2.0 EXISTING ENVIRONMENT AND BASELINE CONDITIONS

2.1 INTRODUCTION

This section presents a description of the existing environmental conditions in the YGP study area. Data included in this Developer's Assessment Report (DAR) were drawn from the review of the existing literature, past environmental studies and from fieldwork conducted primarily during 2004 and 2005. Meteorology and hydrology work at the site have continued to the present. Table 2.1-1 provides a summary of the environmental fieldwork completed in the YGP study area since 2004 (Figure 2.1-1).

TABLE 2.1-1: ENVIRONMENTAL BASELINE FIELDWORK

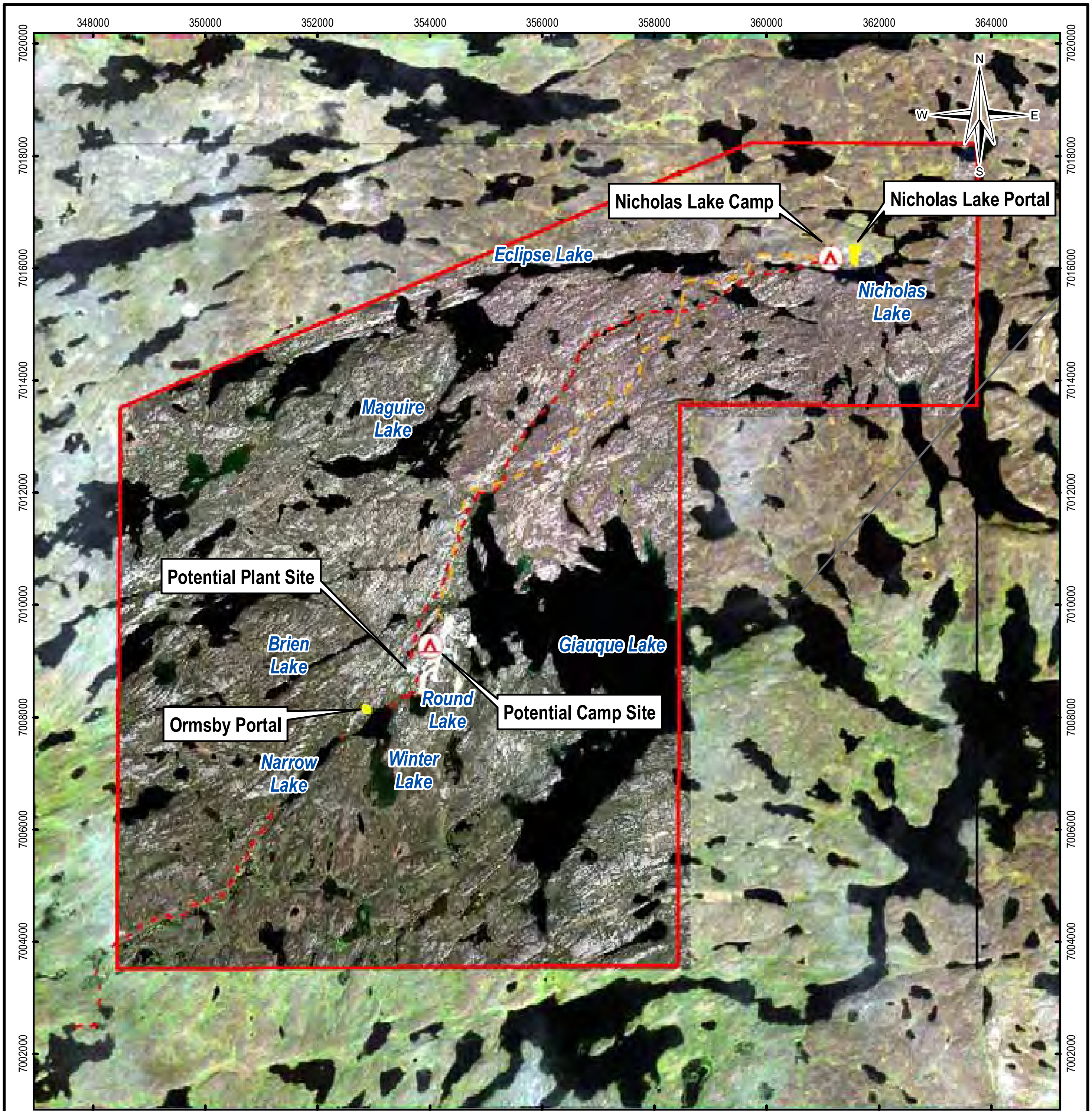
Environmental Baseline Fieldwork	Date
Snow Surveys	April 2004 and 2005
Meteorology and Hydrology	2004 to Present
Surface Water Quality / SNP Sampling	2004 and 2005 / SNP to Present
Aquatic Resources Studies	2004 and 2005
Vegetation Studies	2004 and 2005
Rare Plant Survey	2005
Archaeological Assessment	2004 and 2005
Wildlife and Waterfowl Studies	2004 and 2005

2.2 PRESENT LAND USES

Recent land use permits in the area of the YGP are summarized in Table 2.2-1. The majority of the permits are for exploration activities and to establish exploration camps to support the exploration activity. The surface dispositions in the area are summarized in Table 2.2-2. The location of these activities can be found in Figure 2.2-1.

The present uses of the area relate to mineral exploration and recreation, which can be accessed by two possible existing winter road routes. The most regularly used existing route extends from Prosperous Lake to Nicholas Lake and has been in place since the 1940s. This is the original route used to build and service the Historic Discovery Mine. The other existing route originates from the Tibbitt Lake to Contwoyto Lake winter road which has a branch road from Gordon Lake to Giaugue Lake. The route from Gordon Lake over Thistlethwaite Lake to Giauque Lake has been improved by the Tibbitt to Contwoyto winter road joint venture and has been named the secondary route, which was put in place to reduce traffic loads on the main winter road. From Giauque Lake, the secondary route generally follows the alignment of the winter road mentioned above to Prosperous Lake.

Recreational use of the area includes: casual snowmobiling, hunting and fishing and access to private cabins. There are no known recreation cabins within the YGP area.



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LEGEND

- Camp
- Local Study Area
- Nicholas Lake Access Road
- Winter Road

NOTES

1. Imagery Source: IKONOS (July 27 and August 2, 2004); Landsat TM (August 11, 2001).

ISSUED FOR USE

YELLOWKNIFE GOLD PROJECT

Local Study Area

PROJECTION UTM Zone 12	DATUM NAD83

Scale: 1:100,000

1 0.5 0 1 2 3

Kilometres

FILE NO. V23201097-DAR-003.mxd

Tyhee NWT Corp

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
V23201097	SL	RH	0

OFFICE	DATE
EBA-VANC	February 17, 2011

Figure 2.1-1

TABLE 2.2-1: SUMMARIES OF RECENT LAND USE PERMITS IN THE YGP STUDY AREA

FILE	LAT	LON	STATUS	LOCATION	Use	Permitee
M2000C0035	63.1833	-113.9167	Inactive	GIAQUE LAKE	Mining (Exploration)	Tyhee NWT Corp
M2000C0064	63.0167	-114	Inactive	BARKER LAKE	Oil & Gas	Nickerson and Rasmussen
M2001F0004	62.8833	-114.2667	Open/Active	GIAQUE LAKE	Roads (Private Cons)	RTL-Robertson Transport Ltd.
M2001F0005	63.1667	-113.5667	Open/Active	GORDON LAKE TO NICHOLAS LAKE	Roads (Private Cons)	RTL-Robertson Transport Ltd.
M2001J0086	62.6333	-114.2667	Open/Active	BANTING LAKE	Campsites	Walter Humpheries
M2001Q0002	62.6667	-114.1	Open/Active	PROSPEROUS LAKE	Quarrying	RTL-Robertson Transport Ltd.
M2001X0017	63.25	-113.75	Inactive	85P/4	Miscellaneous	Tyhee NWT Corp
M2002C0010	63.2	-113.75	Inactive	NICHOLAS LAKE	Mining (Exploration)	Tyhee NWT Corp
M2002C0011	63.2	-113.95	Inactive	GAIUQUE LAKE	Mining (Exploration)	Tyhee NWT Corp
M2003H0015	63	-114	Open/Active	WECHO LAKE	Fuel Storage Sites	NWT Geoscience Office
M2003X0034	63.1833	-113.8833	Inactive	DISCOVERY MINESITE	Miscellaneous	DIAND Contaminated Sites
M2004C0026	63.0583	-114.0444	Inactive	GOODWIN LAKE	Mining (Exploration)	Allyn Resources Inc
M2004C0050	63.05	-114	Open/Active	MORRIS LAKE AREA	Mining (Exploration)	Viking Gold Exploration Inc.
M2004F0005	62.7167	-114.2667	Open/Active	BLUEFISH TO DUNCAN LAKE	Roads (Private Cons)	NWT Power Corp
M2004X0052	63.1833	-113.8833	Open/Active	DISCOVERY MINE SITE	Miscellaneous	DIAND Contaminated Sites
M2005C0001	63.1	-113.6167	Open/Active	GIAUQUE LAKE, NICHOLAS LAKE	Mining (Exploration)	Tyhee NWT Corp
M2005D0009	63.1667	-113.8833	Application	ORMSBY PORTAL/GIAUQUE LAKE	Mining	Tyhee NWT Corp
M2006C0035	62.6444	-114.3	Open/Active	BANTING LAKE	Mining (Exploration)	Strongbow Exploration Inc.
M2007C0011	62.9	-114.2083	Open/Active	CLAN LAKE	Mining (Exploration)	Tyhee NWT Corp

Source: http://nwt-tno.inac-ainc.gc.ca/ism-sid/index_e.asp

TABLE 2.2-2: SUMMARY OF SURFACE DISPOSITIONS IN THE YGP AREA

File	LAT	LONG	Type	Status	Location	Purpose	Use	Size (ha.)	Client	Address
085I05027	62.9833	113.4833	Notated	Application	KM 49 INGRAHAM TRAIL	Unauthorized	No Land Tenure	0.49	Unauthorized Occupant	General Delivery, Yellowknife, NT, X1A 2L8
085I13001	62.8911	113.8678	Lease	Open/Active	DUNCAN AND GRAHAM LAKES	Commercial	Fishing Lodge	2.82	Yellow Dog Lodge Inc.	1806 Rutledge Court, Fort Collins, CO, 80526
085I13002	62.8781	113.6411	Lease	Open/Active	NORTH EAST SHORE WEDGE LAKE	Private/ Residential	Traditional Use	2.25	Turner Robert Daniel Bryan	P.O. Box 272, Yellowknife, NT, X1A 2N2
085I13003	62.7625	113.7867	Notated	Application	SOUTH OF WEDGE LAKE	Unauthorized	No Land Tenure	0.49	Unauthorized Occupant	General Delivery, Yellowknife, NT, X1A 2L8
085I13004	62.7772	113.7978	Lease	Open/Active	SOUTH OF WEDGE LAKE	Private/ Residential	Hunting and Fishing	0.09	Mullin Travis Melvin	128 William Bell, Leduc, AB, T9E 7L4
085J06002	62.8031	114.0625	Inactive	Inactive	WHITEBEACH POINT	Private/ Recreational	Cottage	0.36	Carr William John	P.O. Box 2036 , Yellowknife, NT, X1A 2P5
085J09007	62.6267	114.2992	Lease	Open/Active	WEST SHORE BANTINGLAKE	Private/ Recreational	Org. Campsite	0.37	Yellowknife Ski Club	P. O. BOX 1598 , Yellowknife , NT, X1A 2P2
085J09010	62.6167	114.2667	Inactive	Inactive	E SHORE BANTING LAKE	Private/ Recreational	Cottage	0.023	Lovell David	General Delivery, Yellowknife, NT, X1A 2L8
085J09017	62.6722	114.2583	Lease	Open/Active	BLUEFISH LAKE	Mining	Power Plant	4.9	NWT Power Corporation	4 Capital Dr., Hay River, NT, XOE G2
085J09018	62.7167	114.2667	Inactive	Inactive	QUYTA LAKE	Unauthorized	Abandoned Site	7.47	Cadieux Richard	P.O. Box 6, Hay River, NT, X0E 0R0
085J09019	62.6667	114.3167	Inactive	Inactive	BLUEFISH LAKE	Mining	Power Plant	221.54	Cominco Ltd.	Suite 2200 120 Adelaide Street W., Toronto, ON, M5H 1T1
085J09022	62.6667	114.3167	Inactive	Inactive	BLUEFISH LAKE	Mining	Power Plant	2.11	Cominco Ltd.	Suite 2200 120 Adelaide Street W., Toronto, ON, M5H 1T1

TABLE 2.2-2: SUMMARY OF SURFACE DISPOSITIONS IN THE YGP AREA

File	LAT	LONG	Type	Status	Location	Purpose	Use	Size (ha.)	Client	Address
085J09023	62.6667	114.3167	Inactive	Inactive	BLUEFISH LAKE	Mining	Power Plant	0.98	Cominco Ltd.	Suite 2200 120 Adelaide Street W., Toronto, ON, M5H 1T1
085J09024	62.6667	114.3167	Inactive	Inactive	BLUEFISH LAKE	Mining	Power Trans. Line	0.87	Cominco Ltd.	Suite 2200 120 Adelaide Street W., Toronto, ON, M5H 1T1
085J09028	62.6167	114.3	Lease	Open/Active	BERRY HILL	Utility	Communications Facil	2.08	Northern Communication & Navigation Systems Ltd.	P.O. Box 2317, Yellowknife, NT, X1A 2P7
085J09036	62.6667	114.1667	License	Open/Active	THOMPSON MINE TO PROSPEROUS	Mining	Power Trans. Line	93.74	Thompson Lundmark Gold Mines Ltd.	General Delivery, Yellowknife, NT, X1A 2L8
085J09044	62.7	114.25	License	Open/Active	BLUEFISH TO CON MINE	Utility	Power Distribution	76.79	NWT Power Corporation	4 Capital Dr. , Hay River, NT, XOE 1G2
085J09060	62.6667	114.3167	Inactive	Inactive	CLSR42314&42315,BL UEFISH TO GIAUQUE LAKE	Mining	Mine Site	78.57	Discovery Mines Ltd.	Suite 1011 2200 Yonge Street, Toronto, ON, M4S 2C6
085J09090	62.7	114.2	Reserve	Open/Active	BAPTISTE, DRYGEES, ETC LAKES	Government	Research Site	9363.2	Fisheries & Oceans	P.O. Box 2310 , Yellowknife, NT, X1A 2P7
085J09091	62.6667	114.25	Inactive	Inactive	BLUEFISH LAKE	Mining	Power Plant	31.23	Cominco Ltd.	Suite 2200 120 Adelaide Street W., Toronto, ON, M5H 1T1
085J09097	62.7208	114.3397	Lease	Open/Active	NORTH SHORE OF BEAUREGARD LAKE	Private/ Residential	Traditional Use	0.36	Powless Robert	c/o Box 1165 , Yellowknife, NT, X1A 2N8
085J09099	62.7197	114.4206	Lease	Open/Active	NARCISSE LAKE	Private/ Residential	Hunting and Fishing	0.49	Kuniliusee Sara	2 Bromley Drive, Yellowknife, NT, X1A 2X8
085J09105	62.6506	114.2406	Lease	Open/Active	PROSPEROUS LAKE	Private/ Residential	Traditional Use	0.49	Heron Irene M.	#9 Riverbend Road , Hay River, NT, X0E 0R2

TABLE 2.2-2: SUMMARY OF SURFACE DISPOSITIONS IN THE YGP AREA

File	LAT	LONG	Type	Status	Location	Purpose	Use	Size (ha.)	Client	Address
085J09112	62.6361	114.3317	Notated	Application	ORO LAKE	Unauthorized	No Land Tenure	0.49	Unauthorized Occupant	General Delivery, Yellowknife, NT, X1A 2L8
085J09113	62.6667	114.2833	Notated	Application	GREYLING LAKE	Unauthorized	No Land Tenure	0.49	Sutherland David	6076 Caledonia Crescent, Prince George, BC, V2N 2H3
085J09114	62.625	114.2667	Notated	Application	WALSH LAKE	Unauthorized	No Land Tenure	0.49	Unauthorized Occupant	General Delivery, Yellowknife, NT, X1A 2L8
085J09116	62.6397	114.2453	Notated	Application	PROSPEROUS LAKE	Unauthorized	No Land Tenure	0.49	Unauthorized Occupant	General Delivery, Yellowknife, NT, X1A 2L8
085J09119	62.7472	114.4775	Notated	Application	NARCISSE LAKE	Unauthorized	No Land Tenure	0.49	Unauthorized Occupant	General Delivery, Yellowknife, NT, X1A 2L8
085J09120	62.75	114.0167	Inactive	Inactive	EAST SIDE OF RIVER LAKE ROAD, NEAR PRELU	Commercial	Tourist Facility	15	Labelle Barbara	P.O. Box 716 , Yellowknife, NT, X1A 2N5
085J09122	62.7	114.3133	Notated	Application	UNAMED LAKE WEST OF BLUEFISH LAKE	Unauthorized	No Land Tenure	0.49	Unauthorized Occupant	General Delivery, Yellowknife, NT, X1A 2L8
085J09123	62.6236	114.3128	Notated	Application	UNNAMED LAKE WEST OF BANTING LAKE	Unauthorized	No Land Tenure	0.49	Unauthorized Occupant	General Delivery, Yellowknife, NT, X1A 2L8
085J09124	62.6325	114.2833	Notated	Application	WEST OF BANTING LAKE	Unauthorized	No Land Tenure	0.49	Unauthorized Occupant	General Delivery, Yellowknife, NT, X1A 2L8
085J09129	62.6375	114.2694	Notated	Application	BANTING LAKE, NT	Unauthorized	No Land Tenure	0.49	Unauthorized Occupant	General Delivery, Yellowknife, NT, X1A 2L8
085J09130	62.6481	114.2789	Notated	Application	BANTING LAKE, NT	Unauthorized	No Land Tenure	0.49	Unauthorized Occupant	General Delivery, Yellowknife, NT, X1A 2L8

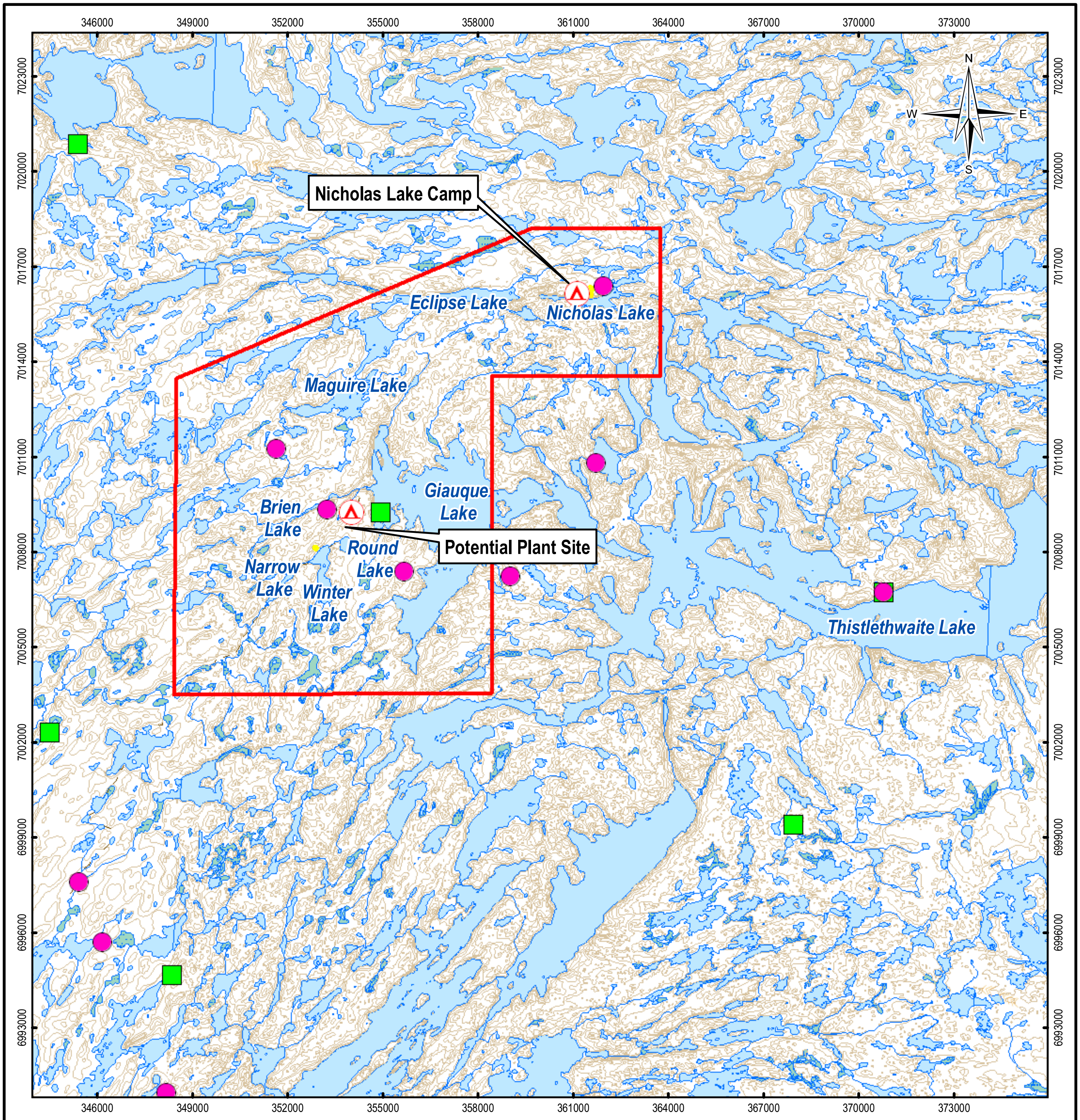
TABLE 2.2-2: SUMMARY OF SURFACE DISPOSITIONS IN THE YGP AREA

File	LAT	LONG	Type	Status	Location	Purpose	Use	Size (ha.)	Client	Address
085J09133	62.7392	114.4553	Lease	Open/Active	NARCISSE LAKE	Private/ Residential	Hunting and Fishing	0.04	O'Keefe Cameron, Loman	email address only okeefe@northwestel.net, Yellowknife, NT,
085J15006	63	114	Easement	Open/Active	YELLOWKNIFE TO SNARE HYDRO	Utility	Power Distribution	737.6	NWT Power Corporation	4 Capital Dr. , Hay River, NT, XOE 1G2
085J16002	62.8053	114.0533	Lease	Open/Active	DUNCAN LAKE	Utility	Hydro Dam	1.18	NWT Power Corporation	4 Capital Dr. , Hay River, NT, XOE 1G2
085J16003	62.8	114.05	Lease	Open/Active	DUNCAN LAKE	Mining	Storage	18	NWT Power Corporation	4 Capital Dr. , Hay River, NT, XOE 1G2
085J16004	62.6667	114.3167	Inactive	Inactive	CLSR42314&42315,BL UEFISH TO GIAUQUE LAKE	Mining	Power Trans. Line	7.57	Consolidated Discovery Yellowknife Mines Limited	Suite 509 25 Adelaide St. W., Toronto, ON, M4S 2T6
085J16005	62.7	114.2	Reserve	Open/Active	AROUND BAPTISTE/ DRYGEESELK	Government	Research Site	0.001	DIAND	10 Wellington Street Les Terrasses de la Chaudiere, Ottawa
085J16006	62.7703	114.21	Lease	Open/Active	SHORT POINT LAKE	Private/ Residential	Traditional Use	0.38	Paul John Robert	Box 124, Cochrane, AB, T0L 1W0
085J16007	62.8	114.0167	Reserve	Open/Active	DUNCAN LAKE	Government	Stream Gauge	1	DOE-WS	Suite 301, 5204 -50th Avenue, Yellowknife, NT, X1A 1E2
085J16008	62.8981	114.3272	Lease	Open/Active	DISCOVERY LAKE	Mining	Mill Site	12.35	Eggenberger Albert C.	34 Bromley Drive, Yellowknife, NT, X1A 2X8
085J16009	62.8833	114.2667	Notated	Application	SITO LAKE	Unauthorized	No Land Tenure	0.49	Unauthorized Occupant	General Delivery, Yellowknife, NT, X1A 2L8
085J16010	62.9939	114.3358	Notated	Application	ROCKY LAKE	Unauthorized	No Land Tenure	0.49	Unauthorized Occupant	General Delivery, Yellowknife, NT, X1A 2L8

TABLE 2.2-2: SUMMARY OF SURFACE DISPOSITIONS IN THE YGP AREA

File	LAT	LONG	Type	Status	Location	Purpose	Use	Size (ha.)	Client	Address
085J16011	62.7553	114.3106	Lease	Open/Active	QUYTA LAKE, NT	Private/ Residential	Hunting and Fishing	0.36	Dragon Joseph Ignace	680 Mansfield Ave, Ottawa. ON, K2A 2T6
085O01002	62.6667	114.3167	Inactive	Inactive	CLSR 42314&42315,BLUEFISHTO GIAUQUE LAK	Mining	Power Trans. Line	0.001	Consolidated Discovery Yellowknife Mines Limited	Suite 509 25 Adelaide St. W., Toronto, ON, M4S 2T6
085O01003	63.0167	114.1667	Inactive	Inactive	CABIN LAKE	Mining	Exploration Camp	0.001	Ashnola Mining Company Ltd.	General Delivery , Yellowknife , NT, X1A 2L8
085O03004	63	114.5	Easement	Open/Active	YELLOWKNIFE TO SNARE HYDRO	Utility	Power Distribution	737.6	NWT Power Corporation	4 Capital Dr. , Hay River, NT, XOE 1G2
085O08002	63.2667	114.2167	Inactive	Inactive	FISHING LAKE	Commercial	Tourist Facility	3.34	Avens Aircraft Service	General Delivery, Yellowknife, NT, X1A 2L8
085P04001	63.1833	113.8833	Reserve	Application	GIAUQUE LAKE	Government	Contaminated Site	100	DIAND – Contaminants & Remediation Directorate	P.O. Box 1500, Yellowknife, NT, X1A 2R3
085P04002	62.6667	114.3167	Inactive	Inactive	CLSR 42314 & 42315, BLUEFISH TO GIAUQUE LAK	Mining	Power Trans. Line	78.57	Discovery Mines Ltd.	Suite 1011 2200 Yonge Street, Toronto, ON, M4S 2C6
085P04003	63.2167	113.65	Reserve	Open/Active	MCCREA RIVER	Utility	Communications Facil	1	Government of the NWT Renewable Resources	P.O. Box 2668, Yellowknife, NT, X1A 2P9
085P04004	63.15	113.6	Notated	Application	THISTLEWAITE LAKE	Unauthorized	No Land Tenure	0.49	Unauthorized Occupant	General Delivery, Yellowknife, NT, X1A 2L8

Source: http://nwt-tno.inac-ainc.gc.ca/ism-sid/index_e.asp



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LEGEND

	Camp		Esker	**Land Use**	
	Local Study Area		Contour		Inactive
	Portal		Watercourse		Open/Active
	Trail		Wetland		
			Waterbody		

NOTES

1. Land Use Source: http://nwt-tno.inac-ainc.gc.ca/ism-sid/index_e.asp
2. Base data source: 1:50,000 NTS.

ISSUED FOR USE

YELLOWKNIFE GOLD PROJECT

Land Uses and Land Dispositions in the Yellowknife Gold Project Area

PROJECTION	DATUM
UTM Zone 12	NAD83

Scale: 1:175,000

2 1 0 2 4

Kilometres

Tyhee NWT Corp

EBA Engineering Consultants Ltd.

FILE NO.			
V23201097-DAR-006.mxd			
PROJECT NO.	**DWN**	**CKD**	**REV**
V23201097	SL	RH	0
OFFICE	**DATE**		
EBA-VANC	February 17, 2011		

Figure 2.2-1

2.3 ENVIRONMENTAL SETTING

The Yellowknife Gold Project (YGP) is situated within two ecoregions. The Great Slave Upland High Boreal Ecoregion covers the southern portion of the study area, while the Great Slave Upland Low Subarctic Ecoregion covers the north. Both ecoregions are dominated by bedrock outcrops and forests composed of black spruce (*Picea mariana*), jack pine (*Pinus banksiana*), and paper birch (*Betula papyrifera*), the latter two species often occurring in areas regenerating after fire (Ecosystem Classification Group 2008).

A large portion of the Great Slave Upland High Boreal Ecoregion was covered by Glacial Lake McConnell, which resulted in the deposition of lacustrine and glaciofluvial materials of varying textures and wave-washed bouldery till in between rock exposures and fractures (Ecosystem Classification Group 2008). These deposition patterns are reflected in the forests growing throughout the ecoregion; forest cover is generally discontinuous and patchy in areas with thin soils over bedrock or coarse-textured outwash. In areas with deeper, finer-textured substrates, forest cover tends to be denser and more continuous. Lowland areas and peat plateaus support wetland communities with a more limited and open tree cover.

The Great Slave Upland Low Subarctic Ecoregion has a colder climate than the Great Slave Upland High Boreal Ecoregion to the south, yet displays similar vegetation patterns (Ecosystem Classification Group 2008). Areas of exposed bedrock support a discontinuous cover of forested woodland while till plains maintain more a more consistent cover of spruce dominated forest. Organic deposits occur frequently across the landscape; however tend to be limited in size.

Fire also influences the structure and distribution of vegetation across the boreal landscape. In High Boreal ecoregions, extensive jack pine forests can develop following intense crown fires that facilitate seed release. The fire return interval in these areas often ranges between 80-140 years (Ecosystem Classification Group 2008). In Low Subarctic ecoregions further to the north, the fire return interval is generally longer, with fires burning every 140 years or more. Fires in these areas are often less severe and are restricted to the ground surface, conditions which tend to favour the regeneration of black spruce.

2.4 CLIMATE

The Yellowknife Gold Project has a continental polar climate, characterized by long, cold winters and short, cool summers. Daily temperatures are often below -20 ºC during winter and can reach 30 ºC in summer. Snow accounts for 38 % of the annual precipitation, which can occur year-round, but usually occurs between late September and early May. Precipitation is seldom of high intensity, and usually occurs as prolonged, low-intensity events.

A 10-metre meteorological station (Site #7 - Tyhee Meteorological Station), was installed on September 28, 2004, and continues to provide site-specific climate conditions at the Yellowknife Gold Project. The station records: wind speed and direction, air temperature, barometric pressure, relative humidity, incident solar radiation, precipitation during the summer period, and pan evaporation. Table 2.4-1 summarizes meteorological data collected at the YGP from 2004 to 2010.

The Yellowknife Airport meteorological station (Climate ID: 2204100), operated by the Meteorological Service of Canada, provide a 75-year climate record for the Yellowknife area and is used as a basis for describing long-term climate trends for the YGP area (Environment Canada 2008). 30-year climate normals (1981-2010) from Yellowknife Airport are presented in Table 2.4-2.

TABLE 2.4-1: SUMMARY OF YELLOWKNIFE GOLD PROJECT CLIMATE DATA (OCTOBER 2004 – DECEMBER 2010)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature													
Average Daily Maximum (ºC)	-21.1	-18.2	-10.8	1.3	8.8	18.0	21.0	17.7	9.4	0.7	-10.6	-18.7	-0.2
Average Daily Minimum (ºC)	-28.8	-26.7	-22.6	-10.2	-2.0	7.7	11.7	9.3	3.2	-4.5	-17.4	-25.9	-8.8
Daily Mean (ºC)	-24.7	-22.5	-16.8	-4.5	3.5	12.9	16.2	13.3	6.1	-2.0	-13.7	-22.2	-4.5
Extreme Maximum (ºC)	0.2	0.4	7.0	16.7	27.0	30.1	30.1	31.3	24.7	15.8	5.3	-2.7	31.3
Extreme Minimum (ºC)	-45.1	-44.5	-40.5	-34.4	-13.7	-1.1	2.7	2.1	-7.2	-16.8	-38.3	-42.5	-45.1
Precipitation													
Precipitation (mm)	14.3	15.9	8.0	12.6	11.2	25.4	42.8	46.0	35.2	17.2	19.2	8.4	256.2
Extreme Daily Precipitation (mm)	11.2	15.5	3.3	10.4	15.0	29.5	21.1	17.0	34.5	7.9	17.0	6.6	34.5

Source: Tyhee Meteorological Station (EBA 2006-2010) Appendix B

TABLE 2.4-2: YELLOWKNIFE CLIMATE NORMALS (1981 – 2010)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature													
Average Daily Maximum (ºC)	-21.6	-18.1	-10.8	0.5	9.7	18.1	21.3	18.1	10.5	1.1	-9.7	-18.1	0.1
Average Daily Minimum (ºC)	-29.5	-27.4	-22.7	-10.9	-0.5	8.6	12.6	10.4	4.1	-4.0	-17.2	-25.9	-8.5
Daily Mean (ºC)	-25.6	-22.8	-16.8	-5.2	4.6	13.4	17.0	14.3	7.3	-1.5	-13.5	-22.1	-4.2
*Extreme Maximum (ºC)	3.4	6.2	9.3	20.3	26.1	30.3	32.5	30.9	26.1	19.0	7.8	2.8	32.5
*Extreme Minimum (ºC)	-51.2	-51.2	-43.3	-40.6	-22.8	-4.4	0.6	-0.6	-9.7	-28.9	-44.4	-48.3	-51.1
Precipitation													
Rainfall (mm)	0.2	0.03	0.2	2.6	13.0	30.7	39.3	39.2	35.8	11.3	0.4	0.2	173.0
Snowfall (cm)	21.4	19.4	17.6	9.6	4.1	0.04	0.0	0.1	3.6	21.4	36.9	23.2	157.1
Precipitation (mm)	15.3	13.4	13.0	10.9	16.9	30.8	39.3	39.2	39.5	29.9	25.7	15.6	289.4
*Extreme Daily Rainfall (mm)	2.4	0.8	3.0	14.4	34.0	36.8	66.0	82.8	37.6	35.6	7.1	2.2	82.8
*Extreme Daily Snowfall (cm)	16.4	23.7	16.2	13.0	11.2	3.0	-	1.0	15.2	26.4	15.0	20.2	26.4
*Extreme Daily Precipitation (mm)	14.2	17.5	12.4	14.4	34.0	36.8	66.0	82.8	38.8	35.6	12.2	11.4	82.8
Mean Month-End Snow Cover (cm)	32	40	38	3	-	-	-	-	1	6	20	26	-

Source: Environment Canada
*Extremes based on historical (1942-2010) data.

2.4.1 Climate Monitoring

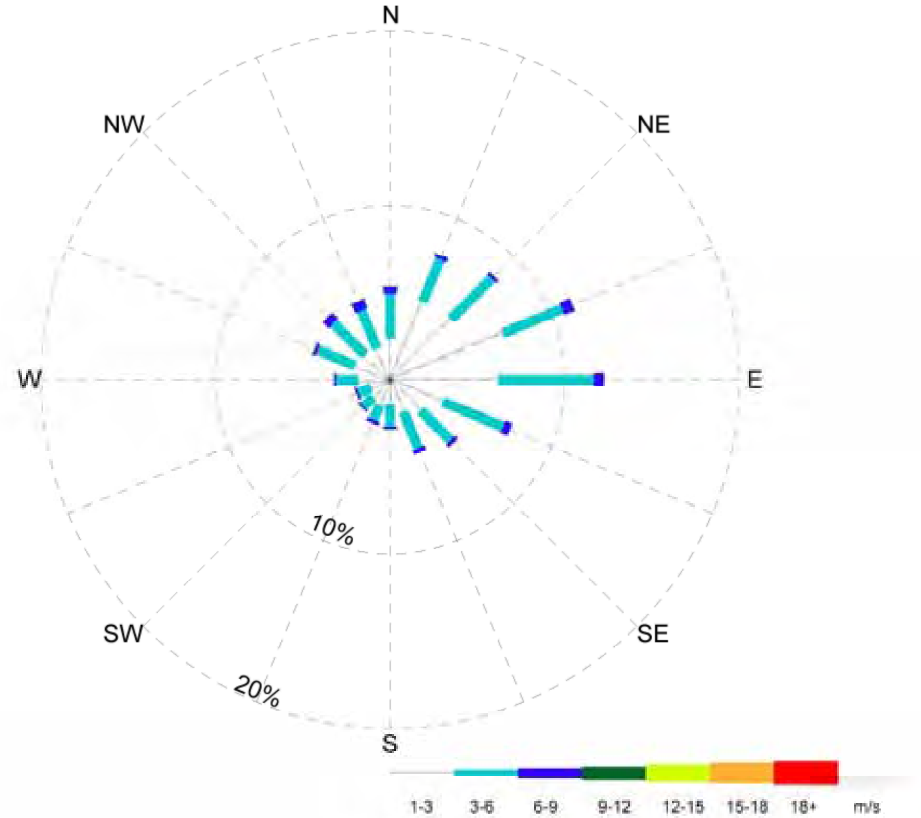
2.4.1.1 Wind Speed and Direction

Frequency distributions of wind speed and wind direction are presented in a stacked bar chart in a polar format called a wind rose. The orientation of the bar represents 16 direction points of a compass, and depicts the direction the wind is blowing from for each 22.5° sector. The length of each bar represents the frequency (%) the wind is blowing from for that given direction. Each bar is divided into segments to represent different wind speed classes.

Figure 2.4-1a illustrates the wind rose and wind speed frequency distribution at the Yellowknife Gold Project, based on the period of record from September 28, 2004 to December 31, 2010. Winds at the YGP are predominantly from the east, with winds blowing from the ENE, E and ESE 31% of the time. Wind speeds are relatively calm with a 95% occurrence of winds below 6 m/s.

The wind rose and wind speed frequency-direction distribution for the Yellowknife Airport (period of record is 56.8 years) is shown in Figure 2.4-1b. A similar directional pattern to those observed at the YGP is evident. Wind speeds also exhibit a similar distribution but are slightly higher, winds less than 6 m/s occur 80% of the period of record.

The average daily wind speed and the daily maximum recorded wind speed at the YGP over the period of record are presented in Figure 2.4-2. Daily maximum wind gusts are typically 7 or 8 m/s and the average daily wind speed is typically 3 m/s. The maximum recorded wind speed over the period of record was 20.6 m/s. The maximum average daily wind speed for the period of record was 9.2 m/s. A sinusoidal yearly pattern to wind gusts is apparent with slightly higher wind gusts occurring during the summer months.



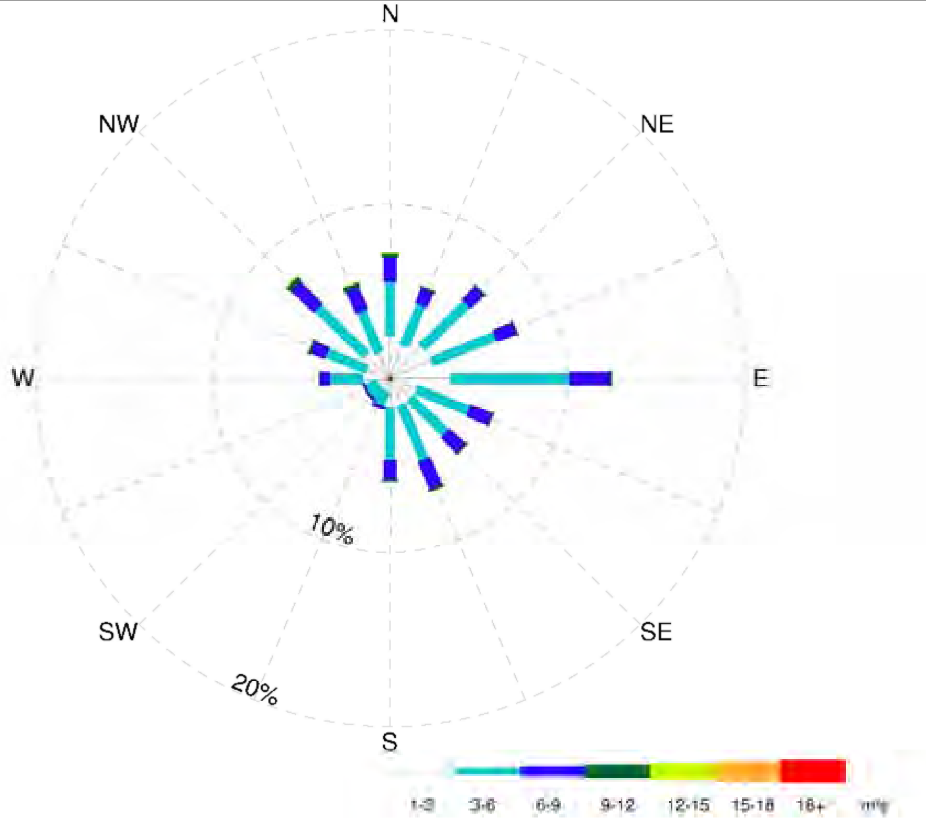
Wind Speed & Direction Frequency Distribution Table

Station Name: Tyhee
NAD 27 location:
N63° 11' 6.2" W113° 53' 40.2"
Elevation above SL: 300 m
Tower Height: 10 m
Record Length: 2190 days
Start Date: Jan. 01, 2005
End Date: Dec. 31, 2010
Comment:

	Percent Occurrence (%)								
Direction	0-1 m/s	1-3 m/s	3-6 m/s	6-9 m/s	9-12 m/s	12-15 m/s	15-18 m/s	18+ m/s	Total (%)
ENE	-	6.99	3.69	0.61	-	-	-	-	11.29
NE	-	4.94	3.30	0.16	-	-	-	-	8.40
NNE	-	4.86	2.63	0.20	0.01	-	-	-	7.71
N	-	2.39	2.58	0.38	0.03	-	-	-	5.38
NNW	-	1.96	2.36	0.50	0.05	-	-	-	4.88
NW	-	2.04	2.58	0.46	-	-	-	-	5.09
WNW	-	2.19	2.33	0.16	-	-	-	-	4.67
W	-	1.80	1.31	0.10	-	-	-	-	3.21
WSW	-	1.20	0.77	0.10	-	-	-	-	2.07
SW	-	1.40	0.76	0.08	-	-	-	-	2.24
SSW	-	1.58	0.91	0.17	-	-	-	-	2.65
S	-	1.39	1.29	0.15	-	-	-	-	2.83
SSE	-	1.99	2.24	0.26	-	-	-	-	4.49
SE	-	2.47	2.43	0.21	-	-	-	-	5.11
ESE	-	3.29	3.71	0.43	-	-	-	-	7.43
E	-	6.19	5.49	0.55	0.02	-	-	-	12.25
Calm	10.30	-	-	-	-	-	-	-	10.30
Total (%)	10.30	46.68	38.37	4.52	0.13	-	-	-	100.00

Figure 2.4-1a

Wind Rose for Yellowknife Gold Project Site



Station Name: Yellowknife Airport
NAD 83 location:
N62° 27' 46.0" W114° 26' 25.0"
Elevation above SL: 206 m
Tower Height: 10 m
Record Length: 58 years
Start Date: January 1, 1953
End Date: December 31, 2010

Wind Speed & Direction Frequency Distribution Table

	Percent Occurrence (%)								
Direction	**0-1 m/s**	**1-3 m/s**	**3-6 m/s**	**6-9 m/s**	**9-12 m/s**	**12-15 m/s**	**15-18 m/s**	**18+ m/s**	**Total (%)**
ENE	-	2.53	3.86	1.19	0.08	-	-	-	7.65
NE	-	2.56	3.52	1.04	0.09	-	-	-	7.23
NNE	-	2.04	2.53	0.93	0.11	0.01	-	-	5.62
N	-	2.44	3.11	1.43	0.21	0.02	-	-	7.22
NNW	-	1.61	2.59	1.35	0.26	0.04	-	-	5.86
NW	-	1.91	3.82	1.81	0.31	0.05	-	-	7.90
WNW	-	1.41	2.42	0.90	0.14	0.02	-	-	4.89
W	-	1.54	1.86	0.52	0.06	-	-	-	4.00
WSW	-	0.69	0.74	0.14	0.01	-	-	-	1.59
SW	-	0.68	0.73	0.14	-	-	-	-	1.55
SSW	-	0.73	0.88	0.19	-	-	-	-	1.79
S	-	1.64	3.01	1.14	0.10	-	-	-	5.91
SSE	-	1.62	3.38	1.71	0.16	0.01	-	-	6.88
SE	-	1.57	2.83	1.24	0.10	-	-	-	5.74
ESE	-	1.57	3.21	1.30	0.07	-	-	-	6.16
E	-	3.41	6.71	2.26	0.12	-	-	-	12.51
Calm	7.51	-	-	-	-	-	-	-	7.51
Total (%)	7.51	27.96	45.19	17.27	1.85	0.19	0.03	-	100.00

Figure 2.4-1b

Wind Rose for Yellowknife Airport

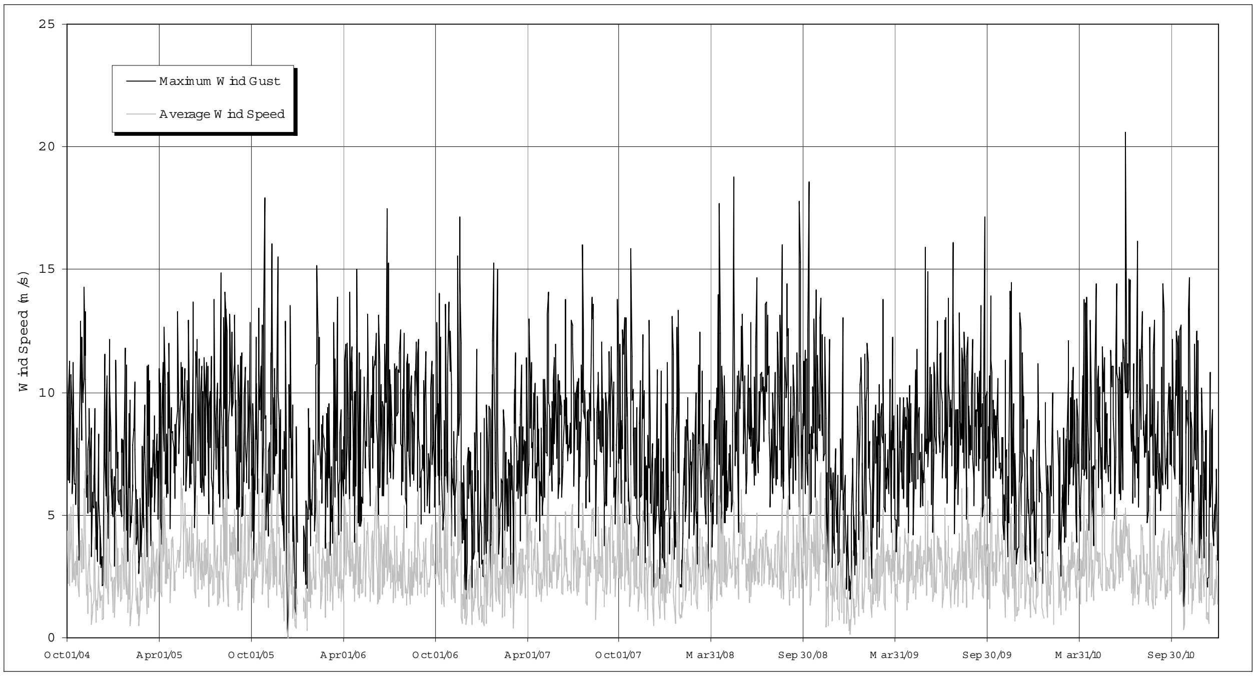


Figure 2.4-2
Daily Maximum Recorded Wind Gust Speed – Yellowknife Gold Project

2.4.1.2 Air Temperature

Figure 2.4-3 illustrates air temperature data recorded at the YGP site over the period of record. The mean air temperature is shown as a thick red line bounded by thin black lines indicating the maximum and minimum temperatures for the day. Generally, daily air temperature varies ±10 °C from the mean. A strong yearly pattern to air temperature is evident. The summer period typically occurs between late May and August with temperatures ranging from as high as 30 °C to as low as 2 °C. The warmest period of the year typically occurs between late June and early August, with a mean temperature of 15 °C and overnight temperatures rarely dropping below 10 °C. In late August, temperatures begin to drop to winter normals.

The coldest period for the site typically occurs between late November and late February. During this period, the mean daily temperature is -25 °C; however the lowest temperature recorded over the period of record was -45.1 °C. Air temperatures rarely rise above -15 °C during the winter period. Temperatures begin to increase between February and April to normal summer temperatures.

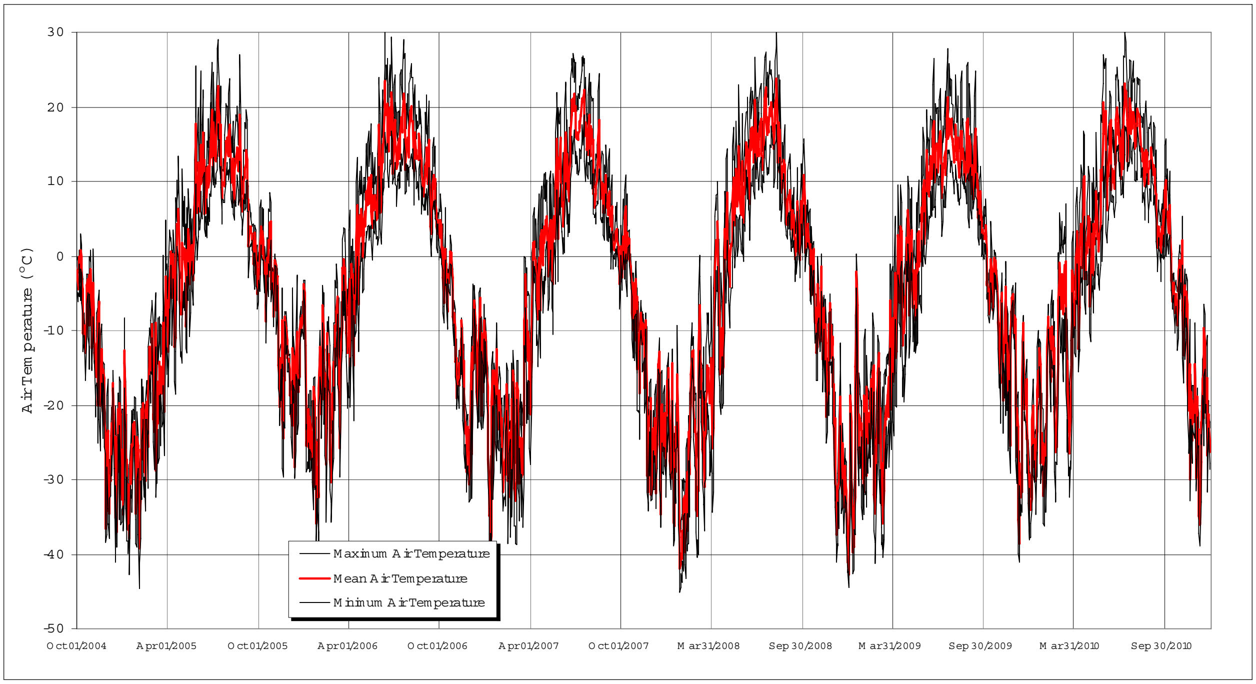


Figure 2.4-3
Daily Air Temperatures – Yellowknife Gold Project

2.4.1.3 Incident Solar Radiation

Due to its latitude of 63° 11', there is a large yearly variation in the amount of solar radiation that the YGP area receives during the year. Over the winter period, the sun is lowest in the sky; hence solar radiation is at a minimum, on the order of less than 100 Watts/square metre (W/m^2) with daily variations usually less than 50 W/m^2. At the winter solstice, the area receives about 5 hours of sunlight per day.

During the summer period, incident solar radiation is at its highest, with peak values averaging about 900 W/m^2. During the summer months, cloud cover can reduce the maximum amount of solar radiation received in the day to less than 400 W/m^2. At the summer solstice, the area receives around 20 hours of sunlight per day. The daily maximum incident solar radiation recorded at the YGP over the period of record is plotted in Figure 2.4-4.

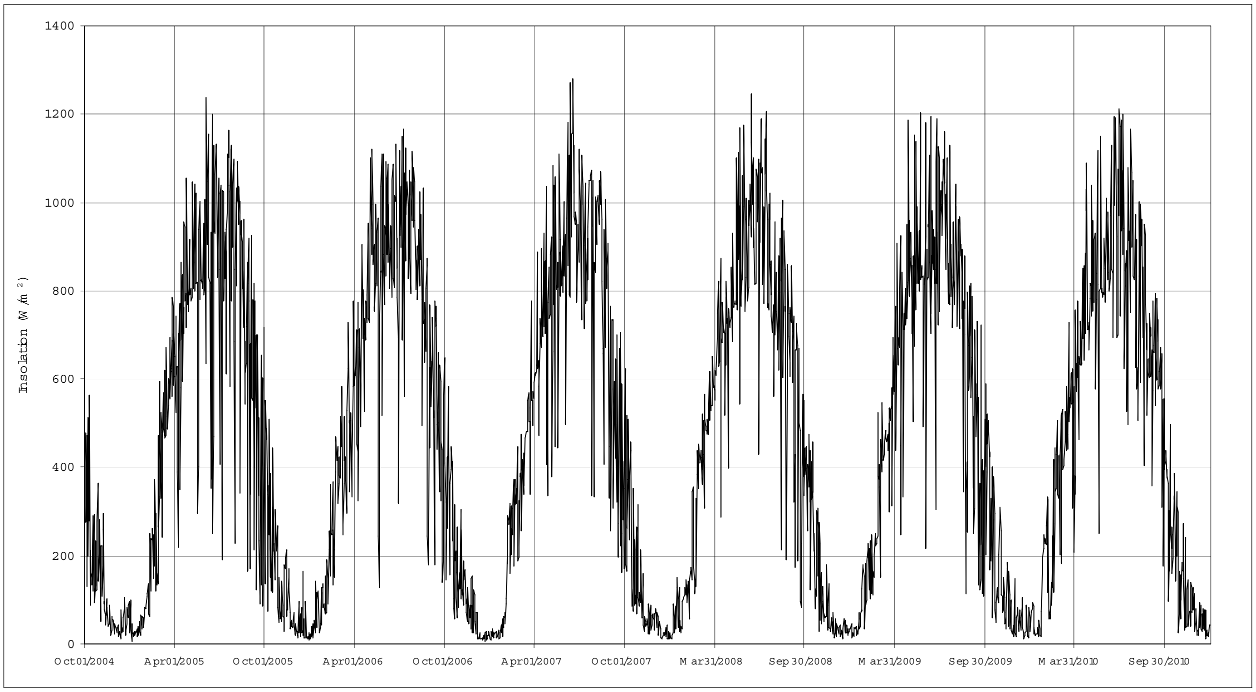


Figure 2.4-4
Daily Maximum Incident Solar Radiation – Yellowknife Gold Project

2.4.1.4 Relative Humidity

The relative humidity (RH) at the site varies on a seasonal basis. Figure 2.4-5 shows the daily relative humidity plotted over the entire period of record. The thick blue line in the figure represents the daily mean % RH. The maximums and minimums are indicated by thin black lines.

During the winter months, the mean % RH is between 80% and 90%. A gradual decrease in mean % RH typically begins to occur in late February, with levels of 50% and 60% commonly occurring in June and July. Mean relative humidity begins to increase in early August to the winter period normals, which typically begin in late October.

The variance of relative humidity is indicated by the envelope between maximum and minimum relative humidity. Over the winter period, the variance is ±15% from the mean. However, during the summer period much larger variations occur, on the order of ±40%.

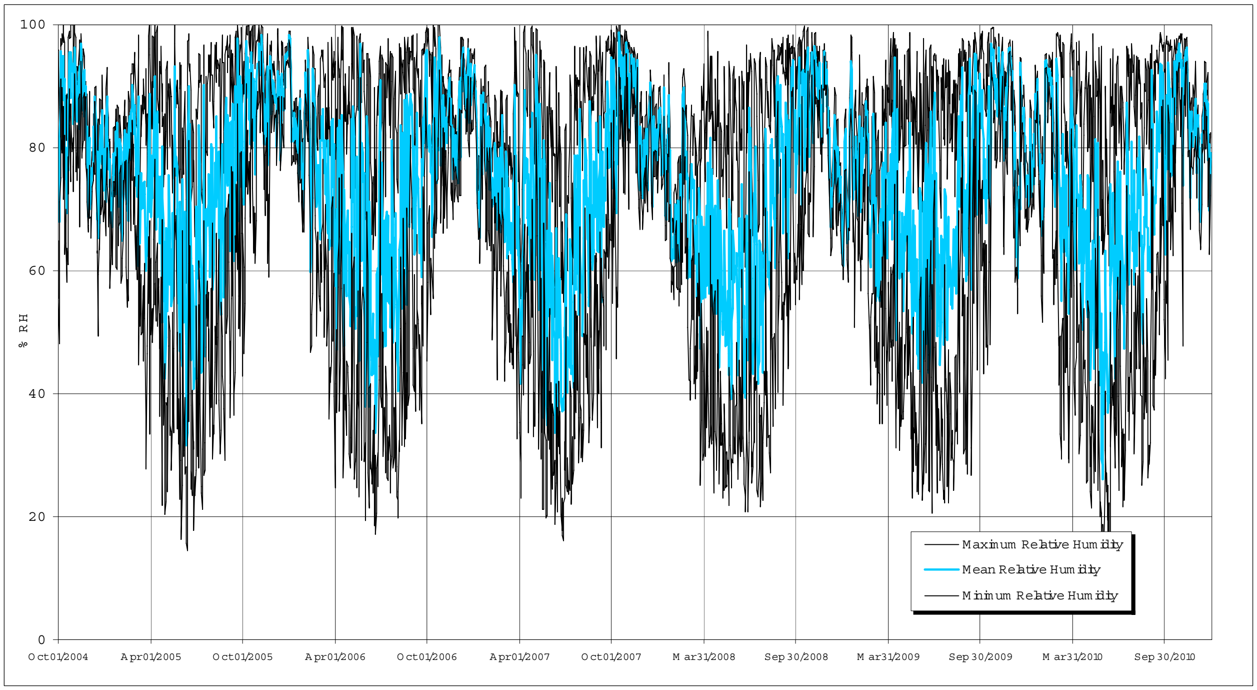


Figure 2.4-5
Daily Maximum, Mean and Minimum Relative Humidity – Yellowknife Gold Project

2.4.1.5 Barometric Pressure

The barometric pressure at the YGP site typically varies between 1,000 hPa and 1,020 hPa throughout the year. The lowest barometric pressure recorded over the period of record was 975 hPa. The highest pressure recorded was 1,044 hPa. There is little seasonal variation to barometric pressure. Barometric pressure can change by more than 30 hPa from one day to the next.

The daily variation in barometric pressure is much less pronounced during the summer period than during the winter months. During the summer, daily variations are less than ±5 hPa. During the winter, day-to-day fluctuations can be as large as ±30 hPa.

The variance of barometric pressure for a single day at the YGP site is indicated by the daily maximum and minimum, shown as black lines about the mean, shown as a green line in Figure 2.4-6.

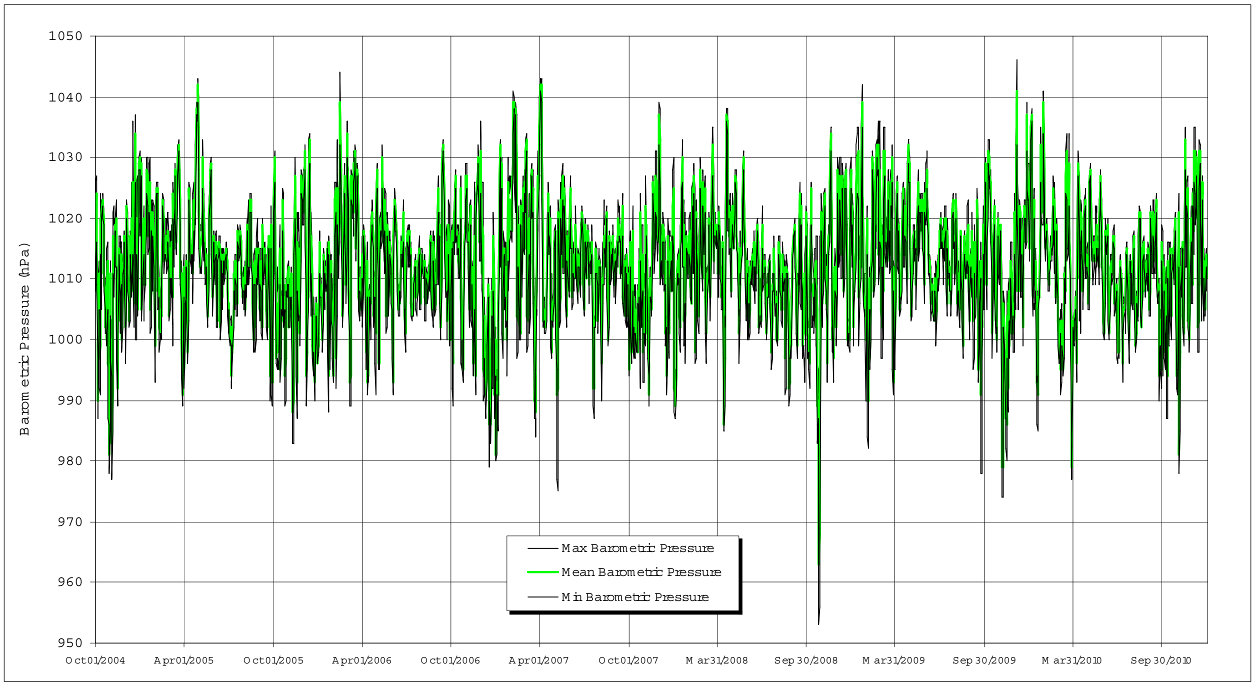


Figure 2.4-6
Daily Barometric Pressure – Yellowknife Gold Project

2.4.1.6 Precipitation

Average monthly precipitation at the YGP site is summarized in Table 2.4-1 and plotted in Figure 2.4-7. Precipitation is highest during the summer months and typically peaks in August with an average total monthly rainfall of 48 mm. The most extreme precipitation event recorded for one day was 35.5 mm of rain on September 23, 2008. Light precipitation events on the order of 1 or 2 mm are quite common; however events in excess of 10 mm have occurred on 23 occasions.

Based on the period from January 2005 to December 2010 the area receives an average of 260 mm of water-equivalent precipitation per year. Precipitation typically falls in the form of rain between June and August and as snow from October to April. During the months of May and September, precipitation can occur as either rain, snow or mixed.

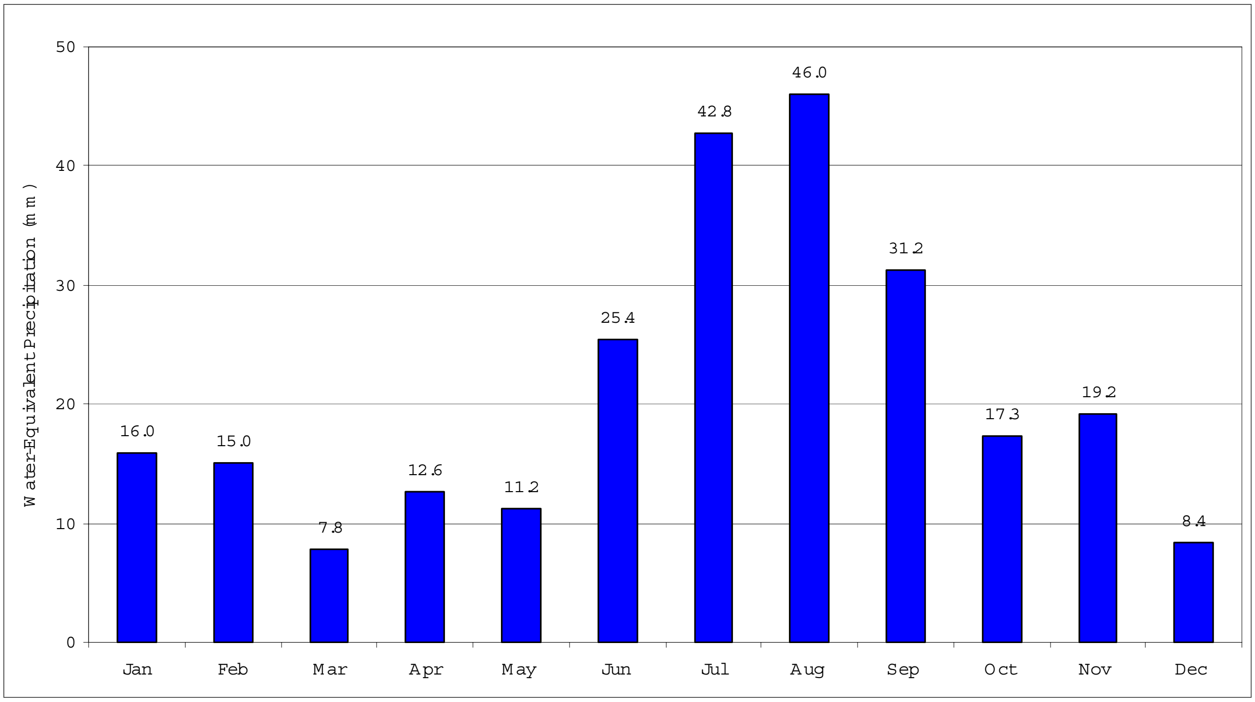


Figure 2.4-7
Average Monthly Precipitation – Yellowknife Gold Project

2.4.1.7 Snow Surveys

Indian and Northern Affairs Canada (INAC 2008a) operates snow survey stations at Little Latham Lake and at five other sites in the Yellowknife River basin. A summary of the data from these stations is presented in Table 2.4-3. This table is supplemented by data collected from the YGP site during a snow survey conducted in May 2004 by EBA.

2.4.1.8 Evaporation

Table 2.4-4a summarizes the monthly average daily pan evaporation rates recorded at the YGP site over the period of record. The highest daily evaporation typically occurs in May and June. Research into evaporation pan rates has shown that lake evaporation is lower than pan evaporation by a factor of 0.6 to 0.8 (Chow 1964). A factor of 0.7 was used to convert pan evaporation to lake evaporation.

The average total annual open water evaporation at the YGP, based on the period the evaporation pan was operational was determined to be 299 mm. Table 2.4-4b summarizes total yearly pan evaporation and calculated lake evaporation at the YGP site based on the period of record.

For a comparison, BHP (2000) reported an average open water evaporation rate at the EKATI Diamond Mine, located 300 km northeast of Yellowknife, of 311 min/year calculated from a Class A Evaporation Pan, during the period 1994 to 1999.

TABLE 2.4-3: SUMMARY OF SNOW SURVEY DATA

Snow Survey Stations		Station Positions		Elevation	Period of Record	Snow Water-Equivalent (SWE)		
INAC Data #	Name	Longitude	Latitude	(m)	Years	Mean (mm)	Max (mm)	Min (mm)
Yellowknife Basin								
07SB-SC02	Tibbitt Lake	113.38 W	62.50 N	244	27	81.4	148.0	29.0
07SB-SC03	Bluefish Hydro	114.25 W	62.68 N	168	13	95.6	170.0	54.0
07SB-SC04	Allan Lake	113.05 W	62.95 N	297	19	93.7	145.5	53.0
07SB-SC05	Denis Lake	112.62 W	63.37 N	411	20	120.2	149.0	85.0
07SB-SC06	Little Latham Lake	113.63 W	63.20 N	305	20	105.3	147.0	66.0
07SB-SC07	Nardin Lake	113.85 W	63.51 N	366	20	116.8	162.0	84.0
07SB-SC08	Sharples Lake East	112.82 W	63.90 N	369	20	120.4	165.0	84.0
Source: Indian and Northern Affairs Canada, 2008								
	Giaque Lake North	113.87 W	63.18 N	-	1	70		
	Maguire Lake East	113.97 W	63.21 N	-	1	75		
	Narrow Lake North End	113.90 W	63.17 N	-	1	87.5		
	Piloski Lake Drainage South End	113.88 W	63.18 N	-	1	87.5		
	Winter Lake South End	113.92 W	63.16 N	-	1	92.5		
Source: EBA 2004 (mean values based on 12 samples/station)								

TABLE 2.4-4A: AVERAGE DAILY EVAPORATION RATES – YELLOWKNIFE GOLD PROJECT												
Year	**Pan Evaporation Rate (mm)**					**Lake Evaporation Rate (mm)**					**Data Days in Month**	
	May	**Jun**	**Jul**	**Aug**	**Sep**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	*****	******
2005	*7.0	4.5	3.5	3.6	**1.6	*4.9	3.2	2.5	2.5	**1.1	5	13
2006		*7.3	5.1	3.6	**2.1		*5.1	3.5	2.5	**1.4	21	21
2007		*6.0	5.2	2.7	**1.7		*4.2	3.6	1.9	**1.2	28	15
2008		*4.6	5.3	2.9	**0.9		*3.2	3.7	2.0	**0.6	30	15
2009		*3.6	5.8	5.0	**1.6		*2.6	4.1	3.5	**1.1	25	28
2010	*5.4	5.9	3.5	3.5	**1.9	*3.8	4.1	2.5	2.5	1.3	12	16
Average	6.2	5.3	4.7	3.6	1.7	4.3	3.7	3.3	2.5	1.2		

Note: 1) A factor of 0.7 has been used to convert pan evaporation to lake evaporation
2) * refers to an incomplete month of data at the start of the data set.
3) ** refers to an incomplete month of data at the end of the data set.

TABLE 2.4-4B: ANNUAL EVAPORATION TOTALS – YELLOWKNIFE GOLD PROJECT					
	Period of Record			**Total Annual Evaporation**	
	Start	**Finish**	**# of Days**	**Pan (mm)**	**Lake (mm)**
2005	May 26/05 @ 11:13	Sep 13/05 @ 19:30	110.3	378	264
2006	Jun 09/06 @ 17:55	Sep 21/06 @ 7:50	103.6	445	312
2007	Jun 02/07 @ 7:30	Sep 15/07 @ 6:55	105.0	431	302
2008	Jun 01/08 07:12	Sep 15/08 07:15	106.0	407	285
2009	Jun 05/09 19:14	Sep 28/09 07:10	114.5	472	330
2010	May 19/10 13:47	Sep 16/10 07:40	119.7	422	295
AVERAGE			107.9	427	299

2.4.1.9 Climate Trends

Changes in climate parameters (specifically, factors that affect ambient temperatures and moisture) can potentially affect a number of aspects of the project, including the operating season for the seasonal winter road. Long- term climate data from the Yellowknife Airport were analyzed to provide an indication of trends in temperature, rainfall, snowfall, total precipitation and snow melt.

Figure 2.4-8 is a plot of mean hourly air temperatures recorded at the YGP (plotted in orange) and at the Yellowknife Airport (plotted in green) between January 2005 and December 2010. The relationship has the regression formula: y = 1.11 + 0.987x (where y is the temperature at Yellowknife Airport) and an R^2 = 0.984. The significance of the correlation suggests that longer term trends with respect to air temperature at the YGP site may be inferred from the historical record at Yellowknife Airport.

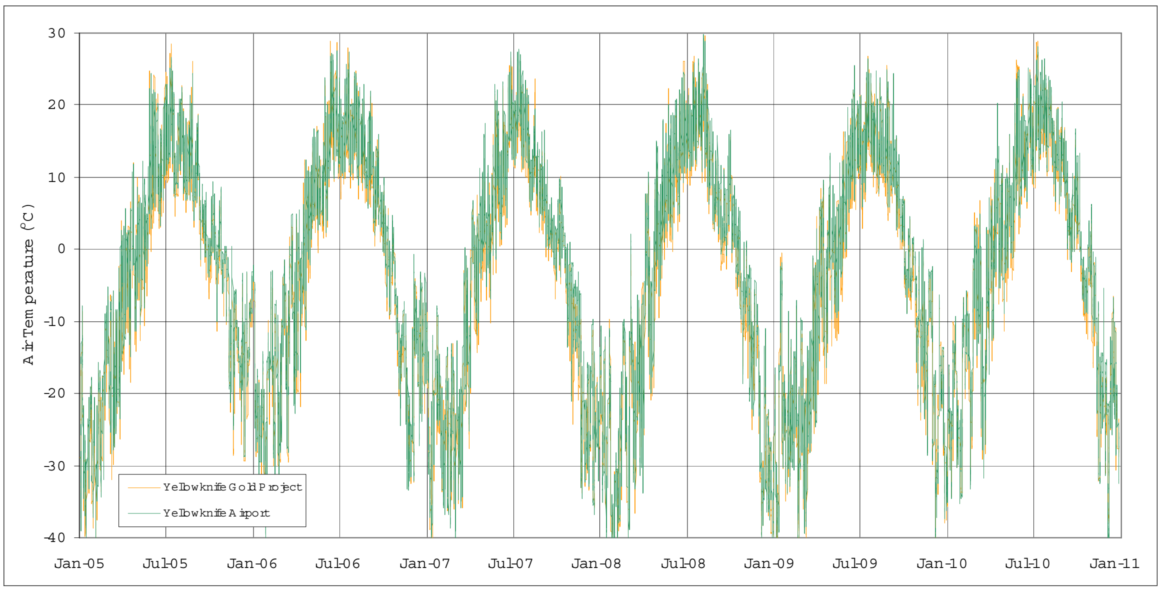


Figure 2.4-8
Comparison of Recorded Air Temperatures – YGP and Yellowknife Airport

Figure 2.4-9 illustrates the overall mean annual temperature trend (plotted in green) for Yellowknife Airport from 1942 to 2010. The mean maximum for the warmest month (red) and the mean minimum for the coldest month (blue) for each year have also been plotted. The trends indicate that in general, the mean annual temperature over the past 65 years has been increasing in Yellowknife at an average rate of 0.025 °C per year.

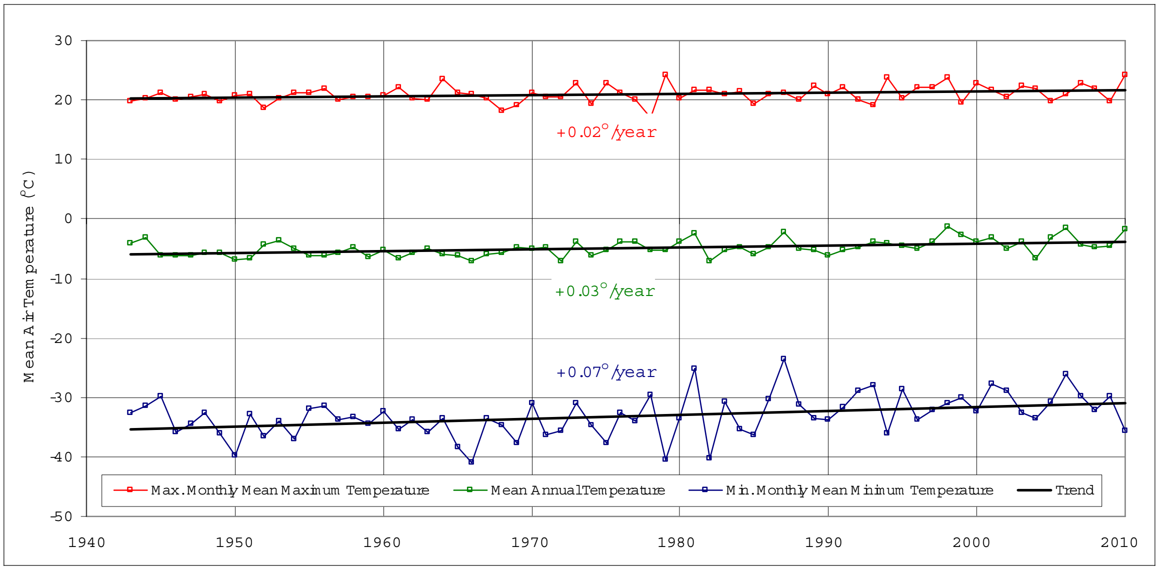


Figure 2.4-9
Annual Air Temperature Trend – Yellowknife Airport (1943 – 2010)

The trends indicate that in general, the mean annual temperature over the past 67 years has been increasing in Yellowknife at an average rate of 0.03°C per year (2.0°C over the entire period). Winter temperatures have increased at a faster rate (4.7°C over the period of record).

Figures 2.4-10 to 2.4-12 illustrate the mean temperature trend over the same period for January, April and July, respectively.

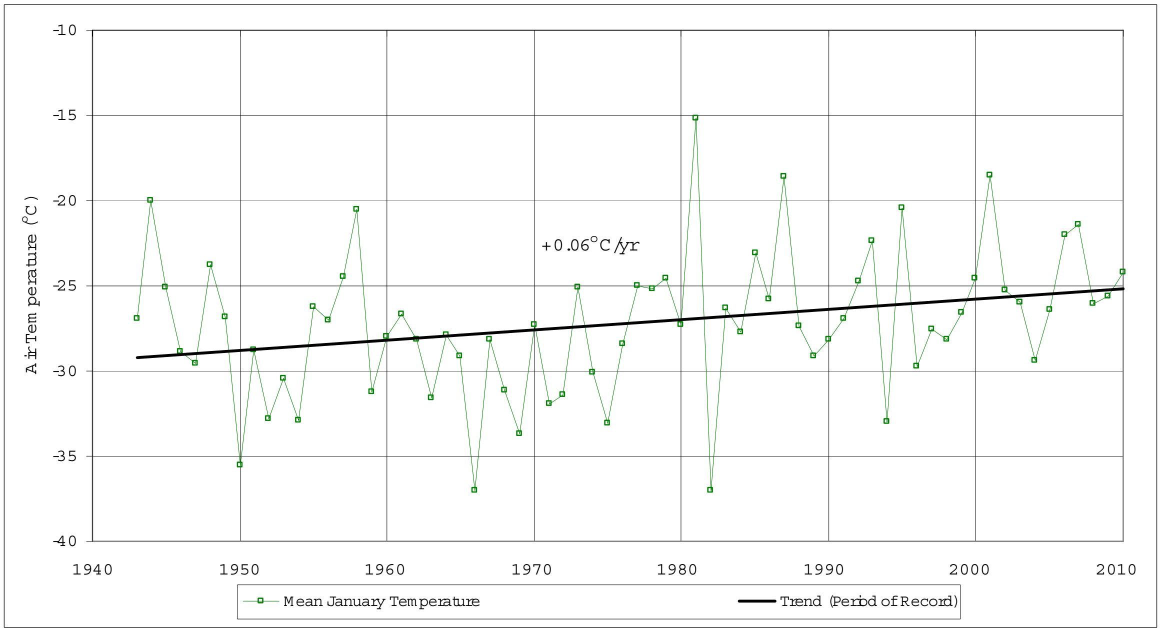


Figure 2.4-10
January Air Temperature Trend – Yellowknife Airport (1943 – 2010)

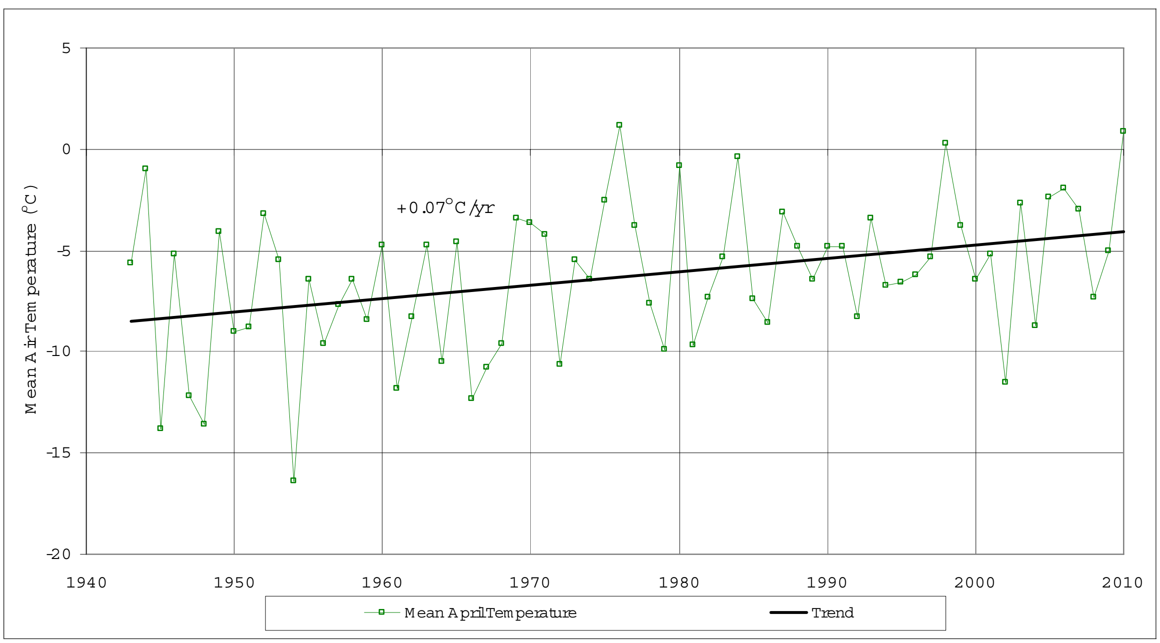


Figure 2.4-11
April Air Temperature Trend – Yellowknife Airport (1943 – 2010)

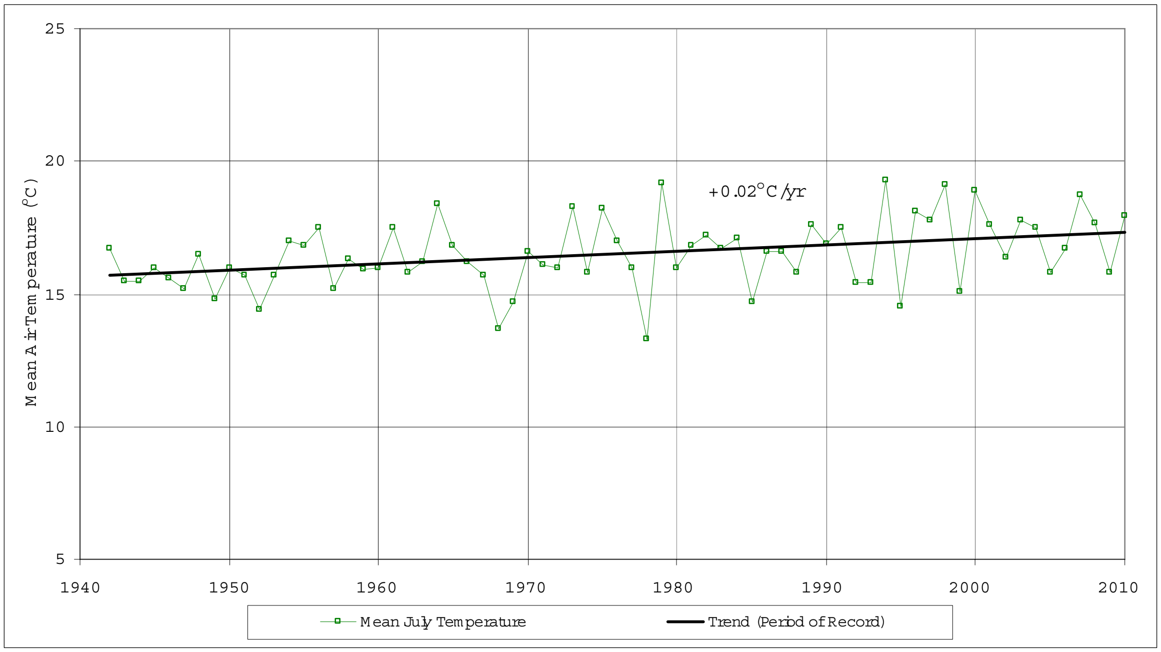


Figure 2.4-12
July Air Temperature Trend – Yellowknife Airport (1942 – 2010)

Over the entire period of record, mean January temperatures at Yellowknife have been increasing by an average of 0.06° C per year. The plot also shows that during the past 30 years, colder Januarys are approximately 5° C warmer on average than during the 30-year period prior. Mean April temperatures, which mark the beginning of the snow melt, have been increasing at nearly the same rate (0.07 °C per year). Average temperatures in January and April also have a high year-to-year variability. Mean July temperatures have been increasing as well, but at a slower rate, averaging 0.02 °C per year.

Annual rainfall and snowfall recorded at Yellowknife Airport since 1943 has been plotted in Figures 2.4-13 and 2.4-14, respectively.

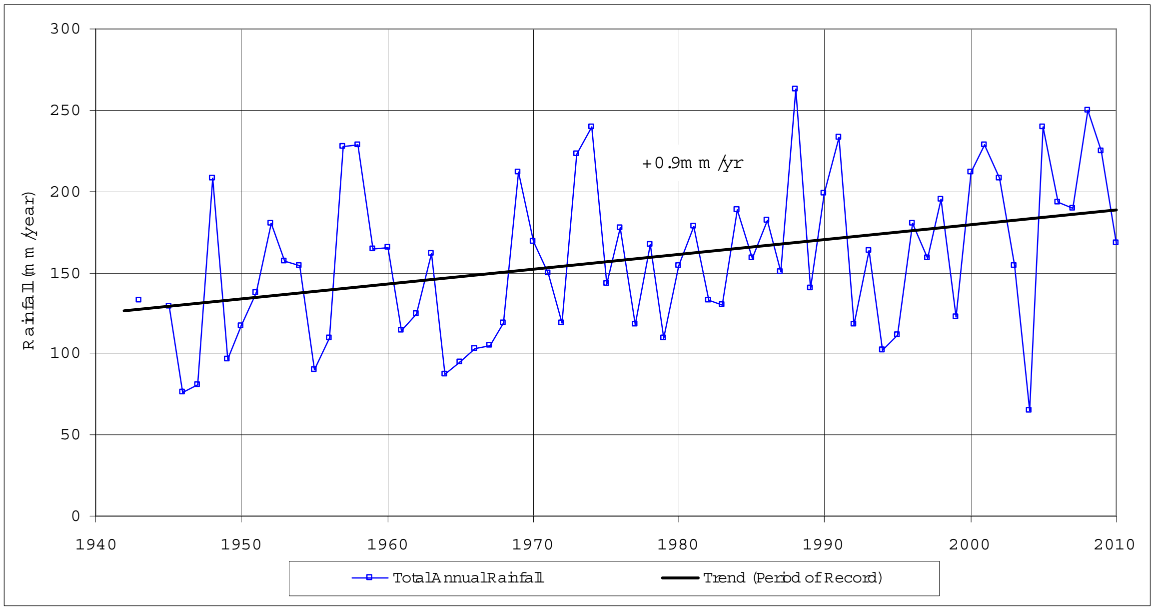


Figure 2.4-13
Trends in Annual Rainfall – Yellowknife Airport (1943 – 2010)

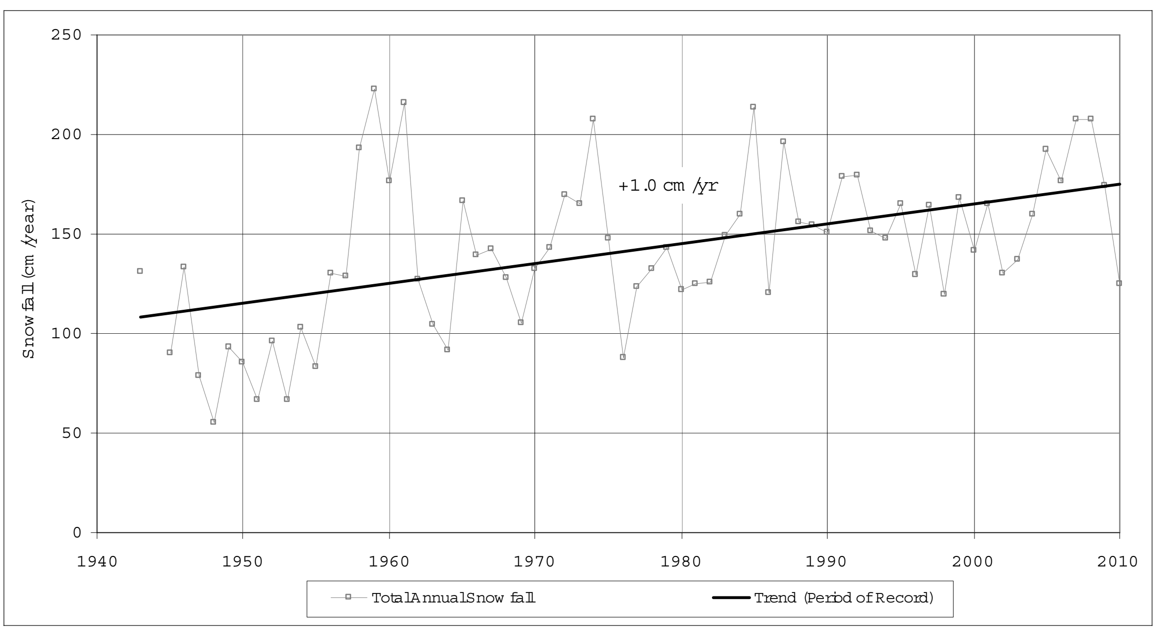


Figure 2.4-14
Trends in Annual Snowfall – Yellowknife Airport (1943 – 2010)

Total annual rainfall has been increasing at Yellowknife Airport by an average of 0.9 mm per year over the period of record. Annual snowfall has increased over the same period by an average of 1 cm per year. The plots also show that a year with above average snowfall does not necessarily correlate with above average rainfall or vice versa, however there does appear to be a cyclic pattern to annual precipitation of approximately 8 to 10 years.

The first date of the year on which the snow pack has completely melted in Yellowknife is plotted in Figure 2.4-14. The figure illustrates that this has been occurring increasingly earlier in the year (on average 0.2 days per year) since snow depth data began being recorded at Yellowknife Airport in 1955.

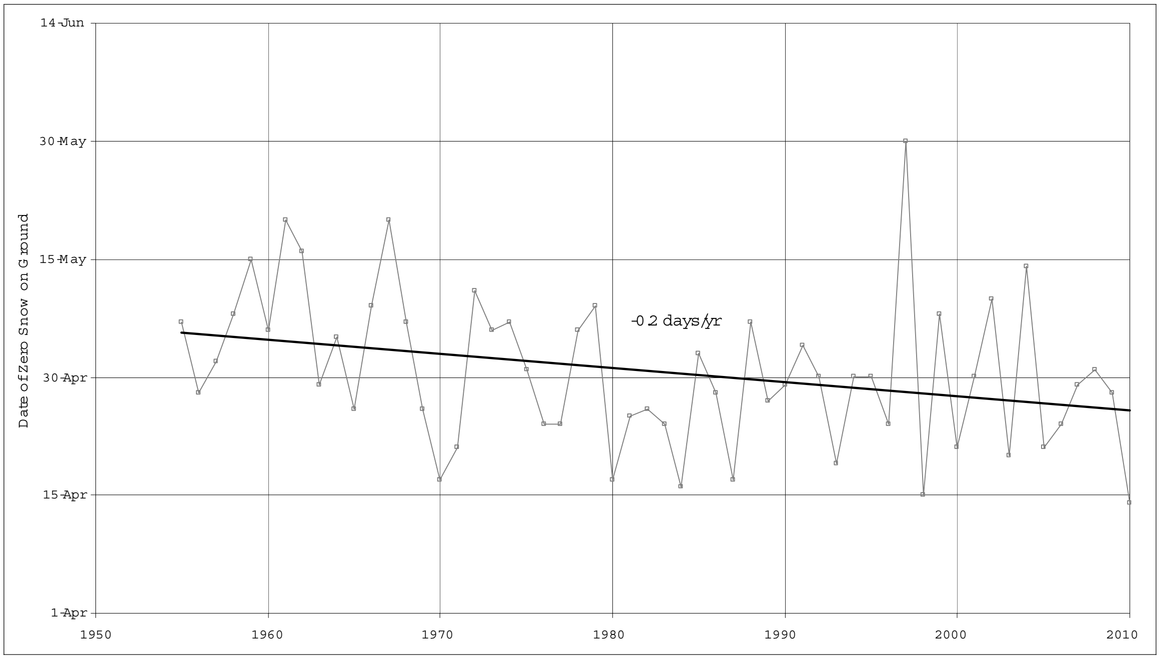


Figure 2.4-15
Date of Zero Snow on Ground – Yellowknife Airport (1955 – 2010)

Climate trends based on data recorded at Yellowknife Airport are indicating that on average, air temperatures are becoming warmer, annual precipitation is increasing and the snowpack is melting increasingly earlier every year.

2.5 AIR QUALITY AND NOISE

2.5.1 Air Quality

Ambient air quality is monitored in the Deh Cho Region at the Northwest Territories Department of Environment and Natural Resources station at Fort Liard River and for the North Slave Region at Yellowknife. With a 2006 population of 3,648 in the Deh Cho Region, compared to 18,700 at Yellowknife and 583 at Fort Liard, the ambient air quality data at Fort Laird provides a good estimate for a range of potential ambient conditions in remote areas of the region such as the proposed YGP site.

Results from the 2008 and 2009 NWT Air Quality Report are presented in Table 2.5-1 along with current NWT air quality standards. National (NAQQO) or Provincial (Alberta) standards that have been adopted in the NWT are denoted with an asterisk.

TABLE 2.5-1: FORT LIARD AND YELLOWKNIFE BASELINE AIR QUALITY (2008 AND 2009)

Species	NWT Standard (*NAQQO , **Alberta)		Fort Liard		Yellowknife	
	Maximum	Avg. Period	2008 Maximum	2009 Maximum	2008 Maximum	2009 Maximum
SO_2	450 μg/m³	1 hr	5 μg/m³	8 μg/m³	13 μg/m³	11 μg/m³
	150 μg/m³	24-hrs	-	-	-	-
	30 μg/m³	annual	2 μg/m³	-	<4 μg/m³	<4 μg/m³
NO_2	*400 μg/m³	1-hr	n/a	n/a	80 μg/m³	44 μg/m³
	*200 μg/m³	24-hrs	n/a	n/a	-	27 μg/m³
	*60 μg/m³	annual	n/a	n/a	4 μg/m³	4 μg/m³
CO	*15 mg/ m³	1-hr	n/a	n/a	2.7 mg/m³	2.2 mg/m³
	*6 mg/ m³	8-hr	n/a	n/a	1.1 mg/m³	-
$PM_{2.5}$	30 μg/m³	24-hr	28 μg/m³	27 μg/m³	62 μg/m³	18 μg/m³
PM_{10}	50 μg/m³	24-hr	54 μg/m³	52 μg/m³	105 μg/m³	100 μg/m³
ground level O_3	*160 μg/m3	1-hr	127 μg/m³	112 μg/m³	111 μg/m³	98 μg/m³
	127 μg/m³	8-hr	120 μg/m³	108 μg/m³	102 μg/m³	96 μg/m³

*Northwest Territories Air Quality RepTable 1ort, Northwest Territories Environment and Natural Resources, 2008 and 2009

SO_2 concentrations are very low at both Yellowknife and Fort Liard and are indicative of baseline conditions. SO_2 is produced greatly as a function of industrial processes and baseline levels at the proposed YGP site are likely closer to, or lower than, what is observed at Fort Liard, or essentially negligible.

Regional NO_2 concentrations are typically higher in the winter months, likely due to increased fuel consumption in combination with winter inversions, characterized by very low wind speeds and a stable atmosphere which result in a diminished ability for dispersion of pollutants. Baseline NO_2 levels would likely be much lower in more remote areas due to fewer sources of combustion (automobiles, butane stoves/heaters industry).

Baseline levels of fine particulate matter ($PM_{2.5}$) are typically higher on average during winter months due to inversion conditions; however, short-period peaks which exceed air quality standards occur during summer months due to forest fire smoke. Typical 24-hour average $PM_{2.5}$ baseline concentrations in the region are in the range of 5 to 10 μg/m³; however forest fires can cause exceedances of air quality standards.

Coarse particulate matter (PM_{10}) concentrations are higher in snow-free months due to road dust and are particularly elevated in April and May due to 'spring-time dust events' from residual winter gravel (GNWT ENR 2010). Peak 24-hour average concentrations in Yellowknife are double those observed in Fort Liard due to increased vehicle traffic and number of roads. Baseline concentrations in remote areas would likely be similar to that observed during the winter at Yellowknife and Fort Liard (typically less than 10 $\mu g/m^3$).

Without the influence of vehicle traffic, ground level ozone (O_3) typically exhibits a spring maximum. At Fort Liard and Yellowknife, one- and eight-hour average concentrations during spring peaks are on the order of 100 $\mu g/m^3$. Baseline concentrations during the rest of the year are typically around 60 $\mu g/m^3$. These levels would be typical of remote areas over the entire region.

In small northern communities, the major contributor to CO production is individual-dwelling wood burning, so peak values would tend to occur during the winter months and be worsened during inversions. However, due to the sparse and dispersed populations that characterize the region, CO levels are not expected to pose a concern to air quality, particularly in remote areas.

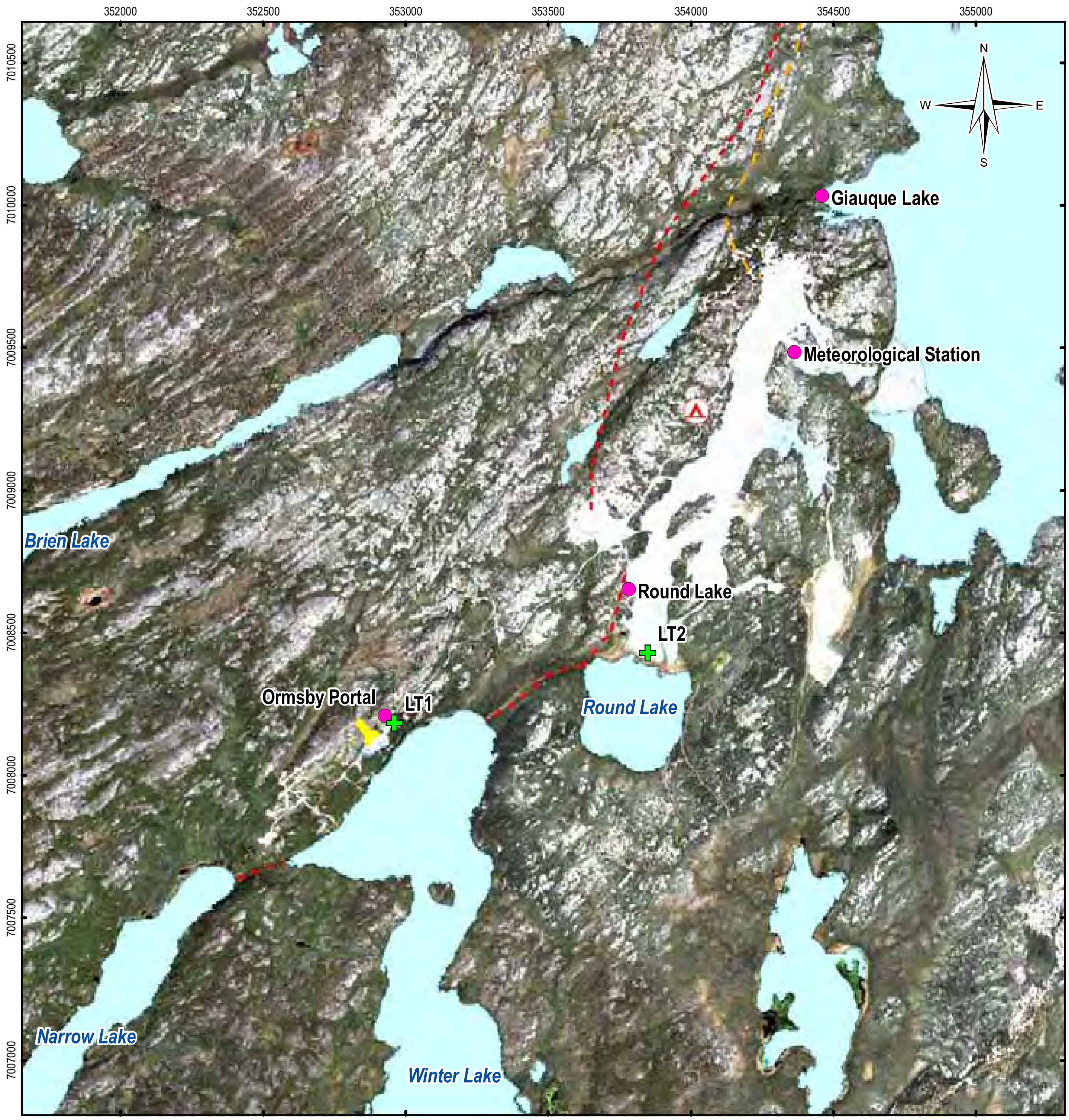
2.5.1.1 Sources of Emission

The proposed YGP will release gaseous and particulate emissions into the atmosphere from several facilities and types of equipment including: the refinery, diesel generators, vehicle traffic-generated airborne dust, and the camp incinerator.

2.5.1.2 On-site Collection of Ambient Air Quality Data

Ambient air quality samplers were deployed at Tyhee NWT Corp's YGP site in July 2005 to measure ambient PM_{10}, SO_2, NO_2 and O_3 concentrations at the locations shown on Figure 2.5-1. Measurements taken at three sites were similar and were assumed to represent background values. One measurement site (Ormsby Portal) was characterized by ongoing vehicular and other activity.

The results of the 24-h PM10 monitoring can be found in Table 2.5-2. The findings indicate that ambient 24-h PM10 concentrations are below the applicable indicator thresholds and consistent with other measurements taken in the Northwest Territories. Background PM_{10} levels were in the 2.1 to 4.4 $\mu g/m^3$; in comparison the PM_{10} concentration at the Ormsby Portal site was 20.7 $\mu g/m^3$. These are generally lower than values measured at other locations in the Northwest Territories which range from 9 to 125 $\mu g/m^3$ for maximum 24-h PM2.5 and from 50 to 400 $\mu g/m^3$ for maximum 24-h TSP.



LEGEND

- Air Monitoring Stations
- Noise Monitoring Stations
- Camp
- Waterbody
- Nicholas Lake Access Road
- Winter Road

NOTES

1. Air Monitoring from RWDI, May 19, 2006.
2. Noise Monitoring estimated from RWDI, May 2006.
3. Imagery Source: IKONOS (July 27 and August 2, 2004); Landsat TM (August 11, 2001).

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YELLOWKNIFE GOLD PROJECT

Air and Noise Monitoring Station Locations

PROJECTION	DATUM
UTM Zone 12	NAD83

Scale: 1:20,000

200 100 0 200 400 600

Metres

FILE NO. V23201097-DAR-024.mxd

PROJECT NO.	DWN	CKD	REV
V23201097	SL	RH	0

OFFICE	DATE
EBA-VANC	February 21, 2011

Tyhee NWT Corp

EBA Engineering Consultants Ltd.

Figure 2.5-1

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TABLE 2.5-2: AMBIENT 24-HOUR PM_{10} CONCENTRATIONS (UG/M[3])[3]	
Monitor Location	**PM10**
Indicator Threshold	50
Meteorological station	2.4
Round Lake	2.1
Round Lake1	4.4
Ormsby Portal	20.7

The first Round Lake sample was taken on July 9, 2005. The second was taken on July 10, 2005. They are not duplicate samples.

The results for the SO_2, NO_2 and O_3 monitoring can be found in Table 2.5-3. Thirty day SO_2 and NO_2 concentrations were directly compared with their respective 1-h, 24-h and annual indicator thresholds. In all cases, the measured results are below the applicable thresholds. Ambient SO_2 concentrations at all four sites were similar at 0.3 μg/m^3. These are lower than recent SO_2 concentrations measured at other locations in the Northwest Territories which range from 11 to 28 μg/m^3 for the 1-h time period and from 1 to 5 μg/m^3 for the annual time period. Background NO_2 levels were in the 0.6 to 1.3 μg/ m^3 range; in comparison the Ormsby Portal site value was 13.6 μg/m^3. These are lower than the maximum 1-h NO_2 measurement of 70 μg/m^3 and the annual average range of 9 to 12 μg/m^3 measured elsewhere in the territory.

Thirty day ozone (O_3) concentrations at all monitoring locations were below the 1-h and 8-h indicator thresholds but above the 24-h and annual thresholds. These results are consistent with other measurements taken in the area. The average 30-day ozone concentration was 34 μg/m^3. This value is similar to what has been measured in Yellowknife during the summer.

TABLE 2.5-3: AMBIENT 30 DAY SO2, NO_2 AND O_3 CONCENTRATIONS (UG/M[3])[3]			
Monitor Location	**SO_2 (μg/m^3) 30 day**	**NO_2 (μg/m^3) 30 day**	**O_3 (μg/m^3) 30 day**
Indicator Threshold	Note 1.	Note 1.	Note 1.
Meteorological station	0.3	0.9	45.2
Round Lake	< 0.3	0.8	33.4
Round Lake	0.3	1.3	33.4
Giauque Lake	0.3	0.6	25.5
Ormsby Portal	< 0.3	13.6	33.4

1. SO_2 Indicator Threshold (μg/m^3): 450 (1-h), 150 (24-h), 30 (annual)
   NO_2 Indicator Threshold (μg/m^3): 400 (1-h), 200 (24-h), 60 (annual)
   O_3 Indicator Threshold (μg/m^3): 100 (1-h), 127 (8-h), 30 (24-h), 30 (annual)
2. < indicates the measurement was below the laboratories detectable limit

In summary, PM_{10}, SO_2, NO_2 and O_3 concentrations are below the applicable indicator thresholds (excepting 24-h and annual O_3 concentrations) and consistent with other measurements in the Northwest Territories. The measurements taken at three of the YGP monitoring locations can be assumed to represent the background concentrations. The higher concentrations at the forth station (Ormsby Portal) reflects continuous activity occurring at the site.

2.5.2 Noise

The Yellowknife Gold Project is located in an area where natural background ambient noise levels are expected to be low, generally in the range of 35 dBA. The acoustic environment is dominated by the sounds of nature, e.g. wind rustling through the foliage.

Man-made sounds that can be heard in the Study Area from time to time are those associated with the limited and intermittent ongoing exploration program at Ormsby, the camp power generator, local exploration-related vehicle traffic, and the daily traffic associated with the secondary winter road route to the diamond mines. This secondary route passes by the Ormsby mine area and crosses Giaque Lake and points east to tie in to the main north/south Tibbitt to Contwoyto Winter Road

The long-term sound level measurements were conducted at the existing facility portal and at the ambient monitoring locations (Figure 2.5-1). At each monitoring location, a sound level meter was set up, calibrated, and run for a period of at least 24-hours to record sound levels during the daytime (07:00 to 22:00) and night-time (22:00 to 07:00) periods. The sound level meter was used to capture 5-minute energy-averaged and percentile exceedance sound levels throughout the duration of the monitoring period. An analysis of the measured sound level data at each monitoring location was performed to determine the existing Ambient Sound Levels. Sound level data acquired during abnormally noisy short-term events (e.g., aircraft over flights or high winds) were not included in the analysis because they do not constitute a true representation of the typical sound environment at the monitoring location. The sound level meters were calibrated before and after measurements were taken, in accordance with the Directive 38 (ERCB, 2007) measurement protocols.

Short-term sound level measurements were conducted at the existing facility portal and at the ambient monitoring locations. Various pieces of existing equipment are currently operating at the YGP, including generators, a ventilation unit and different types of heavy machinery. Equipment measurements were conducted in order to quantify sound sources for input into EIA modeling, as well as to quantify the frequency spectra at the ambient monitoring locations.

Table 2.5-4 summarizes the Survey Sound Levels measured at the monitoring locations during the long-term surveys. Based on observations made during the noise survey, the existing conditions at each of the noise monitoring locations are summarized below.

TABLE 2.5-4: SUMMARY OF LONG TERM MONITORING				
Sound Monitoring Locations	Location No.	Date	Measured Sound Level	
			Measured Daytime Sound Level (dBA Leq Day)	Measured Night-time Sound Level (dBA Leq Night)
Lay-down Area near Ormsby Portal	LT1	July 8-9, 2005	68	63
North Shore of Round Lake	LT2	July 10-11, 2005	44	44

Lay-down

Area near Ormsby Portal – LT1

Due to the close proximity of this location to the Ormsby Portal (100 m), the sound environment is dominated by the noise of the mining equipment and diesel generator. During the July 8, 2005 measurement day, the ventilation unit was switched on at approximately 5 pm, resulting in a relatively steady-state noise of about 63 dBA Leq throughout the night. The next day a significant amount of heavy machinery traffic was present near the lay-down area where the monitor was stationed. Based on the outdoor noise propagation assumption of 6 dB loss per doubling of distance, this would result in a sound level of approximately 40 dBA at 1.5 km.

North Shore of Round Lake – LT2

This location is approximately 1 km from the mine portal, with line-of-sight between the portal and the lake. The night-time Leq was measured to be 44 dBA and included noise from the mine site, primarily the ventilation unit. Facility equipment noise was audible on the recording playback during the night-time period. Based on the outdoor noise propagation assumption of 6 dB loss per doubling of distance, this would result in a sound level of approximately 41 dBA at 1.5 km.

Summary

The existing daytime and night-time sound levels at two monitoring locations were measured continuously for at least 24-hours in order to quantify the existing sound environment. Depending on the monitoring location, the measurement results indicate that the existing baseline sound levels are very close to 40 dBA at 1.5 km during the night-time. The recorded levels would meet the target sound level for remote rural Alberta as discussed in Directive 38 (ERCB, 2007).

2.6 SURFICIAL GEOLOGY AND SOILS

Ecological Land Classification (ELC) combines site, soil, and vegetation information into integrated environmental baseline investigations. Until recently (e.g., 2007), the NWT followed the national classification system of Canada, after which it developed, and continues to develop, its own regional classification system (Ecosystem Classification Group 2008). Terrestrial baseline studies were conducted prior to the completion of the NWT regional classification system; however, naming conventions and descriptions have since been updated to reflect the NWT system.

The YGP is located within the Great Slave Upland High Boreal and Great Slave Upland Low Subarctic Ecoregions (Ecosystem Classification Group 2008), which are characterized by Precambrian bedrock outcrops, ridged to hummocky morainal deposits, discontinuous yet widespread permafrost, and typically Brunisolic or Cryosolic soils.

2.6.1 Surficial Geology

The YGP study area is described in the Soils of Canada (Agriculture Canada 1977) as a strongly rolling plain comprised of igneous and metamorphic rockland with stony, sandy glacial till and fluvial deposits. Exposed bedrock dominates along broad, gently sloping terrain below approximately 400 masl. At higher elevations, bouldery tills blanket the surface and exposed bedrock, when present, is usually ice-scoured and of low-relief (Ecosystem Classification Group 2008). Organic deposits are frequent but tend to be limited in size. A combination of variable-textured glaciolacustrine sediments, glaciofluvial materials, and wave-washed tills are also present as thin, discontinuous accumulations within fractures and between rock outcrops throughout the area.

2.6.2 Soils

The soil climate of the study area is subarctic (humid), with discontinuous permafrost. The dominant soils are Orthic Dystric Brunisols in rockland areas, with Orthic Grey Luvisols and Orthic Eutric Brunisols occurring to a lesser extent. Most soils are well-drained and are often stony and/or lithic (shallow).

In the immediate area of the historic Discovery Mine, soils are limited in extent as bedrock is generally at, or very near, the surface. Mineral soils were observed in the valley bottoms to the north of the historic Discovery mine site and southeast of the historical tailings area. Most of these soils have an organic surface of varying thickness. Shallow mineral soils also occur in depressions in the bedrock. The mineral soils have developed primarily on fine-textured (silt and clay) glaciofluvial or lacustrine materials. Organic soils are present in poorly drained bog and fen areas.

2.6.3 Permafrost

The term "permafrost" describes a ground condition where the soil or rock remains below 0º C for at least two consecutive years (Ecosystem Classification Group 2008), irrespective of material type, ground ice distribution, or thermal stability. Permafrost does not usually form under large lakes and rivers that do not freeze to bottom during winter (GSC 2007).

The YGP occurs entirely within the discontinuous permafrost zone, which is characterized by permafrost that underlies 50-90% of the land area (GSC 2007). In the vicinity of the historic Discovery Mine, permafrost is commonly found in association with organic soils (Klohn Leonoff 1992).

2.7 ECOSYSTEMS AND VEGETATION

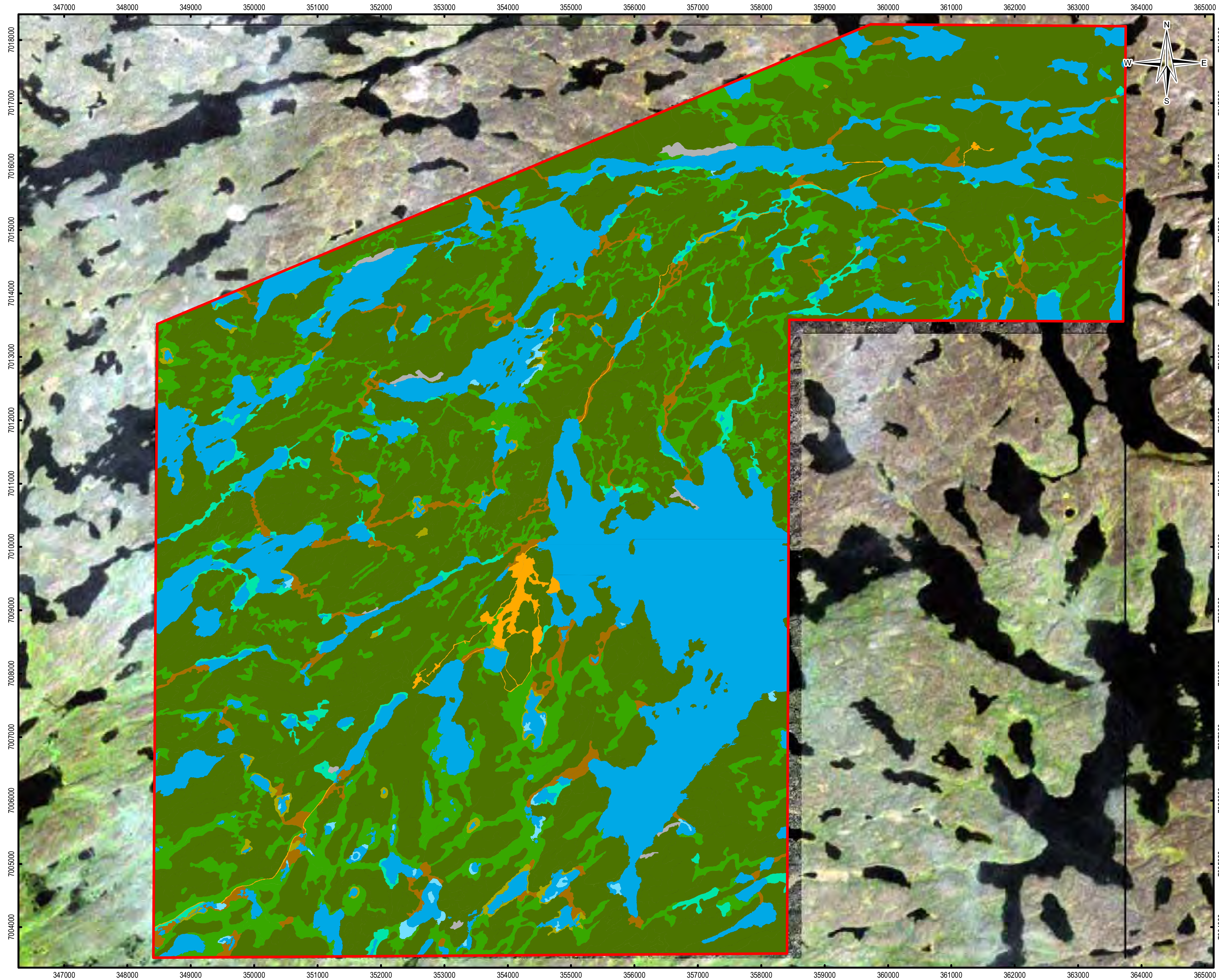
The YGP lies within the Great Slave Upland High Boreal and Great Slave Upland Low Subarctic Ecoregions (Ecosystem Classification Group 2008). These ecoregions are characterized by rolling terrain and bedrock exposures, climax forest and open woodland. Forested ecosystems are frequently dominated by black spruce (*Picea mariana*), white spruce (*P. glauca*), and jack pine (*Pinus banksiana*), while younger communities are composed of various deciduous species including paper birch (*Betula papyrifera*) and alder (*Alnus* spp.). Younger communities are often the result of disturbances such as fire.

Baseline data were collected in July 2004 and in July and August 2005 and focussed on characterizing ecosystem types present in the study area and conducting surveys for rare plants. Field survey methods followed standards established in British Columbia for Describing Terrestrial Ecosystems in the Field (BC Ministry of Environment, Lands, and Parks and BC Ministry of Forests 1998). A total of 130 field inspections were completed in twelve ecosystem types, resulting in a Terrestrial Ecosystem Mapping (TEM) sampling intensity level 5. Mapping at a 1:20,000 scale was completed using IKONOS imagery. Twenty-two ecosystem types were identified within the study area. Fifteen of these were naturally vegetated, three were classified as water, and four were anthropogenic. Field methods, sampling intensities, and results are described in more detail in EBA (2005) (Appendix A, 2005 Vegetation Baseline Report).

Spruce-lichen woodland was the dominant ecosystem type, covering 36% of the YGP study area (Table 2.7-1; Figure 2.7-1). Jack pine-lichen woodland was second most common ecosystem type, covering 19%. Treed bog was the dominant wetland type covering 10% of the YGP study area. Eight naturally vegetated ecosystem types have a restricted distribution, each covering less than 1% of the YGP study area; six are wetlands, and two are sparsely vegetated outcrop associations. More detailed descriptions of the ecosystem types identified are provided below.

TABLE 2.7-1: ECOSYSTEM TYPES MAPPED WITHIN THE YGP STUDY AREA

General Ecosystem Type	Ecosystem Type	Description	Distribution within YGP Area (ha)	Proportion of YGP Area (%)
Upland Forest/ Woodland	SL	Upland spruce – lichen woodland	5,250.6	36.3
	JL	Upland jack pine – lichen woodland	2,810.9	19.4
	AM	Upland spruce – moss forest	479.2	3.3
Water	LA	Waterbody >50 ha	2,764.2	19.1
	PD	Waterbody <50 ha	294.5	2.0
	OW	Open water <2 m depth	30.8	0.2
Treed Wetland	TB	Treed spruce – cloudberry treed bog	1,515.4	10.5
	TF	Treed tamarack – blueberry treed fen	461.8	3.2
Shrub Wetland	SH	Non-treed willow – sedge low shrub fen	234.3	1.6
	BR	Non-treed scrub birch cloudberry low shrub bog	89.2	0.6
Riparian	WR	Riparian wetland, forest spruce – willow forest	257.0	1.8
Graminoid Wetland	EM	Graminoid water sedge – horsetail shallow shore marsh	88.5	0.6
	EA	Graminoid sheathed cottongrass – bog rosemary sedge fen	31.7	0.2
	CE	Graminoid round fruited sedge – Chamisso's cottongrass fen	16.5	0.1
	CA	Graminoid water sedge – narrow leaved cottongrass fen	3.9	0.03
Anthropogenic	TD	Tailings deposit	36.8	0.3
	RP	Road surface	18.4	0.1
	RR	Rural development, includes the old town site	8.9	0.1
	GP	Gravel pit	5.9	0.04
Open Water Wetland	FA	Floating aquatic shallow open water	40.8	0.3
Bedrock and Boulder Fields	BF	Upland boulder field	26.5	0.2
	RO	Upland rock outcrop	8.9	0.1
Total			14,474.7	100.0



LEGEND

- Local Study Area

General Ecosystem Types

- Anthropogenic
- Bedrock and Boulder Fields
- Graminoid Wetland
- Open Water Wetland
- Riparian
- Shrub Wetland
- Sparsely Vegetated
- Treed Wetland
- Upland Forest/Woodland
- Water

NOTES

1. Imagery Source: IKONOS (July 27 and August 2, 2004); Landsat TM (August 11, 2001).

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YELLOWKNIFE GOLD PROJECT

Distribution of General Ecosystem Types in the YGP Study Area

PROJECTION	DATUM
UTM Zone 12	NAD83

Scale: 1:60,000

1 0.5 0 1 2

Kilometres

Tyhee NWT Corp

EBA Engineering Consultants Ltd.

FILE NO.			
V23201097-DAR-055.mxd			
PROJECT NO.	**DWN**	**CKD**	**REV**
V23201097	SL	TP	0
OFFICE	**DATE**		
EBA-VANC	February 15, 2011		

Figure 2.7-1

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2.7.1 Ecosystem Types

Ecosystem types identified within the YGP study area are described in more detail below. Their general distribution in the study area is presented in Figure 2.7-1.

2.7.1.1 Upland Forest and Woodland

The forested and woodland ecosystems are upland units dominated by black and white spruce and jack pine in climax communities. Immediately after fire, these communities are dominated by fast growing deciduous seral species, such as paper birch and alder. The slower growing jack pine becomes the dominant species a few years after fire. In the YGP study area, there are numerous successional stages observed in the upland areas due to fire. Upland units combined cover approximately 59% of the study area.

AM: Spruce – Moss Forest

This is the most productive forest ecosystem of the study area. It is generally found on lower slopes or toe positions in the landscape. It has a moderate nutrient regime with a mesic moisture regime. White spruce is the climatic climax species, but seral communities are dominated by paper birch. This ecosystem is uncommon and accounts for less than 4% of the study area.

JL: Jack Pine – Lichen Woodland

This woodland is typical of dry sites and occurs on upper slopes and crest positions of hills or esker complexes. It has a poor to very poor nutrient regime, with a subxeric to xeric moisture regime. Jack pine is common in mature stands, with bearberry shrubs. Paper birch is present in young seral communities. *Dicranum* and haircap (*Polytrichum* spp.) mosses are common, as well as numerous *Cladonia* lichens. This ecosystem covers approximately 19% of the study area.

SL: Spruce – Lichen Woodland

This woodland is the most commonly occurring ecosystem in the study area, covering approximately 36% overall. It is found on upland sites, in all slope positions. It has a very poor to moderate nutrient regime, with a mesic to submesic moisture regime. Black spruce is common in mature stands, and jack pine and paper birch may dominate seral communities. Labrador tea, alder and bog cranberry are common shrubs.

2.7.1.2 Riparian

One riparian ecosystem was identified in the study area. This ecosystem usually occurs adjacent to streams or in drainage systems between lakes, has a rich nutrient regime, and a subhygric moisture regime. The riparian succession results in a broad range of structural stages from young to mature.

WR: Spruce – Willow Riparian Forest

Paper birch and white spruce dominate in mature stands. Forests that are slightly drier have inclusions of balsam poplar. Shrubs include: willow, red raspberry, and high-bush cranberry. This ecosystem represents less than 2% of the study area.

2.7.1.3 Wetlands

Wetland ecosystems included: graminoid-dominated fens, shrub-dominated fens, treed fens and bogs, marshes, and areas dominated by floating aquatic vegetation. The fens and bogs are generally restricted to upland plateaus of poorly drained organic soils. Differences in water movement distinguish fens from bogs. Marshes and floating aquatic ecosystems are usually restricted to waterbody margins. Wetland ecosystems represent approximately 17% of the study area.

Treed Wetland

<u>TB: Spruce – Cloudberry Treed Bog</u>

This wetland ecosystem occurs on upland peat plateaus with poor drainage and is often surrounded by bedrock outcrops. It has a very poor nutrient regime with a subhydric to subhygric moisture regime. Vegetation is dominated by black spruce, Labrador tea, bog blueberry and bog cranberry. Peat moss is common. This ecosystem was the most abundant of the wetland types, covering over 10% of the study area.

<u>TF: Tamarack Blueberry Treed Fen</u>

This ecosystem occurs in upland peat plateaus with some water movement. It was also found in drainage areas between lakes. It has a poor to rich nutrient regime and a subhydric to hygric moisture regime. Black spruce and tamarack form an open canopy; willow, scrub birch and bog blueberry are common shrubs. It was the second most common wetland type, covering approximately 3% of the study area.

Shrub Wetland

<u>SH: Willow – Sedge Low Shrub Fen</u>

This shrubby fen often co-occurs with sedge fens. Common distribution is near open water, treed fens or drainage areas. It is restricted to wet sites with some water movement. It has a medium to rich nutrient regime and a hydric moisture regime. Willows and sedges are common, with a minor component of leatherleaf. It accounts for approximately 2% of the study area.

<u>BR: Scrub Birch – Cloudberry Low Shrub Bog</u>

This shrubby bog ecosystem is found in close association with spruce – cloudberry treed bog ecosystems and is present as islands within larger spruce – cloudberry treed bog polygons. It is rarely mapped on its own. It has a very poor to poor nutrient regime and a hygric to subhygric moisture regime. Common species include scrub birch, willow, sedges and reed grass. This ecosystem covers less than 1% of the study area.

Graminoid Wetland

EM: Water Sedge Horsetail Shallow Shore Marsh

This shallow shore marsh occurs along the edges of lakes, ponds and open water. It has a poor nutrient regime and a hydric moisture regime. Water sedge is the dominant sedge, but forbs and other sedge species are common. Leatherleaf and willow are also found in small numbers. This ecosystem represents less than 1% of the study area.

EA: Sheathed Cottongrass Bog Rosemary Sedge Fen

This wetland ecosystem is found in association with other sedge fens, shrubby bog, treed bogs and fens, and is rarely mapped on its own. It has a very poor to poor nutrient regime and a subhydric to hygric moisture regime. Leatherleaf, sedges and peat moss are common. This ecosystem accounts for less than 1% of the study area.

CE: Round-fruited Sedge Chamisso's Cottongrass Fen

This is a slightly richer sedge fen than water sedge narrow-leave cottongrass fen or sheathed cottongrass bog rosemary sedge fen. It is found in association with other sedge fens, shrubby fens and treed fens. It is rarely mapped on its own. It has poor to medium nutrient regime with a subhydric to hygric moisture regime. Sedges, cottongrass and peat moss are common. It represents less than 1% of the study area.

CA: Water Sedge Narrow-leave Cottongrass Fen

This sedge fen co-occurs with other sedge fens and shrub bogs. It is also found within spruce - cloudberry tree bog polygons and is rarely mapped on its own. It has a very poor to poor nutrient regime, with a hydric moisture regime. Sedges and cottongrass are common species. This ecosystem represents less than 1% of the study area.

Open Water Wetland

FA: Floating Aquatic Shallow Open Water

This ecosystem occurs in shallow open water in lakes, ponds and open water. It has a medium to rich nutrient regime and a hydric moisture regime. Horsetail and water lily are common. It covers less than 1% of the study area.

2.7.1.4 Bedrock and Boulder Fields

Sparsely vegetated ecosystems are restricted to naturally occurring units that are dominated by boulder or bedrock outcrops. Vegetation is restricted to micro-environments that have developed due to localized weathering of rock. Soil development is poor or non-existent. These ecosystems make up less than 1% of the study area.

BF: Boulder Field

This ecosystem occurs on exposed slopes of hills that have large rock outcrops. Nutrient regime is very poor and moisture regime is very xeric. Vegetation includes common juniper, bearberry, and three-toothed saxifrage. Crustose lichens are common.

RO: Rock Outcrop

This ecosystem is typical of bedrock outcrops that have undergone little weathering. Nutrient regime is very poor and moisture regime is very xeric. Microsites that support vegetation growth are uncommon. Vegetation cover is sparse and crustose lichens are common.

2.7.1.5 Water

Water was divided into three ecosystem types: lake, pond, and shallow open water. Size (50 ha) was used to differentiate lakes and ponds. Waterbodies identified as shallow open water are less than 2 m deep on average. Waterbodies collectively cover over 21% of the YGP area.

2.7.1.6 Anthropogenic

Map units identified during field studies and the development of the ecosystem map include areas previously disturbed by human activities. Historic tailings areas (TD) and gravel pits (GP) were generally devoid of vegetation. Ecosystems defined as rural (RR) were restricted to camp areas and supported a range of vegetation cover. The developed area around the historic Discovery Mine town site was interspersed with mature trees. The footprint of the present YGP camp site has limited vegetation cover as it is located within a rock quarry. Roads (RP) exhibited a range of vegetation cover depending on use. Those that are actively used are typically devoid of vegetation. Abandoned roads and portages had variable vegetation cover.

2.7.2 Fire History

Fire is a common disturbance agent in the boreal forest. Fire return intervals vary within the High Boreal and Low Subarctic ecoregions that comprise the YGP. Fires in High Boreal ecoregions tend to have a return interval of 80-140 years, and often manifest as intense crown fires (Ecosystem Classification Group 2008). Fires in Low Subarctic ecoregions are generally less intense surface burns with return intervals greater than 140 years.

Large fires documented in the YGP study area, according to the GNWT fire history database (GNWT 2002), occurred in 1973 in the southern portion (near the historic Discovery Mine) and more recently in 1996 in the northern portion. Evidence of fire was documented during the field assessments and a fire severity class was assigned to each polygon, where applicable, during the development of the ecosystem map.

Approximately 24% of the YGP study area displayed evidence of recent fire activity, largely of moderate intensity (Table 2.7-2). As expected, forested ecosystem types were affected most.

TABLE 2.7-2: FIRE DISTURBANCE WITHIN THE YGP STUDY AREA				
General Ecosystem Type	Unburned	Fire Intensity		General Ecosystem Type Total (ha)
		Moderate	Severe	
Upland Forest/Woodland	5,831.5	2,343.5	365.7	8,540.7
Water	3,089.5			3,089.5
Treed Wetland	1,393.2	533.0	51.0	1,977.2
Shrub Wetland	230.1	92.2	1.2	323.4
Riparian	213.5	43.5		257.0
Graminoid Wetland	139.2	1.5		140.7
Anthropogenic	68.7	1.2		70.0
Open Water Wetland	40.8			40.8
Bedrock and Boulder Fields	18.9	16.5		35.4
Distribution within YGP Area (ha)	11,025.4	3,031.4	417.9	14,474.7
Proportion of YGP Area (%)	76.2	20.9	2.9	100.0

2.7.3 Rare Plants

A list of rare plant species potentially occurring within the YGP study area was compiled from various sources prior to the conduct of the field surveys. Rare plant habitat potential was also determined for each ecosystem type as a means of identifying potential effects to rare plant habitat. Rare plant habitat potential was based on the number of rare plants that could occur within any given ecosystem type. This approach is a way of bridging the reality that rare plants often occupy microhabitats that are too small to map, particularly at the scales commonly utilized, and that field assessments for rare plants can only confirm their presence in an area, not their absence. Additional detail of this approach is provided in EBA (2006) (Appendix A, EBA 2006 Vegetation Baseline Report).

Based on background research, 89 rare plant species were identified as potentially occurring within the YGP study area (EBA 2006; Appendix A). The distribution of rare plant habitat potential is presented in Table 2.7-3 and in Figure 2.7-2. The majority (66%) of the YGP area was ranked as having moderate rare plant habitat potential, with ecosystems capable of supporting up to 14 different listed species. Wetland ecosystem types had the highest potential to support rare plant species overall.

TABLE 2.7-3: RARE PLANT HABITAT POTENTIAL IN THE YGP STUDY AREA

General Ecosystem Type	Rare Plant Habitat Potential Ranking[1]						General Ecosystem Type Total (ha)
	Very Low	Low	Moderate	High	Very High	N/A[2]	
Upland Forest/Woodland			8,061.5	479.2			8,540.7
Water			30.8			3,058.7	3,089.5
Treed Wetland			1,515.4	461.8			1,977.2
Shrub Wetland	89.2			234.3			323.4
Riparian					257.0		257.0
Graminoid Wetland				3.9	136.8		140.7
Anthropogenic	51.6	18.4					70.0
Open Water Wetland				40.8			40.8
Bedrock and Boulder Fields		35.4					35.4
Distribution within YGP Area (ha)	140.7	53.8	9,607.7	1,220.0	393.7	3,058.7	14,474.7
Proportion of YGP Area (%)	1.0	0.4	66.4	8.4	2.7	21.1	100.0

[1]Potential number of rare plant species:

Very Low: 1 to 4

Low: 5 to 9

Moderate: 10 to 14

High: 15 to 19

Very High: >20

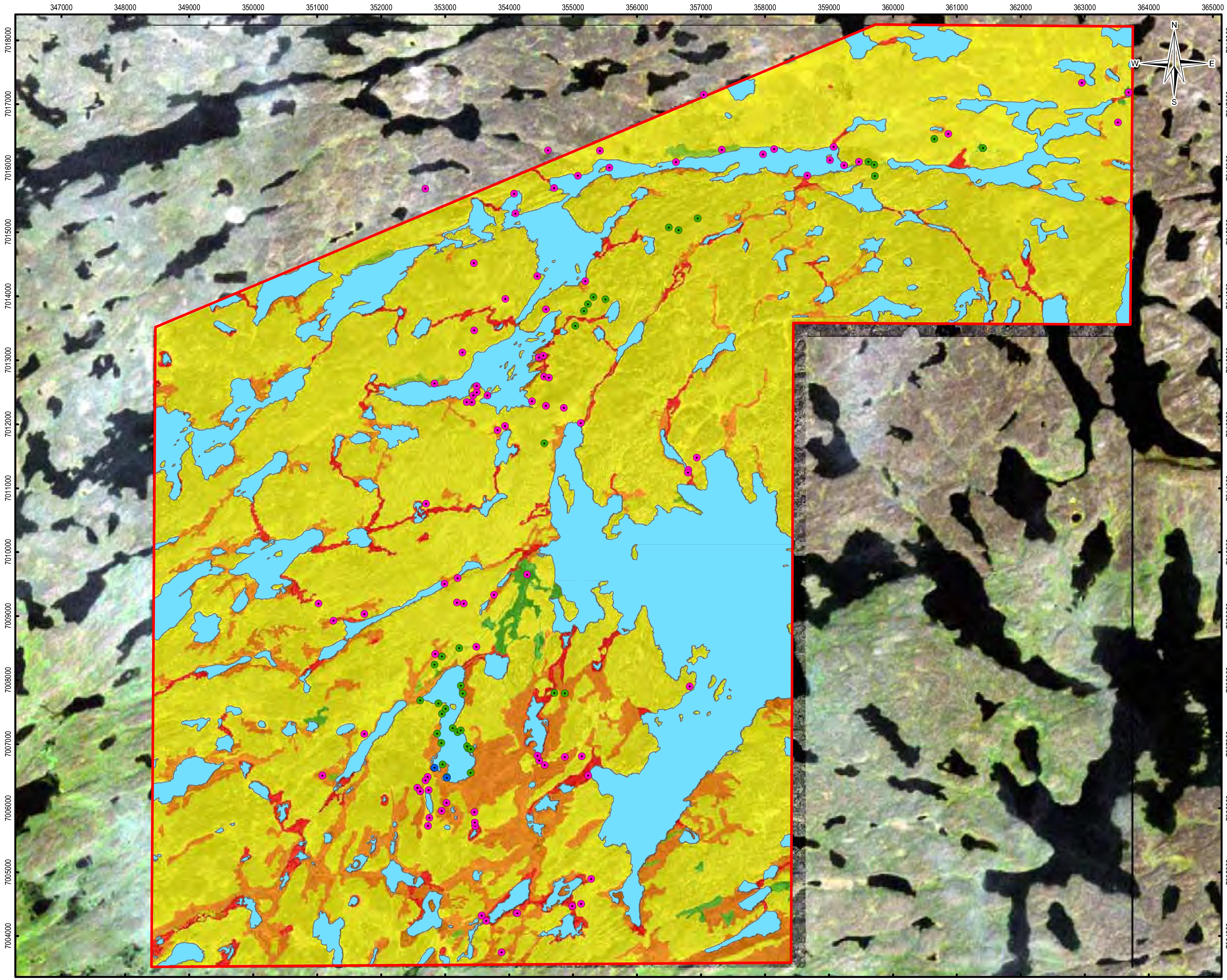
[2]Composed of lakes and ponds with >2 m depth

In 2005, five areas within the study area were surveyed for rare plants (EBA 2006). These areas are shown in Figure 2.7-2. In addition rare plant surveys were conducted along the Ormsby to Nicholas Lake access route. A total of 92 km were surveyed in 14 ecosystem types in July and August 2005.

No rare plants were observed in July. One potentially rare plant was identified, but not confirmed, as *Potamogeton foliosus* (leafy pondweed) during the August survey. Specimens were located in two small bays on the southwest side of Winter Lake (Figure 2.7-2). Water was approximately 1 to 2 m deep and was protected from wave action on the lake. The ecosystem type immediately adjacent to the lake is treed wetland.

Potamogeton species (pondweeds) are difficult to identify and often require the collection of different development stages in order to confirm identification at the species level. A sample of this pondweed was collected from Winter Lake and sent to the University of Alberta herbarium for further identification confirmation. Due to the maturity of the plant, U of A botanists could not confirm or deny its classification as *P. foliosus.*

Leafy pondweed is ranked by ENR as "Sensitive" under the general status program. This ranking was assigned as there are few documented occurrences of this species within the NWT. There is no legal legislation for protection under the existing *NWT Wildlife Act* or under the newly proposed *Territorial Species at Risk Act*.



LEGEND

- Sample Locations 2005
- Sample Locations 2004
- *Potamogeton foliosus* (Identification inconclusive)
- Local Study Area
- Waterbodies

Rare Plant Habitat Potential

- Very Low (0-4 Species)
- Low (5-9 Species)
- Moderate (10-14 Species)
- High (15-19 Species)
- Very High (20+ Species)

NOTES

1. Imagery Source: IKONOS (July 27 and August 2, 2004); Landsat TM (August 11, 2001).

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YELLOWKNIFE GOLD PROJECT

Rare Plant Habitat Potential in the YGP Study Area

PROJECTION	DATUM
UTM Zone 12	NAD83

Scale: 1:60,000

1 0.5 0 1 2

Kilometres

Tyhee NWT Corp

EBA Engineering Consultants Ltd.

FILE NO.

V23201097-DAR-056.mxd

PROJECT NO.	DWN	CKD	REV
V23201097	SL	TP	0

OFFICE	DATE
EBA-VANC	March 18, 2011

Figure 2.7-2

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2.7.4 Rare and Sensitive Ecosystems

No rare ecosystems were identified within the YGP area. While some ecosystems were identified as having a restricted distribution within the study area, they are relatively common within a larger regional context, occurring wherever suitable terrain is present.

Most ecosystem types within northern boreal ecoregions are sensitive to disturbance, due in part to the more severe climate and restricted growing season which can limit the time available for recovery. Sensitive ecosystems in the YGP area include ecosystem types that have a high cover of lichen or *Sphagnum* species, or are relatively nutrient poor or acidic (i.e., of lower pH).

Lichen develop slowly over time and are very sensitive to both physical disturbances and changes in the atmospheric environment, such as increased nutrient input. Ecosystem types with a high *Sphagnum* component often occupy wetter positions on the landscape and can be sensitive to changes that alter drainage patterns. They are frequently acidic and nutrient poor which also render them more sensitive to changes in pH or nutrient status. *Sphagnum* mosses themselves are generally more sensitive to environmental changes due to their particular habitat requirements.

The distribution of sensitive ecosystem types within the YGP study area is shown in Table 2.7-4. Ecosystem types with a high lichen cover are characteristic of approximately 90% of the sensitive ecosystem types present, and cover approximately 30% of the LSA overall.

TABLE 2.7-4: DISTRIBUTION OF SENSITIVE ECOSYSTEM TYPES IN THE YGP STUDY AREA[1]

General Ecosystem Type	Ecosystem Type	Sensitivity	Distribution within YGP Area (ha)	Proportion of YGP Area (%)
Upland Forest/Woodland	JL	High lichen cover; Nutrient poor	2,810.9	19.4
	SL[1]	High lichen cover	68.4	0.5
Treed Wetland	TB	High lichen cover; High *Sphagnum* cover	1,515.4	10.5
	TF	High *Sphagnum* cover	461.8	3.2
Graminoid Wetland	EA	High *Sphagnum* cover	31.7	0.2
	CE	High *Sphagnum* cover	16.5	0.1
Bedrock and Boulder Fields	BF	High lichen cover	26.5	0.2
Sensitive Ecosystem Total			**4,931.2**	**34.1**
Other			9,543.4	65.9
Total			**14,474.6**	**100.0**

[1]Mature and old forest only

2.7.5 Culturally Significant Plants

A number of the plant species found within the YGP study area are of importance to the people of the region. In particular, these include the various berries (e.g., strawberry, raspberry, gooseberry, blueberry, cranberry loganberry, juniper berry and Saskatoon), as well as Labrador tea and rose hips. Other important plants/trees with medicinal properties include white rat root, spruce gum, tamarack, and birch. These plants are common throughout the YGP study area and the larger regional study area.

2.7.6 Biodiversity

Maintenance of current biodiversity levels is considered an important component of ecosystem management in Canada (Bocking 2002) and consequently, political jurisdictions such as the NWT have initiated regional biodiversity action plans (Northwest Territories Biodiversity Team 2004).

Biodiversity is also an important component in ecosystem functioning (Kimmins 1997; Naeem et al. 1999; Loreau et al. 2001; Symstad et al. 2003) and provides an important conceptual link in integrating ecological land classification (ELC), wildlife, and ecosystem health (Golder Associates 2002). Conducting biodiversity assessments at various scales (i.e., species, populations, communities, habitats, ecosystem, landscape, and regional) is now routinely undertaken as part of the environmental assessment (EA) process (Treweek 1999; IUCN 2003). As well, connections between levels of biodiversity are examined by looking at structural and functional relationships such as connectivity, fragmentation, and disturbance within the landscape (Fahrig 2003).

Diversity is difficult to define but has been described as the relative degree of abundance of plant or animal species, communities, habitats, or habitat features per unit of area (Gaston and Spicer 1998). Species diversity is often treated synonymously with ecological diversity, however, other approximations of ecological diversity exist (Begon et al. 1995). For example, habitat diversity is an index that measures the structural complexity of the environment or the number of communities present, while functional diversity is based on ecosystem function or the role of a representative organism within an ecosystem (Kratochwil 1999; Hooper et al. 2002).

For the purposes of the YGP study area, three levels of diversity have been chosen for description, and are restricted to plant species diversity specifically. The levels include (as per Magurran 2003): (1) alpha diversity, which measures the diversity within a particular area or ecosystem and is commonly expressed as species richness (e.g., the number of species present), (2) beta diversity, which assesses the change or difference in species diversity between ecosystems, and (3) gamma diversity, which is the diversity of a larger geographic unit such as an island or landscape, which in this instance would be the YGP area as a whole.

The biodiversity assessment of the YGP study area involved the collection of data, as part of the ELC program (described previously). Floristic and structural diversity were described in each ELC unit assessed, which subsequently acted as surrogates for potential animal diversity in the baseline biodiversity assessment. For example, the spatial attributes of the mapped ecosystems as the raw data for the landscape-level biodiversity assessment were utilized to calculate three diversity indices: species richness, diversity (Shannon's diversity), and evenness. Species richness simply provides a total count of the species documented in a particular ecosystem type. Species diversity combines species richness with an approximation of species abundance. Higher values are indicative of more diverse conditions (Kent and Coker 1992). Species evenness identifies how evenly each documented species is distributed within the ecosystem type in question, and also combines species richness with abundance. Values range between 0-1, with higher values representing a more "even" distribution (i.e., less variation) (Kent and Coker 1992).

Summaries of the life form and structural stage data were generated from the data as well. Landscape level statistics such as patch number, patch density, evenness, and diversity were calculated to assess patterns and structure across the landscape (Turner et al. 2001). As well, PC-ORD software (McCune and Mefford 1999) calculated the ecosystem diversity statistics and FRAGSTATS software (McGarigal and Marks 1995) calculated the landscape metrics.

2.7.6.1 Northern Boreal Characteristics

The northern boreal forest and subarctic is often characterized as a large, homogeneous expanse with relatively warm summers, cold winters, and low species diversity (Johnson and Miyanishi 1999; Elliott-Fisk 2000). Boreal vegetation can be divided into latitudinal subzones and regions (Larson 1980). Boreal forests have two contrasting spatial elements: They are relatively homogeneous at the regional level and heterogeneous at the habitat level (Väisänen 1995). The implication of this dichotomy in scale to biodiversity is that taxa "perceive" forested landscape patterns differently. For example, a stand that is homogeneous for birds may be heterogeneous for beetles (Haila et al. 1994).

In general, species diversity decreases poleward due to the severity of the winters (Väisänen 1995). Species adaptations reflect the short growing season, cold winters, and relatively low diversity of resources (Oechel and Lawrence 1985). Typically, habitat generalists are more widespread than habitat specialists in the same zone (Danks and Footit 1989; Virkalla 1993). Boreal forests appear to be richer in species below the surface than they are above-ground level, a distinction that separates these ecosystems from those at lower latitudes (Väisänen 1995).

The ELC results are comparable to the published literature. Due to the limited fauna species abundance data within the YGP, the diversity discussion focuses on plant species diversity and structural diversity. Indirect reference to faunal abundance and diversity has been made only where appropriate.

2.7.6.2 Species Diversity

Alpha (within habitat) diversity is highly variable within the YGP study area (Table 2.7-5). Ecosystems such as the Spruce – Moss Forest (AM) and Water Sedge – Narrow-leaved Cottongrass Fen have low species richness (6-7) and low evenness, indicating that a few species dominate these ecosystems. In contrast, ecosystems such as the Spruce –

Beta (between habitat) diversity is relatively high. Species richness is greatest for the Tamarack – Blueberry Treed Fen (TF) and Spruce – Cloudberry Treed Bog (TB) and lowest for the Round-fruited Sedge – Chamisso's Cottongrass Fen (CE) and Spruce – Moss Forest (AM) ecosystems. The Spruce – Moss Forest (AM) ecosystem has the lowest diversity of all of the ecosystems, as determined by Shannon's Diversity Index.

Species diversity statistics are not available for the Floating Aquatic Shallow Shore Marsh (FA) and Willow – Sedge Low Shrub (SH) ecosystem units, as the stands representing these units were not sampled.

TABLE 2.7-5: SPECIES DIVERSITY IN THE YGP STUDY AREA

Ecosystem Type	No. of Plots	Species Richness	Shannon's Diversity	Evenness
AM: Spruce – Moss Forest (AM)	3	6 to 7	0.54 to 0.86	0.30 to 0.48
BF: Boulder Field	2	17	1.00 to 2.04	0.35 to 0.72
BR: Scrub Birch – Cloudberry Low Shrub Bog	2	8 to 15	0.44 to 1.15	0.21 to 0.43
CA: Water Sedge – Narrow-leaved Cottongrass Fen	1	7	0.93	0.48
CE: Round-fruited Sedge – Chamisso's Cottongrass Fen	3	8 to 15	0.88 to 2.16	0.43 to 0.80
EA: Sheathed Cottongrass – Bog-rosemary Sedge Fen	1	14	1.41	0.54
EM: Water Sedge – Horsetail Shallow Shore Marsh	4	9 to 13	1.00	0.44
JL: Jack Pine – Lichen Woodland	6	5 to 21	1.00 to 2.14	0.37 to 0.66
SL: Spruce – Lichen Woodland	7	9 to 17	0.67 to 2.24	0.31 to 0.79
TB: Spruce – Cloudberry Treed Bog	5	5 to 31	0.99 to 2.29	0.62 to 0.73
TF: Tamarack – Blueberry Treed Fen	1	22	2.19	0.71
WR: Spruce – Willow Riparian Forest	4	11 to 18	1.16 to 1.65	0.46 to 0.69

2.7.6.3 Structural and Functional Diversity

Functional diversity was inferred from the ELC data collected for the YGP study area by aggregating plant species by life form. The number of tree species is limited within the YGP study area, typically with only two to three species present. Shrub species richness, cover, and vertical structure, attributes important for small mammals and avifauna, are greatest in the Spruce – Willow Riparian (WR) and Spruce – Cloudberry Treed Bog (TB) ecosystems. Lichens are important as nitrogen fixers and as forage for caribou; they are most prominent in Spruce – Cloudberry Treed Bog (TB), Spruce – Lichen Woodland (SL), and Jack Pine – Lichen (JL) ecosystems.

Structural stage descriptions were used to characterize structural diversity at the landscape level (Table 2.7-6). Young forests (n=548) and shrublands (n=547) are the dominant landscape elements and cover 89.4% of the YGP study area. Deciduous and mixed deciduous and coniferous forests are a small part of the forested landscape component. The deciduous shrublands and forests likely contain a greater number and diversity of fauna, particularly bird species, than the coniferous forests within the YGP study area. The observed stature of the forests illustrates the effects of fire in altering the landscape and ecosystems in the YGP study area.

The observed stature of the forests illustrates the effects of fire in altering the landscape and ecosystems in the YGP study area.

TABLE 2.7-6: STRUCTURAL STAGE DIVERSITY IN THE YGP STUDY AREA[1]

Structural Stage	No. of Polygons	Sum (ha)	Mean Patch Size ± SD (ha)
Sparse/Bryoid (SB)	27	73.2	2.7 ± 6.2
Aquatic (AQ)	35	40.8	1.2 ± 1.0
Forb-dominated (FO)	1	0.3	NA
Graminoid-dominated (GR)	67	82.2	1.2 ± 1.3
Shrub-dominated (SH)	547	4,820.6	8.8 ± 18.9
Pole Sapling – Coniferous (PS-c)	12	133.9	11.2 ± 13.4
Pole Sapling – Mixed Deciduous/Coniferous (PS-m)	63	619.6	9.8 ± 9.3
Young Forest – Coniferous (YF-c)	497	5,183.2	10.4 ± 15.1
Young Forest – Mixed Deciduous/Coniferous (YF-m)	51	272.9	5.4 ± 5.8
Mature Forest – Coniferous (MF-c)	3	129.6	43.2 ± 22.7
Mature Forest – Mixed Deciduous/Coniferous (MF-m)	21	50.6	2.4 ± 2.3
Not Applicable (Water)	191	3,067.8	15.6 ± 96.7

[1]Metrics were calculated on the dominant structural stage within a polygon

2.7.6.4 Landscape-level Diversity

The size of the YGP study area is approximately 14,500 ha and landscape-level diversity calculations revealed a total of 1,515 patches (mapped polygons). Of the 22 ecosystems identified, and not including large waterbodies, patch number and abundance were greatest in three ecosystems: Spruce – Lichen Woodland (SL), Jack Pine – Lichen (JL), and Spruce – Cloudberry Treed Bog (TB) (Table 2.7-7).

The three ecosystem types mentioned above, along with lakes (LA), dominate the landscape. The total core area and percentage of core area available is greatest in the Scrub Birch – Cloudberry Low Shrub Bog (BR), Water Sedge Narrow-leaved Cottongrass Fen (CA) and Jack Pine – Lichen Woodland (JL) ecosystems. Patches of these same ecosystems are also highly connected. Patch interspersion was highest for the boulder field (BF) unit and lowest for the Spruce – Cloudberry Treed Bog (TB) unit.

TABLE 2.7-7: ECOSYSTEM TYPE DIVERSITY IN THE YGP STUDY AREA[1]

Ecosystem Type	Number of Polygons	Sum (ha)	Mean Patch Size ± SD (ha)
AM: Spruce – Moss Forest (AM)	65	534.3	8.2 ± 8.9
BF: Boulder Field	5	27.6	5.5 ± 5.0
BR: Scrub Birch – Cloudberry Low Shrub Bog	7	24.5	3.5 ± 2.7
CA: Water Sedge – Narrow-leaved Cottongrass Fen	1	0.4	0.4 ± 0.0
CE: Round-fruited Sedge – Chamisso's Cottongrass Fen	4	2.9	0.7 ± 0.6

TABLE 2.7-7: ECOSYSTEM TYPE DIVERSITY IN THE YGP STUDY AREA[1]			
Ecosystem Type	Number of Polygons	Sum (ha)	Mean Patch Size ± SD (ha)
EA: Sheathed Cottongrass – Bog-rosemary Sedge Fen	2	2.0	1.0 ± 1.0
EM: Water Sedge – Horsetail Shallow Shore Marsh	57	73.4	1.3 ± 1.4
FA: Floating Aquatic Shallow Shore Marsh	35	40.8	1.2 ± 1.0
GP: Gravel Pit	2	5.9	2.9 ± 2.9
JL: Jack Pine – Lichen Woodland	158	2,782.7	17.6 ± 22.0
LA: Lake	46	2,764.2	60.1 ± 191.8
OW: Shallow Open Water	18	9.1	0.5 ± 0.6
PD: Pond	127	294.5	2.3 ± 2.8
RO: Rock Outcrop	7	7.7	1.1 ± 0.7
RP: Road Surface	18	18.4	1.0 ± 0.6
RR: Rural	3	8.9	3.0 ± 1.9
SH: Willow – Sedge Low Shrub	89	210.9	2.4 ± 2.0
SL: Spruce – Lichen Woodland	439	5,495.9	12.5 ± 21.0
TB: Spruce – Cloudberry Treed Bog	296	1,295.5	4.4 ± 5.2
TD: Mine Tailings	2	36.8	18.4 ± 20.9
TF: Tamarack – Blueberry Treed Fen	52	567.8	10.9 ± 14.6
WR: Spruce – Willow Riparian Forest	82	270.5	3.3 ± 2.5

[1]Metrics were calculated on the dominant ecosystem unit within a polygon

Landscape evenness was 0.6, indicating several ecosystems dominate the YGP study area (Table 2.7-8). The landscape-level diversity of the YGP study area is considered moderate. The total amount of core area available is relatively small. Species and habitat diversity are variable within the YGP study area. Species richness and diversity are variable with the forested ecosystems having the greatest species richness, as well as the greatest within-habitat variability. Three of the 22 ecosystems occurring within the YGP study area dominate the landscape.

TABLE 2.7-8: LANDSCAPE-LEVEL STATISTICS FOR THE YGP STUDY AREA	
Metric	Value
Total Area (TA)	14,475.0
Number of Patches (NP)	1,355
Patch Density (PD)	9.4
Patch Richness (PR)	23
Patch Richness Density (PRD)	0.2
Shannon's Diversity Index (SHDI)	1.9
Shannon's Evenness Index (SHEI)	0.6
Total Core Area (TCA)	0.0 to 1,142.2
Core Area Index (CAI)	0.0 to 10.0
Proximity Index (PROX)	0.0 to 1,585.8
Interspersion and Juxtaposition (IJI)	0.0 to 71.0

2.8 SURFACE HYDROLOGY

The Yellowknife Gold Project (YGP) study area is located within the Yellowknife River drainage basin, a catchment of approximately 15,000 km², which drains into Yellowknife Bay of Great Slave Lake, near the city of Yellowknife (Environment Canada 1990) (Figure 2.8-1).

The Ormsby and West Zones of the YGP are located in two much smaller catchments, Brien Lake drainage basin (3.2 km²) and Narrow Lake drainage basin (9.3 km²) (Figure 2.8-2).

Discharges leaving the West Zone exit from Brien Lake (el. 295 masl [metres above sea level]) and enter Shona Lake (el. 291 masl), then generally flow to the southwest through a series of small unnamed lakes, eventually reaching Barker Lake (el. 243 masl), Johnstone Lake (el. 232 masl), Clan Lake (el. 216 masl), and the Yellowknife River.

Discharge from the Ormsby Zone flow into the Narrow Lake basin. This basin consists of Round Lake (el. 288 masl) discharging to Winter Lake (el. 286 masl), then to Narrow Lake (el 282 masl). Narrow Lake discharges to the southwest to Morris Lake (el. 278 masl), then Goodwin Lake (el. 260 masl), Johnstone Lake (el. 232 masl), Clan Lake (el. 216 masl), and the Yellowknife River.

Another area of significance for the Yellowknife Gold Project is the resource located at Nicholas Lake, which is located within the Nicholas Lake drainage basin. Nicholas Lake (el. 325 masl) discharge flows west to Eclipse Lake (el. 311 masl) and eventually into the Yellowknife River via numerous small lakes, ponds and bogs.

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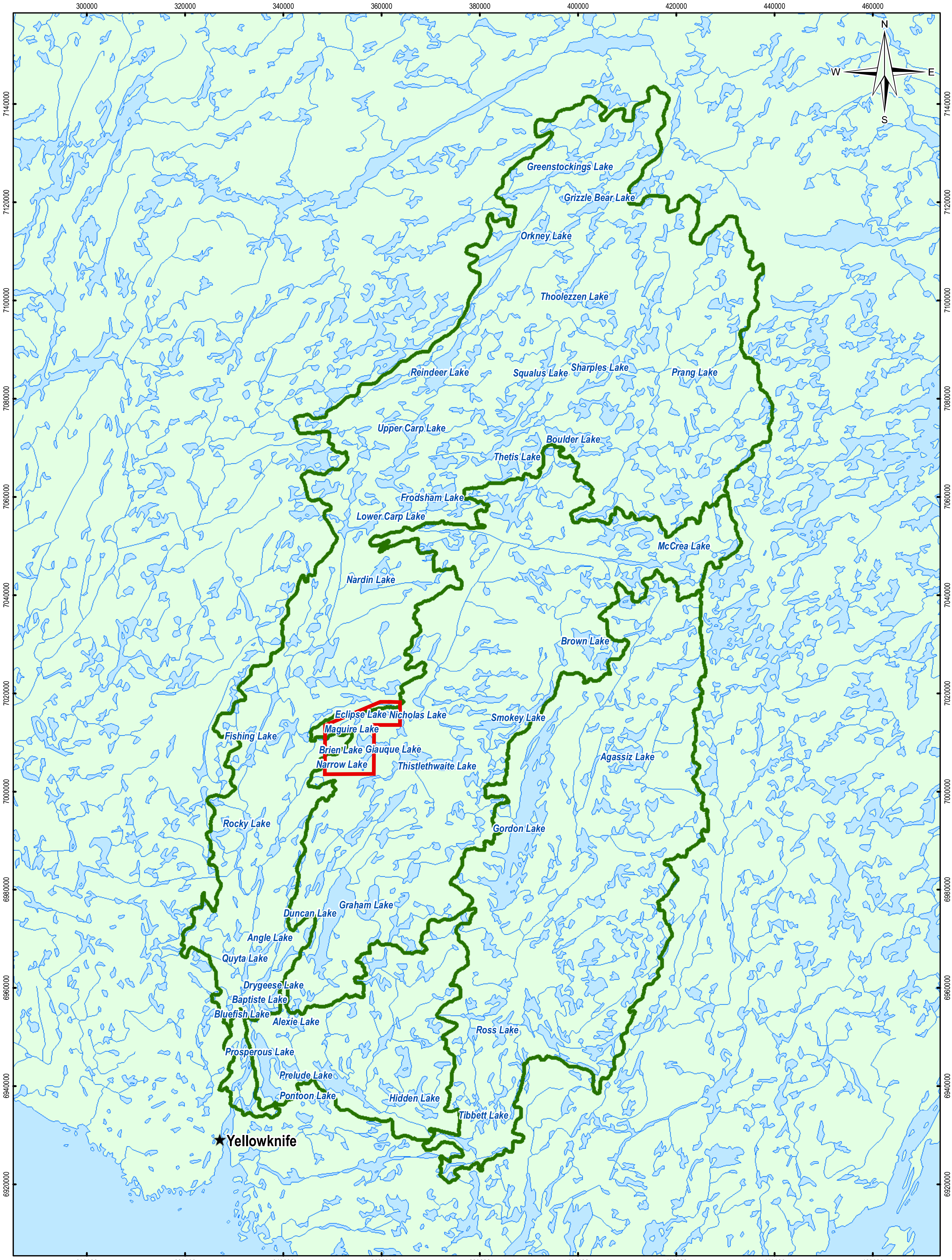

LEGEND

- Local Study Area
- Yellowknife River Basin
- Watercourse
- Waterbody

NOTES

Base data source: National Atlas of Canada.

ISSUED FOR USE

YELLOWKNIFE GOLD PROJECT

Yellowknife River Drainage Basins

PROJECTION	DATUM
UTM Zone 12	NAD83

Scale: 1:750,000

10 5 0 10 20

Kilometres

Tyhee NWT Corp

EBA Engineering Consultants Ltd.

FILE NO.

V23201097-DAR-010.mxd

PROJECT NO.	DWN	CKD	REV
V23201097	SL	RH	0

OFFICE	DATE
EBA-VANC	February 17, 2011

Figure 2.8-1

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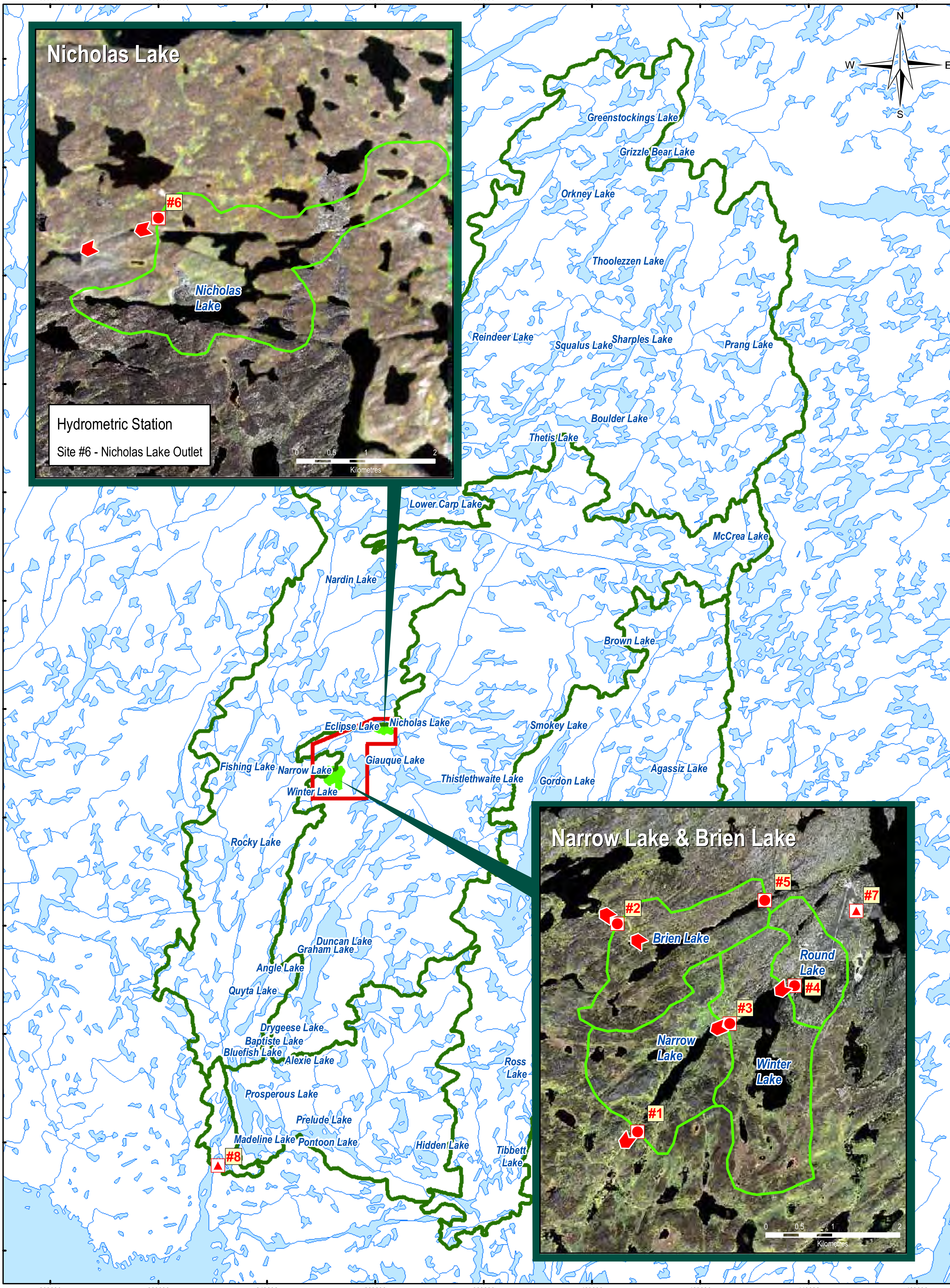

LEGEND

- Local Study Area
- Flow Direction
- Hydrometric Station
- Meteorological Station
- Yellowknife River Basin
- Basin Outline
- Watercourse
- Waterbody

NOTES
1. Base data source: Atlas of Canada.
2. Imagery Source: IKONOS (July 27 and August 2, 2004); Landsat TM (August 11, 2001).

Hydrometric Stations
- Site #1 - Narrow Lake Outlet
- Site #2 - Brient Lake Outlet
- Site #3 - Winter Lake Outlet
- Site #4 - Round Lake Outlet
- Site #5 - NE Brien Lake
- Site #6 - Nicholas Lake Outlet

Meteorological Stations
- Site #7 - Camp Meteorological Station
- Site #8 - Yellowknife MSC Meteorological Station

ISSUED FOR USE

YELLOWKNIFE GOLD PROJECT

Local Study Area Hydrometric Stations

PROJECTION	DATUM
UTM Zone 12	NAD83

Scale: 1:700,000
5 2.5 0 5 10 15 20
Kilometres

FILE NO.: V23201097-DAR-058.mxd

PROJECT NO.	DWN	CKD	REV
V23201097	SL	RH	0

OFFICE	DATE
EBA-VANC	February 17, 2011

Tyhee NWT Corp

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Figure 2.8-2

2.8.1 Hydrological Monitoring

During the 2004 open water season, hydrological investigations were initiated at the hydrometric stations identified in Figure 2.8-2. The hydrological program is an ongoing component of the Yellowknife Gold Project.

In 2004 a total of six sites were selected as part of the ongoing hydrological study. The tasks for sites 2 and 5 were completed by the end of 2004 and the results are presented in this report. No automated hydrometric stations were installed at these two sites.

Table 2.8-1 is a summary of hydrological characteristics of each instrumented catchment basin or combined basin. Approximate basin dimensions, catchment areas, approximate lake elevations and the maximum basin elevations are given.

More information and a detailed discussion on each year's hydrological survey from 2004 to 2010 are provided in Appendix B as a separate report.

TABLE 2.8-1: SUMMARY OF HYDROMETRIC STATION GENERAL BASIN CHARACTERISTICS

Gauging Station Site ID	Basin Name	*Length (m)	*Width (m)	*Drainage Area (m^2)	Approx. Lake Elevation (m)	Maximum Basin Elevation (m)
Combined Basins						
Site 3 + 4	Winter – Round Basin	4,600	1,700	5,500,000	n/a	330
Site 1+3+4	Narrow – Winter Round Basin	4,600	3,400	9,300,000	n/a	350
Individual Basins						
Site 1	Narrow Basin	3,900	1,500	3,800,000	282	350
Site 3	Winter Basin	4,300	1,400	4,300,000	285	330
Site 4	Round Basin	1,800	8,00	1,200,000	288	330
Site 6	Nicholas Basin	6,000	2,000	6,280,000	235	370

* Note basin areas, lengths and widths were determined only up to the location of the hydrometric station.

2.8.1.1 Narrow Lake Drainage Basin

The Narrow Lake drainage basin is approximately 4.6 km by 3.4 km with a total catchment area of 9.3 km^2. The maximum elevation in the basin is approximately 350 masl.

The Narrow Lake drainage basin consists of the Round, Winter and Narrow Lake drainage basins. Discharges from Round Lake (el. 288 masl) flow to the southwest through Winter Lake (el. 286 masl) and continues on to Narrow Lake (el. 282 masl).

The outlet of Narrow Lake is located at the southwest end of the lake and consists of two small creeks that enter a pond about 100 m southwest of the lake, near the existing winter road. The hydrometric station is located on the single creek exiting the pond, in a well-defined channel, about 10 m downstream of the pond. Downstream of the station, there is no well-defined channel and the flow meanders generally southwest through muskeg and stunted growth of birch and conifers. Discharge from the Narrow Lake basin flows southwest to Morris Lake (el. 278 masl), and eventually to the Yellowknife River.

The Narrow Lake Outlet hydrometric station (#1 on Figure 2.8-2) was established on May 19, 2004. During the summer of 2004, a staff gauge was installed at the site and measurements of flow and stage were recorded manually.

The following is a history of the hydrometric installations since 2004 for this site:

- May 19, 2004 – initial site visit. No observed flow as the creek was still frozen.
- May 28, 2004 – site visit to determine a location for the hydrometric station. Discrete measurements of stage and discharge were collected over a four day period.
- October 1, 2004 – site visit to collect stage and discharge data.
- May 22, 2005 – an automated stage recorder and staff gauge were installed at this station. A survey monument was also installed at this site to provide a known reference point for elevation surveys of the site instrumentation.
- July 15, 2005 – station was deactivated to accommodate site improvements.
- July 17, 2005 – the hydrometric station was upgraded by installing a Parshall flume. Discrete discharge measurements were made to ensure correct calibration of the flume.
- September 12, 2005 – the instrumentation was removed for the season.
- June 9, 2006 – the Parshall flume and bulkhead were inspected for damage or leakage. No problems were observed and the pressure transducer and data logger were reinstalled to collect discharge data over the summer of 2006. Discrete discharge measurements were made to ensure correct calibration of the flume.
- September 19, 2006 – the instrumentation was removed for the season.
- May 11, 2007 – instrumentation was re-installed to collect discharge data over the summer of 2007.
- June 10, 2007 – the Parshall flume and bulkhead were inspected for damage or leakage. Leaks were plugged on both sides of the flume. It was observed that during high flows, leaks may occur around the sides of the bulkhead. Discrete discharge measurements were made to ensure correct calibration of the flume.
- September 28, 2007 – the instrumentation was removed for the season.
- June 4, 2008 – the Parshall flume and bulkhead were inspected and there was no damage or leakage. Instrumentation re-installed for the summer and discharge measurements collected for flume calibration.

- July 29, 2008 – the Parshall flume and bulkhead were inspected and there was no damage or leakage. Flume calibration data collected.
- September 26, 2008 – the instrumentation was removed for the season.
- June 6, 2009 - the Parshall flume and bulkhead were inspected and there was no damage or leakage. Instrumentation re-installed for the summer and discharge measurements collected for flume calibration.
- August 24, 2009– the Parshall flume and bulkhead were inspected and there was no damage or leakage. Flume calibration data collected.
- October 10, 2009– the instrumentation was removed for the season.
- May 27, 2010 - the stage recorder was installed for the 2010 hydrological study.
- June 3/2010 - The Parshall flume and bulkhead were inspected. No damage or leakage was observed at this time. Discharge data was collected to check flume calibration and the data logger downloaded to ensure correct hydrometric station operation.
- September 20, 2010 - the hydrometric instrumentation was removed for the season at 09:50 hours.

A total of seven years of discharge data have been collected on the Narrow Lake Outlet. A summary of the discharges for each of the years on record is presented in Figure 2.8-3. The data for 2004 consists of a series of discrete points representing the onsite measurements of discharge using velocity-area measurements. The remaining six years were collected by automated hydrometric station instrumentation.

From the graph, it is clear that 2005 had the highest recorded discharge of 221 L/s, occurring on May 31, 2005. The timing of the peak freshet flow varies slightly from year to year but is most likely to occur during the last 2 weeks of May. Throughout the winter from mid-October to the end of April the outlet is frozen and without discharge.

Table 2.8-2 is a summary of the data recorded at the Narrow Lake hydrometric station.

From the annual time history of discharge data the average monthly discharge and runoff values were calculated for all the years on record. A summary of these monthly averages is presented in Table 2.8-3. Data for the months at the beginning and end of the period of record are incomplete, as the transducer was either installed or removed during these months.

Figure 2.8-3
Narrow Lake Outlet - Discharge Hydrographs— 2004 to 2010

TABLE 2.8-2: NARROW LAKE OUTLET – ANNUAL DISCHARGE AND RUNOFF VALUES – 2005 TO 2010

Site 1 - Narrow Lake Outlet (Round + Winter + Narrow Lake Basins)

Year	Period of Record		Total Measured Basin Discharge (m^3/yr)	Average Basin Discharge (L/s)	Total Basin Runoff (mm)
	Start	Finish			
2005	May 22/05 11:11	Sep 12/05 14:59	748,774	77.3	80.5
2006	Jun 09/06 09:27	Sep 19/06 14:12	328,514	37.2	35.3
2007	May 21/07 09:30	Sep 28/07 16:45	302,216	26.8	32.5
2008	Jun 04/08 08:14	Sep 26/08 11:44	119,043	12.1	12.8
2009	Jun 06/09 08:46	Sep 30/08 23:45	393,860	39.7	45.8
2010	May 217/10 14:35	Sep 20/10 09:50	213,266	19.2	22.9

TABLE 2.8-3: NARROW LAKE OUTLET AVERAGE MONTHLY DISCHAREGE AND RUNOFF – 2005 TO 2010										
Site 1 - Narrow Lake Outlet (Round + Winter + Narrow Lake Basins)										
	Average Basin Discharge					Monthly Total Basin Runoff				
	May	Jun	Jul	Aug	Sep	May	Jun	Jul	Aug	Sep
Year	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)	(mm)	(mm)	(mm)	(mm)	(mm)
2005	*173.6	156.4	44.7	21.6	*27.9	*15.4	43.6	12.9	6.2	*3.0
2006	*no data*	*71.8	35.6	19.9	*28.5	*no data*	*14.4	10.3	5.7	*4.9
2007	*113.5	58.6	11.9	4.8	*<1.0	*11.2	16.3	3.4	1.4	*<1.0
2008	*no data*	*22.0	9.4	1.9	*17.3	*no data*	*5.5	2.7	<1.0	4.1
2009	*no data*	*76.5	55.0	10.9	21.1	*no data*	*17.5	15.8	3.1	5.9
2010	*11.1	9.6	18.2	30.8	*18.7	*0.5	3.0	5.8	9.9	*3.5

* data were not collected all days of the indicated month as the logger was either installed or removed for the season or the station was under repair.

2.8.1.2 Brien Lake Drainage Basin

The outlet of Brien Lake (#2 on Figure 2.8-2) consists of a creek discharging from the northwest end, which conducts flow from Brien Lake to Shona Lake. The creek channel is poorly defined in most areas, and meanders through a 10 to 100 m wide valley, which is fully vegetated with birch and pine. Small willows and long grass dominate much of the wetted area. Along the entire stretch of the one kilometre creek valley only one possible site was found that would be suitable for a hydrometric station. All of the flows from the upstream valley funnel through a 10 m wide bedrock saddle, which provides a good site for the hydrometric station. Only discrete discharge measurements were collected during 2004. These data are presented in Table 2.8-4. The station was decommissioned after the summer of 2004 and no further data have been collected at this site.

TABLE 2.8-4: BRIEN LAKE OUTLET – DISCRETE DISCHARGE MEASUREMENTS - 2004		
Date/Time MDST	Staff Gauge Reading m	*Discharge L/s
May 19/04 14:00	Not installed	0.0
May 29/04 13:54	0.458	159.9
May 29/04 14:35	0.459	165.3
May 29/04 17:20	0.457	151.9
May 30/04 10:30	0.456	169.6
May 30/04 11:26	0.457	166.1
May 30/04 17:38	0.455	140.5
May 30/04 18:18	0.454	154.4
May 31/04 10:21	0.447	133.6
May 31/04 10:56	0.447	144.8
Jun 01/04 11:24	0.444	132.2
Jun 01/04 12:08	0.444	128.5

TABLE 2.8-4: BRIEN LAKE OUTLET – DISCRETE DISCHARGE MEASUREMENTS - 2004		
Date/Time MDST	Staff Gauge Reading m	*Discharge L/s
Jun 01/04 15:11	0.444	116.7
Jun 01/04 15:50	0.444	117.7
Jun 02/04 09:37	0.436	105.9
Jun 02/04 10:17	0.436	114.8
Jun 02/04 15:53	0.435	99.5
Jun 02/04 16:40	0.435	103.6
Sep 30/04 09:00	n/a	0.0

*Calculated from Swoffer meter velocity measurements

2.8.1.3 Winter Lake Drainage Basin

The Winter Lake drainage basin is approximately 4.6 km by 1.7 km and has a catchment area of 5.5 km^2. The elevation of Winter Lake is about 286 masl and the maximum elevation in the basin is approximately 330 masl. Inflows to Winter Lake consist of the Winter Lake basin runoff as well as the outflows from the Round Lake basin.

Winter Lake Outlet (#3 on Figure 2.8-2) discharges from the northwest portion of the lake at a location about 10 m to the south of the existing winter road between Winter and Narrow lakes. The creek channel is typically 30 to 60 cm wide, by 15 to 20 cm deep at the hydrometric station. The creek meanders southwest through a vegetated creek bed until about midway between Winter and Narrow lakes, where it aligns with the existing winter road and flows to Narrow Lake along a poorly-defined diffuse route.

The following is a history of the hydrometric installations since 2004 for this site:

- May 19, 2004 – initial site visit. No observed flow as the creek was still frozen.
- May 28, 2004 – site visit to determine if flow exists between Winter and Narrow lakes and if so what direction it was flowing in. During 2004 there were no requirements for discharge measurements at this site.
- May 20, 2005 – site was selected for the Winter Lake hydrometric station. Only discrete discharge measurements were made during the first portion of the 2005 field survey.
- July 14, 2005 – the hydrometric station was upgraded by installing a Parshall flume. Discharge data collected to check the calibration of the flume.
- September 12, 2006 – the instrumentation was removed for the season.
- June 9, 2006 – the Parshall flume and bulkhead were inspected for damage and leakage. No problems were observed and the pressure transducer and data logger were re-installed to collect discharge data over the summer of 2006. Discharge data collected to check the calibration of the flume.
- September 19, 2006 – the instrumentation was removed for the season.

- May 19, 2007 – instrumentation was re-installed to collect discharge data over the summer of 2007.
- June 10, 2007 – the Parshall flume and bulkhead were inspected for damage and leakage. Leakage around the flume at higher flows was observed to be possible and repairs were made. Discharge data were collected to check the calibration of the flume.
- September 28, 2007 – The instrumentation was removed for the season.
- May 27, 2008 - the instrumentation was installed for the summer of 2008.
- June 3, 2008 - Leakage at higher flows around the flume was observed to be possible and attempts at repairs made. Discharge data were collected to check the calibration of the flume. Plans were made to completely overhaul the flume and bulkhead later that summer.
- July 29, 2008 – The flume and bulkhead were removed from the station and the flume and new bulkhead installed. The flume was installed approximately 10 cm lower than the previous installation to minimize potential backwater effects. Discharge data were collected to check the calibration of the flume.
- September 26, 2008 - The instrumentation was removed for the season.
- June 5, 2009 – Small leaks were plugged in the bulkhead and the instrumentation was installed for the summer of 2008. Discharges were manually measured to verify calibration of the Parshall flume.
- August 21, 2009 - Discharges were manually measured to verify calibration of the Parshall flume.
- October 8, 2009 - The instrumentation was removed for the season.
- May 27, 2010 - The stage recorder was installed for the 2010 hydrological study
- June 5, 2010 Site visit by EBA Hydrologist. During the visit the Parshall flume and bulkhead were inspected and some minor repairs were necessary to prevent leakage through the bulkhead. No leakage was observed after the repairs. Stage discharge data was collected to ensure flume calibration and the data logger downloaded to ensure correct operation.
- September 17, 2010 - The instrumentation was removed for the season.

A total of six years of discharge data have been collected on the Winter Lake Outlet. The discharge hydrographs for each year are presented in Figure 2.8-4. From the hydrographs for the Winter Lake Outlet it is evident that the highest discharge (73 L/s) was recorded on June 26, 2009. The timing of the peak freshet flow varies from year to year, but is most likely to occur in the last two weeks of May. From mid-October to the end of April the outlet is typically frozen and without discharge.

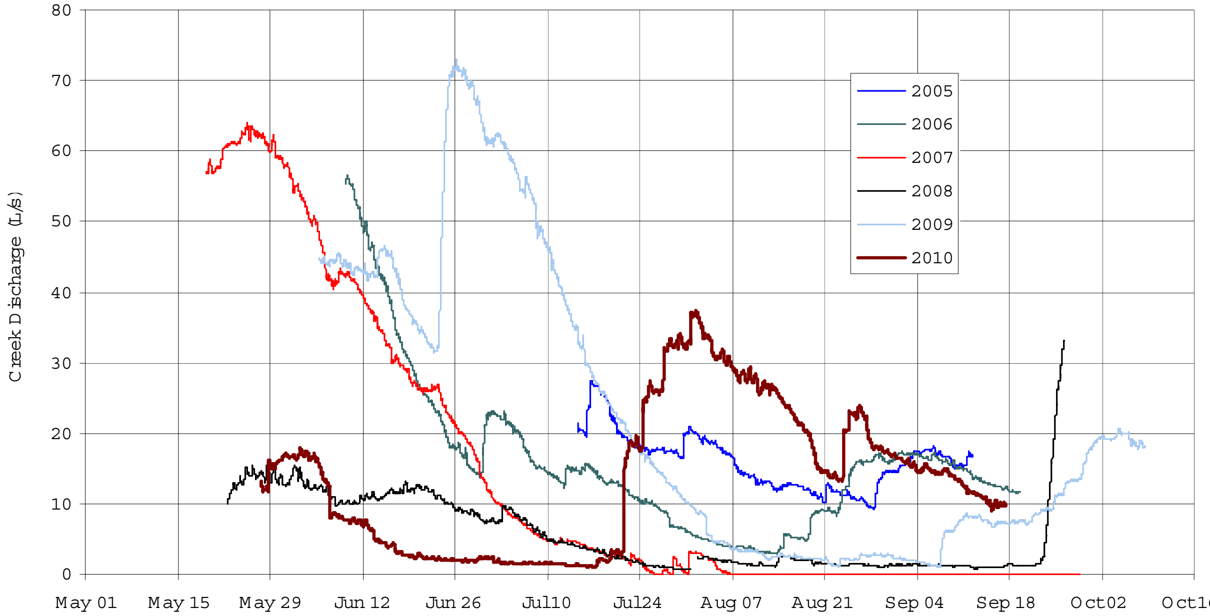

Figure 2.8-4
Winter Lake Outlet - Discharge Hydrographs – 2005 to 2010

Table 2.8-5 is a summary of the measured annual discharge volume, runoff and average flow for the combined basins of Winter and Round lakes for the stated periods of record.

TABLE 2.8-5: WINTER LAKE OUTLET HYDROMETRIC STATION ANNUAL DISCHARGE AND RUNOFF VALUES

Site 3 - Winter Lake Outlet (Winter + Round Lake Basins)					
Year	Period of Record		Total Measured Basin Discharge (m^3/yr)	Average Basin Discharge (L/s)	Total Basin Runoff (mm)
	Start	Finish			
2005	Jul 14/05 14:26	Sep 12/05 10:26	82,933	16.0	15.1
2006	Jun 09/06 11:10	Sep 19/06 13:40	140,046	15.9	25.5
2007	May 19/07 11:04	Sep 28/07 15:49	164,679	14.4	29.9
2008	May22/08 14:45	Sep 26/08 08:00	61,954	5.7	11.3
2009	Jun 05/09 12:30	Sep 30/09 23:45	223,558	21.9	42.9
2010	May 27/10 13:16	Sep 17/10 13:46	131,471	13.5	23.9

From the annual hydrographs, the average monthly discharges at the Winter Lake hydrometric station were computed and a summary is presented in Table 2.8-6. Typically the starting and ending months of each year's period of record do not contain a full month of data, as the transducer was either installed or removed in these months.

TABLE 2.8-6: WINTER LAKE OUTLET HYDROMETRIC STATION ANNUAL MONTHLY DISCHARGE AND RUNOFFS

Site 3 - Winter Lake Outlet (Winter + Round Lake Basins)										
Year	Average Basin Discharge					Monthly Total Basin Runoff				
	May	Jun	Jul	Aug	Sep	May	Jun	Jul	Aug	Sep
	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)	(mm)	(mm)	(mm)	(mm)	(mm)
2005	*no data*	*no data*	*20.1	13.6	*16.5	*no data*	*no data*	*5.5	6.6	*3.0
2006	*no data*	*31.0	13.8	8.0	*14.8	*no data*	*10.5	6.7	3.9	*4.3
2007	*60.3	33.7	4.1	<1.0	*no data*	*11.9	15.9	2.0	<1.0	*no data*
2008	*13.9	11.1	4.0	1.7	*3.4*	*2.0	5.2	1.9	0.8	*1.3*
2009	*no data*	*48.2	33.3	3.2	*7.6*	*no data*	19.3	16.2	1.6	*3.6*
2010	**15.0*	6.5	10.0	23.6	**13.2*	**1.0*	3.0	4.9	11.5	**3.4*

* data were not collected for every day of the indicated month as the logger was either installed or removed for the season or the station was under repair.

2.8.1.4 Round Lake Drainage Basin

The Round Lake drainage basin is about 1.8 km by 0.8 km with a catchment area of 1.2 km^2. The estimated elevation of Round Lake is 288 masl and basin elevations extend up to approximately 330 masl. Inflows to Round Lake consist only of the Round Lake drainage basin runoff.

The outlet of Round Lake (#4 on Figure 2.8-2), which flows into Winter Lake, is situated on the northwest side of Round Lake. There is no distinct flow channel out of Round Lake but rather a diffuse flow through the muskeg into a small marsh approximately 5 m downstream of the lake. The outlet flows southwest into Winter Lake, typically as a subsurface flow, through the muskeg and willow. At one point, about 25 m southwest of the Round Lake Outlet, the flow is contained in a single channel. This site was selected for the hydrometric station.

The following is a history of the hydrometric installations since 2004 for this site:

- May 19, 2004 – initial site visit. No observed flow as the creek was still frozen.
- May 28, 2004 – site visit to determine if flow exists between Round and Winter lakes and if so, what direction it was flowing in. During 2004 there were no requirements for discharge measurements at this site.
- May 20, 2005 – site visit to determine a location for the hydrometric station. Started collecting discrete discharge data for this station.
- July 18, 2005 – Parshall flume installed and instrumented. Discharge data were collected to check the calibration of the flume.
- September 12, 2005 – instrumentation removed for the season.

- June 9, 2006 – Parshall flume and bulkhead inspected for damage or leakage. A leak in the bulkhead was repaired and the pressure transducer and data logger were re-installed. Discharge data were collected to check the calibration of the flume.
- October 3, 2006 – instrumentation removed for the season.
- May 19, 2007 – instrumentation re-installed.
- June 11, 2007 – Parshall flume and bulkhead inspected for damage and leakage. The bulkhead needed repair work, since leakage could occur around the sides during periods of high flow. Discharge data were collected to check the calibration of the flume.
- September 28, 2007 – instrumentation removed for the season.
- May 27, 2008 - the instrumentation was installed for the summer of 2008.
- June 3, 2008 - Leakage at higher flows around the flume was observed to be possible and attempts at repairs made. Discharge data were collected to check the calibration of the flume. Plans made to completely overhaul the flume and bulkhead.
- July 29, 2008 – The flume and bulkhead were removed from the station and the flume and new bulkhead installed. The flume was installed approximately 10 cm lower than the previous installation to minimize potential backwater effects. Discharge data were collected to check the calibration of the flume.
- September 26, 2008 - The instrumentation was removed for the season.
- June 5, 2009 – Small leaks were plugged in the bulkhead and the instrumentation was installed for the summer of 2008. Discharges were manually measured to verify calibration of the Parshall flume.
- August 21, 2009 - Discharges were manually measured to verify calibration of the Parshall flume.
- October 8, 2009 - The instrumentation was removed for the season.
- May 27, 2010 - The stage recorder was reinstalled for the 2010 hydrological study.
- June 4, 2010 – Site Visit by EBA hydrologist. The Parshall flume and bulkhead were inspected for damage and leakage. Some seepage was noted, but was easily repaired by packing more mud and sandbags on upstream side of the bulkhead.
- September 17, 2010 - The water level recorder was removed for the season.

A total of six years of discharge data have been collected for the Round Lake outlet. A summary of the discharges is presented in Figure 2.8-5.

The hydrographs indicate that the largest naturally generated discharge recorded was 28.9 L/s on June 25, 2009. There was a greater measured discharge of 50.7 L/s which occurred on Sep. 27, 2008, but this was attributed to INAC's pumping water contained in a clay pit into Round Lake, which has occurred annually up to 2008 generally during the month of August/September. The timing of the peak freshet flow varies from year to year but is most likely to occur in the last two weeks of May. From mid-October to the end of April the outlet is typically frozen and without discharge.

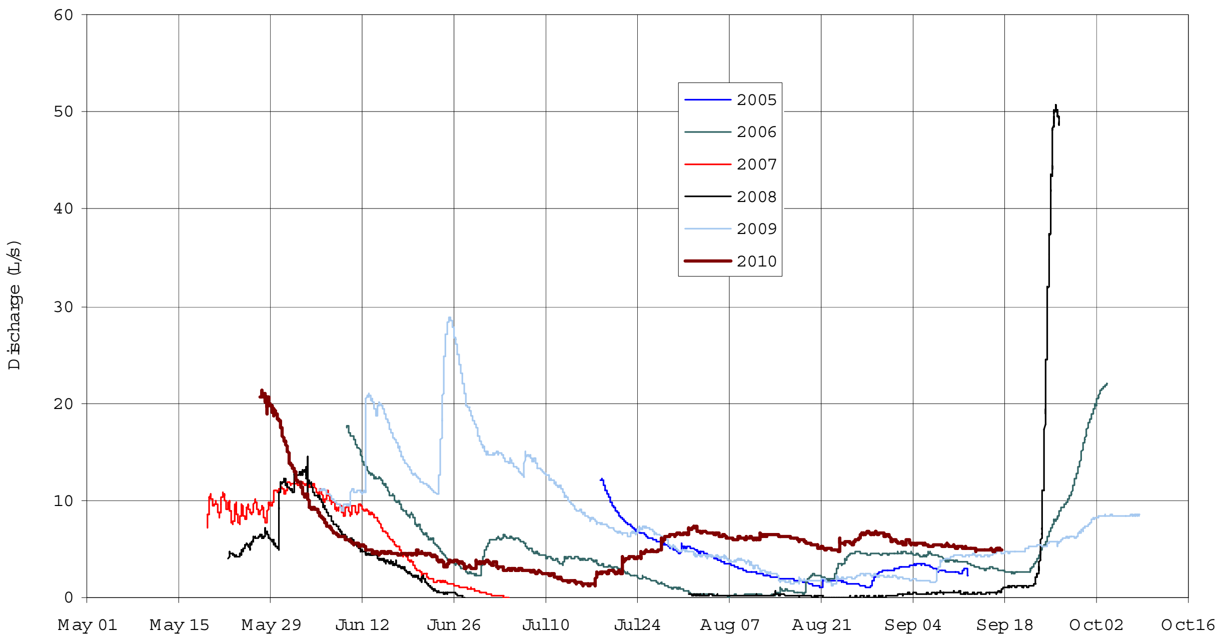

Figure 2.8-5
Round Lake Outlet - Discharge Hydrographs - 2005 to 2010

Table 2.8-7 is a summary of the Round Lake hydrometric station measured annual discharge volume, runoff and average discharge for the stated periods.

TABLE 2.8-7: ROUND LAKE OUTLET HYDROMETRIC STATION ANNUAL DISCHARGE AND RUNOFF VALUES					
Site 4 - Round Lake Outlet (Round Lake Basin only)					
Year	Period of Record		Total Measured Basin Discharge (m^3/yr)	Average Basin Discharge (L/s)	Total Basin Runoff (mm)
	Start	Finish			
2005	Jul 18/05 09:32	Sep 12/05 09:32	17,766	3.7	14.8
2006	Jun 09/06 16:29	Sep 30/06 23:59	42,833	4.4	35.7
2007	May 19/07 10:00	Jul 04/07 09:04	28,947	6.6	24.1
2008	May 22/08 14:27	Sep 26/08 07:42	27,212	3.4	22.7
2009	Jun 05/09 10:14	Sep 30/09 23:59	75,357	7.6	62.8
2010	May 27/10 13:18	Sep 17/10 13:46	54,790	5.6	45.7

From the annual hydrographs for the Round Lake Outlet hydrometric station, the average monthly discharges were computed and are presented in Table 2.8-8. As before, the first and last months of the period have incomplete data as the transducer was installed or removed in these months.

TABLE 2.8-8: ROUND LAKE OUTLET HYDROMETRIC STATION AVERAGE MONTHLY DISCHARGE AND RUNOFFS

Site 4 - Round Lake Outlet (Round Lake Basin only)

Year	Average Basin Discharge					Monthly Total Basin Runoff				
	May	Jun	Jul	Aug	Sep	May	Jun	Jul	Aug	Sep
	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)	(mm)	(mm)	(mm)	(mm)	(mm)
2005	no data	no data	*7.0	2.5	*3.0	no data	no data	*6.9	5.5	*2.5
2006	no data	*8.1	3.5	1.7	5.3	no data	*12.5	7.9	3.8	11.5
2007	*9.5	6.0	<1.0	no data	no data	*9.6	14.5	<1.0	no data	no data
2008	*6.6	*5.1	*<1.0	<1.0	*4.48	*4.5	*9.7	*0.0	<1.0	*8.2
2009	no data	*16.4	9.5	2.7	4.3	no data	*26.2	21.2	6.0	9.4
2010	*18.5	5.7	3.4	6.1	5.3	*5.9	12.3	7.6	13.7	6.3

* data were not collected for every day of the indicated month as the logger was either installed or removed for the season or the station was under repair during the month.

2.8.1.5 Northeast Brien Lake Site

The purpose of this station (#5 on Figure 2.8-2) was to determine if there is flow between northeast Brien Lake and the small unnamed lake to the northeast, and if so, in which direction.

During the survey conducted in 2004 it was concluded that there was no surface flow or defined creek between the two lakes. At the southwest end of the unnamed lake there is a 2 to 3 m increase in elevation along the shore closest to Brien Lake. This topography makes it impossible for surface flows to leave the small lake and flow into Brien Lake. There may be subsurface flows connecting the two lakes, but this could not be determined during the field survey. After the determination there was no surface flow at this station it was dropped from the hydrological program.

2.8.1.6 Nicholas Lake Drainage Basin

The Nicholas Lake drainage basin is approximately 6 km by 2 km, with a total area of 6.28 km^2. Nicholas Lake is at an elevation of 325 masl and maximum basin elevations range up to about 370 masl.

Nicholas Lake outlet (#6 on Figure 2.8-2) is located at the western end of the northwest arm of Nicholas Lake and conveys all flow leaving the Nicholas Lake drainage basin. There is a clearly defined channel about 30 cm deep by 1.5 m wide where the discharge leaves the lake. Within 30 m of the lake outlet, the creek bed is filled with large boulders and there is little evidence of surface flow. The flow travels through boulders for about

700 m prior to discharging into a small lake, and then flows west to Eclipse Lake (el. 311 m) eventually reaching the Yellowknife River via numerous small lakes, ponds and bogs.

The hydrometric station was installed approximately 10 m downstream from the Nicholas Lake outlet. Stage discharge flow gauging techniques were utilized for this hydrometric station.

The following is a history of the hydrometric installations since 2004 for this site:

- May 19, 2004 – initial site visit. No observed flow as the creek was still frozen.
- May 28, 2004 – site visit to determine a location for the hydrometric station. Discrete measurements of stage - discharge were collected.
- September 30, 2004 – site visit to collect stage - discharge data.
- July 13, 2005 – an automated stage and temperature recorder was installed at this station. A survey monument was also installed, to provide a bench mark for elevation surveys of the site instrumentation. Data were collected to augment the stage-discharge relationship.
- September 13, 2005 – the instrumentation was removed for the season.
- Spring 2006 – Nicholas Lake Outlet was excluded from the hydrological study for 2006 and no flow or temperature data were collected.
- June 10, 2007 – Nicholas Lake Outlet was again included in the hydrology survey and instrumentation was re-installed. Data were collected to augment the stage-discharge relationship.
- September 30, 2007 – the instrumentation was removed for the season.
- May 26, 2008 - the instrumentation was installed for the 2008 season.
- June 4, 2008 – Data were collected to augment the stage-discharge relationship. The site was inspected and the data logger downloaded.
- August 2, 2008 - Data were collected to augment the stage-discharge relationship. The site was inspected and the data logger downloaded.
- September 26, 2008 - the instrumentation was removed for the season.
- June 6, 2009 - the instrumentation was installed for the 2008 season. Data were collected to augment the stage-discharge relationship.
- August 24, 2009 - Data were collected to augment the stage-discharge relationship. The site was inspected and an elevation survey conducted.
- October 9, 2009 - the instrumentation was removed for the season.
- May 28, 2010 - The stage and temperature recorder and data logger were reinstalled in the existing hydrometric housing.

- June 4, 2010 – Site Visit by EBA hydrologist and stage discharge measurements were collected to further enhance the stager discharge relationship. The data logger was downloaded and site maintenance conducted.
- September 16, 2010 - The instrumentation was removed for the season.

Discharge data have been collected at the Nicholas Lake Outlet from 2004 to 2009 with the exception of 2006, when the site was dropped from the hydrometric program. A summary of the discharges for the five years of record is presented in Figure 2.8-6. The data for the 2004 hydrograph consist of a series of individual flow measurements recorded throughout the summer using the velocity area method. The remaining data presented in the figure were collected by the automated hydrometric station.

During 1989 Norecol collected discharge data at the outlet of Nicholas Lake from May 29 to October 4, 19891. These data has been incorporated into Figure 2.8-6. The data from 1989 are consistent with the more recently collected data.

From the hydrographs it is evident that the highest discharge recorded was 30 L/s on June 2, 2004. The timing of the peak freshet flow varies from year to year but is most likely to occur in the last two weeks of May or the first week in June, as it did in 2004.

Table 2.8-9 is a summary of the Nicholas Lake annual discharge volume, runoff and average flow for the stated periods of record.

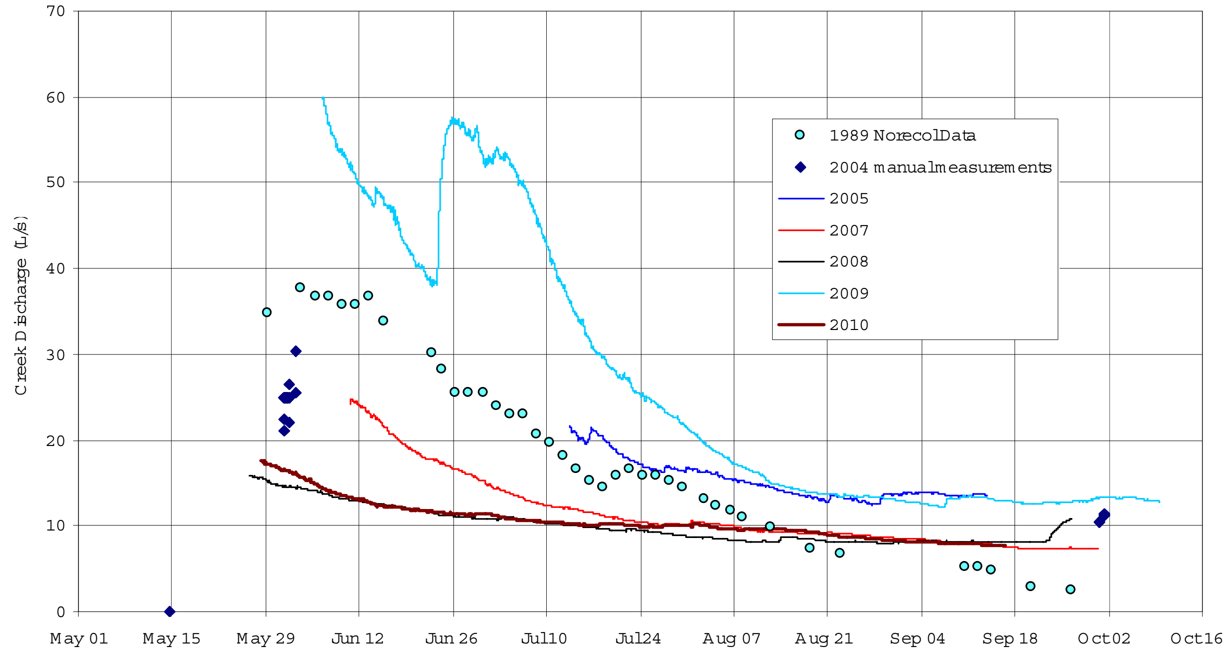

Figure 2.8-6
Nicholas Lake Outlet - Discharge Hydrographs – 1989 to 2010

TABLE 2.8-9: NICHOLAS LAKE OUTLET – ANNUAL DISCHARGE AND RUNOFF VALUES – 2005 TO 2010					
Site 6 - Nicholas Lake Outlet (Nicholas Lake Basin only)					
Year	Period of Record		Total Station Volume (m^3)	Total Basin Runoff (mm)	Average Station Flow (L/s)
	Start	Finish			
1989	May 29/89 09:30	Oct 04/89 10:00	171,377	27.3	19.0
2005	Jul 13/05 10:17	Sep 13/05 16:17	80,272	12.8	14.9
2006	*no data*	*no data*	*no data*	*no data*	*no data*
2007	Jun 10/07 15:51	Sep 30/07 09:06	109,877	17.5	11.4
2008	May 26/08 12:51	Sep 26/08 11:51	105,526	16.8	10.1
2009	Jun 06/09 13:03	Sep 30/09 23:59	278,165	44.3	27.6
2010	May 28/10 09:54	Sep 16/10 10:39	104,945	16.2	15.0

The average monthly discharges were computed and the data are presented in Table 2.8-10. As before, there are incomplete data for the first and last months.

TABLE 2.8-10: NICHOLAS LAKE OUTLET – AVERAGE MONTHLY DISCHARGE AND RUNOFFS 1989 - 2010

Site 6 - Nicholas Lake Outlet (Nicholas Lake Basin only)

Year	Average Basin Discharge					Monthly Total Basin Runoff				
	May	Jun	Jul	Aug	Sep	May	Jun	Jul	Aug	Sep
	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)	(mm)	(mm)	(mm)	(mm)	(mm)
1989	*34.8	32.4	17.9	10.3	4.2	*14.3	13.2	7.5	3.6	1.6
2005	*no data*	*no data*	*20.0	16.2	*15.7	*no data*	*no data*	*5.1	6.9	*2.7
2006	*no data*	*no data*	*no data*	*no data*	*no data*	*no data*	*no data*	*no data*	*no data*	*no data*
2007	*no data*	*20.4	13.3	10.1	*7.6	*no data*	*5.7	5.7	4.3	*3.1
2008	*14.6	12.7	10.8	7.7	7.6	*1.1	5.4	4.6	3.3	2.4
2009	*no data*	51.3	35.8	14.9	13.1	*no data*	17.3	15.3	6.3	5.4
2010	*17.0	12.9	10.3	9.2	*7.8	*0.8	5.3	4.4	3.9	*1.7

* data were not collected for every day of the indicated month as the logger was either installed or removed for the season during the month.

[1] 1989 data based on discrete flow measurements taken approximately every second day.

2.9 SURFACE WATER QUALITY

2.9.1 Overview

The proposed YGP is situated within the Yellowknife River drainage basin, a catchment of approximately 15,000 km^2 that drains into Great Slave Lake via Yellowknife Bay. The area straddles the Great Slave Upland High Boreal and Great Slave Upland Low Subarctic Ecoregions (Ecosystem Classification Group 2008), and is characterized by rolling terrain and bedrock exposures, climax forest and open woodland communities dominated by black spruce, white spruce, and jack pine, and younger communities regenerating following disturbance by fire that are composed of various deciduous species including paper birch and alder.

The main drainage areas associated with the YGP are currently from the West Zone, Ormsby Zone, and the resource at Nicholas Lake. Water from the West Zone flows from Brien Lake to the southwest through a series of small unnamed lakes before reaching Clan Lake and the Yellowknife River (Figure 2.9-1). Water from the Ormsby Zone currently flows into Narrow Lake via Round Lake and Winter Lake (Figure 2.9-1). Narrow Lake flows to the southwest, ultimately reaching Clan Lake and the Yellowknife River. Flows from Nicholas Lake are to the west, eventually reaching the Yellowknife River through numerous small lakes, ponds, and bogs.

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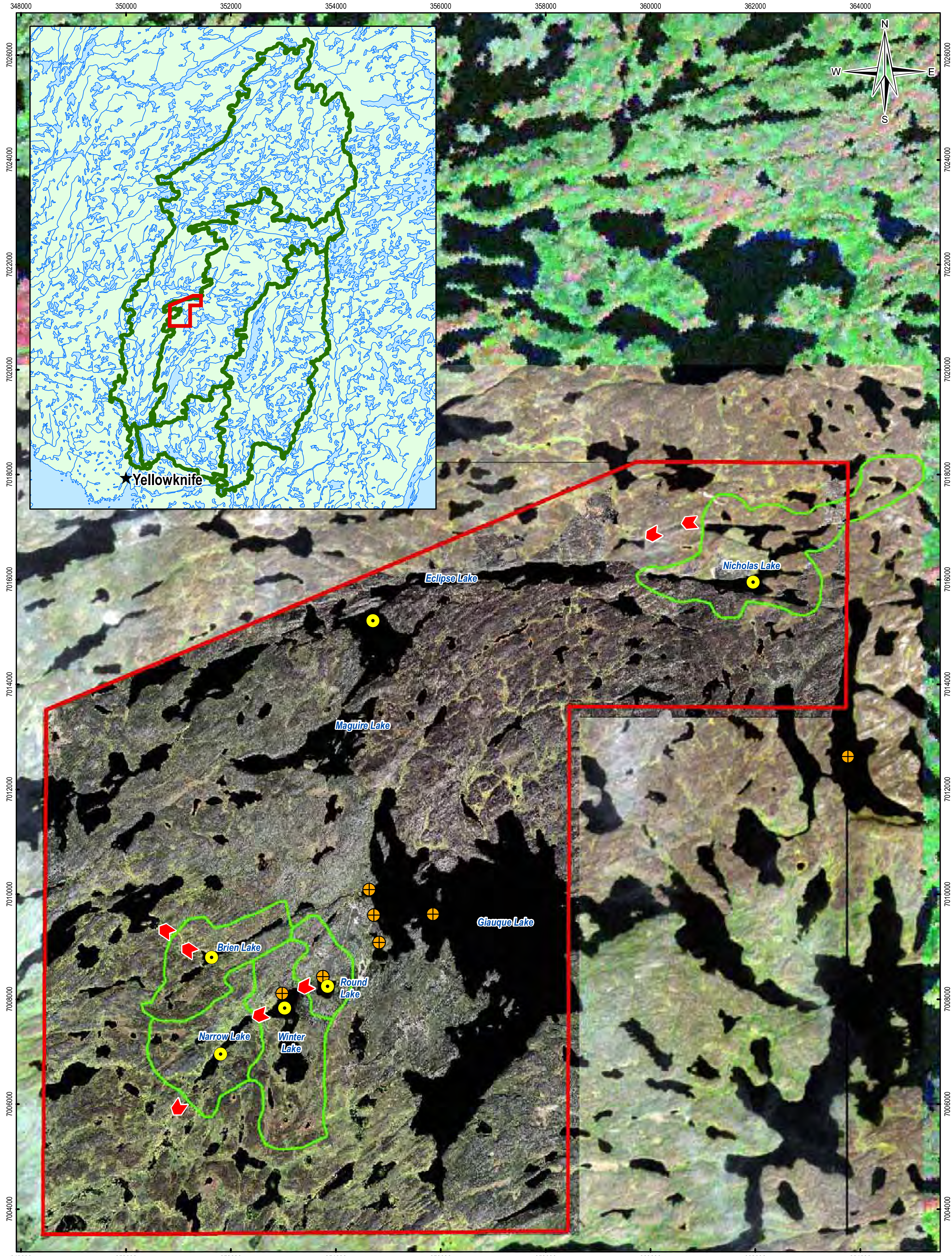

LEGEND

- Local Study Area
- 2004-2005 Water Quality Sampling Locations
- SNP Water Quality Sampling Locations
- Flow Direction
- Yellowknife River Basin
- Basin Outline
- Watercourse
- Waterbody

NOTES

1. Base data source: Atlas of Canada.
2. Imagery Source: IKONOS (July 27 and August 2, 2004); Landsat TM (August 11, 2001).

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YELLOWKNIFE GOLD PROJECT

Drainage Patterns and Water Quality Sampling Sites in the YGP Study Area

PROJECTION	DATUM
UTM Zone 12	NAD83

Scale: 1:70,000

1 0.5 0 1

Kilometres

Tyhee NWT Corp

EBA Engineering Consultants Ltd.

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PROJECT NO.	DWN	CKD	REV
V23201097	SL	TP	0

OFFICE	DATE
EBA-VANC	April 14, 2011

Figure 2.9-1

The YGP area encompasses the historic Discovery Mine which underwent final remediation in 2008 (INAC 2010). A short-term monitoring plan has been developed that will be carried out annually for five years. Activities include monitoring of the tailings cap and lake water quality. Since Mine Site Water Quality is the Key Line of Inquiry (MVEIRB 2009), water quality data from this program and compiled from various other sources are presented to provide both a regional and localized context for water quality in the Yellowknife River drainage basin and watersheds specific to the YGP. Regional water quality information has been compiled primarily from Puznicki (1996), Pienitz et al. (1997), Rühland et al. (2003) and data collected by the GNWT for the Yellowknife River at Yellowknife. Local water quality information has been compiled from baseline studies conducted by Tyhee NWT Corp in 2004 and 2005, as well as through regular and ongoing Surveillance Network Program (SNP) monitoring at the YGP and historic Discovery Mine site (Staples 2009; MESH 2009).

2.9.2 Sampling Methods

Water was sampled at Nicholas, Eclipse, Brien, Narrow, Winter, and Round lakes during the open water season of 2004 and 2005. Samples were located in the main and deepest basin of each lake. Details of the water quality sampling program for these years are presented in Appendix C.

Water samples were analyzed for routine parameters including physical properties, total organic carbon, low-level nutrients, major ions, cyanide, as well as total and dissolved metals. Dissolved metals in particular were analyzed using "ultra-low" detection limits.

A QA/QC program was established for water quality samples collected throughout the YGP site, and included the use of field and travel blanks, as well as the collection of duplicate samples. Full details are provided in Appendix C.

The SNP program outlined in the current advanced exploration water license for the YGP has sampled and reported key water quality data since 1998 in addition to the baseline data collected in 2004 and 2005 described above. SNP sampling is expected to continue throughout the current water license (which expires in October 2013) and Tyhee NWT Corp expects that a similar SNP will be incorporated into the Project's mining and milling water license.

2.9.3 Parameters of Interest

Given the history of the YGP site, which includes production from the historic Discovery Mine, specific parameters have been evaluated which include:

- pH
- Hardness
- Ammonia
- Aluminum
- Arsenic
- Cadmium
- Copper
- Cyanide
- Iron
- Lead
- Mercury
- Nickel
- Zinc

2.9.4 Quality Assurance / Quality Control

As part of the QA/QC program, travel blanks, field blanks and duplicates were collected. Travel blanks and field blanks were utilized in order to assess potential contamination from sample containers or other equipment used in the collection and handling of samples, and to detect other systematic or random errors that may arise from sampling through to analysis. Duplicates were collected to test the validity of the sampling procedures and laboratory methods.

Travel blanks were prepared by Enviro-Test Laboratories (ETL) (now ALS Laboratories) in Edmonton and shipped with the sample bottles via Yellowknife to the YGP site. These bottles were filled with deionized water and preserved in the laboratory prior to shipment. Travel blank bottles remained completely sealed until they were returned to ETL for analysis. Since it was important for the laboratory to use the same type of filter as the ones used in the field, a disposable 45 μm Nalgene filter was submitted to the laboratory along with each sampling event. This "Filter" sample represented the dissolved ultra-low level metals travel blank. One set of travel blanks was used for each sampling event.

Field blanks were prepared in the field in the same environment in which the water samples were collected. Once in the field, field blank sample bottles were filled with deionized water and preserved. One set of field blanks was collected for each sampling event.

Duplicates were prepared in the field in the same environment in which the original water samples were collected. Six sets of duplicates were collected for each sampling event, one at each station.

2.9.4.1 Travel Blanks

One set of travel blanks was collected during each sampling event. Travel blanks were analyzed for total and dissolved ultra-low level metals, total and dissolved organic carbon, low-level nutrients, cyanide, and low-level routine water chemistry.

Results of the travel blanks indicated that all parameters tested were below detection levels. The results indicated that the integrity of the travel blanks was not compromised.

2.9.4.2 Field Blanks

One set of field blanks was collected during each sampling event. The field blanks were analyzed for total and dissolved ultra-low level metals, total and dissolved organic carbon, low-level nutrients, cyanide, and low-level routine water chemistry.

Results of the field blanks indicated that all parameters were below detection levels. The results indicate that the field sampling protocols and methods did not compromise the water quality samples.

2.9.4.3 Duplicates

Duplicates were collected during each sampling event (one at each station), and were analyzed for total and dissolved ultra-low level metals, total and dissolved organic carbon, low-level nutrients, cyanide, redox, and low-level routine water chemistry.

ETL performed a statistical analysis on the all the duplicate samples, to determine if the duplicates were statistically the "same" as or "different" from the original samples. The results of the analysis indicated that in general the duplicates were the same as their original samples.

2.9.5 Regional Water Quality

The Yellowknife River drainage basin is located largely within the boreal forest and grades into a forest-tundra transition zone at its northern extent. Previous limnological studies of subpolar lakes (e.g., Rühland et al. 2003; Pienitz et al. 1997; Puznicki 1996) have identified consistent trends in the water quality parameters assessed that seem strongly linked to geological, vegetation and climatic gradients. In general, boreal forest lakes displayed higher levels of most measured parameters, which declined with increasing latitude and decreasing tree cover.

It is not uncommon for remote northern lakes and rivers that have not been affected by human activities to display water quality parameters above those of established guidelines. Landscape and environmental features such as bedrock and surficial geology, seasonal hydrologic changes, and the degree of vegetation cover, can influence baseline conditions which may include naturally elevated concentrations of certain water quality parameters.

2.9.5.1 Physical Parameters

Water hardness and pH are parameters commonly measured in aquatic environments, particularly due to their ability to influence the solubility of potentially toxic metal ions.

pH

The majority of lakes sampled between Great Slave Lake and the Beaufort Sea displayed pH values ranging between 6.5 and 8.5, a trend which also holds for lakes sampled within the watersheds of the Yellowknife River Basin (Figure 2.9-2). Several lakes were slightly more acidic than the acceptable CCME guidelines for the protection of aquatic life, ranging between 5.5 and 6.5. These lakes were generally located above the treeline in the central and northeastern portion of the area sampled. All of the lakes sampled displayed pH values that were within the range considered as natural for fresh waters (e.g., 4-9; Puznicki 1996).

pH for the Yellowknife River, sampled at the water treatment plant in Yellowknife, fell generally within acceptable CCME guidelines for the protection of aquatic life (Figure 2.9-3). One sample collected in 1998 was slightly below the lower limit of 6.5, measuring 6.4.

Hardness (as $CaCO_3$)

Water hardness is generally characterized as the presence of dissolved calcium salts, expressed as an equivalent of calcium carbonate. Waters in areas dominated by carbonate bedrock tend to be harder while those draining igneous rocks are softer (Puznicki 1996). The vast majority of the lakes tested from Great Slave Lake to the Beaufort Sea had very soft water, with values ranging between 0-30 mg/L (Figure 2.9-2). Lakes in the Yellowknife River Basin contained very soft to soft water.

Water hardness for the Yellowknife River was measured sporadically between 1998 and 2002, and was indicative of very soft water conditions (i.e., <30 mg/L $CaCO_3$; Figure 2.9-3).

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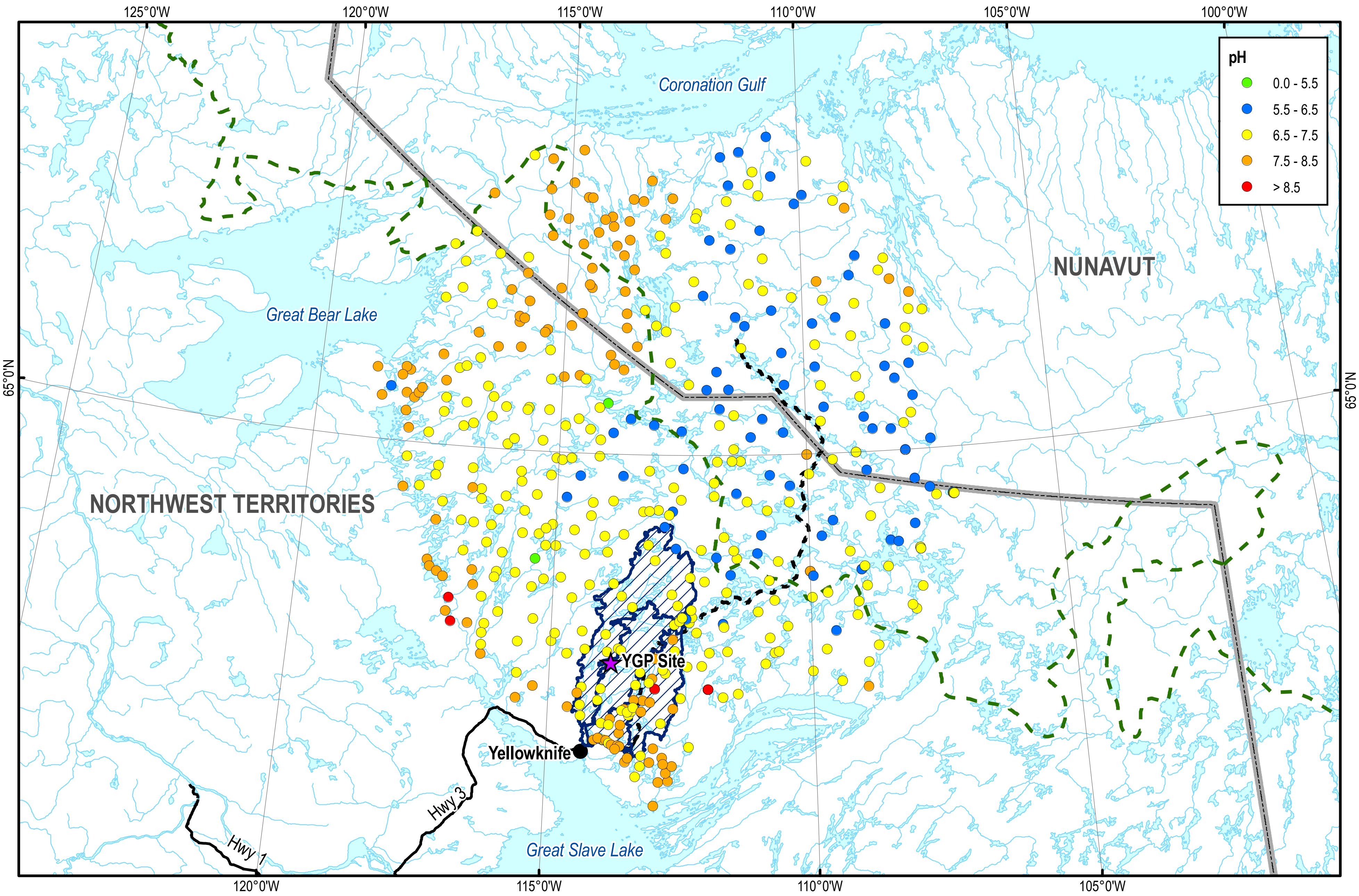

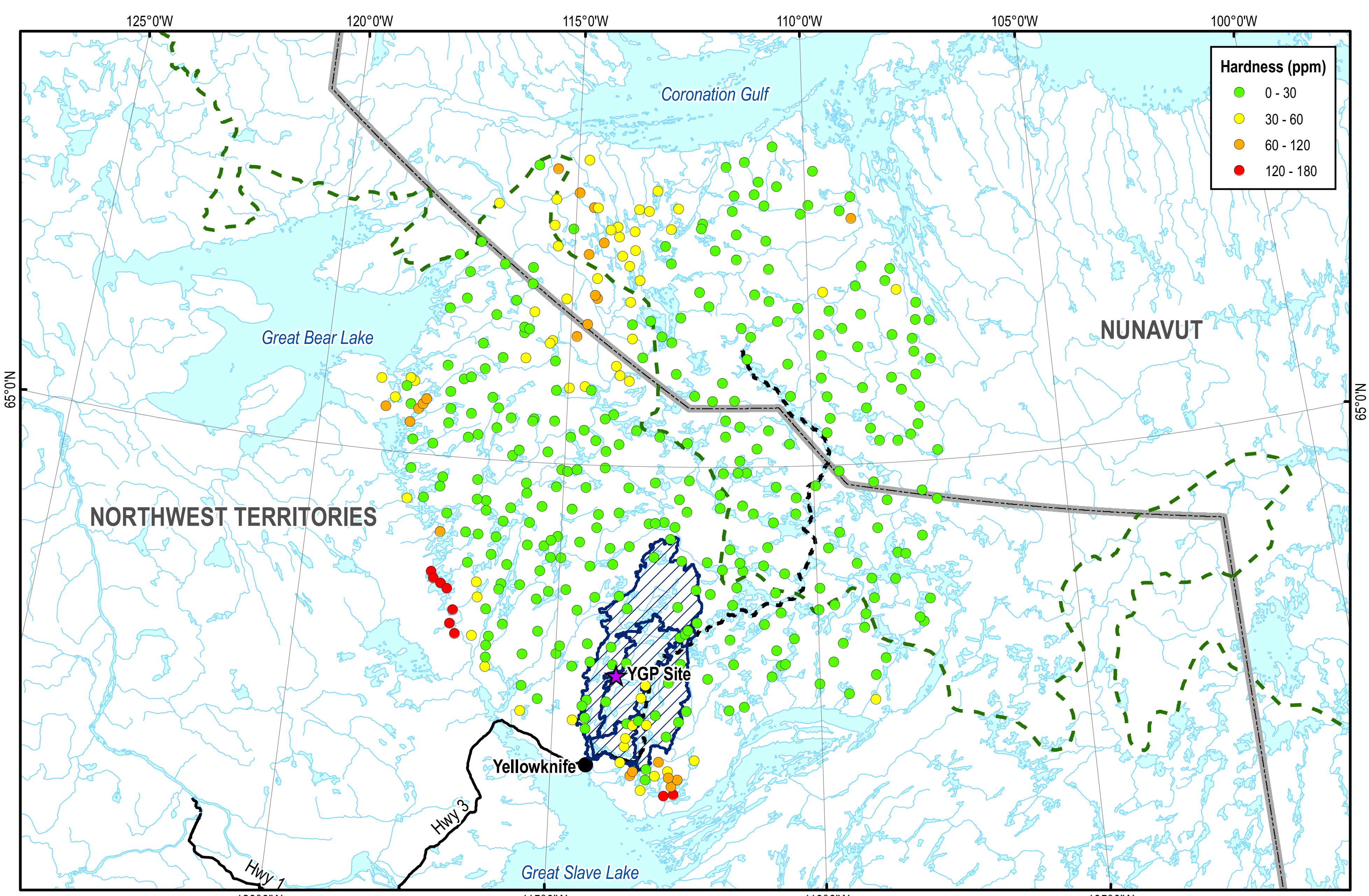

LEGEND

- Yellowknife Gold Project Site
- Yellowknife
- Treeline
- Yellowknife River Basin Watersheds
- NWT - Nunavut Border
- Winter Road
- Road
- River
- Waterbody

NOTES

1. Water quality data from Department of Indian and Northern Affairs (Puznicki, 1996), Ruhland et al. (2003), and Pienitz et al. (1997).
2. Base data source: Atlas of Canada.

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YELLOWKNIFE GOLD PROJECT

Water Quality in the Slave Province
pH and Hardness

PROJECTION	DATUM
NWT Lambert	NAD83

Scale: 1:5,000,000

100 50 0 100
Kilometres

FILE NO.
V23201097-DAR-044.mxd

PROJECT NO.	DWN	CKD	REV
V23201097	SL	TP	0

OFFICE	DATE
EBA-VANC	March 14, 2011

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Figure 2.9-2