FMC100

Laberge
ENVIRONMENTAL SERVICES
P.O. Box 21072
Whitehorse, Y.T.
Y1A 6P7

Office Phone: 867-668-6838
Cell Phone: 867-668-1043
Fax: 867-667-6956

BIOLOGICAL AND SEDIMENT MONITORING PROGRAM

AT

VANGORDA CREEK, FARO, Y.T. 2005

Submitted to:

DELOITTE & TOUCHE INC

Prepared by:

B. E. Burns

Laberge
ENVIRONMENTAL SERVICES

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1.0 INTRODUCTION

On November 8, 1994 Anvil Range Mining Corporation (Anvil) was officially assigned Licence Number IN89-002, which was originally issued to Curragh Resources Inc, by the Yukon Territory Water Board. The mine has not operated since January 1998. Low metal prices (zinc and lead) and financial difficulties experienced by Anvil indicated that this closure had the potential to be long term. On April 21, 1998, Deloitte & Touch Inc was appointed as the interim receiver for the Faro Mine property, operations and assets.

On March 30, 2004, Deloitte and Touch Inc was issued Licence Number QZ03-059 to continue care and maintenance of the Anvil Range Mine site, and to conduct and/or manage additional studies and plans for another five years.

To comply with Part G, Section 64 and Schedule B of the water licence, a biological and sediment monitoring program is to be undertaken every two years on the Vangorda Creek system. Deloitte and Touch Inc contracted Laberge Environmental Services (LES) to conduct these programs during the summer of 2005. The following report presents all data collected and includes some comparisons with past monitoring programs.

2.0 STUDY AREA

The lead-zinc mine near Faro, located at approximately 62° 20' N and 133° 25' W (Figure 1), consists of three open pits, Faro, Grum and Vangorda.

The Grum and Vangorda deposits were extracted within the Vangorda Creek watershed and the ore was transported via the haul road to the mill for concentrating. The following four sampling stations are located upstream and downstream of the mined area (Figure 1):

- V1: Vangorda Creek upstream of the Blind Creek Road and the Vangorda pit.
- V27: Vangorda Creek just upstream of the confluence with Shrimp Creek and downstream of all mining related activity.
- V5: West Fork of Vangorda Creek upstream of the mine access road and downstream of the haul road.
- V8: Vangorda Creek upstream of the bridge to the Faro town water supply, and approximately 500 metres upstream of the confluence with the Pelly River.

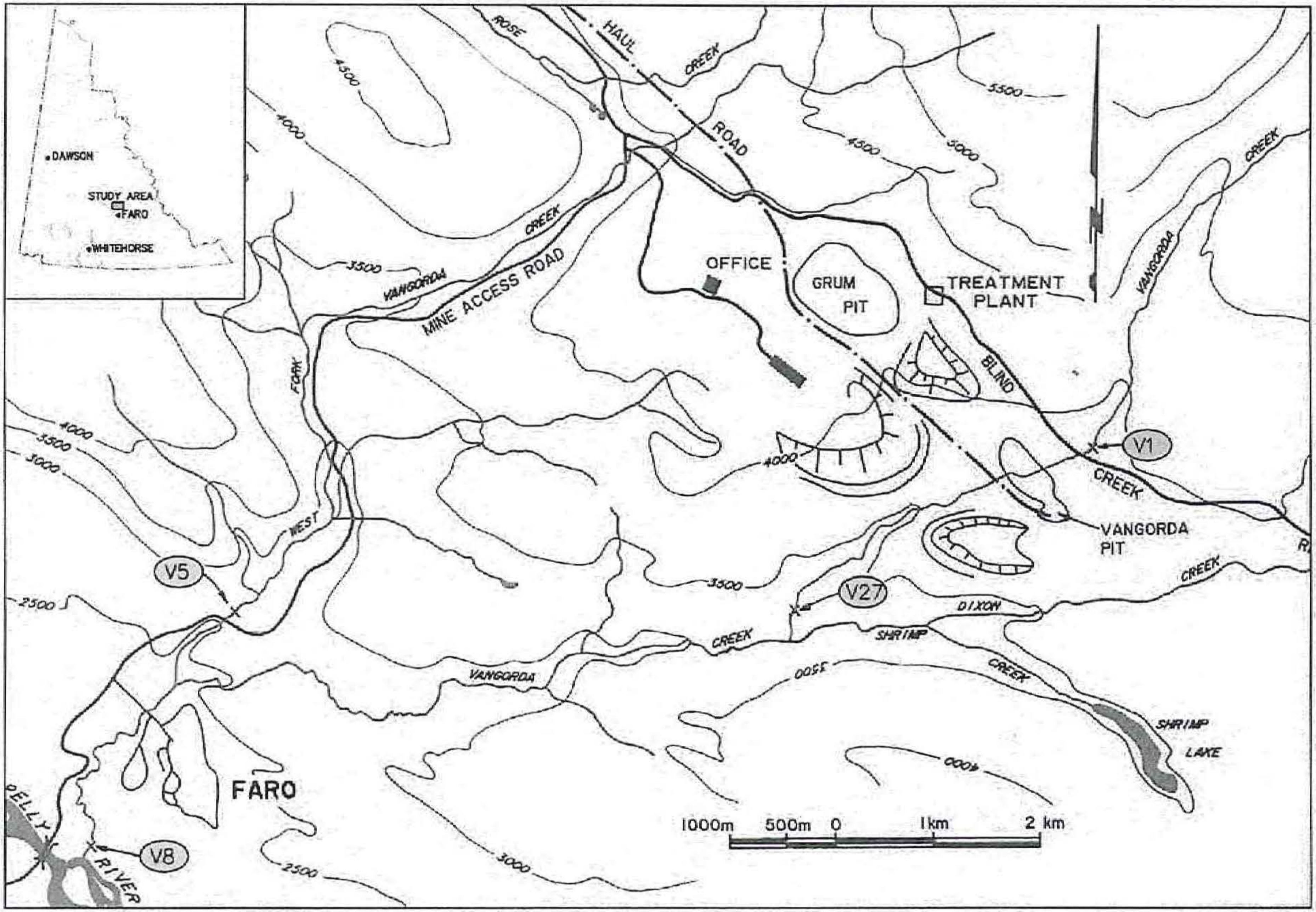

FIGURE 1 : LOCATION OF SAMPLING SITES ON VANGORDA CREEK, FARO

3.0 METHODS

3.1 Water Quality

Water quality samples were collected on two occasions during the biological monitoring program; on July 19th and 20th, and on August 24th and 25th, 2005.

3.1.1 Field Measurements

In-situ measurements were taken at each site during both surveys. Conductivity and temperature were determined with an Orion conductivity meter model 126. Dissolved oxygen readings and pH measurements were taken using Accumet field meters.

3.1.2 Chemical Analyses

All sample bottles were supplied by Cantest Laboratories of Burnaby, B.C. and were provided to LES personnel at the Faro Mine Security Office. At each site, the sample bottles were rinsed three times with the sample water prior to filling. Samples were collected in two litre plastic bottles for sulphates, alkalinity, hardness, colour, turbidity and nonfilterable reside analyses. Ammonia samples were collected in 500 mL plastic bottles and preserved with sulphuric acid. Samples to be analyzed for total and dissolved metals were each collected in 250 mL acid washed plastic bottles. The total metals samples were preserved with nitric acid. The dissolved metals samples were left unpreserved to be filtered and treated at the Cantest lab. Samples were kept cool prior to shipment to Cantest.

3.2 Water Quantity

Discharge was measured at each of the sites on both visits. An area with a uniform cross section was chosen and the velocity and depth were measured using Anvil's Global Water model FP101 in July and a AA Price meter in August. Ten or more readings were taken across the profile of the stream. Total discharge was calculated as the sum of these individual discharges (area x velocity).

3.3 Stream Sediment Sampling

Triplicate sediment samples were collected from the four sites (V1, V27, V5 and V8) during the July visit. Sample sites were selected from an exposed area of the stream bank, generally characterized by the finest grain size evident at the site. Samples were collected with a stainless steel trowel and placed in provided glass jars. The samples were packed on ice when shipped to Cantest in B.C.

At the lab, the samples were dried and passed through a 100 mesh (0.15 mm) stainless steel sieve. The portion passing through the stainless steel sieve was run through an ICP scan for the determination of total metal concentrations.

3.4 Benthic Invertebrate Sampling

3.4.1 Field Collection

Artificial substrate samplers were used for benthic invertebrate sampling. The basket samplers were cylindrical in shape, measured 26 cm long with a diameter of 17 cm, and were constructed of galvanized wire with a 1 cm mesh. Each substrate sampler was filled with washed indigenous gravels collected from the stream bed or the bank at each sample site. The surface area provided by this 'artificial substrate' was approximately 6000 $\pm$ 1000 cm^2 (Baker 1979). Three rock filled samplers were submerged in riffle areas of the stream at each site on July 19th or 20th, 2005. These samplers were left to colonize for five weeks. On August 24th and 25th, 2005, the artificial substrate samplers were retrieved by placing a screened bucket with a 300 micron mesh, downstream and under the basket. On shore the basket was opened in the bucket. Individual rocks were then carefully washed in the screened bucket to remove and collect all invertebrates from that sample. The debris and benthic invertebrates remaining in the bucket were placed in a one litre nalgene bottle and preserved with 10% formalin. These samples were sent to Charles Low PhD, an entomologist in Victoria, B.C. for enumeration and identification.

3.4.2 Laboratory Analysis

All samples were washed through two screens with mesh sizes 1 millimetre and 180 microns. All of the organisms retained by the coarse screen were counted and identified, whereas the organisms on the 180 micron screen were subsampled as necessary. A Folsom plankton splitter was used for the subsampling. The majority of the benthos was identified to the genus level.

4.0 RESULTS AND DISCUSSION

To aid in interpretation, site V27 has been placed after V1 and prior to V5 in all of the tables and graphs. V27 is geographically located below V1 but is upstream of the confluence with the West Fork of Vangorda Creek.

4.1 Water Quality

Water quality samples were collected in July and August, 2005, at the four sites. The analytical results are presented in Appendix A. Sixteen elements were below the method detection limit in all samples: mercury (Hg), antimony (Sb), beryllium (Be), bismuth (Bi), boron (B), cadmium (Cd), chromium (Cr), cobalt (Co), phosphorus, silver (Ag), tellurium (Te), thallium (Tl), thorium (Th), tin (Sn), vanadium (V) and zirconium (Zr).

Schedule B(3) specifically requests the analysis of total hardness, alkalinity, sulphate, suspended solids, ammonia, and total and dissolved ICP metals scan including copper, iron, lead and zinc. The results for these parameters are presented in Table 1.

4.1.1 Temperature

The temperature values reflected the diurnal and seasonal timing of the sampling, ranging from 6.8°C at V5 in August, to 10.7°C in July at V27.

4.1.2 Conductivity

Conductivity, a measure of the total concentration of ionic constituents in water, was low at V1 and significantly higher at the other sites. The highest value of 596 uS/cm was recorded at V8 in August.

4.1.3 pH

All values were slightly alkaline.

4.1.4 Alkalinity

Alkalinity was low at V1 and V27 and considerably higher at V5 and V8.

TABLE 1

WATER QUALITY DATA AT VANGORDA CREEK, 2005

Sample Site	V1		V27		V5		V8		CCME (1999)
Date, 2005	July 20	August 25	July 20	August 25	July 19	August 25	July 19	August 24	
Temp °C	7.7	7.0	10.7	7.2	7.9	6.8	9.2	9.3	
Conductivity (uS/cm) Field	58	77	—	—	417	492	400	596	
Conductivity (uS/cm) Lab	53	10	307	287	384	346	364	407	
pH Field	7.1	—	—	—	8.6	—	8.4	—	6.5 - 9
pH Lab	7.5	—	—	—	8.3	—	8.3	—	
Dissolved Oxygen (mg/L)	11.0	11.3	11.2	10.9	11.8	11.8	10.7	10.9	9.5
Dissolved Oxygen (%)	102.0	98.0	101.0	97.0	104.0	104.0	99.0	100.0	
Alkalinity mg/L as CaCO3	22.3	27.7	47.5	—	171	196	117	140	
Cu: total	<0.001	<0.001	0.001	<0.001	0.002	0.001	0.001	0.024	0.003[1]
Cu: dissolved	<0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	
Pb: total	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	0.002	0.007[1]
Pb: dissolved	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Zn: total	<0.005	<0.005	0.031	0.020	0.007	<0.005	0.011	0.06	0.03
Zn: dissolved	<0.005	<0.005	0.022	0.018	0.007	<0.005	<0.005	0.005	
Fe: total	<0.05	<0.05	<0.05	<0.05	0.55	0.25	0.23	<0.05	0.3
Fe: dissolved	<0.05	<0.05	<0.05	<0.05	0.07	<0.05	0.07	<0.05	
Sulphate	6.9	8.8	125	147	61.8	78.8	100	210	
Ammonia	0.08	0.03	<0.01	<0.01	0.01	0.08	0.01	<0.01	1.04[2]
NFR	<1	<1	<1	<1	41	7	10	<1	
Total Hardness mg/L as CaC03	23	29	159	200	225	280	205	328	
Flow m³/sec	0.450	0.247	0.312	0.284	0.530	0.286	0.875	0.425	

NOTE: All units are expressed as mg/L unless indicated otherwise.
Vaules in bold indicated exceedence of the CCME guideline for the protection of freshwater aquatic life.
[1]: Guideline derived for hardness > 180 mg/L as $CaCO_3$
[2]: Guideline derived for temperature of 10°C and pH of 8.0

4.1.5 Dissolved Oxygen

All sites were well aerated on both occasions.

4.1.6 Sulphate

Sulphate levels were very low at V1. The highest concentration, 210 mg/L, occurred at V8 in August. Sulphate concentrations normally vary from 10 to 80 mg/L in surface waters (Canadian Council of Resource and Environment Ministers (CCREM) 1987).

4.1.7 Ammonia

Ammonia levels were very low and met the CCME guideline of 1.04 mg/L.

4.1.8 Non-filterable Residue (NFR)

Both V1 and V27 had very clear waters on both occasions. The water was visually quite turbid at V5 in July and had a concentration of 41 mg/L of suspended matter. Conditions were improved further downstream where a concentration of 10 mg/L was documented at V8.

4.1.9 Total Hardness

Calcium and magnesium are considered to be the primary contributors to hardness but other cations such as strontium, barium, manganese, iron and aluminum also contribute to total hardness. The hardness varied at each of the sites: V1 was very soft, V8 and V5 were very hard, and V27 was hard in July and very hard in August.

4.1.10 Total and Dissolved Metals

Most metal concentrations were very low where detected. The Canadian Council of Ministry of the Environment (CCME) has established recommended guidelines for the protection of freshwater aquatic life. Note that these guidelines have generally been established under laboratory conditions or at southern locations, usually using aquatic species exotic to the Yukon. As such, the levels recommended for aquatic life are simply guidelines, and <u>not</u> standards. The guidelines for copper and lead vary with hardness (Table 2) as these metals tend to be more toxic to aquatic life in softer waters.

TABLE 2
CCME RECOMMENDED GUIDELINES FOR THE PROTECTION OF FRESHWATER AQUATIC LIFE

HARDNESS as $CaCO_3$ mg/L		COPPER mg/L	LEAD mg/L	IRON mg/L	ZINC mg/L
0 - 60	soft	0.002	0.001	0.3	0.030
60 - 120	moderate	0.002	0.002	0.3	0.030
120 - 180	hard	0.003	0.004	0.3	0.030
>180	very hard	0.004	0.007	0.3	0.030

The guideline for copper was exceeded only in the total metals sample from V8 during the August monitoring.

Lead was only detected in two samples where it met the CCME guideline of 0.007 mg/L for very hard waters.

The guideline for zinc is 0.030 mg/L irrelevant of hardness. This guideline was slightly exceeded in the July total metals sample at V27 and at V8 in the August total metals sample.

The guideline for iron is 0.3 mg/L and was exceeded only in July at V5 in the total metals sample.

4.2 Water Quantity

Flows were measured at each of the sites in July and August. These data are presented with the water quality data in Table 1. Flows were considerably lower in August than in July.

4.3 Stream Sediment Quality

4.3.1 Metal Analyses for the 2005 Survey

Triplicate stream sediment samples were collected from each of the sites in July. The triplicates were averaged, and standard deviation was calculated to determine the spread of the triplicates (Appendix B). Generally the replicates showed little spread and thus were representative samples of the sites. Of the 29 metals analyzed, six were below the method detection limit in all samples: antimony (Sb), beryllium (Be), molybdenum (Mo), silver (Ag), tin (Sn) and boron (B).

To conform with past studies, the metals copper, iron, lead and zinc were examined in greater detail. The mean concentrations of these metals were compared to the CCME (1999) interim freshwater sediment quality guidelines (ISQG) and to the probable effects levels (PEL) in Table 3. Concentrations greater than the PEL have a 50% incidence of creating adverse biological effects.

The stream sediments at V1 had the lowest concentrations of all metals examined and met all applicable guidelines. The concentration of metals in the stream sediments at V5 also met all applicable guidelines. The ISQG was exceeded for lead and zinc at V8. The highest concentration of the four metals was reported in the stream sediments at V27, which would be expected as it is the most directly affected site of those sampled. The ISQG was exceeded for copper and zinc at V27, and the PEL was exceeded for lead.

TABLE 3
SUMMARY OF STREAM SEDIMENT METAL CONCENTRATIONS, 2005

STATION NUMBER	STATION DESCRIPTION	COPPER (ug/g)	LEAD (ug/g)	IRON (%)	ZINC (ug/g)
V-1	Vangorda Cr u/s all mining activity	17.0	19.3	1.6	60
V-27	Vangorda Cr d/s activity and u/s Shrimp Cr	*36.3*	***188***	2.0	*288*
V-5	West Fork of Vangorda Cr	25.0	20.7	1.7	86
V-8	Vangorda Cr approx 500 m u/s Pelly R	34.7	*74.7*	1.9	*192*
ISQG		35.7	35.0		123
PEL		197.0	91.3		315

Note: ISQG = Interim freshwater Sediment Quality Guidelines (exceedences italicized)
PEL = Probable Effects Level (exceedences italicized and in bold)

4.3.2 Comparisons with Past Data

Stream sediments were collected at these sites in 1993 (Burns, 1993), in 1995 (Burns, 1996), in 1997 (Burns, 1998), in 1999 (Burns, 2000) in 2001 (Burns, 2002) and in 2003 (Burns, 2003) as a requirement of the company's water licence. The data for selected metals are presented in Table 4 and in Figures 2, 3, 4 and 5. The 12 year average has been plotted for each metal in each graph.

Metals in sediment are difficult to interpret because levels can vary widely as a function of natural mineralization of local soils in a given watershed, making it difficult to obtain truly representative samples. The data over the years has generally fluctuated, notably at V27. No trends can readily be produced, however the following observations were noted:

- There was a significant reduction in the concentrations of all metals at V27 in 2005.
- The concentrations of copper and iron peaked in 1999 at V27 and have been steadily decreasing in the past six years.
- Iron is relatively similar throughout the years and at the sites, with V1 and V27 having the greatest concentrations.
- Copper concentrations have not varied much at V5 and at V8.
- Concentrations of lead and zinc have generally been much greater at V27 than at the other sites. Lead levels have been consistently very low at V1 and V5.
- Zinc concentrations have remained fairly consistent at V1 and V5.

TABLE 4

COMPARISONS OF METALS IN STREAM SEDIMENTS
1993, 1995, 1997, 1999, 2001, 2003 AND 2005

Site	Year	Copper (mg/L)	Iron (%)	Lead (mg/L)	Zinc (mg/L)
V1	1993	24 (4)	3.7 (4.6)	30 (8)	120 (13)
	1995	33 (2)	3.1 (2.6)	43 (14)	177 (40)
	1997	53 (19)	2.7 (1.0)	58 (35)	132 (71)
	1999	39 (2)	4.0 (0.1)	45 (16)	141 (12)
	2001	19 (7)	2.4 (0.3)	18 (7)	88 (32)
	2003	26 (2)	2.5 (0.3)	37 (10)	132 (16)
	2005	17 (3)	1.6 (0.2)	19 (5)	60 (14)
V27	1993	52 (4)	3.2 (1.5)	587 (518)	436 (126)
	1995	59 (11)	2.7 (4.0)	1305 (1215)	519 (43)
	1997	88 (12)	3.8 (7.0)	1492 (642)	652 (55)
	1999	129 (45)	4.3 (0.7)	2069 (375)	921 (290)
	2001	102 (8)	3.9 (0.2)	2802 (1154)	868 (88)
	2003	74 (9)	3.0 (0.1)	1383 (340)	951 (125)
	2005	36 (5)	2.0 (0.02)	188 (77)	288 (26)
V5	1993	28 (1)	2.2 (0.6)	23 (1)	98 (5)
	1995	36 (2)	1.8 (0.3)	52 (2)	129 (4)
	1997	36 (2)	2.1 (0.6)	35 (3)	100 (5)
	1999	25 (1)	1.8 (0.0)	30 (2)	81 (2)
	2001	28 (7)	1.9 (0.2)	32 (7)	116 (22)
	2003	22 (4)	1.7 (0.1)	25 (8)	80 (15)
	2005	25 (3)	1.7 (0.04)	21 (1.2)	86 (6)
V8	1993	37 (0)	2.8 (0.3)	214 (11)	251 (12)
	1995	48 (4)	2.2 (1.0)	218 (70)	391 (111)
	1997	36 (5)	2.3 (0.6)	114 (6)	221 (25)
	1999	29 (2)	2.0 (0.1)	89 (40)	148 (40)
	2001	34 (1)	2.2 (0)	110 (33)	248 (41)
	2003	29 (4)	1.7 (0.1)	74 (12)	243 (73)
	2005	35 (1)	1.9 (0.01)	75 (7.2)	192 (6)

NOTE: Number in brackets is the standard deviation for that set.

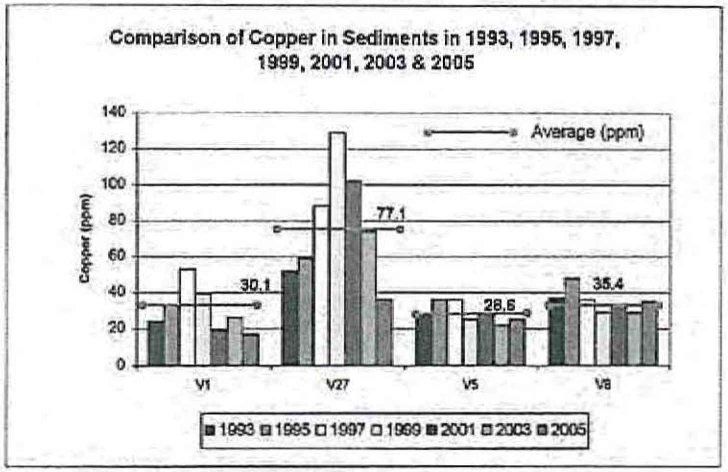

Figure 2 Comparison of copper concentrations in stream sediments over time

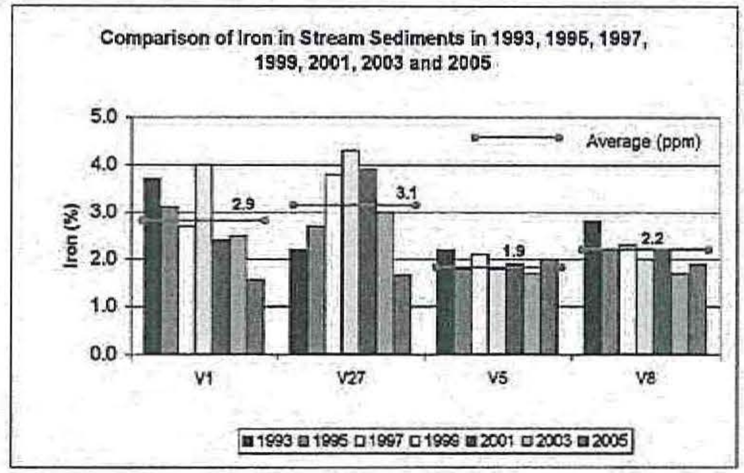

Figure 3 Comparison of iron concentrations in stream sediments over time

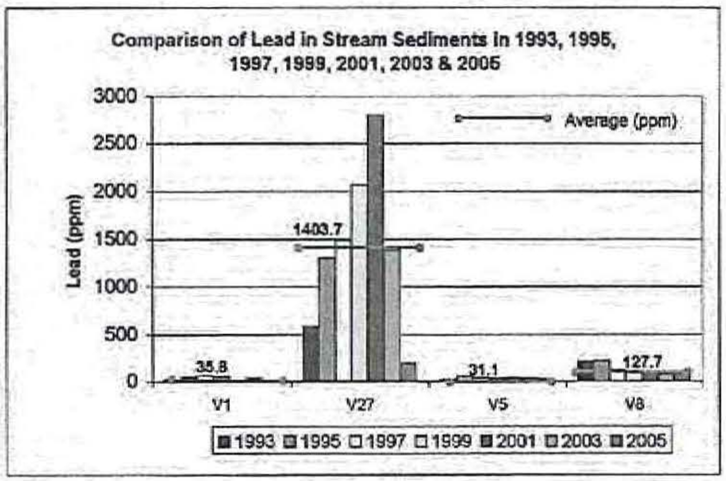

Figure 4 Comparison of lead concentrations in stream sediments over time

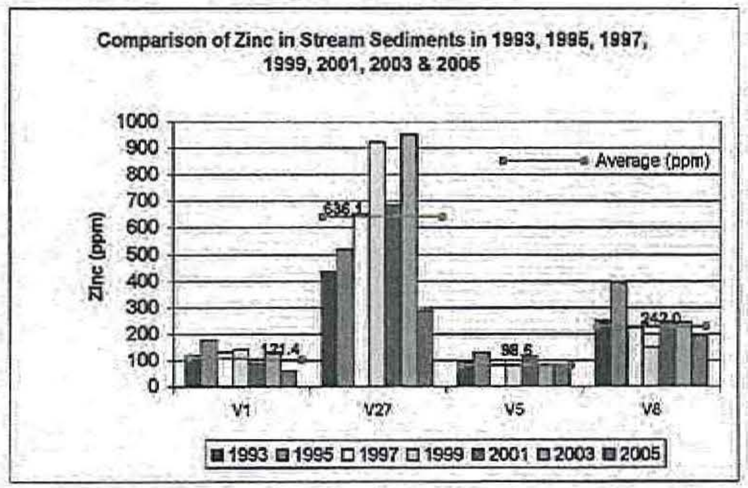

Figure 5 Comparison of zinc concentrations in stream sediments over time

4.4 Benthic Invertebrates

Three phyla were found in the study area: Arthropoda, Annelida and Nematoda. A total of 61 different taxonomic groups were identified within these phyla. These data are presented in Appendix C.

4.4.1 Abundance and Taxonomic Richness

The number of organisms of the triplicates for each site was summed to give a total abundance value for that site. Population numbers varied in the study area, ranging from 5,534 individuals at V1 to 13,570 at V5.

Taxonomic richness was determined for each site by enumerating all the taxonomic groups identified from species to phylum as a measure of community diversity. The diversity ranged from 34 different taxonomic groups at V27 to 45 different taxonomic groups at V8. Diversity decreased slightly downstream of V1 at V27, but increased steadily to the mouth, V8.

The benthic community located at V8 reflects conditions in Vangorda Creek just upstream of its confluence with the Pelly River. The diverse and abundant community documented at V8 would indicate that habitat conditions (water and stream sediment quality) are favourable and consequently there should be negligible impact on the Pelly River from Vangorda Creek.

Abundance and diversity values were plotted and are displayed in Figure 6.

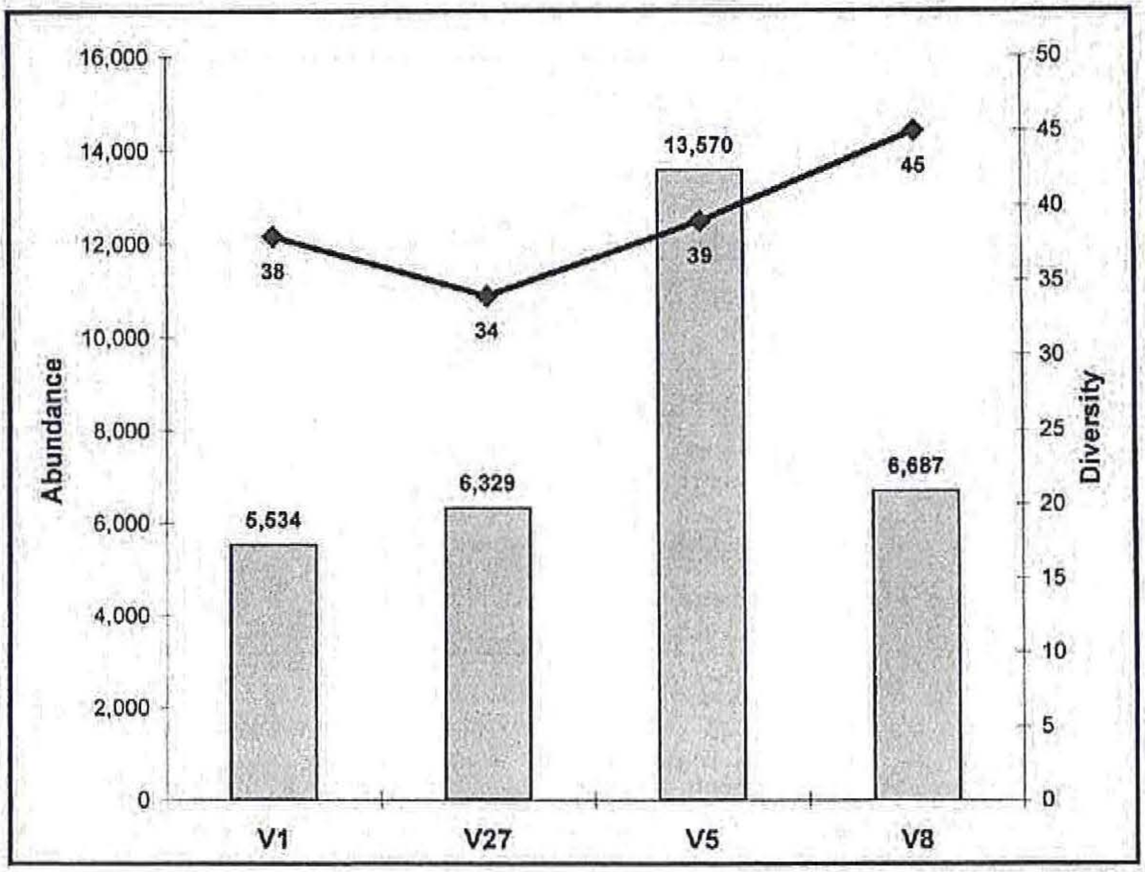

FIGURE 6 Abundance and Diversity at Vangorda Creek, 2005

4.4.2 Distribution

The composition of the benthos communities was displayed as a percentage of the major taxonomic orders for each station (Table 5). Based on this, taxa were classified with respect to their dominance within the community (Table 6).

The orders Plecoptera and/or Diptera dominated all of the sites. Ephemeroptera shared dominance with Diptera and Plecoptera at V1. Ephemeroptera was the subdominant group at V27 and V8, and common at V5. Trichopterans were subdominant at V27 and V5, and common at V1 and V8. Most of the remaining taxa were rare.

TABLE 5
THE PERCENTAGE OF COMPOSITION OF DIFFERENT TAXONOMIC GROUPS AT EACH STATION

TAXONOMIC GROUP	V1	V27	V5	V8
Ephemeroptera (mayflies)	27.2	14.9	4.6	10.3
Plecoptera (stoneflies)	29.9	56.9	11.1	25.9
Trichoptera (caddisflies)	5.4	11.1	11.6	1.1
Diptera (true flies)	36.5	16.8	71.4	59.9
Hydracarina (water mites)	0.8	0.2	0.5	2.6
Other *	0.2	0.04	0.8	0.1

* Other includes one or more of the following taxonomic groups:

Nematoda	Lepidoptera	Collembola	Oligochaeta
Thysanoptera	Aranaea	Homoptera	Hymenoptera

TABLE 6
TAXONOMIC DISTRIBUTION OF BENTHIC INVERTEBRATES

SITE	LOCATION	DOMINANT (≥25%)	SUBDOMINANT (10% to 24.9%)	COMMON (1.0% to 9.9%)	RARE (0.1% to 0.9%)	INCIDENTAL (<0.1%)
V1	Vangorda Cr u/s all mining activity	Diptera Plecoptera Ephemeroptera		Trichoptera	Hydracarina Other	
V27	Vangorda Cr d/s mining activity & u/s Shrimp Cr	Plecoptera	Diptera Ephemeroptera Trichoptera		Hydracarina	Other
V5	West Fork of Vangorda Cr	Diptera	Trichoptera Plecoptera	Ephemeroptera	Other Hydracarina	
V8	Vangorda Cr approx 500 m u/s Pelly R	Diptera Plecoptera	Ephemeroptera	Hydracarina Trichoptera	Other	

The dominant species in the study area was *Zapada sp.*, a Plecopteran, forming 23.9% of the total number of invertebrates collected. This was followed closely by *Brilla sp.*, at 22.9%.

Zapada sp. are shredders of leaf litter (Merritt and Cummins, 1988). The high numbers recorded in the study area could be due to the provision of leaf litter from the riparian shrubs and trees during the late summer/early fall time of sampling. The *Zapada* population was elevated at all of the sites.

The Dipteran *Brilla sp.* is a member of the Chironomidae Family. Large numbers of *Brilla sp.* were collected in all three baskets at V5 and formed 42% of the population here. *Brilla sp.* are burrowers (Merritt and Cummins, 1988) and the habitat conditions at V5, fine sediments and wood detritus, provided favourable conditions for this organism. *Brilla sp.* were also present at the other sites but were far less abundant.

Ephemeroptera, Trichoptera and Plecoptera are sensitive to most types of pollution (Rosenberg and Resh, 1993) and Lehmkuhl (1979) has identified several groups within these insect orders that have very low tolerance to chemical pollution. Eight taxa (four taxa within Plecoptera, three taxa within Ephemeroptera and one taxa within Trichoptera) were identified in the Vangorda watershed (Table 7).

TABLE 7

Presence (+) and Absence (-) of Sensitive Taxa at Vangorda Creek, 2005

Sensitive Taxa	V1	V27	V5	V8
Plecoptera				
Nemouridae	+	+	+	+
Perlodidae	+	+	+	+
Capniidae	+	+	+	+
Taeniopterigidae	+	+	+	+
Ephemeroptera				
Epeorus	+	+	+	+
Ephemerellidae	+	-	+	+
Rhithrogena	+	+	-	+
Trichoptera				
Rhyacophilidae	+	+	+	+
Total # of sensitive taxa:	8	7	7	8

After Lehmkuhl (1979)

All eight sensitive taxa were recorded at V1 and V8. Seven sensitive taxa were present at V27 and V5. As there appears to be good representation of pollution sensitive species at the Vangorda sites, including the downstream sites, it can be assumed that the water and stream sediments are of good quality for the support of aquatic life.

The above statement appears contradictory to the results presented in Section 4.3. The concentration of lead in the stream sediments at V27 was well over the probable effects level

(PEL). According to CCME (1999), there should be severe adverse effects on the aquatic biota under these conditions. However, very high numbers of the pollution sensitive insect orders were present here.

The benthic community at V27 was dominated by Plecoptera, with Ephemeroptera and Trichoptera as subdominant groups. All of these orders are sensitive to most types of pollution, thus their abundant numbers recorded at this site indicates that the elevated levels of metals documented in the sediments are likely not in a bioavailable form.

4.4.3 Comparisons with Past Data

Benthic invertebrate monitoring has been conducted at the four sites on Vangorda Creek every two years commencing in 1991, as a requirement of the company's water licence. Artificial substrate samplers were used for each survey with a colonization period of five to six weeks. To assess the health of the benthic communities, abundance (total population), diversity (taxonomic richness), taxonomic dominance, and presence of sensitive taxa were examined for each site per year (see Table 8). A healthy benthos community would be characterized by numerous individuals, many different types of organisms and the presence of pollution sensitive species.

The lowest population at each of the sites generally occurred in 1991 (Figure 7). During 1991, the samplers were washed into shore during a flood event leaving the baskets at V5 and V8 only partially submerged (Burns, 1991). Consequently, only the lower portion of each sampler was available for colonization, which may account for the lower populations. Population numbers were also low at all the sites in 1999. Populations fluctuated considerably during the other surveys. Of the eight sampling events, the highest populations were documented at V5 on four occassions and twice each at V5 and V27. V1 generally has had the lowest populations throughout the study period. The highest population recorded to date occurred at V5 in 2001. The variation in total abundance can be attributed to many natural factors such as climate, stream flow, life cycles of the various organisms, timing of the sampling, as well as the chemistry of the water and the stream sediments.

To enable comparisons between the surveys, taxonomic richness was determined by using the lowest common dominator. For example, in 1991 and 1993, some of the insect orders were identified to the family level only. If genera or species were identified within this family in 1995, 1997, 1999, 2001, 2003 and/or in 2005, they were lumped together and considered as one taxon. The total taxonomic richness for 1995, 1997, 1999, 2001, 2003 and 2005 are therefore lower in Table 8 than that determined in the individual studies. These diversity values are graphed in

TABLE 8

COMPARISONS OF BENTHIC DATA FOR THE YEARS 1991, 1993, 1995, 1997, 1999, 2001, 2003 AND 2005

Site	Year	Total Abundance	Taxonomic Richness	Dominant Taxa	Total # of Sensitive Taxa
V1	1991	763	17	Diptera & Ephemeroptera	6
	1993	3,090	19	Diptera & Plecoptera	7
	1995	1,758	26	Plecoptera & Diptera	8
	1997	1,663	29	Diptera & Plecoptera	9
	1999	1,025	20	Diptera & Plecoptera	7
	2001	707	21	Diptera & Plecoptera	9
	2003	1,025	30	Diptera & Plecoptera	7
	2005	5,534	32	Diptera, Plecoptera & Ephemeroptera	8
V27	1991	953	24	Diptera	6
	1993	5,952	17	Plecoptera & Diptera	5
	1995	4,929	28	Plecoptera & Diptera	9
	1997	11,751	29	Diptera & Plecoptera & Ephemeroptera	8
	1999	1,061	23	Diptera & Plecoptera	7
	2001	3,698	24	Plecoptera & Trichoptera	7
	2003	1,301	27	Ephemeroptera & Plecoptera	8
	2005	6,329	28	Plecoptera	7
V5	1991	1,298	29	Diptera	7
	1993	2,193	21	Diptera & Plecoptera	6
	1995	1,550	28	Diptera	8
	1997	9,291	38	Diptera	9
	1999	1,284	32	Diptera & Plecoptera	8
	2001	17,232	40	Plecoptera & Diptera	10
	2003	3,377	42	Plecoptera & Diptera	9
	2005	13,570	35	Diptera	7
V8	1991	594	22	Diptera	6
	1993	3,024	19	Diptera & Plecoptera	6
	1995	8,340	35	Diptera	8
	1997	904	25	Diptera & Plecoptera	6
	1999	1,061	28	Diptera	9
	2001	5,867	28	Diptera	7
	2003	3,989	31	Diptera & Plecoptera	8
	2005	6,687	36	Diptera & Plecoptera	8

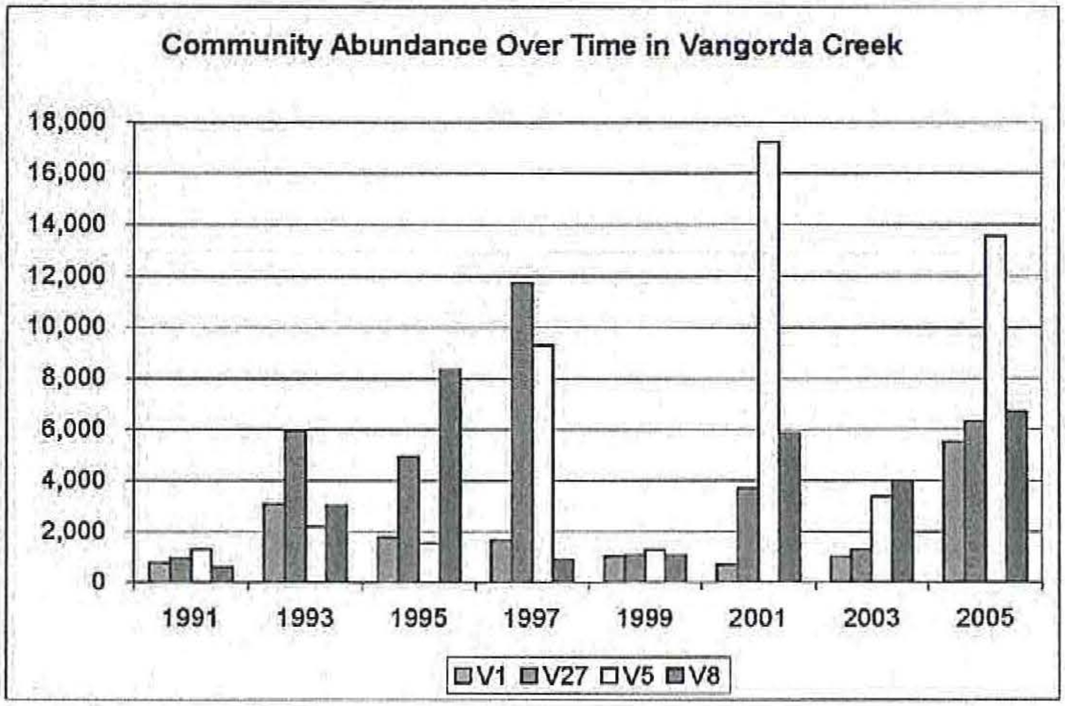

FIGURE 7 **Community Abundance Over Time (1991 to 2005) in Vangorda Creek**

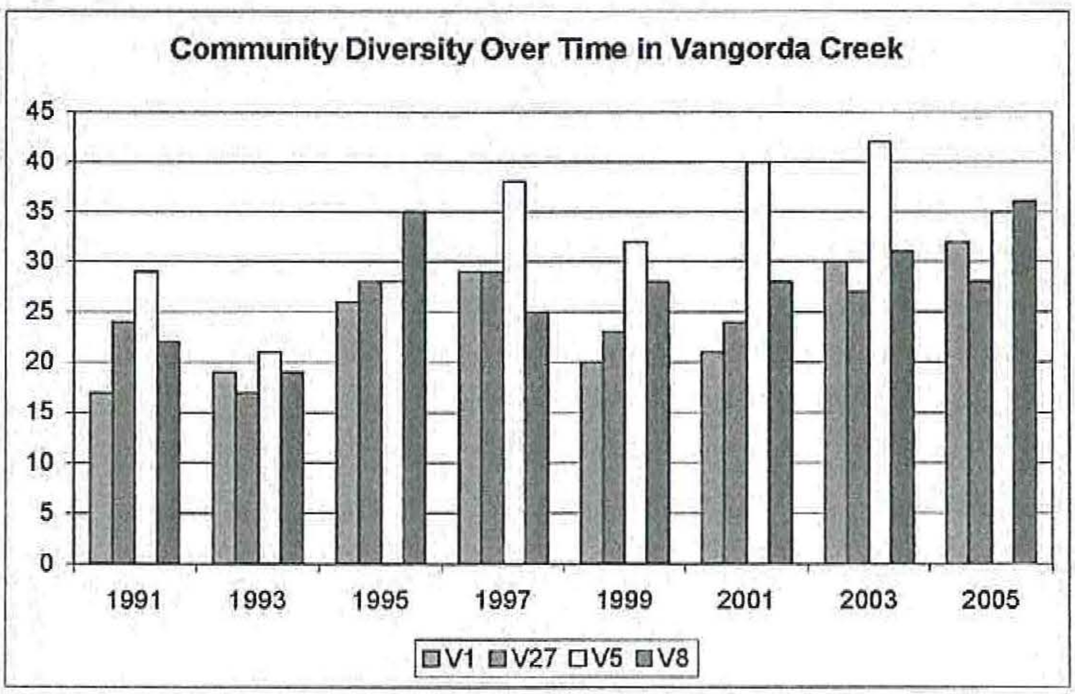

FIGURE 8 **Community Diversity Over Time (1991 to 2005) in Vangorda Creek**

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APPENDIX A

WATER QUALITY DATA

APPENDIX A **WATER CHEMISTRY, JULY 2005**

Client:	Anvil Range Mining Corporation				
Download Date:	7/27/2005				
Project Name:	July 19th, 2005 S.S.F.				
Project Number:					
Chain of Custody:	166613				
Samples received:	7/20/2005				
Sample ID		V-1	V-5	V-8	V27
CANTEST ID		507250046	507250048	507250049	507200349
Date Sampled		7/20/2005	7/19/2005	7/19/2005	7/20/2005
Parameter	Units				
Conventional Parameters					
pH, Laboratory	pH units	7.53	8.32	8.26	
Conductivity	uS/cm	53	384	364	307
Hardness CaCO3	mg/L	23	212	179	151
Hardness (Total) CaCO3	mg/L	23	225	205	159
Total Suspended Solids	mg/L	< 1	41	10	< 1
Total Alkalinity CaCO3	mg/L	22.3	171	117	47.5
Bicarbonate Alkalinity HC(	mg/L	27.2	202	143	57.9
Carbonate Alkalinity CO3	mg/L	< 0.5	2.9	< 0.5	< 0.5
Hydroxide Alkalinity OH	mg/L	< 0.5	< 0.5	< 0.5	< 0.5
Dissolved Sulphate SO4	mg/L	6.9	61.8	99.9	125
Ammonia Nitrogen N	mg/L	0.08	0.01	0.01	< 0.01
Metals Analysis					
Total Mercury Hg	ug/L	< 0.02	< 0.02	< 0.02	< 0.02
Dissolved Aluminum Al	mg/L	0.021	0.027	0.01	0.009
Dissolved Antimony Sb	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Arsenic As	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Barium Ba	mg/L	0.019	0.06	0.044	0.029
Dissolved Beryllium Be	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Bismuth Bi	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Boron B	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
Dissolved Cadmium Cd	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Dissolved Calcium Ca	mg/L	7.56	51.5	45.1	41.6
Dissolved Chromium Cr	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Cobalt Co	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Copper Cu	mg/L	< 0.001	0.001	0.001	0.001
Dissolved Iron Fe	mg/L	< 0.05	0.07	0.07	< 0.05
Dissolved Lead Pb	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Lithium Li	mg/L	< 0.001	0.004	0.004	0.004
Dissolved Magnesium Mg	mg/L	1.09	20.3	16.1	11.4
Dissolved Manganese Mn	mg/L	0.001	0.032	0.016	0.19
Dissolved Mercury Hg	ug/L	< 0.02	< 0.02	< 0.02	
Dissolved Molybdenum M(	mg/L	< 0.0005	0.001	< 0.0005	< 0.0005
Dissolved Nickel Ni	mg/L	< 0.001	0.003	0.001	0.001
Dissolved Phosphorus PO	mg/L	< 0.15	< 0.15	< 0.15	< 0.15
Dissolved Potassium K	mg/L	0.2	0.7	0.6	0.6
Dissolved Selenium Se	mg/L	0.001	< 0.001	< 0.001	< 0.001
Dissolved Silicon SiO2	mg/L	7.3	9.6	8.7	8
Dissolved Silver Ag	mg/L	< 0.00025	< 0.00025	< 0.00025	< 0.00025
Dissolved Sodium Na	mg/L	1.88	3.54	2.6	2.16
Dissolved Strontium Sr	mg/L	0.039	0.22	0.19	0.17
Dissolved Tellurium Te	mg/L	< 0.001	< 0.001	< 0.001	< 0.001

APPENDIX A **WATER CHEMISTRY, JULY 2005**

Sample ID		V-1	V-5	V-8	V27
CANTEST ID		507250046	507250048	507250049	507200349
Date Sampled		7/20/2005	7/19/2005	7/19/2005	7/20/2005
Parameter	Units				
Conventional Parameters					
Dissolved Thallium Tl	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Dissolved Thorium Th	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved Tin Sn	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Titanium Ti	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Uranium U	mg/L	< 0.0005	0.0022	0.0021	0.0009
Dissolved Vanadium V	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Zinc Zn	mg/L	< 0.005	0.007	< 0.005	0.022
Dissolved Zirconium Zr	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
Total Aluminum Al	mg/L	0.032	0.28	0.096	0.026
Total Antimony Sb	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Arsenic As	mg/L	< 0.001	0.001	< 0.001	< 0.001
Total Barium Ba	mg/L	0.021	0.081	0.053	0.031
Total Beryllium Be	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Bismuth Bi	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Boron B	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
Total Cadmium Cd	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Total Calcium Ca	mg/L	7.52	54.6	51.7	43.8
Total Chromium Cr	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Cobalt Co	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Copper Cu	mg/L	< 0.001	0.002	0.001	0.001
Total Iron Fe	mg/L	< 0.05	0.55	0.23	< 0.05
Total Lead Pb	mg/L	< 0.001	0.002	< 0.001	< 0.001
Total Lithium Li	mg/L	< 0.001	0.004	0.005	0.004
Total Magnesium Mg	mg/L	1.09	21.5	18.4	11.9
Total Manganese Mn	mg/L	0.001	0.042	0.028	0.21
Total Molybdenum Mo	mg/L	< 0.0005	0.0008	0.0006	< 0.0005
Total Nickel Ni	mg/L	< 0.001	0.003	0.002	0.001
Total Phosphorus PO4	mg/L	< 0.15	< 0.15	< 0.15	< 0.15
Total Potassium K	mg/L	0.3	0.9	0.8	0.6
Total Selenium Se	mg/L	0.001	< 0.001	< 0.001	< 0.001
Total Silicon SiO2	mg/L	8.2	11	9.9	8.2
Total Silver Ag	mg/L	< 0.00025	< 0.00025	< 0.00025	< 0.00025
Total Sodium Na	mg/L	1.42	3.2	2.69	2.03
Total Strontium Sr	mg/L	0.041	0.23	0.22	0.18
Total Tellurium Te	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Thallium Tl	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Total Thorium Th	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Total Tin Sn	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Titanium Ti	mg/L	< 0.001	0.005	0.003	< 0.001
Total Uranium U	mg/L	< 0.0005	0.0025	0.0024	0.001
Total Vanadium V	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Zinc Zn	mg/L	< 0.005	0.007	0.011	0.031
Total Zirconium Zr	mg/L	< 0.01	< 0.01	< 0.01	< 0.01

APPENDIX A **WATER CHEMISTRY, AUGUST 2005**

Client:	Anvil Range Mining Corporation				
Download Date:	9/12/2005				
Project Name:	Aug 24, 25/05 B. Burns				
Project Number:					
Chain of Custody:	164156				
Samples received:	8/31/2005				
TABLE: Results of WATER Analyses					
Sample ID		V1	V5	V8	V27
CANTEST ID		509010165	509010166	509010167	509010168
Date Sampled		8/25/2005	8/25/2005	8/24/2005	8/25/2005
Parameter	Units				
Conventional Parameters					
Conductivity	uS/cm	10	346	407	287
True Color	CU	5	6	7	< 5
Turbidity	NTU	0.25	4.2	1.4	0.29
Hardness CaCO3	mg/L	29	246	295	177
Hardness (Total) CaCO3	mg/L	29	280	328	200
Total Suspended Solids	mg/L	< 1	7	< 1	< 1
Total Alkalinity CaCO3	mg/L	27.7	196	140	-
Bicarbonate Alkalinity HCO3	mg/L	33.8	231	166	-
Carbonate Alkalinity CO3	mg/L	< 0.5	3.8	2.4	-
Hydroxide Alkalinity OH	mg/L	< 0.5	< 0.5	< 0.5	-
Dissolved Sulphate SO4	mg/L	8.8	78.8	210	147
Ammonia Nitrogen N	mg/L	0.03	0.08	< 0.01	< 0.01
Metals Analysis					
Total Mercury Hg	ug/L	< 0.02	< 0.02	< 0.02	< 0.02
Dissolved Aluminum Al	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
Dissolved Antimony Sb	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Arsenic As	mg/L	< 0.001	0.001	< 0.001	< 0.001
Dissolved Barium Ba	mg/L	0.023	0.068	0.063	0.032
Dissolved Beryllium Be	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Bismuth Bi	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Boron B	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
Dissolved Cadmium Cd	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Dissolved Calcium Ca	mg/L	9.2	58.7	75.8	47.4
Dissolved Chromium Cr	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Cobalt Co	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Copper Cu	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Iron Fe	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
Dissolved Lead Pb	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Lithium Li	mg/L	< 0.001	0.004	0.006	0.004
Dissolved Magnesium Mg	mg/L	1.35	24	25.5	14.3
Dissolved Manganese Mn	mg/L	< 0.001	0.011	0.044	0.081
Dissolved Molybdenum Mo	mg/L	< 0.0005	0.0011	0.0006	< 0.0005
Dissolved Nickel Ni	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Phosphorus PO4	mg/L	< 0.15	< 0.15	< 0.15	< 0.15
Dissolved Potassium K	mg/L	0.3	0.8	0.9	0.6
Dissolved Selenium Se	mg/L	0.002	0.003	0.002	0.001
Dissolved Silicon SiO2	mg/L	8	9.2	8.3	8.3
Dissolved Silver Ag	mg/L	< 0.00025	< 0.00025	< 0.00025	< 0.00025
Dissolved Sodium Na	mg/L	1.53	3.26	3.1	2.24
Dissolved Strontium Sr	mg/L	0.048	0.26	0.34	0.19

APPENDIX A **WATER CHEMISTRY, AUGUST 2005**

Sample ID		V1	V5	V8	V27
CANTEST ID		509010165	509010166	509010167	509010168
Date Sampled		8/25/2005	8/25/2005	8/24/2005	8/25/2005
Parameter	Units				
Conventional Parameters					
Dissolved Tellurium Te	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Thallium Tl	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Dissolved Thorium Th	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved Tin Sn	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Titanium Ti	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Uranium U	mg/L	< 0.0005	0.0032	0.0034	0.0015
Dissolved Vanadium V	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Zinc Zn	mg/L	< 0.005	< 0.005	0.005	0.018
Dissolved Zirconium Zr	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
Total Aluminum Al	mg/L	0.013	0.15	0.13	0.01
Total Antimony Sb	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Arsenic As	mg/L	< 0.001	0.001	0.001	0.001
Total Barium Ba	mg/L	0.025	0.079	0.071	0.037
Total Beryllium Be	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Bismuth Bi	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Boron B	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
Total Cadmium Cd	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Total Calcium Ca	mg/L	9.36	69.3	85.7	54.7
Total Chromium Cr	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Cobalt Co	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Copper Cu	mg/L	< 0.001	0.001	0.024	< 0.001
Total Iron Fe	mg/L	< 0.05	0.25	< 0.05	< 0.05
Total Lead Pb	mg/L	< 0.001	< 0.001	0.002	< 0.001
Total Lithium Li	mg/L	< 0.001	0.004	0.006	0.004
Total Magnesium Mg	mg/L	1.31	25.9	27.5	15.3
Total Manganese Mn	mg/L	< 0.001	0.031	0.061	0.11
Total Molybdenum Mo	mg/L	< 0.0005	0.0013	0.0007	< 0.0005
Total Nickel Ni	mg/L	< 0.001	0.002	0.002	< 0.001
Total Phosphorus PO4	mg/L	< 0.15	< 0.15	< 0.15	< 0.15
Total Potassium K	mg/L	0.3	1.1	1.2	0.8
Total Selenium Se	mg/L	0.002	0.003	0.003	0.003
Total Silicon SiO2	mg/L	7.1	10.3	8.1	8.3
Total Silver Ag	mg/L	< 0.00025	< 0.00025	< 0.00025	< 0.00025
Total Sodium Na	mg/L	1.53	3.63	3.4	2.49
Total Strontium Sr	mg/L	0.049	0.29	0.35	0.22
Total Tellurium Te	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Thallium Tl	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Total Thorium Th	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Total Tin Sn	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Titanium Ti	mg/L	< 0.001	0.004	0.001	< 0.001
Total Uranium U	mg/L	< 0.0005	0.0029	0.003	0.0014
Total Vanadium V	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Zinc Zn	mg/L	< 0.005	< 0.005	0.05	0.02
Total Zirconium Zr	mg/L	< 0.01	< 0.01	< 0.01	< 0.01

APPENDIX B

STREAM SEDIMENT DATA

STREAM SEDIMENT DATA, 20[illegible]

Sample ID	pH pH units	Antimony ug/g	Arsenic ug/g	Barium ug/g	Beryllium ug/g	Cadmium ug/g	Chromium ug/g	Cobalt ug/g	Copper ug/g	Lead ug/g	Mercury ug/g	Molybdenum ug/g	Nickel ug/g	Selenium ug/g	Silver ug/g	Tin ug/g
V1-A	7.1	< 10	< 10	49	< 1	< 0.5	13	8	19	22	< 0.01	< 4	14	< 0.2	< 2	< 5
V1-B	6.7	< 10	< 10	96	< 1	< 0.5	25	11	18	22	0.02	< 4	25	0.3	< 2	< 5
V1-C	6.9	< 10	< 10	56	< 1	< 0.5	13	10	14	14	0.01	< 4	17	< 0.2	< 2	< 5
Mean:	**6.9**	**N.D.**	**N.D.**	**67.0**	**N.D.**	**N.D.**	**17.0**	**9.7**	**17.0**	**19.3**	**0.02**	**N.D.**	**18.7**	**0.30**	**N.D.**	**N.D.**
S.D.:	**0.2**	**N.D.**	**N.D.**	**25.4**	**N.D.**	**N.D.**	**6.9**	**1.5**	**2.6**	**4.6**	**0.01**	**N.D.**	**5.7**		**N.D.**	**N.D.**
V5-A	8	< 10	11	165	< 1	0.9	54	14	27	22	0.04	< 4	68	0.7	< 2	< 5
V5-B	8.1	< 10	< 10	109	< 1	0.9	41	13	22	20	0.03	< 4	66	0.6	< 2	< 5
V5-C	8.1	< 10	< 10	139	< 1	0.8	59	14	26	20	0.04	< 4	77	0.7	< 2	< 5
Mean:	**8.07**	**N.D.**	**11.0**	**137.7**	**N.D.**	**0.87**	**51.3**	**13.7**	**25.0**	**20.7**	**0.04**	**N.D.**	**70.3**	**0.67**	**N.D.**	**N.D.**
S.D.:	**0.06**	**N.D.**		**28.0**	**N.D.**	**0.06**	**9.3**	**0.6**	**2.6**	**1.2**	**0.01**	**N.D.**	**5.9**	**0.06**	**N.D.**	**N.D.**
V27-A	7.6	< 10	27	121	< 1	1	39	16	40	267	0.18	< 4	38	0.3	< 2	< 5
V27-B	7.2	< 10	23	83	< 1	1	40	15	31	114	0.05	< 4	38	0.3	< 2	< 5
V27-C	7.2	< 10	23	113	< 1	0.9	42	15	38	183	0.08	< 4	40	0.3	< 2	< 5
Mean:	**7.33**	**N.D.**	**24.3**	**105.7**	**N.D.**	**1.0**	**40.3**	**15.3**	**36.3**	**188.0**	**0.10**	**N.D.**	**38.7**	**0.30**	**N.D.**	**N.D.**
S.D.:	**0.23**	**N.D.**	**2.3**	**20.0**	**N.D.**	**0.1**	**1.5**	**0.6**	**4.7**	**76.6**	**0.07**	**N.D.**	**1.2**	**0.00**	**N.D.**	**N.D.**
V8-A	7.5	< 10	13	119	< 1	0.9	52	14	35	70	0.06	< 4	53	0.5	< 2	< 5
V8-B	7.6	< 10	14	152	< 1	0.9	53	14	34	83	0.08	< 4	52	0.7	< 2	< 5
V8-C	7.5	< 10	15	129	< 1	0.9	46	15	35	71	0.06	< 4	53	0.6	< 2	< 5
Mean:	**7.53**	**N.D.**	**14.0**	**133.3**	**N.D.**	**0.90**	**50.3**	**14.3**	**34.7**	**74.7**	**0.07**	**N.D.**	**52.7**	**0.60**	**N.D.**	**N.D.**
S.D.:	**0.06**	**N.D.**	**1.0**	**16.9**	**N.D.**	**0.00**	**3.8**	**0.6**	**0.6**	**7.2**	**0.01**	**N.D.**	**0.6**	**0.10**	**N.D.**	**N.D.**

Sample ID	Vanadium ug/g	Zinc ug/g	Aluminum ug/g	Boron ug/g	Calcium ug/g	Iron ug/g	Iron %	Magnesium ug/g	Manganese ug/g	Phosphorus ug/g	Potassium ug/g	Sodium ug/g	Strontium ug/g	Titanium ug/g	Zirconium ug/g
V1-A	13	49	8000	< 1	1350	13800	1.4	3330	280	279	559	83	8	94	2
V1-B	20	76	13600	< 1	2510	17500	1.8	4990	391	522	1110	124	18	209	1
V1-C	14	54	8240	< 1	1410	15300	1.5	3700	335	380	533	55	13	112	2
Mean:	**15.7**	**59.7**	**9947**	**N.D.**	**1757**	**15533**	**1.6**	**4007**	**335.3**	**393.7**	**734.0**	**87.3**	**13.0**	**138.3**	**1.67**
S.D.:	**3.8**	**14.4**	**3166**	**N.D.**	**653**	**1861**	**0.19**	**871**	**55.5**	**122.1**	**325.9**	**34.7**	**5.0**	**61.9**	**0.58**
V5-A	26	92	10200	< 1	20300	16300	1.6	11500	479	1210	501	114	67	135	3
V5-B	26	80	9890	< 1	19500	17000	1.7	11700	456	832	401	114	61	128	3
V5-C	25	87	9970	< 1	18500	16700	1.7	12100	422	614	425	114	52	153	3
Mean:	**25.7**	**86.3**	**10020**	**N.D.**	**19433**	**16667**	**1.7**	**11767**	**452.3**	**885.3**	**442.3**	**114.0**	**60.0**	**138.7**	**3.00**
S.D.:	**0.6**	**6.0**	**161**	**N.D.**	**902**	**351**	**0.04**	**306**	**28.7**	**301.6**	**52.2**	**0.0**	**7.5**	**12.9**	**0.00**
V27-A	21	312	12500	< 1	9140	20200	2.0	7910	806	496	497	81	34	148	3
V27-B	22	261	13800	< 1	8770	20000	2.0	8650	664	455	403	84	34	117	3
V27-C	22	291	12600	< 1	9100	19900	2.0	8270	620	882	442	89	34	123	3
Mean:	**21.7**	**288.0**	**12967**	**N.D.**	**9003**	**20033**	**2.0**	**8277**	**696.7**	**611.0**	**447.3**	**84.7**	**34.0**	**129.3**	**3.00**
S.D.:	**0.6**	**25.6**	**723**	**N.D.**	**203**	**153**	**0.02**	**370**	**97.2**	**235.6**	**47.2**	**4.0**	**0.0**	**16.4**	**0.00**
V8-A	24	199	11500	< 1	10200	18900	1.9	9650	568	671	541	88	38	140	3
V8-B	27	189	11400	< 1	11700	19100	1.9	10200	582	735	472	82	41	159	3
V8-C	24	189	11000	< 1	10100	19100	1.9	9340	549	678	561	83	36	140	3
Mean:	**25.0**	**192.3**	**11300**	**N.D.**	**10667**	**19033**	**1.9**	**9730**	**566.3**	**694.7**	**524.7**	**84.3**	**38.3**	**146.3**	**3.00**
S.D.:	**1.7**	**5.8**	**265**	**N.D.**	**896**	**115**	**0.01**	**436**	**16.6**	**35.1**	**46.7**	**3.2**	**2.5**	**11.0**	**0.00**

APPENDIX C

BENTHIC INVERTEBRATE DATA

APPENDIX C

BENTHIC INVERTEBRAE DATA, VANGORDA CREEK, 2005

	V1a	V1b	V1c	V5a	V5b	V5c	V8a	V8b	V8c	V27a	V27b	V27c	Totals	%
PHYLUM ARTHROPODA														
Class Insecta														
Order Ephemeroptera														
Family Siphlonuridae														
Ameletus sp	5												5	0.02
Family Baetidae														
Baetis sp	77	1243	69	321	177	80	193	60	396	450	153	116	3335	10.38
Family Heptageniidae														
Cinygmula sp	24	7	13			18	3	21	3	150	5	68	312	0.97
Epeorus (Iron) sp	2	14	2	3	3	4	1		1	2		1	33	0.10
Rhithrogena sp	17	13	21				1		1	1			54	0.17
Family Ephemerellidae														
Drunella grandis								1					1	0.00
Ephemerellidae J	1					16			8				25	0.08
Order Plecoptera														
Family Capniidae														
Capnia sp	2			16	1	22	187	23	110	16	16	24	417	1.30
Family Perlodidae														
Isoperla sp		1	1		1		1		1	1			6	0.02
Megarcys sp	2	1	2		1		1			2			9	0.03
Skwala paralella			1										1	0.00
Sweltsa sp group						1			1	1			3	0.01
Family Taeniopterygidae														
Taenionema sp	5	33	6	17	34	6	104	19	84	58			366	1.14
Family Nemouridae														
Zapada sp	166	1210	223	493	267	642	541	74	584	1497	977	1010	7686	23.93
Order Trichoptera														
Trichoptera Unid J	1					1	1			1			4	0.01
Trichoptera P				1									1	0.00
Family Hydropsychidae														
Arctopsyche sp	14	185	64	441	315	226	20		10	144	122	108	1649	5.13
Family Limnephilidae														
Ecclisomyia sp				1	1				1	8	8		19	0.06
Family Hydroptilidae														
Hydroptila sp								1					1	0.00
Family Rhyacophilidae														
Rhyacophilidae Juv			1	32	82	128	10	1	9	88	68	80	499	1.55
Rhyacophila (acropedes or vao)	4	15	8	61	92	171	10	1	3	19	12	13	409	1.27
Rhyacophila hyalinata		2	4	17	1	2	2	2	4	18	2	13	67	0.21
Order Diptera														
Diptera Unid A			2										2	0.01
Chironomidae A				1				1					2	0.01
Family Chironomidae														
Chironomidae P	5	22	5	17	66	2	59	9	71	1	9		265	0.83
Chironomidae L	45	634	72	576	370	563	105	15	185	106	120	122	2913	9.07
Sub Family Orthocladinae														
Brillia sp	43	405	41	1667	1920	2079	666	27	342	68	42	59	7359	22.91
Cardiocladius sp	9	199	26	17		1	8		16	24	26	17	343	1.07
Corynoneura sp	2	16					8		8				34	0.11
Cricotopus sp	20	192	25	138	323	373	907	202	679	66	19	84	3228	10.05
Eukiefferiella sp	22	120	12	148	145	146	137	16	83	80	24	34	967	3.01
Euryhapsis sp	2						8	1					11	0.03
Synorthocladius sp					16			1	9				26	0.08
Thienemanniella sp							8	1	16	8			33	0.10
Family Diamesinae														
Diamesa sp		35	2	35	16	2	2	3	1		8		104	0.32
Sub Family Chironominae														
Micropsectra sp							8						8	0.02
Family Empididae														
Empididae P									1				1	0.00
Chelifera sp				16	64	16	8	1					105	0.33
Weidemannia sp										10	8	9	27	0.08
Family Psychodidae														
Pericoma sp				56	22	49	2		2	1			132	0.41
Family Simulidae														
Cnephia sp L				16	64	16	8	1			16		121	0.38
Prosimulium sp L	6	46	6	211	177	278	52	7	89	25	40	33	970	3.02
Prosimulium sp P						2	2		2				6	0.02
Simulium sp L		8					10	1	1	1	1		22	0.07
Family Tipulidae														
Dicranota sp				2	17	67	17						103	0.32

U = unidentified J = juvenile L = larvae A = adult P = pupae Dam = damaged

APPENDIX C **BENTHIC INVERTEBRAE DATA, VANGORDA CREEK, 2005**

	V1a	V1b	V1c	V5a	V5b	V5c	V8a	V8b	V8c	V27a	V27b	V27c	Totals	%
Order Collembola														
Collembola Unid dam				1									1	0.00
Isotomurus sp			2		16								18	0.06
Order Homoptera														
Family Aphididae		1	1	1									3	0.01
Family Cicadellidae							1						1	0.00
Order Hymenoptera														
Family Formicidae		1										1	2	0.00
Order Lepidoptera L					1								1	0.00
Order Thysanoptera		1											1	0.00
Class Arachnida														
Order Aranaea												1	1	0.00
Order Hydracarina														
Hydracarina Unid J	1	8	1					1	16				27	0.08
Lebertia sp										1			1	0.00
Sperchon sp	1	8	2				1	4		2		2	20	0.06
Unioncola sp		16	5		16	48	48	16	88	8	1		248	0.77
Oribatei			1										1	0.00
PHYLUM ANNELIDA														
Class Oligochaeta														
Order Haplotaxidae														
Family Enchytraeidae								1	9				10	0.03
Family Tubificidae				1	1								2	0.01
PHYLUM NEMATODA	1	1		32	1	64							99	0.31
Total per sample:	479	4437	618	4338	4209	5023	3140	513	3034	2857	1677	1795	32120	
Total per site:	5534			13570			6687			6329				
Taxonomic Richness per sample:	25	28	28	28	29	28	35	28	33	30	21	19		
Taxonomic Richness per site:	38			39			45			34				