# Dahlie Creek

## Salmonid Overwintering and Water Quality Studies: Interim Report

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Prepared for:

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and

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# 1. Introduction

Changes in land use in watersheds under industrial and urban development can lead to fundamental changes in the structure and functioning of stream communities (Dunne and Leopold 1998, Winter and Duthie 1998). Wherever significant human settlement has occurred, stream habitats have been altered in terms of both physical and chemical characteristics. Urbanization generally involves removal of vegetation from riparian areas. Riparian vegetation serves several important functions including maintaining channel stability, moderating stream flows, and increasing aquatic habitat diversity (Hunter 1991). Urbanization in stream watersheds reduces soil permeability, thus altering stream hydrology (Andoh 1994). Peak and low flow events are exacerbated in urban areas due to increased speed of water transmission as a result of decreased infiltration rates and channel complexity (Dunne and Leopold 1998). This usually results in increased sediment loading, widening of the channel, and a decrease in drainage density via a loss of first order channels which may be ephemeral or intermittent (Dunne and Leopold 1998). Stormwater runoff from highways and urban areas contains particulate material and many chemicals, including nutrients, road salts, heavy metals and petroleum hydrocarbons (Hall *et al.* 1996). These potential impacts must be taken into consideration during the planning of urban development.

Dahlie Creek, located within the town of Smithers, is a small tributary to the Bulkley River. Dahlie Creek drains an area of approximately 18 $km^2$ over a distance of 8.2 km. The upper 3.3 km of the creek are located upstream of urban development. The creek has been impacted by anthropogenic activities. Tamblyn and Jessop (1999) completed a detailed fish habitat, riparian, and channel assessment of Dahlie Creek. Low channel complexity, removal of riparian vegetation, culvert obstructions to fish passage, sedimentation, altered flow regime, and channelization were some of the major and widespread impacts identified during the assessment of the lower 2918 m of Dahlie Creek conducted in the fall of 1999 (Tamblyn and Jessop 1999). Significant alterations in the drainage pattern of Dahlie Creek, particularly in reach 3 upstream of the CNR tracks have been identified (Ducks Unlimited Canada 2000). Future developments are proposed for the lower three reaches of Dahlie Creek.

In light of findings in previous studies, and future development underway and/or proposed within the Dahlie Creek watershed, the Town of Smithers contracted SKR Consultants Ltd. and Remington Environmental to conduct fish and water quality assessments in the winter and early spring of 2000. This project was funded by Fisheries Renewal B.C., and the contract was jointly administered by John Malcolm (Town of Smithers) and Angus Glass (Community Futures Development Corporation of Nadina). The main objectives of the project were to:

- document physical characteristics at selected sites within the lower three reaches of Dahlie Creek during the winter,
- conduct fish sampling at selected sites during winter following methods used in the upper Bulkley overwintering study (Donas and Saimoto 2000), and the Morice River overwintering study (Wet'suwet'en and Saimoto 2000), and
- conduct water quality sampling at one site in the lower section of Dahlie Creek.

# 2. Study Area

Dahlie Creek is a second order stream (at 1:50 000 scale) flowing from the southeastern slopes of Hudson Bay Mountain through the town of Smithers. It joins the Bulkley River on the southeast side of town, approximately 2.2 km downstream of the Highway 16 crossing. Juvenile coho (*Oncorhynchus kisutch*), rainbow trout (*Oncorhynchus mykiss*) and cutthroat trout (*O. clarki*) have been captured in the lower three reaches of Dahlie Creek. Juvenile coho captured upstream of highway 16 were speculated to originate from releases by Chandler Park School through the salmonids in the classroom program (Tamblyn and Jessop 1999).

A hydrological assessment of Dahlie Creek has been prepared for the Town of Smithers by Ducks Unlimited Canada (2000). The Dahlie Creek Stormwater Assessment includes plans for combined stormwater management and wetland habitat development within the town. The upper catchment of Dahlie Creek is mainly forested south-east facing lower slope of Hudson Bay Mountain, having an average slope of about 15% and an area of approximately 1210 ha. Upon reaching the valley floor, Dahlie Creek flows through a large wetland, then passes under the CN tracks and through the Town of Smithers. The Dahlie Creek stream channel has experienced significant diversions, presumably during the construction of the Grand Trunk Pacific Railway (now Canadian National) during 1907 to 1910 and during the subsequent establishment of the Smithers townsite and surrounding road systems. The catchment below the railroad is approximately 100 ha in size with an average slope of about 1%. The latter is primarily urban developed with about 10% being green space, namely, Dahlie Creek waterway and associated forested strip plus adjacent lowlands.

Land uses include urban development, including housing, parks and the recently constructed Willowvale Subdivision. Little original riparian forest remains and shrub cover along much of the channel is reduced. Dahlie Creek is crossed by eight roads and the railway tracks. Trails and paths parallel and cross the creek in several locations. Several of the culvert crossings are considered undersized (Ducks Unlimited Canada 2000) and many have perched outlets, which likely restrict fish passage during lower flows (Tamblyn & Jessop 2000). In particular, culverts located at the highway 16 crossing, and at Railway Avenue have been identified as barriers to fish migration.

An older residential area along Railway Avenue is not served by the municipal sewage collection and treatment system. Because of poorly draining soils, these homes have experienced problems with septic field backup. For health reasons, these homeowners are now required to have their septic tanks pumped out at regular intervals (G. Cobb, Town of Smithers, personal communication). Stormwater management in the watershed consists of open ditches or storm sewers that discharge directly into Dahlie Creek. This is true for the newly constructed Willowvale Subdivision, as well.

Industrial development includes the Canadian National rail yard and maintenance facility and Pacific Inland Resources (West Fraser Mills Ltd.) sawmill and wood waste landfill. PIR deposited wood waste into a landfill located east of Pacific Avenue from approximately 1977 to 1994 (Remington 1996). Wood waste leachate from the landfill was discovered to be toxic to aquatic life and site remediation and leachate management plan were put in place. An earth berm was constructed blocking culverts under Pacific Avenue in order to prevent the possible flow of leachate to Dahlie Creek during spring run off. Since then the company has been spray irrigating the contaminated water back onto the landfill site and it is believed that no contamination of Dahlie Creek is occurring (R. Odense, MELP Pollution Prevention, personal communication).

Canadian Tire Ltd. is presently constructing a large retail outlet in the Dahlie Creek watershed. The development will include a large paved parking lot and automotive service center. The provision of oil-water separation and stormwater retention devices has been required by the Town of Smithers (G. Cobb, Town of Smithers, personal communication).

# 3. Sampling and Analytical Methods

## *3.1 Water Quality Sampling*

Dahlie Creek was sampled at the lowest road-accessible point in the watershed, downstream of three culverts under Riverside Drive, approximately 200 m upstream of the confluence with the Bulkley River (Figure 1). Water sampling was conducted on 28 March 2000 by D. Remington. On this date, snowmelt and surface runoff were occurring in the lower catchment (within the town), but higher elevation runoff from the slopes of the mountain had not begun. The weather had been dry for the week preceding sampling.

Water sampling was conducted according to methods outlined in the Ministry of Environment, Lands and Parks (MELP) *Ambient Fresh Water and Effluent Sampling Manual* (Cavanaugh *et al.* 1994). Temperature was measured using an alcohol thermometer. Dissolved oxygen was determined by the Winkler method using a Hach DO Test Kit Model OX-DT with digital titration, accuracy +\- 0.01 mg/L. Field pH was measured using a hand-held Oakton pHTestr 2 with accuracy +/- 0.1 pH units.

The dissolved metals sample was filtered immediately upon collection using a disposable Nalgene 0.45 µm filtration unit. Total and dissolved metals samples were preserved with nitric acid. Preserved and unpreserved field blanks were submitted. All samples were immediately placed in a cooler with ice and shipped air freight to Philip Analytical Services Inc. in Burnaby for analysis.

The shipment arrived at the laboratory the following day in good condition and all analyses were carried out within the appropriate Hold Times. Methods used by Philip are based upon those found in *Standard Methods for the Examination of Water and Wastewater*, 19$^{th}$ Edition, published by the American Public Health Association.

## *3.2 Winter Sampling For Fish*

Winter sampling for fish was conducted at selected sites within the lower three reaches of Dahlie Creek. Sample sites were chosen based on results obtained in previous studies (Tamblyn and Jessop 1999), location in relation to existing and future development and accessibility. Four sites were sampled for fish during the first winter visit on February 8$^{th}$-9$^{th}$ 2000 (Table 1, Figure 1). One of these sites was found to be frozen solid, and was not included during subsequent winter sampling. During initial sampling, a limnological station was marked to ensure that future samples were collected from a consistent location within the site. In addition, trapping locations were also marked, to ensure that minnow traps were set at a consistent location throughout the winter. Site boundaries were identified using flagging tape during the initial site visit.

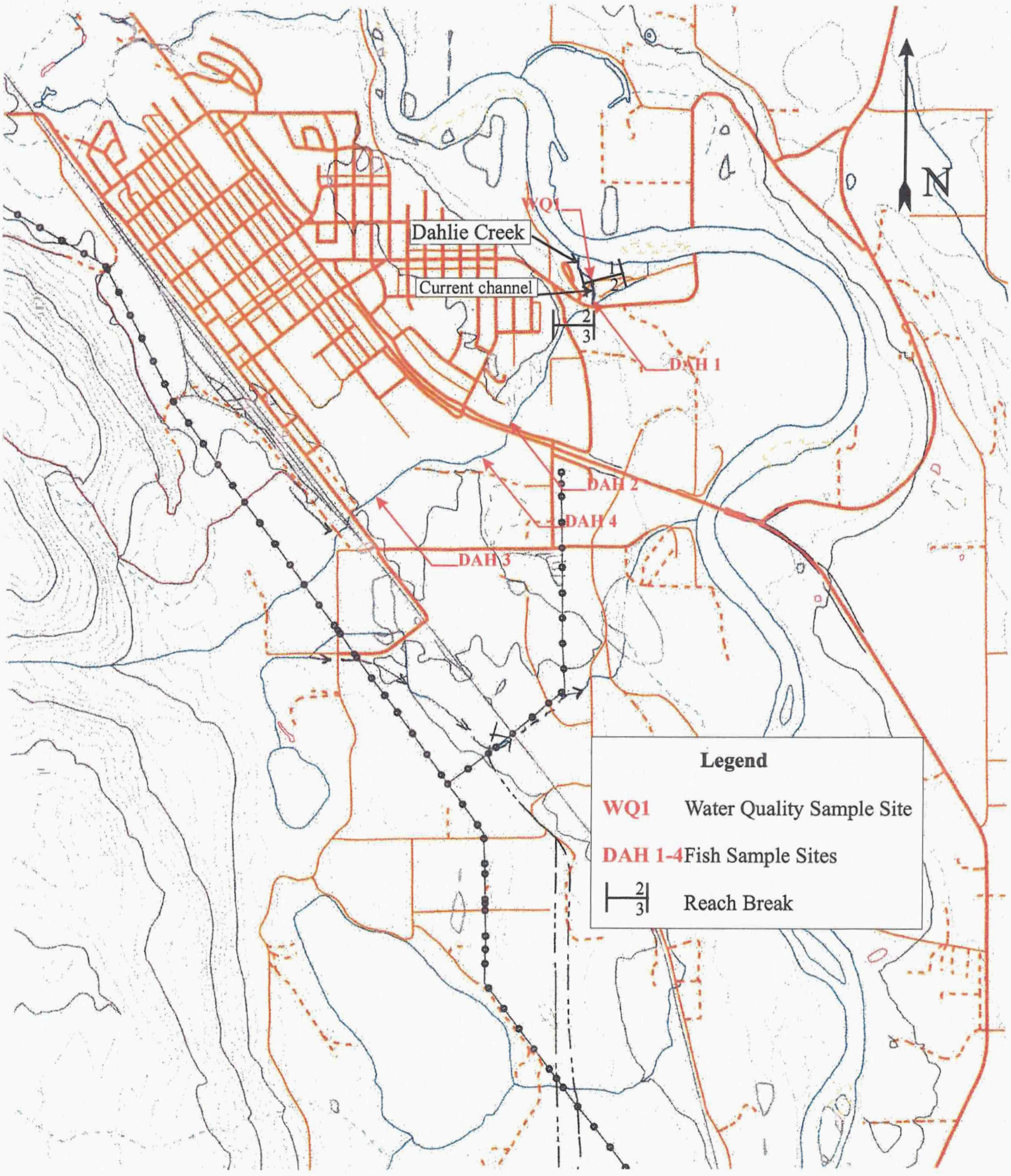


**Figure 1. Location of fish sampling sites (DAH 1 to DAH 4) and Water Quality sampling site (WQ1) within the Dahlie Creek watershed, Smithers, B.C. (approximate scale is 1:30,000)..**

**Table 1. Locations for sample sites included in the Dahlie Creek overwintering and water quality study, February to March 2000. All sites were sampled during the overwinter study. Water quality sampling was conducted downstream of site DAH 1.**

| Site # | Location | Habitat |
|---|---|---|
| DAH 1 | downstream side of Main Street crossing | shallow pool, moderate cover |
| DAH 2 | downstream side of Victoria Drive crossing, adjacent to Hoskins Ford | pool with low cover |
| DAH 3 | at Elks baseball complex | pool/glide edge habitat, moderate cover |
| DAH 4 | downstream side of newly constructed crossing at 16th Avenue, just upstream of Canadian Tire construction site | pool, no cover |

### 3.2.1 Habitat Description

Physical characteristics of sample sites selected for the study were documented on June 26th 2000, since the study was not initiated until February 2000 (Appendix 1). In-stream cover was documented in detail for each site (Table 2). Changes in physical and chemical parameters (Table 3) were recorded during each of the two winter sampling events using a data form designed for overwintering sampling (Appendix 2). Monthly physical and chemical data were collected by removing ice from the limnological station using an ax or by hand. Ice thickness reached up to 40 cm. Photographs were taken of each site.

### 3.2.2 Fish sampling

Low water temperatures precluded the use of electroshockers, since electroshocking at water temperatures below 4°C can be harmful to salmonids. Fish sampling was conducted by setting three minnow traps baited with roe at each of the sample sites during each sampling period. Minnow traps have been shown to be effective in providing relative estimates of juvenile salmonid abundance (Swales 1987). The minnow traps were left for 24 hours. Fish were recovered from the traps, identified to species, measured (fork length ± 1.0 mm), weighed (±0.1 g) and released back into the habitat. Total catch was used as an indicator of fish abundance, as suggested in previous studies (Swales *et al.* 1986).

**Table 2. Physical parameters recorded in the field for each site sampled during the Dahlie Creek overwintering study.**

| | Parameter | Unit/Categories | Methods |
|---|---|---|---|
| channel | channel width | meter | tape |
| | wetted width | meter | tape |
| | max. wetted depth | centimeter | meter stick |
| | max. bankful depth | centimeter | meter stick |
| | interval between channel measurements | meter | tape |
| pools | area | square meter | tape |
| | percent of site | percent | visual estimate |
| | Dominant Substrate | fines, gravel, cobbles, larges, boulders | visual estimate |
| | Sub-Dominant Substrate | fines, gravel, cobbles, larges, boulders | visual estimate |
| | D90 | centimeter | tape |
| glides | area | square meter | tape |
| | percent of site | percent | visual estimate |
| | Dominant Substrate | fines, gravel, cobbles, larges, boulders | visual estimate |
| | Sub-Dominant Substrate | fines, gravel, cobbles, larges, boulders | visual estimate |
| | D90 | centimeter | tape |
| riffles | area | square meter | tape |
| | percent of site | percent | visual estimate |
| | Dominant Substrate | fines, gravel, cobbles, larges, boulders | visual estimate |
| | Sub-Dominant Substrate | fines, gravel, cobbles, larges, boulders | visual estimate |
| | D90 | centimeter | tape |
| cover | Total Instream Cover | None, Trace, Moderate, Abundant | visual estimate |
| | Out of stream Cover | None, Trace, Moderate, Abundant | visual estimate |
| | LWD | None, Trace, Moderate, Abundant | visual estimate |
| | # LWD pieces < 20 cm | number | count |
| | # LWD pieces 20-50 cm | number | count |
| | # LWD pieces > 50 cm | number | count |
| | SWD | None, Trace, Moderate, Abundant | visual estimate |
| | Boulder | None, Trace, Moderate, Abundant | visual estimate |
| | Single boulder > 30 cm | number | count |
| | Boulder clusters | number | count |
| | cobble | None, Trace, Moderate, Abundant | visual estimate |
| | cobble proportion of site | percent | visual estimate |
| | undercut banks | None, Trace, Moderate, Abundant | visual estimate |
| | undercut bank length | meter | tape |
| | average undercut bank width | meter | tape |
| | aquatic vegetation | None, Trace, Moderate, Abundant | visual estimate |
| | overhanging vegetation | None, Trace, Moderate, Abundant | visual estimate |
| other | distance to nearest upstream pool | meter | tape |
| | distance to nearest downstream pool | meter | tape |
| | site length | meter | tape |
| | gradient | percent | clinometer |

**Table 3. Physical and chemical parameters recorded on a monthly basis for each site sampled prior in the Upper Bulkley River overwintering study.**

| | Parameter | Unit/Categories | Method |
|---|---|---|---|
| general site description | weather | description | visual |
| | air temperature | Celsius | alcohol thermometer |
| | Ice Cover | percent | visual estimate |
| | Stream Flow | None, Low, Moderate, High | visual estimate |
| | Potential for fish migration | None, Low, Moderate, High | visual estimate |
| Limnological station | water depth | centimeters | meter stick |
| | ice thickness | centimeters | meter stick |
| | clarity of ice | None, Low, Moderate, High | visual estimate |
| | snow depth | centimeters | meter stick |
| | water temperature | Celsius | alcohol thermometer |
| | turbidity | None, Low, Moderate, High | visual estimate |
| | conductivity | µS/cm | Hanna |
| | Dissolved Oxygen | ppm | Oxyguard |

# 4. Results and Discussion

## *4.1 Water Quality*

Water quality analysis data are found in Tables 4a and 4b. The water temperature was low at the time of sampling (0.5 °C) and dissolved oxygen concentration, 11.74 mg/L, was approximately 85% of saturation. Dahlie Creek water was neutral to slightly alkaline with a pH of 8.2. Alkalinity (131 mg/L as $CaCO_3$) indicates a low sensitivity to acidic inputs. The water is hard, with a dissolved hardness of 168 mg/L. Carbonate alkalinity, and associated hardness, are generally highest in a stream during the winter months, when groundwater recharge is greatest. The water is moderately colored, 30 True Color Units. A water's color may be derived from natural mineral components such as iron and manganese, and from organic materials. Tannins and lignins from decaying vegetation in wetlands associated with a stream are a common source of color in Skeena watershed streams. Petroleum hydrocarbons were not detectable in the 28 March 2000 sample.

Table 5 presents a comparison of selected chemical parameters in Dahlie Creek 28 March 2000 with three nearby rivers, the Morice, Bulkley at Quick and Telkwa. Monthly monitoring in these watersheds was carried out for approximately five years by Ministry of Environment, Lands and Parks (MELP) 1983-1987 (Wilkes and Lloyd 1990). The mean concentration from the five year study is shown in Table 5. Dahlie Creek shows greatest similarities to the Telkwa River, which also drains the slopes of Hudson Bay Mountain. Hardness and alkalinity in Dahlie Creek approximately double the maximum concentrations measured in the Telkwa River (maximum hardness=56 mg/L and maximum alkalinity=62 mg/L as $CaCO_3$). Nitrate+nitrite in Dahlie Creek was an order of magnitude greater than the maximum recorded in the Telkwa River (maximum NO3+NO2=0.13 mg/L (N). Industrial processes, fertilizers and septic tanks may all be sources of nitrate, either in groundwater or surface water via groundwater (Nordin and Pommen 1986).

MELP publishes approved and working water quality guidelines (WQG) for the protection of a given water use, including drinking water, aquatic life, recreation and agriculture (Nagpal et al. 1998, MELP 1998). They are developed in order that water quality data can be assessed and site-specific water quality objectives can be prepared. In general, water quality problems are non-existent if the substance concentration is lower than the guideline(s). However, if the substance concentration exceeds its guideline, an assessment of the water quality is desirable. In addition, specific water quality objectives for the Bulkley and Morice watersheds were developed in anticipation of the Kemano Completion Project (Nijman 1986).

Urban stormwater runoff in Greater Vancouver has been found to contain the elevated levels of the trace metals copper, manganese, lead and zinc, in addition to hydrocarbons and fecal coliforms (Hall *et al.* 1996). Total manganese concentrations in Dahlie Creek did not exceed the maximum recorded in the Telkwa (maximum Mn=0.54 mg/L). MELP WQGs for manganese are under review (Nagpal et al. 1998). The WQG for the protection of freshwater aquatic life ranges from 0.1 to 1.0 mg/L Mn. Dissolved manganese is the important form to consider. Total manganese is often high due to manganese content of suspended sediments, as thus is not important. Manganese in Dahlie Creek was almost entirely dissolved (Mn diss.=0.369 mg/L). In contrast, dissolved manganese in the Telkwa did not exceed 0.02 mg/L.

**Table 4a. Water analysis Dahlie Creek at Riverside Avenue crossing 28 March 2000**

| Parameter | Unit | MDL | 28-Mar-00 |
|---|---|---|---|
| PHYSICAL | | | |
| Temperature | °C | | 0.5 |
| Dissolved Oxygen | mg/L | 0.01 | 11.74 |
| Field pH | pH units | 0.1 | 8.0 |
| Laboratory pH | pH units | 0.1 | 8.2 |
| True Color | Col. Unit | 5 | 30 |
| Specific Conductance | µS/cm | 1 | 378 |
| Residue Nonfilterable (TSS) | mg/L | 4 | 6 |
| Turbidity | NTU | 0.1 | 8.29 |
| Hardness Total - T (calc.) | mg/L | | 171 |
| Hardness Total - D (calc.) | mg/L | | 168 |
| GENERAL INORGANICS | | | |
| Alkalinity Phen. 8.3 as $CaCO_3$ | mg/L | 1 | <1 |
| Alkalinity Total as $CaCO_3$ | mg/L | 1 | 131 |
| Carbonate as $CO_3$= | mg/L | | <0.5 |
| Bicarbonate as $HCO_3$- | mg/L | | 160 |
| Hydroxide as OH- | mg/L | | <0.5 |
| NITROGEN | | | |
| Ammonia Nitrogen (N) | mg/L | 0.005 | 0.021 |
| Nitrate +Nitrite (N) Low Level Diss. | mg/L | 0.005 | 1.30 |
| Nitrite (N) Low Level Diss. | mg/L | 0.001 | 0.011 |
| Nitrate (N) (calc.) | mg/L | | 1.289 |
| PHOSPHORUS | | | |
| Phosphorus Total (P) | mg/L | 0.005 | <0.005 |
| Orthophosphorus (P) Diss. | mg/L | 0.001 | 0.002 |
| HYDROCARBONS | | | |
| EPHw C10-19 | mg/L | 0.1 | <0.1 |
| EPHw C19-32 | mg/L | 0.1 | <0.1 |

**Table 4b. Water analysis –Metals Dahlie Creek at Riverside Avenue crossing 28 March 2000**

| Parameter | Unit | MDL | 28-Mar-00 | Parameter | Unit | MDL | 28-Mar-00 |
|---|---|---|---|---|---|---|---|
| METALS TOTAL | | | | METALS DISSOLVED | | | |
| Aluminum | mg/L | 0.06 | 0.25 | Aluminum Diss. | mg/L | 0.02 | 0.03 |
| Antimony | mg/L | 0.02 | <0.02 | Antimony Diss. | mg/L | 0.015 | <0.015 |
| Arsenic | mg/L | 0.04 | <0.04 | Arsenic Diss. | mg/L | 0.04 | <0.04 |
| Barium | mg/L | 0.001 | 0.070 | Barium Diss. | mg/L | 0.001 | 0.068 |
| Beryllium | mg/L | 0.0002 | <0.0002 | Beryllium Diss. | mg/L | 0.0010 | <0.0010 |
| Bismuth | mg/L | 0.02 | <0.02 | Bismuth Diss. | mg/L | 0.02 | <0.02 |
| Boron | mg/L | 0.04 | <0.04 | Boron Diss. | mg/L | 0.008 | 0.014 |
| Cadmium | mg/L | 0.002 | <0.002 | Cadmium Diss. | mg/L | 0.002 | <0.002 |
| Calcium | mg/L | 0.05 | 46.0 | Calcium Diss. | mg/L | 0.01 | 44.2 |
| Chromium | mg/L | 0.002 | <0.002 | Chromium Diss. | mg/L | 0.002 | <0.002 |
| Cobalt | mg/L | 0.004 | <0.004 | Cobalt Diss. | mg/L | 0.003 | 0.004 |
| Copper | mg/L | 0.003 | <0.003 | Copper Diss. | mg/L | 0.001 | 0.004 |
| Iron | mg/L | 0.05 | 0.93 | Iron Diss. | mg/L | 0.003 | 0.282 |
| Lead | mg/L | 0.03 | <0.03 | Lead Diss. | mg/L | 0.02 | <0.02 |
| Magnesium | mg/L | 0.05 | 13.6 | Magnesium Diss. | mg/L | 0.02 | 13.9 |
| Manganese | mg/L | 0.002 | 0.394 | Manganese Diss. | mg/L | 0.002 | 0.369 |
| Molybdenum | mg/L | 0.005 | <0.005 | Molybdenum Diss. | mg/L | 0.004 | <0.004 |
| Nickel | mg/L | 0.01 | <0.01 | Nickel Diss. | mg/L | 0.008 | <0.008 |
| Phosphorus | mg/L | 0.1 | <0.1 | Phosphorus Diss. | mg/L | 0.04 | 0.12 |
| Potassium | mg/L | 0.5 | 1.4 | Potassium Diss. | mg/L | 0.4 | 2.2 |
| Selenium | mg/L | 0.03 | <0.03 | Selenium Diss. | mg/L | 0.03 | <0.03 |
| Silver | mg/L | 0.03 | <0.03 | Silver Diss. | mg/L | 0.01 | <0.01 |
| Sodium | mg/L | 0.5 | 15.0 | Sodium Diss. | mg/L | 0.01 | 15.6 |
| Strontium | mg/L | 0.001 | 0.182 | Strontium Diss. | mg/L | 0.001 | 0.187 |
| Sulphur | mg/L | 0.1 | 3.9 | Sulphur Diss. | mg/L | 0.03 | 4.27 |
| Tellurium | mg/L | 0.02 | <0.02 | Tellurium Diss. | mg/L | 0.02 | <0.02 |
| Thallium | mg/L | 0.03 | <0.03 | Thallium Diss. | mg/L | 0.02 | <0.02 |
| Tin | mg/L | 0.02 | <0.02 | Tin Diss. | mg/L | 0.02 | <0.02 |
| Titanium | mg/L | 0.003 | <0.003 | Titanium Diss. | mg/L | 0.003 | <0.003 |
| Vanadium | mg/L | 0.003 | <0.003 | Vanadium Diss. | mg/L | 0.003 | 0.003 |
| Zinc | mg/L | 0.01 | 0.01 | Zinc Diss. | mg/L | 0.002 | 0.014 |
| Zirconium | mg/L | 0.003 | <0.003 | Zirconium Diss. | mg/L | 0.003 | <0.003 |

**Table 5. Comparison of selected parameters: Dahlie Creek (28-Mar-00) and mean concentrations (1983-1987) in Morice, Bulkley (at Quick) & Telkwa rivers**

| | pH | True Color | Specific Conduct-ance | Hardness Diss. (mg/L CaCO3 ) | Alkalinity (mg/L CaCO3) | Ammonia (N) (mg/L) | Nitrate + Nitrite (N) (mg/L) | Total Phosphorus (P) (mg/L) | Ortho-phosphorus (P) (mg/L) | Copper T (mg/L) | Manganese T (mg/L) | Lead T (mg/L) | Zinc T (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dahlie Cr. | 8.2 | 30 | 378 | 168 | 131 | 0.021 | 1.30 | <0.005 | 0.002 | <0.003 | 0.394 | <0.03 | 0.010 |
| Morice R. | 7.3 | 12.2 | 52.6 | 21.7 | 23.4 | 0.008 | 0.038 | 0.017 | <0.003 | 0.002 | 0.040 | 0.002 | 0.015 |
| Bulkley R | 7.3 | 23.5 | 63.4 | 24.8 | 28.1 | 0.014 | 0.044 | 0.023 | 0.005 | 0.005 | 0.039 | 0.003 | 0.010 |
| Telkwa R. | 7.5 | 22.2 | 91.3 | 43.0 | 42.0 | 0.010 | 0.074 | 0.032 | 0.004 | 0.004 | 0.050 | 0.003 | 0.014 |

Source: Morice, Bulkley at Quick and Telkwa summary statistics from Wilkes & Lloyd (1990)

One domestic water license exists on Dahlie Creek (Tamblyn & Jessop 2000). Dahlie Creek water in late March exceeded the BC Drinking Water aesthetics WQGs for turbidity, color, iron and manganese. The aesthetics WQGs were identified because of undesirable taste or appearance of raw drinking water rather than because of health concerns.

## *4.2 Fish Abundance*

Fish were captured at only one of the four sites sampled at Dahlie Creek. No fish were captured at sites DAH 1 or DAH 2 during the February or March sampling event. Due to low water levels under extensive ice cover at site DAH 4, no minnow traps could be set at this site on February 8th, 2000. The low water levels indicate that the formation of surface, anchor and frazil ice severly limit overwintering habitat at this site. The site was effectively frozen solid. Fish were captured during both winter sampling events at site DAH 3. One juvenile rainbow trout and three coho were captured at this site on February 8th – 9th 2000, while one rainbow trout and one coho were captured at the site on March 14th – 15th 2000. Coho captured during the study likely originate from releases conducted through the "salmonids in the classroom project" at Chandler Park Middle School. Although size ranges of coho released in 1999 were not recorded, these fish were noted to be around 2 grams in weight (Donas pers. comm.). Coho were not marked during last year's release, but juvenile coho released this spring were marked. Tamblyn and Jessop (1999) also speculate that coho captured in reach 3 originate from released conducted by the school. We are relatively certain that these fish originate from releases, since the culvert at highway 16, coupled with the wire grate, appear to be barriers to fish passage (Tamblyn and Jessop 1999, personal observations).

Of the sites sampled, site DAH 3 was located furthest upstream. Site DAH 3 is located upstream of known barriers to fish passage the highway 16 crossing, and upstream of the Willowvale subdivision as well as the location of the proposed Ducks Unlimited Stormwater Detention Project (Ducks Unlimited Canada 2000). Winter water temperatures appear to be consistently higher at this site than at the other sites sampled. During February sampling period, water temperature at sites DAH 1, DAH 2, and DAH 4 ranged between 0.2 and 0.5°C, while water temperature at site DAH 3 was 0.9°C. Similarly, water temperatures on March 15th 2000 ranged was 1.2°C and 1.1°C at sites DAH 1 and DAH 2, respectively, while temperatures at site DAH 3 was 2.3°C. This may indicate groundwater influence, or warm water inflow at this location. However, the difference in water temperature is not statistically significant ($t=6.314$, $p=0.46$), probably due to the low sample size. Site DAH 3 also had more open water than the other sites sampled in the study. Lack of ice cover allows for re-oxygenation of the water (Schreier *et al.* 1980, Chambers *et al.* 1997), and may prevent declines in oxygen concentrations to critical levels (6 ppm) (Davis 1975, Canadian Council of Ministers of the Environment 1991). Oxygen concentrations were well above critical levels at all sites sampled (10.8 ppm – 14.5 ppm). Winter observations at site DAH 3 indicate that this site had the highest potential for migration of fish. Limited ice cover and moderate water flow resulted indicated that fish were able to move in and out of the site freely. While some researchers indicate that fish move little during winter (Envirocon 1986, Heifetz *et al.* 1986, Dolloff 1987, Swales *et al.* 1986, Giannico and Healey 1998), others report extensive movements of salmonids during winter (Cunjak 1996, Heggersen *et al.* in prep). In the upper Bulkley, coho density indices appear to be higher at sites with a greater potential for migration, while rainbow trout density indices are lower at sites with a greater potential for migration (Donas and Saimoto 2000). Similarly, coho catch per unit effort appears to be greater, and rainbow trout catch per unit effort lower, at sites with a greater potential for migration in the Morice River than sites with a lower potential for migration (Wet'suwet'en and Saimoto 2000). Ability to migrate to and from sites may be important for overwinter survival since entrapment in unsuitable habitat can be avoided (Bustard 1986, Cunjak 1996). Catch per unit effort may be higher at open sites since a wider range of habitat can be effectively sampled than in closed sites. In open sites, fish from outside the immediate sampling area may access the trap during the sampling interval.

Percent pool and substrate composition as well as organic cover have been identified as important components of overwinter habitat (Bustard and Narver 1975, Swales *et al.* 1986, Saimoto and Donas 2000). Pool depth has been identified as an important factor for overwintering habitat suitability in several studies (Bustard and Narver 1975, Swales *et al.* 1986), however, Cunjak and Power (1987) suggest that water depth only becomes important where it provides cover, or is associated with low flows. Site DAH 2 had the highest proportion of pool habitat (60%), while site DAH 3 consisted primarily of pool/glide edge habitat (60%). Instream cover provided as site DAH 2 was rated as trace, however, and may limit the suitability of this habitat for overwintering. In-stream cover was rated as moderate at site DAH 3, and consisted primarily of small and large woody debris, with some undercut banks.

Overhanging vegetation also provided some cover at this site, which may be important even in winter due to incomplete ice cover. While site DAH 1 also has moderate in-stream cover, the majority of this site consists of riffle habitat (50%). Water depth at site DAH 1 was lower than at sites DAH 2 or DAH 3 during both winter sampling events (Appendix 1) and during habitat assessments conducted on June 26th 2000 (Appendix 1). Water depth at this site may be insufficient and water velocities in riffle habitat too high to allow fish to overwinter at this location. Site DAH 1 is located in the lower section reach 2 of Dahlie Creek, which was noted to be aggraded with minimal pool area (Tamblyn and Jessop 1999). Pools in this reach are generally small and shallow (Tamblyn and Jessop 1999), leaving little water during winter low flows and maximum ice thickness as observed at site DAH 1. Sedimentation was noted in this reach in the fall of 1999 (Tamblyn and Jessop 1999) and during our study, particularly at site DAH 2. Increased sediment input leads to increased embededdness which has been documented to be detrimental to overwintering fish (Hillman *et al.* 1987), since salmonids are often associated with interstitial spaces in winter (Bustard and Narver 1975, Swales *eta l.* 1986, Cunjak 1988, Reihle and Griffith 1993). It is interesting that no fish were captured at site DAH 2 during the overwintering study, since catch per unit effort at this site was highest during minnow trapping in November (Tamblyn and Jessop 1999). Fish habitat in reach 3 consists primarily of glides, as the channel is essentially and old ditch, and exhibits few meanders (Tamblyn and Jessop 1999). Habitat sampled at site DAH 3 appears to be representative of habitat characteristics described for reach 3 by Tamblyn and Jessop (1999), since the site consisted primarily of glide/pool edge habitat (60%) with 20% pool and 20% glide. We also noted trash at the sample site, as described by Tamblyn and Jessop (1999). Data collected during this study, and information summarized by Tamblyn and Jessop (1999) indicate that reach 3 offers some suitable overwinter habitat, but that overwinter habitat quality and quantity in reaches 1 and 2 are very low to non-existent due to the lack of deep pools and in-stream cover elements.

## *4.3 Fork Length, Weight and Condition*

Fork length and weight were recorded for all fish captured at site DAH 3. Fulton's condition factor was calculated for each fish (Ricker 1975). Fork length, weight and condition factor data are summarized in Tables 6 and 7. Fork length, weight and condition factor data for rainbow trout captured at Dahlie Creek are similar to rainbow trout/steelhead captured during the upper Bulkley overwintering study (Donas and Saimoto 2000). Coho at Dahlie Creek appear to be slightly larger than coho captured in the upper Bulkley or Toboggan Creek drainages during the 1999/2000 overwintering study. Fork length of coho captured at Dahlie Creek in February 2000 are within or slightly above the range of fork length reported for coho at sites sampled in the upper Bulkley watershed and at Toboggan Creek (Donas and Saimoto 2000). Similarly, weight is within or slightly above the range of weight reported for coho during the upper Bulkley overwintering study. Fulton's condition factor at Dahlie Creek is similar to the range of condition factors observed for coho in the upper Bulkley overwintering study. Coho at Dahlie Creek may appear to be larger due to chance (low sample size), better conditions, or different age structures, among other factors. Water temperatures at site DAH 3 were higher than at other sites in Dahlie Creek. Warmer water temperatures may be conducive to better growth. In addition, productivity at this site may be higher than at sites sampled in the upper Bulkley or Toboggan Creek drainages. It is speculated that coho captured at Dahlie Creek were released by Chandler Park Middle School. If coho are larger at the time or release than their natural counterparts, then they may remain larger during the winter as well. However, coho size at the time of release, and the origin of coho during this study are not known with certainty. Therefore, explanations for the apparent larger body size of coho at Dahlie Creek are mere speculations, based on few fish captured.

**Table 6. Fork length, weight and condition factor data for rainbow trout captured during the Dahlie Creek overwintering study.**

| | February 8th – 9th 2000 | | | | March 14th-15th 2000 | | | |
|---|---|---|---|---|---|---|---|---|
| | N | Range | Mean | SE | N | Range | Mean | SE |
| Fork Length (mm) | 1 | 132-132 | 132 | --- | 1 | 111-111 | 111 | --- |
| Weight (g) | 1 | 25.9-25.9 | 25.9 | --- | 1 | 13.9-13.9 | 13.9 | --- |
| Fulton's Condition Factor (K) | 1 | 1.13 | 1.13 | --- | 1 | 1.02-1.02 | 1.02 | --- |

**Table 7. Fork length, weight and condition factor data for coho captured during the Dahlie Creek overwintering study.**

| | February 8th – 9th 2000 | | | | March 14th-15th 2000 | | | |
|---|---|---|---|---|---|---|---|---|
| | N | Range | Mean | SE | N | Range | Mean | SE |
| Fork Length (mm) | 3 | 98-109 | 104.3 | 3.28 | 1 | 69-69 | 69 | --- |
| Weight (g) | 3 | 10.6-14.9 | 12.8 | 1.24 | 1 | 1.9-1.9 | 1.9 | --- |
| Fulton's Condition Factor (K) | 3 | 1.08-1.15 | 1.12 | 0.097 | 1 | 0.58-0.58 | 0.58 | --- |

# 5. Recommendations for Further Monitoring

Recommendations given in studies previously conducted by Tamblyn and Jessop (1999) and Ducks Unlimited Canada (2000) are not re-iterated here. In addition to recommendations given below, we strongly suggest that recommendations previously provided be reviewed and prioritized.

## *5.1 Fisheries Studies*

Previous studies on Dahlie Creek, and data collected during our study, indicate that Dahlie Creek is likely not one of the main producers of salmonids in the Bulkley watershed. Habitat quality is generally poor to moderate at best within the lower three reaches of the mainstem (Tamblyn and Jessop 1999), and access is restricted by some definite barriers to fish migration (e.g. culvert at Railway Avenue, culvert at Highway 16), and other obstruction which may be passable at some flows. Very few fish were captured during the overwintering study, and we see little benefit in continuation of the overwinter study at Dahlie Creek. Juveniles may utilize some of the habitat in the creek during summer and fall for rearing, however, and some benefit may be gained by conducting population estimates in representative habitats within Dahlie Creek, particularly in reach 3. Coho released this spring by Chandler Park Middle School were marked, making it possible to determine if coho in reach 3 originate from the school. Reach 3 appears to offer some of the better habitat, and is located in the vicinity of new and proposed development. Index sites may be established in the system for monitoring juvenile salmonid densities, particularly if future developments, channel or flow alterations are implemented.

## *5.2 Water Quality Studies*

It is important to stress here that one water sample is insufficient in the assessment of water quality in a stream. The information to date, however, indicates the need to proceed with further monitoring. Monthly water sampling for one complete year would provide a good characterization, but may not be feasible due to cost constraints. Other studies of urban stormwater runoff (Hall et al. 1996) found that contaminant runoff (trace metals and hydrocarbons) were associated with suspended solids and that contaminant concentrations were usually higher during summer storms when there had been long dry periods for contaminants to build up in the streets. Elevated fecal coliform concentrations, far exceeding recreational WQGs, have been documented during late summer base flows in other studies assessing water quality in urban areas.

The following proposed monitoring plan is recommended to measure water quality during dry weather conditions (baseflow) and during summer/early fall storm events. A unit cost per monitoring date has been prepared. The monitoring program can be downsized, if necessary, depending on cost constraints.

### 5.2.1 Proposed Water Quality Monitoring Plan – Dahlie Creek 2000

Monitoring frequency: Three monitoring events during the July to October period attempting to capture summer storm runoff and summer baseflow conditions.

Monitoring parameters: temperature, dissolved oxygen, pH, true color, specific conductance, TSS, turbidity, hardness, alkalinity, ammonia, nitrite, nitrate, total phosphorus, orthophosphorus, extractable petroleum hydrocarbons and total and dissolved metals.

The Town of Smithers has water quality concerns regarding the Railroad Avenue residences that are not yet part of the sewage collection and treatment system. It is suggested that the Town of Smithers conduct bacteriological monitoring during late summer baseflow conditions according to MELP protocols (five times in 30 days). Monitoring to be conducted at the Riverside Drive crossing and, if possible, downstream of the ball fields park at the junction of Railway and Pacific Avenues. These data would be reported and assessed in the final water quality report prepared by Remington Environmental.

*5.2.1.1 Assessment Report*

The scope of the assessment report is presented below in outline form.

1. Study area – monitoring site descriptions, photographs and map showing location of sampling sites and other land use details. The Town of Smithers is preparing the detailed map of the watershed as an in-kind contribution to this project.

2. Methods Section – sampling and analytical methods

3. Summary of existing information - Description of the watershed, review of land-use, review of available information: stormwater assessment, fish habitat, riparian, channel assessment, salmonid overwintering studies and any available information relating to industrial discharges.

4. Results– summarized data in the body text with all raw data in appendixes. Charts or graphs illustrating water quality trends along the downstream gradient where identified.

5. Assessment Section – Comparison of water quality with MELP approved and working water quality guidelines for the protection of a given water use, including drinking water, aquatic life and recreation (Nagpal et al. 1998, MELP 1998) and Bulkley River water quality Objectives (Nijman 1986) and other relevant scientific literature.

6. Recommendations– specific recommendations for: 1) mitigation strategies, 2) strategies for integrated watershed stewardship and 3) a long-term monitoring plan.

*5.2.1.2 Deliverables*

Two bound and one unbound (camera ready) copies of the final report will be delivered, as well as an electronic copy in MS Word 95 and Excel 95.

*5.2.1.3 Schedule*

Draft report submission for review 31 March, 2001

Final report submission – 31 April, 2001

*5.2.1.4 Cost estimate*

Cost estimate for each water quality monitoring event and report preparation is found in Appendix 3.

## *5.3 Projects to Increase Public Awareness*

### 5.3.1 Development of Pamphlet to Encourage Watershed Stewardship

Increased public awareness and increased participation of the general public in watershed stewardship program is a proactive method of ensuring that impacts on our watersheds are minimized. We suggest that an attractive, concise, clear, and easy to understand pamphlet be developed to increase awareness of local fisheries resources. This pamphlet should include a map of streams and their tributaries and identify where fisheries resources are located. Pamphlet may be handed out to local developers, real estate agencies, individuals or agencies proposing to conduct in stream or near stream work etc. to increase public awareness and encourage conservation of our watersheds.

### 5.3.2 Education Programs and Stream Cleaning Activities

Trash was noted in Dahlie Creek during the overwintering study, and in previous assessments of the system (Tamblyn and Jessop 1999). Local schools and/or community groups could be encourage to participate in cleaning up the stream. This would provide an opportunity to present important aspects of fish and fish habitat, as well as water quality issues. Particularly if schools are involved, these activities can be tied into the existing school curriculum by slight adaptations of modules that have been developed (e.g. Aquatic Project Wild, Project WET, etc). For example, Chandler Park school, among many other schools, is already actively involved in the "Salmonids in the Classroom" program. Fish released by the school appear to reside in Dahlie Creek for some time, as indicated by the capture of coho during this study, as well as previously (Tamblyn and Jessop 1999, Bustard personal communications). A "clean the creek" project could easily be incorporated into watershed oriented programs established at the school.

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# Appendix 1. Habitat Data for Sample Sites Examined During the Dahlie Creek Overtwintering Study

# DETAILED SITE DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 1 (first three letters of stream name-site number)

| Date of survey | Time of survey | Surveyors |
|---|---|---|
| 00/06/26 | 21:00 | RS |

| Gazetted Stream Name | Local Stream Name | Watershed Code |
|---|---|---|
| DAHLIE CREEK | DAHLIE CREEK | 46037380033200 |

TRIM Map Number | NTS 1:50000 Map #

UTM: Zone | Northing | Easting

**Site Location: Describe road and foot access**

Main Street

Limnology Station Marked ☐

Upstream Site Boundary marker (e.g. Red flagging) | distance to nearest pool upstream (meters): 3

Downstream Site Boundary marker | distance to nearest pool downstream (meters): 12

**Gradient (%)**: 3 **Site Length (meters)**: 8 **Interval between channel widths (meters)**: 2

Note: Minimum of 6 widths taken at equal intervals (@ .5 intervals, 1.5 intervals, 2.5 intervals ...to... 9.5 intervals)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Channel Width (m)** | 330 | 350 | 380 | 400 | 420 | 450 | | | | |
| **Wetted Width (m)** | 170 | 160 | 200 | 280 | 250 | 240 | | | | |
| **Max. Wetted Depth (cm)** | 1200 | 1600 | 800 | 500 | 700 | 600 | | | | |
| **Max. Bankful Depth (cm)** | 4200 | 4600 | 3800 | 3500 | 3700 | 3600 | | | | |

**Pool Habitat**: max. depth is > 50 cm, average flow is < 0.1 m/sec, excluding edges <10 cm deep

| Percent | Estimated Area (m2) |
|---|---|
| 2 | 50 |

| | |
|---|---|
| Dominant Substrate | C |
| Sub-Dominant Substrate | G |
| D90 | 12 |
| Pool-Substrate Compaction | M |

**Glide Habitat**: average flow is >0.1 m/sec, no surface disturbance, excluding edges <10 cm deep

| Percent | Estimated Area (m2) |
|---|---|
| 35 | 700 |

| | |
|---|---|
| Dominant Substrate | G |
| Sub-Dominant Substrate | C |
| D90 | 10 |
| Pool-Substrate Compaction | M |

**Edge Habitat**: Edges of Pools and Glides that are <10 cm deep

| Percent | Estimated Area (m2) |
|---|---|
| 12 | 25 |

**Riffle Habitat**: Surface disturbance provides cover

| Percent | Estimated Area (m2) |
|---|---|
| 35 | 700 |

| | |
|---|---|
| Dominant Substrate | G |
| Sub-Dominant Substrate | SC |
| D90 | 6 |
| Pool-Substrate Compaction | M |

**Assessment of Fish Habitat** | Instream Cover (N,T,M,A): M | Out of Stream Cover (N,T,M, A): M

| | (N,T,M,A) | N=None, T=Trace, M=Moderate, A=Abundant | | | | | |
|---|---|---|---|---|---|---|---|
| **Functional LWD** | T | Number <20 cm | | Number 20-50 cm | 1 | Number >50 cm | |
| **Functional SWD** | T | | | | | | |
| **Boulder Cover** | N | Single > 30 cm | | Boulder-clusters | | | |
| **Cobble Cover** | M | Percent of site area | 10 | | | | |
| **Undercut Banks** | A | Length (m) | 600 | Average width (m | 50 | | |
| **Aquatic Vegetation** | N | | | | | | |
| **Overhanging Veg.** | M | | | | | | |

**Fish Species Present:**

**Fish Species Suspected:**

# DETAILED SITE DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 1 (first three letters of stream name-site number)

| Date of survey | Time of survey | Surveyors |
|---|---|---|
| 00/06/26 | 21:00 | RS |

## PHOTO DOCUMENTATIO

| Roll Name | Frame Number | Photo Description |
|---|---|---|
| DAHL | 8 | downstream view from road |
| DAH | 1 | upstream view |
| DAH | 2 | downstream view |

## COMMENTS

**Disturbance Indicators**

Debris jam just below culvert (upstream of this site) has created a 0.8m step and partial obstruction to fish passage.

**Comment 1**

Ice jam appears to have changed most of glides into pool habitat during winter when minnow traps were set.

**Comment 2**

**Comment 3**

Dahlie Creek Site DAH 1

Plate 1. Reach 2 – DAH 1. Upstream view (above) and downstream view (below).

# DETAILED SITE DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 2 (first three letters of stream name-site number)

| Date of survey | Time of survey | Surveyors |
|---|---|---|
| 00/06/26 | 21:30 | RS |

| Gazetted Stream Name | Local Stream Name | Watershed Code |
|---|---|---|
| DAHLIE CREEK | DAHLIE CREEK | 46037380033200 |

TRIM Map Number: | NTS 1:50000 Map #: | UTM Zone: | Northing: | Easting:

**Site Location: Describe road and foot access**

at Hoskins Ford

Limnology Station Marked ☐

Upstream Site Boundary marker (e.g. Red flagging): | distance to nearest pool upstream (meters): 50

Downstream Site Boundary marker: | distance to nearest pool downstream (meters): 10

**Gradient (%):** | **Site Length (meters):** 5 | **Interval between channel widths (meters):** 1

Note: Minimum of 6 widths taken at equal intervals (@ .5 intervals, 1.5 intervals, 2.5 intervals ...to... 9.5 intervals)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Channel Width (m)** | 520 | 530 | 510 | 490 | 470 | | | | | |
| **Wetted Width (m)** | 480 | 450 | 480 | 460 | 400 | | | | | |
| **Max. Wetted Depth (cm)** | 4000 | 4500 | 4000 | 2000 | 1000 | | | | | |
| **Max. Bankful Depth (cm)** | 7500 | 8000 | 7500 | 5500 | 4500 | | | | | |

**Pool Habitat**

max. depth is > 50 cm, average flow is < 0.1 m/sec, excluding edges <10 cm deep

| Percent | Estimated Area (m2) |
|---|---|
| 60 | 1200 |

| | |
|---|---|
| Dominant Substrate | F |
| Sub-Dominant Substrate | C |
| D90 | 2 |
| Pool-Substrate Compaction | L |

**Glide Habitat**

average flow is >0.1 m/sec, no surface disturbance, excluding edges <10 cm deep

| Percent | Estimated Area (m2) |
|---|---|
| 30 | 600 |

| | |
|---|---|
| Dominant Substrate | C |
| Sub-Dominant Substrate | G |
| D90 | 10 |
| Pool-Substrate Compaction | L |

**Edge Habitat**

Edges of Pools and Glides that are <10 cm deep

| Percent | Estimated Area (m2) |
|---|---|
| 10 | 2 |

**Riffle Habitat**

Surface disturbance provides cover

| Percent | Estimated Area (m2) |
|---|---|
| 30 | 600 |

| | |
|---|---|
| Dominant Substrate | |
| Sub-Dominant Substrate | |
| D90 | |
| Pool-Substrate Compaction | |

**Assessment of Fish Habitat**

Instream Cover (N,T,M,A): T | Out of Stream Cover (N,T,M, A): T

(N,T,M,A) N=None, T=Trace, M=Moderate, A=Abundant

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Functional LWD** | N | Number <20 cm | | Number 20-50 cm | | Number >50 cm | |
| **Functional SWD** | N | | | | | | |
| **Boulder Cover** | T | Single > 30 cm | 2 | Boulder-clusters | 2 | | |
| **Cobble Cover** | T | Percent of site area | 10 | | | | |
| **Undercut Banks** | T | Length (m) | 100 | Average width (m | 10 | | |
| **Aquatic Vegetation** | N | | | | | | |
| **Overhanging Veg.** | T | | | | | | |

**Fish Species Present:**

**Fish Species Suspected:**

# DETAILED SITE DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 2 (first three letters of stream name-site number)

| Date of survey | Time of survey | Surveyors |
|---|---|---|
| 00/06/26 | 21:30 | RS |

## PHOTO DOCUMENTATIO

| Roll Name | Frame Number | Photo Description |
|---|---|---|
| DAH | 3 | upstream view of culvert |
| DAH | 4 | downstream side view |
| DAHL | 3 | upstream toward culvert |

## COMMENTS

**Disturbance Indicators**: condom floating in pool

**Comment 1**:

**Comment 2**:

**Comment 3**:

Dahlie Creek Site DAH 2

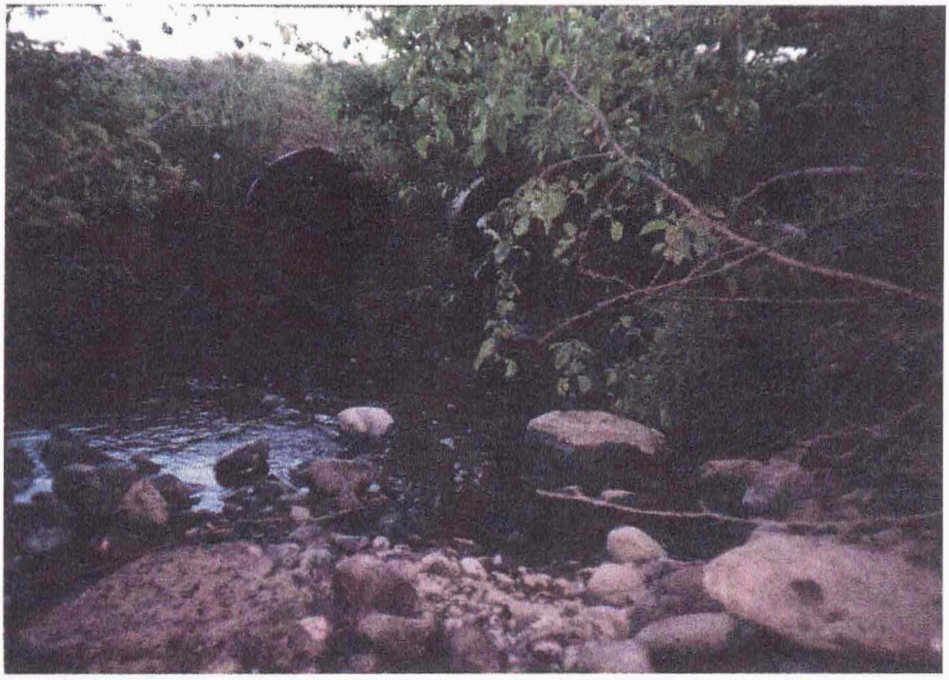


Plate 2. Reach 3 – DAH 2. Upstream view (above) and oblique view (below).

# DETAILED SITE DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 3 (first three letters of stream name-site number)

| Date of survey | Time of survey | Surveyors |
|---|---|---|
| 00/06/26 | 22:00 | RS/ |

| Gazetted Stream Name | Local Stream Name | Watershed Code |
|---|---|---|
| DAHLIE CREEK | DAHLIE CREEK | 46037380033200 |

TRIM Map Number: | NTS 1:50000 Map #: | UTM Zone: | Northing: | Easting:

**Site Location: Describe road and foot access**

at Elk's baseball diamond (foul post)

Limnology Station Marked ☐

Upstream Site Boundary marker (e.g. Red flagging): | distance to nearest pool upstream (meters):

Downstream Site Boundary marker: | distance to nearest pool downstream (meters):

**Gradient (%)** 0 | **Site Length (meters)** 7 | **Interval between channel widths (meters)** 1

Note: Minimum of 6 widths taken at equal intervals (@ .5 intervals, 1.5 intervals, 2.5 intervals ...to... 9.5 intervals)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Channel Width (m)** | 350 | 420 | 410 | 380 | 260 | 250 | | | | |
| **Wetted Width (m)** | 310 | 320 | 310 | 280 | 250 | 230 | | | | |
| **Max. Wetted Depth (cm)** | 3500 | 3000 | 2500 | 2800 | 2000 | 1500 | | | | |
| **Max. Bankful Depth (cm)** | 6500 | 6000 | 5500 | 5800 | 5000 | 4500 | | | | |

**Pool Habitat**

max. depth is > 50 cm, average flow is < 0.1 m/sec, excluding edges <10 cm deep

| Percent | Estimated Area (m2) |
|---|---|
| 20 | 400 |

Dominant Substrate: F
Sub-Dominant Substrate:
D90:
Pool-Substrate Compaction: L

**Glide Habitat**

average flow is >0.1 m/sec, no surface disturbance, excluding edges <10 cm deep

| Percent | Estimated Area (m2) |
|---|---|
| 20 | 400 |

Dominant Substrate: F
Sub-Dominant Substrate:
D90:
Pool-Substrate Compaction:

**Edge Habitat**

Edges of Pools and Glides that are <10 cm deep

| Percent | Estimated Area (m2) |
|---|---|
| 60 | 1200 |

**Riffle Habitat**

Surface disturbance provides cover

| Percent | Estimated Area (m2) |
|---|---|
| 20 | 400 |

Dominant Substrate: F
Sub-Dominant Substrate:
D90:
Pool-Substrate Compaction: M

**Assessment of Fish Habitat**

Instream Cover (N,T,M,A): M | Out of Stream Cover (N,T,M, A): M

(N,T,M,A) N=None, T=Trace, M=Moderate, A=Abundant

| | | | | | | |
|---|---|---|---|---|---|---|
| **Functional LWD** | T | Number <20 cm | 1 | Number 20-50 cm | | Number >50 cm | |
| **Functional SWD** | M | | | | | | |
| **Boulder Cover** | N | Single > 30 cm | | Boulder-clusters | | | |
| **Cobble Cover** | N | Percent of site area | | | | | |
| **Undercut Banks** | T | Length (m) | 50 | Average width (m | 10 | | |
| **Aquatic Vegetation** | N | | | | | | |
| **Overhanging Veg.** | M | | | | | | |

**Fish Species Present:**

**Fish Species Suspected:**

# DETAILED SITE DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 3 (first three letters of stream name-site number)

| Date of survey | Time of survey | Surveyors |
|---|---|---|
| 00/06/26 | 22:00 | RS/ |

## PHOTO DOCUMENTATIO

| Roll Name | Frame Number | Photo Description |
|---|---|---|
| DAHL | 11 | downstream view, Ron in picture |
| DAHL | 4 | upstream |
| DAHL | 5 | downstream |
| DAH | 5 | upstream view |
| DAH | 6 | downstream view |
| DAH | 7 | two 1000mm culverts with 35 cm drop around 40m upstream of site |

## COMMENTS

**Disturbance Indicators**

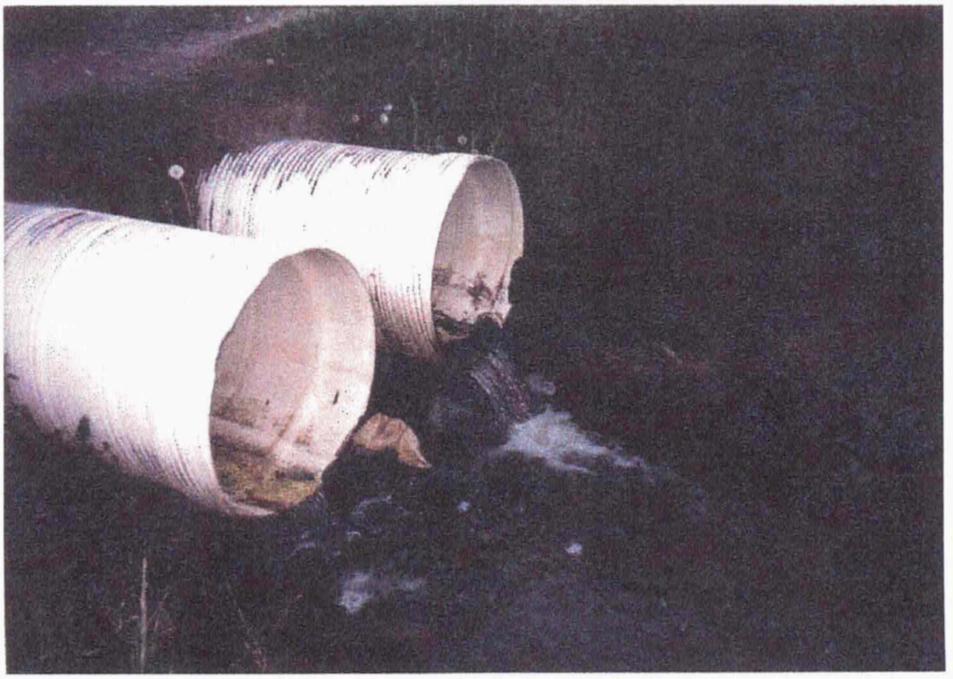
**Comment 1** Gradient % is 0.5

**Comment 2** 35 cm drop from two very long culverts under Railway Station

**Comment 3**

Dahlie Creek Site DAH 3

Plate 3. Reach 3 – DAH 3. Downstream view of site (above) and upstream view of culverts under Railway Avenue (below).



# DETAILED SITE DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 4 (first three letters of stream name-site number)

| Date of survey | Time of survey | Surveyors |
|---|---|---|
| 00/06/26 | 22:30 | RS/ |

| Gazetted Stream Name | Local Stream Name | Watershed Code |
|---|---|---|
| DAHLIE CREEK | DAHLIE CREEK | 46037380033200 |

TRIM Map Number: | NTS 1:50000 Map #: | UTM Zone: | Northing: | Easting:

**Site Location: Describe road and foot access**

3 m downstream of culvert at 16th Ave behind Canadian Tire development

Limnology Station Marked ☐

Upstream Site Boundary marker (e.g. Red flagging):
Downstream Site Boundary marker:
distance to nearest pool upstream (meters): 60
distance to nearest pool downstream (meters): 35

**Gradient (%):** | **Site Length (meters):** 6 | **Interval between channel widths (meters):** 1

Note: Minimum of 6 widths taken at equal intervals (@ .5 intervals, 1.5 intervals, 2.5 intervals ...to... 9.5 intervals)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Channel Width (m)** | 750 | 700 | 680 | 500 | 450 | 300 | | | | |
| **Wetted Width (m)** | 710 | 690 | 650 | 480 | 410 | 230 | | | | |
| **Max. Wetted Depth (cm)** | 2500 | 2000 | 2200 | 1900 | 1700 | 1500 | | | | |
| **Max. Bankful Depth (cm)** | | | | | | | | | | |

| | | Percent | Estimated Area (m2) | | |
|---|---|---|---|---|---|
| **Pool Habitat** | max. depth is > 50 cm, average flow is < 0.1 m/sec, excluding edges <10 cm deep | 0 | | Dominant Substrate | |
| | | | | Sub-Dominant Substrate | |
| | | | | D90 | |
| | | | | Pool-Substrate Compaction | |
| **Glide Habitat** | average flow is >0.1 m/sec, no surface disturbance, excluding edges <10 cm deep | | 1200 | Dominant Substrate | F |
| | | | | Sub-Dominant Substrate | |
| | | | | D90 | |
| | | | | Pool-Substrate Compaction | L |
| **Edge Habitat** | Edges of Pools and Glides that are <10 cm deep | | 2200 | | |
| **Riffle Habitat** | Surface disturbance provides cover | | 1200 | Dominant Substrate | F |
| | | | | Sub-Dominant Substrate | C |
| | | | | D90 | 17 |
| | | | | Pool-Substrate Compaction | L |

**Assessment of Fish Habitat** | Instream Cover (N,T,M,A): N | Out of Stream Cover (N,T,M, A): N

N=None, T=Trace, M=Moderate, A=Abundant

| | (N,T,M,A) | | | | | |
|---|---|---|---|---|---|---|
| **Functional LWD** | N | Number <20 cm | | Number 20-50 cm | | Number >50 cm | |
| **Functional SWD** | N | | | | | |
| **Boulder Cover** | N | Single > 30 cm | | Boulder-clusters | | |
| **Cobble Cover** | T | Percent of site area | 2 | | | |
| **Undercut Banks** | N | Length (m) | | Average width (m | | |
| **Aquatic Vegetation** | N | | | | | |
| **Overhanging Veg.** | N | | | | | |

**Fish Species Present:**

**Fish Species Suspected:**

# DETAILED SITE DESCRIPTION

| Site Name (e.g. TOB-1) | first three letters of stream name-site number | Date of survey | Time of survey | Surveyors |
|---|---|---|---|---|
| DAH - 4 | | 00/06/26 | 22:30 | RS/ |

# PHOTO DOCUMENTATIO

| Roll Name | Frame Number | Photo Description |
|---|---|---|
| DAHL | 6 | upstream view of site looking at culvert |
| DAHL | 7 | downstream oblique view of site |
| DAH | 8 | upstream view of site looking at culvert |
| DAH | 9 | downstream oblique view of site |

# COMMENTS

**Disturbance Indicators**

**Comment 1** some instream rock placement to create pools was observed upstream of culverts

**Comment 2**

**Comment 3**

Dahlie Creek Site DAH 4

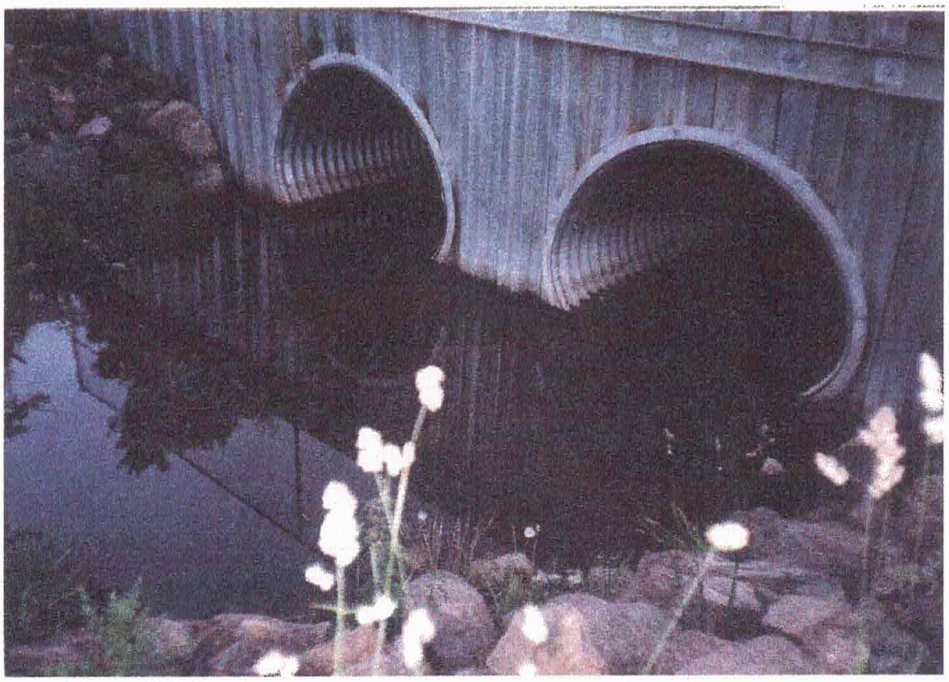


Plate 4. Reach 3 – DAH 4. Upstream view of culverts (above) and oblique view (below).

## Appendix 2. Data collected during winter site visits of sites in the Dahlie Creek drainages

# SITE VISIT DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 1 (first three letters of stream name-site number)

**VISIT #** 1

| Date of survey | Time of survey | Surveyors |
|---|---|---|
| 00/02/09 | 11:25 | rs/rs |

| Gazetted Stream Name | Local Stream Name | Watershed Code |
|---|---|---|
| DAHLIE CREEK | DAHLIE CREEK | 46037380033200 |

**Weather** overcast, flurries

**Air Temperature** -2 ° C

**Ice Cover (%)** 100

**Stream Flow** M (High, Moderate, Limited, None)

**Potential for fish migration** M (High, Moderate, Limited, None)

## LIMNOLOGY STATION

| | |
|---|---|
| Depth from upper surface of ice (cm) | 15 |
| Ice thickness (cm) | 10 |
| Clarity of Ice (H,M,L, or N) (High, Moderate, Limited, None) | N |
| Snow Depth (cm) | 10 |
| Water Temperature | 0 ° C |
| Turbidity (H,M, L, or C) (High, Moderate, Low, or Clear) | C |
| Conductivity | 38 uS |
| Dissolved Oxygen (bottom) | 14 ppm |
| Dissolved Oxygen (surface) | 14 ppm |

## FISH SUMMARY

| Species | Total # of Fish | Mininimum Length (mm) | Maximum Length (mm) |
|---|---|---|---|
| NFC | 0 | | |

## FISH COLLECTION SUMMARY

**Date of Setting** 00/02/08

**Time of Setting** 10:30:00 AM

**Number of traps set** 3

**Date of Collection** 20000209

**Time of Collection** 11:30:00 AM

**Number of traps collected** 3

**NOTE: Cluster contains three traps within an ~5 meter diameter area**

| Capture Method | Cluster Number | Instream Cover: Mean Depth | Dominant | Sub Dominant | Percent ice cover | Species/ Number Captured per Cluster |
|---|---|---|---|---|---|---|
| MT | 1 | 12 | SWD | BD | 100 | NFC / 0 |

## Comments

Location: at mainstreet near Riverside Park
Water level dropped and exposed two of the three traps to air (only one trap was efficient)

# SITE VISIT DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 1 (first three letters of stream name-site number)

**VISIT #** 1

## PHOTO DOCUMENTATION

| Roll Name | Frame Number | Photo Description |
|---|---|---|
| DAH | 1 | upstream view |
| DAH | 2 | downstream view |

## INDIVIDUAL FISH DATA

# SITE VISIT DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 1 (first three letters of stream name-site number)

**VISIT #** 2

| Date of survey | Time of survey | Surveyors |
|---|---|---|
| 00/03/15 | 15:55 | RS/RS |

| Gazetted Stream Name | Local Stream Name | Watershed Code |
|---|---|---|
| DAHLIE CREEK | DAHLIE CREEK | 46037380033200 |

**Weather** sunny, warm- melting in pm, snow in am.

**Air Temperature** 7 ° C

**Ice Cover (%)** 95

**Stream Flow** M (High, Moderate, Limited, None)

**Potential for fish migration** L (High, Moderate, Limited, None)

## LIMNOLOGY STATION

| | |
|---|---|
| Depth from upper surface of ice (cm) | 35 |
| Ice thickness (cm) | 20 |
| Clarity of Ice (H,M,L, or N) (High, Moderate, Limited, None) | L |
| Snow Depth (cm) | 2 |
| Water Temperature | 1 ° C |
| Turbidity (H,M, L, or C) (High, Moderate, Low, or Clear) | M |
| Conductivity | 282 uS |
| Dissolved Oxygen (bottom) | 12 ppm |
| Dissolved Oxygen (surface) | 12 ppm |

## FISH SUMMARY

| Species | Total # of Fish | Mininimum Length (mm) | Maximum Length (mm) |
|---|---|---|---|
| NFC | 0 | | |

## FISH COLLECTION SUMMARY

| | | | |
|---|---|---|---|
| **Date of Setting** | 00/03/14 | **Date of Collection** | 20000315 |
| **Time of Setting** | 4:20:00 PM | **Time of Collection** | 3:55:00 PM |
| **Number of traps set** | 3 | **Number of traps collected** | 3 |

**NOTE: Cluster contains three traps within an ~5 meter diameter area**

| Capture Method | Cluster Number | Instream Cover: Mean Depth | Dominant | Sub Dominant | Percent ice cover | Species/ Number Captured per Cluster |
|---|---|---|---|---|---|---|
| MT | 1 | 15 | SWD | CB | 100 | NFC / 0 / / / / / / / / / / / |

## Comments

Location: at Riverside campground.
Town has been sweeping and spraying roads, this may result in increased turbidity.
Water turbid due to snow melt; water level lower than during first sampling.

Difficult to set all 3 traps, 2 traps set adjacent to eachother.

# SITE VISIT DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 1 (first three letters of stream name-site number)

**VISIT #** 2

## PHOTO DOCUMENTATION

| Roll Name | Frame Number | Photo Description |
|---|---|---|
| DAHL | 8 | downstream view from road |

## INDIVIDUAL FISH DATA

Dahlie Creek Site DAH 1

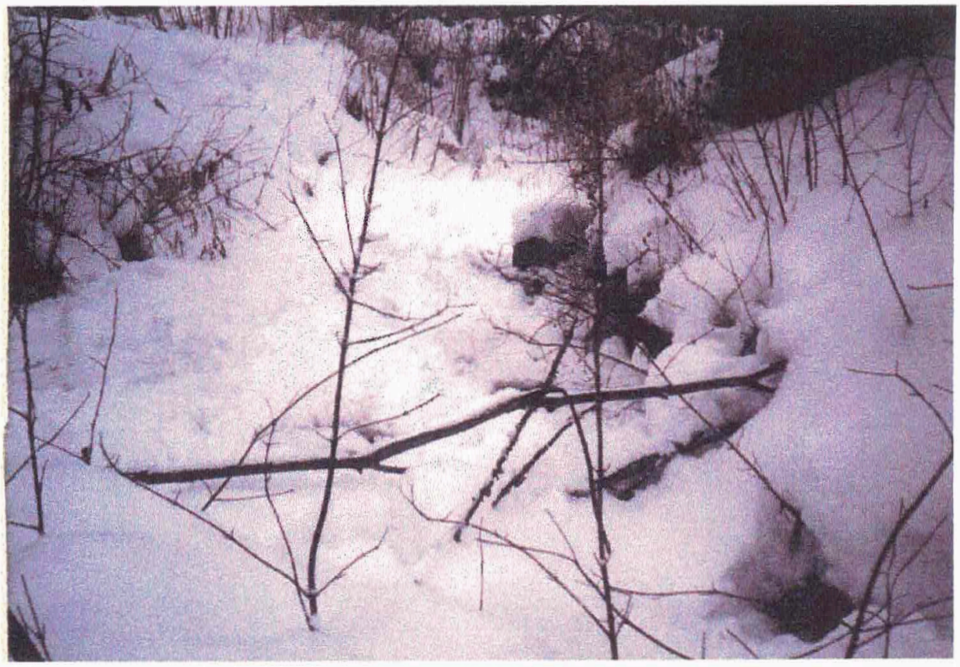


Plate 5. Reach 2 – DAH 1. Upstream view on February 9th 2000 (above) and downstream view on March 15th 2000 (below).

# SITE VISIT DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 2 (first three letters of stream name-site number)

**VISIT #** 1

| Date of survey | Time of survey | Surveyors |
|---|---|---|
| 00/02/09 | 11:30 | RS/RS |

| Gazetted Stream Name | Local Stream Name | Watershed Code |
|---|---|---|
| DAHLIE CREEK | DAHLIE CREEK | 46037380033200 |

**Weather** overcast, flurries

**Air Temperature** -2 ° C

**Ice Cover (%)** 95

**Stream Flow** M (High, Moderate, Limited, None)

**Potential for fish migration** M (High, Moderate, Limited, None)

## LIMNOLOGY STATION

| | |
|---|---|
| Depth from upper surface of ice (cm) | 44 |
| Ice thickness (cm) | 11 |
| Clarity of Ice (H,M,L, or N) (High, Moderate, Limited, None) | N |
| Snow Depth (cm) | 5 |
| Water Temperature | 0 ° C |
| Turbidity (H,M, L, or C) (High, Moderate, Low, or Clear) | C |
| Conductivity | 31 uS |
| Dissolved Oxygen (bottom) | 11 ppm |
| Dissolved Oxygen (surface) | 11 ppm |

## FISH SUMMARY

| Species | Total # of Fish | Mininimum Length (mm) | Maximum Length (mm) |
|---|---|---|---|
| NFC | 0 | | |

## FISH COLLECTION SUMMARY

**Date of Setting** 00/02/08

**Time of Setting** 1:00:00 PM

**Number of traps set** 3

**Date of Collection** 20000209

**Time of Collection** 11:30:00 AM

**Number of traps collected** 3

**NOTE: Cluster contains three traps within an ~5 meter diameter area**

| Capture Method | Cluster Number | Instream Cover: Mean Depth | Instream Cover: Dominant | Instream Cover: Sub Dominant | Instream Cover: Percent ice cover | Species/ Number Captured per Cluster |
|---|---|---|---|---|---|---|
| MT | 1 | 30 | CB | | 80 | NFC / 0 / / / / / / / / / |

## Comments

Location: at Frontage Road crossing (downstream side) by Hoskins Ford dealership
-moderate water velocity may have reduce trap efficiency.

# SITE VISIT DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 2 (first three letters of stream name-site number)

**VISIT #** 1

## PHOTO DOCUMENTATION

| Roll Name | Frame Number | Photo Description |
|---|---|---|
| DAHL | 3 | upstream toward culvert |

## INDIVIDUAL FISH DATA

# SITE VISIT DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 2 (first three letters of stream name-site number)

**VISIT #** 2

| Date of survey | Time of survey | Surveyors |
|---|---|---|
| 00/03/15 | 16:10 | rs/rs |

| Gazetted Stream Name | Local Stream Name | Watershed Code |
|---|---|---|
| DAHLIE CREEK | DAHLIE CREEK | 46037380033200 |

**Weather** sunny warm, melting in pm, snow in am

**Air Temperature** 7 ° C

**Ice Cover (%)** 50

**Stream Flow** M (High, Moderate, Limited, None)

**Potential for fish migration** M (High, Moderate, Limited, None)

## LIMNOLOGY STATION

| | |
|---|---|
| Depth from upper surface of ice (cm) | 40 |
| Ice thickness (cm) | 10 |
| Clarity of Ice (H,M,L, or N) (High, Moderate, Limited, None) | L |
| Snow Depth (cm) | 1 |
| Water Temperature | 1 ° C |
| Turbidity (H,M, L, or C) (High, Moderate, Low, or Clear) | M |
| Conductivity | 235 uS |
| Dissolved Oxygen (bottom) | 12 ppm |
| Dissolved Oxygen (surface) | 12 ppm |

## FISH SUMMARY

| Species | Total # of Fish | Mininimum Length (mm) | Maximum Length (mm) |
|---|---|---|---|
| NFC | 0 | | |

## FISH COLLECTION SUMMARY

**Date of Setting** 00/03/14

**Time of Setting** 4:30:00 PM

**Number of traps set** 3

**Date of Collection** 20000315

**Time of Collection** 4:11:00 PM

**Number of traps collected** 3

**NOTE: Cluster contains three traps within an ~5 meter diameter area**

| Capture Method | Cluster Number | Instream Cover: Mean Depth | Dominant | Sub Dominant | Percent ice cover | Species/ Number Captured per Cluster |
|---|---|---|---|---|---|---|
| MT | 1 | 30 | | | 70 | NFC / / / / / / / / / / / / |

## Comments

Location: at Hoskins Ford dealership
Turbid water due to snow melt
-significant run off from highway and street sewer are adding significant amounts of sediment to this stream

-fish habitat appeared to be good except for sediment
-excellent trap setting in deep slow flowing water but no fish captured or observed

# SITE VISIT DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 2 (first three letters of stream name-site number)

**VISIT #** 2

## PHOTO DOCUMENTATION

| Roll Name | Frame Number | Photo Description |
|---|---|---|
| DAH | 3 | upstream view of culvert |
| DAH | 4 | downstream side view |

## INDIVIDUAL FISH DATA

Dahlie Creek Site DAH 2

Plate 6. Reach 3 – DAH 2. Upstream view on February 9th 2000 (above) and downstream view on March 15th 2000 (below).

# SITE VISIT DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 3 (first three letters of stream name-site number)

**VISIT #** 1

| Date of survey | Time of survey | Surveyors |
|---|---|---|
| 00/02/09 | 12:00 | RS/RS |

| Gazetted Stream Name | Local Stream Name | Watershed Code |
|---|---|---|
| DAHLIE CREEK | DAHLIE CREEK | 46037380033200 |

**Weather** overcast, flurries

**Air Temperature** -2 ° C

**Ice Cover (%)** 40

**Stream Flow** M (High, Moderate, Limited, None)

**Potential for fish migration** H (High, Moderate, Limited, None)

## LIMNOLOGY STATION

| | |
|---|---|
| Depth from upper surface of ice (cm) | 30 |
| Ice thickness (cm) | 3 |
| Clarity of Ice (H,M,L, or N) (High, Moderate, Limited, None) | L |
| Snow Depth (cm) | 2 |
| Water Temperature | 1 ° C |
| Turbidity (H,M, L, or C) (High, Moderate, Low, or Clear) | C |
| Conductivity | 466 uS |
| Dissolved Oxygen (bottom) | 12 ppm |
| Dissolved Oxygen (surface) | 12 ppm |

## FISH SUMMARY

| Species | Total # of Fish | Mininimum Length (mm) | Maximum Length (mm) |
|---|---|---|---|
| RB | 1 | | |
| CO | 3 | | |

## FISH COLLECTION SUMMARY

**Date of Setting** 00/02/08

**Time of Setting** 12:30:00 PM

**Number of traps set** 3

**Date of Collection** 20000209

**Time of Collection** 12:00:00 PM

**Number of traps collected** 3

**NOTE: Cluster contains three traps within an ~5 meter diameter area**

| Capture Method | Cluster Number | Instream Cover: Mean Depth | Dominant | Sub Dominant | Percent ice cover | Species/ Number Captured per Cluster |
|---|---|---|---|---|---|---|
| MT | 1 | 25 | LWD | SWD | 10 | RB / 1 CO / 3 |

## Comments

Location: at Elk's (foul post at baseball diamond)
-open water area indicates and water temperature indicates some ground water input at this site

# SITE VISIT DESCRIPTION

Site Name (e.g. TOB-1) DAH - 3 (first three letters of stream name-site number)

VISIT # 1

## PHOTO DOCUMENTATION

| Roll Name | Frame Number | Photo Description |
|---|---|---|
| DAHL | 4 | upstream |
| DAHL | 5 | downstream |

## INDIVIDUAL FISH DATA

| Capture Method | Cluster Number | Trap Number | Species | Fork Length (mm) | Fish Weight (g) | Type of Fin Clip (e.g. adipose, upper caudal, none) | Type of Recaptured Fin |
|---|---|---|---|---|---|---|---|
| MT | 1 | 1 | RB | 132 | 25.9 | | |
| MT | 1 | 1 | CO | 98 | 10.6 | | |
| MT | 1 | 2 | CO | 106 | 12.9 | | |
| MT | 1 | 2 | CO | 109 | 14.9 | | |

# SITE VISIT DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 3 (first three letters of stream name-site number)

**VISIT #** 2

| Date of survey | Time of survey | Surveyors |
|---|---|---|
| 00/03/15 | 16:30 | rs/rs |

| Gazetted Stream Name | Local Stream Name | Watershed Code |
|---|---|---|
| DAHLIE CREEK | DAHLIE CREEK | 46037380033200 |

**Weather** sunny, warm, melting in pm, snow in am

**Air Temperature** 7 ° C

**Ice Cover (%)** 0

**Stream Flow** M (High, Moderate, Limited, None)

**Potential for fish migration** H (High, Moderate, Limited, None)

## LIMNOLOGY STATION

| | |
|---|---|
| Depth from upper surface of ice (cm) | |
| Ice thickness (cm) | |
| Clarity of Ice (H,M,L, or N) (High, Moderate, Limited, None) | |
| Snow Depth (cm) | |
| Water Temperature | 2 ° C |
| Turbidity (H,M, L, or C) (High, Moderate, Low, or Clear) | C |
| Conductivity | 170 uS |
| Dissolved Oxygen (bottom) | 11 ppm |
| Dissolved Oxygen (surface) | 11 ppm |

## FISH SUMMARY

| Species | Total # of Fish | Mininimum Length (mm) | Maximum Length (mm) |
|---|---|---|---|
| CO | 1 | 111 | 111 |
| RB | 1 | 69 | 69 |

## FISH COLLECTION SUMMARY

**Date of Setting** 00/03/14

**Time of Setting** 4:45:00 PM

**Number of traps set** 3

**Date of Collection** 20000315

**Time of Collection** 4:30:00 PM

**Number of traps collected** 3

**NOTE: Cluster contains three traps within an ~5 meter diameter area**

| Capture Method | Cluster Number | Instream Cover: Mean Depth | Dominant | Sub Dominant | Percent ice cover | Species/ Number Captured per Cluster |
|---|---|---|---|---|---|---|
| MT | 1 | 30 | LWD | SWD | 0 | RB / 1 CO / 1 |

## Comments

Location: at Elk's
-oil film on surface
- not a lot of cover with no ice cover

-no spawning habitat was observed

# SITE VISIT DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 3 (first three letters of stream name-site number)

**VISIT #** 2

## PHOTO DOCUMENTATION

| Roll Name | Frame Number | Photo Description |
|---|---|---|
| DAHL | 11 | downstream view, Ron in picture |

## INDIVIDUAL FISH DATA

| Capture Method | Cluster Number | Trap Number | Species | Fork Length (mm) | Fish Weight (g) | Type of Fin Clip (e.g. adipose, upper caudal, none) | Type of Recaptured Fin |
|---|---|---|---|---|---|---|---|
| MT | 1 | 1 | CO | 111 | 13.9 | none | none |
| MT | 1 | 2 | RB | 69 | 1.9 | none | none |
| MT | 1 | 3 | NFC | | | | |

Dahlie Creek Site DAH 3

Plate 7. Reach 3 – DAH 3. Upstream view on February 9th 2000 (above) and downstream view on March 15th 2000 (below).

# SITE VISIT DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 4 (first three letters of stream name-site number)

**VISIT #** 1

| Date of survey | Time of survey | Surveyors |
|---|---|---|
| 00/02/09 | 13:00 | RS/RS |

| Gazetted Stream Name | Local Stream Name | Watershed Code |
|---|---|---|
| DAHLIE CREEK | DAHLIE CREEK | 46037380033200 |

**Weather** overcast, flurries

**Air Temperature** -2 ° C

**Ice Cover (%)** 100

**Stream Flow** L (High, Moderate, Limited, None)

**Potential for fish migration** L (High, Moderate, Limited, None)

## LIMNOLOGY STATION

| | |
|---|---|
| Depth from upper surface of ice (cm) | 44 |
| Ice thickness (cm) | 40 |
| Clarity of Ice (H,M,L, or N) (High, Moderate, Limited, None) | N |
| Snow Depth (cm) | 10 |
| Water Temperature | 0 ° C |
| Turbidity (H,M, L, or C) (High, Moderate, Low, or Clear) | C |
| Conductivity | 746 uS |
| Dissolved Oxygen (bottom) | 13 ppm |
| Dissolved Oxygen (surface) | 13 ppm |

## FISH SUMMARY

## FISH COLLECTION SUMMARY

| | | | |
|---|---|---|---|
| **Date of Setting** | | **Date of Collection** | |
| **Time of Setting** | | **Time of Collection** | |
| **Number of traps set** | | **Number of traps collected** | |

## Comments

Location: at 16th Ave, 3 meters downstream of culvert

No traps set due to insufficient water, thick surface and some anchor ice.
Dug 2 holes in ice and neither had sufficient water.

# SITE VISIT DESCRIPTION

**Site Name (e.g. TOB-1)** DAH - 4 (first three letters of stream name-site number)

**VISIT #** 1

## PHOTO DOCUMENTATION

| Roll Name | Frame Number | Photo Description |
|---|---|---|
| DAHL | 6 | upstream view of site looking at culvert |
| DAHL | 7 | downstream oblique view of site |

## INDIVIDUAL FISH DATA

Dahlie Creek Site DAH 4

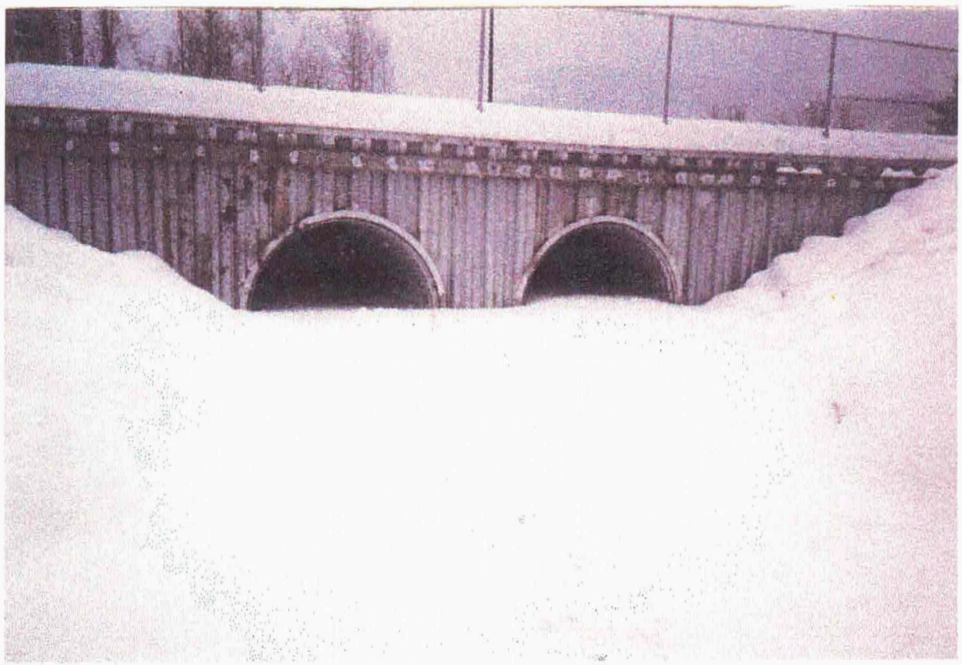


Plate 8. Reach 3 – DAH 4. Upstream view (above) and oblique view (below) on February 9th 2000.

## Appendix 3. Cost estimate for proposed water quality sampling project in Dahlie Creek

**Appendix 3. Cost estimate for water quality monitoring and report preparation - Dahlie Creek**

| **Field parameters** | |
|---|---|
| Temperature, Dissolved Oxygen, pH | n/c |
| | |
| **Laboratory analysis** | |
| Alkalinity | $14 |
| True Color | $6 |
| Specific Conductance | $5 |
| pH | $5 |
| Residue Nonfilterable (TSS) | $13 |
| Turbidity | $6 |
| Ammonia (N) | $12 |
| Nitrate+Nitrite (N) Low level | $18 |
| Nitrite (N) Low level | $18 |
| Ortho Dissolved Phosphorus (Low level) | $18 |
| Total Phosphorus | $18 |
| Extractable Petroleum Hydrocarbons | $80 |
| Total Metals - ICP-MS (Low Level) | $120 |
| Dissolved Metals by ICP-MS + filtration unit | $137 |
| *Lab analysis total* | *$470* |
| | |
| *Air freight* | *$30* |
| | |
| *Professional Services one day @ $400* | *$400* |
| | |
| **Cost for one monitoring event** | **$900** |
| **Cost for three monitoring events** | **$2,700** |

| **Data analysis and report preparation** | |
|---|---|
| D. Remington 5 days @ $400 | $2,000 |
| B&W and color photocopy, expendables | $100 |
| **Total - report preparation** | **$2,100** |
| | |
| **Total study cost** | **$4,800** |

GST will be applied to all costs and services.