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PROPERTY FILE

Preliminary Environmental Assessment of a Proposed Quarry West of Apple Bay on Holberg Inlet

Prepared for Homegold Resources Ltd. by:

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February 2000

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1. Introduction

Homegold Resources Ltd. intends to develop a quarry for chalky geyserite near Apple Bay on the north side of Holberg Inlet. The quarried rock will probably be trucked to Port Hardy over existing logging roads, but may be loaded onto barges at a log dump facility on nearby Norton Point. A preliminary environmental assessment was conducted to:

- identify environmentally significant or sensitive habitats located in the vicinity of the proposed quarry site,
- identify possible impacts the quarry may have on the habitat attributes of the area, and finally,
- to recommend measures to mitigate these impacts during the development, operation, and eventual reclamation of the quarry.

A site visit took place on December 9 and 10, 1999.

Habitats within and adjacent to the proposed quarry were mapped and described. The drainage within the study area was characterized. Gee traps were used to assess fish presence and water samples were collected for analysis. The habitat present at the existing log dump facility was recorded.

2. Environmental Assessment

The proposed quarry is located approximately six kilometers west of Apple Bay and one kilometer north of Holberg Inlet, between Wanokana and Youghpan Creeks. The study area and each of the habitats and watersheds on and adjacent to the site are shown in Figure 1. This map is derived from a portion of B.C. Land Data TRIM map 92L.062. Additional information about small streams and habitat types was added by combining ground observations and air photo interpretation.

The quarry area potentially includes the Wan Knobs but is likely to commence in the area to the south, between the Knobs and the wetland and stream bottoms to the south. The limits of the study area include all areas that have runoff from any of the possible quarry sites that are currently being considered (see Figure 1). The actual area that will be affected by the quarry will probably be smaller than the study area.

2.1 Habitat

The study area is divisible into 6 main habitat types.

The first are the rocky, exposed areas near the peaks of the western and eastern knobs. These uplands are at the centre of the study area, and are characterized by a sparse canopy of fire-damaged conifers and a dense shrub layer dominated by salal. Pine trees and Labrador tea were both common in these exposed areas, but not in the other parts of the study area. Wildlife trails were very well defined and prevalent throughout this area. Two black-tailed deer were observed. This habitat type can be seen in the background of Photo 4 and the foregrounds of Photos 6 and 7.

The second is a recent clearcut covering the southwest face of the knobs. Based on the size and spacing of the small conifers, it was probably replanted in 1998 or 1999. It is shown in Photo 5. A few much less defined game trails were noted in this area.

The third is an older clearcut area to the north, east, and south of the knobs, which was replanted in 1988. It is shown in the backgrounds of Photo 3 and 6. This area is very heavily vegetated and is dominated by cedar and hemlock. There is significant growth of alders along the roads and streams, some of which have been recently weeded out.

The fourth habitat type is an area of older growth forest to the west of the potential quarry area.

The fifth comprises various marshes, swamps and wetlands. The largest is a marsh located to the north of the knobs and presumably feeds the streams to the east and west. The next largest is a wetland located to the east of the knobs and was likely a cedar swamp prior to logging. A similar but smaller area exists to the west of the knobs. Finally, a less well defined marsh exists at the headwaters of the east and west flowing

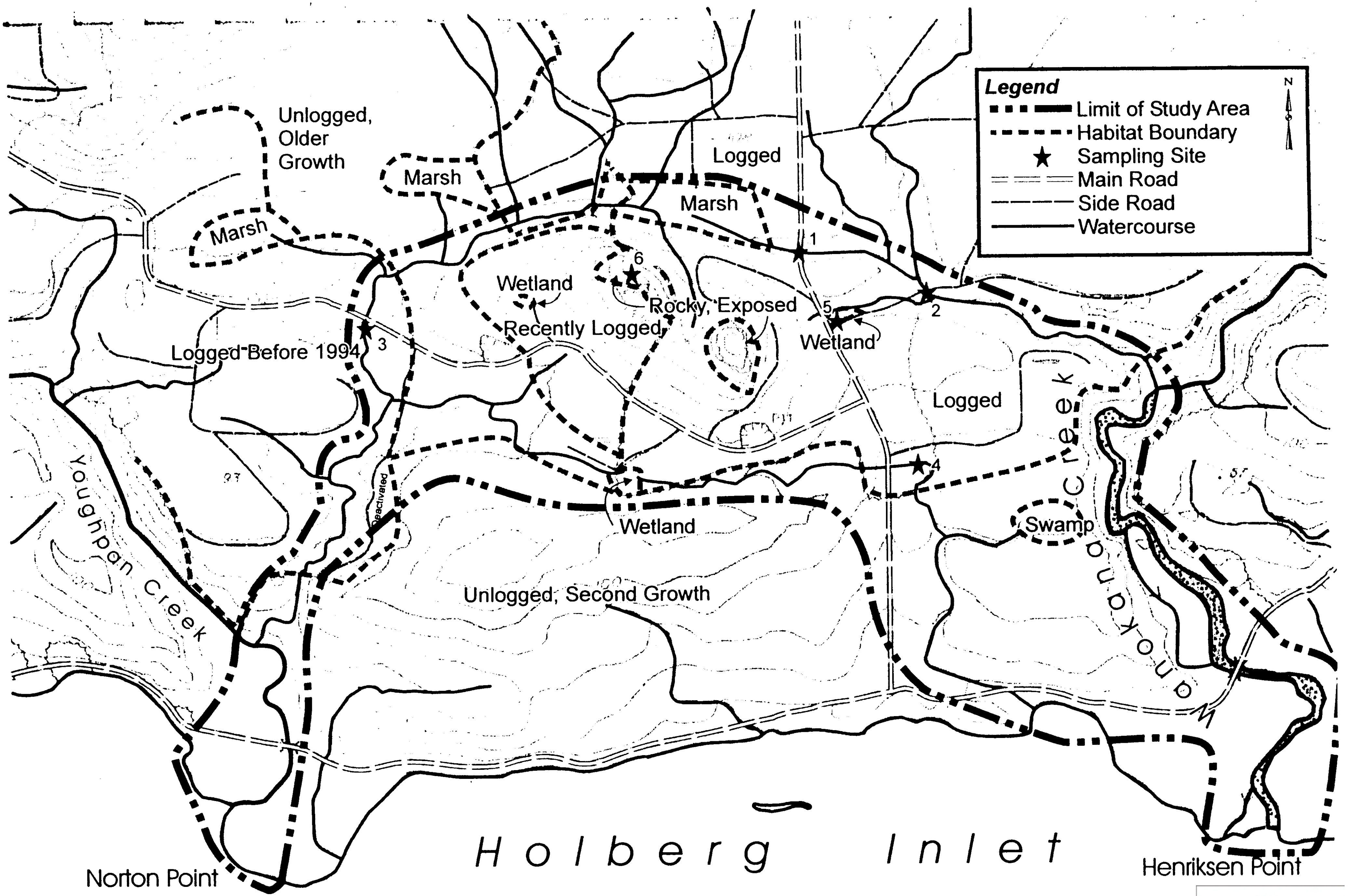

Figure 1: Habitats and Sampling Sites in the Area of the Proposed Mine

The base map was derived from TRIM map 92L.062, and habitat observations were derived from air photos and Field observations.

streams south of the knobs. Some of these areas are shown, in the foreground of Photo 3, and in the middle of Photos 6 and 7.

The sixth is the unlogged, second growth forests that cover the two southern peripheral "arms" of the study area along the Youghpan and Wanokana Creeks. Potential runoff from the quarry is reduced, due to the downstream location.

2.2 *Wildlife*

Black-tailed deer and numerous wildlife trails were observed on the knolls.

Thomas Plath of the Ministry of Environment, Lands and Parks (MELP) was interviewed over the phone regarding the red-listed wildlife species in the area. Those known to occur in the Holberg area are: the northern goshawk lang-eye subspecies (restricted to mature forest), marbled murrelett (restricted to oldgrowth forest), water shrew (brook-sized species), and the long-eared myotis bat.

Logged conditions precludes existence of most of these species near the quarry, except near Wanokana and Youghpan Creeks.

2.3 *Stream Assessment*

Four small, possibly ephemeral, streams drain the core of the study area. Two drain into Youghpan Creek to the west, while a third augments the flow of Wanokana Creek to the east. The fourth flows east and then south directly into Holberg Inlet. The areas to be quarried are in the headwaters of the study area.

Physical stream data were recorded at Sampling Sites 1 to 4 (see Figure 1). Photographs were taken to document the stream conditions at most Sampling Sites. Photo 1 of site 3 and Photo 2 of site 4 have been included in Appendix 2. The average bankfull depth ranged from 0.3 m to 0.7 m. The average bankfull width varied from 0.7 m to 6 m. The overhanging vegetation along the creek banks provided continuous cover (100%). Water temperature ranged from 4.5°C to 6.0°C. As vegetative cover of the streams is typically 100%, water temperature is unlikely to be a limiting factor for fish survival.

The Department of Fisheries and Oceans (DFO) Fish Inventory System (FISS) database provides some information about Wanokana and Youghpan Creeks: Wanokana Creek is known to support a late run of coho as well as chum salmon. Some chums were noted in Youghpan Creek in 1994, but this creek was very badly damaged by poor logging practices earlier in the century and its potential is limited.

No fish were found in Gee traps left overnight at each of the four sites on December 9, 1999. The sampled areas, immediately downstream of the proposed quarry area, are probably above barriers, although the effort expended on trapping is not sufficient to confirm fish absence. Two streams drain into Youghpan Creek, which as indicated in the FISS database probably only supports chum. Chum would only be expected downstream since spawning takes place in the mainstem and the emerging fry move directly out to sea. The Wanokana supports coho fry that do tend to move upstream so barriers are a more likely explanation of their absence in the traps. The stream draining directly to Holberg Inlet is probably too small to support fish.

2.4 Water Quality

Water samples were collected at Sampling Sites 1, 3, and 4 to provide background water quality information. The samples were assayed for nutrients, dissolved anions, total metals, conductivity, total dissolved solids, total suspended solids, hardness and pH (Appendix 3). Results were compared to two sources: the British Columbian Approved Water Quality Guidelines and the Canadian Environmental Quality Guidelines.

All of the samples met most of the criteria of both the provincial and federal water quality guidelines. The nutrients, anions and physical parameters, with the exception of pH, were within the guidelines. The metals, with the exception of aluminum and iron, were within the guidelines for dissolved metals since total metals did not exceed the guidelines. For aluminum and iron the total metal exceeded the criteria for dissolved metals.

The pH of the water was generally low. The pH of water from site 3, at 5.68, did not meet the B.C. standard. Acidic conditions (pH<4.0) have been documented from natural acid rock drainage in both Wanokana and Youghpan Creeks[1]. It is possible therefore that the stocks of fish in these creeks are adapted to lower pH.

The total iron in water collected from sites 1 and 3 exceeded the dissolved iron criteria of the Canadian Environmental Quality Guidelines for Freshwater Aquatic Life. All samples had total aluminum levels that exceeded the maximum dissolved aluminum standards for the B.C. Approved Water Quality Guidelines for Freshwater Aquatic Life by four to ten times. Although dissolved metals are only a portion of the total, these high levels suggest that this aspect of water quality should be further investigated. The low pH increases the solubility of aluminum, and since it is present in the chalky geyserite, this may be an issue in the environmental management of this project.

There was a noticeable quantity of total sulphates, but no guidelines were available as they are currently under review.

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[1] Koyanagi & Panteleyev. *Natural Rock-Drainage in the Red Dog-Hushamu-Pemberton Hills Area, Northern Vancouver Island.* Geological Fieldwork 1993, Paper 1994-1, B.C. Geological Survey Branch.

2.5 Log Dump Facility

A loading platform built about 500 metres to the west of Norton Point (see Figure 1) may be used for loading chalky geyserite from trucks to a barge. Since Norton Point is the outlet of Youghpan Creek, this site is somewhat estuarine in character. A saltmarsh lies along the foreshore immediately east and west of the access road to the facility. An area of bare rock separates the saltmarsh from a rockweed-covered area in the mid-intertidal zone. Backshore vegetation was dense and overhanging. Several small streams flow into the inlet near the facility. The habitat adjacent to the log dump was photographed (Photos 8 and 9).

Use of this area as a loading facility should not create any problems, provided care is taken not to spill excessive amounts of material.

2.6 Reclamation

The overburden in the quarry area is primarily topsoil, which should be stockpiled during quarry operations. Reclamation should proceed in a sequential fashion. Once a portion of the quarry is mined out, stockpiled soil, or soil from newly opening parts of the quarry can be distributed over the area. Grass can be planted to stabilize the soil, while shrubs, alders and other deciduous trees should be included for diversity and to help condition the soil. Coniferous trees would be planted to return the area to productive forest land.

Sequential restoration will allow restored areas to become stable prior to eliminating the water detention system, so that water quality in the streams is not likely to be affected by drainage from large areas of exposed or recently covered rock.

Pockets or depressions could be restored as ponds or wetlands similar to the ones described above, depending on the topography of the area after the quarrying.

3. Recommendations and Conclusion

The proposed quarry site has been severely disturbed by logging, and is unlikely to provide habitat for any of the known red-listed species. The knobs, mainly the western one, provide good wildlife habitat and should be conserved unless they are to be quarried.

Preventative measures and best management practices for this type of quarry include:

- Minimize the area to be disturbed.
- Minimize the hauling road network.
- Stockpile the best soil material for future use.

- Maintain detention ponds to avoid discharge of sediments.
- The potential for contamination of the adjacent salmon bearing streams should be addressed and measures taken to avoid degradation of water quality.

Some of the wetlands and streams could be in close proximity to quarrying activities. As these areas provide important biodiversity, opportunities for wildlife, and influence fisheries values downstream; suitable setbacks should be provided. All water draining from the quarry, stockpiles and roads should be directed to detention ponds to protect against the introduction of sediments and contaminants into the wetlands and streams. This will also provide an opportunity to monitor and if necessary adjust water quality, prior to discharging to the streams.

The elevated levels of aluminum and iron necessitate the careful management of the discharge water. Chalky geyserite contains aluminum, and the pH of the streams on site is slightly to highly acidic. Acidic conditions increase the solubility of metals and their availability in both water and sediments. Natural acid rock drainage in the area has resulted in acidic conditions in both Wanokana and Youghpan Creeks. Additional inputs of metals and acidic water could degrade water quality in these creeks.

Additional clarification of the water quality issues and a specific plan to assure that discharge water meets criteria for the preservation of aquatic life is recommended.

Careful site management during quarry operations and reclamation should ensure that this project does not result in environmental degradation. Since the area has been recently logged, once it is reclaimed, the site would be expected to offer forest lands, equivalent to those existing presently.

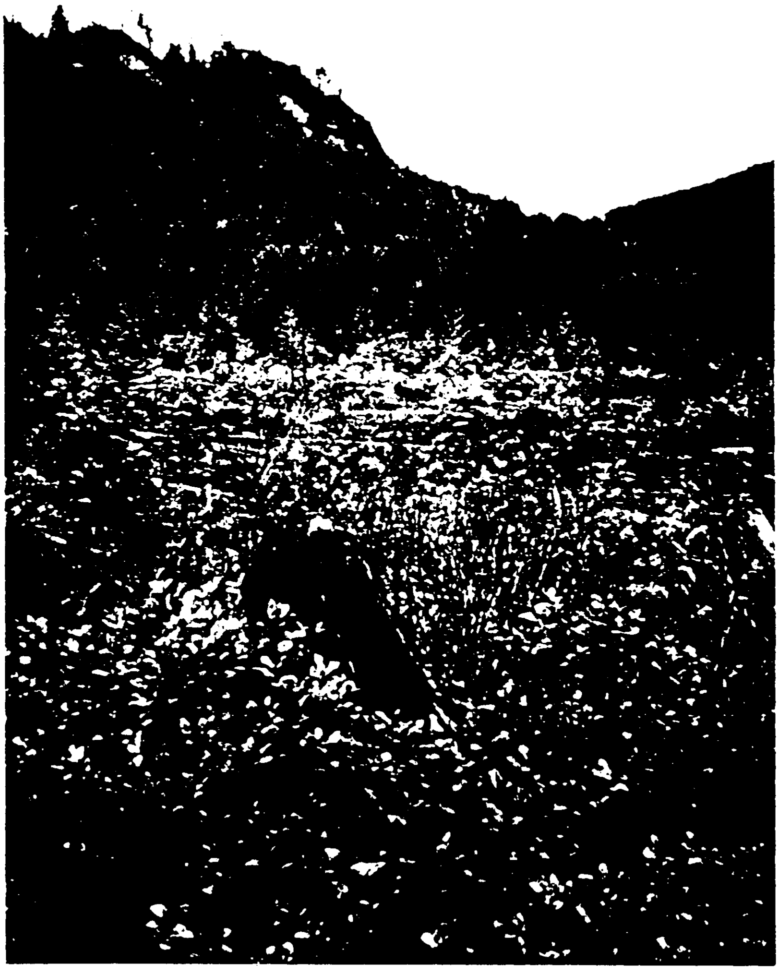
Appendix 1: Photographs

Photo 1: Sampling Site 3, a trap location, on a tributary of Youghpan Creek. This tributary is in a logged area.

Photo 2: Sampling Site 4, a trap location, on a tributary of Wanokana Creek. This small stream has a very dense, low riparian zone, and is located in a logged area.

Photo 3: Sampling Site 5, a wetland which may have been a cedar swamp prior to logging.

Photo 4: View of the eastern knob from the east. This photo shows vegetation typical of the logged area that was replanted in 1988.



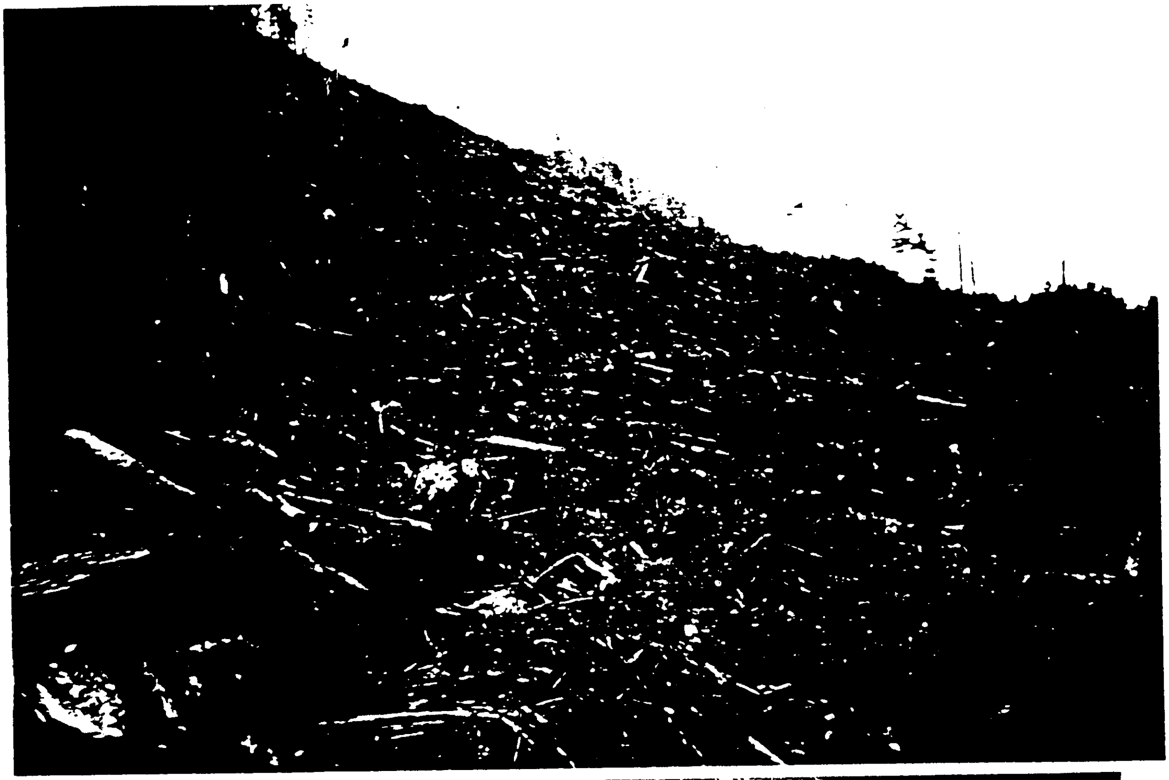


Photo 5: The southwest face of the western knob. This recently logged area appears to have been replanted in 1998 or 1999.

Photo 6 (Right): Looking northeast from the peak of the western knob (Sampling Site 6). The peak has a sparse canopy of fire-damaged trees, and a dense understorey dominated by salal.

Photo 7: Looking north from the peak of the western knob. The marsh below feeds two of the main tributaries of the study area.

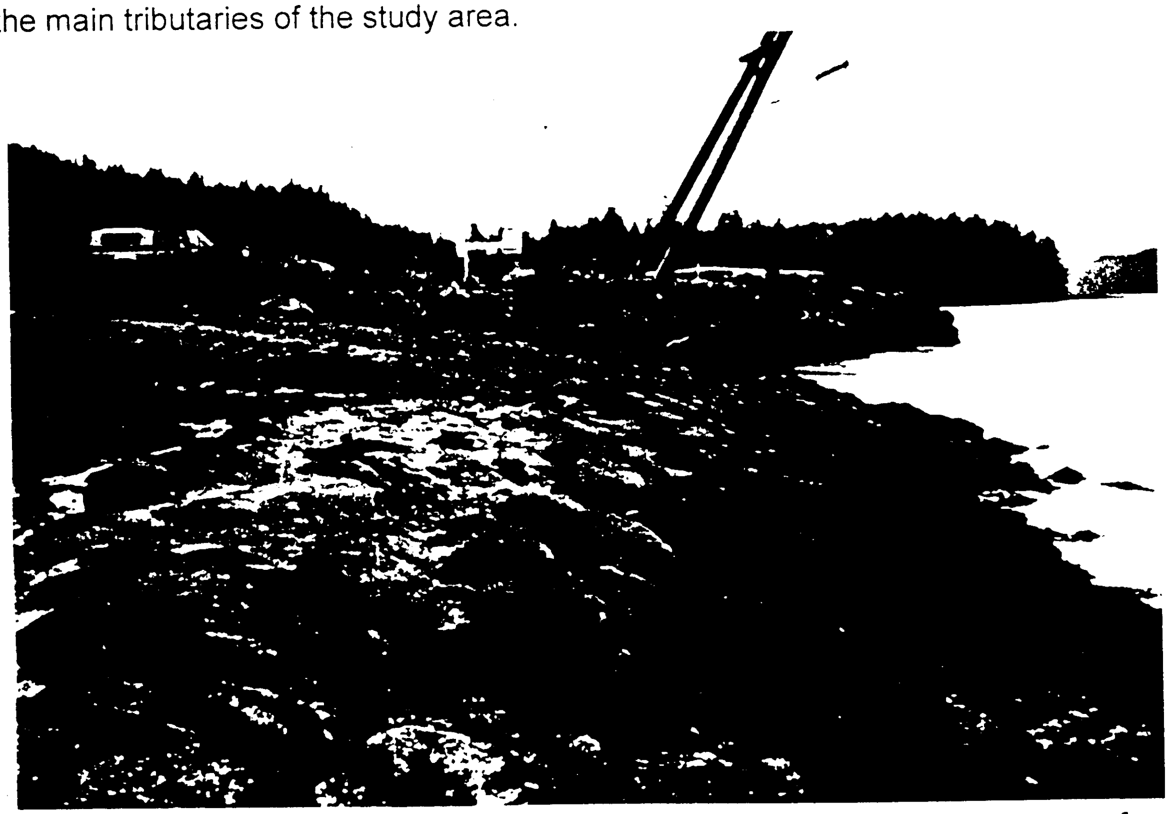


Photo 8: Loading platform located on a small peninsula about 500m to the west of Norton Point and the mouth of Youghpan Creek. The rocks in the foreground comprise a mid-intertidal rockweed zone. This area may be considered for transferring the chalky geyserite from trucks to barges.

Photo 9: The view from the potential loading platform. A well-developed saltmarsh zone extends from the rocky shelf, in the upper intertidal, to the edge of the forest. The rockweed in the mid intertidal is visible near the shore.

Appendix 2: Field Data

SAMPLING SITE: 1

Project: Holberg **Stream:** Unnamed **Reach :**
Location: Stream Crossing on Pemberton Main, south of Pemberton 300.

GPS UTM: 09U 0589829
UTM 5608079

Observer: Bruce Wright **Map #:** 92L.062 **Weather:** Overcast
Date: December 10, 1999 **Time:** 11:00 am

Channel Type	Meandering; slow flow	Channel Length Surveyed:	10m
Floodplain Description	Gently sloped valley	Avg. Bankfull Depth	0.3m
Over-Hanging Veg.	100%	Avg. Bankfull Width	3m
Water Clarity	Clear	Avg. Wetted Depth Avg. Wetted Width	.25m 2m
Temperature	6C		

Structures and Barriers to fish (Bt=total; Bp=partial; Bm=mitigatable; B?=possible)

type	Barrier	location	description
Bridge	No	Pemberton Main	

Tributaries

location	side of entry	description/notes

Substrate Material

% fines(type)	%gravels		%coarse			%bedrock
<2mm	2-16mm	16-64mm	64-128mm	128-256	>256	
sand 50%	50% gravel		<1% cobbles			

Bank Description

type	%	description	%gradient
Vegetated	60		
Cutbank	40		

Stream characteristics <1% **%GRADIENT:**

type	percentage	number, descriptions
pools	10	
riffles	0	
runs	90	Slow flowing

Adjacent Land Use

type	Comments
Logging	

Vegetation: species present

	description/characteristics
riparian overstorey	75% cover: 90% alder, 10% cedar
riparian understorey	100% cover: salal, huckleberry, and salmonberry
herb layer	Ferns (sword and deer)
instream vegetation (eg. LWD, seaweed.)	

Wildlife

	species/location	Sampling Method
invertebrates		
vertebrates		

Fish Trap set(date): Dec. 9, 1999

1 3:10

2

Trap retrieved(date): Dec. 10, 1999

1 11:00

2

catch	**species**	**length**	**habitat**	**location/notes**
None				

Other Data:
Water Sample 5
Field Photo 15

Water Quality problems:
Iron probably too high
Total aluminum probably too high

SAMPLING SITE: 2

Project: Holberg **Stream:** Unnamed **Reach :**
Location: Stream Crossing on P200 about 75 metres east of Pemberton Main, 2 traps 20 metres apart.

GPS UTM: 09U 0590199
UTM 5607918

Observer: Bruce Wright **Map #:** 92L.062 **Weather:** Overcast
Date: December 10, 1999 **Time:** 10:00 am

Channel Type	Wandering	Channel Length Surveyed:	150m
Floodplain Description	Steep-sided valley	Avg. Bankfull Depth	0.5m
Over-Hanging Veg.	100%	Avg. Bankfull Width	About 6m
Water Clarity	Tannic staining (some foam present)	Avg. Wetted Depth Avg. Wetted Width	0.25m 3m
Temperature	5 C		

Structures and Barriers to fish (Bt=total; Bp=partial; Bm=mitigatable; B?=possible)

type	Barrier	location	description
Bridge	No	At zero point	Logging bridge (timber construction)

Tributaries

location	side of entry	description/notes
100m upstream	Right	Drains logged swamp

Substrate Material

% fines(type)	%gravels		%coarse			%bedrock
<2mm	2-16mm	16-64mm	64-128mm	128-256	>256	
Sand 25%	25%		50% cobble			

Bank Description

type	%	description	%gradient
Gravel bar	50	Angular gravel and sand point bars	<5%
Cutbank	50		

Stream characteristics <5 **%GRADIENT:**

type	percentage	number, descriptions
pools	30	Good riffle-pool sequence
riffles	40	
runs	30	

Adjacent Land Use

type	Comments
Logging	Clearcut to streambank

Vegetation: species present

	description/characteristics
riparian overstorey	Alder 25% cover
riparian understorey	Cedar, hemlock, salmonberry, devil's club, 10% cover
herb layer	Salal ferns 100% cover
instream vegetation (eg. LWD, seaweed.)	Filamentous green algae.

Wildlife

	species/location	Sampling Method
invertebrates	None noted	
vertebrates	Stellar's jay	

Fish Trap set(date): Dec. 9, 1999

1 3:25

2 3:30

Trap retrieved(date): Dec. 10, 1999

1 10:00

2 9:50

catch	**species**	**length**	**habitat**	**location/notes**
None				

Other Data:
Field Photo 19

SAMPLING SITE: 3

Project: Holberg **Stream:** Unnamed **Reach :**

Location: 2 Traps, Above and Below Stream Crossing on Pemberton 100. The stream was surveyed for about 100m downstream of the crossing, to WP007

GPS UTM:	Trap 1:	09U 0588567 UTM 5607841
	WP007:	09U 0588548 UTM 5607817

Observer: Bruce Wright **Map #:** 92L.062 **Weather:** Overcast

Date: December 10, 1999 **Time:** 11:35 am

Channel Type	Straight, riffle-pool sequence	Channel Length Surveyed:	100m
Floodplain Description	Gentle sloped valley	Avg. Bankfull Depth	0.5m
Over-Hanging Veg.	100%	Avg. Bankfull Width	6.0m
Water Clarity	Tannic staining	Avg. Wetted Depth Avg. Wetted Width	0.25m 3.0m
Temperature	4.5C		

Structures and Barriers to fish (Bt=total; Bp=partial; Bm=mitigatable; B?=possible)

type	Bar.	location	description
Bridge	No	At traps	Log

Tributaries

location	side of entry	description/notes
		Stream drains to the east and has two tributaries: one on the north side and one on the south.

Substrate Material

% fines(type)	%gravels		%coarse			%bedrock
<2mm	2-16mm	16-64mm	64-128mm	128-256	>256	
10%	40% gravel		40% cobble			10%

Bank Description

type	%	description	%gradient
Gravel bar	10	Gravel and cobble point bars	

Stream characteristics 3 **%GRADIENT:**

type	percentage	number, descriptions
pools	10	Deep at the bridge
riffles	60	
runs	30	

Adjacent Land Use

type	Comments
logging	

Vegetation: species present

	description/characteristics
riparian overstorey	100% alder. Cedar and hemlock nearby
riparian understorey	Salmonberry, salal, a few huckleberry
herb layer	Salal, ferns, moss
instream vegetation (eg. LWD, seaweed.)	Nil. Minimal LWD

Wildlife

	species/location	Sampling Method
invertebrates		
vertebrates		

Fish Trap set(date): Dec. 9, 1999

1 4:10

2 4:15

Trap retrieved(date): Dec. 10, 1999

1 11:35

2 11:40

catch	species	length	habitat	location/notes
None				Pool below riffle
None			Edge of run	Below bridge

Other Data:
This is the main stream on the western part of the study area.

Field Photos 13 and 14

Appendix 1 Photo 1

Water Sample 2

Potential Problems:

Low pH (5.65)

Total Aluminum Probably too high (exceeds Dissolved Aluminum provincial guideline).

Iron probably too high

SAMPLING SITE: 4

Project: Holberg **Stream:** Unnamed **Reach :**
Location: Small stream crossing on Pemberton Main A – One Trap

GPS UTM: 09U 0590114
UTM 5607423

Observer: Bruce Wright **Map #:** 92L.062 **Weather:** Overcast
Date: December 10, 1999 **Time:** 9:30 am

Channel Type	Ephemeral	Channel Length Surveyed:	100m
Floodplain Description'	Dense brush	Avg. Bankfull Depth	0.7m
Over-Hanging Veg.	100%	Avg. Bankfull Width	0.7m
Water Clarity	Good – slight tannic staining	Avg. Wetted Depth Avg. Wetted Width	0.35m 0.7m
Temperature	6C		

Structures and Barriers to fish (Bt=total; Bp=partial; Bm=mitigatable; B?=possible)

type	Bar.	location	description
		At road	Culvert – no barrier

Tributaries

location	side of entry	description/notes

Substrate Material

% fines(type)	%gravels		%coarse			%bedrock
<2mm	2-16mm	16-64mm	64-128mm	128-256	>256	
100%						

Bank Description

type	%	description	%gradient
Cutbank		Deeply incised – probably an ephemeral channel	5-10%

Stream characteristics **%GRADIENT:**

type	percentage	number, descriptions
pools	80%	
riffles	20%	Riffle is more of a small waterfall or drop.
runs		

Adjacent Land Use

type	Comments
Logging	

Vegetation: species present

	description/characteristics
Riparian overstorey	Low (recent clearcut). 50% hemlock, 50% cedar
Riparian understorey	Salal and huckleberry
herb layer	Moss, deer fern
Instream vegetation (eg. LWD, seaweed.)	Extensive structural LWD

Wildlife

	species/location	Sampling method
invertebrates	Not observed	
vertebrates		

Fish Trap set(date): Dec. 9, 1999

1 4:40

2

Trap retrieved(date): Dec. 10, 1999

1 9:30

2

catch	**species**	**length**	**habitat**	**location/notes**
None			Small stream ephemeral 100% vegetated	

Other Data:
Field Photo 20

Appendix 1 Photo 2

Water Sample 4

Water quality problems:

Aluminum probably too high

SAMPLING SITE: 5

Project: Holberg **Stream:** **Reach :**
Location: Logged cedar swamp, bounded by Pemberton Main on the west, Pemberton 200 on the south, extending as far north as WP004 and as far east as WP005.

GPS UTM: WP004: 09U 0589868
UTM 5607944
WP005: 09U 0590031
UTM 5607903

Observer: Bruce Wright **Map #:** 92L.062 **Weather:** Overcast
Date: December 10, 1999 **Time:**

Adjacent Land Use

type	Comments
Logging	

Vegetation: species present

	description/characteristics
riparian overstorey	Many stumps so probably not that wet
riparian understorey	
herb layer	Salal and ferns or hummocks (limited standing water)
instream vegetation (eg. LWD, seaweed.)	

Other Data:
Field Photos 17 and 18
Appendix 1 Photo 3

This sampling site may have been a cedar swamp before it was logged. Most of the new tree growth is cedar.

SAMPLING SITE: 6

Project: Holberg **Stream:** **Reach :**
Location: Peak of the West Wan Knob, alt. 254m

GPS UTM: 09U 0589344
UTM 5607959

Observer: Bruce Wright **Map #:** 92L.062 **Weather:** Overcast
Date: December 10, 1999 **Time:**

Adjacent Land Use

type	Comments
Logging	

Vegetation: species present

	description/characteristics
riparian overstorey	Pine trees (contortus?)
riparian understorey	
herb layer	Labrador tea extant.
instream vegetation (eg. LWD, seaweed.)	

Other Data:
Appendix 1 Photo 6

Obvious game trails

Appendix 3: Water Quality Report

RESULTS OF ANALYSIS - Water

File No. L3333

Sample ID		2 Pembert. 100	5 Pemb. P300	4 Pembert. Main A
Sample Date		99 12 10	99 12 10	99 12 10
Sample Time		14:00	11:15	09:30
Physical Tests				
Conductivity	(umhos/cm)	44	51	27
Total Dissolved Solids		42	34	17
Hardness	CaCO3	9.43	12.0	6.54
pH		5.68	6.56	6.38
Total Suspended Solids		<3	4	<3
Turbidity	(NTU)	1.2	1.4	0.3
Dissolved Anions				
Bromide	Br	<0.5	<0.5	<0.5
Chloride	Cl	2.1	3.1	2.2
Fluoride	F	0.03	<0.02	0.03
Sulphate	SO4	11	10	4
Nutrients				
Nitrate Nitrogen	N	<0.005	<0.005	0.006
Nitrite Nitrogen	N	0.001	<0.001	0.001
Total Phosphate	P	0.006	0.008	0.007

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS - Water

File No. L3333

Sample ID		2 Pembert. 100	5 Pemb. P300	4 Pembert. Main A
Sample Date		99 12 10	99 12 10	99 12 10
Sample Time		14:00	11:15	09:30
Total Metals				
Aluminum	T-Al	0.463	0.157	0.197
Antimony	T-Sb	<0.2	<0.2	<0.2
Arsenic	T-As	<0.2	<0.2	<0.2
Barium	T-Ba	<0.01	0.01	<0.01
Beryllium	T-Be	<0.005	<0.005	<0.005
Boron	T-B	<0.1	<0.1	<0.1
Cadmium	T-Cd	<0.0002	<0.0002	<0.0002
Calcium	T-Ca	2.80	3.65	1.79
Chromium	T-Cr	<0.01	<0.01	<0.01
Cobalt	T-Co	<0.01	<0.01	<0.01
Copper	T-Cu	<0.01	<0.01	<0.01
Iron	T-Fe	0.37	0.61	0.12
Lead	T-Pb	<0.001	<0.001	<0.001
Magnesium	T-Mg	0.6	0.7	0.5
Manganese	T-Mn	0.035	0.019	0.009
Mercury	T-Hg	<0.00005	<0.00005	<0.00005
Molybdenum	T-Mo	<0.03	<0.03	<0.03
Nickel	T-Ni	<0.05	<0.05	<0.05
Selenium	T-Se	<0.001	<0.001	<0.001
Silver	T-Ag	<0.0001	<0.0001	<0.0001
Sodium	T-Na	<2	4	<2
Thallium	T-Tl	<0.0001	<0.0001	<0.0001
Uranium	T-U	<0.00001	<0.00001	<0.00001
Zinc	T-Zn	<0.005	<0.005	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

ADDENDUM TO:

PRELIMINARY ENVIRONMENTAL ASSESSMENT OF A PROPOSED QUARRY WEST OF APPLE BAY ON HOLBERG INLET

August 2000

Prepared for:

Homegold Resources Ltd.

By

Nova Pacific Environmental

Table of Contents

4. Introduction

The purpose of this addendum to the report released in February of 2000 is twofold.

1. To elaborate on the ecological classification of the various wetlands in the study area.

2. To discuss the additional background water quality information that has been collected. This includes analyses for dissolved aluminum (D-Al), which had been identified during the first round of water samples as a potential factor affecting aquatic life.

Figure 1 is a map of the site showing sampling locations and key environmental features.

5. Part 1: Classifying and Assessing the Various Wetlands

A field survey of the areas that had been previously identified as possible wetlands was conducted on March 16-17, 2000. A habitat ecologist, who specializes in the identification and classification of wetlands, completed a brief field survey of three of the wetlands identified in Figure 1 of the report "*Preliminary Environmental Assessment of a Proposed Quarry West of Apple Bay on Holberg Inlet*". The purpose of the survey was to verify that these areas are in fact wetlands and to determine the types of wetland involved. Figure 1, included with this addendum shows the new wetland labels.

Wetlands are defined by their three basic components: wetland hydrology, hydric soils, and hydrophytic vegetation. All three components must be present for an area to be classified as a wetland. Hydrophytic vegetation may grow in habitats other than wetlands (e.g. seasonally flooded depressions, adjacent watercourses).

The initial field survey of the study area identified seven possible wetlands. The second field survey ground-truthed three of the sites. Air photo interpretation, based on the signatures collected from the ground-truthed sites, was used to classify the sites that could not be accessed during this survey. The survey was conducted in mid-March; therefore some plants were not in evidence while others could not be identified. More species would be evident during a spring or summer survey.

The wetland polygons A, B, and C appear to provide similar habitat based on air photo interpretation. Wetland polygon C was ground-truthed and found to support a mature open fen. The fen was *Carex* (sedge) dominated; *Myrica gale* (bog rosemary) was abundant. Other species that were noted included *Ledum groenlandicum* (Labrador tea), *Vaccinium oxycoccus* (bog cranberry), and *Blechnum spicant* (deer fern). A few small *Thuja plicata* (western red cedar) and *Tsuga heterophylla* (western hemlock) were present.

Wetland D could not be accessed during the field survey. Air photo interpretation and notes collected by the fisheries biologist during the previous field survey indicate that this area is likely a small treed swamp.

Wetland E, a Sphagnum bog, was ground-truthed. In addition to Sphagnum, *Ledum groenlandicum* (Labrador tea), *Vaccinium oxycoccus* (bog cranberry), and various *Carex* spp. (sedges) were abundant. A few young *Thuja plicata* (western red cedar) and some *Pteridium aquilinum* (bracken fern) were noted. A water sample (#8) was collected slightly downstream of the bog. This water sample, typical of those in the study area, had high D-Al levels and was relatively acidic.

The area identified as a wetland, labeled F near the southern limit of the study area and the centre of Figure 1, supported a few hydrophytic species, but was not a true wetland.

Wetland G was not ground-truthed. Air photo interpretation of the polygon suggests that the area supports a shrub swamp.

Initially, the quarrying activities should not impact any of these wetlands, provided that water discharged to them meets the criteria discussed in the next section. Area D, the treed swamp, may eventually be within the quarry areas but it is small and has been logged over in any event. Area F may well provide the best location for impounding and treating the quarry runoff water prior to its release into either the west or east drainage.

6. Part 2: Results of the Second Round of Water Quality Testing

Samples were taken to replicate the three initial water sampling sites, and three additional locations were analyzed for some of the parameters. The additional sampling locations were selected to broaden the picture with respect to water quality in the study area. Site #7 is on the same tributary of the Youghpan as Site #3, located adjacent to and upstream of the drainage from the Wan Knobs. Site #8 is located immediately downstream of a bog and was included to observe the effect of the bog on pH and metals. Site #9, situated partway up the flank of the western knob, provided a sample that appeared to be flowing in close contact with the potential quarry material as well as providing background data for water draining to the southeast of the quarry site.

The *Chemical Analysis Reports* for these samples and the samples taken in December 1999 are presented in the appendix to this addendum.

The water quality of the streams in the study area met or exceeded the *BC Approved Water Quality Guidelines (Criteria)* in all categories except dissolved aluminum (D-Al) and total iron content. Key water quality results are shown in Table 1. The relevant criteria and values that exceed the criteria are shown in bold print. Because several variables affect the toxicity of D-Al, it is discussed in more detail under the subheading below.

Iron, total aluminum content, and pH were generally somewhat higher in March than in December. Readings for pH are consistently acidic although two samples were near neutral in March. For some samples, pH values may be due to the prevalence of natural acid rock drainage in the region[1], while other low pH values may be attributable to organic sources. Koyanagi & Panteleyev (1993) indicated that the effects of natural acid rock drainage are most significant in the small tributaries to the northwest of the Wanokana (organic acids are also significant in this system), as well as in the whole of the Youghpan system. Site #7, for example, above the study area, may be acidic because of natural rock drainage, while organic sources probably cause the acidic conditions at site #8, which is at the exit of a bog.

Natural acid rock drainage from off site areas upstream of the quarry site may contribute to the low pH in the receiving waters for runoff; however, conditions on the site are such that natural or induced acid rock drainage are not expected.[2] Low pH readings noted, are within the background readings and are presumably arising from organic sources.

The BC Ministry of Environment (MELP) has not yet approved official water quality guidelines for iron. However, in their compendium of guidelines being developed or

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[1] Koyanagi & Panteleyev. *Natural Rock-Drainage in the Red Dog-Hushamu-Pemberton Hills Area, Northern Vancouver Island.* Geological Fieldwork 1993, Paper 1994-1, B.C. Geological Survey Branch.

[2] Homegold Resources Ltd., *Acid Rock Drainage Potential Assessment for the Apple Bay Project, PEM-100 Quarry unpubl.*

under review, maximum iron content is listed as 0.3 mg/L. Four of the water samples, 1, 3, 7, and 9 exceeded this by 2.3, 2.5, 1.1, and 4.8 times, respectively.

Iron content can be decreased through oxidation, causing precipitation. This process is faster at higher pH[3].

6.1 Regarding the Issue of Dissolved Aluminum in Stream Water

Due to the unusually high total aluminum (T-Al) levels measured in the streams around the potential quarry site in December, the second set of water samples was analyzed for dissolved aluminum (see attached Chemical Analysis Report). D-Al content was compared to the criteria for the protection of freshwater aquatic life as listed in "A Compendium of Working Water Quality Guidelines for British Columbia".

Where pH is less than or equal to 6.5, the applicable criteria for dissolved aluminum is calculated as follows:

$$\text{Maximum allowable D-Al (mg/L)} = e^{\{1.209 - (2.426 \cdot pH) + (0.286 \cdot K)\}}$$

where:

pH is the instantaneous pH value, $K = (pH)^2$ and the mathematical constant *e* is 2.718281...

Dissolved aluminum content in the six water samples taken at sites 1,3,4,7,8, and 9,on March 17, 2000 was, respectively, 0.9, 3.89, 1.46, 12.42, 6.09, and 22.45 times higher than the applicable criteria. While this is a limited sample size, one can conjecture as to what is the cause of the variability. The first site drains from the fen at the northeast of the study area. Here pH is relatively high, and this is the only sample where D-Al did not exceed the criteria. The wetland, therefore, may be exerting a positive influence on this water quality. The sample at site 3 reflects the naturally low pH in the area, as well, the high background content of aluminum. Site 4 exhibits relatively high pH, and drains an area that, although not a wetland, supports some aquatic plant species. Again, there may be some benefit through natural wetland processes to the water quality. Site 7 is from a larger stream above the study area, and shows the pH (possibly influenced by natural acid rock drainage), and background aluminum levels to the North of the quarry site. Despite being at the exit of a wetland, Site 8 has low pH and high D-Al readings. In this case, the wetland is a bog, probably causing the low pH, and chalky geyserite, which has a high aluminum content, has been dumped, apparently during previous roadbuilding activities, above the wetland. Site 9, which has the lowest pH and highest D-Al of all the samples, was taken relatively high on the side of the west knob, and illustrates the likely need to treat the water draining from the anticipated quarry.

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[3] *Guidelines for Interpreting Water Quality Data.* Prepared by Ministry of Environment, LandData BC, and Geographic Data BC, for the Land Use Task Force Resources Inventory Committee. 1997.

On average D-Al is about 8 times higher than the maximum allowable for freshwater aquatic life.

Three factors contribute to the presence of dissolved aluminum and its toxicity:

1. The rocks and soil of the study area are rich in aluminum, providing a ready source for the local streams.
2. The quantity of aluminum that dissolves into the streams is inversely proportional to the water hardness. As the water in local streams is very soft, aluminum dissolves relatively easily in it.
3. The level of toxicity of D-Al is inversely proportional to the pH, and the local streams are acidic, with pH values from 6.95 to 5.16.

6.2 Discussion

The activity of quarrying would expose unweathered rock faces containing aluminum and iron. With the low hardness and low pH, it is anticipated that these minerals would dissolve and increase stream concentrations unless mitigative measures are undertaken. Artificial inputs of aluminum to the local streams would be unacceptable due to high natural levels of D-Al. Similarly, artificial inputs of iron should be avoided.

It is probable that the runoff water will require some treatment and in that event, the most likely course of action would be to increase the pH, possibly through addition of limestone to a runoff collection pond. This would have the added effect of increasing water hardness, which tends to decrease the toxic effects of the metals. However, further evaluation of this issue, including determination of target parameters for water to be released from such ponds is anticipated.

As the streams naturally have high levels of dissolved oxygen, iron content cannot be decreased through artificial inputs of oxygen to the water. Ponding of the water would allow time for oxidation while higher pH, would increase the rate of oxidation and thereby decrease the amount of iron in the water.

APPENDIX: CHEMICAL ANALYSIS REPORTS FROM ASL LABORATORIES

188 Triumph Street, Vancouver, BC Canada V5L 1K5

analytical
service
laboratories
ltd.

FAX: (604) 253-6700 TEL: (604) 253-4188

CHEMICAL ANALYSIS REPORT

Date: April 3, 2000

ASL File No. L5549

Report On: Water Analysis (Holberg 2)

Report To: **New Pacific Ventures**
3676 Yale Street
Vancouver, BC
V5K 1C8

Attention: **Mr. Bruce Wright**

Received: March 18, 2000

ASL ANALYTICAL SERVICE LABORATORIES LTD.
per:

Joanne Patrick, B.Sc. - Project Chemist
Can Dang, B.Sc. - Project Chemist

RESULTS OF ANALYSIS - Water

File No. L5549

Sample ID			1	3	4	7	8
Sample Date			00 03 17	00 03 17	00 03 17	00 03 17	00 03 17
Physical Tests							
Conductivity	(umhos/cm)		50	48	30	-	-
Total Dissolved Solids			40	42	36	-	-
Hardness	CaCO3		10.9	11.0	7.67	-	-
pH			6.97	6.55	6.95	5.61	5.64
Dissolved Anions							
Bromide	Br		<0.5	<0.5	<0.5	-	-
Chloride	Cl		3.1	2.6	2.4	-	-
Fluoride	F		0.04	0.07	0.06	-	-
Sulphate	SO4		9	10	3	-	-
Nutrients							
Nitrate Nitrogen		N	<0.1	<0.1	<0.1	-	-
Nitrite Nitrogen		N	<0.1	<0.1	<0.1	-	-
Total Phosphate		P	0.006	0.006	0.005	-	-

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS - Water

File No. L5549

Sample ID		1	3	4	7	8
Sample Date		00 03 17	00 03 17	00 03 17	00 03 17	00 03 17
Total Metals						
Aluminum	T-Al	0.2	0.5	0.4	0.6	0.3
Antimony	T-Sb	<0.2	<0.2	<0.2	<0.2	<0.2
Arsenic	T-As	<0.2	<0.2	<0.2	<0.2	<0.2
Barium	T-Ba	0.01	0.01	<0.01	<0.01	0.02
Beryllium	T-Be	<0.005	<0.005	<0.005	<0.005	<0.005
Bismuth	T-Bi	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	T-B	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium	T-Cd	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium	T-Ca	3.25	3.27	2.03	3.08	5.63
Chromium	T-Cr	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	T-Co	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	T-Cu	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	T-Fe	0.70	0.75	0.18	0.34	0.28
Lead	T-Pb	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	T-Li	<0.01	<0.01	<0.01	<0.01	<0.01
Magnesium	T-Mg	0.7	0.7	0.6	0.7	1.0
Manganese	T-Mn	0.014	0.032	0.012	0.029	0.114
Molybdenum	T-Mo	<0.03	<0.03	<0.03	<0.03	<0.03
Nickel	T-Ni	<0.05	<0.05	<0.05	<0.05	<0.05
Phosphorus	T-P	<0.3	<0.3	<0.3	<0.3	<0.3
Potassium	T-K	<2	<2	<2	<2	<2
Selenium	T-Se	<0.2	<0.2	<0.2	<0.2	<0.2
Silicon	T-Si	2.85	2.51	1.58	2.65	2.27
Silver	T-Ag	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	T-Na	4	2	<2	2	2
Strontium	T-Sr	0.021	0.018	0.013	0.016	0.032
Thallium	T-Tl	<0.2	<0.2	<0.2	<0.2	<0.2
Tin	T-Sn	<0.03	<0.03	<0.03	<0.03	<0.03
Titanium	T-Ti	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	T-V	<0.03	<0.03	<0.03	<0.03	<0.03
Zinc	T-Zn	<0.005	<0.005	<0.005	<0.005	<0.005
Dissolved Metals						
Aluminum	D-Al	0.153	0.35	0.233	0.41	0.207

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS - Water

File No. L5549

Sample ID	9
Sample Date	00 03 17

Physical Tests

pH	5.16

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS - Water

File No. L5549

Sample ID		9
Sample Date		00 03 17
Total Metals		
Aluminum	T-Al	1.6
Antimony	T-Sb	<0.2
Arsenic	T-As	<0.2
Barium	T-Ba	0.02
Beryllium	T-Be	<0.005
Bismuth	T-Bi	<0.1
Boron	T-B	<0.1
Cadmium	T-Cd	<0.01
Calcium	T-Ca	0.47
Chromium	T-Cr	<0.01
Cobalt	T-Co	<0.01
Copper	T-Cu	<0.01
Iron	T-Fe	1.45
Lead	T-Pb	<0.05
Lithium	T-Li	<0.01
Magnesium	T-Mg	0.4
Manganese	T-Mn	0.009
Molybdenum	T-Mo	<0.03
Nickel	T-Ni	<0.05
Phosphorus	T-P	<0.3
Potassium	T-K	<2
Selenium	T-Se	<0.2
Silicon	T-Si	1.67
Silver	T-Ag	<0.01
Sodium	T-Na	<2
Strontium	T-Sr	0.032
Thallium	T-Tl	<0.2
Tin	T-Sn	<0.03
Titanium	T-Ti	0.04
Vanadium	T-V	<0.03
Zinc	T-Zn	<0.005
Dissolved Metals		
Aluminum	D-Al	0.55

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

Appendix 1 - QUALITY CONTROL - Replicates

File No. L5549

Water		8	8
		00 03 17	QC # 191818
Physical Tests			
pH		5.64	5.71
Total Metals			
Aluminum	T-Al	0.3	0.3
Antimony	T-Sb	<0.2	<0.2
Arsenic	T-As	<0.2	<0.2
Barium	T-Ba	0.02	0.02
Beryllium	T-Be	<0.005	<0.005
Bismuth	T-Bi	<0.1	<0.1
Boron	T-B	<0.1	<0.1
Cadmium	T-Cd	<0.01	<0.01
Calcium	T-Ca	5.63	5.76
Chromium	T-Cr	<0.01	<0.01
Cobalt	T-Co	<0.01	<0.01
Copper	T-Cu	<0.01	<0.01
Iron	T-Fe	0.28	0.28
Lead	T-Pb	<0.05	<0.05
Lithium	T-Li	<0.01	<0.01
Magnesium	T-Mg	1.0	1.0
Manganese	T-Mn	0.114	0.117
Molybdenum	T-Mo	<0.03	<0.03
Nickel	T-Ni	<0.05	<0.05
Phosphorus	T-P	<0.3	<0.3
Potassium	T-K	<2	<2
Selenium	T-Se	<0.2	<0.2
Silicon	T-Si	2.27	2.30
Silver	T-Ag	<0.01	<0.01
Sodium	T-Na	2	2
Strontium	T-Sr	0.032	0.032
Thallium	T-Tl	<0.2	<0.2
Tin	T-Sn	<0.03	<0.03
Titanium	T-Ti	<0.01	<0.01
Vanadium	T-V	<0.03	<0.03
Zinc	T-Zn	<0.005	0.006

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

Outlines of the methodologies utilized for the analysis of the samples submitted are as follows:

Conventional Parameters in Water

These analyses are carried out in accordance with procedures described in "Methods for Chemical Analysis of Water and Wastes" (USEPA), "Manual for the Chemical Analysis of Water, Wastewaters, Sediments and Biological Tissues" (BCMOE), and/or "Standard Methods for the Examination of Water and Wastewater" (APHA). Further details are available on request.

Metals in Water

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" 20th Edition 1998 published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotplate or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by atomic absorption/emission spectrophotometry (EPA Method 7000 series), inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B), and/or inductively coupled plasma - mass spectrometry (EPA Method 6020).

Recommended Holding Time:

Sample:	6 months
Reference:	EPA
For more detail see:	ASL "Collection & Sampling Guide"

End of Report