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Wastewater Process Intensification Workshop

May 17th, 2022

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Purpose of this Workshop

Wastewater process intensification is an innovation strategy that benefits municipal wastewater treatment through improved efficiency, safety, and flexibility; while enabling, smaller, lower cost and more environment friendly wastewater treatment operations. Wastewater process intensification is a holistic approach starting with an analysis of constraints followed by the selection or development of intensification methods. Wastewater process intensification aims at drastic improvements of performance by rethinking the process as a whole. This strategy aims to increase capacity or improve effluent quality by maximizing usage of existing infrastructure. Objectives of municipal wastewater process intensification can include reducing energy consumption, increasing recovery of treated water, energy, and resources, reducing footprint, reducing waste or generating the value from waste, improving treatment process flexibility and resiliency, or a combination of these objectives The purpose of this forum was to facilitate a structured engagement between technology providers, consulting engineers, regulators, and end-users (including wastewater treatment plant managers) and researchers focused on wastewater process intensification.

This forum focused on the potential benefits of wastewater process intensification, highlighting opportunities, specific case studies and the challenges that must be overcome to realize broader technology adoption.

Circle and Transfer-In

The tables gathered in circle together. The circle is a powerful tool that can help teams move into more honest and open conversations simply by setting up the chairs and inviting everyone to take a seat. Participants sat at tables in these circles for practical reasons during this workshop.

The container of this circle was established with an invitation to participate in the spirit of Dr. Angeles Arrien's Principles of Engagement.

Principles of Engagement

Choose to show up and be fully present

We discussed physically being present in addition to practicing the art of not being in the future or the past in our minds. This is much easier said than done of course.

Pay attention to what has heart and meaning

Our passion, creativity and genius are linked to what has heart and meaning for us. The more people we have in our organizations that are linked to their passions means we have more intrinsic motivation, more creativity and more people contributing their unique strengths towards a collective vision.

Tell truth without blame or judgement

We can only tell the truth that we feel safe enough to share. It can take time to build deeper levels of trust within a team, but it doesn't have to. When we become aware and decide to no longer tolerate or accept blame and judgement in the room, we can build trust more rapidly. Blame does not equal accountability. This is a mistake often made within an organization. Reframing what accountability means and how an organization is going to consciously practice it is a powerful and worthwhile endeavour.

Be open to outcome, not attached to outcome

We often feel that we are supposed to enter a meeting with the solution already decided and then drive 'buy-in' under the disguise of participation. This is often felt but not spoken and leads to a life depleting environment. Over time this erodes trust and severely limits creativity and innovation. We can improve this by being clear about when we are asking for acceptance vs truly collaborating to co-create a solution.

The circle began with a transfer-in exercise that connected both the right and left side of the participant's brain helping them to become fully present in the room. The facilitator laid intuitive cards face down in the centre of the tables prior to the participants arriving. Once in circle, each person was asked to select a card, think about and engage in a meaningful discussion with a partner about what the card said to them about why they chose to participate in this workshop. Each person introduced

their discussion partner into the circle and shared their wisdom. This gently nudged everyone into listening mode, which is an important shift when we gather with meaning and to co-create.

Hopes and Fears

After Art Umble's opening keynote address, each table explored their individual and collective hopes and fears about this workshop and about Wastewater Intensification in general. All hopes and fears that felt present on this day were welcome. In sharing collective hopes, it becomes apparent that the responsibility is on each team member to work toward achieving these hopes or to work in the spirit of the hopes. It also helps the team to see the hopes instead of assuming everyone is aligned or misaligned. It is equally important to share the fears that have been brought into the session on this day. An unspoken fear is one of the most powerful things in this world as it can silently dictate behaviour and impede on conscious choice. The acknowledgement of these fears lessens their power but does not prevent them from showing up. It is much easier to navigate through a known and spoken fear then a silent one. Bringing a fear up in this setting moves it into the consciousness of the team where conscious choices can be accessed should the fear arise instead of subconscious choice which usually impedes the collective.

The teams hopes and fears are found in Tables 1 to 11 below.

This tool can be used for so many conversations. Whenever resistance is felt in the room, differing of opinions, pushback, silence, the need for a difficult conversation, etc. you can invite the person or group of people into a discussion about their hopes and fears regarding the topic at hand. This widens the conversation, allows space for different perspectives, and helps everyone move into listening, sharing, clarifying and understanding behaviours. This is a key ingredient to unlocking the potential within the conversation. The team must be prepared to listen to all the different perspectives. This helps to clarify misunderstandings and assumptions. We can actively apply curiosity by saying, "Would you like to get out our hopes and fears about this? Maybe there is some wisdom we can't yet see."

Table 1: Group 1 Hopes & Fears

Hopes	Fears
• Energy savings • Support environmental protection • Holistic approach • Cost savings • Future generations • GHG reductions • Resiliency • Reliability • Excitement • Process innovation • Partnerships • Successful implementation • Optimize space • Promote sustainability	• Stakeholder disjunct • Technology cost • Regulatory barrier(s) • Complexity • Reliability • Operator buy-in + champion • Lack of acceptance • inertia

Table 2: Group 2 Hopes and Fears

Hopes	Fears
• Easily implantable ideas • Exploring new tech for increased capacity • Learn and listen to experiences of other municipalities, comparing plants • Technology transfer • Building new relationships • Energy reduction + carbon footprint	• Imposter syndrome • NO FEAR • Costs involved in implementation • Time constraints + delays • Risk with new technology • Speed of technological change • MECP buy-in and approvals

Table 3: Group 3 Hopes and Fears

Hopes	Fears
• Bold, creative • Accessible/scalable • TN removal increased importance through tech and policy • Perspective shift to resource recovery • Fringe benefits contaminant removal, greenhouse	• Reliability with risk adverse user base, highly complex • Difficult intersection of hydraulics and nitrogen removal • Too constrained

Table 4: Group 4 Hopes and Fears

Hopes	Fears
• Learn more about WW generally and intensification • Make WWTP/RRF more sustainable/energy efficient – prepare for future generations (technology will last!) • Understand what owners (everyone?) are looking for with respect to intensification – energy, carbon, $$, footprint, finding balance • Identify options and TRL's	• New technology not well proven – prove work cost • Public deception – don't understand, wrong perception – install public confidence • Lack of funding/investment to drive innovation – for disruptive changes – need for early adopters

Table 5: Group 5 Hopes and Fears

Hopes	Fears
• Intensification is proven effective and adopted widely (where appropriate) • Convincing clients to adopt intensification where it makes sense • Costs (O&M & Capital) continue to go down such that intensification is more favourable • Reducing timelines to better facilitate expansions	• White elephants of tech • Lose momentum so system-wide approach is stalled • Regulatory pressures – may stall projects • System performance is significantly impacted by wet weather flow • Compliance concerns (with high strength WW)

Table 6: Group 6 Hopes and Fears

Hopes	Fears
• Nutrient recovery • Water re-use and reclamation • Learn easy to implement techniques • SSO materials and nutrients recovery in wastewater • Biosolids management intensification	• Costs to implement at smaller facilities • Difficult to operate in small facilities • Don't understand the science well enough to achieve what we want to do in the field • Operational complexity • Increased staffing requirements

Table 7: Group 7 Hopes and Fears

Hopes	Fears
• Reducing costs for rate payers • Continuous learning	• White elephants! • Painting ourselves into a corner

Table 8: Group 8 Hopes and Fears

Hopes	Fears
• Accelerate real projects • Innovation and research matters!! • Driving solutions for our clients with measurable outcomes • Doing more demonstrations • Cross sharing among all stakeholders (muni, tech providers, ops, regulators) • More engagement with "green" projects to reduce costs to rate payer	• Unknown • Ontario too conservative? • Passage of time and no action supporting the intent • Risk on innovative projects! • Access to funding – growth ≠ funding • Limited municipal budgets

• More funding focused on early stages of adopting a technology (integrated) • Holistic master planning (CC, AM, process, ops)	

Table 9: Group 9 Hopes and Fears

Hopes	Fears

• Learn from peers
• Collaboration – w/t – key for success
• Practical insights
• Awareness on need
• Applicable to all S/M/L
	• Scale up
	• Failure
	  ○ Contingency
	  ○ Compliance
	  ○ Change
	• Too big to get it done
	• Of inaction

Table 10: Group 10 Hopes and Fears

Hopes	Fears
• Get the big picture • Digitalization can play an important role • Better future	• Not enough knowledge • Digitalization – is it in the right direction? • Investment for innovation • No fear

Table 11: Group 11 Hopes and Fears

Hopes	Fears
• Collaboration between municipal and industry/academia • Learning new technology at larger scale • New research projects to move from bench to pilot scale • Learning from people with different expertise	• Lack of funding for research • Fear of failure – leading to loss of innovation • Operators' adaption to new technologies

Storytelling

All participants were able to choose two of five storytelling opportunities listed below to learn about a particular site who chose to implement wastewater intensification. They learned about why they chose it, what it meant for that particular site and what impacts it had. Challenges were also shared. Storytelling is an overlooked way to communicate as we often default to PowerPoint presentations. Storytelling is an innate part of who we are as humans and is a powerful way to share in a relatable way that makes the speakers feel accessible, questions are fielded easily and fluidly and there is a sense of trust and intimacy that is difficult to re-create in presentation mode. There is a time and place for both presentations and storytelling.

1. The Region of Waterloo Hespeler WWTP (Includes a non-nitrifying extended aeration process), Olav Natvik, Stantec

During the course of a major upgrade project, the Region of Water became interested in the potential of membrane aerated biofilm reactor (MABR) technology to future-proof the plant and meet imminent ammonia effluent limits. An engineering study concluded that MABR would improve nutrient removal and deliver significant capital cost and process aeration energy savings while also preserving space onsite. MABR technology was piloted and is now being implemented at full-scale. The project is in the final stages of construction

2. North Toronto Treatment Plan - Kelly Frensch, CIMA + Eliav Eini, Toronto Water

Upgrades at the North Toronto Treatment Plant are underway to restore the treatment capacity to its rated capacity of 45.5 MLD from its current average daily flow of 18.5 MLD, while providing a high level of nitrification and energy efficiency. The City has a unique opportunity for a full-scale head-to-head evaluation of innovative technologies such as MABR, and five different types of diffusers at a plant where the inlet flow rate can be controlled. Technologies are being evaluated for their energy consumption and level of enhanced treatment in a compact footprint.

3. Improving lagoon capacity and performance with a simple, low-energy solution – Wudneh Shewa, Bishop Water Technologies

After completing its master plan, a growing community was considering replacing the WWT lagoon to increase capacity and achieve discharge requirements. Instead, lagoon process intensification with an in-situ IFAS system enabled the municipality to improve cold-weather ammonia removal, achieve continuous discharge and increase capacity – for less than half the cost of a mechanical WWTP alternative.

4. Singapore – Digital Twins – Tim Constantine, Jacobs

Digital twins, simply put, are a digital representation (a model!) of the WWTP that is tied to plant information (e.g. SCADA and lab information). Over time, the Digital Twin can essentially be calibrated to how the plant operates using Machine Learning techniques. It can then be used either as (1) a support tool for operations staff, as the Digital Twin can create predictions on the current "health" of the plant (creating something like a weather forecast), or (2) used to control some of the plant operations such as RAS rate, etc. to maximize available capacity.

5. Metro Water Recovery, Resource Recovery facility, Denver – Art Umble, Stantec

The challenge facing the district was limited capacity due to shallow secondary clarifiers greatly limiting the solids loading rate. The intensification method applied was use of hydro cyclone technology (InDENSE™ from World Water Works, Inc.) to promote biomass granulation, thereby increasing the rate of settleability of the biomass.

Case Studies

To activate learning through application, each table worked on the same three case studies. These case studies are from real municipalities in Ontario, and they wished to remain anonymous. The case studies are below and so are the suggested solutions and key considerations that were shared by different tables during the workshop.

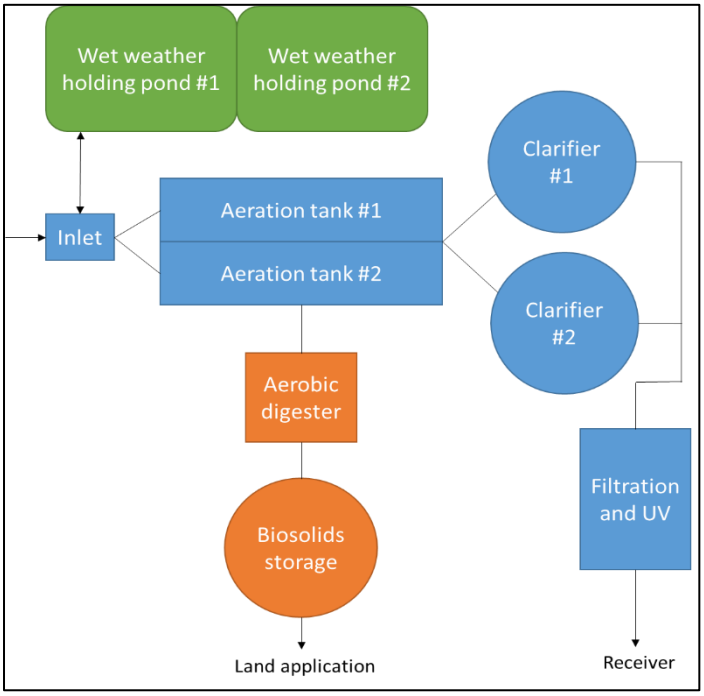
Case Study # 1

Challenge:

A fast-growing small community near a large urban area needs to expand the capacity of its wastewater treatment plant and address aging infrastructure. The plant discharges to a small receiver so it must meet stringent effluent limits, which will become more stringent when the plant treatment capacity is increased. Currently, operators are challenged managing the current treatment process, which includes managing steadily increasing biosolids volumes in recent years. Also, the treatment plant receives odour complaints from neighbours. Odours come primarily from the digester and the equalization ponds.

Current State:

The treatment plant is an extended aeration process with effluent filtration and UV disinfection. A process diagram is shown below.



The current rated capacity is 3,400 m3/d with a peak day capacity of 8,900 m3/d. The population is projected to grow to 15,000 people in 2041 from the current 10,000, and a capacity increase to 5,100 m3/d is needed to service the town to 2041. Sewage flows are over 80% of plant capacity and steadily increasing. The current and future effluent objectives and limits are:

Parameter	Current capacity of 3,400 m³/d		Future capacity of 5,100 m³/d	
	Objective (mg/L)	Limit (mg/L)	Objective (mg/L)	Limit (mg/L)
$cBOD_5$	4.0	5.0	4.0	5.0
TSS	4.0	5.0	4.0	5.0
TAN (Oct 1 – May 31)	2.0	2.4	1.1	1.2
TAN (June 1 to Sept 30)	0.5	0.8	0.35	0.4
TP	0.12	0.25	0.09	0.12
NO_3-N	N/A	N/A	10.0	13.0
pH	6.0-9.5	6.0-9.5	6.0-9.5	6.0-9.5
E.coli	100/100 mL	N/A	100/100 mL	N/A

Note: *Objectives and limits are monthly averages and geometric mean for E.coli. pH is single sample result.*

Biosolids are land-applied in accordance with the Nutrient Management Act.

Constraints:

- Maintain affordable water and sewer rates.
- Minimize the impact on neighbouring residences and businesses from odours and traffic.
- A relatively fast solution is required to address the community's rapid growth.

Discussion Questions:

1. What is a possible intensification solution?
2. What are some benefits of the solution (financial, social and environmental)?

3. What are some challenges?
4. What are potential actions to implement the solution?

Shared Solutions:

Group A

- 50% increase in capacity
- IFAS handles solids without overloading
- Wet weather ponds for equalization of the peaks
- Fix the peak in aerobic digestion and have thicker sludge going in
- Only if these don't work will I recommend increasing the size of the plant

Group B

- Implement settling in the holding pond to have some removal
- MABR
- Anaerobic digestion

Group C

- Retrofit for denitrification/nitrification
- Membrane type technology
- Build more capacity on the digester or provide storage

Group D

- Floating aerators on top of ponds
- Remove ponds
- Dewater solids and bring solids to a larger facility
- Aerobic digester can be used as an extra aeration tank and turn one of the tanks anaerobic for nitrification/denitrification

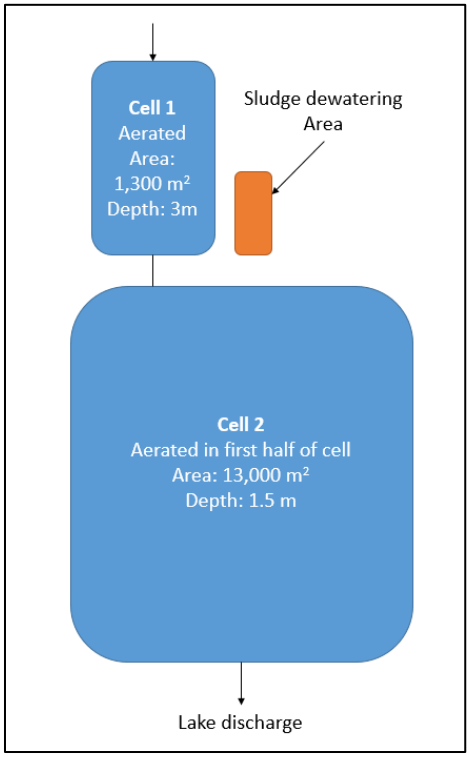
Case Study #2

Challenge:

A small community in Northern Ontario is experiencing growth. Wastewater is treated in a continuous discharge sewage lagoon that is nearing its treatment capacity. The effluent requirements include a limit on Total Ammonia Nitrogen, and at times the treatment plant can struggle to meet it in cold months.

Current State:

The lagoon system has two aerated cells. A process diagram is shown below.



Flow rates at the lagoon are over 80% of the rated capacity of 400 m^3/d, so planning for a capacity increase is needed. The effluent objectives and limits are:

Parameter	Objective	Limit
$cBOD_5$	15 mg/L	20 mg/L
TSS	20 mg/L	30 mg/L
TAN	5.0 mg/L	6.0 mg/L
TP	0.4 mg/L	0.6 mg/L
pH	6.5 - 8.5 inclusive	6.5 – 9.0 inclusive
E.coli	150 CFU/100 mL	200 CFU/100 mL

Note: *Objectives and limits are monthly averages and geometric mean for E.coli. pH is single sample result.*

Constraints:

- Affordable solution that is not capital intensive
- Lack of financial tools available to the municipality (e.g. small rate-payer base)
- Implementing upgrades can take a significant amount of time

Discussion Questions:

1. What is a possible intensification solution?
2. What are some benefits of the solution (financial, social and environmental)?
3. What are some challenges
4. What are potential actions to implement the solution?

Shared Solutions:

Group A

- UV for the E.Coli
- Geotubes for sludge
- Anaerobic pond in the beginning
- Chemical addition for P removal
- Adding IFAS system

Group B

- Add MABR between cell 1 and cell 2 or after cell 2
- Modular membranes

Group C

- Do a pilot; take smaller step to reach the solution

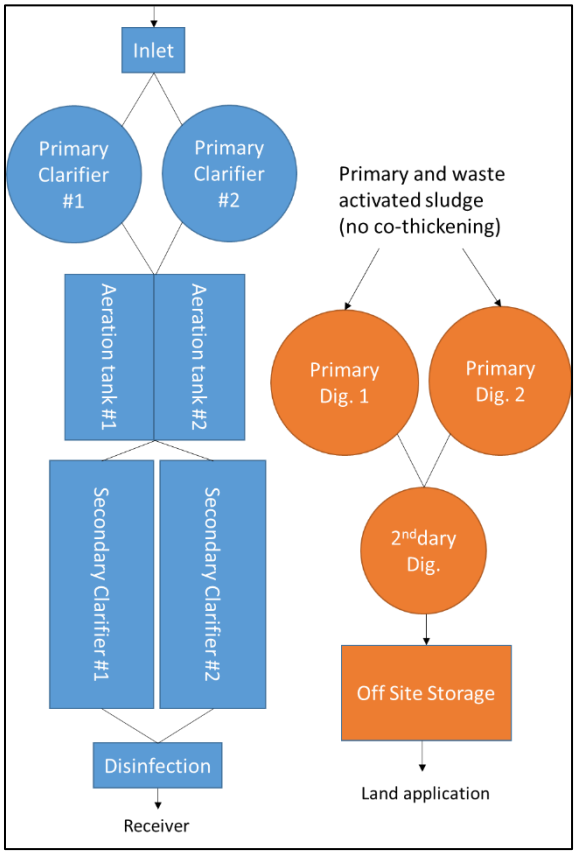
Case Study #3

Challenge:

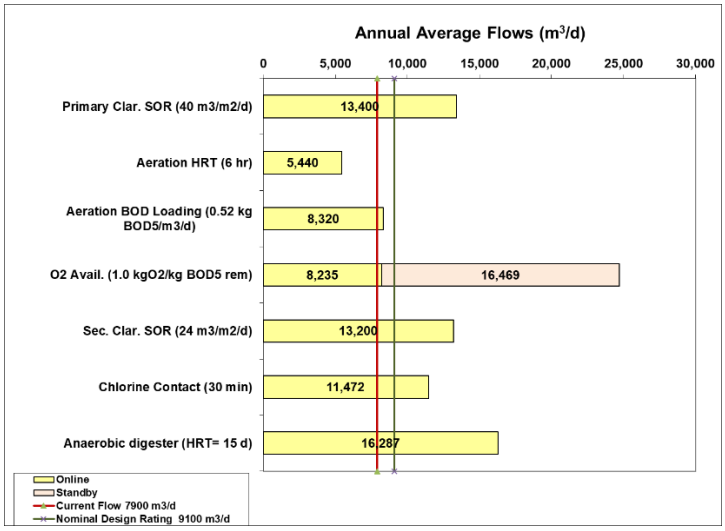
A medium-sized community needs to upgrade and potentially expand its wastewater treatment plant. Preliminary design work revealed the cost of improvements are much more than originally budgeted. The community is now looking to scale down the project to a retrofit that maximizes use of existing infrastructure.

Current State:

The treatment plant uses a conventional activated sludge treatment process. Disinfection is by chlorination/de-chlorination. A process diagram is shown below.



The current rated capacity is 9,100 m3/d with a peak flow capacity of 21,000 m3/d. A process review was recently completed and found the key performance limiting process was the aeration basin at current flows, as shown in the Performance Potential Graph, below.



The current and effluent limits are:

Parameter	Limit (mg/L)	Target*	2021 Performance
$cBOD_5$	25.0	N/A	6.8
TSS	25.0	N/A	5.8
TP	1.0	0.3	0.13

**Total Phosphorus target is for a regional water quality program. There are no effluent objectives. There are no limits for Total Ammonia Nitrogen but they may be required if capacity is expanded.*

A key consideration is the plant does experiences high wet weather flows that can cause bypasses of the secondary treatment process. Improvements to the collection system has helped reduce raw sewage flows (2021 flow was 70% of capacity).

Constraints:

- Expansion is challenging because of bedrock close to the surface.
- Expansion of the aeration basins to current standards would require relocating the primary clarifiers.
- Affordability.

Discussion Questions:

1. What is a possible intensification solution?
2. What are some benefits of the solution (financial, social and environmental)?
3. What are some challenges
4. What are potential actions to implement the solution?

Shared Solutions:

Group A

- BOD removal with CEPT
- Pass solids through digestion for methane production

- This means less aeration
- Keep aeration the same
- Free chlorine

Group B

- Biggest problem feed flow – implement step feed

Group C

- Look where the flow is coming into – influent infiltration

Key Learnings and Take Aways

Each table was asked to record their key learning and take aways from this workshop. The purpose of sharing these together is so the oneness isn't only on the individual to gather all the potentials learnings on their own. Sharing what resonated with one might help another digest and integrate a learning. The complete list of learnings from all tables are listed below.

Table 12: Key learnings and take aways

Key learnings and take aways
• Have a bold vision • Collaborate with different stakeholders – brings out creativity • Systems is important thinking • Learned a lot of new technical stuff in wastewater treatment • Learning about alternative nitrogen removal tech • Maximizing the benefits of existing facilities with energy savings and recovery • Fine line between innovation and being a guinea pig • Taking an unbiased and objective view of innovation ideas (optimize your excitement) • Functional test plant at City of Toronto • Sharing of ideas between stakeholders • Continue to develop purchasing strategies and procedures • Benefit of starting pilot projects as a cost savings to test potential solutions • Benefits of having workshops in person again • Enjoyed real case studies with variety (example MABR's, Digital Twins) • Pilot studies important – proof/demonstration – convincing public funders • Diverse perspectives (tech, municipalities, academia) • Hopes/fears – getting buy-in – piloting might help • Don't dismiss new tech! Talk to /learn from others – networking, piloting • Innovation requires partnerships – municipalities, engineers, tech providers, diverse perspectives • Get over fear of innovation • Process intensification is a strategy – not a project • Simple is better…when possible • Piloting is a low-cost way to get buy-in • Talk to operators who have real-life experience

- How we procure is a challenge
- Piloting works
- There are many approaches to intensification
- The market needs are important
- Intensification is not only technology
- The problems are broad
- Many different stakeholders (consultants, muni, academia, government, industry)
- The definition of intensification is unique in water industry
- Barriers and benefits of intensification
- Case studies of intensification
- History of intensification
- An effective forum for workshop
- Importance of OWC for leading
- Reinforcement of collaboration as a key for achievement of goals
- Intensification can also mean retrofitting existing infrastructure
- Marketing of products for recovery initiatives
- For case study work it is important to see all perspectives
- How to convince clients of new technology – pilot demonstration
- Regulation, compliance, needs of stakeholders
- Leadership & Vision
- New drivers e.g., Climate change actions
- Simple solutions to complex problems
- Finding market for recovered resources

Closing Circle

To wrap up the workshop, we passed the mic around the room and invited participants to share a final thought into our "collective circle". Participants were able to pass or to share with no pressure from the room. We captured some of the words and sentiments that were shared.

- Would love to stay in touch with this group
- Learned lots, appreciated the opportunity
- Impressed by broad stakeholder group
- Impressed by insights and how it affects all stakeholders
- Excited to see high level of engagement
- OWC unique and important in ecosystem
- Appreciated everyone being so open to share
- Glad young grad students were able to attend and be involved
- Put skin in the game, make something happen
- De-mystify fear of adoption of new technology
- Commend everyone for showing up and embracing innovation
- Great to see everyone, familiar and new
- 3 takeaways: 1 – optimize before expand, 2 – intensification is a strategy, 3 – take ownership of challenges and solutions

Appendix: Participant List

Name	Title	Affiliation
Sasha Rollings-Scattergood	VP, Technology	Anaergia
Clyde Fernandes	Business Development Manager	Aquicon Water
Wudneh Shewa	Technical Solutions and Project Manager	Bishop Water Technologies
Kelly Frensch	Partner/Director - Water	CIMA+
Tim Robertson	Division Manager, Wastewater	City of Guelph
John Mansell	Manager of Pollution Control	City of St. Thomas
Dwight Houweling	Principal Process Engineer	Dynamita
Kristi-Ann Watson	Water and Wastewater Engineering Technologist	Haldimand County
Stephanie Nolet	Project Manager, Water & Wastewater Infrastructure	Haldimand County
Chandra Baker	Superintendent - Wastewater Treatment	Halton Region
Rajeev Goel	Director Water Digital	Hatch
Tim Constantine	Global Technology Leader	Jacobs
Baoqiang Liao	Professor	Lakehead University
Carlos Diaz	Water Research Centre Coordinator	Lambton College
Teri Vanos	Equipment Technician	Lambton College
Ajay Singh	Technical Director	Lystek International
Ron Nielsen	Senior Policy Advisor	MECP
Ashley Hannon	Director, Business Development	Mitacs
Luxmy Begum	Senior Project Manager	MTE Consultants
Emily Jarvis	Water and Wastewater Compliance Technologist	Norfolk County
Larry Conrad	Director, Environmental Services	Norfolk County
Mariana Balaban	Project Director	Norfolk County
Shaun Earls	Water and Wastewater Compliance Officer	Norfolk County
Stephanie Davis	Manager, Water and Wastewater Compliance	Norfolk County

Aaron Law	Program Manager	Ontario Clean Water Agency
Hank Andres	Regional Hub Manager - Region of Waterloo	Ontario Clean Water Agency
Iman Hashemi	VP Innovation & Infrastructure Solutions	Ontario Clean Water Agency
Indra Maharjan	Solution Provider	Ontario Clean Water Agency
John Kingsbury	Director Business Development	Ontario Clean Water Agency
Kyle VanPaemel	Senior Operations Manager	Ontario Clean Water Agency
Renee Hornick	Senior Operations Manager	Ontario Clean Water Agency
Sangeeta Chopra Chartier	Director - Process Optimization and Technical Services	Ontario Clean Water Agency
Rahim Kanji	Executive Director	Ontario Water Consortium
Robert Nyman	Manager, Partnerships & Programs	Ontario Water Consortium
Ted Mao	Strategy & Partnership	Ontario Water Consortium
Jason Kreitzer	Supervisor of Wastewater Operations	Oxford County
Harpreet Rai	Process Engineer	R V Anderson Associates
Alice Custard	Project Engineer	Regional Municipality of Durham
Sorin Manta	Project Engineer	Regional Municipality of Durham
Anna Lacourt	Supervisor, Wastewater Operations	Regional Municipality of York
Nicola Crawhall	Program Manager, Strategic Policy and Research	Regional Municipality of York
Art Umble	Senior Vice President, Wastewater Global Practice Leader	Stantec
Mehran Andalib	Wastewater Sector Leader	Stantec
Olav Natvik	Wastewater Process Engineer	Stantec
Jeff Peeters	Senior Product Manager	SUEZ Water Technologies & Solutions
Sylvain Donnaz	Biology Process Leader (Technology)	SUEZ Water Technologies & Solutions
Youngseck Hong	Principal Engineer	SUEZ Water Technologies & Solutions

Geoff Totten	Regional Sales Manager	SUEZ Water Technologies & Solutions
Annyse Balkwill	Founder/Facilitator	The LuminUS Group
Farokh laqa Kakar	PhD Candidate	Toronto Metropolitan University
Rania Hamza	Assistant Professor	Toronto Metropolitan University
Zanina Ilieva	PhD Candidate	Toronto Metropolitan University
Eliav Eini	Senior Engineer	Toronto Water
Kyle Snell	Manager of Environmental Services	Township of King
Jeff Little	Manager of Public Works	Township of Lucan Biddulph
Laura Black	Global Product Manager	Trojan Technologies
Serge Levesque	PhD Candidate	University of Guelph
Sheng Chang	Professor	University of Guelph
Christopher Lawson	Assistant Professor	University of Toronto
Mandeep Rayat	Manager, Institute for Water Innovation	University of Toronto
Narasimman Lakshminarasimman	PhD Candidate	University of Waterloo
Rajesh Seth	Professor, Civil & Environmental Engineering	University of Windsor
Domenico Santoro	Sr. Manager, R&D	USP Technologies
Niema Afroze	PhD Candidate	Western University
Michele Samuels	Global Practice Manager - Asset Performance	Xylem