

**CARMACKS COPPER PROJECT**

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**ADDENDUM TO  
VOLUME 1**

**BIOPHYSICAL ASSESSMENT OF THE  
CARMACKS COPPER MINE SITE**



***Hallam Knight Piésold Ltd.***  
ENVIRONMENTAL CONSULTANTS

**WESTERN COPPER HOLDINGS LIMITED**

**CARMACKS COPPER PROJECT**

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**ADDENDUM TO  
VOLUME 1**

**BIOPHYSICAL ASSESSMENT OF THE  
CARMACKS COPPER MINE SITE**

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November, 1994

**WESTERN COPPER HOLDINGS LIMITED**

**CARMACKS COPPER PROJECT**

**ADDENDUM TO VOLUME 1**

**BIOPHYSICAL ASSESSMENT OF THE  
WILLIAMS CREEK MINE SITE**

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## **1.0 INTRODUCTION**

The Carmacks Copper Project is located 38 km northwest of the town of Carmacks, Yukon. Development of the property would entail an open pit mine (19,000 t/d for 300 days/year), ore crushing facility, heap leach pad, a solvent extraction-electrowinning process facility and camp accommodations for approximately 150 people.

The Carmacks Copper Project would provide the Yukon Territory with resource development resulting in economic benefits and employment. Development of this copper mine is required to provide a boost in a declining Canadian metal export market which is an important factor in providing jobs and economic benefits for the country.

An initial assessment of the baseline environmental conditions was undertaken from 1992 to 1994. The scope-of-work included assessments of terrain and vegetation characteristics, wildlife habitat capabilities, surficial hydrology, climate, water quality, aquatic resources and natural resource use. The following information provides further details concerning the existing vegetation community types in the vicinity of the Carmacks Copper Project and the current utilization of the area by wildlife. Also included are monthly updates of Williams Creek hydrology conducted by J. Gibson and Associates.

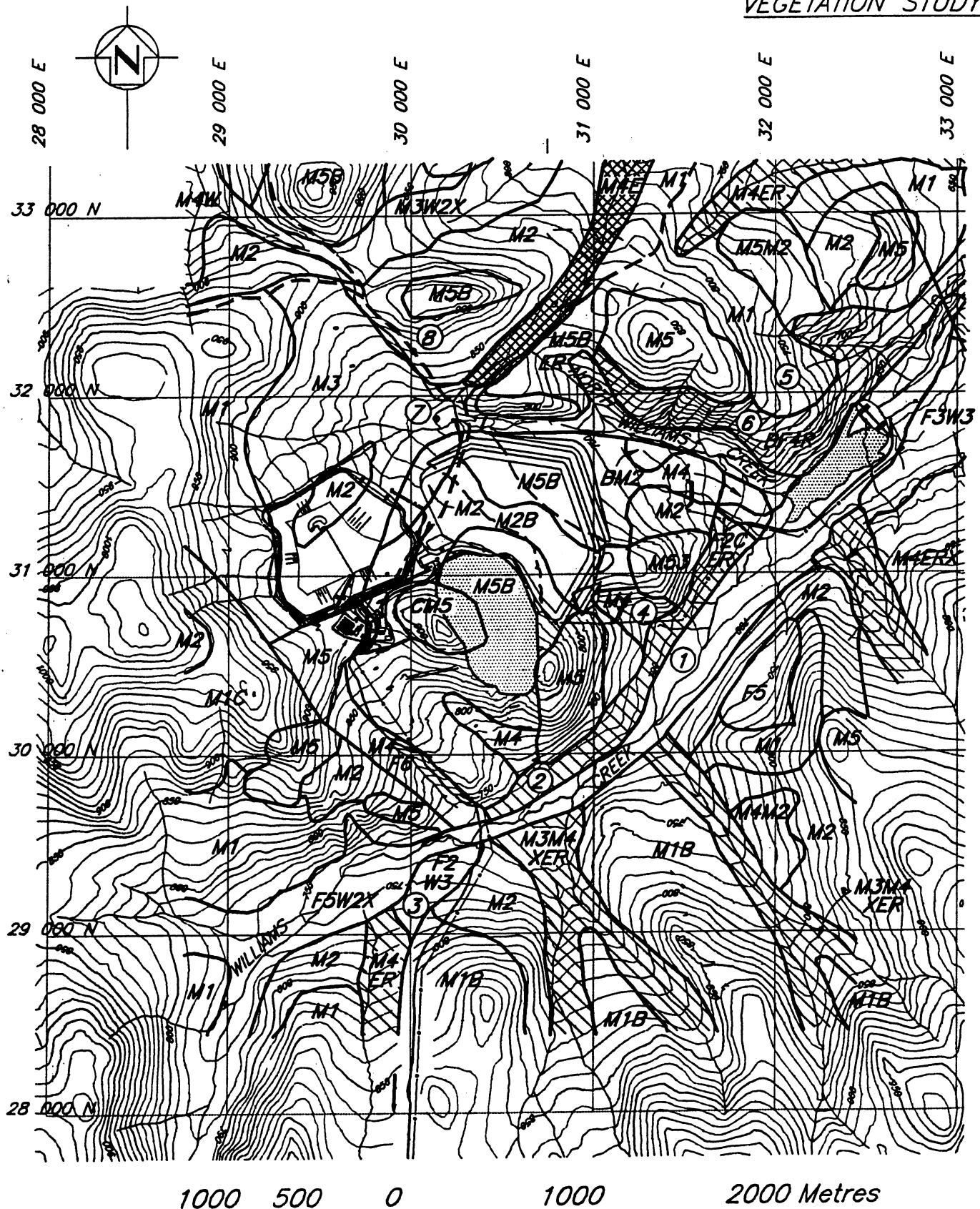
## **2.0 VEGETATION SURVEY**

A vegetation survey of the Carmacks Copper Project area was conducted by Hallam Knight Piesold Ltd. in July 1994. Eight transects were established on the Carmacks Copper Project property (Figure 1). Sampling consisted of transect (20 m<sup>2</sup>) documentation of understory and ground cover species. Species composition was determined for dominant trees (trees that comprise the upper portion of the height distribution population of the main canopy), tall shrubs (all woody plants between 2 and 10 m tall, including shrubs and advanced tree regeneration), low shrubs (all woody

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*Hallam Knight Piesold Ltd.*

WESTERN COPPER HOLDINGS  
 CARMACKS COPPER PROJECT  
 VEGETATION STUDY (JULY 1994)



LEGEND TERRAIN INTERPRETIVE MAP Geotechnical and Environmental Considerations	
LANDFORMS and MATERIALS	COMMON VEGETATION TYPE
<p>Morainal Landforms - valley bottom and lower slope glacial till; mainly a dense sandy silty matrix, but may be closer and looser in upper valleys.</p> <p>M1 mainly thick subdued till landforms; average depths exceed 2m and slopes are usually less than 25%; in places there may be a thin veneer of silt and gravel.</p> <p>M2 sloping till blanket overlying bedrock; depths range from 1-3m; slopes are mainly less than 40%.</p> <p>M3 wet, subdued to moderately sloping till; features poor drainage, seepage, and/or shallow organic capping on slopes usually less than 30%.</p> <p>M4 Gullied till on valley sides; may contain fluvial and/or colluvial deposits; usually incised into bedrock.</p> <p>M5 Shallow deposits of till overlying bedrock; dominantly south and east facing slopes; slopes greater than 40%.</p> <p>Colluvial Landforms - lower slope, gravity transported debris derived from bedrock.</p> <p>C accumulation of deep colluvial fans, cones and aprons (1-3m); blocky and rubbly debris may provide a source of coarse aggregate or ballast.</p> <p>Bedrock Landforms</p> <p>B areas of bedrock outcrop and shallow colluvium</p> <p>Fluvial-Glaciofluvial Landforms - valley-bottom and lower-slope granular material; texturally variable from clean, coarse sand and gravels to dirty, silty gravels with variable interlayers; in places, may be capped with thin veneer of silt or minor wet areas may occur; potential sources of aggregate depending on thickness of deposit and texture.</p> <p>F1 level to gently subdued surface, thick deposits</p> <p>F2 subdued to moderately sloping (15-30%), thick deposits</p> <p>F3 hummocky and ridged, moderately to moderately steeply sloping (30-65%), thick deposits.</p> <p>F4 steeply sloping scarps (greater than 65%), thick deposits, south facing.</p> <p>F5 subdued fluvial fans and low lying terraces; high water table and occasional flooding may occur near channels and in depressions.</p> <p>F6 variable thickness (.5-2m) of sand and gravel overlying subdued to moderately sloping till surface; well-drained.</p> <p>F7 steeply sloping scarps (65%)</p> <p>Wetlands - valley-bottom and depressional areas which are wet for most of the year; inundation from high water table or flooding is the main constraint, but soft compressible soils are also common.</p> <p>W1 dominantly organic materials greater than 1m thick.</p> <p>W2 variable extent and thickness of organics (40-150cm) overlying wet floorplain sediments.</p> <p>W3 thin organics (less than 1m) and poorly drained mineral soil on floodplains and in large depressions; overbank silts and fine sands occur on floodplain lacustrine silts and till usually underlie depressions.</p>	<p>Aspen, Kinnikinnick, minor Lodgepole Pine</p> <p>Lodgepole Pine, Aspen, Black Spruce</p> <p>Black Spruce, Willow, Labrador Tea</p> <p>Black Spruce, Willow, moss</p> <p>Aspen, Lodgepole Pine, grass</p> <p>Black Spruce, Willow, moss</p> <p>Open stands of Lodgepole Pine, Aspen and grasses.</p> <p>White and Black Spruce, Willow, moss</p> <p>White and Black Spruce, Willow, moss</p> <p>Aspen, Kinnikinnick, grass</p> <p>Aspen and grasses</p> <p>White Spruce, Birch, Willow, moss</p> <p>Lodgepole Pine, Willow, Labrador Tea</p> <p>Black Spruce, Willow, moss</p> <p>Black Spruce, Labrador Tea, Willow</p> <p>Willow, sedge, moss</p> <p>Black Spruce, Labrador Tea, moss</p>
<p><b>GEOMORPHIC CONDITIONS AND PROCESSES</b></p> <p>Permafrost - perennial frozen ground.</p> <p>X areas of potential ground ice occur on poorly-drained till slopes and floodplain areas where organic soils predominate.</p> <p>Terrain Hazard Units</p> <p>R slopes which show evidence of active landsliding; mass movement and erosion hazard.</p> <p>ER slopes which have the potential for mass movement and/or have high erosion potential.</p> <p>E slopes which have moderate erosion potential.</p> <p>D toe-slope areas actively receiving deposition from upslope landslides or on-going erosion.</p> <p>U1 areas highly susceptible to flooding, channel shifting, or inundation by high water table.</p> <p>U2 areas potentially susceptible to flooding, channel shifting, or inundation by high water table.</p>	

LEGEND

- - - Index Contour
- - - Intermediate Contour
- - - Depression Contour
- Stream
- - - Intermittent Stream
- - - Indefinite Stream
- Single Tree
- Brush / Scrub
- ◊ Swamp
- ▬ Paved Road
- ▬ Dirt Road
- Water Quality Monitoring Station
- ③ Vegetation transects

Seed Mix (kg/ha)

- 1) Yukon wheatgrass (3), Violet wheatgrass(6), Northern fescue(4), Artic lupine(1), Yellow locoweed(1), Glaucous bluegrass(3).
- 2) Meadow foxtail(5), Tufted hairgrass(4), Polargrass(1), Bluejoint reedgrass(1), Altai fescue(6).
- 3) Meadow foxtail(3), Tufted hairgrass(4), Bluejoint reedgrass(1), Fowl bluegrass(8).
- 4) Yukon wheatgrass (3), Violet wheatgrass(6), Northern fescue(3), Artic lupine(2), Glaucous bluegrass(3), Sheep fescue(3), Snowy locoweed(1).

CAD FILE: PROJECT 1000/H1811/201.B3 Plot scale 1:50

Scale 1000 500 0 1000 2000 Metres

Nov. 17, 1994

HALLAM KNIGHT PIESOLD LTD.

NOTE:  
 Map units are defined by one or more symbols representing the occurrence of significance terrain features and conditions and/or geomorphic hazards which may have a beneficial or constraining effect on mine-facility and access-road development.

FIGURE 1

**Table 1**  
**Carmacks Copper Project**  
**Tree and plant species observed at the Carmacks Copper Project site.**

Trees

Black spruce (*Picea mariana*)  
White spruce (*Picea glauca*)  
Lodgepole pine (*Pinus contorta* var. *latifolia*)  
Trembling aspen (*Populus tremuloides*)  
Paper birch (*Betula papyrifera*)

Shrubs

Green alder (*Alnus viridis* ssp. *fruticosa*)  
Mountain alder (*Alnus viridis* ssp. *sinuata*)  
Willow spp. (*Salix* spp.)  
Wild rose (*Rosa acicularis*)  
Shrubby cinquefoil (*Potentilla fruticosa*)  
Labrador tea (*Ledum groenlandicum*)  
Soapberry (*Shepherdia canadensis*)  
Common juniper (*Juniperus communis*)  
Kinnikinnick (*Arctostaphylos uva-ursi*)  
Scrub birch (*Betula glandulosa*)

Herbs

Swamp cinquefoil (*Potentilla palustris*)  
Mountain death-camas (*Zygadenus elegans*)  
Arctic lupine (*Lupinus arcticus*)  
Tall lungwort (*Mertensia paniculata*)  
Cutleaf anemone (*Anemone multifida*)  
Single delight (*Moneses uniflora*)

Herbs (cont'd.)

Heart-leaved arnica (*Arnica cordifolia*)

Thoroughwort (*Bupleurum triradiatum*)

Twinflower (*Linnaea borealis*)

Alpine milk-vetch (*Astragalus alpinus*)

Bog blueberry (*Vaccinium uliginosum*)

Dwarf blueberry (*Vaccinium caespitosum*)

Lingonberry (*Vaccinium vitis-idaea*)

Mountain bilberry (*Vaccinium membranaceum*)

Leather-leaf (*Chamaedaphne calyculata*)

One-leaved rein orchid (*Platanthera obtusata*)

Red swamp currant (*Ribes triste*)

Cloudberry (*Rubus chamaemorus*)

Sweet coltsfoot (*Petasites frigidus*)

Bog cranberry (*Vaccinium oxycoccus*)

Red bearberry (*Arctostaphylos rubra*)

Fireweed (*Epilobium angustifolium*)

Stoloniferous mitrewort (*Mitella nuda*)

Crowberry (*Empetrum nigrum*)

Wintergreen (*Pyrola* sp.)

Pink wintergreen (*Pyrola asarifolia*)

Northern Jacob's ladder (*Polemonium boreale*)

Kinnikinnick (*Arctostaphylos uva-ursi*)

Pasture sage (*Artemisia frigida*)

Capitate lousewort (*Pedicularis capitata*)

Labrador lousewort (*Pedicularis labradorica*)

Low braya (*Braya humilis*)

Gorman's penstemon (*Penstemon gormanii*)

Four-petalled gentian (*Gentiana propinqua*)

Nagoon berry (*Rubus acaulis*)

Yarrow (*Achillea millefolium*)

### Grasses

Water sedge (*Carex aquatilis*)

Altai fescue (*Festuca altaica*)

Reedgrass (*Calamagrostis* spp.)

Wheatgrass (*Agropyron* spp.)

Polargrass (*Arctagrostis latifolia*)

Horsetail (*Equisetum* sp.)

### Lichens

Green reindeer lichen (*Cladina mitis*)

Grey reindeer lichen (*Cladina rangiferina*)

Freckled lichen (*Peltigera aphthosa*)

Dog lichen (*Peltigera canina*)

Green kidney lichen (*Nephroma arcticum*)

Pixie cup lichen (*Cladonia pyxidata*)

Orange-foot lichen (*Cladonia ecmocyna*)

Curled cetraria (*Cetraria culcullata*)

### Mosses

Red-stem feathermoss (*Pleurozium schreberi*)

Common red sphagnum moss (*Sphagnum capillaceum*)

Common green sphagnum moss (*Sphagnum girgensohnii*)

Common brown sphagnum moss (*Sphagnum fuscum*)

Club moss (*Lycopodium* sp.)

Golden fuzzy fen moss (*Tomenthypnum nitens*)



**Table 2**  
**Carmacks Copper Project**  
**Vegetation Transect Site #1**

**Gradient:** <1%      **Altitude:** 710 m (2040 ft)      **Aspect:** north

**Observations:**

Adjacent to Williams Creek 2 km downstream of the exploration camp  
Area is transitional, adjacent to creek thick growth of alder and willow into black and white spruce and birch.

**Species present:**

Willow spp. (3 shrub species)  
Net-veined willow  
Black spruce  
Nagoonberry  
Shrubby cinquefoil  
Bog cinquefoil  
Mountain alder  
Horsetail  
Red swamp currant  
Pink wintergreen  
Single delight  
Labrador tea  
Streamside moss  
Alpine milk vetch  
Red bearberry  
Lingonberry  
Mitrewort  
Crowberry  
Leather leaf  
One-leaved rein orchid  
Alpine bistort  
Water sedge  
Reedgrass

**Most common:**

Tree layer  
    Black spruce  
Tall shrub layer  
    Willow spp. - 50%  
    Mountain alder - 50%  
Low shrub layer  
    Scrubby cinquefoil - 60%  
    Labrador tea - 30%  
Herb layer  
    Reedgrass - 40%

**Horsetail - 10%**

**Water sedge - 10%**

**Red bearberry - 5%**

**Moss and lichen layer**

**Streamside moss**

## Vegetation Transect Site #2

**Gradient:** 28%      **Altitude:** 720 m (2069 ft)      **Aspect:** south

### Observations:

Aspen and white spruce slope, well drained.

### Species present:

Willow spp. (3)  
White spruce  
Trembling aspen  
Lodgepole pine  
Scrubby cinquefoil  
Northern Jacob's ladder  
Wild rose  
Fireweed  
Common juniper  
Harebell  
Cut-leaf anemone  
Kinnikinnick  
Twinflower  
Club moss  
Altai fescue  
Yarrow  
Curled cetraria

### Most common:

#### Tree layer

Trembling aspen - 69%  
White spruce - 29%

#### Tall shrub layer

Willow spp.

#### Low shrub layer

Kinnikinnick - 50%  
Shrubby cinquefoil - 35%

#### Herb layer

Altai fescue - 40%  
Twinflower - 10%  
Fireweed - 10%

#### Moss and lichen layer

Club moss

### Vegetation Transect Site #3

**Gradient:** 17%      **Altitude:** 750 m (2155 ft)      **Aspect:** north

**Observations:**

Spruce dominated wetlands, poor drainage will thick layer of moss.

**Species present:**

- Black spruce
- Willow sp.
- Scrubby cinquefoil
- Labrador tea
- Reindeer lichen
- Red bearberry
- Lingonberry
- Coltsfoot
- Crowberry
- Dog lichen
- Red sphagnum moss
- Cloudberry
- Bog blueberry
- Groundsel
- Orange-foot lichen
- Pixie cup lichen
- Red stem feather moss
- Curled cetraria
- Labrador lousewort
- Freckled lichen
- Twinflower
- Horsetail
- Golden fuzzy fen moss
- Red-stemmed feathermoss
- One-leaved rein orchid

**Most common:**

- Tree layer
  - Black spruce
- Tall shrub layer
  - Willow
- Low shrub layer
  - Labrador tea
- Herb layer
  - Red bearberry - 30%
  - Crowberry - 30%
- Moss and lichen layer
  - Red-stem feathermoss - 30%

Golden fuzzy fen moss - 30%

Reindeer lichen - 15%

## Vegetation Transect Site #4

**Gradient:** 3%      **Altitude:** 760 m (2184 ft)      **Aspect:** east southeast

### Observations:

Poorly drained gully, dominated by black spruce, in the vicinity of a small tributary to Williams Creek.

### Species present:

- Black spruce
- Lodgepole pine
- Labrador tea
- Wild rose
- Single delight
- Wintergreen
- Reindeer lichen
- Tall lungwort
- Twinflower
- Red bearberry
- Lingonberry
- Crowberry
- Dog lichen
- Red stem feather moss

### Most common:

- Tree layer
  - Black spruce
- Tall shrub layer
  - none
- Low shrub layer
  - Labrador tea - 70%
- Herb layer
  - Red bearberry - 40%
  - Crowberry - 20%
  - Twinflower - 15%
- Moss and lichen layer
  - Red stem feather moss - 80%
  - Reindeer lichen - 20%

## Vegetation Transect Site #5

**Gradient:** 15%      **Altitude:** 730 m (2098 ft)      **Aspect:** east

### Observations:

Coniferous/deciduous mix upper slope.

### Species present:

- Lodgepole pine
- White spruce
- Trembling aspen
- Wild rose
- Mountain death camass
- Kinnikinnick
- Mountain bilberry
- Soapberry
- Cutleaf anemone
- Willow sp.
- Fireweed
- Capitate lousewort
- Four-petalled gentian
- Heart-leaved arnica
- Reindeer lichen
- Twinflower
- Clubmoss
- Wheatgrass
- Fescue

### Most common:

#### Tree layer

Trembling aspen - 47%

White spruce - 36%

#### Tall shrub layer

willow sp.

#### Low shrub layer

Kinnikinnick - 60%

Wild rose - 25%

#### Herb layer

Twinflower - 30%

Fescue - 30%

Mountain bilberry - 15%

#### Moss and lichen layer

Clubmoss - 80%

Reindeer lichen - 20%

## Vegetation Transect Site #6

**Gradient:** 33%      **Altitude:** 760 m (2184 ft)      **Aspect:** southeast

### Observations:

Steep south aspect slope.

### Species present:

Trembling aspen  
Wild rose  
Kinnikinnick  
Soapberry  
Cutleaf anemone  
Thoroughwort  
Northern Jacob's ladder  
Pasture sage  
Gorman's penstemon  
Low braya  
Purple reedgrass  
Fescue

### Most common:

Tree layer

Trembling aspen

Tall shrub layer

Trembling aspen

Low shrub layer

Kinnikinnick - 60%

Wild rose - 25%

Herb layer

Fescue - 60%

Thoroughwort - 15%

Moss and lichen layer

none



## Vegetation Transect Site #7

**Gradient:** 5%      **Altitude:** 800 m (2299 ft)      **Aspect:** east

### Observations:

Gentle slope with moderate to poor drainage.

### Species present:

- Black spruce
- Scrub birch
- Labrador tea
- Willow sp.
- Shrubby cinquefoil
- Crowberry
- Lingonberry
- Red bearberry
- Cloudberry
- Red-stem feathermoss
- Sphagnum moss
- Reindeer lichen
- Trembling aspen

### Most common:

- Tree layer
  - Black spruce
- Tall shrub layer
  - Willow sp.
- Low shrub layer
  - Shrubby cinquefoil - 50%
  - Scrub birch - 30%
- Herb layer
  - Lingonberry - 40%
  - Crowberry - 30%
- Moss and lichen layer
  - Red-stem feathermoss
  - Reindeer lichen

## Vegetation Transect Site #8

**Gradient:** 15%      **Altitude:** 860 m (2471 ft)      **Aspect:** southeast

### Observations:

Slope with moderate to good drainage.

### Species present:

- Lodgepole pine
- Trembling aspen
- White spruce
- Black spruce
- Willow sp.
- Wild rose
- Twinflower
- Lingonberry
- Fireweed
- Red-stem feathermoss
- Kinnikinnick
- Arctic lupine
- Trembling aspen
- Fescue sp.

### Most common:

#### Tree layer

Lodgepole pine - 30%

White spruce - 25%

#### Tall shrub layer

Willow sp. - 25%

Trembling aspen - 15%

#### Low shrub layer

Willow sp. - 40%

Wild rose - 20%

#### Herb layer

Lingonberry - 40%

Fireweed - 20%

#### Moss and lichen layer

Red-stem feathermoss

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Carmacks Copper Project

Table 3  
Vegetation Study: Tree species

Transect #	Tree Species	Height (m)	Diameter at Breast Height (cm)	% Composition	# Trees/Transect
1	Black spruce	12.9	67	0.5	45
	Black spruce	8.1	38	4	
	Black spruce	6.9	29	4	
	Black spruce	5.1	22	1.5	
				10	
1	Mountain alder	2.7 (avg.)	8	40	TNTC*
1	Willow spp.	4.8 (avg.)	15	40	TNTC
2	White spruce	6	32	20	16
	White spruce	9.3	52	60	
	White spruce	10.4	57	19	
	White spruce	2.3	13	1	
				26	
2	Trembling aspen	18.8	48	16.5	41
	Trembling aspen	17.3	41	16.5	
	Trembling aspen	15.7	35	16.5	
	Trembling aspen	8.3	30	16	
	Trembling aspen	16.9	63	0.5	
				66	
2	Lodgepole pine	14.9	80		2
	Lodgepole pine	8.6	45		
				3	
2	Willow sp.	10	—		3
	Willow sp.	2.4	—		
	Willow sp.	4.8	—		
				5	
					62
3	Black Spruce	7.8	42	7.5	150
	Black Spruce	5.5	24	22	
	Black Spruce	4.9	11	7.5	
	Black Spruce	5.6	27	30	
	Black Spruce	2	13	7.5	
				74.6	
3	Willow sp.	0.52	—	19.8	50
	Willow sp.	2.1	—	5	
				24.8	
3	Green alder	0.4	—		1
				0.6	
					201

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Carmacks Copper Project

Table 3  
Vegetation Study: Tree species

4	Black spruce	7.7	31	58	
	Black spruce	4.2	17	39	
				97	74
4	Lodgepole pine	13.2	65		
				3	2
					76
5	White spruce	14	76	2	
	White spruce	6.5	31	24.5	
	White spruce	1.5	11	5	
	White spruce	3.6	20	3.5	
				35	21
5	Trembling aspen	10.26	34	18.5	
	Trembling aspen	2.5	19	28	
				46.5	28
5	Lodgepole pine	15.7	85		
	Lodgepole pine	16.1	92		
				16.5	10
5	Willow sp.	3.5	-		
				2	1
					60
6	Trembling aspen	2.8	18	15	
	Trembling aspen	1.5	10	85	
					160

plants less than 2 m high including shrubs and established tree regeneration), herbs (herbaceous species, regardless of their height, and some low woody plants), mosses, lichens, liverworts, tree seedlings and fungi. Diameter at breast height (DBH), in cm, and tree height in m, was determined for transects 1 to 6. Results of the survey are presented in Tables 1 to 3.

### **3.0 WILDLIFE SURVEY**

A fecal count survey was conducted in the project area concurrent with the vegetation study. Four transects (5 m<sup>2</sup>) were established at transects 1 to 6. Pellets groups and scat were identified and quantified. Also, signs of ungulate browsing and all animal tracks were noted. Results from the survey are presented in Table 4.

### **4.0 HYDROLOGY**

Ongoing hydrology of the Williams Creek watershed has been conducted by J. Gibson and Associates. Monthly reports include results from the water level data logger, staff gauge discharge calibrations, thermistor readings and site observations.

**Carmacks Copper Project**

**Table 4  
Wildlife Survey (July 1994)**

<b>Site</b>	<b>Habitat Unit*</b>	<b>Species</b>	<b>Sign</b>
1	Willow Dominant wetlands	common sandpiper grey wolf black bear varying hare  moose  (chipmunk or mouse) <sup>+</sup>	sighting tracks tracks pellets browse on willow/alder pellets trail pellets
2	Aspen dominant uplands	varying hare  red squirrel  spruce grouse	holes pellets browse on willow sighting pellets middens pellets
3	Spruce dominant wetlands	varying hare  vole red squirrel chipmunk moose	browse pellets hole in moss pellets pellets pellets
4	Spruce gully	moose spruce grouse (raven) black cap chickadee red squirrel varying hare	trail sighting guano sighting pellets pellets
5	Conifer dominant uplands	varying hare  red squirrel  owl chipmunk moose	browse pellets sighting browse pellets pellet pellets pellets browse
6	Steep Grassy Slopes	varying hare  grey wolf vole  mule deer	pellets browse on young aspen scat hole pellets pellets

\* Based on studies conducted by D.Blood and Associates, 1992.

+ identification not confirmed

J. Gibson & Associates  
Site 15 Comp 111 RR # 2  
Whitehorse, Yukon  
Y1A 5W8

April 18, 1994

Western Copper Holdings Ltd.  
# 900 - 850 West Hastings Street  
Vancouver, B.C.  
V6C 1E1

Attention: Ken McNaughton

As scheduled, a trip was made into the Williams Creek property on April 15, 1994 in hopes of installing the water level data logger early to ensure spring high water levels were recorded. Due to road conditions that would prohibit the use of either a snow machine or an ATV, a helicopter was used. The following data was collected:

1. **Water level data logger.** The logger site established in May of 1993 was under glacial ice cover to a depth greater than 1.91 meters. This is the difference between survey benchmark # 2 (under ice) and gauge zero on the staff gauge (creek bottom). The instrument culvert and housing were completely ice covered. No attempt was made to remove the ice cover as there would be no where for melt water to run and it would just re-freeze and ruin the instrument. The glacial ice cover was continuous from downstream of the logger site to upstream of the access road crossing. There was no melt water running on the ice surface as the temperature range of -10 to +5 Celsius over the past 10 days had halted the melt. Temperatures are forecast to increase starting April 20/21 and the glacial ice should start to melt. At least half the ice must melt before we think about putting the instrument in. I have scheduled another attempt for May 4 and 5, Merrice Creek should still be at lower water for crossing. The snow has melted off the south facing road surfaces and will hopefully be mostly gone from the north facing slopes - especially on the south side of Merrice Creek to allow ATV access.

2. **Moose congregations.** Prior to the flight I talked with Mike Vance at the LSCFN office in Carmacks. He pinpointed the area as the Yukon River valley at the mouths of Merrice and Williams Creeks. He also suggested we check out lower Williams Creek for the spring grayling run. I invited Mike to accompany me on the trip but he could not get away.

We checked the areas by helicopter and found no moose or any fresh tracks or bedding sign. No moose were found in the Williams Creek valley. The upper watershed around piezometers RC-4,5 and 6 had some old moose track as did the access road along most of it's length. There was also relatively fresh coyote track along the road from Williams to Merrice Creek. Only one snowshoe hare track was found around the upper piezometers, there was far more squirrel tracks. As the Yukon River and Williams Creek downstream of Nancy Lee Creek were under total ice cover I didn't check for grayling.

3. **Piezometer measurements.** Water levels in all five piezometers were

measured. The ">" symbol again indicates the maximum depth the probe would descend.

RC-4 217 ft into mud - probe stopped dead  
RC-5 > 147 ft  
RC-6 > 210 ft  
RC-9 > 221 ft  
RC-1 water @ 66.3 ft

4. **Thermistor measurements.** Attached are the recording sheet with the April 15, 1994 readings. No problems encountered.

As noted above, the next visit is scheduled for May 4 and 5. This is 3 weeks earlier than the data logger was installed in 1993. Given the present melt condition and the amount of glacial ice on the site, this should be in ample time to record the water level rise to freshet. I will also continue with the piezometer and thermistor readings.

If you have any questions, please give me a call.

I enclose my invoice for the April 15 survey, including a photocopy of the Trans North flight bill which is already paid.

Your truly,



John



Thermistor String Number Th2

Location 2000 N RC-2

0 E

LOWER

Date Installed

SEPT. 11/92

INST DIAL	Temperature Readings										
	1	2	3	4	5	6	7	8	9	10	
Location on String	0'	7'	9'	11'	13'	17'	20'	25'	45'	65'	85'
True Depth	0'	5.3'	6.9'	8.4'	10.0'	13.0'	15.3'	19.2'	34.4'	49.9'	65.1'
Date											
APRIL 29, 1993	-00.1	-00.1	-00.2	-00.2	-00.3	-00.3	-00.3	-00.3	-00.2	-00.2	-105.9
AUG 2, 1993	6.3	2.9	-00.0	-00.2	-00.3	-00.3	-00.3	-00.3	-00.2	-00.2	-103.4
SEPT 2, 1993	5.8	3.7	1.7	-00.1	-00.3	-00.3	-00.3	-00.3	-00.2	-00.3	-104.3
OCT 29, 1993	1.2	1.0	0.6	0.3	-00.2	-00.3	-00.3	-00.3	-00.2	-00.3	-
APR 15 1994	0.0	-0.0	-0.1	-0.0	-0.1	-0.2	-0.2	-0.3	-0.2	-0.3	-

Thermistor String Number TH1

Location 2650 N RC-07 UPP-1

125 E

Date Installed SEPT 7/92

Location on String	Temperature Readings										
	1	2	3	4	5	6	7	8	9	10	11
0'		7'	9'	11'	13'	17'	20'	25'	45'	65'	85'
True Depth	0'	5.37	6.97	8.47	10.073	13.077	15.370	19.2725	34.475	49.575	65.175
Date											
APRIL 29, 1993	00.0	00.0	00.0	00.1	00.0	00.0	-00.1	-00.2	-00.3	-00.3	-109.6
AUG 2, 1993	4.7	3.1	2.0	1.3	0.3	0.0	-00.1	-00.2	-00.3	-00.3	-105.4
SEPT 2, 1993	5.0	3.8	2.9	2.1	0.7	0.0	00.1	-00.2	00.3	-00.3	-100.0
OCT 29/93	2.0	2.0	1.9	1.7	0.7	00.1	-00.1	-00.2	-00.3	-00.3	-
APR 15/94	-0.0	-0.0	-0.0	0.1	-0.0	0.0	-0.1	-0.2	-0.3	-0.3	-

RECEIVED JUN - 1 1994

J. Gibson & Associates  
Site 15 Comp 111 RR # 2  
Whitehorse, Yukon  
Y1A 5W8

May 25, 1994

Western Copper Holdings Ltd.  
#900 - 850 West Hastings Street  
Vancouver, B.C.  
V6C 1E1

Attention: Ken McNaughton

Additional survey trips to the Williams Creek site were done May 2 and May 13, 1994 to monitor glacial ice decrease and install the water level data logger.

On the May 2, 1994 trip ice at the logger site had melted down to the top of the instrument culvert. The instrument shelter was built up 16 inches (for safety) and the logger installed. The logger was programmed from the benchmarks as the staff gauge was still under ice. Flows remained on top of channel ice 1.20 meters thick. Creek volume was measured at 0.235 cubic meters per second - a 38% increase over the previous high measured on May 28, 1993. Unfortunately with the ice situation the flow does not plot against a gauge height. It is still good data however. The staff gauge at the road crossing was also under ice cover so no flow measurement was done there.

On the May 13 survey, ice levels had decreased approximately 0.30 meters, enough to allow staff gauge readings. Total flow still remained on top of the channel ice however and volumes had decreased substantially to 0.047 cms. The logger was left operating after recalibrating against the staff gauge reading. Flows were also measured at the road crossing staff gauge (0.038 cms) in an ice free channel. This measurement plotted perfectly on the stage discharge curve.

The glacial ice problem at the logger site is also happening at two sites (Casino and Dip creeks) on the Pacific Sentinel Casino property to the north west of Williams Creek. At the Minto Creek property to the north, heavy glacial ice built up over the winter in the upper watershed, but as there was no surface flow noted until after April 15 the problem of freshet flows on top of channel ice did not occur.

The May 13 survey was done jointly with Water Resources (Northern Affairs) staff. Water Resources took samples at all sites accessible in the upper creek (W-1,3,4,5,7,9). When their analysis data is available I will forward it to you.

Thermistor and piezometer readings were taken at all sites on the May 13 survey.

Piezometers - RC-01 water @ 67 ft  
 RC-09 water @ 190 ft  
 RC-04 > 148 ft  
 RC-05 203 ft into light brown/white mud  
 RC-06 > 343 ft

Note: ">" indicates maximum depth probe would descend.

The M scope probe was shipped back to your office at the request of Max. A further set of readings will be done in the fall.

Thermistors

RC-2  
 True Depth(ft)    0   5.3   6.9   8.4   10.0   13.0   15.3   19.2   34.4   49.9  
 Temp                0.1 -0.0 -0.1 -0.0   -0.1   -0.2   -0.2   -0.3   -0.2   -0.3

RC-07  
 True Depth(ft)    0   7   9   11   13   17   20   25   45   65  
 Temp                -0.0 -0.0 -0.0   0.1   0.0   0.0   -0.1   -0.2   -0.3   -0.3

I contacted Dan Cornett today about the weather station project for Williams Creek. The proposal under the Northern Studies Program will be reviewed next week in Calgary and an answer should be firm by June 1. If the proposal is rejected there is another "inhouse" Water Resources alternative under discussion. As yet no equipment list has been drawn up so installation is not in the immediate future.

Another trip to Williams Creek will be done in the next week to check on ice conditions, logger operations and obtain more flow measurements.

If you have any questions or suggestions, please give me a call.

I enclose my invoice covering the May 2 and 13 surveys.

Yours truly,

John Gibson.

P.W.: WC: ENVIRO BASELINE

WATER

RECEIVED JUN 23 1994

J. Gibson & Associates  
Site 15 Comp 111 RR #2  
Whitehorse, Yukon  
Y1A 5W8

June 19, 1994

Western Copper Holdings Ltd.  
# 900 - 850 West Hastings Street  
Vancouver, B.C.  
V6C 1E1

Attention: Ken McNaughton

Dear Ken:

I enclose a number of photographs that explain the problems I had during freshet with the data logger installation. A picture is worth a thousand words. I hope they explain why operations did not go "smoothly" during that period. I have also attached photos of the Merrice and Williams Creeks road crossings as of May 30, 1994. Both have some bank or road bed erosion but nothing a 4 wheel drive vehicle can not surmount.

I have had little success in correlating a gauge height for flow measurements taken May 2 and May 13 while there was ice on the channel invert. In discussions with Water Resources hydrology staff we have established a range of gauge heights for each flow but anything more definite is not possible. The problem lies in the irregular natural channel shape and the large increase in mean velocity while flows were on top of the ice. The data is still very useful as it defines the higher end of the stage discharge curve where no previous flow measurements had been obtained.

Data updates will continue to be sent to Hallam Knight Piesold. I will combine with Sue Blundell should she require a trip to the site to update the vegetation and wildlife studies.

As you have no doubt heard, the weather station has received approval. I will stay in touch with Dan Cornett.

If you have any questions, give me a call.

Yours truly,



John Gibson.



April 15, 1994. Williams Creek Data Logger Stations.  
Instrument housing under glacial ice cover.



May 2, 1994. Williams Creek Data Logger station. Freshet  
flows on top of ice. Instrument shelter  
visible.



May 2, 1994. Williams Creek Data Logger Station.  
Extension to instrument housing to permit logger  
installation. Flow remain on top of channel ice.  
Ice decreased by 0.4 meters.



May 13, 1994. Williams Creek Data Logger station.  
Flows remain on top of ice. Ice decreased a  
further 0.4 meters.



May 30, 1994. Williams Creek Data Logger Station.  
No further ice on channel invert.



May 30, 1994. Williams Creek Data Logger station.  
Instrument extension removed - normal  
operation.





May 30, 1994. Merrice Creek road crossing - minor erosion to north bank



May 30, 1994. Williams Creek road crossing - minor erosion to road bed during freshet.

P:W:ENVIR-BASELINE  
:WATER

RECEIVED JUL 27 1994

J. Gibson & Associates  
Site 15 Comp 111 RR # 2  
Whitehorse, Yukon  
Y1A 5W8

July 21, 1994

Western Copper Holdings Ltd.  
#900 - 850 West Hastings Street  
Vancouver, B.C.  
V6C 1E1

Attention : Ken McNaughton

Dear Ken:

I enclose hydrology and thermistor data for Williams Creek from the May 30 and July 9/10, 1994 site visits. For each visit there are two flow measurements for the data logger site and one for the staff gauge at the road crossing. The thermistor data is from July 9, 1994.

The data logger continues to operate within 0.001 meters of the staff gauge reading (spot on). I have yet to download any data as it has only been gathering data for two months and the memory has lots of room left. The recent flow measurements have been plotting above the 1993 stage discharge curve which indicates there has been a change in the stream channel profile. A higher gauge height for the same flow indicates a deposition of material in the cross section - possibly from the lengthy glacial ice cover period this spring. On the next visit I will resurvey the staff gauge to see if it has shifted down - giving us higher readings.

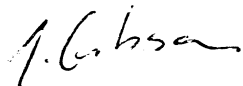
I also enclose the lab analysis results for water samples taken May 13, 1994 by Water Resources (Northern Affairs). Their station numbers correspond with my water quality stations from 1989 - 1992. All the above data will also be sent to Hallam Knight Piesold.

I also enclose my invoice for the May 30 and July 9/10 surveys. The July survey was done in conjunction with Sue Blundell of Hallam Knight. At her request I supplied an assistant biologist to help her with the vegetation survey. The assistant's wages are part of my invoice. As part of my time was spent waiting for them to finish the vegetation surveys, I have billed you at half rate for that portion.

Road work was being done by Tony Wheeler ahead of us and we were able to drive right to camp in 2 wheel drive.

If you have any questions, give me a call.

Yours truly,



John Gibson.

Williams Creek Property - Carmacks Copper

July 9, 1994 Thermal Profiles

Thermistor String # Th2 (RC-02)

<u>True Depth</u>	<u>0'</u>	<u>5.3'</u>	<u>6.9'</u>	<u>8.4'</u>	<u>10.0'</u>	<u>13.0'</u>	<u>15.3'</u>	<u>19.2'</u>	<u>34.4'</u>	<u>49.9'</u>
July 9/94	9.0	6.7	4.9	3.5	2.4	2.2	2.2	2.0	2.0	1.8

Thermistor String # Th1 (RC-07)

<u>True Depth</u>	<u>0'</u>	<u>7.0'</u>	<u>9.0'</u>	<u>11.0'</u>	<u>13.0'</u>	<u>17.0'</u>	<u>20.0'</u>	<u>25.0'</u>	<u>45.0'</u>	<u>65.0'</u>
July 9/94	4.0	2.8	2.1	1.8	1.5	1.5	1.4	1.2	1.1	1.1

Readings for RC-02 above zero celsius for all depths. First zero+ readings for 10 ft or deeper.

Readings for RC-07 also above zero for all depths. First zero+ readings for 20 ft or deeper.

As readings were significantly different from past records, instrument battery was changed onsite. Readings remained same after battery change.

STAFF GAUGE - DISCHARGE CALIBRATION

Project Name Carmacks Copper                      Site ID    Data logger

Project #:    Date: May 30, 1994

S.G. @ Start    0.458                              S.G. @ Finish:                      0.46

Distance	Depth	Velocity	Width	Area	Discharge
-----	-----	-----	-----	-----	-----
2.9	0	0	0.05	0	0
3	0.13	0.018	0.1	0.013	0.000234
3.1	0.18	0.119	0.1	0.018	0.002142
3.2	0.23	0.182	0.1	0.023	0.004186
3.3	0.26	0.185	0.1	0.026	0.00481
3.4	0.28	0.185	0.1	0.028	0.00518
3.5	0.3	0.179	0.1	0.03	0.00537
3.6	0.28	0.199	0.1	0.028	0.005572
3.7	0.22	0.207	0.1	0.022	0.004554
3.8	0.26	0.215	0.1	0.026	0.00559
3.9	0.25	0.158	0.125	0.03125	0.004937
4.05	0	0	0.075	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
-----	-----	-----	-----	-----	-----
1.15			1.15	0.24525	0.042575

Data Logger Reading:                      0.46

Channel under ice?:                      no

Method:                      Price meter

Crew:                      Gibson





STAFF GAUGE - DISCHARGE CALIBRATION

Project Name Carmacks Copper Site ID Data logger

Project #: Date: July 10, 1994

S.G. @ Start 0.468 S.G. @ Finish: 0.468

Distance	Depth	Velocity	Width	Area	Discharge
3.77	0	0	0.065	0	0
3.9	0.13	0.038	0.115	0.01495	0.000568
4	0.18	0.097	0.1	0.018	0.001746
4.1	0.22	0.137	0.1	0.022	0.003014
4.2	0.26	0.158	0.1	0.026	0.004108
4.3	0.28	0.165	0.1	0.028	0.00462
4.4	0.27	0.169	0.1	0.027	0.004563
4.5	0.26	0.182	0.1	0.026	0.004732
4.6	0.25	0.188	0.1	0.025	0.0047
4.7	0.25	0.199	0.1	0.025	0.004975
4.8	0.25	0.188	0.1	0.025	0.0047
4.9	0.22	0.119	0.1	0.022	0.002618
5	0	0	0.05	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
1.23			1.23	0.25895	0.040344

Data Logger Reading: 0.468

Channel under ice?: no

Method: Price meter

Crew: Gibson

## STAFF GAUGE - DISCHARGE CALIBRATION

Project Name - Carmacks Copper                      Site ID S.G.@ Road X-ing

Project #:    Date: May 30, 1994

S.G. @ Start 0.238                                  S.G. @ Finish:                                  0.238

Distance	Depth	Velocity	Width	Area	Discharge
4.7	0	0	0.05	0	0
4.8	0.16	0.311	0.1	0.016	0.004976
4.9	0.15	0.566	0.1	0.015	0.00849
5	0.15	0.464	0.1	0.015	0.00696
5.1	0.16	0.379	0.075	0.012	0.004548
5.15	0.18	0.142	0.05	0.009	0.001278
5.2	0	0	0.025	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
----- 0.5	-----	-----	----- 0.5	----- 0.067	----- 0.026252

Data Logger Reading:                      no logger at this site

Channel under ice?:                      no

Method:                      Price meter

Crew:                      Gibson





**Quanta Trace Laboratories Inc.**

#401-3700 Gilmore Way  
Burnaby, B.C. V5G 4M1

Tel: (604) 438-5226  
Fax: (604) 436-0565

**ANALYSIS OF WATER SAMPLES**

To: NORTHERN AFFAIRS PROGRAM  
WATER LABORATORY  
#345-300 Main St.,  
Whitehorse, Yukon  
Y1A 2B5

Workorder: 23281  
Received: 17-May-94  
Completed: 30-May-94

Attn: Pat Thomson

Re: William's Creek Fresh Water

**METHODOLOGY**

Samples were analysed using procedures detailed in publications of the American Public Health Association, U.S Environmental Protection Agency, B.C Ministry of the Environment, and Environment Canada - Conservation and Protection.

Dissolved metals were determined in a filtered (0.45 um) and acidified sample aliquot by ICP-AES with ultrasonic nebulization (EPA Method 200.7).

Total metals were determined in a sample aliquot which was acid digested in a closed teflon vessel in a microwave oven (EPA Method 3015). The digest was analyzed by ICP-AES with ultrasonic nebulization (EPA Method 200.7)



**Quanta Trace Laboratories Inc.**

#401-3700 Gilmore Way  
Burnaby, B.C. V5G 4M1

Tel: (604) 438-5226  
Fax: (604) 436-0565

To: NORTHERN AFFAIRS PROGRAM

W/O: 23281 Page 1

Sample type	fresh	fresh	fresh	fresh	fresh
Identification	4069 W3	4069 W3	4070, W4	4070, W4	4071, W5
	13-May-94	13-May-94	13-May-94	13-May-94	13-May-94
Lab Reference #	23281-001	23281-001	23281-002	23281-002	23281-003

PHYSICAL TESTS - ALKALINITY					
Hydroxide CaCO3	< 5.	-	< 5.	-	< 5.
Carbonate CaCO3	< 5.	-	< 5.	-	< 5.
Bicarb. CaCO3	112.	-	79.	-	50.
Total Alk. CaCO3	112.	-	79.	-	50.
Results in	mg/L		mg/L		mg/L

PHYSICAL TESTS					
Conduct. uS/cm	240.	-	207.	-	135.
pH	7.7	-	7.8	-	7.8
Turbidity FTU	1.	-	2.	-	2.

SOLIDS					
Suspended 105C	< 5.	-	< 5.	-	6.
Dissolved 105C	188.	-	179.	-	129.
Results in	mg/L		mg/L		mg/L

ANIONS BY IEC					
Chloride Cl	0.83	-	0.78	-	0.59
Fluoride F	< 1.	-	< 1.	-	< 1.
Nitrate NO3-N	< 0.05	-	< 0.05	-	< 0.05
Nitrite NO2-N	< 0.5	-	< 0.5	-	< 0.5
Sulfate SO4	14	-	18.6	-	11.6
Results in	mg/L		mg/L		mg/L

NITROGEN					
Ammonia NH3-N	< 0.05	-	0.07	-	< 0.05
Results in	mg/L		mg/L		mg/L

PHOSPHOROUS					
Total PO4-P	0.008	-	0.040	-	0.009
Results in	mg/L		mg/L		mg/L

TOTAL HARDNESS					
T Hardness CaCO3	110.	105.	88.2	83.1	52.4

Quanta Trace Laboratories Inc.

#401-3700 Gilmore Way  
Burnaby, B.C. V5G 4M1

Tel: (604) 438-5226

Fax: (604) 436-0565

To: NORTHERN AFFAIRS PROGRAM

W/O: 23281 Page 2

Sample type	fresh	fresh	fresh	fresh	fresh
Identification	4069 W3	4069 W3	4070, W4	4070, W4	4071, W5
Lab Reference #	13-May-94	13-May-94	13-May-94	13-May-94	13-May-94
Lab Reference #	23281-001	23281-001	23281-002	23281-002	23281-003
ICP - ULTRASONIC NEBULIZATION					
Method used	filt. 0.45µl wave HNO3		filt. 0.45µl wave HNO3		filt. 0.45µl
	DISSOLVED	TOTAL	DISSOLVED	TOTAL	DISSOLVED
Aluminum	Al < 0.01	0.04	< 0.01	0.03	0.01
Antimony	Sb < 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Arsenic	As < 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Barium	Ba 0.039	0.040	0.030	0.030	0.023
Berellium	Be < 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Bismuth	Bi < 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Cadmium	Cd < 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Calcium	Ca 33.9	33.9	24.5	25.0	15.1
Chromium	Cr < 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cobalt	Co < 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Copper	Cu 0.023	0.028	0.021	0.016	0.009
Iron	Fe 0.160	0.380	0.245	0.390	0.076
Lead	Pb < 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Lithium	Li < 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Magnesium	Mg 5.96	6.00	6.43	6.50	3.51
Manganese	Mn 0.097	0.124	0.068	0.069	0.007
Molybdenum	Mo < 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Nickel	Ni 0.005	0.005	0.004	0.003	0.004
Phosphorus	P < 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Potassium	K 1.4	1.4	1.2	1.	1.1
Selenium	Se < 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Silicon	Si 6.17	6.23	5.09	5.10	4.97
Silver	Ag < 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Sodium	Na 5.37	5.41	6.55	6.58	5.22
Strontium	Sr 0.248	0.235	0.229	0.218	0.083
Sulfur	S 3.93	3.92	5.39	5.40	3.08
Tin	Sn < 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Titanium	Ti 0.002	0.005	0.002	0.004	0.002
Thorium	Th < 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Uranium	U < 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Vanadium	V < 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Zinc	Zn < 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Zirconium	Zr < 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Results in	µg/L	µg/L	µg/L	µg/L	µg/L

**Quanta Trace Laboratories Inc.**

#401-3700 Gilmore Way  
 Burnaby, B.C. V5G 4M1

Tel: (604) 438-5226

Fax: (604) 436-0565

To: NORTHERN AFFAIRS PROGRAM

W/O: 23281 Page 3

Sample type	fresh	fresh	fresh	fresh	fresh
Identification	4071, W5	4072, W7	4072, W7	4072, W7	4072, W7
	13-May-94	13-May-94	13-May-94	13-May-94	13-May-94
Lab Reference #	23281-003	23281-004A	23281-004A	23281-004B	23281-004B

PHYSICAL TESTS - ALKALINITY

Hydroxide CaCO3	-	< 5.	-	< 5.	-
Carbonate CaCO3	-	< 5.	-	< 5.	-
Bicarb. CaCO3	-	73.	-	74.	-
Total Alk. CaCO3	-	73.	-	74.	-
Results in		mg/L		mg/L	

PHYSICAL TESTS

Conduct. uS/cm	-	145.	-	143.	-
pH	-	7.7	-	7.7	-
Turbidity FTU	-	1.	-	1.	-

SOLIDS

Suspended 105C	-	< 5.	-	< 5.	-
Dissolved 105C	-	145.	-	147.	-
Results in		mg/L		mg/L	

ANIONS BY IEC

Chloride Cl	-	< 0.3	-	< 0.3	-
Fluoride F	-	< 1.	-	< 1.	-
Nitrate NO3-N	-	< 0.05	-	< 0.05	-
Nitrite NO2-N	-	< 0.5	-	< 0.5	-
Sulfate SO4	-	4.6	-	4.6	-
Results in		mg/L		mg/L	

NITROGEN

Ammonia NH3-N	-	< 0.05	-	< 0.05	-
Results in		mg/L		mg/L	

PHOSPHOROUS

Total PO4-P	-	< 0.005	-	< 0.005	-
Results in		mg/L		mg/L	

TOTAL HARDNESS

T Hardness CaCO3	53.3	61.5	62.9	61.7	63.5
------------------	------	------	------	------	------

Quanta Trace Laboratories Inc.

#401-3700 Gilmore Way  
Burnaby, B.C. V5G 4M1

Tel: (604) 438-5226

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To: NORTHERN AFFAIRS PROGRAM

W/O: 23281 Page 4

Sample type		fresh	fresh	fresh	liquid	liquid
Identification		4071, W5	4072, W7	4072, W7	4072, W7	4072, W7
Lab Reference #		13-May-94	13-May-94	13-May-94	13-May-94	13-May-94
		23281-003	23281-004A	23281-004A	23281-004B	23281-004B
ICF - ULTRASONIC NEBULIZATION						
Method used		lowave HND3	filt. 0.45u	lowave HND3	filt. 0.45u	lowave HND3
		TOTAL	DISSOLVED	TOTAL	DISSOLVED	TOTAL
Aluminum	Al	0.25	< 0.01	< 0.01	< 0.01	< 0.01
Antimony	Sb	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Arsenic	As	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Barium	Ba	0.024	0.027	0.024	0.025	0.024
Beryllium	Be	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Bismuth	Bi	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Cadmium	Cd	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Calcium	Ca	15.2	18.8	19.2	18.9	19.4
Chromium	Cr	0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cobalt	Co	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Copper	Cu	0.023	0.01	0.014	0.021	0.014
Iron	Fe	0.447	0.166	0.172	0.175	0.175
Lead	Pb	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Lithium	Li	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Magnesium	Mg	3.55	3.41	3.54	3.44	3.57
Manganese	Mn	0.014	0.012	0.013	0.011	0.013
Molybdenum	Mo	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
Nickel	Ni	0.002	0.004	0.003	0.005	0.001
Phosphorus	P	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Potassium	K	1.2	1.	1.0	1.	1.2
Selenium	Se	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Silicon	Si	5.26	5.25	5.42	5.27	5.46
Silver	Ag	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Sodium	Na	5.25	3.48	3.48	3.54	3.60
Strontium	Sr	0.086	0.082	0.086	0.084	0.088
Sulfur	S	2.99	1.32	1.31	1.35	1.38
Tin	Sn	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Titanium	Ti	0.016	0.002	0.002	0.002	0.002
Thorium	Th	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Uranium	U	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Vanadium	V	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Zinc	Zn	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Zirconium	Zr	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Results in		mg/L	mg/L	mg/L	mg/L	mg/L

## Quanta Trace Laboratories Inc.

#401-3700 Gilmore Way  
Burnaby, B.C. V5G 4M1

Tel: (604) 438-5226

Fax: (604) 436-0568

To: NORTHERN AFFAIRS PROGRAM

W/O: 23281 Page 6

Sample type		fresh	fresh
Identification		4073, W9	4073, W9
		13-May-94	13-May-94
Lab Reference #		23281-005	23281-005
ICP - ULTRASONIC NEBULIZATION			
Method used		filt. 0.45ul wave HND3	
		DISSOLVED	TOTAL
Aluminum	Al	< 0.01	0.01
Antimony	Sb	< 0.02	0.02
Arsenic	As	< 0.02	0.02
Barium	Ba	0.027	0.028
Beryllium	Be	< 0.0002	0.0002
Bismuth	Bi	< 0.02	0.02
Cadmium	Cd	< 0.0005	0.0005
Calcium	Ca	20.1	20.9
Chromium	Cr	< 0.001	0.001
Cobalt	Co	< 0.001	0.001
Copper	Cu	0.022	0.027
Iron	Fe	0.098	0.137
Lead	Pb	< 0.01	0.01
Lithium	Li	< 0.002	0.002
Magnesium	Mg	6.30	6.60
Manganese	Mn	0.021	0.023
Molybdenum	Mo	< 0.005	0.005
Nickel	Ni	0.002	0.002
Phosphorus	P	< 0.05	0.05
Potassium	K	1.1	1.1
Selenium	Se	< 0.02	0.02
Silicon	Si	4.60	4.80
Silver	Ag	< 0.001	0.001
Sodium	Na	6.72	6.72
Strontium	Sr	0.222	0.238
Sulfur	S	3.60	3.71
Tin	Sn	< 0.01	0.01
Titanium	Ti	0.002	0.003
Thorium	Th	< 0.01	0.01
Uranium	U	< 0.06	0.06
Vanadium	V	< 0.002	0.002
Zinc	Zn	< 0.005	0.005
Zirconium	Zr	< 0.001	0.001
Results in		mg/L	mg/L

Test results are for internal use only. Quanta Trace liability is limited to the testing fee paid.

Analyst



Quanta Trace Laboratories Inc.

#401-3700 Gilmore Way  
Burnaby, B.C. V5G 4M1

Tel: (604) 438-5224  
Fax: (604) 436-0565

To: NORTHERN AFFAIRS PROGRAM

W/O: 23281 Page 5

Sample type	fresh	fresh
Identification	4073, W9	4073, W9
	13-May-94	13-May-94
Lab Reference #	23281-005	23281-005
PHYSICAL TESTS - ALKALINITY		
Hydroxide CaCO3	< 5.	-
Carbonate CaCO3	< 5.	-
Bicarb. CaCO3	102.	-
Total Alk. CaCO3	102.	-
Results in	mg/L	
PHYSICAL TESTS		
Conduct. uS/cm	200.	-
pH	7.8	-
Turbidity FTU	1.	-
SOLIDS		
Suspended 105C	< 5.	-
Dissolved 105C	160.	-
Results in	mg/L	
ANIONS BY IEC		
Chloride Cl	0.5	-
Fluoride F	< 1.	-
Nitrate NO3-N	< 0.05	-
Nitrite NO2-N	< 0.5	-
Sulfate SO4	14.4	-
Results in	mg/L	
NITROGEN		
Ammonia NH3-N	< 0.05	-
Results in	mg/L	
PHOSPHOROUS		
Total PO4-P	< 0.005	-
Results in	mg/L	
TOTAL HARDNESS		
T Hardness CaCO3	76.5	79.8



P.W.W.C.: ENV. BASELINE  
: WATER

RECEIVED OCT 17 1994

J. Gibson & Associates  
Site 15 Comp 111 RR #2  
Whitehorse, Yukon  
Y1A 5W8

October 11, 1994

Western Copper Holdings Ltd.  
#900 - 850 West Hastings Street  
Vancouver, B.C.  
V6C 1E1

Dear Ken:

I enclose a copy of the 1994 hydrology data for Williams Creek logger station #2. A copy has also gone to Knight Piesold's hydrologist in Vancouver.

As noted on the phone, a battery problem resulted in data loss from July 24 to August 24, 1994.

The logger was removed and installed August 24, 1994 at the new site below the freshwater dam (station #3).

I will be returning to pull the logger, read piezometers and thermistors as soon as the M scope arrives from Smithers. Temperatures are now consistently below freezing at night.

I enclose my invoice for the August 24 site visit and data workup.

If you have any questions, please give me a call at (403) 633-4522.

Yours truly,



John Gibson.

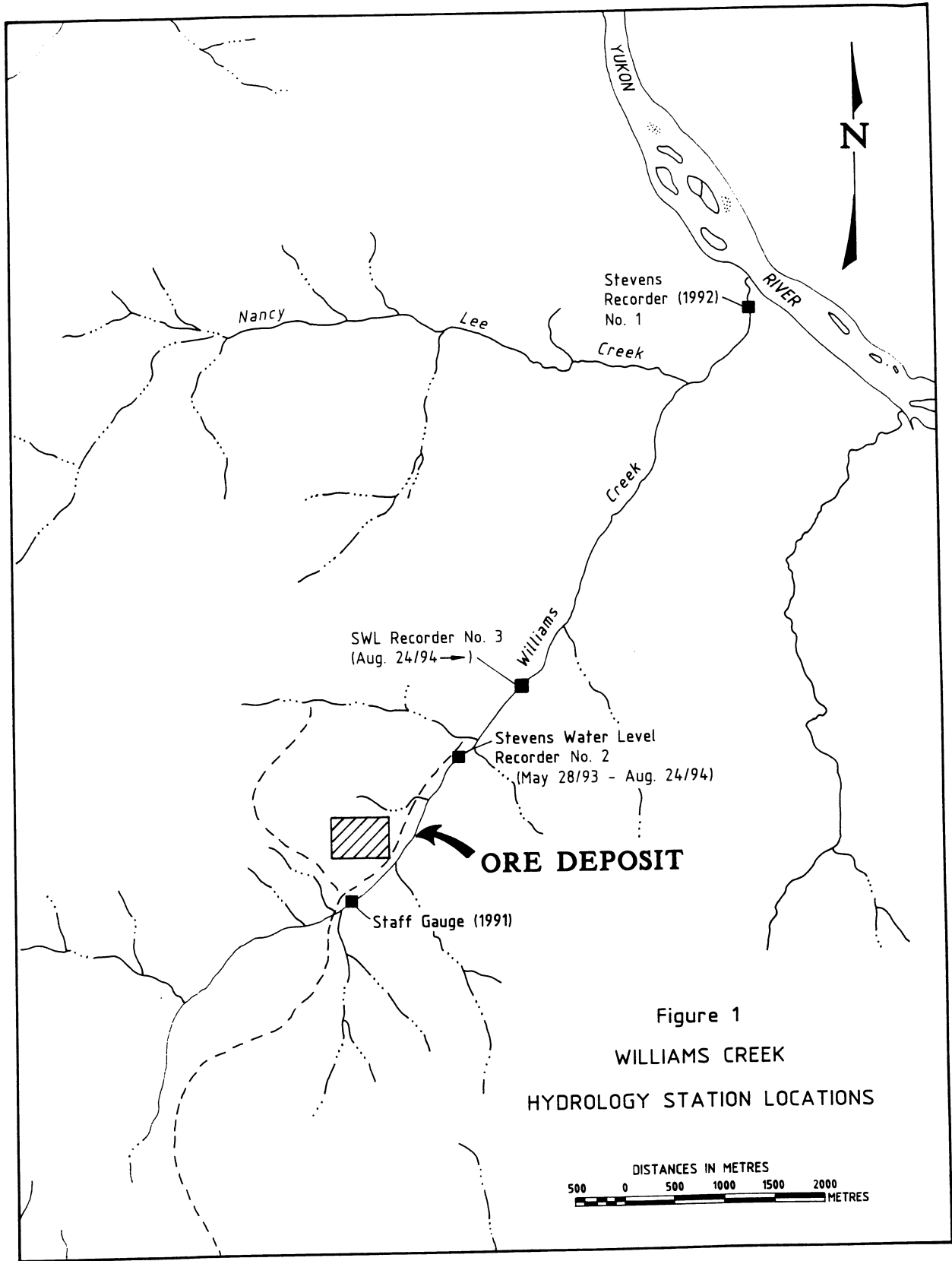
1993/1994 Flow Measurement Summary

Project: Carmacks Copper

Station: Williams Creek at Data Logger Station #2

Date	G.H. (m)	Corr. (m)	Corr G.H(m)	Q (cms)	Comments
-----	-----	-----	-----	-----	-----
1993					
May 28	0.533	0	0.533	0.144	
	0.539	0	0.539	0.145	
July 2	0.37	0	0.37	0.036	DL=0.368
	0.368	0	0.368	0.035	
Aug 2	0.22	0	0.22	0.009	DL=0.221
Sept 2	0.4	0	0.4	0.035	DL=0.40
Oct 29	0.398	0	0.398	0.029	ice
1994					
May 2	ice	-	-	0.2473	ice
May 13	ice	-	-	0.0457	ice
May 30	0.459	-0.056	0.399	0.0429	ice free
	0.465	-0.056	0.409	0.043	
July 9	0.48	-0.057	0.423	0.0459	DL=0.481
July 10	0.468	-0.058	0.41	0.403	
-----	-----	-----	-----	-----	-----

All flow measured with Price meter



STAFF GAUGE SURVEY / CORRECTIONS

Station: Williams Creek at Data Logger Station #2

Date Installed: May 28, 1993

Date Removed: August 24, 1994

Date	Elev. BM#1	Elev. BM#2	Elev. Base S.G.	Correction
May 28/93	100.000	99.305	97.391	-
Aug 2/93	100.000	99.291	97.391	0.00
Oct 29/93	100.000	99.291	97.391	0.00
May 30/94	100.000	99.295	97.447	-0.056
Aug 24/94	100.000	99.294	97.451	-0.060
	m	m	m	m

May/94 shift (0.056) in staff gauge likely due to major glaciation past winter and spring.

Stage Discharge Relationship for  
 Williams Creek at Data Logger Station #2  
 May 1993 - August 1994.

Gauge Height (m)	Flow Volume (cms)	Gauge Height (m)	Flow Volume (cms)
0.2	0.01	0.48	0.0966
0.21	0.0104	0.49	0.1038
0.22	0.0108	0.5	0.111
0.23	0.0112	0.51	0.1198
0.24	0.0116	0.52	0.1286
0.25	0.012	0.53	0.1374
0.26	0.0128	0.54	0.1462
0.27	0.0136	0.55	0.155
0.28	0.0144	0.56	0.1644
0.29	0.0152	0.57	0.1738
0.3	0.016	0.58	0.1832
0.31	0.0174	0.59	0.1926
0.32	0.0188	0.6	0.202
0.33	0.0202	0.61	0.213
0.34	0.0216	0.62	0.224
0.35	0.023	0.63	0.235
0.36	0.027	0.64	0.246
0.37	0.031	0.65	0.257
0.38	0.035	0.66	0.27
0.39	0.039	0.67	0.283
0.4	0.043	0.68	0.296
0.41	0.0494	0.69	0.309
0.42	0.0558	0.7	0.322
0.43	0.0622	0.71	0.3364
0.44	0.0686	0.72	0.3508
0.45	0.075	0.73	0.3652
0.46	0.0822	0.74	0.3796
0.47	0.0894	0.75	0.394

Williams Creek Hydrology Data 1994  
 Data Logger Station # 2  
 Period May 2 to July 24, 1994.

Date	Av.GH(m)	Q (cms)	MaxGH(m)	Q (cms)	MinGH(m)	Q (cms)
May 2/94	1.183	Ice	1.183	Ice	1.183	Ice
3	1.183	Ice	1.183	Ice	1.183	Ice
4	1.183	Ice	1.183	Ice	1.183	Ice
5	1.183	Ice	1.183	Ice	1.179	Ice
6	1.175	Ice	1.177	Ice	1.173	Ice
7	1.173	Ice	1.174	Ice	1.173	Ice
8	1.172	Ice	1.173	Ice	1.172	Ice
9	1.172	Ice	1.172	Ice	1.172	Ice
10	1.172	Ice	1.172	Ice	1.172	Ice
11	1.172	Ice	1.172	Ice	1.172	Ice
12	1.172	Ice	1.172	Ice	1.172	Ice
13	0.840	Ice	0.904	Ice	0.013	Ice
14	0.901	Ice	0.906	Ice	0.900	Ice
15	0.896	Ice	0.902	Ice	0.894	Ice
16	0.897	Ice	0.900	Ice	0.895	Ice
17	0.891	Ice	0.894	Ice	0.888	Ice
18	0.881	Ice	0.887	Ice	0.876	Ice
19*	0.652	0.257	0.672	0.283	0.632	0.237
20*	0.624	0.224	0.629	0.235	0.623	0.227
21*	0.553	0.155	0.620	0.224	0.446	0.070
22	0.354	0.021	0.361	0.027	0.340	0.022
23	0.309	0.017	0.329	0.021	0.284	0.014
24	0.288	0.015	0.302	0.016	0.273	0.014
25	0.277	0.014	0.287	0.014	0.264	0.013
26	0.275	0.014	0.285	0.014	0.264	0.013
27	0.334	0.020	0.383	0.036	0.275	0.014
28	0.393	0.039	0.398	0.042	0.385	0.037
29	0.402	0.043	0.407	0.046	0.396	0.041
30	0.411	0.049	0.418	0.052	0.398	0.042
May 31	0.415	0.053	0.419	0.052	0.412	0.050
June 1	0.406	0.049	0.409	0.047	0.402	0.044
2	0.397	0.043	0.405	0.046	0.392	0.040
3	0.379	0.035	0.390	0.039	0.372	0.032
4	0.360	0.027	0.369	0.030	0.356	0.025
5	0.354	0.023	0.360	0.027	0.351	0.023
6	0.335	0.020	0.348	0.022	0.328	0.019
7	0.310	0.017	0.325	0.019	0.305	0.016
8	0.292	0.015	0.302	0.016	0.287	0.015
9	0.280	0.014	0.288	0.015	0.275	0.014
10	0.272	0.014	0.275	0.014	0.268	0.013
11	0.263	0.013	0.268	0.013	0.260	0.013
12	0.258	0.013	0.260	0.013	0.255	0.012
13	0.251	0.012	0.255	0.012	0.246	0.012
14	0.241	0.012	0.245	0.011	0.236	0.011
15	0.235	0.011	0.236	0.011	0.232	0.011
16	0.232	0.011	0.233	0.011	0.230	0.011
17	0.240	0.012	0.241	0.012	0.238	0.012

Date	Av.GH(m)	Q (cms)	MaxGH(m)	Q (cms)	MinGH(m)	Q (cms)
June 18	0.237	0.011	0.238	0.011	0.234	0.011
19	0.249	0.012	0.255	0.013	0.238	0.012
20	0.252	0.012	0.259	0.013	0.251	0.012
21	0.272	0.014	0.281	0.014	0.259	0.013
22	0.295	0.015	0.299	0.016	0.283	0.014
23	0.292	0.015	0.298	0.016	0.284	0.014
24	0.279	0.014	0.284	0.015	0.272	0.013
25	0.278	0.014	0.303	0.016	0.269	0.013
26	0.407	0.049	0.466	0.086	0.323	0.018
27	0.501	0.111	0.557	0.160	0.469	0.090
28	0.560	0.164	0.567	0.169	0.550	0.155
29	0.533	0.137	0.548	0.152	0.519	0.128
June 30	0.511	0.120	0.522	0.131	0.496	0.107
July 1	0.480	0.097	0.492	0.104	0.468	0.086
2	0.490	0.104	0.497	0.109	0.480	0.097
3	0.499	0.110	0.501	0.111	0.495	0.108
4	0.486	0.097	0.495	0.109	0.471	0.089
5	0.464	0.085	0.470	0.089	0.460	0.082
6	0.456	0.079	0.461	0.083	0.449	0.075
7	0.447	0.071	0.451	0.075	0.443	0.070
8	0.447	0.071	0.452	0.076	0.436	0.066
9	0.428	0.062	0.436	0.066	0.419	0.054
10	0.409	0.049	0.417	0.053	0.399	0.042
11	0.388	0.039	0.397	0.042	0.378	0.034
12	0.366	0.031	0.376	0.033	0.354	0.024
13	0.337	0.022	0.353	0.025	0.317	0.018
14	0.306	0.016	0.316	0.018	0.294	0.015
15	0.293	0.015	0.294	0.015	0.291	0.015
16	0.288	0.015	0.291	0.015	0.283	0.014
17	0.280	0.014	0.282	0.014	0.275	0.014
18	0.273	0.013	0.274	0.014	0.270	0.013
19	0.267	0.013	0.269	0.014	0.262	0.012
20	0.268	0.013	0.277	0.014	0.262	0.012
21	0.275	0.014	0.277	0.014	0.267	0.013
22	0.264	0.013	0.267	0.014	0.258	0.012
23	0.250	0.012	0.254	0.012	0.238	0.011
July 24	0.240	0.012	0.242	0.012	0.238	0.011

All gauge heights are corrected for gauge shifts

May 19,20,21\* - Final transition from ice effect  
to open water channel

Williams Creek, Yukon. Comparison of Average  
 Daily Flow Volumes between 1993 and 1994.  
 Data Logger Station #2.

Date	1993	1994
May 28	0.164	0.039
29	0.336	0.043
30	0.322	0.049
31	0.235	0.053
June 1	0.183	0.049
2	0.155	0.043
3	0.129	0.035
4	0.104	0.027
5	0.089	0.023
6	0.082	0.02
7	0.069	0.017
8	0.056	0.015
9	0.049	0.014
10	0.039	0.014
11	0.035	0.013
12	0.031	0.013
13	0.023	0.012
14	0.017	0.012
15	0.015	0.011
16	0.014	0.011
17	0.014	0.012
18	0.014	0.011
19	0.017	0.012
20	0.02	0.012
21	0.017	0.014
22	0.015	0.015
23	0.016	0.015
24	0.016	0.014
25	0.014	0.014
26	0.014	0.049
27	0.013	0.111
28	0.012	0.164
29	0.012	0.137
30	0.011	0.12
July 1	0.012	0.097
2	0.023	0.104
3	0.043	0.11
4	0.035	0.097
5	0.023	0.085
6	0.023	0.079
7	0.023	0.071
8	0.039	0.071
9	0.049	0.062
10	0.049	0.049

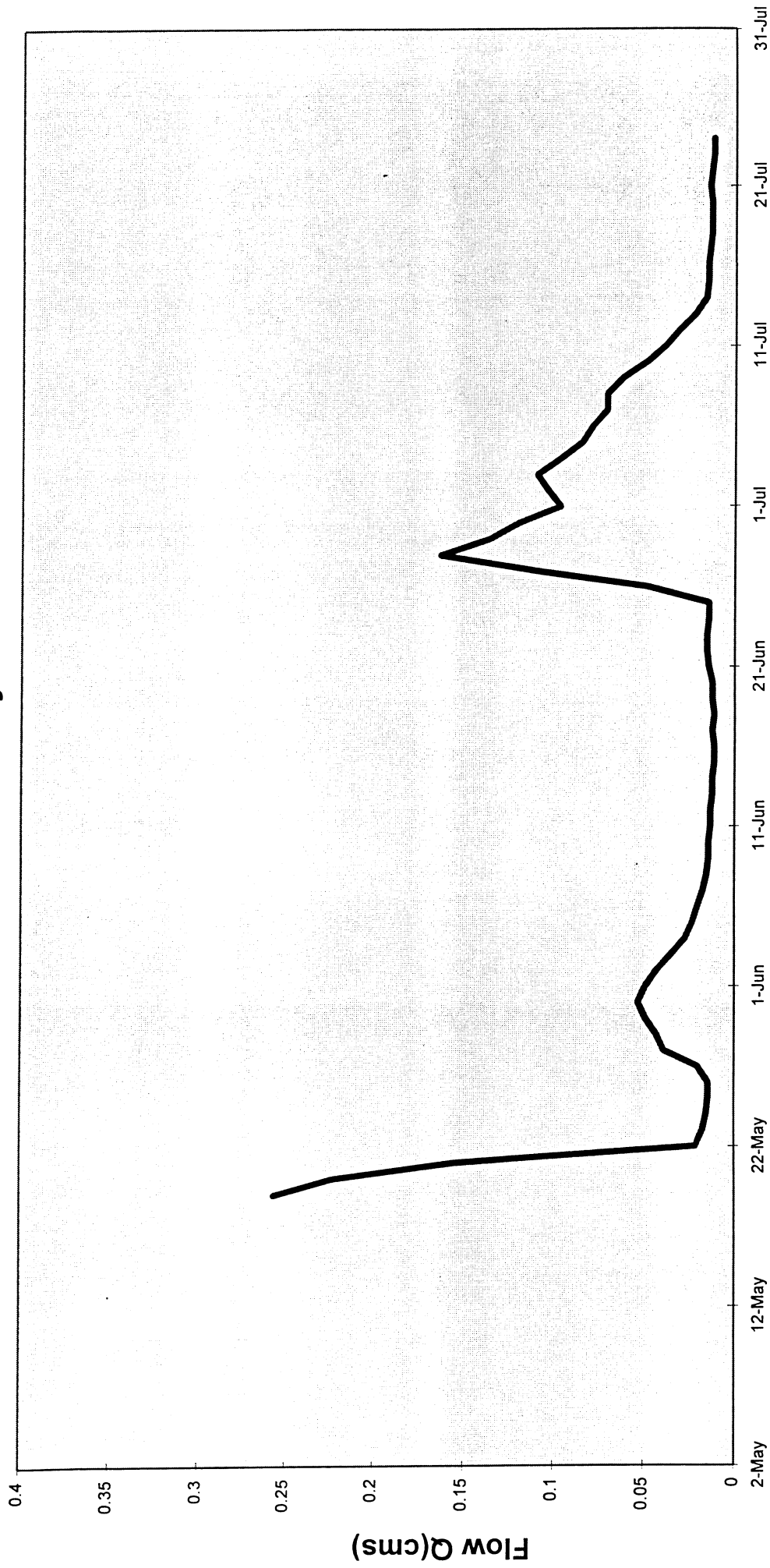


Date	1993	1994
11	0.043	0.039
12	0.035	0.031
13	0.023	0.022
14	0.02	0.016
15	0.017	0.015
16	0.014	0.015
17	0.014	0.014
18	0.012	0.013
19	0.012	0.013
20	0.012	0.013
21	0.012	0.014
22	0.013	0.013
23	0.012	0.012
24	0.012	0.012

cms
cms

1993 period of record - May 28 to Oct 29  
1994 period of record - May 2 to July 24

# Williams Creek Logger Station #2 1994 Mean Daily Rates



Dates: May 2 to July 24, 1994

STAFF GAUGE - DISCHARGE CALIBRATION

Project Name Carmacks Copper Site ID Williams @ data logger

Project #: Date: May 2, 1994

S.G. @ Start: ice S.G. @ Finish: ice

Distance (m)	Depth (m)	Velocity (m/s)	Width (m)	Area (m sq)	Discharge (cms)
2.6	0	0	0.15	0	0
2.9	0.1	0.137	0.25	0.025	0.003425
3.1	0.1	0.215	0.25	0.025	0.005375
3.4	0.2	0.366	0.25	0.05	0.0183
3.6	0.18	0.464	0.2	0.036	0.016704
3.8	0.2	0.326	0.2	0.04	0.01304
4	0.15	0.195	0.2	0.03	0.00585
4.2	0.16	0.342	0.2	0.032	0.010944
4.4	0.2	0.492	0.2	0.04	0.01968
4.6	0.2	0.533	0.2	0.04	0.02132
4.8	0.21	0.847	0.2	0.042	0.035574
5	0.22	0.631	0.2	0.044	0.027764
5.2	0.17	0.533	0.2	0.034	0.018122
5.4	0.12	0.662	0.2	0.024	0.015888
5.6	0.12	0.311	0.2	0.024	0.007464
5.8	0.1	0.578	0.25	0.025	0.01445
6.1	0.1	0.161	0.3	0.03	0.00483
6.4	0.08	0.269	0.3	0.024	0.006456
6.7	0.04	0.24	0.225	0.009	0.00216
6.85	0	0	0.075	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
4.25			4.25	0.574	0.247346

Data Logger Reading: no reading, under complete ice cover

Channel under ice?: flows atop 1.1 m ice

Method: Price meter

Crew: J.Gibson









STAFF GAUGE - DISCHARGE CALIBRATION

Project Name Carmacks Copper Site ID Data logger

Project #: Date: July 10, 1994

S.G. @ Start 0.468 S.G. @ Finish: 0.468

Distance	Depth	Velocity	Width	Area	Discharge
-----	-----	-----	-----	-----	-----
3.77	0	0	0.065	0	0
3.9	0.13	0.038	0.115	0.01495	0.000568
4	0.18	0.097	0.1	0.018	0.001746
4.1	0.22	0.137	0.1	0.022	0.003014
4.2	0.26	0.158	0.1	0.026	0.004108
4.3	0.28	0.165	0.1	0.028	0.00462
4.4	0.27	0.169	0.1	0.027	0.004563
4.5	0.26	0.182	0.1	0.026	0.004732
4.6	0.25	0.188	0.1	0.025	0.0047
4.7	0.25	0.199	0.1	0.025	0.004975
4.8	0.25	0.188	0.1	0.025	0.0047
4.9	0.22	0.119	0.1	0.022	0.002618
5	0	0	0.05	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
-----	-----	-----	-----	-----	-----
1.23			1.23	0.25895	0.040344

Data Logger Reading: 0.468  
 Channel under ice?: no  
 Method: Price meter  
 Crew: Gibson





STAFF GAUGE - DISCHARGE CALIBRATION

Project Name - Carmacks Copper      Site ID S.G.@ Road X-ing

Project #:                              Date: May 30, 1994

S.G. @ Start 0.238                      S.G. @ Finish:                      0.238

Distance	Depth	Velocity	Width	Area	Discharge
4.7	0	0	0.05	0	0
4.8	0.16	0.311	0.1	0.016	0.004976
4.9	0.15	0.566	0.1	0.015	0.00849
5	0.15	0.464	0.1	0.015	0.00696
5.1	0.16	0.379	0.075	0.012	0.004548
5.15	0.18	0.142	0.05	0.009	0.001278
5.2	0	0	0.025	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
			0	0	0
0.5			0.5	0.067	0.026252

Data Logger Reading:      no logger at this site

Channel under ice?:      no

Method:              Price meter

Crew:              Gibson