be interpreted and governed by the law in force in the Province of Ontario and the provisions of this Warranty.

11. Priority of the Warranty Certificate
This warranty supersedes any contract or understanding, written or verbal, entered into between the Customer and RH2O. In case of any contradiction between this warranty and other documents issued by RH2O, this warranty shall prevail.

12. Jurisdiction
The parties acknowledge that any litigation regarding the present Warranty Certificate must be introduced in the judicial district of Toronto, Ontario.

NOTES

United States Environmental Protection Agency | Office of Water Washington, D.C. | EPA 832-F-00-016 September 2000

Wastewater Technology Fact Sheet
Package Plants

DESCRIPTION

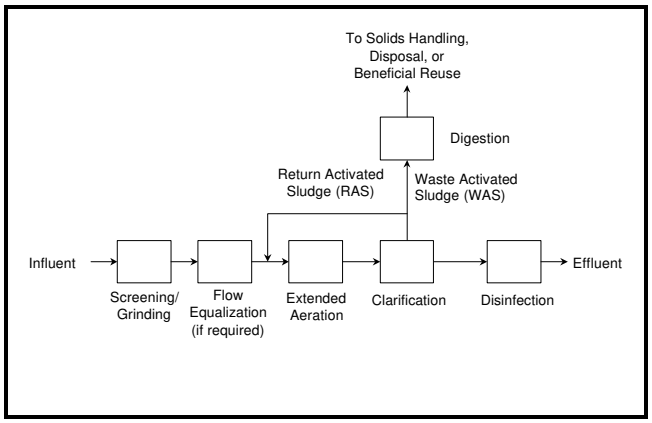
Package plants are pre-manufactured treatment facilities used to treat wastewater in small communities or on individual properties. According to manufacturers, package plants can be designed to treat flows as low as 0.002 MGD or as high as 0.5 MGD, although they more commonly treat flows between 0.01 and 0.25 MGD (Metcalf and Eddy, 1991).

The most common types of package plants are extended aeration plants, sequencing batch reactors, oxidation ditches, contact stabilization plants, rotating biological contactors, and physical/chemical processes (Metcalf and Eddy, 1991). This fact sheet focuses on the first three, all of which are biological aeration processes.

Extended aeration plants

The extended aeration process is one modification of the activated sludge process which provides biological treatment for the removal of biodegradable organic wastes under aerobic conditions. Air may be supplied by mechanical or diffused aeration to provide the oxygen required to sustain the aerobic biological process. Mixing must be provided by aeration or mechanical means to maintain the microbial organisms in contact with the dissolved organics. In addition, the pH must be controlled to optimize the biological process and essential nutrients must be present to facilitate biological growth and the continuation of biological degradation.

As depicted in Figure 1, wastewater enters the treatment system and is typically screened immediately to remove large suspended, settleable, or floating solids that could interfere with or damage equipment downstream in the process. Wastewater may then pass through a grinder to reduce large particles that are not captured in the screening process. If the plant requires the flow to be regulated, the effluent will then flow into equalization basins which regulate peak wastewater flow rates. Wastewater then enters the aeration chamber, where it is mixed and oxygen is provided to the microorganisms. The mixed liquor then flows to a clarifier or settling chamber where most microorganisms settle to the bottom of the clarifier and a portion are pumped back to the incoming wastewater at the beginning of the plant. This returned material is the return activated sludge (RAS). The material that is not returned, the waste activated sludge (WAS), is removed for treatment and disposal. The clarified wastewater then flows over a weir and into a collection channel before being diverted to the disinfection system.



Source: Parsons Engineering Science, 2000.

FIGURE 1 PROCESS FLOW DIAGRAM FOR A TYPICAL EXTENDED AERATION PLANT

Extended aeration package plants consist of a steel tank that is compartmentalized into flow equalization, aeration, clarification, disinfection, and aerated sludge holding/digestion segments. Extended aeration systems are typically manufactured to treat wastewater flow rates between 0.002 to 0.1 MGD. Use of concrete tanks may be preferable for larger sizes (Sloan, 1999).

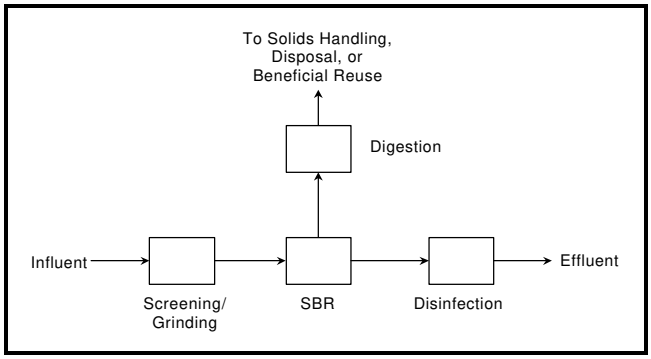
Extended aeration plants are usually started up using "seed sludge" from another sewage plant. It may take as many as two to four weeks from the time it is seeded for the plant to stabilize (Sloan, 1999).

Sequencing batch reactors

A sequencing batch reactor (SBR) is a variation of the activated sludge process. As a fill and draw or batch process, all biological treatment phases occur in a single tank. This differs from the conventional flow through activated sludge process in that SBRs do not require separate tanks for aeration and sedimentation (Kappe, 1999). SBR systems contain either two or more reactor tanks that are operated in parallel, or one equalization tank and one reactor tank. The type of tank used depends on the wastewater flow characteristics (e.g. high or low volume). While this setup allows the system to accommodate continuous influent flow, it does not provide for disinfection or holding for aerated sludge.

There are many types of SBR systems, including continuous influent/time based, non-continuous influent/time based, volume based, an intermittent cycle system (a SBR that utilizes jet aeration), and various other system modifications based on different manufacturer designs. The type of SBR system used depends on site and wastewater characteristics as well as the needs of the area or community installing the unit. Package SBRs are typically manufactured to treat wastewater flow rates between 0.01 and 0.2 MGD; although flow rates can vary based on the system and manufacturer.

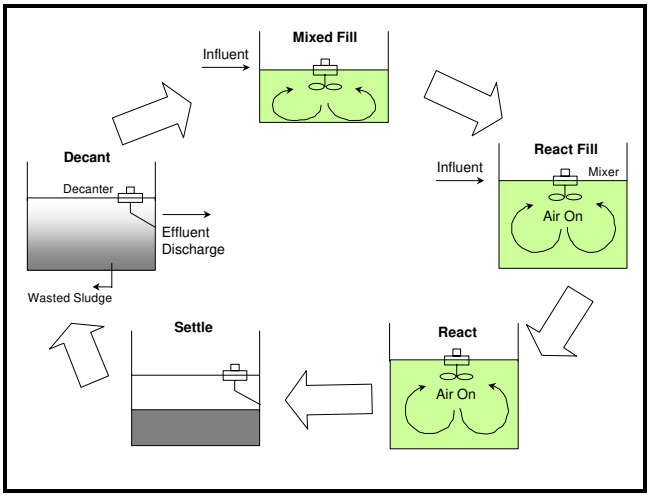
As seen in Figure 2, the influent flow first goes through a screening process before entering the SBR. The waste is then treated in a series of batch phases within the SBR to achieve the desired effluent concentration. The sludge that is wasted from the SBR moves on to digestion and eventually to solids handling, disposal, or beneficial reuse. The treated effluent then moves to disinfection. An equalization tank is typically needed before the disinfection unit in batch SBRs in order to store large volumes of water. If the flow is not equalized, a sizable filter may be necessary to accommodate the large flow of water entering the disinfection system. In addition, SBR systems typically have no primary or secondary clarifiers as settling takes place in the SBR.



Source: Parsons Engineering Science, 2000.

FIGURE 2 PROCESS FLOW DIAGRAM FOR A TYPICAL SBR

There are normally five phases in the SBR treatment cycle: fill, react, settle, decant, and idle. The length of time that each phase occurs is controlled by a programmable logic controller (PLC), which allows the system to be controlled from remote locations (Sloan, 1999). In the fill phase, raw wastewater enters the basin, where it is mixed with settled biomass from the previous cycle. Some aeration may occur during this phase. Then, in the react phase, the basin is aerated, allowing oxidation and nitrification to occur. During the settling phase, aeration and mixing are suspended and the solids are allowed to settle. The treated wastewater is then discharged from the basin in the decant phase. In the final phase, the basin is idle as it waits for the start of the next cycle. During this time, part of the solids are removed from the basin and disposed of as waste sludge (Kappe, 1999). Figure 3 shows this sequence of operation in an SBR.



Source: CASS Water Engineering, Inc., 2000.

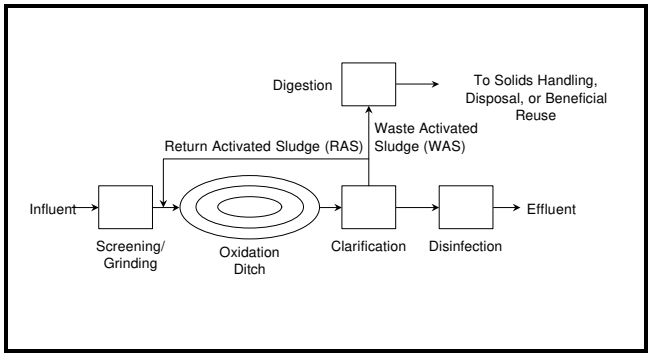
FIGURE 3 SBR SEQUENCE OF OPERATION

Sludge wasting is an important step in the SBR process and largely affects system performance. It is not considered a basic phase since the sludge is not wasted at a specific time period during the cycle. The quantity and rate of wasting is determined by performance requirements. An SBR system does not require an RAS system, as both aeration and settling occur in the same tank. This prevents any sludge from being lost during the react step and eliminates the need to return sludge from the clarifier to the aeration chamber (Metcalf and Eddy, 1991).

Oxidation ditches

An oxidation ditch, a modified form of the activated sludge process, is an aerated, long term, complete mix process. Many systems are designed to operate as extended aeration systems. Typical oxidation ditch treatment systems consist of a single or multi-channel configuration within a ring, oval, or horseshoe-shaped basin. Horizontally or vertically mounted aerators provide aeration, circulation, and oxygen transfer in the ditch.

Package oxidation ditches are typically manufactured in sizes that treat wastewater flow rates between 0.01 and 0.5 MGD. As seen in Figure 4, raw wastewater is first screened before entering the oxidation ditch. Depending on the system size and manufacturer type, a grit chamber may be required. Once inside the ditch, the wastewater is aerated with mechanical surface or submersible aerators (depending on manufacturer design) that propel the mixed liquor around the channel at velocities high enough to prevent solids deposition. The aerator ensures that there is sufficient oxygen in the fluid for the microbes and adequate mixing to ensure constant contact between the organisms and the food supply (Lakeside, 1999).



Source: Parsons Engineering Science, 1999.

FIGURE 4 PROCESS FLOW DIAGRAM FOR A TYPICAL OXIDATION DITCH

Oxidation ditches tend to operate in an extended aeration mode consisting of long hydraulic and solids retention times which allow more organic matter to break down. Treated sewage moves to the settling tank or final clarifier, where the biosolids and water separate. Wastewater then moves to other treatment processes while sludge is removed. Part of it is returned to the ditch as RAS, while the rest is removed from the process as the waste activated sludge (WAS). WAS is wasted either continuously or daily and must be stabilized prior to disposal or beneficial reuse.

APPLICABILITY

In general, package treatment plants are applicable for areas with a limited number of people and small wastewater flows. They are most often used in remote locations such as trailer parks, highway rest areas, and rural areas.

Extended aeration plants

Extended aeration package plants are typically used in small municipalities, suburban subdivisions, apartment complexes, highway rest areas, trailer

parks, small institutions, and other sites where flow rates are below 0.1 MGD. These systems are also useful for areas requiring nitrification.

Sequencing batch reactors

Package plant SBRs are suitable for areas with little land, stringent treatment requirements, and small wastewater flows. More specifically, SBRs are appropriate for RV parks or mobile homes, campgrounds, construction sites, rural schools, hotels, and other small applications. These systems are also useful for treating pharmaceutical, brewery, dairy, pulp and paper, and chemical wastes. While constant cycles with time-fixed process phases are sufficient in most cases, phases should be individually adapted and optimized for each plant. SBRs are also suited for sites that need minimal operator attendance and that have a wide range of inflow and/or organic loadings.

Industries with high BOD loadings, such as chemical or food processing plants, will find SBRs useful for treating wastewater. These systems are also suitable for facilities requiring nitrification, denitrification, and phosphorous removal. Most significantly, SBRs are applicable for areas where effluent requirements can change frequently and become stricter, as these systems have tremendous flexibility to change treatment options. However, part of the economic advantage of the SBR process is lost when advanced treatment processes must be added downstream since intermediate equalization is normally required.

Oxidation ditches

Oxidation ditches are suitable for facilities that require nutrient removal, have limitations due to the nature of the site, or want a biological system that saves energy with limited use of chemicals unless required for further treatment. Oxidation ditch technology can be used to treat any type of wastewater that is responsive to aerobic degradation. In addition, systems can be designed for denitrification and phosphorous removal.

Types of industries utilizing oxidation ditches include: food processing, meat and poultry packing, breweries, pharmaceutical, milk processing, petrochemical, and numerous other types. Oxidation ditches are particularly useful for schools, small industries, housing developments, and small communities. Ultimately, this technology is most applicable for places that have a large amount of land available.

ADVANTAGES AND DISADVANTAGES

Some advantages and disadvantages of package plants are listed below.

Extended aeration plants

Advantages

C Plants are easy to operate, as many are manned for a maximum of two or three hours per day.

C Extended aeration processes are often better at handling organic loading and flow fluctuations, as there is a greater detention time for the nutrients to be assimilated by microbes.

C Systems are easy to install, as they are shipped in one or two pieces and then mounted on an onsite concrete pad, above or below grade.

C Systems are odor free, can be installed in most locations, have a relatively small footprint, and can be landscaped to match the surrounding area.

C Extended aeration systems have a relatively low sludge yield due to long sludge ages, can be designed to provide nitrification, and do not require a primary clarifier.

Disadvantages

C Extended aeration plants do not achieve denitrification or phosphorus removal without additional unit processes.

C Flexibility is limited to adapt to changing effluent requirements resulting from regulatory changes.

C A longer aeration period requires more energy.

- Systems require a larger amount of space and tankage than other "higher rate" processes, which have shorter aeration detention times.

Sequencing batch reactors

Advantages

- SBRs can consistently perform nitrification as well as denitrification and phosphorous removal.
- SBRs have large operational flexibility.
- The ability to control substrate tension within the system allows for optimization of treatment efficiency and control over nitrogen removal, filamentous organisms, and the overall stability of the process.
- Since all the unit processes are operated in a single tank, there is no need to optimize aeration and decanting to comply with power requirements and lower decant discharge rates.
- Sludge bulking is not a problem.
- Significant reductions in nitrate nitrogen can occur by incorporating an anoxic cycle in the system.
- SBRs have little operation and maintenance problems.
- Systems require less space than extended aeration plants of equal capacity.
- SBRs can be manned part time from remote locations, and operational changes can be made easily.
- The system allows for automatic and positive control of mixed liquor suspended solids (MLSS) concentration and solids retention time (SRT) through the use of sludge wasting.

Disadvantages

- It is hard to adjust the cycle times for small communities.
- Post equalization may be required where more treatment is needed.
- Sludge must be disposed frequently.
- Specific energy consumption is high.

Oxidation ditches

Advantages

- Systems are well-suited for treating typical domestic waste, have moderate energy requirements, and work effectively under most types of weather.
- Oxidation ditches provide an inexpensive wastewater treatment option with both low operation and maintenance costs and operational needs.
- Systems can be used with or without clarifiers, which affects flexibility and cost.
- Systems consistently provide high quality effluent in terms of TSS, BOD, and ammonia levels.
- Oxidation ditches have a relatively low sludge yield, require a moderate amount of operator skill, and are capable of handling shock and hydraulic loadings.

Disadvantages

- Oxidation ditches can be noisy due to mixer/aeration equipment, and tend to produce odors when not operated correctly.
- Biological treatment is unable to treat highly toxic waste streams.
- Systems have a relatively large footprint.
- Systems have less flexibility should regulations for effluent requirements change.

DESIGN CRITERIA

Table 1 lists typical design parameters for extended aeration plants, SBRS, and oxidation ditches.

TABLE 1 TYPICAL DESIGN PARAMETERS FOR PACKAGE PLANTS

	Extended Aeration	SBR	Oxidation Ditch
BOD_5 loading (F:M) (lb BOD_5/ lb MLVSS)	0.05 - 0.15	0.05 - 0.30	0.05 - 0 30
Oxygen Required Avg. at 20EC (lb/lb BOD_5 applied)	2 - 3	2 - 3	2 - 3
Oxygen Required Peak at 20EC (value x avg. flow)	1.5 - 2.0	1.25 - 2.0	1.5 - 2.0
MLSS (mg/L)	3000 -6000	1500 -5000	3000 -6000
Detention Time (hours)	18 - 36	16 - 36	18 - 36
Volumetric Loading (lb BOD_5/d/ 10^3 cu ft)	10 - 25	5 - 15	5 - 30

Source: Adapted from Metcalf and Eddy, 1991 and WEF, 1998.

Extended aeration plants

Package extended aeration plants are typically constructed from steel or concrete. If the system is small enough, the entire system will arrive as one unit that is ready to be installed. If the system is larger, the clarifier, aeration chamber, and chlorine tank are delivered as separate units, which are then assembled on-site (WEF, 1985).

Key internal components of extended aeration treatment plants consist of the following: transfer pumps to move wastewater between the equalization and aeration zones; a bar screen and/or grinder to decrease the size of large solids; an aeration system consisting of blowers and diffusers for the equalization, aeration, and sludge holding zones; an airlift pump for returning sludge; a skimmer and effluent weir for the clarifier; and UV, liquid hypochlorite, or tablet modules used in the disinfection zone. Blowers and the control panel containing switches, lights, and motor starters are typically attached to either the top or one side of the package plant (Sloan, 1999).

Biological organisms within the system need sufficient contact time with the organic material in order to produce effluent of an acceptable quality. Typical contact time for extended aeration package plants is approximately 18-24 hours. The contact time, daily flow rate, influent parameters, and effluent parameters determine the size of the aeration tank where air is used to mix wastewater and to supply oxygen to promote biological growth. A package extended aeration system is sized based on the average volume of wastewater produced within a twenty-four hour period. Although provisions are made for some peaking factor, a flow equalization system may be necessary to prevent overloading of the system from inconsistent flow rates in the morning and evening. Equalization allows the wastewater to be delivered to the treatment plant at more manageable flow rates (WEF, 1985).

Systems should be installed at sites where wastewater collection is possible by gravity flow. In addition, the site should be stable, well drained, and not prone to flooding. The facility should be installed at least 30 meters (100 feet) from all residential areas and be in accordance with all health department regulations or zoning restrictions (WEF, 1985).

In order to ensure ease of operation and maintenance, extended aeration systems should be installed so that the tank walls extend nearly 0.15 meters (6 inches) above ground. This will supply insulation in the winter, prevent surface runoff from infiltrating the system, and allow the system to be serviced readily. If a plant is installed below ground, it must have distinct diversion ditching or extension walls in order to prevent surface water infiltration into the plant. When the plant is installed completely above ground, it may be

necessary to provide insulation for cold weather and walkways for easy maintenance (WEF, 1985).

Sequencing batch reactors

Important internal components include an aeration system, which typically consists of diffusers and a blower; a floating mixer; an effluent decanter; a pump for withdrawing sludge; and a sequence of liquid level floats. The PLC and the control panel are usually positioned within a nearby control building (Sloan, 1999).

When the wastewater flow rate at the site is less than 0.05 MGD, a single, prefabricated steel tank can be used. This tank is divided into one SBR basin, one aerobic sludge digester, and one influent pump well. Concrete tanks may also be used, but in North America are not as cost effective as steel for small systems. If the plant must be able to treat 0.1 to 1.5 MGD, multiple concrete SBR basins are commonly used (CASS, 1999).

The design of SBR systems can be based on carbonaceous BOD removal only or both carbonaceous and nitrogenous BOD removal. The system can be expanded to achieve optimum nitrification and carbonaceous removal by operating primarily in an oxic state with few anoxic periods such as during settle and decant.

Denitrification and biological phosphorous removal can be promoted by providing adequate anoxic periods after intense aerobic cycles. This allows DO to be dissipated and nitrate to be used by the consuming organism and released as elemental nitrogen. By introducing an anaerobic process after the anoxic process, bacteria conducive to excess phosphorous uptake will develop. Phosphorous will be released in the anaerobic phase, but additional phosphorous is incorporated into the cell mass during subsequent aerobic cycles. Since the excess phosphorous is incorporated in the cell mass, cell wastage must be practiced to achieve a net phosphorous removal. Anaerobic conditions should be avoided in treating the waste sludge since they may result in the release of the phosphorous.

A low food to microorganism (F:M) ratio SBR system designed for an average municipal flow pattern will usually have an operating cycle duration of four hours, or six cycles per day. For a two reactor system, there will be twelve cycles per day and for a four reactor system, twenty-four cycles per day. The distribution and number of cycles per day can be adjusted based on specific treatment requirements or to accommodate alternate inflow patterns.

Cycle sequences are time controlled with sufficient volume provided to handle design flow rates. If incoming flow is significantly less than the design flow, only a portion of the reactor capacity is utilized and aeration time periods can be reduced to save energy and prevent over aeration. If flow rates are greater than usual resulting from storm runoff, the control system detects the high rise in the reactor and modifies the cycle to integrate peak flow rates. This will shorten the aeration, settle, and decant sequences, minimize the anoxic sequence (if supplied), and provide more cycles per day. As a result, hydraulic surges are incorporated and the diluted wastewater is processed in less time. In order to make the above optimizations, the logic control must be provided by the PLC (Kappe, 1999).

Small SBRs can experience a variety of problems associated with operation, maintenance, and loadings. Therefore, more conservative design criteria are typically used due to the wide range of organic and hydraulic loads generated from small communities. This type of design utilizes a lower F:M ratio and longer hydraulic retention time (HRT) and SRT (CASS, 1999).

Oxidation ditches

Key components of a typical oxidation ditch include a screening device, an influent distributor (with some systems), a basin or channel, aeration devices (mechanical aerators, jet mixers, or diffusers, depending on the manufacturer), a settling tank or final clarifier (with some systems), and an RAS system (with some systems). Typically, the basin and the clarifier are individually sized to meet the specific requirements of each facility. These components are often built to share a common wall in order to reduce costs and save space (Lakeside, 1999).

Concrete tanks are typically used when installing package plant oxidation ditches. This results in lower maintenance costs as concrete tanks do not require periodic repainting or sand blasting. Fabricated steel or a combination of steel and concrete can also be used for construction, depending on site conditions (Lakeside, 1999).

The volume of the oxidation ditch is determined based on influent wastewater characteristics, effluent discharge requirements, HRT, SRT, temperature, mixed liquor suspended solids (MLSS), and pH. It may be necessary to include other site specific parameters to design the oxidation ditch as well.

Some oxidation ditches do not initially require clarifiers, but can later be upgraded and expanded by adding clarifiers, changing the type of process used, or adding additional ditches (Kruger, 1999).

PERFORMANCE

The performance of package plants in general can be affected by various operational and design issues (Metcalf and Eddy, 1991).

- Large and sudden temperature changes
- Removal efficiency of grease and scum from the primary clarifier (except with oxidation ditches that do not use primary clarifiers)
- Incredibly small flows that make designing self-cleansing conduits and channels difficult
- Fluctuations in flow, BOD_5 loading, and other influent parameters
- Hydraulic shock loads, or the large fluctuations in flow from small communities
- Sufficient control of the air supply rate

Extended aeration plants

Extended aeration plants typically perform extremely well and achieve effluent quality as seen in Table 2. If chemical precipitation is used, total phosphorous (TP) can be < 2 mg/L. In some cases, extended aeration systems result in effluent with < 15 mg/L BOD and < 10 mg/L TSS.

TABLE 2 EXTENDED AERATION PERFORMANCE

	Typical Effluent Quality	Aldie WWTP (monthly average)
BOD (mg/L)	< 30 or <10	5
TSS (mg/L)	< 30 or <10	17
TP (mg/L)	< 2*	**
NH_3-N (mg/L)	< 2	**

* May require chemicals to achieve.
** DEQ does not require monitoring of these parameters.

Source: Sloan, 1999 and Broderick, 1999.

Aldie Wastewater Treatment Plant

The Aldie Wastewater Treatment Plant, located in Aldie, Virginia, is an extended aeration facility which treats an average of 0.0031 MGD with a design flow of 0.015 MGD. This technology was chosen because it would allow the area to meet permit requirements while minimizing land use. The plant consists of an influent chamber which directs the flow to two parallel aeration basins, parallel clarifiers, and a UV disinfection system.

Sequencing batch reactors

The treatment performance of package plant SBRs is largely influenced by the plant operator. While the process requires little assistance, training programs are available to teach operators how to become skilled with small plant operations. SBRs perform well, often matching the removal efficiency of extended aeration processes. Systems can typically achieve the effluent limitations listed in Table 3.

In addition, SBR systems have demonstrated a greater removal efficiency of carbonaceous BOD than other systems due to optimization of microbial activity via anoxic stress and better utilization of applied oxygen in the cyclic system. The system can consistently provide carbonaceous BOD effluent levels of 10 mg/L.

TABLE 3 SBR PERFORMANCE

	Typical Effluent	Harrah WWTP	
		% Removal	Effluent
BOD (mg/L)	10	98	3
TSS (mg/L)	10	98	3
NH_3 (mg/L)	< 1	97	0.6

Source: Sloan, 1999 and Reynolds, 1999.

Harrah Wastewater Treatment Plant

The Harrah wastewater treatment plant in Oklahoma treats an average wastewater flow of 0.223 MGD. The SBR has achieved tertiary effluent quality without filtration from the time it was first installed. Pretreatment involves an aerated grit chamber and comminutor. Waste activated sludge is taken to a settling pond where the settled sludge is dredged annually. A nitrogen removal study performed for nine months confirmed that nitrification and denitrification occur consistently without special operator care.

Oxidation Ditches

Although the manufacturer's design may vary, most oxidation ditches typically achieve the effluent limitations listed in Table 4. With modifications, some oxidation ditches can achieve TN removal to # 5 mg/L and TP removal with biological means.

City of Ocoee Wastewater Treatment Plant

Currently, the wastewater treatment plant in Ocoee, Florida accepts an average flow of 1.1 to 1.2 MGD. The city chose to use an oxidation ditch because it was an easy technology for the plant staff to understand and implement. The facility is also designed for denitrification without the use of chemical additives. Nitrate levels consistently test at 0.8 to 1.0 mg/L with limits of 12 mg/L (Holland, 1999). Table 4 indicates how well the Ocoee oxidation ditch performs.

TABLE 4 OXIDATION DITCH PERFORMANCE

	Typical Effluent Quality		Ocoee WWTP	
	With 2° Clarifier	With Filter	% Removal	Effluent
CBOD (mg/L)	#10	5	> 97	4.8
TSS (mg/L)	#10	5	> 97	0.32
TP (mg/L)	2	1	NA	NA
$N\text{-}NO_3$ (mg/L)	NA	NA	> 95	0.25

Note: 2° = secondary. NA = not available.

Source: Kruger, 1999 and Holland, 1999.

OPERATION AND MAINTENANCE

Operation requirements will vary depending on state requirements for manning package treatment systems. Manning requirements for these systems may typically be less then eight hours a day. Each type of system has additional operational procedures that should be followed to keep the system running properly. Owners of these systems must be sure to follow all manufacturer's recommendations for routine and preventative maintenance requirements. Each owner should check with the manufacturer to determine essential operation and maintenance (O&M) requirements.

Depending on state requirements, most systems must submit regular reports to local agencies. In addition, system operators must make safety a primary concern. Wastewater treatment manuals and federal and state regulations should be checked to ensure safe operation of these systems.

Extended aeration plants

Operational procedures for these systems consist of performing fecal coliform tests on the effluent to ensure adequate disinfection and making periodic

inspections on dissolved oxygen levels (DO) and MLSS concentrations in the aeration compartment. Sludge-volume index (SVI) tests in the clarifier must also be performed to determine how well the sludge is settling. Other sampling and analyses will be required on the effluent in accordance with state regulations.

Typical maintenance steps for extended aeration systems include checking motors, gears, blowers, and pumps to ensure proper lubrication and operation. Routine inspection of equipment is also recommended to ensure proper operation. Check with the manufacturer for specific O&M requirements.

Sequencing batch reactors

To ensure proper functioning of the system, O&M must be provided for several pieces of equipment. Operational procedures include sampling and monitoring of DO, pH, and MLSS levels. Additional sampling and analyses on the effluent will be required based on state regulations.

Maintenance requirements include regular servicing of aeration blowers, which is usually performed when greasing is done, and monthly inspection of belts on the blowers to determine if they need to be adjusted or replaced. Submersible pumps require routine inspections and servicing as required by the manufacturer. The decanter will require monthly greasing. Additional O&M may be required depending on system requirements. Check with the manufacturer for specific maintenance requirements.

Oxidation ditches

Depending on the manufacturer's design, typical operational procedures for oxidation ditches include monitoring of DO, pH, MLSS, and various other types of sampling and analyses.

Maintenance steps include periodically inspecting the aerator, regularly greasing rotors, and following manufacturer recommendations for maintenance of the pumps. Operators should follow all manufacturer recommendations for operation and maintenance of the equipment.

COSTS

Costs are site specific and generally depend on flow rate, influent wastewater characteristics, effluent discharge requirements, additional required equipment, solids handling equipment, and other site specific conditions. Manufacturers should be contacted for specific cost information.

Extended aeration plants

As provided by Aeration Products, Inc., smaller extended aeration package plants designed to treat less than 0.02 MGD cost approximately $4 to $6 per gallon of water treated, based on capital costs. For larger plants, capital costs will be approximately between $2 to $2.50 per gallon of wastewater treated. Maintenance processes for these plants are labor-intensive and require semi-skilled personnel, and are usually completed through routine contract services. Maintenance cost averages $350 per year.

Table 5 provides the cost estimates for various extended aeration packages. These costs include the entire package plant, as well as a filtration unit.

TABLE 5 COST ESTIMATES FOR EXTENDED AERATION

Flow (MGD)	Estimated Budget Cost per Gallon ($)
0.015	9-11
0.04	7
1.0	1.3

Note: Larger flow rates are available from the manufacturer. Estimated cost per gallon was determined based on the mid-flow range.

Source: Parsons Engineering Science, 1999.

Sequencing batch reactors

The capital cost per capita for small SBR plants is greater than for large SBR plants. Approximate equipment costs disregarding concrete or steel tanks costs are provided in Table 6. Operation energy costs are likely to be higher for small SBR plants than for larger plants as a result of numerous loadings.

TABLE 6 COST ESTIMATES FOR SBRs

Flow (MGD)	Estimated Budget Cost per Gallon ($)
0.01	4-5
0.05	2
0.2	0.7
1.0	0.25

Note: Larger flow rates are available from the manufacturer. Estimated cost per gallon was determined based on the mid-flow range.

Source: CASS, 1999.

System costs will vary, depending on the specific job. Factors influencing cost include average and peak flow, tank type, type of aeration system used, effluent requirements, and site constraints. Operation and maintenance costs are site specific and may range from $800 to $2,000 dollars per million gallons treated. Labor and maintenance requirements may be reduced in SBRs because clarifiers and RAS pumps may not be necessary. On the other hand, maintenance requirements for the more sophisticated valves and switches associated with SBRs may be more costly than for other systems.

Oxidation ditches

Table 7 lists budget cost estimates for various sizes of oxidation ditches. Operation and maintenance costs for oxidation ditches are significantly lower than other secondary treatment processes. In comparison to other treatment technologies, energy requirements are low, operator attention is minimal, and chemical addition is not required.

REFERENCES

Other Related Fact Sheets

Sequencing Batch Reactors
EPA 932-F-99-073
September 1999

TABLE 7 COST ESTIMATES FOR OXIDATION DITCHES

Flow Range (MGD)	Budget Price ($)	Estimated Budget Cost per Gallon ($)
0 - 0.03	80,000	5.33
0.03 - 0.06	91,000	2.02
0.06 - 1.1	97,500	0.17
1.1 - 1.7	106,000	0.08
1.7 - 2.5	114,700	0.05

Note: Larger flow rates are available from the manufacturer. Estimated cost per gallon was determined based on the mid-flow range.

Source: Lakeside, 1999.

Oxidation Ditches
EPA 832-F-00-013
September 2000

Aerobic Treatment
EPA 832-F-00-031
September 2000

Other EPA Fact Sheets can be found at the following web address:
http://www.epa.gov/owmitnet/mtbfact.htm

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APPENDIX

F

FINANCIAL MODEL SAMPLE OUTPUTS

F.1 SAMPLE MODEL OUTPUTS

Sample Model outputs are provided on the following pages. These outputs are not intended to be indicative of recommended development characteristics or potential; rather, they are intended to display the types of information that can be gleaned from the Model, and the format in which the information is presented. The collection of outputs summarized on the following pages incorporates the primary Model outputs, but is not an exhaustive list of every output available.

The Model provides three tabs summarizing outputs:

1) FULL SUMMARY, IN 2017 DOLLARS

This tab provides a collection of key calculations and metrics for each year in the Model's evaluation period. Results are presented in 2017 dollars (CAD), reflective of the inputs and calculations in the Model. A representative screenshot is provided in **Figure F-1**.

2) FULL SUMMARY, IN YEAR-OF-EXPENDITURE DOLLARS

This tab provides a collection of key calculations and metrics for each year in the Model's evaluation period. Results are presented in year-of-expenditure dollars, reflective of approximate dollar values anticipated in future years as a function of user-provided inflation rates for each year in the Model evaluation period. A representative screenshot is provided in **Figure F-2**.

3) QUICK SUMMARY

This tab provides a dashboard summary of key metrics summed for the entire evaluation period. The dashboard presents results in both tabular and chart form. Representative results are presented in **Table F-1** and **Figure F-3**.

Figure F-1: Full Summary (2017 Dollars) Sample Output

Full Summary (2017$)	-	No Errors							
Model Period Ending	EOMONTH	date	-	-	2018	2019	2020	2021	2022	2023
Forecast Period Flag	-	flag	30	-	-	-	1	1	1	1
Operation Year Counter	-	counter	378	-	-	-	-	-	-	1
Active Input Column Label	Catastrophe Prop. Tax	case name								
	Constant	Unit	Total							
UTILITY FEES										
Stabilized Annual Fee per Occupied Residential Unit		2017 $ / unit			-	-	2,287	2,287	2,287	2,287
Total Number of Occupied Residential Units		units			-	-	-	-	19	43
Residential Portion of Total Cost		2017 $	3,813,828		-	-	-	-	42,533	99,245
Stabilized Annual Fee per Occupied Commercial Unit		2017 $ / unit			-	-	-	-	-	-
Total Number of Occupied Commercial Units		units			-	-	-	-	-	-
Commercial Portion of Total Cost		2017 $	-		-	-	-	-	-	-
Total Utility Fee		**2017 $**	**3,813,828**		-	-	-	-	**42,533**	**99,245**
PROPERTY TAX FEES										
Base Residential Tax Rate		%			-	-	0.16686%	0.16686%	0.16686%	0.16686%
Incremental Residential Tax Rate		%			-	-	0.00070%	0.00070%	0.00070%	0.00070%
New Residential Tax Rate		%			-	-	0.16755%	0.16755%	0.16755%	0.16755%
Residential Tax Increase per New Unit		2017 $			-	-	1.74	1.74	1.74	1.74
Base Commercial Tax Rate		%			-	-	0.16686%	0.16686%	0.16686%	0.16686%
Incremental Commercial Tax Rate		%			-	-	0.00070%	0.00070%	0.00070%	0.00070%
New Commercial Tax Rate		%			-	-	0.16755%	0.16755%	0.16755%	0.16755%
Commercial Tax Increase per New Unit		2017 $			-	-	-	-	-	-
Total Incremental Residential Taxes (County-Wide)		2017 $	1,009,207		-	-	-	-	-	37,378
Total Incremental Commercial Taxes (County-Wide)		2017 $	8,044		-	-	-	-	-	298
Total Incremental Taxes (County-Wide)		**2017 $**	**1,017,252**		-	-	-	-	-	**37,676**
Estimated Annual Payment Leakages		**2017 $**	**95,346**		-	-	-	-	**1,063**	**2,481**
DEVELOPER COST OBLIGATIONS (O&M)										
O&M Expenditures		**2017 $**	**81,861**		-	-	-	-	-	**81,861**
RESERVE FUND BALANCE and CAPITAL BORROW										

Figure F-2: Full Summary (Year-of-Expenditure Dollars) Sample Output

Full Summary (YoE$)	-	No Errors								
Model Period Ending	EOMONTH	date	-	-	2018	2019	2020	2021	2022	2023
Forecast Period Flag	-	flag	30	-	-	-	1	1	1	1
Operation Year Counter	-	counter	378	-	-	-	-	-	-	1
Active Input Column Label	Catastrophe Prop	case name								
	Constant	Unit	Total							
Inflation Factor	0	factor	0	0	1.02	1.03	1.05	1.07	1.09	1.11
UTILITY FEES										
Stabilized Annual Fee per Occupied Residential Unit		YoE $ / unit			-	-	2,405	2,446	2,488	2,530
Total Number of Occupied Residential Units		units			-	-	-	-	19	43
Residential Portion of Total Cost		YoE $	5,301,987		-	-	-	-	46,274	109,808
Stabilized Annual Fee per Occupied Commercial Unit		YoE $ / unit			-	-	-	-	-	-
Total Number of Occupied Commercial Units		units			-	-	-	-	-	-
Commercial Portion of Total Cost		YoE $	-		-	-	-	-	-	-
Total Utility Fee		**YoE $**	**5,301,987**		-	-	-	-	**46,274**	**109,808**
PROPERTY TAX FEES										
Base Residential Tax Rate		%			-	-	0.16686%	0.16686%	0.16686%	0.16686%
Incremental Residential Tax Rate		%			-	-	0.00070%	0.00070%	0.00070%	0.00070%
New Residential Tax Rate		%			-	-	0.16755%	0.16755%	0.16755%	0.16755%
Residential Tax Increase per New Unit		YoE $			-	-	1.83	1.86	1.89	1.93
Base Commercial Tax Rate		%			-	-	0.16686%	0.16686%	0.16686%	0.16686%
Incremental Commercial Tax Rate		%			-	-	0.00070%	0.00070%	0.00070%	0.00070%
New Commercial Tax Rate		%			-	-	0.16755%	0.16755%	0.16755%	0.16755%
Commercial Tax Increase per New Unit		YoE $			-	-	-	-	-	-
Total Incremental Residential Taxes (County-Wide)		YoE $	1,402,218		-	-	-	-	-	41,356.36
Total Incremental Commercial Taxes (County-Wide)		YoE $	11,177		-	-	-	-	-	329.65
Total Incremental Taxes (County-Wide)		**YoE $**	**1,413,395**		-	-	-	-	-	**41,686**
Estimated Annual Payment Leakages		**YoE $**	**132,550**		-	-	-	-	**1,157**	**2,745**
DEVELOPER COST OBLIGATIONS (O&M)										
O&M Expenditures		**YoE $**	**90,574**		-	-	-	-	-	**90,574**
RESERVE FUND BALANCE and CAPITAL BORROW										

Table F-1: Model Summary Results

General

Active Funding Option	**Catastrophe Prop. Tax**	
Number of Phases	**1**	Phases
Communal System Capital Costs	**1,177,860**	2017 $
Reserve Fund Balance at Lifecycle Close	**1,657,600**	2017 $
Potential Catastrophe Cost at Lifecycle Close	**977,624**	2017 $
Total Lifecycle Utility Fees Paid	**3,813,800**	2017 $
Total Lifecycle Incremental Property Tax Paid	**1,017,300**	2017 $
Total Lifecycle Hookup Fees Paid	**124,000**	2017 $
Lifecycle Developer O&M Obligations	**81,861**	2017 $
Potential Induced Lifecycle Tax Revenue	**524,713**	2017 $
Estimated Lifecycle Payment Leakages	**95,346**	2017 $
Total Development Area	**13.55**	Hectares
Steady-State Unit Cost for Water/Wastewater (No Connection Fee)	**7.93**	2017 $ / m3
Steady-State Utility Fee for Water/Wastewater (No Connection Fee)	**6.27**	2017 $ / m3
Estimated Steady-State Water Consumption (Full Development)	**22,630**	m3/year

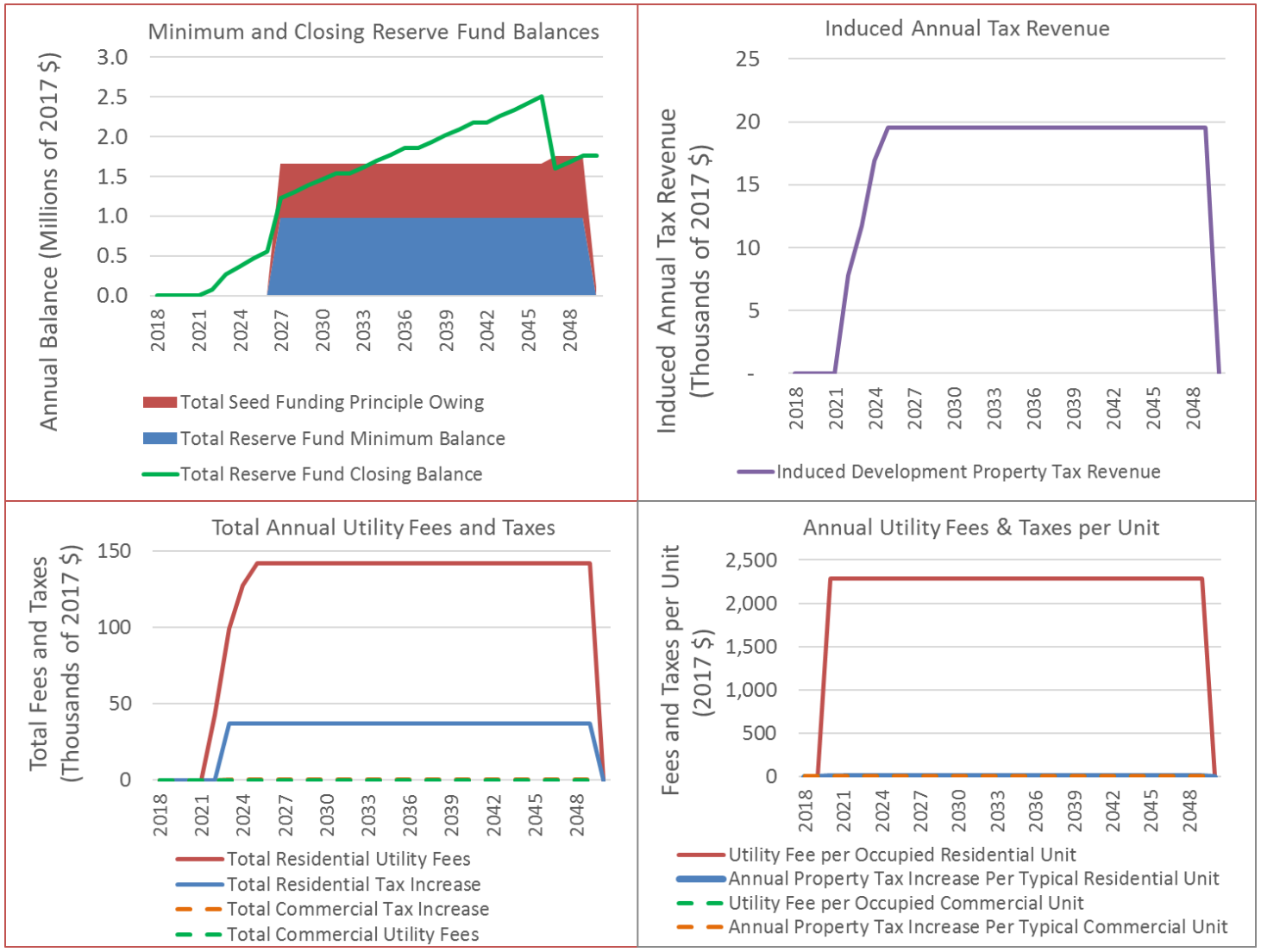
Residential

Total Number of Residential Units	**62**	Units
Initial Hookup Fee per Residential Unit	**2,000**	2017 $
Estimated Stabilized Annual Utility Fee per Residential Unit	**2,287**	2017 $
Existing Tax Rate (Residential)	**0.1669%**	%
New Tax Rate (Residential)	**0.1676%**	%
Annual Property Tax Increase Per Typical Residential Unit	**2.09**	2017 $

Commercial

Total Area of Commercial Units	**-**	m2
Initial Hookup Fee per Commercial Unit	**2,000**	2017 $
Estimated Stabilized Annual Utility Fee per Commercial Unit	**-**	2017 $
Existing Tax Rate (Commercial)	**0.1669%**	%
New Tax Rate (Commercial)	**0.1676%**	%
Annual Property Tax Increase Per Typical Commercial Unit	**2.78**	2017 $

Figure F-3: Reserve Balances, Induced Annual Tax Revenue, and Utility Fees and Taxes Required to Pay for Proposed Communal System (in 2017 Dollars)



F.2 BASIC USER GUIDE

As discussed in greater detail during the training session WSP held with the County on January 28, 2019, the Model is colour-coded to make user interaction simple and clear. Tabs in the model are coloured as followed:

- Red tab: User guide

- Yellow tabs: User input is entered and stored
  - Cells intended for user input are highlighted in yellow; other cells represent calculations or static inputs which should not be changed to ensure integrity and functionality of the Model is maintained.

- Grey tab: Time and escalation calculations are performed. This tab should not be adjusted by the user.

- Green tabs: Model calculations are performed. Generally speaking, these tabs should not be adjusted by the user.
  - One exception exists within the 'Stabilized Utility Fees' tab and the 'Stabilized Property Tax' tab, where buttons (represented by a calculator icon) need to be clicked to update the Model outputs whenever Model inputs have been adjusted by the user.

- Purple tabs: Results are summarized and presented to the user.

Steps required to use the Model are as follows:

1. The user enters and/or modifies data in yellow cells in the InpC ('Input Column') tab.

2. The user enters and/or modifies data in yellow cells in the InpR ('Input Row') tab.

3. The user clicks the Calculator button in the InpC tab (cell I7).

4. The user retrieves results from the Summary tabs.

COUNTY OF FRONTENAC
COMMUNAL SERVICES STUDY

JUNE 2019

FRONTENAC

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