

# Klondike River Chinook Salmon Restoration and Instream Incubation Trial



## Prepared For

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Down to Earth Biology

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## EXECUTIVE SUMMARY

Tr'ondëk Hwëch'in prepared a Chinook stock restoration plan for the Klondike River watershed during early 2018 which recommended that an instream incubation trial be conducted on the Klondike River. The current project aimed to test the feasibility of instream egg incubation as a restoration tool for Klondike River Chinook and to collect information to help long-term Chinook restoration plans for the watershed. This project involved the following components: water temperature monitoring, monitoring juvenile Chinook presence, a Chinook spawning aerial survey, instream egg incubation and hatching success monitoring.

Water temperature monitoring was completed in combination with the instream incubation component of the project and involved the continuous collection of water temperature data at a number of sites in the main channel of the Klondike River and a groundwater fed channel adjacent to the Tr'ondëk Teaching and Learning Farm (the Farm Channel). As would be expected, the groundwater channel was colder than the mainstem of the river during the summer but considerably warmer during the winter months. The juvenile monitoring was conducted in June and July 2018 to collect baseline information on juvenile habitat the Farm Channel and to compile information on length and weight of juvenile Chinook throughout the summer. Large numbers of juvenile Chinook were observed and captured during the June sampling event. Although sampling effort was less during the July event, large numbers of juvenile Chinook were still captured with minimal effort.

A spawning Chinook aerial survey was conducted by helicopter on July 22, 2018 in order to identify areas for egg planting and source areas for broodstock collection. The instream egg incubation component of the project involved preparations at each site to construct artificial redds with available stream substrate to mimic natural conditions. Broodstock for the project was collected in the Klondike River and eggs and milt were transported to each site for planting. A cumulative total of 8,136 eggs were planted at six sites in the Klondike River including five sites in main channel areas, and a single site in the Farm Channel (a groundwater channel). Eggs were planted using three methods: Whitlock Vibert boxes, custom designed closed mesh bags, and directly into the substrate using egg insertion pipes. Success monitoring was conducted periodically between October 2018 and May 2019 in order to assess the rate of development of the planted eggs and to determine survival at all sites. The success monitoring indicated a mean hatching success of 61% across all sites, but individual survival estimates by incubator were highly variable and ranged from 16.5-95%. Survival to fry emergence was available using the closed mesh bag for a single site in the Farm Channel and was found to be relatively high (91%). Consistent information was not available for the main channel sites because conditions were not conducive to allowing closed mesh bags to remain in place through the spring freshet period.

The current project provided information on the merits of instream egg incubation as a restoration tool for Klondike River Chinook and provided new information on the timing of development for incubating eggs and alevin. The lessons learned during this trial project are useful for the planning of the 2019/2020 project which will aim to plant eggs in different habitats with varying site conditions (e.g., water temperature) to further assess egg survival and development rates.



## ACKNOWLEDGEMENTS

Natasha Ayoub of the Tr'ondëk Hwëch'in (Fish and Wildlife Manager) contributed to all aspects of this project including portions of the fieldwork. Additional personnel from Tr'ondëk Hwëch'in participated in the project including Alice McCulley and Jordan Ross. Trix Tanner (Salmonid Enhancement Program - Fisheries and Oceans Canada) assisted with project permitting and provided advice on overall project direction. Lee Whalen of Dawson City rented his jetboat to the field crew which was a critical component of the project. We would also like to thank the TH youth and Elders who accompanied us on our field site visits. Funding for this project was provided by the Yukon River Panel's Restoration and Enhancement Fund.

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## 1 INTRODUCTION

Tr'ondëk Hwëch'in (TH) citizens are physically, culturally and spiritually connected to the Yukon River salmon fishery. This fishery has been a major contributor to the traditional economy since early days of the Tr'ondëk Hwëch'in, or People of the River, who have historically focused salmon harvest at the confluence of the Yukon and Klondike Rivers, or Tr'ochëk. As a primary stakeholder in subsistence and commercial salmon fisheries, TH has a vested interest in the health of salmon stocks found within their Traditional Territory. Klondike River Chinook salmon have faced declining populations for a number of decades and TH have been involved with and have supported salmon restoration projects in their Traditional Territory.

The Klondike River appears to be the highest priority candidate for stock restoration due to the cultural connection for TH. Klondike River Chinook have been impacted both during and after the Klondike Gold Rush due to large scale dredging/placer mining and associated hydroelectric developments. As a result, TH prepared a Chinook stock restoration plan for the Klondike River watershed during early 2018 (EDI and TH 2018). The restoration plan identified an instream incubation trial be conducted on the Klondike River over the near-term, with a medium-term goal to develop some form of an incubation facility or small-scale hatchery in the watershed.

The methods used for the instream incubation component of the project closely followed those currently being used by Teslin Tlingit Council (TTC) on Deadman Creek and Morley River within the Teslin River watershed of southern Yukon. Using these methods in the Klondike River, the 2018 project results will be used to further determine the feasibility of such methods for stock restoration in the Yukon River watershed, and to collect information about the timing and rate of egg and alevin development. This method is innovative in its application for stock restoration and is very much a work in progress, particularly with the development of approaches to determine success given that determining survival beyond the alevin stage is challenging. However, the stewardship opportunities of such a project and ability to use results for guiding future restoration initiatives are cornerstones of this project. In combination with the instream incubation trial, TH is collecting information to facilitate the development of a small-scale incubation facility in the Klondike watershed in the near future. Information on juvenile size during the summer can be combined with the results of the incubation trial to plan an incubation facility which is ecologically relevant and produces fry which are as similar in size to wild juveniles as possible.

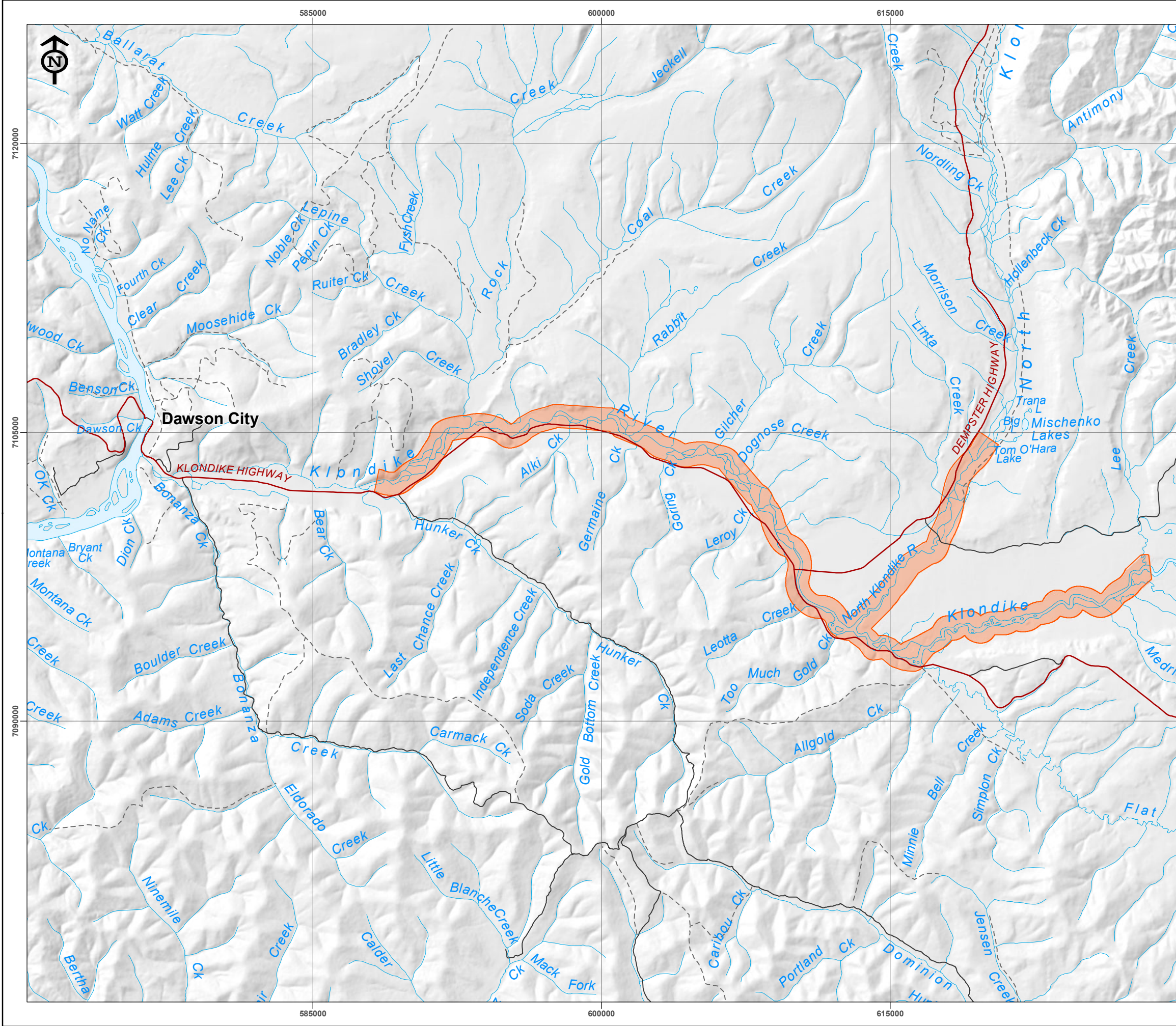


## 1.1 OBJECTIVES

The overall objective of this project was to restore Chinook salmon spawning numbers using instream egg planting. The project also provided a unique learning opportunity to test the egg planting methods to determine the utility of this method for restoring Chinook stocks elsewhere in the Yukon River watershed. The specific objectives of the project were as follows:

- Deploy up to 15,000 fertilized Chinook eggs into the Klondike River to test the feasibility of egg planting methods on the Klondike River watershed,
- Develop an understanding of the development rates of eggs and alevin in the watershed,
- Conduct follow up monitoring during the winter and spring to determine the fate of the planted eggs,
- Conduct a juvenile Chinook sampling program during the summer of 2018 to collect data on habitat utilization by juveniles and changes to length and weight over the summer months, and
- Provide local capacity building and technical training for Tr'ondëk Hwëch'in citizens and employees.

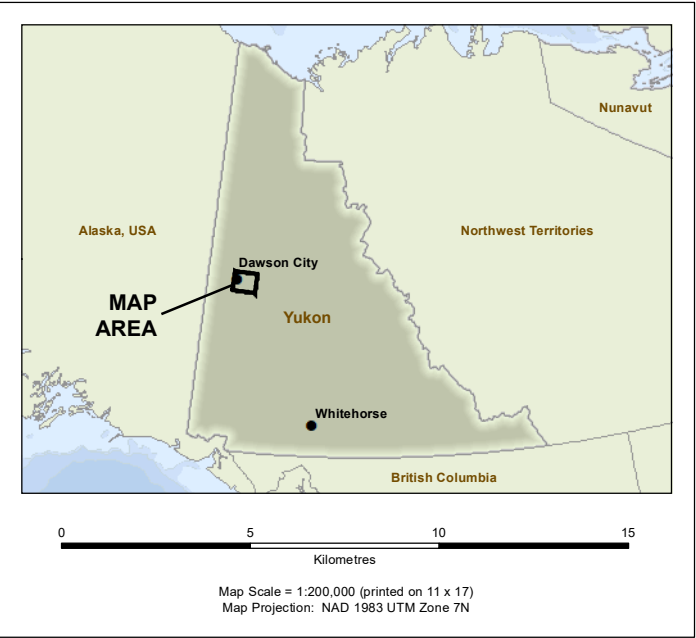




### Map 1. Overview of project area

**Legend**

- Highway
- Secondary Road
- Trails
- Project Area



**Data Sources**  
Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) [www.geomatics.yukon.ca](http://www.geomatics.yukon.ca).

Project data displayed is site specific. Data collected by EDI Environmental Dynamics Inc., 2018 was obtained using Garmin GPS technology.

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## 2 METHODS

### 2.1 WATER TEMPERATURE MONITORING

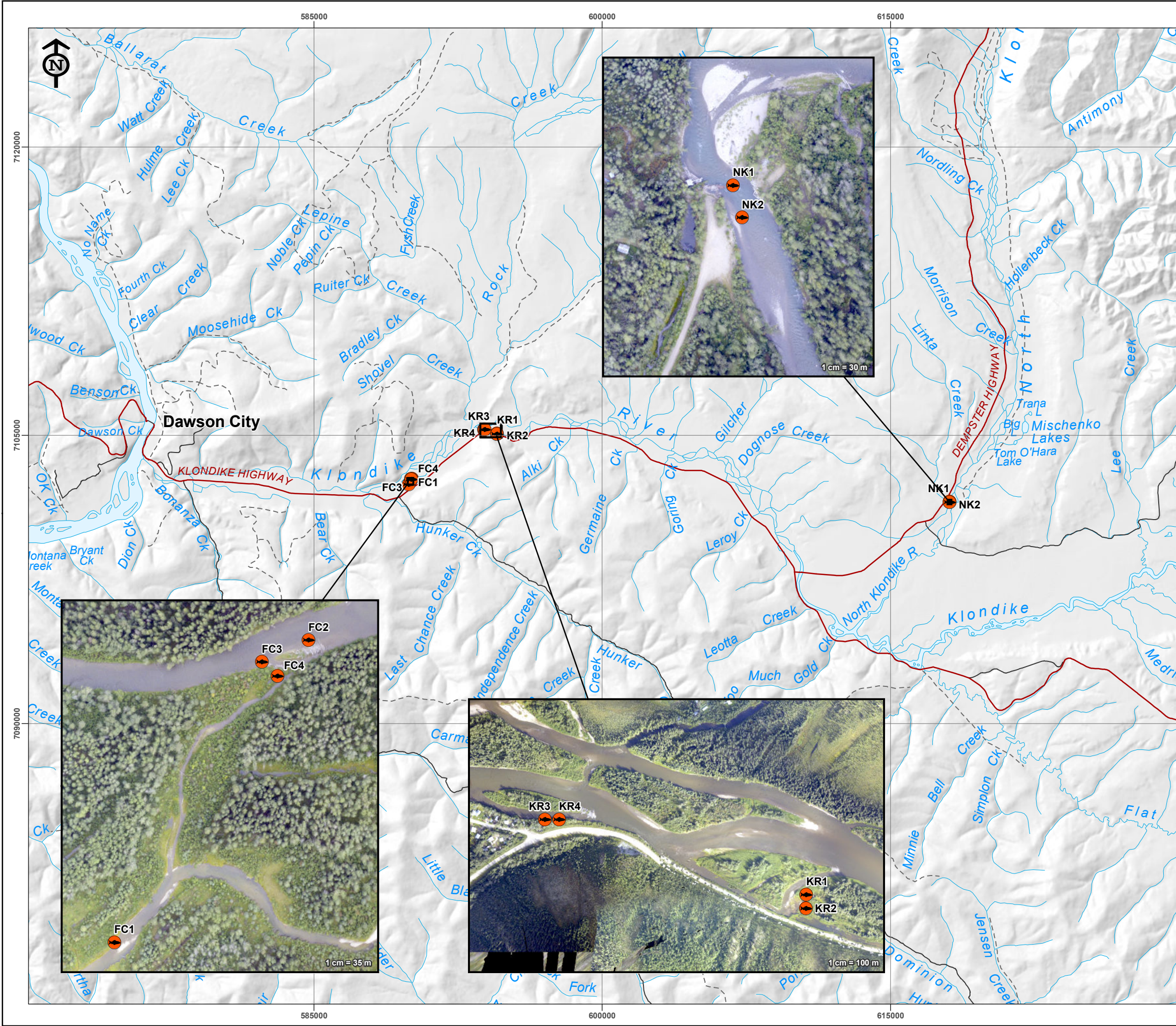
Water temperature monitoring involved the deployment of water temperature loggers at each of the six egg planting sites and a nearby surface water monitoring location. The surface water location provided a means to obtain water temperature data prior to the removal of all egg incubation media. This logger was downloaded on a few occasions during the fall of 2018 to calculate accumulated thermal units (ATUs) and plan the timing of the success monitoring field investigation in October 2018. The remaining loggers were retrieved in combination with the additional success monitoring field visits during the winter and spring of 2018/2019.

### 2.2 JUVENILE MONITORING

Sampling for juvenile Chinook was conducted in the Klondike River and the area known as the TH Farm Channel, which is a small groundwater fed channel in the slough behind TH C-7B settlement land parcel, located across from the Dawson City airport. The overall objective of this component of the project is to continue to collect presence/absence information on juvenile Chinook in the TH Farm Channel and to collect data on juvenile Chinook length/weight during the summer months.

Sampling was conducted on two occasions under a Scientific Fish Collection License issued by DFO; June 22-25 and July 23-24, 2018 (Map 2; Photos A1 and A2, APPENDIX A). Minnow trapping consisted of three traps set at each station. All traps were baited with Yukon River origin salmon roe and left to soak overnight as per Yukon River Panel protocols. Dip netting was also used during the June sampling event as numerous juveniles were observed around the traps. Field crews measured water quality parameters (water temperature, pH, specific conductance, and dissolved oxygen) for each station along with water depth and a general habitat description. Digital photos were collected for all sampling stations along with GPS co-ordinates and set/pull times. Upon retrieval of the traps, all fish were counted and identified to species, with a minimum of 10 individuals of each species from each trap measured for fork length.





### Map 2. Juvenile Chinook monitoring locations in the Klondike River

**Legend**

- Juvenile Chinook Monitoring Locations
- Highway
- Secondary Road
- Trails

0 5 10 15  
Kilometres

Map Scale = 1:200,000 (printed on 11 x 17)  
Map Projection: NAD 1983 UTM Zone 7N

**Data Sources**  
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Aerial imagery provided by Great River Air. (Collected August 8 - 10, 2018).

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## 2.3 AERIAL SURVEY

An aerial survey for spawning Chinook was completed on the Klondike River from Goring Creek to Lee Creek on July 22, 2018. The primary objective of this survey was to locate potential broodstock collection areas and egg planting sites, as well as to determine access for these project components. During the survey, observers were located in the front and back seats of the helicopter and the pilot positioned them over the river, with the best possible vantage point at approximately 40-45 m above ground level. Surveys were completed in an upstream manner and observers wore polarized glasses to reduce glare. Redds and adult Chinook were counted, photographed and locations recorded with an iPad (Avenza Maps).

## 2.4 INSTREAM EGG INCUBATION

The project underwent a YESAB project review during the summer of 2018 and permits were issued for the work by DFO including a Scientific Fish Collection License for the broodstock collection and an Introduction, Transplant and Transport (ITT) permit for the broodstock collection and subsequent egg planting in the Klondike River.

The instream egg incubation (egg planting) component of the project involved four stages: (1) site selection and preparation, (2) broodstock collection, (3) egg fertilization, and (4) egg deployment (below sections).

### 2.4.1 SITE PREPARATION

During the site selection process in the Klondike River, sites were chosen for egg planting based on certain site characteristics. These characteristics included suitable substrate, depth, flow rates and potential for groundwater input. Ease of access to the site during summer and winter months was also taken into consideration for the ongoing success monitoring.

At all sites in the Klondike River, working/cleaning of the substrate was required to mimic the natural redd construction and to prepare each of these sites for egg planting. This was accomplished by digging/raking of the streambed with hand tools. Care was taken to avoid disturbing natural Chinook redds, although none were found to be located in close proximity to the planting sites. GPS co-ordinates were collected for all sites and a rock with a unique combination of colored flagging tape was placed on each prepared site to facilitate locating sites for monitoring. The final step of site preparation was to move all cleaned substrate to the sides of the deployment area between the two egg insertion pipes, thus leaving a trench. It was within this trench that the eggs were planted during the egg deployment (Section 2.4.5).

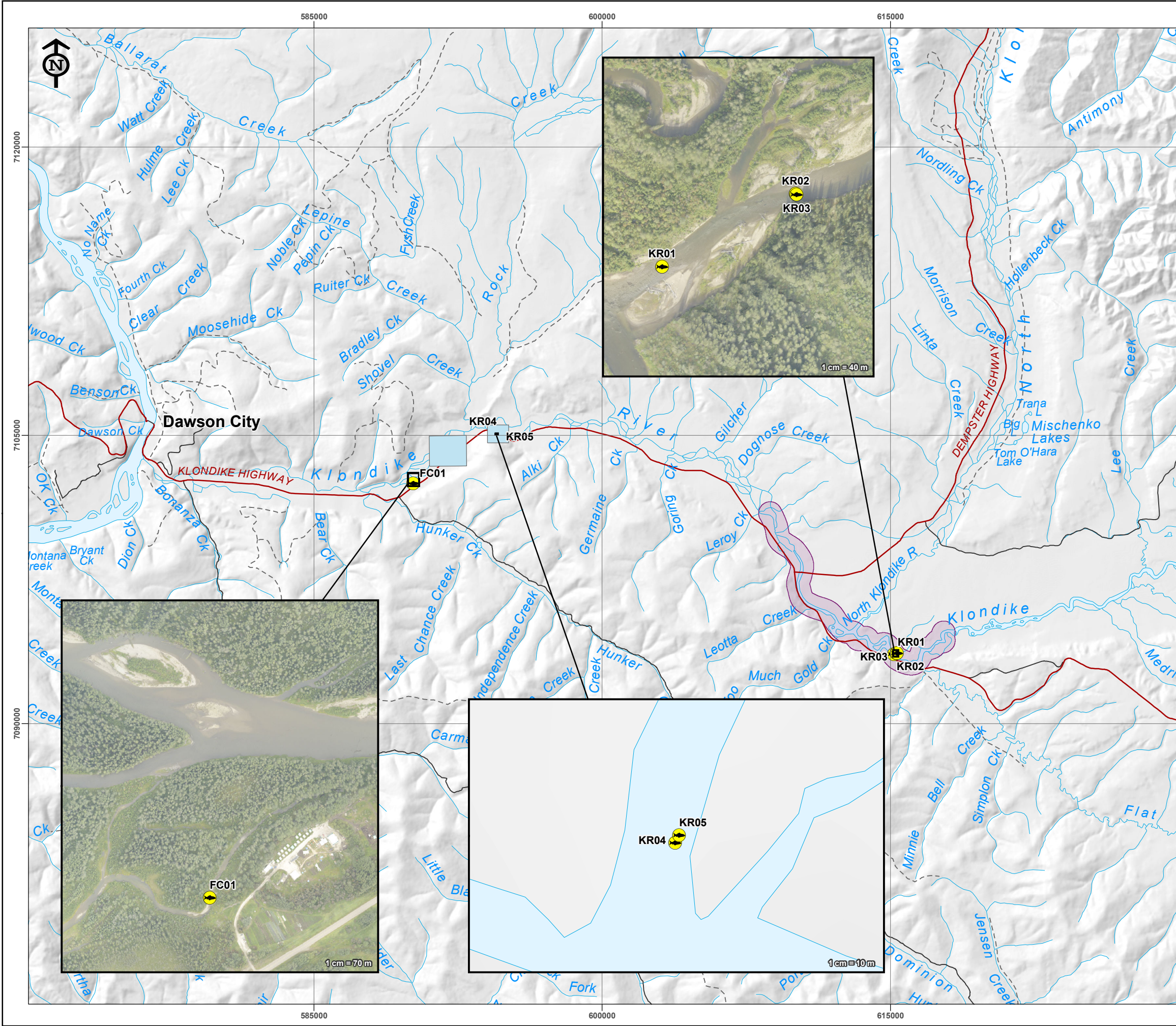
A total of six egg planting sites were selected on the Klondike River (Map 3) and were separated into three general areas, including:

- Sites KR01, KR02 and KR03 were located in a primary side channel of the Klondike River approximately 7 km upstream of the Dempster Highway crossing.



- Sites KR04 and KR05 were located in a secondary side channel of the Klondike River approximately 1.5 km upstream of the Rock Creek confluence.
- Site FC01 was located in the area known as the TH Farm Channel, a groundwater fed side channel of the Klondike River across from the Dawson City airport.





Map 3. Brood stock collection and egg incubation sites on the Klondike River

- Legend
- Egg Incubation Sites
  - Highway
  - Secondary Road
  - Trails
  - Brood Stock Collection Area



Data Sources  
Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) [www.geomaticsyukon.ca](http://www.geomaticsyukon.ca).

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## 2.4.2 WOLMAN PEBBLE COUNTS & SPOT VELOCITY MEASUREMENTS

Wolman pebble counts were conducted to determine the size of riverbed material (e.g., gravels, cobbles) at each egg planting site. One hundred random pebble samples were measured at each location; the length (mm) of the second largest axis (B-axis) of each pebble was recorded. The collection of this information helps to quantify the substrate size within the Klondike River. By collecting data on the composition of the stream bed, we can demonstrate that the substrate within our planting sites contain suitable sized substrate for egg survival. Additionally, spot velocities were collected at all egg planting sites using a Swoffer velocity meter to measure flow rates for comparison with success rates.

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## 2.4.3 BROODSTOCK COLLECTION

Broodstock collection was conducted on the Klondike River on July 25, 2018. A small jet boat was used to move to different locations and locate broodstock more efficiently. Male and females spawners were captured by angling/snagging, and visual counts of redds and spawning females were recorded during the broodstock collection week to determine the number of spawners and redds present. All Chinook salmon captured were measured from mid-eye to fork and snout to fork, sexed, sampled for scales and genetics (paired auxiliary processes); scale and genetic samples were provided to DFO for analysis. Fish not suitable for broodstock were released promptly and those to be used for broodstock were temporarily placed in holding tubes or to allow for eggs and milt to be collected simultaneously.

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## 2.4.4 EGG FERTILIZATION

When a sufficient number of males and females were captured to conduct an egg take, each fish had its vent carefully wiped dry and the eggs/milt were placed in sterilized, dry plastic containers. Eggs were enumerated by weight to obtain an estimate of the total number collected. Eggs and milt were kept in a clean dark cooler with an ice pack to keep cool until fertilization.

Egg fertilization was conducted in close proximity to each egg planting site to reduce the amount of handling and transport into the stream. An umbrella was set up over the area to provide shelter from the rain and sun during the fertilization and water hardening process. Prior to fertilization, all eggs were mixed such that individual sites had a mix of eggs from more than one female and milt to maximize fertilization rates. The fertilization was done in batches with only enough eggs to fertilize one to three sites in order to reduce the amount of egg holding time between fertilization and planting into the stream. Eggs were weighed to estimate the number required for each site(s) and milt from three males was used for each batch of fertilization. After being fertilized, the eggs were flushed clean with stream water and allowed to water harden for 20 minutes before being loaded into the various incubation media for planting in the stream.



### 2.4.5 EGG DEPLOYMENT

The egg deployment at each site involved the use of three methods of egg planting: Whitlock-Vibert boxes, custom designed closed mesh bags, and egg insertion pipes. Whitlock-Vibert boxes are a commercially available incubator which provides a means of measuring hatching success; however, they cannot be used to measure emergence success given that alevin are able to exit the incubator. Custom designed closed mesh bags were fabricated and filled with stream substrate to replicate natural conditions. A predetermined number of eggs were then planted into the bag using an egg insertion pipe (see below) and the bag zipped closed. Egg insertion pipes involved the use of a metal or plastic PVC pipe inserted into cleaned substrate; one to three of these pipes were used at each site, with a predetermined number eggs placed into each pipe depending on eggs available for planting and substrate size (larger amount of substrate allowed for more egg planting). Half of the eggs were placed into the pipe at a depth of approximately 25 cm below the surface of the bed, with the remainder deposited 5-10 cm closer to the bed surface. All incubation media were marked with a unique color combination of flagging tape and sketched onto a site plan to facilitate future success monitoring. Following the placement of all eggs at each site, previously cleaned substrate was piled into a mound to protect the eggs and mimic the construction of a natural Chinook redd.

## 2.5 SUCCESS MONITORING

Success monitoring was conducted from October 2018 through to mid-May 2019 on the Klondike River. The primary objective of this monitoring was to determine egg hatching success in all incubation media at each site. Methods were also tested to determine the feasibility of measuring survival through to the emergence stage.

The timing of the success monitoring was determined largely by ice conditions on the Klondike River and varied between each group of sites. The single monitoring site in the Farm Channel was monitored the most frequently due to the ease of access, with site visits between November 2018 and mid-May 2019. The two sites located near Rock Creek (K04 and K05) were visited on October 12 and November 6, 2018 and March 12, 2019. Monitoring of sites upstream of the Dempster Highway crossing (K01, K02 and K03) was not completed until April 3, 2019 given that ice conditions were not conducive to safely working on the ice and a helicopter was eventually required to access these sites.

At all sites, the closed egg incubation media (Whitlock-Vibert boxes and closed mesh bags) were retrieved to obtain a measure of hatching success. The initial plan was to leave the closed mesh bags in place through to the emergence period; however, the rate of development indicated that this would occur after freshet. The Klondike River is known to experience a very large freshet and for the sites located in the main channel or large side channels of the river, it was determined that it would be unlikely for the bags to remain in place through a period of high spring flows.

Upon retrieval of the Whitlock-Vibert boxes, the contents were photographed, and the contents examined to determine survival. Obtaining an accurate measure of survival is dependant on being able to get an accurate count of the remaining dead eggs. Alevin are able to exit the incubator and therefore without this accurate



count of dead eggs, an estimate of survival cannot be made. This problem is alleviated by the closed mesh bags because alevin are unable to exit the bags and remain within the substrate that comprises the contents of the bags. Following enumeration, any live alevin encountered within the incubation media were redistributed into the substrate by excavating a small hollow in the streambed and allowing the alevin to re-burrow into the gravel. One exception was in the Farm Channel, where a portion of the alevin retrieved were placed into a second closed mesh bag for more regular monitoring of development in combination with site visits with school groups and community members.



### 3 RESULTS AND DISCUSSION

#### 3.1 WATER TEMPERATURE MONITORING

Water temperature loggers were buried in the substrate at all six of the egg planting sites either through placement in the closed mesh bag or attached to a rebar pounded into the stream bed. Upon retrieval, data was unavailable from two of the monitoring sites due to one logger being lost (KR02) and one logger containing corrupted data (KR05). The water temperature at site FC01 is typical of an area influenced by groundwater. The temperature at FC01 during the summer was less than areas dominated by surface flow and this was the inverse during the fall and winter (Figure 1). The three remaining sites were located in areas dominated by surface flows and generally showed a decreasing trend during the late summer and fall to temperatures very near freezing over the winter months. Site KR03 shows characteristics of potential groundwater upwelling, as characterized by slightly cooler temperatures during the summer months and slightly warmer temperatures during the fall (Figure 1).

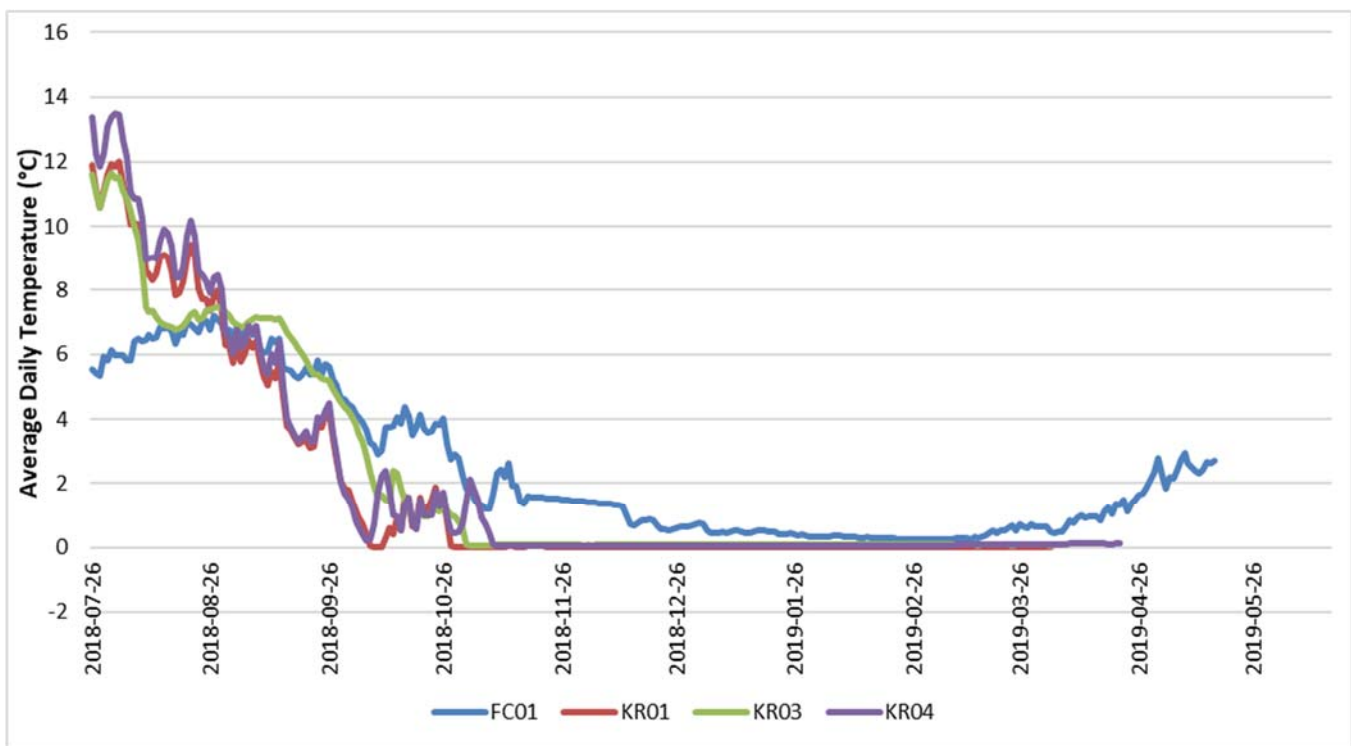


Figure 1. Daily average surface water temperature from egg planting sites in the Klondike River from July 26, 2018 through to May 16, 2019. Note that values at the FC01 are interpolated from November 18 to December 10 due to a data loss issue.



### 3.2 JUVENILE MONITORING

The juvenile Chinook sampling events captured 245 fish of three species, with the catch dominated by juvenile Chinook salmon during two sampling events. Minnow trapping was the primary sampling method with dipnetting used to increase the sampling size of juvenile Chinook captured (June sampling event only). Based upon minnow trapping data, the CPUE was highest in the TH Farm Channel during June and highest in the Klondike River main channel during July (Table 1).

**Table 1. Summary of juvenile Chinook minnow trap sampling and catch-per-unit-effort (CPUE) in the TH Farm Channel and the Klondike River mainstem during June and July 2018.**

Sampling Area	Sampling Event	Number of Sites Sampled	Number of Traps Set	Total Juvenile Chinook Captured	Mean CPUE of Juvenile Chinook per Site (number/24 hours)
TH Farm Channel	June	4	12	50	20.67
	July	2	6	26	9.78
Klondike River Main Channel	June	4	12	22	8.22
	July	1	3	116	43.16
North Klondike River	June	2	6	1	0.41

The average fork length was approximately 52 mm during the June sampling event with a range of 36 mm to 57 mm (Photo A3 in APPENDIX A). As expected, the average fork length increased to approximately 61 mm during the July sampling event with a range of 51 mm to 74 mm (Figure 2). Data collected on the weight of juvenile Chinook captured showed a similar trend over time. During June, weights averaged 1.0 gram and ranged from 0.4 to 1.7 grams. This increased to an average of 2.7 grams during July with a range of 1.3 to 4.7 grams.

In addition to the juvenile Chinook sampling conducted for the current project, there was additional sampling carried out by other programs in the Klondike River watershed during 2018. This information can be drawn upon to provide additional context for the sampling data presented here. The north mainstem stewardship program carried out by the Dawson District Renewable Resources Council (Hunt 2018) conducted minnow trapping for juvenile Chinook at accessible locations in the Klondike River during from July 24-26 and August 10, 2018. During July, a total of 178 juvenile were weighed and averaged 2.7 g with a range of 1.2 to 5.0 g. In August 36 fish were weighed, with weights increasing to an average of 3.9 g and a range of 2.1 to 6.4 g. When viewed in combination with the sampling data from the current project, this information indicates that juvenile Chinook in the Klondike River watershed do not reach the 2.0 g benchmark until some point during early July (Figure 3).



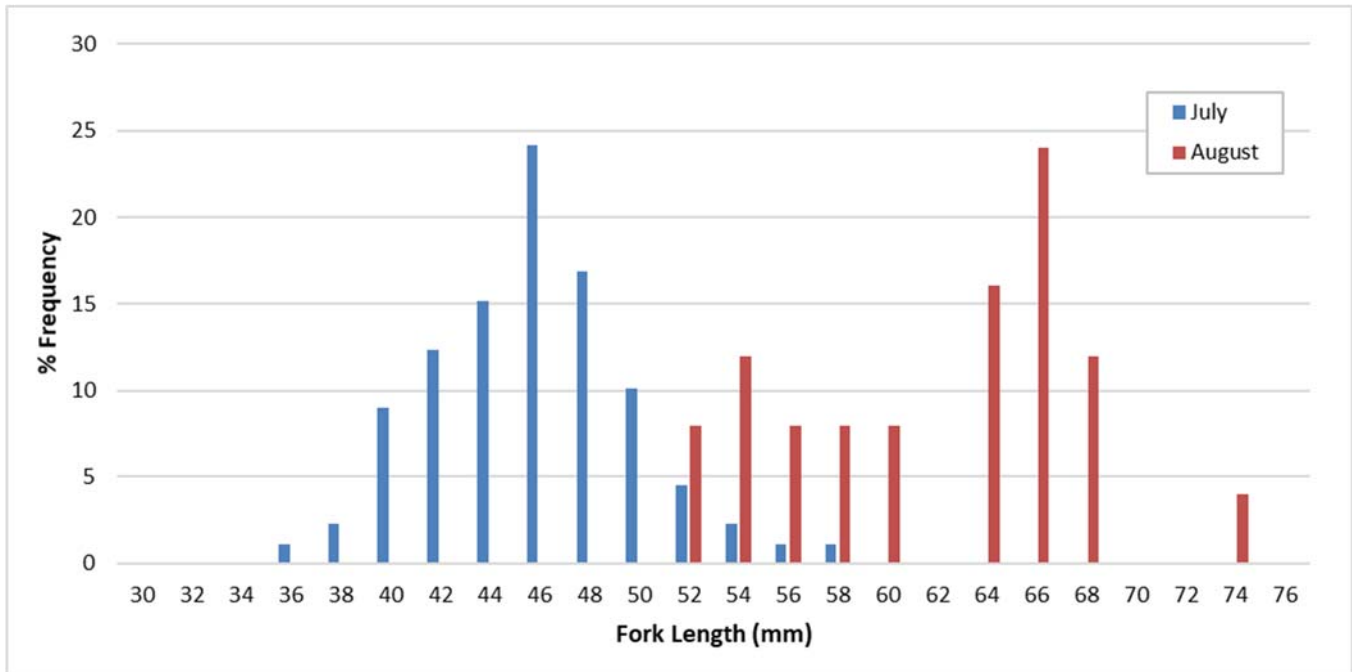


Figure 2. Klondike River juvenile Chinook fork length frequencies from June and July 2018 (n=203).

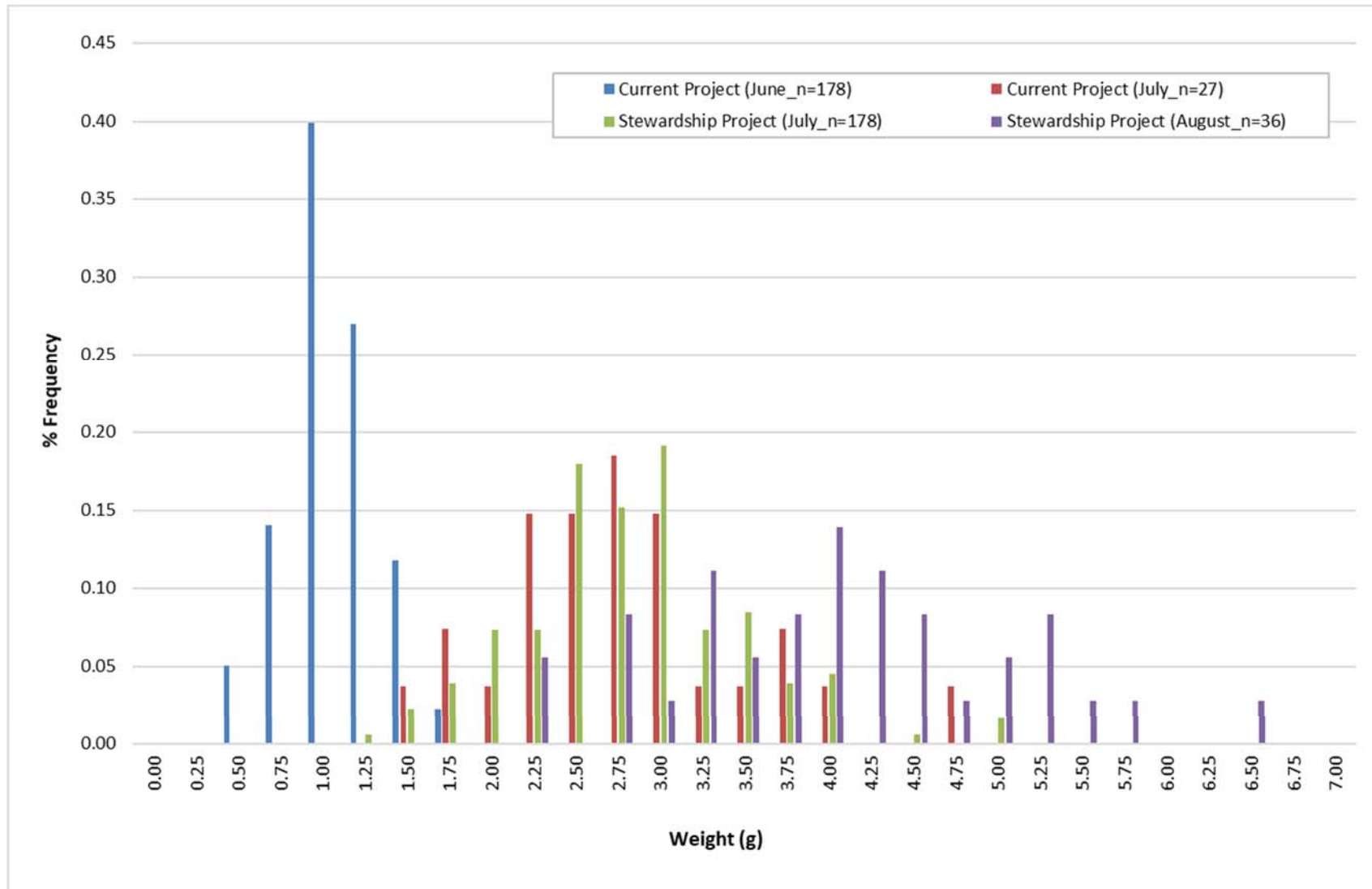
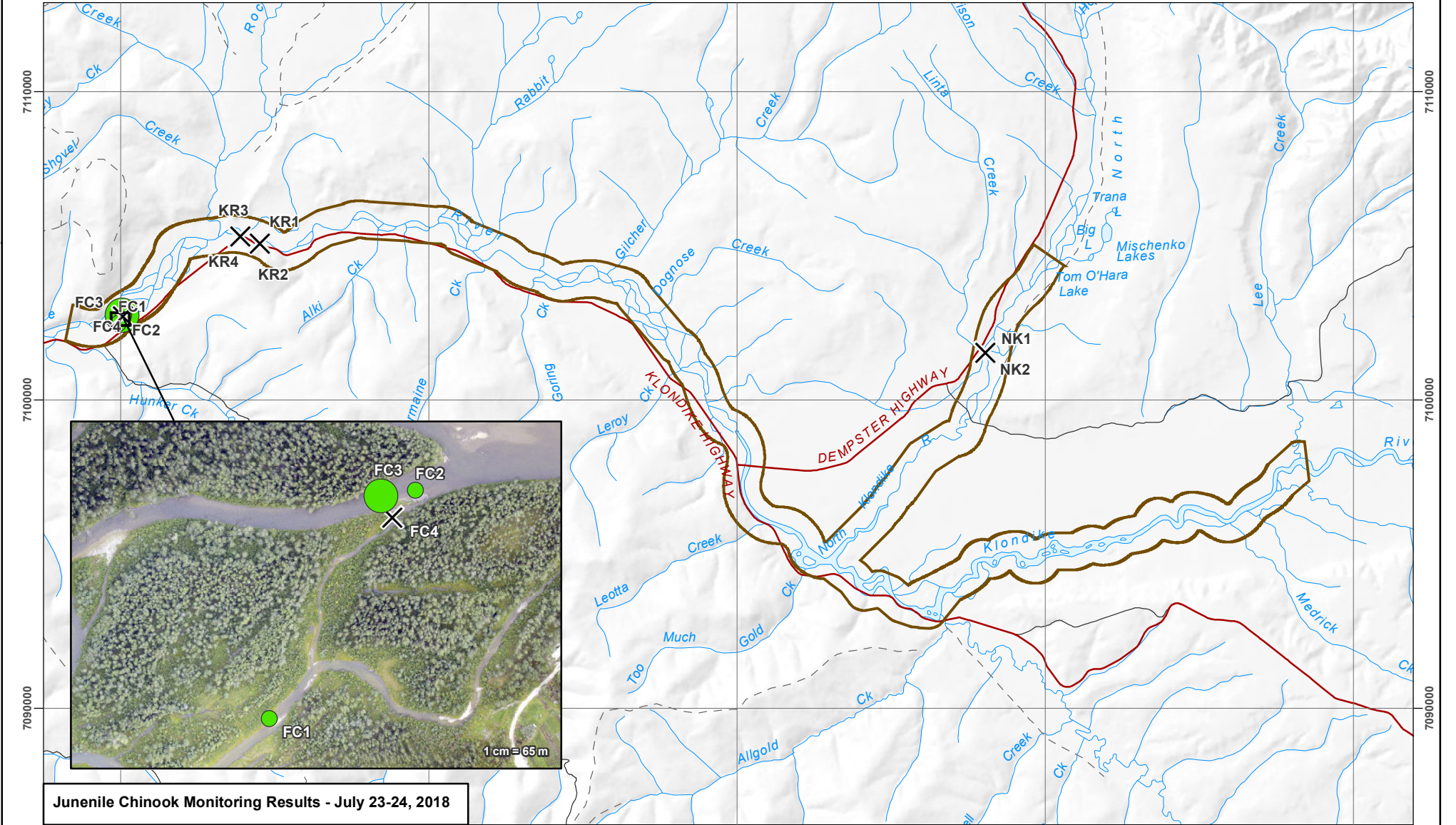
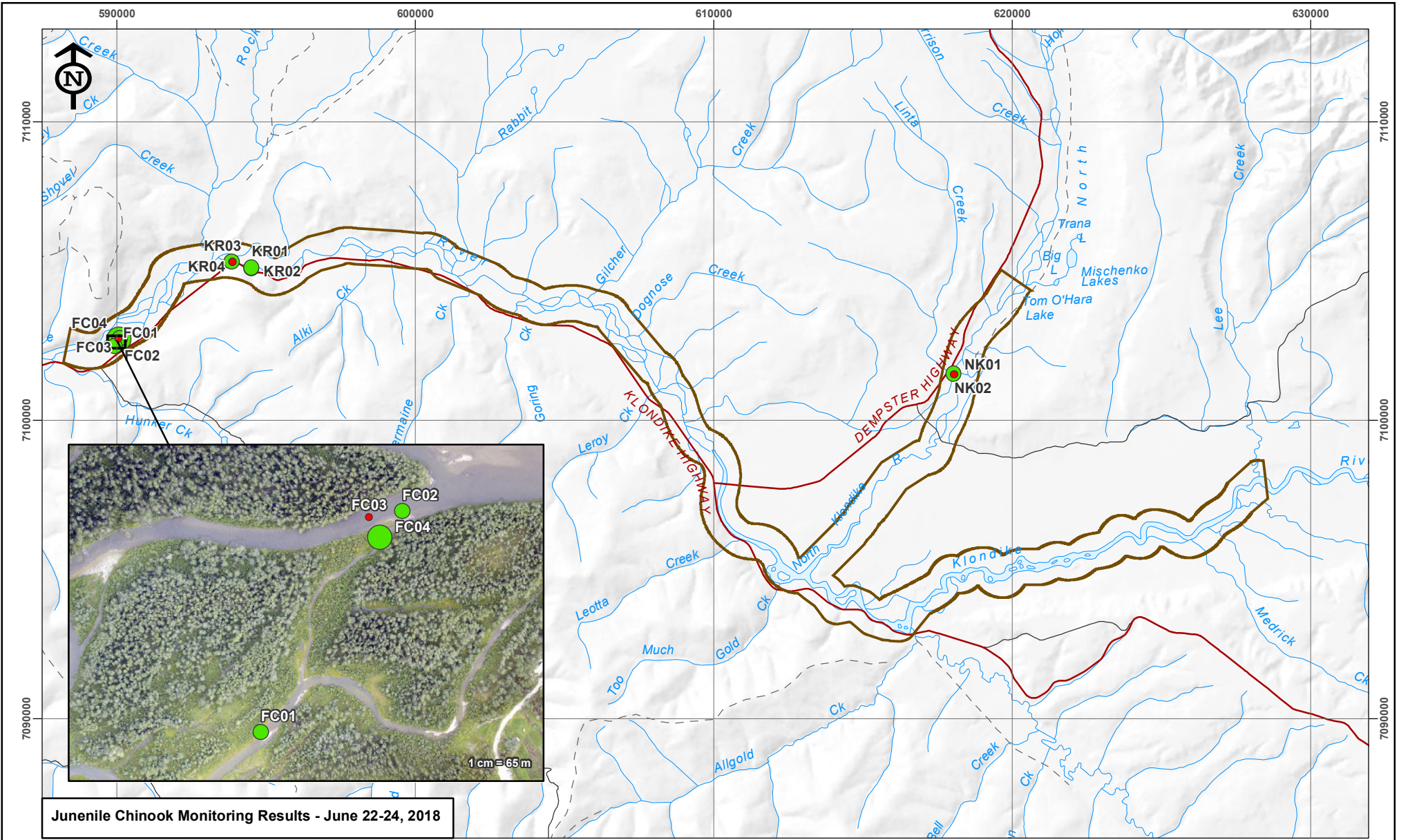


Figure 3. Klondike River juvenile Chinook weights collected by the current project and the DDRRC's stewardship project during June, July and August 2018.





**Legend**

- Highway
- Secondary Road
- Trail
- Aerial Survey Extent

**Juvenile Chinook Monitoring Results**

- 0
- 1 - 5
- 5 - 20
- >20
- Not sampled

**Map 4. Juvenile Chinook monitoring results in the Klondike River**

Data Sources  
1:250,000 and 1:1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 and 1:1,000,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) [www.geomatics.yukon.ca](http://www.geomatics.yukon.ca).

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Aerial imagery provided by Great River Air. (Collected August 8-10, 2018).

Disclaimer  
EDI Environmental Dynamics Inc. has made every effort to ensure this map is free of errors. Data has been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.

0 2 4 6 8 10  
Kilometres

Map Scale 1:175,000 (printed on 11 x 17)  
Map Projection: NAD 1983 CSRS UTM Zone 7N

Drawn: HG	Checked: PS/BSc	Date: 2019-05-31
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**MAP AREA**

Dawson City

Klondike River

Dempster Highway

North Klondike River

Klondike Highway

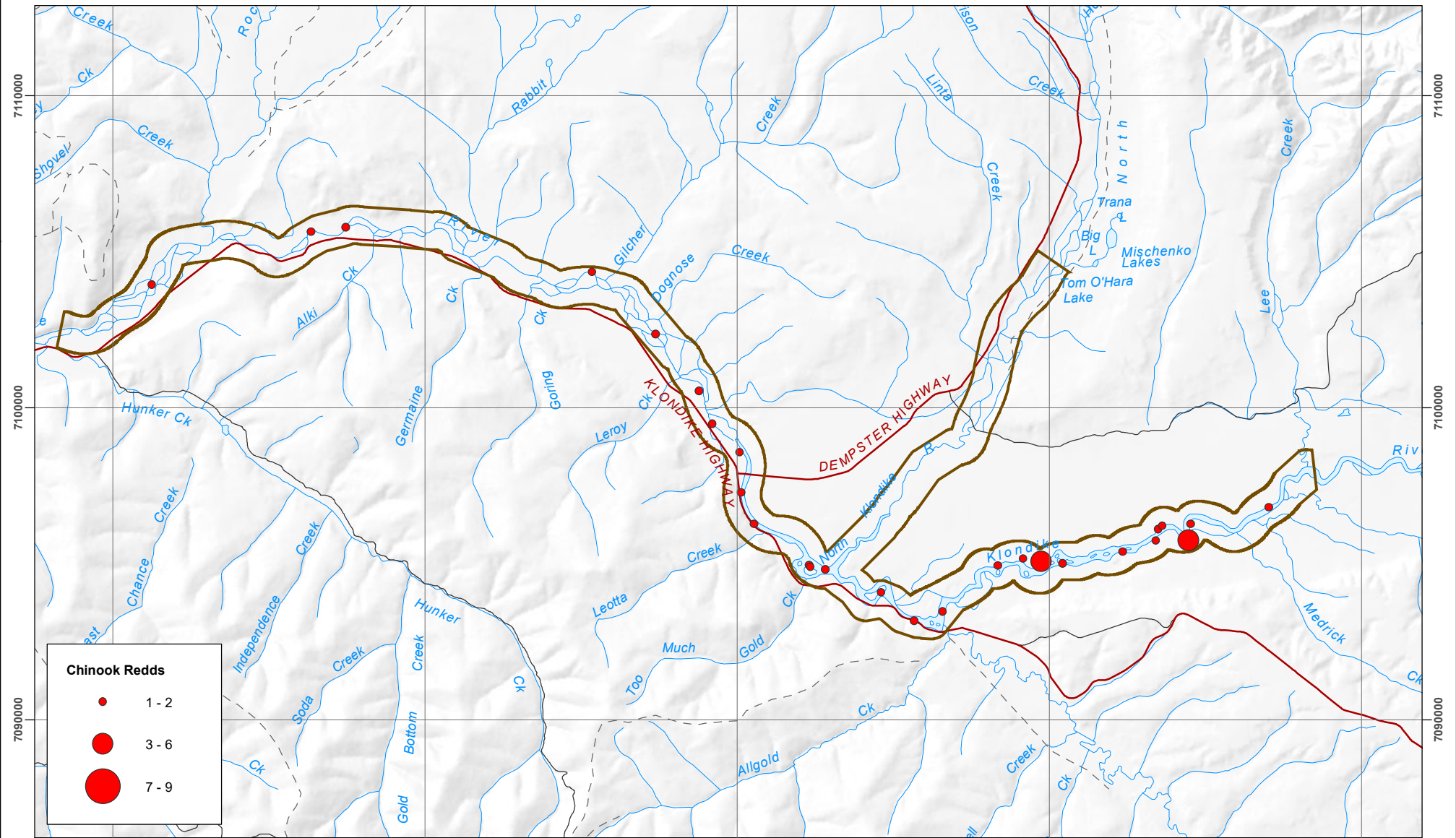
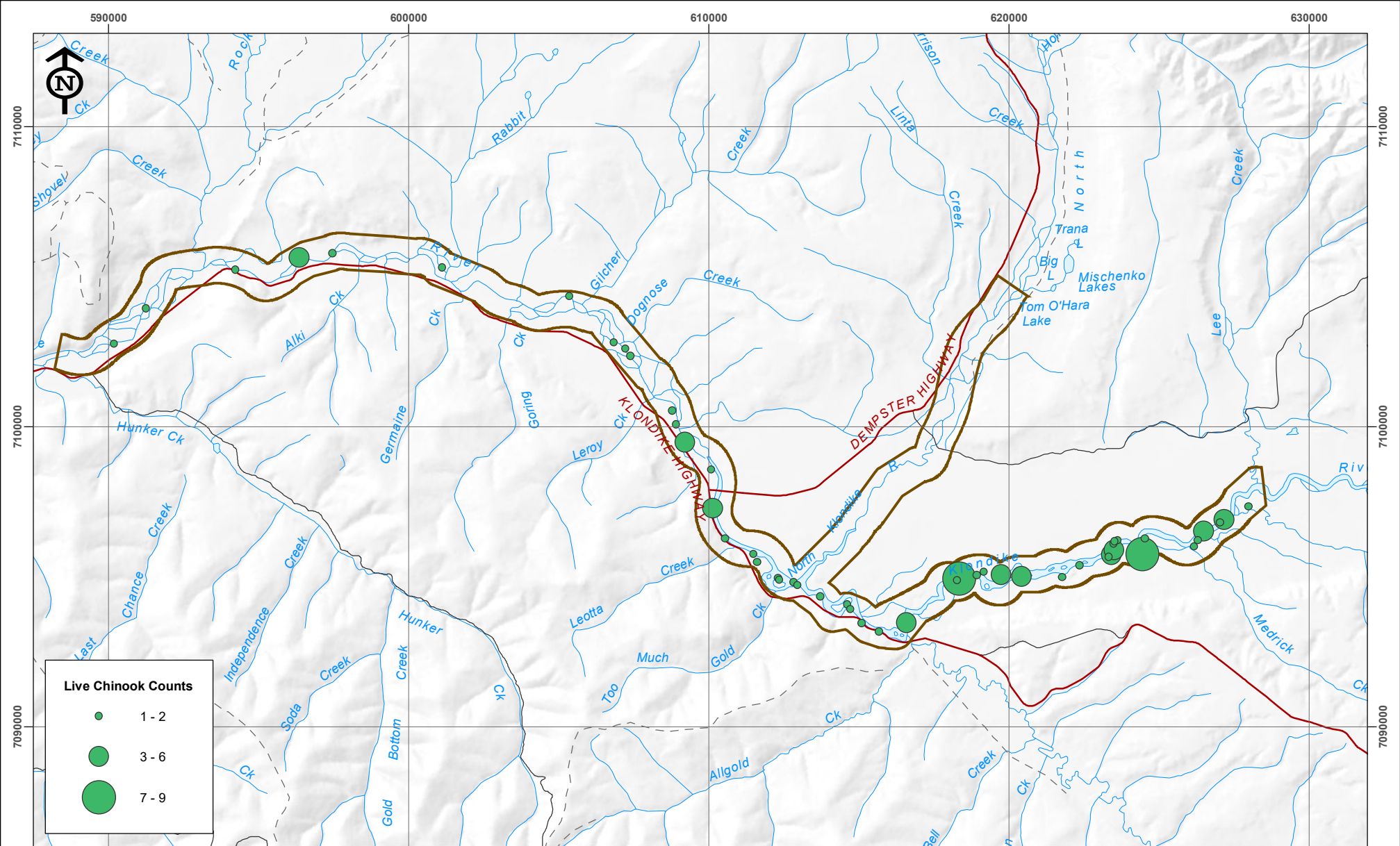




### 3.3 AERIAL SURVEY

The aerial survey conducted on July 22, 2018 observed 37 Chinook redds and 100 Chinook spawners. Survey conditions were very good with clear skies, high visibility and relatively low flows (Photo A4 in APPENDIX A). Based on the condition of the fish observed, the lack of carcasses and the number of spawning fish and redds observed, it appeared as though the aerial survey was conducted during the early portion of the 2018 Klondike River run.

Live Chinook and redds were observed through the survey on the Klondike River with the highest numbers documented in the upper portion of the survey area between the confluences of All Gold and Lee creeks (Map 5). A second cluster of fish was observed between the North Klondike confluence and the Dognose Creek area. Due to its accessibility, this portion of the review was a focal point for the broodstock collection component of the project (Section 3.4.2). Although no Chinook were observed in the North Klondike River during the July 22 survey, six live Chinook and nine redds were observed in the river during an August 1, 2018 survey (EDI 2018a unpublished data). This same survey observed 98 live Chinook, four carcasses and 51 redds within a survey extent which was consistent with the July 22, 2019 survey conducted for the current project.



**Legend**

- Highway
- Secondary Road
- Trail
- Aerial Survey Extent

**Map 5. Chinook spawning aerial survey results**

Data Sources  
1:250,000 and 1:1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 and 1:1,000,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) [www.geomaticsyukon.ca](http://www.geomaticsyukon.ca).

Project data is site specific. Survey data collected by EDI Environmental Dynamics Inc., 2018. Locations obtained using Garmin GPS technology.

Disclaimer  
EDI Environmental Dynamics Inc. has made every effort to ensure this map is free of errors. Data has been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.

0 2 4 6 8 10  
Kilometres

Map Scale 1:175,000 (printed on 11 x 17)  
Map Projection: NAD 1983 CSRS UTM Zone 7N

Drawn: HG	Checked: PS/BSc	Date: 2019-05-31
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**MAP AREA**

Dawson City

Klondike River

Dempster Highway

North Klondike River

Klondike Highway





### 3.4 INSTREAM EGG INCUBATION

#### 3.4.1 SITE PREPARATION

The preparation of the six egg planting sites required 1.5 days to complete for a crew of four individuals. The river substrate at all of the sites was found to be loosely compacted and was relatively straight-forward to prepare for egg planting.

#### 3.4.2 WOLMAN PEBBLE COUNTS & SPOT VELOCITY MEASUREMENTS

Wolman pebble counts were conducted at all five artificial planting sites in the Klondike River with the exception of the TH Farm Channel. All five sites had fairly similar substrate size (Table 2; Figure 4) with a medium substrate size in the range of 42 to 60 mm. A number of natural Chinook redds were observed; however, the conditions were unsafe to obtain pebble count data, primarily due to water depths.

**Table 2.** Summary of Wolman pebble counts conducted at the Klondike River instream egg incubation sites.

Parameter	Site				
	K01	K02	K03	K04	K05
Minimum (mm)	18	18	4	19	4
Maximum (mm)	147	145	102	118	190
Mean (mm)	64.11	57.47	44.58	51.28	54.25
Median (mm)	60	51	42	46	45.5

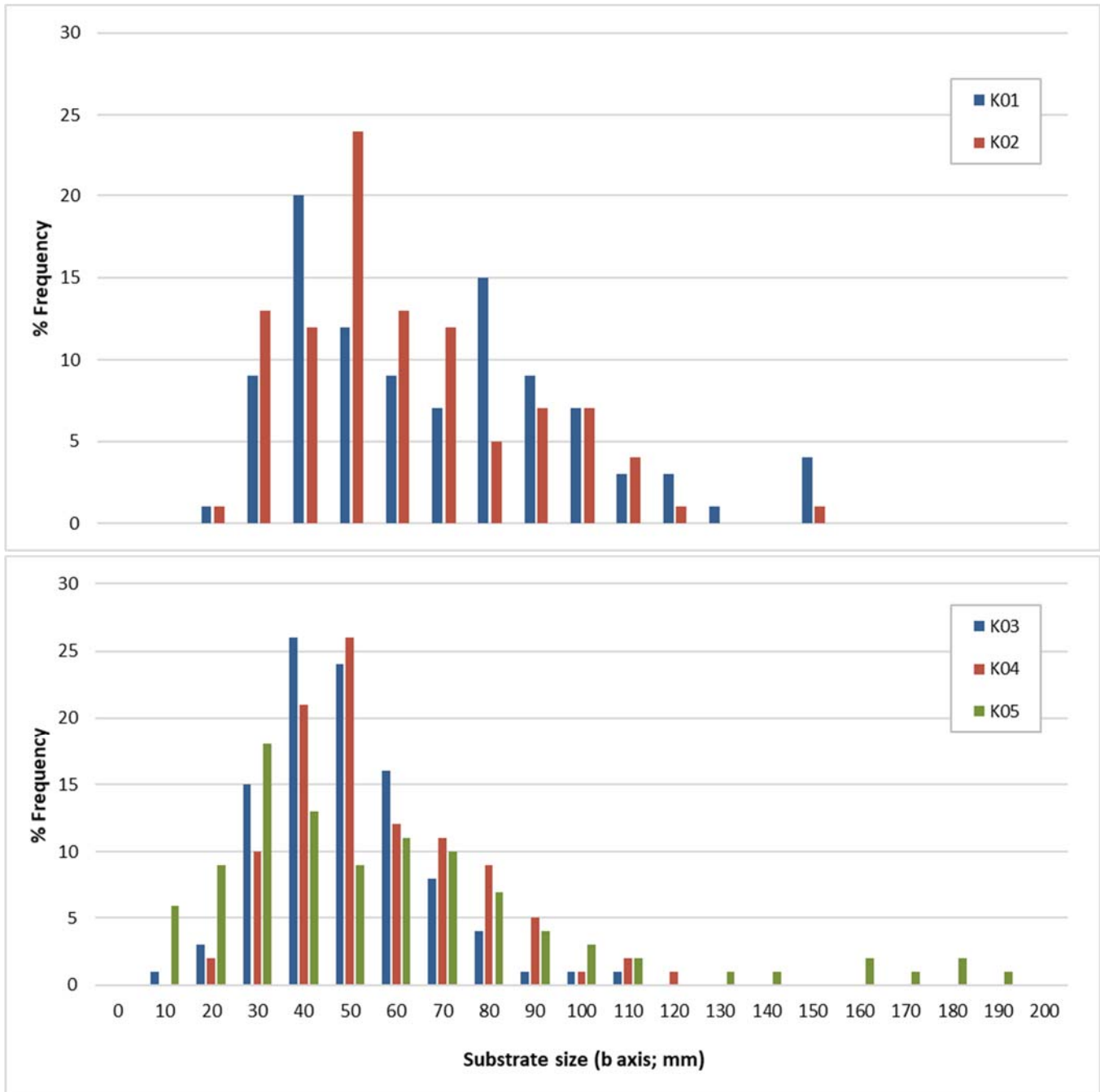


Figure 4. Wolman Pebble Count data collected at egg planting sites in the Klondike River, July 2018.



Similar to the Wolman pebble counts, spot velocities were collected at all egg planting sites in the Klondike River. Three areas of the water column were measured for water velocity: just above the substrate (best indication of intra-gravel flow), 10 cm above the substrate, and at 60% of the total water depth. When considering the measurements just above the substrate, the five planting sites in the main channel of the Klondike River had velocities ranging from 0.28 m/s to 0.41 m/s and an average of 0.36 m/s (Table 3). The velocity at the TH Farm Channel site (FC01) was considerably less than that of the main channel sites at 0.14 m/s.

**Table 3. Spot velocity measurements collected at all artificial redds using a Swoffer velocimeter, July 24-25, 2018.**

Site	Site Depth (m)	Velocity just above bed (m/s)	Velocity 10 cm above bed (m/s)	Velocity at 60% depth (m/s)
K01	0.56	0.41	0.67	1.23
K02	0.80	0.28	0.36	0.58
K03	0.82	0.33	0.48	0.59
K04	0.55	0.32	0.48	0.65
K05	0.57	0.45	0.75	1.07
FC01	0.20	0.14	-	0.31

### 3.4.3 BROODSTOCK COLLECTION

A total of seven spawning Chinook salmon were captured by targeted angling/snagging while attempting to obtain broodstock; the majority of these fish were ripe and suitable for the collection of eggs or milt and included four males and three females. Milt was collected from four males, with at least three males being used to fertilize each batch of eggs. A total of two females were live spawned for broodstock; one of the females was mostly spent and yielded approximately 300 eggs with the remaining eggs (7,836) collected from the second female. The third female captured was not yet ripe and was released to spawn naturally.

Age, sex, and length data along with genetic samples were collected from all seven of the captured Chinook and were provided to DFO for analysis (Photo A5 in APPENDIX A). Scale samples were analyzed by the Pacific Biological Station (PBS) with results indicating that the majority of Chinook aged were from the 2013 brood year (5 years old; four out of six) with the remainder from the 2012 brood year (6 years old, two out of six). The seventh individual could not be reliably aged. The Chinook salmon sampled during broodstock collection had fork lengths ranging from 800 to 995 mm with an average of 880 mm. Of the fish sampled, females were larger (average = 941 mm) compared to males (average = 835 mm).

### 3.4.4 EGG FERTILIZATION AND DEPLOYMENT

Eggs were planted in the Klondike River on July 26, 2018 using three methods: Whitlock-Vibert boxes to determine hatching success, closed mesh bags (insertion pipe in a bag) to determine emergence success and egg insertion pipes to increase the number of eggs planted (Table 4: Photos A6 to A15 in APPENDIX A). A



total of 8,136 eggs were planted at the six sites in total with the majority of eggs planted in Whitlock-Vibert boxes.

**Table 4. Summary of 2018 egg planting the Klondike River.**

Area	Site	WVB				Closed Bag	Egg Insertion Pipe		TOTAL
		1	2	3	4	1	1	2	
Main Channel	KR01	200	200	200	200	200	525	392	1,917
	KR02	200	200	200	200		805		1,605
	KR03	200	200	200	200	200	359		1,359
	KR04	200	200	200	200	200	470		1,470
	KR05	200	200	200	200		749		1,549
Farm Channel	FC01	200	200	90		138			628
TOTAL		4,490				738	2,908	392	8,136

### 3.4.5 SUCCESS MONITORING

The success monitoring component of the project was completed in stages due to varying site characteristics (ice conditions) and the need to determine the appropriate timing of monitoring events. The primary goal of the monitoring was to determine the egg hatching rate amongst sites, determine the rate of development and in the case of the Farm Channel site (FC01), determine survival through to the fry emergence stage.

Hatching success was highly variable between and within sites and ranged from a low of 16.5% to a high of 95%. Across all sites, the highest mean survival was 88.3% at site KR05 followed by sites KR04 (61.3%) and FC01 (59.8%; Table 5). All of the egg incubation media were washed out of site KR01, likely a result of a period of high flow during mid-August 2018. This site had the highest velocity among all sites planted (1.23 m/s at 60% depth), and it appears as though the substrate of the site was washed away by this relatively high velocity flow. Accurate survival data was not available for many of the Whitlock-Vibert boxes at sites KR02 and KR03 because an accurate count of dead eggs could not be made due to eggs being squished into a single, indistinguishable mass. Live alevin are able to exit the boxes and therefore without an accurate count of the remaining dead eggs, a measure of hatching success cannot be calculated. Observations of these boxes indicated a relatively high number of eggs and it is likely that survival was in the range of 30-50% for these boxes.

With the exception of the egg planting site in the Farm Channel (FC01), all of the egg incubation media contained a large amount of sediment. This was especially apparent in the Whitlock-Vibert boxes, likely because these boxes provide a void in the substrate where sediment may collect. Due to this shortcoming of the Whitlock-Vibert boxes, the closed mesh bags filled with substrate are assumed to provide a more accurate representation of egg survival. The two mesh bags deployed at sites in the main channel of the Klondike (KR03 and KR05) provided variable estimates of survival with 19% and 88%, respectively.

The single closed mesh bag left in place for monitoring emergence success in the Farm Channel was retrieved on May 16, 2019 and found to have 91.3% survival with free swimming fry. Upon retrieval, the bag was found



to be free of sediment although portions of the substrate in the vicinity of the planting site contained a large amount of algae. The relatively high survival at this site demonstrate the value of groundwater discharge areas as suitable areas for egg incubation due to warmer winter temperatures and minimal fine sediment accumulation due to a lack of surface flow from the main channel of the Klondike River. Winter conditions also appear to be much more favourable in the groundwater fed Farm Channel than the main channel Klondike River (A24 and A25 in APPENDIX A).

**Table 5. Summary of hatching success as determined by Whitlock-Vibert boxes and closed mesh bags in the Klondike River.**

Site	Incubator Type <sup>A</sup>	Total Eggs Planted	Inferred Survival <sup>B</sup> (%)	Notes
FC01	WVB	200	37.5	
	WVB	200	86.0	
	WVB	90	56.0	
KR01	WVB	200	-	Site blown out, survival data not available.
	WVB	200	-	
	WVB	200	-	
	WVB	200	-	
	Bag	200	-	
KR02	WVB	200	-	Could not discern dead eggs, some alevins present but could not determine overall survival.
	WVB	200	-	
	WVB	200	-	
	WVB	200	-	
KR03	WVB	200	33.0	Could not discern dead eggs.
	WVB	200	16.5	
	WVB	200	-	
	WVB	200	-	
	Bag	200	19.0	
KR04	WVB	200	80.5	
	WVB	200	72.0	
	WVB	200	14.0	
	WVB	200	52.0	
	Bag	200	88.0	
KR05	WVB	200	77.5	
	WVB	200	94.0	
	WVB	200	95.0	
	WVB	200	86.5	

<sup>A</sup> WVB – Whitlock-Vibert box; Bag – closed mesh bag.

<sup>B</sup> Inferred survival assumes that a large proportion of the alevins had already exited the incubators.

Due to the use of consistent methods with Teslin Tlingit Council's Deadman Creek Chinook Restoration Project (EDI 2017, 2018b, 2019), it is possible to draw comparisons with the hatching success data on the Klondike River with applicable data collected on Deadman Creek and Morley River in the Teslin area. The hatching success from the Klondike River during 2018/2019 was slightly greater than that of Deadman Creek but less than that of Morley River (Table 6). It is important to note that conditions in Morley River are known to be very good for incubation due to its location directly downstream of Morley Lake. This lake effect results in relatively little sediment transport as well as relatively warm water throughout the year which limits ice



coverage. Such conditions do not occur on the Klondike River and in a general sense may explain why the hatching success is lower.

**Table 6.** Summary of egg hatching success data collected through the use of instream incubation in Deadman Creek and Morley River compared to data from the current project on the Klondike River.

Stream	Year	Range of Hatching Success	Mean Hatching Success
Deadman Creek	2016/2017	31 – 90%	55 %
	2017/2018	11 – 86 %	56 %
	2018/2019	13 – 96 %	40 %
Morley River	2016/2017	71 – 96 %	87 %
	2017/2018	74 – 98 %	85 %
	2018/2019	55 – 97 %	75 %
Klondike River	2018/2019	14 – 95 %	61 %

#### 3.4.5.1 Development Rates

The success monitoring component of the project provides an opportunity to assess the rate of egg and alevin development in comparison to the water temperature regime at each of the egg planting sites (see A16 to A23 in APPENDIX A for the various development stages across planting sites). Based upon data from the Whitehorse Rapids Fish Hatchery, Yukon River Chinook typically hatch into alevin at 480 to 540 accumulated thermal units (ATUs) and emerge as fry at 900-1,000 ATUs (Alexco 2017). Results from the Deadman Creek Chinook Restoration Project in the Teslin River watershed (EDI 2017, 2018, 2019) have indicated that at near freezing water temperatures (below 1.6 °C) there is a base rate development and therefore hatching, and particularly fry emergence, can occur at far less ATUs than in a hatchery setting. As a result, data from the site visits on the Klondike River can be compared to the development rates observed in Deadman Creek and help to inform TH's future plans for an incubation facility on the Klondike River. Due to the site accessibility and frequent visits to the Farm Channel egg planting site (FC01), these results are particularly valuable. During the November 16, 2018 site visit, the water temperature measured at the site was 1.4 °C and the majority of eggs appeared to be recently hatched at 554 ATUs. During the April 4, 2019 site visit, the water temperature was 0.2 °C and the alevin appeared to be more advanced than indicated by the ATUs (636 ATUs). During the May 16, 2019 site visit, the closed mesh bag contained emergent fry which appeared to be more developed than indicated by the ATUs (713 ATUs).

Site visits to the Klondike River main channel sites were not as frequent as the Farm Channel due to more challenging ice conditions and site accessibility. However, hatching at site KR05 appeared to happen around approximately October 10, 2018 as indicated by the presence of recently hatched alevin on October 13 at 561 ATUs. During the March 12, 2019 visit to this site, the water temperature was less than 0.1 °C and the alevin appeared to be more advanced than indicated by the ATUs (561 ATUs).





## 4 CONCLUSION

The current project provided information on the merits of instream egg incubation as a restoration tool for Klondike River Chinook and provided new information on the timing of development for incubating eggs and alevin. Although the egg survival results obtained during this first year of the project were variable within and between sites, a number of sites had hatching success values above 80%, and in the case of the Farm Channel, a survival rate of 91% to the fry emergence stage. A number of valuable lessons were learned during Year 1 of the project and will be used to better plan and execute Year 2 during 2019/2020. An important component of Year 2 will be to select egg planting sites which are conducive to the monitoring of egg development and survival through to the fry emergence stage. Conducting such assessments in different habitats with varying water temperature regimes will help to further refine the knowledge of development timing gained during the 2018/2019 project and will help to further TH's medium-term goal of a larger scale restoration project on the Klondike River in the future.



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## APPENDIX A. PHOTOGRAPHS

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Photo A1. Overview of habitat in the TH Farm Channel, June 23, 2018.



Photo A2. Dipnetting of juvenile Chinook in a side channel of the Klondike River, June 24, 2018.





Photo A3. Small juvenile Chinook captured in Klondike River, June 23, 2018.



Photo A4. Survey conditions during the July 22, 2018 aerial survey.



Photo A5. ASL collection from Klondike River brood stock.



Photo A6. Holding Chinook broodstock in fish holding bags prior to collection of eggs/milt.





Photo A7. Collecting milt from Klondike River Chinook.



Photo A8. Egg take from Klondike River Chinook.





Photo A9. Site preparations by snorkeling at site K03 on the Klondike River.



Photo A10. Enumerating eggs prior to planting.





Photo A11. Egg planting by snorkeling at site K03 in the Klondike River.



Photo A12. Overview of site K01 in a side channel of the Klondike River.





Photo A13. Overview of sites K02 and K03 in a side channel of the Klondike River.



Photo A14. Overview of sites KR04 and KR05 on a side channel of the Klondike River.





Photo A15. Overview of site FC01 in the Farm Channel, a groundwater fed side channel adjacent to the TH teaching and Learning Farm.



Photo A16. Advanced eyed eggs at site FC01 on October 13, 2018 at 462 ATUs.





Photo A17. Advanced eyed eggs and recently hatched alevin at site FC01 on November 16, 2018 at 554 ATUs.



Photo A18. Alevin at site FC01 on December 11, 2018 at 590 ATUs.



Photo A19. Advanced alevin at site FC01 on March 8, 2019 at 630 ATUs.

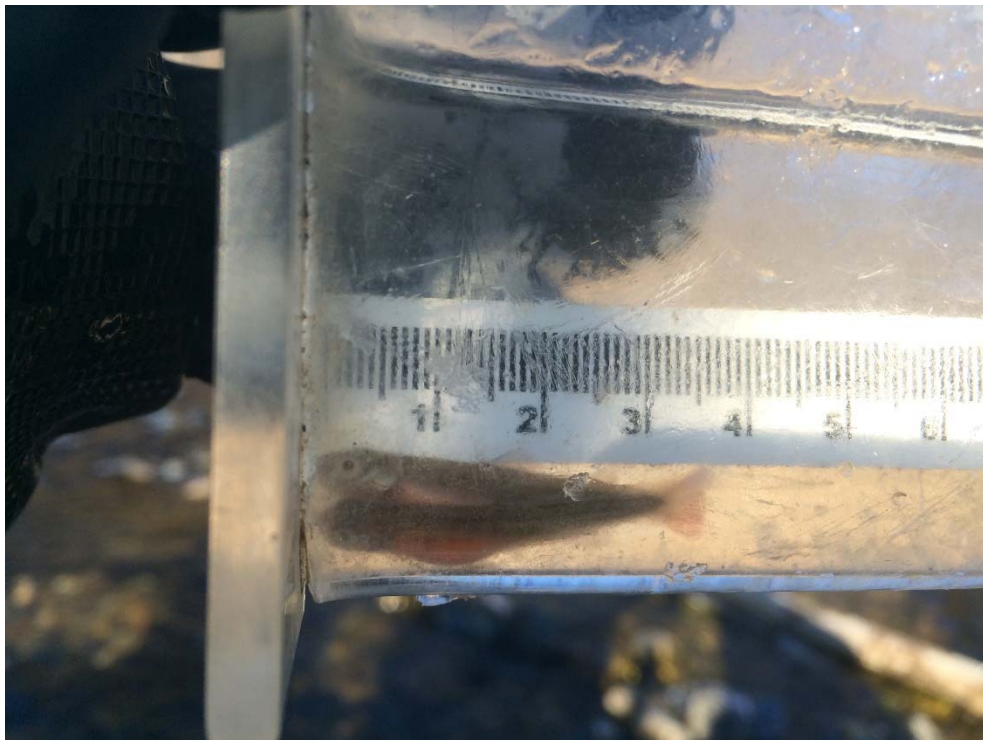


Photo A20. Advanced alevin at site FC01 on April 4, 2019 at 643 ATUs.





Photo A21. Emergent fry at site FC01 on May 16, 2019 at 713 ATUs.

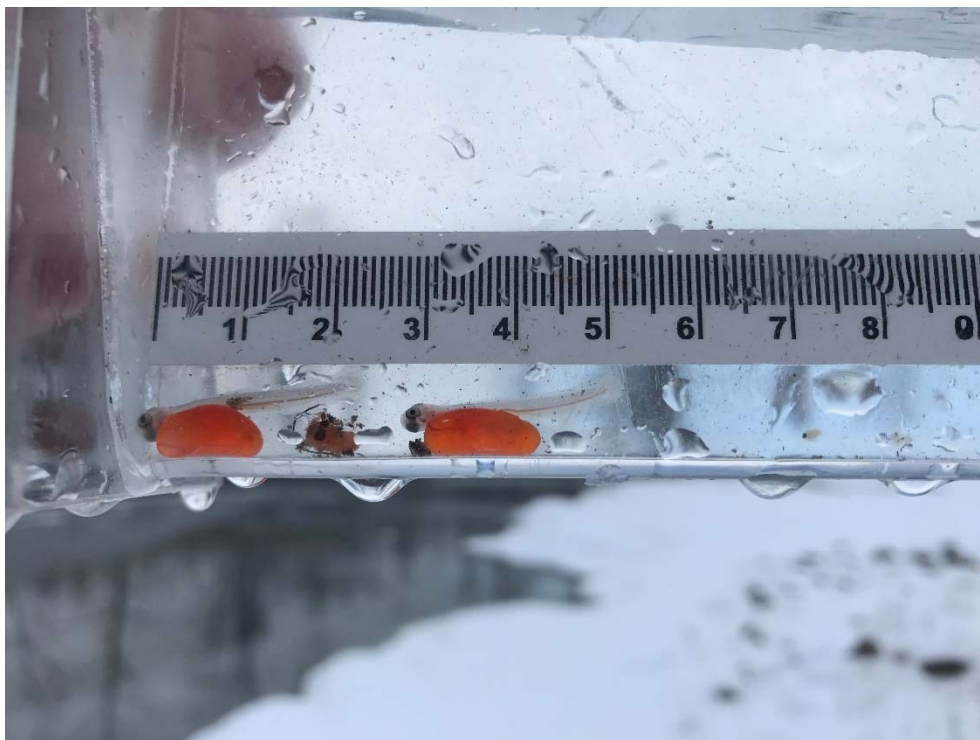


Photo A22. Recently hatched alevin at site KR05 on October 13, 2018 at 527 ATUs.



Photo A23. Alevin at site KR05 on March 12, 2019 at 561 ATUs.



Photo A24. Overview of site conditions at sites KR02 and KR03 on March 8, 2019.





Photo A25. Overview of site conditions at site FC01 on March 8, 2019.

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## APPENDIX B. FISH SAMPLING DATA

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Table B1. Summary of fish sampling effort.

Site ID	Set Date &Time	Pull Date &Time	Temp (°C)	pH	DO (mg/L)	SPC (µs/cm)	Turbidity (NTU)	Effort (hours)
FC1.1	22/06/2018 13:46	23/06/2018 09:00	4.7	6.5	8.42	316.6	C/M	19.23
FC1.2	22/06/2018 13:46	23/06/2018 09:00	4.7	6.5	8.42	316.6	C/M	19.23
FC1.3	22/06/2018 13:46	23/06/2018 09:00	4.7	6.5	8.42	316.6	C/M	19.23
FC2.1	22/06/2018 14:00	23/06/2018 10:08	9.4	7.73	12.6	257.2	C	20.13
FC2.2	22/06/2018 14:00	23/06/2018 10:10	9.4	7.73	12.6	257.2	C	20.17
FC2.2	22/06/2018 14:00	23/06/2018 10:10	9.4	7.73	12.6	257.2	C	20.17
FC2.3	22/06/2018 14:00	23/06/2018 10:10	9.4	7.73	12.6	257.2	C	20.17
FC3.1	22/06/2018 14:15	23/06/2018 10:21	9.5	7.76	12.42	242.9	C	20.10
FC3.2	22/06/2018 14:15	23/06/2018 10:25	9.5	7.76	12.42	242.9	C	20.08
FC3.3	22/06/2018 14:15	23/06/2018 10:30	9.5	7.76	12.42	242.9	C	20.25
FC4.1	22/06/2018 14:20	23/06/2018 09:39	9.6	7.63	10.31	246.3	M	19.32
FC4.2	22/06/2018 14:20	23/06/2018 09:35	9.6	7.63	10.31	246.3	M	19.25
FC4.3	22/06/2018 14:20	23/06/2018 09:24	9.6	7.63	10.31	246.3	M	19.07
KR1.1	22/06/2018 15:25	23/06/2018 14:00	8.8	7.74	12.83	248.9	C	22.58
KR1.2	22/06/2018 15:25	23/06/2018 14:00	8.8	7.74	12.83	248.9	C	22.58
KR1.2	22/06/2018 15:25	23/06/2018 14:00	8.8	7.74	12.83	248.9	C	22.58
KR1.3	22/06/2018 15:25	23/06/2018 14:00	8.8	7.74	12.83	248.9	C	22.58
KR1.3	22/06/2018 15:25	23/06/2018 14:00	8.8	7.74	12.83	248.9	C	22.58
KR2.1	22/06/2018 15:35	23/06/2018 13:00	9.1	7.78	10.34	252.8	M	21.42
KR2.1	22/06/2018 15:35	23/06/2018 13:00	9.1	7.78	10.34	252.8	M	21.42
KR2.1	Dip netted after trap pull		9.1	7.78	10.34	252.8	M	
KR2.1	Dip netted after trap pull		9.1	7.78	10.34	252.8	M	
KR2.2	22/06/2018 15:35	23/06/2018 12:55	9.1	7.78	10.34	252.8	M	21.33
KR2.3	22/06/2018 15:35	23/06/2018 12:50	9.1	7.78	10.34	252.8	M	21.25
KR3.1	22/06/2018 16:11	23/06/2018 11:30	8.8	7.78	12.79	251.3	M	19.32
KR3.2	22/06/2018 16:11	23/06/2018 11:30	8.8	7.78	12.79	251.3	M	19.32



Site ID	Set Date & Time	Pull Date & Time	Temp (°C)	pH	DO (mg/L)	SPC (µs/cm)	Turbidity (NTU)	Effort (hours)
KR3.3	22/06/2018 16:11	23/06/2018 11:30	8.8	7.78	12.79	251.3	M	19.32
KR3.3	22/06/2018 16:11	23/06/2018 11:30	8.8	7.78	12.79	251.3	M	19.32
KR4.1	22/06/2018 11:50	23/06/2018 11:50	8.8	7.78	12.45	251.7	M	24.00
KR4.1	Dip netted after trap pull		8.8	7.78	12.45	251.7	M	
KR4.2	22/06/2018 11:42	23/06/2018 11:42	8.8	7.78	12.45	251.7	M	24.00
KR4.3	22/06/2018 11:45	23/06/2018 11:45	8.8	7.78	12.45	251.7	M	24.00
NK1.1	23/06/2018 16:45	25/06/2018 12:05	7.4	7.67	12.71	267.3	C	43.33
NK1.2	23/06/2018 16:45	25/06/2018 12:05	7.4	7.67	12.71	267.3	C	43.33
NK1.3	23/06/2018 16:45	25/06/2018 12:05	7.4	7.67	12.71	267.3	C	43.33
NK2.1	23/06/2018 17:00	25/06/2018 12:12	7.4	7.67	12.71	267.3	C	43.20
NK2.2	23/06/2018 17:00	25/06/2018 12:12	7.4	7.67	12.71	267.3	C	43.20
NK2.3	23/06/2018 17:00	25/06/2018 12:12	7.4	7.67	12.71	267.3	C	43.20
FC1.1.A	23/07/2018 12:47	24/07/2018 10:08						21.35
FC1.1.B	23/07/2018 12:49	24/07/2018 09:57						21.13
FC1.1.B	23/07/2018 12:49	24/07/2018 09:57						21.13
FC1.1.C	23/07/2018 12:54	24/07/2018 09:49						20.92
FC2.1.A	23/07/2018 13:15	24/07/2018 10:32						21.28
FC2.1.A	23/07/2018 13:15	24/07/2018 10:32						21.28
FC2.1.B	23/07/2018 13:15	24/07/2018 10:32						21.28
FC2.1.C	23/07/2018 13:15	24/07/2018 10:32						21.28
FC3.1.A	23/07/2018 13:20	24/07/2018 10:52						21.53
FC3.1.A	23/07/2018 13:20	24/07/2018 10:52						21.53
FC3.1.B	23/07/2018 13:20	24/07/2018 10:52						21.53
FC3.1.B	23/07/2018 13:20	24/07/2018 10:52						21.53
FC3.1.C	23/07/2018 13:20	24/07/2018 10:52						21.53



Table B2. Summary of fish capture data.

Site ID	Species	Fork Length (mm)	Weight (g)	Release condition
FC1.3	CH	50	1.2	Released Good
FC4.3	CH	44	0.9	Released Good
FC4.3	CH	46	1.1	Released Good
FC4.3	CH	46	1	Released Good
FC4.3	CH	47	1.1	Released Good
FC4.3	CH	46	1.1	Released Good
FC4.3	CH	50	1.3	Released Good
FC4.3	CH	48	1.1	Released Good
FC4.3	CH	46	1.1	Released Good
FC4.3	CH	47	1.2	Released Good
FC4.3	CH	46	1.1	Released Good
FC4.3	CH	45	1.1	Released Good
FC4.3	CH	45	1	Released Good
FC4.3	CH	46	1.1	Released Good
FC4.2	CH	46	1.1	Released Good
FC4.2	CH	49	1.2	Released Good
FC4.2	CH	45	0.9	Released Good
FC4.2	CH	47	1.2	Released Good
FC4.2	CH	45	0.9	Released Good
FC4.2	CH	46	1.1	Released Good
FC4.2	CH	46	1	Released Good
FC4.2	CH	48	1.1	Released Good
FC4.2	CH	47	1.1	Released Good
FC4.2	CH	45	1	Released Good
FC4.2	CH	47	1.2	Released Good
FC4.2	CH	43	0.8	Released Good



Site ID	Species	Fork Length (mm)	Weight (g)	Release condition
FC4.2	CH	48	1.1	Released Good
FC4.2	CH	46	0.9	Released Good
FC4.2	CH	46	1.1	Released Good
FC4.2	CH	47	1.2	Released Good
FC4.2	CH	48	1.1	Released Good
FC4.2	CH	47	1	Released Good
FC4.2	CH	44	0.9	Released Good
FC4.2	CH	46	1	Released Good
FC4.2	CH	45	0.9	Released Good
FC4.2	CH	46	0.9	Released Good
FC4.2	CH	45	1	Released Good
FC4.2	CH	45	1	Released Good
FC4.2	CH	46	0.9	Released Good
FC4.2	CH	47	1	Released Good
FC4.2	CH	47	1.1	Released Good
FC4.2	CH	44	1	Released Good
FC4.2	CH	49	1.1	Released Good
FC4.2	CH	50	1.3	Released Good
FC4.2	CH	43	0.8	Released Good
FC4.2	CH	47	1	Released Good
FC4.2	CH	45	1	Released Good
FC2.1	CCG	80	n/a	Released Good
FC2.2	CH	44	0.9	Released Good
FC2.2	CH	44	0.9	Released Good
FC2.2	CH	45	0.9	Released Good
FC2.2	CCG	74	n/a	Released Good
FC2.1	CCG	65	n/a	Released Good





Site ID	Species	Fork Length (mm)	Weight (g)	Release condition
FC2.3	CCG	72	n/a	Released Good
FC2.3	CCG	71	n/a	Released Good
FC2.3	CCG	70	n/a	Released Good
FC3.1	CCG	49	n/a	Released Good
FC3.1	CCG	58	n/a	Released Good
3.1	CCG	77	n/a	Released Good
FC3.2	CCG	64	n/a	Released Good
KR3.1	CCG	72	n/a	Released Good
KR3.1	CCG	73	n/a	Released Good
KR3.1	CCG	70	n/a	Released Good
KR3.1	CCG	78	n/a	Released Good
KR3.1	CCG	80	n/a	Released Good
KR3.3	CH	47	1	Released Good
KR3.3	CCG	69	n/a	Released Good
KR3.3	CCG	75	n/a	Released Good
KR3.3	CCG	60	n/a	Released Good
KR3.3	CCG	58	n/a	Released Good
KR3.3	CCG	70	n/a	Released Good
KR3.3	CCG	60	n/a	Released Good
KR3.2	CCG	60	n/a	Released Good
KR3.2	CCG	73	n/a	Released Good
KR3.2	CCG	66	n/a	Released Good
KR3.2	CCG	64	n/a	Released Good
KR3.2	CCG	67	n/a	Released Good
KR4.3	CCG	77	n/a	Released Good
KR4.3	CCG	88	n/a	Released Good
KR4.3	CCG	67	n/a	Released Good



Site ID	Species	Fork Length (mm)	Weight (g)	Release condition
KR4.3	CCG	67	n/a	Released Good
KR4.3	CCG	76	n/a	Released Good
KR4.1	CCG	71	n/a	Released Good
KR4.1	CCG	80	n/a	Released Good
KR4.1	CCG	80	n/a	Released Good
KR4.1	CCG	78	n/a	Released Good
KR4.1	CCG	79	n/a	Released Good
KR4.1	CH	39	0.5	Released Good
KR4.1	CH	44	0.7	Released Good
KR4.1	CH	43	0.9	Released Good
KR4.1	CH	41	0.7	Released Good
KR4.1	CH	41	0.8	Released Good
KR4.1	CH	42	0.8	Released Good
KR4.1	CH	44	0.9	Released Good
KR4.1	CH	39	0.7	Released Good
KR4.1	CH	39	0.6	Released Good
KR4.1	CH	39	0.6	Released Good
KR4.1	CH	42	0.8	Released Good
KR4.1	CH	43	0.9	Released Good
KR4.1	CH	37	0.5	Released Good
KR4.1	CH	42	0.9	Released Good
KR4.1	CH	43	0.9	Released Good
KR4.1	CH	47	1.2	Released Good
KR4.1	CH	43	0.8	Released Good
KR4.1	CH	40	0.6	Released Good
KR4.1	CH	42	0.8	Released Good
KR4.1	CH	41	0.8	Released Good



Site ID	Species	Fork Length (mm)	Weight (g)	Release condition
KR4.1	CH	44	0.9	Released Good
KR4.1	CH	44	1.1	Released Good
KR4.1	CH	42	0.8	Released Good
KR4.1	CH	41	0.7	Released Good
KR4.1	CH	43	0.8	Released Good
KR4.1	CH	38	0.5	Released Good
KR4.1	CH	36	0.5	Released Good
KR4.1	CH	40	0.7	Released Good
KR4.1	CH	43	0.8	Released Good
KR4.1	CH	43	0.8	Released Good
KR4.1	CH	42	0.8	Released Good
KR4.1	CH	41	0.8	Released Good
KR4.1	CH	39	0.6	Released Good
KR4.1	CH	45	0.9	Released Good
KR4.1	CH	44	0.8	Released Good
KR4.1	CH	41	0.7	Released Good
KR4.1	CH	45	1.1	Released Good
KR4.1	CH	38	0.6	Released Good
KR4.1	CH	45	0.9	Released Good
KR4.1	CH	44	0.9	Released Good
KR4.1	CH	42	0.7	Released Good
KR4.1	CH	44	0.9	Released Good
KR2.3	BB	110	n/a	Released Good
KR2.2	CCG	70	n/a	Released Good
KR2.2	CCG	62	n/a	Released Good
KR2.2	CCG	61	n/a	Released Good
KR2.2	CH	47	0.9	Released Good



Site ID	Species	Fork Length (mm)	Weight (g)	Release condition
KR2.2	CH	50	1.2	Released Good
KR2.2	CH	53	1.6	Released Good
KR2.2	CH	47	1	Released Good
KR2.2	CH	43	1.5	Released Good
KR2.2	CH	46	1.1	Released Good
KR2.2	CH	46	1.1	Released Good
KR2.2	CH	45	1.2	Released Good
KR2.2	CH	42	0.8	Released Good
KR2.2	CH	50	1.4	Released Good
KR2.1	CCG	80	n/a	Released Good
KR2.1	CCG	80	n/a	Released Good
KR2.1	CCG	74	n/a	Released Good
KR2.1	CH	46	0.9	Released Good
KR2.1	CH	53	1.5	Released Good
KR2.1	CH	48	1.2	Released Good
KR2.1	CH	52	1.5	Released Good
KR2.1	CH	52	1.3	Released Good
KR2.1	CH	52	1.4	Released Good
KR2.1	CH	52	1.4	Released Good
KR2.1	CH	45	1	Released Good
KR2.1	CH	42	0.8	Released Good
KR2.1	CH	49	1.2	Released Good
KR2.1	CH	47	1.1	Released Good
KR2.1	CH	47	1.1	Released Good
KR2.1	CH	46	1.1	Released Good
KR2.1	CH	42	0.7	Released Good
KR2.1	CH	53	1.6	Released Good





Site ID	Species	Fork Length (mm)	Weight (g)	Release condition
KR2.1	CH	44	0.7	Released Good
KR2.1	CH	45	1	Released Good
KR2.1	CH	47	1.2	Released Good
KR2.1	CH	46	1	Released Good
KR2.1	CH	47	1	Released Good
KR2.1	CH	57	1.6	Released Good
KR2.1	CH	50	1.5	Released Good
KR2.1	CH	40	0.6	Released Good
KR2.1	CH	40	0.5	Released Good
KR2.1	CH	45	1	Released Good
KR2.1	CH	40	0.6	Released Good
KR2.1	CH	52	1.4	Released Good
KR2.1	CH	45	1	Released Good
KR2.1	CH	40	0.5	Released Good
KR2.1	CH	45	1.1	Released Good
KR2.1	CH	44	0.8	Released Good
KR2.1	CH	49	1.2	Released Good
KR2.1	CH	49	1.1	Released Good
KR2.1	CH	49	1.4	Released Good
KR2.1	CH	50	1.2	Released Good
KR2.1	CH	47	0.9	Released Good
KR2.1	CH	43	0.6	Released Good
KR2.1	CH	42	0.7	Released Good
KR2.1	CH	47	1.1	Released Good
KR2.1	CH	49	1.1	Released Good
KR2.1	CH	49	1.3	Released Good
KR2.1	CCG	21	n/a	Released Good



Site ID	Species	Fork Length (mm)	Weight (g)	Release condition
KR2.1	CH	49	1.1	Released Good
KR2.1	CH	53	1.4	Released Good
KR2.1	CH	42	0.7	Released Good
KR2.1	CH	52	1.4	Released Good
KR2.1	CH	40	0.7	Released Good
KR2.1	CH	36	0.4	Released Good
KR2.1	CH	48	1	Released Good
KR2.1	CH	45	0.8	Released Good
KR2.1	CH	57	1.4	Released Good
KR2.1	CH	47	1.1	Released Good
KR2.1	CH	40	1.3	Released Good
KR2.1	CH	51	1.4	Released Good
KR2.1	CH	42	0.7	Released Good
KR2.1	CH	48	1.1	Released Good
KR2.1	CH	39	0.5	Released Good
KR2.1	CH	48	1.1	Released Good
KR2.1	CH	42	0.8	Released Good
KR2.1	CH	55	1.7	Released Good
KR2.1	CH	55	1.3	Released Good
KR2.1	CH	41	0.7	Released Good
KR2.1	CH	49	1.2	Released Good
KR2.1	CH	40	0.7	Released Good
KR2.1	CH	52	1.3	Released Good
KR2.1	CH	46	0.9	Released Good
KR2.1	CH	40	0.6	Released Good
KR2.1	CH	45	1	Released Good
KR2.1	CH	45	1	Released Good



Site ID	Species	Fork Length (mm)	Weight (g)	Release condition
KR2.1	CH	43	0.8	Released Good
KR2.1	CH	44	0.8	Released Good
KR2.1	CH	37	0.4	Released Good
KR2.1	CH	46	1	Released Good
KR1.3	CH	50	1.4	Released Good
KR1.3	CCG	81	n/a	Released Good
KR1.3	CCG	71	n/a	Released Good
KR1.3	CCG	72	n/a	Released Good
KR1.3	CCG	65	n/a	Released Good
KR1.3	CCG	66	n/a	Released Good
KR1.3	CCG	63	n/a	Released Good
KR1.2	CH	48	1.1	Released Good
KR1.2	CCG	75	n/a	Released Good
KR1.2	CCG	63	n/a	Released Good
KR1.2	CCG	64	n/a	Released Good
NK1.3	CH	41	0.6	Released Good
FC1.1.B	BB	112	9.2	Released Good
FC1.1.B	CH	77	4.7	Released Good
FC1.1.B	CH	72	3.4	Released Good
FC1.1.B	CH	71	3.2	Released Good
FC1.1.C	CCG	90		Released Good
FC2.1.C	CH	68	3	Released Good
FC2.1.C	CH	65	3.6	Released Good
FC2.1.C	CH	55	2.1	Released Good
FC3.1.A	CH	53	1.3	Released Good
FC3.1.A	CH	65	2.3	Released Good
FC3.1.A	CH	63	2.6	Released Good





Site ID	Species	Fork Length (mm)	Weight (g)	Release condition
FC3.1.A	CH	66	2.6	Released Good
FC3.1.A	CH	53	1.6	Released Good
FC3.1.A	CH	65	2.6	Released Good
FC3.1.A	CH	60		Released Good
FC3.1.B	CH	51	2.1	Released Good
FC3.1.B	CH	65	2.3	Released Good
FC3.1.B	CH	60	2.7	Released Good
FC3.1.B	CH	63	2.8	Released Good
FC3.1.B	CH	58	2	Released Good
FC3.1.B	CH	67	2.8	Released Good
FC3.1.B	CH	65	3.6	Released Good
FC3.1.B	CH	58	2.4	Released Good
FC3.1.C	CH	63	2.5	Released Good
FC3.1.C	CH	64	2.7	Released Good
FC3.1.C	CH	67	3	Released Good
FC3.1.C	CH	54	1.6	Released Good
FC3.1.C	CH	51	2.1	Released Good
FC3.1.C	CH	74	3.9	Released Good
FC3.1.C	CH	56	2.2	Released Good