BOX 6263, FORT ST. JOHN, B.C. V1J 4H7 PHONE/FAX (250) 787-9101

## INVESTIGATION OF REPORTED FISH KILL TSINHIA LAKE – SUMMER 2003

Date: December 31, 2003

Attention: Renate Hambuechen Oil & Gas Resource Officer Applications and Approvals Branch Oil & Gas Commission Fort St. John, B.C.

In early July 2003, the Oil & Gas Commission received a report of a suspected fish kill in Tsinhia Lake from Mr. Billy Bedine, a member of the Fort Nelson First Nation. Mr. Bedine and his family, who are long-time seasonal residents of Tsinhia Lake, had noticed numerous dead fish along the shoreline near their cabin. On July 11, 2003, Diversified Environmental Services (Diversified) conducted a preliminary investigation into Mr. Bedine's report.

Tsinhia Lake lies at the headwaters of Tsinhia Creek, a tributary to the Kiwigana River, which is a sub-basin of the Fort Nelson River. Tsinhia Lake is an warm, shallow water body located in the Maxhamish Upland biophysical area. The lake has an estimated maximum depth of 2-3 metres and supports resident populations of white sucker, finescale dace and brook stickleback. Mean depth is approximately 1.5 metres.

Water enters the lake primarily through seepage from adjacent upland and wetland complexes. The primary inlet stream is characterized by low seasonal flow, and discontinuous channel. Subsequently, the exchange rate of the lake is relatively low.

During the July 11 investigation, Mr. Bedine accompanied Diversified staff on a reconnaissance of the entire shoreline of the lake (plate 1), including the primary inlet (plate 2) and outlet. Relatively low numbers of dead and dying fish, representing all three species, were noted in all areas of the lake, but appeared to be more numerous along the northeast shoreline. Although this area contains the mouth of the primary inlet, it is also the shoreline most exposed to prevailing winds. Schools of apparently healthy brook stickleback were also observed along this shoreline, in the vicinity of the lake inlet.

Mr. Bedine expressed concern at the presence of an "oil-like" sheen on the surface of the water in sheltered portions of the lake margin, in the vicinity of the inlet, and wondered if this might be related to a recently completed gas well located approximately 300 m from the north shoreline of the lake or an associated tie-in pipeline crossing of the inlet stream located approximately 1000 m upstream of the lake inlet.

A ground inspection of the lease site and associated tie-in pipeline ROW was conducted (plate 3). No evidence of potential surface contamination from either the wellsite or the nearby directionally-drilled tie-in pipeline crossing under the primary inlet stream was noted.

A mineral sheen, similar to that noted near the lake inlet, was observed on the surface of stagnant pools of the inlet stream, both upstream and downstream of the pipeline crossing (plate 4). This was believed to be a natural phenomenon which is commonly observed in similar "muskeg" seepage areas where surface discharge is low, and mineral concentrations and water temperatures are high.

At the time of the July 11 inspection, water temperature in Tsinhia Lake was 24° C at surface and 23° C at 1.5 m depth. Ambient air temperature was 29° C. Dissolved oxygen was measured at approximately 8 ppm throughout the water column at 1450 hrs. All three species present in the lake are known to be tolerant of very low dissolved oxygen levels and warm temperatures and are typically not subject to summer kills which periodically effect many "sport-fish" species.

The majority of dead and dying fish inspected had varying degrees of fungal infection of the gill filaments. This condition is often not the primary cause of death but rather a symptom of other environmental stressors and may be accelerated by high water temperatures.

Water samples from 4 sites were collected and analyzed. Site 1 was located on the primary inlet immediately upstream of the mouth, site 2 was located in the lake at the inlet mouth, site 3 was near the centre of the lake and site 4 was at the lake outlet.

Samples from all 4 sites were analyzed for trace metals to detect potential differences in water quality in portions of the lake (Appendix I). The samples taken on July 11 could not be analyzed for the presence of petroleum hydrocarbons, so additional samples containing "metallic sheen" surface film were subsequently collected at sites 1, 2 and 3 and analyzed for extractable petroleum hydrocarbons.

Differences in concentrations of some metals were detected between the inlet and outlet sides of the lake and appear to be the result of natural process. Levels of iron and aluminum, found at the lake inlet, exceeded the current B.C. guidelines for protection of aquatic life (<u>http://wlapwww.gov.bc.ca/wat/wq/BCguidelines</u>).

High concentrations of aluminum, however, are common in naturally acidified waterbodies such as bog lakes. High levels of iron likely contributed to the metallic surface film noted in and near the primary inlet.

No direct evidence linking the fish kill in Tsinhia Lake to adjacent industrial activity was noted during this investigation and, based on limited information, it appears probable that the event was the result of natural phenomena.

In the event that further fish kills are reported in the future and warrant a more detailed investigation, it is recommended that all fish sampling and water analysis be replicated in at least one comparable, shallow lake in the immediate area, for comparative purposes.

Due to the potential variety and combination of biological, chemical and climatic factors, the identification of causative agents through the analysis of fish tissue samples can be very difficult and expensive, and was not undertaken during this cursory investigation.

Cordially,

Brad Culling Diversified Environmental Services Fort St. John, B.C. Ph: (250) 787-9101 Email: <u>bculling@pris.bc.ca</u>



Plate1: Typical shoreline of Tsinhia Lake



Plate 2: Mouth of primary inlet to Tsinhia Lake (back-flooded back beaver dams and impoundments); view upstream.



Plate 3: Recently drilled gas well located immediately north of Tsinhia Lake (Tsinhia Lake visible in background).



Plate 4: Upper Tsinhia Creek at tie-in pipeline crossing approximately 1000 m upstream of Tsinhia Lake (note metallic surface film).

# **APPENDIX I**

Results of Laboratory Analysis of Tsinhia Lake Water Samples



## Analytical Report

Norwest Labs 7217 Roper Road Edmonton, AB. T6B 3J4 Phone: (780) 438-5522 Fax: (780) 438-0396

Bill to:	Diversified Environmental Serv	rices Project			NWL Lot ID:	244484
eport to:	Diversified Environmental Serv	rices ID:	Tsinhia		Control Number	E 139470
	Box 6263	Name:			Date Reseived:	b115 2003
	Fort St. John, BC, Canada	Location:			Date Received.	Jul 13, 2003
A+	v IJ 4H/	LSD:			Date Reported:	101 22, 2005
Sampled F	an. Drad Carinig	PO:			Report Number:	424104
Compar	ογ.	1.0				
Compa	iy.	Acct. Code				
					Page:	1 of 3
		NWL Number	244484-1	244484-2	244484	4-3
		Sample Date	Jul 12 2003	Jul 12 2003	Jul 12 2	003
		Sample Description	Sample #1	Sample #2	Sample #3	
		Matrix	Water - General	Water - General		
Analyte		Units	Results	Results	Results	Detection Limit
Metals To	otal					
Calcium	Total	mg/L	45.0	42.8	25.6	0.2
iron	Total	mg/L	1.5	6.5	0.2	0.1
Magnesium	n Total	mg/L	9.5	8.9	5.6	0.2
Manganes	e Total	mg/L	0.103	0.163	0.024	0.005
Potassium	Total	mg/L	1.2	1.2	1.3	0.4
Silicon	Total	mg/L	2.20	2.20	1.89	0.05
Sodium	Total	mg/L	4.1	4.0	2.9	0.4
Sulphur	Total	mg/L	1.96	2.75	6.83	0.05
Mercury	Total	mg/L	<0.0002	<0.0002	<0.0002	0.0002
Aluminum	Total	mg/L	0.243	0.120	0.040	0.005
Antimony	Total	mg/L	<0.0002	<0.0002	<0.0002	0.0002
Arsenic	Total	mg/L	0.0011	0.0029	0.0005	0.0002
Barium	Total	mg/L	0.043	0.056	0.025	0.001
Beryllium	Total	mg/L	<0.0001	<0.0001	<0.0001	0.0001
Bismuth	Total	mg/L	<0.0005	<0.0005	<0.0005	0.0005
Boron	Total	mg/L	0.014	0.013	0.013	0.002
Cadmium	Total	mg/L	0.00004	0.00018	0.0003	8 0.00001
Chromium	Total	mg/L	<0.0005	<0.0005	<0.0005	0.0005
Cobalt	Total	mg/L	0.0003	0.0005	<0.0001	0.0001
Copper	Total	mg/L	<0.001	0.002	0.001	0.001
Lead	Total	mg/L	0.0003	0.0009	0.0004	0.0001
Lithium	Total	mg/L	0.004	0.004	0.003	0.001
Molybdenu	m Total	mg/L	<0.001	<0.001	<0.001	0.001
Nickel	Total	mg/L	0.0009	0.0014	<0.0005	0.0005
Selenium	Total	mg/L	0.0002	<0.0002	<0.0002	0.0002
Silver	Total	mg/L	<0.0001	<0.0001	<0.0001	0.0001
Strontium	Total	mg/L	0.105	0.097	0.063	0.001
Thallium	Total	mg/L	<0.00005	<0.00005	<0.0000	5 0.00005
Titanium	Total	mg/L	0.0048	0.0037	0.0018	0.0005
Uranium	Total	mg/L	<0.0005	<0.0005	<0.0005	0.0005
Vanadium	Total	mg/L	0.0008	0.0013	0.0006	0.0001
Zinc	Total	mg/L	0.004	0.009	0.007	0.001



## Analytical Report

Norwest Labs 7217 Roper Road Edmonton, AB. T6B 3J4 Phone: (780) 438-5522 Fax: (780) 438-0396

Bill to:	Diversified Environmental Services	Project		
eport to:	Diversified Environmental Services	ID:	Tsinhia	
Box 6263		Name:		
	Fort St. John, BC, Canada V114H7	Location:		
Att	n: Brad Culling	LSD:		
Sampled B	v:	P.O.:		
Compan	y:	Acct. Code:		

NWL Lot ID:	244484		
Control Number:	E 139470		
Date Received:	Jul 15, 2003		
Date Reported:	Jul 22, 2003		
Report Number:	424164		

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		NWL Number	244484-4			
		Sample Date	Jul 12 2003			
		Sample Description	Sample #4			
		Matrix	Water - General			
Analyte		Units	Results	Results	Results	Detection Limit
Metals Total	And a					
Calcium	Total	mg/L	26.5			0.2
Iron	Total	mg/L	0.2			0.1
Magnesium	Total	mg/L	5.8			0.2
Manganese	Total	mg/L	0.036			0.005
Potassium	Total	mg/L	1.1			0.4
Silicon	Total	mg/L	1.21			0.05
Sodium	Total	mg/L	2.4			0.4
Sulphur	Total	mg/L	6.74			0.05
Mercury	Total	mg/L	<0.0002			0.0002
Aluminum	Total	mg/L	0.025			0.005
Antimony	Total	mg/L	<0.0002			0.0002
Arsenic	Total	mg/L	0.0005			0.0002
Barium	Total	mg/L	0.027			0.001
Beryllium	Total	mg/L	<0.0001			0.0001
Bismuth	Total	mg/L	<0.0005			0.0005
Boron	Total	mg/L	0.013			0.002
Cadmium	Total	mg/L	<0.00001			0.00001
Chromium	Total	mg/L	<0.0005			0.0005
Cobalt	Total	mg/L	<0.0001			0.0001
Copper	Total	mg/L	<0.001			0.001
Lead	Total	mg/L	<0.0001			0.0001
Lithium	Total	mg/L	0.003			0.001
Molybdenum	Total	mg/L	<0.001			0.001
Nickel	Total	mg/L	<0.0005			0.0005
Selenium	Total	mg/L	<0.0002			0.0002
Silver	Total	mg/L	<0.0001			0.0001
Strontium	Total	mg/L	0.067			0.001
Thallium	Total	ma/L	<0.00005			0.00005
Titanium	Total	mg/L	0.0009			0.0005
Uranium	Total	mg/L	<0.0005			0.0005
Vanadium	Total	mg/L	0.0004			0.0001
Zinc	Total	mg/L	0.001		/	0.001

Approved by: Anthony Neumann, MSc Laboratory Operations Manager

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#### Methodology and Notes

Norwest Labs 7217 Roper Road Edmonton, AB. T6B 3J4 Phone: (780) 438-5522 Fax: (780) 438-0396

Bill to: Diversified Environmental Services Report to: Diversified Environmental Services Box 6263 Fort St. John, BC, Canada V1J 4H7 Attn: Brad Culling Sampled By: Company: Project ID: Tsinhia Name: Location: LSD: P.O.: Acct. Code: 
 NWL Lot ID:
 244484

 Control Number:
 E 139470

 Date Received:
 Jul 15, 2003

 Date Reported:
 Jul 22, 2003

 Report Number:
 424164

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MethodName	Reference		Method	Date Analysis Completed	Location
Mercury (Total) in water	MDMES	*	Determination of Mercury in Water by Cold Vapor Atomic Absor, 245.1	Jul 22, 2003	Norwest Labs Edmonton
Metals ICP-MS (Total) in water	US EPA	•	Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	Jul 22, 2003	Norwest Labs Edmonton
Metals Trace (Total) in water	АРНА	*	Inductively Coupled Plasma (ICP) Method, 3120 B	Jul 22, 2003	Norwest Labs Edmonton

\* Norwest method(s) is based on reference method

#### References:

MDMES US EPA APHA

Method of Analysis:

Mthds for the Determination of Metals in Environmental Smpls US Environmental Protection Agency Test Methods Standard Methods for the Examination of Water and Wastewater

Comments:

Norwest		Anal	Analytical Report			Norwest Labs #104, 19575-55 A Ave. Surrey, BC. V3S 8P8 Phone: (604) 514-3322 Fax: (604) 514-3323	
Bill to: D eport to: D B Fr V Attn: Sampled By: Company:	iversified Environmental Servic iversified Environmental Servic ox 6263 ort St. John, BC, Canada 1J 4H7 Brad Culling Brad Culling Diversified Environmental	ces Project ces ID: Name: Location: LSD: P.O.: Acct. Code:	Tsinhia		NWL Lot ID: Control Number: Date Received: Date Reported: Report Number: Page:	<b>258576</b> E 160329 Sep 30, 2003 Oct 03, 2003 454248	
Analyte		NWL Number Sample Date Sample Description Matrix Units	258576-1 Sep 29, 2003 Sample #1 Water - General Results	258576-2 Sep 29, 2003 Sample #2 Water - Genera Results	25857 Sep 29, Sampi Water - G Results	76-3 2003 e #3 Seneral Detection Limit	
Extractable P EPHw10-19(SG) EPHw19-32(SG)	etroleum Hydrocarbons - Wa ) )	ug/L ug/L	<100 <100	<100 <100	<100 <100	100 100	

Approved by: John Davidson, Dipl. T, CPHI (C) Senior Chemist, Inorganics

NORWEST		Methodo	logy and Notes	Norwest Labs #104, 19575-55 A Ave. Surrey, BC. V3S 8P8 Phone: (604) 514-3322 Fax: (604) 514-3323		
Bill to: Diversi Report to: Diversi Box 626 Fort St. V1J 4H Attn: Brad Sampled By: Brad Company: Dive	fied Environmental Services fied Environmental Services 53 John, BC, Canada 7 I Culling I Culling ersified Environmental	Project ID: Name: Location: LSD: P.O.: Acct. Cod	Tsinhia de:	NWL Control N Date Re Date Re Report N	Lot ID: 258576 umber: E 160329 ceived: Sep 30, 2003 ported: Oct 03, 2003 umber: 454248 Page: 2 of 2	
Method of Analy MethodName	sis: Reference		Method	Date Analysis Started	Location	
EPH(SG) - Water	B.C. Ministry * No	of WLAP *	BCMELP Method for EPH in Waters (Version 2.1, July 20, 1999), CSR - 4 (s) is based on reference method	3-Oct-03	Norwest Labs Surrey	

#### References:

B.C. Ministry of WLAP

B.C. Ministry of Water, Land and Air Protection

Comments: