

WORKING FOR WATERSHEDS

Appendix: Research Methodology

Process & Approach

The Delphi project team worked to establish a clear definition and overarching statistical framework for BC's Watershed Sector. Key inputs to help establish and refine this framework included previous work for the Green Infrastructure Ontario Coalition and the University of Oregon Report *Economic and Employment Impacts of Forest and Watershed Restoration in Oregon*.^{1,2}

The project team undertook secondary research and a high-level literature scan of online reports, websites, and other sources, in BC and select regions across North America, and globally to identify various definitional frameworks for BC's Watershed Sector. As part of the review, the project team examined various priorities and programs relevant to watershed restoration and green infrastructure, federal departments in Canada, and select regional and local government efforts. Based on this scan and secondary research, a definitional structure was developed.

Concurrently, the project team developed a statistical framework, based on industry codes (i.e., North American Industry Classification System or NAICS codes at the 6-digit level) where appropriate, to put statistical rigour around the qualitative definitional structure. This definitional framework and the related NAICS codes are presented in Table 1.

Outreach

The project team conducted a series of in-depth, key informant interviews by telephone and video conference, allowing for contact with respondents in locations across the province. The project team interviewed 14 key informants to build on existing knowledge, fill-in research gaps, review and identify relevant and previous economic impact assessments, review the definitional framework, and identify key players in BC's Watershed Sector.

To compliment the key informant interviews, a short online survey was developed and distributed by the project team, client, and partners to networks of members and newsletter subscribers. This survey enabled a broader reach than was possible within the scope of the key informant interviews and

¹ https://greeninfrastructureontario.org/app/uploads/2020/07/Economic-Impact-Assessment-of-GI-Sector-in-Ontario_UP-DATED_july20-20.pdf

² <https://scholarsbank.uoregon.edu/xmlui/bitstream/handle/1794/10776/WP24.pdf>

allowed further information gaps to be filled and insights to be gathered in support of the research. The survey sought to answer questions including:

- What resources and data does the organization collect or have access to that might support the economic impact analysis?
- What reports could the organization share with respect to previous work done to analyze the economic impact of the Watershed Sector or sub-sectors?
- What are the key trends they see related to the Watershed Sector in BC or for any related sub-sectors?
- What are the top policies or regulatory drivers impacting BC's Watershed Sector?
- What opportunities do they see for growing BC's Watershed Sector?

Assessing the Size of BC's Watershed Sector in 2019

Delphi estimated the current state and value (i.e., GDP, revenues or gross output, and jobs) of BC's Watershed Sector in 2019 by developing "intensity ratios" for the various industry NAICS codes relevant and inline with the agreed to definitional and statistical framework. Intensity ratios are essentially the amount or percentage of watershed-relevant activity occurring within each of the broader traditional industry NAICS codes (i.e., market penetration of activities).

This intensity ratio analysis was based on both secondary research and analysis of watershed project spending by category as a percentage of total spending (a high-level summary of the results is included at the end of this Appendix). The project team estimated the amount of activities where data was available or could be estimated under a set of reasonable assumptions. This included examining available databases for watershed projects and assets in BC and in some cases across Canada, including detailed assets and investments in watershed protection and restoration (where relevant and inline with the agreed upon definition) from various publications by the BC government, various municipalities, and other key players within the sector. These estimates were complemented by a review of companies active in key industries, as well as from relevant industry association and supporting organization websites and through the key informant interviews.

The final intensity ratios by industry were then applied to the specific NAICS codes in order to estimate the macro economic impact and activity in terms of current GDP, gross output, and the number of jobs (direct, indirect, and induced) related to the Watershed Sector and relevant subsectors in BC. The value of relevant assets and investments was converted to direct, indirect, and induced jobs, GDP, and gross output through the Statistics Canada Input-Output multiplier Tables.

Forecasting the Growth of the Sector to 2030

Two growth scenarios were developed for BC's Watershed Sector for the period of 2019 to 2030, as described below. Assumptions and modelling were developed for each of the five subsectors under the two scenarios. A 1% average annual growth rate was applied to the total 2019 watershed jobs by sub-sector out to 2030, based on the average population forecast published by Statistics Canada over this period, with the exception of the Watershed Management and Restoration and Industrial Water Management and Infrastructure subsectors. Population growth rates were factored into these subsectors with a 0.5 multiplier to account for less impact of BC's population growth on the activities in these subsectors. Average GDP, gross output, and indirect / induced employment and GDP multipliers for each subsector were then used to convert 2030 jobs under the two scenarios to these additional economic impact factors.

Scenario 1: Business as Usual (BAU)

In this scenario, activities in the watershed sector continue to grow along their historical trajectory. This includes rates of investment and project activity in the past 5-15 years, trends in post-secondary enrollment, and forecast growth rates for key occupations in the sector.

Scenario 2: Watershed Security Fund Investment (Stretch)

For this scenario, projected growth of the Watershed Sector was calculated based on an assumed expenditure of \$100 million annually for the next ten years through the Watershed Security Fund, or a total contribution of \$1 billion.

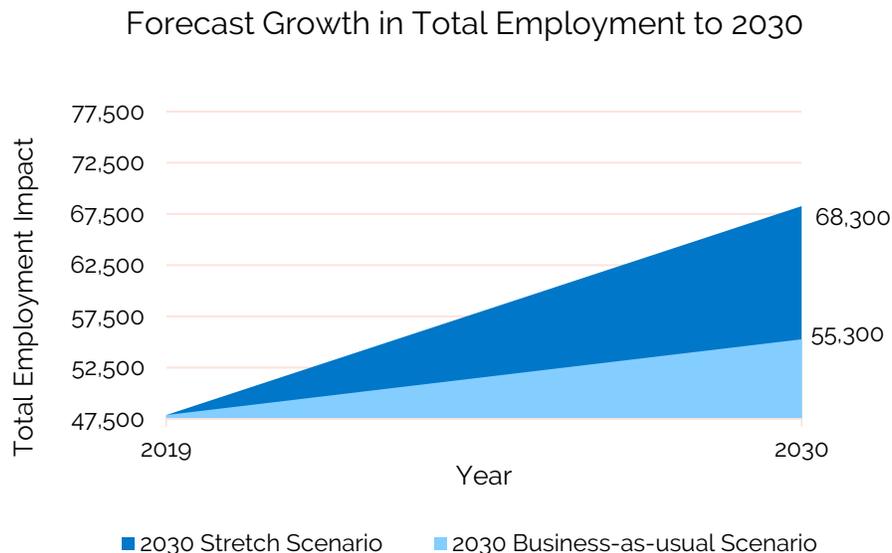


Table 1: Growth Rates & Assumptions by Subsector

Watershed Subsector	2030 (BAU)		2030 (STRETCH)	
	11-year Growth (2019-2030)	Assumptions & Rationale	11-year Growth (2019-2030)	Assumptions & Rationale
Watershed Management & Restoration	28%	Growth continues in line with historical trend of 1.9% per year. Assume population growth only has a partial impact.	145%	37.5% of Watershed Security Fund (planning, monitoring, assessments, projects)
Urban Water Management & Infrastructure	13%	Industry growth continues in line with population. Natural asset work remains largely focused on early stage inventories.	32%	20% of Watershed Security Fund (climate adaptation solutions and natural infrastructure).
Industrial Water Management & Infrastructure	12%	Based on average growth rates for key occupations in the sector (WorkBC) Assume population growth only has a partial impact. Projected WorkBC 2029 forecast out to 2030.	15%	5% of Watershed Security Fund (ecosystem services, efficient practices, implementation of innovative water technologies).
Education, Training & Capacity Building	17%	Education based on historical 2% growth of post-secondary enrollment over the past decade. (85% of subsector) Assuming social advocacy organizations grow at the same projected rate as natural and applied science professionals (approx 1.1% annual growth). (15% of subsector) Also projected WorkBC 2019-2029 forecast out to 2030.	69%	12.5% of Watershed Security Fund (skills training, public education, community-based initiatives).
Regulatory & Public Administration	18%	Based on WorkBC public administration occupation forecast.	52%	30% of Watershed Security Fund (hiring land managers in Indigenous communities, policy development, governance structures, partnership support).

Table 2: Watershed Sector Industries & Intensity Ratios

NAICS	Industry Description	Subsector	Intensity Ratio	Notes & Assumptions
111421 - Nursery and tree production	This industry comprises establishments primarily engaged in: - Growing, under cover or in open fields, - Nursery and floriculture products, such as nursery stock, shrubbery, cut flowers, flower seeds, potted flowering and foliage plants, - Flower bedding plants, ornamental plants, or some combination of these.	Industrial Water Management & Infrastructure	0.05	5% of tree and shrub production goes towards plantings in forests and urban green spaces, which helps improve the health of the watershed.
113210 - Forest nurseries and gathering of forest products	This industry comprises establishments with two different production processes: - Growing trees for the purpose of reforestation - Gathering forest products.	Industrial Water Management & Infrastructure	0.95	95% of industry activity from forest nurseries. Small proportion of activity from gathering forest products.
115310 - Support activities for forestry	This industry comprises establishments primarily engaged in performing particular support activities, such as: - Forestry maintenance (e.g., spacing and thinning trees, reforestation, etc.) - Forest Conservation - Pest control - Fire fighting.	Industrial Water Management & Infrastructure	0.63	Most of this activity helps maintain healthy watersheds. Initial estimate reduced based on stakeholder feedback.
221111 - Hydro-electric power generation	This industry comprises establishments primarily engaged in the generation of bulk hydro-electric power.	Industrial Water Management & Infrastructure	0.11	Estimates based on data available in BC Hydro budget. Relevant expenditure includes environmental liabilities, water quality and decommissioning, material and external services.
221310 - Water supply and irrigation systems	This industry comprises establishments primarily engaged in operating water collection, treatment and distribution systems for domestic and industrial needs.	Urban Water Management & Infrastructure	0.85	Based on infrastructure data from Statistics Canada. All public investments are considered 'urban'. [Table: 36-10-0608-01]
		Industrial Water Management & Infrastructure	0.15	Based on infrastructure data from Statistics Canada. All private investment is considered 'industrial'. [Table: 36-10-0608-01]

NAICS	Industry Description	Subsector	Intensity Ratio	Notes & Assumptions
221320 – Sewage treatment facilities	This industry comprises establishments primarily engaged in operating sewer systems and sewage treatment facilities that collect, treat and dispose of waste.	Urban Water Management & Infrastructure	0.95	Based on infrastructure data from Statistics Canada. All public investments are considered 'urban'. [Table: 36-10-0608-01].
		Industrial Water Management & Infrastructure	0.05	Based on infrastructure data from Statistics Canada. All private investment is considered 'industrial'. [Table: 36-10-0608-01]
237110 – Water and sewer line and related structures construction	This industry comprises establishments primarily engaged in the construction of water and sewer lines, mains, pumping stations, treatment plants and storage tanks. Out of scope activity includes geothermal and other pipes (5%).	Urban Water Management & Infrastructure	0.90	Based on infrastructure data from Statistics Canada. All public investments are considered 'urban'. [Table: 36-10-0608-01].
		Industrial Water Management & Infrastructure	0.05	Based on infrastructure data from Statistics Canada. All private investment is considered 'industrial'. [Table: 36-10-0608-01]
237990 – Other heavy and civil engineering construction	This industry comprises the following engineering activities in the water sector: - Anchored earth retention contractors - Dam construction - Dikes (dykes) and other flood control structures, construction - Drainage project construction - Earth retention system construction - Farm drainage tile installation - Flood control project construction - Floodway and drainage canals and ditches, construction - Land drainage contractor - Pond construction, general contractors - Retaining walls, anchored (e.g., with piles, soil nails, tie-back anchors), construction - Sediment control system construction - Spillways, floodwater, construction Note: marine projects are out of scope	Watershed Management & Restoration	0.04	Estimates based on survey of restoration project budgets.
		Urban Water Management & Infrastructure	0.09	Based on infrastructure data from Statistics Canada. [Table: 36-10-0608-01]
		Industrial Water Management & Infrastructure	0.03	Based on infrastructure data from Statistics Canada. [Table: 36-10-0608-01]

NAICS	Industry Description	Subsector	Intensity Ratio	Notes & Assumptions
238110 – Poured concrete foundation and structure contractors	This industry comprises of the following activities in the water sector: - Retaining walls - Poured concrete - Construction - Structure contractors	Watershed Management & Restoration	0.01	Estimates based on survey of restoration project budgets.
		Urban Water Management & Infrastructure	0.04	Based on infrastructure data from Statistics Canada. All public investments are considered 'urban'. [Table: 36-10-0608-01]
		Industrial Water Management & Infrastructure	0.03	Based on infrastructure data from Statistics Canada. All private investment is considered 'industrial'. [Table: 36-10-0608-01]
238910 – Site preparation contractors	This industry comprises of the following activities in the water sector: - Drainage system installation (e.g., cesspool, septic tank), contractors - Earth moving, contractors - Excavating, earthmoving or land clearing, (agricultural, mining, other) - Grading, construction site - Land clearing, contractors - Land levelling, irrigation, contractors - Shovel equipment work, construction, rental with operator	Watershed Management & Restoration	0.01	Estimates based on survey of restoration project budgets.
		Urban Water Management & Infrastructure	0.09	Based on infrastructure data from Statistics Canada. All public investments are considered 'urban'. [Table: 36-10-0608-01].
		Industrial Water Management & Infrastructure	0.03	Based on infrastructure data from Statistics Canada. All private investment is considered 'industrial'. [Table: 36-10-0608-01]
238990 – All other specialty trade contractors	This industry comprises of the following activities in the water sector: - Fencing - Green roof systems Note: very small proportion of relevant activity	Watershed Management & Restoration	0.002	Estimates based on survey of restoration project budgets.
		Industrial Water Management & Infrastructure	0.004	Approximately 50 contractors in BC working in green roof system installation and water-related construction support (fencing, driveways, etc.).
332420 – Metal tank (heavy gauge) manufacturing	This industry comprises establishments primarily engaged in cutting, forming and joining heavy gauge steel to manufacture water tanks.	Urban Water Management & Infrastructure	0.16	38 manufacturers found in BC of which approximately 20 are related to water. Since, the manufacturers produce multiple types of tanks including water, it is assumed 30% of production is related to water.

NAICS	Industry Description	Subsector	Intensity Ratio	Notes & Assumptions
411130 – Nursery stock and plant merchant wholesalers	This industry comprises establishments primarily engaged in wholesaling nursery stock, trees, bushes, and other plants.	Industrial Water Management & Infrastructure	0.05	5% of trees and shrubs sold by wholesalers go towards reforestation and urban green spaces, which contribute to healthy watersheds.
541320 – Landscape architectural services	This industry comprises establishments primarily engaged in planning, designing and administering the development of land areas for projects such as parks and other recreational areas, by applying knowledge of land characteristics, location of buildings and structures, use of land areas, and design of landscape projects. Note: does not include landscape architecture related to water management in urban areas.	Watershed Management & Restoration	0.05	Estimates based on survey of restoration project budgets. 5% of landscape architecture work has a direct impact on water.
541330 – Engineering services	This industry comprises establishments primarily engaged in applying principles of engineering in the design, development and utilization of new machines/ materials/instruments/ structures/processes/systems to improve water management and in turn lead to better watershed health.	Urban Water Management & Infrastructure	0.054	Sample of engineering firms suggests 22% are involved in urban water management. Approximately 25% of relevant companies' work is specific to water.
		Watershed Management & Restoration	0.003	Estimates based on survey of restoration project budgets.
		Industrial Water Management & Infrastructure	0.046	Sample of engineering firms suggests 15% are involved in industrial water management. Approximately 25% of relevant companies' work is specific to water.
541420 – Industrial design services	This industry includes electronic devices, tool design, modelling services, industrial design consulting services that design/model water and wastewater treatment equipment/processes.	Urban Water Management & Infrastructure	0.10	Bottom-up estimate from known industrial design companies working in water tech.
		Industrial Water Management & Infrastructure	0.10	Bottom-up estimate from known industrial design companies working in water tech.

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541620 - Environmental consulting services	This industry comprises establishments primarily engaged in providing advice and assistance to other organizations on environmental issues, such as the control of environmental contamination from pollutants, toxic substances and hazardous materials.	Urban Water Management & Infrastructure	0.05	Estimate based on ECO Canada study and Statistics Canada data tables. [Table: 21-10-0168-01]
		Watershed Management & Restoration	0.06	Estimates based on survey of restoration project budgets and data from Oregon study.
		Industrial Water Management & Infrastructure	0.25	Estimate based on ECO Canada study and Statistics Canada data tables. [Table: 21-10-0168-01]
541690 - Other scientific and technical consulting services	This industry comprises establishments primarily engaged in providing advice and assistance to other organizations on scientific and technical issues.	Industrial Water Management & Infrastructure	0.05	5% of industry activity is relevant to watersheds.
		Urban Water Management & Infrastructure	0.05	5% of industry activity is relevant to watersheds.
561730 - Landscaping services	This industry comprises establishments primarily engaged in providing landscape care and maintenance services, such as: - Installing trees, shrubs, plants, lawns or gardens, and walkways - Retaining walls, decks, fences, ponds and similar structures	Watershed Management & Restoration	0.12	Estimates based on survey of restoration project budgets.
611210 - Community Colleges	This industry comprises establishments primarily engaged in providing academic, or academic and technical, courses and granting associate degrees, certificates or diplomas related to water systems that are below the university level.	Education, Training & Capacity Building	0.01	Estimates based on relevant course offerings.
611310 - Universities	This industry comprises establishments primarily engaged in providing academic courses and granting degrees related to water systems at baccalaureate or graduate levels.	Education, Training & Capacity Building	0.03	Estimates based on relevant course offerings.
611510 - Technical and trade schools	This industry comprises establishments primarily engaged in providing vocational and technical training in technical water systems subjects and trades.	Education, Training & Capacity Building	0.01	Estimates based on relevant course offerings.
813310 - Social advocacy organizations	This industry comprises of establishments based in British Columbia primarily engaged in promoting a water-specific education including challenges and opportunities within the BC water sector.	Education, Training & Capacity Building	0.10	29 out of 855 charities registered in BC are related to water. Estimate adjusted to account for other non-profit organizations (e.g., local nature conservation organizations) that are not registered charities.

NAICS	Industry Description	Subsector	Intensity Ratio	Notes & Assumptions
911910 - Other federal government public administration	This industry comprises of the administration of water-specific projects and programs in British Columbia that are either fully or partially supported by the federal government.	Regulatory & Public Administration	0.01	Based on review of relevant activity in federal budgets.
912910 - Other provincial and territorial public administration	This industry comprises of the administration of provincial and territorial government programs responsible for managing water resources in British Columbia.	Regulatory & Public Administration	0.02	Based on review of relevant activity in provincial budgets. Estimate increased based on stakeholder feedback.
913190 - Other municipal protective services	This industry comprises of establishments of local governments, not classified to any other industry, primarily engaged in dealing with major emergencies and catastrophes.	Regulatory & Public Administration	0.10	Based on review of relevant activity in local government budgets. 10% of municipal expenditure goes to emergency preparedness and relevant protective services
913910 - Other local, municipal and regional public administration	This industry comprises of the administration of local municipal, and regional government programs responsible for managing local water resources.	Regulatory & Public Administration	0.14	Based on proportion of water-related municipal and regional district budget expenditures.
914110 - Aboriginal public administration	This industry comprises establishments of aboriginal governments primarily engaged in providing to their constituents access to safe drinking water and wastewater treatment systems that would otherwise be provided by federal, provincial or municipal levels of governments.	Regulatory & Public Administration	0.03	Based on review of Indigenous Services Canada budget. Note this is a conservative estimate and does not capture the full extent of water-related activity in First Nations and Indigenous-led organizations.