

# Onsite

ONTARIO ONSITE WASTEWATER ASSOCIATION NEWSLETTER  
Education | Engagement | Leadership

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## A Case Study on the Role of the Municipal Responsibility Agreement

The Role of the Municipal Responsibility Agreement in a Decentralized Residential Development

*By: Clearford Water Systems Inc.*

### PROJECT OVERVIEW

**Location:** Otonabee-South Monaghan, Ontario

**Challenge:** The site, located in a rural municipality, was in an un-serviced area with no "reasonable expectation" for future municipal servicing. To construct housing the developer required decentralized water and wastewater facilities, leading to the requirement for a Municipal Responsibility Agreement (MRA).

### SOLUTION

Due to the complexity of the site and working with a municipality and a developer new to decentralized operations, communication and consultation were absolutely critical. Our recommendation going forward is to have these consultations early and update progress often to make sure any potential questions are addressed and all parties thoroughly understand what is to be constructed and, ultimately, managed in accordance with the conditions set out in the MRA.

### BOTTOM LINE

The MRA was a key document for this development, as well as many others, where decentralized servicing was required. The site plan, condominium plan, reserve fund studies, and the Environmental Compliance Approval (ECA) are all tied to the MRA. Before any site permissions can be obtained, it is required that a draft MRA is reviewed by all parties.

*Story continues on page 28*



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## PRESIDENT'S MESSAGE



Summer 2021 is well underway and by all accounts it looks like it is shaping up to be yet another busy year for our members and our industry. It is no different at OOWA, as the committees continue to work diligently on your behalf.

The Onsite Technical Committee volunteers have been busy

finalizing the site evaluation guidance document that addresses several design and installation issues that members have been bringing to us for some time. The committee has also started work on a guidance document for grey water systems and will be working on an FAQ document that addresses key inspection points for regulators. On the horizon is a guidance document that will outline different methods of detection. If you are interested in contributing to this, or any guidance document, please get in touch.

The Events Committee delivered our first ever Virtual Part 8 Panel Discussion via Zoom to 50+ attendees over the lunch hour on June 16th. We would like to thank our panelists Danielle Ward of Adams Brothers Construction, Brad Smale of the Township of Norwich and Kevin Warner of Cambium for their thoughtful contributions. Thank you, as well, to Bill Goodale of Tatham Engineering and Tiny Township for moderating. A special thanks to Nico Nirschl and the Liberty Pumps team for sponsoring the event. The group managed to address five topics that generated many excellent questions and comments from attendees. OOWA will be continuing to host these virtual panel discussions on a quarterly basis. Stay tuned for information on our next virtual panel session scheduled for 12:00pm-1:00pm on Wednesday, September 15th.

In light of the easing of social restrictions the Events Committee is gearing up for a return to in-person events with a focus on planning a regional meeting this fall. This event will be held outside in the central Ontario/Muskoka area with a strong social emphasis and a summer BBQ feel! Again, stay tuned for more information on how to join us.

Our 2022 conference planning task group is underway discussing the possibility of a return to in-person at the Ottawa Convention Event and Conference Centre. The call for presentations was released last month so if you have an idea for a presentation please let us know.

OOWA is currently helping to update information of the now famous 'Septic Smart' homeowner resource package.

Septic Smart was initiated by Terry Davidson from the Rideau Valley Conservation Authority/Ottawa Septic System Office many years ago and was supported by the Ministry of Agriculture Food and Rural Affairs. It has since become a staple resource with brochures and an excellent DVD of educational videos with a notable cameo by the Ontario Rural Wastewater Centre's Doug Joy. You can watch them on [OMAFRA's website](#).

In June of this year OOWA was approached by representatives of the Ministry of Environment, Conservation and Parks (MECP) and Dr. Clare Robinson, Ph.D. who is an Associate Professor and Canada Research Chair in Water Quality with the Department of Civil and Environmental Engineering at Western University, to partner on a research grant application to the Natural Sciences and Engineering Research Council of Canada. The project focuses on how onsite sewage systems may be contributing to excess nutrient loading in the Lake Erie and Lake Simcoe watersheds. OOWA will have the opportunity to provide technical advice to the project direction, methods, and data analysis. As a project partner OOWA will also have access to the resulting data and assist in the dissemination of the findings to our organizational partners and the public. OOWA is keen to support this research initiative and looks forward to providing our expertise.

In this edition of the newsletter, we're featuring articles that consider the ongoing shift from urban to rural Ontario and the critical importance of planning with the goal of ensuring sustainable servicing. Clearford's cover story looks at how Municipal Responsibility Agreements (MRAs) are the critical foundation to any successful decentralized wastewater system project. An article from the National Onsite Wastewater Recycling Association (NOWRA) looks at how one American cottage community is working towards providing affordable wastewater infrastructure. In this unprecedented real estate market, rural and waterfront property buyers are forgoing home and septic inspections to win bidding wars, often with disastrous results. Septic re-inspections, whether privately or municipally initiated, continues to be a challenge and one that has avoided a legislative trigger. With no clear solution it is certainly an issue that calls out for attention. To this end, we feature some perspectives from key stakeholders about this ongoing struggle.

We hope your summer is a safe and prosperous one!

A handwritten signature in black ink that reads "Brady Straw".

Brady Straw, President



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*The opinions expressed in this newsletter by contributing authors are not necessarily the opinions of OOWA's Board of Directors or the Association.*

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# A Conversation Starter: Septic System Inspections and Home Ownership Transfers

At this point, it would be clichéd to say that this past year has been unlike any other. The amount of social and economic upheaval wrought by COVID 19 caught everyone off guard. What stood out as an unexpected trend has been the mass exodus of people relocating from large centres to smaller rural communities. As a result, the real estate market has been spiralling out of control. As Chuck Murney, President of the Lakelands Association of Realtors aptly describes it; “The real estate market right now has been termed as unprecedented. With the average sale

price increasing more than 30% in the last 16 months, we have not only seen record sales numbers but an intensified number of properties changing hands all while working with the lowest number of properties on the market throughout Muskoka, Haliburton & Parry Sound areas.”.



This hot real estate market has made it much more challenging to inspect and assess existing septic systems as part of the property ownership transfer process. Currently, the only other avenues for reviewing private operational septic systems are through municipal re-inspection programs, mandatory municipal source water protection inspections, complaint-based investigations or homeowners experiencing failing systems. These existing inspection opportunities already come with their own set of challenges in terms of execution, consistency of approach and uniform results, now real estate transfer septic inspections are being undermined.

As an onsite professional specializing in private inspections, Kathryn Stasiuk-Riddell of KSR Engineering concurs saying, “this hot market has encouraged buyers to forgo inspection conditions on their offers, frustrating risk-averse buyers who are keen to protect themselves from expensive and unforeseen upgrade costs. No incentives are currently provided to sellers or realtors associated with inspections of a home or inspection of the home’s wastewater treatment and disposal infrastructure, however in a normal market, a realtor and seller team would come to expect this condition on most, if not all bids.”

The implications of forgoing home and septic inspections has been unfolding over the past few months with a handful of horror stories that have made it in the press. Stories of serious building deficiencies and failed or even incomplete septic systems being discovered only after buyers take possession. As Chuck points out, “it is unfortunate that in the current market where most properties receive multiple offers that sellers typically only look at offers that do not have conditions. On the other hand, for buyers the reward for winning the offer on a property often outweighs the risks involved.” Leigh Gate, President of the Ontario Association of Home Inspectors, adds that “many issues can go undetected for a period of time, leading to further problems. Replacing a septic system may include updated environmental considerations or costly cleanup. In today’s competitive real estate market, it can be a challenge to have conditions accepted within the offer, although unexpected repair costs can be a much larger risk.”

In clarifying the role of listing agents preparing for marketing a property Chuck says that “a pre-listing inspection goes a long way but sellers need to be willing to fork out the cash. Beyond that, obtaining septic installation paperwork and a report from recent pump-out give insight into the age & state of the system. Conversely, buyer’s agents should be looking for the same info to provide and gain a better understanding of the life of the septic system.” Kathryn shares with us that “the Real Estate Council of Ontario reminds buyers to protect themselves with inspections, and so does the provincial ‘what to know before buying a home’ page but this does not change the market reality: offers with conditions are bumped to the bottom of the pile.” For companies who offer septic inspection services, Kathryn notes that “inspection companies find themselves in this bind of offering a service that can be dropped during specific market conditions. Buyers find themselves in a bind where they aren’t competitive with inspection conditions, so they take on the risk themselves and sometimes choose to inspect after the purchase.”



# A Conversation Starter: Septic System Inspections and Home Ownership Transfers

Despite the potential pitfalls of buying a property without inspections, there is still considerable pressure for first time home buyers and those anxious to escape the city to take risks when buying. Chuck maintains that “a home inspection including inspection of the septic system is highly recommended and the best way to protect everyone’s interests. Realtors that are used to dealing with septic’s understand the risks that are involved and can better educate their clients. Our members understand the importance of keeping clients protected and, while by no means experts, through experience & education many can spot and point out the danger signs associated with septic’s.” Leigh adds that inspections completed by professionals is the best way to mitigate unforeseen issues and advocates for consumer protection when purchasing real estate; “Buyers should have the ability to hire professional inspectors to assess all major systems of a property. Where a property includes a well, wood burning appliance or septic system, those components should be professionally inspected. Many of our members are qualified for these systems or assist the buyer in sourcing the appropriate professional.”

It's safe to say that these stakeholders agree that inspections protect all parties involved, but should there be a mechanism that ensures inspections take place despite market pressures? Kathryn suggests that the province could consider “intervening via either update to applicable legislation to include a requirement for home and septic inspections, or by putting pressure on the real estate market industry members to discourage the practice of prioritization of condition-free bids.” In a 2018 letter to then Environmental Commissioner of Ontario, Doug Vergunst, then Chief Building Official of the Northwestern Health Unit, suggests that “implementing a point of sale requirement would address the need to manage private systems better. Doing so would:

- Treat all sewage systems equally
- Address standardization across the province
- Ensure that there is consistency between the original design and the current use of systems
- Catch systems that need immediate attention at the best possible time
- Address the inconsistency/gap for having a legal document to operate a private system
- Have the least amount of new government involved to start to manage infrastructure that needs management”

As noted in the title of this article, presenting insights from industry insiders on the topic of ownership transfer inspections is intended to be a conversation starter. It is common knowledge that the current situation is not ideal for our industry and that the potential benefits of taking some action will serve the best interests of our environment and human health. What are your thoughts? What role could education and outreach play? Is there legislative action that the province should consider? Or is this an issue that municipalities might address with appropriate by-laws? We want to hear from you!



Photo Credit: ESSE Canada

# MEMBER PROFILE

## Andrew Vitaterna

**Name of Business:** Clearford Water Systems Inc.

**Services:** Operations and Maintenance of Decentralized Water and Wastewater Treatment Systems

**Service Area:** Ontario Wide

**Number of Years in Role:** 35

### What got you started in the onsite wastewater industry?

As a professional engineer since 1987, I spent the first 13 years of my career in the consulting engineering business designing decentralized water and wastewater treatment systems.

In 1996, I managed my very first design/build project for a communal wastewater plant and secured a long-term operations contract for the facility, which we continue to operate to this day. That project was the foundation to starting up design/build/operate services at ASI Water, now under Clearford which operates over 180 sites across the province.

### Give us one reason/secret for your success.

Clearford is among a small number of firms with staff who understand the full scope of work in decentralized servicing and have an in-house support team to provide expertise in every aspect of this work from initial design and approvals through to commissioning and long term operations. It is Clearford's focus to efficiently deliver decentralized services while taking into account the tight budgets and quick turn-around times inherent with this Client sector.

### What was the most challenging onsite job you worked on or participated in?

The most challenging project was drinking water related and occurred shortly after the Walkerton outbreak. One of my clients had an old drinking water system that was built before regulations existed. Soon after a few E. coli hits, the entire community went under a Boil Water Advisory. This became public very quickly and I was interviewed by the Buffalo and Toronto TV news stations about this issue being labelled as the next "Walkerton". In a very short time frame, we (ASI Water now Clearford) worked with our



ANDREW VITATERNA, P. ENG  
V.P. Business Development

client to communicate to the public what had happened and a clear path forward for preventative action. Within 6 months, a state-of-the-art membrane filtration water treatment plant was designed and built in-house and remains under Clearford's operations.

### If you could change one thing about the onsite/decentralized industry, what would it be?

Before operations can commence, there is a quite lengthy design and approval process required. With the concept of communal, decentralized servicing still foreign to some, it is important to spend time educating your network on advantages of a decentralized system. The best complementary support to this effort is recognition from municipalities and regulatory authorities which appears to be on the horizon for private treatment systems in decentralized developments. It is also very important for designers to select their operations team early in the design stage so that the engineers can incorporate into their design any historic servicing failures that may have occurred. Too often, the operations team is brought into the process upon commissioning which in some cases is too late to incorporate design improvements for optimal operations.

### Where do you see the onsite industry going?

Going forward, the nature, role, and importance of water and wastewater technologies will continue to evolve and grow. Since the COVID-19 pandemic, populations in rural areas have increased leading to a higher demand in housing in traditionally un-serviced area. Fostering this relocation movement is top of mind and supports our efforts in protecting public health and the environment by delivering decentralized systems.

# New & Renewed Members Listing

For the period of March 10, 2021 - July 22, 2021

## NEW MEMBERS:

**Jennifer Andersen**, Centre for Advancement of Water and Wastewater Technologies (CAWT), Fleming College  
**Sarah Baltare**, Municipality of Chatham-Kent  
**Kyle Bambury**, Paterson Group Inc  
**Chris Beeg**, Township of South Frontenac  
**Isaac Botchwey**, McGill University  
**Ana Brankovan**, University of Toronto  
**Dash Delarosbel**, Temagami Barge Limited  
**Adam Dillon**, Paterson Group Inc  
**Jillian Fitzmaurice**, North Bay-Mattawa Conservation Authority  
**Bob Garner**, R.J. Burnside & Associates Limited  
**Timothy Gentles**, City of Belleville  
**Damien Gilbert**, CADUCEON Environmental Laboratories  
**Kevin Haines**, Wood PLC  
**Meagan Hawkins**, Township of Ramara  
**Gary Hendy**, GAMAN Consultants Inc.  
**Brent Hewlett**, Township of South Frontenac  
**Ryan Hiemstra**, Ottawa Septic System Office  
**Robert Jackson**, D.M. Wills Associate Limited  
**Claire Kartner**, WSP  
**Alicia Kimberley**, Peto MacCallum Ltd  
**JOHN LOMBARDO**, Fit Mechancial Inc.  
**Jacklyn Lutin**, Fleming College - Student  
**Ray Millar**, Onsite Septic Solutions  
**James Richmond**, Township of Stone Mills  
**Heather Robb**, Fleming College  
**Nick Romero**, MTE Consultants Inc.  
**Rebecca Roy**, Township of South Frontenac  
**Amanda Savage**, North Bay-Mattawa Conservation Authority  
**Zachary Savoie**, Gunnell Engineering Ltd.  
**Gursewak Singh**, University of Guelph, Guelph  
**Kathryn Stasiuk Riddell**, KSR Engineering  
**Bethany Taylor**, Mac Taylor Corporation  
**David Thompson**, Barnboard Construction Group

## RENEWED MEMBERS:

**Robin Allen**, North Bay-Mattawa Conservation Authority  
**Steven Barrie**, Steve Barrie Backhoe & Equipment Rental  
**Dan Beaton**, J.H. Cohoon Engineering Ltd.  
**Marie-Christine Belanger**, Premier Tech Water & Environment  
**Robert Bezaire**, Underground Specialties  
**Brad Billings**, Billings Construction  
**Ella Bird**, North Bay-Mattawa Conservation Authority  
**Joseph Burns**, Howard Burns Equipment Rentals  
**Brenda Burrows-Rabb**, Rabb Construction Ltd  
**Don Butwell**, City Of Quinte West  
**Brian Campbell**, Wyevale Concrete Products Limited  
**Duane Campbell**, Howard Campbell & Sons  
**Gemma Charlebois**, MTE Consultants Inc  
**Louie Chiarappa**, Hernandez Sanitation Services  
**Howard Clark**, P. Medley & Sons Ltd  
**Brad Code**, Lockwood Brothers Construction  
**David Cousens**, Kinburn Plumbing & Heating  
**Nicole Couvrette**, City of Quinte West  
**Morgan Crane**, MTE Consultants Inc.  
**William Dainty**, Headwaters Construction Ltd.  
**Robert DeAcetis**, Deson Construction  
**Matt Doyle**, Township of South Frontenac  
**Eric Draper**, The Septic Store  
**Dwaine Fisher**, Fisher Excavating & Grading  
**Sasha Fredette**, North Bay-Mattawa Conservation Authority  
**Carl Gauthier**, Bionest Technologies Inc.  
**Adam Gebarowski**, City of Quinte West  
**Clayton Gilbert**, Gilbert & Son Construction Inc  
**Jack Gilbert**, Gilbert & Son Construction Inc  
**Perry Gingerich**, P. Gingerich Excavating  
**Mark Goodman**, Pump My Tank Inc  
**Adrian Greco**, Greenwood Excavating  
**Paul Greer**, Paul Greer & Son's Exc Ltd.  
**Seth Harder**, Tamarack North Ltd.  
**Kirk Hastings**, Onsite Septic Solutions  
**Brody Hodges**, Lockwood Brothers Construction  
**Aaron Jantzi**, Rhino Excavation  
**Kirk Johnstone**, Northumberland County  
**Andy Jones**, Town Of Gravenhurst  
**Greg Keith**, Matrix Property Inspections



# New & Renewed Members Listing

For the period of March 10, 2021 - July 22, 2021

## RENEWED MEMBERS CONTINUED:

**Sarah Kelly**, Tamarack North Ltd.

**Michael Killam**, Paterson Group Inc

**Rick Kraemer**, Thunder Bay District Health Unit

**Joe Kuipers**, City of Belleville

**Lloyd Laidman**, Intuitive Water Systems Inc

**Coralie Lamaire-Chad**, Bionest Technologies Inc

**Phillip Lappan**, City of Quinte West

**Peter Libicz**, Home Inspection Right Away

**Corey Lockwood**, Lockwood Brothers Construction

**Derk Maat**, Scicorp International Corp.

**Ben MacNeil**, Leeds, Grenville & Lanark Health Unit

**Chad Mann**, Lloyd Collins Construction Ltd.

**Cathy Marcellus**, Wyeval Concrete Products Limited

**Dean McDonald**, Township of North Glengarry

**Dominic Mercier**, Enviro-Step Technologies

**Dale Moak**, David Brown Construction

**Wayne Moore**, Cottage Country Environmental Services

**Cody Morden**, Charles Morden Construction Inc.

**Cassidy Morgan**, University of Guelph

**Natalie Moroz-Cornell**, City Of Quinte West

**Kevin Morris**, C.F. Crozier & Associates Inc.

**John Moudakis**, JM Consulting

**Dave Parent**, Septic Consulting & Design Services

**Adam Peloso**, City Of Quinte West

**Doug Post**, D.F.Post Contracting Inc.

**William Pottruff**, Thunder Bay District Health Unit

**Nick Preikschas**, MTE Consultants Inc.

**Arlene Quinn**, Municipality of Highlands East

**Jason Rail**, The Septic Store

**Laura Reavie**, Skootamatta Environmental Consulting Inc

**Kris Rivard**, North Bay-Mattawa Conservation Authority

**Norman Rivington**, N.S. Rivington Cartage Ltd

**Darryl Robins**, Darryl M. Robins Consulting Inc.

**Will Rounds**, Corporation of the City Of London

**Todd Rumble**, Rumble & Associates Inc.

**Frank Salaris**, Insight360 Home Inspections

**William Sikkema**, City of Quinte West

**Robin Smith**, Robin Smith Engineering

**Wilf Stefan**, Clearford Water Systems

**Jason Stephens**, Stephens Excavating

**Bruce Stowe**, Roth North America

**Graham Taylor**, Mac Taylor Corporation

**Wayne Teel**, Wayne Teel Septic Services

**Brendon Underwood**, Underwood Construction Ltd.

**Brent Underwood**, Underwood Construction Ltd.

**Hendrik Van de Glind**, Paterson Group Inc

**Brent Van Herk**, BVH Excavating & Septic Inc

**Rob Vander Doelen**, Chung & Vander Doelen Engineering Ltd

**Peter Vanderboom**, Alpha Excavation

**Andrew Vangerven**, Van Gerven Excavating

**Andrew Vitaterna**, Clearford Water Systems Inc

**Dave Whidden**, Waubauskene Septic & Landscaping

**Robert Whyte**, Calder Engineering Ltd.

**Dave Wilhelm**, MTE Consultants Inc.

**Amanda Willis**, City of Belleville

**John Yantha**, Yantha Backhoe & Trucking Ltd.

**Brian Zingula**, R.J. Burnside & Associates Limited



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OOWA members get guaranteed and discounted rates on car and trunk rentals. Reference business Account Number LC23343 when booking a rental vehicle.



OOWA has redeveloped the Registered Professional Program (RPP) to include an 'In-Development Stream' that addresses the needs of ongoing training and continuing education demands from our members. OOWA Professional Designations include: Wastewater Service Technician, Designer, Installer, Private or Regulatory Inspector, Residuals Hauler, Project & Administrative Professional and Technical Sales Consultant.



OOWA collaborates with other associations in communicating to government with one united voice on issues that are of mutual concern to our industries. OOWA is proud to inform our members know that you can access membership rates for events and resources provided by our association partners:



- The Ontario Association of Septic Industry Service
- The Ontario Building Officials Association
- The Ontario Ground Water Association

To get more information on these member benefits please visit our website at: [www.oowa.org/about/join-oowa/](http://www.oowa.org/about/join-oowa/)



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# The Impact of Soil Structure on System Installation

An in-depth look at grade, size and type and how the classification affects onsite wastewater treatment

*By Sara Heger, Ph.D.*

*Onsite Installer Magazine*

*July 19, 2021*

While soil texture describes the percentage of each size class (sand, silt and clay), soil structure is the organization of these individual soil particles into a larger arrangement. The size and orientation of the aligned particles means that structure affects acceptance (and thus water treatment) in a similar way as texture.

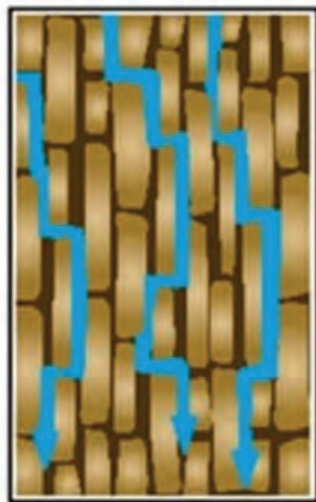
Structure is described in three parts: grade, size and type. Grade refers to the expression of the structure; size refers to the size of the individual structural units (peds); type refers to the shape of the ped. All these parts of the description can be related to both water movement and treatment.

Soil structure develops over time (many hundreds to thousands of years) through physical and chemical weathering. Examples of forces forming soil structure include freeze/thaw cycles, wet/dry cycles, plant rooting, earth-inhabiting invertebrate activity, etc. These forces are concentrated in the upper portion of the soil (within 3 to 5 feet of the soil surface) leaving virtually no soil structure at greater depths. If enough force is used, any body of soil material can be broken into smaller pieces.

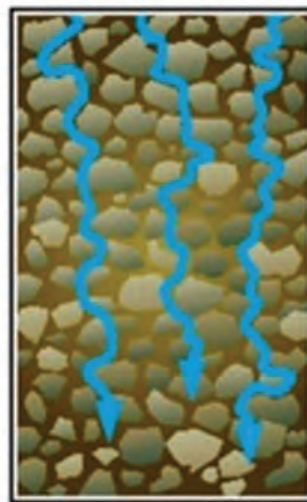
There are four grade levels of structure. Grade 3 is strong or well expressed; grade 2 is moderately expressed; grade 1 is weakly expressed; grade 0 is structureless. A well-structured soil (grade 2 or 3) accepts effluent more quickly because of stable well-expressed voids or macroporosity. However, excessively large voids may allow effluent to flow too quickly without proper treatment. Often this is referred to as preferential flow and may also occur through worm and root channels. A weakly structured soil has few well-defined structural pores, resulting in flow being controlled more by the soil texture than by soil structure.



Granular



Prismatic



Subangular  
blocky



Platy

A structureless soil (grade 0) has no structural porosity so all water flow is controlled by texture. Loose sand is considered to have a grade 0 and is further defined as single grained. Because the inherent porosity of the sand is large, water will flow through it readily.

On the other hand, if the soil is described as massive (coherent), water will flow through it more slowly. This grade is often associated with unstructured clays or more compacted soils. Grade influences the flow and the exchange of air. Well-structured soils promote greater air exchange. The greater air exchange results in more aerobic soil conditions and improved treatment.

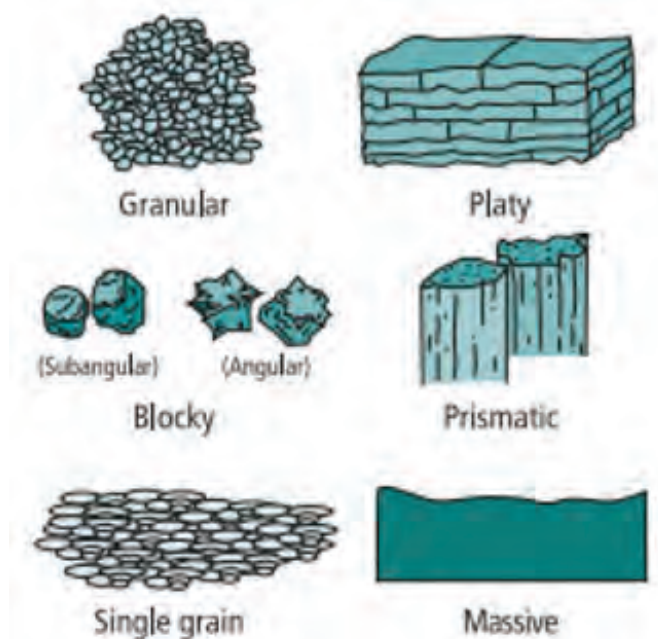
Structure is broken into sizes, ranging from very fine to very coarse. Soils with a finer structure have a greater amount of macroporosity. Soils with more macroporosity tend to conduct water more rapidly as well as allow for more air exchange. Finer soil structure may result in better air exchange and improved wastewater treatment.

Finally, structure is described in terms of its shape or type. Granular structure, common at the soil surface, looks like granola or Grape-Nuts. It may act more like a sand texture and allows for rapid water movement. Blocky structure is composed of peds that are roughly the same size. When these are rounded (subangular), they do not fit well together. Thus, voids (pores) tend to be more conductive than if they are angular. Prismatic structure has most pores oriented vertically. While this may be good for water movement, it may also promote preferential flow. Platy structure has horizontally oriented macropores which limit downward water movement. As the soil goes from granular to platy and then to massive, the structural porosity decreases, and the infiltration rate or ability to move water decreases.

Large pores develop between soil structural units. These pores allow a soil to accept and transmit water more efficiently than soils without soil structure. Understanding soil structure is key to the proper sizing of a soil treatment system.

Soil structure can be destroyed due to excavation and compaction during installation. Once the structure is destroyed, it takes decades for it to re-form in the soil. There is little that can be done to artificially recreate good structure. Therefore, a careless installation can turn a good site into an unusable one simply by destroying soil structure.

*This article first appeared online at [OnsiteInstaller.com](http://OnsiteInstaller.com) on July 19, 2021. It is reproduced with permission.*



# MEMBER PROFILE

## John Martin

**Name of Business:** Cromar Advanced Septic Systems

**Services:** Distributor of products used in the onsite wastewater industry. Eljen GSF A-42 systems, Roth MultiTank, BioBarrier and MicroFAST treatment systems, FujiMAC Air pumps and more. We also provide the mandated service and maintenance across the province on many of these products.

**Service Area:** Ontario

**Number of Years in Role:** 15 years in the onsite wastewater industry

### What got you started in the onsite wastewater industry?

In late 2006 I was working in a sales/marketing position with a company supplying progressive cavity pumps to municipal wastewater treatment plants across Southwestern Ontario. I decided it was time for a change and simply answered a job posting. The onsite wastewater industry seemed like a great fit with my recent background at that time and was hired to fill the sales position. I quickly took on the position of Regional Manager with that company until 2015 when I started Cromar Advanced Septic Systems.

### Give us one reason/secret for your success.

The real reason for any success I may experience in this industry is that in early 2007 after being in the industry for 3 months I realized that I enjoyed this industry much more than any job I had been employed in previously. It was then that I decided the onsite wastewater industry was where I should be. I think the secret for success as a distributor is recognizing that septic installers must be confident in offering your product to their customers. I listened to many installers explain how complicated many of the sewage treatment systems on the market were for them to install, not to mention the difficulty in understanding how they function or how to do repairs if customers called with any problems or alarms. We supply products that are not only price competitive but also quick and simple to install so an installer can have that confidence.



**JOHN MARTIN**  
Owner of Cromar Advanced Septic Systems

### If you could change one thing about the onsite/decentralized industry, what would it be?

I would certainly like to see more younger people consider the onsite wastewater industry as an opportunity for a successful and rewarding career. I am noticing the average age of people I deal with seems to be getting lower. It is this next generation that the industry will rely on to grow the industry with new products, ideas and meet the demands of future growth in building off the grid that municipalities are allowing. The Ontario Onsite Wastewater Association plays an extremely important role in furthering the reputation that this industry offers a great opportunity for a successful and prosperous career.

### Where do you see the onsite industry going?

I believe the industry is ready to experience some exciting opportunities. I also believe it is time that the traditional way of looking at wastewater treatment through only big pipe projects is changing in many decision makers minds and different levels of government are recognizing that traditional big pipe is financially restricting to getting projects off the ground fast. At the same time, the innovation being brought forward by many companies in new and improved onsite wastewater technologies not only protect the health and safety of the residents in Ontario but the environment as well and as the stakeholders in rural development projects realize the opportunity using these products offer, we as an industry will benefit greatly.





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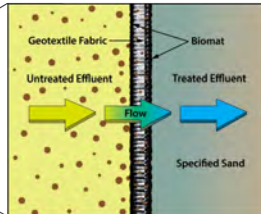
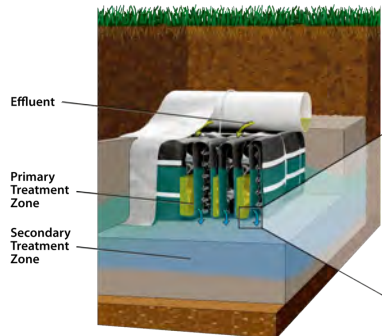
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# Greenhill Produce Achieves A Double Win

## Waterloo Biofilter's On-Site Wastewater Treatment Solution Exceeds Expectations

Greenhill Produce of Thamesville, Ontario, is one of the largest pepper-producing companies in Canada. In a recent expansion project, they contracted Waterloo Biofilter to play a crucial technical role in their progress.

### Expansion of Operations Faces Challenges

For the 23250 Kent Bridge Road project, Greenhill planned to expand their operations to encompass 100 acres of land and bolster their on-site labour force from 72 to 100. However, the septic system treating sanitary wastewater from the bunkhouses and other buildings was already at capacity. Greenhill needed a larger and more robust treatment solution before their project could proceed.

The company was required to achieve the Environmental Compliance Approval (ECA) parameters governing the effluent quality and discharge of up to 35,000 L/day of treated sanitary wastewater to the subsurface disposal system, as follows:

Parameter	Treated Effluent (Maximum)
Carbonaceous Biochemical Oxygen Demand (cBOD <sub>5</sub> )	10 mg/L
Total Suspended Solids (TSS)	10 mg/L

For this project, nitrogen and phosphorus removal were not a concern.

A substantial design hurdle involved the site's layout. Multiple bunkhouses and production facilities were located across the 100-acre site. Collecting wastewater from all these sources and pumping or gravity-feeding the flow to a central treatment facility demanded careful review. The final design had to ensure 24/7 year-round operation regardless of seasonal weather conditions and system demand.

### Up to the Task

Greenhill knew Waterloo Biofilter had worked in their area and understood Waterloo were experts in solving tricky decentralized wastewater treatment challenges. In March 2016, Greenhill contacted Waterloo to review their project. Acting on Waterloo's suggestion, Greenhill engaged the services of an engineering consultant to design the new treatment system.

## Implementation Proceeds Smoothly Despite Bumps in the Road

Waterloo typically does not get involved with the collection systems feeding their treatment process. In this case, Waterloo assisted the engineer by offering design suggestions and the necessary components to collect wastewater from each of the numerous and widespread source locations.

Further, Waterloo provided detailed oversight of the installation work, minimizing the risk of system problems arising once operations commenced.

Another advantage Greenhill appreciated – Waterloo employed a unique factory-assembled basket design to contain the proprietary foam media used in their treatment process. The baskets not only enhanced airflow around the media but also improved quality control while reducing shipping costs and on-site installation time.

Brad VanderEnde was Greenhill's lead contact on the project. He noted the strict ECA requirements impacting this development resulted in many 'on-the-fly' changes in the design as the job progressed. However, as Brad notes, "Waterloo had a solution for every roadblock we encountered with the ECA."



**Installing Process Tanks**

## The End Result: A Happy Client and a New Project

Greenhill commissioned Waterloo Biofilter's sanitary wastewater treatment system in March 2018, with the first treated effluent discharged in May 2018.

For the reporting period May 1 2019 to April 30 2020, influent wastewater BOD<sub>5</sub> and TSS averaged 207 mg/L and 38 mg/L, respectively. The treated effluent quality improved to an average of 5 mg/L for each parameter – well within ECA requirements. Incidentally, total nitrogen reduction over that period averaged 42% (from 77.9 mg/L to 45.3 mg/L), indicative of a properly operating biofilter process.

Greenhill Produce was so satisfied by the outcome of this endeavour, they contracted Waterloo Biofilter once again to design and supply the wastewater treatment process (including phosphorous removal) for their next expansion project.

# MEMBER PROFILE

## Arlene Quinn

**Name of Business:** Municipality of Highlands East

**Service Area:** All of Highlands East

**Number of Years in Role:** 2019 under contract, Hired full time in spring of 2020 to current

### What got you started in the onsite wastewater industry?

After moving to cottage country, I discovered commuting to Courtice was not for me. I began work with my partner's family business that among other things, installs septic's. Stoughton's are 50 years and three generations in the industry. I am now at an age where being on the other side of the fence (Inspecting) seems more suitable (the joints were complaining loudly!) so, when a job opportunity came up to work for the Municipality, I applied and was fortunate to be hired. I am very lucky to be able to live, work and play in cottage country doing something I love!

### Give us one reason/secret for your success.

I love learning about anything septic and try to take as many courses as I can to further my knowledge.

### What was the most challenging onsite job you worked on or participated in?

This is difficult to answer, our area generally has challenges with septic installs. Between bedrock, ground water and small lots, I can't nail down one particular site or install to name.



**ARLENE QUINN**  
Septic Inspector

### If you could change one thing about the onsite/decentralized industry, what would it be?

The key thing I come across for onsite sewage systems in our area is lack of knowledge and understanding in cottage property owners. Although some are well versed and maintain their septic's well, there are many more who do not. I find this frustrating and wish owners would take initiative on learning about septic use & maintenance. Our Municipality currently has a Septic Maintenance Program we are working through, and I am continually amazed at the resistance I get when any corrections or installs are required. Lake health is in the balance and it should be a priority for all concerned.

### Where do you see the onsite industry going?

With builds getting increasingly larger on lakefront lots, I can see tertiary systems becoming more the norm than the exception in the future.

## JOIN AN OOWA COMMITTEE!

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*Homes in the Town of Lake Santeetlah with small “grandfathered” lots and steep, rocky sites present challenges for effective onsite wastewater management.*

# PLANNING FOR SUSTAINABILITY

## Robust Decision Making and Adaptive Management Help Communities Effectively Manage Wastewater

**By Victor D’Amato**

When leaders in the Town of Lake Santeetlah (TOLS) received a \$5M estimate to collect and convey wastewater miles across rugged terrain and over pristine surface waters to the nearest centralized treatment plant, they knew there had to be a better solution to undersized and aging septic systems in this scenic North Carolina mountain town of about 200 homes. After all, even relatively uninformed members of the public have seen the headlines in the popular news media touting space-age, building-scale water recycling technologies, and other innovative wastewater systems. Surely there had to be a way to bring resilient and affordable wastewater management to those residents with problematic onsite wastewater systems (OWS),

while respecting their residents’ preferences and property rights.

TOLS is not alone. Communities large and small throughout the United States struggle to make sound water infrastructure decisions, and then face intense backlash when prohibitive cost estimates are presented. So-called “septic to sewer” initiatives in multiple high-profile areas in the U.S., while well-intentioned, often miss the mark of targeting the right drivers and addressing stakeholder concerns from the outset. For example, septic to sewer initiatives in Cape Cod, Massachusetts in the 2000s were met with strong community resistance, leading regional authorities and local jurisdictions to adopt plans that rely on a multi-sectoral approach to

reducing nutrient loading to coastal waters. “Sewering” to replace existing OWS received less support from residents due to its high estimated costs (over \$50,000 per home in some cases) and problematic secondary impacts (e.g., growth pressures). Understanding the connected nature of coastal embayments on the Cape led the Cape Cod Commission to develop a Regional Wastewater Management Plan and an Area-Wide Water Quality Management Plan intended to provide an adaptive, rather than prescriptive, framework for making progress toward meeting nutrient loading targets established by Total Maximum Daily Loads (TMDLs).

As in many areas – particularly along the Eastern Seaboard of the U.S. – wastewater planning initia-

tives on the Cape were driven by a need to reduce nitrogen loading to surface waters. The resulting plans include a suite of activities for reducing nutrient loads including centralized sewerage (where affordable), upgrades to existing OWS, cluster systems, and a variety of non-traditional water quality management options (e.g., dry toilet, permeable reactive ground-water barriers, stormwater BMPs, oyster mariculture). Communities on the South Shore of Long Island, New York having similar issues as Cape Cod (e.g., densely settled communities on old OWS, nutrient enrichment of coastal embayments) have focused much of their energies toward upgrading OWS, particularly the most problematic ones (e.g., cesspools) while centralizing wastewater collection and treatment in village and town

centers. The cost implications of septic to sewer conversions are typically substantial, particularly considering the amount of nutrient loading reduced (i.e., cost per unit mass of nutrients removed), the uncertainty around potential load reductions and time scale during which delivered load reductions are realized, and the secondary impacts of sewerage. Clearly, robust upfront planning is an essential element of any area-wide effort to address problems with existing OWS. In the halls of the Maryland Department of Environment (MDE), conversations often revolve around two of their challenging goals: meeting the State's obligations under the Chesapeake Bay TMDL and providing effective and reliable wastewater systems to historically underserved communities

Although TOLS and MDE might not appear to be similar, their challenges – namely protecting water quality and ensuring effective wastewater management – are indeed linked, with the main difference being a question of scale. In contrast to approximately 200 systems in TOLS, the State of Maryland has approximately 420,000 soil discharging OWS, including about 52,000 in the Chesapeake Bay critical area (within 1,000 feet of Bay tidal waters). As a key member of the Chesapeake Bay Partnership (CBP), MDE has been a leader in proactive OWS management. Since 2006, the MDE has awarded funding for sewerage or upgrading with best available technology (BAT) over 12,000 septic systems through the Bay Restoration Fund (BRF) On-site Sewer Disposal System grant program. **Continues on next page.**

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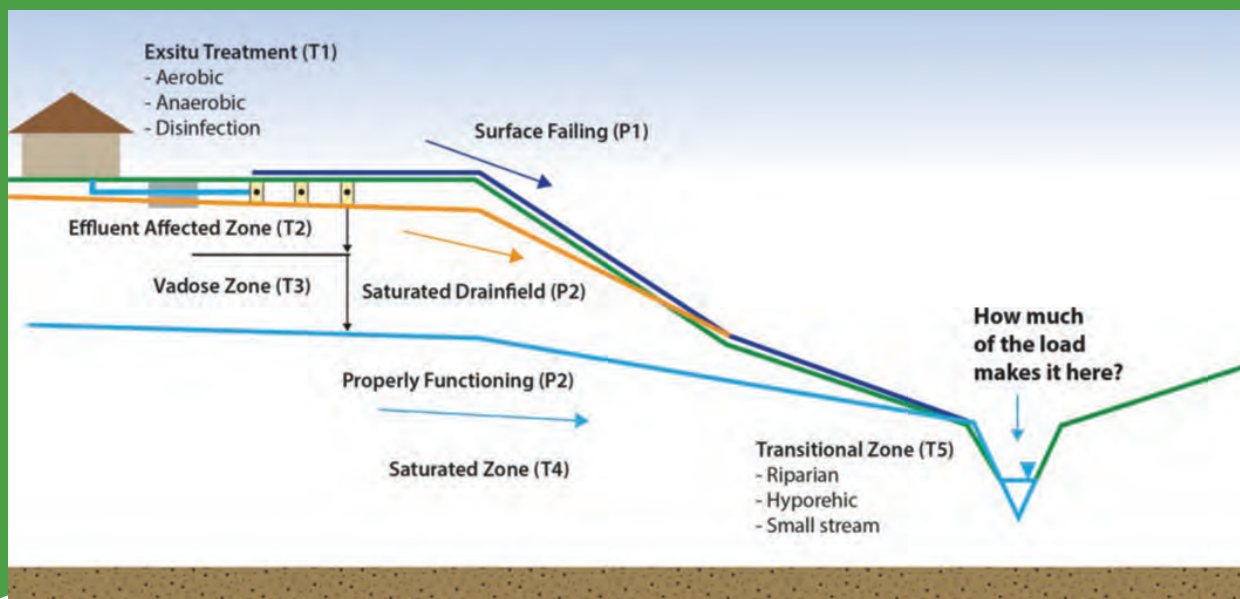


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*The CBP Attenuation Panel developed a treatment and attenuation framework that helps estimate pollutant load delivery associated with OWS.*

MDE has also been an instrumental participant in the CBP Wastewater Treatment Working Group (WTWG), under which several Expert Panels were formed to address nitrogen loading associated with OWS. One such Panel – the CBP’s OWS Total Nitrogen (TN) Attenuation Expert Panel – recommended spatially-variable, scientifically-supported improvements to the CBP’s TN load estimation methodology (previously, the CBP assumed the same reductions for all OWTS within the Chesapeake Bay Watershed regardless of site characteristics or geographic location). The Panel’s work, which concluded with a final report, approved in 2016, included three main steps:

- 1) Developing a conceptual framework for evaluating and communicating nutrient removal processes in OWS.
- 2) Conducting a literature review focused on TN removal in OWS and the hydrogeomorphology of and the relative transmission of TN through varied watershed geologies.
- 3) Using modeling (Colorado School of Mines’ STUMOD and USGS’ SPARROW models) to corroborate findings from the literature. The Panel’s nitrogen loading recommendations are now being

used in the OWS sector within the Chesapeake Bay Watershed, but as importantly, the framework and resulting attenuation estimates are a model for TOLS, Long Island, and virtually any other area addressing the water quality impacts of OWS.

MDE has already leveraged the Attenuation Panel results to inform its Phase III Watershed Implementation Plan (WIP) while targeting those underserved communities of concern. Through the CBP, MDE created a tool that uses existing spatially referenced state data to make more robust, scientifically based OWS upgrade or retrofit prioritization decisions that feature favorable nitrogen load reduction/cost ratios. The resulting methodology includes (1) techniques for data pre-processing to generate a “baseline” GIS layer of potential project sites (focused on areas with high densities of legacy OWTS); and (2) a multi-criteria decision analysis (MCDA) tool to prioritize potential project sites by their risk (focused on nitrogen loading but also including other co-benefits and confounding risk factors) and upgrade or retrofit feasibility (Tetra Tech, 2019). The MCDA tool allows for variable weighting of individu-

al components of the assessment based on user-selected objectives and data quality ratings and generates feasibility ratings for sewer extension and decentralized system upgrades as outputs. The methodologies and tool were tested using campgrounds and mobile home parks (MHP) in Maryland as historically underserved areas likely to feature high densities of legacy OWTS that could be targeted for upgrade or retrofit projects. The outputs allow for potential projects to be rated and ranked for both the risk of existing OWS (e.g., nitrogen loading) and the feasibility of a project to mitigate those risks. Projects falling into the high risk/high feasibility category would be favored for additional analyses to validate the results and move forward with implementation as warranted.

Back in TOLS, Town leaders developed an adaptive decentralized wastewater management plan which demonstrated to reluctant residents that the community’s wastewater management objectives could be met by taking small steps, and without sewerage and associated sunk costs. After multiple meetings with community leaders and stakeholders, a set of recommendations were

provided to help TOLS move forward with a more proactive wastewater management approach while respecting the community's reluctance to TOLS providing full wastewater services at this time.

1) Raise awareness among residents and elevate the discussion about wastewater management, through a public education campaign

2) Better understand existing onsite wastewater systems in the Town and any problems using field inspections, permit file reviews and property owner surveys

3) Better understand local impacts of onsite systems on water quality, by increasing sampling locations especially nearshore during high use periods

4) Provide options for individual property owners and groups of property owners, by sharing information, facilitating discussions, and brokering access

to land for small cluster systems

5) Take proactive steps to mitigate potential future problems with onsite systems, by securing access to potential cluster sites via purchase, long term lease, etc.

Clearly, wastewater management decisions are highly specific to the community and its context. However, all wastewater management planning processes can be simplified by focusing on three main efforts:

- Inventory of existing wastewater systems, including OWS
- Prioritization of existing wastewater systems for enhanced management
- Management planning and implementation

Whether evaluating OWS in TOLS or the State of Maryland, the tools and approaches illustrated

in these case studies and in other communities, applied within the Inventory-Prioritize-Manage framework, can be used to help solve even the most vexing wastewater management challenges.

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#### About the Author:

Victor D'Amato is the Supervisor of the Viable Utilities Unit in North Carolina's Division of Water Infrastructure. Prior to returning to state government in May 2021, Vic worked for 21 years as a consulting engineer with Tetra Tech and ARCADIS. Vic earned his BS in Civil Engineering from Penn State University and his MS in Water Resources Engineering from the University of North Carolina at Chapel Hill. He currently serves as the Vice Chair of the Small Community Committee of the Water Environment Federation.

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# MEMBER PROFILE

## Nico Nirschl

**Name of Business:** Liberty Pumps

**Services:** Liberty Pumps is a leading U.S. manufacturer of pumping products for ground water and wastewater removal in residential and commercial applications. With a focus on innovative product design, our wide range of pump styles includes sump pumps, sewage pumps, effluent pumps, drain pumps, grinder pumps, complete pre-assembled sewage packages, and pump accessories.

**Service Area:** Ontario, Quebec and all the Atlantic provinces

**Number of Years in Role:** 4 years with Liberty Pumps

### What got you started in the onsite wastewater industry?

During my schooling I ended up doing multiple co-op programs to see where I wanted to focus my time after graduation. One of my co-op placements was with an Environmental engineering firm in Sarnia specializing in Phase I & Phase II Environmental Site Assessments; Contaminated Soil & Groundwater Remediation; Biological & Chemical Wastewater Treatment systems; Odor Neutralization Products & Equipment and Microbial Remediation Products. It was while working with them that I realized that I wanted to make a difference and to help do my part.

### Give us one reason/secret for your success.

The drive to make a difference. Everyone has an ability to make a change if you care enough.

### What was the most challenging onsite job you worked on or participated in?

It is hard to narrow this down to one job, as all of them have their own challenges. The ones that stick with me the most are the ones where the systems are undersized and eventually fail. Everyone is quick to point the finger at someone else. The fact is that we all need to work together to find a solution to help protect our environment.

### If you could change one thing about the onsite/decentralized industry, what would it be?

I would like to see more light shed on our industry and the



**NICO NIRSCHL**  
Regional Sales Manager- Canada

importance of organizations like this. We need to lobby for more funding and better education for all of Ontarians and Canadians in general on the importance of maintaining their systems. I would love to see a separate government body overseeing maintenance schedules and upkeep of each system in the field.

### Where do you see the onsite industry going?

I see that there is a lot of concern growing for aging and failing systems that are not regulated. It would be nice to see a governing body following up with maintenance schedule requirements for all systems in the field to ensure that there are less failures out there that cause environmental disasters.

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We know that onsite system owners want to hire only the best people. Your RPP designation tells potential clients that you are a qualified professional, that your skills and knowledge are current and that you are engaged with and care about your industry.

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2. Review the [RPP Background document](#).
3. Select one or more RPP designations that apply to you and review the [Aptitudes by Designation](#) document to see what courses/aptitudes you still need of if you can apply directly to your chosen designation.
4. Check out the [FAQ document](#) to help with some specific program requirements.
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# A Case Study on the Role of the Municipal Responsibility Agreement

*Story continued from cover...*

## BACKGROUND

The site, located south of Peterborough, ON, is an undeveloped residential property of 21 hectares area abutting the west side of the Otonabee River in an un-serviced area with no “reasonable expectation” for future municipal servicing.

To harmonize the growing community that rests among trails, lakes, and cottage country, the developer proposed constructing a single-family detached residential development with a rural feel close to urban areas.

### Clearford as Operating Authority

With a concept in place, the developer originally teamed up with the now subcontracted Operating Authority, Clearford (formerly ASI Water), in 2008/2009. Clearford’s involvement at that time was to prepare the technical evaluation for servicing options including the on-site Water (W) and Wastewater (WW) treatment systems. This work included preparing the Functional Servicing Report (FSR) which formed part of the Schedule B Class Environmental Assessment (Class EA) for the proposed development.

Drawing heavily on decentralized water and wastewater experience, Clearford helped to develop the path forward.



## Decentralized Development Debut

On-site servicing was a new opportunity for both the municipality and the developer. Previous to the proposed development, the rural municipality typically relied on individual wells and septic systems.

### Early education

Throughout the various consultations, frequent communications, and open-house presentations, the municipality and developer soon became well versed on the processes and approvals involved in constructing decentralized systems.

The early education went beyond ‘Decentralized 101’, and brought perspective, exhibiting examples of similar developments to the project site, including condominium developments in other municipalities, operational data, culminating with construction cost estimates and designs.

*“Routine consultations with the municipality and the developer enhanced the ability to arrive at a very clear, succinct MRA.”*

**- John Levie,**  
Vice President, Engineering

## SHIFT IN AUTHORITIES

### Adaptability is key

Changes at approval authorities and staffing resulted in revisiting, and often revising, the site plans and servicing designs. To do so, all aspects of development, execution, maintenance, and finance, were considered. As a result, the draft MRA was revised to reflect the latest designs and changes.

## Municipal Responsibility Agreement

The MRA is a legal agreement between a number of parties: the municipality; the developer or site owner/the board of directors; and often the operating authority.

The MRA has legal authority under several pieces of legislation and is a requirement to obtain an ECA. The MRA provides for oversight at the municipal level for the construction, operation, and management of communal and private water and wastewater servicing.

### MRA Objective

A well-crafted MRA clearly delineates the responsibilities and obligations for the site owner, the municipality, and the operating authority. This delegation of responsibility assures the proper management, operation, and maintenance of the systems for problem-free communal and decentralized servicing.

## MRA Requirement

The requirement for an MRA will be identified during the municipal consultation, typically early in the planning process. Only on-site wastewater systems that exceed 10m<sup>3</sup>/d, will involve an MRA subsequent to an ECA.

## MRA Process

The process involved to draft and review the agreement is an iterative approach between the municipality and the owner to develop a reasonable framework or expectation. The most commonly applied approach is to use similar files or developments as examples to shape the foundation of the proposed MRA and servicing.

The consultation process is primarily between the developer and its counsel, and the municipality and their counsel. Other parties—the operating authority, municipal engineer, third-party financial review, facility management firms, various consultants and planners—may be brought into the discussions to produce a well-reasoned and sound agreement.

## Reserve Fund Studies

For both the water and wastewater systems, reserve fund studies are often required as part of the MRA. Although the water and wastewater systems were on the same site, it was critical the systems were maintained separately per the agreement funded by the owner.

The MRA established a routine financial review. The review period is most often from five years to ten years; however, the project site was ordered a more frequent financial review of three years as a result of it being the first encountered for the municipality.



## Consequence of Failure

Historic servicing failures of communal systems were found to have a similar cause: a lack of sufficient funds. In these cases, user rates had to increase to compensate for additional service and upgrades to address the failures.

Untenable servicing for the residences can skew the financials plan, resulting in high fees to manage the sites properly. When adjusting the user rates, the parties are to remain mindful to ensure user rates are not unbearable.

An unfeasible financial plan may lead to permanent residents forced to move from their homes, stemming from unsustainable operations of the systems and a risk of environmental impairment.

In these unfortunate situations, the MRA is a reliable enforcement document used to ensure adequate funding is set out initially, a plan is in place to maintain funding for the life of the assets, and if there are heightened costs, identify who, out of the parties, are responsible for covering those expenses.

## Viability to Verification

To show the viability from a financial perspective, Clearford put together basic reserve fund studies that provided both capital and operating cost estimates for the water and wastewater systems.

These financial considerations were then:

1. **Reworked** into the condominium plan revisions;
2. **Added** to the condominium fees by the minimum management firm; and,
3. **Viability** reviewed by the municipality to make sure it met the expectations and will be financially viable.
4. **Verified** financials.

The end result was a scaled to accommodate a phased development, where the homes are to be built out in three phases and the water and wastewater servicing to be completed in two phases.

## Streamlined Review Process

The Ministry of Environment, Conservation and Parks (MECP) has recognized the shift in development, with dedicated review streams for private wastewater systems and a move to standardized templates for small wastewater treatment systems. The shift in dedicated staff and reduced haggling over terms and conditions has produced a shorter turn around time for approvals and less uncertainty over the content and monitoring requirements for these systems.

# A Case Study on the Role of the Municipal Responsibility Agreement

*"Over the past 10-20 years, discussions between private operations companies and regulatory agencies have evolved significantly.*

*What used to have close to zero interest, decentralized systems are now viewed as viable option for un-serviced areas."*

**- John Levie,**  
Vice President, Engineering

## Conclusion

Within the past couple of years, there has been a big awakening in areas un-serviced by municipal infrastructure. Although the concept of communal, decentralized servicing is still foreign to some, it is highly achievable with the right team.

Innovative technologies and concentrated water and wastewater expertise have fostered a steady growth in decentralized systems. However, since the COVID-19 pandemic and with many choosing to relocate from dense urban centres to rural locations, there has been an increase in the demand for housing in traditionally un-serviced area.

With substantial growth in decentralized systems ahead, Municipal Responsibility Agreements will remain key documents to ensure the proper manufacturing, maintenance, and operation of water and wastewater facilities.





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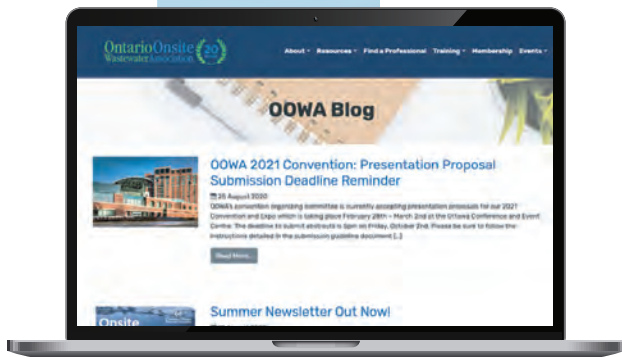
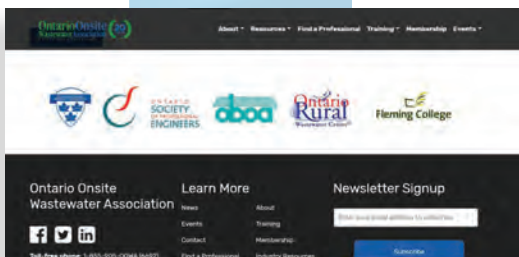
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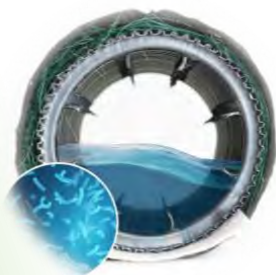


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