Evaluation of Habitat Expansion Outcomes on Upper Terra Nova River, 2019 (*Final Report, February 21, 2020)*

Freshwater-Alexander Bays
Ecosystem Corporation (FABEC)

Evaluation of Habitat Expansion Outcomes on Upper Terra Nova River, 2019

Project Report

Submitted by:
Freshwater- Alexander Bays Ecosystem Corporation (FABEC)
P.O. Box 153, Glovertown South, NL A0G 4K0
www.fabec.org

Table of Contents

1.0 Introduction

Terra Nova River is the fourth largest river on the island of Newfoundland. Since the early 1900's various initiatives have been undertaken to expand accessible habitat and increase the river's Atlantic salmon population. Permanent infrastructure now includes fishways at Grant Falls (11 km from the ocean), Terra Nova River Falls (22 km from the ocean) and Mollyguajeck Falls (56 km from the ocean).

Between 1985 and 2002 the Terra Nova-Alexander Bay Development Association, in partnership with the Department of Fisheries and Oceans, managed a salmon enhancement program to establish a salmon population in the watershed above Mollyguajeck Falls, which until 1985 had been largely inaccessible for salmon migration. The newly opened habitat upstream from Mollyguajeck is estimated to represent sixty percent of the river's salmon production capacity above Grant Falls (Bourgeois, 2002). Initially the enhancement program involved the construction of a fishway around Mollyguajeck Falls, then the transfer of 1,412 spawners from the lower river to locations above Mollyguajeck, and finally between 1995 and 2002, the release of 2.5 million salmon fry incubated at a hatchery in Terra Nova in various locations of the upper watershed.

In 2015 the Freshwater-Alexander Bays Ecosystem Corporation obtained assistance to evaluate the outcomes of these efforts to establish a foothold from which to grow a natural population of salmon in the upper watershed. The project had two main goals:

(1) To assess the effectiveness of the Mollyguajeck fishway in accommodating the passage of salmon around Mollyguajeck falls.

(2) To determine the proportion of total salmon returns upstream of Grant Falls fishway that migrated past Mollyguajeck Falls to the upper watershed. This would provide an indicator of spawning escapement to the upper watershed relative to its spawning capacity and the resulting contribution to the growth of the river's overall salmon population.

The 2015 project was followed up by a similar project in in 2016, modifications to the Mollyguajeck fishway in 2017, and follow-up salmon counts in 2018 and 2019.

2.0 Partners

FABEC would like to express our appreciation to the partners who made this project possible. We thank the Atlantic Salmon Conservation Foundation for its financial contribution, Terra Nova National Park for its donation of materials, equipment, and helicopter time, DFO's Salmonids Section and Regional Headquarters, which provided various materials as well as professional expertise, and Traytown Builders Ltd., which lent a satellite telephone for two successive years.

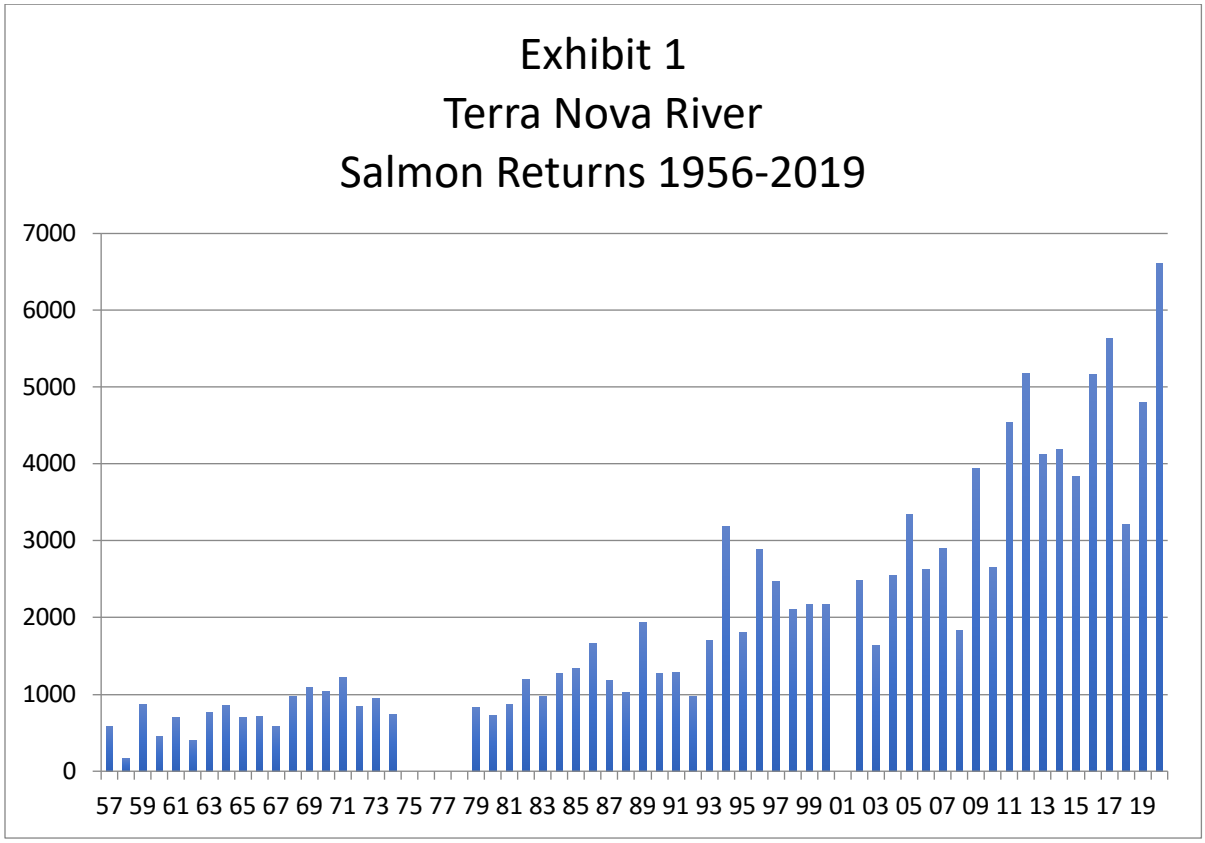
Especially we would like to acknowledge the major investment made by DFO in the design and construction of the permanent water diversion dam at Mollyguajeck Falls. If the 2018 and 2019 results are any indication, this new infrastructure will prove its worth in the years and decades to come.

3.0 Background

3.1 Terra Nova River Salmon Returns - 1956 to 2019

Exhibit 1 shows the history of Atlantic salmon returns through the lower Terra Nova River Fishway since 1956. It should be noted that these counts take place at Grant Falls located 11 kilometres from the ocean, therefore do not account for salmon that spawn in the lower section of the main river and in the Maccle's Brook tributary. As the graph shows, the stock has improved dramatically over the 53-year period.

Returns improved noticeably in the years after the commercial salmon fishery closed in 1992. This period coincided with the early days of the Terra Nova River salmon enhancement program. As reflected in the graph, the average annual return from 1956 to 1991 was 952, then increased to 2,334 from 1992 to 2001, 3,123 from 2002 to 2011 and 4,695 from 2012 to 2019. A record return was achieved in 2019 when 6,607 salmon migrated through the Grant Falls fishway.



3.2 Mollyguajeck Fishway – 2015 to 2019

2015

FABEC's 2015 salmon count at Mollyguajeck Falls was the first to take place since 2001. Due to 2015's dry conditions, streamflow through the Mollyguajeck fishway was too low to allow salmon passage for most of the season. Only 297 salmon were counted through the fishway as compared to 329 in 2001. Water levels fell so low that only 17 salmon managed to migrate through the fishway between August 21 and October 2, when the project ended.

This experience demonstrated a serious deficiency with the Mollyguajeck fishway. During long dry periods, the fishway effectively dried up thus preventing salmon passage. The 2015 report correlated daily salmon counts to streamflow data at the Terra Nova River water gauging station at Glovertown. This comparison showed that after measured streamflow dropped below about 17 m^3/second at the station (which was the case continuously from mid-August to early October), few salmon managed to migrate past Mollyguajeck. The 2015 report concluded that the Mollyguajeck fishway was deficient in its ability to facilitate salmon passage during dry periods and recommended that modifications be made to the fishway to increase flow during dry periods.

2016

In its follow-up project in 2016, FABEC helicoptered 200 bags of sand to the site so as to be prepared to create a temporary diversion dam if water conditions again fell too low in the fishway for salmon passage. This indeed happened by mid-August so the sandbags were used to build a makeshift dam to divert water from the main river into the fishway. This proved successful and managed to keep water high enough to allow salmon passage. The final count when the project ended in early October was 965, over three times the 2015 count.

During the 2016 project, DFO staff and a consulting team of engineers and hydrologists visited the site to assess the low water problem. They observed how FABEC's temporary dam was working and concluded that the best permanent solution was to construct a concrete dam similar in design to the makeshift dam.

2017

While FABEC did not undertake a project that year, 2017 was an eventful year in that DFO invested in the construction of a permanent diversion dam costing several hundred thousand dollars in design and engineering fees, contractor costs, helicopter charges, and DFO staff costs. The construction went smoothly, aided by another autumn of very low water. Exhibits 2 and 3 on the following page shows photos of the diversion dam during and after construction.

Exhibit 2 – Diversion Dam Under Construction, September 2017

Exhibit 3 – Completed Diversion Dam

2018

The effectiveness of the new dam in maintaining flow in the fishway during dry conditions was proven in the 2018 project. While river levels fell as low or lower as they were during the previous counts, the lowest depth recorded in the fish trap was 34.5 cm as compared to zero cm in 2015 and 13.0 cm in 2016. Although 2018 had an average streamflow rate of only 11.6 m^3/second across the 75 successive days of the count (i.e. Aug 9-Oct 22), there was not a day in that period when fish passage was impeded because of low water in the fishway.

An unanticipated result of the diversion dam was that water levels at beginning of the season made installation of the fish trap exceedingly difficult, in fact delayed the start-up of counting operations until August 9, more than two weeks later than in 2016. The delay was mitigated by placing a fence across the fishway on July 20 to hold salmon back until the trap could be installed. While late July has normally been the target date to begin the Mollyguajeck count, the number of salmon that move up river before this point is unknown. If resources are available for another project in 2020, FABEC will consider the pros and cons of an earlier start-up date.

Despite the delay, the project ran for 80 days from August 9th to October 22nd during which time 1,148 salmon were counted at Mollyguajeck, an increase of 19% from 2016 and almost four times the 2015 count. The diversion dam made a huge improvement in the ability of salmon to get past Mollyguajeck Falls.

2019

The 2019 project got underway on July 19 with the transportation of supplies to Mollyguajeck and preparation of the fish trap and fence for operation. The count officially began on July 23 although five salmon were recorded on the morning of July 20. Project staff consisted of four people working in 2-person teams on 4-day rotations. Staff accessed the site by foot from an old logging road 5 kilometres away.

The count extended from July 20th to October 22nd with daily counts taking place on 89 days. The total count for the period was 1,570, an increase of 36.8% from 2018 and more than five times the 2015 count. The 2019 project confirmed once again that the diversion dam was effective in maintaining adequate water flow in the fishway during all periods. While average river levels (17.4 m^3/second) were higher than 2018 (11.6 m^3/second), the lowest depth recorded in the fish trap was 37.5 cm compared to 34.5 cm in 2018.

4.0 Fishway Performance

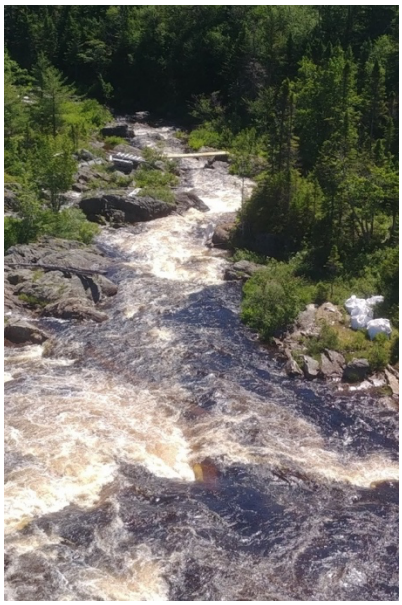
Mollyguajeck is a rustic fishway, which unlike the river's two other fishways, was originally constructed without built infrastructure. Explosives were used to blast a channel through bedrock. Water from the main river above the falls flows into a natural channel lying below the falls. The fishway provides a complete route around the falls for salmon to navigate.

Exhibit 4 shows the location and flow direction of the fishway. The inflow channel receives water from the main river and then turns 90º towards the bottom of the falls. The square in the photo shows where the fish trap was installed. The channel flowing toward the bottom of the photo previously contained water only when flows were relatively high. However after the diversion dam was in place, water now flows in this channel throughout the summer. The installation includes a fish fence across this stream to prevent salmon from bypassing the trap.

Exhibit 4 – Fishway Location and Water Flow Direction

Exhibit 5 below shows the water flow entering the fishway. In the background is the catwalk across the channel that provides staff access to the fish trap.

Exhibit 5 – Water Entering the Fishway



The photo in Exhibit 6 shows the fishway and Mollyguajeck Falls during very high water. The arrows show the flow direction toward the trap and back to the main river flow at the base of Mollyguajeck Falls.

Exhibit 6 – Water Flow Through the Fishway

In 2019 counting operations began on July 23, when water depth inside the trap measured 53 cm. By August 14 after 632 salmon had been counted through the trap, the depth measured 37.5 cm. Thereafter water levels remained above that depth. The average depth over 86 days was 44.4 cm compared to 40.5 in 2018. On the day of the last count, October 22, the recorded depth was 50.5 cm.

Exhibits 7 and 8 compare Terra Nova River streamflow data with depth measurements in the Mollyguajeck fish trap for the years 2015 (no diversion dam), 2016 (makeshift dam for part of season) and 2018 and 2019 (after permanent dam installed).

For 2015 the exhibits show a strong relationship between recorded river streamflow (or discharge) rates and fishway water depth. As streamflow rates fell, the measured depth in the fish trap fell at a proportionately similar rate. By August 23 when streamflow had fallen to 14.5 m^3/sec, there was 10 cm of water in the trap. Over the next 45 days, there were only four days when water was high enough for salmon passage.

A similar situation unfolded in 2016. As streamflow rates dropped off, water measurements in the trap fell proportionately. On August 12 sandbags were used to build a diversion dam. This was partially successful but water in the fishway continued to drop to a point where few salmon could get through. On August 20 the dam was extended farther out into the main current. The result was immediate and raised the level in the trap

from 13 to 26 cm. Over the next day and a half, 104 salmon passed through. Thereafter water levels were no longer a constraint.

The next count was taken in 2018 after DFO built the permanent diversion dam. As shown in Exhibit 9C, the proportional relationship between river flow and the trap water level changed significantly. Over the project period, average river streamflow was 11.6 m3/second compared to an average measured depth in the fish trap of 39.3 cm. The lowest streamflow point was 7.0 m^3/second compared to the lowest recorded fish trap depth of 34.5 cm.

Water conditions were much more favourable in 2019. Average streamflow at the water station was 44.8 m^3/second while average fish trap depth was 17.4 cm. The low points were 11.4 m^3/second of streamflow and 37.5 cm of water depth in the trap.

The effectiveness of the new dam was demonstrated most clearly in 2018, which had the lowest average river flow of the four monitoring years. Compared to 2015 when the fishway all but dried up, in 2018 water depth in the trap never dropped below 34.5 cm.

EXHIBIT 7
Terra Nova River Streamflow Rate vs Depth Inside Mollyguajeck Fish Trap

	2015		2016		2018		2019	
Week Ending	Avg. Streamflow (m^3/sec)	Avg. Trap Depth (cm)	Avg. Streamflow (m^3/sec)	Avg. Trap Depth (cm)	Avg. Streamflow (m^3/sec)	Avg. Trap Depth (cm)	Avg. Streamflow (m^3/sec)	Avg. Trap Depth (cm)
02-Aug	16.9	30.0	24.8	26.0	n/a	n/a	15.6	45.3
09-Aug	20.6	25.0	18.8	20.0	n/a	n/a	13.1	41.9
16-Aug	18.1	18.0	13.9	15.5	21.5	45.0	13.1	39.9
23-Aug	14.8	10.0	9.6	22.0	14.6	41.5	13.0	42.6
30-Aug	10.9	7.0	10.1	30.0	11.9	39.5	12.8	41.6
06-Sep	9.4	1.0	13.5	42.0	9.6	39.0	13.2	39.5
13-Sep	7.0	0.0	19.1	44.0	7.8	35.0	12.7	40.1
20-Sep	9.4	2.0	21.5	42.0	7.9	37.7	12.8	41.8
27-Sep	9.0	7.0	22.6	41.0	8.2	38.0	16.1	42.6
04-Oct	7.3	3.0	29.8	n/a	7.8	38.5	25.9	49.1
11-Oct	n/a	n/a	n/a	n/a	7.4	40.5	25.3	48.6
18-Oct	n/a	n/a	n/a	n/a	9.3	43.0	24.2	47.0
22-Oct	n/a	n/a	n/a	n/a	22.0	70.0	31.4	50.3
AVERAGE	12.3	8.6	18.8	31.8	11.6	39.3	17.4	44.8
LO POINT	5.6	0.0	8.5	13.0	7.0	34.5	11.4	37.5
HI POINT	27.2	20.1	44.3	42.9	53.0	70.0	32.3	53.0

Exhibit 8A
2015 Streamflow Rate VS Water Depth in Trap

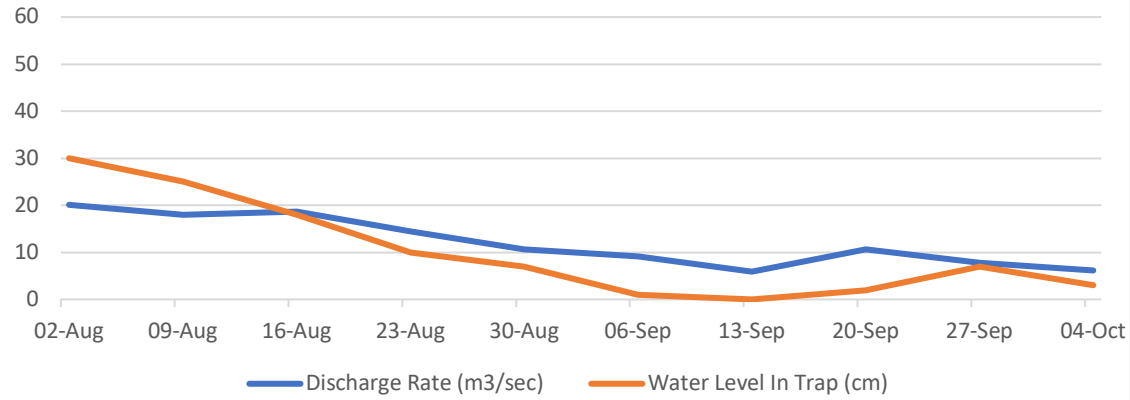


Exhibit 8B
2016 Streamflow Rate VS Water Depth in Trap

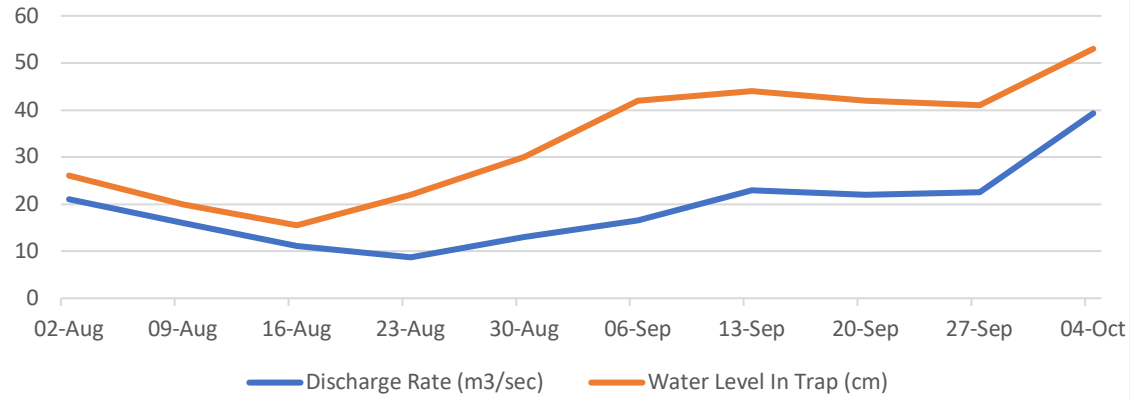
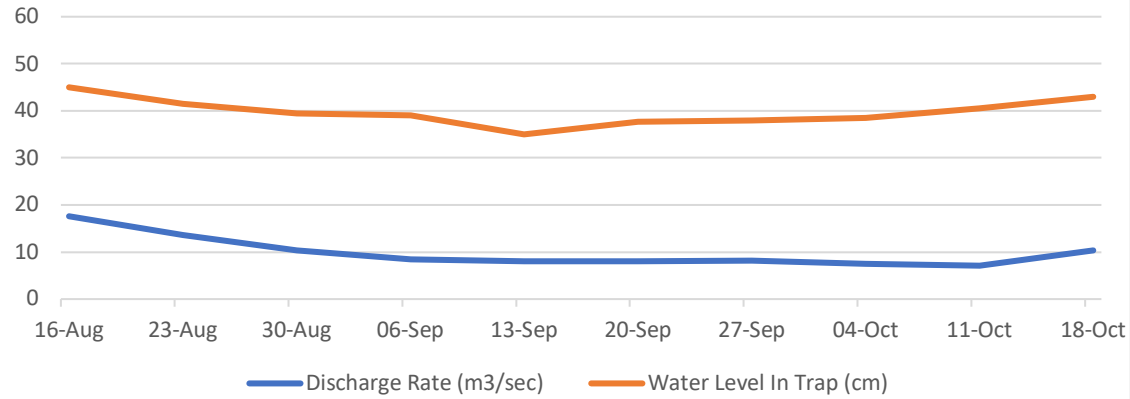
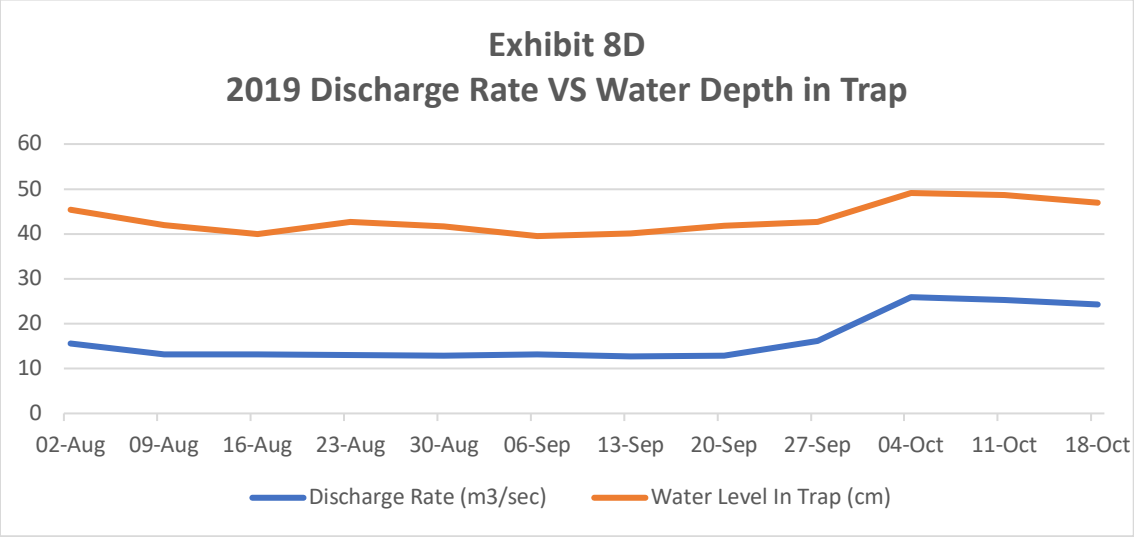


Exhibit 8C
2018 Streamflow Rate VS Water Depth in Trap





5.0 Assessment of Salmon Returns

Exhibit 9 provides 2019 weekly salmon returns at Mollyguajeck Falls relative to average weekly streamflow rates at the Glovertown water station and shows a comparison to the years 2015, 2016, 2018, and 2019. Exhibit 10 shows the same information graphically. These comparisons display the nature of the relationship between annual river flow conditions and salmon movement through the Mollyguajeck fishway.

Exhibit 9
Weekly Streamflow Rates (m^3/sec) VS Salmon Returns

	2015		2016		2018		2019	
Week Ending	Streamflow (m^3/sec)	No. of Salmon	Streamflow (m^3/sec)	No. of Salmon	Streamflow (m^3/sec)	No. of Salmon	Streamflow (m^3/sec)	No. of Salmon
02-Aug	16.7	8	24.8	137			15.6	190
09-Aug	20.6	93	18.0	150			13.1	190
16-Aug	18.1	160	13.2	29	21.5	205	13.1	315
23-Aug	14.8	22	9.3	121	14.6	173	13.0	235
30-Aug	10.9	0	10.7	183	11.9	150	12.8	146
06-Sep	9.4	3	14.0	103	9.6	155	13.2	139
13-Sep	7.0	0	20.1	109	7.8	129	12.7	79
20-Sep	9.4	7	21.3	60	7.9	117	12.8	65
27-Sep	9.0	0	22.7	62	8.2	44	16.1	139
04-Oct	7.3	4	33.3	11	7.8	55	25.9	22
11-Oct					7.4	60	25.3	8
18-Oct					9.3	14	24.2	38
25-Oct					22.0	46	31.4	4
Avg Streamflow	11.9		18.8		11.4		17.4	
Total Salmon		297		965		1148		1570
Weekly Average		29.7		96.5		104.4		120.8

In 2015 the Mollyguajeck count lasted for 70 days. As reflected in Exhibits 9 and 10A, 281 salmon passed through the fishway in the first 21 days for an average of 13.4 per day. This correlated to an average streamflow rate of 19.0 m^3/second at the Glovertown water station. Over the remaining 7 weeks, average streamflow fell to 9.2 m^3/second and only 21 salmon, or an average 0.4 per day, migrated through the fishway.

The 2016 project operated for 69 days and saw a total of 965 salmon migrate past Mollyguajeck for an average of 14.0 salmon per day. This corresponded to an average streamflow of 12.6 m^3/second. While river levels were somewhat higher in 2016, a significant factor was FABEC's installation of a temporary dam using sandbags and plywood to divert more water into the fishway as river levels fell. Our first attempt on August 12 made only a slight difference. But on August 20 the dam was extended farther out into the main current and succeeded in raising the water in the fishway by 10 cm. Over the next day and a half, 104 salmon were released from the counting trap. The following week after a major rainstorm, 143 salmon were released from the trap in a single day.

With data provided from the 2015 and 2016 projects, DFO decided to build a permanent concrete diversion dam at the entrance to the fishway. Construction was completed in October 2017. FABEC's 2018 project lasted for 75 days over which time the discharge rate averaged only 11.4 m^3/second, similar to 2015's low water levels. In the face of these dry conditions, the new dam performed well. Low water flow in the fishway never became a problem. Over the period 1,148 salmon were released from the fish trap for an average of 15.3 salmon per day.

Prior to the construction of the diversion dam, the Mollyguajeck fishway's effectiveness in allowing salmon passage declined after discharge rates dropped much below 20 m^3/second. While this might not have been a problem in years with only a short rainless period, in ten of the last 24 years discharge rates remained below 20 m^3/second for more than forty days during the main salmon run. The driest years experienced between August 1 and October 31 included 2001 (57 days below 20 m3/second), 2002 (94 days), 2003 (68 days), 2015 (86 days), 2017 (92 days) and 2018 (69 days).

Based on knowledge gained from the 2001, 2015, and 2016 salmon counts, it is a fairly safe conclusion that salmon were held back from reaching the upper watershed in low rainfall years because of low water in Mollyguajeck fishway.

2018 was a similar dry year to 2015. However, unlike 2015 water conditions were not an impediment to fish passage through the fishway. In 2015 297 salmon managed to get through the fishway representing only 7.7% of the number that migrated through the Grant Falls fishway. In contrast 1,148 passed Mollyguajeck in 2018 representing 23.9% of those that migrated past Grant Falls. Credit for this improvement can be attributed to the new diversion dam. Whereas in 2015 the fishway was all but dry for a significant period, in 2018 water depth in the trap never fell below 34.5 cm.

2019's water conditions were generally favourable with an average streamflow at the Glovertown water station of 17.4 m^3/second compared to 11.9 and 11.4 m^3/second in 2015 and 2018 respectively. Nevertheless, as shown in Exhibit 10E, streamflow remained lower than 15 m^3/second for at least 58 consecutive days. As shown in Exhibit 10B, in 2015 when flow conditions were lower than that level, very few salmon managed to migrate through Mollyguajeck fishway. The 2019 results confirm the conclusion from the 2018 project that the Mollyguajeck diversion dam has been successful in maintaining adequate flow in the fishway for salmon passage during dry periods that previously prevented salmon migration past this point in the river.

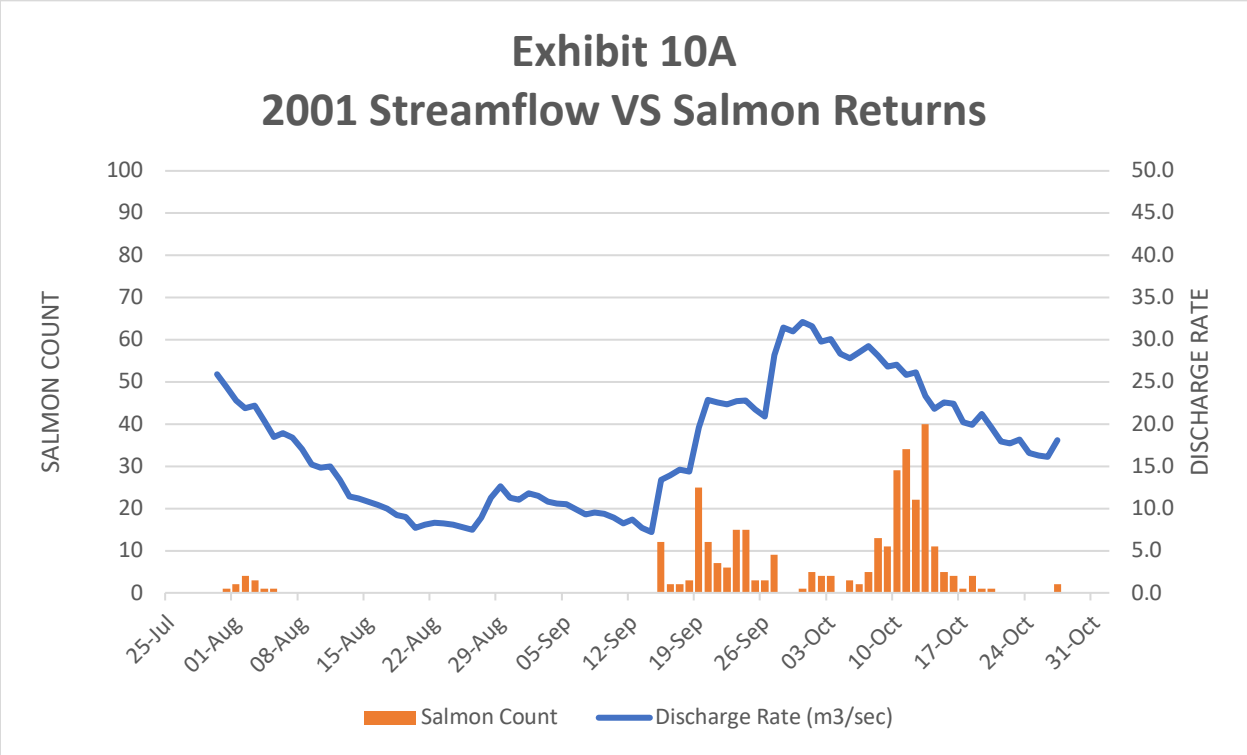


Exhibit 10B
2015 Streamflow VS Salmon Returns

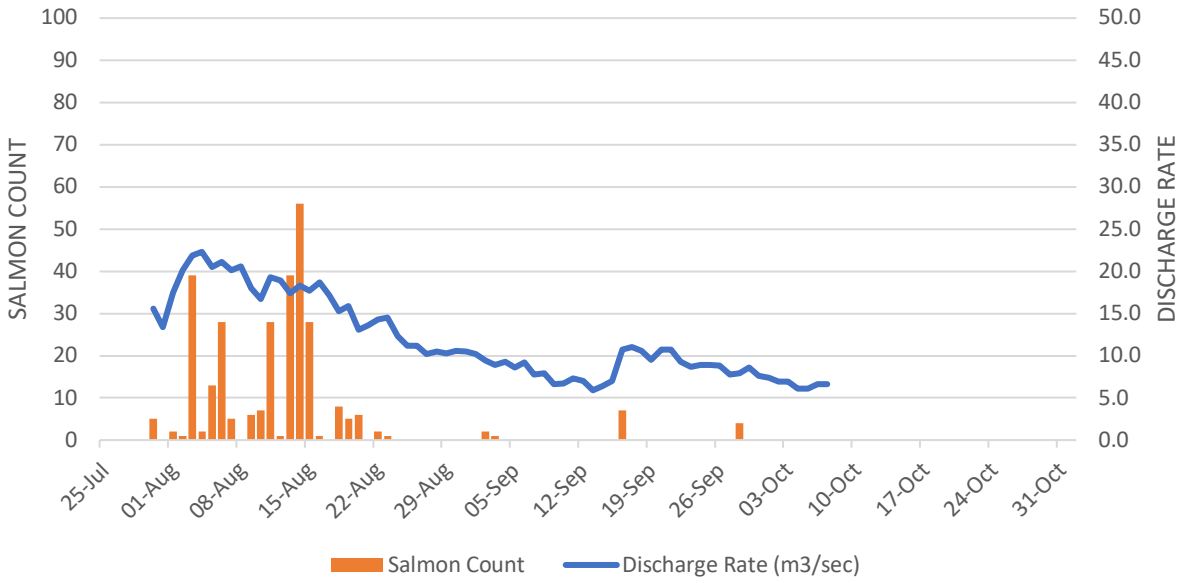


Exhibit 10C
2016 Streamflow VS Salmon Returns

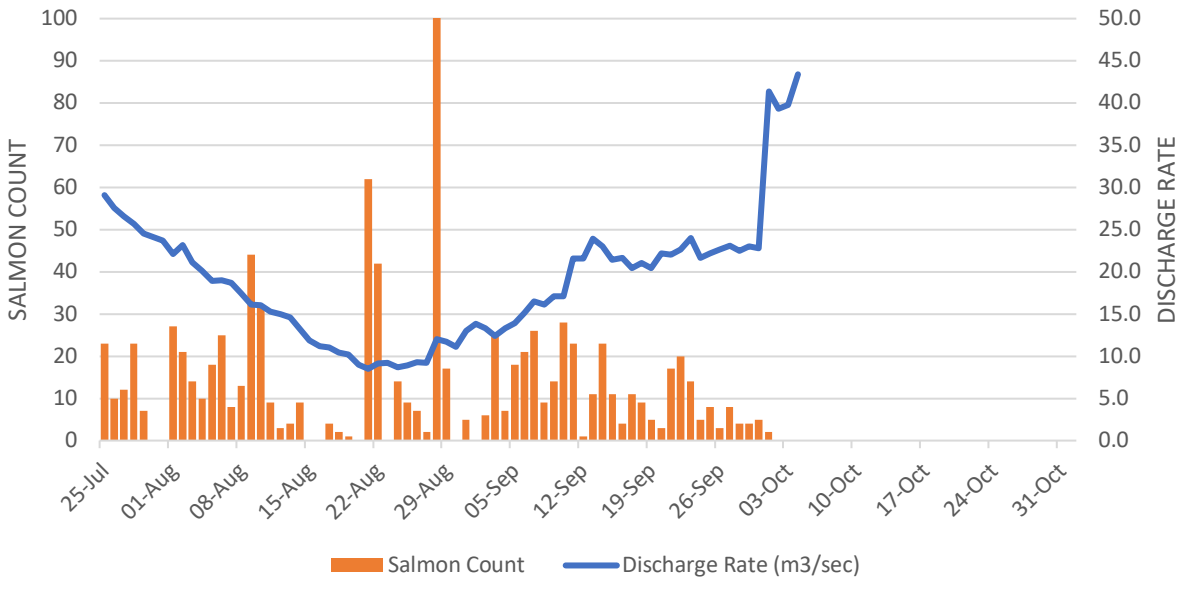


Exhibit 10D
2018 Streamflow VS Salmon Returns

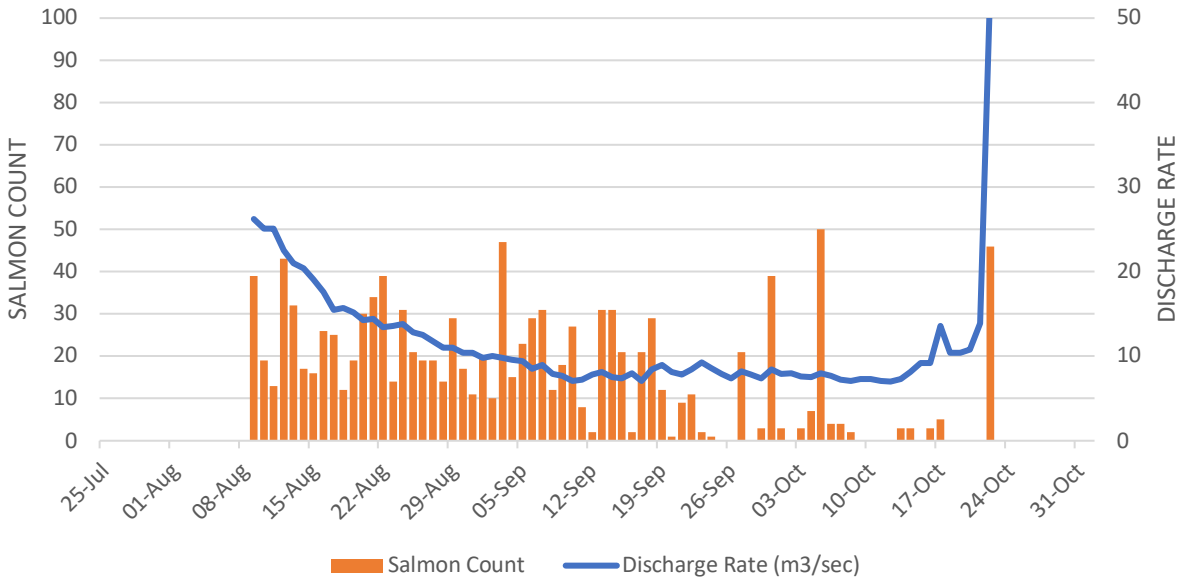
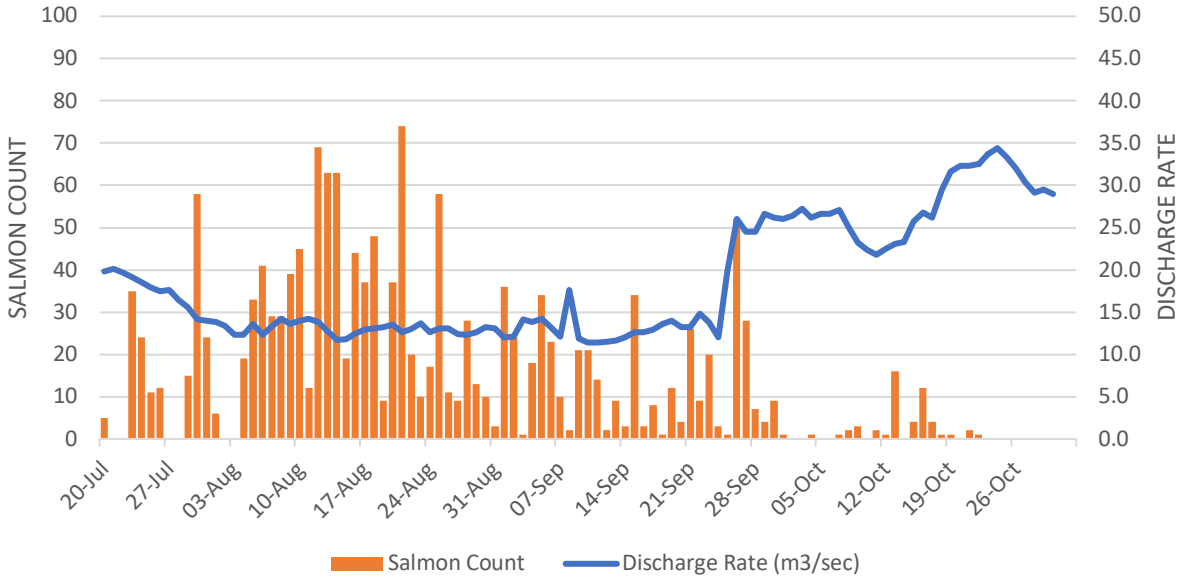


Exhibit 10E
2019 Discharge Rate VS Salmon Returns



Successive Mollyguajeck counts of 965 in 2016, 1,148 in 2018, and 1,570 in 2019 provide compelling evidence that the effort to establish a spawning population in the upper watershed has been successful. In 2018 and 2019, almost a quarter of the salmon that migrated through the lower fishway continued their journey to the upper watershed. Along with the Terra Nova River's strong conservation program, FABEC feels that the enhancement program was a significant factor in the river's population growth since 1985. The 2018 count of 4,784 salmon was 2.8 times higher than the 1985 count of 1,669 and 1.9 times higher than the 2001 count of 2,481. Similarly the 2019 count of 6,607 was 4.0 and 2.7 times respectively the 1985 and 2001 counts.

This growth was achieved despite the ineffectiveness of Mollyguajeck fishway during years with long periods of low water conditions. Based on our correlation of streamflow data with fishway water levels, it can be argued that there were a number of years when many - probably most - of the salmon destined for the upper watershed remained stranded below Mollyguajeck Falls.

6.0 Stock Conditions Compared to Conservation Requirements

As shown in Exhibit 11, in 2019 the river as a whole achieved 73.9% of its spawning capacity of 8,937 salmon, which compares to a previous range of 36.0% to 63.1% between 2015 and 2018. While 2017 was an exception, in general the size of Terra Nova River's population has increased enormously against historic levels.

Exhibit 11
Salmon Escapement Compared to Conservation Requirements

		From Grant Falls to Mollyguajeck	Above Mollyguajeck	Entire River above Grant Falls
Conservation Requirement*		3,575	5,362	8,937
2001	Spawning Escapement	2,152	329	2,481
	Conservation Level Achieved	60.2%	6.1%	27.8%
2015	Spawning Escapement	4,871	297	5,168
	Conservation Level Achieved	136.3%	5.5%	57.8%
2016	Spawning Escapement	4,670	965	5,636
	Conservation Level Achieved	130.6%	18.0%	63.1%
2017	Spawning Escapement	No data collected	No data collected	3,215
	Conservation Level Achieved			36.0%
2018	Spawning Escapement	3,646	1,148	4,794
	Conservation Level Achieved	102.0%	21.4%	53.6%
2019	Spawning Escapement	5,038	1,570	6,607
	Conservation Level Achieved	140.9%	29.3%	73.9%

* (C. E. Bourgeois, J. Murray and G. Clarke, A *review of Atlantic salmon enhancement activities on Terra Nova River*, 2002)

This improvement has taken place despite the obvious constraint to salmon migration past Mollyguajeck Falls in years of low rainfall. Now that the water flow problem in the fishway has been eliminated, all else being equal, there is room for optimism that the river's population will grow toward its spawning potential more quickly than in the past.

Exhibit 11 compares escapement to conservation requirements in the two sections of Terra Nova River lying above Grant Falls – (1) from Grant Falls to Mollyguajeck and (2) above Mollyguajeck. It is useful to point out several aspects related to these numbers.

The first point is that in 2015, when a very healthy 5,168 fish were counted through the lower fishway, only 297 of these managed to pass Mollyguajeck representing a conservation achievement of only 5.5% in the upper watershed compared to 136.3% in the lower river. This imbalance of spawning activity is most likely attributed to the fact that salmon were prevented from moving further upstream by lack of water in the fishway.

Escapement to the upper watershed showed a steady improvement in the years 2016, 2018 and 2019 most likely as a consequence of the improved waterflow through the Mollyguajeck fishway. The conservation achievement in these years was 18.0%, 21.4% and 29.3% respectively.

The 2018 results provide an encouraging contrast to 2015. While total river returns were less, escapement past Mollyguajeck was almost four times higher than 2015. Whereas the upper watershed achieved only 5.5% of conservation in 2015, this quadrupled to 21.4% in 2018. Meanwhile the conservation level in the lower river dropped from 136.3% in 2015 to 102.0% in 2018, representing a closer balance in spawning escapement between the two sections of river.

While the Mollyguajeck count of 1,570 in 2019 was encouraging relative to previous numbers, this still represents less than a third of the upper watershed's spawning capacity. Based on 2019 numbers, the entire section of river above Grant Falls is achieving almost three-quarters of conservation requirements. However, this heavily favours the lower section, which achieved 140.9% of conservation compared to 29.3% in the upper watershed. While the 2019 results indicate a continuing imbalance in spawning activity between the two sections of river, they do show an encouraging gradual increase in absolute numbers migrating to the upper watershed.

7.0 Conclusion and Recommendation

As in 2018, 2019 was an encouraging year in terms of total spawner returns to the river and the number migrating to the upper watershed. Until 2017 the Mollyguajeck fishway was a weak link in the Terra Nova salmon enhancement initiative. With the installation of the new diversion dam, low water in the fishway no longer appears to be an impediment to salmon passage.

Nevertheless with the climate appearing to change rapidly, low water generally in the river appears to be an issue of rising concern.

Recommendation

Terra Nova River is classified as Class 2 for a small portion of the river and Class 0 (catch and release only) for all of the remainder. While there is reason for optimism that the population will continue to improve with a gradual increase in spawning escapement past Mollyguajeck Falls, the upper watershed remains less than 30% seeded while the river as a whole remains less than 75% seeded.

FABEC recommends no changes to the current management plan for the river. It is our opinion that the status quo should be maintained for all areas of the river that are designated as Class 2 and Class 0.

APPENDIX A

MOLLYGUAJECK FISHWAY LOGSHEET - 2019

JULY 20 to OCTOBER 22 (95 DAYS)

Mollyguajeck Fishway Logsheet - 2019

Day No.	Date	Environmental Conditions									Salmon Count			
		Mollyguajeck Fishway						TN Park	Glovertown Water Station					
		Air Temp (°C)		Water Temp (°C)		Water Trap Depth (cm)		Daily	Stream-	Water	Per Day			Cumu-
		Lo	Hi	Lo	Hi	Lo	Hi	Rainfall (mm)	flow (m3/sec)	Temp Avg. (°C)	≤ 63 cm	> 63 cm	Total	lative
	19-Jul	na	na	na	na	na	na	0.0	24.7	19.0	na	na		
1	20-Jul	na	na	na	na	na	na	0.0	21.0	18.7	5	0	5	5
2	21-Jul	na	na	na	na	na	na	2.6	19.8	17.4	na	na		5
3	22-Jul	na	na	na	na	na	na	3.2	20.1	17.0	na	na		5
4	23-Jul	17.0	23.3	na	na	53.0	53.0	4.1	19.7	17.1	34	1	35	40
5	24-Jul	12.0	20.0	na	na	43.0	46.0	0.0	19.1	17.3	23	1	24	64
6	25-Jul	18.0	27.0	na	na	45.0	45.0	0.0	18.5	17.8	11	0	11	75
7	26-Jul	14.0	23.0	na	na	45.0	45.0	0.0	17.9	19.4	12	0	12	87
8	27-Jul	na	na	na	na	na	na	0.0	17.5	20.4	na	na		87
9	28-Jul	na	na	na	na	na	na	0.0	17.6	20.7	na	na		87
10	29-Jul	22.0	27.0	21	21	45.0	46.0	0.0	16.4	20.1	14	1	15	102
11	30-Jul	19.7	29.3	19	21	45.0	46.0	3.4	15.6	20.8	52	6	58	160
12	31-Jul	15.6	26.6	20	22	45.0	46.0	0.0	14.1	20.6	22	2	24	184
13	01-Aug	35.6	36.5	22	22	45.0	45.0	1.1	14.0	21.7	6	0	6	190
14	02-Aug	na	na	na	na	na	na	1.6	13.8	23.0	na	na		190
15	03-Aug	na	na	na	na	na	na	0.0	13.4	22.8	na	na		190
16	04-Aug	23.6	29.1	22	23	41.0	43.0	0.0	12.3	22.1	17	2	19	209
17	05-Aug	16.5	21.2	21	23	41.0	43.0	18.8	12.3	21.0	31	2	33	242
18	06-Aug	17.2	24.4	20	22	41.5	43.0	0.0	13.6	19.4	37	4	41	283
19	07-Aug	17.5	19.0	20	21	41.5	42.0	0.0	12.3	18.4	27	2	29	312
20	08-Aug	24.0	29.0	21	21	42.0	42.0	0.0	13.3	19.5	29	0	29	341
21	09-Aug	12.0	18.0	20	21	41.0	42.0	2.7	14.2	20.1	35	4	39	380
22	10-Aug	18.0	28.0	21	21	41.0	41.0	0.6	13.6	20.3	40	5	45	425
23	11-Aug	18.0	20.0	21.0	21.0	41.0	41.0	0.0	14.0	20.4	10	2	12	437
24	12-Aug	24.0	25.0	21.4	21.6	38.5	39.5	0.0	14.2	21.1	64	5	69	506
25	13-Aug	14.0	24.4	19.4	20.4	38.5	38.5	1.5	13.8	20.3	58	5	63	569
26	14-Aug	17.3	24.0	19.3	21.5	37.5	40.5	0.0	12.8	20.5	55	8	63	632
27	15-Aug	11.0	22.6	19.7	20.5	39.5	39.5	8.4	11.7	20.3	15	4	19	651
28	16-Aug	19.0	24.0	20.3	21.2	39.0	43.0	0.0	11.8	19.9	43	1	44	695
29	17-Aug	15.0	27.0	19.7	22.7	40.0	43.0	0.0	12.5	20.3	34	3	37	732
30	18-Aug	12.0	20.0	20.1	21.4	43.5	44.0	0.0	12.9	20.4	45	3	48	780

Mollyguajeck Fishway Logsheet - 2019 (continued)

Day		Environmental Conditions									Salmon Count			
		Mollyguajeck Fishway						TN Park	Glovertown Water Station					
		Air Temp (°C)		Water Temp (°C)		Water Trap Depth (cm)		Daily	Stream-	Water	Per Day			Cumu-
No.	Date	Lo	Hi	Lo	Hi	Lo	Hi	Rainfall (mm)	flow (m3/sec)	Temp Avg. (°C)	≤ 63 cm	> 63 cm	Total	lative
31	19-Aug	15.0	21.0	20.1	20.2	44.0	45.0	0.0	13.1	19.6	8	1	9	789
32	20-Aug	19.0	23.0	20.3	20.8	41.0	41.5	0.0	13.2	20.6	35	2	37	826
33	21-Aug	12.0	26.0	19.5	21.5	42.0	43.0	0.0	13.5	20.9	70	4	74	900
34	22-Aug	9.0	15.0	19.5	20.4	41.0	43.0	4.8	12.6	20.0	20	0	20	920
35	23-Aug	15.0	17.0	19.1	20.1	43.0	43.0	0.0	13.0	19.4	10	0	10	930
36	24-Aug	10.0	16.0	19.8	20.7	42.5	44.0	0.0	13.7	19.1	15	2	17	947
37	25-Aug	5.0	24.0	18.1	20.8	41.0	42.0	0.0	12.6	18.0	55	3	58	1005
38	26-Aug	10.0	29.0	18.5	21.6	41.5	42.0	0.0	13.1	18.3	11	0	11	1016
39	27-Aug	10.0	18.0	19.2	19.4	41.0	41.0	1.2	13.1	17.2	7	2	9	1025
40	28-Aug	12.0	15.0	18.4	18.6	41.5	41.5	0.0	12.4	17.6	22	6	28	1053
41	29-Aug	9.0	16.0	17.0	18.6	40.5	41.5	0.6	12.3	16.9	12	1	13	1066
42	30-Aug	12.0	17.0	17.5	18.8	41.0	41.0	7.7	12.6	16.6	7	3	10	1076
43	31-Aug	15.0	22.0	18.0	18.7	39.5	41.0	0.0	13.2	17.8	2	1	3	1079
44	01-Sep	16.0	22.0	19.8	19.8	38.0	38.5	0.0	13.1	18.8	33	3	36	1115
45	02-Sep	8.0	23.0	17.2	19.8	38.5	38.5	0.0	12.0	17.8	20	4	24	1139
46	03-Sep	14.0	15.0	17.2	18.1	37.5	39.0	29.0	12.1	16.7	1	0	1	1140
47	04-Sep	15.0	21.0	17.4	17.6	39.5	40.0	0.0	14.1	17.4	15	3	18	1158
48	05-Sep	19.0	20.0	17.5	19.1	40.0	40.5	0.0	13.8	18.5	30	4	34	1192
49	06-Sep	6.0	22.0	17.1	18.7	41.0	41.5	0.0	14.2	18.3	20	3	23	1215
50	07-Sep	4.0	22.0	16.5	17.3	40.0	40.0	2.1	13.2	17.2	10	0	10	1225
51	08-Sep	12.0	18.0	17.1	18.0	40.0	41.0	0.0	12.1	15.5	2	0	2	1227
52	09-Sep	11.0	12.0	15.2	15.2	39.5	39.5	0.0	17.6	13.5	20	1	21	1248
53	10-Sep	0.0	19.0	14.5	15.4	39.5	40.0	0.7	11.9	12.9	19	2	21	1269
54	11-Sep	4.0	15.0	14.7	15.3	39.5	39.5	5.9	11.4	12.9	11	3	14	1283
55	12-Sep	9.0	10.0	14.2	14.3	41.0	41.5	6.0	11.4	12.5	2	0	2	1285
56	13-Sep	15.0	16.0	14.1	15.3	40.0	40.0	0.6	11.5	12.2	8	1	9	1294
57	14-Sep	1.0	18.0	13.6	15.6	41.0	42.0	0.0	11.6	12.4	3	0	3	1297
58	15-Sep	14.0	17.8	14.0	15.1	40.0	41.0	0.0	12.0	12.9	31	3	34	1331
59	16-Sep	12.0	14.0	14.0	14.3	42.0	42.0	10.9	12.6	13.7	2	1	3	1334
60	17-Sep	7.0	8.0	14.0	14.1	41.0	41.0	1.2	12.6	13.7	7	1	8	1342

Mollyguajeck Fishway Logsheet - 2019 (continued)

Day		Environmental Conditions									Salmon Count			
		Mollyguajeck Fishway						TN Park	Glovertown Water Station					
		Air Temp (°C)		Water Temp (°C)		Water Trap Depth (cm)		Daily	Stream-	Water	Per Day			Cumu-
No.	Date	Lo	Hi	Lo	Hi	Lo	Hi	Rainfall (mm)	flow (m3/sec)	Temp Avg. (°C)	≤ 63 cm	> 63 cm	Total	lative
61	18-Sep	4.0	8.0	13.6	14.0	41.5	43.0	12.4	12.9	12.3	1	0	1	1343
62	19-Sep	3.0	24.0	12.0	14.6	42.5	42.5	0.6	13.6	11.4	10	2	12	1355
63	20-Sep	4.0	16.0	13.4	13.9	42.5	42.5	0.0	14.0	12.0	4	0	4	1359
64	21-Sep	10.0	13.0	13.0	13.1	43.0	43.0	1.3	13.2	12.2	23	3	26	1385
65	22-Sep	2.0	17.2	12.5	14.0	42.5	42.5	0.0	13.2	11.5	9	0	9	1394
66	23-Sep	11.0	12.0	12.5	14.0	42.5	42.5	0.0	14.8	12.1	19	1	20	1414
67	24-Sep	2.0	13.6	12.0	13.4	42.5	42.5	2.1	13.8	13.3	3	0	3	1417
68	25-Sep	7.0	8.0	12.4	12.8	41.5	41.5	9.6	12.0	12.3	1	0	1	1418
69	26-Sep	8.0	13.0	12.1	12.3	42.0	43.0	25.8	19.8	11.5	44	8	52	1470
70	27-Sep	12.0	14.0	12.8	13.1	43.5	44.0	0.8	26.0	11.5	24	4	28	1498
71	28-Sep	8.0	14.0	12.2	12.4	45.0	46.0	0.0	24.5	11.8	6	1	7	1505
72	29-Sep	10.0	14.5	12.6	13.0	46.5	48.0	0.0	24.5	12.3	4	0	4	1509
73	30-Sep	5.0	15.0	12.4	12.6	49.5	49.5	4.9	26.6	11.5	7	2	9	1518
74	01-Oct	3.0	9.0	11.1	12.7	49.5	51.5	0.6	26.2	10.3	1	0	1	1519
75	02-Oct	2.0	6.0	11.1	11.8	51.5	51.5	1.3	26.0	9.3	0	0	0	1519
76	03-Oct	10.0	12.0	11.0	11.1	49.0	50.0	0.0	26.4	8.8	0	0	0	1519
77	04-Oct	2.0	10.0	11.3	11.4	49.0	50.5	0.0	27.2	8.0	0	1	1	1520
78	05-Oct	2.0	9.0	9.2	9.5	49.0	49.0	1.3	26.2	7.7	0	0	0	1520
79	06-Oct	-1.0	10.0	9.0	9.5	48.5	48.5	0.0	26.6	7.4	0	0	0	1520
80	07-Oct	9.0	12.3	9.2	9.8	48.5	48.5	0.0	26.6	8.0	1	0	1	1521
81	08-Oct	9.0	13.0	9.5	11.3	48.5	50.0	1.5	27.1	9.8	2	0	2	1523
82	09-Oct	8.0	17.2	9.1	11.3	48.5	50.5	0.6	25.1	10.6	3	0	3	1526
83	10-Oct	-6.0	9.2	9.1	9.7	48.5	48.5	0.0	23.2	10.5	0	0	0	1526
84	11-Oct	11.0	16.0	11.0	11.4	46.5	48.0	0.0	22.4	10.1	2	0	2	1528
85	12-Oct	3.0	15.0	11.1	11.2	45.5	46.5	8.4	21.8	10.4	1	0	1	1529
86	13-Oct	14.0	16.0	11.0	11.4	46.5	46.5	5.5	22.5	11.2	13	3	16	1545
87	14-Oct	2.0	3.0	11.6	11.7	46.0	46.0	0.6	23.1	11.2	0	0	0	1545
88	15-Oct	4.0	9.0	11.1	11.5	45.5	45.5	0.7	23.3	10.2	3	1	4	1549
89	16-Oct	9.4	15.4	9.8	11.2	47.0	47.0	24.8	25.7	9.9	9	3	12	1561
90	17-Oct	3.0	11.0	9.2	11.3	48.5	49.0	0.0	26.8	9.1	4	0	4	1565

Mollyguajeck Fishway Logsheet - 2019 (continued)

Day No.	Date	Environmental Conditions									Salmon Count			
		Mollyguajeck Fishway						TN Park Daily Rainfall (mm)	Glovertown Water Station		Per Day			Cumu-lative
		Air Temp (°C)		Water Temp (°C)		Water Trap Depth (cm)			Stream-flow (m3/sec)	Water Temp Avg. (°C)				
		Lo	Hi	Lo	Hi	Lo	Hi				≤ 63 cm	> 63 cm	Total	
91	18-Oct	7.0	12.6	10.8	11.2	49.0	49.0	0.0	26.2	9.5	1	0	1	1566
92	19-Oct	6.0	8.0	11.4	11.7	50.0	50.5	0.0	29.4	10.6	1	0	1	1567
93	20-Oct	3.0	4.0	11.5	11.8	49.5	50.5	0.6	31.6	9.5	0	0	0	1567
94	21-Oct	3.0	4.0	11.4	11.7	50.0	5.1	0.6	32.3	8.6	2	0	2	1569
95	22-Oct	3.0	3.0	11.4	11.4	50.5	50.5	2.5	32.3	8.3	1	0	1	1570
TOTAL								**225.22**			**1426**	**144**	**1570**	

APPENDIX B

GRANT FALLS FISHWAY LOGSHEET – 2019 & 2018

JUNE 13 to SEPTEMBER 13 (93 DAYS)

Daily Salmon Count - Terra Nova River								
	2019				2018			
Date	≤ 63 cm	> 63 cm	Total	Cumulative	≤ 63 cm	> 63 cm	Total	Cumulative
13-Jun	0	0	0	0	0	0	0	0
14-Jun	2	0	2	2	0	0	0	0
15-Jun	0	0	0	2	0	0	0	0
16-Jun	0	0	0	2	0	0	0	0
17-Jun	2	0	2	4	0	0	0	0
18-Jun	1	0	1	5	0	1	1	1
19-Jun	0	0	0	5	2	0	2	3
20-Jun	12	0	12	17	1	0	1	4
21-Jun	21	2	23	40	2	1	3	7
22-Jun	37	9	46	86	8	2	10	17
23-Jun	2	0	2	88	4	0	4	21
24-Jun	1	0	1	89	11	7	18	39
25-Jun	2	1	3	92	3	1	4	43
26-Jun	7	1	8	100	3	0	3	46
27-Jun	19	3	22	122	0	0	0	46
28-Jun	48	3	51	173	3	0	3	49
29-Jun	52	5	57	230	1	0	1	50
30-Jun	93	6	99	329	18	4	22	72
01-Jul	101	5	106	435	24	2	26	98
02-Jul	43	7	50	485	7	0	7	105
03-Jul	2	0	2	487	21	1	22	127
04-Jul	33	3	36	523	33	3	36	163
05-Jul	23	4	27	550	45	1	46	209
06-Jul	97	6	103	653	88	7	95	304
07-Jul	136	13	149	802	73	6	79	383
08-Jul	184	8	192	994	62	8	70	453
09-Jul	116	4	120	1114	114	3	117	570
10-Jul	102	4	106	1220	148	5	153	723
11-Jul	93	3	96	1316	261	23	284	1007
12-Jul	33	1	34	1350	190	8	198	1205
13-Jul	61	2	63	1413	104	5	109	1314
14-Jul	88	5	93	1506	55	2	57	1371
15-Jul	41	2	43	1549	14	0	14	1385
16-Jul	191	13	204	1753	35	1	36	1421
17-Jul	96	8	104	1857	24	4	28	1449
18-Jul	135	7	142	1999	47	6	53	1502
19-Jul	93	13	106	2105	61	6	67	1569

	2019 continued				2018 continued			
Date	≤ 63 cm	> 63 cm	Total	Cumulative	≤ 63 cm	> 63 cm	Total	Cumulative
20-Jul	224	20	244	2349	61	6	67	1636
21-Jul	230	19	249	2598	94	12	106	1742
22-Jul	144	16	160	2758	114	9	123	1865
23-Jul	136	12	148	2906	145	19	164	2029
24-Jul	137	12	149	3055	158	16	174	2203
25-Jul	197	17	214	3269	77	8	85	2288
26-Jul	241	29	270	3539	195	17	212	2500
27-Jul	218	18	236	3775	221	22	243	2743
28-Jul	163	20	183	3958	117	10	127	2870
29-Jul	186	16	202	4160	96	11	107	2977
30-Jul	314	37	351	4511	100	8	108	3085
31-Jul	192	13	205	4716	129	8	137	3222
01-Aug	202	5	207	4923	141	15	156	3378
02-Aug	152	6	158	5081	94	10	104	3482
03-Aug	75	3	78	5159	78	5	83	3565
04-Aug	112	11	123	5282	54	5	59	3624
05-Aug	110	8	118	5400	46	5	51	3675
06-Aug	326	21	347	5747	67	6	73	3748
07-Aug	92	2	94	5841	102	8	110	3858
08-Aug	35	5	40	5881	64	11	75	3933
09-Aug	42	3	45	5926	53	4	57	3990
10-Aug	45	2	47	5973	81	5	86	4076
11-Aug	41	1	42	6015	49	6	55	4131
12-Aug	40	1	41	6056	56	9	65	4196
13-Aug	51	1	52	6108	39	3	42	4238
14-Aug	30	3	33	6141	52	4	56	4294
15-Aug	12	0	12	6153	50	2	52	4346
16-Aug	13	1	14	6167	55	6	61	4407
17-Aug	18	4	22	6189	23	1	24	4431
18-Aug	22	2	24	6213	31	2	33	4464
19-Aug	32	1	33	6246	25	1	26	4490
20-Aug	18	2	20	6266	15	1	16	4506
21-Aug	21	2	23	6289	28	2	30	4536
22-Aug	21	2	23	6312	43	1	44	4580
23-Aug	31	2	33	6345	33	4	37	4617
24-Aug	21	2	23	6368	28	3	31	4648
25-Aug	8	1	9	6377	14	0	14	4662
26-Aug	12	0	12	6389	17	1	18	4680

	2019 continued				2018 continued			
Date	**≤ 63 cm**	**> 63 cm**	**Total**	**Cumulative**	**≤ 63 cm**	**> 63 cm**	**Total**	**Cumulative**
27-Aug	29	4	33	6422	10	3	13	4693
28-Aug	12	2	14	6436	15	1	16	4709
29-Aug	3	0	3	6439	8	0	8	4717
30-Aug	11	0	11	6450	10	0	10	4727
31-Aug	16	0	16	6466	5	1	6	4733
01-Sep	7	1	8	6474	10	0	10	4743
02-Sep	2	0	2	6476	0	0	0	4743
03-Sep	11	0	11	6487	0	0	0	4743
04-Sep	55	5	60	6547	0	0	0	4743
05-Sep	10	0	10	6557	4	0	4	4747
06-Sep	13	0	13	6570	6	0	6	4753
07-Sep	14	1	15	6585	9	0	9	4762
08-Sep	10	0	10	6595	1	0	1	4763
09-Sep	10	1	11	6606	0	0	0	4763
10-Sep	1	0	1	6607	0	0	0	4763
11-Sep	0	0	0	6607	1	0	1	4764
12-Sep	0	0	0	6607	3	1	4	4768
13-Sep	n/a	n/a	n/a		26	0	26	4794
Total	6135	472	6607		4415	379	4794	

References

Bourgeois, C. E., J. Murray and G. Clarke. *A review of Atlantic salmon enhancement activities on the Terra Nova River (SFA 5), Newfoundland.* DFO, St. John's, 2002.

Environment Canada. *Hydrometric Data for TERRA NOVA RIVER AT GLOVERTOWN (02YS005).* (www.wateroffice.ec.gc.ca)

Environment Canada. Historical Weather for Terra Nova National Park (https://weather.gc.ca/city/pages/nl-15_metric_e.html)

Fisheries and Oceans Canada, Daily salmon count for Terra Nova River collected by FABEC for DFO.