CARMACKS COPPER PROJECT

ADDENDUM TO
VOLUME 1

BIOPHYSICAL ASSESSMENT OF THE CARMACKS COPPER MINE SITE

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ENVIRONMENTAL CONSULTANTS

WESTERN COPPER HOLDINGS LIMITED

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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.

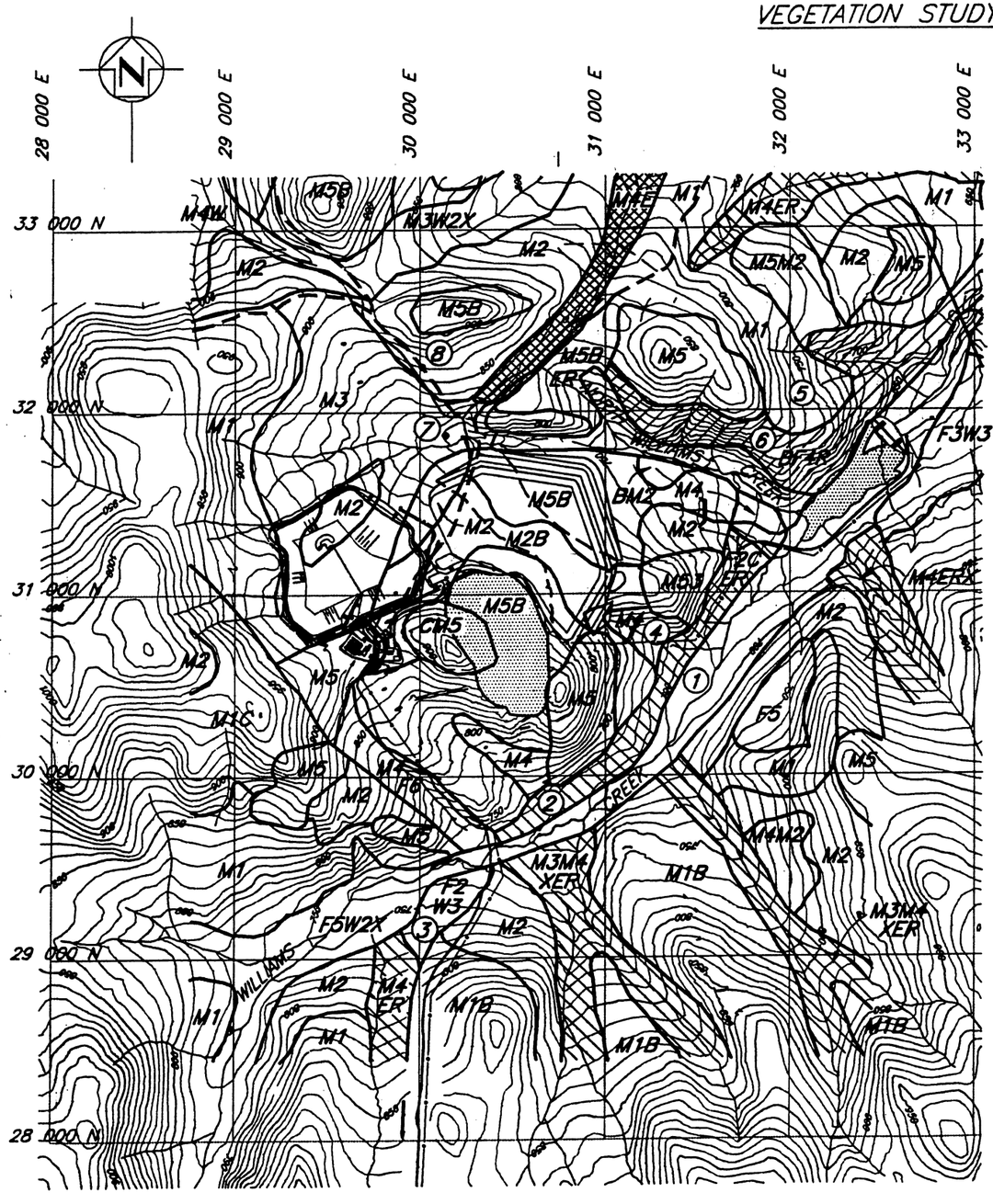
The Carmacks Copper Project would provide the Yukon Territory with resource development resulting in economic benefits and employment. Development of this copper mine is required to provide a boost in a declining Canadian metal export market which is an important factor in providing jobs and economic 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^2) documentation of understorey 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

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



CAD FILE: \PROJECT\1000\H1811\PD\B3 Plot scale 1=30

LEGEND
TERRAIN INTERPRETIVE MAP
Geotechnical and Environmental Considerations

LANDFORMS and MATERIALS	COMMON VEGETATION TYPE
Morainal Landforms – valley bottom and lower slope glacial till: mainly a dense sandy silty matrix, but may be closer and looser in upper valleys.	
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.	Aspen, Kinnikinnick, minor Lodgepole Pine
M2 sloping till blanket overlying bedrock; depths range from 1–3m; slopes are mainly less than 40%.	Lodgepole Pine, Aspen, Black Spruce
M3 wet, subdued to moderately sloping till; features poor drainage, seepage, and/or shallow organic capping on slopes usually less than 30%.	Black Spruce, Willow, Labrador Tea
M4 Gullied till on valley sides; may contain fluvial and/or colluvial deposits; usually incised into bedrock.	Black Spruce, Willow, moss
M5 Shallow deposits of till overlying besrock; dominantly south and east facing slopes; slopes greater than 40%.	Aspen, Lodgepole Pine, grass
Colluvial Landforms – lower slope, gravity transported debris derived from bedrock.	
C accumulation of deep colluvial fans, cones and aprons (1–3m); blocky and rubbly debris may provide a source of coarse aggregate or ballast.	Black Spruce, Willow, moss
Bedrock Landforms	
B areas of bedrock outcrop and shallow colluvium	Open stands of Lodgepole Pine, Aspen and grasses.
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 thicknes of deposit and texture.	
F1 level to gently subdued surface, thick deposits	White and Black Spruce, Willow, moss
F2 subdued to moderately sloping (15–30%), thick deposits	White and Black Spruce, Willow, moss
F3 hummocky and ridged, moderately to moderately steeply sloping (30–65%), thick deposits.	Aspen, Kinnikinnick, grass
F4 steeply sloping scarps (greater than 65%), thick deposits, souta facing.	Aspen and grasses
F5 subdued fluvial fans and low lying terraces; high water table and occassional floodeing may occur near channels and in depressions.	White Spruce, Birch, Willow, moss
F6 variable thickness (.5–2m) of sand and gravel overtying subdued to moderately sloping till surface; well–drained.	Lodgepole Pine, Willow, Labrador Tea
F7 steeply sloping scarps (65%)	Black Spruce, Willow, moss
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.	
W1 dominantly organic materials greater than 1m thick.	Black Spruce, Labrador Tea, Willow
W2 variable extent and thickness of organics (40–150cm) overlying wet floorplain sediments.	Willow, sedge, moss
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.	Black Spruce, Labrador Tea, moss

GEOMORPHIC CONDITIONS AND PROCESSES

Permafrost – perenial frozen ground.

X areas of potential ground ice occur on poorly–drained till slopes and floodplain areas where organic soils predominate.

Terrain Hazard Units

R slopes which show evidence of active landsliding; mass movement and erosion hazard.

ER slopes which have the potential for mass movement and/or have high erosion potential.

E slopes which have moderate erosion potential.

D toe–slope areas actively receiving deposition from upslope landslides or on–going erosion.

U1 areas highly susceptible to flooding, channel shifting, or inundation by high water table.

U2 areas potentially susceptible to flooding, channel shifting, or inundation by high water table.

NOTE:
Map units are defined by one or more symbols representing the occurence 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.

LEGEND

- Index Contour
- Intermediate Contour
- Depression Contour
- Stream
- Intermittant Stream
- Indefinite Stream
- Single Tree
- Brush / Scrub
- Swamp
- Paved Road
- Dirt Road
- W4 – 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), Pokergrass(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(8), Northern fescue(3), Artic lupine(2), Glaucous bluegrass(3), Sheep fescue(3), Snowy locoweed(1).*

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 (*Chamaeddaphne 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 (*Artemesia frigida*)

Capitate lousewort (*Pedicularis capitate*)

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
- Trembing 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
- Trembing 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

Western Copper Holdings Ltd.
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	
	Black spruce	8.1	38	4	
	Black spruce	6.9	29	4	
	Black spruce	5.1	22	1.5	
				10	45
1	Mountain alder	2.7 (avg.)	8	40	TNTC*
1	Willow spp.	4.8 (avg.)	15	40	TNTC
2	White spruce	6	32	20	
	White spruce	9.3	52	60	
	White spruce	10.4	57	19	
	White spruce	2.3	13	1	
				26	16
2	Trembling aspen	18.8	48	16.5	
	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	41
2	Lodgepole pine	14.9	80		
	Lodgepole pine	8.6	45		
				3	2
2	Willow sp.	10	–		
	Willow sp.	2.4	–		
	Willow sp.	4.8	–		
				5	3
					62
3	Black Spruce	7.8	42	7.5	
	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	150
3	Willow sp.	0.52	–	19.8	
	Willow sp.	2.1	–	5	
				24.8	50
3	Green alder	0.4	–		
				0.6	1
					201

Western Copper Holdings Ltd.
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^2) 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)

Site	Habitat Unit*	Species	Sign
1	Willow Dominant wetlands	common sandpiper grey wolf black bear varying hare moose (chipmunk or mouse)+	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

(L:\Hallam\H1811\Vol1\Addend\Table-3.WK3)

PLACER ENTREE WATER

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

Knight and Piésold Ltd.
CONSULTING ENGINEERS

Thermistor String Number Th2

Location −2000 N RC-2 (LOWER)

0 E

Date Installed SEPT 11/92

INST DIAL	1	2	3	4	Temperature Readings 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	←

THERMA[illegible]

Knight and Piésold Ltd.
CONSULTING ENGINEERS

Thermistor String Number Th1

Location 2650 N RC-07 UP 1

125 E

Date Installed SEPT 7/92

	Temperature Readings										
	1	2	3	4	5	6	7	8	9	10	11
Location on String	0'	7'	9'	11'	13'	17'	20'	25'	45'	65'	85'
True Depth	0'	~~5.3'~~ 7	~~6.9'~~ 9	~~8.4'~~ 11	~~10.0'~~ 13	~~13.0'~~ 17	~~15.3'~~ 20	~~19.2'~~ 25	~~34.4'~~ 45	~~49.9'~~ 65	~~65.1'~~ 85
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	—

P;W;WC; FINAL - Background
; WATER

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,

J.G

John Gibson.

P:\WINDY-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 been 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,

J. Gibson

John Gibson.

Williams Creek Property - Carmacks Copper

July 9, 1994 Thermal Profiles

Thermistor String # Th2 (RC-02)

True Depth	0'	5.3'	6.9'	8.4'	10.0'	13.0'	15.3'	19.2'	34.4'	49.9'
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)

True Depth	0'	7.0'	9.0'	11.0'	13.0'	17.0'	20.0'	25.0'	45.0'	65.0'
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 reamined 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
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: May 30, 1994

S.G. @ Start 0.465 S.G. @ Finish: 0.465

Distance	Depth	Velocity	Width	Area	Discharge
2.9	0	0	0.05	0	0
3	0.14	0.036	0.1	0.014	0.000504
3.1	0.18	0.11	0.1	0.018	0.00198
3.2	0.22	0.188	0.1	0.022	0.004136
3.3	0.28	0.195	0.1	0.028	0.00546
3.4	0.28	0.179	0.1	0.028	0.005012
3.5	0.3	0.185	0.1	0.03	0.00555
3.6	0.28	0.199	0.1	0.028	0.005572
3.7	0.22	0.211	0.1	0.022	0.004642
3.8	0.27	0.207	0.1	0.027	0.005589
3.9	0.24	0.151	0.125	0.03	0.00453
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
1.15			1.15	0.247	0.042975

Data Logger Reading: 0.466

Channel under ice?: no

Method: Price meter

Crew: Gibson

STAFF GAUGE - DISCHARGE CALIBRATION

Project Name Carmacks Copper Site ID Data logger

Project #: Date: July 9, 1994

S.G. @ Start 0.48 S.G. @ Finish: 0.48

Distance	Depth	Velocity	Width	Area	Discharge
3.75	0	0	0.1	0	0
3.95	0.1	0.017	0.15	0.015	0.000255
4.05	0.15	0.094	0.1	0.015	0.00141
4.15	0.23	0.112	0.1	0.023	0.002576
4.25	0.26	0.161	0.1	0.026	0.004186
4.35	0.28	0.185	0.1	0.028	0.00518
4.45	0.29	0.182	0.1	0.029	0.005278
4.55	0.28	0.195	0.1	0.028	0.00546
4.65	0.26	0.199	0.1	0.026	0.005174
4.75	0.22	0.195	0.1	0.022	0.00429
4.85	0.26	0.203	0.1	0.026	0.005278
4.95	0.22	0.154	0.2	0.044	0.006776
5.25	0	0	0.15	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
1.5			1.5	0.282	0.045863

Data Logger Reading: 0.481

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
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
0.5			0.5	0.067	0.026252

Data Logger Reading: no logger at this site

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: July 10, 1994

S.G. @ Start 0.195 S.G. @ Finish: 0.195

Distance	Depth	Velocity	Width	Area	Discharge
3.3	0	0	0.05	0	0
3.4	0.16	0.417	0.1	0.016	0.006672
3.5	0.18	0.566	0.1	0.018	0.010188
3.6	0.16	0.326	0.1	0.016	0.005216
3.7	0.15	0.409	0.1	0.015	0.006135
3.8	0.16	0.195	0.1	0.016	0.00312
3.9	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
			0	0	0
			0	0	0
0.6			0.6	0.081	0.031331

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)436-0569

To: NORTHERN AFFAIRS PROGRAM W/O: 23281

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	P04-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

/2...

Quanta Trace Laboratories Inc.
#401-3700 Gilmore Way
Burnaby, B.C. V5G 4M1
Tel:(604)438-522
Fax:(604)436-056

To: NORTHERN AFFAIRS PROGRAM

W/O: 23281 Page

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
ICP - ULTRASONIC NEBULIZATION						
Method used		filt. 0.45u DISSOLVED	uwave HNO3 TOTAL	filt. 0.45u DISSOLVED	uwave HNO3 TOTAL	filt. 0.45u 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
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	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	0.085
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	0.008
Zirconium	Zr	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Results in		mg/L	mg/L	mg/L	mg/L	mg/L

/3...

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

Sample type		fresh	fresh	fresh	fresh	fresh
Identification		4071, W3	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	-	143.	-	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

/4...

Quanta Trace Laboratories Inc.
#401-3700 Gilmore Way
Burnaby, B.C. V5G 4M1
Tel:(604)438-522
Fax:(604)436-056

To: NORTHERN AFFAIRS PROGRAM

W/O: 23281 Page

Sample type		fresh	fresh	fresh	liquid	liquid
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
ICP - ULTRASONIC NEBULIZATION						
Method used		uwave HNO3 TOTAL	filt. 0.45u DISSOLVED	uwave HNO3 TOTAL	filt. 0.45u DISSOLVED	uwave HNO3 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	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
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

/5...

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 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. 0.45u DISSOLVED	uwave HNO3 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

Analyst

Quanta Trace Laboratories Inc.
#401-3700 Gilmore Way
Burnaby, B.C. V5G 4M1

Tel:(604)438-522(
Fax:(604)436-056

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

/6...

P;W:WC: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

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

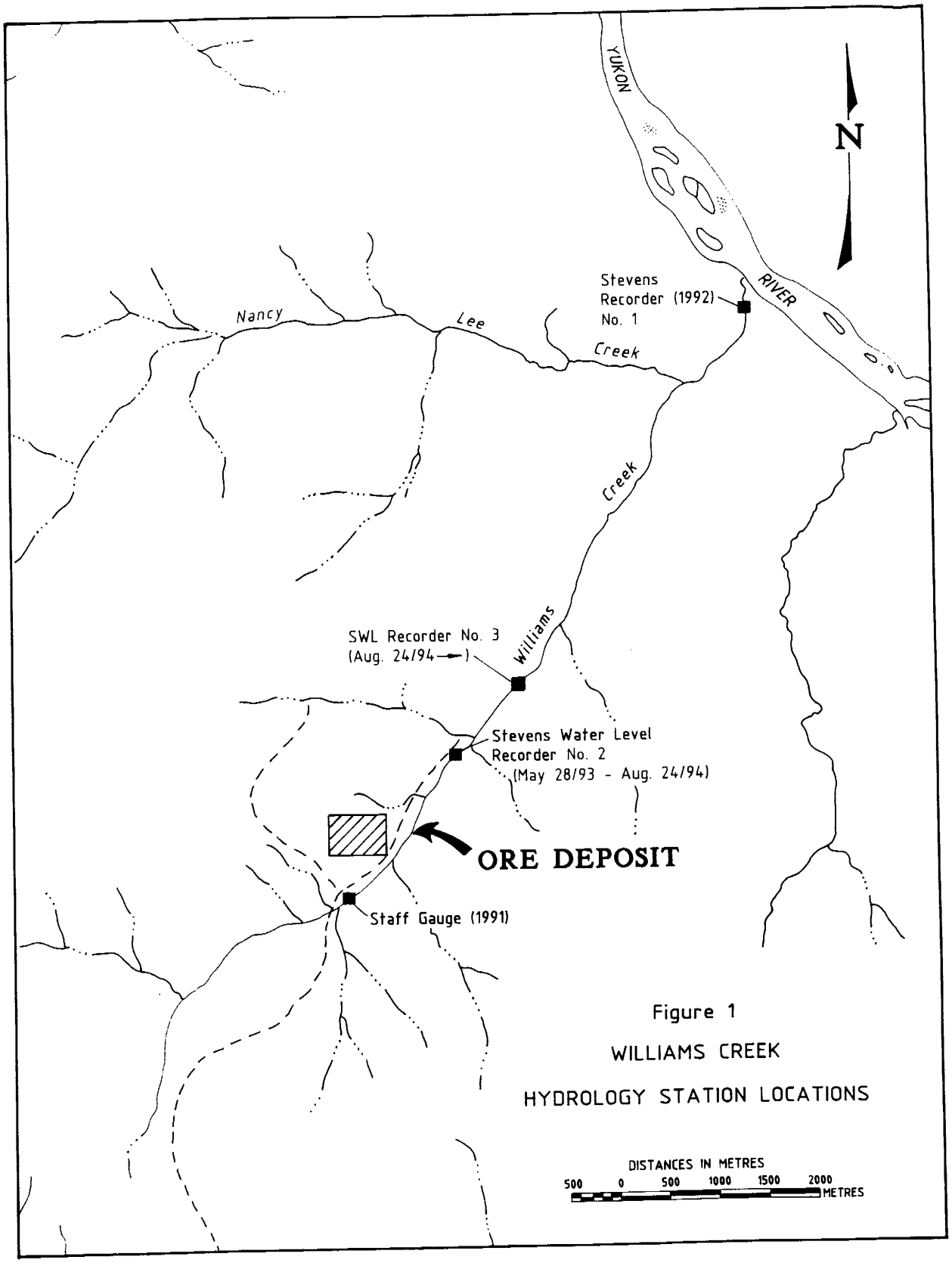


Figure 1

WILLIAMS CREEK

HYDROLOGY STATION LOCATIONS

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
	m	m	m	m
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

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

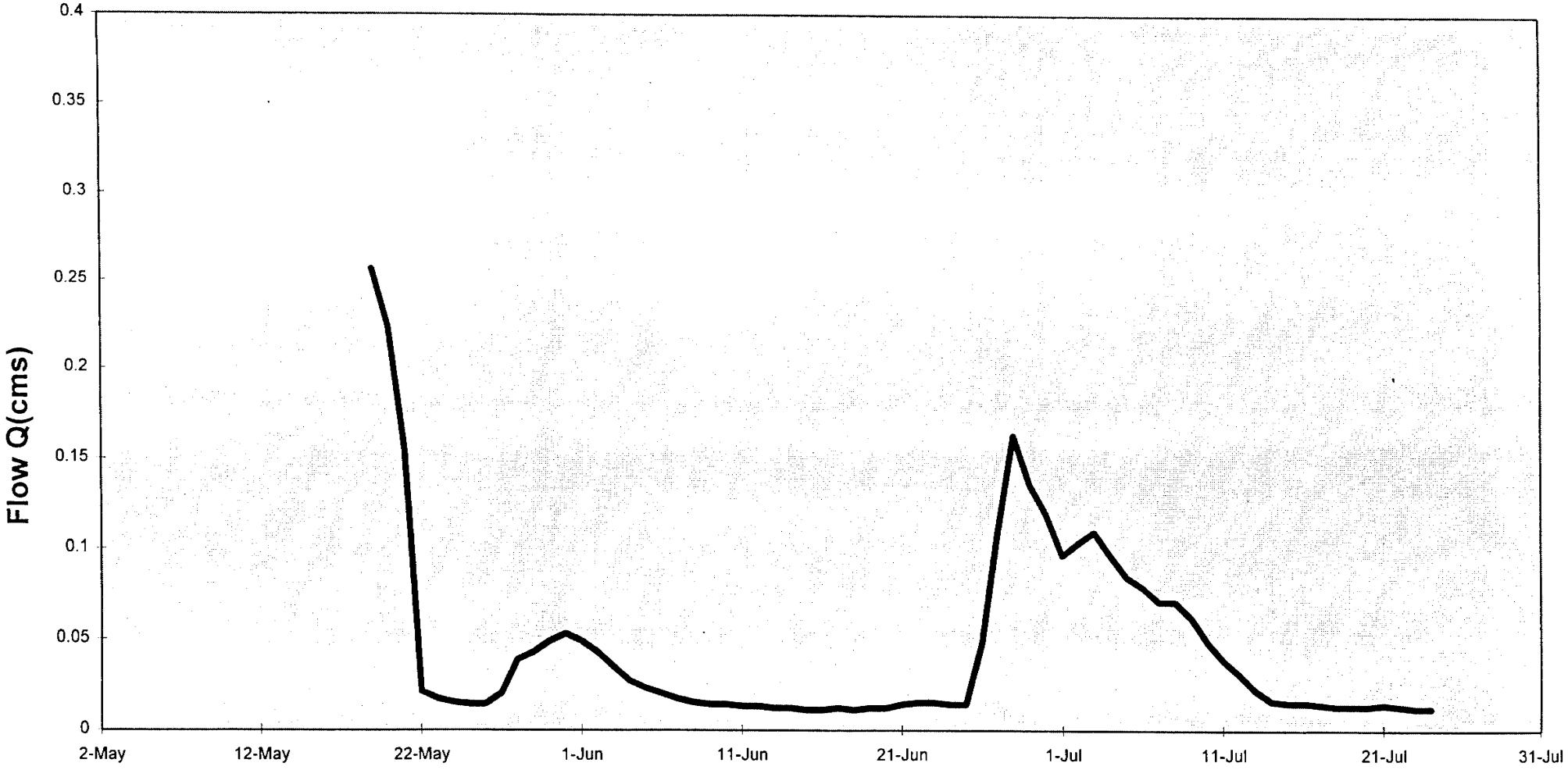
Williams Creek, Yukon. Comparison of Average Daily Flow Volumes between 1993 and 1994.
Data Logger Station #2.

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
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 Williams @ Data Logger

Project #: Date: May 13, 1994

S.G. @ Start: 0.962 ice S.G. @ Finish: 0.962 ice

Distance (m)	Depth (m)	Velocity (m/s)	Width (m)	Area (m sq)	Discharge (cms)
4.35	0	0	0.075	0	0
4.5	0.08	0.145	0.125	0.01	0.00145
4.6	0.11	0.114	0.1	0.011	0.001254
4.7	0.12	0.211	0.1	0.012	0.002532
4.8	0.14	0.566	0.1	0.014	0.007924
4.9	0.13	0.662	0.1	0.013	0.008606
5	0.13	0.788	0.1	0.013	0.010244
5.1	0.12	0.679	0.1	0.012	0.008148
5.2	0.08	0.51	0.1	0.008	0.00408
5.3	0.06	0.251	0.1	0.006	0.001506
5.4	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
1.05			1.05	0.099	0.045744

Data Logger Reading: none, under ice cover

Channel under ice?: flows atop solid ice cover

Method: Price meter

Crew: J.Gibson

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
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: May 30, 1994

S.G. @ Start 0.465 S.G. @ Finish: 0.465

Distance	Depth	Velocity	Width	Area	Discharge
2.9	0	0	0.05	0	0
3	0.14	0.036	0.1	0.014	0.000504
3.1	0.18	0.11	0.1	0.018	0.00198
3.2	0.22	0.188	0.1	0.022	0.004136
3.3	0.28	0.195	0.1	0.028	0.00546
3.4	0.28	0.179	0.1	0.028	0.005012
3.5	0.3	0.185	0.1	0.03	0.00555
3.6	0.28	0.199	0.1	0.028	0.005572
3.7	0.22	0.211	0.1	0.022	0.004642
3.8	0.27	0.207	0.1	0.027	0.005589
3.9	0.24	0.151	0.125	0.03	0.00453
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	0.247	0.042975

Data Logger Reading: 0.466

Channel under ice?: no

Method: Price meter

Crew: Gibson

STAFF GAUGE - DISCHARGE CALIBRATION

Project Name Carmacks Copper Site ID Data logger

Project #: Date: July 9, 1994

S.G. @ Start 0.48 S.G. @ Finish: 0.48

Distance	Depth	Velocity	Width	Area	Discharge
3.75	0	0	0.1	0	0
3.95	0.1	0.017	0.15	0.015	0.000255
4.05	0.15	0.094	0.1	0.015	0.00141
4.15	0.23	0.112	0.1	0.023	0.002576
4.25	0.26	0.161	0.1	0.026	0.004186
4.35	0.28	0.185	0.1	0.028	0.00518
4.45	0.29	0.182	0.1	0.029	0.005278
4.55	0.28	0.195	0.1	0.028	0.00546
4.65	0.26	0.199	0.1	0.026	0.005174
4.75	0.22	0.195	0.1	0.022	0.00429
4.85	0.26	0.203	0.1	0.026	0.005278
4.95	0.22	0.154	0.2	0.044	0.006776
5.25	0	0	0.15	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
1.5			1.5	0.282	0.045863

Data Logger Reading: 0.481

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
			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: July 10, 1994

S.G. @ Start 0.195   S.G. @ Finish: 0.195

Distance	Depth	Velocity	Width	Area	Discharge
3.3	0	0	0.05	0	0
3.4	0.16	0.417	0.1	0.016	0.006672
3.5	0.18	0.566	0.1	0.018	0.010188
3.6	0.16	0.326	0.1	0.016	0.005216
3.7	0.15	0.409	0.1	0.015	0.006135
3.8	0.16	0.195	0.1	0.016	0.00312
3.9	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
			0	0	0
0.6			0.6	0.081	0.031331

Data Logger Reading: no logger at this site

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
0.5			0.5	0.067	0.026252

Data Logger Reading: no logger at this site

Channel under ice?: no

Method: Price meter

Crew: Gibson