



Local Industrial and Commercial Applications for On-Site Alternative Water Systems

Toolkit for businesses: non-potable water systems

Prepared by: Emily Mistick, UBC Greenest City Scholar, 2018

Prepared for: Meg O'Shea, Vancouver Economic Commission and Chris Radziminski, City of Vancouver Water Works Design Branch

August, 2018

This report was produced as part of the Greenest City Scholars (GCS) Program, a partnership between the City of Vancouver and The University of British Columbia, in support of the Greenest City Action Plan.

This GCS project was conducted under the mentorship of City staff. The opinions and recommendations in this report, and any errors, are those of the author, and do not necessarily reflect the views of the City of Vancouver or The University of British Columbia.

The following are the official partners and sponsors of the Greenest City Scholars Program:



THE UNIVERSITY OF BRITISH COLUMBIA
sustainability

Acknowledgments

I would like to sincerely thank all everyone who participated in this project through interviews, site tours, and workshop participation. Thank you for your insights into alternative water and your contributions to what I hope will be an impactful project. Thank you especially to my mentors, Meg O'Shea and Chris Radziminski for your contribution, support, and feedback throughout the project.

Table of contents

Executive summary	1
Summary of interviews	5
Regulatory summary	9
Guide to commercially available systems	14
Public consultation workshop recap	16
Toolkit	22
References	24

Executive summary

Introduction

In this study, we have assembled a toolkit for industrial and commercial on-site use of alternative water sources (rainwater, stormwater, greywater, foundational water, or steam condensate). The toolkit includes current regulations, commercially available systems, steps for system setup, and local case studies. The resources included are based on interviews with local subject experts and businesses, in which I assessed the common water sources, potential water uses, and benefits and obstacles to using non-potable water for industrial applications.

This project was completed concurrently with City of Vancouver Waterworks Design Branch's drafting of a [proposed amendment](#) to the Vancouver Building Bylaw. The amendment will be proposed to council in January 2019 and aims to improve ease of permitting for many alternative water systems. Our GCS study acted as an intermediary to help Waterworks Design Branch understand what local businesses are doing, and to help businesses understand what the City requires of them.

The publicly available toolkit will equip businesses with the information and tools needed to create more sustainable solutions for their non-potable water needs through alternative water systems.

Background

Alternative water systems make use of non-potable water, such as rainwater or condensate, that would otherwise go to the storm system or sewer. The water is stored and treated, then put to use in applications where the water does not need to be potable, such as toilet flushing or irrigation. Alternative water systems improve sustainability by decreasing drinking water use.

Vancouver Economic Commission (VEC) initiated this study after finding that businesses are interested in saving water through non-potable water systems, but are impeded by a lack of resources to guide system setup. I conducted interviews to confirm this finding and gather details about the systems that are desired and the information that is needed to actualize them. We found several small to medium businesses who have built or attempted to build systems, but they are doing so as side projects to the main focus of their work and lack the time to properly research system options, interpret local regulations, and seek out case studies. This study draws together resources to empower these businesses with tools and information.

This project has substantial potential for impact on water savings in Vancouver, as the Industrial, Commercial and Institutional sector represents about 25% of the City of Vancouver's potable water consumption. Alternative water sources with appropriate treatment have the potential to supply a large portion of water required for industrial applications where potable water is not necessary. In case studies we found commercial businesses to decrease their potable water use by 55-85% through the use of

alternative water sources. This opportunity to reduce water in industrial applications will contribute to achieving the City of Vancouver Greenest City Goal of reducing the per capita water consumption to 33% below 2006 consumption.

At the time of this study, the City of Vancouver Waterworks Design Branch is proposing an amendment to the Vancouver Building Bylaw (VBBL) that aims to improve the safety and regulation of alternative water systems while improving the ease and accessibility of setting up new systems on private property. Waterworks Design Branch is interested in the case studies and findings from this study in order to inform the development of this and future bylaw amendments. Additionally, Metro Vancouver is beginning a [Greywater Reuse and Rainwater Harvesting Demonstration project](#) in 2019. Metro Vancouver will install metering of alternative water systems in order to study water use patterns and any regulatory and operational challenges.

Approach

To assess current local knowledge and activity surrounding alternative water systems, I carried out twelve stakeholder interviews. Six of these were informational interviews with experts and six were visits to businesses (three with systems, three interested in systems). Businesses and contacts were initially selected based on existing relationships between local businesses and VEC, and additional stakeholder contacts were added as we gained connections through interviews. The information gathered through interviews, in addition to literature review, was used to assemble the toolkit and two summary documents: a summary of regulations, and a review of locally available commercial systems. These summaries are presented briefly in the toolkit and available in longer form in this report, and as a downloadable pdf where the toolkit is available online.

Following the site visits, I conducted a public consultation workshop in collaboration with City of Vancouver Waterworks Design Branch. City of Vancouver first presented the draft bylaw amendment, then I presented the draft toolkit. The workshop was attended mainly by engineers and consultants in the industry who offered their feedback on both the City's bylaw and VEC's toolkit. Following the workshop, I completed the first draft of the toolkit and sent the pre-publication draft to our interviewed stakeholders for their additional feedback. Following this feedback, we finalized the publicly available toolkit which will be available on the VEC website as well as within this report.

Summary conclusions

- Small to medium businesses are interested in alternative water systems.
- The main challenge preventing these businesses from installing systems is a need for information about how to get started setting one up. Cost is not the main hurdle even for small businesses. Small recycling businesses would be willing to pay up to \$10,000 for a system even if there is no return on investment from water cost savings.
- The main driver of interest in setting up systems is core environmental values and a desire to do the right thing, in line with other sustainable initiatives the business is engaged in.
- Small to medium businesses are largely self-sufficient and are already installing alternative water systems themselves, even if those systems are not properly permitted.
- One business we consulted that did try to follow permitting procedures found the process opaque and expensive.
- Many of the desired systems are not yet covered by the Vancouver Building Bylaw. For example, we found many businesses interested in using water for washing equipment but this is not a use covered by the proposed bylaw amendment.
- The main challenge of the study was business engagement, as business owners are extremely busy. Businesses were responsive to my requests for interviews, but much less responsive to requests for feedback on the draft toolkit.

Recommendations for VEC

- Publish and promote 'Toolkit for businesses: Non-potable water systems' to increase awareness of and spark interest in alternative water systems.
- Create a directory of service providers relevant to alternative water systems such as consultants, engineers, vendors, installers, and maintenance workers. This will facilitate connections with businesses.
 - Businesses' main hurdle is figuring out what to do and how to do it because these are usually side projects. A directory would give welcome direction and benefit both the service providers and the businesses hiring services.
- Support initiatives for education about alternative water systems.
 - Alternative water systems risk being decommissioned due to knowledge gaps about their operation and maintenance. Building managers are not necessarily trained on these systems, plumbers may lack knowledge of newer systems, and users may be wary of using non-potable water. Developing initiatives to educate maintenance professionals on alternative water systems and connect them with businesses who have alternative water systems would help address this knowledge gap.

Recommendations for City of Vancouver

- Include equipment washing applications as a water use covered by the Vancouver Building Bylaw.
 - There are two main concerns preventing this from happening: risks to human health and discharge of contaminated water to the sewer.
 - To address health concerns: If the water quality standards are followed, health concerns should be low. For the most conservative approach, requirements for personal protective equipment like masks could be instituted.
 - To address discharge concerns: This could be handled by allowing any system that conforms with the Sewer and Watercourse Bylaw, rather than prescribing specific water uses.
- Provide a user friendly system for testing and reporting
 - Businesses are setting up these systems as passion projects. The ongoing workload managing and tracking the system as per City requirements must be as easy as possible so that businesses do set these systems up and continue operating them.
- Allow for exemptions from bylaw requirement that all alternative water systems be connected to toilets, urinals, and trap primers
 - Some smaller businesses, like the recycling companies interviewed for this project, may want to use alternative water for specific uses like bin washing without also connecting the system to toilets. Mandatory connections could become prohibitively expensive in the setup of these smaller systems.
- Investigate the potential for a subsidy program to incentivize the adoption of non-potable water systems. Currently there is very little financial incentive to set them up. Though we found several businesses who are motivated by core values and do not see cost as a barrier, there are likely many more businesses who would use an alternative water system if it were financially beneficial.

Summary of interviews

Detailed notes and contact details are stored within VEC records.

Business interviews

Business	Alternative water system?
Coast Mountain Bus Company	System in place
MEC Head Office	System in place
LandSea Tours	System in place
BokoEco	Interested in a system
Regional Recycling	Interested in a system
Recycling Alternative	Interested in a system
EcoAction Recycling	Interested in a system
Delta Hotels by Marriot	Heat recover system, no alternative water use

Informational interviews

Business	Type
Climate Smart	Sustainability consultant
AME	Engineering consultant
Tourism Vancouver	Tourism sector representative
Creative Energy	Utilities sector, insight on local buildings
BARR Plastics	Component supplier

Other known case studies that were not interviewed at this time:

Telus Garden, Vancouver Convention Center, UBC Pool, UBC Nest, Richmond BMW

Summary of system site visits

Detailed notes stored within VEC records

	MEC Head Office	LandSea Tours
System in place?	Yes	Yes
Water source	Rainwater	Recaptured vehicle wash water
Water use	Toilet flushing Irrigation of non-food crops	Toilets
Water disposal	Sewer	Sewer
System details	Rooftop rainwater is captured from a TPO roof, pre-filtered using a vortex filter and sand filter, stored in a 7,000 gallon basement cistern, and disinfected with chlorine before use.	Vehicle wash water is recaptured, filtered with oil sock filter, pumped to 10,000 L storage, filtered with filtercloth, disinfected with bleach, and finally pumped to toilet flushing.
Cost	Built into new building costs, no estimate for just the water system	\$7,000
Suppliers	Pageau Morel et Associes	FilterCo
Perception of regulation	Building has applicable permits	Permits are an obstacle due to time delays and high expense of some requirements (oil water filter is prohibitively expensive)
Motivation	Core sustainability values Brand image	Core sustainability values Solution for bus wash discharge in the absence of an oil water separator
Influence of public sentiment	Important	Important, business reduces water use during restrictions even though they are not required to do so
Perception of risk	Risks are not a large concern because proper filtration and disinfection are in place.	Understands there is some risk which prompted the use of bleach in storage
Challenges	Irrigation of street level plants was not allowed due to potential public exposure to non-potable water	Particulate filter non usable because oil content is still too high

Summary of system site visits

Detailed notes stored within VEC records

	Coast Mountain Bus Company	BokoEco
System in place?	Yes	No, interested in a system
Water source	Recaptured bus wash water	Rainwater
Water use	Bus washing	Product manufacturing: brewing a probiotic compost additive
Water disposal	Closed loop system	Potential for closed loop system
System details	Recaptured bus wash water is pumped to a hydrocyclone filter	System in planning and testing stages. Rooftop rainwater filtered with activated charcoal before use in manufacturing. Manufacturing process already uses ceramic beads for filtration which are estimated to be adequate for the alternative water source. System uses upcycled 270L totes for modular storage.
Cost	\$380,000. Little cost difference between this system and a conventional system	< \$10,000
Suppliers		Self-taught design using YouTube resources
Perception of regulation	Applicable permits acquired	No permitting yet
Motivation	Corporate social responsibility policy and opportunity for change when the system was up for renovation.	Core sustainability values
Influence of public sentiment	Important, business reduces water use and washes buses by hand during water restrictions even though not required	Important, desire to market product as even more sustainable
Perception of risk	None	Not much concern as there is no aeration of the water and the product is not for human contact

Summary of system site visits

Detailed notes stored within VEC records

	Regional Recycling	EcoAction Recycling	Recycling Alternative
System in place?	Interested in a system	Interested in a system	Interested in a system
Water source	Rainwater	Rainwater	Rainwater
Water use	Recycling bin washing	Recycling bin washing	Recycling bin washing
Water disposal	Sewer	Sewer	Grease separator before discharge to sewer
System details	Desired: rainwater, filtered as necessary, stored, then pumped into existing wash bay and discharged to sewer.	Same desired system as Regional Recycling. Both companies expressed interest in a publicly visible cistern.	Potable water bin washing followed by pre-disposal grease separator.
Cost	Current spending on water is \$500	Could spend up to \$10,000	Filtration system for used wash water cost nearly \$100,000
Suppliers	None	None	Not known
Perception of regulation	Not aware of regulatory requirements	Not aware of regulatory requirements	Advocate for greater clarity in regulation. Much less money could have been spent on their filtration system had they had clearer guidance in permitting.
Motivation	Core sustainability values, no cost argument	Core sustainability values	Core sustainability values
Influence of public sentiment	Important	Important	Important
Challenges	How to get started? Need information about regulations and commercially available systems	How to get started? Need information about regulations and commercially available systems	Interested in rainwater harvesting system but not yet able to install due to high cost of the pre-disposal filtration system.

Regulatory summary

This section summarizes the current regulatory environment for commercial on-site alternative water source applications in the City of Vancouver

1. Current regulations

Presently, the design of rainwater harvesting systems is covered under the Vancouver Building By-law (VBBL). The design of any other alternative water systems must be approved through the "Alternative Solutions" procedure of the VBBL. There are currently no national, provincial or municipal standards for ongoing maintenance and operations of rainwater systems. This gap is being addressed by VBBL amendments which will be proposed to Council in 2018.

1.1 Building and plumbing

All water system projects must comply with Vancouver by-laws (Vancouver Building Bylaw 10908; Water Works By-law 4848, Sewer and Watercourse By-law 8093, etc.) and be issued applicable permits (e.g., electrical, plumbing). Regulations for the design and installation of non-potable water systems are found in Section 2.7 Non-Potable Water Systems (Division B -- Part 2) of the Building Bylaw. This section refers to ASHRAE Handbooks, ASPE Handbooks, and CSA 128.1 for technical specifications. Of particular importance in these regulations are clear labeling of non-potable plumbing components and prevention of cross contamination. Plumbing systems for human contact and human consumption must remain completely separate from non-potable water systems.

1.2 Water sources

Rainwater harvesting is covered under the Vancouver Building By-law (VBBL). Any other alternative water systems must be approved through the "Alternative Solutions" procedure of the VBBL.

1.3 Water uses and health considerations

Growth of microorganisms and presence of chemical contaminants in systems can pose a health risk, thus water quality needs to be carefully considered. To mitigate health risks, all systems need some level of filtration. The degree of treatment should be commensurate with application, considering factors such as whether or not the water from the system will be near people and whether or not the water will be aerosolized. A qualified professional can help guide treatment choice. If you are instituting a system that is covered by the VBBL, the appropriate building, plumbing, and electrical permits cover health permitting concerns. For systems requiring Alternative Solutions, it is recommended to consult a qualified professional or Vancouver Coastal Health to determine if a health permit is required.

1.4 Water discharge

Commercial and industrial businesses may be required to obtain a wastewater discharge permit from City of Vancouver Environmental Protection (City of Vancouver Sewer and Watercourse By-law 8093). This applies whether or not there is an alternative water system in place. However, it is important to be aware that as water sources and water uses shift with the implementation of an alternative water system, permits need to be amended for system changes.

Summary table of selected references

Document	Regulatory region	Purpose	Relevance to alternative water systems
Vancouver Building Bylaw (VBBL) 10908 Section 2.7 Non-Potable Water Systems (Division B Part 2)	City of Vancouver	The building bylaw covers building systems. Regulations for the design and installation of non-potable water systems are found in Section 2.7	Section 2.7 refers to ASHRAE Handbooks, ASPE Handbooks, and CSA 128.1-06 for technical specifications.
VBBL Alternative Solutions	City of Vancouver	Procedure for permitting alternative solutions to systems regulated by the Vancouver Building Bylaw	Necessary if an alternative water system is desired that is not covered by the Vancouver Building Bylaw
CSA Standard B128.1-06	Canada	Engineering practices specifically for non-potable water systems	This standard describes the design, installation, maintenance, and plumbing components of non-potable water systems that shall be followed per Vancouver Building Bylaw 10908 Section 2.7. This includes specifications for: air gaps/backflow preventers, filter systems, pressure tanks, pumps, roof gutters/drains/screens, storage tanks, treatment systems, warning labels, pressure testing, cross-connection testing, and proposed maintenance schedules.
Water Works Bylaw 4848	City of Vancouver	The Water Works Bylaw covers the water distribution system, and specific elements of building systems.	Cross connection control requirements to prevent contamination of the potable water system are detailed in this by-law.

Summary table of selected references

Document	Regulatory region	Purpose	Relevance to alternative water systems
ASHRAE Handbooks and ASPE Handbooks	North America	Guide engineering practices	Best engineering practices to be followed per Vancouver Building Bylaw 10908 Section 2.7
NSF Protocol P151	International	Guidelines for materials used in rainwater harvesting systems Double check that this is the purpose	Recommended, not required: Recommends roofing materials to minimize contaminants in rainwater harvesting
Sewer and Watercourse By-law 8093	City of Vancouver	Water discharge regulations	This bylaw regulates the water quantity and water quality that can be discharged to the sewer system by commercial and industrial businesses. Businesses must obtain a permit for their water discharge and apply to amend it as necessary when redesigning a water system.
Canada Occupational Health and Safety Regulations	Canada	Occupational health and safety	When entry into a large water storage tank is necessary, regulations for working in confined spaces must be followed.
Recreational water quality guidelines	British Columbia	Guidelines for recreational water quality	For alternative water systems including recreational water use, these recommendations must be met.

2. Proposed building bylaw amendment

A proposed amendment to the VBBL will cover additional system and maintenance requirements for commercial and industrial alternative water systems. This amendment will allow more systems to be implemented under VBBL without requiring an Alternative Solution. The proposed bylaw was distributed as part of a public letter on May 31, 2018, will go before Council in Fall of 2018, and if passed will go take effect January 1, 2019. The following sections summarize what is covered by the proposed bylaw amendment.

2.1 Permissible water sources and uses

Water sources

Addressed by VBBL	Require Alternative Solutions
Rainwater Clear-water waste**	Anything not covered by VBBL, including: Greywater Black water Recaptured water Any other source

Water uses

Addressed by VBBL	Require Alternative Solutions
Toilets flushing Urinals flushing Trap primers Irrigation Boiler makeup water Cooling tower makeup water	Anything not covered by VBBL, including: Washing (vehicles, bins, laundry, etc) Product manufacturing Recreational water Any other use

2.2 Operation and maintenance requirements

In order to ensure a standard of operation and maintenance, more formal reporting and inspection will be required. Annual registration and operating permits would be required for rainwater cisterns, building water treatment systems, cooling towers/evaporative condensers, and decorative water features. A maintenance log and operational manual would be required for all non-potable systems. Commissioning, inspection, maintenance, and reporting requirements are outlined in the proposed bylaw section 2.7.7.2.

** Clear-water waste means waste water with impurity levels that will not be harmful to health and may include cooling water and condensate drainage from refrigeration and air-conditioning equipment and cooled condensate from steam heating systems, but does not include storm water. Examples of clear-water waste are the waste waters discharged from a drinking fountain, cooling jacket, air conditioner or relief valve outlet.

2. Proposed building bylaw amendment

2.3 Engineering requirements

- On-site non-potable water systems would need to be designed by a registered professional engineer. Engineering would be required to comply with proposed by-law amendment requirements. Please refer directly to the proposed by-law amendment. The following list highlights proposed changes, but is not exhaustive:
- Water closets, urinals, or trap primers are required to remain connected to the non-potable water system if installed.
- Air gaps for backflow prevention are required to prevent cross contamination between potable and non-potable water sources.
- Metering of potable and non-potable water volumes is required.
- Piping must be purple in colour and conform to the requirements of NSF-rw and NSF/ANSI Standard 14.

2.4 Water quality

The proposed bylaw amendment dictates required quality standards for the first time. It requires turbidity <10 NTU; E. coli <100 CFU / 100ml; temperature <20 degrees Celsius. Other proposed specifications intended to ensure sufficient water quality include: required pre-filtering of particulate matter before storage, and withdrawal of water from a minimum of 0.3 m from the bottom of cisterns.

Guide to select commercially available systems

This section outlines components that make up alternative water systems and provides an examples of component suppliers. The schematic below outlines the flow of a system, and is of useful reference when looking through the components list. The VEC does not endorse any particular supplier. Sample suppliers are provided as examples.

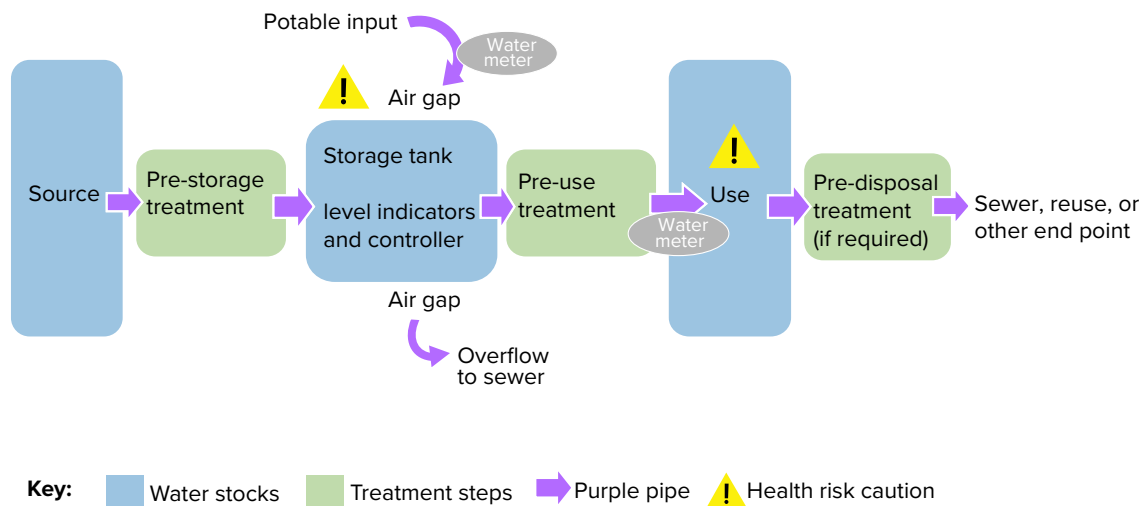


Figure: Blockflow diagram of a generalize alternative water system.

Component	Details	Sample supplier
Collection area	Typically rooftop or other pre-existing infrastructure	None
<i>Pre-filters:</i> First flush diverters Screening Cascade style filters Vortex style filters Bucket style filters	Any treatment used before storage is typically called a “pre-filter.” First flush diverters prevent the first	BARR Plastics
Tank	Tanks (often called cisterns) supplied by BARR range from 1,000 to 40,000 gallons. Tanks need to be appropriately sized according to use needs and rainfall averages. Rainfall averages can be highly localized, so it is recommended to find the rain gauging station nearest you.	BARR Plastics

Component	Details	Sample supplier
<i>Tank accessories:</i> Calming inlet Floating extractor Overflow siphon	A calming inlet prevents disturbance of fine sediment that may build up at the bottom of the tank.	BARR Plastics
Pump and water meter	In most cases at least one pump will be needed. At least 2 water meters are needed to meet the requirement of metering potable and non-potable inputs to the system.	Widely available, no specific recommendations
Filters: Sediment filters Particulate filters Carbon filters	Filtration will be required to meet the water quality requirement that turbidity (cloudiness of the water) be less than 10 NTU.	FilterCo, Watertiger
Disinfection systems: UV disinfection Chlorination systems	Disinfection will be required to meet the water quality requirement of E.coli levels less than 100 CFU/100mL	FilterCo, Rainfresh
Purple piping	Pipes conveying non-potable water must be purple in color	Uponor
Monitoring systems		3 Phase Power
Modular all-inclusive systems	These all encompassing “plug and play” skid design systems include all components between collection and use.	Watts RainCycle system, BARR plastics
Design consulting	Systems are required to be designed by a registered professional engineer. There are many engineering design firms who help clients with alternative water systems.	AME, Pageau Morel et Associates, Integral Group

Public consultation workshop

Workshop recap

On June 28, 2018, we held a public workshop to present the developing toolkit and solicit feedback from interested stakeholders. The workshop was part of a day-long event that included presentations by City Waterworks Branch, Vancouver’s Chief Plumbing Inspector, and displays by vendors of commercially available alternative water systems. The event was open to the public and attended mainly by engineers and consultants in the industry.

First, Waterworks Design Branch presented a proposed bylaw amendment. The proposed amendment to the Vancouver Building Bylaw aims to improve the safety and regulation of alternative water systems, as well as the ease and accessibility of setting up new systems.

After the presentation of the proposed bylaw amendment, I presented my developing toolkit and gathered feedback from attendees. We completed an activity in which we asked the audience to help develop a list of non-potable water sources that they work with or know that others may be working with, and any non-potable water uses they could think of. This list is included in the report below. The presentation was well received, and we received substantial constructive feedback and insight. Waterworks Design Branch is interested in the case studies and findings from our study in order to inform the development of this and future bylaw amendments. Additional amendments to the bylaw are expected in the future to incrementally support a greater range of alternative water system use.

Slide deck



Introductions

Vancouver Greenest City 2020 Action Plan
Greenest City Scholar Program

Goal #8: Clean Water: Reduce per capita water consumption to 33% below 2006 consumption

GCS project: Local Industrial and Commercial Applications for On-Site Alternative Water Systems
Emily Mistick – UBC MSc candidate
Meg O’Shea – Vancouver Economic Commission
Chris Radziminski – CoV Water Design Branch

Introductions

Project goal: Create a toolkit for Local Industrial and Commercial Applications for On-Site Alternative Water Systems

Workshop goal: Feedback on the developing toolkit

Workshop agenda:

- Motivation and background
- Case studies
- “Use cases” for toolkit
- Generalized system design
- Commercially available systems
- Feedback

Project motivation

Demand ↑: population increase 42% by 2040

Supply ↓: longer dry seasons in summer, decreased snowpack, increased storm intensity

Water supply gap is projected by 2030

Stage 3 restrictions every year by 2040

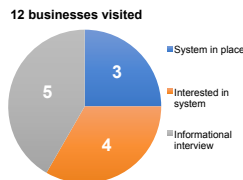
38% water cost increase by 2022

Businesses express interest in reducing potable water consumption, but don’t know how to get started

Sources:
Metro Vancouver 2018 Budget
Metro Vancouver “Comprehensive Regional Water System Plan” (2017)
Population Density and the Metro 2040 Growth Model, Metro Vancouver
Indicators of Climate Change for British Columbia 2016 Update, BC Ministry of Environment

What we've heard

- Contacted 20 businesses
- Range of business sizes
- 3 with systems in place:
 - 1 rainwater
 - 2 recaptured wash water
 - 2,000 to 7,700 gallon tanks
- Some interested in even smaller systems (100 L use per day)
- Motivated by core values



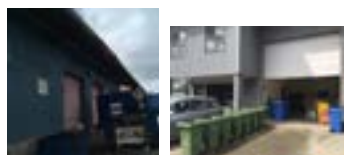
Case study 1: MEC Head Office



Source	• Rain
Use	• Toilet flushing • Irrigation
System	• Rooftop rainwater harvesting • Vortex filter pre-storage • 7,700 gallon basement cistern • Sand filter pre-storage • Chlorine for disinfection post-storage
Motivation	• Core sustainability values • Cost savings unlikely
Challenges	Irrigation not allowed at ground level
Suppliers	Hired engineering firm for design and component selection (Pageau Morel et Associates)



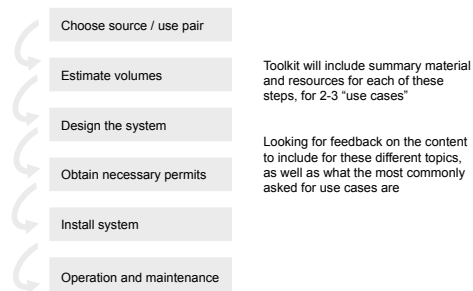
Case study 2: Rainwater for bin washing



Interested businesses	Regional Recycling, EcoAction Recycling, Recycling Alternative
Source	• Rain
Use	• Bin washing 100 – 1,500 L per day
Desired system	• Rooftop rainwater harvesting • Cistern storage • Treatment system (pre- and post-use)
Motivation	• Core sustainability values • Cost savings unlikely
Challenges	What to do first? • Permits • Design • Suppliers • Cost



Developing toolkit overview



Source/use pairs

What are your water sources and uses?

Source	Use	# case studies



Regulatory overview

	Water sources:	Water uses:
Vancouver Building Bylaw:	• Rain water • Clear-water waste	• Toilet flushing • Urinal flushing • Trap primers • Irrigation • Boiler makeup water • Cooling tower makeup water
Alternative Solutions:	• Grey water • Black water • Pool drain water • Recaptured water • Any other source	• Washing (vehicles, bins, laundry) • Product manufacturing • Recreational water • Any other use



Source/use pairs

What are your water sources and uses?

Source	Use	# case studies
Rain	→ Toilets	3
Rain	→ Irrigation	3
Rain	→ Bin washing	3
Rain	→ Product manufacturing	1
Recaptured vehicle wash	→ Vehicle washing	1
Recaptured vehicle wash	→ Toilets	1
Recaptured recreational water	→ Toilets	1
...



Regulatory overview

Proposed requirement highlights:	
Permits	• Applicable building, plumbing, and electrical permits
Maintenance	• Annual registration and operating permits • Commissioning, inspection, maintenance, and reporting requirements
Engineering	• Design by registered professional engineer <ul style="list-style-type: none"> • Air gaps for backflow prevention • Metering required • Piping must be purple in colour
Water quality	• Turbidity < 10 NTU • E. coli < 100 CFU / 100ml • Temperature < 20 degrees C



Regulatory overview

Proposed requirement highlights:	
Permits	• Applicable building, plumbing, and electrical permits
Maintenance	• Annual registration and operating permits • Commissioning, inspection, maintenance, and reporting requirements
Engineering	• Design by registered professional engineer • Air gaps for backflow prevention • Metering required • Piping must be purple in colour
Water quality	• Turbidity < 10 NTU • E. coli < 100 CFU / 100ml • Temperature < 20 degrees C

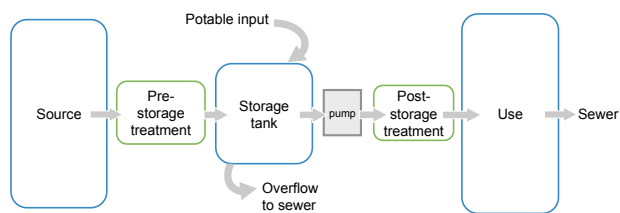
Toolkit use cases

Use case	Source use pair		Covered by draft bylaw amendment?	# Case studies
1	Rain	Toilets	Yes	3
2	Rain	Irrigation	Yes	3
3	Clear water waste	Any covered use	Yes	0
4	Rain	Bin washing	No	3
5	Rain	Product manufacture	No	1
6	Recaptured vehicle wash water	Toilets	No	1
7	Recaptured recreational water	Toilets	No	1
8	Recaptured vehicle wash water	Vehicle washing	No	1
9	Clear water waste	Any uncovered use	No	0

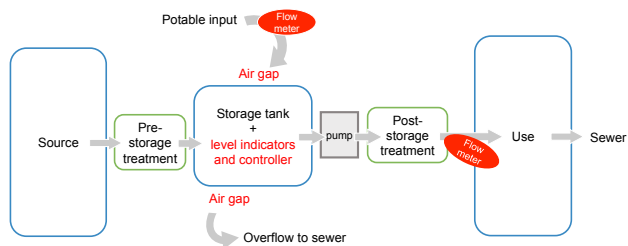
Toolkit use cases: organized by bylaw coverage

Use case	Covered by draft bylaw amendment?	Source	Use	# Case studies
1	Yes	Rain	Toilets	3
2	Yes	Rain	Irrigation	3
3	Yes	Clear water waste	Covered use	0
4	No	Covered source: Rain, clear water waste	Uncovered use: Washing, product manufacture	4
5	No	Uncovered source: Recaptured wash water, recaptured recreational water	Covered use: Toilets	2
6	No	Uncovered source: Recaptured wash water	Uncovered use: Washing	1

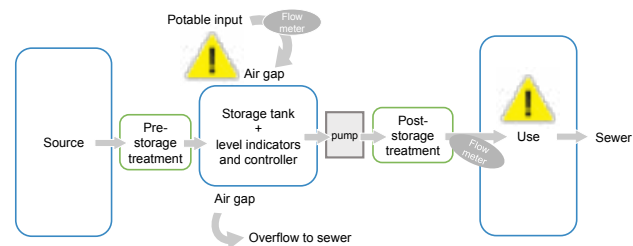
Conceptual alternative water system



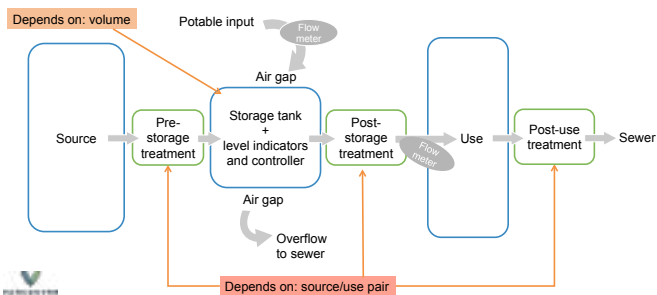
Added details



Risk mitigation – why this is regulated



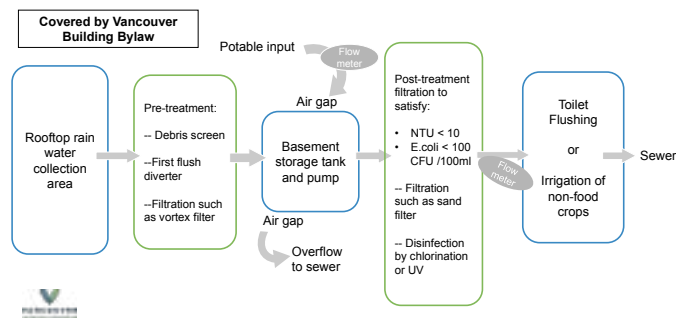
Decision points



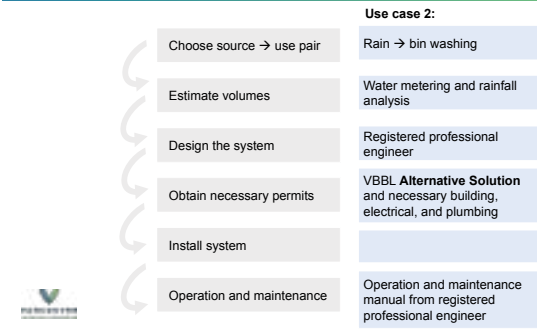
Toolkit steps: use case 1

Use case 1:	
Choose source → use pair	Rain → toilets or irrigation
Estimate volumes	Water metering and rainfall analysis
Design the system	Registered professional engineer
Obtain necessary permits	VBBL and necessary building, electrical, and plumbing
Install system	
Operation and maintenance	Operation and maintenance manual from registered professional engineer

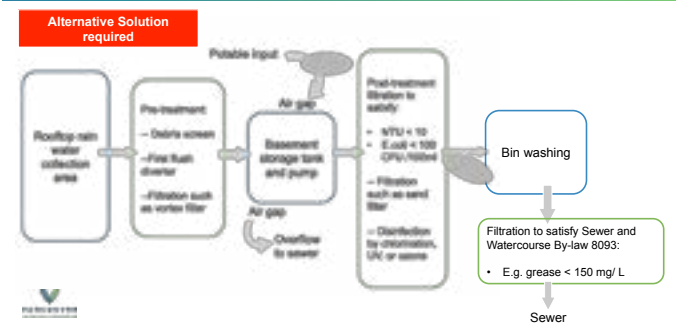
Use case 1: rain to toilets or irrigation



Toolkit steps: use case 2



Use case 2: rain to bin washing



Examples of local vendors

Component suppliers:

Component	Supplier
Tanks, pre-filters	BARR Plastics
Piping	Uponor
Modular all-inclusive system	Watts
Filters	FilterCo, Watertiger

Engineering:

- o AME Group
- o Pageau Morel et Associes
- o Integral Group
- o Etc.

Key findings

- Small to medium businesses are interested
 - These businesses are largely self-sufficient and are installing systems themselves
 - Many desired systems are not yet covered by VBBL
- Challenges:**
- Finding out what businesses are doing
 - Who is using clear water waste?
 - Businesses do not always meter their water
- Questions:**
- Was this understandable? What is missing, surprising, could be improved?
 - Terminology?
 - Do you know of other resources to include for businesses?

Thank you!

Commercial and industrial alternative water systems toolkit

Emily Mistick, 412-480-162
emistick@vancouvereconomic.com

Meg O'Shea, 604-366-8051
moshea@vancouvereconomic.com

Public consultation workshop

Water source/use activity

During the workshop, we asked audience members to contribute to a list of non-potable water sources and uses that they have used or heard of others using. The list is marked up to indicate whether the source and use is covered by the Vancouver Building Bylaw (green) or requires an Alternative Solution (red)

<u>Source</u>	<u>Use</u>
✓ Rooftop Rain ^{snow dew}	✓ toilets ^{ice}
✓ Surface runoff	✓ irrigation
✓ Green roof runoff	✓ vehicle washing
✓ Parking lot runoff	✓ asphalt rollers ^{Atwaterford}
✓ groundwater (natural)	✓ ice rinks
✓ grey water	✓ industrial cleaning
✓ Condensate	✓ water features
✓ Recaptured	✓ construction ^{dust suppression} ↳ tool cooling
	✓ washing animals
	✓ recreational
	✓ fire suppression

Public consultation workshop

What we heard

Minutes from workshop discussion

- No one in attendance knows of anyone reusing clear water waste
- Businesses desire a tool for rough water volume estimates (I am working on something simple for this)
- Consultants want a clear answer of what types of irrigation are allowed
- There is a need to educate people that cleaning the roof is necessary; customers have been surprised in the past that it is part of an ongoing maintenance plan
- Presentation of my block flow schematics was well-received (rep from Barr interested in getting a copy)
- The city should let people know about the projected increase in water costs so businesses can prepare for the future: future-proofing and faster ROI
- Condensate is usually quite acidic due to the metals it comes in contact with. Can be blended but if it represents a high enough percentage of the eventual water source, you will need additional treatment.
- Things not covered are designated so because of the increased chance for human contact
- Clarification that “uncovered” does not mean disallowed, just that require an additional permitting process (more time, more money)
- Business motivation for systems?
- Businesses have approached members of the audience for systems most often because they believe it is environmentally the right thing to do
- They know it’s not a savings but they want to do their part (and keep up with their peers)
- Some want to irrigate during restrictions
- It looks good, they like the concept and the image, they communicate their efforts
- The communicative power is a prime motivation (social marketing tool which may lead to sales, increased revenue and deal flows)
- Water meter effect on residential could be used as a case study (reduced water use and showed cost savings)
- How to organize the toolkit? What do businesses ask about first?
- What is allowed and what is most effective
- Organizing by what is covered first answers a basic question immediately
- Businesses like to see a comparative case and ask about emulating it
- Use term water “audit” rather than water “metering” (for toolkit)
- Keep in mind residents in Telus gardens because of “dirty” toilet water (collecting off a green roof). Signage can be useful in those cases; i.e., no big red crosses but instead a more positive message about why the water is coloured and what good it is doing
- A suggestion of a more technical workshop by the city to walk through what the concerns will be and what equipment options will address those concerns

Toolkit

The culmination of this project is a toolkit that equips and empowers businesses to set up their own on site non-potable water system. This toolkit was assembled from information gathered from expert interviews, site visits to businesses, and feedback from a public consultation workshop. A draft of the toolkit was sent to stakeholders with a request for feedback before final publication. The toolkit is publicly available through VEC's website and in the next pages below.

Toolkit for businesses: Non-potable water systems

This toolkit provides resources for Vancouver businesses wishing to install non-potable water systems to reduce their use of municipally-provided treated drinking water. The toolkit includes a summary of relevant regulations, local suppliers, case studies, and a step-by-step guide to setting up an alternative water system.

Authors: Emily Mistick, Meg O'Shea
Vancouver Economic Commission

Brief glossary:

Potable water
Water suitable for drinking, usually treated water provided by the municipality

Non-potable water
Water not suitable for drinking

Alternative water system
Systems that use water from sources other than the drinking water supply

Condensate
Condensate water from applications that produce water vapour

Grey water
Mildly contaminated water, such as water draining from bathroom sinks

Black water
Toilet waste water

Filtration
Removes particles

Disinfection
Removes microorganisms

Cistern
Storage container

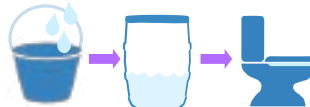
What are non-potable water systems?

These systems make use of non-potable water, such as rainwater or condensate, that would otherwise go directly to the storm system or sewer. The water is stored and treated, then put to use in situations where the water does not need to be potable, such as toilet flushing or irrigation. These systems benefit the environment by reducing use of municipally treated water.

Non-potable sources

Such as:
-- Rainwater
-- Condensate

Treatment and storage



Non-potable uses

Such as:
-- Toilet flushing
-- Irrigation of non-food crops

Benefits to businesses

Environmental values
A common motivation for using an alternative water system is to demonstrate sustainability as a core value. There is a high potential for positive environmental impact in the business sector, since 25% of Vancouver's potable water is used in commercial and industrial applications.

Self-reliance and resilience
Stored on-potable water can be used during summer water restrictions. Some businesses are able to decrease their potable water use by 55-80% by using alternative water systems.

Future financial benefits
Current return on investment for alternative water systems is long (10 years or more), but this is expected to change. Metro Vancouver anticipates a 38% increase in water rates and 55% increase in sewer rates by 2022.

Regulatory overview

Some alternative water systems are covered by [Vancouver Building Bylaw \(VBBL\)](#) requirements. Sources and uses not covered by VBBL require an [Alternative Solutions](#) permit, which can add expense and delay to the process. As of June 2019, alternative water systems will require an annual operating permit from the City of Vancouver.

	Vancouver Building Bylaw	Alternative Solutions
Water source	Rainwater Condensate	Grey water Black water Recaptured water Any other source
Water use	Toilets Urinals Irrigation Cooling tower makeup water	Boiler makeup water Trap primers Washing Recreation Product manufacturing Any other use

Additional details are available in the [Alternative Water Systems Regulatory Summary](#) at the Vancouver Economic Commission.

STEP-BY-STEP GUIDE

1/ Water sources and uses

Does your business have potential [uses](#) for non-potable water?
Do you have non-potable water [sources](#) available that can be used for these needs?
Choose a water source and water use, keeping in mind the regulatory implications (see above).

2/ Water treatment

When?	Before storage	Before use	Before disposal
How much?	Pre-treatment must be used to minimize sediment buildup. Level of treatment is not prescribed.	Water quality must achieve: Turbidity < 10 NTU E. coli < 100 CFU / 100mL Temperature < 20 C	Must comply with Sewer and Watercourse Bylaw 8093
How?	Many options including: first flush diverters, screening	Many options including: filtration (such as sand filters or particulate filters), disinfection (such as UV or chlorination)	Not prescribed
Why?	Because some human contact is always possible (particularly through water vapour), non-potable water must be treated to safeguard human health. When the water quality requirements are met, health hazards are very low.		

3/ Tank sizing

Water volume audit

First, estimate the annual volume of water available from the alternative water source. Then estimate the volume of water needed for the selected use. Here are some basic examples of equations to use for estimating volumes.

Source: Rainwater: $\text{Volume(L/month)} = 0.8 \times \text{Surface Area (m}^2\text{)} \times \text{Rainfall (mm/month)}$

Online tools: [Surface area calculator tool](#), [Environment Canada monthly rainfall database](#)

Use: Low flow toilets (4.8 L/flush): $\text{Volume (L/day)} = \text{Average number daily occupants} \times 30 \text{ (L/person)}$

Use: Irrigation: $\text{Volume(L/day)} = \text{Evapotranspiration} \times \text{Plant factor} \times \text{Surface area} / \text{Irrigation efficiency}$
Online tools: [BC Agricultural Water Calculator](#), [Irrigation Tutorials](#)

Tank size decision

Next, decide how much water to store. One rule of thumb is to store 5% of the annual volume of the source or use, whichever is greater. Choose a tank size based on how long you want to be able to go without added water input. For example, if more water use is desired in the summer, consider a tank larger than 5% of annual use.

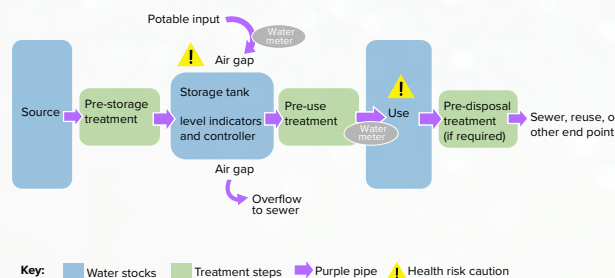
4/ Engineering details

Non-potable water systems must be designed by a **registered professional engineer**.

Requirements include but are not limited to:

- Air gaps are required to prevent cross contamination of potable and non-potable water.
- Non-potable water and potable water top up volumes must be metered.
- All piping used to supply non-potable water must be purple in colour.

Schematic highlighting key components:



Commercially available systems:

Product:	Example supplier:
All inclusive systems	Watts (RainCycle) , BARR Plastics
Pre-filters and storage tanks	BARR Plastics
Purple pipe	Uponor
Filters	FilterCo , Watertiger
Engineering service	AME, Disney&Young
Monitoring system	3 Phase Power



These suppliers are provided as informational examples. The VEC does not endorse individual vendors.

5/ Necessary permits

- | | | |
|---|--|---|
| Construction permits: | Annual operating permit: | Relevant bylaws: |
| <input checked="" type="checkbox"/> Building permit | <input checked="" type="checkbox"/> Onsite non-potable water system (ONWS) operating permit (available online later in 2019) | <input checked="" type="checkbox"/> Vancouver Building Bylaw |
| <input checked="" type="checkbox"/> Plumbing permit | | <input checked="" type="checkbox"/> Sewer and Watercourse Bylaw |
| <input checked="" type="checkbox"/> Electrical permit | | <input checked="" type="checkbox"/> Water Works Bylaw |
| <input checked="" type="checkbox"/> Alternative Solution (if necessary) | | |

6/ Operation and maintenance

Typical maintenance:

Regular inspection and cleaning of water collection surface, and cleaning/replacement of filters, following manufacturer's recommended maintenance schedule.

Vancouver Building Bylaw operating permit requirements:

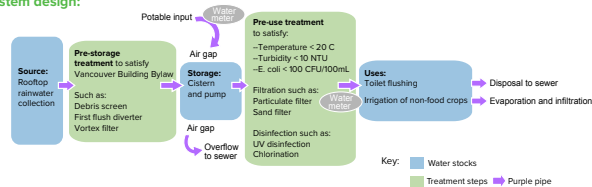
- | | |
|--|--|
| Testing:
Every 3 months water quality tests must be done by an accredited laboratory. | Operation manual:
Manual must include system diagrams, safety information, and engineer contact details. |
| Reporting:
Water quality reports must be submitted to the City of Vancouver every 3 months (forms online later in 2019). | Maintenance log:
A log of up-to-date inspection, maintenance, and water quality test result records is required. |

USE CASE 1 Rainwater for toilet flushing and irrigation

Water source: Rooftop rainwater **Water use:** Toilet flushing and non-food crop irrigation

Permitting: Covered by the Vancouver Building Bylaw

System design:



Case study: MEC Head Office

LEED Platinum certified, 400 employee facility uses rooftop rainwater for toilets and irrigation. 80% of its non-potable water use comes from rain, reducing overall potable water use by 55%.

System design: Rainwater is harvested from a thermoplastic polyolefin (TPO) roof, pre-filtered using a vortex filter and sand filter, stored in a 26,000 L basement cistern, and disinfected with chlorine before use.

Motivation: Core sustainability values

Challenges: Irrigation was not allowed at street level due to possible contact with the public.

Engineering: Pageau Morel et Associés

Top right: MEC Head Office

Bottom right: Rooftop rainwater collection area

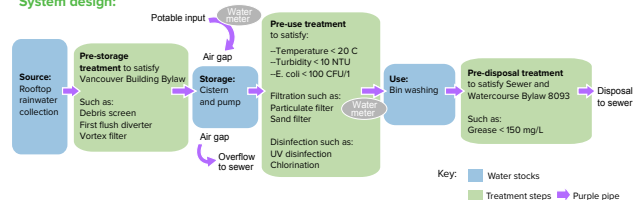


USE CASE 2 Rainwater for bin washing

Water source: Rooftop rainwater **Water use:** Washing recycling bins

Permitting: Alternative Solution permit required for this system

System design:



Case study: Recycling companies

Local companies including Regional Recycling, Recycling Alternative, and EcoAction Recycling have expressed interest in using rainwater to wash bins.

Water volume: 100 - 1,500 L per day

System design: These businesses desire rooftop rainwater harvesting, cistern storage, and appropriate treatment systems.

Motivation: Core sustainability values

Challenges: These businesses are seeking information about permits, design, and suppliers. This toolkit aims to provide those resources.

Top left: EcoAction Recycling bin washing bay

Bottom left: Regional Recycling loading dock and desired cistern location



Additional toolkit resources:

- [Rainwater harvesting introductory video](#)
- [Contact plumbing inspection](#) for case-specific questions
- [Directory of Registered Professional Engineers](#)

This toolkit was created for the Vancouver Economic Commission as a Greenest City Scholar project. For more information, contact info@vancouvereconomic.com



References

- American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) (2017). ASHRAE Hand books. <<https://www.ashrae.org/technical-resources/ashrae-handbook>>
- BARR Plastics Commercial Case Studies. Referenced July 2018. <http://www.barrplastics.com/Commercial-Case-Studies_ep_101-1.html>
- Canada Labor Code (2018). Canada Occupational Health and Safety Regulations. <Canada Occupational Health and Safety Regulations (2018)>
- Canada Mortgage and Housing Corporation (CMHC). (2012). Guidelines for Residential Rainwater Harvesting Systems Handbook. <<https://www.cmhc-schl.gc.ca/odpub/pdf/67608.pdf>>
- CDC (2018). How Legionella affects building water systems and people. <<https://www.cdc.gov/legionella/>>
- City of Vancouver (2018). Re: Proposed plumbing and mechanical systems amendments <<https://www.mcabc.org/wp-content/uploads/2018/05/City-of-Van.-bylaw-changes-document-May-31-2018.pdf>>
- City of Vancouver (2014). Vancouver Building Bylaw 10908. <<http://vancouver.ca/your-government/vancouver-building-bylaw.aspx>>
- City of Vancouver (2017). Water Works Bylaw 4848. <<http://vancouver.ca/your-government/water-works-bylaw.aspx>>
- City of Vancouver (2017). Sewer and Watercourse Bylaw 8093 <http://app.vancouver.ca/bylaw_net/ConsolidatedReport.aspx?bylawid=8093>
- Environment and Climate Change Canada (2016) Canadian Environmental Sustainability Indicators: Water Withdrawal and Consumption by Sector. <www.ec.gc.ca/indicateurs-indicators/default.asp?lang=en&n=5736C951-1>
- Government of Canada (2012). Guidelines for Canadian Recreational Water Quality. <<https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-recreational-water-quality-third-edition.html>>
- NSF International (2013). NSF Protocol P151. <https://www.nsf.org/newsroom_pdf/water_rainwater_catchment.pdf>
- Regional District of Nanaimo. Rainwater Harvesting Best Practices Guidebook <<http://rdn.bc.ca/events/attachments/evID6235evattID1344.pdf>>
- Standards Council of Canada (2006). CSA Standard B128.1-06. <<https://www.scc.ca/en/standardsdb/standards/23075>>
- Standards Council of Canada (2007). CSA Standard B64.10. <<https://www.scc.ca/en/standardsdb/standards/28959>>
- WATTS RainCycle System Brochure <<http://pages.wattswater.com/WATTS-RainCycle.html>>
- William J Worthen Foundation (2018). Water Reuse Practice Guide (WRPG). <<https://www.collaborativedesign.org/water-reuse-practice-guide/>>