

**An Assessment of
Chinook Salmon Spawning Activity
on Rose Creek
Downstream of The Faro Mine Complex,
During August of 2010**

Prepared for:
Patricia L. Randell, B.Sc., M.Sc.
Project Manager
Assessment & Abandoned Mines
Energy, Mines & Resources
Government of Yukon

Prepared by:
Paul Sparling
White Mountain Environmental Consulting
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Executive Summary

White Mountain Environmental Consulting conducted an assessment of chinook salmon spawning utilization during August of 2010 on Rose Creek downstream of the Faro Mine Complex. The assessment found evidence of spawning activity from previous years but no active spawning fish were observed during the assessment. A central spawning area approximately 20 kilometers (by creek) of the mine site was identified.

1.0 Background

Chinook salmon spawning activity in the Rose /Anvil Creek system has always been poorly understood and represents a significant data gap in fisheries knowledge around the Faro Mine Complex (FMC). It has been well documented that adult salmon do enter Anvil Creek and spawning does occur as far up Rose Creek as the Rose Creek Diversion Channel, however little is known about the distribution of natal habitats in Rose Creek downstream of the FMC or in Rose Creeks receiving waters of Anvil Creek.

Chinook spawning was observed in 2009 in the Rose Creek Diversion channel (Sparling 2009). Prior to this observation anecdotal references to adult salmon in Rose Creek had been common and fisheries investigations in the area had on at least 2 occasions recorded chinook salmon eggs in Arctic grayling stomachs (Sparling 2006, 2008). No record of chinook salmon spawning downstream of the FMC in Rose Creek has been documented. It is not unlikely that Rose Creek was avoided by chinook salmon during periods of contamination when the mine was running.

Chinook spawning in Anvil Creek has been documented on several occasions including historical references, counts of spawning salmon has been attempted, but mapping of the spawning areas has never been completed. Deep tannin staining and turbulent flows have thwarted attempts at aerial observations within Anvil Creek. Historic references to Anvil Creek suggest that Anvil Creek supports a consistent low number of spawning chinook salmon.

2.0 Study Area

Rose Creek, a tributary to Anvil Creek, originates upstream of the FMC then flows around the mine tailings area contained within the Rose Creek Diversion Channel. Rose Creek is repatriated to its native channel immediately downstream of the tailings where it becomes the receiving water for the treated water from the FMC. Rose Creek then meanders for a distance of 36 Kilometers (a direct distance of 12km) to its confluence with Anvil Creek.

The area of study for this project consisted of the reach of Rose Creek extending from immediately downstream of the FMC at the treated water discharge site to the confluence with Anvil Creek (Figures 1 and 2). The habitats of Rose Creek upstream of the diversion channel consists of the two forks of Rose Creek which join immediately upstream of the diversion channel, these habitats are small and it is unlikely that even in a good return year that they would be utilized for salmon spawning. All areas with

potential for spawning in the diversion channel and the North and South Forks of Rose Creek were assessed prior to and after the survey.

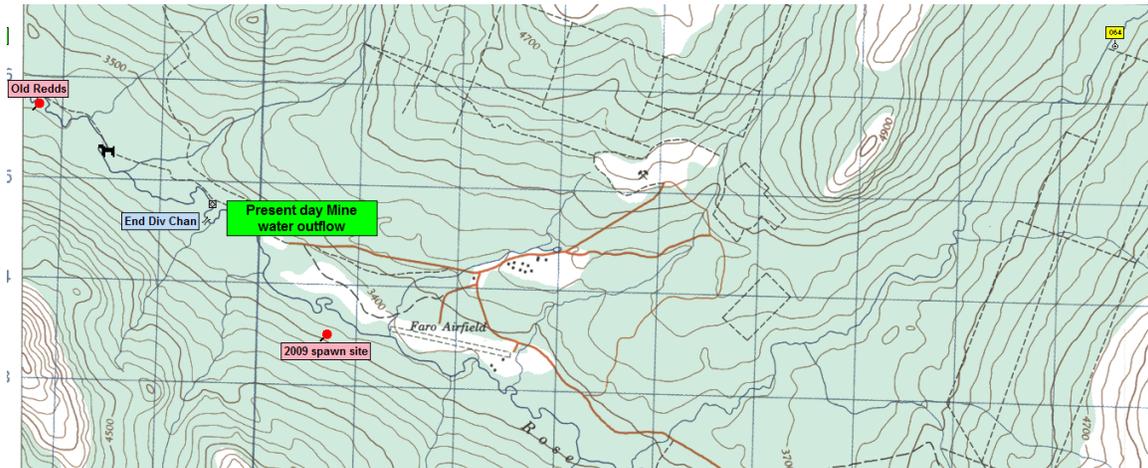


Figure 1: The upper reaches of Rose Creek. The 2010 survey of Rose Creek was initiated at the end of the diversion channel (blue box). The present day diversion channel does not show on this 1:50,000 scale topographic map. Rose Creek flows to the left. The continuation of this map is presented in Figure 2.

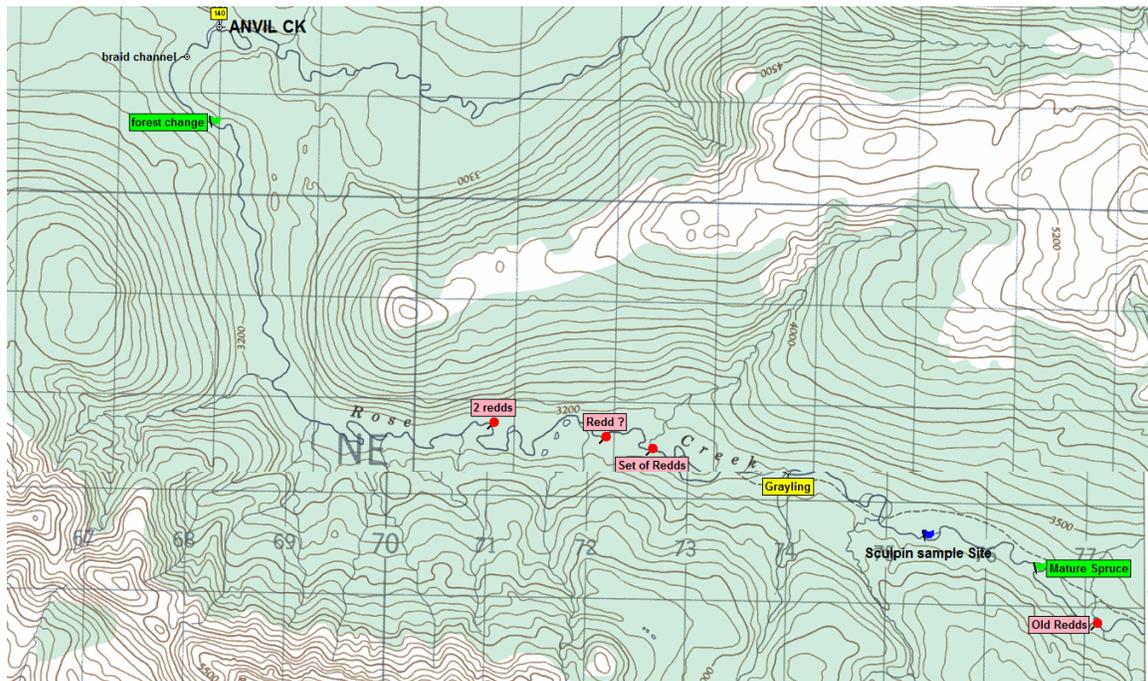


Figure 2: The lower reach of Rose Creek, the creek flows from right to left. The 2010 float survey concluded at the confluence with Anvil Creek. The right margin of this figure joins the left margin of Figure 1.

3.0 Methods

The primary focus of the assessment was to identify and map all Chinook salmon redds within Rose Creek. Rose Creek was surveyed for the presence of spawning chinook salmon between August 13 and August 18, 2010, and was timed to capture the spawning dates recorded during the summer of 2009 when spawning was observed in the Rose Creek Diversion channel.

The survey was accomplished with a crew of 3 experienced technicians using two 10' Zodiac boats. The boats were either paddled, drifted or carried down the length of the study reach. The crew wore polarized glasses to enhance visibility into the water at all times. Observations of suitable habitat areas, old redds from previous years, and the presence of current year spawners were made for the entire reach. All observations were mapped using a hand held GPS and field notes were recoded in a field notebook.

Distinguishing chinook salmon redds from previous year spawning is often difficult and subjective, however the spawning activities of chinook salmon leave distinct impressions in the creek bottom that can last for generations depending on the site and ice scouring in the spring melt. In many instances repeated spawning over years can result in large "dunes" being formed. On Rose Creek redds from previous years were identified by observing scours in the creek bottom in areas suitable for spawning and then stopping to observe the conditions and the shape and size of the scours. Only scours that could not have been made by hydrological events were recorded. The presence of multiple historic redd scours increased the confidence in describing "old redds".

Only areas with multiple depressions (redds) were listed as positive locations, other areas with only a single depression were listed as potential sites. All suspected redd sites were visually evaluated for location within the creek channel, correct substrate, flow and depth characteristics.

A land based evaluation of chinook spawning in the Rose Creek diversion channel was conducted prior to the survey of Rose Creek and was repeated at the conclusion of the Rose Creek survey.

A secondary component of the Rose Creek evaluation was to identify sites with suitable habitat for the capture of large numbers of slimy sculpin. These sites were sampled at a later date in August of 2010, as a component of a sentinel species sampling program for long term monitoring of the FMC.

The crew was retrieved from the confluence of Rose and Anvil Creeks at the completion of the program with a helicopter.

4.0 Results and Discussion

The survey of Rose Creek was initiated on the afternoons of August 16, and was completed over a period of 4 days with 4 overnight camps. The water level of Rose Creek at the time of the survey was very low (Figure 4) affecting the survey in 2 ways; first it made travel tricky and at times very difficult, as lifting the boats was required on many

occasions. The second affect of the low water was excellent visibility into the creek meaning the crew had an excellent view of the entire water column at most times resulting in a high level of confidence in the results. Water temperatures during the survey ranged between 12.1° and 14.1°C on a daily basis.

No salmon were observed during the survey however the project was successful in locating 5 areas with old redd sites, all from previous years with the exception of a single location that may have been a spawning site from 2010 (Figures 2 and 3, Table 1). This single location may have been the result of a log scour and may not have been a redd, even though there was little in the way of large debris moving in the low water conditions. Three of the sites had evidence of multi year activity with the densest area of redds consisting of at least seven old redds (Figure 3), three of which appeared to have been used in successive years. This site, approximately 10 km upstream of the confluence with Anvil Creek and near the outlet of a small feeder creek was located at WP 135 (table 1).

The central area of chinook salmon spawning activity was documented approximately 25 kilometers downstream of the FMC. The area extends for a distance of at least 5 kilometers and is represented in Figure 2 the area begins at the yellow grayling flag and continues downstream to the last redd marker (Table 1, wp's 54 and 137). The area has pockets of suitable habitats, with depths that varied between 0.5 meters and >2.0 meters, well sorted coarse substrates and an average velocity of less than 1m/sec..

Arctic grayling and round whitefish were observed throughout the survey, however in the upper reaches the fish were scattered and occurred as single fish. The first observations of Arctic grayling and round whitefish in groups was made approximately 2.5 kilometers upstream of this multi redd area. The observances of both of these species increased moving downstream from this point and were most abundant near the confluence with Anvil Creek.

The abundance of spawning chinook salmon in the Rose/ Anvil system will always be partly affected by the size of the returns (number of returning salmon in the Yukon basin) in a given year. Also, in most natal creeks the distance upstream that returning fish travel is dependant on the number of fish returning, ie; salmon will travel further upstream in a year with more fish. With this in mind, the return in 2009 was significantly higher than the well below average return of 2010. Based on this, it is not surprising that adult salmon were observed in the Rose Creek diversion channel during 2009 and not in 2010.

Rose Creek is a natal creek and its ability to support spawning salmon will always potentially be affected by the effluent from the FMC. Rose Creek should be monitored in subsequent years as a partial measure of the effectiveness of mine remediation efforts.

| Date | WP | Location | Comment |
|-------------|-----------|---------------------------|--|
| Aug 15 | 53 | 62°20.76'N / 133°26.49'W | Spawning location, 2009 |
| Aug 16 | 130 | 62°21.99'N / 133° 29.84'W | Set of 5 redds , multi yr |
| Aug 16 | 131 | 62°22.05'N / 133°30.58'W | Old redds, deep water |
| Aug 17 | 135 | 62°23.03'N / 133° 36.03'W | Set of several redds, multi yr. |
| Aug 17 | 136 | 62°23.01'N / 133° 36.57'W | Potentially this years redd |
| Aug 17 | 137 | 62°23.17'N / 133°37.87 'W | Set of 2 redds |
| Aug 17 | 54 | 62°22.88'N / 133°34.29 'W | 1 st grouping of AG, 1 old redd |

Table 1: Way point locations for significant sites recorded during fish habitat surveys of Rose Creek, August 2010.

Figure 3: The location of multi year spawning activity by chinook salmon on Rose Creek during August of 2010. The site had not been used in 2010 but did show evidence of activity in at least 2 previous seasons. Several old redds were located upstream of the throat of the riffle nearer to the right bank of the creek (the forshore). Submerged substrates were similar to those on the exposed shoreline.

Figure 4

Figure 4: At the time of the 2010 survey water levels in Rose Creek were low. Rose Creek possesses a variety of habitats and flow regimes. Wide shallow areas, such as the one shown above, made boat travel difficult in places.

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