Winter River – Tracadie Bay Watershed Association

2016 Field Report

Public version

Hilary Shea

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5.6 Other Streams ..... **Error! Bookmark not defined.**

1 Executive Summary

The Winter River - Tracadie Bay Watershed Association (WRTBWA) crew accomplished a great amount of stream restoration and water monitoring around the watershed this year! The group expanded restoration and monitoring efforts into the south and east side of Tracadie Bay. The chainsaw operators worked hard to clear debris from almost 10 km of streams with a large focus in the other sub-watersheds around Tracadie Bay such as Black River, MacAulay's Creek, and Pipers Creek. The group built nine brush mats around the watershed, two of which are quite large, located in the head of tide of MacAulay's Creek and the rest in the Friston and VanWesterneng Branches of Winter River. The instream silt trap was excavated near the Union Pumping Station in the early fall to remove the excess sediment. The summer crew installed three silt fences to mitigate sediment runoff, one below an agricultural field and two at pit road crossings. Over 900 native trees and shrubs were planted in the watershed to enhance the diversity and effectiveness of buffer zones. The crew installed 15 cover logs in Winter River to help reduce fish predation. The coordinator collaborated with the province on fixing several problem culverts on public roads to increase fish passage. In addition, two damaged culverts were removed by hand at an abandoned road crossing to connect fish passage upstream in Pipers Creek.

Our research technician continued with several monitoring projects including water-level and temperature loggers, v-notch weirs, stream assessments and fish population surveys. New surveys this year included headwater surveys in the spring and fall, CABIN monitoring in the fall and water quality monitoring with our new YSI equipment measuring conductivity, temperature, dissolved oxygen, pH, and nitrate testing Winter River and several other streams around Tracadie Bay!

Again, it was another dry year in the headwaters of Winter River from July to December. In addition to the 25 springs that dry up in Brackley for 6 months, the other headwater tributaries Vanco and Cudmore also had springs that we monitor dry up in the fall for a couple weeks, the first time documented by WRTBWA. Water quantity is a well-known issue for this watershed, but is not the only hurdle to overcome. The summer water temperature of Officer's Pond also creates a temperature barrier for fish from early June to late September. The pond sustained temperatures well over 20°C during this time and had large amounts of smelly green algae mat for most of the summer. Placing a dissolved oxygen logger in the pond would provide additional insight on additional habitat constraints. The CABIN results will give some insight on how these water temperatures are affecting the macro invertebrates downstream of the dam.

2 Staff

Hilary Shea and Jill Poirier began working in the watershed early May. In June, Jill Poirier accepted a position with the PEI Analytical Laboratory. Tessa Doncaster started as the summer crew supervisor/chainsaw operator in late May, while Fawn Maika was the second chainsaw operator and started in June. Both Fawn and Tessa left in early July to work for the Atlantic Wildlife Institute in New Brunswick. The crew supervisor role was designated to Hilary Shea in conjunction with her research position. Steven Corkum and Tate Saulnier joined the team and were the two main chainsaw operators for the watershed. In addition, Emily Dennis, Vicki Johnson and Amber Fox were on the summer crew. In the fall, Steven was available to work part-time on Monday, Wednesdays and Fridays until December.

Summer Staff		
Name	**Start**	**End**
Hilary Shea	May 2	Jan 13
Steven Corkum	July 11	Nov 30
Amber Fox	June 20	Sept 10
Vicki Johnson	July 20	Sept 10
Tate Saulnier	June 27	Aug 25
Emily Dennis	June 9	Aug 23
Fawn Maika	June 6	July 7
Tessa Doncaster	May 24	July 7
Jill Poirier	May 9	June 7

Figure 1: Winter River crew (L to R) - Hilary, Emily, Steven, Sarah, Vicki, and Amber
***Missing: Tate, Tessa, Fawn and Jill*

2.1 Educational Training Opportunities

Canadian Aquatic Biomonitoring Network (CABIN) Project Manager Online and Field Training Course
Canadian Rivers Institute
"The Canadian Aquatic Biomonitoring Network (CABIN) is an aquatic biological monitoring program developed and maintained by Environment Canada for assessing the health of freshwater ecosystems in Canada. CABIN is based on the network of networks approach that promotes inter-agency collaboration and data-sharing to achieve consistent and comparable reporting on freshwater quality and aquatic ecosystem conditions in Canada."

Stream Rehabilitation Training Trout Unlimited
"The Stream Rehabilitation Training (SRT) is a set of 6 workshops intended to help to improve water quality, water quantity and habitat in watershed and their streams, leading to stable, functional streams and stream corridors with healthy plant and animal communities. An ultimate outcome includes a sustainable environment that supports healthy human communities."

3 Project Activities 2016

3.1 Tree planting

It was a successful planting season, with a few setbacks along the way. At the beginning of the planting season, several trays of trees were left at the Vanco site for the children from the local elementary schools to plant. Due to weather, one of the events was cancelled. The trees, due to the lack of truck transportation were left on site for a few weeks. When the group had a truck to use we went to the site and discovered most of the trees were dry and/or had been eaten by hares. The group successfully nursed 75% of these trees back to health, but their growth might be affected due to the hare damage. During the summer, more deciduous trees were predated from the hares in the holding area.

3.1.1 *Site 1*

The native planting site is adjacent to the headwaters springs of the Pater Branch on Winter River and below an active agricultural field. In the spring, this area was surveyed and found a large amount of sediment runoff within the buffer zone. This summer, approximately 60 trees and shrubs were planted within the buffer zone including: Green Ash, Blue leaf Birch, Red Maple, Larch, Black Spruce, White Spruce, Bayberry, Pussy Willow, and Winterberry. In addition, the watershed group installed a 200m long sediment fence to mitigate the sediment runoff for an effective short-term solution.

Figure 3: Pater branch, Winter River



Figure 2: (top) riparian zone full of silt from spring runoff; (bottom) trays of trees to be planted below the silt fence

3.1.2 *Site 2*

This planting site is adjacent to the headwater tributary of Black River and below an active agricultural field. In June, the staff planted within the buffer zones of the hay fields on both banks. This area had a narrow buffer zone to the field and needed to be expanded to stabilize the banks of the river and reduce sediment runoff into the stream. During harvest, some trees and shrubs perished so the fall staff planted a few more shrubs in this area.

Figure 5: Black River, Winter River

Figure 4: (top) tilled field next to riparian zone; (bottom, left) Steven planting shrubs; (bottom, right): planting site

3.1.3 *Site 3*

In June, the staff planted shrubs and trees around the groundwater springs on the Pleasant Grove Rd of the MacLauchlan Branch in Winter River. The plantings have grown quite nicely over the summer and will increase shade and diversity within the area. No pictures were taken at this site.

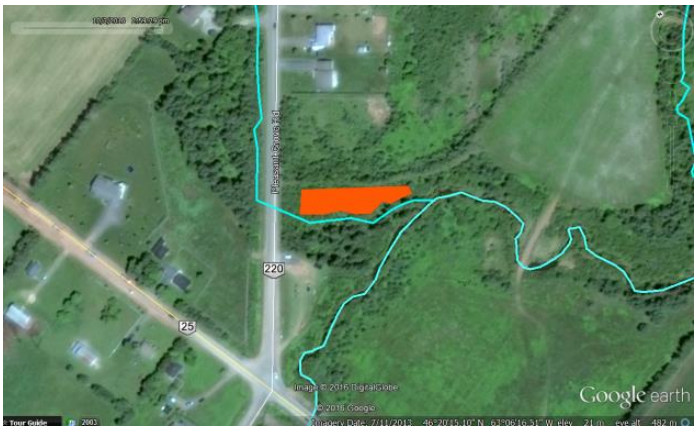


Figure 6: MacLauchlan Branch, Winter River

3.1.4 *Site 4*

The staff along with kids from West Royalty and West Kent Elementary Schools planted a couple hundred trees in the old abandoned shale pit next to the Vanco Pit. Unfortunately, the weather took a turn and one of the planting events was cancelled. In the summer, a silt fence was installed along the Vanco Pit road crossing because a weak point of the berm along the road blew out in the spring causing sediment runoff into the stream. After the installation of fencing, shrubs were planted to provide extra stability.

Figure 8: Vanco Branch, Winter River

Figure 7: (left) old abandoned pit; (right) Elementary kids planting trees

3.1.5 *Site 5*

In June, the staff planted shrubs around the groundwater springs on the Cudmore Branch of Winter River. The buffer zones are quite narrow next to the grass fields. By planting shrubs it will increase shade and provide extra bank stability adjacent to the headwaters.

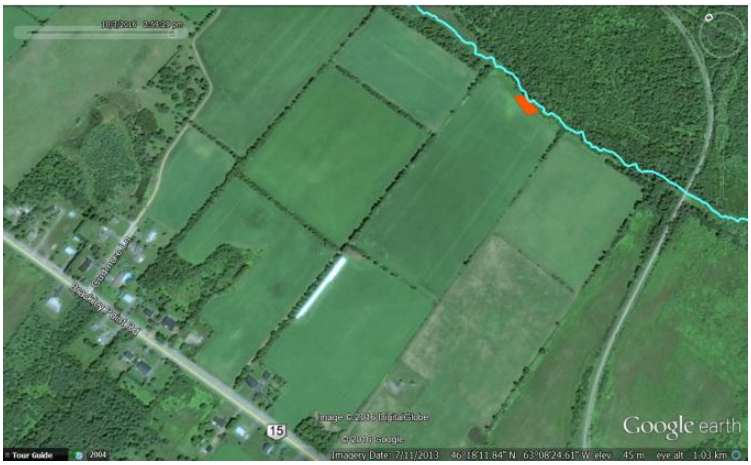


Figure 10: Cudmore Branch, Winter River

Figure 9: Shrub plantings near headwater springs

3.1.6 *Site 6*

In August, the staff removed several small beaver dams and two culverts at a private crossing on Pipers Creek. At the crossings, shrubs and trees were planted in the area to provide bank stability and shade to the stream. Just below the large beaver dam, a few shrubs and trees were planted in the areas that were flooded from the small beaver dams. More shrubs are needed along the banks in this area.

Figure 11: Pipers Creek

Figure 12: Site after beaver dam removal.

3.1.7 *Site 7*

In the fall, the chainsaw operator thinned patches of Balsam Fir within the buffer zone along the Winter River Trail. This area was planted by staff and two volunteers with native shrub and trees that were left over from the summer. More diversification is needed in this area, as selection of species were thin in the fall with only red maple, yellow birch, willow and spruce to choose from.

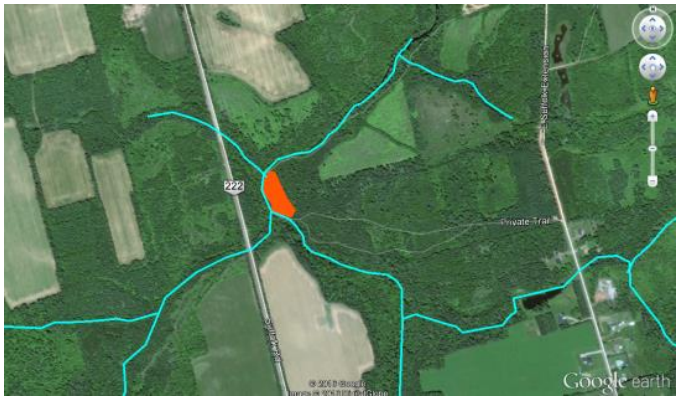


Figure 13: Winter River Trail

Figure 14: Volunteers and staff planting trees by Winter River trail.

3.2 Stream Clearing

The summer crew cleared approximately 10 km of stream in the watersheds this season. At the beginning of the season Tessa cleared ~1.4 km in the north Friston Branch and ~ 0.6 km in MacAulay's Creek. In July, Steve and Tate cleared the Vanwesterneng Branch that crosses along the East Suffolk road for ~1.5 km. In addition, a few sections along Black River where we had permission were cleared of large blockages totaling ~1.6 km reach. All the tributaries below beaver dams were cleared on Pipers Creek, totaling ~2.4 km. In addition, blockages were selectively taken out from the main stem of the Winter River: near the mazer branch, above Officers pond, and up by the Cudmore branch totalling 1 km.

Figure 15: Friston Branch – 1.4 km

Figure 16: MacAulay's Creek – 0.6 km

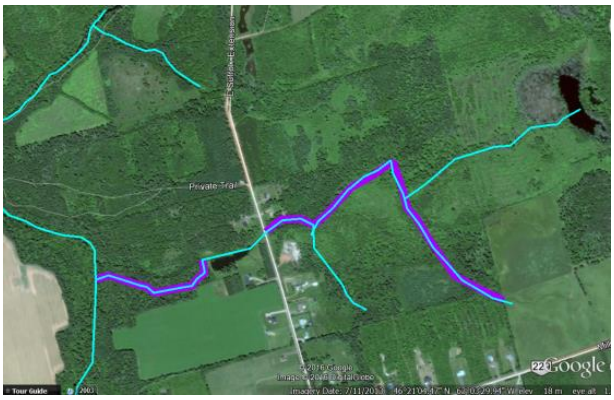


Figure 17: Vanwesterneng Branch – 1.5 km

Figure 18: Black River – 1.6 km

Figure 19: Piper's Creek – 2.4 km

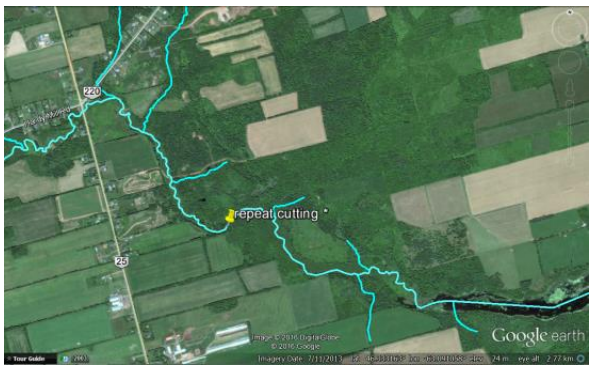


Figure 20: Winter River, above Officers pond.

Figure 21: Black River – before and after debris removal.

Figure 22 : Black River – before and after debris removal.

Figure 23: Vanwesterneng Branch – before and after debris removal.

Figure 24: Vanwesterneng Branch – before and after debris removal.

Figure 25: Winter River, Above Officers Pond – The stream at this location was 6 feet deep; the chainsaw operator was only able to remove the debris above and around the blockage. In a fall assessment, the water level is now well below this blockage and a chainsaw operator in 2017 should be able to take the rest of it out.

3.3 Brush mats

In total, the crew installed 6 small and 2 large brush mats. The 2 large brush mats are below the culvert on Donaldston road on MacAulay's Creek. There were two old beaver dams removed last year in the estuary that uncovered densely silted banks along the river. The crew also installed 5 smaller brush mats along the Friston north branch near the pit where there was an excess amount of silt deposited. In Vanwesterneng, a couple of small brush mats were installed.

Figure 26: Brush mats at MacAulay's Creek

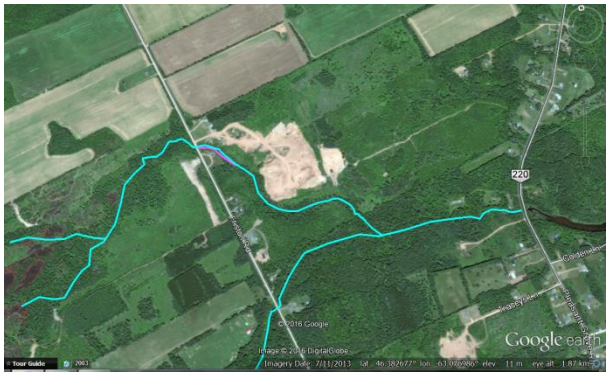


Figure 27: Brush Mats at Friston South Branch, Winter River

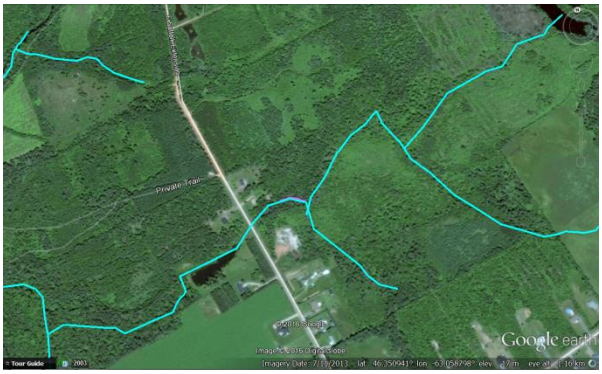


Figure 28: Brush mats at Vanwesterneng Branch, Winter River

Figure 29: Brush mats at MacAulay's Creek

Figure 30: Friston Branch brush mats

3.4 Silt Fencing

In the spring, key locations for sediment runoff were identified by Hilary and Jill during the stream assessments. In the summer the crew installed 3 silt fences to mitigate this problem. A small silt fence was installed at an abandoned pit road that was a source of silt during snow melt above the headwaters of the Wheatley Branch in Winter River. In addition, a second small silt fence was installed along the pit road of the Vanco Branch. The berm on the pit road beside the culvert had begun eroding away in the spring and was a direct source of silt runoff into the tributary. This silt fence was fixed during the summer after a heavy rainfall event, as leaks were found and plugged up with hay bales. This fence was accompanied with native shrub plantings. A large, 200 m long silt fence was installed adjacent to the headwaters of the Pater Branch in Winter River. This area is adjacent to a large active field that is the direct source of the sediment runoff during snow melt or precipitation events. A large effort was made here to mitigate the agricultural runoff and was accompanied with native tree and shrub species.

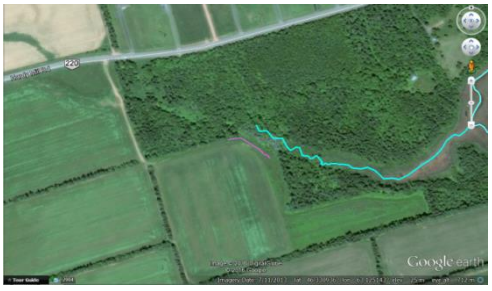


Figure 31: Silt fence at Pater Branch, Winter River

Figure 32: Silt fence at Vanco Branch, Winter River

Figure 33: Silt fence at Wheatley Branch, Winter River

Figure 34: Headwaters of the Wheatley Branch, Winter River –
showing silt issues at road crossing, and silt fence that was installed to deal with silt.

Figure 35: Sediment moving between an agricultural field and the headwaters of
Pater Branch, Winter River; silt fence installed to deal with silt.

Figure 36: Sediment fencing below a pit road, adjacent to the stream of Vanco Branch, Winter River

3.5 Cover Logs

The crew installed 15 cover logs along Winter River in areas that lack woody debris cover and shade from vegetation.

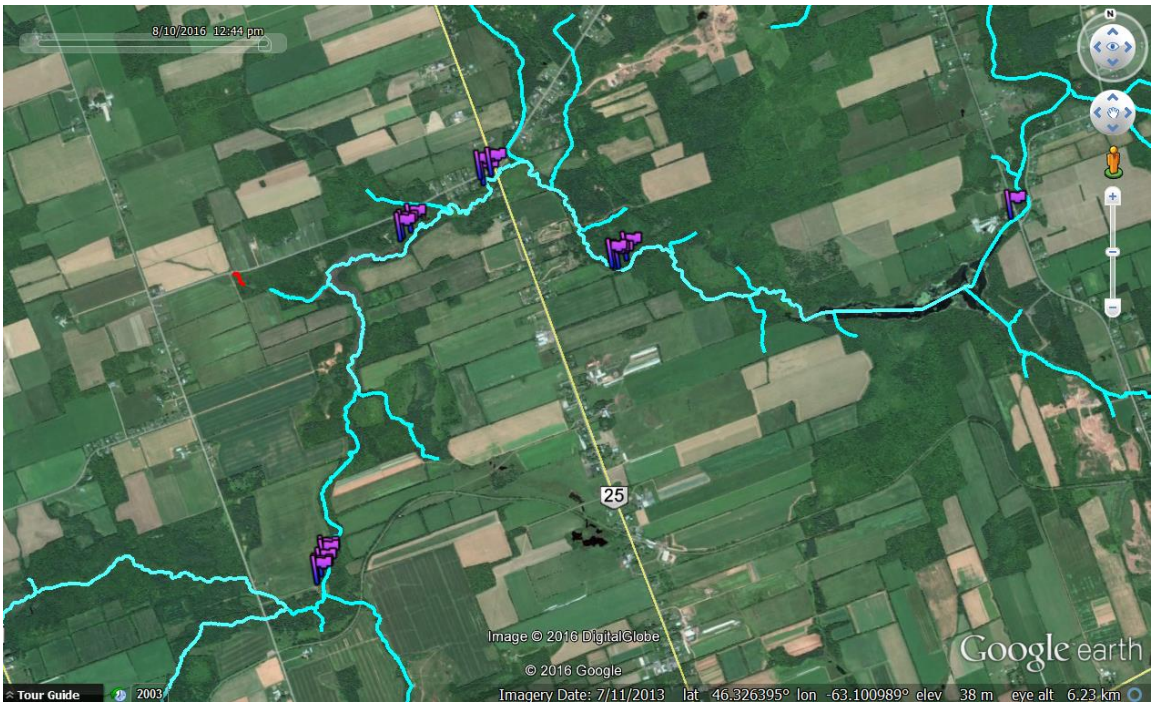


Figure 37: Cover logs along the main stem of Winter River

3.6 Private Culvert Removal

The crew removed two private culverts that were side by side at a road crossing located along Pipers Creek. These culverts were located at an old crossing and were impeding proper flow and fish passage. The metal culverts were removed with hand tools by the summer crew. In addition, geotextile fabric and shrubs were planted adjacent to the stream to increase bank stability.

Figure 38: Culvert removal at Piper's Creek

Figure 39: Culvert removal at Pipers Creek, check up on the "toe" rock to ensure it block passage

3.7 Substrate Enhancement

Pebble substrate was added to the Pleasant Grove corner springs to improve spawning grounds for fish in Winter River. This area has a high density of young of the year and is generally sandy. With the addition of pebbles, this will improve the spawning grounds for Brook Trout. In addition, native shrub plantings will provide additional cover for fish in the area.

Figure 40: Substrate Enhancement at MacLauchlan Branch in Winter River

Figure 41: A before and after picture of pebble enhancement in the springs on the MacLauchlan Branch, Winter River

3.8 Sediment Trap Excavation

In early September, the instream sediment trap near the Union Road pumping station was excavated. This in-stream sediment trap acts as a collection area for silt flowing down from the headwaters, to prevent the silt from moving further downstream into important fish habitat. Silt is removed every 3-4 years as material accumulates. The rate of deposition of silt depends on the land use practices in upstream areas, and is mostly heavily influenced by potato farming.

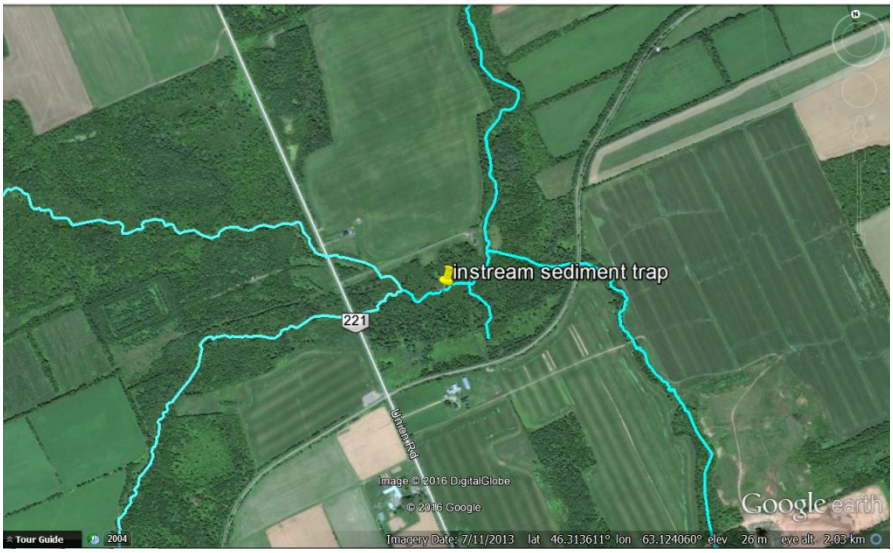


Figure 42: Silt trap location.

Figure 43: Long reach excavator at work, site after banks were stabilized with geo-jute.

3.8 Alewife aka “Gaspereau” Movement

In early June, Alewife move upstream to spawn in the Winter River. During the upstream migration, thousands of fish swim upstream to the Suffolk dam. Here, the dam comes alive with fish fighting the velocity of the fish ladder. Many fish tumble back down the fishway after fighting the constant current against other fish. The Alewife population become overcrowded within the fishway and below the dam creating a problem for the species to reach their spawning grounds. A few hours were spent assisting 3800 Alewife over the Suffolk Dam with buckets. More time should be dedicated to this effort until the fishway is improved for passage.

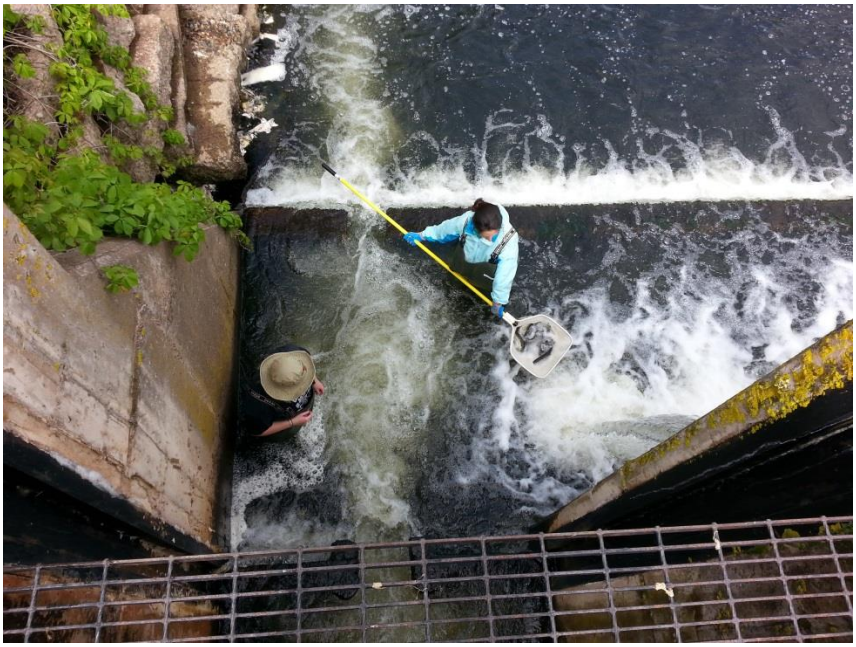


Figure 44: Catching Alewife in June to move above the Suffolk Dam

4 Water Monitoring

4.1 Water-Level Loggers

The water-level loggers were placed in the same location for Officers, Hardy and Union in 2016. The other loggers were moved from their locations in 2015. After the spring, many on site field velocity measurements could not be registered on the flow meter as the flow was too slow at the depth loggers in Winter River. However, "The Orange Method" was started in late July, timing a fresh orange floating down the river at a set distance and the r-curve for the readings improved. Next year, the technicians should take a reading with the velocity meter (if able) and the orange method on every site from the beginning to get a more accurate correlation. The "Tim's Outlet", "Officers Outlet" and the "Friston Branch" were left in the streams over winter. In 2016, the logger (S/N 10685269) was moved around quite a bit due to the improper site location/river conditions. In 2017, this logger could be moved to Black River, downstream of the Donaldston Rd culvert, to compare with "Tim's Outlet" in Winter River. Both loggers are close to the head of tide and encompass most of the drainage area of the watershed. Comparing these two may give insight to the impact of water extraction on the lower end of the watershed. This logger could also be moved up in the Cudmore Branch to give insight of how water extraction is affecting flow of the other headwater branches. If both locations interest the watershed group, moving either the "Officers" OR "Union" depth logger would work as Environment Canada also monitors both spots and only one of the groups loggers is necessary for comparison.

Flashiness:

"The flashiness is counted by the number of times in the season that the discharge reaches 3x that of the median flow. The term 'flashiness' refers to the frequency and rapidity of short-term changes in stream flow during runoff events and changes in the flashiness of streams can greatly affect the presence and distribution of stream biota" – Parks Canada Paper, 2014

R-B Index:

"The 'R-B Index' is a measure of flow variability and flashiness. The index measures oscillation in discharge relative to total discharge, and a result, characterizes the way a catchment processes inputs into its stream flow outputs." – Parks Canada Paper, 2014

"It measures oscillations in flow (or discharge) relative to total flow (or discharge), and as such, appears to provide a useful characterization of the way watersheds process hydrologic inputs into their streamflow outputs." – David Baker, 2004

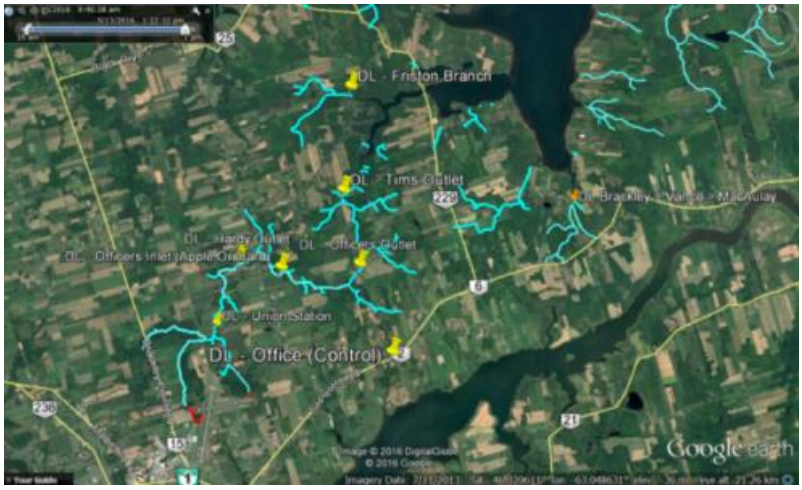


Figure 45: Water Level Logger Locations 2016

2016 Water Level Logger Locations						
	Name	**Location**	**Serial Number**	**Date Installed**	**Date Taken Out**	**Notes**
1	WR @ Tim's Creek Outlet	46° 21.119'N 63° 4.309'W	10685268	16-May-16 9:23	07-Nov-16 12:05 PM	Below tributary outlet
2	WR @ Officer's Outlet	46° 19.903'N 63° 3.925'W	10685267	16-May-16 9:05	07-Nov-16 11:55 AM	Below Suffolk Dam
3	WR @ Officer's Inlet (Apple Orchard)	46° 19.847'N 63° 5.800'W	10685271	16-May-16 10:10	07-Nov-16 1:00 PM	Below Apple Orchard
4	WR @ Hardy Outlet	46° 19.997'N 63° 6.803'W	10685270	16-May-16 10:30	07-Nov-16 1:15 PM	Below Hardy Dam
5	WR @ Union Station	46° 18.968'N 63° 7.318'W	10685272	16-May-16 11:30	07-Nov-16 1:30 PM	Below EC station
6	Friston Branch	46° 22.835'N 63° 4.133'W	10685266	16-May-16 9:45	07-Nov-16 12:20 PM	Above culvert
7a	Brackley Branch	46° 18.919'N 63° 7.768'W	10685269	16-May-16 11:00	16-Jun-16 10:00 AM	Above culvert
7b	Vanco Branch	46° 18.837'N 63° 07.318'W		16-Jun-16 11:00	26-Aug-16 2:00 PM	Above outlet
7c	MacAulay's Creek	46° 21.074' N 62°58.753' W		26-Aug-16 15:00	07-Nov-16 12:35 PM	Above culvert
8	Office (control)	46° 18.450'N 63° 3.146'W	10685265	16-May-16 8:30	07-Nov-16 1:45 PM	Attached to telephone pole

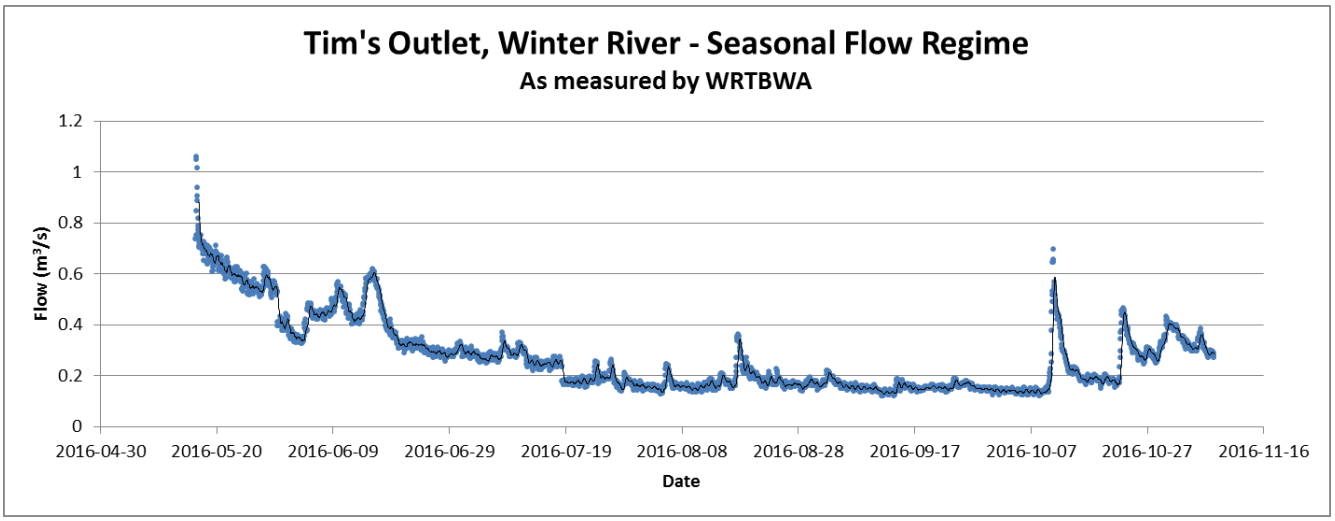
4.1.1 *Site 1: Tim's Outlet*

Observations

Velocity meter measurements were almost sufficient for the season. However, due to low water levels during the summer/fall, it was hard to capture the entire cross section with the meter. The water depths near the banks were too shallow for the meter and/or had stagnant flow. Most of the undercuts were unusable as habitat during the monitoring season as the rivers width/depth dropped significantly.

Outliers

May 30th at 11am and July 18th at 9 am - There was a slight drop in water discharge because field measurements were taken then. Debris, algae and sediment tend to attach or accumulate around the depth logger. Every time measurements are taken, the logger is cleaned off by the technician. This 2 cm difference in water depth after cleaning, accounts for the change in the discharge.



R^2 Value = 0.5523	Discharge (m^3/s)	Water level instream (m)	Date (dd-mm-yyyy)
Minimum Flow	0.120839831	0.25	11-09-2016
Median Flow	0.215666119		
Maximum Flow	1.059138556	0.44	16-05-2016

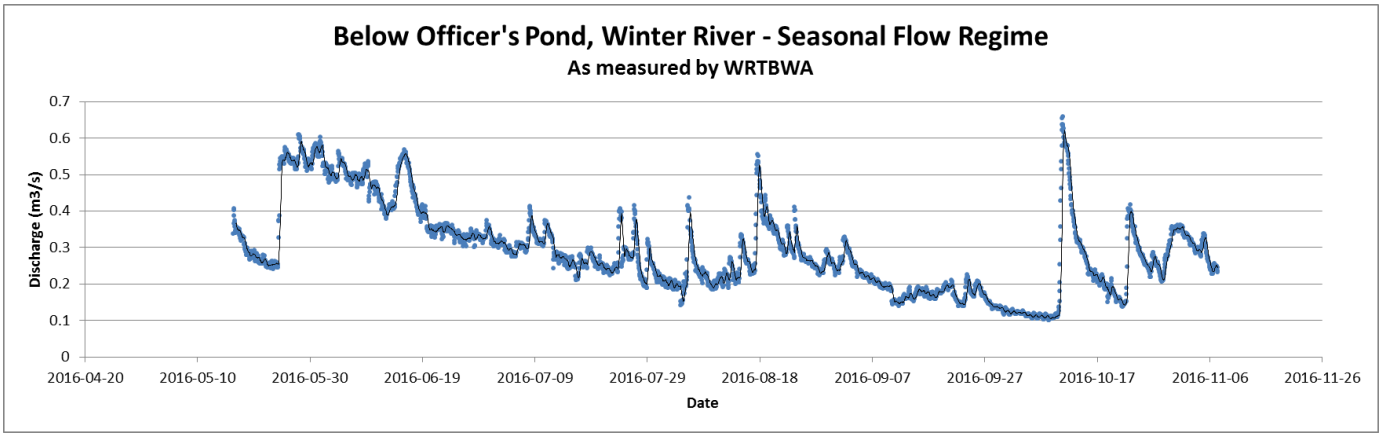
R-B Index: 0.083358
Flashiness (# of high flow pulses): 11
High flow threshold: 0.647 m^3/s

4.1.2 *Site 2: Officer's Outlet*

Observations
In May, at the beginning of the monitoring season the velocity meter measurements were only possible in the thalweg. This was a continuing problem as it wasn't the true cross section of river discharge. Therefore, the addition of the "Orange Method" made it possible to measure shallow and slower areas of the stream.

Outliers
May 24, 2016 between 9 am and 3 pm – There is a drastic increase in water discharge. Baffles were installed in the culvert below the depth logger sometime in the spring accounting for the increased water level, adjusting the discharge reading at the same time.

- ✓ July 24, 2016 between 11 pm and 12 pm the next day - spikes up, no rain and no measurements
- ✓ September 10 @ 10 am - spikes down, no rain and no measurements



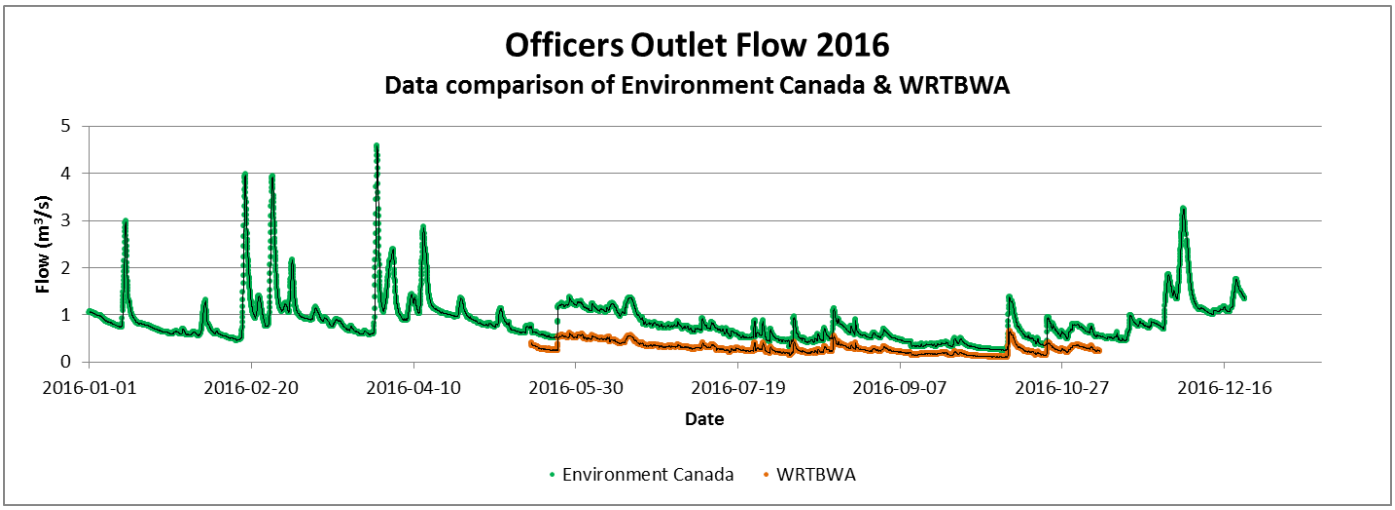


Figure 46: The depth logger at this site measures less flow than the Environment Canada Station. Possible cause: the infield measurements did not capture the full cross section. Since using the orange, it is hard to capture the discharge near the banks due to alder vegetation in the stream.

R^2 Value = 0.6225	Discharge (m3/s)	Water level instream (m)	Date (dd-mm-yyyy)
Minimum Flow	0.100552216	.304	08/10/2016
Median Flow	0.270250311		
Maximum Flow	0.658937702	.557	10/10/2016

R-B Index: 0.100449357
Flashiness (# of high flow pulses): 0
High flow threshold: 0.811 m^3/s

4.1.3 *Site 3: Apple Orchard*

Observations

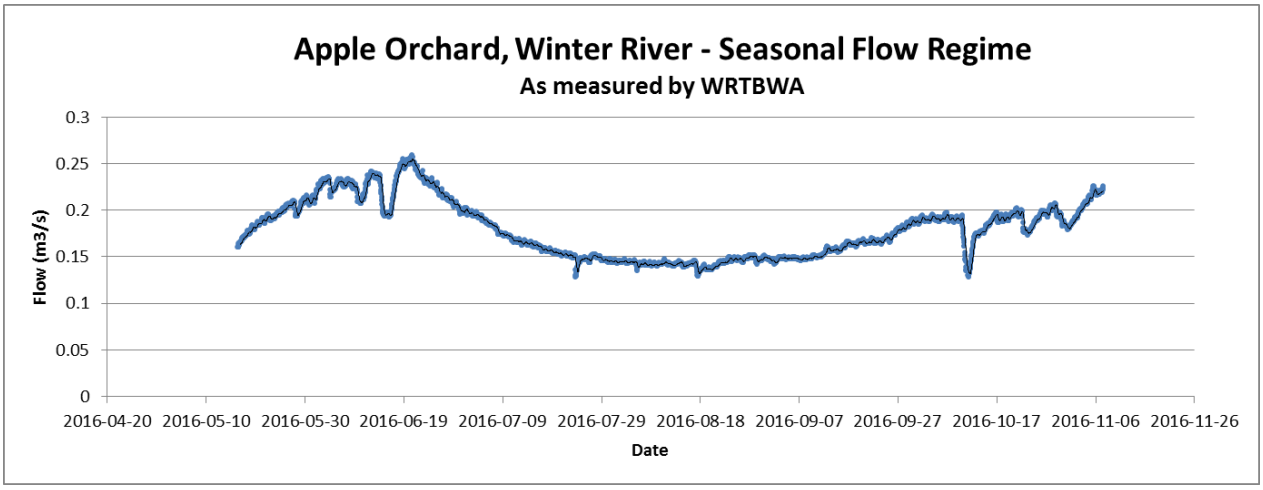
In May, at the beginning of the monitoring season the velocity meter measurements were only possible in the thalweg. This was a continuing problem as it wasn't the true cross section of river discharge. Hence, the addition of the "Orange Method" made it possible to measure the slower areas of the stream. Eventually, due to the impounding beaver dam downstream the flow was stagnant and the velocity meter could not take a measurement. So, the "Orange Method" was used for the remainder of the season.

My suggestion is to move the logger upstream, since the data is unusable for flow comparison because of the beaver since the landowners are not willing to take them out. The logger needs to be far enough downstream from the "MacLauchlan Branch" so it does not influence the logger like it did in 2015. In addition, the landowner was cooperative to let us through the Apple Orchard to take measurements, but one of the dogs tied outside on the property could be of danger to the staff if it ever got loose as it is very protective of its property. Ask Hilary for further details.

Outliers

During the monitoring season, several factors have influenced the discharge readings at this location. This data will not be used to compare flows, but shows some interesting trends due to external factors.

1. York Bridge Replacement Upstream - the construction of the York Bridge ensued during the late summer and up until December.
2. Beaver Dam Downstream – a beaver dam was found downstream in the early fall. This explains the "stagnant" river effect, as measurements even with the orange were quite difficult to measure all season.
   October 10 to 11, 2016 – water level/discharge drops significantly and rises back up again in a few days. Only explanation I thought of, the landowners removed the beaver dam and beavers proceeded to rebuild it??
3. Large Blockage Downstream – this blockage consisted of a few large trees with vines and other vegetation beginning to grow over top. This blockage back pooled the water behind it, and when it was partially removed, released the water with it, decreasing the depth of the river upstream.
4. Hardy Dam Vandals – there is a small drop in flow discharge around the time the hardy outlet was released and fixed.



R^2 Value = 0.2973	Discharge (m3/s)	Water level instream (m)	Date (dd-mm-yyyy)
Minimum Flow	0.127601951	.667	23/07/2016
Median Flow	0.176821141		

Maximum Flow	0.25863046	.362	20/06/2016

R-B Index: 0.023423445
Flashiness (# of high flow pulses): 0
"High flow" threshold: 0.530 m^3/s

4.1.4 *Site 4: Hardy Outlet*

Observations

The Hardy Mill Pond, visually seemed lower and was only draining through the fish ladder, not like in 2015 when the water was also pouring over the dam. This location worked alright with the velocity meter, but water depth was becoming an issue as the summer/fall proceeded. There were times when the orange would just not float and instead roll over the substrate because there were only a few centimeters of water in the river, due to the vandalism of the hardy outlet. Perhaps if no vandalism occurs next year, this location would be ideal but the temperatures may be inaccurate which I will talk about in the next section.

Outliers

Bored people vandalized the hardy outlet on Friday July 23, 2016 and Friday September 9, 2016 and let the 2nd outlet of the pond go by removing 3 -4 wooden boards out of the outlet which controlled the level of the pond. There was a period once the boards were put back in, that there was no water in the stream below the Hardy Mill Dam because the pond level was too low because it was emptying for days.

Taken out 1st time:

Date	Time	Depth (m)	Discharge (m^3/s)
23/07/2016	17:00	0.063	0.01828494
23/07/2016	18:00	0.236	0.351448076

Fixed 1st time:

Date	Time	Depth (m)	Discharge (m^3/s)
26/07/2016	17:00	0.069	0.022414113
26/07/2016	18:00	-0.001	#NUM!
26/07/2016	19:00	0.001	1.71716E-06

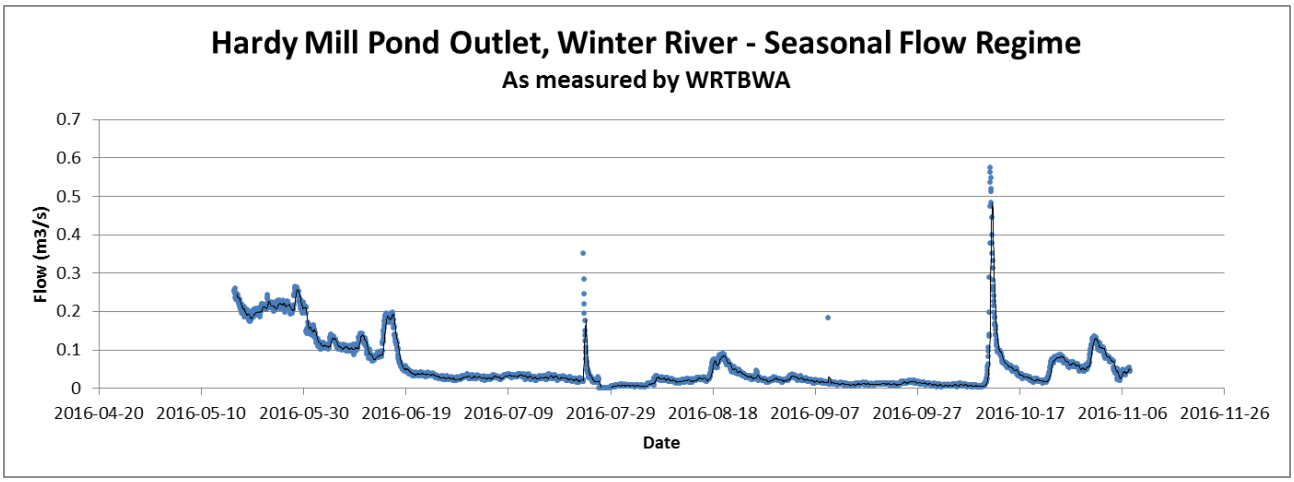
Taken out 2nd time:

Date	Time	Depth (m)	Discharge (m^3/s)
09/09/2016	11:00	0.058	0.015195467
09/09/2016	12:00	0.176	0.182270329
09/09/2016	13:00	0.056	0.014047659

Fixed 2nd time:

Date	Time	Depth (m)	Discharge (m^3/s)
11/09/2016	8:00	0.051	0.011394443
11/09/2016	9:00	0.046	0.009044699

Figure 47: Fixing the pond outlet on July 26, 2016



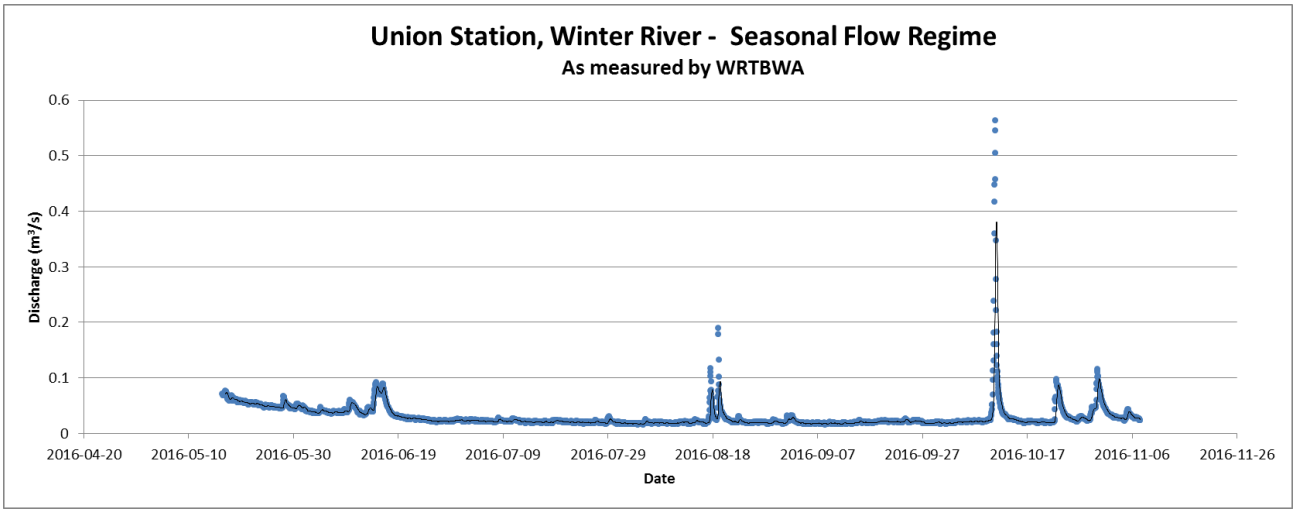
R^2 Value = 0.8571	Discharge (m3/s)	Water level instream (m)	Date (dd-mm-yyyy)
Minimum Flow	0.000001717	.001	26/07/2016
Median Flow	0.028651876		
Maximum Flow	0.574730864	.156	11/10/2016

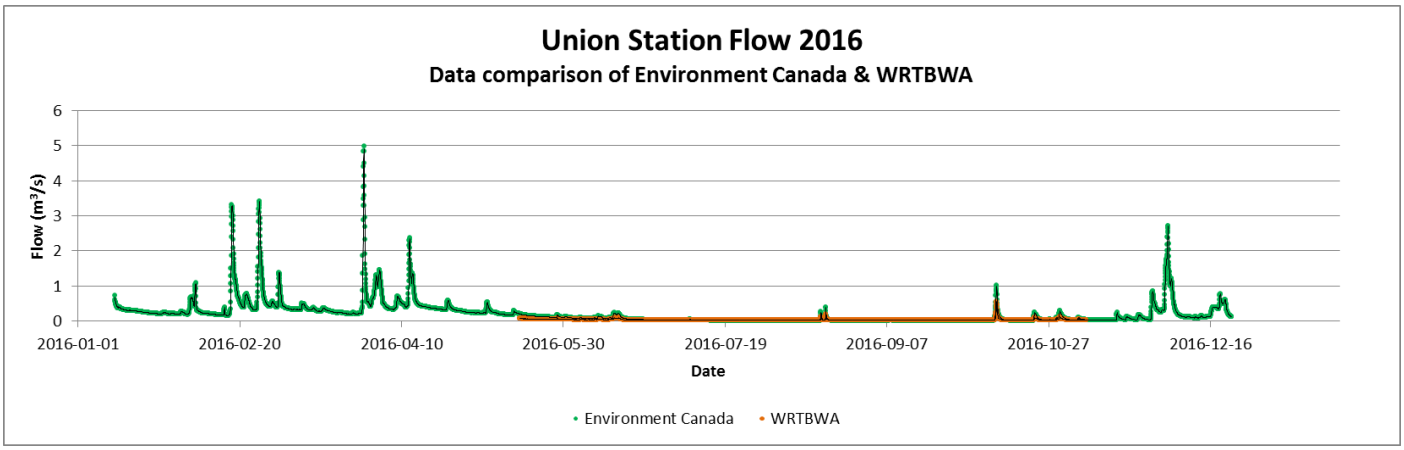
R-B Index: 0.219341
Flashiness (# of high flow pulses): 23
"High flow" threshold: 0.086 m^3/s

4.1.5 *Site 5: Union Station*

Observations
The discharge was extremely low in the headwaters, the Brackley Branch went dry mid-July, and for the first time observed by WRTBWA the Vanco and Cudmore springs that we monitor also went dry for a couple weeks in the fall. No velocity meter measurements could be taken, even in rain events, nothing all summer. The "Orange Method" was the main method, but would take minutes just to travel a couple of meters. A few times, the orange floated back upstream, perhaps some background research on what to do with "reverse" flows in rivers would be helpful.

Outliers
The only outlier at union would be when we clean off the depth logger and accidentally adjusts the substrate underneath of it, which causes a sudden increase/decrease in the next hourly measurement.





R^2 Value = 0.2842	Discharge (m3/s)	Water level instream (m)	Date (dd-mm-yyyy)
Minimum Flow	0.015	.258	04/08/2016
Median Flow	0.021840618		
Maximum Flow	0.563060786	.733	10/10/2016

R-B Index: 0.18788203
Flashiness (# of high flow pulses): 9
"High flow" threshold: 0.066 m^3/s

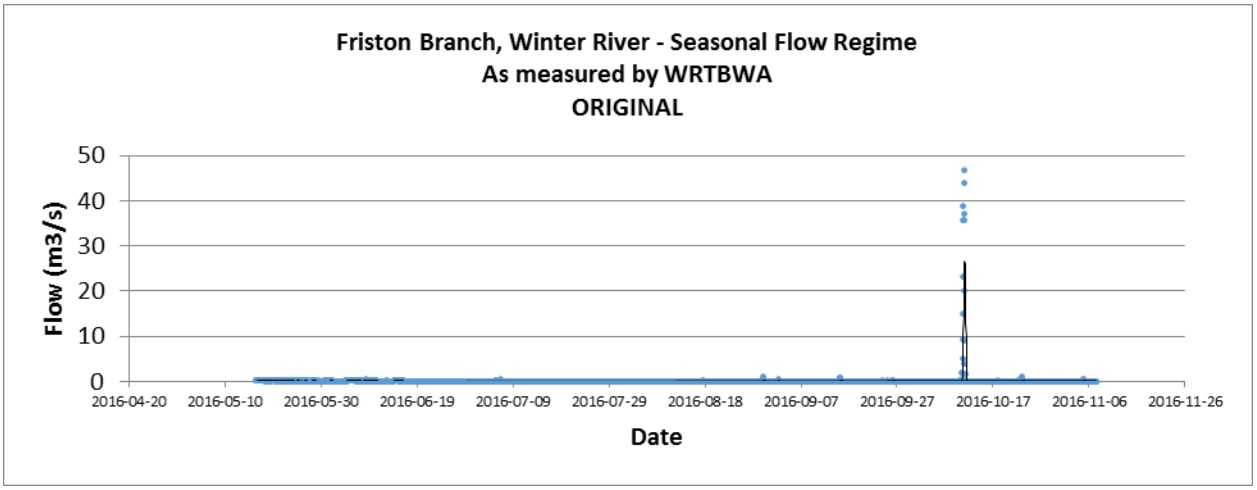
4.1.6 *Site 6: Friston Branch*

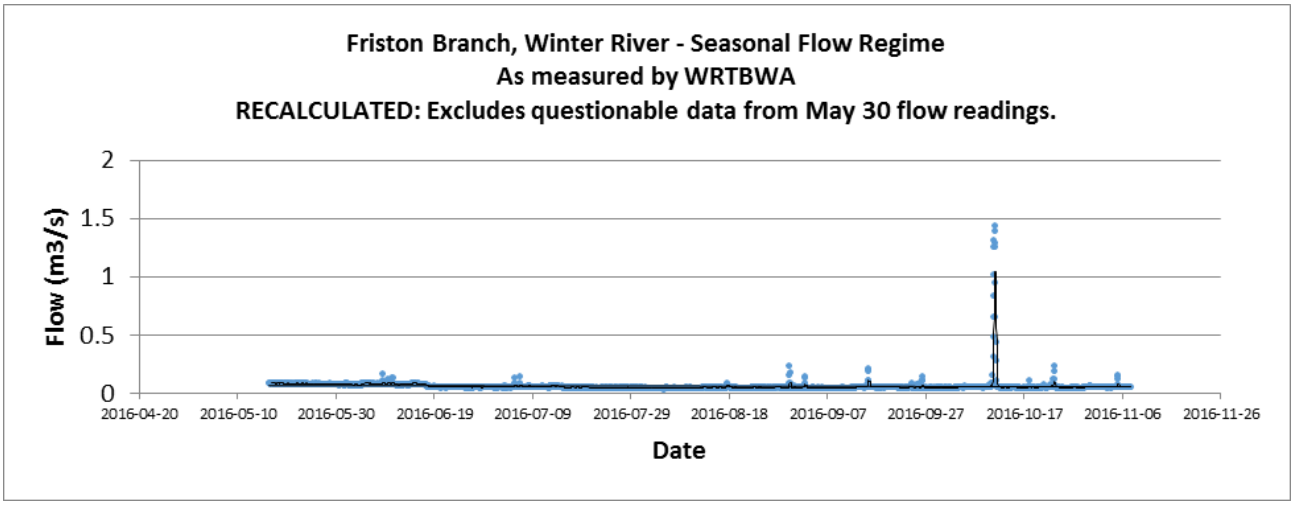
Observations

This tributary has the most consistent flow out of all the loggers. Every day the measurements were always the same water depth and velocity. There are only significant fluctuations in flow during precipitation events. Extensive clear cutting was happening upstream of the Friston Rd during late summer and fall. This could have an impact on how quickly the rain runs off the newly cut land, instead of absorbing into the forest ground.

Outliers

May 30, 2016 – depth logger measurements were taken by Jill and Tessa. The water depth measurements are questionable on this date as the velocities look "normal" compared to other days, yet the water depth jumps half a meter higher. It did drizzle and shower that day, but other depth loggers showed minimal impact.





R^2 Value = 0.0072	Discharge (m3/s)	Water level instream (m)	Date (dd-mm-yyyy)
Minimum Flow	0.073961	.097	04/08/2016
Median Flow	0.081257		
Maximum Flow	.2188245	.929	10/10/2016

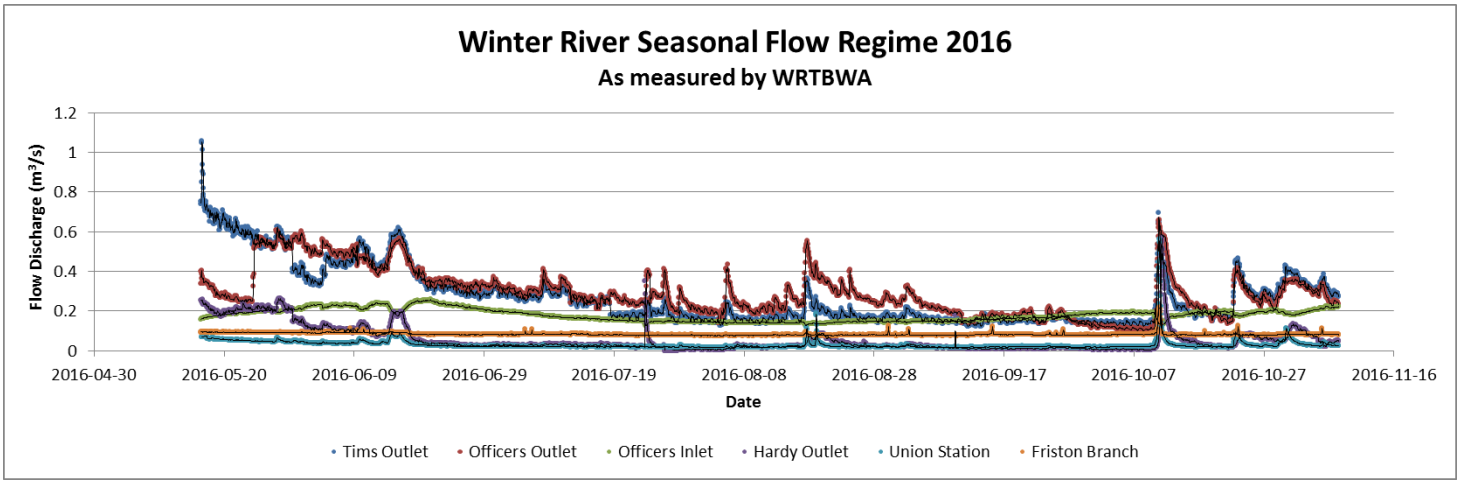
R-B Index: 0.023
Flashiness (# of high flow pulses): 1
"High flow" threshold: 0.244 m^3/s

4.1.7 *Site 7a, 7b and 7c: Brackley/Vanco/MacAulay's*

Observations

This logger was moved around quite a bit. At first, the logger was installed in Brackley to hopefully capture some flow before it is drained dry in July. But, before the "Orange Method" was initiated, there were absolutely no velocity measurements from the meter at this location. The logger was then moved to the "Vanco Branch" in attempt to capture flow from another headwater branch. However, this branch is quite narrow and shallow and taking measurements in this location was very inconsistent, so it was then moved to MacAulay's Creek, completely outside the Winter River watershed. Measurements were not as frequent at this location since it is further away. There was not enough correlation to complete data analysis on this logger. Perhaps moving this to Black River below Donaldston Road would capture the flow trends of another watershed without the impacts from water extraction.

Winter River-Tracadie Bay Watershed Association Flow Regime: Results 2016						
	Tim's Outlet	**Officer's Outlet**	**Officer's Inlet**	**Hardy Outlet**	**Union Station**	**Friston Branch**
Minimum Flow (m3/s)	0.12084	0.10055	0.12760	0.00000	0.01500	0.073961
Median Flow (m3/s)	0.21567	0.27025	0.17682	0.02865	0.02184	0.081257
Minimum Depth (cm)	24.8	30.4	36.2	-.001 (dry stream)	25.8	9.7
R-B Index (no units)	0.08	0.10	0.02	0.2	0.19	0.023



4.2 Temperature Loggers

The temperature loggers were deployed in May and continued to take hourly data until October. Two temperature loggers used from last season, had a full memory capacity within a couple weeks from deployment. The estuary temperature logger was hooked onto a dock in the Winter River Circle neighbourhood, perhaps too much foot traffic and was lost. Find another location for next season to capture some temperatures within the estuary. The Hardy Mill Pond surface logger was dislodged and not found at the end of the season. The rest of the temperature loggers successfully measured hourly temperatures. Some may be affected by sun, so best efforts were made to keep the loggers in the shade. In most locations, the water temperatures were less than 20 degrees except within Officers Pond on Winter River, below a private pond on Winter River, and below two beaver ponds located on the east side of Tracadie.

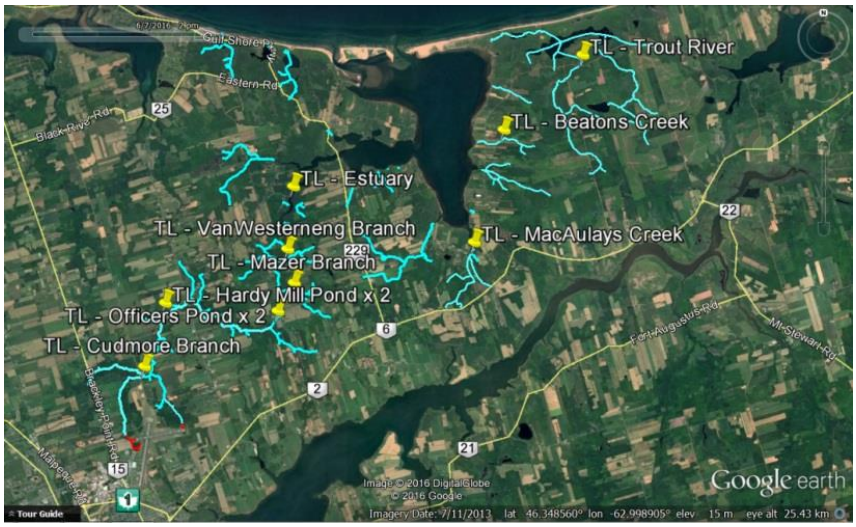


Figure 48: Temperature Logger locations 2016

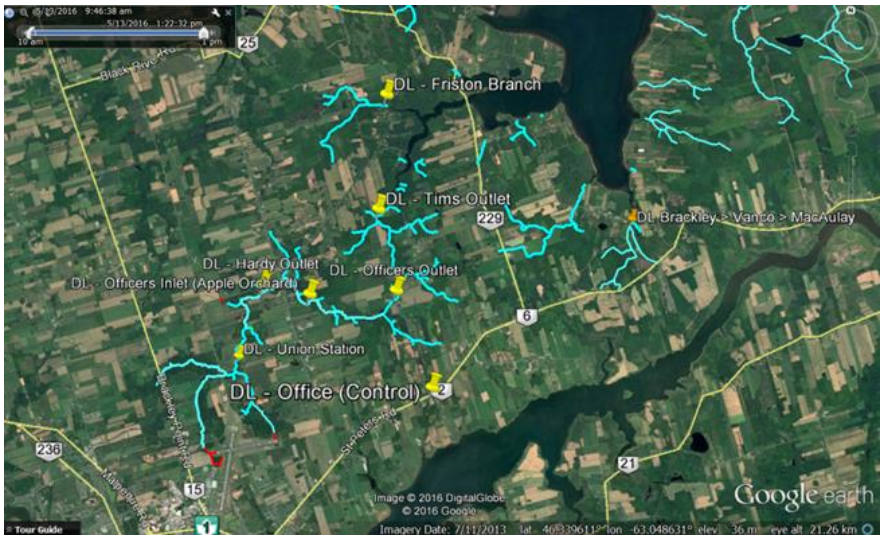
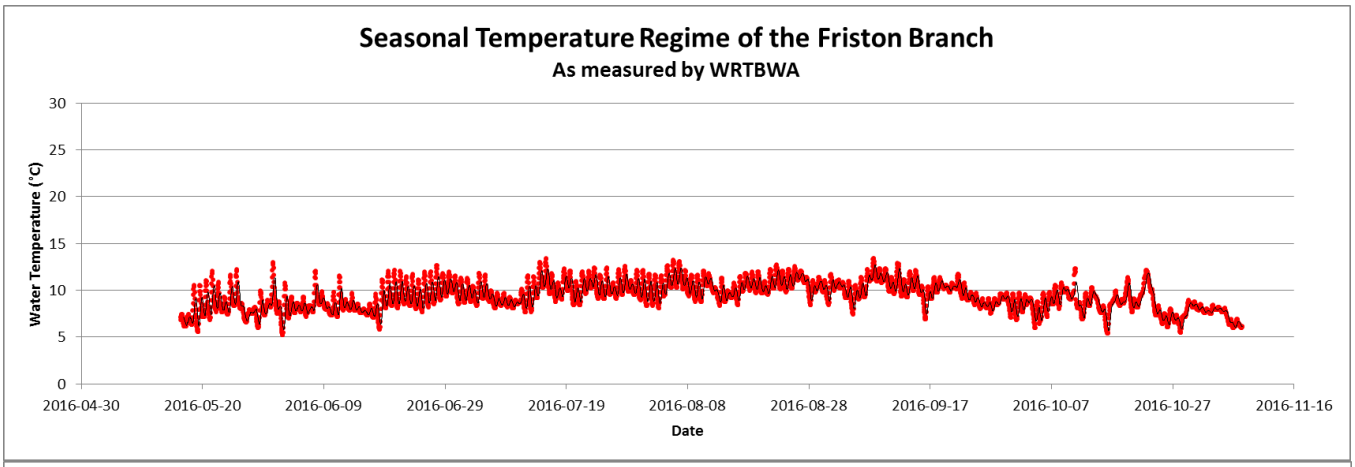
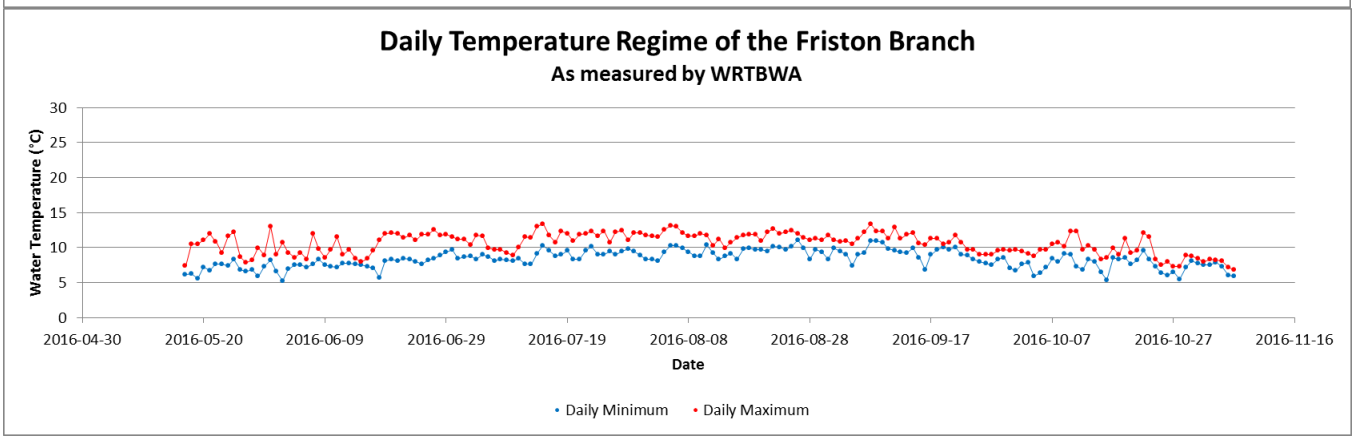


Figure 49: Depth Logger locations 2016

2016 Temperature Logger Locations						
	Name	**Location**	**Serial Number**	**Date Installed**	**Date Taken Out**	**Notes**
1	Winter River Estuary (TL)	46° 22.127' N 63° 3.606' W	10880491	2016-05-30 14:38	LOST - not present on the dock	Winter River Circle - local dock
2	Friston Branch, Winter River (DL)	46° 22.835'N 63° 4.133'W	10685266	2016-05-16 9:45	2016-11-07 12:20	Upstream of culvert
3	Tim's Outlet, Winter River (DL)	46° 21.119'N 63° 4.309'W	10685268	2016-05-16 9:23	2016-11-07 12:05	Below Tim's Tributary
4	Vanwesterneng Branch, Winter River (TL)	46° 20.963' N 63° 3.760' W	10731629	2016-05-30 13:30	2016-10-28 13:00	Below Private Pond
5	Mazer Branch, Winter River (TL)	46° 20.336' N 63° 3.582' W	10880468	2016-05-31 9:15	2016-10-28 12:20	Below Private Pond
6	Officer's Outlet, Winter River (DL)	46° 19.903'N 63° 3.925'W	10685267	2016-05-16 9:05	2016-11-07 11:55	Below the Suffolk Dam
7	Officer's Pond, Winter River (TL)	46° 19.813' N 63° 4.019' W	10880488	2016-05-31 11:05	2016-10-20 8:45	Bottom Logger
8	Officer's Pond, Winter River (TL)	46° 19.813' N 63° 4.019' W	10880490	2016-05-31 11:05	2016-10-20 8:45	Surface Logger
9	Officer's Inlet, Winter River (DL)	46° 19.847'N 63° 5.800'W	10685271	2016-05-16 10:10	2016-11-07 13:00	Just below the Apple Orchard
10	Hardy Outlet, Winter River (DL)	46° 19.997'N 63° 6.803'W	10685270	2016-05-16 10:30	2016-11-07 13:15	Just below the Hardy Dam
11	Hardy Mill Pond, Winter River (TL)	46° 19.962' N 63° 7.044' W	10731605	2016-06-07 15:30	2016-10-20 9:30	Bottom Logger
12	Hardy Mill Pond, Winter River (TL)	46° 19.962' N 63° 7.044' W	10880489	2016-06-07 15:30	LOST - rope let go	Surface Logger
13	Union Station, Winter River (DL)	46° 18.968'N 63° 7.318'W	10685272	2016-05-16 11:30	2016-11-07 13:30	Downstream of station
14a	Brackley Branch, Winter River (DL)	46° 18.919'N 63° 7.768'W	10685269	2016-05-16 11:00	2016-06-16 10:00	Upstream of culvert
14b	Vanco Branch, Winter River (DL)	46° 18.837'N 63° 07.318'W		2016-06-16 11:00	2016-08-26 14:00	Upstream of outlet
14c	MacAulay's Creek (DL)	46° 21.074' N 62°58.753' W		2016-08-26 15:00	2016-11-07 12:35	Upstream of culvert
15	Cudmore Branch, Winter River (TL)	46° 18.782' N 63° 7.600' W	10880492	2016-05-17 12:48	2016-10-26 16:00	Downstream of culvert
16	Trout River (TL)	46° 24.567' N 62° 55.815' W	10731604	2016-05-30 14:04	2016-10-24 11:11	Downstream of culvert
17	Beaton's Creek (TL)	46° 23.178' N 62° 57.942' W	10880486	2016-05-24 16:00	2016-10-24 11:25	Below Beaver Pond
18	MacAulay's Creek (TL)	46° 21.090' N 62° 58.741' W	10880487	2016-05-30 13:30	2016-10-24 11:33	Downstream of culvert
19	Atmospheric control (DL) at Office					

4.2.1 *Site 2*

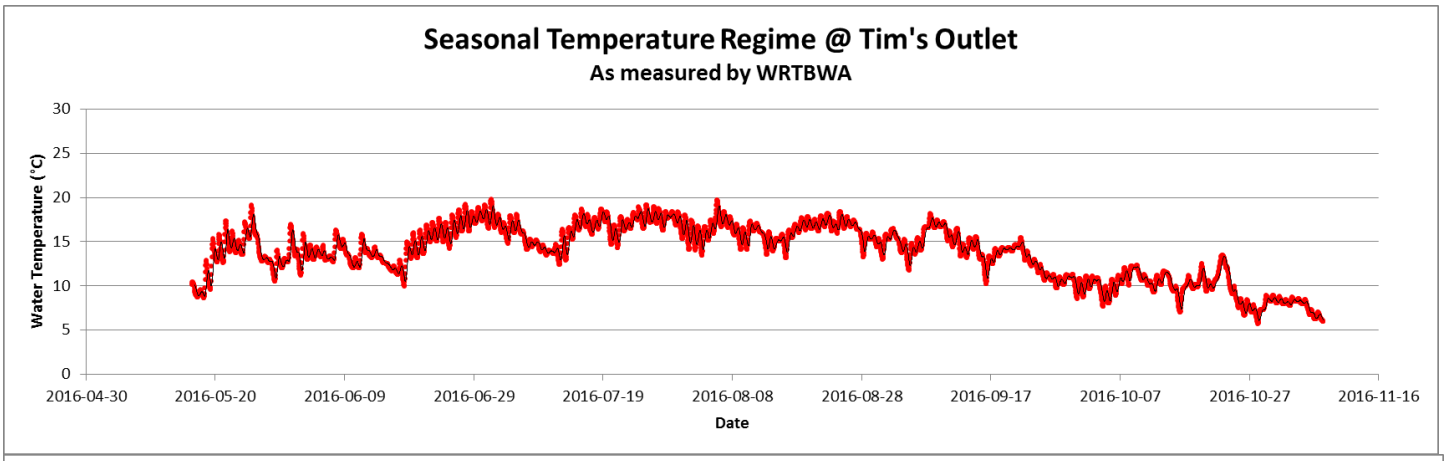


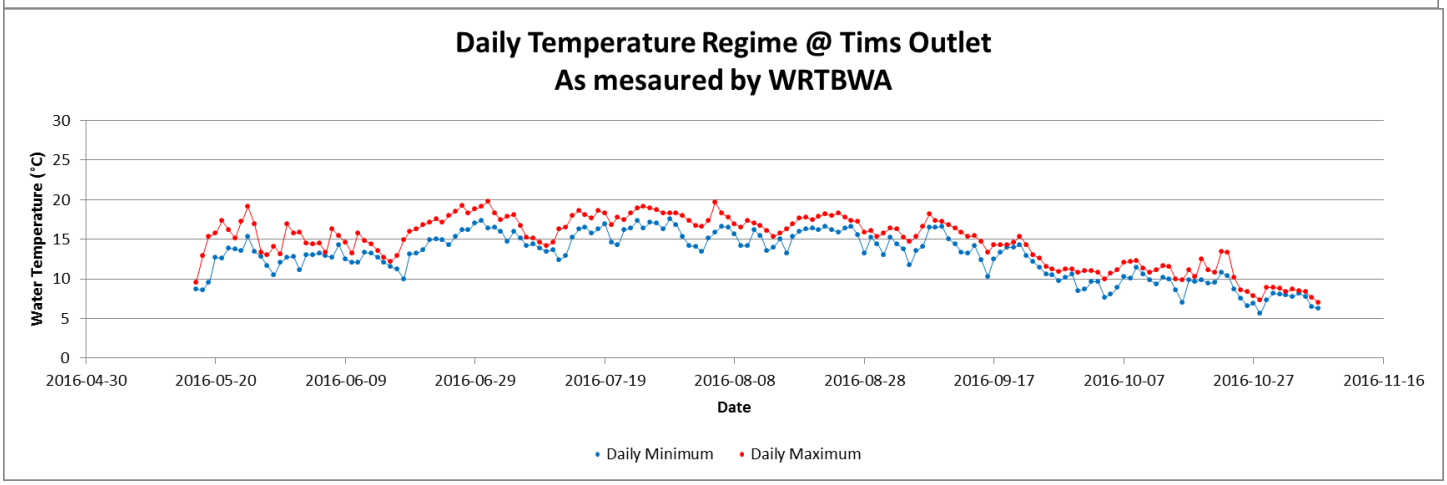


Minimum Temperature	5.24	2016-06-02
Median Temperature	9.28	
Maximum Temperature	13.37	2016-07-15

Optimal Growth for Brook trout (11-18 °C)	15.5%	**Stress Zone (>20°C)**	0%
Tolerant Brook trout range (0-20 °C)	100%	**Longest # of Hours in Stress Zone**	0

4.2.2 *Site 3*

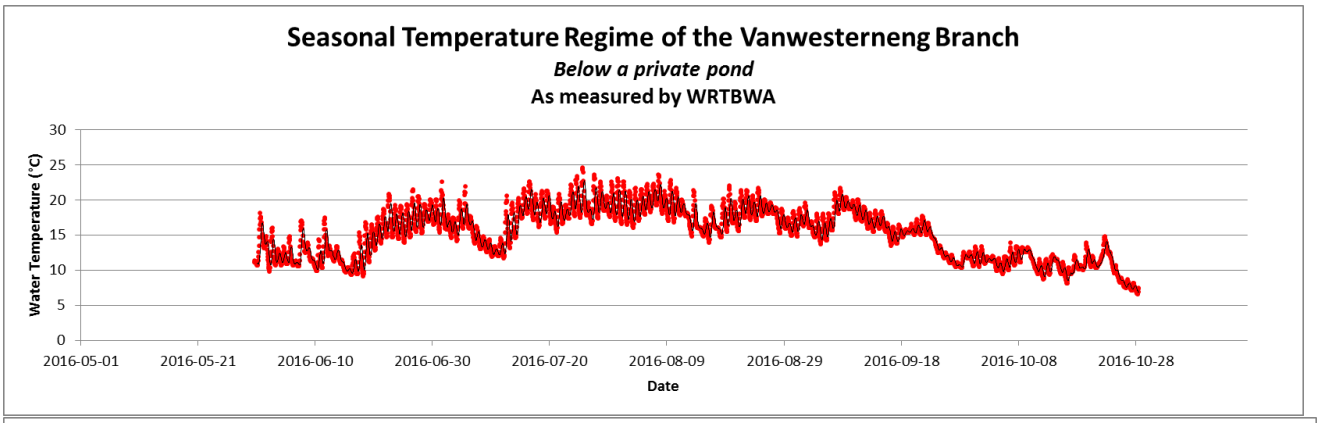


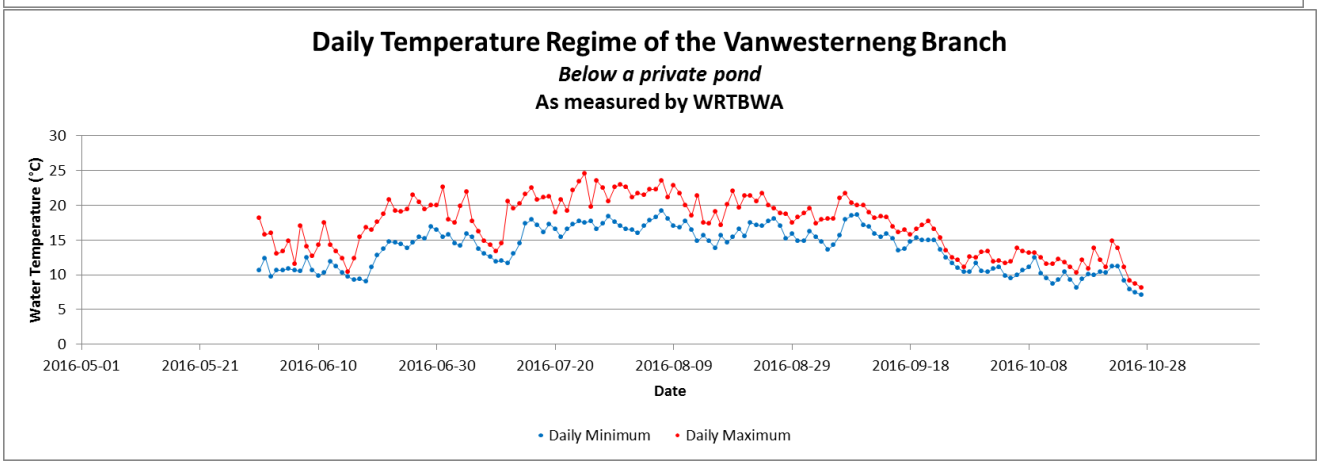


Minimum Temperature	5.66	2016-11-07
Median Temperature	14.33	
Maximum Temperature	19.76	2016-07-01

Optimal Growth for Brook trout (11-18 °C)	73.3%	**Stress Zone (>20°C)**	0%
Tolerant Brook trout range (0-20 °C)	100%	**Longest # of Hours in Stress Zone**	0

4.2.3 *Site 4*

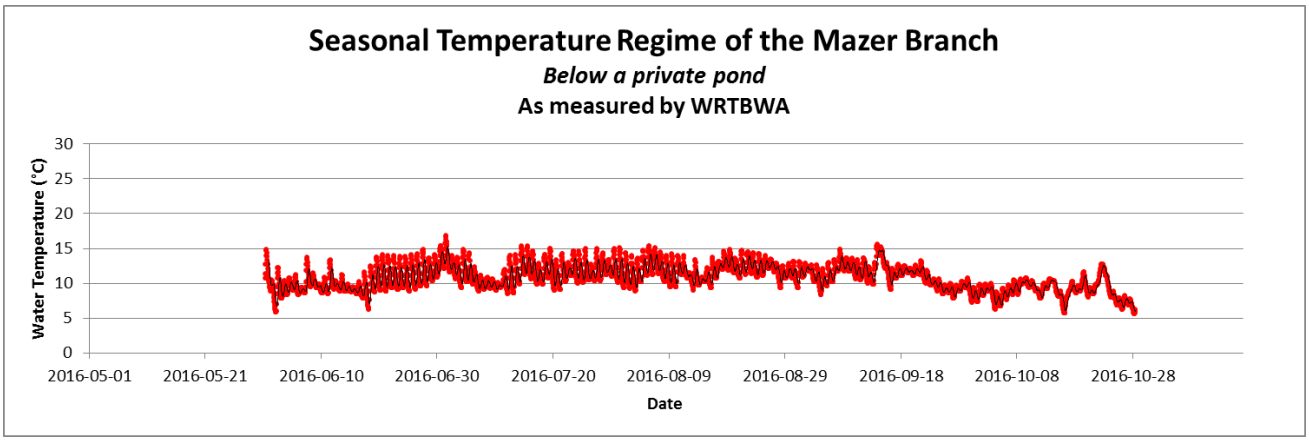


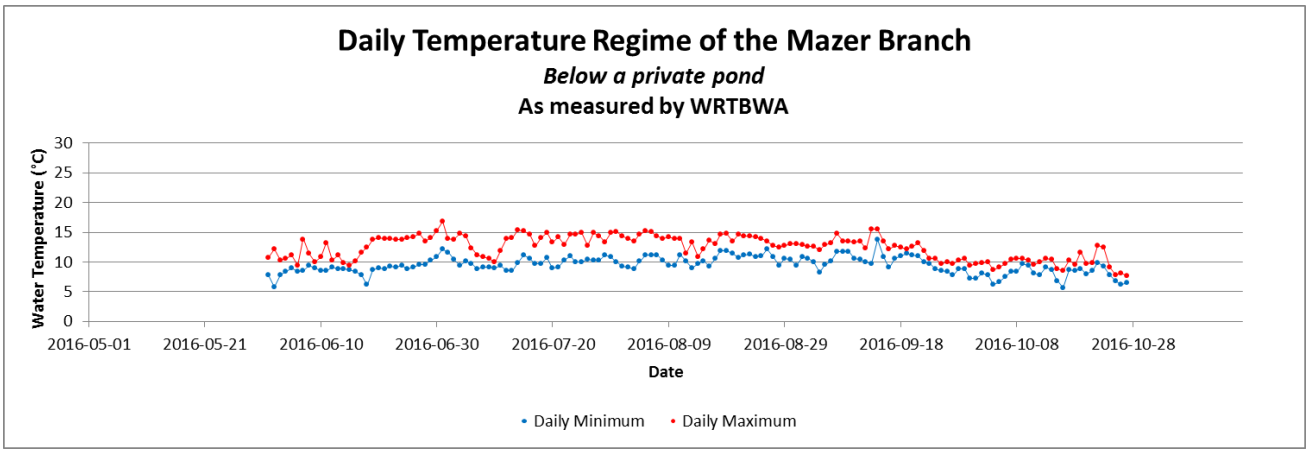


Minimum Temperature	7.08	2016/10/27
Median Temperature	15.76	
Maximum Temperature	24.55	2016/07/25

Optimal Growth for Brook trout (11-18 °C)	58.80%	**Stress Zone (>20°C)**	9.06%
Tolerant Brook trout range (0-20 °C)	90.94%	**Longest # of Hours in Stress Zone**	15

4.2.4 *Site 5*

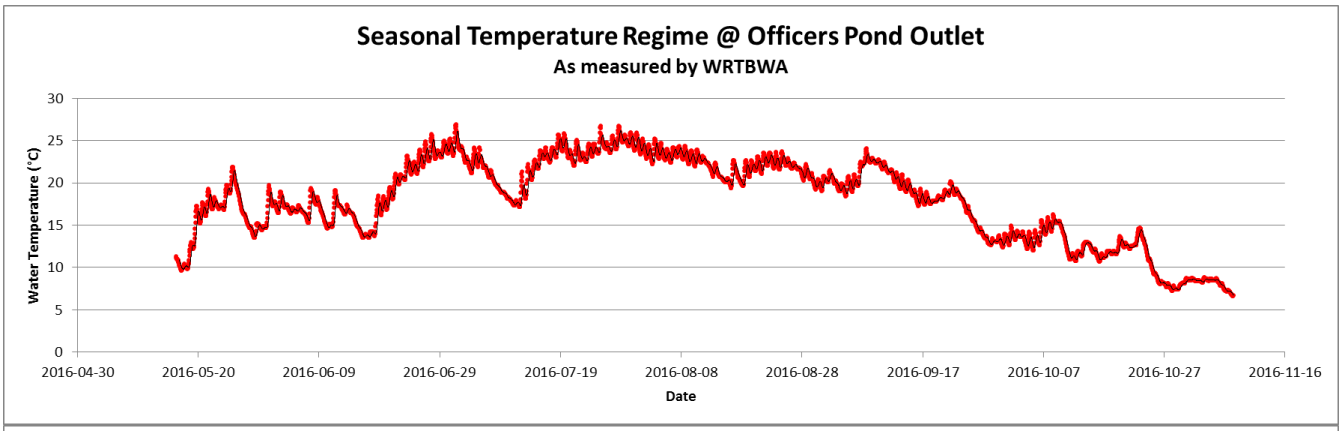


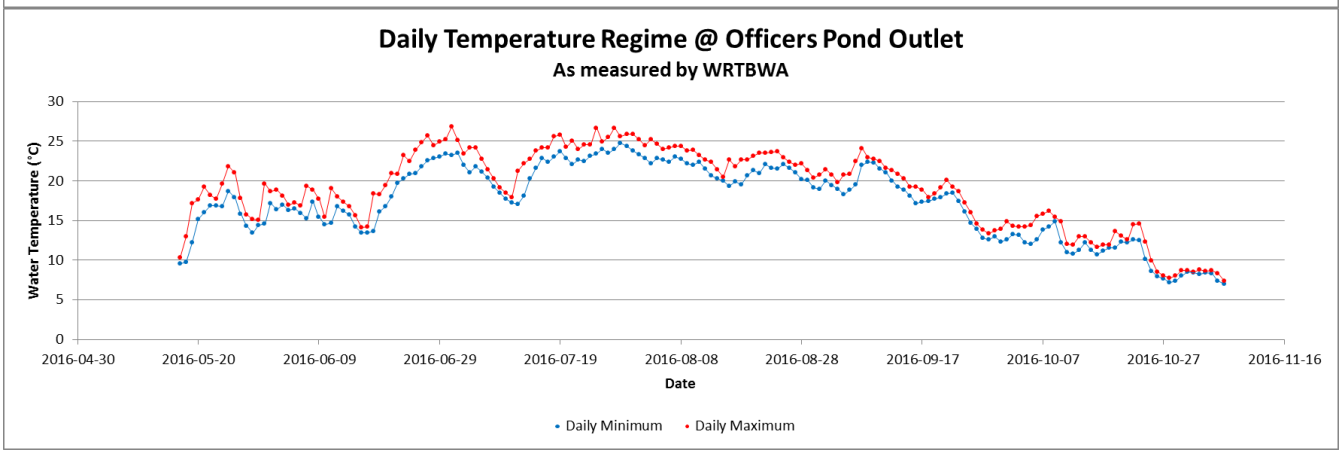


Minimum Temperature	5.66	2016-10-28
Median Temperature	10.65	
Maximum Temperature	16.81	2016-07-01

Optimal Growth for Brook trout (11-18 °C)	44.3%	**Stress Zone (>20°C)**	0%
Tolerant Brook trout range (0-20 °C)	100%	**Longest # of Hours in Stress Zone**	0

4.2.5 *Site 6*

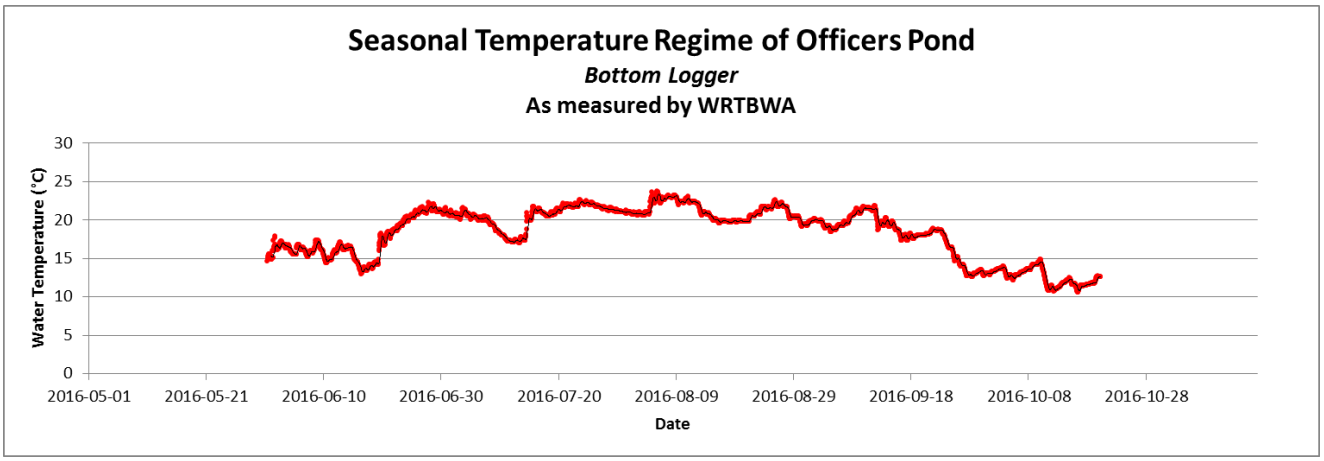




Minimum Temperature	6.98	2016-11-07
Median Temperature	18.81	
Maximum Temperature	26.88	2016-07-01

Optimal Growth for Brook trout (11-18 °C)	35.2%	**Stress Zone (>20°C)**	42.4%
Tolerant Brook trout range (0-20 °C)	57.6%	**Longest # of Hours in Stress Zone**	804

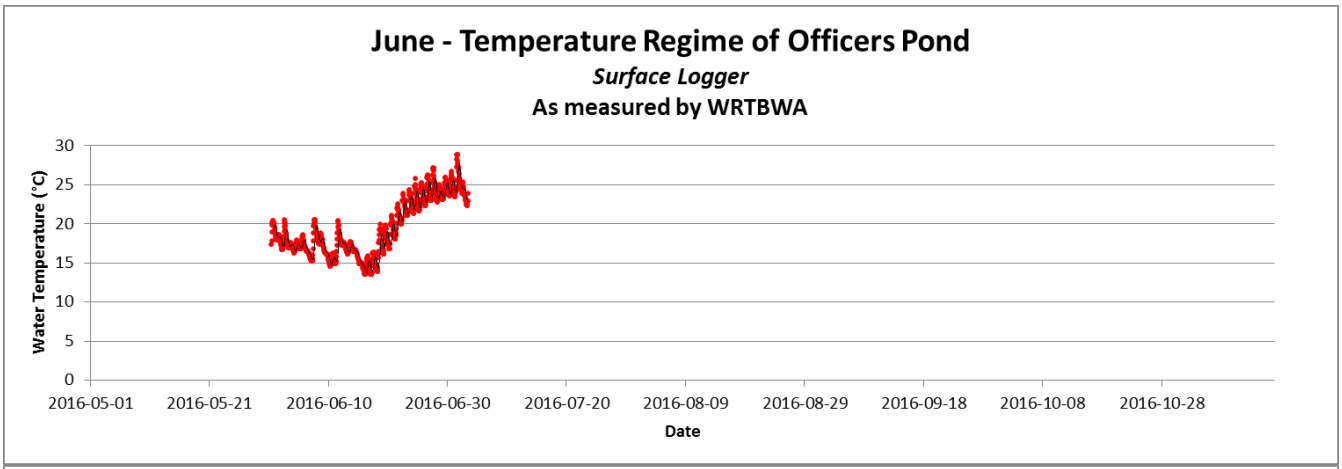
4.2.6 *Site 7*

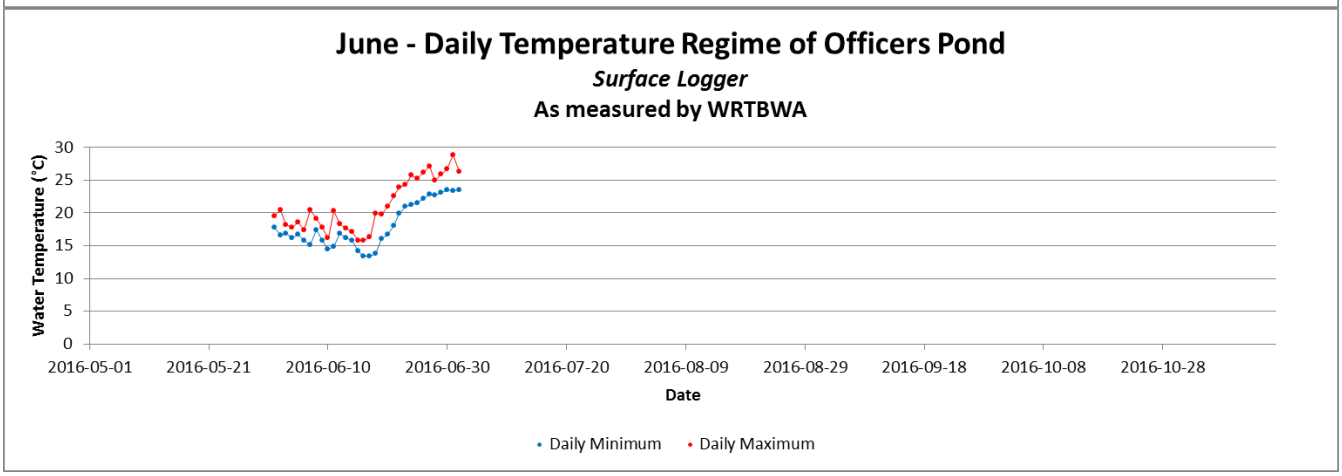


Minimum Temperature	10.55	2016-10-16
Median Temperature	19.57	
Maximum Temperature	23.77	2016-08-05

Optimal Growth for Brook trout (11-18 °C)	37.2%	**Stress Zone (>20°C)**	42.4%
Tolerant Brook trout range (0-20 °C)	57.6%	**Longest # of Hours in Stress Zone**	745

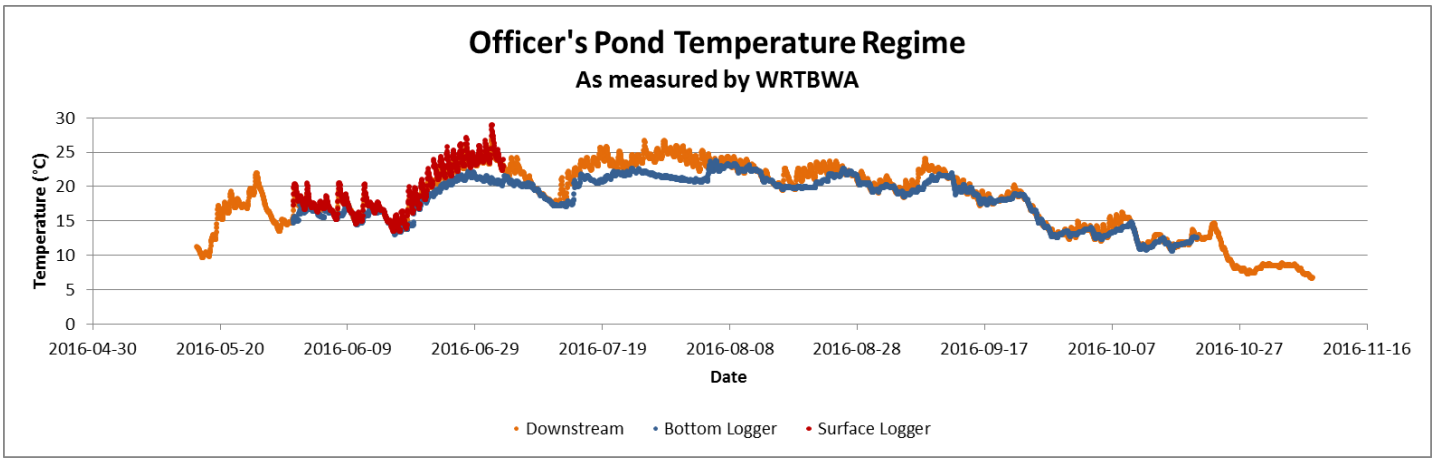
4.2.7 *Site 8*



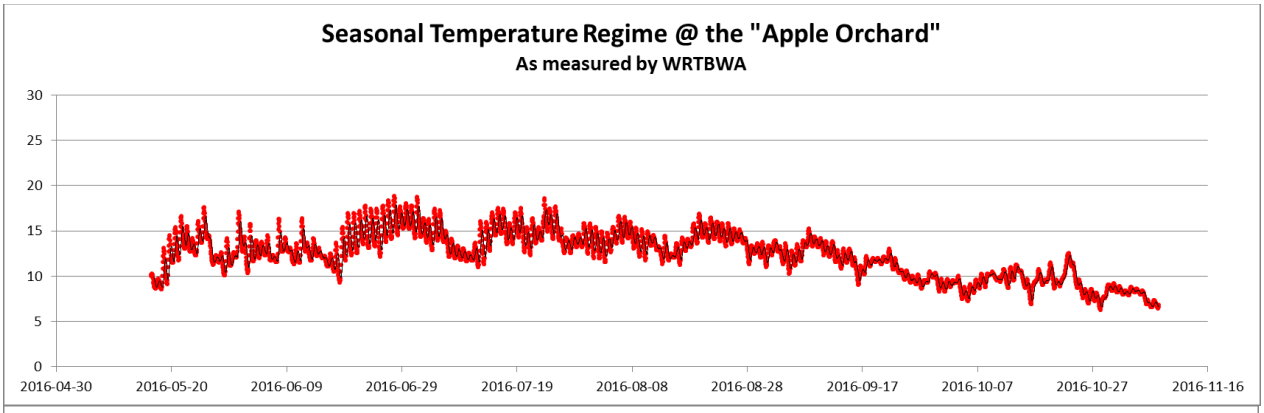


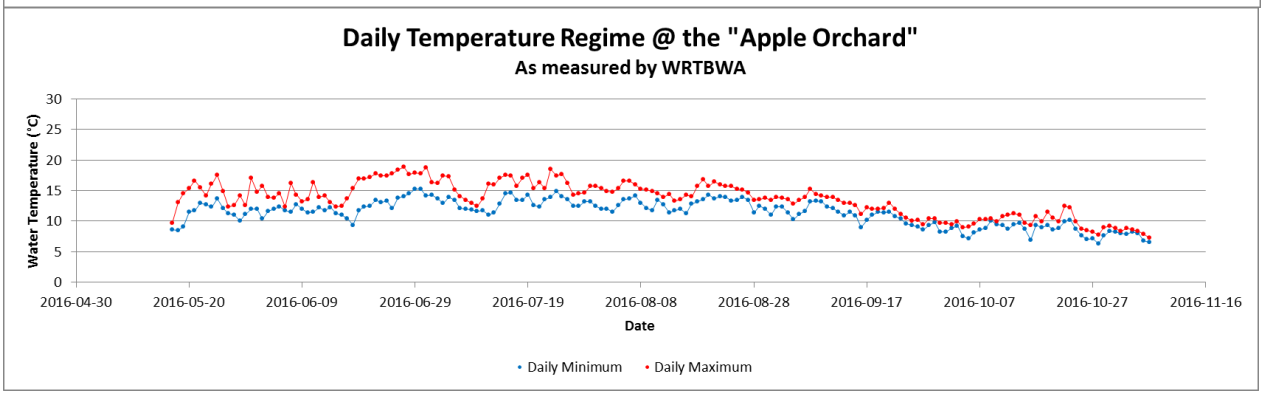
***Note: temperature logger ran out of memory capacity one month after deployment*

Site 6, 7 and 8 Combined



4.2.8 *Site 9*

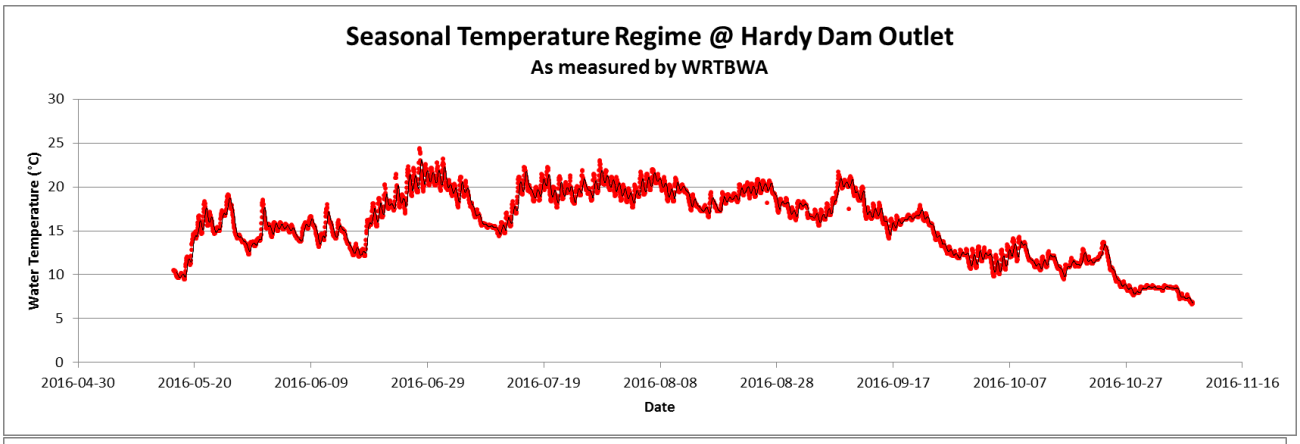


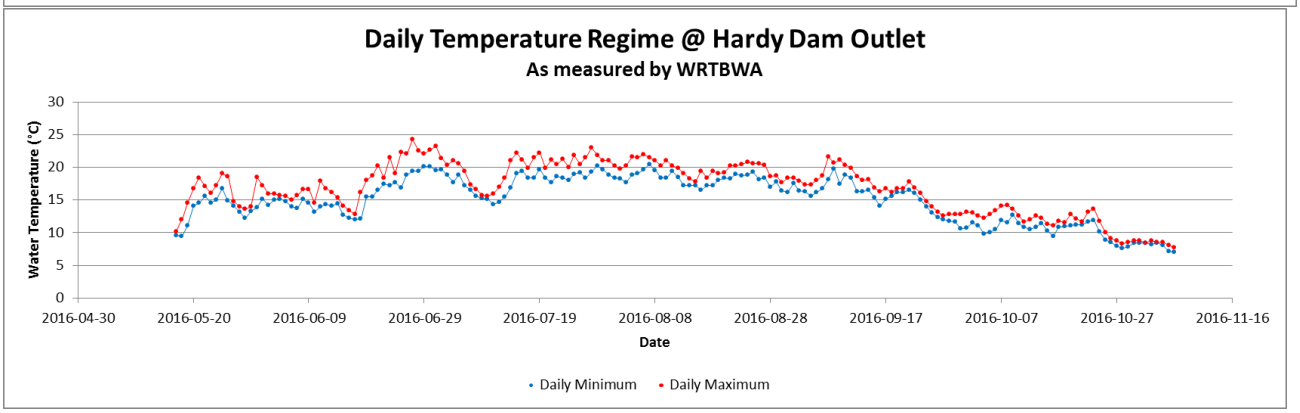


Minimum Temperature	6.27	2016-10-28
Median Temperature	12.59	
Maximum Temperature	18.81	2016-06-27

Optimal Growth for Brook trout (11-18 °C)	70.9%	**Stress Zone (>20°C)**	0%
Tolerant Brook trout range (0-20 °C)	100%	**Longest # of Hours in Stress Zone**	0

4.2.9 *Site 10*

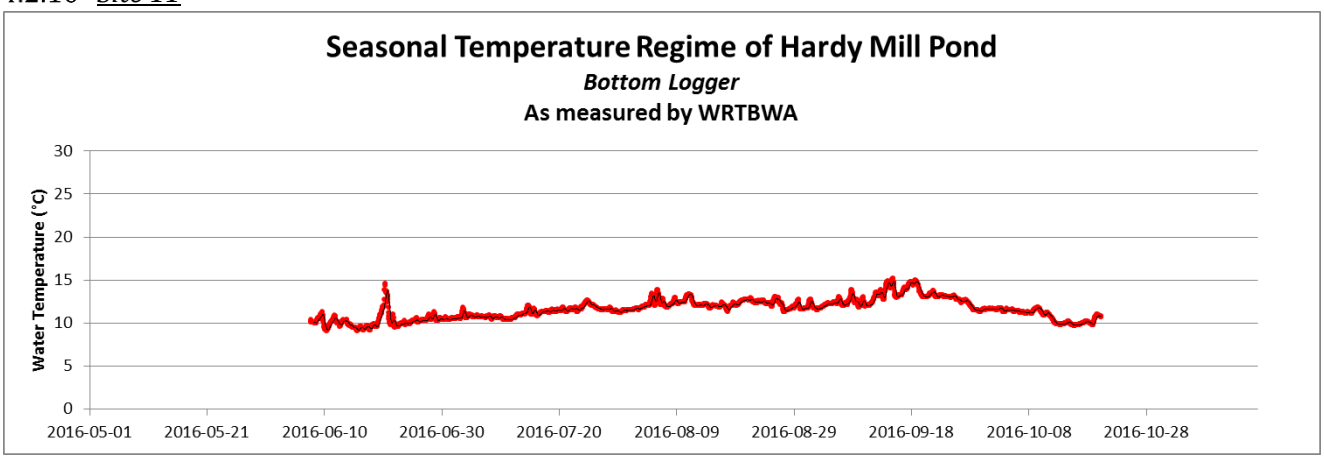




Minimum Temperature	6.98	2016-11-07
Median Temperature	16.43	
Maximum Temperature	24.35 *air temp	2016-06-27 *after vandals released the 2nd outlet for the dam, we closed the outlet a few days later. This is the cause for extremely low water levels below the dam

Optimal Growth for Brook trout (11-18 °C)	52.0%	**Stress Zone (>20°C)**	13.6%
Tolerant Brook trout range (0-20 °C)	86.4%	**Longest # of Hours in Stress Zone**	67

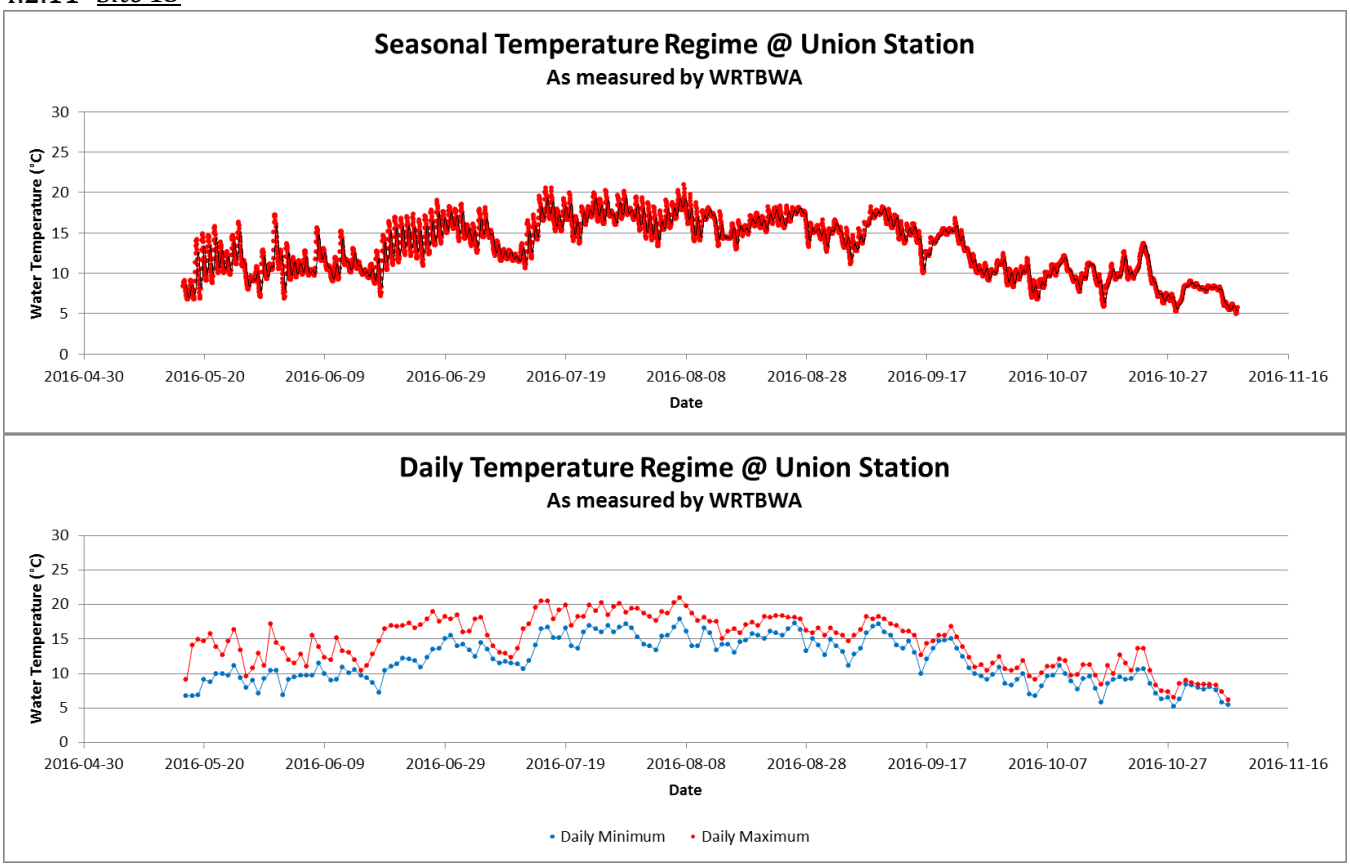
4.2.10 *Site 11*



Minimum Temperature	9.08	2016-06-10
Median Temperature	11.63	
Maximum Temperature	15.19	2016-09-14

Optimal Growth for Brook trout (11-18 °C)	67.7%	**Stress Zone (>20°C)**	0%
Tolerant Brook trout range (0-20 °C)	100%	**Longest # of Hours in Stress Zone**	0

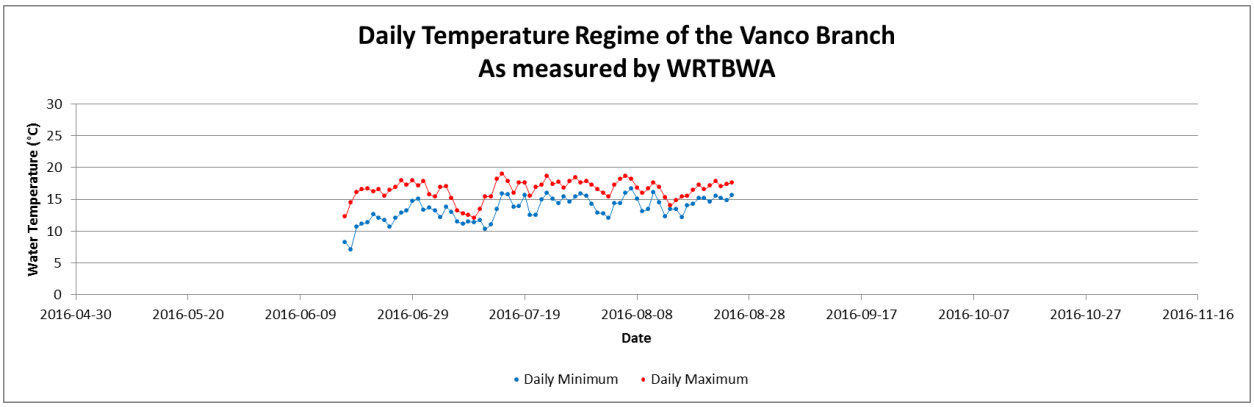
4.2.11 *Site 13*



Minimum Temperature	5.24	2016-10-28
Median Temperature	13.37	
Maximum Temperature	21.00	2016-08-07

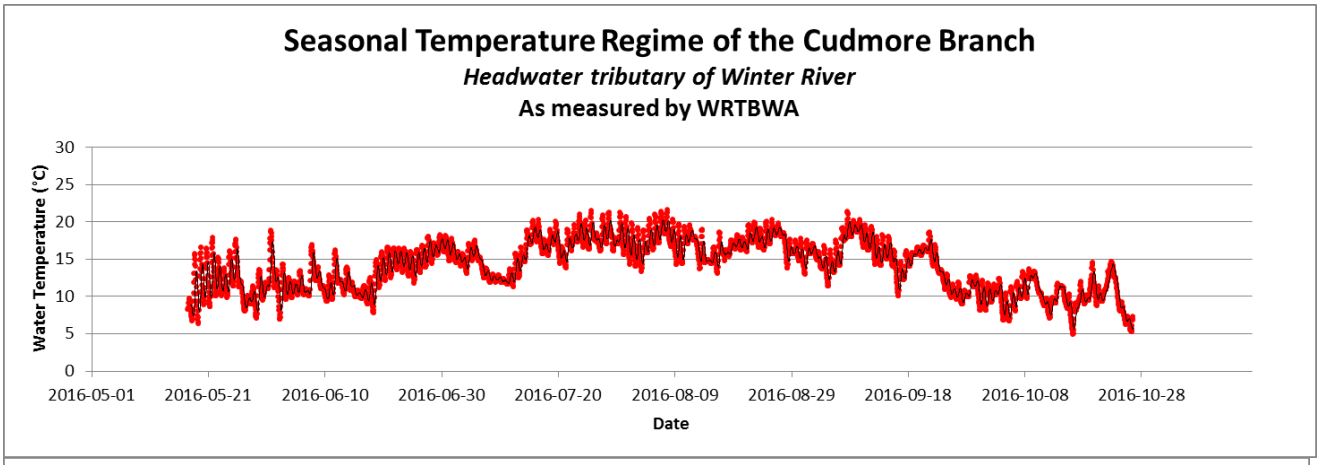
Optimal Growth for Brook trout (11-18 °C)	61.9%	**Stress Zone (>20°C)**	0.3%
Tolerant Brook trout range (0-20 °C)	99.7%	**Longest # of Hours in Stress Zone**	3

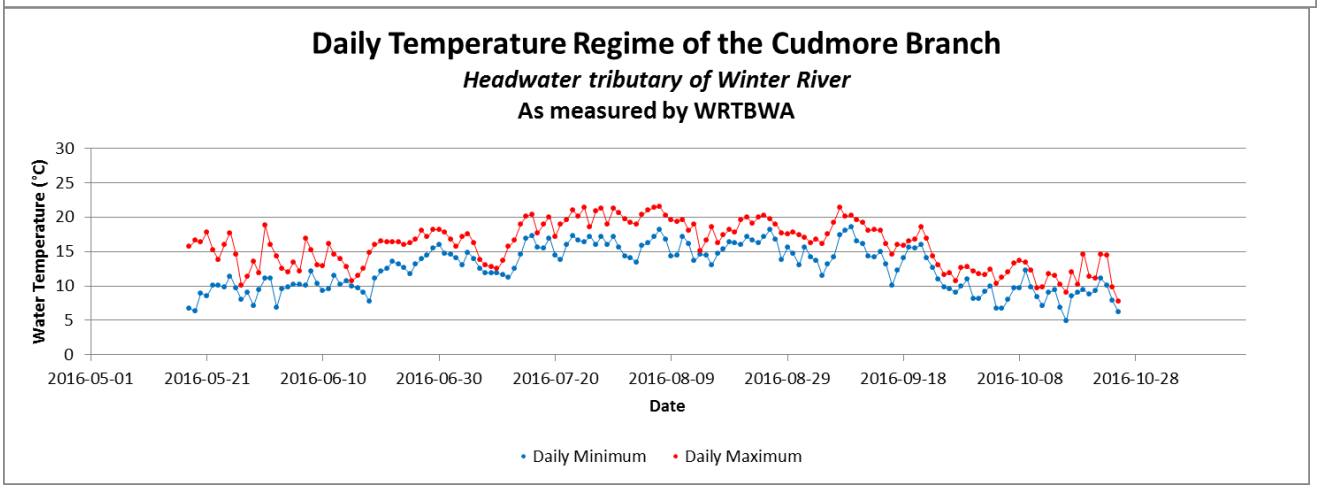
4.2.12 *Site 14*



***Note: depth logger was moved around, so a full seasonal analysis is unavailable.*

4.2.13 *Site 15*

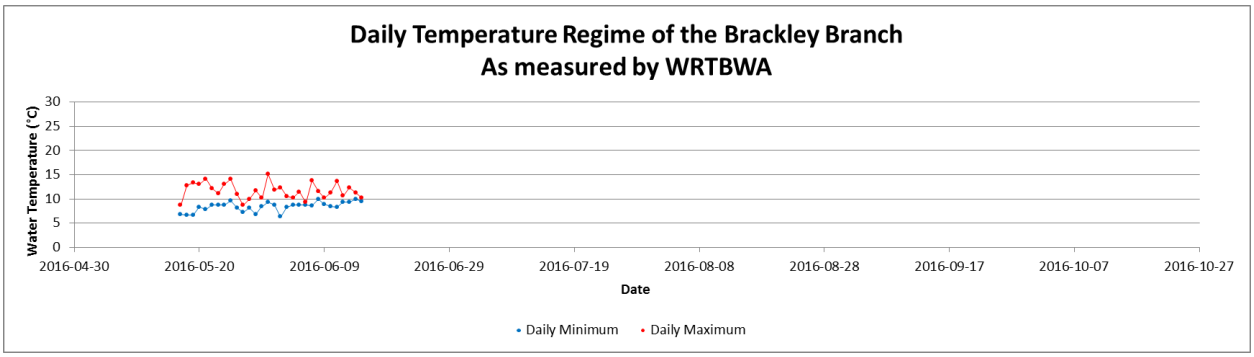




Minimum Temperature	4.93	2016-10-16
Median Temperature	14.52	
Maximum Temperature	21.57	2016-08-07

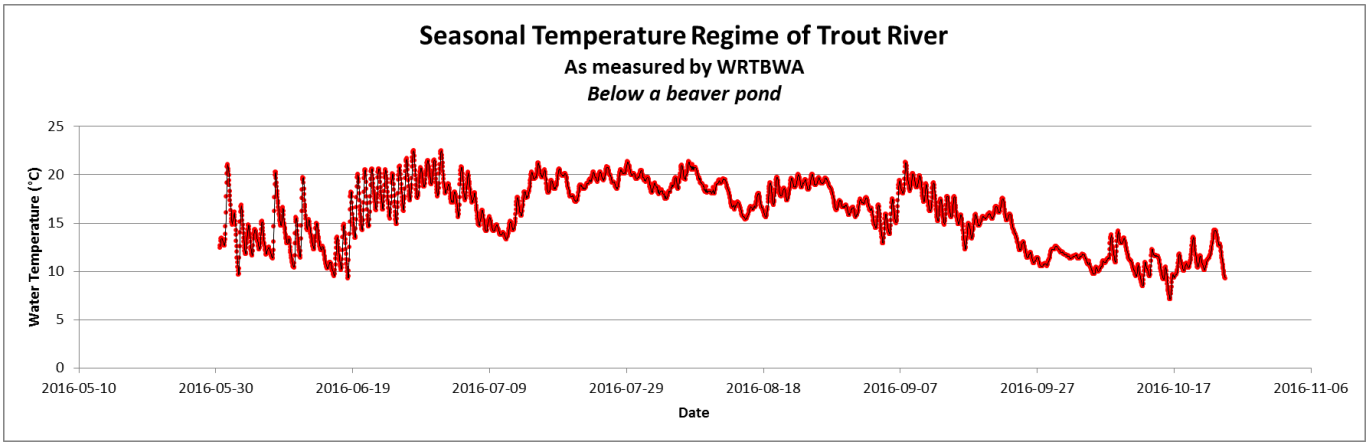
Optimal Growth for Brook trout (11-18 °C)	65.1%	**Stress Zone (>20°C)**	1.9%
Tolerant Brook trout range (0-20 °C)	98.1%	**Longest # of Hours in Stress Zone**	8

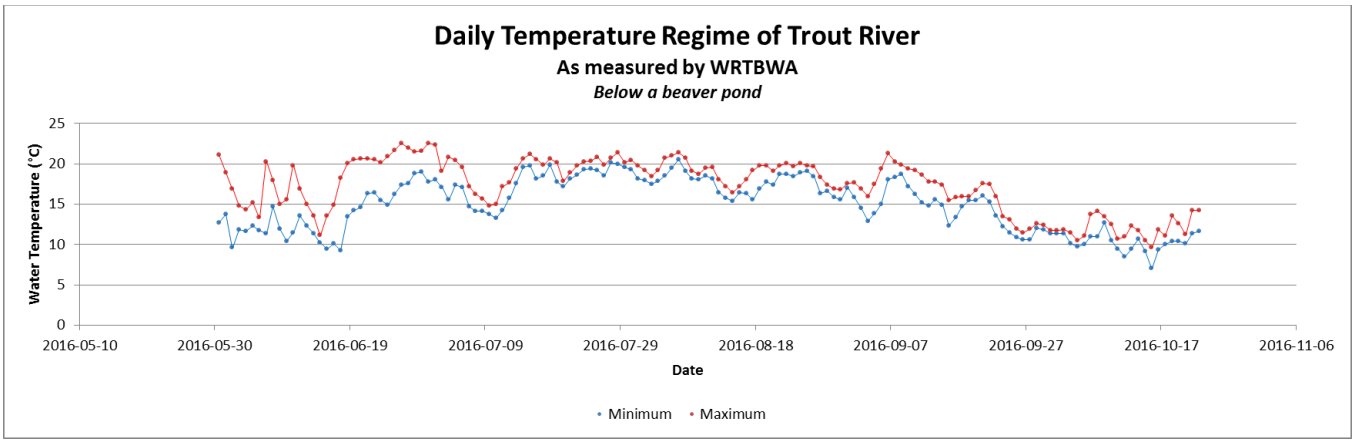
4.2.14 *Site 16*



***Note: depth logger was moved around, so a full seasonal analysis is unavailable.*

4.2.15 *Site 17*

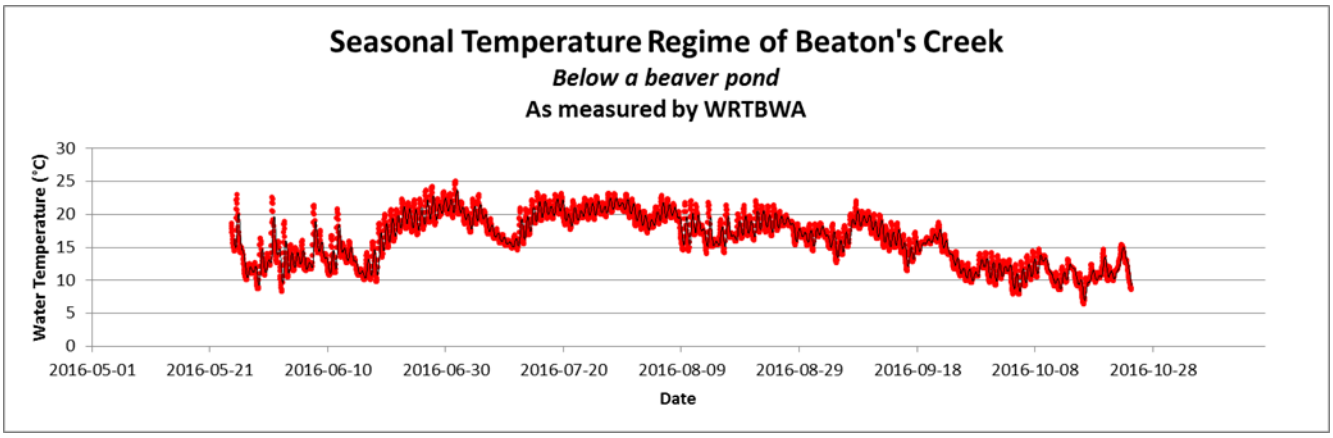


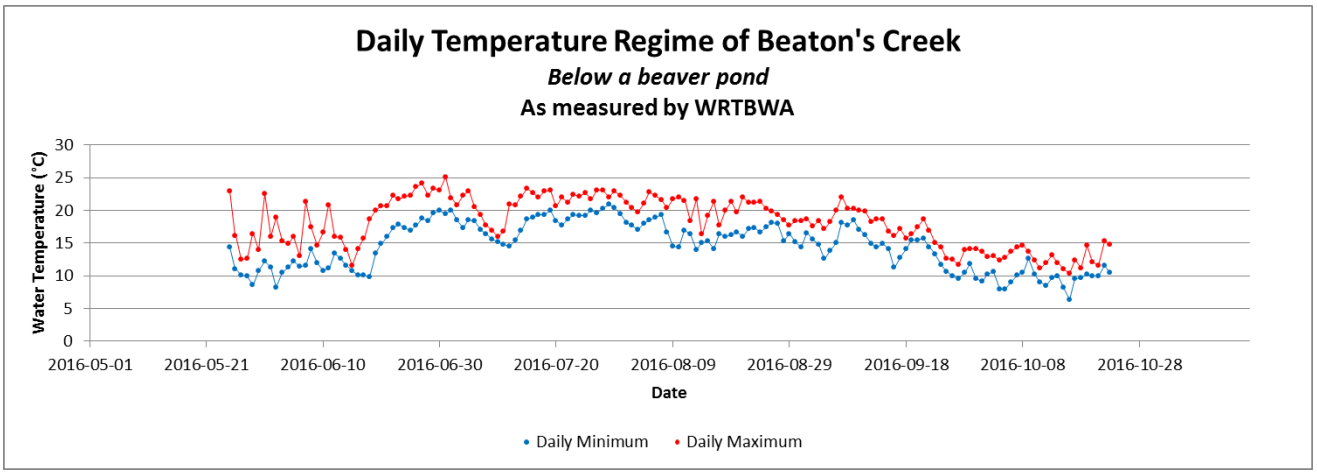


Minimum Temperature	7.08	16/10/2016
Median Temperature	16.52	
Maximum Temperature	22.53	27/06/2016

Optimal Growth for Brook trout (11-18 °C)	53.62%	**Stress Zone (>20°C)**	9.5%
Tolerant Brook trout range (0-20 °C)	90.5%	**Longest # of Hours in Stress Zone**	41

4.2.16 *Site 18*

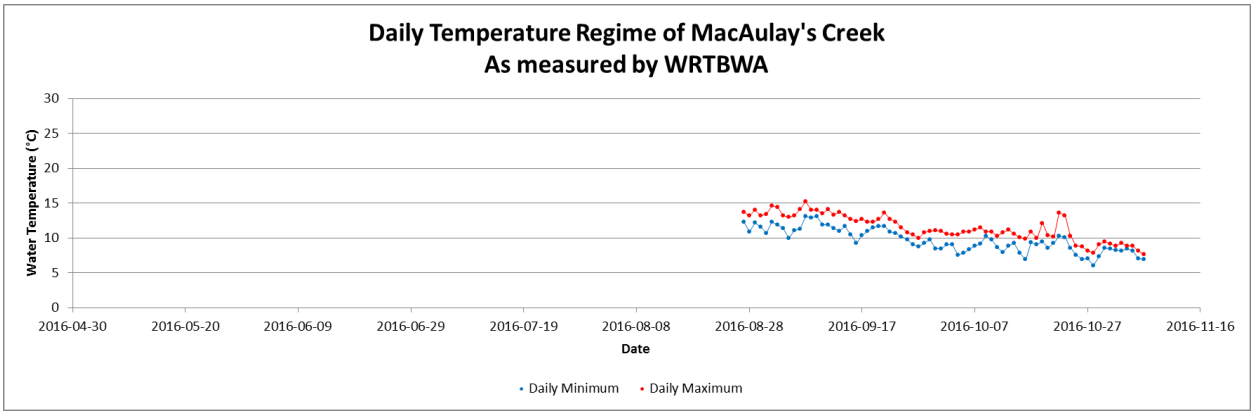




Minimum Temperature	6.37	2016-10-16
Median Temperature	16.52	
Maximum Temperature	25.03	2016-07-01

Optimal Growth for Brook trout (11-18 °C)	50.6%	**Stress Zone (>20°C)**	19.4%
Tolerant Brook trout range (0-20 °C)	80.6%	**Longest # of Hours in Stress Zone**	91

4.2.17 *Site 19b*



***Note: depth logger was moved around, so a full seasonal analysis is unavailable.*

4.2.18 *Summary*

Winter River – Tracadie Bay Watershed Association Temperature Regime: Results 2016							
		Median Temp (°C)	**Max Temp (°C)**	**Stress Zone (>20 °C)**	**Longest stress zone duration (hr)**	**Optimal Zone (11-18 °C)**	**Tolerant Zone (0-20 °C)**
Winter River	Friston Branch (DL)	9.28	13.37	0%	0	15.5%	100%
	Tim's Outlet (DL)	14.33	19.76	0%	0	73.3%	100%
	Vanwesterneng Branch (TL) *below private pond*	15.76	24.55	9.06%	15	58.8%	90.9%
	Mazer Branch (TL) *below private pond*	10.65	16.81	0%	0	44.3%	100%
	Officer's Pond Outlet (DL) *below man-made dam*	18.81	26.88	42.43%	804 (34 d)	35.2%	57.6%
	Officer's Pond *Bottom (TL)	19.57	23.77	42.38%	745 (~31 d)	37.2%	57.6%
	Apple Orchard (DL)	12.59	18.81	0%	0	70.9%	100%
	Hardy Outlet (DL) * *below man-made dam*	16.43	24.35 *air temp	13.56% *air temp	67 *air temp	52.0% *vandalism	86.4% *vandalism
	Hardy Mill Pond *Bottom TL)	11.63	15.19	0%	0	67.7%	100%
	Union Station (DL)	13.37	21.00	0.29%	3	61.9%	99.7%
	Cudmore Branch (TL)	14.52	21.57	1.88%	8	65.1%	98.1%
Tracadie Bay (East)	Beaton's Creek (TL) *below beaver pond*	16.52	25.03	19.42%	91	50.6%	80.6%
	Trout River (TL) *below beaver pond*	16.52	22.53	9.50%	41	53.6%	90.5%

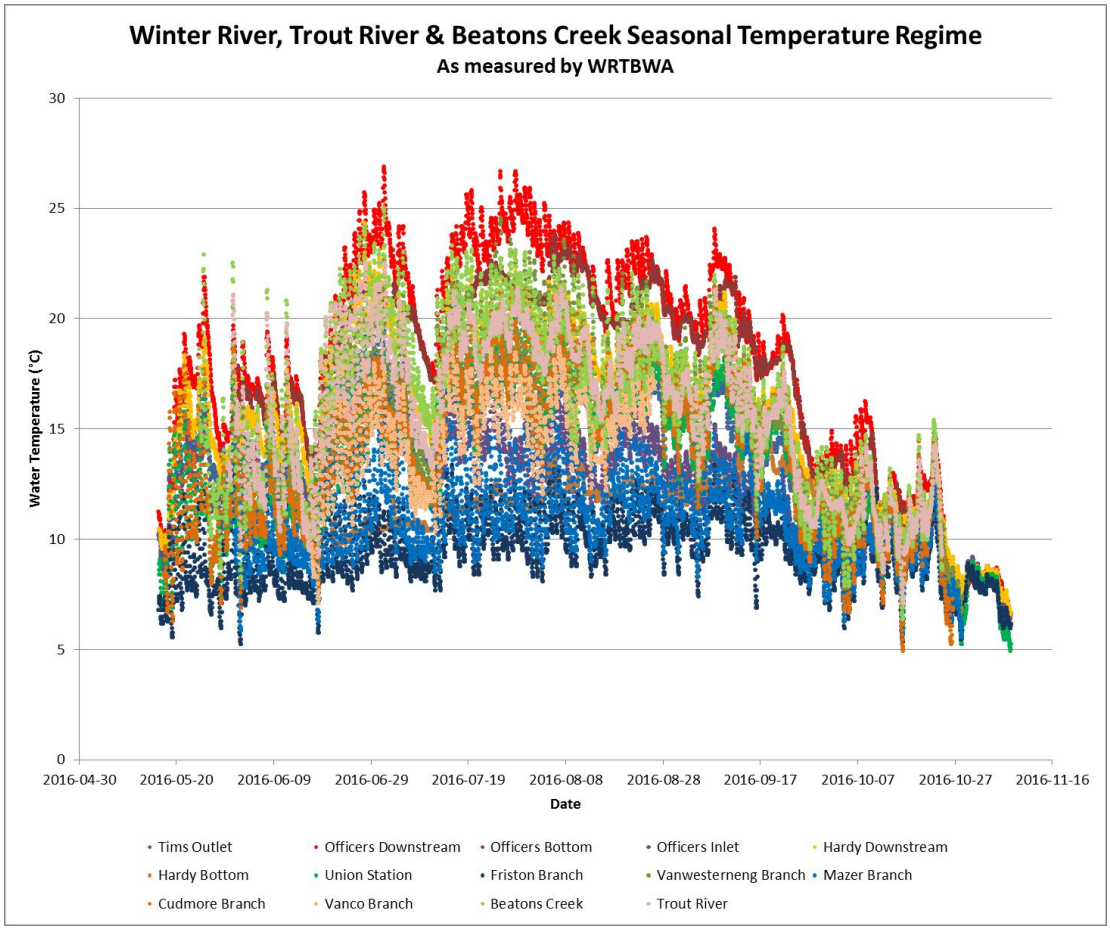


Figure 50: Plot of all temperature data, to show commonalities and differences between sites over time.

4.3 V-Notch Weirs

4.3.1 *Observations*

The v-notch weirs were installed in early May and monitored until mid-December. The v-notch weirs are useful on springs that form a shape of a bowl with a defined outlet. The Tim lower weir needed to be moved in the fall since it is located in the floodplain and the measurements were inaccurate due to flooding. Pleasant grove #5 spring was fixed multiple times in the summer due to erosion around the weir. This accounts for the variation of flow from this spring. The Brackley Branch followed the same pattern as previous years and dried up at the end of July, this was followed by a "fish rescue" with Rosie MacFarlane to move as many Brook Trout from the pools to a safe downstream location. The Vanco Branch and Cudmore #6 also went dry for a few weeks in the fall, first time documented by Winter River. It was a very dry year in the watershed.

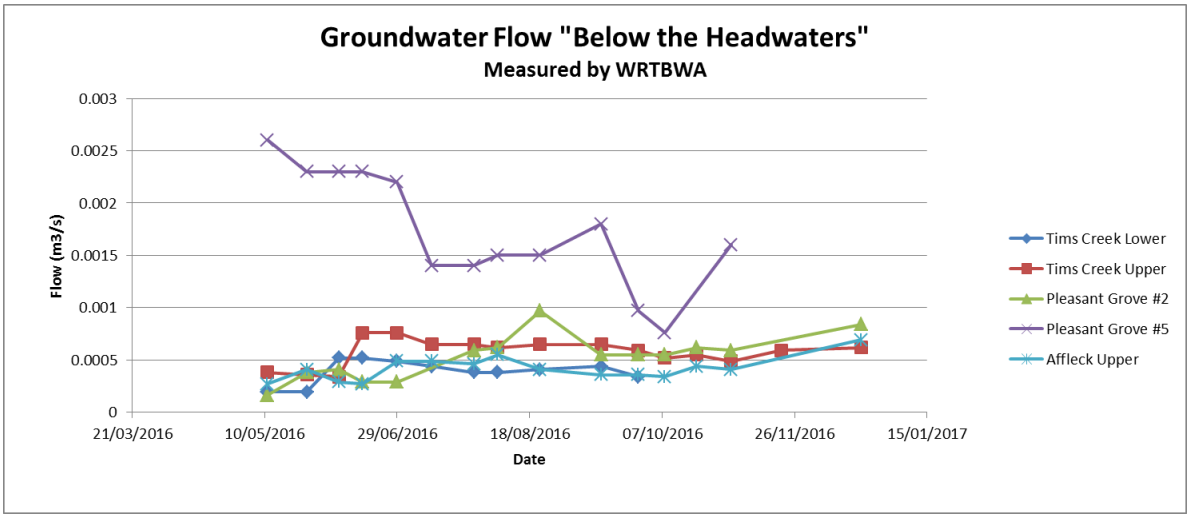
**Note: The following trend graphs have a degree of error with weather impacts from rain and snow, although best efforts were made to take measurements at least a few days after a precipitation or snow-melt event. Daily variation from morning to late afternoon must also be factored in because of evaporation from increased air temperatures in the summer months. Human error such as multiple personal taking measurements throughout the monitoring season or simply moving the weir due to flooding or lowering from lack of flow in the headwaters. This is a trend-line visualization of seasonal groundwater fluctuations from selected springs to show how the increase in water extraction affects the springs and stream base flow (as shown from the water-level loggers) of Winter River.*

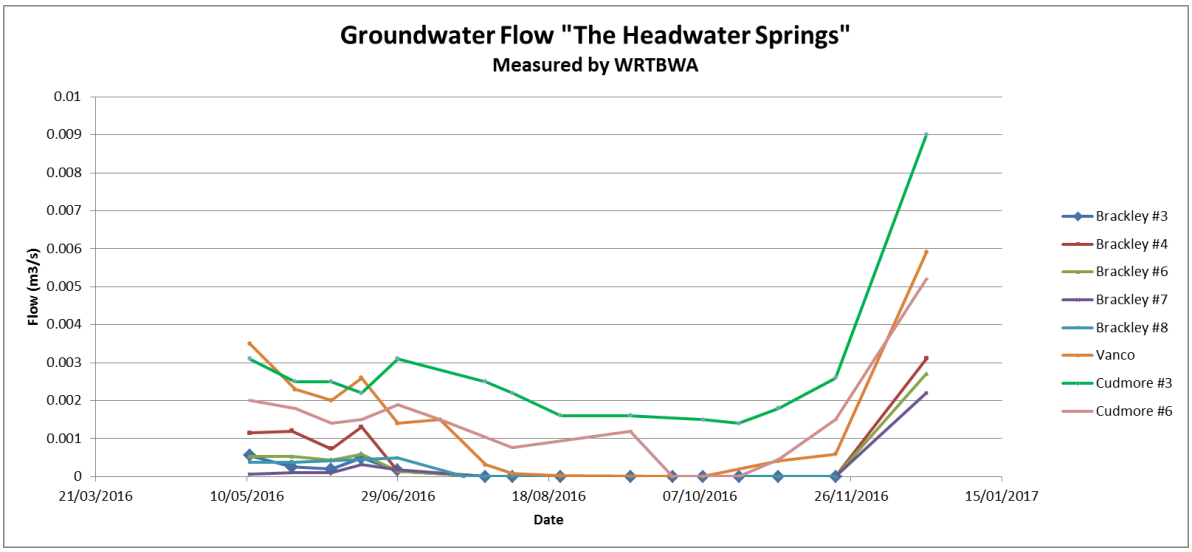
Figure 51: V-notch Weir locations for 2016 monitoring season

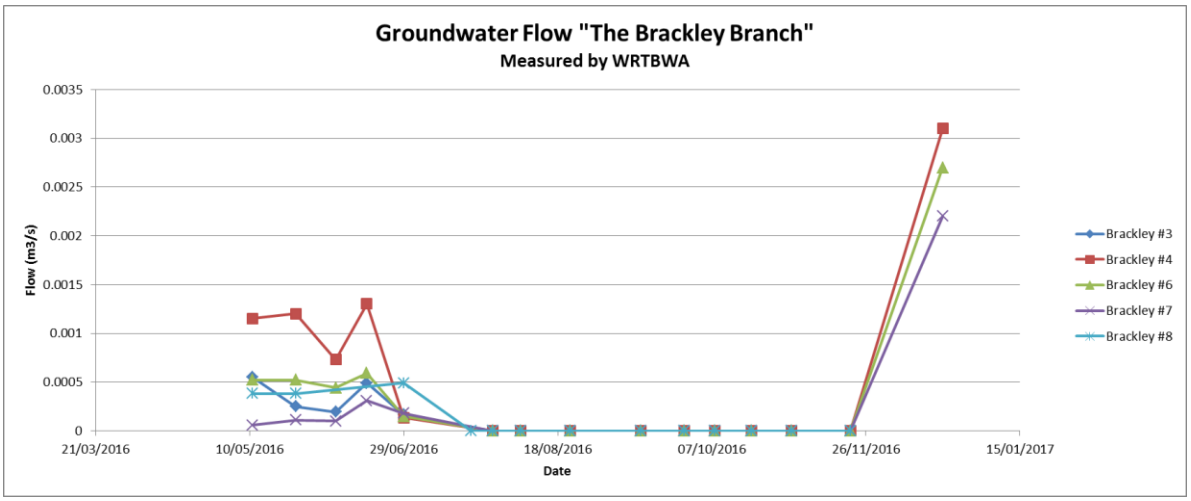
4.3.2 *Results 2016*

Groundwater Spring Monitoring 2016																					
		May		June				July				August		Sept		Oct		Nov		Dec
Spring Location	Wellfield Distance (m)	2016-05-25	2016-05-26	2016-06-07	2016-06-16	2016-06-17	2016-06-29	2016-07-12	2016-07-13	2016-07-21	2016-07-28	2016-08-06	2016-08-22	2016-09-14	2016-09-28	2016-10-08	2016-10-20	2016-11-02	2016-11-21	2016-12-21
Brackley #3	698	W	X	W	X	W	W	L	X	L	D	D	D	D	D	D	D	D	D	W
Brackley #4	736	W	X	W	X	W	W	L	X	L	D	D	D	D	D	D	D	D	D	W
Brackley #6	764	W	X	W	X	W	W	L	X	L	D	D	D	D	D	D	D	D	D	W
Brackley #7	871	W	X	W	X	W	W	L	X	L	D	D	D	D	D	D	D	D	D	W
Brackley #8	932	W	X	X	X	X	W	L	X	D	D	D	D	D	D	D	D	D	D	W
Vanco	1386	X	W	W	X	W	W	X	W	X	W	W	W	L	D	D	L	W	W	W
Cudmore #6	1572	X	W	W	X	W	W	X	W	X	X	W	X	W	D	D	L	W	W	W
Cudmore #3	1710	X	W	W	X	W	W	X	X	X	W	W	W	W	L	W	W	W	W	W
Affleck's Upper	2472	X	W	W	W	X	W	W	X	X	W	W	W	W	W	W	W	W	X	W
Tim's Creek Lower	2692	X	W	W	W	X	W	W	X	X	W	W	W	W	W	W	X	W	W	W
Tim's Creek Upper	2696	X	W	W	W	X	W	W	X	X	W	W	W	W	W	W	W	W	W	W
Pleasant Grove #2	2926	X	W	W	W	X	W	X	X	X	W	W	W	W	W	W	X	W	X	W
Pleasant Grove #5	2927	X	W	W	W	X	W	W	X	X	W	W	W	W	W	W	W	W	X	X

W	Water
L	Very Low
D	Dry
X	Not monitored


Groundwater Flow "Below the Headwaters"
Measured by WRTBWA
Flow (m3/s)
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
21/03/2016
10/05/2016
29/06/2016
18/08/2016
07/10/2016
26/11/2016
15/01/2017
Date
Tims Creek Lower
Tims Creek Upper
Pleasant Grove #2
Pleasant Grove #5
Affleck Upper


Groundwater Flow "The Headwater Springs"
Measured by WRTBWA
Flow (m3/s)
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
21/03/2016
10/05/2016
29/06/2016
18/08/2016
07/10/2016
26/11/2016
15/01/2017
Date
Brackley #3
Brackley #4
Brackley #6
Brackley #7
Brackley #8
Vanco
Cudmore #3
Cudmore #6


Groundwater Flow "The Brackley Branch"
Measured by WRTBWA
Flow (m3/s)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
21/03/2016
10/05/2016
29/06/2016
18/08/2016
07/10/2016
26/11/2016
15/01/2017
Date
Brackley #3
Brackley #4
Brackley #6
Brackley #7
Brackley #8

4.4 Stream Assessments

Staff members walked along the Mazer, Island Coastal, Vanco, York, Tim's, and Friston Branches that flow directly into Winter River to assess the areas for habitat and to prioritize future projects. In addition, Trout River on the east side of Tracadie bay was partly walked by summer staff. We based our methodology on that used by Gauthier & Parkman in their 2009 survey of the main branch of the Winter River, then added extra categories on stream substrate, erosion issues, beaver activity, and the status of previous enhancement projects. The GPS was lost in July, so the York assessment is not logged onto google earth. This information will be very valuable for future watershed management planning. For further information about the stream assessments refer to the excel file and google earth.

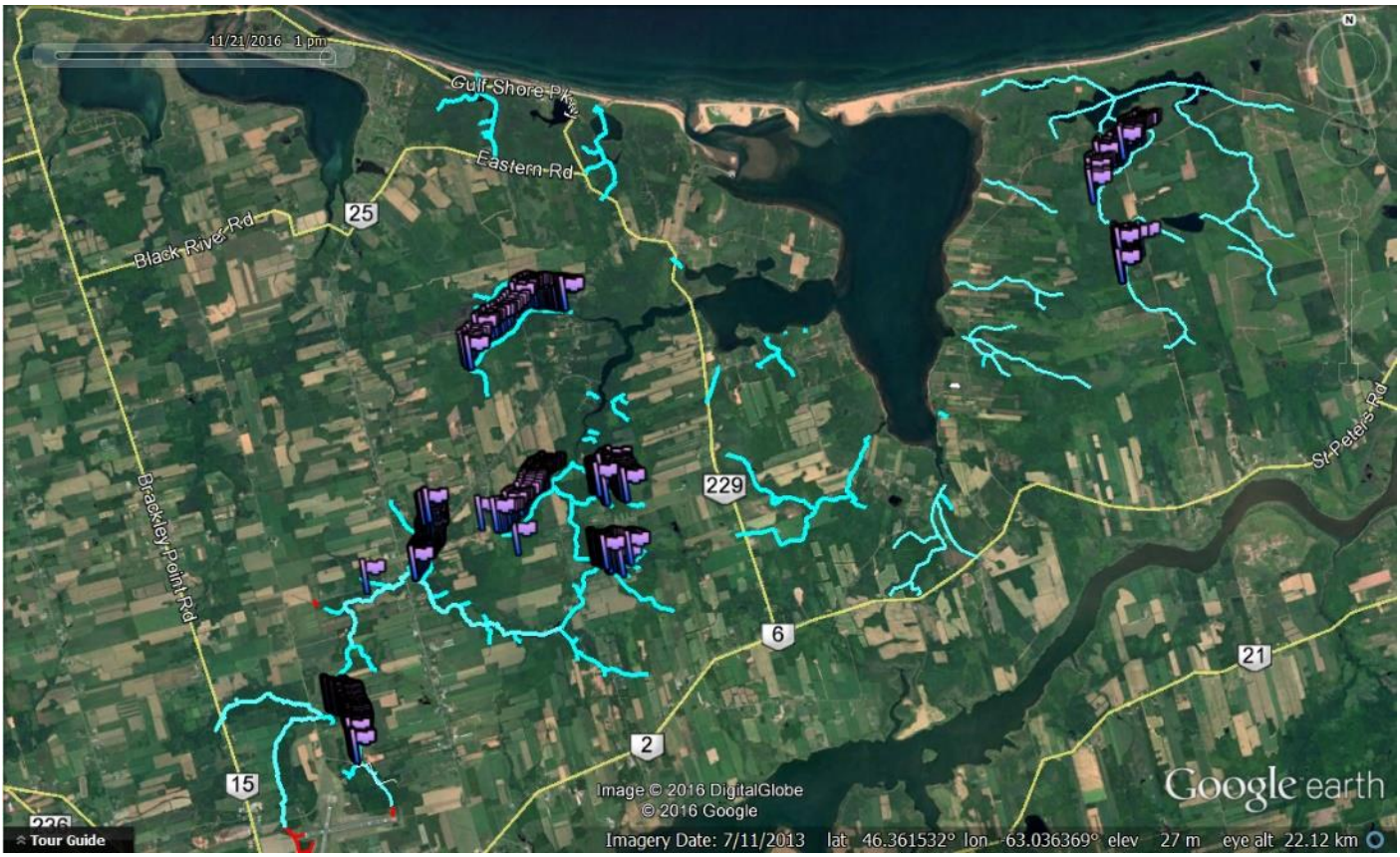


Figure 52: Stream Assessment Sites 2016

4.5 CABIN Monitoring

Canadian Aquatic Biomonitoring Network (CABIN) is a long-term monitoring program which measures macro aquatic invertebrate communities as indicators of environmental health. By sampling these indicator species and taking instream physical measurements, we can determine which areas of our watershed deviate most from healthy ecosystem composition. This data can be used to target restoration and enhancement efforts in future, and to measure the effect of these efforts on long term data trends. Some of these insect species that indirectly indicate biological health are also more direct measures of fish food supplies. In July, the watershed coordinator and research intern were certified through the Canadian Rivers Institute in CABIN field training and completed an online course in CABIN project management. In October, 9 sites were sampled for macro invertebrates in the Tracadie Bay area. We are now waiting for results from professional laboratories to continue with the next phase of this project.

No results available until March 2017

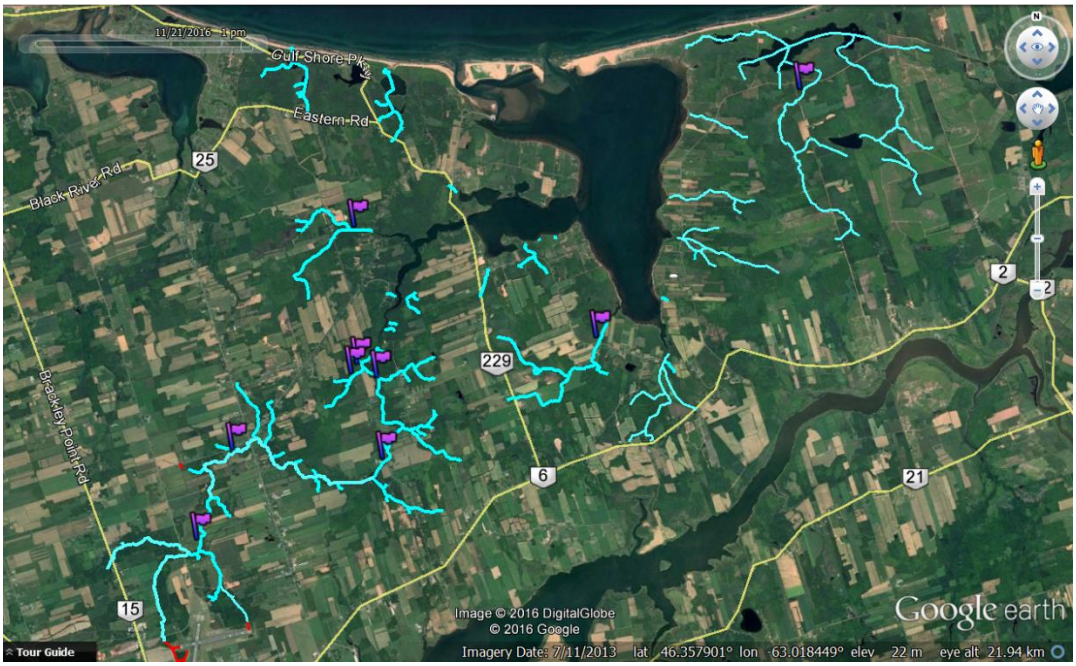


Figure 53: CABIN Sites 2016

Figure 54: Hilary and Steve getting ready in the stream for CABIN Monitoring

Figure 55: Steven kicking up macro invertebrates into the net

4.6 Redd Surveys

Redd surveys are conducted by walking the streams in November when the sea run Brook Trout move up to spawn into the fresh water rivers. Using a GPS and field notebook, the group record all spawning grounds and describe the estimated size and presence of Brook Trout on the redd. All redd counts have been down across all watersheds this year. Redd surveys were going smooth for a couple days until the weather took a turn one week in November. After this, it made stream conditions almost impossible to see through the surface of the water. All redd counts have been down across all watersheds this year. We managed to see redds at the following locations:

Figure 56: Redd Survey 2016 on Tim's Creek, Winter River

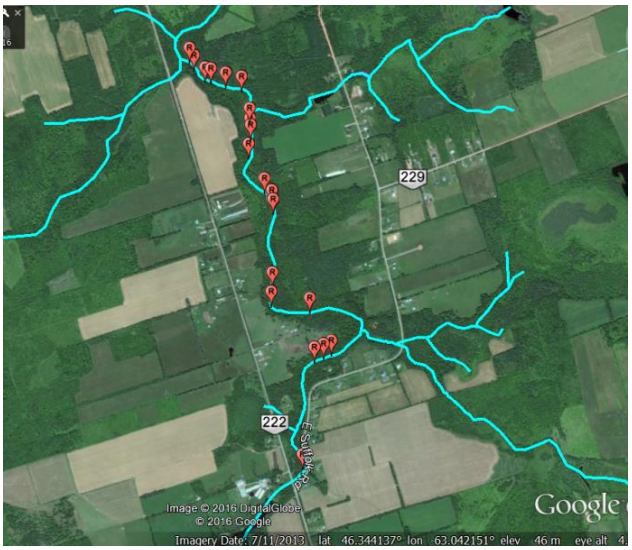


Figure 57: Redd Survey 2016 below the Suffolk dam, Winter River

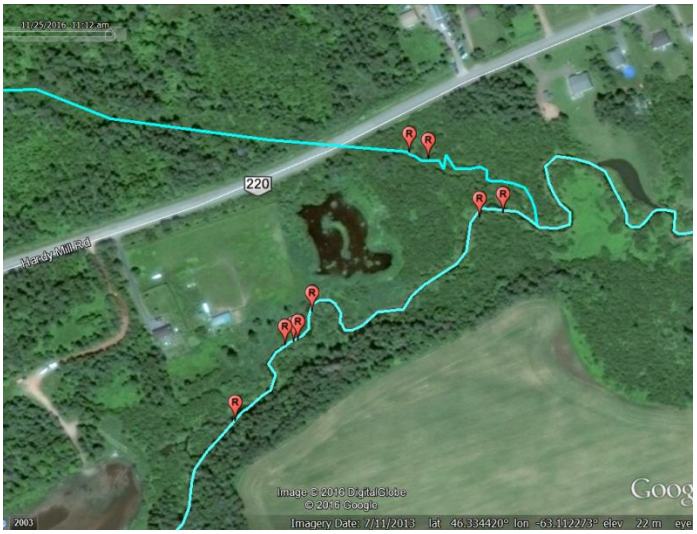


Figure 58: Redd Survey 2016 - Between Hardy Mill Pond and York Rd.

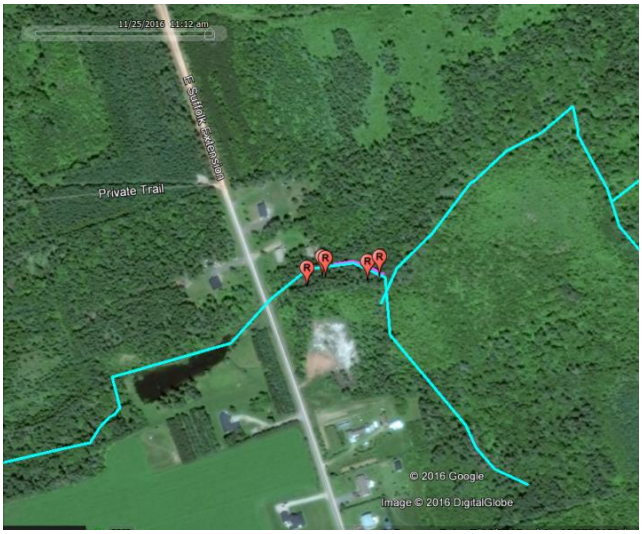
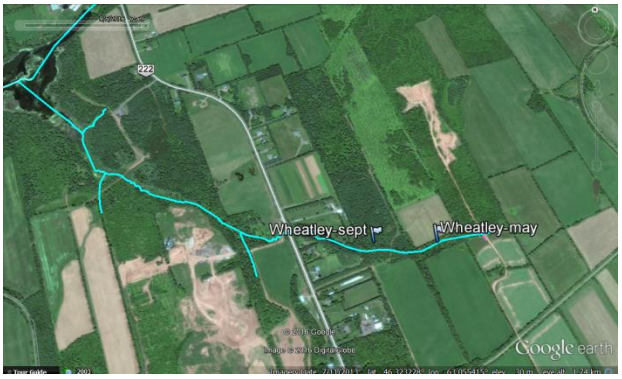


Figure 59: Vanwesterneng Branch - possible redds 2016

Figure 60: Brook trout redds of Winter River

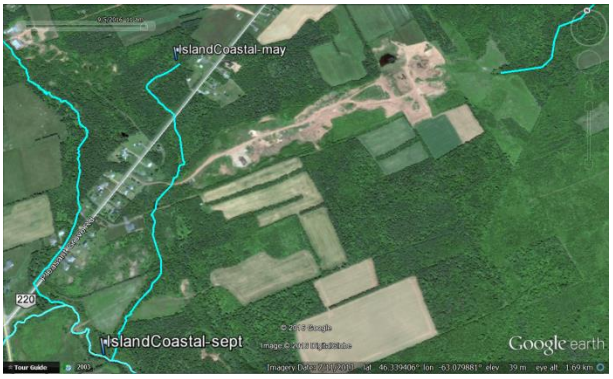
4.7 Headwater Surveys

The survey is conducted between May 1 to May 15 and September 1 to September 15 annually, with no significant rainfall or snow-melt event in the last 3 days. This is a visual survey to assess surface water connectivity and water velocity within the thalweg of the study headwater streams. Collecting long-term trends can give us insight on how water extraction is affecting other branches of the Winter River. There are 5 classifications: 0 – no surface water, 1 – surface water in pools only, 2 – surface water present but no visible flow, 3 – flow only interstitial, 4 – surface flow continuous.



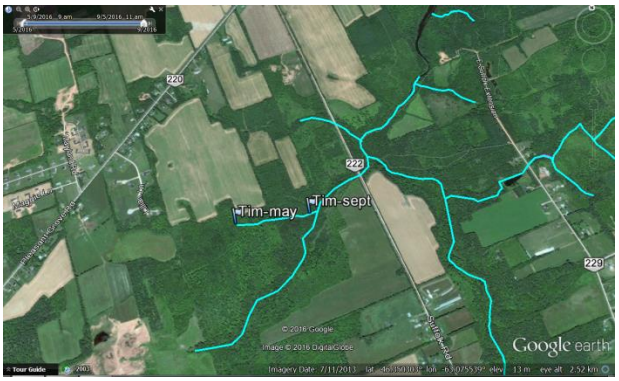
Wheatley Branch

Distance - ~220 metres



Island Coastal Branch

Distance - ~ 1250 metres

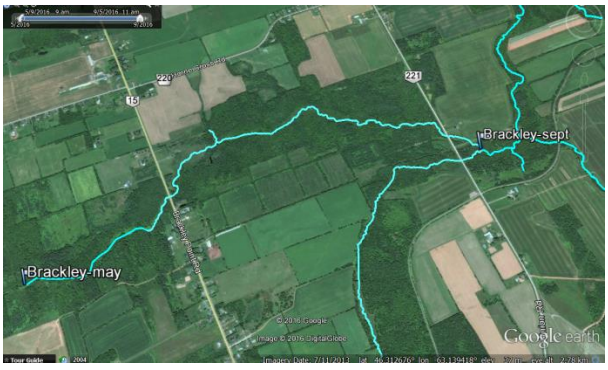


Tim's Branch

Distance - ~400 metres

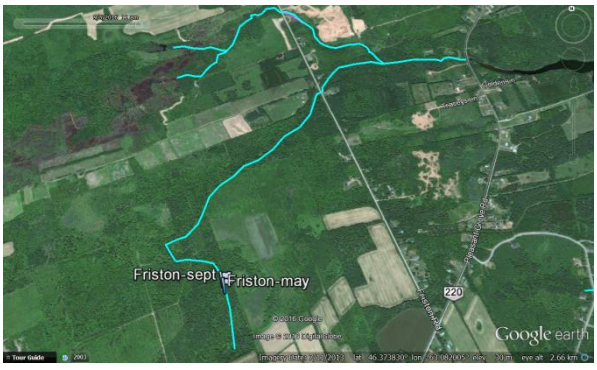
Pater Branch

Distance - ~125 metres



Brackley Branch

Distance - ~3200 metres



Friston Branch

Distance – 0.0 metres

4.8 Beaver Surveys

Figure 61: Beaver Activity - East side of Tracadie Bay

Figure 62: Beaver Activity - South side of Tracadie Bay

Figure 63: Beaver Activity - Winter River

5 Future Project Wish List

This section of the document is to be used for potential future projects, all of which require landowner permission in advance, thus this section has been removed in the publicly available version of this document.