



# TA'AN KWÄCH'ÄN COUNCIL

## FOX CREEK CHINOOK SALMON RESTORATION PROJECT

CRE-25-19

**FINAL REPORT - April 1, 2019 to March 31, 2020**

*Prepared for: The Yukon River Panel and the Pacific Salmon Commission*

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***March 2020***

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## **ABSTRACT**

Ta'an Kwäch'än Council (TKC) Elders initiated the Fox Creek Chinook Salmon Stock Restoration Project to rebuild extirpated stocks in this historic traditional fishing stream. The project includes stewardship and restoration activities that are guided by both traditional and scientific knowledge. Project planning began in 2006, with restoration activities beginning in 2008 and continuing over two salmon life cycles. Phase I, or the first salmon life cycle ended in 2015, and the project is now in Phase II, or the second salmon life cycle. Chinook fry have been released into Fox Creek annually since 2009 and adults have been returning to spawn since 2013. Spawning success has been confirmed with wild fry emerging from spawning redds since 2016. Restoration activities and monitoring are conducted annually by TKC staff and citizens to ensure the continued success of rebuilding this stock. Various partners have contributed to this project over the years, including DFO, the Whitehorse Rapids Fish Hatchery, Yukon Energy, Yukon College, Al von Finster, and other consultants. Funding for the project has been granted annually by the Yukon River Panel Restoration and Enhancement Fund.

## **ACKNOWLEDGMENTS**

Ta'an Kwäch'än Council (TKC) would like to extend special thanks to Yukon River Panel for providing ongoing funding through the Restoration and Enhancement Trust Fund for this extensive restoration project.

Special thanks are also extended to Yukon Energy Corporation who have donated broodstock, eggs and fry for the project since 2008. Yukon Energy Corporation (YEC) owns and operates the Whitehorse Rapids Fish Ladder and the Whitehorse Rapids Fish Hatchery where broodstock is collected and eggs are reared to the eyed stage. The Ladder and Hatchery are managed by Lawrence Vano, and Warren Kapaniuk of Access Consulting.

TKC citizens; Elder Betsy Jackson and Coralee Johns are the founders of the project. Other TKC citizens and staff, and members of the public assist with the annual fry release. Trix Tanner (Department of Fisheries and Oceans) oversaw this years' project and provided mentoring and guidance on field techniques, biological sampling and adult carcass recovery. Al von Finster (AvF Research & Development) also provided experienced direction and advice.

# TABLE OF CONTENTS

Introduction .....	1
Project Location.....	1
Training, Mentoring and Capacity Building.....	3
Project Planning and Implementation.....	3
2019 Project Activities .....	3
Broodstock Collection and Incubation.....	3
Annual Fry Release .....	4
Juvenile Monitoring.....	7
Hydrology and Water Quality .....	8
Water Temperature Monitoring .....	9
Barrier Monitoring.....	10
Adult Return Monitoring.....	10
Trail Maintenance.....	11
Redd Monitoring .....	11
Discussion .....	12
References .....	14
Appendix A: Fox Creek Chinook Salmon Restoration Plan – Phase II, the Second Salmon Lifecycle .....	15

## List of Tables

Table 1. Fox Creek juvenile 2019 results summary .....	8
Table 2. Fox Creek in-situ water quality measurements 2019.....	9

## List of Figures

Figure 1. Fox Creek Chinook salmon restoration project location. ....	2
Figure 2. Chinook salmon fry released into Fox Creek 2009-2019.....	4
Figure 3. Monitoring locations along Fox Creek.....	5
Figure 4. TKC staff transfer the fry for distribution at the release site. ....	6
Figure 5. The first batch of fry is released into Fox Creek. ....	6
Figure 6. Taylor LaChapelle gently releases fry into Fox Creek.....	6
Figure 7. Provisional hydrograph for Fox Creek hydrometric station 2019.....	9
Figure 8. Map of active beaver dams at Fox Creek. ....	10
Figure 9. Fox Creek daily average temperatures and accumulated thermal units 2016 – 2017. ....	11

## INTRODUCTION

In 2007, Ta'an Kwäch'än Council (TKC) initiated a Community Stewardship program which focused on building capacity for TKC citizens in stewardship and restoration of wild salmon stocks and habitats within their Traditional Territory (Marjanovic 2008 & 2009). The Yukon River Panel Restoration and Enhancement Fund has supported the project since that time and what started as a stewardship program has evolved into the Fox Creek Chinook Salmon Restoration Program.

A restoration plan was developed in 2008 by EDI Environmental Dynamics Inc. to help restore extirpated Chinook salmon stocks in Fox Creek and improve harvest opportunities for TKC citizens (Anderton, 2008). This plan covered one Chinook salmon life cycle which ended in 2015. Phase II, or the second salmon lifecycle of the plan was developed in early 2016 and will be complete in 2021 (Appendix A).

Major components of the project include:

- Training, mentoring and capacity building
- Project planning and implementation
- Broodstock collection and incubation
- Annual fry release
- Juvenile monitoring
- Hydrology and water quality
- Water temperature monitoring
- Monitoring adult returns & barriers
- Trail maintenance
- Redd monitoring

Project activities conducted in 2019 are described in this report. Detailed methods, standards, adaptive management and implementation activities can be found in the Fox Creek Chinook Salmon Restoration Plan – Phase II, the Second Salmon Lifecycle (Appendix A).

## PROJECT LOCATION

Fox Creek (*Kwätän'aya Chù*), is a third order stream in the western central portion of Ta'an Kwäch'än Council's Traditional Territory (Figure 1). It crosses the North Klondike highway approximately 50 kilometers north of Whitehorse, Yukon and flows from the southern end of Fox Lake southeasterly from an elevation of 2,525 feet through the Richthofen Valley then drains into the center portion of Lake Laberge, at the north end of Richthofen Island at an elevation of 2,025 feet.

The Creek is 21.3 km long and has a total drainage area of 399.4 square kilometers. A major tributary, Pilot Creek, enters from the west about 12.2 kilometers downstream from the outlet of Fox Lake. Other unnamed tributaries enter the stream from the west between Pilot Creek and the Klondike Highway crossing.

The terrain upstream of the bridge is flat marshland; it then flows downstream through rolling hills and a series of spruce stands, swamps and rock outcroppings to a flooded marshland at its mouth on Lake Laberge. Much of the watershed burned in the late 1950s and aspen is the dominant tree species in the

drainage basin. The marshland areas are heavily populated by beaver where activity changes stream dynamics and creates barriers to fish passage. Land uses around the stream include residential, agricultural, grazing and tourism.

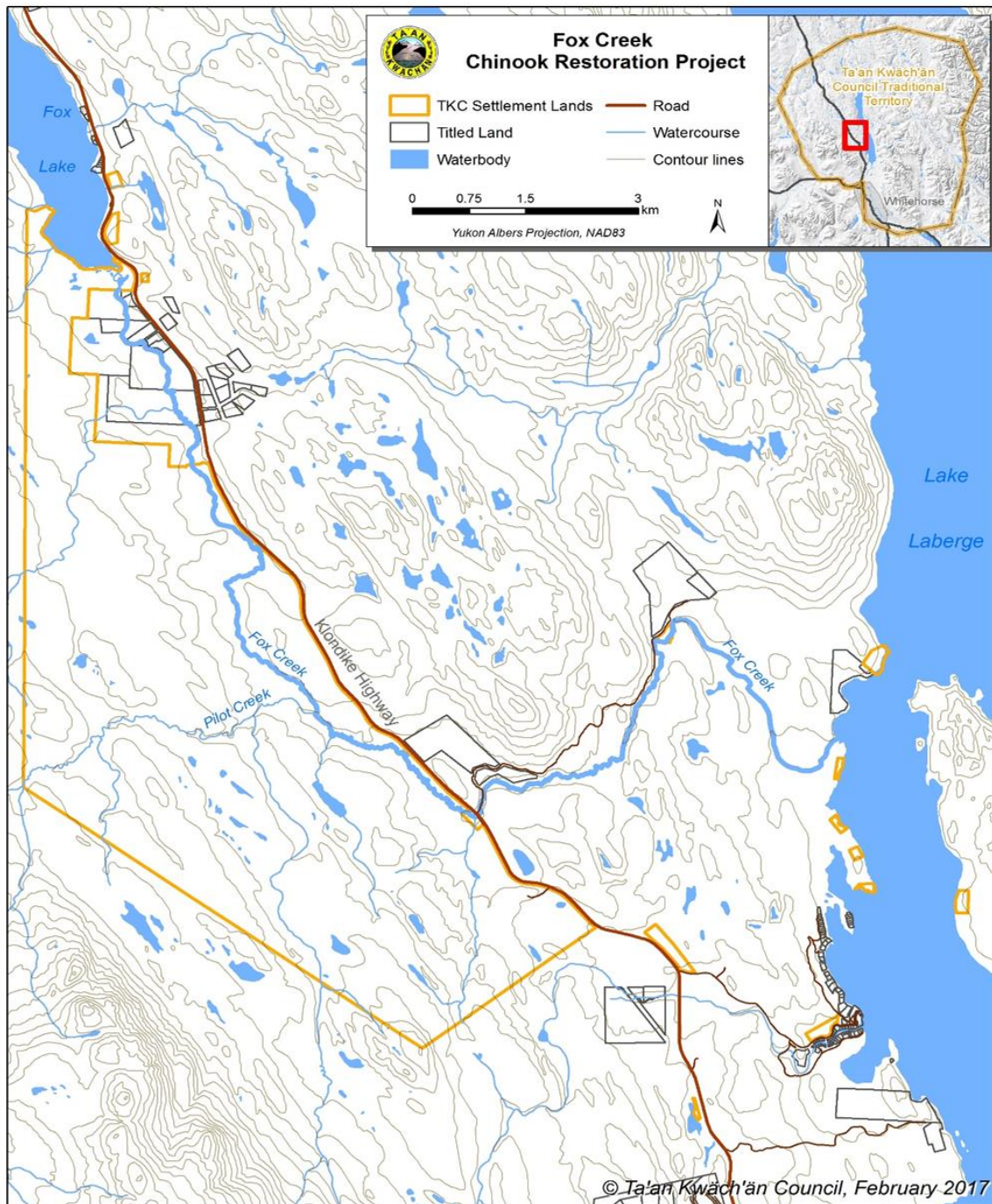


Figure 1. Fox Creek Chinook salmon restoration project location.

## **TRAINING, MENTORING AND CAPACITY BUILDING**

Deb Fulmer was the project manager for the fourth consecutive year and Belit Peters was hired for a second year as a summer student to assist with Fox Creek field operations and the collection and input of data. TKC Environmental Monitors and summer student Taylor LaChapelle conducted the 2019 fry release.

Yukon River Panel, Yukon Energy, Whitehorse Rapids Fish Hatchery, Department and Fisheries and Oceans, and the Yukon Salmon Sub-Committee (YSSC) supported TKC staff in production, planning, scheduling and field efforts, data analysis and reporting. We thank our partners who bring excellent value to this project, we couldn't do it without you.

## **PROJECT PLANNING AND IMPLEMENTATION**

Project implementation was guided by the Fox Creek Chinook Salmon Restoration Plan, Phase II – The Second Salmon Life Cycle (updated February 2020) (Appendix A).

The 2019 project was based out of the TKC Lands, Resources and Heritage (LRH) office in Whitehorse, field equipment was supplied by TKC from R&E and TKC contribution dollars. Deb Fulmer, former Fish and Wildlife Program Coordinator, coordinated project planning and supervised all activities. Other TKC LRH staff contributed to the project by assisting with monitoring and maintenance work throughout the year.

Project planning involved a pre-season planning meeting with the project partners, hosted by TKC. On June 4, 2019 all partners met at TKC to discuss tendering a feasibility study to look at options for replacing the McIntyre Creek Incubation Facility, which was lost to fire in 2018, and TKC is currently tendering this contract. Plans for the field season including fry tagging and release were also discussed. TKC did not have a post-season meeting in 2019, due to staffing shortages, but intends hold a partner meeting in 2020 to discuss both 2019 and future project activities.

Yukon River Panel protocols for Canadian R&E projects were adhered to, including those for the collection and reporting of data from the sampling of juvenile salmon (Appendix A).

## **2019 PROJECT ACTIVITIES**

Methods and results from the 2019 field season are summarized in this section. For more details on standardized methods, see the Fox Creek Chinook Salmon Restoration Plan, Phase II – the Second Salmon Lifecycle (Appendix A). Raw monitoring data is available upon request from TKC.

## **BROODSTOCK COLLECTION AND INCUBATION**

In previous years, Yukon Energy Corporation collected broodstock from the Whitehorse Rapid Fish Ladder, fertilized the eggs and raised them to the eyed stage at the Whitehorse Rapids Fish Hatchery (WRFH) and then donated a certain amount to the Fox Creek project to be incubated at the McIntyre Creek Incubation Facility (MCIF). However, in March 2018, the MCIF was destroyed by fire, so for the

past two seasons TKC has been unable to carry out incubation of the eggs and fry tagging. TKC is in the process of conducting a feasibility study to look at options for replacing the facility.

In 2019, Yukon Energy Corporation donated ~2,000 fry from the Whitehorse Rapids Fish Hatchery operations to allow TKC to hold the annual fry release. The number of fry donated this year was lower than previous years due to low salmon returns at the fish ladder, resulting in limited availability of broodstock. Clipping and tagging of the fry was done by WRFH staff.

### ANNUAL FRY RELEASE

Fry releases into Fox Creek have taken place annually from 2009 to present with a total of 334,608 fry being released to date. TKC released approximately 2,500 Chinook salmon fry into Fox Creek on June 6, 2019 (Figure 2). Approximately 2,000 of the fish released were donated by Yukon Energy and the Whitehorse Rapids Fish Hatchery, and about 500 fish were from the Stream to Sea Program, which raises Chinook salmon in Yukon schools.

The fry release was not conducted as a public event this year due to construction activities in the launch area and other restraints, but TKC hopes to continue the tradition of the public release in future years. In 2019, the fry release was conducted at the highway crossing, near monitoring site MS08-02 (Figure 3, Figure 4, Figure 5, Figure 6).

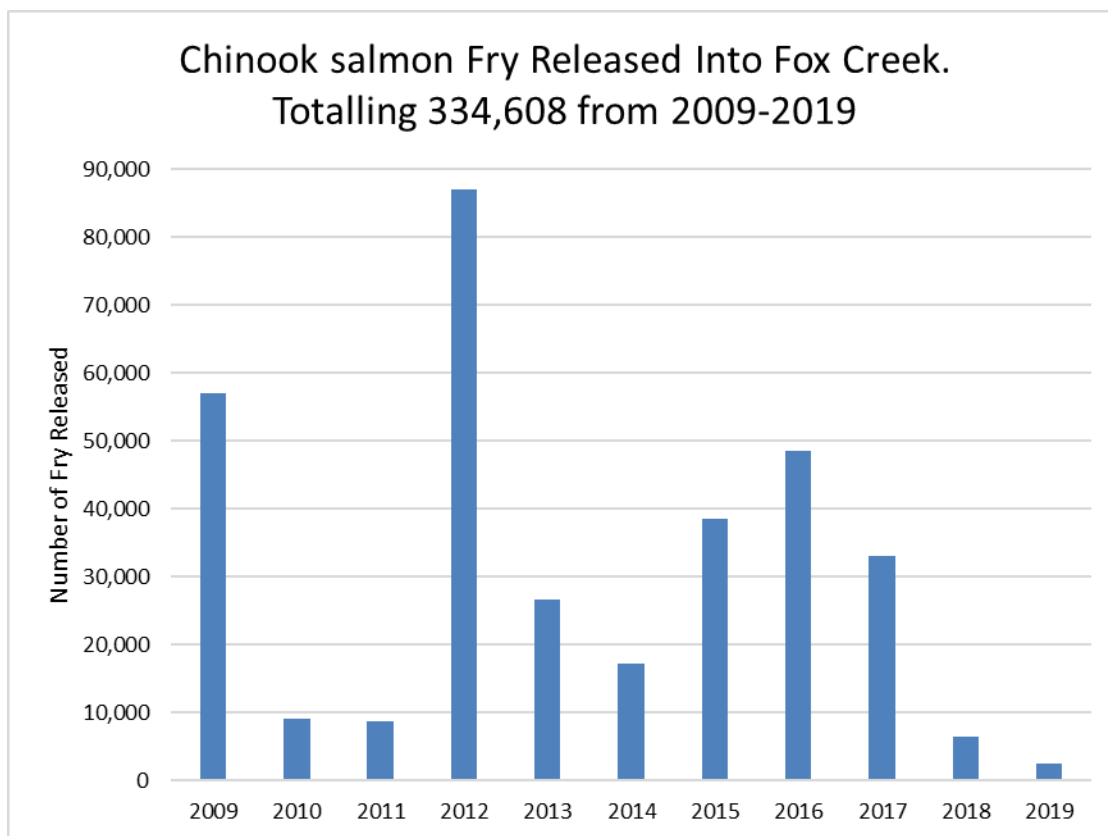


Figure 2. Chinook salmon fry released into Fox Creek 2009-2019.

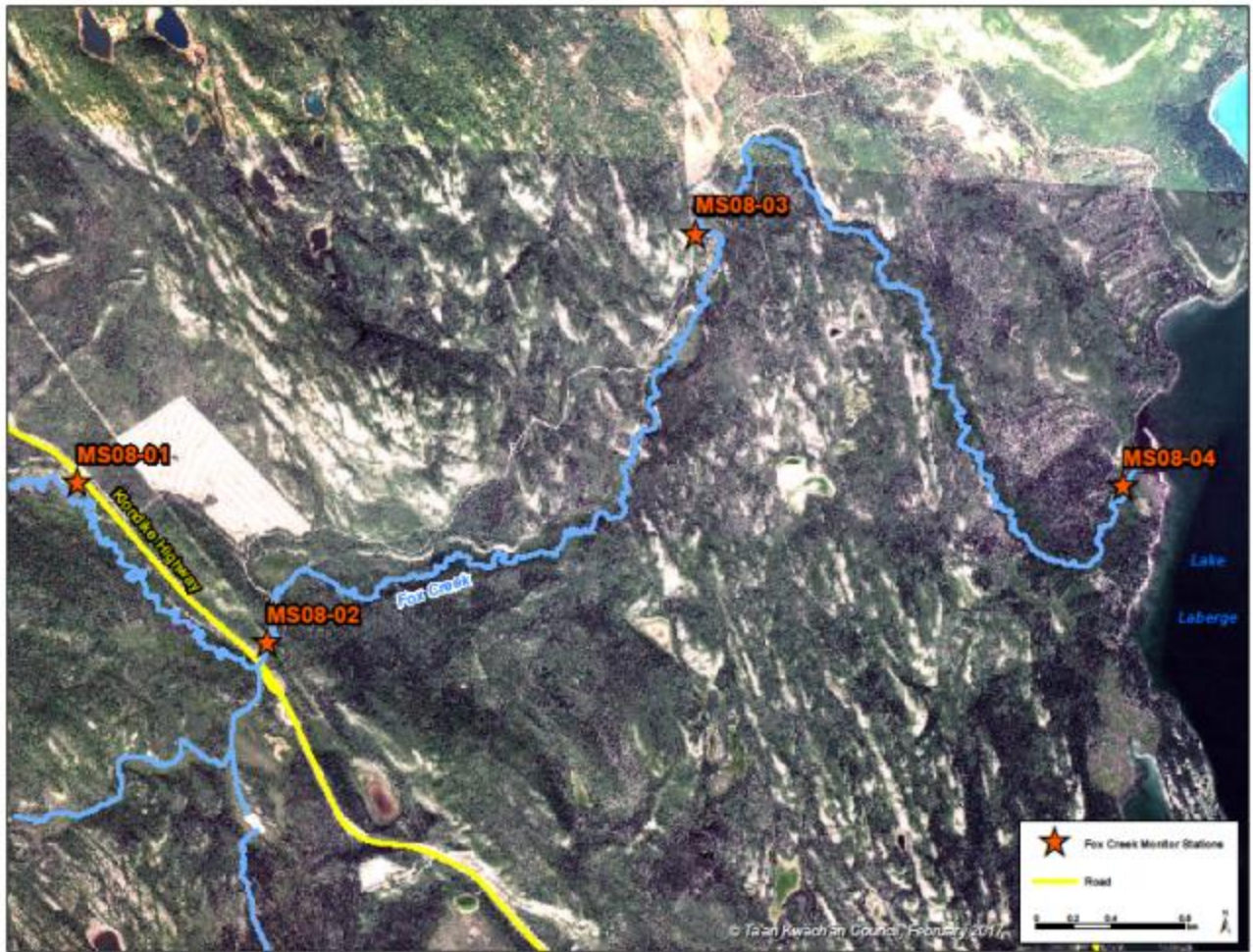


Figure 3. Monitoring locations along Fox Creek.



Figure 4. TKC staff transfer the fry for distribution at the release site.



Figure 5. The first batch of fry is released into Fox Creek.



Figure 6. Taylor LaChapelle gently releases fry into Fox Creek.

## JUVENILE MONITORING

The Fox Creek bio-physical monitoring program focusses primarily on the presence of overwintered juvenile Chinook salmon and the biological productivity of Fox Creek. The overwintered juvenile Chinook are sampled in the spring as an indicator of continued habitat viability. The biological productivity is monitored by calculating the rate of growth of young-of-year juvenile salmon from hatchery releases. In 2015 we captured the first wild 0+ juveniles that were assumed to be the progeny of spawning in Fox Creek. Since then, we have monitored wild 0+ fry and have increased our monitoring network to accommodate this. We also continue to document the presence of “residual” Chinook salmon; these are male salmon that do not migrate to the sea but may spawn with returning females. The residuals may be fish from the preceding year’s release or those from previous releases. Any 1+ or older fish captured on or after July 1 is considered a residual (Moody et al, 1993; Bradford and Grout, 2001; von Finster and MacKenzie- Grieve, 2006 & 2007). They are documented as residual hatchery or residual wild.

The Fox Creek project has four monitoring sites (Figure 3). They were chosen in 2008 and have been maintained since. Monitoring occurs at roughly monthly intervals, ideally from May through October. In 2019 juvenile monitoring was conducted on May 10, June 18, July 18, and August 7. Due to staffing shortages, monitoring was not done in September.

A total of 53 juvenile Chinook were observed, captured and measured throughout the 2019 season, 70% of which were considered wild (Table 1). This percentage of wild fish is higher than previous years (56% in 2018, and 7% in 2017); however, this data should be interpreted with caution because sample sizes have varied considerably from year to year, and many smaller fry that were released over the years were not clipped or had bad clips which has made it difficult to distinguish them from wild fry. A total of 32 juveniles were observed across all monitoring sites during the May visit, which is an indicator of overwintering success (Table 1). Overall, there were a greater number of wild juveniles (both 0+ and 1+) captured at the two downstream sites (MS08-03 & 04), than the upstream sites (MS08-01 & 02), which saw a greater number of hatchery juveniles (0+ and 1+) – this is similar to previous years. No wild or hatchery residuals were captured in the biophysical monitoring program in 2019.

Yukon Energy donated 2,000 0+ juveniles to the Fox Creek project from the Whitehorse Rapids Fish Hatchery in 2019. The fry donated were considered “smalls”, which are fry that are too small to tag prior to release. The Whitehorse Rapids juveniles and an additional 500 fry raised in the classrooms from the Stream to Sea Program were released on June 6, 2019 at MS08-02. Fork lengths were not measured immediately prior to release. Juveniles from the Whitehorse Rapids Fish Hatchery released to Michie Creek tend to migrate downstream soon after release. It is unclear whether juveniles from the Whitehorse Rapids Hatchery remained in Fox Creek in 2019, because no hatchery fish were captured after June 18. There was insufficient data in 2019 to calculate growth rates of juveniles. TKC may discontinue this analysis in future years because we are unable to determine limiting factors for fork length data due to the different sizes of fry that have been released into Fox Creek in recent years.

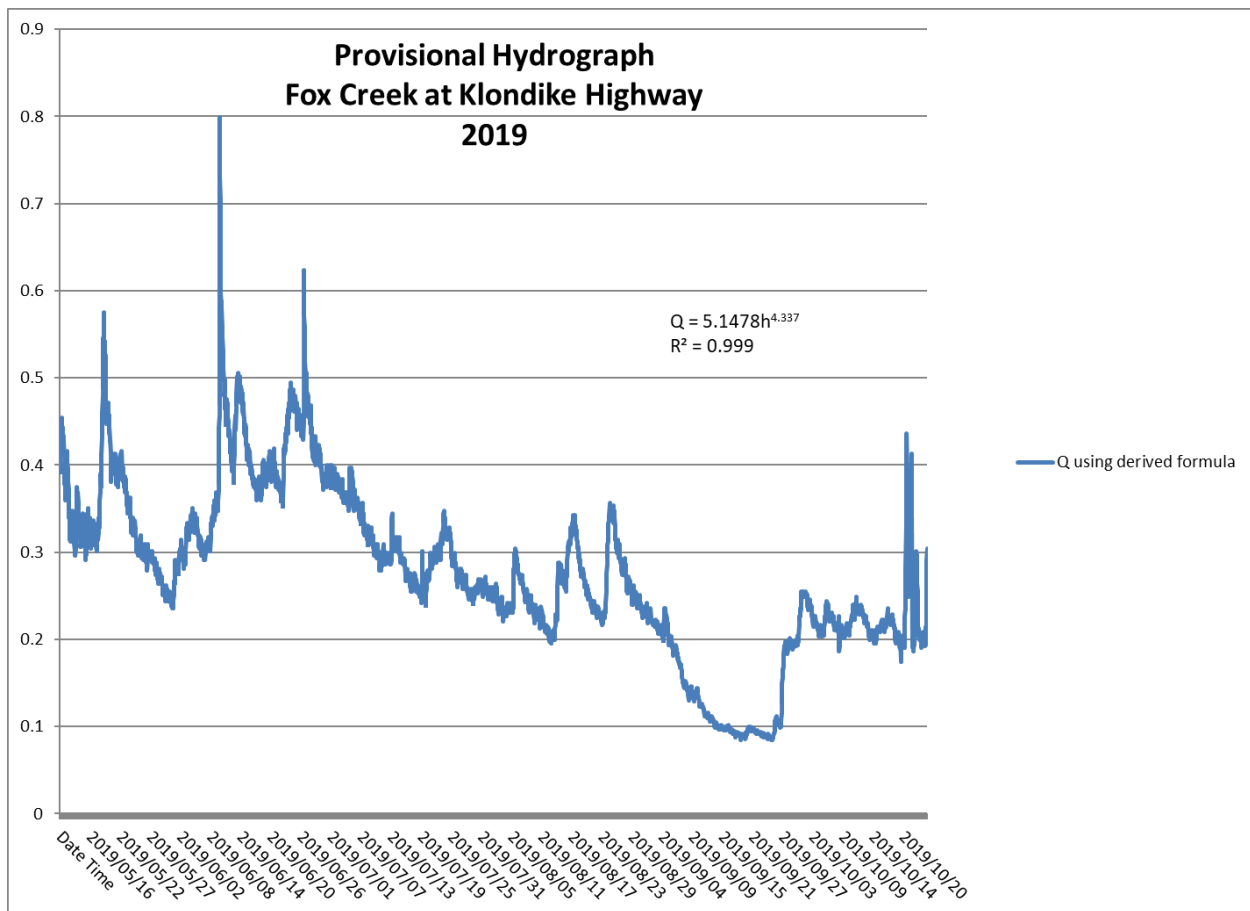
**Table 1. Fox Creek juvenile 2019 results summary**

Monitoring Date	Parameter	MS08-01	MS08-02	MS08-03	MS08-04	TOTAL # of Chinook
May 10/19	# of Chinook	1	8	16	7	<b>32</b>
	Avg Weight (g)	5.8	5.5	4.7	5.3	
	Avg Length (mm)	85	85.4	80	83	
	# Unclipped & %	0	1/8 = 12.5%	16/16 = 100%	7/7 = 100%	
June 18/19	# of Chinook	0	6	1	0	<b>7</b>
	Avg Weight (g)	N/A	2.2	9.5	N/A	
	Avg Length (mm)	N/A	60	96	N/A	
	# Unclipped & %	N/A	0%	1/1 = 100%	N/A	
July 18/19	# of Chinook	0	1	0	0	<b>1</b>
	Avg Weight (g)	N/A	1.8	N/A	N/A	
	Avg Length (mm)	N/A	65	N/A	N/A	
	# Unclipped & %	N/A	1/1 = 100%	N/A	N/A	
August 7/19	# of Chinook	2	1	6	4	<b>13</b>
	Avg Weight (g)	1.3	4.5	6.9	14.3	
	Avg Length (mm)	69	76	85.5	106	
	# Unclipped & %	2/2 = 100%	0%	6/6 = 100%	4/4 = 100%	
<b>TOTAL</b>		<b>3</b>	<b>16</b>	<b>23</b>	<b>11</b>	<b>53</b>
<b>TOTAL UNCLIPPED</b>		<b>2/3 = 67%</b>	<b>1/16 = 6%</b>	<b>23/23 = 100%</b>	<b>11/11 = 100%</b>	<b>37/53 = 70%</b>

## HYDROLOGY AND WATER QUALITY

TKC installed a hydrometric station, including a staff gauge on June 8<sup>th</sup>, 2017. The goal of the hydrometric station is to develop a rating curve over time so TKC staff members will only read a staff gauge to determine discharge instead of conducting a manual measurement using a flow meter. TKC project staff conduct manual discharge measurements each month as well as a winter under ice salt slug discharge measurement.

We contracted Laberge Environmental Services who worked with TKC staff members to install the hydrometric station and record results since 2017. They were contracted again in 2019 to construct the Fox Creek hydrograph from the 2019 hydrometric data (Figure 7). The rating curve was not updated in 2019, as the 2018 curve had a sufficient R<sup>2</sup> rating, which will enable TKC staff to discontinue manual discharge measurements in future years.



**Figure 7. Provisional hydrograph for Fox Creek hydrometric station 2019.**

An under-ice salt slug discharge measurement was not conducted in 2019, however in-situ measurements were conducted monthly and are displayed in Table 2 below.

**Table 2. Fox Creek in-situ water quality measurements 2019.**

Date	Time	H2O Temp	Oxygen % Sat	Oxygen mg/L	Sp. Cond.	Cond.	pH	ORP	Hg
9-May-19	13:00	6.1	109.7	13.6	277.5	not recorded	7.2	89.7	not recorded
19-Jun-19	15:02	not recorded	95.5	10.51	339.5	not recorded	7.44	146.9	not recorded
18-Jul-19	14:10	16.3	82.0	8.00	361.0	301.8	7.80	137.6	not recorded
6-Aug-19	16:23	16.4	79.2	7.73	357.1	298.8	8.03	197.6	699.2
7-Aug-19	11:40	14.0	93.0	9.54	357.2	282.5	7.97	175.3	701.7

## WATER TEMPERATURE MONITORING

TKC has collected water temperature data from Fox Creek since 2006 and has contributed to Al von Finster's long term water temperature monitoring program (von Finster, 2010). The water temperature data is showing a weak trend of warming, especially in June and July; however, continued data collection is needed to have more confidence in this trend. TKC is in the process of updating these results and analysis with data collected from 2017-2019.

## BARRIER MONITORING

Stream surveys to record active beaver dams that are potential barriers to upstream migration have been conducted annually with a focus on the lower section of the creek. TKC has hired citizen trappers who are actively trapping the creek during the 2019 winter season. Pelts from trapping efforts are tanned and donated to the TKC sewing group to make traditional garments and the meat is utilized by Elders and interested citizens. No new beaver dams were observed in 2019 (Figure 8).

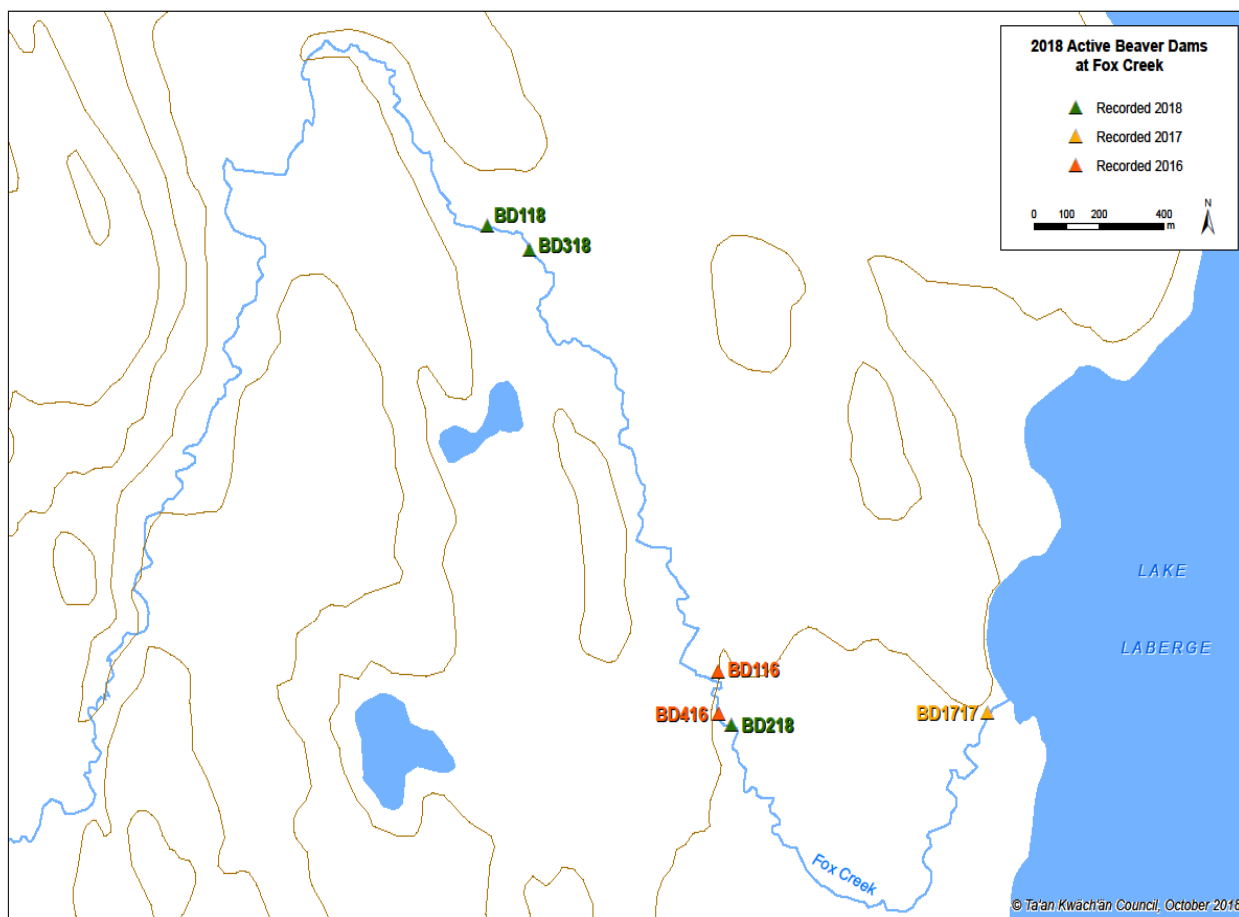


Figure 8. Map of active beaver dams at Fox Creek.

## ADULT RETURN MONITORING

TKC has confirmed that adult Chinook salmon have been returning to Fox Creek every year since 2013. Unfortunately, due to staffing shortages, TKC was only able to conduct two days of adult monitoring in 2019 – on August 20 & 28. No adults were observed on August 20, and four adult salmon were seen on August 28 – three were seen near MS08-04 (likely two males and a female), and one was seen about 1 km upstream of MS08-04, below beaver dam BD416 (likely a female). Staff were unable to determine if adipose fins were present on any of the adults observed.

TKC usually collects data and recovers the heads of returning adult carcasses to contribute to DFO's Age Sex and Length (ALS) program. Unfortunately, due to staffing shortages, no carcasses were recovered in 2019.

## TRAIL MAINTENANCE

In 2019 the trails were maintained by TKC staff and summer students. Existing trails were de-brushed including the ATV trail into juvenile monitoring site MS08-04, the adult monitoring trail on the lower portion of the creek, and the access trails to the juvenile monitoring sites MS08-01 and 04. The remaining trails downstream of juvenile monitoring site MS08-03 were all still in great condition.

## REDD MONITORING

Redd monitoring was discontinued in 2019 based on project partner discussions after three consecutive years of monitoring. The purpose of redd monitoring at Fox Creek was to determine the viability of Chinook salmon redds, and this was completed successfully in 2018. Using methodologies developed from the temperature monitoring program, results showed that eyed eggs would develop in mid September, alevins in early November and 0+ fry emergence in early June (Figure 9). This emergence timing corresponded with the 0+ fry observations and bio-monitoring results.

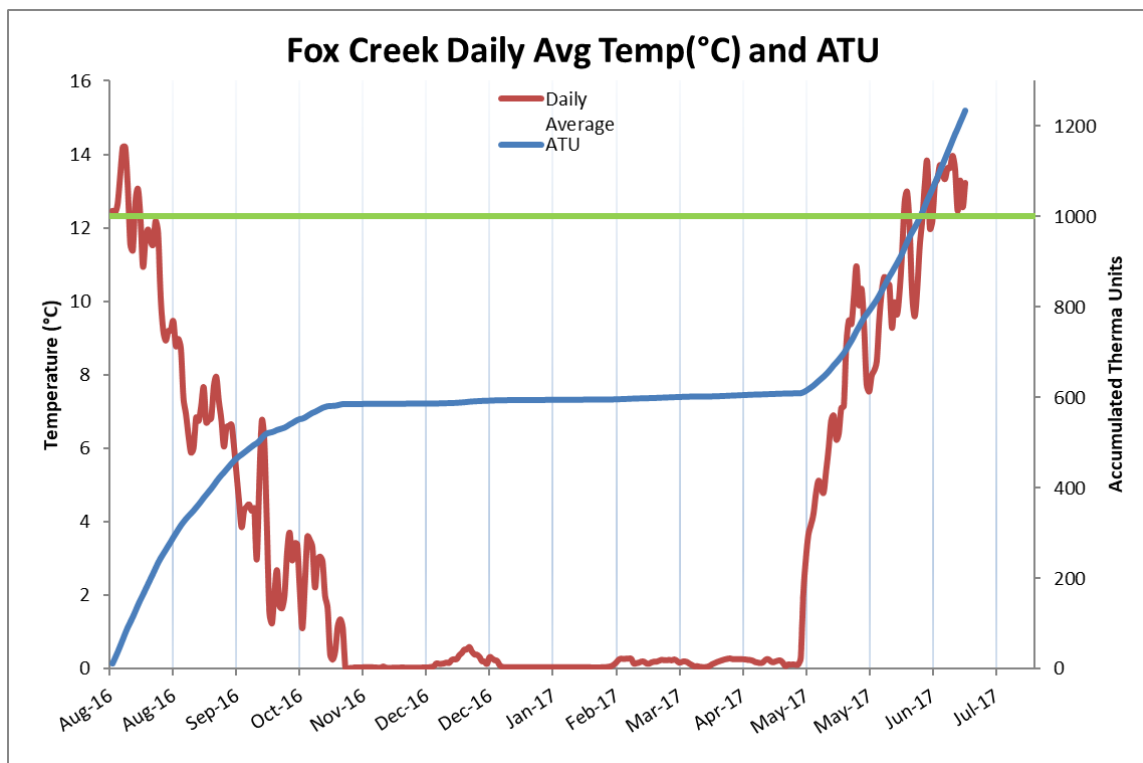


Figure 9. Fox Creek daily average temperatures and accumulated thermal units 2016 – 2017.

## DISCUSSION

The goal of Ta'an Kwäch'än Council's Fox Creek Chinook Salmon Restoration Project is to re-establish a self-sustaining natural population of Chinook with sufficient spawners for long-term persistence; abundant enough to contribute to a sustainable harvest for current and future generations as part of our natural culture and heritage. This goal must be realized through both stewardship and restoration efforts.

The stewardship part of that goal is being met by engagement and direct involvement of TKC citizens throughout all aspects of the project. Through the life of the project, many TKC citizens have received valuable training and experience in salmon restoration. The project has also built capacity with youth in the community through public events and educational experiences. Because the TKC community has been so involved in this program Traditional Ecological Knowledge (TEK) is continually being fed into management decisions. The restoration part of the goal is ongoing and will be realized with continued monitoring and barrier removal. The project team is still determining what the long-term vision is for Fox Creek - after the second salmon lifecycle is complete. The return of adults every year to spawn is encouraging, as are the wild fry being observed and captured in the lower reaches of Fox Creek, where spawning is occurring.

Broodstock collection has been challenging throughout the program due to limited numbers of returning salmon to the Whitehorse Rapids Fishway in recent years, which limits the amount of broodstock that Yukon Energy can collect and distribute. Incubation and rearing have also been challenging, especially with the loss of the McIntyre Incubation Facility in 2018, making TKC reliant on donated fry for the last two years. TKC is in the process of conducting a feasibility study to look at options for replacing the facility, but until then, will not be able to conduct incubation of eggs and fry rearing and tagging.

Water temperature data which has been collected since 2006 is showing a weak trend of warming, especially in June and July; however, continued data collection is needed to have more confidence in this trend. Warming water in Fox Creek (depending on the degree) could have both positive and negative effects. Warmer stream waters could positively affect juveniles by increasing Accumulated Thermal Units (ATUs) resulting in earlier fry emergence and stronger smolts migrating to the ocean. Negative effects of warming include potential for disease, parasites, reduction in spawning and increased stress on returning adults, especially if temperatures are high during migration and spawning.

Monitoring adult returns, and barrier management continue to be very important components of this project and adults have been observed returning to Fox Creek for the last five years. Stream walks have been the only method used thus far to observe returning adults; however, this method does not allow for enumerating adult returns, as there is a high probability of fish being missed. Therefore, TKC is exploring options for installing a video enumeration weir to count adults during the 2020 season. Stream walks would still be required to locate spawning areas, manage obstructions, and collect carcasses. Beaver activity in this system is high and creates barriers to returning adults. TKC is actively trapping beaver to reduce their numbers, which has resulted in a reduced number of barriers in the lower portion of the creek.

Fox Creek restoration efforts are guided by outcomes and lessons learned. TKC will continue to engage with citizens on this project and meet with project partners regularly to discuss results and plan future restoration efforts.

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**APPENDIX A: FOX CREEK CHINOOK SALMON RESTORATION PLAN – PHASE II,  
THE SECOND SALMON LIFECYCLE**



## TA'AN KWÄCH'ÄN COUNCIL

# FOX CREEK CHINOOK SALMON RESTORATION PLAN

### Phase II – The Second Salmon Life Cycle

*Prepared for: The Yukon River Panel and the Pacific Salmon Commission*

*Prepared By: Ta'an Kwäch'än Council  
Kristina Beckmann, Lands Resources & Heritage Department*

***Developed March 2016 – Updated February 2020***



**Returning Adult Chinook salmon Observed in Fox Creek August 2015**

## TABLE OF CONTENTS

Introduction .....	3
Project Planning and Implementation .....	5
Training, Mentoring and Capacity Building.....	5
Broodstock Collection .....	5
Fry Transport & Release.....	5
Juvenile Chinook Monitoring .....	6
Hydrology and Water Quality .....	6
Trail Maintenance .....	6
Monitoring Adult Chinook Salmon Returns & Barriers.....	7
Beaver Management.....	7
Redd Monitoring .....	7
References .....	8
Personal Communications: .....	9
Appendix A – Standards and Methods .....	10
Appendix B - Phase II Annual Implementation and Monitoring Plan .....	23
PHASE II ONGOING ANNUAL ACTIVITIES .....	24
FOX CREEK– DETAILED IMPLEMENTATION AND MONITORING PLAN (IMP)– UPDATED FEBRUARY 2020.....	27

# LIST OF APPENDICES

## APPENDIX A

### **APPENDIX A – STANDARDS AND METHODS**

- Broodstock Quantity Collection
- Fry Transport and Release
- Bio-Physical (Juvenile) Monitoring
- Hydrology and Water Quality
- Adult Returns and Barriers
- Beaver Management
- Redd Monitoring

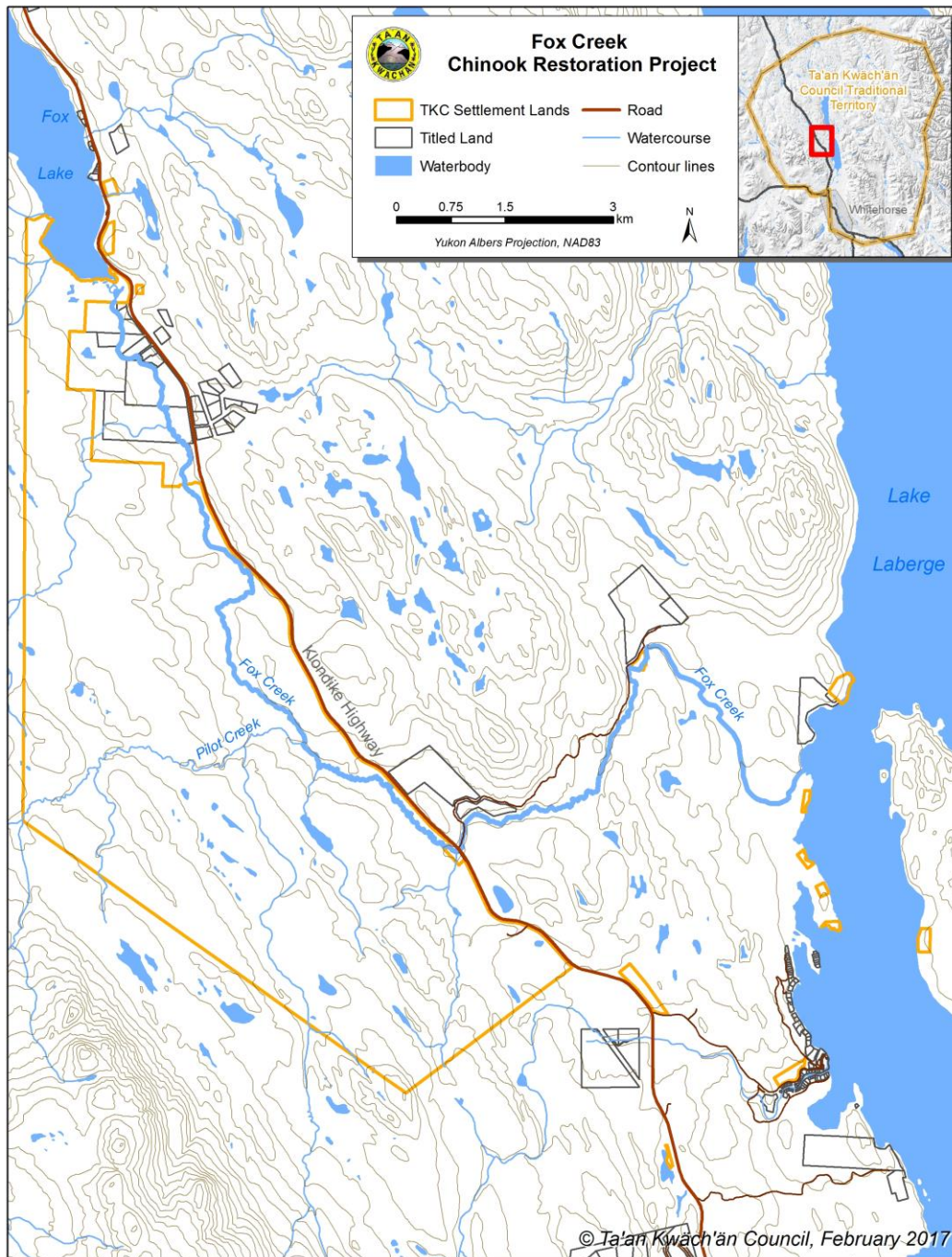
## APPENDIX B

### **APPENDIX B – PHASE II ANNUAL IMPLEMENTATION AND MONITORING PLAN**

- Ongoing Annual Activities
- Detailed Implementation and Monitoring Plan

## INTRODUCTION

Fox Creek is a lake-headed tributary to Lake Laberge and the Yukon River, located approximately 50 km north of Whitehorse. It lies within the traditional territory of Ta'an Kwäch'än Council (TKC) and historically supported a Chinook salmon fishery. However, since the late 1950's this stock has been extirpated. Habitat changes (forest fire/beavers and/or fishing (easy access to Fox Creek)), may have played a role in decline of this stock.



**GOAL:**

Ta'an Kwäch'än Council's goal for the Fox Creek Salmon Chinook Salmon Restoration Program is to re-establish a self-sustaining population of Chinook with sufficient spawners to have a high probability of long-term persistence, in the face of variability in survival, due to natural changes in the environment. TKC aims to ensure that a viable natural stock is abundant enough to contribute to a sustainable harvest for current and future generations as part of their natural culture and heritage.

**BACKGROUND:**

From 2007 to 2015 TKC assessed, developed and implemented Phase I of this program and Year 8 (2015) marked the end of that phase. The Phase I *Chinook Salmon Stock Restoration Plan for Fox Creek* (CRE-52N-07) suggested restoration of this extirpated stock be conducted over 2 Chinook salmon life cycles. Activities included but were not limited to; funding and permitting applications, broodstock collection, fertilization and incubation at (WRFH), participation in McIntyre Creek Incubation Facility (MCIF) operations, the annual Chinook fry release at the North Klondike highway crossing on Fox Creek, monthly bio-physical monitoring of juvenile Chinook salmon, the monitoring of adult salmon returns, water quality, hydrology monitoring, trail and beaver dam management.

TKC is now entering into Phase II or the second Chinook salmon life cycle. The Phase II annual activities include: planning and implementation with project partners; training, mentoring and capacity building for TKC staff and citizens; broodstock collection, fertilization and incubation; fry transport and release, bio-physical monitoring of juveniles; water quality, hydrology and temperature monitoring; trail maintenance; monitoring adult returns; beaver management; and redd monitoring. Proposed standards and methods for activities are detailed in Appendix A with an implementation and monitoring plan for ongoing and proposed scheduled activities in Appendix B.

The latter part of Phase I saw the return of Chinook salmon to Fox Creek and the stock is showing signs of recovery. Phase II will use knowledge gained in Phase I to guide an implementation and monitoring approach to establish a viable natural self sustaining Chinook salmon population that will contribute to a sustainable harvest for TKC citizens.

## **PROJECT PLANNING AND IMPLEMENTATION**

Pre and post-season planning meetings will be hosted by TKC with project partners. Matters to be discussed will include; resources, schedule, procedures, support for annual events, as well as project adaptations and modifications. The Fox Creek plan is intended to be a flexible living document that can be adapted based on the learning that occurs during the implementation of the phase II of the project.

Yukon River Panel protocols for Canadian R&E projects will be adhered to, including those for the collection and reporting of data from the sampling of juvenile salmon (YRP 2009a), and obstruction management (YRP 2009b). Standards and methods for the project components are detailed in Appendix A and the management plan in Appendix B.

## **TRAINING, MENTORING AND CAPACITY BUILDING**

Education and training opportunities for TKC citizens and staff will include both formal opportunities, such as post secondary, technical, first aid, bear and equipment safety and informal options such as workshops, mentoring and experiential learning with professionals.

## **BROODSTOCK COLLECTION**

Broodstock for Fox Creek will be taken either from stocks passing through the Whitehorse Rapids Fishway or from the Takhini River. The Whitehorse Rapids Fish Hatchery (WRFH) is operated privately by Yukon Energy Corporation and its primary purpose is to provide fry for release upstream of the dam as a mitigation measure. Prior to 2018, an annual allocation of eggs was requested based on available broodstock each season for rearing and tagging in the McIntyre Creek Incubation Facility (MCIF) – which was operated by Yukon College. However, after an unfortunate fire that destroyed the MCIF in March 2018, TKC has been receiving an annual allocation of fry from the WRFH (based on availability) to meet annual release targets until a replacement facility is planned and built. We hope that our present relationship with the WRFH will be maintained through Phase 2 of the project. Reports are produced by WRFH outlining annual procedures and production, and reports on operations and releases have been provided annually to the Yukon River panel Restoration and Enhancement Fund (Collins, 2016).

From project inception to date, Whitehorse Rapids Fish Hatchery has been the sole source for brood stock however discussions have taken place regarding alternate sources – such as the Takhini River. Broodstock source options will continue to be discussed as part of the Annual Implementation and Monitoring Plan.

## **FRY TRANSPORT & RELEASE**

Fry releases into Fox Creek have taken place annually from 2009 to present. Fry transport and release is guided by DFO's publication, "Habitat and Enhancement Facts and Figures handbook, 4th Edition, Salmonid Enhancement Program". Fry release methodology specifically for the Fox Creek project, is detailed in Appendix A. Phase II fry release timing, locations and numbers will be adapted based on the following, (YSSC Technical Team personal communication February 2016);

- Incubation and hatchery rearing strategy will mimic natural conditions in the Yukon and imprint of juveniles to Fox Creek. This may include exclusive rearing at McIntyre Creek and release into Fox Creek at earliest possible stage post adipose fin clip (if permission is granted to not coded wire tag the fish).
- Releases should be physically spread out in Fox creek to the extent it is logistically feasible.
- The number of juveniles released will take into account the predicted abundance of naturally produced fry to minimize potential for negative effects on wild fry due to competition for food or space.

## **JUVENILE CHINOOK MONITORING**

Juvenile Chinook sampling at the four established locations using four baited Gee-fry traps per station will continue into Phase II and as detailed in Appendix A. Phase II will expand to include targeted baited trap monitoring using 1/8 mesh Gee-traps at higher frequency downstream of known spawning locations to determine the presence and timing of fry emergence, (von Finster, 2016).

Initially only three upstream sites were planned for monitoring. The lower fourth site was added as it indicates the entrance of non-natal rearing and assists in the timing of juvenile release distribution, (Collins, 2016).

## **HYDROLOGY AND WATER QUALITY**

Phase II Hydrology and Water Quality monitoring as described in the Phase I plan will continue and Appendix A provides a detailed description. Yukon Government Water Resources and other agencies will be contacted in the development of standards for Fox Creek.

Surface water temperature monitoring in Fox Creek using in-stream Tidbit V2 temperature loggers with support from Al von Finster will continue at the present station, and may be augmented to address specific issues or opportunities. Objectives of collecting water temperature data in Fox Creek include; interannual thermal regimes, trend development, emergent timing, rearing and winter conditions. This information is valuable and can be compared to similar systems for reference.

## **TRAIL MAINTENANCE**

The Fox Creek trail is approximately 14 km long and is located adjacent to the creek from the North Klondike Highway crossing to the mouth at Lake Laberge. It provides safe and efficient access to the creek for all project purposes, is critical to the success of the project and will be maintained during Phase II.

## **MONITORING ADULT CHINOOK SALMON RETURNS & BARRIERS**

An annual survey of the creek will be conducted each mid July to determine whether barrier removal or other actions are required to ensure that Adult Chinook Salmon can migrate upstream throughout the portion of the creek designated as potential spawning habitat. From this survey an annual implementation and monitoring strategy will be developed to manage barriers and plan enumeration activities for the anticipated annual return.

The annual implementation and monitoring strategy may include obstruction management where required to allow Adult Chinook Salmon to migrate upstream. The obstructions are most likely to be active beaver dams.

An applicable, achievable and efficient adult enumeration and assessment process is presently under discussion with DFO Salmon Enhancement Program and progress toward its development will be reported in annual Project Reports. Assuming success, the first returning progeny from spawning occurring in the creek are expected in 2018 and our intent is to be able to accurately determine the numbers of this cohort.

Spawning locations will be recorded as redds or observed spawning activity through stream walks. Moribund adults or carcasses encountered will be sampled for Age/Sex/Length (ASL) and for Coded Wire Tags as detailed in Appendix A.

## **BEAVER MANAGEMENT**

To allow access to spawning grounds for returning adults, beaver management using traditional trapping methods, is an integral part of restoration efforts. It also increases culture, capacity, experience and awareness into the community by allowing elders to pass on traditional knowledge to younger generations. Products from trapping efforts will be utilized by the community.

## **REDD MONITORING**

The evaluation of redd spawning sites to confirm the viability of spawn is a valuable measure of the success of the restoration project approach. An effort to document the incubation success of the identified redds will include an evaluation of the sites using site specific temperature records embedded in the gravel for comparison to surface temperatures to determine if there are any significant differences. The results of the temperature records will be used to indicate the approximate emergence timing of spawned eggs allowing specific bio-physical monitoring to verify the incubation success and assist in characterising Fox Creek salmon life history (Collins and von Finster, 2016).

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## **APPENDIX A – STANDARDS AND METHODS**

## BROODSTOCK QUANTITY AND COLLECTION

In the 2008 Fox Creek Restoration Plan, the method for determining target numbers of fry release as provided by Fisheries and Oceans Canada was based upon available rearing habitat, with 1 m<sup>2</sup> of stream area per juvenile Chinook salmon in the upper Yukon River watershed. In order to calculate the area of habitat available in Fox Creek, the average wetted width of the stream, 5.5m (from data provided by Grady, 1997) was multiplied by the estimated 16,300 m length of the stream from its mouth at Lake Lebarge to the confluence of Pilot Creek. This calculation resulted in an estimated 89,650 m<sup>2</sup> of available juvenile Chinook rearing habitat. However, this estimation is based upon very limited wetted width data. Therefore, improved estimates should be generated through monitoring of wetted width as part of the ongoing implementation and monitoring strategy. In consideration of dynamic annual adult returns through the Whitehorse Rapids Fishway, the limitations of available data, and other operational limitations, the target number of fry for release into Fox Creek was 50,000 to 100,000 (Anderton 2008).

To achieve these target numbers, an estimated production of 4,000 fry per adult female (brood stock) was used for reference. Fecundity and egg to fry survival rates vary from year to year and between fish. Therefore, this is considered a conservative estimate based upon an estimated average fecundity of 5,000 eggs per female and an 80% egg to fry survival (Tanner pers. com., 2008).

To achieve a target of 50,000 to 100,000 fry for release, 12 to 25 adult females are required. The number of adult males required for fertilization is generally double that of the females taken in order to achieve a matrix spawning approach in which two males are used to fertilise an individual female's eggs, therefore increasing genetic variance in the resulting hatchery production of fry (Anderton 2008).

## FRY TRANSPORT AND RELEASE

Fry transport and release is guided by the following publication:

Habitat and Enhancement Facts and Figures handbook, 4<sup>th</sup> Edition, Salmonid Enhancement Program. Fisheries and Oceans Canada.

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### **FIELD PREP:**

One week in advance read the DFO publication and note desired oxygen levels and temperatures

- Minimum 2 weeks before scheduled event ensure notification is sent to citizens and partners
- One week before release check in with incubation facility and examine equipment
- Both oxygen tanks must be full. Use large tank and small one for back-up
- Ensure valves, regulator and flow meter are in good working order
- Micro bubbler plate diffuser is cleaned and working properly (looking for a cloud of fine bubbles)  
**Make sure the micro bubble plate is submerged in water first or it can explode if its run dry**
- Check for leaks
- Bucket for oxygen tank with padding around it. Bungee down both tanks.
- Tote is cleaned with iodine
- Tote fits in truck – 42 x 48 x \_\_\_\_ make sure drain faces back
- Have 4 sets of ratchet straps, dip nets, buckets, etc.
- Ensure there are volunteers to assist with transfers at pick up and release locations
- Check seal on the tote and replace if necessary
- Clean, test and calibrate dissolved oxygen (DO) meter and replace battery
- Attach a hanger for the DO probe so it hangs in the ideal spot away from oxygen diffuser.
- Bolt two 2x4's to the floor of the box 43 inches long and spaced as wide as the base of the tote
- Ensure you have someone to photograph and someone to document the operation

### **EQUIPMENT:**

Tote 48 x 42"	Hose and clamps	Bear spray, bangers and horn
Ratchet Straps 4 thin, 2 thick	Chest waders and boots	Two 2 x 4's 43" long
Buckets 10L, 12 and screening for buckets	Smaller buckets and zip lock baggies	Padding for oxygen tank to hold it securely inside the bucket
2 oxygen tanks (full), regulator and flow meter	Florescent flagging, caution and duct tape	Camera, field note books, pencils, sharpies
YSI meter calibrated	Weather stripping	GPS
Zap straps and bungee cords	Tree snips	Dip nets 5 small and one large
Micro bubble plate diffuser or air stone	Snacks, water, hot dogs, buns, condiments, fire starter, wood.	Hat and other personal gear, change of clothes

## JUVENILE MONITORING

### ***METHODS:***

Monitoring at four stations conducted prior to and monthly after release. The stations include:

- MS08-01 – located upstream of the North Klondike Highway Crossing approximately 2 km.
  - Coordinates: N61.10868, W135.31239
- MS08-02 – previously located at the North Klondike Highway Crossing where the staff gauge is but has been moved to approximately 100 meters downstream of the bridge where there is a pull out off the Fox Creek road.
  - Coordinates: N61.10133, W135.29282
- MS08-03 – located approximately 4-5 km downstream of the highway crossing.
  - Coordinates: N61.12205, W135.25172
- MS08-04 – located 100 to 200 meters upstream of the mouth of the creek; dependent on the time of year and Laberge Lake water levels.
  - Coordinates: N61.11069, W135.20796.

Monitoring events are conducted monthly both before and after the annual fry releases as follows:

- On or about mid-May to sample 1+ overwintering JCS as ice leaves;
- Prior to the first release; on or about mid-June and at approximately 1000 ATU's to determine whether any 1+ plus remain and if 0+ wild fish are present;
- A representative sample of hatchery JCS at time of release to establish a baseline against which growth will be assessed;
- Mid-August, to determine growth and distribution of 0+ wild and hatchery fish;
- Mid-September, to determine growth and distribution of 0+ wild and hatchery fish at end of annual growing season.
- Mid-October if weather permits

The monthly monitoring event at each station to include:

- Juvenile Chinook sampling using four baited Gee-fry traps per station (1/8 mesh to June and 1/4 mesh traps once the fish are over 48-50 mm fork length larger mesh thereafter),
- Determination of species and if adipose fin is present,
- Measurements of fish fork length (mm) as primary metric and weight (nearest 0.1 gram) as a secondary metric,
- Collection of water temperature, in situ measurements,
- Flow measurements and water level reading from the staff gauge (located just downstream from the Klondike Highway Bridge).

For each juvenile Chinook captured, trained TKC staff anaesthetize them and record whether the fish is hatchery raised (adipose fin clipped) or wild (adipose fin present). They are then measured and weighed.

## JUVENILE MONITORING

### *PROTOCOLS:*

#### *2009 YUKON RIVER PANEL*

#### **Protocol for collection and reporting of data from juvenile salmon sampled in Canadian R&E Projects.**

**May 1, 2009**

This Protocol is to encourage standard methods of collection and reporting of data from juvenile salmon captured in projects funded by the Yukon River Panel within the Canadian Sub-basin. The “Juvenile Chinook Salmon Sampling Form” is suggested for routine sampling of streams and rivers. Specific data reporting requirements for other types of sampling, such as downstream migration traps, etc, should be agreed to with the Technical Contact assigned to your project.

#### **Salmon Species and Number (SPP/# on the Juvenile Salmon Sampling Form)**

Note the species of each juvenile salmon caught. If large numbers are captured, record the total number and measure a subset. A minimum subset of 30 salmon of a given species per sampling site is recommended.

#### **Length measurements – mandatory**

If less than 30 juvenile salmon are captured at a sampling site, measure the fork lengths of all. If more than 30 are captured, measure at least 30. Record the measurement to the nearest millimetre (mm).

#### **Weight Measurements - optional**

If juvenile salmon are weighed the following standards are to be followed:

Scales/balances are to be calibrated as per the manufacturer’s recommendations prior to weighing fish at each station;

Excess water should be removed from the surface of the fish by blotting with a cloth or paper towel

Scales/balances must be located on flat surface during use;

Weights are to be recorded to the nearest 0.1g;

#### **Reporting**

The data must be presented by date and site. The sites must be described by UTM or Latitude/Longitude co-ordinates, or shown clearly on a map located in the report or in an appendix.

The data collected is to be presented in an appendix to your final report. If this is not possible, it may be submitted either electronically or as hard copy to the Technical Contact for your project.

## HYDROLOGY AND WATER QUALITY

Hydrology and Water Quality is guided by the following publication:

*Manual of British Columbia Hydrometric Standards, BC Min. of Environment for the Resources Information Standards Committee, 2009*

[https://www.for.gov.bc.ca/hts/risc/pubs/aquatic/hydrometric/man\\_BC\\_hydrometric\\_stand\\_V1.0.pdf](https://www.for.gov.bc.ca/hts/risc/pubs/aquatic/hydrometric/man_BC_hydrometric_stand_V1.0.pdf)

Going forward the following monitoring is recommended as per the 2015 plan and recent discussions with YRP tech team and current project partners.

### **Stream Stage:**

- Monitor flow via pressure transducer(s) from Mid-July to Mid-September
- A stream gauge and flow monitoring station is developed at a discrete and accessible location along the creek.
- Discussions with Yukon Government Water Resources expand WQ monitoring program in TKC TT
- Development of a rating curve.

### **Water Quality:**

Develop a water quality sampling station, at or near the stream stage sampling site. With the following parameters measured two times during winter months, and whenever feasible during summer months;

- Dissolved oxygen
- pH
- turbidity
- conductivity
- total metals

## MONITORING ADULT CHINOOK SALMON RETURNS & BARRIERS

### ***METHODS:***

Barriers will be surveyed in mid June (in conjunction with redd and bio-monitoring) to indicate areas that can prevent or potentially limit passage. Reaches of stream morphology, barriers, spawning and rearing habitat have been documented, photographed and geo-referenced. These locations will be referenced during the expected adult return period to assess passage success, assist in recording annual adult distribution, and document obvious changes in stream morphology – such as landslides, etc.

TKC staff will observe, locations of all adult Chinook and whether they are migrating or displaying obvious spawning activity and developing Redds. If possible, staff will describe and record, individual returning adults including; markings, injuries, size, sex and behaviour. When carcasses are found, the length will be measured, scale samples taken, and heads collected for submission to DFO for further analysis. The locations of any potential spawning sites will be geo-referenced and flagged.

### FOX CREEK ADULT SURVEY PROTOCOL

(Draft v.3, Aug 2015)

General guidance:

A HAT and POLARISED sunglasses are necessary to complete a successful survey.

Live adult and carcass survey results are very important to determine the success of the project.

Upon observing salmon in Fox Creek, the following guidance should be followed to record the observation and to detail enough information to be able to report on the observation and to accurately return to the site for further investigation.

This information is necessary to document the behaviour of the fish observed to determine if the area was used for spawning or if they are still migrating within the stream.

Notify DFO immediately upon conclusion of the days survey if salmon (live or carcasses) are observed in the stream. We will make every effort to return to the site with you to document everything that can be learned at this point and to ensure further investigation of restoration at Fox Creek. Continue to survey the entire stream on subsequent days to ensure that all salmon that may have returned are located. This will ensure we have documented all locations that spawning has, or may have, taken place for later investigation.

## **1. Live Adults**

Points to record:

1. Count how many at location, try to stay back somewhat to not disturb their behaviour as this is important to record as per below
2. Describe fish observed: Do they have any white markings/injuries on them (Usually near the tail, this results from digging and defending territory), Are they large or small Chinook? Is an adipose fin present or not on each fish? Are you confident that you can record the sex of the fish observed, if unable to tell record as such.
3. GPS location of observation, save on GPS and write in notebook and affix labeled ribbon to nearby tree at eye level as a back-up.
4. Photograph as much as is necessary to represent the stream location, take notes on photograph identification numbers
5. Observe and record behaviour:
  - Are they below an obstruction and either not able to pass or in the process of attempting to pass? OR
  - Are they in pairs or groups of 3 so that are occupying a spawning site Redd or specific area of the stream. A Redd will appear to be a cleaned off area of gravels. May or may not be obvious depending on the amount of digging that may have been done. A giveaway is if you see them defending an area against other fish or if you see them turn on their side and dig at the bottom briefly. OR
  - Are they in deeper water like a pool or behind logs and appear to be hiding/holding. This is observed when fish are not yet ready to spawn either because they are still migrating, looking for mates or awaiting appropriate conditions (flow, temp). They will hold in areas where they can hide and or get refuge out of the stronger currents.

NOTE sometimes you can surprise them and they will move to refuge to hide. If you suspect this has occurred watch them for about 15 minutes from a distance and see if they return to a redd area or what they do. Fish that are ripe for spawning will usually return to their redd within this time.

## **2. Carcasses**

Points to record:

1. Record the location and number of carcasses as you do with the live adults.
2. Take pictures of the carcass and stream area found.
3. Check for adipose clip and note if clipped or not.
4. Remove the head, gills, attach head tag to jaw with zip tie and store in individual labelled bags whether the adipose is clipped or not. Freeze or bring to DFO after the days survey completed.

5. If it is a female cut it open to determine how many, if any eggs, are still within the salmon. This tells us the proportion of eggs that the salmon likely spawned. (e.g. If no eggs observed then it is a 100% spawned fish). A basic estimate of the number is all that's needed. Less than approximately 30-50 eggs still within the salmon is not unusual.
6. Collect/record Age/Sex/Length (ASL). Record sex, Collect scale samples as per scale card instructions for age analysis, measure the fork length and post orbital hypural length (bring field book, scale cards, tape measure and tweezers) See diagrams below for length descriptions. To find the hypural plate for accurate measurement you may have to slice away the skin covering it. Take a picture of carcass with head tag visible or some identifier.

### **Summary of equipment for adult surveys:**

<ul style="list-style-type: none"> <li>• Polarized sunglasses and hat</li> <li>• GPS</li> <li>• Camera</li> <li>• Field Notebook/Pencil</li> <li>• Map</li> <li>• Ribbon</li> <li>• Zip ties</li> </ul>	<ul style="list-style-type: none"> <li>• Knife (for removing head)</li> <li>• Zip locks or garbage bags for heads</li> <li>• Permanent marker</li> <li>• Scale Cards</li> <li>• Sharp tweezers</li> <li>• Tape Measure</li> <li>• Labels for each head</li> </ul>
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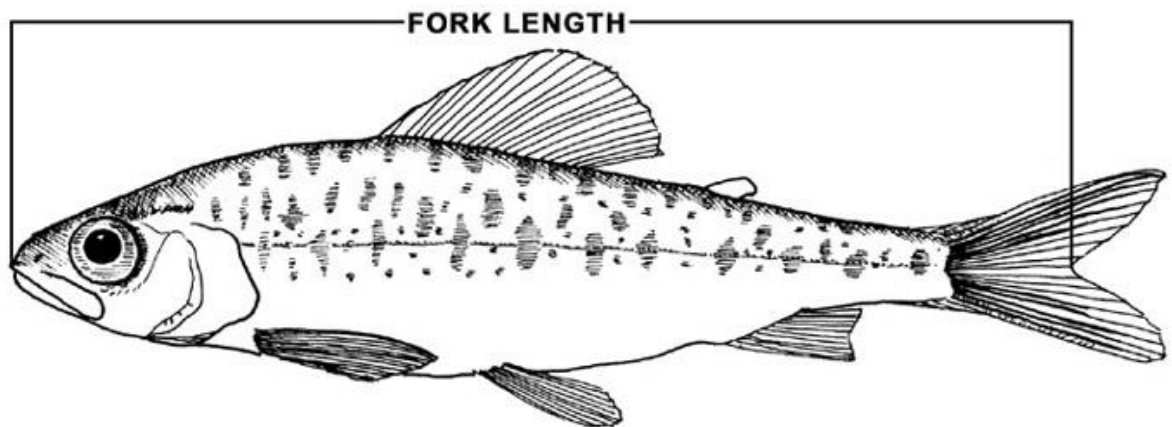


Photo courtesy [juvenilefishid.com](http://juvenilefishid.com)

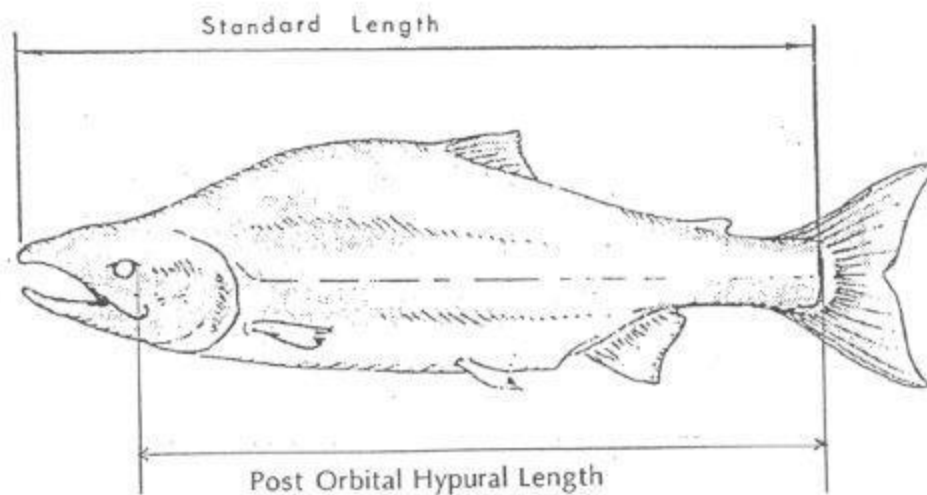
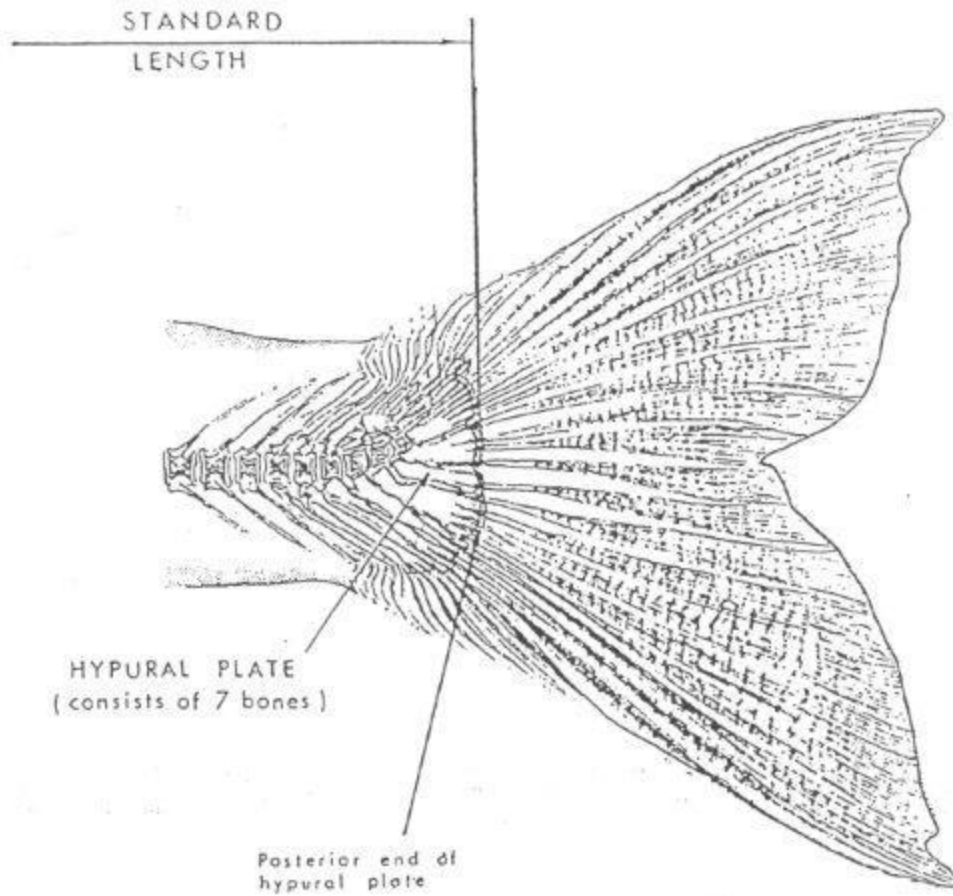


Image courtesy of Pacific Streamkeepers Federation

## Labelling and head preparation for CWT Samples

### *In The Field*

In some cases, during transport heads may thaw so it is important that all heads shipped to the Whitehorse office should have gills and any excess flesh removed to help slow the rotting process.



1. Head with excess flesh and gills removed

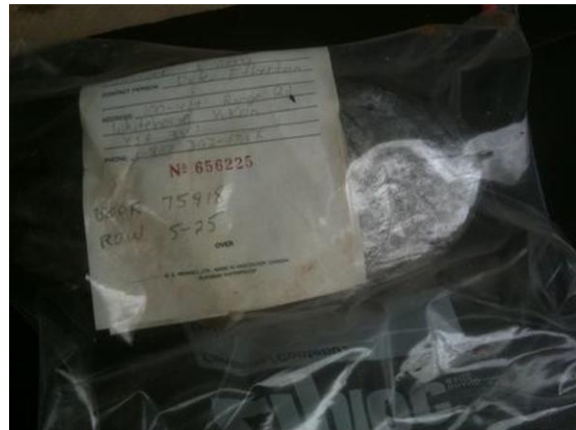


Figure 2. Properly packaged head

A jaw tag should be filled out (if applicable) using a pencil and attached to the jaw. In some cases, a jaw tag will be supplied to you that does not have a spot to fill out the required information. This makes it very important to ensure the jaw tag number is referenced in the dataset. The heads are stored in a communal freezer until shipped for analysis and if not labelled properly it will become hard (if not impossible) to identify them. If you do not have a jaw tag handy write down the required information on a piece of waterproof paper and slip it in with the head and tag.

Required information includes:

- **Date (month, day, and year)** ie August 15, 2019 (spell the month)
- **Drainage** ie Yukon
- **Project** ie Fox Creek
- ***Sample collector names:***
- **Jaw tag #** (make one up and reference it in the sample data)
- **Species** ie Chinook
- **Project Manager Name**

Before freezing the head, place the head in a Ziploc freezer bag and ensure the **jaw tag # is visible from the outside**. If putting more than one head in a freezer bag, ensure that each jaw tag number can be easily read (Figure 2). When shipping to Whitehorse, keep heads separated by project. Properly label the shipping container with the year, drainage, species, project name and project manager name. Try to keep all the heads from a project in the same container(s). If you use garbage bags as containers, wrap up all excess plastic and label the bag as to what is in it.

### ***Lab Storage***

A freezer has been dedicated for storage of CWT heads until they are ready to be shipped south for analysis. The freezer is in the lab and will be labelled for easy identification. Before storing any heads in the freezer, ensure that they are all labelled as per instructions above.



**BAD ☹️**



**GOOD 😊**

## **BEAVER MANAGEMENT**

The TKC resources manager technician conducts an annual trapping program to control beaver populations and activities in this area. The program involves both traditional and non-traditional methods. Traditional methods include workshops to teach traditional ways, trapping with elders and traditional annual hunts. Local trappers, both citizens and non-citizens, are hired to trap using current non-traditional methods.

## **REDD MONITORING**

### ***METHODS:***

Based on the observation of adults displaying spawning behaviour and disturbed substrate, redd locations will be recorded for future reference. Additional temperature data loggers will be placed at some of the potential redd sites to determine if incubation temperatures near established redds are similar to winter surface water measurements and assist in determining emergence timing of fry for subsequent bio-monitoring.

Methods to evaluate the rate of development of alevins or swim up fry prior to or at the expected time of emergence or shortly thereafter will be determined by flow conditions occurring at the time that sampling is necessary. Methods available may include; fyke net sampling to capture drifting emerged fry, use of an emergence trap, electrofishing, redd excavation, 1/8 mesh juvenile Gee-trapping or a combination of approaches.

## **APPENDIX B - PHASE II ANNUAL IMPLEMENTATION AND MONITORING PLAN**

**Updated: February 2020**

## **PHASE II ONGOING ANNUAL ACTIVITIES**

### **Training and Capacity Building**

- Employ young TKC citizens in restoration positions.
- Provide formal training opportunities to meet career development goals of current LRH staff.
- Build, mentorship and training opportunities for TKC staff/citizens with partners and other agencies.
- Ensure TKC staff are trained in predator defense and certified for firearm use prior to each field season.
- Identify opportunities for other department staff to contribute skills, expertise and time to the project.
- Build linkages between project activities and goals, and existing TKC programs such as Culture, Family, and Fish Camps.
- Encourage TKC staff to communicate information about Yukon River salmon and the project to TKC citizens through presentations, newsletters, and website and by including citizens in project activities (e.g. fry release into Fox Creek).
- Provide education and awareness about the Chinook salmon decline, best practices and conservation efforts towards tangible results with TKC Citizens, youth and the public.

### **Planning and Implementation**

- Coordinate pre-and post-season meetings with project partners.
- Work with project partners and experts to increase TKC knowledge and experience.
- Attend Yukon River Panel meetings and DFO teleconferencing.
- Gain knowledge and understanding of the marine ecology, Yukon River system and Alaskan Tribal communities.

### **Incubation and Releases**

- Incubation and hatchery rearing strategy should be carried out in a way that maximizes opportunity to mimic natural conditions in the Yukon and imprinting juveniles to Fox Creek. This could include exclusive rearing at McIntyre Creek and release into Fox Creek at earliest possible stage post adipose fin clip.
- Releases should be physically spread out in Fox creek to the extent it is logistically feasible.
- Use preliminary analysis of biophysical monitoring to advise fry release strategies.

- The number of fish releases should consider the predicted abundance of naturally produced fry to minimize potential for negative effects on wild fry due to competition caused by excess fry releases in fully seeded habitats.

### **Bio-physical Monitoring of Juveniles**

- Continue baited G-trap monitoring at Bio-physical Sampling Stations both before and after releases.
- Use 1/8 mesh traps to ensure Young of Year (YoY) can be captured. Fork Length is primary metric, weight considered secondary metric.
- Use 1/4 mesh traps once the fish are over 48-50 mm fork length.
- Include targeted baited trap monitoring at higher frequency downstream of known spawning locations to determine if successful fry emergence has occurred, and the timing of it.
- Provide training, maintain equipment and follow protocols to ensure consistency of data collected for long term monitoring.

### **Hydrology and Water Quality**

- Monitor water temperature via loggers year-round.
- Ensure water quality (particularly DO) measurement occurs at least twice in winter.
- Monitor flow via pressure transducer(s) from mid-July to mid-September.
- Collect additional water quality and discharge information as feasible.

### **Monitoring Adult Returns and Barrier Management**

- Record beaver activity and potential obstructions to migrating adult salmon prior to the spawning period.
- Remove obstructions that would limit potential spawning ability.
- Monitor adult salmon returns through stream walks.
- Collect adult carcass samples and deliver to DFO for analysis.

### **Redd Monitoring**

- Document and map potential spawning habitat in the lower reaches of Fox Creek
- Record and monitor potential redd sites
- Install artificial redds using data loggers to calculate ATU's to 1000
- Conduct bio-physical monitoring in June to monitor emerging Young of Year

## **Trail Maintenance**

- Ensure the Fox Creek access trail remains open through ongoing trail maintenance as easy and safe access to the creek is required for all project components (particularly line of sight for early detection of bears).

**FOX CREEK– DETAILED IMPLEMENTATION AND MONITORING PLAN (IMP)– UPDATED FEBRUARY 2020**

<b>Project Year</b>	<b>Year of Fry Release</b>	<b>Planning and Implementation</b>	<b>Broodstock Collection, Incubation and Rearing</b>	<b>Releases</b>	<b>Bio-physical Monitoring of Juveniles</b>	<b>Hydrology and Water Quality</b>	<b>Monitoring Adult Returns and Barriers</b>	<b>Redd Monitoring</b>
9 (2016)	2012	Develop data collection sheets for project components. Develop spreadsheets or database to house all monitoring data. A central location for all data to allow easy access for multi-year analysis.	Maximize genetic diversity by utilizing Whitehorse Rapids Fish Hatchery for broodstock collection and rearing to the eyed stage. Utilize MCIF for rearing to fry stage and assist with monitoring, daily maintenance and operations.	Consider staggering release dates and possibly re-evaluating release locations to accommodate the numbers of fry.	Ongoing annual activities guided by implementation and monitoring plan. (IMP).	Conduct winter water quality monitoring with parameters; dissolved oxygen, pH, turbidity, ORP, conductivity, Nitrates, and total metals. As per the Restoration Plan 2008 recommendations, stream gauging and flow measurements should be conducted during regular monitoring events to improve discharge data.	Conduct stream walk surveys both before spawning period and daily during and after. Digitize and map reaches of stream morphology including barriers, spawning and rearing habitat that have been photographed and geo-referenced	Conduct daily stream walk surveys during spawning period.
10 (2017)	2013	Move toward digital data entry in the field with appropriate instruments.	Maximize genetic diversity by utilizing Whitehorse Rapids Fish Hatchery for broodstock collection and rearing to the eyed stage. Utilize MCIF for rearing to fry stage and assist with monitoring, daily maintenance and operations	Approach to estimating rearing capacity of the system should be developed and refined. (IE: assumption of 1m2/fry is likely reasonable but total habitat needs to consider beaver activity, creek length and width). Develop methods using Streamkeepers Handbook	Add data from 2017 biophysical monitoring to 2009 – 2016 analysis document.	Continue year-round water quality, temperature, and discharge measurements. Determine water quality standards to be used. Install a hydrometric station, including a staff gauge to develop a rating curve over time.	Conduct stream walk surveys and develop interim additional methods to enumerate returning adults. Actively manage beaver to restore unimpeded Chinook access to the bridge and consider pros and cons of facilitating access further upstream. Meet with FN Elders to determine historical Chinook population size.	Develop redd monitoring protocols specific to Fox Creek.
11 (2018)	2014	Move toward digital data entry in the field with appropriate instruments.	Develop criteria for determining when hatchery intervention/contribution to Fox Creek should cease. Discuss option of thermal marking opposed to coded wire tagging.	Conduct a Streamkeepers Habitat Survey of juvenile Chinook rearing habitat from BD 315 to the mouth. Supply Fry Release posters to all partners.	Add data from 2018 biophysical monitoring to 2009 – 2017 analysis document. To track wild to hatchery ratio and overwintering activity. Calculate average unclipped, clipped and standard deviation. Utilize a slot detector to confirm wild fry.	Continue year-round water quality, temperature, and discharge measurements. Refine rating curve. Work with Water Resources to develop a water quality monitoring network. Compare results over time to assess trends.	Conduct a Streamkeepers Habitat Survey of Chinook spawning habitat from BD 315 to the mouth. Develop methods to enumerate returning adults. Coordinate with DFO projects to assess options. Actively manage beaver. Meet with FN Elders to determine historical Chinook population size.	Refine redd monitoring protocols specific to Fox Creek with support of experts.
12 (2019)	2015	Move toward digital data entry in the field with appropriate instruments. Support DFO, to host annual workshops of past and current restoration projects.	Conduct a feasibility study for the rebuild of MCIF and other restoration methods with Yukon First Nations.	Yukon Department of Highways and Public works is replacing the Fox Creek Bridge so work in partnership with them to coordinate fry release.	Continue monitoring at regular sites plus 2018 redd locations and cumulate results with existing data.	Yukon Department of Highways and Public works is replacing the Fox Creek Bridge so work in partnership with them to maintain water quality. Refine rating curve.	Install a weir to monitor and record returning adults.	GPS redd locations to monitor wild juveniles.
13 (2020)	2016	Meet with project partners and TKC citizens to discuss next steps for the project.	Conduct a feasibility study for the rebuild of MCIF and other restoration methods with Yukon First Nations.	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities
14 (2021)	2017	Annual IMP activities	Consider phasing out of hatcheries and relying on the natural system to recover.	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities

15 (2022)	2018	Annual IMP activities	Consider phasing out of hatcheries and relying on the natural system to recover.	Continue with annual fry release if deemed necessary.	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities
16 (2023)	2019	Annual IMP activities	Consider phasing out of hatcheries and relying on the natural system to recover.	Continue with annual fry release if deemed necessary.	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities
17 (2024)	2020	Annual IMP activities	Consider phasing out of hatcheries and relying on the natural system to recover.	Continue with annual fry release if deemed necessary.	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities
18 (2025)	2021	Annual IMP activities	Consider phasing out of hatcheries and relying on the natural system to recover.	Continue with annual fry release if deemed necessary.	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities
19 (2026)	2022	Annual IMP activities	Consider phasing out of hatcheries and relying on the natural system to recover.	Continue with annual fry release if deemed necessary.	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities
20 (2027)	2023	Annual IMP activities	Consider phasing out of hatcheries and relying on the natural system to recover.	Continue with annual fry release if deemed necessary.	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities
21 (2028)	2024	Annual IMP activities	Consider phasing out of hatcheries and relying on the natural system to recover.	Continue with annual fry release if deemed necessary.	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities
22 (2029)	2025	Annual IMP activities	Consider phasing out of hatcheries and relying on the natural system to recover.	Continue with annual fry release if deemed necessary.	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities
23 (2030)	2026	Annual IMP activities	Consider phasing out of hatcheries and relying on the natural system to recover.	Continue with annual fry release if deemed necessary.	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities