CreekWatch
Urban Stormwater Monitoring

2018

Alberta CreekWatch

ALBERTA CREEKWATCH

A Report Card on Urban Creek Water Quality, 2018

RANK	CREEK	SCORE	LOCATION	NUMBER OF STORMWATER OUTFALLS
1	Fish Creek	86%	Calgary	14
2	Pine Creek	72%	Calgary	2
3	Jumpingpound Creek	71%	Cochrane	3
4	Waskasoo Creek	68%	Red Deer	99
5	Wedgewood Creek	65%	Edmonton	1
6	West Nose Creek	64%	Calgary	22
7	Oldman Creek	61%	Strathcona County	1
8	Blackmud Creek	59%	Edmonton	11
9	Fulton Creek	58%	Edmonton	7
10	Mill Creek	54%	Edmonton	46
11	Whitemud Creek	53%	Edmonton	16
12	Confederation Creek	52%	Calgary	17
12	Gold Bar Creek	52%	Edmonton	6
13	Nose Creek	51%	Calgary	119

www.creekwatch.ca

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Summary

This fourth annual CreekWatch Report Card examines the state of urban creeks in Alberta based on the water quality data collected with the assistance of community-based environmental monitoring groups, water quality technicians and lab analysis.

CreekWatch is a program of the non-profit RiverWatch Institute of Alberta, specializing in community-based environmental monitoring and award-wining science education for twenty-five years. This 2018 Report shares our findings with the public, governments, and water quality professionals to collaboratively work towards the base-line monitoring and improvement of our urban creeks in Alberta.

Urban creeks function as receiving waterbodies for stormwater runoff and surface contaminants, with the water volume, flow rate, sediments, water quality and bacteria levels being of concern. Increased impermeability or surface-hardening in created urban environments quickly sheds more run-off water than is characteristic of pre-development environments, and this has burdened our receiving creeks with sudden flow changes, accelerated erosion and scouring, deteriorating water quality and increased levels of bacteria. The historical presence and abundance of fish in some creeks has been lost, along with fondly remembered local swimming holes.

CreekWatch has undertaken a role to monitor nutrient, physical and chemical indicators of water quality in stormwater creeks. In Table 1 below, the top creek rankings denote greater overall water quality, while lower rankings signify lesser overall water quality. This year's data indicates that Fish Creek in Calgary had the best and highest ranked water quality; Nose Creek in Calgary had the lowest. The monitored creeks all had some amount of stormwater input.

Table 1 Overall urban creek rankings for 2018

Rank 2018	Creek	Score	Location	Number of Stormwater Outfalls
1	Fish Creek	86%	Calgary	14
2	Pine Creek	72%	Calgary	2
3	Jumpingpound Creek	71%	Cochrane	3
4	Waskasoo Creek	68%	Red Deer	99
5	Wedgewood Creek	65%	Edmonton	1
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13	Nose Creek	51%	Calgary	119

In 2018 between the months of March and October, there were 72 trained volunteers and two science technicians in Edmonton, Cochrane, Red Deer and Calgary whose work combined for 380 site visits, over 4,000 collected data points, and an estimated 400 hours total time spent monitoring fourteen urban waterways.

How healthy are Alberta's urban stormwater creeks? The CreekWatch monitoring program suggests that Alberta has a range of water quality exemplified in their stormwater creeks and perhaps reflective of the number and loading of stormwater outfalls.

There would be merit in correlating the water quality ranking of urban creeks with the number of their stormwater outfalls, the stormwater nutrient and sediment loading; the stormwater volume and rate of flow rate; the upslope residential, commercial and industrial development characteristics; and the best management practices employed on each creek.

To achieve improved urban creek water quality in the future, it is recommended that agencies, governments and the public:

- increase public and industry education, making everyone aware that a.) stormwater runoff from our streets, homes, businesses, and parking lots travels through storm drains largely untreated into our waterways, and b.) their stewardship actions can make a positive difference;
- consider stormwater impacts in any new snow removal planning involving the spray of anti-icing agents;
- uncover (daylight) and remove pipes and culverts from partially buried creeks, reinstating open-air ecosystem functions;
- continue addressing sediment loading generated by stormwater through the implementation of erosion controls, bioengineering and settling in stormwater ponds;
- increase the use of Low Impact Development (LID) green infrastructure (constructed/engineered wetlands, rain gardens, greens roofs and permeable pavements) as a means for stormwater reduction and treatment;
- investigate and initiate stormwater reuse technology to divert stormwater from oversubscribed drainages;
- continue identifying and correcting sewage and stormwater cross-connections;
- support new and entrepreneurial stormwater technologies;
- take measures to control invasive species;
- consider provincial changes to water licensing to address stormwater runoff as a source of new water.

Introduction

The primary goal of CreekWatch is to support a community-based environmental monitoring network able to collect useable, cost-effective and publicly available baseline water quality data on urban stormwater creeks in Alberta. Urban stormwater tributaries face unique stressors that already make them some of the most highly impacted local waterways, and consequently, they are of interest and importance to communities and watershed managers.

Urban creeks function as receiving waterbodies for stormwater runoff and surface contaminants, with the volume, flow rate and water quality being of concern. Pre-development run-off was much less than it is today – the majority of meltwater and stormwater either evaporated, transpired from vegetation or soaked into topsoil. Post-development run-off is greatly increased nowadays in built urban environments, and this new water source is rapidly shed from impermeable roofs, roadways, parking lots and driveways.

Photo 1
Pavement and stormwater drain

Photo 2
Dump no pollutants, drains to river

With increasing residential and industrial development, many urban surfaces are now impermeable, allowing increased snowmelt and rainwater volumes that no longer soak into the soil. Along the surface run-off journey, stormwater collects various contaminants from vehicles, roadway maintenance, industries, pet waste and neighborhood yards that ultimately discharges into creeks via stormwater outfalls that impact river ecology and urban sustainability. See Table 2 for total stormwater outfalls and drainage area per monitored creek.

Table 2 Total drainage area and number of urban stormwater outfalls per monitored creek

	Calgary & Area						Edmonton & Area							Red Deer
	Fish Creek	Nose Creek	West Nose Creek	Pine Creek	Confederation Creek	Jumpingpound Creek	Whitemud Creek	Blackmud Creek	Mill Creek	Fulton Creek	Oldman Creek	Gold Bar Creek	Wedgewood Creek	Waskasoo Creek
Total Outfalls	14	119	22	2	17	3	16	11	46	7	1	6	1	99
Drainage Area (km²)	444	976	590	231	17	604	372	694	89	31	131	30	169	700

Source: City of Calgary Water Resources, 2018; City of Edmonton Drainage Services, 2018, City of Red Deer Environmental Services, 2017.

Increasingly, we expect a lot of our stormwater ponds, wetlands and creeks. The first stormwater ponds were constructed in the 1970's to retain large sediments, attenuate peak flows and minimize downstream flood risks. These original assets only provided basic services and are now in waning condition.

Nowadays, not only must the stormwater be collected and control-released into our creeks and rivers, but we also expect stormwater not to impair the triple bottom-line of economics, environment and society. Stormwater management must address public safety, affordability, social values, aesthetics, recreational opportunities, water treatment, environmental function, and asset maintenance and lifecycle considerations.

Looking to the future, we also envision that climate change, water license closures, community collaborations, stormwater re-use, government legislation and overland flood mitigation are additional considerations for stormwater management.

Unlike wastewater and drinking water management that are long-established in our towns and cities, stormwater management is an emergent and evolving discipline that is designing for tomorrow. While today's cities make plans and take action over time to address better stormwater management, it is important to begin measuring where we're at in order to judge if we have gone anywhere in the future. This is the role of CreekWatch.

CreekWatch has undertaken the monitoring of nutrient, physical and biological indicators of water quality at the mouths of stormwater creeks. This data then becomes a report card on how well we're doing with stormwater management in the upslope catchment area draining to a creek.

In Table 1 above, the top creek rankings denote greater overall water quality, while lower rankings signify lesser overall water quality. This year's data indicates that Fish Creek in Calgary had the best and highest ranked water quality; Nose Creek in Calgary had the lowest.

CreekWatch
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Site Information

Sampling sites were identified on urban tributaries of the North Saskatchewan River in Edmonton, the Red Deer River in Red Deer, and the Bow River in Cochrane and Calgary. Sites were selected based on the consideration of accessibility, perceived value of tributary importance, the extent of our resources to collect data, and the advice and suggestions from water quality professionals. Samples were collected at the mouth of each selected tributary.

Study Design

The first four years of CreekWatch (2015-2018) have established a framework and tools for incorporating community-based environmental monitoring into address existing issues and research gaps in stormwater monitoring, including:

- the number and frequency of stormwater creeks being monitored
- baseline data for stormwater quality
- reliability of volunteer citizen science data
- the cost-efficiency of monitoring programs
- the public availability of online data
- and the engagement of a public able to understand and contribute to the management of rivers and streams.

The CreekWatch program collected data on 10 parameters: dissolved oxygen, pH, turbidity, chloride, ammonia-nitrogen, nitrate-nitrogen, water temperature, conductivity, salinity, and fecal coliforms.

Three levels of data collection were undertaken in 2018 as means to involve volunteers, increase the number of sampling events, and to provide quality assurance.

Photo 3
Volunteers creekside performing Level One water quality tests

Photo 4
Level One Hach monitoring lab

Level One Data data was obtained through trained volunteers using manual equipment, as seen in Photo 3. This involved the use of Hach testing kits housed in wheeled coolers (portable labs) for ease of transport and access (See Photo 4). Expectations were that each volunteer would collect data on their own free time at least 2 – 4 times through the open-water season. We had 16 volunteers in Edmonton, 8 in Red Deer, and 48 volunteers in the Calgary area. Water sampling occurred between the months of March and October 2018.

Photo 5
CreekWatch Technician using Level Two equipment

Photo 6
Level Two Electronic monitoring equipment

Level Two Data data was collected by CreekWatch Technicians on a weekly basis between March – October. This involved the use of a YSI Professional Plus instrument capable of measuring a wide range of parameters. Also included in the equipment were two separate LaMotte 1200 Colorimeters, one for nitrate-nitrogen and one for phosphorus. See Photo 5 and 6.

The collection of Level Three data happened once in 2018, and this involved the submission of water samples to Exova for laboratory-based testing. All three levels of data were collected at the same time, allowing for a unique comparison between the three different data levels to verify accuracy and consistency.

All volunteers and technicians were provided a unique PIN to access the data entry portion of the CreekWatch website, and once submitted, it was available for public viewing in real-time.

Once data has been submitted, it becomes publicly available on our website. Anyone who visits www.creekwatch.ca is able to create a data graph and view data.

In 2018, between the months of March and October:

- there were 72 volunteers and two science technicians in Edmonton, Red Deer, Cochrane and Calgary
- a combined 380 total sampling events
- over 4,000 collected water sample data points
- an estimated 400 hours total time spent on fifteen urban creeks
- fourteen portable water monitoring kits were distributed
- 19 sampling locations were monitored across urban creeks in Alberta

Table 3 Total Sampling Events per Creek in 2017

	Calgary & Area						Edmonton & Area							Red Deer	
	Fish Creek	Nose Creek	West Nose Creek	Confederation Creek	Pine Creek	Jumpingpound Creek	Whitemud Creek	Blackmud Creek	Gold Bar Creek	Mill Creek	Wedgewood Creek	Fulton Creek	Oldman Creek	Waskasoo Creek	Total Events
Level One	2	3	2	32	42	31	2	2	1	8	1	2	1	23	152
Level Two	24	17	17	3	24	3	21	21	21	21	22	2	18	2	216
Level Three	1	1	1	1	1	1	1	1	1	1	1	1	1	—	12
Total Events	27	21	20	36	67	34	24	24	23	30	24	5	20	25	380

Looking back at the weather of 2018, it was a year of extremes that may have affected stormwater creek volumes.

- Record-breaking temperatures and extremely low rainfalls were widespread across much of the province from May to August.
- Several Alberta counties declared states of agricultural disaster due to extreme drought.
- Forest fires were burning across Western Canada at rates well above normal forcing governments to impose fire bans.

This fourth year of CreekWatch March - October 2017 established an effective framework and tools for incorporating community-based environmental monitoring as a tool for tracking effective stormwater management.

Three key successful strategies were again applied to address quality assurance and quality control during CreekWatch Year Four:

1. Monitoring equipment required constant kit maintenance, upkeep, and the replacing of consumables throughout the season for both Level One and Level Two equipment.
2. Data accuracy was evaluated again this year by collecting three levels of data on the same day to compare our equipment results against lab results.
3. The engagement of volunteers was ongoing throughout the season with frequent program updates, friendly reminders, and technical support for equipment and online data entry.

Photo 7
Strathcona County's Oldman Creek

Stewardship Action

In July 2018, a stewardship project was coordinated along a section of the Bow River at Beaver Dam Flats in Calgary. This was coordinated with the help of the City of Calgary and a group of 44 volunteers who spent part of an afternoon removing invasive plants from selected areas. The target plant for the day was Yellow clematis (*Clematis occidentalis*), which has taken up residence along much of the Bow River and its tributaries in Calgary. Listed as a noxious weed in Alberta, this plant is a perennial vine that produces several stems growing to a length of up to 4m and produces bright yellow nodding flowers with four petals. As seen in the photos below, our volunteers made a worthwhile contribution removing 28 large garbage bags of this plant and look forward to more events in 2019. a worthwhile contribution removing 28 large garbage bags of this plant and look forward to more events in 2019.

Photo 8
Yellow clematis (*Clematis occidentalis*) along the Bow River.

Photo 9
Volunteers were equipped with shovels and gloves to properly remove the entire plant.

Analysis

In creating a report card summary of stormwater creek water quality, it became apparent that there is a range of creek water quality in Edmonton, Red Deer and Calgary. This report provides baseline water quality data for the 2018 open-water season and will be used going forward to compare differences in water quality over the years.

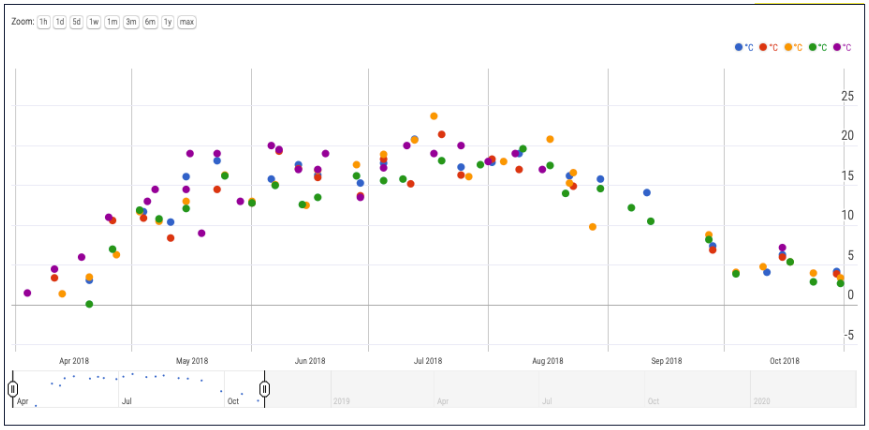
Of special note:

- The top-ranked creek, Calgary's Fish Creek, contains multiple constructed wetlands that collect stormwater runoff from the streets of the surrounding communities. These networks of engineered wetlands function to allow sediment to settle and pollutants to be removed before water moves downstream.
- The lowest ranked creek, Calgary's Nose Creek, drains significant urban land areas without sufficient wetlands to settle out the runoff.
- Red Deer's Waskasoo Creek, while not ranking high or low, has nearly 100 stormwater outfalls whose impacts are mitigated with headwater wetlands.

With climate change considerations in mind, it is interesting to track temperatures in urban creeks that may affect dissolved oxygen concentrations and fish survivability. The 2018 CreekWatch data showed Calgary creeks to approach or exceed 20C on 8 occasions between July and August; Edmonton creeks 14 times and beginning earlier in May. See graphs on the next page.

Photo 10
Red Deer's Waskasoo Creek as it enters the Red Deer River

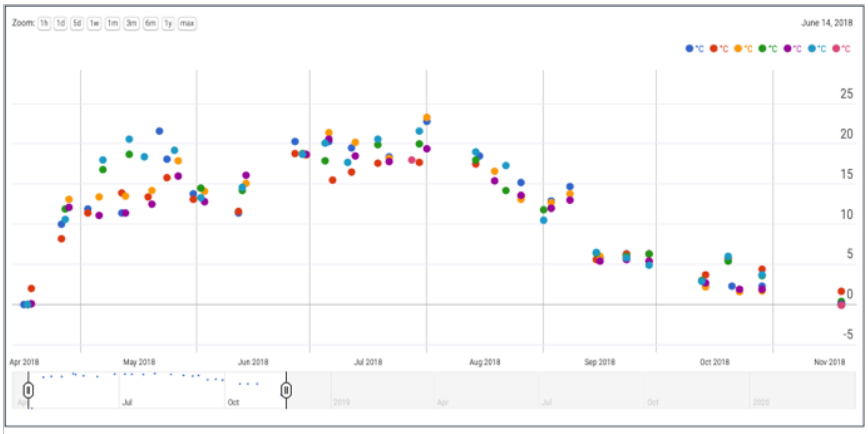
Temperature - Calgary and Area Creeks 2018



	Bow River Basin: Nose Creek at mouth - Water Temperature (°C)	Bow River Basin: West Nose Creek - Water Temperature (°C)	Bow River Basin: Fish Creek - Water Temperature (°C)	Bow River Basin: Pine Creek at mouth - Water Temperature (°C)	Bow River Basin: Confederation Creek - Water Temperature (°C)
Median	**15.8**	**14.7**	**13**	**12.7**	**17**

Photo 11 – Screen capture of the data-graphing platform showing temperature for five urban creeks

Temperature - Edmonton and Area Creeks 2018

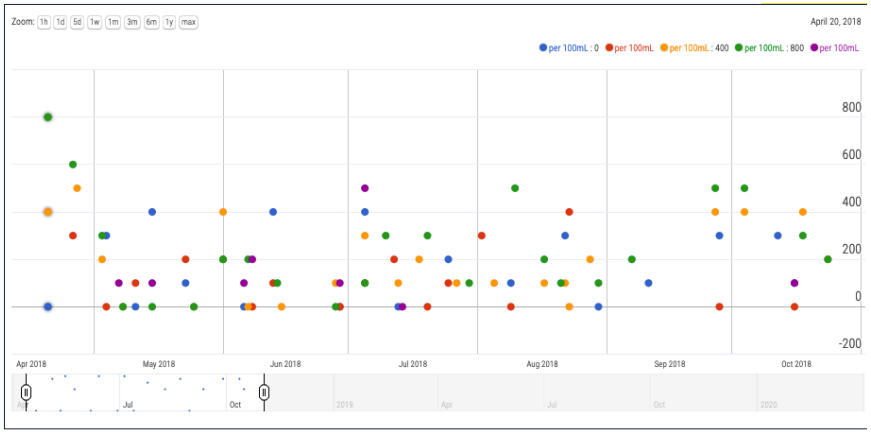


North Saskatchewan River Basin: Whitemud Creek at mouth - Water Temperature (°C)	North Saskatchewan River Basin: Mill Creek at Mill Creek Swimming Pool - Water Temperature (°C)	North Saskatchewan River Basin: Blackmud Creek - Water Temperature (°C)	North Saskatchewan River Basin: Oldman Creek - Water Temperature (°C)	North Saskatchewan River Basin: Wedgewood Creek - Water Temperature (°C)	North Saskatchewan River Basin: Gold Bar Creek - Water Temperature (°C)	North Saskatchewan River Basin: Fulton Creek - Water Temperature (°C)

Photo 12 – Screen capture of the data-graphing platform showing temperature for seven urban creeks

The 2018 CreekWatch data showed stormwater creeks contained significant levels of *E. coli* bacteria of indeterminate origin and likely of some note to recreation users. Calgary and area creek *E. coli* concentrations were generally below 500 CFU/100mL; Edmonton and area creek *E. coli* concentrations were generally lower and below 1000 CFU/100mL. Some recreation standards are at 200 CFU/100mL. See graphs below.

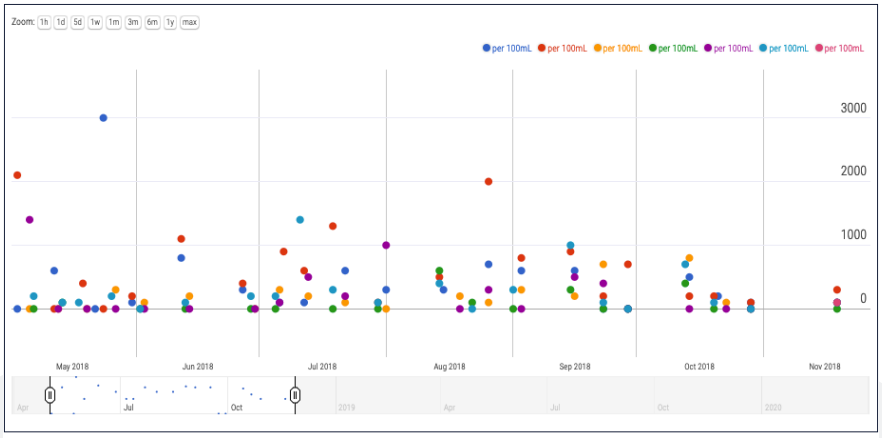
E. coli - Calgary and Area Creeks 2018



	Bow River Basin: Nose Creek at mouth - E. coli (per 100mL)	Bow River Basin: West Nose Creek - E. coli (per 100mL)	Bow River Basin: Fish Creek - E. coli (per 100mL)	Bow River Basin: Pine Creek at mouth - E. coli (per 100mL)	Bow River Basin: Confederation Creek - E. coli (per 100mL)
Median	**100**	**100**	**150**	**200**	**100**

Photo 13 – Screen capture of the data-graphing platform showing *E. coli* for five urban creeks

E. coli - Edmonton and Area Creeks 2018



	North Saskatchewan River Basin: Whitemud Creek at mouth - E. coli (per 100mL)	North Saskatchewan River Basin: Mill Creek at Mill Creek Swimming Pool - E. coli (per 100mL)	North Saskatchewan River Basin: Blackmud Creek - E. coli (per 100mL)	North Saskatchewan River Basin: Oldman Creek - E. coli (per 100mL)	North Saskatchewan River Basin: Wedgewood Creek - E. coli (per 100mL)	North Saskatchewan River Basin: Gold Bar Creek - E. coli (per 100mL)	North Saskatchewan River Basin: Fulton Creek - E. coli (per 100mL)
Median	**300**	**400**	**100**	**0**	**0**	**100**	**100**

Photo 14 – Screen capture of the data-graphing platform showing *E. coli* for seven urban creeks

Next Steps

Looking ahead to the 2019 season, CreekWatch will take steps to expand the project scope to allow:

- The addition of more volunteers to complement the current volunteer base established in 2015-2018 through collaboration with other corporate and community groups.
- Early season monitoring of the spring freshet with experienced volunteers.
- The addition of flow calculations on each creek.
- The purchasing of additional equipment for additional groups of volunteers.
- Consider contributions to Low Impact Development projects and awareness.

Conclusion & Recommendations

The key CreekWatch objective is to provide credible and affordable community-based environmental monitoring to support informed decisions on urban stormwater management, and to make this data readily available in a timely manner to watershed managers and the public. An annual report card on the water quality of urban stormwater creeks is one method to accomplish this objective.

How healthy are Alberta's urban stormwater creeks? The CreekWatch monitoring program suggests that Alberta has a range of water quality exemplified in its stormwater creeks.

Photo 15
Calgary's Fish Creek, ranked highest overall water quality

Photo 16
Calgary's Nose Creek, ranked lowest overall water quality

To achieve improved urban creek water quality in the future, it is recommended that agencies, governments and the public:

- increase public and industry education, making everyone aware that a.) stormwater runoff from our streets, homes, businesses, and parking lots travels through storm drains largely untreated into our waterways, and b.) their stewardship actions can make a positive difference;
- consider stormwater impacts in any new snow removal planning involving the spray of anti-icing agents;
- uncover (daylight) and remove pipes and culverts from partially buried creeks, reinstating open-air ecosystem functions;
- continue addressing sediment loading generated by stormwater through the implementation of erosion controls, bioengineering and settling in stormwater ponds.
- increase the use of Low Impact Development (LID) green infrastructure (constructed/engineered wetlands, rain gardens, greens roofs and permeable pavements) as a means for stormwater reduction and treatment
- investigate and initiate stormwater reuse technology to divert stormwater from oversubscribed drainages;
- continue identifying and correcting sewage and stormwater cross-connections
- create municipal budgeting for asset maintenance, repair and expansion
- support new and entrepreneurial stormwater technologies
- take measures to control invasive species
- consider provincial changes to water licensing to address stormwater runoff as a source of new water.

Photo 17
The future of urban stormwater management is dependent on a reconsideration of hard, impermeable surfaces.

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Urban Stormwater Monitoring

Acknowledgements

CreekWatch was made possible through HSBC funding and HSBC volunteers in a collaborative effort with the RiverWatch Institute of Alberta. Additional funding support was received from Dream Development, Invistec Consulting Ltd. and Raywalt Construction Co. Ltd.

The enthusiasm and time donated by citizen science volunteers is amazing. Eighty-one trained volunteers used a loan-pool of monitoring equipment to collect data from their local creeks in Edmonton, Red Deer, Cochrane and Calgary. Volunteers were recruited from the following organizations:

HSBC Bank Canada
Dream Developments
Invistec Consulting Ltd.
Friends of Confederation Creek
Cochrane Neighborhood Community
Ann and Sandy Cross Conservation Area
EPCOR
Waskasoo Neighborhood Community

Advice and support was received from organizations and professionals across Alberta to help plan, develop, manage, display and analyze CreekWatch data collection, and include the following:

Alberta Environment & Parks
City of Calgary Water Resources
City of Red Deer Environmental Services
Bow River Basin Council
North Saskatchewan Watershed Alliance
EPCOR
Web3 Marketing
Web Heroes
Exova
Victoria Hansen

Thank you everyone.