Chinook salmon (*Oncorhynchus tshawytscha*) Stock and Habitat Assessment in the McQuesten River Drainage Basin and Recommendations for a Stock Restoration Plan

Prepared for the Yukon River Panel
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Introduction

The rivers and creeks that make up the McQuesten River system drain an area of about 4,800 square kilometers. The major tributaries to the McQuesten River are the South McQuesten, the North McQuesten and the East McQuesten Rivers. The McQuesten River empties into the Stewart River.

Traditionally, these lands and waters were used by the Nacho Nyak Dun First Nation for hunting, fishing, trapping and as a transportation corridor. This had little impact on the environment. In the late 1800s, prospectors attracted by gold, silver and zinc, began mining the region. Hard rock and placer mining, primarily in the southern half of the area, continues today. In some places, mining and other activities, including logging and road construction, have degraded the environment.

Specifically, the drainage area of the United Keno Hill Mining (UKHM) Complex has been heavily polluted. Flat Creek and Christal Creek, which flow into the South McQuesten River, are the principal drainages in this area. The pollution started in the 1940s with direct discharge of tailings into the watershed. The practice was eventually stopped in the 1960s, but toxic effluent continued to be discharged into the 1970s. UKHM mining activity slowed down in the 1980s, and at present UKHM is not in full operation. In response to pressure from government agencies and public concern, effluents and other discharges from UKHM have improved in quality.

The long history of placer mining in the McQuesten River watershed has substantially increased the amount of sediment deposited in certain of the waters. This is especially true in the South McQuesten River.

At the turn of the century, locals called the McQuesten River the "Red River" because of the high numbers of Chinook salmon spawning there. Today, local elders feel that there are substantially less salmon in the mainstem McQuesten River than when they were young. Documented studies and anecdotal evidence indicate that Chinook salmon still use the mainstem McQuesten River for spawning (Ennis *et al.*, 1982; Gormican *et al.*, 1992; DFO records). Juvenile Chinook salmon have been captured in the McQuesten River

(Gormican *et al.*, 1992).

DFO personnel feel that the decades of quartz mining and milling pollution of the South McQuesten River resulted in near extermination of Chinook salmon in that portion of the river (A. von Finster, pers. comm.). It is unknown to what extent Chinook salmon have repopulated the South McQuesten River since the pollution there decreased. There is only anecdotal evidence of spawning in the South McQuesten River (DFO records). What appears to be old spawning dunes have been reported at the outlet of McQuesten Lake (DFO files). In 1994, White Mountain Environmental Consultants captured juvenile Chinook salmon in the South McQuesten River (DFO files).

There is no information available on spawning in the East McQuesten River, but there is some documentation of spawning in the North McQuesten River (Hedman, 1995, A. von Finster, pers. comm.). More study is necessary to adequately describe Chinook salmon utilization in the McQuesten drainage basin.

To support a Chinook salmon population, a watershed must provide adequate habitat for spawning, rearing and migrating. This means the stream must have water quality and physical characteristics capable of ensuring the survival of migrating adults as well as overwintering eggs and juveniles. Also, there must be no obstacles to migration, and there must be suitable substrate available for egg laying.

Over the years, water quality testing has been conducted on specific locations in the McQuesten drainage basin by governments and industry. These are primarily locations that have been impacted by mining activity. However, baseline data on water quality for most of the drainage basin is not available. Information on physical characteristics that pertain to Chinook salmon habitat have been recorded for the mainstem McQuesten River (Gormican *et al.*, 1992), but such information is lacking for the rest of the watershed. Further studies are necessary to determine the quality and quantity of Chinook salmon habitat in the McQuesten drainage basin.

This study, which was conducted over a two-year period, attempted to assess the existing Chinook salmon population and the degree of habitat utilization in the McQuesten River drainage basin. Recommendations are made for a wild stock restoration plan. Investigations were made into incubation box sites.

Objectives:

1. To assess Chinook salmon spawning and rearing habitat in the McQuesten River drainage basin by measuring physical parameters and conducting year round chemical analysis on water samples.
2. To assess migrating habitat by looking for stream obstructions.
3. To assess the extent of Chinook salmon utilization of habitat in the McQuesten River drainage basin by counting migrating and spawning salmon and by trapping juveniles.
4. To formulate a wild stock restoration plan for the McQuesten River drainage basin, which includes determining broodstock collection sites and sites for juvenile release.
5. To assess locations for facilities designed to incubate eggs from wild stock for the restoration of Chinook salmon in the McQuesten River drainage basin.

Study Area:

This section of the Yukon experiences cold winters and warm summers. Mean January temperatures recorded at Mayo, the nearest weather recording station, are –26°C, and the mean temperature for July, the warmest month, is 15.6°C. On average, the Mayo weather station receives approximately 300 mm of precipitation, with most of it occurring as rain in June, July and August.

The McQuesten River system drains about 4,800 square kilometers before emptying into the Stewart River. Several large tributaries and small creeks make up the drainage. See accompanying map.

The South McQuesten River arises from McQuesten Lake and flows southwesterly for approximately 100 km (channel length) before joining the North McQuesten River. The headwaters of the East McQuesten River are in the Ogilvie Mountains near Eagle Lake. This river flows southwesterly for approximately 40 km until it joins the North McQuesten River. The North McQuesten River arises in the Ogilvie Mountains then flows 50 km southeast until it is joined by the East McQuesten River. It continues in a southerly direction for approximately 50 km until it joins with the South McQuesten River to form the McQuesten River mainstem. The McQuesten River flows approximately 100 km southwest until it reaches the Stewart River.

As well as the main tributaries in the McQuesten River watershed, there are forty-

seven named creeks and twenty-six unnamed creeks.

Access:

The McQuesten River is accessible by road near its mouth where it crosses the Klondike Highway. Road access is also possible at the South McQuesten bridge, where the Dublin Gulch road crosses the river. A road leaves the Silver Trail Highway ten miles east of Mayo and picks up what remains of the old Conservative Trail, which goes to the McQuesten River near the mouth of Bear Creek. The Elsa settling pond road crosses the Elsa flats and leads to the South McQuesten River. Christal Creek, a tributary of the South McQuesten River, is accessible from the Silver Trail Highway near Keno City, and on the Hanson Lake road. Near the bridge on the Klondike Highway, a four-wheel-drive road, follows the river upstream as far as Vancouver Creek. A trail, only navigable with an all terrain vehicle, continues on from the Minto Lake road to the McQuesten River at Ortell's Crossing. This trail continues to the North McQuesten River.

Methodology:

Habitat Assessment:

On August 21 and 22, 1997 and on August 12 and 14, 1998, reconnaissance helicopter flights were made over the McQuesten River watershed, noting stream characteristics and type of substrate.

Physical and chemical parameters relating to Chinook salmon habitat were measured at representative sites along the mainstem McQuesten River as well as the North and South McQuesten Rivers. Several of these sites were chosen because they were accessible overland by roads or trails. Sites along the McQuesten and South McQuesten Rivers, which were not readily accessible by road, were evaluated during a canoe trip in August 1977. Sites on the North McQuesten River were accessed during the helicopter flights in August 1998. In 1997, physical and chemical habitat parameters were measured at ten sites. In 1998, eight sites were assessed.

Conductivity (mhos/cm) was measured by a Hanna Instruments 9033 meter. A Hanna Instruments 9025 meter was used to determine pH and water temperature (^{o}C).

Dissolved oxygen values (mg/L) were measured by an OxyGuard Handy Mk II meter. Stream velocity (m/s) was calculated using a Scientific Instruments 1205 Current Meter. At some sites, water velocity was determined by measuring the time that it took an orange to float a known distance. At these sites, three measurements were taken and averaged to get water velocity.

Year round water temperatures at one location in the North McQuesten River will be determined by placing a temperature data logger (Minilog TR) in protective PVC tubes in this area and leaving it for a year. This data logger should be in place by the end of October 1998.

The stream substrate was categorized into the following size classes: silt (0.004-0.06 mm), sand (0.06-2.0 mm), gravel (2.0-16mm), pebble (16-64 mm), cobble (64-256 mm) and boulder (>256 mm). In 1997, the composition of the substrate with respect to particle size was estimated visually. In 1998, random samples of substrate were taken, the particles were measured and the percentage of each size category was calculated.

At some sites, physical parameters were not measured, but water was collected for dissolved metal analysis. Most of these water quality sites were chosen because they were accessible by roads or trails. Many of these sample sites were concentrated in areas known or suspected to have been impacted by mining. Road accessible water quality sites were sampled in the summers of 1997 and 1998 and will continue to be sampled during the winter of 1998-1999. In the North McQuesten River and some sections of the mainstem McQuesten River, water quality sites were accessed by helicopter in August 1998. Water samples were collected in plastic bottles provided by Chemex Labs in Vancouver, where samples were sent for analysis. In 1997 the water samples were analyzed for dissolved metals; in 1998 the water samples will be analyzed for dissolved metals and hardness.

During the winter of 1997, water quality samples were only analyzed for dissolved metals, however during the winter of 1998, water temperature, pH and dissolved oxygen will also be measured on collected water samples.

Migrating habitat was assessed during a canoe trip in July 1997 and on the helicopter overflights of the watershed in August of 1997 and 1998. Photographs were taken of possible obstructions to migration and they were noted on a map.

Stock Assessment:

Adult Chinook salmon distribution was estimated by counting spawning adults, carcasses and redds during two helicopter flights in 1997 and two flights in 1998 at what was judged to be the height of spawning. The 1997 flights took place on August 21 and 22, and the 1998 flights took place on August 12 and August 14. Observers in 1997 were Jason Hwang, Simone Macdonald and Ronalda Moses. In 1998, observers were Simone McDonald, Ronalda Moses and Patricia Smith.

Juvenile Chinook salmon populations were assessed by setting G-minnow traps baited with salmon roe at various locations in the drainage basin. At each sampling site, traps were set in a variety of habitat types. Traps were set on July 23, 1997 and retrieved on July 24, 1997 at road accessible sites on the South McQuesten River. Traps were set using a helicopter in the East McQuesten River, the North McQuesten River and the South McQuesten River on August 21, 1997 and retrieved on August 22, 1997. On August 12, 1998, traps were set in the North McQuesten and the mainstem McQuesten Rivers during a helicopter reconnaissance of the watershed. These were retrieved on August 14, 1998. Traps were set at the McQuesten Bridge on the Klondike Highway and at the South McQuesten Bridge on August 31, 1998 and retrieved on September 2, 1998. In 1998, subsets of six juvenile Chinook salmon from each trap were anesthetized in water containing dissolved alka seltzer. Fork length of these fish was measured to the nearest millimeter.

Restoration Plan

Decisions regarding the viability of using McQuesten River Chinook salmon broodstock for the restoration of the overall McQuesten River drainage basin population were based on the stock and habitat assessment of the drainage basin.

Assessment of Incubation Facility Sites:

Several sites were evaluated and rated according to an incubation site criteria list provided by Trix Tanner, a DFO biologist (T. Tanner, pers. comm.) Factors looked at were accessibility, water temperature, water quality, water quantity, fish presence and stream gradient. The sites for assessment were picked following consultation with NND band members as well as other knowledgeable locals. A preliminary assessment of nine locations

was conducted from a helicopter and by driving to sites. Four of these locations satisfied the conditions of the preliminary investigation so further assessment was conducted on them.

The nine sites considered in the preliminary assessment were: Rusty Creek, McGinty Creek, Crooked Creek, Mud Creek, the upper reaches of Moose Creek, an unnamed creek three miles past Stewart Crossing on the Klondike Highway, an unnamed creek on the Ten-Mile Gravel Pit Road, Four-Mile Creek on the Ethel Lake Road and a warm spring at the headwaters of Partridge Creek. Further assessment was conducted on Rusty Creek, McGinty Creek, Four-Mile Creek on the Ethel Lake Road and the unnamed creek on the Ten-Mile Gravel Pit Road.

Assessment of the above four creeks involved measuring water temperature, dissolved oxygen, pH, conductivity and turbidity. Creek width, depth and velocity were measured, and the volume of flow was calculated by determining the area of a cross section of the creek and multiplying this by the water velocity. This method of determining flow overestimates to some extent the amount of water because it doesn't take into consideration the slower water along the sides. However, in creeks this size, this is not considered significant. Stream gradient was determined with a Suunto Clinometer. The distance of creek required to provide the necessary drop of 1 meter to allow for gravity feeding and emptying of the incubation boxes was determined. Two G-minnow traps baited with salmon roe were placed in each stream to test for the presence of fish. These traps were checked in 48 hours. Temperature data loggers (Minilog TR supplied by Vemco Ltd.) will be placed in these four locations in October 1998. The data loggers will be put in protective PVC tubes and left in place until the spring of 1999. Water samples were collected in 1 Liter plastic bottles and will be analyzed for dissolved metals, suspended solids, ammonia, nitrites and hardness. At regular intervals throughout the winter, measurements will be taken of the pH, conductivity and dissolved oxygen levels of the creeks. Winter water flow and spring runoff flow will also be monitored. Arrangements will be made in the spring to test the total gas pressure in the creeks that satisfy the winter conditions necessary for an incubation site.

Results and Discussion:

Habitat Assessment:

In 1997, heavy rainfall during July and August resulted in high water levels in the

McQuesten River drainage basin, whereas in 1998, lower than normal rainfall in June, July and August caused water levels in the McQuesten River system to be low.

The South McQuesten River flows out of McQuesten Lake into a wide valley. See accompanying map. The river here is sinuous, and the channel form is generally pool/glide with some riffle. At the time of the 1998 flight, a mudslide near the confluence with Cache Creek had deposited sediment into the river. This caused the water to be turbid for a couple of kilometers downstream, and prevented us from seeing the substrate.

Approximately two kilometers from McQuesten Lake, the South McQuesten River flows into a secondary valley. The flow is primarily pool/glide, with some riffle and a few minor rapids. From the mouth of Hanson Creek to the mouth of Haggart Creek the river flows in a sinuous to locally meandering channel. The channel form is generally pool/glide and some riffles. The substrate here appears to be primarily a mixture of coarse gravel and cobbles.

Downstream of Haggart Creek to the confluence with the North McQuesten River, the South McQuesten River channel is sinuous to meandering in form. Sand capped bars are common. The channel form varies between pool/glide and pool/riffle. Coarse gravel and cobbles make up the substrate in the riffles. Good viewing conditions on the 1998 flight allowed us to see sedimentation built up along the riverbanks and on gravel bars in this section.

The helicopter overflights did not extend to the headwaters of the North McQuesten River. This river was surveyed for approximately two kilometers upstream of the confluence with the East McQuesten River. The channel here is braided and not well defined. Channel form was primarily riffle and minor rapids. The substrate appeared to be boulders and cobbles.

Downstream of the confluence with the East McQuesten River, the North McQuesten channel is well defined and broad. The flow is primarily pool/glide and pool/riffle. The substrate appeared to be coarse gravel and cobbles. The water in this river is very clear. There was no evidence of accumulated sediment.

The East McQuesten River was not surveyed to the headwaters. The lower portion of the East McQuesten River has well defined channels with a channel form of pool/glide and riffles. The substrate is predominantly coarse gravel and cobbles.

The mainstem McQuesten River flows from the confluence of the North and South McQuesten Rivers to the Stewart River. The channel is broad and flows through a wide valley with a sinuous and sometimes meandering form. Gravel bars capped with sand are common. The channel form is pool/glide and pool/riffle. Substrate appears to be coarse gravel and cobble in the riffles and glides, with fine sediment accumulating in the pools. The channel characteristics are fairly similar to the mouth.

Some of the parameters measured at habitat assessment sites in the drainage basin during the study period are summarized in Table 1. Unfortunately, not all parameters were measured at all sites. Raw data collected at all habitat assessment sites is included as Appendix 1.

The information gathered at the habitat assessment sites confirms what was seen during the overflight with respect to substrate. Sites in the South McQuesten and McQuesten Rivers had substrates consisting of predominantly coarse gravel, pebbles and cobbles (2-256 mm). Some sites had a blanket of sand and silt. This agrees with the findings of the Yukon Placer Mining Study (Gormican, 1992) which found the composition of substrate at assessment sites in the mainstem McQuesten River to be 53% cobble and gravel and 38% sand and silt. The substrate at sites in the North McQuesten River were also a mixture of coarse gravel and cobbles, but without a blanket of fine material.

In Crooked Creek, a tributary of the Stewart River, Chinook salmon redds were documented in substrate that was a mixture of rocks ranging in size from 1 mm to 300 mm (Smith, 1997). In Janet Creek, also a tributary of the Stewart River, Chinook salmon spawned in rocks ranging from 40-300 mm (Smith, 1996). Considering this, there appears to be abundant areas with suitably sized substrate for Chinook salmon spawning in all sections of the North, South, East and mainstem McQuesten rivers.

Stream velocity measurements were not available for all habitat assessment sites. The sites in the McQuesten River where velocity was measured had water speeds ranging from .24 m/s to .8 m/s. The North McQuesten River sites had higher velocities of 1.1 m/s and 1.9 m/s. Good Chinook salmon spawning habitat has water velocities that provide enough flow to oxygenate redds but not so much flow that redds are washed away. In a study on the upper Yukon Basin, Milligan *et al.* (1985) observed Chinook salmon spawning in water with speeds of 1.62-1.91 m/s. Chinook salmon in Janet Creek spawned in water with

velocities of .48-.54 m/s (Smith, 1996) and Chinook salmon in Crooked Creek spawned in water with velocities of .44-.62 m/s (Smith, 1997). This suggests that the velocity of water in the East, North, South and mainstem McQuesten Rivers is not a deterrent to Chinook salmon spawning.

Dissolved oxygen levels, which ranged from 8.2 mg/L in the North McQuesten to 12.2 mg/L at Sunshine Creek in the mainstem McQuesten River, were within the acceptable range for all Chinook salmon life stages.

The habitat assessment sites had pH values that ranged from 7.65 to 8.9. For aquatic life to survive, pH values must be between 6.5-9.0. The pH values recorded at Christal Creek (8.9) and in the South McQuesten River where Seattle Creek enters (8.6) are approaching the upper range of allowable pH limits.

Conductivity is the measure of a water sample to carry an electric current, which depends on the ionic concentration. This is a quick test for measuring the dissolved material in a solution. Conductivity varies with temperature. As water temperature goes up so does conductivity. Generally, values between 150 and 500 mhos/cm at 25°C are acceptable for the support of a fish population. All conductivity values measured in this study were within this range, but as they were all at different temperatures, it is difficult to compare one site against another

The surface water temperatures recorded in this study in the various McQuesten Rivers were acceptable for Chinook salmon spawning during the period when spawning may be expected to take place.

Turbidity occurs when suspended matter in water causes light to be scattered or absorbed rather than transmitted. Increased turbidity in north temperate fresh waters is usually associated with decreased productivity of aquatic environments. Measured NTUs were low at all assessment sites except in the South McQuesten River near the confluence with Seattle Creek and near Flat Creek and below Christal Creek.

The sites sampled do not completely reflect the sediment content of the McQuesten River system. Historically, Haggart Creek was heavily placer mined, and sediments that were deposited in the creek years ago are now working their way downstream. Several creeks in the mainstem McQuesten River and South McQuesten River are still placer mined today.

Periodic releases from placer operations introduce sediment into the system. At this time, active placer claims are present on Vancouver Creek, Bear Creek, Johnson Creek, Seattle Creek, Rodin Creek, Goodman Creek and the Haggart Creek drainage. On August 24, 1998, the NND Lands Office received a complaint that there were high levels of sediment in the South McQuesten River downstream of Seattle Creek. This type of report is not uncommon.

Water Quality:

This study was a synoptic survey of water quality at a number of stations in the McQuesten River drainage basin. Single water samples were taken at different times and under different flow regimes. Table 2 shows the water quality sampling sites and sampling dates in 1997, and Table 3 shows the water quality sampling sites and dates in 1998. A printout of the dissolved metal analysis from Chemex Labs, Vancouver for the 1997 sampling sites is included as Appendix 2. The metal analysis of the 1998 sites is not available at this time. These results will be included in a final report in March.

The metal analysis was compared to the Canadian Water Quality Guidelines for Freshwater Aquatic Life prepared by the Task Force on Water Quality Guidelines of the Canadian Council of Ministers of the Environment (CREMM Guidelines). These guidelines are reported as total metal concentration in an unfiltered sample. The samples in this study were analyzed for dissolved metals, but the assumption was made that the guidelines were valid for dissolved metals.

The water samples were analyzed for a large array of dissolved metals. Some of these metals are not included in the CREMM Guidelines for aquatic life, so no comment will be made on their concentrations. Metals without CREMM Guidelines for aquatic life are: antimony (Sb), barium (Ba), bismuth (Bi), calcium (Ca), cobalt (Co), magnesium (Mg), manganese (Mn), molybdenum (Mo), phosphorus (P), potassium (K), sodium (Na), strontium (Sr), tin, (Sn), titanium (Ti), uranium (U) and vanadium (V).

Following is a summary of the findings for metals, which are included in the CREMM Guidelines. Table 4 shows where dissolved metal concentrations exceeded the CREMM Guidelines for aquatic life and which metals exceeded the guidelines.

Silver (Ag)—The CREMM Guidelines level for silver is 1ug/L. All the samples collected in 1997 had silver concentrations below this level.

Aluminum (Al)—The CREMM Guidelines level for aluminum concentration is .1 mg/L. This level is exceeded in samples collected where Cache Creek, Seattle Creek and Haggart Creek enter the South McQuesten River, at the outlet of McQuesten Lake and at the confluence of the North and South McQuesten Rivers.

Arsenic (As)—None of the samples collected in 1997 had levels of arsenic over the CREMM Guidelines concentration of 50 ug/L.

Beryllium (Be)—According to the CREMM Guidelines, there is insufficient data to recommend a limit for beryllium with respect to aquatic life. All water samples collected in 1997 had beryllium concentrations below the detectable limit of the analysis.

Cadmium(Cd)—The toxicity of cadmium depends on the hardness of the water. Hardness of the water is a measure of the $CaCO_3$ concentration. Hard water has a $CaCO_3$ concentration of >120mg/L, moderate water has 60-120 mg/L $CaCO_3$ and soft water has <60 mg/L $CaCO_3$. Soft water increases the sensitivity of fish to toxic substances.

As the hardness of the water samples collected in 1997 was not determined, it is impossible to define what level of cadmium would be toxic. The CREMM Guidelines for cadmium concentration range from 0.2 ug/L for soft water to 1.8 ug/L for hard water. Acceptable levels of cadmium for all water types are exceeded at samples taken from where Cache Creek enters the South McQuesten, at the outlet of McQuesten Lake and Christal Creek.

Chromium (Cr)—The CREMM Guidelines list the chromium levels that protect fish as 20 ug/L and the levels that protects all aquatic life including zooplankton and phytoplankton as 2.0ug/L. None of the samples collected in 1997 exceeds the CREMM Guidelines to protect fish, but samples collected where Seattle Creek enters the South McQuesten and a site near the South McQuesten Bridge exceed the chromium concentration limits to protect zooplankton and phytoplankton.

Copper (Cu)—The toxicity of copper depends on the hardness of the water. The acceptable limits of copper concentration range from 2 ug/L for soft water to 4 ug/L for hard water. Samples collected where Seattle Creek and Cache Creek enter the South McQuesten River exceed the limits of copper concentration for all water types. Samples collected at the outlet of McQuesten Lake and where the Conservative Trail crosses the McQuesten River

exceed the limits of copper concentration for soft water.

Iron (Fe)—The acceptable limit of iron concentration in water is 0.3 mg/L. This concentration is exceeded where Bear Creek enters the McQuesten River, and where Cache Creek, Seattle Creek and Haggart Creek enter the South McQuesten, and at the outlet of McQuesten Lake as well as in Haggart Creek below Dublin Gulch and Christal Creek.

Mercury (Hg)—To protect aquatic life, the acceptable mercury concentration in the water is 0.1ug/L. Unfortunately, the limit of detection for mercury concentration in the analysis performed on the water samples collected in 1997 was 1 ug/L. Therefore, although all the water samples collected were below the detectable limit of the analysis for mercury concentration, it is impossible to say if they are below the acceptable CREMM Guidelines for mercury concentration.

Nickel (Ni) —The toxicity of nickel for aquatic life depends on the hardness of the water. The CREMM Guidelines for nickel concentration range from 25 ug/L for soft water to 150 ug/L for hard water. None of the water samples collected had nickel concentrations exceeding the guidelines for hard water, but the site where Cache Creek enters the South McQuesten River and the outlet of McQuesten Lake had nickel concentrations exceeding the acceptable guidelines for soft water.

Lead (Pb)—The toxicity of lead depends on the hardness of the water. The CREMM Guidelines for lead range from 1ug/L for soft water to 7 ug/L for hard water. Levels of lead exceeded the guidelines for all water types where the old Conservative Trail crosses the McQuesten River. Acceptable levels of lead in soft water were exceeded where Seattle Creek enters the South McQuesten River and at the outlet of McQuesten Lake.

Selenium(Se)—The CREMM Guidelines level for selenium concentration in water is 1 ug/L. This level is exceeded at the South McQuesten Lookout, which is near the South McQuesten Bridge.

Zinc (Zn)—The CREMM Guidelines list .03 mg/L or 30ug/L as a tentative guideline for the acceptable water level of zinc with respect to aquatic life. This limit is exceeded where the old Conservative Trail crosses the McQuesten River, and where Cache Creek enters the South McQuesten River, and at the outlet of McQuesten Lake and in Christal Creek. Some zinc levels are very high. At the outlet of McQuesten Lake the zinc concentration is 652 ug/L, which is twenty times the acceptable level. In Cache Creek the

zinc concentration is 354 ug/L and in Christal Creek it is 390 ug/L. These last two are over ten times the acceptable level.

Only one sample was taken at each station in this study. This reduces the statistical validity of the findings. Also, by not taking multiple samples in more than one station in a given area, any differences in dissolved metal concentrations over a short distance are missed. The dissolved metal concentration in a river can vary significantly in a short distance due to different amounts of mixing. This is especially true where tributaries enter the river.

Taking more than one sample also helps identify contaminated samples. In this study, there is the possibility that the sample collected at the outlet of McQuesten Lake was contaminated. The analysis on this sample showed the water there to have high levels of aluminum, cadmium, copper, iron, nickel, lead and zinc. McQuesten Lake was not affected by pollution from the UKHM complex and it has a good fish population, therefore, this sample is suspect.

The water samples were taken at various times of the year in different parts of the McQuesten River drainage, so it is difficult to compare the sites. Different flow regimes affect water quality. Water from rapid run-off can be expected to be soft with relatively low dissolved solids and conductivity, while ground water is harder, with higher conductivity and dissolved solids. In 1997, the water level in the McQuesten River drainage was high due to heavy rainfall, whereas water levels were low in 1998. Therefore one would expect to see differences in the dissolved metal concentrations between the two years.

This synoptic survey indicated that most stations in the mainstem McQuesten River had water quality that was within the CREMM Guidelines at the time of sampling. Negative effects to water quality appear to remain from the UKHM complex in the South McQuesten River. Additionally, there are indications of naturally occurring exceedences of the CREMM Guidelines for Freshwater Aquatic Life in some areas of the South McQuesten River.

Water quality sampling has been conducted in the South McQuesten River for a number of years by various agencies and organizations, but there appears to have been no analysis of the trend of concentrations in the river. This would seem to be an important undertaking, especially if UKHM opens again.

Migrating Habitat:

Over most of the McQuesten River drainage basin, there were no obstacles to Chinook salmon migration. One spot that might be an impediment to migration is a large logjam located approximately 1 km upstream of the bridge over the South McQuesten River. The logjam, which appears to be made up in part of sawn logs, is located at the upstream end of the Haggart Creek fan. See accompanying map. DFO Habitat and Enhancement Branch staff have been monitoring this logjam since 1992. In 1996, they noted that the river had forged a channel around the outside of the jam.

During the 1998 overflight, the logjam was inspected by having the pilot hover a few feet above it. There appeared to be no river channel around the jam. Despite the large size of the logjam and low water levels in the river, it looked like there were channels in the jam that fish could navigate. See accompanying photographs. After consultation with Gail Faulkner, a biologist with DFO Habitat and Enhancement Branch, who also viewed the site in August, 1998, it was decided that Chinook salmon could likely make their way through the logjam. Gail felt that the logjam had moved downstream somewhat compared to previous years. She feels it is possible that nature may eventually take care of the problem.

Spawning Survey:

During the 1997 helicopter overflight of the McQuesten watershed, which in hindsight was thought to be after the peak of spawning, visibility was poor due to high water and overcast skies. The mainstem McQuesten River was not flown in this survey. Only one live salmon was spotted in 1997 in the McQuesten River drainage. This probably does not reflect the number of Chinook salmon in the drainage basin. The salmon was seen on a large redd in the South McQuesten River, upstream of the logjam near Haggart Creek. Two carcasses were spotted in the North McQuesten River in 1997.

On the overflight in August 1998, viewing conditions were excellent due to good weather and low water levels. The streambed was clearly visible. Ninety-four adult Chinook salmon and thirty-six carcasses were spotted. These were all in the mainstem McQuesten River. No adult salmon or carcasses were seen in the North McQuesten River or the South McQuesten River. Over half the fish spotted were on redds, the remainder were swimming upstream. This indicates that the spawning season was well underway at the time of the

survey. Many large redds and overlapping redds were seen between the mouth and Sunshine Creek. These are shown on the accompanying map. Some of these redd aggregates had over a dozen Chinook salmon on them.

Overall, the number of Chinook salmon returning to the Yukon River Basin in 1998 was low (A. von Finster, pers. comm.). Assuming the escapements in 1998 were 30-40% of normal, then the expected number of Chinook salmon returning to the McQuesten River would be 325-433. This number is in general agreement with the 294 adult Chinook salmon observed in the mainstem McQuesten River in 1992 by the Yukon River Mining Study (Gormican, 1992).

This suggests that in a year with normal escapement numbers, the spawning habitat in the mainstem McQuesten River is well utilized. However, despite apparently abundant spawning habitat in the North McQuesten River, there appears to be little spawning occurring there. There also appears to be little Chinook salmon spawning in the South McQuesten River. This may be related to past and present water quality, sediment regimes in the river, and to access beyond the Haggart Creek logjam.

Trapping Results:

The G-minnow trapping results for 1997 are presented in Table 5, and the 1998 trapping results are presented in Table 6. Fourty-six traps were set in 1997, but only 2 Chinook salmon were captured. This is most likely due to poor trapping conditions.

In 1998, numerous juvenile Chinook salmon were trapped in the mainstem McQuesten River. High densities (90 and 118 fish per trap) were captured in some traps. All nine traps set in the McQuesten River in 1998 captured juvenile Chinook salmon, although one trap had only one fish. Juvenile Chinook salmon were captured in habitats with and without instream and overstream cover. Juvenile Chinook salmon habitat in the mainstem McQuesten River appeared to be well utilized.

Traps set in the North McQuesten River in 1998 captured lower numbers of juvenile Chinook salmon than traps set in the mainstem McQuesten River. The highest number of juvenile Chinook salmon captured in a single trap in the North McQuesten River was 17. But out of eight traps set in the North McQuesten River in 1998, only one trap captured no fish. The trap that captured 17 juveniles was at Site 1, which was near the confluence with

the mainstem McQuesten River. The highest number of juveniles captured per trap at Site 2, which was farther upstream, was 5.

The juveniles captured in the North McQuesten River tended to be slightly larger than juveniles captured in the mainstem McQuesten River. This indicates that there is good salmon rearing habitat available here, and that the lower number of juvenile Chinook salmon are able to exploit the habitat and grow faster than juveniles in the mainstem McQuesten River. This suggests that rearing habitat in the North McQuesten River is under utilized.

Only two juvenile Chinook salmon were captured in the South McQuesten River in 1998, however only two traps were set. These juveniles were found upstream of the logjam. This is not enough traps to adequately describe the juvenile Chinook salmon population in this section of the South McQuesten River. This might indicate that rearing habitat here is under utilized, but it might also mean that there isn't much suitable rearing habitat available due to high sediment loads or poor water quality.

In 1994, White Mountain Environmental Consultants captured 66 juvenile Chinook salmon in Haggart Creek and 72 juvenile Chinook salmon in the South McQuesten River downstream of the logjam (DFO files). This indicates that utilization of the rearing habitat differs from year to year.

Restoration Plans:

1)North McQuesten River—Stock restoration is recommended because of apparent availability of spawning and rearing habitat and low numbers of spawners. This is subject to winter water sampling, which will be complete by spring 1999. Habitat restoration is not required due to the generally untouched nature of the drainage basin.

2)mainstem McQuesten River—Stock restoration is not recommended because there are apparently appropriate levels of Chinook salmon here. Habitat restoration is not required due to the generally untouched nature of the drainage basin.

3)South McQuesten River—No stock restoration should proceed until water quality concerns related to UKHM complex have been addressed. Habitat restoration activities should be confined to monitoring of Haggart Creek logjam, analysis of trends of quartz mining quality and continued monitoring of water quality at selected sites on the river.

4)East McQuesten River—Stock restoration is not recommended because of

difficulties in access. Habitat restoration is not required due to generally untouched nature of the drainage basin.

Stock restoration of the North McQuesten River would best be achieved by artificially incubating eggs and rearing fry from wild stock before releasing them into the system. This would increase their survival rate thereby increasing stock numbers. The most practical method of doing this is to use streamside incubation boxes.

This process involves capturing broodstock, recovering eggs and fertilizing them, then placing them in insulated boxes designed to bring an adequate and even flow of oxygenated water past the eggs. The salmon eggs are held in the incubation boxes through hatching and the alevin stage. When they reach the swim-up stage they are transferred to feeding tanks and held there until they reach a weight where they can be released.

Managing a streamside incubation project requires technical expertise. It is essential that the manager be trained in all aspects of such a project.

The Chinook salmon stock that is present in the mainstem McQuesten River is considered to be the same stock that occupies the North McQuesten River. Since the mainstem of the river is more accessible than the North McQuesten, and there appears to be an adequate supply of spawners in the McQuesten River, this seems the best location for broodstock collection for a wild stock restoration program. The river is accessible near the bridge on the Klondike Highway. A four-wheel-drive road follows the north side of the river upstream to Vancouver Creek. Broodstock could be collected between the bridge and Vancouver Creek.

One method of capturing Chinook salmon is to collect them when they go through a counting weir. But considering the cost of building and manning a counting weir, and the large numbers of Chinook salmon observed in the lower part of the McQuesten River, it seems more practical to collect broodstock using a seine net. This involves setting a seine net into holding pools or walking the net down the river.

Captured fish, which are held until they are ready to spawn, must be handled carefully to avoid damaging the fish or the eggs and milt. They are best held in tubes made of ten-inch PVC tubes (T, Tanner, L. Vano, pers. comm.). These tubes are set in the stream so water flows over the fish.

When females are ripe they are killed by a blow to the head and then bled by cutting

through the gill arches. Eggs are recovered by incising the females upward from vent to head, just lateral to the ventral midline. Loose eggs will then fall from the fish. Milt is expressed from male fish by gently squeezing the fish. The eggs are fertilized by mixing the milt with the eggs.

Fertilized eggs are placed in the incubation boxes. Incubation boxes can be located at the site of broodstock collection or at another site. For successful incubation, the site must satisfy certain criteria. These criteria will be discussed in more detail later. The McQuesten River, which is to be used as a broodstock collection site, is not a suitable location for incubation boxes. A site will have to be selected.

The rate at which Chinook salmon eggs and juveniles develop is controlled by the water temperature. Accumulated Thermal Units (ATUs) are the sum of water temperatures over O°C over a period of time. ATUs should be monitored to determine when the eggs reach the eyed stage. The eggs should not be handled until this time. At the eyed stage, eggs are shocked by pouring them from one container to another. This causes dead eggs to turn white, therefore they can be culled. When the Chinook salmon progress to the alevin stage, which is a larval fish with its own food supply in a yolk sac, they move to biorings, which form artificial gravel at the bottom of the incubation box. Other than monitoring temperature and ensuring that water is flowing through the box, the systems requires no labor at this time.

Alevins become fry when they are ready to swim off the bottom and start feeding. At this point, they are transferred to feeding tanks. The feeding tanks must be plumbed to allow oxygenated water to flow through the tank. Commercial fish food is provided with automatic feeders. The feeders must be stocked daily and the tank requires daily cleaning.

Fry are released when they reach a weight where they will not be at a disadvantage to wild fry. Trix Tanner, who runs a streamside incubation facility in Whitehorse, releases fry into the Takhini River and Tatchun Creek at .5 grams (T. Tanner, pers. comm.).

Fry that are to be released into the North McQuesten River will have to be flown to the release site by helicopter as the access to this area is only by a rough trail. Since there appears to be abundant summer rearing habitat available in the North McQuesten River, the release site will probably be determined by a good landing site for the helicopter. Before release, the water holding the fry should be gradually mixed with stream water to acclimatize the fry to the temperature and chemical composition of their new environment.

Fry that have been artificially incubated generally are tagged with wire-coded tags before release. This should be done by a professional tagger. If the fry are tagged then they can be identified when they are caught in the fishery or they return to spawn. In this way, the success of the stock restoration project can be monitored. To detect returning spawners that were artificially incubated and released into the North McQuesten River, a counting fence or another means by which the stock may be assessed should be in place near the mouth of the river by four years after the fry release.

Incubation Sites:

There are several criteria that must be satisfied for a site to be suitable as a location for streamside incubation boxes. A site must be accessible year round. The cost of access for daily maintenance and feeding of fry should be considered. The stream gradient is important because it allows water to flow through the boxes bringing oxygen to the eggs. In order for this to happen the incubation box must be fed by an intake at a higher elevation than the water level in the box. The drainpipe must discharge at a water level lower than the lowest level required in the operating box. The incubation boxes that will likely be used in this project require a water level of 1 meter. The steeper the stream gradient, the less pipe is needed to gravity feed the boxes, and the less pipe length, the less the likelihood of freezing (T. Tanner, pers. comm.)

The rate of development of Chinook salmon eggs, alevin and fry is temperature dependent. If the temperature is too low, they will either not develop or they will develop too slowly and by the time they reach the weight at which they can be released they will be at a disadvantage to wild fry. Water temperatures of at least 4°C are required in early incubation and rearing (T. Tanner, pers. comm.).

Water volume is also important. A minimum flow of 60 liters per minute (LPM) is required for incubating 100000 Chinook salmon eggs, and 200 LPM is required for rearing 100000 fry (T. Tanner, pers. comm.). A creek that is subject to extremely high flows at spring runoff is undesirable.

For incubation boxes to be successful, there must be good water quality at the site. The level of suspended solids in the water is especially important during rearing. Too many suspended solids can damage the gills of alevins and fry, leading to infections. Dissolved

heavy metals can be very toxic to fish. Water at incubation sites must fall within the CREMM Guidelines as being suitable for aquatic life. Dissolved oxygen levels at incubation sites must be at least 6mg/L. Higher levels are better. Ammonia is a product of microbiological activity. The toxicity of ammonia is related to pH. As pH increases so does the toxicity of ammonia. The pH levels in the creeks we are evaluating are basic, therefore the acceptable levels of ammonia in these creeks is close to the lower limit of the guidelines, which is 2.2 mg/L.

Of the nine creeks assessed according to the above criteria, the following five were eliminated on the preliminary investigation.

Crooked Creek-- this creek flows northeasterly from its headwaters south of Ethel Lake and empties into the Stewart River near Stewart Crossing. Randy McGinty, who traps along Crooked Creek, stated that sections of Crooked Creek are open all year. However, the gradient of Crooked Creek is too low to provide sufficient head for water to flow through incubation boxes. Also, during spring runoff, water levels in Crooked Creek can be very high and problems with incubation boxes being swept downstream were anticipated.

Mud Creek:-- Mud Creek flows out of Black Lake, which is north of Mayo. Ed Sinnott, who lives beside this creek, stated it flowed all year. However, Mud Creek has a very low gradient and its flow is impeded by several beaver dams.

Moose Creek--The Ten-Mile Gravel Pit road continues north of the Silver Trail Highway for approximately 16 km until it intersects with the upper reaches of Moose Creek. This spot is accessible by road and is a choice spot for setting up a camp. However, the gradient here is very low and the water was silty.

Unnamed Creek three miles east of Stewart Crossing on the Klondike Highway-- Several locals stated that this creek flowed year round, however Tim Dolan, Foreman of the YTG Highway Crew, said that without the heat tape that his crew placed in this creek, it freezes up. Although this creek had a steep gradient, which would allow water to flow through the incubation boxes, the level of water in the creek was very low. There would not be enough flow to provide the minimum amount required for incubation boxes.

Warm Springs at the headwaters of Partridge Creek--Several locals said this spring, which is not extremely hot, feeds into Partridge Creek, keeping the headwaters flowing year round. A helicopter reconnaissance of the area failed to find the warm springs, and also

revealed that there is no road into the area. Because of the distance to the spring and its inaccessibility, it was not considered further.

Further assessment was done on four more creeks. The initial physical and chemical findings at these four creeks are presented in Table 7.

The creeks, which received further assessment, were:

Rusty Creek--This creek arises north of the Silver Trail Highway approximately 15 km east of Stewart Crossing. It flows south into a backwater of the Stewart River. It is accessible approximately 1 km north of the Silver Trail by a side road. Several locals thought that this creek flowed all winter. The physical and chemical parameters that have been measured on Rusty Creek to this point are within the criteria for an incubation box site. This creek is approximately 40 km from Mayo, so the cost of driving here for daily feeding and cleaning must be considered.

McGinty Creek--This creek arises north of the Silver Trail Highway and flows south until it empties into the Stewart River approximately halfway between Mayo and Stewart Crossing. It is accessible where it crosses the Silver Trail Highway. This creek apparently runs year round. Currently, water is being diverted from the creek at a spot approximately 1 km upstream from the highway. This water is piped to Hungry Mountain Farm. Also, locals use water from this creek for drinking. The parameters measured so far on this creek indicate that it would be suitable for an incubation site. This creek is approximately 35 km from Mayo.

Unnamed creek on the Ten-Mile Gravel Pit road--This creek arises north of the Silver Trail and flows southward. It appears to arise from groundwater, and its flow alternates above and below ground. It is accessible approximately 1 km north of the Silver Trail Highway at the site of an old bridge across it. At this location, the parameters measured so far indicate it is an acceptable spot for an incubation site. The temperature at the end of August was 4.0°C. This is the bare minimum required during early incubation and rearing. This site is approximately 16 km from Mayo.

Four-Mile Creek on the Ethel Lake Road--This creek arises south of Ethel Lake and flows southwesterly until it joins Crooked Creek. It is accessible at a bridge site on an old road spur beside the Ethel Lake road. The temperature, pH, dissolved oxygen and flow levels of this creek are within the required limits for incubation box sites. One drawback to this site

is its location. It is 70 km from Mayo, which means it would be necessary to establish a camp here to facilitate the daily feeding and cleaning that must be done during the rearing stage. There is ample space here for a camp.

For all the sites, the length of pipe necessary to provide enough head to fill and empty the boxes by gravity feed was calculated. This pipe length could probably be decreased by minor damming of the creeks to build up water head.

Until all the criteria involved in assessing sites for incubation boxes have been evaluated, a final decision cannot be made on the best location for the boxes. Information that is not available at this time is the water levels of dissolved metals, ammonia, nitrites, and hardness, the winter level of dissolved oxygen, pH, conductivity and turbidity, daily water temperatures for the complete incubation and rearing operation, winter water flows, spring runoff flows and total gas pressure of the water. All this information should be available by spring 1999.

The incubation boxes that will most likely be used in this project are boxes that were previously used by the Stewart Valley Salmon for the Future Society. The Mayo Renewable Resource Council has taken over the assets of the Society and has agreed to loan them for an appropriate project. These boxes are currently located beside the Wareham Dam powerhouse. They were plumbed to receive water that had been warmed coming through the dam turbines. These are being moved because the water contained a lot of sediment, which irritated the gills of the fry and led to bacterial gill disease and fish death.

However, the moving and replumbing of the boxes might be a major job. The water inlet on these boxes is at the same level as the outlet, at the bottom of the boxes. The inlet pipes would have to be moved and the boxes reconstructed in order for the boxes to fill and empty by gravity feed.

An option that might be considered is leaving the boxes in the location they are presently at and attempting to filter or screen the incoming water to reduce the amount of sediment. Yukon Energy would have to agree with this plan as they own the property where the boxes are sitting.

Recommendations:

1. Monitoring of Chinook salmon habitat should continue in the McQuesten River drainage

basin. This should include:

a) monitoring water quality in the mainstem McQuesten River, the South McQuesten River and the North McQuesten River on a regular, consistent basis. In order to add to the existing database and to analyze trends in water quality, a sampling regime should be developed in consultation with the Environmental Protection Service of DFO.

b) yearly evaluations by helicopter of the large logjam near Haggart Creek on the South McQuesten River.

2. Monitoring of the Chinook salmon population in the McQuesten River drainage basin should continue. This should include:

a) annual helicopter spawning surveys of the drainage basin. This could be in conjunction with 1b.

b) juvenile Chinook trapping in the whole McQuesten River drainage basin but especially in the South McQuesten River. This could be in conjunction with 1b.

3. A stock restoration plan for the North McQuesten River should be implemented. This should include:

a) training personnel in all areas of management of a streamside incubation program.

b) selection of a site for streamside incubation boxes and getting the boxes set up.

c) running an incubation and rearing program for the first year with a small number of Chinook salmon eggs to make sure the system is working properly.

d) capturing broodstock by seine net from the lower mainstem McQuesten River.

e) tagging released fry with wire-coded tags for identification when they are caught in the fishery or return to spawn.

f) releasing artificially incubated fry into the North McQuesten River at a weight of .5 grams. They should be transported to the North McQuesten River by helicopter.

g) having a counting weir or other method for assessing stock in place in the North McQuesten River in four years time after the release of the first fry to monitor the success of the incubation program.

4. The water quality and physical habitat of the McQuesten River drainage basin should be given a high level of protection.

Literature Cited

CREEM Guidelines: Prepared by the Task Force on Water Quality Guidelines of the Canadian Council of Ministers of the Environment. Ottawa, Ontario.

Dolan, Tim. Foreman of YTG Highway Crew, Mayo, Yukon.

Ennis, G.L. (Chairman) *et al.*, 1984 *Yukon River Basin Study: Fisheries Work Group Program Report.* Vancouver. Yukon River Basin Study.

Gormican, S., P. Vonk, R. Firth, W. Duval and S. Skey, Yukon Placer Mining Study, Volume II, Reports of Principle Investigators. Prepared for the Yukon Placer Implementation Review Committee, Whitehorse, Yukon by Seakem Group in association with Northwest Hydraulic Consultants Ltd., Aquatic Environments Ltd. and ARA Consulting Group. July, 1992.

Hedmann,D. & Associates, 1995. *Compilation of Environmental Information Pertaining to the McQuesten River Watershed.* Prepared for Water Resources Division, Northern Affairs Program, DIAND, Whitehorse, Yukon.

Faulkner, G. DFO biologist

McGinty, Randy, Stewart Crossing, Yukon.

Milligan, P.A., W.O. Rublee, D.D. Cornett and R.A.C. Johnston. The Distribution and Abundance of Chinook Salmon (*Oncorhynchus tshawytscha*) in the Upper Yukon River Basin as Determined by a Radio-Tagging and Spaghetti Tagging Program: 1982-1983.

Sinnott, Ed, Mayo, Yukon.

Smith, P. 1996. Chinook Salmon (*Oncorhynchus tshawytscha*) spawning and juvenile rearing habitat in Janet Creek: inventory, restoration and utilization. Prepared for the Stewart Valley Salmon for the Future Society and the Yukon River Salmon Restoration and Enhancement Fund.

Smith, P. 1997. Chinook Salmon (*Oncorhynchus tshawytscha)* habitat and population in Crooked Creek. Prepared for the Stewart Valley Salmon for the Future Society and the Yukon River Salmon Restoration and Enhancement Fund.

Tanner, T. DFO biologist.

Vano, L. Whitehorse Rapids Salmon Hatchery Attendant

von Finster, A. DFO biologist.

Table 1. Physical and Chemical Parameters Measured at Habitat Assessment Sites

Location	Dissolved Oxygen	pH	Temperauture °C	Conductivity mhos/cm	Turbidity NTU	Velocity m/s	Substrate P=pebble,C=cobble, B=boulder Sa=sand, S=silt G=gravel
South McQuesten R.							
Christal Ck	11.5	8.9	7.9	376			23%C,35%P,30%G,5%S,5%Sa
Haggart Ck above Holloway	10.3	7.43	10.9	208			10%B,25%C,10%P,15%G,25%Sa,15%S
Haggart Ck below Holloway	10.0	7.86	14.4	247			10%B,15%C,40%P,15%G,5%Sa,15%S
Upstream of Christal Ck	8.8	7.78	18.2	260			5%B,60%C,15%P,10%G,10%Sa
Below Christal Ck		7.66	17.4	283	19.0	.47	
Below Elsa flats	11.9	7.74	15.9	308	34.2		
S Mcquesten Bridge	11.6	7.91	14.8	326	5.8		
Above Seattle Ck	8.4	7.65	13.4	315	1.47		30%C,20%P,30%G,20%Sa
Seattle Ck	11.8	8.6	8.3	252	26.1		10%P,80%G,10%Sa
Below Seattle Ck	9.3	7.75	13.4	313	1.72		10%C,15%P,45%G,5%S
North Mcquesten R.							
Site 1	8.2	7.83	11.1	309	3.8	1.1	20%C,60%P,20%C
Site 2	8.6	7.86	11.2	325	4.4	1.9	50%C,50%P
McQuesten R.							
Ortell's Crossing	9.3	7.65	13.3	339	6.7	.24	
Sunshine Ck	12.2	7.84	6.9	113	1.2		50%B,20%C,10%P,10%G,5%Sa
Site 1 (1998)	10.3	7.88	13.2	303	3.8	0.37	60%P,40%G
Near Bear Ck	11.46	7.74	7.8	142			10%B,30%C,15%P,30%G,10%Sa
Site 2 (1998)	8.8	7.57	13.4	309	5.8	0.8	80%P,20%G
Near Vancouver Ck	8.4	7.66	8.4	252			10%B,20%C,20%P,20%G,20%Sa

Table 2. Water Quality Sites from Certificate of Analysis A9813099

Sample	Dates Sampled
Vancouver Creek , McQuesten R.	Aug 22/97
Below Bear Creek , McQuesten R.	Aug 22/97
Bear Creek, McQuesten R.	Oct 8/97
Above Bear Creek, McQuesten R.	Aug 22/97
40 Mile Creek, McQuesten R.	Aug 22/97
End of 10 mile road, McQuesten R.	Sept 6/97
Mth. N McQuesten R, McQuesten R.	Aug 22/97
Seattle Creek, South McQuesten R	Aug 22/97
Haggart Creek, South McQuesten R.	Aug 22/97
Haggart Creek/McQuesten, South McQuesten R.	Oct 20/97,Oct 28/97
Above McQuesten-Haggart Creek, S. McQuesten R.	Sept 11/97
Elsa Flats, South McQuesten R.	Sept 11/97
Cache Creek, South McQuesten R.	Sept 11/97
Below McBridge, South McQuesten R.	Sept 13/97
McQuesten River Lookout, S. McQuesten R.	Oct 20, Oct 28
McQuesten R, South McQuesten R.	Feb 6/97
Mouth of McQuesten River, South McQuesten River	Jan 21/98
Haggart Creek below mine	Nov 7/98
Haggart Creek above mine	Jan 7/98
Haggart below Dublin Gulch	Jan 7/98
Christal Creek A	Feb 6/98
Christal Creek B	Feb 6/98
Christal Creek Keno	March/98
Christal below Keno A	March/98
Christal below Keno B	March/98
High Creek B1 , B2 and B3	June 25/97, June 28/97

NOTE: Mth of N. McQuesten River is the confluence of the North and South McQuesten Rivers. The end of 10 Mile Road is where the Conservative Trail crosses the McQuesten River. McBridge is the bridge over the South McQuesten. The McQuesten River lookout is near the South McQuesten Bridge. McQuesten R. sampled on Feb6/97,and Haggart Creek/ McQuesten and Above McQuesten-Haggart Creek are a short distance above the South McQuesten Bridge. Mouth of McQuesten R. was mislabeled. This site is actually at the outlet of McQuesten Lake. Haggart Creek below mine was taken on Haggart Creek below Holloways's mine, and Haggart Creek above mine was taken above Holloway's mine. Christal Creek A and B are from Christal Creek near the Hanson Lake road. Christal Creek Keno and Christal below Keno A and B where taken from Christal Creek at the highway crossing near Keno City. High Creek samples were taken to teach water sampling technique.

Table 3. Collection sites for water quality analysis in 1998

Location	Dates Sampled
S. McQuesten R. at Cache Creek	July 20, August 7
S. McQuesten R. at Christal Creek	July 20, August 7
Christal Creek below Keno	July 15, August 7
S. McQuesten R. below Elsa flats	July 7
Haggart Creek	July 15
Haldane Creek	August 7
S. McQuesten R. at bridge	July 3, July 21, July 26, August 19
McQuesten R. at bridge	August 7, August 20
McQuesten R. Site 1 (1998)	August 12
McQuesten R. Site 2 (1998)	August 12
N. McQuesten R. Site 1 (1998)	August 12
N. McQuesten R. Site 2 (1998)	August 12

Tables 4 Synoptic Survey of Water Quality in McQuesten River drainage basin in 1997.

Location	Dissolved Metal which exceeded CREMM Guidelines										
	Al	Cd	Cr	Cu in hard water	Cu in soft water	Fe	Ni in soft water	Pb in hard water	Pb in soft water	Se	Zn
Christal Creek		X				X					X
Haggart Creek below Dublin Gulch						X					
Outlet of McQuesten Lake	X	X			X	X	X		X		X
S. McQuesten R. at Cache Creek	X	X		X		X	X				X
S. McQuesten R. at Haggart Creek	X					X					
S McQuesten Bridge			X								
S. McQuesten R. at Seattle Creek	X		X	X		X			X		
South McQuesten Lookout near bridge										X	
Confluence of North and South McQuesten R.	X										
McQuesten R. near Conservative Trail					X			X			X
McQuesten R. near Bear Creek						X					

Table 5 Trapping results from 1997

Location	Dates Traps were set	Dates Traps were retrieved	Trap	Habitat type	Number of juvenile chinook trapped
South McQuesten bridge	July 23, 1997	July 24, 1997	1	In small log jam	0
			2	Overstream cover	0
			3	Large backeddy	0
			4	Large backeddy	0
Haggart Creek	July 23, 1997	July 24, 1997	1	Overstream cover	0
			2	Overstream cover	0
South McQuesten R. at end of Elsa settling pond road	July 23, 1998	July 24, 1997	1	Pool	0
			2	Instream cover	0
			3	Backeddy, overstream cover	0
			4	Overstream cover	0
South McQuesten R. 63°03'59-135°21'45	August 21, 1997	August 22, 1997	1		0
			2		0
			3		0
			4		0
South McQuesten R. 63°03'17-135°22'25	August 21, 1997	August 22, 1997	1		0
			2		0
			3		0
			4		0
South McQuesten R. 63°59'12-135°27'24	August 21, 1997	August 22, 1997	1		0
			2		0
			3		0
			4		0
South McQuesten R.	August 21, 1997	August 22, 1997	1		0
			2		0
			3		0
			4		0
South McQuesten R. 64°14'17—136°16'39	August 21, 1997	August 22, 1997	1		0
			2		0
			3		0
			4		0

Table 5 continued

North McQuesten R. 63°51'45—-135°27'24	August 21, 1997	August 22, 1997	1		0
			2		0
			3		0
			4		0
North McQuesten R. 63°51'45—-136°22'36	August 21, 1997	August 22, 1997	1		0
			2		0
			3		0
			4		0
North McQuesten R. 64°07'06—136°04'22	August 21, 1997	August 22, 1997	1		0
			2		0
			3		0
North McQuesten R. 64°08'36—136°04'48	August 21, 1997	August 22, 1997	1		0
			2		0
			3		
			4		0
North McQuesten R. 64°14'17—-136°16'39	August 21, 1997	August 22, 1997	1		0
			2		0
			3		0
			4		0
East McQuesten R. 64°06'56—-136°00'43	August 21, 1997	August 22, 1997	1		0
			2		0
			3		0
			4		0
North McQuesten R. 64°07'26—135°58'08	August 21, 1997	August 22, 1997	1		0
			2		0
			3		

Table 6. Trapping Results from 1998

Location	Dates Traps were set	Dates traps were retrieved	Trap #	Habitat Type	Number of Juvenile Chinook salmon	Average fork length (mm)
North McQuesten R 63°50'09- 136°17'52	August 12, 1998	August 14, 1998	1	Glide, cobble/gravel, no cover	17	70
			2	Pool, silt bottom, no cover	5	66
			3	Riffle, cobbles, no cover	1	66
			4	Pool, silt over cobbles, no cover	5	78
North McQuesten R 63°58'37- 136°20'53	August 12, 1998	August 14, 1998	1	Glide, cobbles, instream cover	0	
			2	Riffle, gravel, no cover	6	68
			3	Pool, silt, no cover	2	66
			4	Glide, cobble/gravel, instream cover	4	70
McQuesten R 63°45'51 136°33'59	August 12, 1998	August 14, 1998	1	Glide, cobbles, no cover	10	64
			2	Riffle, cobbles, no cover	68	64
			3	Riffle, cobbles, no cover	46	65
			4	Glide, gravel, instream cover	53	62
McQuesten R 63°39'09- 136°53'19	August 12, 1998	August 14, 1998	1	Riffle, cobbles, no cover	90	69
			2	Swift riffle, cobbles, no cover	1	64
			3	Glide, cobbles, overstream cover	11	63
			4	Slow riffle, cobbles, no cover	118	61
South Mcquesten Bridge	August 31, 1998	September 2, 1998	1		0	
			2		2	
Mcquesten river at bridge on Klondike Highway	August 31,1998	September 2,1998	1		4	
			2		2	

Table 7. Physical and chemical parameters of potential incubation box sites.

Location	August water temp C	pH	dissolved oxygen mg/L	conduct. mhos/s	turbidity NYU	average creek depth m	creek width m	steam velocity m/s	creek flow LPM	stream gradient	pipe nec. for 1 m drop (m)	fish presence
Rusty Creek	4.3	7.58	8.3	322	4.8	0.18	1.3	0.48	6740	6%	16.7	no
Ten Mile Gravel Pit Creek	4	7.65	8.2	306	2.4	0.07	0.6	0.29	730	4%	25	no
Ethel Lake Rd Creek	4.7	7.89	7.8	204	2.8	0.1	1.8	0.9	9600	8%	12.5	no
McGinty Creek	4.6	7.72	8.1	213	2.6	0.06	1.45	0.69	3600	5%	20	no

Appendix 1. Raw data from habitat assessment sites, 1997 and 1998

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

SITE CODE: _____ RECORDER'S NAME(s): Ronalda M #11

DATE (ddmmyy): 07/16/97 TIME of DAY: 3:05 p.m.

LOCATION Sunshine Creek / McQuesten River.

PHOTO NUMBER(S) (film/exps): _____

WEATHER Cloudy/ Fair AIR TEMPERATURE 16.3 °C

CLOUD COVER 100 % RAIN IN LAST WEEK ? Y ☒ N ☐

GPS: 63° 47 57 N 136° 29 34 W

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% ☐ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)		
trees (<10m)		
shrubs / vines		
herbaceous		

Vegetation shading of river[3]: <5% ☐ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover; may total >100%. [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

Stream Width[4] (m) 1 14 ft 7½ 2 14 ft 3 in 3 14 feet Min _____ Max _____

bank width[5] (m) 1 20 ft 15 in 2 18 ft 8 in 3 18 ft 3½ Min _____ Max _____

bank height (m)[6] 1 2 feet 1½ 2 2 feet 3 2 feet Min _____ Max _____

REACH HABITAT CLASSIFICATION

% in Reach: Riffle= 90 Edge[7]= ∅ Pool= ∅ Plants= 5 Run= 5

FROM CENTER RIFFLE:

Water Temperature (°C): 6.9 Conductivity (mS/cm): 113

pH: 7.84 Dissolved Oxygen (mg/l): 12.2 Turbidity (NTU) 1.20

[4] From edges of water [5] From tops of banks [6] From water surface vertical to top of bank [7] Length of both banks as % of reach length which can be effectively sampled with sweep net

DISCHARGE AT CENTER TRANSECT

13.42 11.51

Reading	Transect Position (m)	Depth (cm)	Flow (cm/s; revs/30s)
1.			13.42
2.			11.51
3.			10.54
4.			10.26
5.			11.85
6.			
7.			
8.			
9.			
10.			

GENERAL OBSERVATIONS: CIRCLE YOUR CHOICE(S)

WATER ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. sterile

WATER OILS: 1. slick 2. sheen 3. globs 4. flecks 5. none

TURBIDITY: 1. clear 2. slight 3. turbid 4. opaque

PLUME: 1. little 2. some 3. lots

(amount of fine sediment generated when kick-sampling)

SEDIMENT OILS: 1. absent 2. light 3. moderate 4. profuse

SEDIMENT ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. anaerobic 6. none 7. other _____

FLOW LEVEL: (relative to "water mark" i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

1. No flow (dry / isolated) 2. Low (<water mark) 3. Moderate (=) 4. High (>water mark) 5. Flood

Bare ground above water mark: Left bank 0 % Right bank 0 %

Are the undersides of stones which are not deeply embedded black? 1. yes 2. no

SEDIMENT DEPOSITS: 1. none 2. sludge 3. sawdust 4. paper fibre 5. sand 6. relict shells 7. other _____

LOCAL CATCHMENT EROSION: 1. none 2. moderate 3. heavy

LOCAL NonPointSource POLLUTION: 1. no evidence 2. potential _____ 3. obvious _____

DAMS / BARRIERS: 1. present (upstream / downstream) 2. absent

CHANNELIZATION: 1. yes (no. of channels = _____) 2. no

SITE CLASSIFICATION: 1. steep valley 2. broad valley 3. wetland/bog

LANDUSE: Left Bank 1. Forest 2. Forestry 3. Native pasture 4. Grazing 5. Cropped 6. Residential 7. Commercial 8. Industrial 9. Recreational

BARS: (bed surface protruding from water & forming a bar) _____ %

ADDITIONAL NOTES ON SITE:

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

SITE CODE: _____ RECORDER'S NAME(s): Ronalda M #11

DATE (ddmmyy): 07/16/97. TIME of DAY: 3:05 p.m.

LOCATION Sunshine Creek / McquestenRiver.

PHOTO NUMBER(S) (film/exps): _____

WEATHER Cloudy/ Fair AIR TEMPERATURE 16.3 °C

CLOUD COVER 100 % RAIN IN LAST WEEK ? Y ☒ N ☐

GPS: 63° 47 57 N 136° 29 34 W

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% ☐ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)		
trees (<10m)		
shrubs / vines		
herbaceous		

Vegetation shading of river[3]: <5% ☐ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover, may total >100%. [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

Stream Width[4] (m) 1 14 ft 7½ 2 14 ft 3 inch 3 14 feet Min _____ Max _____

bank width[5] (m) 1 26 ft 15 inch 2 18 ft 8 inch 3 18 ft 3½ Min _____ Max _____

bank height (m) [6] 1 2 feet 1½ 2 2 feet 3 2 feet Min _____ Max _____

REACH HABITAT CLASSIFICATION

% in Reach: Riffle= 90 Edge[7]= Ø Pool= Ø Plants= 5 Run= 5

FROM CENTER RIFFLE:

Water Temperature (°C): 6.9 Conductivity (mS/cm): 113

pH: 7.84 Dissolved Oxygen (mg/l): 12.2 Turbidity (NTU) 1.20

[4] From edges of water [5] From tops of banks [6] From water surface vertical to top of bank. [7] Length of both banks as % of reach length which can be effectively sampled with sweep net

AL REACH SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		0 %	9.5	*Boulder*	(>256mm)	50 %	9.0
Cobble	(64-256mm)	20 %	6.5	*Pebble*	(16-64mm)	10 %	4.5
Gravel	(2-16mm)	10 %	2.0	*Sand*	(0.06-2mm)	5 %	2.0
Silt	(0.004-0.06mm)	____ %	6.5	*Clay*	(<0.004mm)	____ %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) 10 %

Muck/Mud (black, very fine organics) 0 %

Periphyton	0	1	(2)	3	4	(percent of reach covered by)
Moss	(0)	1	2	3	4	(percent of reach covered by)
Filamentous algae	0	1	(2)	3	4	(percent of reach covered by)
Macrophytes	(0)	1	2	3	4	(percent of reach covered by)

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

RIFFLE ONLY SUBSTRATUM DESCRIPTION: Same as above

			PHI				PHI
Bedrock		____ %	9.5	*Boulder*	(>256mm)	____ %	9.0
Cobble	(64-256mm)	____ %	6.5	*Pebble*	(16-64mm)	____ %	4.5
Gravel	(2-16mm)	____ %	2.0	*Sand*	(0.06-2mm)	____ %	2.0
Silt	(0.004-0.06mm)	____ %	6.5	*Clay*	(<0.004mm)	____ %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) ____ %

Muck/Mud (black, very fine organics) ____ %

Periphyton	0	1	2	3	4	(percent of reach covered by)
Moss	0	1	2	3	4	(percent of reach covered by)
Filamentous algae	0	1	2	3	4	(percent of reach covered by)
Macrophytes	0	1	2	3	4	(percent of reach covered by)

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

MACROINVERTEBRATES COLLECTED BY: Edward

METHOD (e.g. (kicknet), T-sampler): ____

Length or area of riffle sampled: 10 m

Sample preserved in field? Y ☒ N ☐

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

SITE CODE: _____ RECORDER'S NAME(s): Ronalda m

DATE (ddmmyy): 15/7/97 TIME of DAY: 3:09 pm

LOCATION below Seattle Creek #7

PHOTO NUMBER(S) (film/exps): Ø

WEATHER Fair AIR TEMPERATURE _____ °C

CLOUD COVER 100 % RAIN IN LAST WEEK ? Y ☑ N ☐

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% ☐ 6-25% ☐ 26-50% ☐ 51-75% ☑ >76% ☐

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)	30	
trees (<10m)	5	
shrubs / vines	10	
herbaceous	10	

Vegetation shading of river[3]: <5% ☑ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover, may total >100%. [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

	1	2	3	Min	Max
Stream Width[4] (m)					
bank width[5] (m)					
bank height (m)[6]					

REACH HABITAT CLASSIFICATION

% in Reach: Riffle= Ø Edge[7]= Ø Pool= 30 Plants= Ø Run= 90

FROM CENTER RIFFLE:

Water Temperature (°C): 13.4 Conductivity (mS/cm): 313

pH: 7.75 Dissolved Oxygen (mg/l): 9.3 Turbidity (NTU) 1.72

[4] From edges of water [5] From tops of banks [6] From water surface vertical to top of bank [7] Length of both banks as % of reach length which can be effectively sampled with sweep net

/TAL REACH SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		Ø %	9.5	*Boulder*	(>256mm)	Ø %	9.0
Cobble	(64-256mm)	10 %	6.5	*Pebble*	(16-64mm)	15 %	4.5
Gravel	(2-16mm)	45 %	2.0	*Sand*	(0.06-2mm)	5 %	2.0
Silt	(0.004-0.06mm)	30 %	6.5	*Clay*	(<0.004mm)	Ø %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)
Detritus (sticks, wood, CPOM) 5 %
Muck/Mud (black, very fine organics) 5 %

Periphyton	0	1	2	3	4	**(percent of reach covered by)**
Moss	0	1	2	3	4	**(percent of reach covered by)**
Filamentous algae	0	1	2	3	4	**(percent of reach covered by)**
Macrophytes	0	1	2	3	4	**(percent of reach covered by)**

0= <10% 1=10-35% 2=35-65% 3=65-90% 4=>90%

RIFFLE ONLY SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		____ %	9.5	*Boulder*	(>256mm)	____ %	9.0
Cobble	(64-256mm)	____ %	6.5	*Pebble*	(16-64mm)	____ %	4.5
Gravel	(2-16mm)	____ %	2.0	*Sand*	(0.06-2mm)	____ %	2.0
Silt	(0.004-0.06mm)	____ %	6.5	*Clay*	(<0.004mm)	____ %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)
Detritus (sticks, wood, CPOM) ____ %
Muck/Mud (black, very fine organics) ____ %

Same as above

Periphyton	0	1	2	3	4	(percent of reach covered by)
Moss	0	1	2	3	4	(percent of reach covered by)
Filamentous algae	0	1	2	3	4	(percent of reach covered by)
Macrophytes	0	1	2	3	4	(percent of reach covered by)

0= <10% 1=10-35% 2=35-65% 3=65-90% 4=>90%

MACROINVERTEBRATES COLLECTED BY: Smac

METHOD (e.g. kicknet, T-sampler): Kicknet

Length or area of riffle sampled: ____

Sample preserved in field? Y ☑ N ☐

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

SITE CODE: _____ RECORDER'S NAME(s): ; Me

DATE (ddmmyy): July 26/98 TIME of DAY: 2:05 pm

LOCATION MCQ River Below christie creek

PHOTO NUMBER(S) (film/exps): _____

WEATHER cloudy AIR TEMPERATURE 17.0°C

CLOUD COVER 25 % RAIN IN LAST WEEK ? Y ☑ N ☐

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% ☑ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)	25	
trees (<10m)	25	
shrubs / vines	~~30~~ 25	
herbaceous	25	

Vegetation shading of river[3]: <5% ☐ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover; may total >100%. [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

	1	2	3	Min	Max
Stream Width[4] (m)	15	17.5	20	15	20
bank width[5] (m)	15	18	25	15	25
bank height (m)[6]	3	3.3	3.5	3ft	3.5

REACH HABITAT CLASSIFICATION

% in Reach: Riffle= 65 Edge[7]= Ø Pool= 15 Plants= Ø Run= 75

FROM CENTER RIFFLE:

Water Temperature (°C): 17.4 Conductivity (mS/cm): 283

pH: 7.66 Dissolved Oxygen (mg/l): 34.8 ? Turbidity (NTU) 15

[4] From edges of water. [5] From tops of banks. [6] From water surface vertical to top of bank. [7] Length of both banks as % of reach length which can be effectively sampled with sweep net.

DISCHARGE AT CENTER TRANSECT

30 sec

Reading	Transect Position (m)	Depth (cm)	Flow (cm/s; revs/30s)	Velocity m/s
1.	.5 ft		32	.33
2.	.2 ft		56	.86
3.	.2 ft		33	.34
4.	2.5 ft		44	.45
5.	2.0 ft		25	.26
6.	2.6 ft		60	.60
7.				
8.				
9.				
10.				

$\bar{x} = .47 m/s$

GENERAL OBSERVATIONS: CIRCLE YOUR CHOICE(S)

WATER ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. sterile

WATER OILS: 1. slick 2. sheen 3. globs 4. flecks 5. none

TURBIDITY: 1. clear 2. slight 3. turbid 4. opaque

PLUME: 1. little 2. some 3. lots

(amount of fine sediment generated when kick-sampling)

SEDIMENT OILS: 1. absent 2. light 3. moderate 4. profuse

SEDIMENT ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. anaerobic

6. none 7. other _____

FLOW LEVEL: (relative to "water mark" i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

1. No flow (dry / isolated) 2. Low (<water mark) 3. Moderate (=) 4. High (>water mark) 5. Flood

Bare ground above water mark: Left bank 5 % Right bank 15 %

Are the undersides of stones which are not deeply embedded black? 1. yes 2. no

SEDIMENT DEPOSITS: 1. none 2. sludge 3. sawdust 4. paper fibre 5. sand

6. relict shells 7. other _____

LOCAL CATCHMENT EROSION: 1. none 2. moderate 3. heavy

LOCAL NonPointSource POLLUTION: 1. no evidence 2. potential _____ 3. obvious _____

DAMS / BARRIERS: 1. present (upstream / downstream) 2. absent

CHANNELIZATION: 1. yes (no. of channels = _____) 2. no

SITE CLASSIFICATION: 1. steep valley 2. broad valley 3. wetland/bog

LANDUSE: 1. Forest 2. Forestry 3. Native pasture 4. Grazing 5. Cropped

Left Bank 6. Residential 7. Commercial 8. Industrial 9. Recreational

BARS: (bed surface protruding from water & forming a bar) _____%

ADDITIONAL NOTES ON SITE:

Cat trail across river due to forestry fires management

TOTAL REACH SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		_____%	9.5	*Boulder*	(>256mm)	_____%	9.0
Cobble	(64-256mm)	_____%	6.5	*Pebble*	(16-64mm)	_____%	4.5
Gravel	(2-16mm)	_____%	2.0	*Sand*	(0.06-2mm)	_____%	2.0
Silt	(0.004-0.06mm)	_____%	6.5	*Clay*	(<0.004mm)	_____%	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) _____%

Muck/Mud (black, very fine organics) _____%

Periphyton	0	1	2	3	4	**(percent of reach covered by)**
Moss	0	1	2	3	4	**(percent of reach covered by)**
Filamentous algae	0	1	2	3	4	**(percent of reach covered by)**
Macrophytes	0	1	2	3	4	**(percent of reach covered by)**

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

RIFFLE ONLY SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		_____%	9.5	*Boulder*	(>256mm)	_____%	9.0
Cobble	(64-256mm)	_____%	6.5	*Pebble*	(16-64mm)	_____%	4.5
Gravel	(2-16mm)	_____%	2.0	*Sand*	(0.06-2mm)	_____%	2.0
Silt	(0.004-0.06mm)	_____%	6.5	*Clay*	(<0.004mm)	_____%	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) 3 %

Muck/Mud (black, very fine organics) 15 %

Periphyton	0	1	2	3	4	**(percent of reach covered by)**
Moss	0	1	2	3	4	**(percent of reach covered by)**
Filamentous algae	0	1	2	3	4	**(percent of reach covered by)**
Macrophytes	0	1	2	3	4	**(percent of reach covered by)**

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

MACROINVERTEBRATES COLLECTED BY: None collected

METHOD (e.g. kicknet, T-sampler): _____

Length or area of riffle sampled: 10 m

Sample preserved in field? Y ☐ **N** ☑

(1) 8 cm - 4.9 (6) 12.8 - 9.5

(2) 4.5 - 2.6 (7) 6. - 4.8

(3) 7.7 - 4.8 (8) 9.8 - 7

(4) 11.9 - 11.2 (9) 7.5 - 6.3

(5) 7.7 - 6.5 (10) 2.9 - 2

SITE CODE: _____

DATE: _____

HABITAT ASSESSMENT FIELD DATA SHEET

CIRCLE ONE CHOICE FOR EACH OF THE NINE HABITAT DESCRIPTORS

	CATEGORY			
Habitat Variable	Excellent	Good	Fair	Poor
1. Bottom substrate/available cover	Greater than 50% rubble, gravel, submerged logs, undercut banks or other stable habitat 20, 19, 18, 17, 16	30-50% **15, 14, 13, 12, 11**	10-30% **10, 9, 8, 7, 6**	Less than 10% **5, 4, 3, 2, 1, 0**
2. Embeddedness	Gravel, cobble and boulder particles are between 0 & 25% surrounded by fine sediment 20, 19, 18, 17, 16	Gravel, cobble and boulder particles are between 25 & 50% surrounded by fine sediment **15, 14, 13, 12, 11**	Gravel, cobble and boulder particles are between 50 & 75% surrounded by fine sediment **10, 9, 8, 7, 6**	Gravel, cobble and boulder particles are over 75% surrounded by fine sediment **5, 4, 3, 2, 1, 0**
3. Velocity/depth	Slow deep (<0.3 m/s & >0.5m); Slow shallow; Fast deep; Fast shallow; habitats all present 20, 19, 18, 17, 16	Only 3 of the four habitat categories present (missing riffles or runs receive lower score than missing pools) **15, 14, 13, 12, 11**	Only 2 of the four habitat categories present (missing riffles/ runs receive lower score) **10, 9, 8, 7, 6**	Dominating by one velocity/depth category (usually pool) **5, 4, 3, 2, 1, 0**
4. Channel alteration	Little or no enlargement of islands or point bars and/or no channelisation 15, 14, 13, 12	Some new increase in bar formation, mostly from coarse gravel; and/or some channelisation present **11, 10, 9, 8**	Moderate deposition of new gravel, coarse sand, on old and new bars; pools partly filled w/silt; and/or embankments on both banks **7, 6, 5, 4**	Heavy deposits of fine materials, increased bar development; most pools filled with silt; and/or extensive channelisation **3, 2, 1, 0**
5. Bottom scouring and deposition	Less than 5% of the bottom affected by scouring and deposition 15, 14, 13, 12	5-30% affected. Scours at constrictions and where grades steepen, some deposition in pools **11, 10, 9, 8**	30-50% affected. Deposits and scours at obstruction and bends. Some deposition in pools. **7, 6, 5, 4**	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed **3, 2, 1, 0**
6. Pool/riffle index. *(Distance between riffles divided by stream width)*	0-7 Variety of habitat. Deep riffles and pools 15, 14, 13, 12	7-15 Adequate depth in pools and riffles. Bends provide habitat **11, 10, 9, 8**	15-25 Occasional riffle or bend. Bottom contours provide some habitat. **7, 6, 5, 4**	>25 Essentially a straight stream. Generally all flat water or shallow riffle. **3, 2, 1, 0**
7. Bank stability	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. 10, 9	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. **8, 7, 6**	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. **5, 4, 3**	Unstable. Many eroded areas. Side slopes > 60% common. "Raw" areas frequent along straight sections and bends. **2, 1, 0**
8. Bank vegetative stability	Over 80% of the streambank surfaces covered vegetation, gravel, or larger material. 10, 9	50-79% of the streambank surfaces covered by vegetation, gravel, or larger material **8, 7, 6**	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. **5, 4, 3**	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. **2, 1, 0**
9. Streamside cover	Dominant vegetation trees. 10, 9	Dominant vegetation shrubs. 8, 7, 6	Dominant vegetation is herbaceous. **5, 4, 3**	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings **2, 1, 0**

From US EPA RBA Protocols 1989; updated May 1996 by R Bailey

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

SITE CODE: _____ RECORDER'S NAME(s): Ronalda

DATE (ddmmyy): 31/7/98 TIME of DAY: 12:38pm

LOCATION Ortell's Crossing

PHOTO NUMBER(S) (film/exps): _____

WEATHER Sunny AIR TEMPERATURE _____ °C

CLOUD COVER 15 % RAIN IN LAST WEEK ? Y ☒ N ☐

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% ☐ 6-25% ☐ 26-50% ☐ 51-75% ☒ >76% ☐

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)	30	
trees (<10m)	50	
shrubs / vines	10	
herbaceous	10	

Vegetation shading of river[3]: <5% ☐ 6-25% ☐ 26-50% ☒ 51-75% ☐ >76% ☐

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover, may total >100%. [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

	1	2	3	Min	Max
Stream Width[4] (m)	60 ft				
bank width[5] (m)					
bank height (m)[6]					

REACH HABITAT CLASSIFICATION

% in Reach: Riffle= 5 Edge[7]= 0 Pool= 10 Plants= 40 Run= 50

FROM CENTER RIFFLE:

Water Temperature (°C): 13.3 Conductivity (mS/cm): 339

pH: 7.65 Dissolved Oxygen (mg/l): 9.3 Turbidity (NTU) 6.7

[4] From edges of water [5] From tops of banks [6] From water surface vertical to top of bank [7] Length of both banks as % of reach length which can be effectively sampled with sweep net

DISCHARGE AT CENTER TRANSECT

Reading	Transect Position (m)	Depth (cm)	Flow (cm/s, revs/30s)	velocity m/s
1.			17	.18
2.			26	.27
3.			19	.20
4.			25	.26
5.			24	.25
6.			28	.29
7.				
8.				
9.				
10.				

$\bar{x}$ = .24 m/s

GENERAL OBSERVATIONS: CIRCLE YOUR CHOICE(S)

WATER ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. sterile

WATER OILS: 1. slick 2. sheen 3. globs 4. flecks 5. none

TURBIDITY: 1. clear 2. slight 3. turbid 4. opaque

PLUME: 1. little 2. some 3. lots

(amount of fine sediment generated when kick sampling)

SEDIMENT OILS: 1. absent 2. light 3. moderate 4. profuse

SEDIMENT ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. anaerobic 6. none 7. other _____

FLOW LEVEL: (relative to "water mark" i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

1. No flow (dry / isolated) 2. Low (<water mark) 3. Moderate (=) 4. High (>water mark) 5. Flood

Bare ground above water mark: Left bank 0 % Right bank 15 %

Are the undersides of stones which are not deeply embedded black? 1. yes 2. no

SEDIMENT DEPOSITS: 1. none 2. sludge 3. sawdust 4. paper fibre 5. sand 6. relict shells 7. other _____

LOCAL CATCHMENT EROSION: 1. none 2. moderate 3. heavy

LOCAL NonPointSource POLLUTION: 1. no evidence 2. potential _____ 3. obvious _____

DAMS / BARRIERS: 1. present (upstream / downstream) 2. absent

CHANNELIZATION: 1. yes (no. of channels = _____) 2. no

SITE CLASSIFICATION: 1. steep valley 2. broad valley 3. wetland/bog

LANDUSE: Left Bank 1. Forest 2. Forestry 3. Native pasture 4. Grazing 5. Cropped 6. Residential 7. Commercial 8. Industrial 9. Recreational

BARS: (bed surface protruding from water & forming a bar) 0 %

ADDITIONAL NOTES ON SITE:

Bridge over [illegible]

TOTAL REACH SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		_____%	9.5	*Boulder*	(>256mm)	_____%	9.0
Cobble	(64-256mm)	_____%	6.5	*Pebble*	(16-64mm)	_____%	4.5
Gravel	(2-16mm)	_____%	2.0	*Sand*	(0.06-2mm)	_____%	2.0
Silt	(0.004-0.06mm)	_____%	6.5	*Clay*	(<0.004mm)	_____%	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) 10 %

Muck/Mud (black, very fine organics) 50 %

Periphyton	0	1	2	3	4	**(percent of reach covered by)**
Moss	0	1	2	3	4	**(percent of reach covered by)**
Filamentous algae	0	1	2	3	4	**(percent of reach covered by)**
Macrophytes	0	1	2	3	4	**(percent of reach covered by)**

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

RIFFLE ONLY SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		_____%	9.5	*Boulder*	(>256mm)	_____%	9.0
Cobble	(64-256mm)	_____%	6.5	*Pebble*	(16-64mm)	_____%	4.5
Gravel	(2-16mm)	_____%	2.0	*Sand*	(0.06-2mm)	_____%	2.0
Silt	(0.004-0.06mm)	_____%	6.5	*Clay*	(<0.004mm)	_____%	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) _____%

Muck/Mud (black, very fine organics) _____%

Periphyton	0	1	2	3	4	**(percent of reach covered by)**
Moss	0	1	2	3	4	**(percent of reach covered by)**
Filamentous algae	0	1	2	3	4	**(percent of reach covered by)**
Macrophytes	0	1	2	3	4	**(percent of reach covered by)**

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

MACROINVERTEBRATES COLLECTED BY: _____

METHOD (e.g. kicknet, T-sampler): _____

Length or area of riffle sampled: _____

Sample preserved in field? Y ☐ N ☐

SITE CODE: _____

DATE: _____

HABITAT ASSESSMENT FIELD DATA SHEET

CIRCLE ONE CHOICE FOR EACH OF THE NINE HABITAT DESCRIPTORS

	CATEGORY			
Habitat Variable	Excellent	Good	Fair	Poor
1. Bottom substrate/available cover	Greater than 50% rubble, gravel, submerged logs, undercut banks or other stable habitat **20, 19, 18, 17, 16**	30-50% **15, 14, 13, 12, 11**	10-30% **10, 9, 8, 7, 6**	Less than 10% **5, 4, 3, 2, 1, 0**
2. Embeddedness	Gravel, cobble and boulder particles are between 0 & 25% surrounded by fine sediment **20, 19, 18, 17, 16**	Gravel, cobble and boulder particles are between 25 & 50% surrounded by fine sediment **15, 14, 13, 12, 11**	Gravel, cobble and boulder particles are between 50 & 75% surrounded by fine sediment **10, 9, 8, 7, 6**	Gravel, cobble and boulder particles are over 75% surrounded by fine sediment **5, 4, 3, 2, 1, 0**
3. Velocity/depth	Slow deep (<0.3 m/s & >0.5m); Slow shallow; Fast deep; Fast shallow; habitats all present **20, 19, 18, 17, 16**	Only 3 of the four habitat categories present (missing riffles or runs receive lower score than missing pools) **15, 14, 13, 12, 11**	Only 2 of the four habitat categories present (missing riffles/ runs receive lower score) **10, 9, 8, 7, 6**	*Dominating by one velocity/depth category (usually pool) **5, 4, 3, 2, 1, 0**
4. Channel alteration	Little or no enlargement of islands or point bars and/or no channelisation **15, 14, 13, 12**	Some new increase in bar formation, mostly from coarse gravel; and/or some channelisation present **11, 10, 9, 8**	Moderate deposition of new gravel, coarse sand, on old and new bars; pools partly filled w/silt; and/or embankments on both banks **7, 6, 5, 4**	Heavy deposits of fine materials, increased bar development; most pools filled with silt, and or extensive channelisation **3, 2, 1, 0**
5. Bottom scouring and deposition	Less than 5% of the bottom affected by scouring and deposition **15, 14, 13, 12**	5-30% affected. Scours at constrictions and where grades steepen, some deposition in pools **11, 10, 9, 8**	30-50% affected. Deposits and scours at obstruction and bends. Some deposition in pools. **7, 6, 5, 4**	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed **3, 2, 1, 0**
6. Pool/riffle index *(Distance between riffles divided by stream width)*	0-7 Variety of habitat. Deep riffles and pools **15, 14, 13, 12**	7-15 Adequate depth in pools and riffles. Bends provide habitat **11, 10, 9, 8**	15-25 Occasional riffle or bend. Bottom contours provide some habitat **7, 6, 5, 4**	>25 Essentially a straight stream. Generally all flat water or shallow riffle. **3, 2, 1, 0**
7. Bank stability	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. **10, 9**	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. **8, 7, 6**	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. **5, 4, 3**	Unstable. Many eroded areas. Side slopes > 60% common. "Raw" areas frequent along straight sections and bends. **2, 1, 0**
8. Bank vegetative stability	Over 80% of the streambank surfaces covered vegetation, gravel, or larger material. **10, 9**	50-79% of the streambank surfaces covered by vegetation, gravel, or larger material **8, 7, 6**	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. **5, 4, 3**	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. **2, 1, 0**
9. Streamside cover	Dominant vegetation trees. **10, 9**	Dominant vegetation shrubs. **8, 7, 6**	Dominant vegetation is herbaceous. **5, 4, 3**	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge* materials, culverts, or mine tailings **2, 1, 0**

From US EPA RBA Protocols 1989; updated May 1996 by R Bailey

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

SITE CODE: _____ RECORDER'S NAME(s): _____

DATE (ddmmyy): 12/8/98 TIME of DAY: 3:25pM

LOCATION ~~[illegible]~~ McQuesten Site 1 63° 45' 51 / 136° 33' 09

PHOTO NUMBER(S) (film/exps): _____

WEATHER cloudy AIR TEMPERATURE 16.7 °C

CLOUD COVER 90 % RAIN IN LAST WEEK ? Y ☐ N ☐

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% ☐ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)		
trees (<10m)		
shrubs / vines		
herbaceous		

Vegetation shading of river[3]: <5% ☐ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover, may total >100%. [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

	1	2	3	Min	Max
Stream Width[4] (m)					
bank width[5] (m)					
bank height (m)[6]					

REACH HABITAT CLASSIFICATION

% in Reach: Riffle= _____ Edge[7]= _____ Pool= _____ Plants= _____ Run= _____

FROM CENTER RIFFLE:

Water Temperature (°C): 13.2 Conductivity (mS/cm): 303

pH: 7.88 Dissolved Oxygen (mg/l): ~~[illegible]~~ 10.3 Turbidity (NTU) ~~10.3~~ 38

[4] From edges of water [5] From tops of banks [6] From water surface vertical to top of bank [7] Length of both banks as % of reach length which can be effectively sampled with sweep net

time [illegible] a known distance

DISCHARGE AT CENTER TRANSECT

Reading	Transect Position (m)	Depth (cm)	~~Flow (cm/s; revs/30s)~~ Time
1.	10 m	29 cm	30s
2.			25 s
3.			25s
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Velocity

- .3 m/s
- .4 m/s
- .4 m/s

$\bar{x}$ velocity = ~~[illegible]~~ .37 m/s

GENERAL OBSERVATIONS: CIRCLE YOUR CHOICE(S)

WATER ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. sterile

WATER OILS: 1. slick 2. sheen 3. globs 4. flecks 5. none

TURBIDITY: 1. clear 2. slight 3. turbid 4. opaque

PLUME: 1. little 2. some 3. lots

(amount of fine sediment generated when kick sampling)

SEDIMENT OILS: 1. absent 2. light 3. moderate 4. profuse

SEDIMENT ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. anaerobic 6. none 7. other _____

FLOW LEVEL: (relative to "water mark" i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

1. No flow (dry / isolated) 2. Low (<water mark) 3. Moderate (=) 4. High (>water mark) 5. Flood

Bare ground above water mark: Left bank _____% Right bank _____%

Are the undersides of stones which are not deeply embedded black? 1. yes 2. no

SEDIMENT DEPOSITS: 1. none 2. sludge 3. sawdust 4. paper fibre 5. sand 6. relict shells 7. other _____

LOCAL CATCHMENT EROSION: 1. none 2. moderate 3. heavy

LOCAL NonPointSource POLLUTION: 1. no evidence 2. potential _____ 3. obvious _____

DAMS / BARRIERS: 1. present (upstream / downstream) 2. absent

CHANNELIZATION: 1. yes (no. of channels = _____) 2. no

SITE CLASSIFICATION: 1. steep valley 2. broad valley 3. wetland/bog

LANDUSE: Left Bank 1. Forest 2. Forestry 3. Native pasture 4. Grazing 5. Cropped 6. Residential 7. Commercial 8. Industrial 9. Recreational

BARS: (bed surface protruding from water & forming a bar) _____%

ADDITIONAL NOTES ON SITE:

TOTAL REACH SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		____ %	9.5	*Boulder*	(>256mm)	____ %	9.0
Cobble	(64-256mm)	____ %	6.5	*Pebble*	(16-64mm)	60 %	4.5
Gravel	(2-16mm)	40 %	2.0	*Sand*	(0.06-2mm)	____ %	2.0
Silt	(0.004-0.06mm)	____ %	6.5	*Clay*	(<0.004mm)	____ %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) ____ %

Muck/Mud (black, very fine organics) ____ %

Periphyton	0	1	2	3	4	(percent of reach covered by)
Moss	0	1	2	3	4	(percent of reach covered by)
Filamentous algae	0	1	2	3	4	(percent of reach covered by)
Macrophytes	0	1	2	3	4	(percent of reach covered by)

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

(1) 1.2 x 1.8 cm ~~cobble~~ gravel
(2) 2.1 x 1.2 cm ~~cobble~~ gravel
(3) 2.3 x 1.3 cm ~~cobble~~ pebble
(4) 2.5 x 1.8 cm ~~cobble~~ pebble
(5) 2.9 x 2.3 cm pebble
(6) 3.8 x 2.6 cm ~~boulder~~ pebble
(7) 2.6 x 1.6 cm pebble
(8) 1.5 x 1.1 cm gravel
(9) 2.2 x 1.3 cm gravel
(10) 2.5 x 2.8 cm pebble

RIFFLE ONLY SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		____ %	9.5	*Boulder*	(>256mm)	____ %	9.0
Cobble	(64-256mm)	____ %	6.5	*Pebble*	(16-64mm)	____ %	4.5
Gravel	(2-16mm)	____ %	2.0	*Sand*	(0.06-2mm)	____ %	2.0
Silt	(0.004-0.06mm)	____ %	6.5	*Clay*	(<0.004mm)	____ %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) ____ %

Muck/Mud (black, very fine organics) ____ %

Periphyton	0	1	2	3	4	(percent of reach covered by)
Moss	0	1	2	3	4	(percent of reach covered by)
Filamentous algae	0	1	2	3	4	(percent of reach covered by)
Macrophytes	0	1	2	3	4	(percent of reach covered by)

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

MACROINVERTEBRATES COLLECTED BY: _____

METHOD (e.g. kicknet, T-sampler): _____

Length or area of riffle sampled: _____

Sample preserved in field? Y ☐ N ☐

SITE CODE: _____

DATE: _____

HABITAT ASSESSMENT FIELD DATA SHEET

CIRCLE ONE CHOICE FOR EACH OF THE NINE HABITAT DESCRIPTORS

	CATEGORY			
Habitat Variable	Excellent	Good	Fair	Poor
1. Bottom substrate/available cover	Greater than 50% rubble, gravel, submerged logs, undercut banks or other stable habitat **20, 19, 18, 17, 16**	30-50% **15, 14, 13, 12, 11**	10-30% **10, 9, 8, 7, 6**	Less than 10% **5, 4, 3, 2, 1, 0**
2. Embeddedness	Gravel, cobble and boulder particles are between 0 & 25% surrounded by fine sediment **20, 19, 18, 17, 16**	Gravel, cobble and boulder particles are between 25 & 50% surrounded by fine sediment **15, 14, 13, 12, 11**	Gravel, cobble and boulder particles are between 50 & 75% surrounded by fine sediment **10, 9, 8, 7, 6**	Gravel, cobble and boulder particles are over 75% surrounded by fine sediment **5, 4, 3, 2, 1, 0**
3. Velocity depth	Slow deep (<0.3 m/s & >0.5m); Slow shallow; Fast deep; Fast shallow; habitats all present **20, 19, 18, 17, 16**	Only 3 of the four habitat categories present (missing riffles or runs receive lower score than missing pools) **15, 14, 13, 12, 11**	Only 2 of the four habitat categories present (missing riffles/ runs receive lower score) **10, 9, 8, 7, 6**	Dominating by one velocity/depth category (usually pool) **5, 4, 3, 2, 1, 0**
4. Channel alteration	Little or no enlargement of islands or point bars and/or no channelisation **15, 14, 13, 12**	Some new increase in bar formation, mostly from coarse gravel; and/or some channelisation present **11, 10, 9, 8**	Moderate deposition of new gravel, coarse sand, on old and new bars; pools partly filled w/silt; and/or embankments on both banks **7, 6, 5, 4**	Heavy deposits of fine materials, increased bar development; most pools filled with silt, and/or extensive channelisation **3, 2, 1, 0**
5. Bottom scouring and deposition	Less than 5% of the bottom affected by scouring and deposition **15, 14, 13, 12**	5-30% affected. Scours at constrictions and where grades steepen, some deposition in pools **11, 10, 9, 8**	30-50% affected. Deposits and scours at obstruction and bends. Some deposition in pools. **7, 6, 5, 4**	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed **3, 2, 1, 0**
6. Pool/riffle index *(Distance between riffles divided by stream width)*	0-7 Variety of habitat. Deep riffles and pools **15, 14, 13, 12**	7-15 Adequate depth in pools and riffles. Bends provide habitat **11, 10, 9, 8**	15-25 Occasional riffle or bend. Bottom contours provide some habitat. **7, 6, 5, 4**	>25 Essentially a straight stream. Generally all flat water or shallow riffle. **3, 2, 1, 0**
7. Bank stability	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. **10, 9**	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. **8, 7, 6**	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. **5, 4, 3**	Unstable. Many eroded areas. Side slopes > 60% common. "Raw" areas frequent along straight sections and bends. **2, 1, 0**
8. Bank vegetative stability	Over 80% of the streambank surfaces covered vegetation, gravel, or larger material. **10, 9**	50-79% of the streambank surfaces covered by vegetation, gravel, or larger material **8, 7, 6**	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. **5, 4, 3**	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. **2, 1, 0**
9. Streamside cover	Dominant vegetation trees. **10, 9**	Dominant vegetation shrubs. **8, 7, 6**	Dominant vegetation is herbaceous. **5, 4, 3**	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings **2, 1, 0**

From US EPA RBA Protocols 1989; updated May 1996 by R Bailey

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

SITE CODE: _____ RECORDER'S NAME(s): Ronalda m

DATE (ddmmyy): 15/7/97 TIME of DAY: 3:09 pm

LOCATION below Seattle Creek #7

PHOTO NUMBER(S) (film/exps): Ø

WEATHER Fair AIR TEMPERATURE _____ °C

CLOUD COVER 100 % RAIN IN LAST WEEK ? Y ☑ N ☐

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% ☐ 6-25% ☐ 26-50% ☐ 51-75% ☑ >76% ☐

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)	30	
trees (<10m)	5	
shrubs / vines	10	
herbaceous	10	

Vegetation shading of river[3]: <5% ☑ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover, may total >100%. [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

Stream Width[4] (m) 1 _____ 2 _____ 3 _____ Min _____ Max _____

bank width[5] (m) 1 _____ 2 _____ 3 _____ Min _____ Max _____

bank height (m) [6] 1 _____ 2 _____ 3 _____ Min _____ Max _____

REACH HABITAT CLASSIFICATION

% in Reach: Riffle= Ø Edge[7]= Ø Pool= 30 Plants= Ø Run= 90

FROM CENTER RIFFLE:

Water Temperature (°C): 13.4 Conductivity (mS/cm): 313

pH: 7.75 Dissolved Oxygen (mg/l): 9.3 Turbidity (NTU) 1.72

[4] From edges of water [5] From tops of banks. [6] From water surface vertical to top of bank [7] Length of both banks as % of reach length which can be effectively sampled with sweep net

DISCHARGE AT CENTER TRANSECT

Reading	Transect Position (m)	Depth (cm)	Flow (cm/s; revs/30s)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

GENERAL OBSERVATIONS: CIRCLE YOUR CHOICE(S)

WATER ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. sterile

WATER OILS: 1. slick 2. sheen 3. globs 4. flecks 5. none

TURBIDITY: 1. clear 2. slight 3. turbid 4. opaque

PLUME: 1. little 2. some 3. lots

(amount of fine sediment generated when kick-sampling)

SEDIMENT OILS: 1. absent 2. light 3. moderate 4. profuse

SEDIMENT ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. anaerobic

6. none 7. other _____

FLOW LEVEL: (relative to "water mark" i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

1. No flow (dry / isolated) 2. Low (<water mark) 3. Moderate (=) 4. High (>water mark) 5. Flood

Bare ground above water mark: Left bank 100 % Right bank 100 %

Are the undersides of stones which are not deeply embedded black? 1. yes 2. no

SEDIMENT DEPOSITS: 1. none 2. sludge 3. sawdust 4. paper fibre 5. sand

6. relict shells 7. other _____

LOCAL CATCHMENT EROSION: 1. none 2. moderate 3. heavy

LOCAL NonPointSource POLLUTION: 1. no evidence 2. potential _____ 3. obvious _____

DAMS / BARRIERS: 1. present (upstream / downstream) 2. absent

CHANNELIZATION: 1. yes (no. of channels = _____) 2. no

SITE CLASSIFICATION: 1. steep valley 2. broad valley 3. wetland/bog

LANDUSE: 1. Forest 2. Forestry 3. Native pasture 4. Grazing 5. Cropped

Left Bank 6. Residential 7. Commercial 8. Industrial 9. Recreational

BARS: (bed surface protruding from water & forming a bar) _____ %

ADDITIONAL NOTES ON SITE:

Below Seattle Creek

TOTAL REACH SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		Ø %	9.5	*Boulder*	(>256mm)	Ø %	9.0
Cobble	(64-256mm)	10 %	6.5	*Pebble*	(16-64mm)	15 %	4.5
Gravel	(2-16mm)	45 %	2.0	*Sand*	(0.06-2mm)	5 %	2.0
Silt	(0.004-0.06mm)	30 %	6.5	*Clay*	(<0.004mm)	~~50~~ Ø %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) 5 %

Muck/Mud (black, very fine organics) 5 %

Periphyton	0	1	2	3	4	**(percent of reach covered by)**
Moss	0	1	2	3	4	**(percent of reach covered by)**
Filamentous algae	0	1	2	3	4	**(percent of reach covered by)**
Macrophytes	0	1	2	3	4	**(percent of reach covered by)**

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

RIFFLE ONLY SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		____ %	9.5	*Boulder*	(>256mm)	____ %	9.0
Cobble	(64-256mm)	____ %	6.5	*Pebble*	(16-64mm)	____ %	4.5
Gravel	(2-16mm)	____ %	2.0	*Sand*	(0.06-2mm)	____ %	2.0
Silt	(0.004-0.06mm)	____ %	6.5	*Clay*	(<0.004mm)	____ %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) ____ %

Muck/Mud (black, very fine organics) ____ %

Same as above

Periphyton	0	1	2	3	4	**(percent of reach covered by)**
Moss	0	1	2	3	4	**(percent of reach covered by)**
Filamentous algae	0	1	2	3	4	**(percent of reach covered by)**
Macrophytes	0	1	2	3	4	**(percent of reach covered by)**

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

MACROINVERTEBRATES COLLECTED BY: Smac

METHOD (e.g. kicknet, T-sampler): Kicknet

Length or area of riffle sampled: ____

Sample preserved in field? Y ☑ N ☐

SITE CODE: _____

DATE: _____

HABITAT ASSESSMENT FIELD DATA SHEET

CIRCLE ONE CHOICE FOR EACH OF THE NINE HABITAT DESCRIPTORS

	CATEGORY			
Habitat Variable	Excellent	Good	Fair	Poor
1. Bottom substrate/available cover	Greater than 50% rubble, gravel, submerged logs, undercut banks or other stable habitat 20, 19, 18, 17, 16	30-50% **15, 14, 13, 12, 11**	10-30% **10, 9, 8, 7, 6**	Less than 10% **5, 4, 3, 2, 1, 0**
2. Embeddedness	Gravel, cobble and boulder particles are between 0 & 25% surrounded by fine sediment 20, 19, 18, 17, 16	Gravel, cobble and boulder particles are between 25 & 50% surrounded by fine sediment **15, 14, 13, 12, 11**	Gravel, cobble and boulder particles are between 50 & 75% surrounded by fine sediment **10, 9, 8, 7, 6**	Gravel, cobble and boulder particles are over 75% surrounded by fine sediment **5, 4, 3, 2, 1, 0**
3. Velocity/depth	Slow deep (<0.3 m/s & >0.5m); Slow shallow; Fast deep; Fast shallow; habitats all present 20, 19, 18, 17, 16	Only 3 of the four habitat categories present (missing riffles or runs receive lower score than missing pools) **15, 14, 13, 12, 11**	Only 2 of the four habitat categories present (missing riffles/ runs receive lower score) **10, 9, 8, 7, 6**	Dominating by one velocity/depth category (usually pool) **5, 4, 3, 2, 1, 0**
4. Channel alteration	Little or no enlargement of islands or point bars and/or no channelisation 15, 14, 13, 12	Some new increase in bar formation, mostly from coarse gravel; and/or some channelisation present **11, 10, 9, 8**	Moderate deposition of new gravel, coarse sand, on old and new bars; pools partly filled w/silt; and/or embankments on both banks **7, 6, 5, 4**	Heavy deposits of fine materials, increased bar development; most pools filled with silt; and/or extensive channelisation **3, 2, 1, 0**
5. Bottom scouring and deposition	Less than 5% of the bottom affected by scouring and deposition 15, 14, 13, 12	5-30% affected. Scours at constrictions and where grades steepen, some deposition in pools **11, 10, 9, 8**	30-50% affected. Deposits and scours at obstruction and bends. Some deposition in pools. **7, 6, 5, 4**	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed **3, 2, 1, 0**
6. Pool riffle index. *(Distance between riffles divided by stream width)*	0-7 Variety of habitat. Deep riffles and pools 15, 14, 13, 12	7-15 Adequate depth in pools and riffles. Bends provide habitat **11, 10, 9, 8**	15-25 Occasional riffle or bend. Bottom contours provide some habitat. **7, 6, 5, 4**	>25 Essentially a straight stream. Generally all flat water or shallow riffle. **3, 2, 1, 0**
7. Bank stability	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. 10, 9	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. 8, 7, 6	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. **5, 4, 3**	Unstable. Many eroded areas. Side slopes > 60% common. "Raw" areas frequent along straight sections and bends. **2, 1, 0**
8. Bank vegetative stability	Over 80% of the streambank surfaces covered vegetation, gravel, or larger material. 10, 9	50-79% of the streambank surfaces covered by vegetation, gravel, or larger material 8, 7, 6	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. **5, 4, 3**	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. **2, 1, 0**
9. Streamside cover	Dominant vegetation trees. 10, 9	Dominant vegetation shrubs. 8, 7, 6	Dominant vegetation is herbaceous. **5, 4, 3**	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings **2, 1, 0**

From US EPA RBA Protocols 1989; updated May 1996 by R Bailey

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

SITE CODE: _____ RECORDER'S NAME(s): Smac

DATE (ddmmyy): July 14/97 TIME of DAY: 2:33 pm

LOCATION Seattle Creek #5

PHOTO NUMBER(S) (film/exps): Ø

WEATHER Rainy AIR TEMPERATURE 13 °C

CLOUD COVER 100 % RAIN IN LAST WEEK ? Y ☑ N ☐

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% ☐ 6-25% ☒ 26-50% ☐ 51-75% ☐ >76% ☐

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)	Ø	
trees (<10m)	Ø	
shrubs / vines	10	
herbaceous	Ø	

Vegetation shading of river[3]: <5% ☑ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover; may total >100%. [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

Stream Width[4] (m)	1 10ft 3½in	2 11ft 2in	3 13ft	Min 10	Max 13
bank width[5] (m)	1 46	2 29ft 5in	3 28ft	Min 28	Max 46
bank height (m)[6]	1 3ft 5in	2 1ft 9in	3 1ft	Min 1	Max 3

REACH HABITAT CLASSIFICATION

% in Reach: Riffle= 100 Edge[7]= Ø Pool= Ø Plants= Ø Run= Ø

FROM CENTER RIFFLE:

1 ft deep

Water Temperature (°C): 8.3 Conductivity (mS/cm): 252

pH: 8.6 Dissolved Oxygen (mg/l): 11.8 Turbidity (NTU) 26.1

[4] From edges of water [5] From tops of banks. [6] From water surface vertical to top of bank [7] Length of both banks as % of reach length which can be effectively sampled with sweep net

DISCHARGE AT CENTER TRANSECT

Reading	Transect Position (m)	Depth (cm)	Flow (cm/s; revs/30s)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

GENERAL OBSERVATIONS: CIRCLE YOUR CHOICE(S)

WATER ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. sterile

WATER OILS: 1. slick 2. sheen 3. globs 4. flecks 5. none

TURBIDITY: 1. clear 2. slight 3. turbid 4. opaque

PLUME: 1. little 2. some 3. lots

(amount of fine sediment generated when kick-sampling)

SEDIMENT OILS: 1. absent 2. light 3. moderate 4. profuse

SEDIMENT ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. anaerobic

6. none 7. other _____

FLOW LEVEL: (relative to "water mark" i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

1. No flow (dry / isolated) 2. Low (<water mark) 3. Moderate (=) 4. High (>water mark) 5. Flood

Bare ground above water mark: Left bank 100 % Right bank 100 %

Are the undersides of stones which are not deeply embedded black? 1. yes 2. no

SEDIMENT DEPOSITS: 1. none 2. sludge 3. sawdust 4. paper fibre 5. sand

6. relict shells 7. other _____

LOCAL CATCHMENT EROSION: 1. none 2. moderate 3. heavy

LOCAL NonPointSource POLLUTION: 1. no evidence 2. potential _____ 3. obvious _____

DAMS / BARRIERS: 1. present (upstream / downstream) 2. absent

CHANNELIZATION: 1. yes (no. of channels = _____) 2. no

SITE CLASSIFICATION: 1. steep valley 2. broad valley 3. wetland/bog

LANDUSE: 1. Forest 2. Forestry 3. Native pasture 4. Grazing 5. Cropped

Left Bank 6. Residential 7. Commercial 8. Industrial 9. Recreational

BARS: (bed surface protruding from water & forming a bar) 0 %

ADDITIONAL NOTES ON SITE:

Mine upstream

TOTAL REACH SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		Ø %	9.5	*Boulder*	(>256mm)	Ø %	9.0
Cobble	(64-256mm)	Ø %	6.5	*Pebble*	(16-64mm)	10 %	4.5
Gravel	(2-16mm)	80 %	2.0	*Sand*	(0.06-2mm)	10 %	2.0
Silt	(0.004-0.06mm)	Ø %	6.5	*Clay*	(<0.004mm)	Ø %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) Ø %

Muck/Mud (black, very fine organics) Ø %

Periphyton	0	1	2	3	4	**(percent of reach covered by)**
Moss	0	1	2	3	4	**(percent of reach covered by)**
Filamentous algae	0	1	2	3	4	**(percent of reach covered by)**
Macrophytes	0	1	2	3	4	**(percent of reach covered by)**

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

RIFFLE ONLY SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		____ %	9.5	*Boulder*	(>256mm)	____ %	9.0
Cobble	(64-256mm)	____ %	6.5	*Pebble*	(16-64mm)	____ %	4.5
Gravel	(2-16mm)	____ %	2.0	*Sand*	(0.06-2mm)	____ %	2.0
Silt	(0.004-0.06mm)	____ %	6.5	*Clay*	(<0.004mm)	____ %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Same as above

Detritus (sticks, wood, CPOM) ____ %

Muck/Mud (black, very fine organics) ____ %

Periphyton	0	1	2	3	4	**(percent of reach covered by)**
Moss	0	1	2	3	4	**(percent of reach covered by)**
Filamentous algae	0	1	2	3	4	**(percent of reach covered by)**
Macrophytes	0	1	2	3	4	**(percent of reach covered by)**

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

MACROINVERTEBRATES COLLECTED BY: Gary Brown

METHOD (e.g. kicknet, T-sampler): Kicknet

Length or area of riffle sampled: 10 m

Sample preserved in field? Y ☑ N ☐

Change Sample
7.50
5.74
6.64

SITE CODE: _____

DATE: _____

HABITAT ASSESSMENT FIELD DATA SHEET

CIRCLE ONE CHOICE FOR EACH OF THE NINE HABITAT DESCRIPTORS

	CATEGORY			
Habitat Variable	Excellent	Good	Fair	Poor
1. Bottom substrate/available cover	Greater than 50% rubble, gravel, submerged logs, undercut banks or other stable habitat 20, 19, 18, 17, 16	30-50% 15, 14, 13, 12, 11	10-30% 10, 9, 8, 7, 6	Less than 10% 5, 4, 3, 2, 1, 0
2. Embeddedness	Gravel, cobble and boulder particles are between 0 & 25% surrounded by fine sediment 20, 19, 18, 17, 16	Gravel, cobble and boulder particles are between 25 & 50% surrounded by fine sediment 15, 14, 13, 12, 11	Gravel, cobble and boulder particles are between 50 & 75% surrounded by fine sediment 10, 9, 8, 7, 6	Gravel, cobble and boulder particles are over 75% surrounded by fine sediment 5, 4, 3, 2, 1, 0
3. Velocity/depth	Slow deep (<0.3 m/s & >0.5m); Slow shallow; Fast deep; Fast shallow; habitats all present 20, 19, 18, 17, 16	Only 3 of the four habitat categories present (missing riffles or runs receive lower score than missing pools) 15, 14, 13, 12, 11	Only 2 of the four habitat categories present (missing riffles/ runs receive lower score) 10, 9, 8, 7, 6	Dominating by one velocity/depth category (usually pool) 5, 4, 3, 2, 1, 0
4. Channel alteration	Little or no enlargement of islands or point bars and/or no channelisation 15, 14, 13, 12	Some new increase in bar formation, mostly from coarse gravel; and/or some channelisation present 11, 10, 9, 8	Moderate deposition of new gravel, coarse sand, on old and new bars; pools partly filled w/silt; and/or embankments on both banks 7, 6, 5, 4	Heavy deposits of fine materials, increased bar development; most pools filled with silt; and/or extensive channelisation 3, 2, 1, 0
5. Bottom scouring and deposition	Less than 5% of the bottom affected by scouring and deposition 15, 14, 13, 12	5-30% affected. Scours at constrictions and where grades steepen, some deposition in pools 11, 10, 9, 8	30-50% affected. Deposits and scours at obstruction and bends. Some deposition in pools. 7, 6, 5, 4	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed 3, 2, 1, 0
6. Pool/riffle index. *(Distance between riffles divided by stream width)*	0-7 Variety of habitat. Deep riffles and pools 15, 14, 13, 12	7-15 Adequate depth in pools and riffles. Bends provide habitat 11, 10, 9, 8	15-25 Occasional riffle or bend. Bottom contours provide some habitat. 7, 6, 5, 4	>25 Essentially a straight stream. Generally all flat water or shallow riffle. 3, 2, 1, 0
7. Bank stability	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. 10, 9	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. 8, 7, 6	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. 5, 4, 3	Unstable. Many eroded areas. Side slopes > 60% common. "Raw" areas frequent along straight sections and bends. 2, 1, 0
8. Bank vegetative stability	Over 80% of the streambank surfaces covered vegetation, gravel, or larger material. 10, 9	50-79% of the streambank surfaces covered by vegetation, gravel, or larger material 8, 7, 6	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. 5, 4, 3	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. 2, 1, 0
9. Streamside cover	Dominant vegetation trees. 10, 9	Dominant vegetation shrubs. 8, 7, 6	Dominant vegetation is herbaceous. 5, 4, 3	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings 2, 1, 0

From US EPA RBA Protocols 1989; updated May 1996 by R Bailey

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

SITE CODE: _____ RECORDER'S NAME(s): Ronalda M

DATE (ddmmyy): 15/7/97 TIME of DAY: 3:30

LOCATION Above Seattle Creek #9

PHOTO NUMBER(S) (film/exps): Ø

WEATHER Rainy AIR TEMPERATURE 14.8 °C

CLOUD COVER 100 % RAIN IN LAST WEEK ? Y ☑ N ☐

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% ☐ 6-25% ☐ 26-50% ☑ 51-75% ☐ >76% ☐

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)	Ø	
trees (<10m)	Ø	
shrubs / vines	70	
herbaceous	Ø	

Vegetation shading of river[3]: <5% ☑ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover, may total >100%. [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

	1	2	3	Min	Max
Stream Width[4] (m)					
bank width[5] (m)					
bank height (m) [6]					

REACH HABITAT CLASSIFICATION

% in Reach: Riffle= Ø Edge[7]= Ø Pool= Ø Plants= Ø Run= 90

FROM CENTER RIFFLE:

Water Temperature (°C): 13.4 Conductivity (mS/cm): 315

pH: 7.65 Dissolved Oxygen (mg/l): 8.4 Turbidity (NTU) 1.47

[4] From edges of water [5] From tops of banks [6] From water surface vertical to top of bank [7] Length of both banks as % of reach length which can be effectively sampled with sweep net

DISCHARGE AT CENTER TRANSECT

Reading	Transect Position (m)	Depth (cm)	Flow (cm/s; revs/30s)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

GENERAL OBSERVATIONS: CIRCLE YOUR CHOICE(S)

WATER ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. sterile

WATER OILS: 1. slick 2. sheen 3. globs 4. flecks 5. none

TURBIDITY: 1. clear 2. slight 3. turbid 4. opaque

PLUME: 1. little 2. some 3. lots

(amount of fine sediment generated when kick-sampling)

SEDIMENT OILS: 1. absent 2. light 3. moderate 4. profuse

SEDIMENT ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. anaerobic

6. none 7. other _____

FLOW LEVEL: (relative to "water mark" i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

1. No flow (dry / isolated) 2. Low (<water mark) 3. Moderate (=) 4. High (>water mark) 5. Flood

Bare ground above water mark: Left bank _____% Right bank _____%

Are the undersides of stones which are not deeply embedded black? 1. yes 2. no

SEDIMENT DEPOSITS: 1. none 2. sludge 3. sawdust 4. paper fibre 5. sand

6. relict shells 7. other _____

LOCAL CATCHMENT EROSION: 1. none 2. moderate 3. heavy

LOCAL NonPointSource POLLUTION: 1. no evidence 2. potential _____ 3. obvious _____

DAMS / BARRIERS: 1. present (upstream / downstream) 2. absent

CHANNELIZATION: 1. yes (no. of channels = _____) 2. no

SITE CLASSIFICATION: 1. steep valley 2. broad valley 3. wetland/bog

LANDUSE: 1. Forest 2. Forestry 3. Native pasture 4. Grazing 5. Cropped

Left Bank 6. Residential 7. Commercial 8. Industrial 9. Recreational

BARS: (bed surface protruding from water & forming a bar) Ø %

ADDITIONAL NOTES ON SITE:

Above Seattle Creek

TOTAL REACH SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		Ø %	9.5	*Boulder*	(>256mm)	Ø %	9.0
Cobble	(64-256mm)	30 %	6.5	*Pebble*	(16-64mm)	20 %	4.5
Gravel	(2-16mm)	30 %	2.0	*Sand*	(0.06-2mm)	20 %	2.0
Silt	(0.004-0.06mm)	Ø %	6.5	*Clay*	(<0.004mm)	Ø %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) Ø %

Muck/Mud (black, very fine organics) Ø %

Periphyton	0	1	2	3	4	(percent of reach covered by)
Moss	0	1	2	3	4	(percent of reach covered by)
Filamentous algae	0	1	2	3	4	(percent of reach covered by)
Macrophytes	0	1	2	3	4	(percent of reach covered by)

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

RIFFLE ONLY SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		____ %	9.5	*Boulder*	(>256mm)	____ %	9.0
Cobble	(64-256mm)	____ %	6.5	*Pebble*	(16-64mm)	____ %	4.5
Gravel	(2-16mm)	____ %	2.0	*Sand*	(0.06-2mm)	____ %	2.0
Silt	(0.004-0.06mm)	____ %	6.5	*Clay*	(<0.004mm)	____ %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) ____ %

Muck/Mud (black, very fine organics) ____ %

Periphyton	0	1	2	3	4	(percent of reach covered by)
Moss	0	1	2	3	4	(percent of reach covered by)
Filamentous algae	0	1	2	3	4	(percent of reach covered by)
Macrophytes	0	1	2	3	4	(percent of reach covered by)

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

MACROINVERTEBRATES COLLECTED BY: Smac

METHOD (e.g. kicknet, T-sampler): Kicknet

Length or area of riffle sampled: 10m

Sample preserved in field? Y ☑ N ☐

SITE CODE: _____

DATE: _____

HABITAT ASSESSMENT FIELD DATA SHEET

CIRCLE ONE CHOICE FOR EACH OF THE NINE HABITAT DESCRIPTORS

	CATEGORY			
Habitat Variable	Excellent	Good	Fair	Poor
1. Bottom substrate/available cover	Greater than 50% rubble, gravel, submerged logs, undercut banks or other stable habitat **20, 19, 18, 17, 16**	30-50% **15, 14, 13, 12, 11**	10-30% **10, 9, 8, 7, 6**	Less than 10% **5, 4, 3, 2, 1, 0**
2. Embeddedness	Gravel, cobble and boulder particles are between 0 & 25% surrounded by fine sediment **20, 19, 18, 17, 16**	Gravel, cobble and boulder particles are between 25 & 50% surrounded by fine sediment **15, 14, 13, 12, 11**	Gravel, cobble and boulder particles are between 50 & 75% surrounded by fine sediment **10, 9, 8, 7, 6**	Gravel, cobble and boulder particles are over 75% surrounded by fine sediment **5, 4, 3, 2, 1, 0**
3. Velocity depth	Slow deep (<0.3 m/s & >0.5m); Slow shallow; Fast deep; Fast shallow; habitats all present **20, 19, 18, 17, 16**	Only 3 of the four habitat categories present (missing riffles or runs receive lower score than missing pools) **15, 14, 13, 12, 11**	Only 2 of the four habitat categories present (missing riffles/ runs receive lower score) **10, 9, 8, 7, 6**	Dominating by one velocity/depth category (usually pool) **5, 4, 3, 2, 1, 0**
4. Channel alteration	Little or no enlargement of islands or point bars and/or no channelisation **15, 14, 13, 12**	Some new increase in bar formation, mostly from coarse gravel; and/or some channelisation present **11, 10, 9, 8**	Moderate deposition of new gravel, coarse sand, on old and new bars; pools partly filled w/silt; and/or embankments on both banks **7, 6, 5, 4**	Heavy deposits of fine materials, increased bar development; most pools filled with silt; and/or extensive channelisation **3, 2, 1, 0**
5. Bottom scouring and deposition	Less than 5% of the bottom affected by scouring and deposition **15, 14, 13, 12**	5-30% affected. Scours at constrictions and where grades steepen, some deposition in pools **11, 10, 9, 8**	30-50% affected. Deposits and scours at obstruction and bends. Some deposition in pools. **7, 6, 5, 4**	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed **3, 2, 1, 0**
6. Pool/riffle index. *(Distance between riffles divided by stream width)*	0-7 Variety of habitat. Deep riffles and pools **15, 14, 13, 12**	7-15 Adequate depth in pools and riffles. Bends provide habitat **11, 10, 9, 8**	15-25 Occasional riffle or bend. Bottom contours provide some habitat **7, 6, 5, 4**	>25 Essentially a straight stream. Generally all flat water or shallow riffle. **3, 2, 1, 0**
7. Bank stability	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. **10, 9**	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. **8, 7, 6**	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. **5, 4, 3**	Unstable. Many eroded areas. Side slopes > 60% common. "Raw" areas frequent along straight sections and bends. **2, 1, 0**
8. Bank vegetative stability	Over 80% of the streambank surfaces covered vegetation, gravel, or larger material. **10, 9**	50-79% of the streambank surfaces covered by vegetation, gravel, or larger material **8, 7, 6**	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. **5, 4, 3**	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. **2, 1, 0**
9. Streamside cover	Dominant vegetation trees. **10, 9**	Dominant vegetation shrubs. **8, 7, 6**	Dominant vegetation is herbaceous. **5, 4, 3**	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings **2, 1, 0**

From US EPA RBA Protocols 1989; updated May 1996 by R Bailey

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

SITE CODE: _____ RECORDER'S NAME(s): Ronalda

DATE (ddmmyy): 26/7/98 TIME of DAY: 10:33am

LOCATION McQuesten Bridge (South McQuesten Bridge)

PHOTO NUMBER(S) (film/exps): _____

WEATHER Sunny AIR TEMPERATURE 10 °C

CLOUD COVER 10 % RAIN IN LAST WEEK ? Y ☒ N ☐

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% ☐ 6-25% ☐ 26-50% ☑ 51-75% ☐ >76% ☐

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)	60%	
trees (<10m)	10%	
shrubs / vines	20%	
herbaceous	10%	

Vegetation shading of river[3]: <5% ☑ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover, may total >100%. [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

	1	2	3	Min	Max
Stream Width[4] (m)	45	46.3	50	45	50
bank width[5] (m)	65	68	70	65	70
bank height (m)[6]	1.5	1.9	2.5	1.5	2.5

REACH HABITAT CLASSIFICATION

% in Reach: Riffle= 10 Edge[7]= Ø Pool= 15 Plants= Ø Run= 70

FROM CENTER RIFFLE:

Water Temperature (°C): 14.8 Conductivity (mS/cm): 326

pH: 7.91 Dissolved Oxygen (mg/l): 11.6 Turbidity (NTU) 5.8

[4] From edges of water. [5] From tops of banks. [6] From water surface vertical to top of bank. [7] Length of both banks as % of reach length which can be effectively sampled with sweep net.

DISCHARGE AT CENTER TRANSECT

Reading	Transect Position (m)	Depth (cm)	Flow (cm/s; revs/30s)
1.	24	15 cm	
2.	18	12	
3.	26	7.6	
4.	17	8	
5.	9	9.5	
6.	37	30 cm	
7.			
8.			
9.			
10.			

GENERAL OBSERVATIONS: CIRCLE YOUR CHOICE(S)

WATER ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. sterile

WATER OILS: 1. slick 2. sheen 3. globs 4. flecks 5. none

TURBIDITY: 1. clear 2. slight 3. turbid 4. opaque

PLUME: 1. little 2. some 3. lots

(amount of fine sediment generated when kick-sampling)

SEDIMENT OILS: 1. absent 2. light 3. moderate 4. profuse

SEDIMENT ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. anaerobic

6. none 7. other _____

FLOW LEVEL: (relative to "water mark" i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

1. No flow 2. Low 3. Moderate 4. High 5. Flood

(dry / isolated) (<water mark) (=) (>water mark)

Bare ground above water mark: Left bank ~~0~~ % Right bank ~~2~~ 10 %

Are the undersides of stones which are not deeply embedded black? 1. yes 2. no

SEDIMENT DEPOSITS: 1. none 2. sludge 3. sawdust 4. paper fibre 5. sand

6. relict shells 7. other _____

LOCAL CATCHMENT EROSION: 1. none 2. moderate 3. heavy

LOCAL NonPointSource POLLUTION: 1. no evidence 2. potential _____ 3. obvious _____

DAMS / BARRIERS: 1. present (upstream / downstream) 2. absent

CHANNELIZATION: 1. yes (no. of channels = _____) 2. no

SITE CLASSIFICATION: 1. steep valley 2. broad valley 3. wetland/bog

LANDUSE: 1. Forest 2. Forestry 3. Native pasture 4. Grazing 5. Cropped

Left Bank 6. Residential 7. Commercial 8. Industrial 9. Recreational

BARS: (bed surface protruding from water & forming a bar) _____%

ADDITIONAL NOTES ON SITE:

McQuesten Bridge Mines located above haggart

$$\begin{array}{r} 14 \\ \times 28 \\ \hline 112 \\ 280 \\ \hline 392 \end{array} \qquad \begin{array}{r} 392 \\ +60 \\ \hline 452 \end{array}$$

452 in - across

2cm x 3.5cm 6cm x 6.2cm 1cm x 1cm 4 x 2.5cm 1.0 x 2.6cm

TOTAL REACH SUBSTRATUM DESCRIPTION: 7.5cm x 3cm 4.5 x 1.5 cm

			PHI				PHI
Bedrock		____%	9.5	*Boulder*	(>256mm)	____%	9.0
Cobble	(64-256mm)	____%	6.5	*Pebble*	(16-64mm)	____%	4.5
Gravel	(2-16mm)	____%	2.0	*Sand*	(0.06-2mm)	____%	2.0
Silt	(0.004-0.06mm)	____%	6.5	*Clay*	(<0.004mm)	____%	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) 10 %

Muck/Mud (black, very fine organics) 35 %

Periphyton	0	1	2	3	4	**(percent of reach covered by)**
Moss	0	1	2	3	4	**(percent of reach covered by)**
Filamentous algae	0	1	2	3	4	**(percent of reach covered by)**
Macrophytes	0	1	2	3	4	**(percent of reach covered by)**

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

RIFFLE ONLY SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		0 %	9.5	*Boulder*	(>256mm)	____%	9.0
Cobble	(64-256mm)	____%	6.5	*Pebble*	(16-64mm)	____%	4.5
Gravel	(2-16mm)	____%	2.0	*Sand*	(0.06-2mm)	____%	2.0
Silt	(0.004-0.06mm)	____%	6.5	*Clay*	(<0.004mm)	____%	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) ____%

Muck/Mud (black, very fine organics) ____%

Periphyton	0	1	2	3	4	**(percent of reach covered by)**
Moss	0	1	2	3	4	**(percent of reach covered by)**
Filamentous algae	0	1	2	3	4	**(percent of reach covered by)**
Macrophytes	0	1	2	3	4	**(percent of reach covered by)**

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

MACROINVERTEBRATES COLLECTED BY: _____

METHOD (e.g. kicknet, T-sampler): _____

Length or area of riffle sampled: 1.0m

Sample preserved in field? Y ☐ **N** ☑

SITE CODE: _____

DATE: _____

HABITAT ASSESSMENT FIELD DATA SHEET

CIRCLE ONE CHOICE FOR EACH OF THE NINE HABITAT DESCRIPTORS

	CATEGORY			
Habitat Variable	Excellent	Good	Fair	Poor
1. Bottom substrate/available cover	Greater than 50% rubble, gravel, submerged logs, undercut banks or other stable habitat 20, 19, 18, 17, 16	30-50% 15, 14, 13, 12, 11	10-30% 10, 9, 8, 7, 6	Less than 10% 5, 4, 3, 2, 1, 0
2. Embeddedness	Gravel, cobble and boulder particles are between 0 & 25% surrounded by fine sediment 20, 19, 18, 17, 16	Gravel, cobble and boulder particles are between 25 & 50% surrounded by fine sediment 15, 14, 13, 12, 11	Gravel, cobble and boulder particles are between 50 & 75% surrounded by fine sediment 10, 9, 8, 7, 6	Gravel, cobble and boulder particles are over 75% surrounded by fine sediment 5, 4, 3, 2, 1, 0
3. Velocity/depth	Slow deep (<0.3 m/s & >0.5m); Slow shallow; Fast deep; Fast shallow; habitats all present 20, 19, 18, 17, 16	Only 3 of the four habitat categories present (missing riffles or runs receive lower score than missing pools) 15, 14, 13, 12, 11	Only 2 of the four habitat categories present (missing riffles/ runs receive lower score) 10, 9, 8, 7, 6	Dominating by one velocity/depth category (usually pool) 5, 4, 3, 2, 1, 0
4. Channel alteration	Little or no enlargement of islands or point bars and/or no channelisation 15, 14, 13, 12	Some new increase in bar formation, mostly from coarse gravel; and/or some channelisation present 11, 10, 9, 8	Moderate deposition of new gravel, coarse sand, on old and new bars; pools partly filled w/silt; and/or embankments on both banks 7, 6, 5, 4	Heavy deposits of fine materials, increased bar development; most pools filled with silt; and/or extensive channelisation 3, 2, 1, 0
5. Bottom scouring and deposition	Less than 5% of the bottom affected by scouring and deposition 15, 14, 13, 12	5-30% affected. Scours at constrictions and where grades steepen, some deposition in pools 11, 10, 9, 8	30-50% affected. Deposits and scours at obstruction and bends. Some deposition in pools. 7, 6, 5, 4	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed 3, 2, 1, 0
6. Pool/riffle index. *(Distance between riffles divided by stream width)*	0-7 Variety of habitat. Deep riffles and pools 15, 14, 13, 12	7-15 Adequate depth in pools and riffles. Bends provide habitat 11, 10, 9, 8	15-25 Occasional riffle or bend. Bottom contours provide some habitat. 7, 6, 5, 4	>25 Essentially a straight stream. Generally all flat water or shallow riffle. 3, 2, 1, 0
7. Bank stability	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. 10, 9	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. 8, 7, 6	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. 5, 4, 3	Unstable. Many eroded areas. Side slopes > 60% common. "Raw" areas frequent along straight sections and bends. 2, 1, 0
8. Bank vegetative stability	Over 80% of the streambank surfaces covered vegetation, gravel, or larger material. 10, 9	50-79% of the streambank surfaces covered by vegetation, gravel, or larger material 8, 7, 6	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. 5, 4, 3	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. 2, 1, 0
9. Streamside cover	Dominant vegetation trees. 10, 9	Dominant vegetation shrubs. 8, 7, 6	Dominant vegetation is herbaceous. 5, 4, 3	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings 2, 1, 0

From US EPA RBA Protocols 1989; updated May 1996 by R Bailey

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

SITE CODE: _____ RECORDER'S NAME(s): _____

DATE (ddmmyy): 26/7/98 TIME of DAY: 11:58am

LOCATION Below Elsa Flats #1

PHOTO NUMBER(S) (film/exps): _____

WEATHER cloudy/sunny AIR TEMPERATURE 15 °C

CLOUD COVER 25 % RAIN IN LAST WEEK ? Y ☒ N ☐

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% ☒ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)	40%	
trees (<10m)	40%	
shrubs / vines	10%	
herbaceous	10%	

Vegetation shading of river[3]: <5% ☐ 6-25% ☒ 26-50% ☐ 51-75% ☐ >76% ☐

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover, may total >100%. [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

	1	2	3	Min	Max
Stream Width[4] (m)					
bank width[5] (m)					
bank height (m)[6]					

REACH HABITAT CLASSIFICATION

% in Reach: Riffle= 15 Edge[7]= 0 Pool= 10 Plants= 5 Run= 80

FROM CENTER RIFFLE:

Water Temperature (°C): 15.9 Conductivity (mS/cm): 308

pH: 7.74 Dissolved Oxygen (mg/l): 11.9 Turbidity (NTU) 34.2

[4] From edges of water [5] From tops of banks [6] From water surface vertical to top of bank [7] Length of both banks as % of reach length which can be effectively sampled with sweep net

DISCHARGE AT CENTER TRANSECT

Reading	Transect Position (m)	Depth (cm)	Flow (cm/s; revs/30s)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

GENERAL OBSERVATIONS: CIRCLE YOUR CHOICE(S)

WATER ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. sterile

WATER OILS: 1. slick 2. sheen 3. globs 4. flecks 5. none

TURBIDITY: 1. clear 2. slight 3. turbid 4. opaque

PLUME: 1. little 2. some 3. lots

(amount of fine sediment generated when kick sampling)

SEDIMENT OILS: 1. absent 2. light 3. moderate 4. profuse

SEDIMENT ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. anaerobic 6. none 7. other _____

FLOW LEVEL: (relative to "water mark" i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

1. No flow (dry / isolated) 2. Low (<water mark) 3. Moderate (=) 4. High (>water mark) 5. Flood

Bare ground above water mark: Left bank 5 % Right bank 10 %

Are the undersides of stones which are not deeply embedded black? 1. yes 2. no

SEDIMENT DEPOSITS: 1. none 2. sludge 3. sawdust 4. paper fibre 5. sand 6. relict shells 7. other _____

LOCAL CATCHMENT EROSION: 1. none 2. moderate 3. heavy

LOCAL NonPointSource POLLUTION: 1. no evidence 2. potential _____ 3. obvious _____

DAMS / BARRIERS: 1. present (upstream / downstream) 2. absent

CHANNELIZATION: 1. yes (no. of channels = _____) 2. no

SITE CLASSIFICATION: 1. steep valley 2. broad valley 3. wetland/bog

LANDUSE: Left Bank 1. Forest 2. Forestry 3. Native pasture 4. Grazing 5. Cropped 6. Residential 7. Commercial 8. Industrial 9. Recreational

BARS: (bed surface protruding from water & forming a bar) 5 %

ADDITIONAL NOTES ON SITE:

Rock bed halfway across river.

TOTAL REACH SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		_____%	9.5	*Boulder*	(>256mm)	_____%	9.0
Cobble	(64-256mm)	_____%	6.5	*Pebble*	(16-64mm)	_____%	4.5
Gravel	(2-16mm)	_____%	2.0	*Sand*	(0.06-2mm)	_____%	2.0
Silt	(0.004-0.06mm)	_____%	6.5	*Clay*	(<0.004mm)	_____%	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) 30 %

Muck/Mud (black, very fine organics) 50 %

Periphyton	0	1	2	3	4	(percent of reach covered by)
Moss	0	1	2	3	4	(percent of reach covered by)
Filamentous algae	0	1	2	3	4	(percent of reach covered by)
Macrophytes	0	1	2	3	4	(percent of reach covered by)

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

RIFFLE ONLY SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		_____%	9.5	*Boulder*	(>256mm)	_____%	9.0
Cobble	(64-256mm)	_____%	6.5	*Pebble*	(16-64mm)	_____%	4.5
Gravel	(2-16mm)	_____%	2.0	*Sand*	(0.06-2mm)	_____%	2.0
Silt	(0.004-0.06mm)	_____%	6.5	*Clay*	(<0.004mm)	_____%	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) _____%

Muck/Mud (black, very fine organics) _____%

Periphyton	0	1	2	3	4	(percent of reach covered by)
Moss	0	1	2	3	4	(percent of reach covered by)
Filamentous algae	0	1	2	3	4	(percent of reach covered by)
Macrophytes	0	1	2	3	4	(percent of reach covered by)

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

MACROINVERTEBRATES COLLECTED BY: _____

METHOD (e.g. kicknet, T-sampler): _____

Length or area of riffle sampled: _____

Sample preserved in field? Y ☐ N ☐

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

SITE CODE: _____ RECORDER'S NAME(s): Smac

DATE (ddmmyy): July 9/97 TIME of DAY: 2.20 pm #10

LOCATION Mcquestion River (upstream Christal creek)

PHOTO NUMBER(S) (film/exps): Ø

WEATHER Fair AIR TEMPERATURE 23.6 °C

CLOUD COVER 90 % RAIN IN LAST WEEK ? Y ☑ N ☐

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% ☐ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☑

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)	25	
trees (<10m)	25	
shrubs / vines	90	
herbaceous	100	

Vegetation shading of river[3]: <5% ☐ 6-25% ☒ 26-50% ☐ 51-75% ☐ >76% ☐

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover; may total >100%. [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

	1	2	3	Min	Max
Stream Width[4] (m)	11.89	13	11.5	11.5	13
bank width[5] (m)	14.94	17	14	14	17
bank height (m) [6]	0.79	0.70	0.85	0.7	0.85

REACH HABITAT CLASSIFICATION

% in Reach: Riffle= 70 Edge[7]= Ø Pool= 15 Plants= 5 Run= 10

FROM CENTER RIFFLE:

Water Temperature (°C): 18.2 Conductivity (mS/cm): 260

pH: 7.78 Dissolved Oxygen (mg/l): 8.8 Turbidity (NTU) Ø

[4] From edges of water [5] From tops of banks. [6] From water surface vertical to top of bank [7] Length of both banks as % of reach length which can be effectively sampled with sweep net

DISCHARGE AT CENTER TRANSECT

Reading	Transect Position (m)	Depth (cm)	Flow (cm/s; revs/30s)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

GENERAL OBSERVATIONS: CIRCLE YOUR CHOICE(S)

WATER ODOURS: (1. normal) 2. sewage 3. petroleum 4. chemical 5. sterile

WATER OILS: 1. slick 2. sheen 3. globs 4. flecks (5. none)

TURBIDITY: (1. clear) 2. slight 3. turbid 4. opaque

PLUME: (1. little) 2. some 3. lots

(amount of fine sediment generated when kick-sampling)

SEDIMENT OILS: (1. absent) 2. light 3. moderate 4. profuse

SEDIMENT ODOURS: (1. normal) 2. sewage 3. petroleum 4. chemical 5. anaerobic

6. none 7. other _____

FLOW LEVEL: (relative to "water mark" i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

1. No flow (dry / isolated) 2. Low (<water mark) (1. Moderate) (=) 4. High (>water mark) 5. Flood

Bare ground above water mark: Left bank Ø % Right bank Ø %

Are the undersides of stones which are not deeply embedded black? (1. yes) 2. no

SEDIMENT DEPOSITS: 1. none 2. sludge 3. sawdust 4. paper fibre (5. sand)

6. relict shells 7. other _____

LOCAL CATCHMENT EROSION: (1. none) 2. moderate 3. heavy

LOCAL NonPointSource POLLUTION: (1. no evidence) 2. potential _____ 3. obvious _____

DAMS / BARRIERS: 1. present (upstream / downstream) (2. absent)

CHANNELIZATION: 1. yes (no. of channels = Ø) 2. no

SITE CLASSIFICATION: 1. steep valley 2. broad valley (3. wetland/bog)

LANDUSE: (1. Forest) 2. Forestry 3. Native pasture 4. Grazing 5. Cropped

Left Bank 6. Residential 7. Commercial 8. Industrial (9. Recreational)

BARS: (bed surface protruding from water & forming a bar) _____%

ADDITIONAL NOTES ON SITE:

Cat trail off of Mcquesten Lake road.

TOTAL REACH SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		Ø %	9.5	*Boulder*	(>256mm)	5 %	9.0
Cobble	(64-256mm)	60 %	6.5	*Pebble*	(16-64mm)	15 %	4.5
Gravel	(2-16mm)	10 %	2.0	*Sand*	(0.06-2mm)	10 %	2.0
Silt	(0.004-0.06mm)	____ %	6.5	*Clay*	(<0.004mm)	____ %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) 1 %

Muck/Mud (black, very fine organics) 10 %

Periphyton	0	(1)	2	3	4	(percent of reach covered by)
Moss	(0)	1	2	3	4	(percent of reach covered by)
Filamentous algae	(0)	1	2	3	4	(percent of reach covered by)
Macrophytes	(0)	1	2	3	4	(percent of reach covered by)

0= <10% 1=10-35% 2=35-65% 3=65-90% 4=>90%

RIFFLE ONLY SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		____ %	9.5	*Boulder*	(>256mm)	____ %	9.0
Cobble	(64-256mm)	____ %	6.5	*Pebble*	(16-64mm)	____ %	4.5
Gravel	(2-16mm)	____ %	2.0	*Sand*	(0.06-2mm)	____ %	2.0
Silt	(0.004-0.06mm)	____ %	6.5	*Clay*	(<0.004mm)	____ %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Same as above

Detritus (sticks, wood, CPOM) ____ %

Muck/Mud (black, very fine organics) ____ %

Periphyton	0	1	2	3	4	(percent of reach covered by)
Moss	0	1	2	3	4	(percent of reach covered by)
Filamentous algae	0	1	2	3	4	(percent of reach covered by)
Macrophytes	0	1	2	3	4	(percent of reach covered by)

0= <10% 1=10-35% 2=35-65% 3=65-90% 4=>90%

MACROINVERTEBRATES COLLECTED BY: Kent Sinnott

METHOD (e.g. kicknet, T-sampler): Kicknet

Length or area of riffle sampled: 10m

Sample preserved in field? Y ☑ N ☐

SITE CODE: _____

DATE: _____

HABITAT ASSESSMENT FIELD DATA SHEET

CIRCLE ONE CHOICE FOR EACH OF THE NINE HABITAT DESCRIPTORS

	CATEGORY			
Habitat Variable	Excellent	Good	Fair	Poor
1. Bottom substrate/available cover	Greater than 50% rubble, gravel, submerged logs, undercut banks or other stable habitat 20, 19, 18, 17, 16	30-50% **15, 14, 13, 12, 11**	10-30% **10, 9, 8, 7, 6**	Less than 10% **5, 4, 3, 2, 1, 0**
2. Embeddedness	Gravel, cobble and boulder particles are between 0 & 25% surrounded by fine sediment 20, 19, 18, 17, 16	Gravel, cobble and boulder particles are between 25 & 50% surrounded by fine sediment **15, 14, 13, 12, 11**	Gravel, cobble and boulder particles are between 50 & 75% surrounded by fine sediment **10, 9, 8, 7, 6**	Gravel, cobble and boulder particles are over 75% surrounded by fine sediment **5, 4, 3, 2, 1, 0**
3. Velocity/depth	Slow/deep (<0.3 m/s & >0.5m); Slow shallow; Fast deep; Fast shallow; habitats all present 20, 19, 18, 17, 16	Only 3 of the four habitat categories present (missing riffles or runs receive lower score than missing pools) **15, 14, 13, 12, 11**	Only 2 of the four habitat categories present (missing riffles/ runs receive lower score) **10, 9, 8, 7, 6**	Dominating by one velocity/depth category (usually pool) **5, 4, 3, 2, 1, 0**
4. Channel alteration	Little or no enlargement of islands or point bars and/or no channelisation 15, 14, 13, 12	Some new increase in bar formation, mostly from coarse gravel; and/or some channelisation present **11, 10, 9, 8**	Moderate deposition of new gravel, coarse sand, on old and new bars; pools partly filled w/silt; and/or embankments on both banks **7, 6, 5, 4**	Heavy deposits of fine materials, increased bar development; most pools filled with silt; and/or extensive channelisation **3, 2, 1, 0**
5. Bottom scouring and deposition	Less than 5% of the bottom affected by scouring and deposition 15, 14, 13, 12	5-30% affected. Scours at constrictions and where grades steepen, some deposition in pools **11, 10, 9, 8**	30-50% affected. Deposits and scours at obstruction and bends. Some deposition in pools. **7, 6, 5, 4**	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed **3, 2, 1, 0**
6. Pool/riffle index. *(Distance between riffles divided by stream width)*	0-7 Variety of habitat. Deep riffles and pools 15, 14, 13, 12	7-15 Adequate depth in pools and riffles. Bends provide habitat **11, 10, 9, 8**	15-25 Occasional riffle or bend. Bottom contours provide some habitat. **7, 6, 5, 4**	>25 Essentially a straight stream. Generally all flat water or shallow riffle. **3, 2, 1, 0**
7. Bank stability	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. 10, 9	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. **8, 7, 6**	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. **5, 4, 3**	Unstable. Many eroded areas. Side slopes > 60% common. "Raw" areas frequent along straight sections and bends. **2, 1, 0**
8. Bank vegetative stability	Over 80% of the streambank surfaces covered vegetation, gravel, or larger material. 10, 9	50-79% of the streambank surfaces covered by vegetation, gravel, or larger material **8, 7, 6**	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. **5, 4, 3**	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. **2, 1, 0**
9. Streamside cover	Dominant vegetation trees. 10, 9	Dominant vegetation shrubs. **8, 7, 6**	Dominant vegetation is herbaceous. **5, 4, 3**	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings **2, 1, 0**

From US EPA RBA Protocols 1989; updated May 1996 by R Bailey

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

SITE CODE: _____ RECORDER'S NAME(s): Kent Sinnott

DATE (ddmmyy): July 11/97 TIME of DAY: 1:45 pm

LOCATION Haggart Creek (below Holloways) #19 N 2500 ft

PHOTO NUMBER(S) (film/exps): _____

WEATHER Fair/Sunny AIR TEMPERATURE 23.1 °C

CLOUD COVER 40 % RAIN IN LAST WEEK ? Y ☑ N ☐

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% ☐ 6-25% ☐ 26-50% ☐ 51-75% ☑ >76% ☐

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)	60	alot of dead trees ?
trees (<10m)	30	high water levels ?
shrubs / vines	70	
herbaceous	85	

Vegetation shading of river[3]: <5% ☑ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover, may total >100%. [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

	1	2	3	Min	Max
Stream Width[4] (m)	7.01	7.01	13.72	7.01	13.72
bank width[5] (m)	14.63	16.15	14.94	14.63	16.15
bank height (m)[6]	0.81	0.81	0.81	0.81	0.81

REACH HABITAT CLASSIFICATION

% in Reach: Riffle= 70 Edge[7]= Ø Pool= 10 Plants= Ø Run= 20

FROM CENTER RIFFLE:

Water Temperature (°C): 14.4 Conductivity (mS/cm): 247

pH: 7.86 Dissolved Oxygen (mg/l): 10.0 Turbidity (NTU) Ø

[4] From edges of water [5] From tops of banks [6] From water surface vertical to top of bank [7] Length of both banks as % of reach length which can be effectively sampled with sweep net

DISCHARGE AT CENTER TRANSECT

w 5.18m

Reading	Transect Position (m)	Depth (cm)	Flow (cm/s; revs/30s)
1.	0.5	30.5	
2.	1.5	41	
3.	2.5	45	
4.	3.5	38	
5.	4.5	33	
6.			
7.			
8.			
9.			
10.			

GENERAL OBSERVATIONS: CIRCLE YOUR CHOICE(S)

WATER ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. sterile

WATER OILS: 1. slick 2. sheen 3. globs 4. flecks 5. none

TURBIDITY: 1. clear 2. slight 3. turbid 4. opaque

PLUME: 1. little 2. some 3. lots

(amount of fine sediment generated when kick-sampling)

SEDIMENT OILS: 1. absent 2. light 3. moderate 4. profuse

SEDIMENT ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. anaerobic

6. none 7. other _____

FLOW LEVEL: (relative to "water mark" i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

1. No flow (dry / isolated) 2. Low (<water mark) 3. Moderate (=) 4. High (>water mark) 5. Flood

Bare ground above water mark: Left bank 50 % Right bank 65 %

Are the undersides of stones which are not deeply embedded black? 1. yes 2. no

SEDIMENT DEPOSITS: 1. none 2. sludge 3. sawdust 4. paper fibre 5. sand

6. relict shells 7. other _____

LOCAL CATCHMENT EROSION: 1. none 2. moderate 3. heavy

LOCAL NonPointSource POLLUTION: 1. no evidence 2. potential placer mine upstream 3. obvious _____

DAMS / BARRIERS: 1. present (upstream / downstream) 2. absent

CHANNELIZATION: 1. yes (no. of channels = _____) 2. no

SITE CLASSIFICATION: 1. steep valley 2. broad valley 3. wetland/bog

LANDUSE: 1. Forest 2. Forestry 3. Native pasture 4. Grazing 5. Cropped

Left Bank 6. Residential 7. Commercial 8. Industrial 9. Recreational

BARS: (bed surface protruding from water & forming a bar) 2.5 %

ADDITIONAL NOTES ON SITE:

placer mine operating upstream.

TOTAL REACH SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		0 %	9.5	*Boulder*	(>256mm)	10 %	9.0
Cobble	(64-256mm)	15 %	6.5	*Pebble*	(16-64mm)	40 %	4.5
Gravel	(2-16mm)	15 %	2.0	*Sand*	(0.06-2mm)	5 %	2.0
Silt	(0.004-0.06mm)	15 %	6.5	*Clay*	(<0.004mm)	0 %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) Ø %

Muck/Mud (black, very fine organics) Ø %

Periphyton	0	1	2	3	4	**(percent of reach covered by)**
Moss	0	1	2	3	4	**(percent of reach covered by)**
Filamentous algae	0	1	2	3	4	**(percent of reach covered by)**
Macrophytes	0	1	2	3	4	**(percent of reach covered by)**

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

RIFFLE ONLY SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		____ %	9.5	*Boulder*	(>256mm)	____ %	9.0
Cobble	(64-256mm)	____ %	6.5	*Pebble*	(16-64mm)	____ %	4.5
Gravel	(2-16mm)	____ %	2.0	*Sand*	(0.06-2mm)	____ %	2.0
Silt	(0.004-0.06mm)	____ %	6.5	*Clay*	(<0.004mm)	____ %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) ____ %

Muck/Mud (black, very fine organics) ____ %

Same as above

Periphyton	0	1	2	3	4	**(percent of reach covered by)**
Moss	0	1	2	3	4	**(percent of reach covered by)**
Filamentous algae	0	1	2	3	4	**(percent of reach covered by)**
Macrophytes	0	1	2	3	4	**(percent of reach covered by)**

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

MACROINVERTEBRATES COLLECTED BY: Simone Mac

METHOD (e.g. kicknet, T-sampler): Kicknet

Length or area of riffle sampled: 10 m

Sample preserved in field? Y ☑ N ☐

SITE CODE: _____

DATE: _____

HABITAT ASSESSMENT FIELD DATA SHEET

CIRCLE ONE CHOICE FOR EACH OF THE NINE HABITAT DESCRIPTORS

	CATEGORY			
Habitat Variable	Excellent	Good	Fair	Poor
1. Bottom substrate/available cover	Greater than 50% rubble, gravel, submerged logs, undercut banks or other stable habitat 20, 19, 18, 17, 16	30-50% **15, 14, 13, 12, 11**	10-30% **10, 9, 8, 7, 6**	Less than 10% **5, 4, 3, 2, 1, 0**
2. Embeddedness	Gravel, cobble and boulder particles are between 0 & 25% surrounded by fine sediment 20, 19, 18, 17, 16	Gravel, cobble and boulder particles are between 25 & 50% surrounded by fine sediment **15, 14, 13, 12, 11**	Gravel, cobble and boulder particles are between 50 & 75% surrounded by fine sediment **10, 9, 8, 7, 6**	Gravel, cobble and boulder particles are over 75% surrounded by fine sediment **5, 4, 3, 2, 1, 0**
3. Velocity/depth	Slow deep (<0.3 m/s & >0.5m); Slow shallow; Fast deep; Fast shallow; habitats all present 20, 19, 18, 17, 16	Only 3 of the four habitat categories present (missing riffles or runs receive lower score than missing pools) **15, 14, 13, 12, 11**	Only 2 of the four habitat categories present (missing riffles/ runs receive lower score) **10, 9, 8, 7, 6**	Dominating by one velocity/depth category (usually pool) **5, 4, 3, 2, 1, 0**
4. Channel alteration	Little or no enlargement of islands or point bars and/or no channelisation 15, 14, 13, 12	Some new increase in bar formation, mostly from coarse gravel; and/or some channelisation present **11, 10, 9, 8**	Moderate deposition of new gravel, coarse sand, on old and new bars; pools partly filled w/silt; and/or embankments on both banks **7, 6, 5, 4**	Heavy deposits of fine materials, increased bar development; most pools filled with silt; and/or extensive channelisation **3, 2, 1, 0**
5. Bottom scouring and deposition	Less than 5% of the bottom affected by scouring and deposition 15, 14, 13, 12	5-30% affected. Scours at constrictions and where grades steepen, some deposition in pools **11, 10, 9, 8**	30-50% affected. Deposits and scours at obstruction and bends. Some deposition in pools. **7, 6, 5, 4**	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed **3, 2, 1, 0**
6. Pool riffle index. *(Distance between riffles divided by stream width)*	0-7 Variety of habitat. Deep riffles and pools 15, 14, 13, 12	7-15 Adequate depth in pools and riffles. Bends provide habitat **11, 10, 9, 8**	15-25 Occasional riffle or bend. Bottom contours provide some habitat. **7, 6, 5, 4**	>25 Essentially a straight stream. Generally all flat water or shallow riffle. **3, 2, 1, 0**
7. Bank stability	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. 10, 9	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. **8, 7, 6**	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. **5, 4, 3**	Unstable. Many eroded areas. Side slopes > 60% common. "Raw" areas frequent along straight sections and bends. **2, 1, 0**
8. Bank vegetative stability	Over 80% of the streambank surfaces covered vegetation, gravel, or larger material. 10, 9	50-79% of the streambank surfaces covered by vegetation, gravel, or larger material **8, 7, 6**	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. **5, 4, 3**	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. **2, 1, 0**
9. Streamside cover	Dominant vegetation trees. 10, 9	Dominant vegetation shrubs. 8, 7, 6	Dominant vegetation is herbaceous. **5, 4, 3**	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings **2, 1, 0**

From US EPA RBA Protocols 1989; updated May 1996 by R Bailey

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

SITE CODE: _____ RECORDER'S NAME(s): Smac

DATE (ddmmyy): July 11/97 TIME of DAY: 12:45

LOCATION Haggart Creek above Hillays & Dynasty #20

PHOTO NUMBER(S) (film/exps): Ø

N 2600 ft

WEATHER Fair/Sunny AIR TEMPERATURE 18 °C

CLOUD COVER 40 % RAIN IN LAST WEEK ? Y ☑ N ☐

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% ☐ 6-25% ☑ 26-50% ☐ 51-75% ☐ >76% ☐

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)	Ø	
trees (<10m)	5	
shrubs / vines	90	
herbaceous	10	

Vegetation shading of river[3]: <5% ☑ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover; may total >100%. [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

	1	2	3	Min	Max
Stream Width[4] (m)	5.18	3.05	5.49	3.05	5.49
bank width[5] (m)	7.62	8.84	10.67	7.62	10.67
bank height (m)[6]	0.53m	0.74m	0.66		

REACH HABITAT CLASSIFICATION

% in Reach: Riffle= 60 Edge[7]= Ø Pool= Ø Plants= Ø Run= 40

FROM CENTER RIFFLE:

Water Temperature (°C): 10.9 Conductivity (mS/cm): 208

pH: 7.43 Dissolved Oxygen (mg/l): 10.3 Turbidity (NTU) Ø

[4] From edges of water [5] From tops of banks [6] From water surface vertical to top of bank [7] Length of both banks as % of reach length which can be effectively sampled with sweep net

DISCHARGE AT CENTER TRANSECT

Width of Creek at test site 4.27 m

Reading	Transect Position (m)	Depth (cm)	Flow (cm/s; revs/30s)
1.	0.5	30	
2.	1.5	23	
3.	2.5	39	
4.	3.5	42	
5.			
6.			
7.			
8.			
9.			
10.			

GENERAL OBSERVATIONS: CIRCLE YOUR CHOICE(S)

WATER ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. sterile

WATER OILS: 1. slick 2. sheen 3. globs 4. flecks 5. none

TURBIDITY: 1. clear 2. slight 3. turbid 4. opaque

PLUME: 1. little 2. some 3. lots

(amount of fine sediment generated when kick-sampling)

SEDIMENT OILS: 1. absent 2. light 3. moderate 4. profuse

SEDIMENT ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. anaerobic

6. none 7. other _____

FLOW LEVEL: (relative to "water mark" i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

1. No flow (dry / isolated) 2. Low (<water mark) 3. Moderate (=) 4. High (>water mark) 5. Flood

Bare ground above water mark: Left bank 50 % Right bank 35 %

Are the undersides of stones which are not deeply embedded black? 1. yes 2. no

SEDIMENT DEPOSITS: 1. none 2. sludge 3. sawdust 4. paper fibre 5. sand

6. relict shells 7. other _____

LOCAL CATCHMENT EROSION: 1. none 2. moderate 3. heavy

LOCAL NonPointSource POLLUTION: 1. no evidence 2. potential _____ 3. obvious _____

DAMS / BARRIERS: 1. present (upstream / downstream) 2. absent

CHANNELIZATION: 1. yes (no. of channels = _____) 2. no

SITE CLASSIFICATION: 1. steep valley 2. broad valley 3. wetland/bog

LANDUSE: 1. Forest 2. Forestry 3. Native pasture 4. Grazing 5. Cropped

Left Bank 6. Residential 7. Commercial 8. Industrial 9. Recreational

BARS: (bed surface protruding from water & forming a bar) 15 %

ADDITIONAL NOTES ON SITE:

Mine Site above + below
- Channels Two or Three during high water

TOTAL REACH SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		Ø %	9.5	*Boulder*	(>256mm)	10 %	9.0
Cobble	(64-256mm)	25 %	6.5	*Pebble*	(16-64mm)	10 %	4.5
Gravel	(2-16mm)	15 %	2.0	*Sand*	(0.06-2mm)	25 %	2.0
Silt	(0.004-0.06mm)	15 %	6.5	*Clay*	(<0.004mm)	Ø %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) Ø %

Muck/Mud (black, very fine organics) Ø %

Periphyton	0	1	2	3	4	(percent of reach covered by)
Moss	0	1	2	3	4	(percent of reach covered by)
Filamentous algae	0	1	2	3	4	(percent of reach covered by)
Macrophytes	0	1	2	3	4	(percent of reach covered by)

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

RIFFLE ONLY SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		____ %	9.5	*Boulder*	(>256mm)	____ %	9.0
Cobble	(64-256mm)	____ %	6.5	*Pebble*	(16-64mm)	____ %	4.5
Gravel	(2-16mm)	____ %	2.0	*Sand*	(0.06-2mm)	____ %	2.0
Silt	(0.004-0.06mm)	____ %	6.5	*Clay*	(<0.004mm)	____ %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) ____ %

Muck/Mud (black, very fine organics) ____ %

Same as above

Periphyton	0	1	2	3	4	(percent of reach covered by)
Moss	0	1	2	3	4	(percent of reach covered by)
Filamentous algae	0	1	2	3	4	(percent of reach covered by)
Macrophytes	0	1	2	3	4	(percent of reach covered by)

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

MACROINVERTEBRATES COLLECTED BY: Kent Sinnott

METHOD (e.g. kicknet, T-sampler): Kicknet

Length or area of riffle sampled: _____

Sample preserved in field? Y ☑ N ☐

SITE CODE: _____

DATE: _____

HABITAT ASSESSMENT FIELD DATA SHEET

CIRCLE ONE CHOICE FOR EACH OF THE NINE HABITAT DESCRIPTORS

	CATEGORY			
Habitat Variable	Excellent	Good	Fair	Poor
1. Bottom substrate/available cover	Greater than 50% rubble, gravel, submerged logs, undercut banks or other stable habitat 20, 19, 18, 17, 16	30-50% 15 14, 13, 12, 11	10-30% 10, 9, 8, 7, 6	Less than 10% 5, 4, 3, 2, 1, 0
2. Embeddedness	Gravel, cobble and boulder particles are between 0 & 25% surrounded by fine sediment 20 19, 18, 17, 16	Gravel, cobble and boulder particles are between 25 & 50% surrounded by fine sediment 15, 14, 13, 12, 11	Gravel, cobble and boulder particles are between 50 & 75% surrounded by fine sediment 10, 9, 8, 7, 6	Gravel, cobble and boulder particles are over 75% surrounded by fine sediment 5, 4, 3, 2, 1, 0
3. Velocity/depth	Slow deep (<0.3 m/s & >0.5m); Slow shallow; Fast deep; Fast shallow; habitats all present 20 19, 18, 17, 16	Only 3 of the four habitat categories present (missing riffles or runs receive lower score than missing pools) 15, 14, 13, 12, 11	Only 2 of the four habitat categories present (missing riffles/ runs receive lower score) 10, 9, 8, 7, 6	Dominating by one velocity/depth category (usually pool) 5, 4, 3, 2, 1, 0
4. Channel alteration	Little or no enlargement of islands or point bars and/or no channelisation 15 14, 13, 12	Some new increase in bar formation, mostly from coarse gravel; and/or some channelisation present 11, 10, 9, 8	Moderate deposition of new gravel, coarse sand, on old and new bars; pools partly filled w/silt; and/or embankments on both banks 7, 6, 5, 4	Heavy deposits of fine materials, increased bar development; most pools filled with silt; and/or extensive channelisation 3, 2, 1, 0
5. Bottom scouring and deposition	Less than 5% of the bottom affected by scouring and deposition 15 14, 13, 12	5-30% affected. Scours at constrictions and where grades steepen, some deposition in pools 11, 10, 9, 8	30-50% affected. Deposits and scours at obstruction and bends. Some deposition in pools. 7, 6, 5, 4	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed 3, 2, 1, 0
6. Pool/riffle index. *(Distance between riffles divided by stream width)*	0-7 Variety of habitat. Deep riffles and pools 15 14, 13, 12	7-15 Adequate depth in pools and riffles. Bends provide habitat 11, 10, 9, 8	15-25 Occasional riffle or bend. Bottom contours provide some habitat. 7, 6, 5, 4	>25 Essentially a straight stream. Generally all flat water or shallow riffle. 3, 2, 1, 0
7. Bank stability	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. 10 9	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. 8, 7, 6	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. 5, 4, 3	Unstable. Many eroded areas. Side slopes > 60% common. "Raw" areas frequent along straight sections and bends. 2, 1, 0
8. Bank vegetative stability	Over 80% of the streambank surfaces covered vegetation, gravel, or larger material. 10 9	50-79% of the streambank surfaces covered by vegetation, gravel, or larger material 8, 7, 6	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. 5, 4, 3	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. 2, 1, 0
9. Streamside cover	Dominant vegetation trees. 10, 9	Dominant vegetation shrubs. 8 7, 6	Dominant vegetation is herbaceous. 5, 4, 3	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings 2, 1, 0

From US EPA RBA Protocols 1989; updated May 1996 by R Bailey

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

SITE CODE: _____ RECORDER'S NAME(s): _____

DATE (ddmmyy): 12/8/98 TIME of DAY: 1:45 pm

LOCATION North McQuesten Site 2 63° 58' 37 136° 20' 53

PHOTO NUMBER(S) (film/exps): _____

WEATHER Sunny AIR TEMPERATURE 21.6 °C

CLOUD COVER 12 % RAIN IN LAST WEEK ? Y ☐ N ☐

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% ☐ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)		
trees (<10m)		
shrubs / vines		
herbaceous		

Vegetation shading of river[3]: <5% ☐ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover, may total >100%. [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

Stream Width[4] (m) 1 _____ 2 _____ 3 _____ Min _____ Max _____

bank width[5] (m) 1 _____ 2 _____ 3 _____ Min _____ Max _____

bank height (m)[6] 1 _____ 2 _____ 3 _____ Min _____ Max _____

REACH HABITAT CLASSIFICATION

% in Reach: Riffle= _____ Edge[7]= _____ Pool= _____ Plants= _____ Run= _____

FROM CENTER RIFFLE:

Water Temperature (°C): 11.2 Conductivity (mS/cm): 325

pH: 7.96 Dissolved Oxygen (mg/l): 8.6 Turbidity (NTU) 4.4

[4] From edges of water [5] From tops of banks. [6] From water surface vertical to top of bank. [7] Length of both banks as % of reach length which can be effectively sampled with sweep net

Time it took orange to float a known distance

DISCHARGE AT CENTER TRANSECT

Reading	Transect Position (m)	Depth (cm)	~~Flow (cm/s; revs/30s)~~ Time (sec)	velocity
1.	~~left~~ 16	28 cm	7 s/16m	2.3 m/s
2.			9 s/16m	1.8 m/s
3.			10 s/16m	1.6 m/s
4.				
5.				
6.				$\bar{X}$ velocity = 1.9 m/s
7.				
8.				
9.				
10.				

GENERAL OBSERVATIONS: CIRCLE YOUR CHOICE(S)

WATER ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. sterile

WATER OILS: 1. slick 2. sheen 3. globs 4. flecks 5. none

TURBIDITY: 1. clear 2. slight 3. turbid 4. opaque

PLUME: 1. little 2. some 3. lots

(amount of fine sediment generated when kick-sampling)

SEDIMENT OILS: 1. absent 2. light 3. moderate 4. profuse

SEDIMENT ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. anaerobic

6. none 7. other _____

FLOW LEVEL: (relative to "water mark" i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

1. No flow (dry / isolated) 2. Low (<water mark) 3. Moderate (=) 4. High (>water mark) 5. Flood

Bare ground above water mark: Left bank _____% Right bank _____%

Are the undersides of stones which are not deeply embedded black? 1. yes 2. no

SEDIMENT DEPOSITS: 1. none 2. sludge 3. sawdust 4. paper fibre 5. sand

6. relict shells 7. other _____

LOCAL CATCHMENT EROSION: 1. none 2. moderate 3. heavy

LOCAL NonPointSource POLLUTION: 1. no evidence 2. potential _____ 3. obvious _____

DAMS / BARRIERS: 1. present (upstream / downstream) 2. absent

CHANNELIZATION: 1. yes (no. of channels = _____) 2. no

SITE CLASSIFICATION: 1. steep valley 2. broad valley 3. wetland/bog

LANDUSE: 1. Forest 2. Forestry 3. Native pasture 4. Grazing 5. Cropped

Left Bank 6. Residential 7. Commercial 8. Industrial 9. Recreational

BARS: (bed surface protruding from water & forming a bar) _____%

ADDITIONAL NOTES ON SITE:

TOTAL REACH SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		____%	9.5	*Boulder*	(>256mm)	____%	9.0
Cobble	(64-256mm)	50 %	6.5	*Pebble*	(16-64mm)	50 %	4.5
Gravel	(2-16mm)	____%	2.0	*Sand*	(0.06-2mm)	____%	2.0
Silt	(0.004-0.06mm)	____%	6.5	*Clay*	(<0.004mm)	____%	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)
Detritus (sticks, wood, CPOM) ____%
Muck/Mud (black, very fine organics) ____%

Periphyton	0	1	2	3	4	(percent of reach covered by)
Moss	0	1	2	3	4	(percent of reach covered by)
Filamentous algae	0	1	2	3	4	(percent of reach covered by)
Macrophytes	0	1	2	3	4	(percent of reach covered by)

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

① 9.5 x 3.6 cm cobble
② 4.2 x 3.7 cm pebble
③ 6.4 x 4.1 cm pebble
④ 5.3 x 3.8 cm pebble
⑤ 3.3 x 2.6 cm pebble
⑥ 7.2 x 6 cm cobble
⑦ 11.5 x 9.2 cm cobble
⑧ 5.7 x 5.8 cm pebble
⑨ 9.8 x 6.2 cm cobble
⑩ 11.5 x 12.1 cm cobble

RIFFLE ONLY SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		____%	9.5	*Boulder*	(>256mm)	____%	9.0
Cobble	(64-256mm)	____%	6.5	*Pebble*	(16-64mm)	____%	4.5
Gravel	(2-16mm)	____%	2.0	*Sand*	(0.06-2mm)	____%	2.0
Silt	(0.004-0.06mm)	____%	6.5	*Clay*	(<0.004mm)	____%	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)
Detritus (sticks, wood, CPOM) ____%
Muck/Mud (black, very fine organics) ____%

Periphyton	0	1	2	3	4	(percent of reach covered by)
Moss	0	1	2	3	4	(percent of reach covered by)
Filamentous algae	0	1	2	3	4	(percent of reach covered by)
Macrophytes	0	1	2	3	4	(percent of reach covered by)

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

MACROINVERTEBRATES COLLECTED BY: _____

METHOD (e.g. kicknet, T-sampler): _____

Length or area of riffle sampled: _____

Sample preserved in field? Y ☐ N ☐

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

SITE CODE: _____ RECORDER'S NAME(s): _____

DATE (ddmmyy): 12/8/98 TIME of DAY: 12pm

LOCATION North McQuesten Site 1 63° 50' 09 136° 19' 02

PHOTO NUMBER(S) (film/exps): _____

WEATHER Sunny AIR TEMPERATURE 21.2 °C

CLOUD COVER 10 % RAIN IN LAST WEEK ? Y ☐ N ☐

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% ☐ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)		
trees (<10m)		
shrubs / vines		
herbaceous		

Vegetation shading of river[3]: <5% ☐ 6-25% ☑ 26-50% ☐ 51-75% ☐ >76% ☐

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover, may total >100%. [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

Stream Width[4] (m) 1 _____ 2 _____ 3 _____ Min _____ Max 72cm

bank width[5] (m) 1 _____ 2 _____ 3 _____ Min _____ Max _____

bank height (m) [6] 1 _____ 2 _____ 3 _____ Min _____ Max _____

REACH HABITAT CLASSIFICATION

% in Reach: Riffle= _____ Edge[7]= _____ Pool= _____ Plants= _____ Run= _____

FROM CENTER RIFFLE:

Water Temperature (°C): 11.1 °C Conductivity (~~mS~~ uS/cm): 309

pH: 7.83 Dissolved Oxygen (mg/l): 8.2 Turbidity (NTU) 3.8

[4] From edges of water [5] From tops of banks [6] From water surface vertical to top of bank [7] Length of both banks as % of reach length which can be effectively sampled with sweep net

DISCHARGE AT CENTER TRANSECT

Time it took an orange to float a known distance

Reading	Transect Position (m)	Depth (cm)	~~Flow (cm/s; revs/30s)~~ Time (s)	Velocity
1.	10m		8 s	1.25 m/s
2.			9 s	1.11 m/s
3.			12 s	.83 m/sec
4.				
5.				
6.				$\bar{X}$ velocity = 1.1 m/s
7.				
8.				
9.				
10.				

GENERAL OBSERVATIONS: CIRCLE YOUR CHOICE(S)

WATER ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. sterile

WATER OILS: 1. slick 2. sheen 3. globs 4. flecks 5. none

TURBIDITY: 1. clear 2. slight 3. turbid 4. opaque

PLUME: 1. little 2. some 3. lots

(amount of fine sediment generated when kick-sampling)

SEDIMENT OILS: 1. absent 2. light 3. moderate 4. profuse

SEDIMENT ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. anaerobic

6. none 7. other _____

FLOW LEVEL: (relative to "water mark" i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

1. No flow (dry / isolated) 2. Low (<water mark) 3. Moderate (=) 4. High (>water mark) 5. Flood

Bare ground above water mark: Left bank _____% Right bank _____%

Are the undersides of stones which are not deeply embedded black? 1. yes 2. no

SEDIMENT DEPOSITS: 1. none 2. sludge 3. sawdust 4. paper fibre 5. sand

6. relict shells 7. other _____

LOCAL CATCHMENT EROSION: 1. none 2. moderate 3. heavy

LOCAL NonPointSource POLLUTION: 1. no evidence 2. potential _____ 3. obvious _____

DAMS / BARRIERS: 1. present (upstream / downstream) 2. absent

CHANNELIZATION: 1. yes (no. of channels = _____) 2. no

SITE CLASSIFICATION: 1. steep valley 2. broad valley 3. wetland/bog

LANDUSE: 1. Forest 2. Forestry 3. Native pasture 4. Grazing 5. Cropped

Left Bank 6. Residential 7. Commercial 8. Industrial 9. Recreational

BARS: (bed surface protruding from water & forming a bar) _____%

ADDITIONAL NOTES ON SITE:

_____

TOTAL REACH SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		____%	9.5	*Boulder*	(>256mm)	____%	9.0
Cobble	(64-256mm)	20 %	6.5	*Pebble*	(16-64mm)	60 %	4.5
Gravel	(2-16mm)	20 %	2.0	*Sand*	(0.06-2mm)	____%	2.0
Silt	(0.004-0.06mm)	____%	6.5	*Clay*	(<0.004mm)	____%	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) ____%

Muck/Mud (black, very fine organics) ____%

Periphyton	0	1	2	3	4	**(percent of reach covered by)**
Moss	0	1	2	3	4	**(percent of reach covered by)**
Filamentous algae	0	1	2	3	4	**(percent of reach covered by)**
Macrophytes	0	1	2	3	4	**(percent of reach covered by)**

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

1. 4.5 x 3.2 cm pebble
2. 5.1 x 4.6 cm pebble
3. 7.6 x 4.8 cm cobble
4. 5.3 x 4.5 cm pebble
5. 6.3 x 2.8 cm pebble
6. 6.4 x 6.6 cm cobble
7. 2 x 1.3 cm pebble
8. 2.6 x 1.6 cm gravel
9. 4.2 x 3.6 cm pebble
10. 1 x 1.6 cm gravel

RIFFLE ONLY SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		____%	9.5	*Boulder*	(>256mm)	____%	9.0
Cobble	(64-256mm)	____%	6.5	*Pebble*	(16-64mm)	____%	4.5
Gravel	(2-16mm)	____%	2.0	*Sand*	(0.06-2mm)	____%	2.0
Silt	(0.004-0.06mm)	____%	6.5	*Clay*	(<0.004mm)	____%	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) ____%

Muck/Mud (black, very fine organics) ____%

Periphyton	0	1	2	3	4	**(percent of reach covered by)**
Moss	0	1	2	3	4	**(percent of reach covered by)**
Filamentous algae	0	1	2	3	4	**(percent of reach covered by)**
Macrophytes	0	1	2	3	4	**(percent of reach covered by)**

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

MACROINVERTEBRATES COLLECTED BY: _____

METHOD (e.g. kicknet, T-sampler): _____

Length or area of riffle sampled: _____

Sample preserved in field? Y ☐ N ☐

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

13

SITE CODE: _____ RECORDER'S NAME(s): Smac

DATE (ddmmyy): 07/17/97 TIME of DAY: 4:36 pm.

LOCATION Vancouver Creek / ~~South Mequester~~

PHOTO NUMBER(S) (film/exps): _____

WEATHER Sunny / Fair AIR TEMPERATURE _____ °C

CLOUD COVER 50 % RAIN IN LAST WEEK ? Y [X] N [ ]

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% [ ] 6-25% [X] 26-50% [ ] 51-75% [ ] >76% [ ]

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)	Ø	
trees (<10m)	Ø	
shrubs / vines	100	
herbaceous	Ø	

Vegetation shading of river[3]: <5% [X] 6-25% [ ] 26-50% [ ] 51-75% [ ] >76% [ ]

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover, may total >100%. [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

Stream Width[4] (m) 1 25 Feet 2 28 3 30 Min _____ Max _____

bank width[5] (m) 1 40 Feet 2 38 3 42 Min _____ Max _____

bank height (m) [6] 1 3ft 5 inch 2 3ft 4 inch 3 2ft 2 inch Min _____ Max _____

REACH HABITAT CLASSIFICATION

% in Reach: Riffle= 100 Edge[7]= Ø Pool= Ø Plants= Ø Run= Ø

FROM CENTER RIFFLE:

Water Temperature (°C): 8.4 Conductivity (mS/cm): 252

pH: 7.66 Dissolved Oxygen (mg/l): 8.4 Turbidity (NTU) _____

[4] From edges of water [5] From tops of banks [6] From water surface vertical to top of bank [7] Length of both banks as % of reach length which can be effectively sampled with sweep net

DISCHARGE AT CENTER TRANSECT

Reading	Transect Position (m)	Depth (cm)	Flow (cm/s; revs/30s)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

GENERAL OBSERVATIONS: CIRCLE YOUR CHOICE(S)

WATER ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. sterile

WATER OILS: 1. slick 2. sheen 3. globs 4. flecks 5. none

TURBIDITY: 1. clear 2. slight 3. turbid 4. opaque

PLUME: 1. little 2. some 3. lots

(amount of fine sediment generated when kick-sampling)

SEDIMENT OILS: 1. absent 2. light 3. moderate 4. profuse

SEDIMENT ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. anaerobic

6. none 7. other _____

FLOW LEVEL: (relative to "water mark" i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

1. No flow (dry / isolated) 2. Low (<water mark) 3. Moderate (=) 4. High (>water mark) 5. Flood

Bare ground above water mark: Left bank 60 % Right bank 30 %

Are the undersides of stones which are not deeply embedded black? 1. yes 2. no

SEDIMENT DEPOSITS: 1. none 2. sludge 3. sawdust 4. paper fibre 5. sand

6. relict shells 7. other _____

LOCAL CATCHMENT EROSION: 1. none 2. moderate 3. heavy

LOCAL NonPointSource POLLUTION: 1. no evidence 2. potential _____ 3. obvious _____

DAMS / BARRIERS: 1. present (upstream / downstream) 2. absent

CHANNELIZATION: 1. yes (no. of channels = _____) 2. no

SITE CLASSIFICATION: 1. steep valley 2. broad valley 3. wetland/bog

LANDUSE: 1. Forest 2. Forestry 3. Native pasture 4. Grazing 5. Cropped

Left Bank 6. Residential 7. Commercial 8. Industrial 9. Recreational

BARS: (bed surface protruding from water & forming a bar) 0 %

ADDITIONAL NOTES ON SITE: Old Road Site above Creek

TOTAL REACH SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		Ø %	9.5	*Boulder*	(>256mm)	10 %	9.0
Cobble	(64-256mm)	20 %	6.5	*Pebble*	(16-64mm)	20 %	4.5
Gravel	(2-16mm)	20 %	2.0	*Sand*	(0.06-2mm)	20 %	2.0
Silt	(0.004-0.06mm)	Ø %	6.5	*Clay*	(<0.004mm)	Ø %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) 0 %

Muck/Mud (black, very fine organics) 50 %

Periphyton	0	1	2	3	4	(percent of reach covered by)
Moss	0	1	2	3	4	(percent of reach covered by)
Filamentous algae	0	1	2	3	4	(percent of reach covered by)
Macrophytes	0	1	2	3	4	(percent of reach covered by)

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

RIFFLE ONLY SUBSTRATUM DESCRIPTION: Same as above

			PHI				PHI
Bedrock		____ %	9.5	*Boulder*	(>256mm)	____ %	9.0
Cobble	(64-256mm)	____ %	6.5	*Pebble*	(16-64mm)	____ %	4.5
Gravel	(2-16mm)	____ %	2.0	*Sand*	(0.06-2mm)	____ %	2.0
Silt	(0.004-0.06mm)	____ %	6.5	*Clay*	(<0.004mm)	____ %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) ____ %

Muck/Mud (black, very fine organics) ____ %

Periphyton	0	1	2	3	4	(percent of reach covered by)
Moss	0	1	2	3	4	(percent of reach covered by)
Filamentous algae	0	1	2	3	4	(percent of reach covered by)
Macrophytes	0	1	2	3	4	(percent of reach covered by)

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

MACROINVERTEBRATES COLLECTED BY: Simone

METHOD (e.g. kicknet, T-sampler): Kicknet

Length or area of riffle sampled: 25 Feet

Sample preserved in field? Y ☐ N ☒

19.39
17.99
14.22
16.68

SITE CODE: Vancouver Creek

DATE: 07/17/97

HABITAT ASSESSMENT FIELD DATA SHEET

CIRCLE ONE CHOICE FOR EACH OF THE NINE HABITAT DESCRIPTORS

	CATEGORY			
Habitat Variable	Excellent	Good	Fair	Poor
1. Bottom substrate/available cover	Greater than 50% rubble, gravel, submerged logs, undercut banks or other stable habitat 20, 19, 18, 17, 16	30-50% 15, 14, 13, 12, 11	10-30% 10, 9, 8, 7, 6	Less than 10% 5, 4, 3, 2, 1, 0
2. Embeddedness	Gravel, cobble and boulder particles are between 0 & 25% surrounded by fine sediment 20, 19, 18, 17, 16	Gravel, cobble and boulder particles are between 25 & 50% surrounded by fine sediment 15, 14, 13, 12, 11	Gravel, cobble and boulder particles are between 50 & 75% surrounded by fine sediment 10, 9, 8, 7, 6	Gravel, cobble and boulder particles are over 75% surrounded by fine sediment 5, 4, 3, 2, 1, 0
3. Velocity/depth	Slow deep (<0.3 m/s & >0.5m); Slow shallow; Fast deep; Fast shallow; habitats all present 20, 19, 18, 17, 16	Only 3 of the four habitat categories present (missing riffles or runs receive lower score than missing pools) 15, 14, 13, 12, 11	Only 2 of the four habitat categories present (missing riffles/ runs receive lower score) 10, 9, 8, 7, 6	Dominating by one velocity/depth category (usually pool) 5, 4, 3, 2, 1, 0
4. Channel alteration	Little or no enlargement of islands or point bars and/or no channelisation 15, 14, 13, 12	Some new increase in bar formation, mostly from coarse gravel; and/or some channelisation present 11, 10, 9, 8	Moderate deposition of new gravel, coarse sand, on old and new bars; pools partly filled w/silt; and/or embankments on both banks 7, 6, 5, 4	Heavy deposits of fine materials, increased bar development; most pools filled with silt; and/or extensive channelisation 3, 2, 1, 0
5. Bottom scouring and deposition	Less than 5% of the bottom affected by scouring and deposition 15, 14, 13, 12	5-30% affected. Scours at constrictions and where grades steepen, some deposition in pools 11, 10, 9, 8	30-50% affected. Deposits and scours at obstruction and bends. Some deposition in pools. 7, 6, 5, 4	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed 3, 2, 1, 0
6. Pool/riffle index. *(Distance between riffles divided by stream width)*	0-7 Variety of habitat. Deep riffles and pools 15, 14, 13, 12	7-15 Adequate depth in pools and riffles. Bends provide habitat 11, 10, 9, 8	15-25 Occasional riffle or bend. Bottom contours provide some habitat. 7, 6, 5, 4	>25 Essentially a straight stream. Generally all flat water or shallow riffle. 3, 2, 1, 0
7. Bank stability	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. 10, 9	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. 8, 7, 6	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. 5, 4, 3	Unstable. Many eroded areas. Side slopes > 60% common. "Raw" areas frequent along straight sections and bends. 2, 1, 0
8. Bank vegetative stability	Over 80% of the streambank surfaces covered vegetation, gravel, or larger material. 10, 9	50-79% of the streambank surfaces covered by vegetation, gravel, or larger material 8, 7, 6	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. 5, 4, 3	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. 2, 1, 0
9. Streamside cover	Dominant vegetation trees. 10, 9	Dominant vegetation shrubs. 8, 7, 6	Dominant vegetation is herbaceous. 5, 4, 3	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings 2, 1, 0

From US EPA RBA Protocols 1989; updated May 1996 by R Bailey

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

SITE CODE: _____ RECORDER'S NAME(s): Smac

DATE (ddmmyy): 07/16/97 TIME of DAY: 8:10 p.m.

LOCATION Bear Creek / McQuesten River #12

PHOTO NUMBER(S) (film/exps): _____

WEATHER Fair / Sunny AIR TEMPERATURE 20.2 °C

63.46 35
136 31 22

CLOUD COVER 70 % RAIN IN LAST WEEK ? Y ☒ N ☐

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% ☒ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)	Ø	
trees (<10m)	Ø	
shrubs / vines	66	
herbaceous	5	

Vegetation shading of river[3]: <5% ☒ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☐

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover; may total >100% [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

Stream Width[4] (m)	1 19 ft 7 in	2 17 feet	3 22 ft 6 in	Min 17	Max 22
bank width[5] (m)	1 21 in	2 20	3 25 1/2 ft	Min 20	Max 25
bank height (m)[6]	1 9.2	2 1 ft 10 inch	3 11 inch	Min 1	Max _____

REACH HABITAT CLASSIFICATION

% in Reach: Riffle= 98 Edge[7]= Ø Pool= Ø Plants= 2% Run= 2

FROM CENTER RIFFLE:

Water Temperature (°C): 7.8 Conductivity (mS/cm): 142

pH: 7.74 Dissolved Oxygen (mg/l): _____ Turbidity (NTU) 11.46

[4] From edges of water [5] From tops of banks [6] From water surface vertical to top of bank [7] Length of both banks as % of reach length which can be effectively sampled with sweep net

DISCHARGE AT CENTER TRANSECT

11.54
11.84
15.49
13.47
13.42

37 9in Apart

Reading	Transect Position (m)	Depth (cm)	Flow (cm/s; revs/30s)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

GENERAL OBSERVATIONS: CIRCLE YOUR CHOICE(S)

WATER ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. sterile

WATER OILS: 1. slick 2. sheen 3. globs 4. flecks 5. none

TURBIDITY: 1. clear 2. slight 3. turbid 4. opaque

PLUME: 1. little 2. some 3. lots

(amount of fine sediment generated when kick-sampling)

SEDIMENT OILS: 1. absent 2. light 3. moderate 4. profuse

SEDIMENT ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. anaerobic

6. none 7. other _____

FLOW LEVEL: (relative to "water mark" i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

1. No flow (dry / isolated) 2. Low (<water mark) 3. Moderate (=) 4. High (>water mark) 5. Flood

Bare ground above water mark: Left bank 5 % Right bank 60 %

Are the undersides of stones which are not deeply embedded black? 1. yes 2. no

SEDIMENT DEPOSITS: 1. none 2. sludge 3. sawdust 4. paper fibre 5. sand

6. relict shells 7. other _____

LOCAL CATCHMENT EROSION: 1. none 2. moderate 3. heavy

LOCAL NonPointSource POLLUTION: 1. no evidence 2. potential _____ 3. obvious _____

DAMS / BARRIERS: 1. present (upstream / downstream) 2. absent

CHANNELIZATION: 1. yes (no. of channels = _____) 2. no

SITE CLASSIFICATION: 1. steep valley 2. broad valley 3. wetland/bog

LANDUSE: 1. Forest 2. Forestry 3. Native pasture 4. Grazing 5. Cropped

Left Bank 6. Residential 7. Commercial 8. Industrial 9. Recreational

BARS: (bed surface protruding from water & forming a bar) _____ %

ADDITIONAL NOTES ON SITE:

TOTAL REACH SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		Ø %	9.5	*Boulder*	(>256mm)	10 %	9.0
Cobble	(64-256mm)	30 %	6.5	*Pebble*	(16-64mm)	15 %	4.5
Gravel	(2-16mm)	30 %	2.0	*Sand*	(0.06-2mm)	10 %	2.0
Silt	(0.004-0.06mm)	5 %	6.5	*Clay*	(<0.004mm)	Ø %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) Ø %

Muck/Mud (black, very fine organics) Ø %

Periphyton	(0)	1	2	3	4	(percent of reach covered by)
Moss	(0)	1	2	3	4	(percent of reach covered by)
Filamentous algae	(0)	1	2	3	4	(percent of reach covered by)
Macrophytes	(0)	1	2	3	4	(percent of reach covered by)

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

RIFFLE ONLY SUBSTRATUM DESCRIPTION: Same as above

			PHI				PHI
Bedrock		____ %	9.5	*Boulder*	(>256mm)	____ %	9.0
Cobble	(64-256mm)	____ %	6.5	*Pebble*	(16-64mm)	____ %	4.5
Gravel	(2-16mm)	____ %	2.0	*Sand*	(0.06-2mm)	____ %	2.0
Silt	(0.004-0.06mm)	____ %	6.5	*Clay*	(<0.004mm)	____ %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) ____ %

Muck/Mud (black, very fine organics) ____ %

Periphyton	0	1	2	3	4	(percent of reach covered by)
Moss	0	1	2	3	4	(percent of reach covered by)
Filamentous algae	0	1	2	3	4	(percent of reach covered by)
Macrophytes	0	1	2	3	4	(percent of reach covered by)

0= <10% *1=10-35%* *2=35-65%* *3=65-90%* *4=>90%*

MACROINVERTEBRATES COLLECTED BY: Edward Brown

METHOD (e.g. kicknet, T-sampler): Kicknet

Length or area of riffle sampled: 25 Feet

Sample preserved in field? Y ☒ N ☐

SITE CODE: Bear Creek

DATE: 07/16/97

HABITAT ASSESSMENT FIELD DATA SHEET

CIRCLE ONE CHOICE FOR EACH OF THE NINE HABITAT DESCRIPTORS

	CATEGORY			
Habitat Variable	Excellent	Good	Fair	Poor
1. Bottom substrate/available cover	Greater than 50% rubble, gravel, submerged logs, undercut banks or other stable habitat **20, 19, 18, 17, 16**	30-50% **15, 14, 13, 12, 11**	10-30% **10, 9, 8, 7, 6**	Less than 10% **5, 4, 3, 2, 1, 0**
2. Embeddedness	Gravel, cobble and boulder particles are between 0 & 25% surrounded by fine sediment **20, 19, 18, 17, 16**	Gravel, cobble and boulder particles are between 25 & 50% surrounded by fine sediment **15, 14, 13, 12, 11**	Gravel, cobble and boulder particles are between 50 & 75% surrounded by fine sediment **10, 9, 8, 7, 6**	Gravel, cobble and boulder particles are over 75% surrounded by fine sediment **5, 4, 3, 2, 1, 0**
3. Velocity/depth	Slow deep (<0.3 m/s & >0.5m); Slow shallow; Fast deep; Fast shallow; habitats all present **20, 19, 18, 17, 16**	Only 3 of the four habitat categories present (missing riffles or runs receive lower score than missing pools) **15, 14, 13, 12, 11**	Only 2 of the four habitat categories present (missing riffles/ runs receive lower score) **10, 9, 8, 7, 6**	Dominating by one velocity/depth category (usually pool) **5, 4, 3, 2, 1, 0**
4. Channel alteration	Little or no enlargement of islands or point bars and/or no channelisation **15, 14, 13, 12**	Some new increase in bar formation, mostly from coarse gravel; and/or some channelisation present **11, 10, 9, 8**	Moderate deposition of new gravel, coarse sand, on old and new bars; pools partly filled w/silt; and/or embankments on both banks **7, 6, 5, 4**	Heavy deposits of fine materials, increased bar development; most pools filled with silt; and/or extensive channelisation **3, 2, 1, 0**
5. Bottom scouring and deposition	Less than 5% of the bottom affected by scouring and deposition **15, 14, 13, 12**	5-30% affected. Scours at constrictions and where grades steepen, some deposition in pools **11, 10, 9, 8**	30-50% affected. Deposits and scours at obstruction and bends. Some deposition in pools. **7, 6, 5, 4**	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed **3, 2, 1, 0**
6. Pool/riffle index. *(Distance between riffles divided by stream width)*	0-7 Variety of habitat. Deep riffles and pools **15, 14, 13, 12**	7-15 Adequate depth in pools and riffles. Bends provide habitat **11, 10, 9, 8**	15-25 Occasional riffle or bend. Bottom contours provide some habitat. **7, 6, 5, 4**	>25 Essentially a straight stream. Generally all flat water or shallow riffle. **3, 2, 1, 0**
7. Bank stability	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. **10, 9**	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. **8, 7, 6**	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. **5, 4, 3**	Unstable. Many eroded areas. Side slopes > 60% common. "Raw" areas frequent along straight sections and bends. **2, 1, 0**
8. Bank vegetative stability	Over 80% of the streambank surfaces covered vegetation, gravel, or larger material. **10, 9**	50-79% of the streambank surfaces covered by vegetation, gravel, or larger material **8, 7, 6**	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. **5, 4, 3**	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. **2, 1, 0**
9. Streamside cover	Dominant vegetation trees. **10, 9**	Dominant vegetation shrubs. **8, 7, 6**	Dominant vegetation is herbaceous. **5, 4, 3**	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings **2, 1, 0**

From US EPA RBA Protocols 1989; updated May 1996 by R Bailey

FIELD SAMPLING SHEET (Revised by R Bailey May 1996)

SITE CODE: _____ RECORDER'S NAME(s): Ronalda Moses

DATE (ddmmyy): 8/7/97 TIME of DAY: 12:50 pm

LOCATION Christal Creek (McQuesten Lake Bridge) #1

PHOTO NUMBER(S) (film/exps): _____

WEATHER Fair

CLOUD COVER 80 % AIR TEMPERATURE 24.5 °C

RAIN IN LAST WEEK ? Y ☑ N ☐

RIPARIAN VEGETATION

Vegetation cover of riparian zone[1]: <5% ☐ 6-25% ☐ 26-50% ☐ 51-75% ☐ >76% ☑

Vegetation type:	% Cover of riparian zone[2]	Notes
trees (>10m)	50 %	
trees (<10m)	70 %	
shrubs / vines	30 %	
herbaceous	80-90 %	

Vegetation shading of river[3]: <5% ☐ 6-25% ☑ 26-50% ☐ 51-75% ☐ >76% ☐

[1] Riparian zone is 2x estimated flood plain width. [2] From 'Plan' view, estimation of outline cover, may total >100%. [3] Estimate as at midday in leaf.

REACH (Length = 10x MEAN WIDTH) MEASUREMENTS:

Stream Width[4] (m) 1 3.2 2 3.66 3 2.74 Min 2.74 Max 3.66

ank width[5] (m) 1 7.6 2 7.6 3 5.33 Min 5.33 Max 7.6

nk height (m) [6] 1 0.69 2 0.74 3 0.79 Min 0.69 Max 0.79

ACH HABITAT CLASSIFICATION

Reach: Riffle= 95 Edge[7]= Ø Pool= Ø Plants= Ø Run= Ø

CENTER RIFFLE:

emperature (°C): 7.9 Conductivity (mS/cm): 376

89 Dissolved Oxygen (mg/l): 11.5 Turbidity (NTU) Ø

ater [5] From tops of banks [6] From water surface vertical to top of bank [7] Length of both banks as % of reach length which

DISCHARGE AT CENTER TRANSECT

Width 10'6"

Reading	Transect Position (m)	Depth (cm)	Flow (cm/s; revs/30s)
1.	0.5	28	8.01
2.	1.5	14	10
3.	2.5	17	9
4.			7
5.			7.5
6.			
7.			
8.			
9.			
10.			

?

GENERAL OBSERVATIONS: CIRCLE YOUR CHOICE(S)

WATER ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. sterile

WATER OILS: 1. slick 2. sheen 3. globs 4. flecks 5. none

TURBIDITY: 1. clear 2. slight 3. turbid 4. opaque

PLUME: 1. little 2. some 3. lots

(amount of fine sediment generated when kick-sampling)

SEDIMENT OILS: 1. absent 2. light 3. moderate 4. profuse

SEDIMENT ODOURS: 1. normal 2. sewage 3. petroleum 4. chemical 5. anaerobic 6. none 7. other _____

FLOW LEVEL: (relative to "water mark" i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

1. No flow (dry / isolated) 2. Low (<water mark) 3. Moderate (=) 4. High (>water mark) 5. Flood

Bare ground above water mark: Left bank 0 % Right bank 10 %

Are the undersides of stones which are not deeply embedded black? 1. yes 2. no

SEDIMENT DEPOSITS: 1. none 2. sludge 3. sawdust 4. paper fibre 5. sand 6. relict shells 7. other _____

LOCAL CATCHMENT EROSION: 1. none 2. moderate 3. heavy

LOCAL NonPointSource POLLUTION: 1. no evidence 2. potential _____ 3. obvious _____

DAMS / BARRIERS: 1. present (upstream / downstream) 2. absent

CHANNELIZATION: 1. yes (no. of channels = _____) 2. no

SITE CLASSIFICATION: 1. steep valley 2. broad valley 3. wetland/bog

LANDUSE: 1. Forest 2. Forestry 3. Native pasture 4. Grazing 5. Cropped

Left Bank 6. Residential 7. Commercial 8. Industrial 9. Recreational

BARS: (bed surface protruding from water & forming a bar) 0 %

ADDITIONAL NOTES ON SITE:

Sampled upstream above bridge on McQuesten Lake Road.

TOTAL REACH SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		0 %	9.5	*Boulder*	(>256mm)	____ %	9.0
Cobble	(64-256mm)	25 %	6.5	*Pebble*	(16-64mm)	35 %	4.5
Gravel	(2-16mm)	30 %	2.0	*Sand*	(0.06-2mm)	5 %	2.0
Silt	(0.004-0.06mm)	5 %	6.5	*Clay*	(<0.004mm)	____ %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) 5 %

Muck/Mud (black, very fine organics) 0 %

Periphyton	(0)	1	2	3	4	(percent of reach covered by)
Moss	(0)	1	2	3	4	(percent of reach covered by)
Filamentous algae	(0)	1	2	3	4	(percent of reach covered by)
Macrophytes	(0)	1	2	3	4	(percent of reach covered by)

0= <10% 1=10-35% 2=35-65% 3=65-90% 4=>90%

RIFFLE ONLY SUBSTRATUM DESCRIPTION:

			PHI				PHI
Bedrock		____ %	9.5	*Boulder*	(>256mm)	____ %	9.0
Cobble	(64-256mm)	____ %	6.5	*Pebble*	(16-64mm)	____ %	4.5
Gravel	(2-16mm)	____ %	2.0	*Sand*	(0.06-2mm)	____ %	2.0
Silt	(0.004-0.06mm)	____ %	6.5	*Clay*	(<0.004mm)	____ %	9.5

ORGANIC SUBSTRATUM (% cover of inorganic substrate)

Detritus (sticks, wood, CPOM) ____ %

Muck/Mud (black, very fine organics) ____ %

Same as above

Periphyton	0	1	2	3	4	(percent of reach covered by)
Moss	0	1	2	3	4	(percent of reach covered by)
Filamentous algae	0	1	2	3	4	(percent of reach covered by)
Macrophytes	0	1	2	3	4	(percent of reach covered by)

0= <10% 1=10-35% 2=35-65% 3=65-90% 4=>90%

MACROINVERTEBRATES COLLECTED BY: Kent

METHOD (e.g. kicknet, T-sampler): Kicknet

Length or area of riffle sampled: 10 m

Sample preserved in field? Y ☑ N ☐

Appendix 2. Dissolved metal analysis from 1997 water quality sites.

Chemex Labs Ltd.

Analytical Chemists * Geochemists * Registered Assayers

212 Brooksbank Ave., North Vancouver
British Columbia, Canada V7J 2C1
PHONE: 604-984-0221 FAX: 604-984-0218

To: NACHO NYAK DUN BAND

BOX 220
YUKON
Y0B 1M0

Project : McQUESTEN R.
Comments: ATTN: SIMONE MacDONALD

Certificate Date: 09-M[illegible]-98
Invoice No : 19813[illegible]9
P.O. Number :
Account : PON

* PLEASE NOTE

CERTIFICATE OF ANALYSIS A9813099

SAMPLE	PREP CODE		Ag ug/L	Al mg/L	As ug/L	Ba ug/L	Be ug/L	Bi ug/L	Ca mg/L	Cd ug/L	Co ug/L	Cr ug/L	Cu ug/L	Fe mg/L	Hg ug/L	K mg/L	Mg mg/L	Mn ug/L	Mo ug/L	Na mg/L	Ni ug/L
BELOW BEAR CRK.	221	--	< 0.05	< 0.001	1	73.3	< 0.5	< 0.05	48.6	< 0.1	0.06	2.0	< 0.1	0.10	< 1	0.60	12.05	< 0.05	< 0.1	1.95	1.4
ABOVE BEAR CRK.	221	--	< 0.05	0.018	1	73.3	< 0.5	< 0.05	46.9	< 0.1	0.16	< 0.5	0.2	0.24	< 1	0.60	11.70	49.4	< 0.1	1.90	2.4
BEAR OCT 8/97	221	--	< 0.05	0.075	5	46.6	< 0.5	< 0.05	45.3	< 0.1	0.26	0.5	1.6	0.31	< 1	1.20	11.20	45.3	0.2	1.95	2.0
CASHE CRK. #8	221	--	< 0.05	0.335	1	48.9	< 0.5	< 0.05	33.0	< 0.1	1.26	0.5	1.8	0.60	< 1	1.00	16.75	235	< 0.1	2.10	4.0
CASHE CRK. #2	221	--	< 0.05	0.468	2	52.6	< 0.5	< 0.05	33.2	2.2	12.40	0.5	4.6	0.40	< 1	0.70	12.25	387	< 0.1	1.30	78.8
SEATTLE CREEK	221	--	0.05	2.09	4	74.8	< 0.5	< 0.05	40.6	0.1	1.94	3.5	4.1	3.20	< 1	0.70	6.18	188.5	< 0.1	1.50	6.4
BELOW McBRIDGE#7	221	--	< 0.05	< 0.001	3	44.4	< 0.5	< 0.05	42.7	< 0.1	0.02	1.5	< 0.1	0.08	< 1	1.10	13.15	< 0.05	0.1	1.90	1.2
VANCOUVER CR.#25	221	--	< 0.05	0.012	< 1	24.4	< 0.5	< 0.05	18.70	< 0.1	0.04	< 0.5	0.7	0.05	< 1	0.40	4.77	3.45	< 0.1	2.25	0.8
40 MILE #24	221	--	< 0.05	< 0.001	< 1	26.6	< 0.5	< 0.05	23.7	< 0.1	0.04	< 0.5	0.4	0.06	< 1	0.45	5.69	3.05	< 0.1	1.15	0.8
McQ.R(LKOUT)9/20	221	--	< 0.05	< 0.001	< 1	182.5	< 0.5	< 0.05	60.7	0.4	0.06	< 0.5	< 0.1	0.14	< 1	0.70	21.3	< 0.05	0.1	1.25	1.4
McQ.R(LKOUT)9/28	221	--	< 0.05	< 0.001	1	179.5	< 0.5	< 0.05	61.5	0.2	0.06	< 0.5	< 0.1	0.14	< 1	0.75	22.0	< 0.05	0.2	1.30	1.4
McQ.R.ELSA FLATS	221	--	< 0.05	< 0.001	< 1	71.9	< 0.5	< 0.05	42.4	< 0.1	0.06	< 0.5	< 0.1	0.09	< 1	0.45	9.88	< 0.05	< 0.1	1.70	1.2
MOUTH McQ.R. #9	221	--	< 0.05	0.134	< 1	64.1	< 0.5	< 0.05	45.4	1.2	1.74	1.5	3.3	0.17	< 1	0.70	12.30	54.2	0.1	1.95	21.0
MOUTH McQ.R. #24	221	--	< 0.05	0.035	< 1	43.1	< 0.5	< 0.05	34.3	0.8	2.08	0.5	2.6	0.09	< 1	0.35	11.05	29.4	0.1	1.20	30.2
MTH.N.McQ.R. #19	221	--	< 0.05	0.124	< 1	60.7	< 0.5	< 0.05	36.5	< 0.1	0.22	0.5	1.1	0.35	< 1	0.30	8.49	23.5	0.1	1.30	2.2
MOUTH MCQUESTEN	221	--	< 0.05	0.003	< 1	45.1	< 0.5	< 0.05	23.1	4.1	24.4	0.5	2.1	0.04	< 1	0.80	12.20	706	< 0.1	1.00	147.5
McQ.R.END10ML.RD	221	--	< 0.05	0.006	1	83.0	< 0.5	< 0.05	52.5	1.1	0.50	0.5	2.6	0.20	< 1	0.95	12.60	46.2	0.1	2.40	4.2
McQU.R. FEB 6/97	221	--	< 0.05	< 0.001	< 1	77.9	< 0.5	< 0.05	48.5	< 0.1	0.04	1.5	< 0.1	0.09	< 1	0.55	12.45	7.40	< 0.1	2.20	1.2
HGRT.ABV.MNE.#10	221	--	< 0.05	< 0.001	< 1	33.7	< 0.5	< 0.05	33.0	< 0.1	0.48	< 0.5	0.1	0.05	< 1	1.00	11.60	0.10	< 0.1	2.20	2.2
HGRT.ABOVE MINE	221	--	< 0.05	< 0.001	< 1	75.6	< 0.5	< 0.05	45.2	< 0.1	0.48	< 0.5	< 0.1	0.09	< 1	0.70	11.90	18.70	0.1	2.10	1.6
ABV.McQ.-HGRT CR	221	--	< 0.05	< 0.001	1	60.3	< 0.5	< 0.05	52.0	0.1	0.08	2.5	< 0.1	0.10	< 1	0.50	15.50	< 0.05	0.3	1.70	6.2
HGRT CR.BLW.MINE	221	--	< 0.05	< 0.001	3	45.0	< 0.5	< 0.05	40.9	< 0.1	0.04	1.5	< 0.1	0.06	< 1	1.25	11.65	< 0.05	0.3	2.30	1.2
HGRT/McQU 9/20	221	--	< 0.05	0.009	5	48.4	< 0.5	< 0.05	43.7	0.1	0.10	< 0.5	< 0.1	0.16	< 1	1.20	13.70	8.30	< 0.1	2.05	1.8
HGRT/McQU 9/28	221	--	< 0.05	< 0.001	4	47.7	< 0.5	< 0.05	44.5	< 0.1	0.06	2.0	< 0.1	0.08	< 1	1.20	13.95	< 0.05	0.1	2.05	1.5
HGRT/BLW DUBL GL	221	--	< 0.05	0.077	3	44.3	< 0.5	< 0.05	42.4	< 0.1	0.30	0.5	< 0.1	0.31	< 1	1.15	15.55	52.6	< 0.1	2.10	2.2
HGRT/BELOW 10/7	221	--	< 0.05	0.040	5	45.9	< 0.5	< 0.05	45.7	< 0.1	0.62	< 0.5	< 0.1	0.23	< 1	1.15	11.95	45.5	< 0.1	1.95	1.8
HAGGART CREEK	221	--	< 0.05	0.128	5	48.0	< 0.5	< 0.05	41.2	< 0.1	0.50	< 0.5	0.4	0.40	< 1	1.20	11.45	39.1	< 0.1	2.20	2.2
HIGH CR. B1 6/25	221	--	< 0.05	< 0.001	1	30.6	< 0.5	< 0.05	61.3	1.2	0.46	1.5	5.1	0.15	< 1	0.15	12.40	< 0.05	0.1	1.05	2.6
HIGH CR. B2 6/28	221	--	< 0.05	0.044	< 1	45.9	< 0.5	< 0.05	38.9	0.1	0.72	< 0.5	11.7	0.13	< 1	0.40	11.40	17.25	0.1	1.25	9.6
HIGH CR. B3 6/25	221	--	< 0.05	0.181	1	57.8	< 0.5	< 0.05	43.9	0.1	2.34	< 0.5	2.7	0.30	< 1	0.65	7.13	471	< 0.1	1.60	6.6
CHRIS.CR 2/6/98A	221	--	< 0.05	< 0.001	2	57.3	< 0.5	< 0.05	158.5	0.4	0.38	0.5	< 0.1	0.41	< 1	0.55	23.3	1180	< 0.1	1.70	8.0
CHRIS.CR 2/6/98B	221	--	< 0.05	< 0.001	1	74.7	< 0.5	< 0.05	170.5	2.2	1.10	0.5	< 0.1	0.44	< 1	0.45	24.5	3060	< 0.1	1.50	10.6
CHRISTAL CR KENO	221	--	< 0.05	0.014	< 1	47.8	< 0.5	< 0.05	164.5	3.8	0.78	< 0.5	1.1	0.49	< 1	0.35	26.2	471	< 0.1	1.80	7.6
CHRIS.BLW KENO A	221	--	< 0.05	< 0.001	< 1	85.8	< 0.5	< 0.05	52.9	< 0.1	0.28	0.5	< 0.1	0.12	< 1	0.55	13.45	23.9	< 0.1	2.20	1.6
CHRIS.BLW KENO B	221	--	< 0.05	0.003	< 1	80.5	< 0.5	< 0.05	49.1	< 0.1	0.08	0.5	< 0.1	0.11	< 1	0.50	12.75	9.20	< 0.1	2.10	1.8

CERTIFICATION: [signature]

* REC. ACIDIFIED:SEATTLE CREEK,VANCOUVER CREEK,40 MILE#24,MOUTH OF NORTH MCQUESTEN#19