

Current Program Review

SWOT Analysis, Program Value Analysis and Program Resources

Environmental Monitoring Strategy



Abstract

A comprehensive review of Kawartha Conservation's Integrated Watershed Management Environmental Monitoring programs

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Glossary of Terms

CA – Conservation Authority

DO – Dissolved Oxygen

ECCC – Environment Canada and Climate Change

ELC – Ecological Land Classification

EMRB – Environmental Monitoring Reporting Branch

FBV – Feature Benefit Value

KNC-NHS – Kawartha Naturally Connected, Natural Heritage System

KWW – Kawartha Water Watch

MECP – Ministry of Environment, Conservation and Parks

MNRF – Ministry of Natural Resources and Forestry

OBBN – Ontario Benthic Biomonitoring Program

OSAP – Ontario Stream Assessment Protocol

PFAS – Polyfluoroalkyl Substances

PGMN – Provincial Groundwater Monitoring Network

PWQMN – Provincial Water Quality Monitoring Network

OLW – Ontario Low Water Response

PPS – Provincial Policy Statement

PSW – Provincially Significant Wetland

SWOT – Strengths, Weaknesses, Opportunities and Threats

QA/QC – Quality Assurance and Quality Control

Introduction

As part of the first steps in developing the next 10 year Environmental Monitoring Strategy, it is crucial that we undertake a comprehensive review of all current environmental programs. Currently the Integrated Watershed Management team monitors a number of different Environmental parameters; These can be categorized under the following major headings; Biomonitoring; Climate, Groundwater, Landuse, Temperature monitoring, Water Quality and Water Quantity. Within each one of those headings specific monitoring programs are conducted.

This document will look at each environmental monitoring program listed below and outline the strengths, weaknesses, opportunities and threats through a SWOT analysis as well as provide a Program Value analysis for each. To capture the financial impact of each environmental program, a detailed look at efforts required for staffing, travel, supplies, equipment, lab fees and professional development were reviewed as well as the in-kind contributions the program receives over the course of one year.

By undertaking this comprehensive review of each environmental program it allows us to see the value of each program and how it impacts not only Kawartha Conservation but the broader watershed community and our municipal partners.

Within this document you will find a comprehensive review for the following environmental monitoring programs.

Environmental Programs
BIOMONITORING
<ul style="list-style-type: none"> • Aquatic Macrovertebrates
CLIMATE
<ul style="list-style-type: none"> • Precipitation and Snow Survey • Low Water Response • Senior Climate Change Program
GROUNDWATER
<ul style="list-style-type: none"> • Baseflow • Provincial Groundwater Monitoring Network (PGMN) • Shallow Groundwater Monitoring
LANDUSE
<ul style="list-style-type: none"> • Ecological Land Classification
TEMPERATURE MONITORING
<ul style="list-style-type: none"> • Coldwater Streams
WATER QUALITY
<ul style="list-style-type: none"> • Provincial Water Quality Monitoring Network (PWQMN) • Kawartha Water Watch (KWW)
WATER QUANTITY
<ul style="list-style-type: none"> • Water Levels and Flow

BIOMONITORING

Aquatic Benthic Macroinvertebrates

Program Description

Aquatic bugs are reliant upon healthy waterbodies and the land through which they flow. They contribute to functioning ecosystems upon which all life depends. Living organisms respond to changing environmental conditions, therefore, they are valuable in our monitoring programs for their role as indicators of water resource health.

SWOT Analysis

Strengths

- Biomonitoring data provides surface water quality indicator data to assist with completion of Watershed Report Cards, part of a collective conservation authority effort to report on comparable environmental parameters for our communities and stakeholders.
- Ongoing partnerships with Fleming College through their Environmental Technical Services program.
- Integrative monitoring tool for water resource assessments, including: cumulative effects, and being a benchmark to assess how well we are doing in the management/restoration of our creeks.
- Helps our Planning and Regulations department to identify sensitive streams, and watercourse permanency.
- Part of Provincial OBBN program, a hub for training, networking, and data centralization.
- Staff expertise facilitates educational programming opportunities.
- A good program to evaluate condition of urban streams due to available datasets from 2016-2020.
- Biocriteria project will help to identify reference conditions, which are 'minimally impacted' or best attainable conditions. This is valuable to have because they are benchmarks for 'healthy' condition, against which to evaluate sample sites. This can help in setting aquatic restoration targets, to evaluate stream health, and it identify healthy areas that require enhanced protection.
- Well established benthos dataset that makes it relatively easy to query historical/current data to help identify trends, identify gaps, to assist with establishing 'referencing conditions' or 'average conditions'.
- Minimal supply costs.

Weaknesses

- Taxonomic resolution for our program is currently operating at a 27-group; greater resolution is required for more accurate results and application of advanced indices.
- Annual monitoring stations not established to determine annual variability.
- Long-term strategy for the benthic program is not developed.
- Aquatic Benthic macroinvertebrates represents only one of several biomonitoring taxa; other species may be more appropriate in different scenarios/evaluations.
- Assessments using benthic macroinvertebrates are most readily applied to flowing wadeable streams, science in lake shorelines or wetlands is still developing.
- A data analysis technique referred to as the reference condition approach is not well developed, which would allow comparisons to development pressure on the landscape.
- Our data is available on line but we need to make this more accessible to the public and easier to download and use.
- Perceived lack of credibility or understanding in the development sector.

	<ul style="list-style-type: none">• Bio-data can be hard to interpret regarding healthy or degraded conditions, particularly at the coarse taxonomic resolution that we monitor at and due to inherent variability in populations of aquatic life and species tolerance.
Opportunities	<ul style="list-style-type: none">• Expansion into other indicator taxa: e.g., fishes, amphibians, algae, etc.• Revenue generating potential, for example: hosting OBBN training courses and electrofishing training courses, or taxonomic identification services.• Data could contribute to a watershed wide monitoring program, or monitoring programs to track condition of regulated features including watercourses, wetlands, and shorelines.• Data could be used to monitor development phases, compliance monitoring, etc.• Data could be used to set stewardship/restoration targets, expectations, etc.
Threats	<ul style="list-style-type: none">• Not keeping up to date within respect to training, including: taxonomy, sampling approaches, data management, data analyses, etc.• Accessibility to laboratory services (and associated timing and costs of ID) or educational courses in advanced species identification to perform more detailed taxonomic identification.• Expansion into other aquatic biomonitoring would require an investment into sampling equipment and resources (training and/or personnel).

Program Value Analysis

Program Value

- Reporting on key findings, raising community awareness, helping to protect our watershed for a sustainable future.
- Enabling clean water for future generations.
- Accessible program for youth, which helps draw connections with the environment for future sustainable communities.
- Direct link between actions on the landscape and impact on aquatic environments; valuable for implementation of lake management plans and watershed plans.

Program Benefit

- Collaborative with community and industry partners maximizing cost savings and information exchange opportunities.
- Contributes to making development application reviews more efficient, for example through biomonitoring to confirm the presence of regulated areas, flagging sensitive regulated areas, and confirming development buffer widths.
- Contributes to other areas of our organizational programming, for example our Education Program (teaching youth how to identify our local aquatic life), and our Stewardship Program (setting benchmarks for aquatic ecosystem restoration projects).
- Contributes to quantifying existing conditions of our aquatic ecosystems and how development and other pressures are impacting the health of our natural heritage resources.

Program Feature

- The aquatic macro-invertebrates program samples living organisms at 10-20 sites every year to monitor the health of stream and nearshore lake environments. For the past 5-10 years, this program has focused on characterizing 'normal expectations' for aquatic life within our streams as well as monitoring streams that flow

through urban areas. Metrics produced help to indicate changes in response to environmental stressors such as development, climate change and invasive species.

- A total of 15 days is spent in the field sampling and identifying living organisms during the month of May.
- At least 27-taxonomic group (OBBN and OSAP standards) are identified.
- We apply industry standard techniques to collect, manage, and report data, while striving to be continuously innovative in technology.
- We have a good dissection microscope available for taxonomic ID.
- We utilize one month of in-kind support from the Ministry of Environment, Conservation and Parks (MECP). Their support includes database management, taxonomic reference materials, study design advice and verifying the quality assurance and quality control of the data.

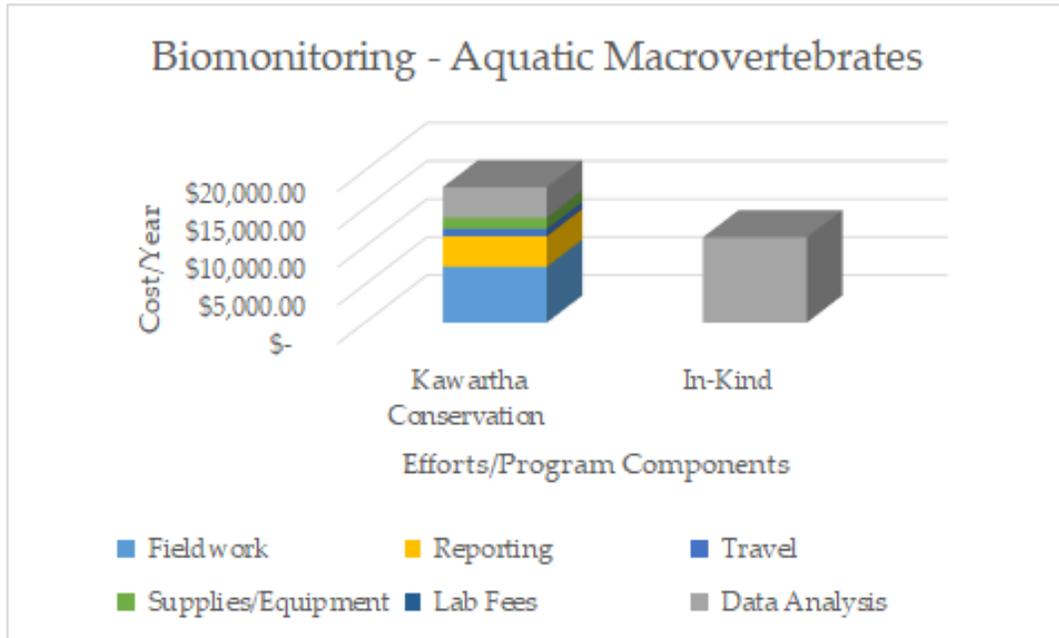
Program Resourcing

Program Components	Internal Effort/ Cost per annum	External Contribution
Staff		
<i>Technical Staff</i>	252 hrs	140 hrs
<i>Seasonal</i>	105 hrs	
Travel	15 days	
Supplies	\$1500	
Equipment	n/a	
Lab Fees	n/a	
Professional Development	\$1,000*	

*To become certified in OBBN, training is a one-time cost.

- ❖ Estimated Effort/Sampling Site: 17hrs/site (@15 sites/year)
- ❖ Estimated Cost/Sampling Site: \$164/site (@15 sites/year)

The table below provides an overall visual interpretation of the program resourcing for the Biomonitoring program.



In-Kind Contribution

Includes 1 month of support from an OBBN Coordinator at the Ministry of Environment, Conservation Parks, to manage data sets and assist with general program operation and advice.

CLIMATE

1. *Precipitation and Snow Surveys*
2. *Low Water Response*
3. *Senior Climate Change Program*

1. Precipitation and Snow Surveys

Program Description

Kawartha Conservation monitors weather and climate parameters around the watershed including precipitation, air temperature, humidity, wind speed and direction. The data collected helps a variety of programs and projects, including flood forecasting and warning, low water, climate change, water quality and aquatic research.

SWOT Analysis

Strengths	<p>Precipitation</p> <ul style="list-style-type: none"> • Precipitation information provides a base for decision making across a number of programs and projects, including but not limited to Flood Forecasting and Warning, Low Water Response, Water Quality and review of development and planning applications (storm water management proposals, water budgets). • The ability to access real-time data improves flood forecasting and emergency preparedness. • Provides data for road infrastructure design (culverts, bridges). • Long term precipitation data provides information on local climatic changes. • Ongoing partnership with agencies (MNRF, ECCC). • Current monitoring consists of high-quality monitoring stations <p>Snow Survey</p> <ul style="list-style-type: none"> • Snow surveys provide data to inform the potential for flooding to occur during spring freshet. • Conducting snow surveys requires staff time only as equipment is provided by MNRF Surface Water Monitoring Centre. • Sampling of all 4 locations is completed within one day. • Data is managed externally by MNRF Surface Water Monitoring Centre.
Weaknesses	<p>Precipitation</p> <ul style="list-style-type: none"> • Costs to establish new high-quality stations that measure all types of precipitation can be high. • Equipment issues or repairs can be time-consuming. • Strict location requirements for monitoring equipment placement (from external agency partnerships) limit options for network expansion. • Geographic distribution of monitoring locations not sufficient to address changing weather patterns • Our precipitation records generally do not have long term data sets available for direct measurements of long term climactic trending (<30 year datasets) • Precipitation monitoring is combined with other program areas currently and does not have a distinct plan or funding stream.

	<ul style="list-style-type: none"> • There is currently no long term plan around gathering this data and how it feeds into the climate change picture. • Inhouse data does not have a consistent storage protocol and some historic data requires an investment of time to analyze outputs and trends. • The data produced is not reported on a consistent basis or in an easily accessible format for the public. <p>Snow Survey</p> <ul style="list-style-type: none"> • None noted.
Opportunities	<p>Precipitation</p> <ul style="list-style-type: none"> • Increased level of interest from the public and governments on climate change provides rationale to expand program area. • Climate change is a global and federal concern so there is the potential for funding grants to be available to support this program area. • Data can be made more accessible for the public and other users, for use in practical applications or for general interest. • Increased reporting of precipitation information to a variety of audiences and in a range of formats. • Many different agencies and businesses monitor precipitation, which could be harmonized or centralized in the watershed (e.g. agriculture, roads, TSW) <p>Snow Survey</p> <ul style="list-style-type: none"> • Opportunity to embrace new technology for data collection and submission - automatic continuous snow monitoring station. • Enhance snow monitoring by adding additional parameters such as soil moisture and temperature monitoring that will improve runoff forecasting for flood forecasting program.
Threats	<p>Precipitation</p> <ul style="list-style-type: none"> • Lack of visibility of the program area and reporting diminishes the importance to maintain resources and funding. • Partners choose to discontinue support for data management across a number of our monitoring locations, leaving gaps in our data or require us to invest if we want to maintain those monitoring activities . • Loss of long term monitoring stations due to discontinuation from partner agencies. For example we lost a long term record when provincial funds were pulled for the Lindsay Water Treatment Plant. • Access to regional precipitation is important, as the watershed is impacted by the Gull and Burnt river systems <p>Snow survey</p> <ul style="list-style-type: none"> • Relies somewhat on partner involvement especially for data management. • Lack of provincial funding could cause for program to be reduced. • Access to information for regional snow surveys critical for flood forecasting outlook in the spring, impacted by the Gull and Burnt river systems.

Program Value Analysis

Program Value

Precipitation & Snow Survey

- Protecting people, property, and communities from flooding within the Kawartha Watershed.
- Provides information to help understand local changes to the watershed (including the ecosystem and natural heritage) due to climatic shifts.
- Provides long term local climatic data to help identify trends and how that fits with the provincial and national climate change scenario.

Program Benefit

Precipitation

- Contributes to development application reviews, providing information used to assess stormwater Infrastructure proposals, and road infrastructure design (culverts, bridges).
- Contributes to developing water budgets for watershed lake management plans, planning application reviews, and source water protection actions.
- Collaborative program area working with government, municipalities, and community partners to maximize data exchange.

Snow Survey

- Collection of snow data allows us to predict spring runoff conditions, analyze long term trends in climate conditions and inform our low water response program for the Kawartha Watershed.
- Program data helps with flood forecasting and the prevention of property damage from flooding and keeping local residents safe.

Program Feature

Precipitation

- Precipitation data is part of the flood forecasting and warning operation that the organization performs on behalf the municipalities it serves.
- Precipitation is monitored from 3 – all weather gauges (Indian Point, Ken Reid CA, Port Perry) and collects data remotely; with maintenance occurring twice per year.
- MNRF retrieves data remotely from the Indian Point and Port Perry all weather gauges, and then posts information on a secure website which is made available to the professional community including, conservation authorities, consultants, municipalities, and academia. This secure website is not accessible to the public.
- Currently there are 5 tipping bucket locations across the Kawartha watershed that collect rain precipitation only. Maintenance is performed once a year at each site. Data is collected remotely by MNRF and posted on their website.
- All precipitation locations are ‘near real time’ data with a delay of approximately 4 hours between actual and reported information being available.
- We calculate total precipitation for a certain period and intensity with recorded data provided in 15-minute intervals.

Snow Survey

- Provides data on the depth and density of snow throughout Kawartha Conservation jurisdiction.
- Snow surveys are conducted on the 1st and 15th of each month typically between the months of November to April.
- 4 snow survey locations are monitored across the watershed and include Ken Reid Conservation Area, Indian Point Provincial Park, Pigeon River Conservation Area, and Woodville.

- Collaboration with MNRF Surface Water Monitoring Centre allows for cost savings on equipment and data management.

Program Resourcing

Program Components	Precipitation		Snow Survey	
	Internal Efforts/Cost per annum	External In-Kind Contribution	Internal Efforts/Cost per annum	External In-kind Contribution
Staff	70 hrs	10 hrs	147 hrs	10 hrs
Travel	4 days		11 days	
Supplies	\$50		n/a	
Equipment	n/a		n/a	
Lab Costs	n/a		n/a	
Professional Development	n/a		n/a	

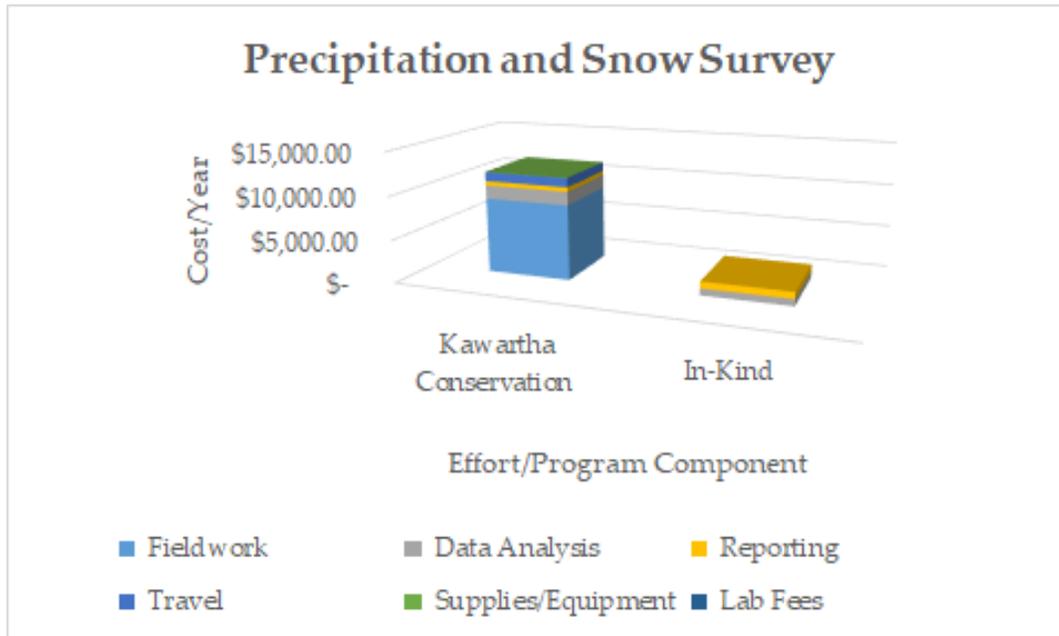
Precipitation:

- ❖ Estimated Effort/Sampling Site: 8.75 hrs./site (@8 sites/year)
- ❖ Estimated Cost/Sampling Site: \$38.25/site (@8 sites/year)

Snow Survey:

- ❖ Estimated Effort/Sampling Site: 36.75 hrs./site (@4 sites/year)
- ❖ Estimated Cost/Sampling Site: \$176/site (@4 sites/year)

The table below provides an overall visual interpretation of program resourcing for both the precipitation and snow survey program.



NOTE - The precipitation monitoring program is costly to establish and can be expensive to repair equipment.

As an example, the cost of establishing the Port Perry weather monitoring gauge (2016-2018) was \$20,000, with approximately \$18,000 directly related to the real-time, all-weather precipitation monitoring. After that, the yearly maintenance of the station has not exceeded \$300.

The cost of the all-weather precipitation gauge alone is around \$10,000 (depending on the brand), and a datalogger with transmitting capabilities is more than \$5,000. Should any repairs to be required, it is reasonable to assume that their price could range between \$1,000-\$2,000.

Developing the watershed monitoring network, including precipitation monitoring, we always strive to achieve more results for less money by partnering with other agencies, seeking grants, and funding opportunities, establishing the multiparameter monitoring stations and utilizing partners monitoring locations within the watershed (i.e., Environment and Climate Change Canada) by adding our own equipment.

In-Kind Contribution

Includes just over 2.8 days of MNRF staff support for data management on both the precipitation and snow survey monitoring programs.

The MNRF provided the following pieces of equipment for both programs.

- All weather station for Indian Point (\$12,000)
- 3 Tipping Buckets - \$2,000
- Snow survey kit - \$1500

2. Low Water Response

Program Description

The Ontario Low Water Response (OLWR) Program was developed in response to the drought conditions experienced in Ontario in the late 1990's through to early 2000. The Program is intended to ensure provincial preparedness, to assist in coordination and to support local response in the event of a drought. This program is based on existing legislation and regulations and builds upon existing relationships between the province and local government bodies.

SWOT Analysis

Strengths	<ul style="list-style-type: none"> • Program highlights Kawartha Conservation as a leader for this program area within the watershed. • Minimal resources required to download data each month. • Province has established consistent parameters and framework for reporting
Weaknesses	<ul style="list-style-type: none"> • Funding is not consistent from the Province – in previous years the MRNF has funded the entire program • Lack of direction from Province over the last few years with regard to the delivery and operation and outputs from this program • This program it is not prioritized provincially or locally and can be difficult to plan for (resources and funding). • Challenging to see an outcome from this program for stakeholders and the public. • Municipalities run their own low water campaigns that do not necessarily align with low water messaging from Kawartha Conservation in terms of indicator 'levels'. • Declaration of Level 3 is independent of the data establishing the Level 3 condition, and outside local influence (Provincial determination)
Opportunities	<ul style="list-style-type: none"> • Collaborate with member municipalities to help them develop their own Low Water/Drought Emergency Response Plans. • Pursue educational opportunities with local schools by developing curriculum linked lessons focussed on the impact of low water. • Engage with enthusiastic and supportive external clients from sectors/stakeholders and integrate them into the Water Response Teams. • Collaborate with other partners in delivering the program to seek opportunities for datasharing and more varied reporting.
Threats	<ul style="list-style-type: none"> • Provincial funding is currently not being provided to support this program area • There is a lack of interest from local stakeholders and the public in low water issues and operation of a program to manage this ongoing pressure. • Meaningful impact of voluntary measures that can be established by the Water Response Team can be questioned. • A lack of direction from the provincial government.

Program Value Analysis

Program Value

- Community resilience to be able to adapt to low water conditions which are critical for a rural community dependent on groundwater and surface water resources.
- Predictive indicator on low/water drought conditions across the watershed.
- Kawartha Conservation takes a lead as a community partner and advises stakeholders and municipalities on low water status.
- The program fits into the Conservation Authorities mandate of a "local resource management agency" and dealing with natural hazards.

Program Benefit

- Kawartha Conservation advises the community and partners/municipalities on low water and drought conditions.
- Provides information to landowners within the watershed of potential disruption to water supply within private wells.
- Educates watershed residents on the value of water resources within the watershed.
- Historically, the province (MNRF) has helped to fund specific areas of the program involving data collection, equipment, and administrative costs.

Program Feature

- A Province-led program (MNRF) where Conservation Authorities, as partners, monitor local conditions with regards to a deficit of precipitation and flow in watercourses and coordinates community response to low water/drought situation when it arises.
- Program utilizes an already established monitoring network, no additional investment is required.
- Local watershed parameters, such as precipitation and flows in rivers and stream in conjunction with local information such as social, economic, and environmental impacts are used to determine severity of the conditions. As defined by the provincial guidelines, there are three levels of Low Water Conditions, escalating from Level I to Level III.
- Conditions are monitored to provide a cumulative status over the previous 3-month period.
- The program is focused on community engagement, education, and outreach.
- Coordinated community approach when low water has been declared, between local municipality and Kawartha Conservation.

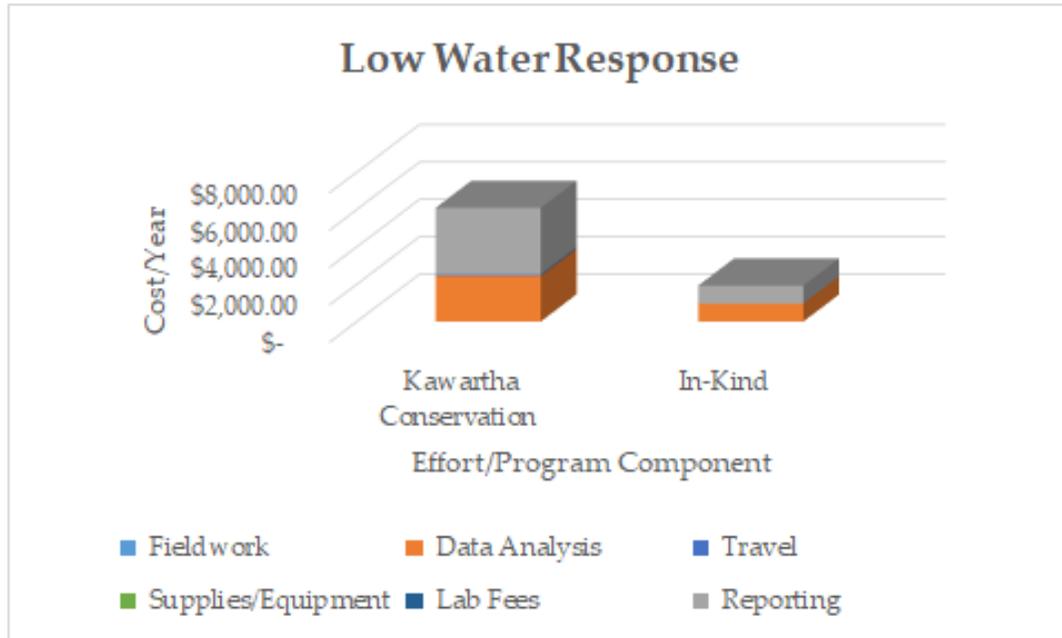
Summary of the OLWR Indicators

	<u>Level I</u> <i>Indicates a potential water supply problem, primarily a warning level – key focus is conservation of water.</i>	<u>Level II</u> <i>Indicates a potentially serious problem – conservation of water extended to restrictions on non-essential uses.</i>	<u>Level III</u> <i>Indicates a failure of the water supply to meet demand – Key focus is on regulation and enforcement</i>
Precipitation	<80% of the average precipitation over the last 3 months	<60% of the average precipitation over the last 3 months	<40% of the average precipitation over the last 3 months
Flow	Spring: Month flow is < 100% of the Minimum Summer Month Flow	Spring: Month flow is <70% of the Minimum Summer Month Flow	Spring: Month flow is <50% of the Minimum Summer Month Flow
	Summer: Month flow is < 70% of the Minimum Summer Month Flow	Summer: Month flow is <50% of the Minimum Summer Month Flow	Summer: Month flow is <30% of the Minimum Summer Month Flow

Program Resourcing

Program Components	Internal Efforts/Cost per annum	External In-kind Contribution
Staff	112 hrs	24 hrs
Travel	1 day	
Supplies	n/a	
Equipment	n/a	
Lab Fees	n/a	
Professional Development	n/a	

The table below provides an overall visual interpretation of program resourcing for the Low Water Response program.



In-Kind Contribution

The MNRF provides in kind support on monthly provincial condition reports, indicators analysis and mapping.

Historically, the MNRF has provided funding opportunities when low water response is initiated, or to address program needs. For example, they have covered costs that include.

- Information collection (e.g., data management, mapping, tracking changes).
- Communication activities (e.g., advertising, Water Response Team meetings (meeting room rental, refreshments, travel)).
- Dedicated OLWR Projects (permanent and non-permanent staff time, costs of materials, etc.).
- Financial compensation for volunteers, including WRT members (travel).
- Monitoring equipment, including a flow meter and precipitation gauge.
- The last funding was available in 2018.

Summary of the OLWR related funding, 2006-2018.

Year	Amount
2005	\$19,274.00
2007	\$14,029.00
2008	\$9,077.53
2009	\$23,968.45
2011	\$12,350.00
2012	\$11,552.00
2013	\$4,428.00

2014	\$3,920.00
2015	\$5,207.45
2016	\$19,531.66
2017	\$5,517.59
2018	\$8,000.00
Total	\$136.855.68

3. Seniors Climate Change Program

Program Description

The overall aim of the Senior’s Climate Change program is to develop a Seniors' led citizen science climate action group, that facilitates seniors mentoring other seniors, in the use of technology and climate data collection. This program has been initiated on award of funding from Employment and Social Development Canada’s ‘New Horizons for Seniors’ program.

The objectives include.

- To provide a new opportunity for social interaction and meaningful activities between seniors.
- To create a `seniors' science' volunteer community that promotes mentoring of peers and development of new skills.
- To gather climate related data (precipitation, water, and air temperature) to inform future decision making around flood forecasting and lake management planning activities.
- To support the climate change strategies being implemented by member municipalities in the watershed and by Kawartha Conservation.

SWOT Analysis

Strengths	<ul style="list-style-type: none"> • Engages watershed residents in a way that fulfills a desire to contribute to the community, and in the work that we do. • Fills data gaps in our monitoring programs. • This program meets a number of corporate strategic objectives including implementing citizen science programs to increase knowledge, addressing science and information data gaps and track the impacts of climate change and changes in our environment and inform our adaptation strategies. • Volunteer participation allows for larger amounts of data to be collected across our watershed keeping costs of the overall program relatively low.
Weaknesses	<ul style="list-style-type: none"> • Risk of generating poor data. • Turnover of volunteers can be recurring in volunteer programs. • Very dependant on volunteers (time, skillset, proximity to location). • Time required to support volunteers can be intensive. • Ongoing need to ensure engagement amongst volunteers • Exposure to liability
Opportunities	<ul style="list-style-type: none"> • Funding is currently available to support volunteer programs. • Expanded partnership opportunities with other climate volunteer programs • Collection of long term climate data with better geographic coverage that will help us better understand climate changes occurring in across our watershed.

Threats	<ul style="list-style-type: none">• Volunteers lose interest in program and stop participating .• Staff time involved to coordinate can be high and impacts other program areas.• Equipment required fails and no funding is available to replace outside of one-off grants.
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Program Value Analysis

Program Value

- Promoting environmental awareness and community connection by involving volunteers in collection of data and reporting on results.
- Promoting healthy lifestyles for seniors.
- Supports environmental sustainability, the protection of people and investments and the health of our lakes.
- To support climate change strategies being implemented by the municipalities within the Kawartha Lakes area and by Kawartha Conservation.
- To gather climate related data to inform future decision making around one of the biggest environmental issues of our time.

Program Benefit

- The network will capture climate data throughout the Kawartha watershed, capturing localized variation in precipitation and storm events and long-term temperature trends.
- To create a 'seniors' science' volunteer community that promotes mentoring of peers and development of new skills.
- The Senior Citizen Climate Action Group data can help identify regional climate trends and impacts that help inform decision makers in Climate Change Adaptations.

Program Feature

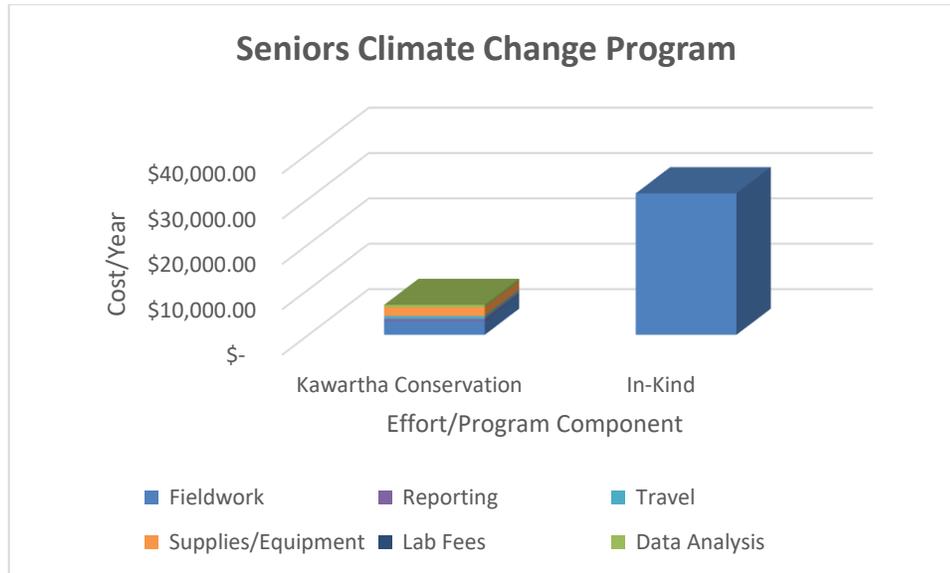
- The Senior Climate Program involves citizen scientist that are over the age of 65.
- This senior citizen volunteer program will have volunteers collect data on precipitation, air temperature and water temperature while encouraging networking and the use of technology.
- This program will have 3 lead senior volunteers which will mentor the other senior volunteers who are participating in the program and that have difficulty with technology.
- In total there will be 3 lead volunteers and 27 additional senior volunteers that will require 1hr/week of their time each year.

Program Resourcing

Program Components	Internal Efforts/ Cost per annum	External In-kind Contribution
Staff	82 hrs	1560 hrs
Travel	10 days	
Supplies	\$1320	
Equipment	\$630	
Lab Fees	n/a	
Professional Development	n/a	

- ❖ Estimated Effort/Sampling Site: 2.75 hrs./site (@30 sites/year)
- ❖ Estimated Cost/Sampling Site: \$86.33/site (@30 sites/year)

The table below provides an overall visual interpretation of the program resourcing for the Seniors Climate Change Program.



In-Kind Contribution

This project is primarily run by volunteers across our watershed. 30 volunteers are required, 1hr per week.

GROUNDWATER MONITORING

1. *Baseflow*
2. *Provincial Groundwater Monitoring Network (PGMN)*
3. *Shallow Groundwater*

1. Baseflow

Program Description

Baseflow is the amount of water in a watercourse that comes from groundwater. This is typically measured during times when there is no runoff potential from rainfall or snowmelt events, primarily in the dry summer season. The amount of baseflow in a watercourse may vary considerably along its length due to groundwater table levels and geological influences, such as underlying soils and bedrock conditions.

The objective of the baseflow monitoring program is to measure stream discharge at numerous locations throughout the watershed under baseflow conditions to collect spatial data and develop a conceptual understanding of groundwater-surface water interactions within a watershed. Datasets provide an indication of the sensitivity of a watercourse to changes in land use, water extraction or extended periods of dry weather and conditions of aquatic habitat.

SWOT Analysis

Strengths	<ul style="list-style-type: none"> • Good indicator of local groundwater (recharge/discharge) conditions. • Does not require an expensive automated monitoring network. • Supports other programs and projects (aquatic ecosystem, low water response, development, watershed and lake management planning), planning.
Weaknesses	<ul style="list-style-type: none"> • Difficult to plan for as this program is weather dependent. • Time consuming and labour intense - 1 site takes about 0.5 to 1.5 hours. • For best results baseflow monitoring needs to be completed in consecutive days.
Opportunities	<ul style="list-style-type: none"> • Use of the baseflow findings as part of the groundwater indicators in Watershed Report Cards. • Select 'Reference Sites' and report dynamics while completing the watershed-wide detailed measurements once every 5 years. • To enhance reporting opportunities by making program data available.
Threats	<ul style="list-style-type: none"> • Availability of resources to undertake monitoring as activities need to be undertaken when suitable weather conditions are prevalent. • Availability of suitable equipment to ensure program can be delivered, should dedicated equipment fail.

Program Value Analysis

Program Value

- Captures long term trends in groundwater status over time, critical for rural living.

Program Benefit

- Contributes to other organizational program areas such as aquatic research and stream water temperature and lake/watershed planning.
- Predictive indicator on low/water drought conditions across the watershed.
- Monitoring baseflow illustrates areas of significant groundwater discharge and enables the findings to be incorporated into the planning process.
- Allows for spatial analysis of the discharge areas around the entire watershed, making it very comparable.
- Information is useful in defining watercourse permanence for permitting activities.

Program Feature

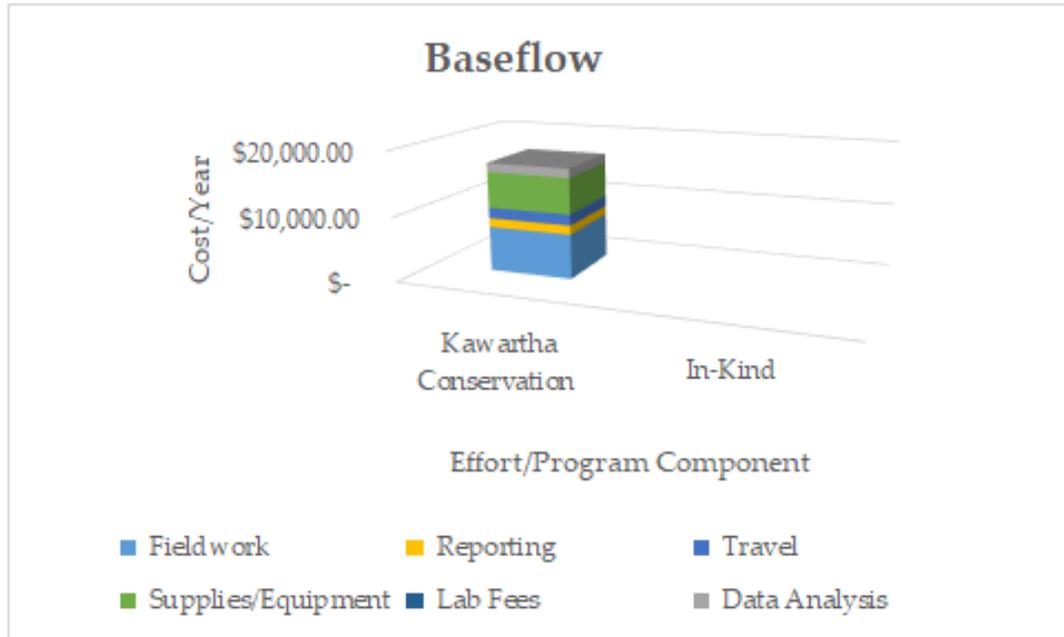
- Year to year baseflow monitoring rotates through 23 sub watersheds that fall within the Kawartha Watershed.
- The number of sites for Baseflow monitoring depends on the size of the sub watershed and resources available each year. Several parameters are considered that include the spatial resolution on the monitoring program, observed flow and weather conditions.
- Measurements are done during summer low flow period (late July – September) when precipitation amounts do not exceed 5 mm during the previous 14 days.
- Sites are selected immediately upstream and downstream of important discharge areas so that increases in low flow are attributed to stream reaches.

Program Resourcing

Program Components	Internal Efforts/Cost per annum	External In-kind Contribution
Staff		
Technical	93 hrs	
Seasonal	280 hrs	
Travel	20 days	
Supplies	n/a	
Equipment	\$5,600	
Lab Fees	n/a	
Professional Development	n/a	

- ❖ Estimated Effort/Sampling Site: 6.22 hrs./site (@60 sites/year)
- ❖ Estimated Cost/Sampling Site: \$114.67/site (@60 sites/ year)

The table below provides an overall visual interpretation of the program resourcing for the Baseflow Program.



In-Kind Contribution

There is currently no in-kind contribution for the Baseflow monitoring program.

2. Provincial Groundwater Monitoring Network (PGMN) – Water Levels and Water Quality

Program Description

The provincial groundwater monitoring network (PGMN) is a program that Kawartha Conservation delivers in partnership with the Ministry of Environment, Conservation and Parks (MECP). This program was established by the province in 2000 and consists of collecting and managing ambient (baseline) groundwater levels and quality information from key aquifers located across our watershed and determines where, how, and why the groundwater resource is changing. There are 490 wells across the province being monitored and Kawartha Conservation monitors 13 of those wells. Approximately 50% of our watershed population is dependent on groundwater supply and a total of 14 communities in Kawartha Conservation watershed are serviced by municipalities operated by drinking water supply plants depending on groundwater.

SWOT Analysis

Strengths	<ul style="list-style-type: none"> • Both the water levels and water quality components of this program are provincially funded for supplies, equipment, and training. • Data is readily available online for the public. • Program is expected to continue over the long term, i.e., continued surveillance of groundwater water quantity and quality. • Information collected provides valuable data on groundwater resources within the Kawartha watershed. • Long term analysis is now possible due to 10-17 years of available monitoring data. • The PGMN program complements the PWQMN program
Weaknesses	<ul style="list-style-type: none"> • Without provincial funding, this program would be very costly to expand. • Downloaded data is in raw form and is sent to the MECP for further processing and upload to provincial website. • Limited in house staff expertise in hydrogeology. • Changing technology impacts consistency of equipment, and compatibility with current databases. • Selection process for monitoring locations focused on level of land development (rural vs urban) and soil composition, rather than a more holistic watershed approach. • Currently, only one water quality sample is taken each year for each site preventing any short term changes to be identified quickly.
Opportunities	<ul style="list-style-type: none"> • Expansion to real time capabilities could be explored at two locations. Data loggers are much more efficient to handle this upgrade. • Increased reporting on the state of groundwater resources within our watershed through our social media platforms. • Increase the data analysis across more environmental parameters and begin reporting on those. • Frequency of water quality sampling could be increased; number of monitoring parameters could be expanded.
Threats	<ul style="list-style-type: none"> • If the province stops funding then the program would struggle to continue.

Program Value Analysis

Program Value

- Protecting the groundwater resources and supplies for future generations.
- This program provides data on groundwater quality and quantity which represents the largest type of water supply relied on by rural residents within our watershed.

Program Benefit

- Program feeds into drought assessment and contingency planning.
- Can define emerging issues and trends regarding water shortages and contamination.
- Address concerns of the public and businesses in relation to groundwater supply and quality.
- Provide scientific data to guide water taking and land use policy.
- Support integrated development planning.
- The entire program is funded by MECP apart from staff time and travel.

Program Feature

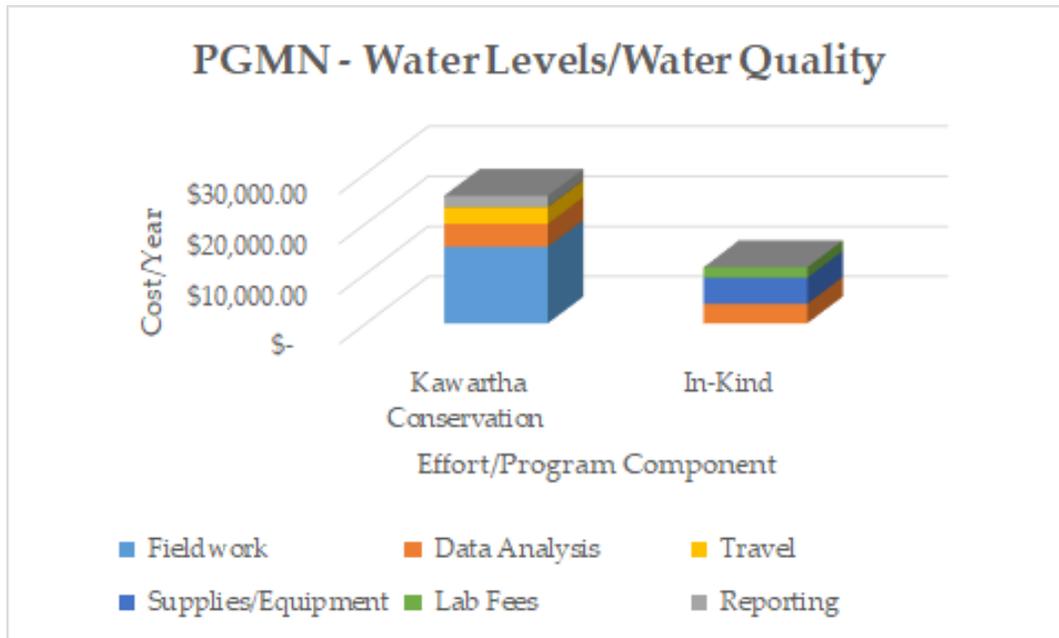
- Monitors the state of groundwater resources, both quantity and quality, for 13 wells within the Kawartha Watershed.
- Water levels are recorded hourly by a data logger situated at each well and then downloaded and transferred to the Provincial Groundwater Management Information System (PGMIS) 3 or 4 times each year. Static water level measurements, that are used to verify and validate datalogger readings, are completed monthly, nine times per year (April-December).
- Raw data is sent to MECP and through the partnership processes the data and performs the quality assurance and quality control.
- Reports findings to MECP, municipal partners, consultant industry, academia, and watershed residents.
- Data analysis on water levels involves calculating average daily levels, building yearly graphs and interpretation of data.
- Groundwater Quality for each of the 13 wells is done once a year and performed in late September, early October.
- Staff measure pH, Conductivity, Temperature and D.O. with samples being taken and sent to the provincial lab for further analysis on metals and nutrients.

Program Resourcing

Program Components	PGMN – Water Levels		PGMN – Water Quality	
	Internal Efforts/Cost per annum	External In-Kind Contribution	Internal Efforts/Cost per annum	External In-Kind Contribution
Staff	184 hrs	35 hrs	191 hrs	14 hrs
Technical	84 hrs			
Seasonal				
Travel	20 days		10 days	
Supplies	\$50			
Equipment	n/a			\$5200
Lab Fees	n/a			\$2100
Professional Development	n/a			

- ❖ Estimated Effort/Sampling Site: 35.3 hrs./site (@13 sites/year)
- ❖ Estimated Cost/Sampling Site: \$197.70/site (@13 sites/year)

The table below provide an overall visual interpretation of program resourcing for both the water levels and water quality components for the PGMN program.



NOTE – Approximately \$135,000 of in-kind contribution by the MECP has been provided over the years by MECP to establish the current groundwater network within our watershed. This included funding for well drilling, monitoring, and transmitting equipment, pumps, dedicated laptop, and ongoing equipment repairs.

In-Kind Contribution

Throughout the year the MECP provides in-kind contribution through staff support for equipment maintenance, data analysis and data management. The MECP also provides funding for supplies and well maintenance which has been estimated at \$562/well and covers all Lab fees and shipping costs.

3. Shallow Groundwater

Program Description

The shallow groundwater program evaluates the impacts of climate change and land use changes on shallow groundwater resources less than 3 metres deep across the Kawartha watershed.

SWOT Analysis

Strengths	<ul style="list-style-type: none"> • This project focuses on the local shallow groundwater (no deeper than 3 m), which compliments the existing groundwater program (PGMN). • Involves participation from watershed residents. • This program is research orientated and will help to identify long term climate changes across the watershed.
Weaknesses	<ul style="list-style-type: none"> • This program is reliant on voluntary participation by watershed residents. • Monitoring sites are located on private properties. • To achieve the best results, it has to be a long-term project, so a long-term commitment from landowners is required. • Sites require specific soil/groundwater settings, not every field/property is appropriate. • Staff expertise in hydrogeology is required to support the project.
Opportunities	<ul style="list-style-type: none"> • Long-term monitoring will contribute to data needed to evaluate the impacts of climate change and land-use change. • Developing positive relationships with various watershed community types, eg. Agriculture.
Threats	<ul style="list-style-type: none"> • Willingness of private landowners to participate. • The time required for for staff to perform advance analysis is not available with current work load. • Changes to site characteristics for monitoring locations. • This program was initiated from special project funding (non-municipal) which does not exist anymore.

Program Value Analysis

Project Value

- Identifies areas on the landscape focused on groundwater that are most sensitive to future climate change.
- Provides options for sustainable water/land management practices that will optimize water supply for agriculture, private wells, and streams.
- Understanding of the groundwater resource, critical for rural living.
- Establishes a water table level “baseline” to analyze the long-term effects of climate change.

Project Benefit

- Establishing a relationship with the various community types across the Kawartha watershed and providing them valuable data to make informed decisions for their businesses. e.g. helping agricultural communities assess drought conditions over time.
- The project compliments groundwater monitoring carried out under the PGMN program.

Project Feature

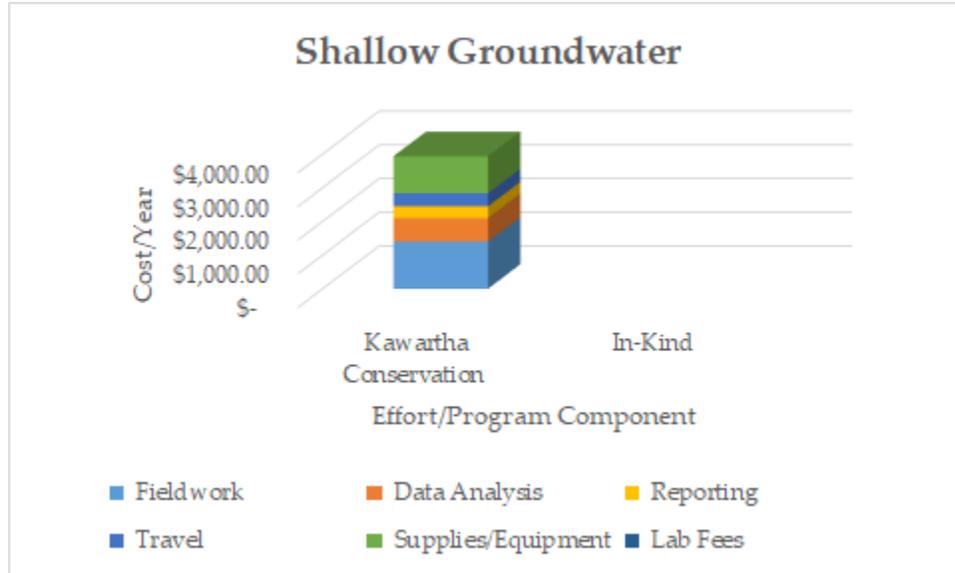
- Soil type and land use characteristics are used in combination to determine site locations and data loggers are installed less than 3 meters below the surface at these locations.
- Water level of the shallow groundwater is measured at 4 locations across the Kawartha watershed, 1 on a private landowner’s property and 3 on CA lands.
- Data is recorded hourly, stored in dataloggers, and downloaded 6 times per year.

Program Resourcing

Program Components	Internal Efforts/Cost per annum	External In-kind Contribution
Staff	51 hrs	
Travel	6 days	
Supplies	\$1100	
Equipment	n/a	
Lab Costs	n/a	
Professional Development	n/a	

- ❖ Estimated Effort/Sampling Site: 12.75 hrs./sites (@4 sites/year)
- ❖ Estimated Cost/Sampling Site: \$96/site (@4 sites/year)

The table below provides an overall visual interpretation of program resourcing for the shallow groundwater program.



In-Kind Contribution

In kind contribution for the shallow groundwater program relies on the participation of private landowners allowing for monitoring location/equipment to be set up and housed on their property. At this time, we currently only have one monitoring location being utilized on a private resident’s property.

LANDUSE CHANGE

Ecological Land Classification

Program Description

The ecological land classification (ELC) provides tools and techniques for consistent description, identification, classification, and mapping of community types. ELC is now becoming the standard method across Ontario to meet the need of ecosystem management and land use planning. It helps to identify changes in land use across the Kawartha watershed. The purpose of ELC is to delineate and classify ecologically distinct areas of the earth's surface, and to capture the urban/rural components to provide a consistent spatial context for better monitoring and reporting. ELC is one of the key inputs into the development of natural heritage systems. The use of these ecological units can provide a common framework for local and regional assessments and reporting of ecological indicators of the watershed environment.

SWOT Analysis

<p>Strengths</p>	<ul style="list-style-type: none"> • Developed partnerships with several groups through KNC. • The Natural Heritage System defined through the KNC (KNC-NHS) helps to inform planning and regulations, and stewardship programming. • Data collection through ELC including forests, interior forests, riparian forests, and wetlands help provide information for the Watershed Report Card and lake/watershed planning. • Data collection through ELC helps understand watershed-wide changes, both urban, rural and ecological. • Data collection through ELC helps to define regulated areas as part of Kawartha's Ontario Regulation 182/06. • Data collection through ELC helps to locate features that are significant through the Provincial Policy Statement (PPS), which, then informs municipal Official Plans. • Ability to help define boundaries of wetlands to support the Planning and Regulations department. • Partnership opportunities allows for imagery acquisition to be more cost effective per organization.
<p>Weaknesses</p>	<ul style="list-style-type: none"> • ELC data is currently captured by performing onscreen digitization, resulting in areas within the watershed not being field truthed and may be inaccurate. • Imagery acquisition is required for ELC updating to take place, substantial money is required every 5 years to accomplish the updating, even with partnership opportunities available. • Additional training is required to identify significant natural heritage features as per Planning Policy Statement. • ELC at the scale that we perform it is meant to be a landuse scale analysis; additional effort/training is required for site-level application. • Lack of good georeferenced database showing all ELC availability. • Value behind ELC is apparent in our work for a variety of purposes, however the scope and budget are not defined and are generally conducted as needed/required. • Various natural heritage system strategies might require consolidation. • KNCNHS is not able to be re-defined by staff, but required by MNRF who have refocused efforts on other priority projects.

<p>Opportunities</p>	<ul style="list-style-type: none"> • Can expand to undertake field monitoring of natural heritage features, in particular regulated features (e.g., wetlands). • Can expand to obtain biodiversity estimates in our properties (for example using bioblitz's.) • In house expertise to re-evaluate provincially significant wetlands and other wetlands on behalf of MNRF.
<p>Threats</p>	<ul style="list-style-type: none"> • Staff training opportunities in ELC are limited (there is no provincial momentum for this program area currently). • No annual financial commitment to this program. • Ongoing imagery acquisition is required to maintain current ELC mapping; if a municipality chooses not to support a special project levy, the data is not available to do ELC

Program Value Analysis

Program Value

- To contribute to quantifying existing conditions of our natural areas and land use and to understand how development and other pressures are impacting the health of our natural heritage resources.
- Inform development application reviews, by confirming the presence of significant natural heritage features such as wetlands within Kawartha Conservation's Ontario Regulation 182/06 by flagging sensitive features and confirming development buffer widths for those features.
- Contributes to understanding landscape scale changes over time on our lakes and rivers which our economies rely upon and in the protection of features for the protection of people and property.
- Useful to see how activities on the landscape are impacting climate change resilience.

Program Benefit

- Ecological Land Classification is used to monitor changes on our landscape in response to development pressures, and other environmental stressors such as agriculture, aggregate extraction, and urbanization.
- The key findings of the program promoted using social media and website posts, making findings available and accessible to partners and the public.
- Contributes to other areas of our organizational programming, for example our Stewardship Program (setting benchmarks for restoration projects and natural heritage system improvements).

Program Feature

- Applies Ecological Land Classification standardized methodology to categorize land use using GIS and monitors changes over time.
- Land use mapping is updated when new orthophoto imagery is made available. Usually every 5 years.
- Using GIS software, polygons are generated using on screen digitization of like land use features using ortho-imagery as reference. Polygons are then labeled to ELC Community series level.
- ELC land use mapping products include:

Year	Status
1988, 2002, 2008	Entire Watershed
2013	Entire watershed except portion of watershed in Trent Lakes
2015	Durham portion of watershed only
2018	Durham portion of watershed only and all Lake Management Plan lakes 200m around shorelines.

- Land use statistics are derived from the ELC land use mapping product and used to gauge the health of terrestrial systems in watershed report cards and lake management plans.

Program Updates

Ecological Land Classification mapping has no annual budget allocation. The updates are usually done if requested by municipal partners or if special projects require them which can result in a patchwork of ELC over time. A comprehensive complete ELC for every batch of orthophotos received would be preferred.

TEMPERATURE MONITORING

Coldwater Streams

Program Description

The purpose of the coldwater Streams Water Temperature monitoring program is to evaluate how well coldwater streams are doing within Kawartha Conservation’s jurisdiction, in terms of their existing thermal regime and whether they are likely to remain capable of supporting sensitive coldwater aquatic life. Water temperature data have been routinely collected at multiple locations along known coldwater streams since 2006.

SWOT Analysis

Strengths	<ul style="list-style-type: none"> • Minimal resources required to run the program. • Utilizes partnerships with Fleming College, such as: Coop programs, and volunteer opportunities to undertake field monitoring. • Routine monitoring stations, therefore ability to see what trends exists over time. (Currently, we have 5+ years of data at most sites, and some sites approaching 10 years). • Water Temperature, or thermal regime is a key data reporting element that contributes to a number of products provincially and locally. • Monitoring sites are located across all municipalities that fall within our watershed where coldwater streams exist.
Weaknesses	<ul style="list-style-type: none"> • Difficult to determine whether logger is out of water (i.e., recording air temperature not water temperature) if site visits are not conducted. • We deploy loggers for this program during spring and sometimes spring high water levels can be problematic to proceed with deployment. • Data analyses can be time consuming and complex given its continuous data and there is currently no data manipulation database that exists to support the program. • Temperature data is not available online nor within a georeferenced database.
Opportunities	<ul style="list-style-type: none"> • Fill in data gaps with point-in-time measurements. • Add temperature sensors to Environment Canada flow gauge stations. • Undertake sampling of aquatic life to obtain a better understanding of coldwater stream health and trends. • Opportunity to create a citizen science temperature monitoring program. • Data can lead to significant funding proposals, given coldwater stream management is a conservation priority for many organizations. • Possibility to expand program to include monitoring of lake temperature, including periods of temperature stratification, and deep coldwater habitats. • Could be fundamental to a climate change monitoring program.
Threats	<ul style="list-style-type: none"> • Potential for data interpretation errors, mistaking out of water air temperature as water temperature. • Data loss due to various factors including: equipment loss from flooding, theft, construction, or logger malfunctioning. • Overwhelming amount of continuous data collected from given loggers and with lack of automation can prevent analysis on large datasets.(e.g., every 30-60min all year).

Program Value Analysis

Program Value

- Helps to understand how climate change and changing landscapes impact on water resources.
- Ability to understand impacts to provincially important species for economic purposes.
- Temperature is a good indicator of health of coldwater streams, a sensitive regulated feature.

Program Benefit

- Water temperature is proven to change in response to ongoing development pressures, and other environmental stressors such as climate change and existing infrastructure (e.g., dams and their online ponds).
- We collaborate with community and industry partners wherever possible to maximize cost savings and information exchange opportunities, helping to promote the organization and work that we do.
- By profiling this program through communications -related initiatives, we draw more attention to the impacts of climate change, thermal pollution, sensitive aquatic life, and ultimately the value of using water temperature as an important indicator of watershed health, with specific emphasis on impacts of development and a warming climate.
- Contributes to quantifying existing conditions of our aquatic ecosystems and how development and other pressures are impacting the health of our natural heritage resources.
- Contributes to other areas of our organizational programming, for example our Stewardship Program (setting benchmarks for aquatic ecosystem restoration projects), and Conservation Areas (evaluating the health of our natural heritage assets).

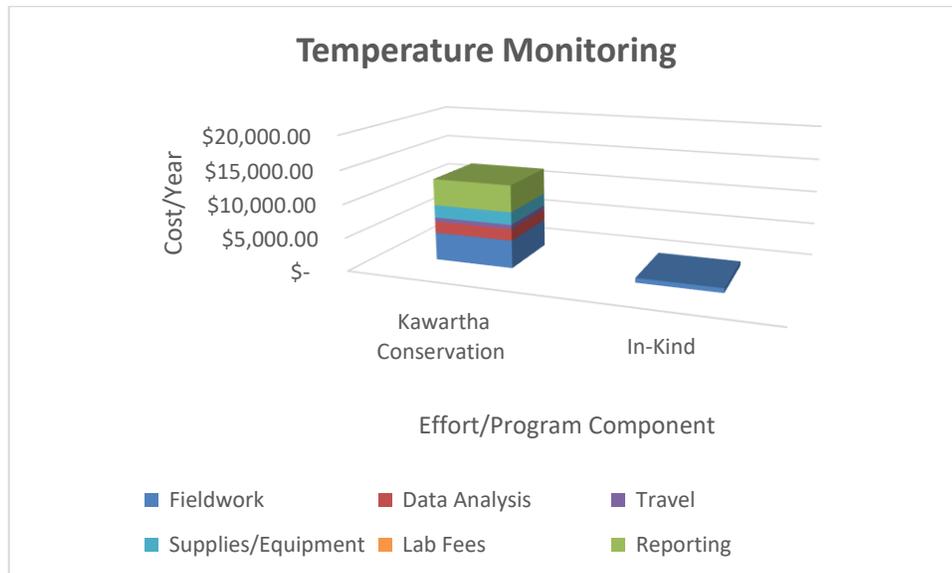
Program Feature

- We monitor water temperature at 30 locations yearly across our watershed to evaluate the thermal habitat status of our most sensitive streams.
- Candidate sampling locations include all stream-road intersections within watercourses identified as coldwater.
- We use water temperature and associated metrics as indicators of the health of coldwater streams.
- Industry standard techniques are applied to collect, manage, and report data, while striving to be continuously innovative in technology for example the use of bluetooth data loggers.
- Data loggers are set to record temperature at 1-hour intervals, starting at one minute past the hour.
- We collect 6 months of data each field sampling event with deployment and retrieval occurring in April and October each year.
- Logger installation uses one of three techniques; staked, tethered or free-weight.
- Data is downloaded from data loggers twice per year during the months of April and October.
- Data is analyzed for general descriptive statistics including average, maximum and minimum temperature, thermal regime and # of lethal days for Brook Trout.

Program Resourcing

Program Components	Internal Efforts/Cost per annum	External In-kind Contribution
Staff	147 hrs	35 hrs
Technical	35 hrs	
Seasonal		
Travel	10 days	
Supplies	\$900	
Equipment	\$1000	
Professional Development	\$1000	

The table below provides an overall visual interpretation of the program resourcing for the Temperature Monitoring program.



- ❖ Estimated Effort/Sampling Site: 6.07 hrs./site (@30 sites/year)
- ❖ Estimated Cost/Sampling Site: \$84.67/site (@30 sites)

In-Kind Contribution

One-week unpaid co-op position provides in kind contribution to this program by helping to retrieve and deploy temperature loggers.

WATER QUALITY

1. *Provincial Water Quality Monitoring Network (PWQMN)*

2. *Kawartha Water Watch (KWW)*

1. Provincial Water Quality Monitoring Network (PWQMN)

Program Description

The objectives of PWQMN are to

- Continued surveillance of water quality to detect trends and threats.
- To ensure compliance with the Provincial Water Quality Objectives.
- Provide and deliver water quality data for water quality studies/assessments.

The Provincial Water Quality Monitoring Network (PWQMN) was started in 1964 to collect surface water quality information from rivers and streams at strategic locations throughout Ontario. Over time stations were added and discontinued in response to changing MECP and program-specific needs. Since 1964, water quality information has been collected at more than 2000 locations throughout the province. The assembled database represents a wealth of historic and current surface water quality information.

The PWQMN is based upon partnerships with Conservation Authorities and other partner organization that provide staff and transportation for stream water sample collection. Currently, water quality samples are collected at over 350 stations in partnership with 26 Conservation Authorities and other partner organizations. Provincial network coordination, data management and data dissemination to clients is provided by the Environmental Monitoring and Reporting Branch (EMRB) of the MECP.

SWOT Analysis

Strengths	<ul style="list-style-type: none"> • A relatively long record of data with approximately 40 years of continuous data for two site locations within the watershed, with all other site locations having approximately 20 years' worth of data. • Partnerships with MECP provides all the training, equipment, and some supplies for this program. • Many of the people within the Kawartha watershed have an existing personal connection to water and water quality (through recreational and lifestyle activities), this connection results in resident investment in wanting to know the results. • Data collected informs us of small-scale changes (land use) across the watershed that can be used in the decision-making process for stewardship projects, planning and/or regulations. • Water quality data in conjunction with benthic data supports the production of watershed report cards.
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	<ul style="list-style-type: none"> • Aims to address seasonal bias by sampling during winter months (recent). • PWQMN is very credible, where sites have been used as a reference site for research projects (collaboration with academia). • Complements other monitoring schedules and activities.
Weaknesses	<ul style="list-style-type: none"> • General water quality is limited to nutrients and some physical parameters such as (pH, Temperature, DO, Conductivity). • Data heavy (lots of numbers generated) but no reporting or result sharing strategy from the province or locally, aside from some historic reporting. • Stream flow data is not collected in unison with water quality, limiting the usefulness of the data for loading calculations.
Opportunities	<ul style="list-style-type: none"> • Expansion into other parameters, for example pharmaceuticals, micro-plastics, PFAS, heavy metals. • Creation of long-term monitoring program that can track key parameters across both tributaries and lakes across our watershed. • Could be used as a template to establish other monitoring networks, i.e., citizen science and Indigenous monitoring hubs. • Upgrading to real-time monitoring of water quality (real time sensors that can link to online servers). Standardization of protocols could collaborate with adjacent CAs to undergo a broader assessment. • Access to or monitoring of water levels in addition to water quality samples would provide significant value-added benefit to the monitoring effort (e.g. staff gauge, dam records or more elaborate water level monitoring).
Threats	<ul style="list-style-type: none"> • Lack of funding and interest which can result in gaps in the data (spatial and temporal gaps). • Lack of reporting and result-sharing, which feeds into the lack of interest. • If partnership with province disappears, it would be costly to continue.

Program Value Analysis

Program Value

- Protection of water quality for future generations.
- Integral to stream and health, primary economic driver for our watershed community.
- Protection of human health and domestic livestock health.

Program Benefit

- The network is part of a wide-scale monitoring network that looks at the boarder trends and impacts to water quality, urbanization, salt usage, nutrient loading, and contaminants.
- Water quality data is available for reporting of key findings. This could be used to bring awareness to water quality issues in our area, and to heighten the need to continuous monitoring to detect changes in our watershed.
- Can illustrate the direct link between land-water interactions, especially those that are complex (use of long-term data).
- Continued working relations with MECP to satisfy the data needs of municipal partners, community groups, academia, consultants, and watershed residents.
- Consistent surveillance of the water quality of our region by experts at the regional and provincial level. This can be used to protect municipal drinking water (surface) intakes.

- Continue open access data to all sites within the network.
- PWQMN has been a collaboration between CAs and MECP. Lab cost and equipment usage, data QA/QC, standardization of procedures, study design, are all covered by MECP. This maximized cost saving and promotes collaboration and information sharing.
- PWQMN data has been used to assess land use, agricultural, urban, and natural resource policies.
- PWQMN can be aggregated into watershed that looks at regional trends and impacts, helps inform decision makers.

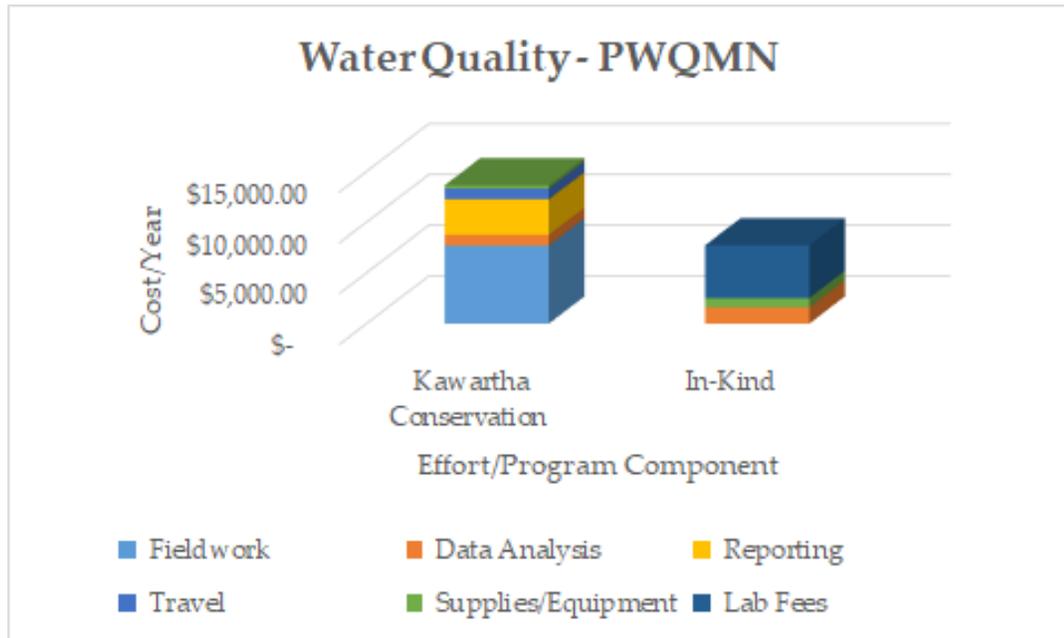
Program Feature

- Kawartha Conservation monitors at 11 sampling sites across our watershed and they are sampled once a month throughout the year. Sites were selected by MECP, some of which have been sampled since the mid-1960s, while others are relatively new and were established in 2004.
- Samples are taken from the upstream side of the waterway through a standardized method that can be applied to all regions of Ontario.
- Variables monitored include general chemistry (alkalinity, Cl, pH, Ca, Mg, Na, K, hardness), nutrients (NH3, NO2, NO3, TKN, PO4, TP) and metals (22 different types) which is sent to MECP laboratories to be analyzed. In addition, Kawartha Conservation also collects temperature, conductivity, pH, and DO at each site.
- MECP provides all the necessary training, equipment, and most supplies for this program. Data management, and, QA/QC, is also provided by this collaboration.

Program Resourcing

Program Components	Internal Efforts/Cost per annum	External In-kind Contribution
Staff Technical Seasonal	207.50 hrs 42hrs	20 hrs
Travel	13 days	
Supplies	\$312	\$440
Equipment	n/a	\$480
Lab Fees	n/a	\$5280
Professional Development	\$600	

The table below provides an overall visual interpretation of program resourcing for the PWQMN program.



- ❖ Estimated Effort/Sampling Site: 22.68 hrs./site (@11 sites/year)
- ❖ Estimated Cost/Sampling Site: \$104/site (@11 sites/year)

In-Kind Contribution

MECP provides in kind contribution for the PWQMN program through staff support for coordination of the PWQMN program, lab analysis and data management. They provide each CA with turbidity calibration solution and ensure that all shipping cost are paid for each month. They also provide the YSI equipment and cover all lab expenditures and repair costs if needed throughout the year.

2. Kawartha Water Watch (KWW)

Program Description

Kawartha Water Watch (KWW) is a volunteer-based citizen science water quality monitoring program that exists primarily to give volunteers an opportunity to be actively involved in an environmental monitoring program. Kawartha Water Watch also provides water quality data on waterbodies that are not the focus of Kawartha Conservation’s primary water quality monitoring projects, e.g., PWQMN. The Kawartha Water Watch program has been successfully running for over 20 years and is partially funded by community groups.

SWOT Analysis

Strengths	<ul style="list-style-type: none"> • Engages watershed residents in the work that we do specific to water quality. • Fills data gaps in our current monitoring programs. • Program covers strategic objective to engage with watershed residents. • Participation of citizen scientists allows for overall cost of program to be lower.
Weaknesses	<ul style="list-style-type: none"> • Risk of generating poor data. • Turnover of volunteers is high due to proximity to Fleming. • Very dependant on volunteers (time, skillset, proximity to location, etc). • Communication and engagment requirements can be high between coordinator and volunteers.
Opportunities	<ul style="list-style-type: none"> • Funding is readily available to support volunteer programs. • Some volunteer programs exist and provide partnership opportunities. • Create a sustainable volunteer group with partnerships with educational institutions and businesses. • Ensure information collected meshes well with other water quality monitoring.
Threats	<ul style="list-style-type: none"> • Volunteers turnover. • Lack of interest from the watershed community. • Insufficient staff time to coordinate the program.

Program Value Analysis

Program Value

- Engaging community residents such as waterfront owners and cottage associations to be more involved in protecting their own water resources.
- Community awareness to help them protect our watershed for a sustainable future.
- This program enables clean water for future generation.

Program Benefit

- This volunteer program captures nutrient data on streams, rivers and lakes that are not captured by regular operational monitoring programs.
- KWW has been a collaboration between volunteers and lake associations. Lab costs and equipment are partially covered by cottage, landowner or other associations that take part in the monitoring.
- KWW data has been used to augment other program data in Watershed Report cards and various management plans.
- KWW data can be aggregated into other watershed data that looks at regional trends and impacts on the watershed and helps us to inform decision makers.

Program Feature

- Provides ongoing water quality monitoring data that involves community groups and individuals in the collection of data across watercourses and lakes within the Kawartha watershed and surrounding area.
- Program has been running for over 20 years.
- Sample sites were selected by Kawartha Conservation staff to augment water quality data where little or no data exists.
- 17 active sites at the following locations: Crego Lake (5), Staples River (1), Pearn's Creek (1), Mariposa Brook (3), Jennings Creek (1), Sinister Creek (1), Sucker Creek (1), Janetville Creek (1), East Cross Creek (1), Lake Scugog (2)

SWOT, Program Value Analysis and Program Resourcing Review

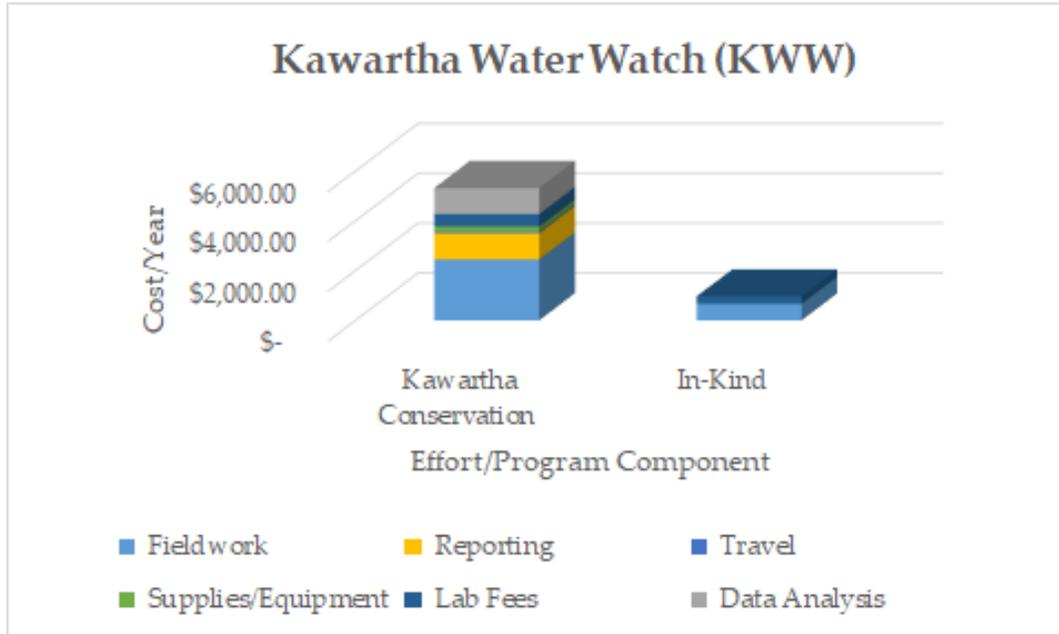
- Samples are taken from the upstream side of the waterway and from a depth of approximately 0.30 metres.
- Samples are taken once a month between June to August each year, with a September sampling make-up day if needed.
- Volunteers take two samples; one measures Total Phosphorous and another sample that measures Nitrate/Nitrite. Depending on locations some volunteers will also take samples for E. coli and T. coli.
- In addition to nutrients volunteers also collect other parameters such as Alkalinity, pH and turbidity using either titration kits or secchi discs (lakes).
- Nutrient samples are sent to offsite laboratory for analysis.
- Each volunteer is provided with a Water Quality Kit that includes all the necessary supplies for testing.
- At the end of each monitoring year, a report is generated and shared with active volunteers and watershed residents.
-

Program Resourcing

Program Components	Internal Efforts/Cost per annum	External In-kind Contribution
Staff	98 hrs	33 hrs
Travel	1 day	
Supplies	\$200	
Equipment	n/a	
Lab Fees	\$500	\$300
Professional Development	n/a	

- ❖ Estimated Effort/Sampling Site: 5.76 hrs/site (@17 sites/year)
- ❖ Estimated Cost/Sampling Site: \$44.94/site (@17 sites/year)

The table below provides an overall visual interpretation of program resourcing for the Kawartha Water Watch (KWW) program.



In-Kind Contribution

In-kind contributions to the Kawartha Water Watch program are provided by volunteers that participate in this program by conducting all the lake sampling. A small donation of \$300 is also provided by one of the cottage lake associations each year to help offset the cost of lab fees for their lake.

WATER QUANTITY

Water Levels and Flows

Program Description

The objective of flow monitoring is to provide information on the quantity of water in rivers and streams by continuous automatic measurement and recording of water levels at set locations and periodic measurements of stream discharge across the Kawartha watershed. Stream discharge is defined as the volume of water that flows through a transection of a channel during a specific period. Discharge measurements are taken as close as possible to the set location of the installed water level monitoring equipment. Corresponding water levels are taken and relationships in the form of a rating curve and a mathematical equation is developed. The collection of water level monitoring data on local watercourses is also crucial for the Flood forecasting and warning program as it provides a good indication of high-water levels and adversely low water conditions.

SWOT Analysis

Strengths	<ul style="list-style-type: none"> • Majority of monitoring locations are part of the Canada-wide monitoring network provided by Water Survey Canada (WSC) and are operated and maintained to specific high standard requirements. • All WSC locations within our watershed provides data that is available for the public to view. • Provides important decision-making information to a variety of programs and projects, including but not limited to Flood Forecasting and Warning, Low Water Response, lake management and watershed planning, climate change. • Provides information for planning, including stormwater management road infrastructure and water budgeting.
Weaknesses	<ul style="list-style-type: none"> • To expand this program would be quite costly as this is currently done by WSC. • No clear objectives or budget attached to this current monitoring program. • Involves annual maintenance costs (utilities, network fees). • Lack of good georeferenced database and data showing different landcover types across watershed. • Partners have authority/control over access to the program and data sharing.
Opportunities	<ul style="list-style-type: none"> • To add more monitoring locations, especially in urban settings. • Integrate both water level and flow monitoring locations with other sampling networks and vice versa. • Make data available to the public through the Kawartha Conservation website. • Formalize the relationship with the WSC by signing a partner agreement.
Threats	<ul style="list-style-type: none"> • Aging infrastructure • Partners discontinue monitoring site locations. • No funds or staff capacity to maintain/operate our stations (ISCO sites).

Program Value Analysis

Program Value

- Key indicator for understanding changes in climate (precipitation, evapotranspiration), water demand, land use or watershed's natural cover.
- Contributes to protecting people, property, and keeping communities safe from flooding within the Kawartha watershed.

Program Benefit

- Data collected is used for development of water budgets for Lake Management Plans, Planning and Source Water Protection programs.
- Water quantity information helps to inform infrastructure design such as bridges and culverts, as well as assisting in development, calibration and verification of water resources, hydrological and hydraulic models.
- Collaboration with community and industry partners wherever possible to maximize cost savings and information exchange opportunities.
- Data obtained in both the water level and flow monitoring will benefit member municipalities in planning activities, especially when development activity increases across the watershed.

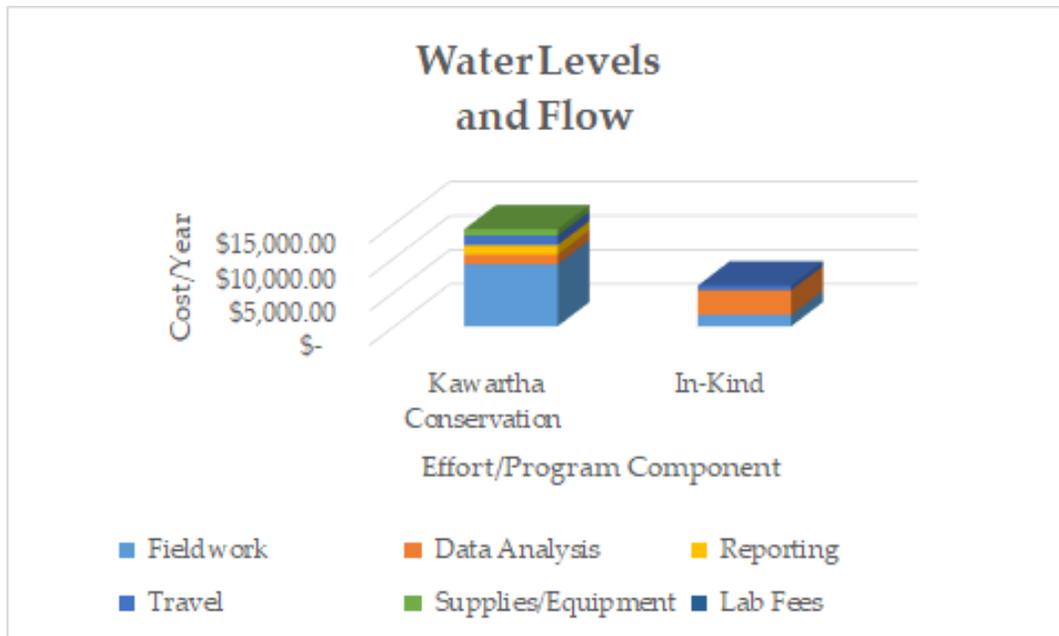
Program Feature

- Flow monitoring is obtained by both automatic measurement and recording of water levels at a set location which is accompanied by periodic measurements of stream discharge.
- Stream discharge is typically measured in cubic meter per second and requires a two-person crew.
- Discharge measurements are taken as close as possible to the location of the water level monitoring equipment.
- Stream velocity is a major component of stream discharge monitoring that requires specialized equipment (Flow Meter).
- Development stage, discharge is measured bi-weekly and after significant rain events to capture elevated water levels and flow.
- Relationship between water levels and stream discharge are plotted using a rating curve.
- To establish a rating curve that is considered reliable it takes 3 to 4 years of monitoring both the water levels and flow to perform any meaningful statistical analysis.
- When rating curve is considered developed, then periodic discharge measurements are still required for rating curve maintenance and verification.
- Through a third-party assistance partnership agreement Kawartha has access to data from 5 sampling sites across our watershed that are run by ECCC for water levels/flow.
- We currently monitor 4 active sites within our watershed (East Cross Creek, Jennings Creek, Nogies Creek and Layton River). For these sites, sensors monitor water level hourly. Real time access is currently not available for these 4 locations.

Program Resourcing

Program Components	Internal Efforts/Cost per annum	External In-kind Contribution
Staff		
Technical	182 hrs	66 hrs
Seasonal	140 hrs	
Travel	20 days	7 days
Supplies	\$300	
Equipment	\$720	
Professional Development	n/a	

The table below provides an overall visual interpretation of the program resourcing for the Water Levels and Flow program.



- ❖ Estimated Effort/Sampling Site: 2.75 hrs./site (@9 sites/year)
- ❖ Estimated Cost/Sampling Site: \$86.33/site (@9 sites/year)

In-Kind Contribution

In-kind contributions for this program area are provided by Environment Canada and Climate Change through routine field visits by their field technicians to one of the Water level/Flow Station being monitored within the Kawartha watershed. Staff also provide ongoing data analysis on collected data throughout the year.

Comparison of Monitoring Programs

The information above was analyzed to determine effort and cost for the program areas. The results are presented in the table below and in the accompanying charts.

Program	Initial Station Cost	Internal Effort Hrs/site	Internal Cost \$/site	External Contribution hrs/site	External Cost Contribution \$/site
Aquatic Benthic Macro-Invertebrates	\$0	17	\$164 (annual)	9.3	N/A
Precipitation	\$20-25K	8.75	\$38.25 (annual)	1.25 hrs/site	N/A
Snow survey	\$100	36.75	\$176 (annual)	2.5	
Low Water Response	N/A	N/A (could work this out)	N/A	N/A	N/A
Seniors Climate Change Program	\$86.33	2.75	N/A	52	N/A
Baseflow	\$0	6.22	\$114.67	0	\$0
PGMN		35.3	\$197.70	3.77	\$211.54
Shallow Groundwater	\$275	12.75	\$96	\$0	\$0
Ecological Land Classification	N/A	N/A	N/A	N/A	N/A
Temperature Monitoring	\$115	6.07	\$84.67	N/A	N/A
Water Levels and Flows	20K (ISCO) 30-50 K (WSC)	35.78	\$255.56	13.2 (for 5 sites)	\$89.60 (for 5 sites)
PWQMN	\$0	22.68	\$104	1.82	\$563.64
KWW	\$100	5.76	\$44.94	1.94	\$17.65

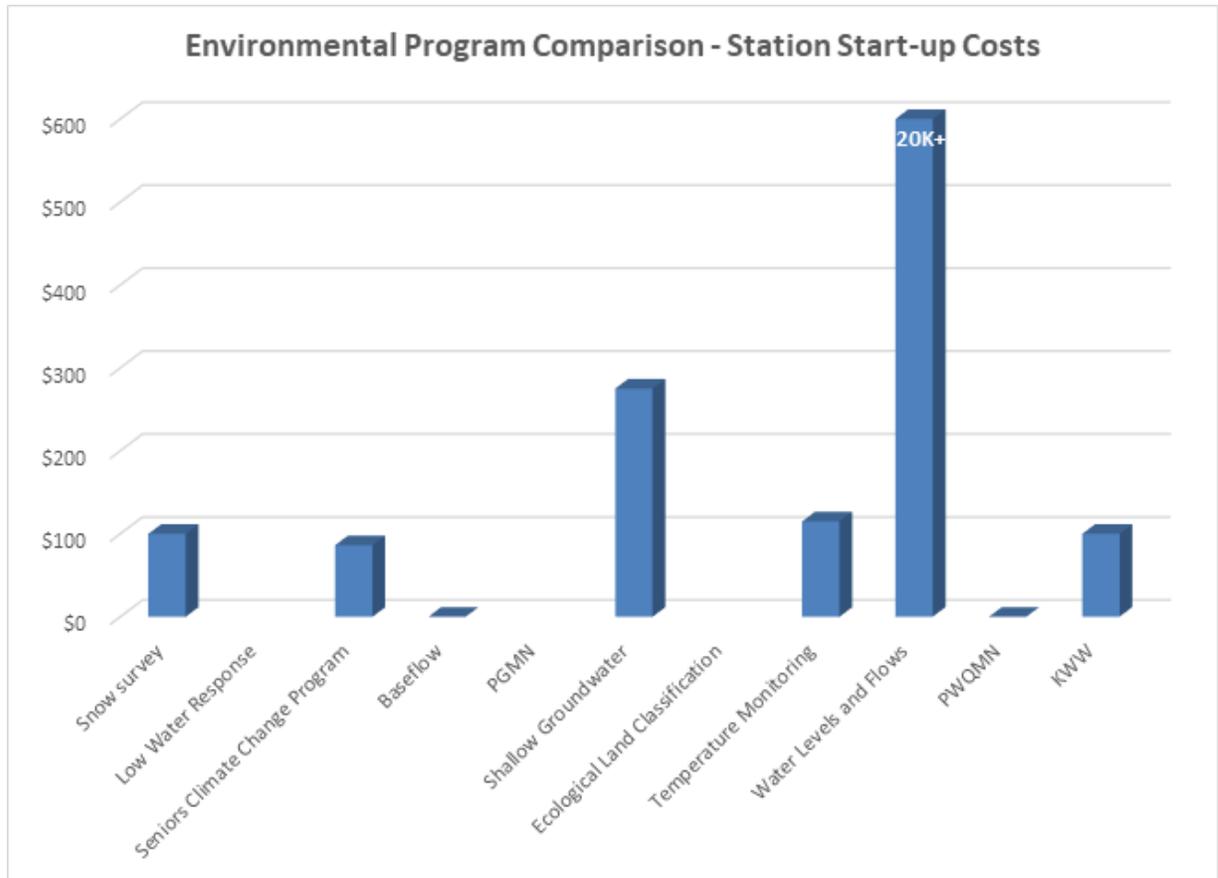
Baseflow – estimated at 3 sites/day for 20days = 60 sites

PGMN – assumed water level equipment has a lifespan of 8 years, prorated annually accordingly.

Shallow groundwater – assumed that the \$1,100 in supplies relates to initiation costs for the site, not ongoing costs.

Temperature monitoring – kept all items as an annual cost.

Initiation of continuous automated water level sites are the most expensive type of monitoring that dwarfs the costs of initiation any other monitoring site.



The Senior’s Climate change program is estimated to have the greatest investment from external volunteers/parties amongst all monitoring programs. Snow survey, Provincial Groundwater Monitoring network and water levels and flows have the highest investment of effort per sampling site, followed by the Provincial Water Quality Monitoring Network. The PWQMN and PGMN currently benefit from the greatest financial cost-share of the monitoring program from external sources, while water levels and flows, PGMN, snow surveys and the monitoring of benthic macro-invertebrates and baseflow have the highest direct per station costs of the monitoring programs.

