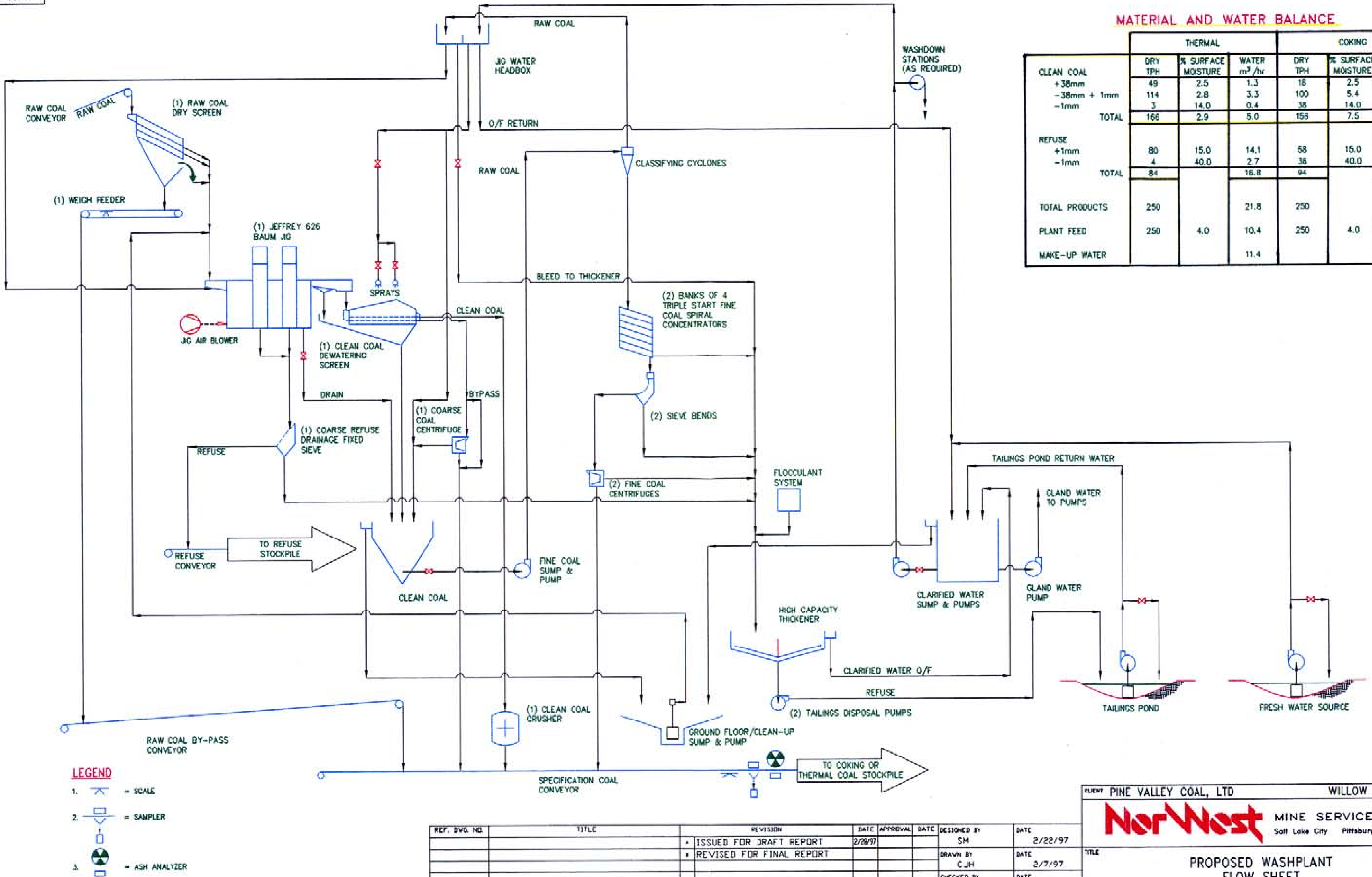
FIGURES

PLANT SITE DRAWINGS

DRAWING NO.
1942-SC-01



MATERIAL AND WATER BALANCE

	THERMAL			COKING		
	DRY TPH	% SURFACE MOISTURE	WATER m^3/hr	DRY TPH	% SURFACE MOISTURE	WATER m^3/hr
CLEAN COAL						
+38mm	49	2.5	1.3	18	2.5	0.5
-38mm + 1mm	114	2.8	3.3	100	5.4	5.7
-1mm	3	14.0	0.4	38	14.0	6.2
TOTAL	166	2.9	5.0	156	7.5	12.4
REFUSE						
+1mm	80	15.0	14.1	58	15.0	10.2
-1mm	4	40.0	2.7	36	40.0	24.0
TOTAL	84		16.8	94		34.2
TOTAL PRODUCTS	250		21.8	250		46.6
PLANT FEED	250	4.0	10.4	250	4.0	10.4
MAKE-UP WATER			11.4			36.2

REF. DWG. NO.	TITLE		REVISION	DATE	APPROVAL	DATE
		•	ISSUED FOR DRAFT REPORT	2/28/97		
		•	REVISED FOR FINAL REPORT			

DESIGNED BY SH DATE 2/22/97
DRAWN BY CJH DATE 2/7/97
CHECKED BY DATE
APPROVED BY DATE

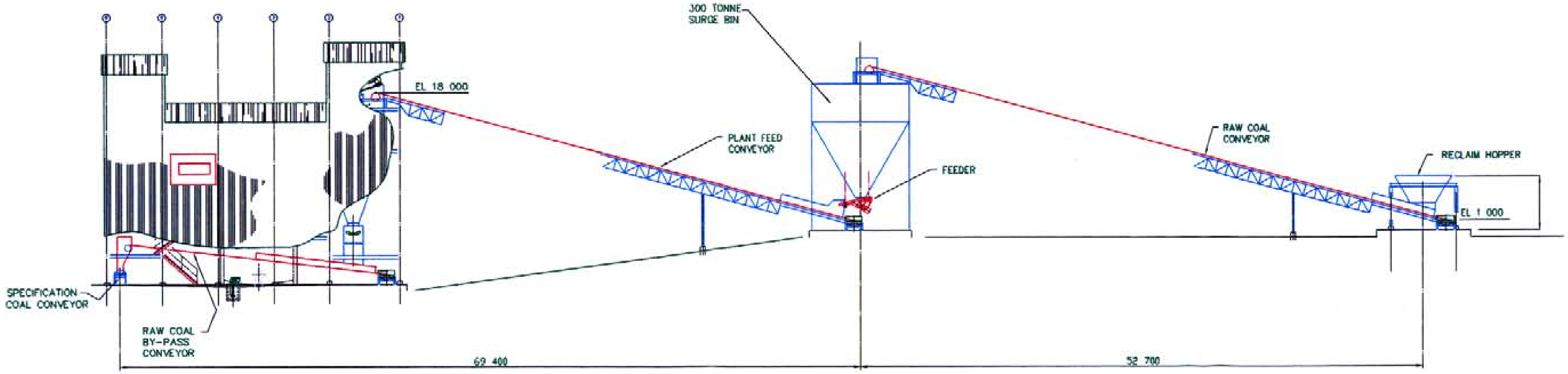
CLIENT PINE VALLEY COAL, LTD WILLOW CREEK MINE

NorWest MINE SERVICES, INC.
Salt Lake City Pittsburgh Calgary

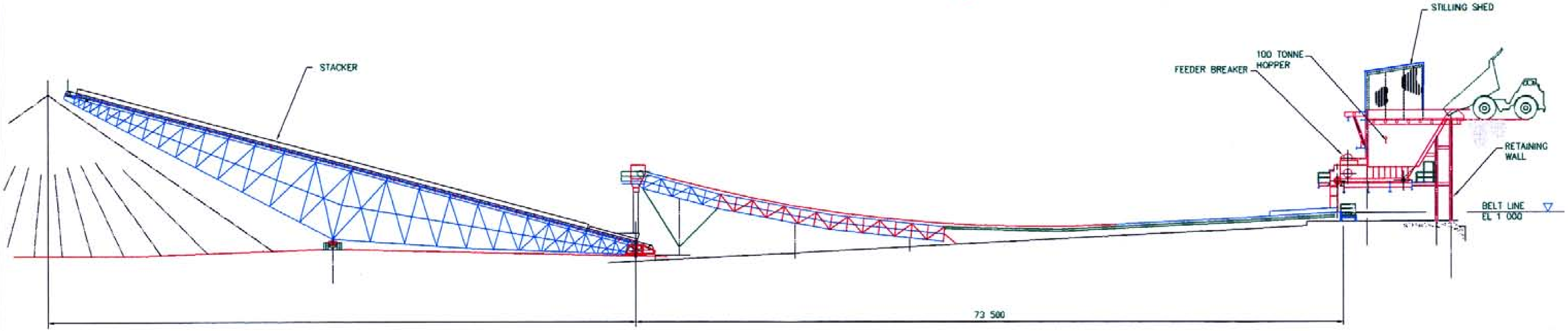
TITLE
PROPOSED WASHPLANT
FLOW SHEET

SCALE NTS
ISSUED
DRAWING NO. 1942-SC-01
REV. B

DRAWING NO.
1942-SC-06



SECTION (B) SC-03



0 2 4 6 8 10 20
(METERS)

SECTION (A) SC-03

REF. DWG. NO.	TITLE	REVISION	DATE	APPROVAL	DATE
		A ISSUED FOR CLIENT REVIEW	2/3/97		
		B ISSUED FOR DRAFT REPORT	2/28/97		
		C ISSUED FOR FINAL REPORT			

DESIGNED BY	DATE
DB	
DRAWN BY	**DATE**
CJH	1/22/97
CHECKED BY	**DATE**
APPROVED BY	**DATE**

CLIENT PINE VALLEY COAL LTD. WILLOW CREEK MINE

NorWest MINE SERVICES, INC.
Salt Lake City Pittsburgh Calgary

TITLE
NEW MINE DEVELOPMENT
MATERIAL HANDLING FACILITIES – TRUCK DUMP, STOCKPILE AND PLANT FEED CONVEYORS

SCALE 1 : 400
ISSUED
DRAWING NO. 1942-SC-06
REV. C

FIGURES

FIGURE 1.5-1
CONCEPTUAL DEVELOPMENT SCHEDULE
Willow Creek Project

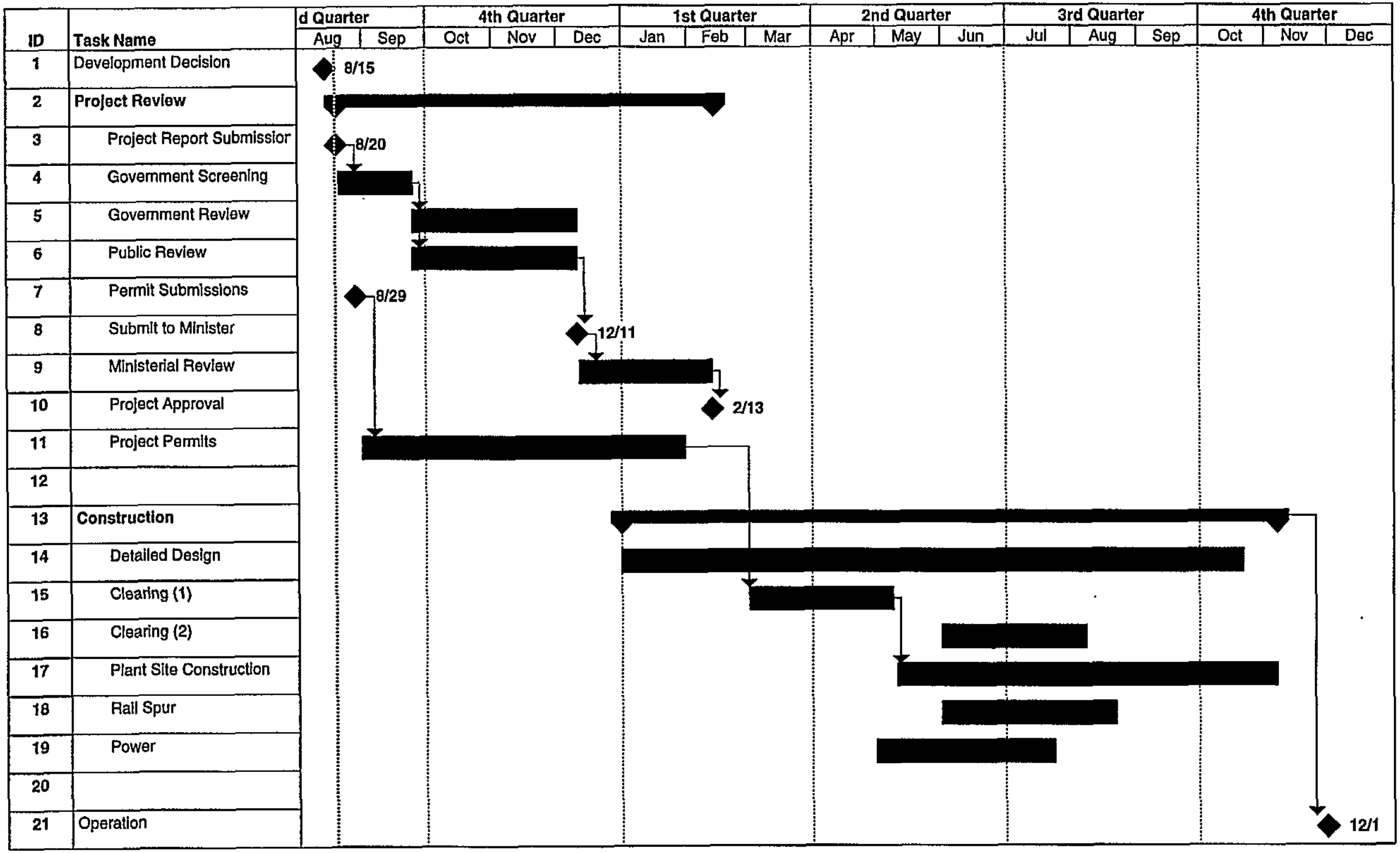
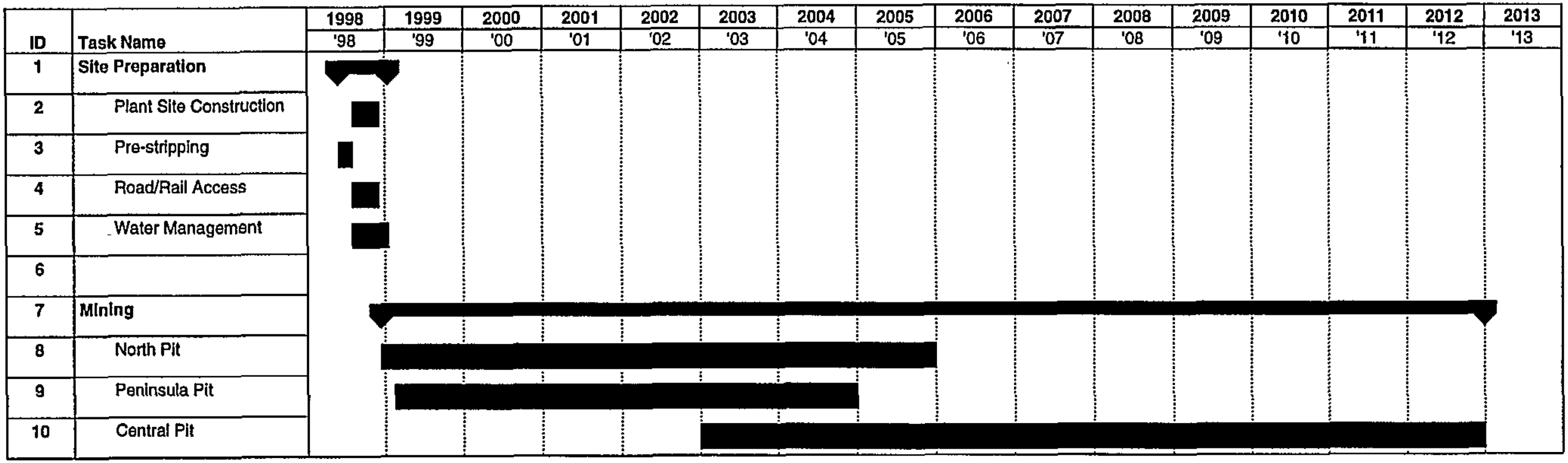
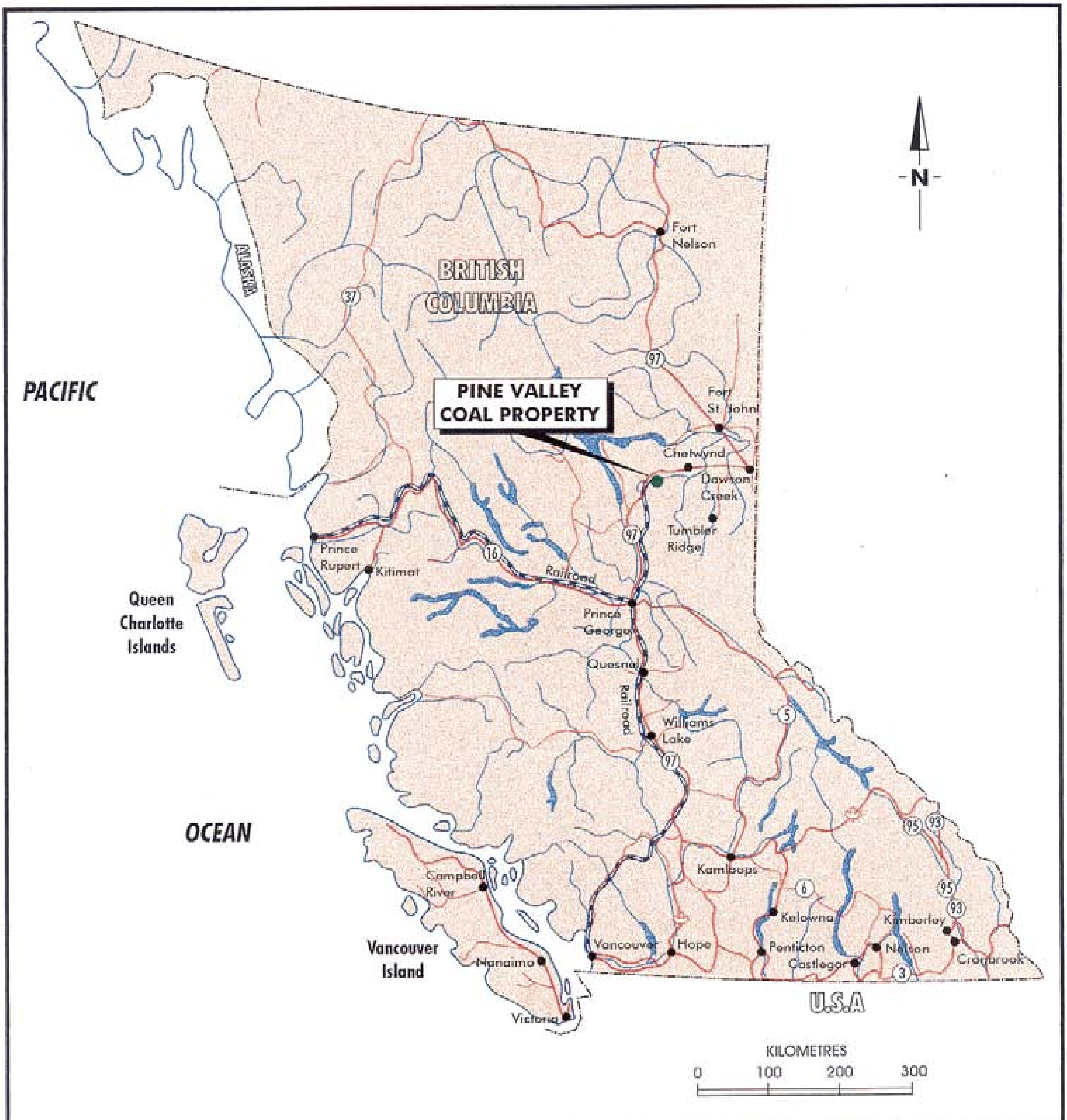


FIGURE 1.5-2
CONCEPTUAL MINE CONSTRUCTION AND OPERATION SCHEDULE
Willow Creek Project





WILLOW CREEK PROJECT
LOCATION MAP

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

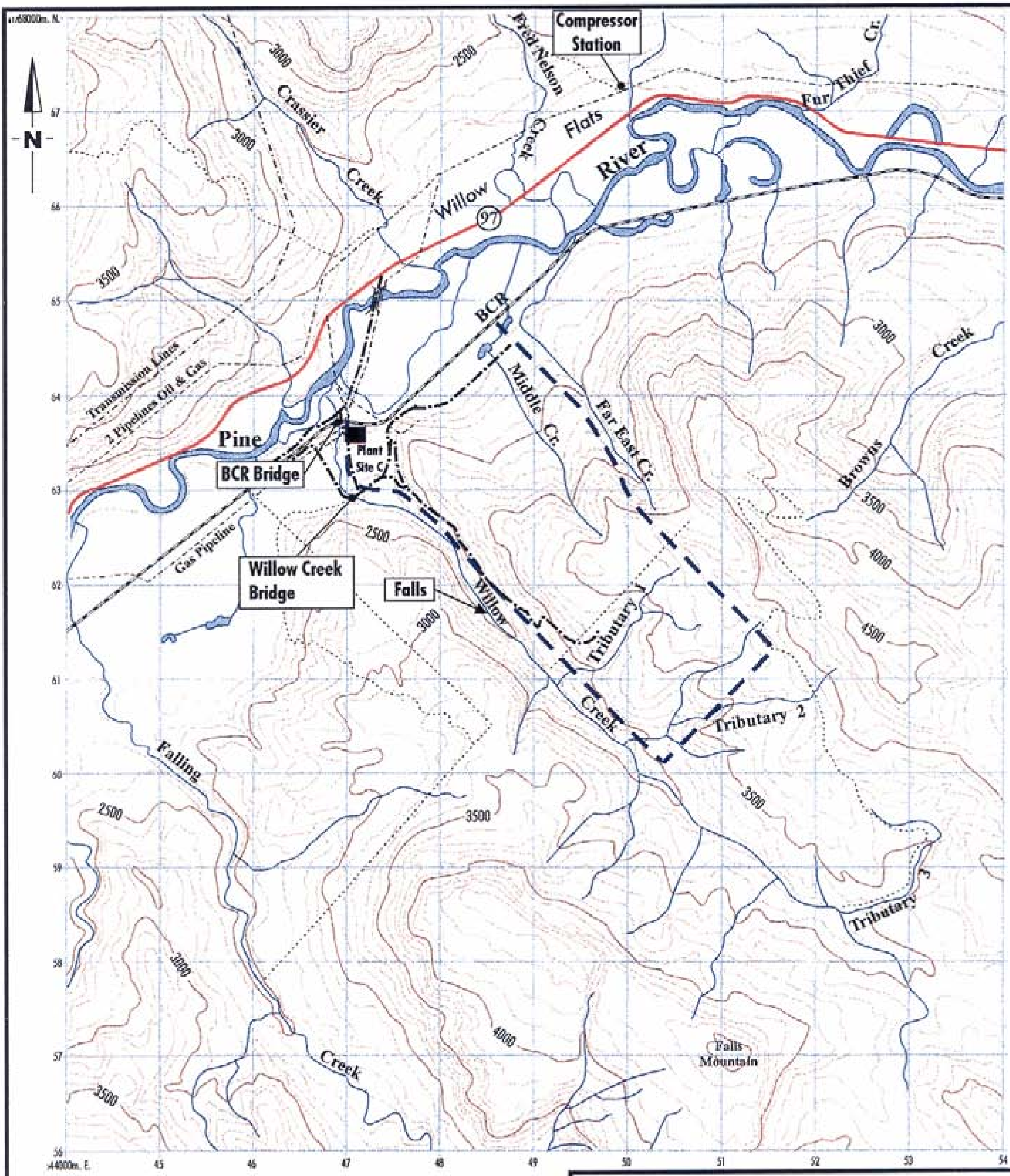
PINE VALLEY COAL LTD.

JUNE 1997

FIGURE 1.2-1

NORECOL DAMES & MOORE
GROUP A DAMES & MOORE SUBSIDIARY

NDM-33079-001-cdr-f1 1sl



LEGEND

Willow Creek Project Area	— —
Highway	—
Mine Road	—·—·—

METRES
0 1000 2000

NORECOL DAMES & MOORE

GROUP A DAMES & MOORE SUBSIDIARY

NDM-33079-001-cdr-f07ra

ROAD ACCESS TO PROJECT SITE

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

PINE VALLEY COAL LTD.

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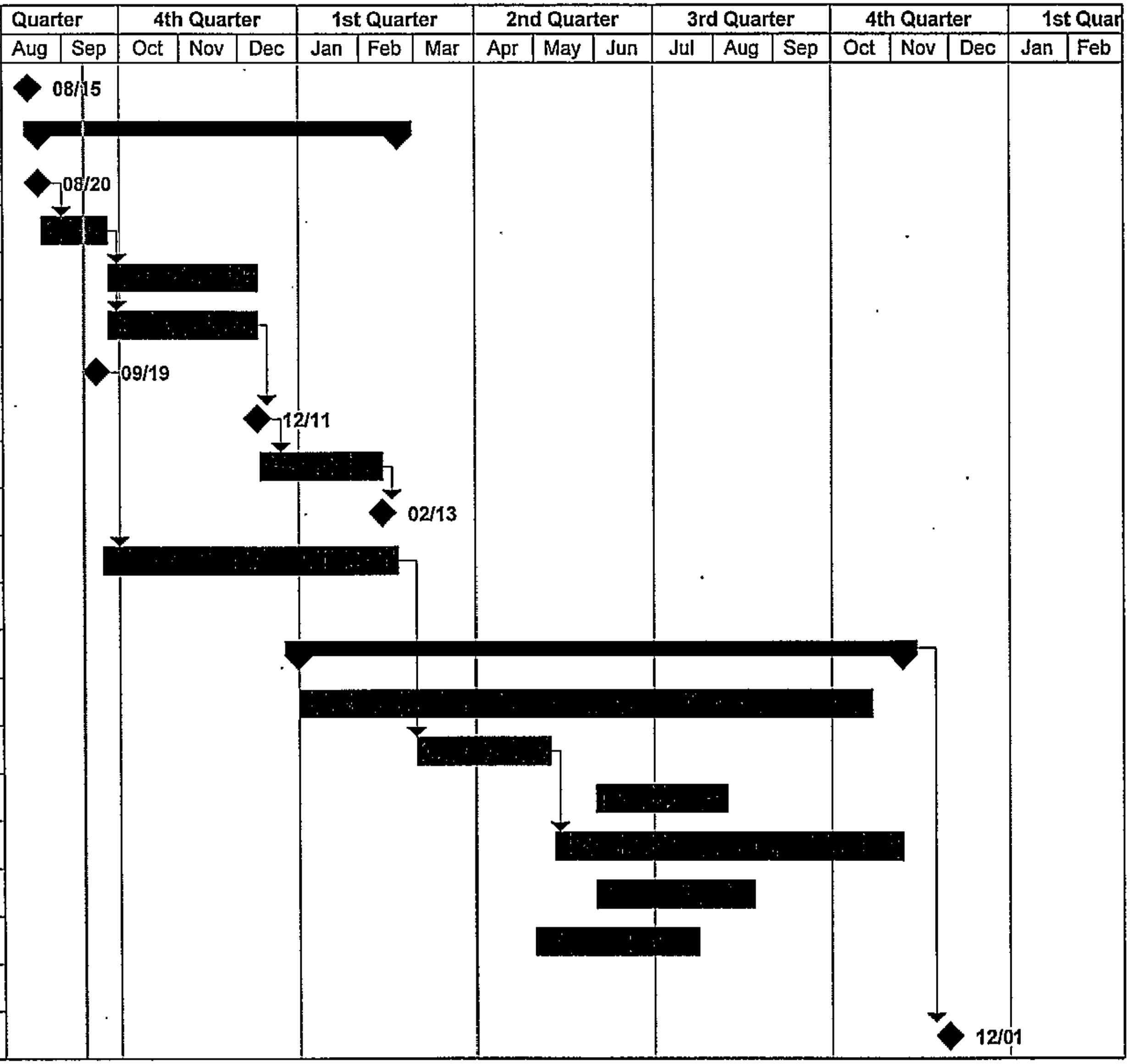
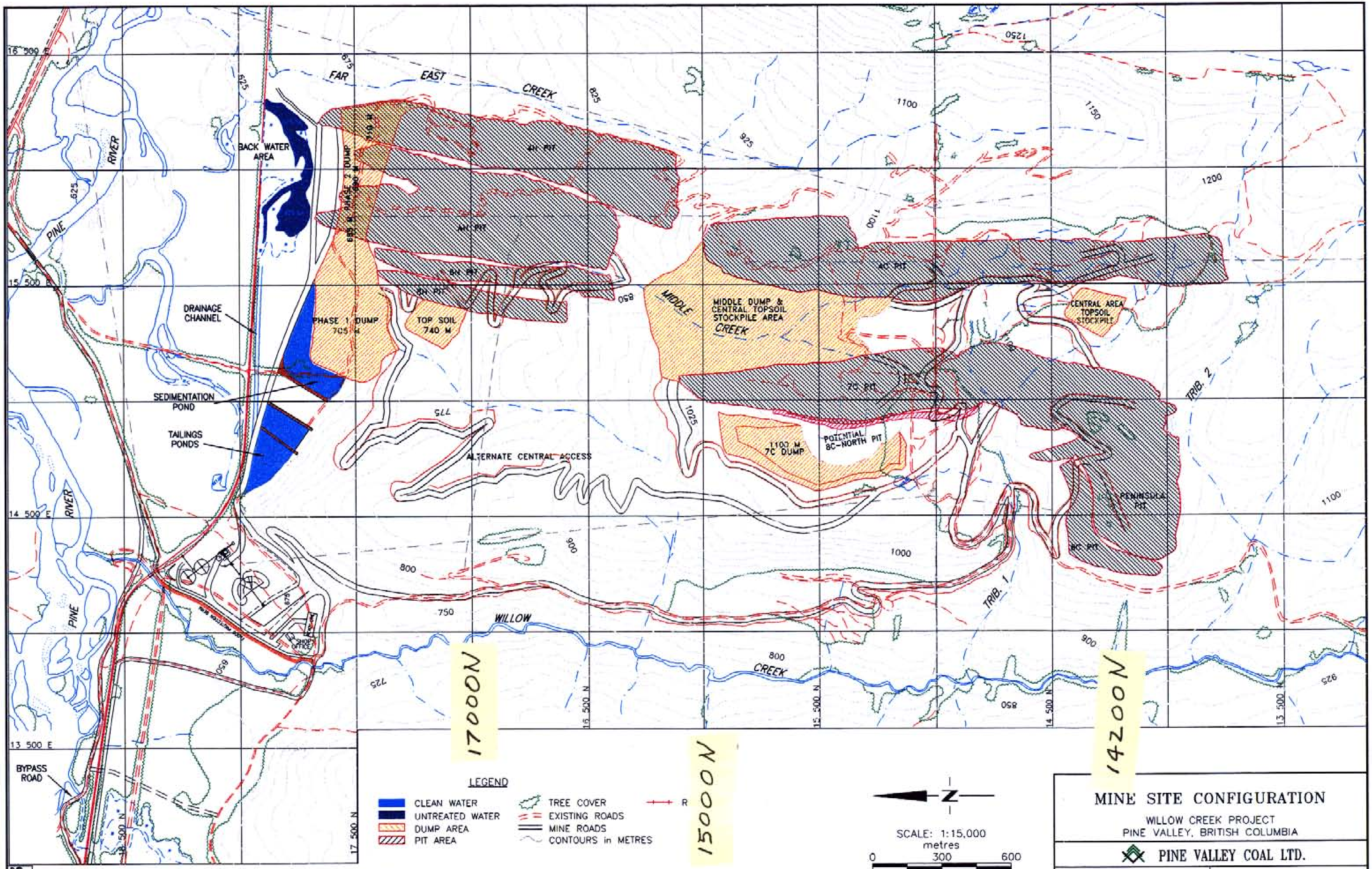
FIGURE 1.2-2

FIGURE 1.5-1
CONCEPTUAL DEVELOPMENT SCHEDULE
Willow Creek Project

ID	Task Name	Duration	Start
1	Development Decision	1d	Fri 97/08/15
2	**Project Review**	**133d**	**Wed 97/08/20**
3	Project Report Submissio	1d	Wed 97/08/20
4	Government Screening	25d	Thu 97/08/21
5	Government Review	55d	Thu 97/09/25
6	Public Review	55d	Thu 97/09/25
7	Permit Submissions	1d	Fri 97/09/19
8	Submit to Minister	1d	Thu 97/12/11
9	Ministerial Review	45d	Fri 97/12/12
10	Project Approval	1d	Fri 98/02/13
11	Project Permits	110d	Mon 97/09/22
12			
13	**Construction**	**222d**	**Thu 98/01/01**
14	Detailed Design	210d	Thu 98/01/01
15	Clearing (1)	50d	Mon 98/03/02
16	Clearing (2)	50d	Mon 98/06/01
17	Plant Site Construction	130d	Mon 98/05/11
18	Rail Spur	60d	Mon 98/06/01
19	Power	60d	Fri 98/05/01
20			
21	Operation	1d	Tue 98/12/01





NORECOL DAMES & MOORE and NORWEST MINE SERVICES

GROUP A DAMES & MOORE SUBSIDIARY

NDM-33079-001-newaug97-fig21-1

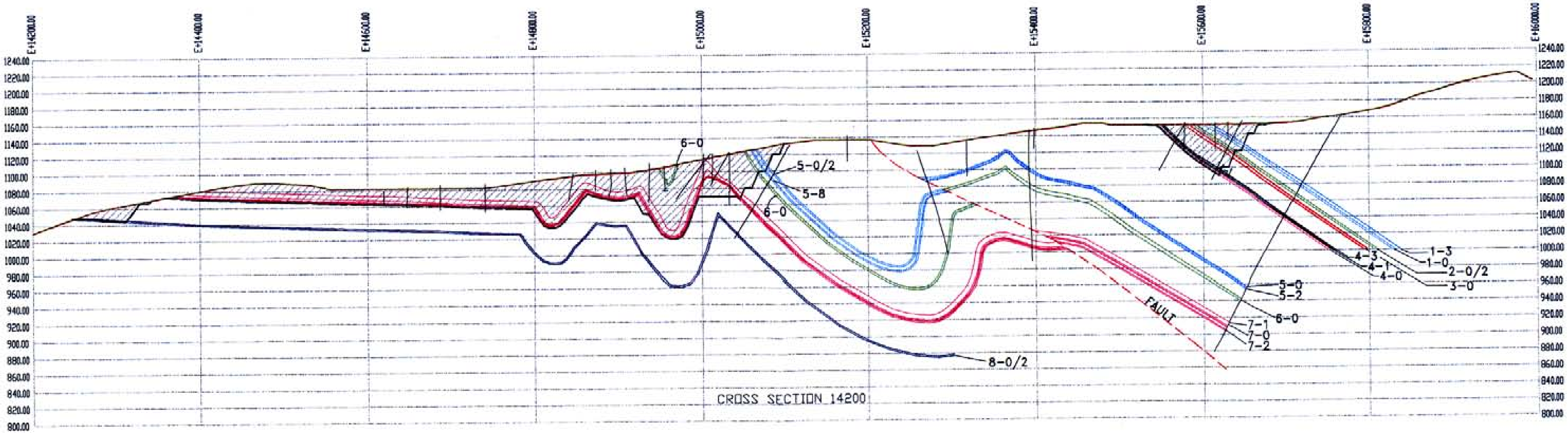
MINE SITE CONFIGURATION

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

PINE VALLEY COAL LTD.

AUGUST 1997

FIGURE 2.1-1



LEGEND

▨ Pit

8-0 Seam Number

N

SCALE: 1:5000
metres
0 100 200

NDM-33079-001-newaug97-fig22-1

WILLOW CENTRAL

SECTION 14200N

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

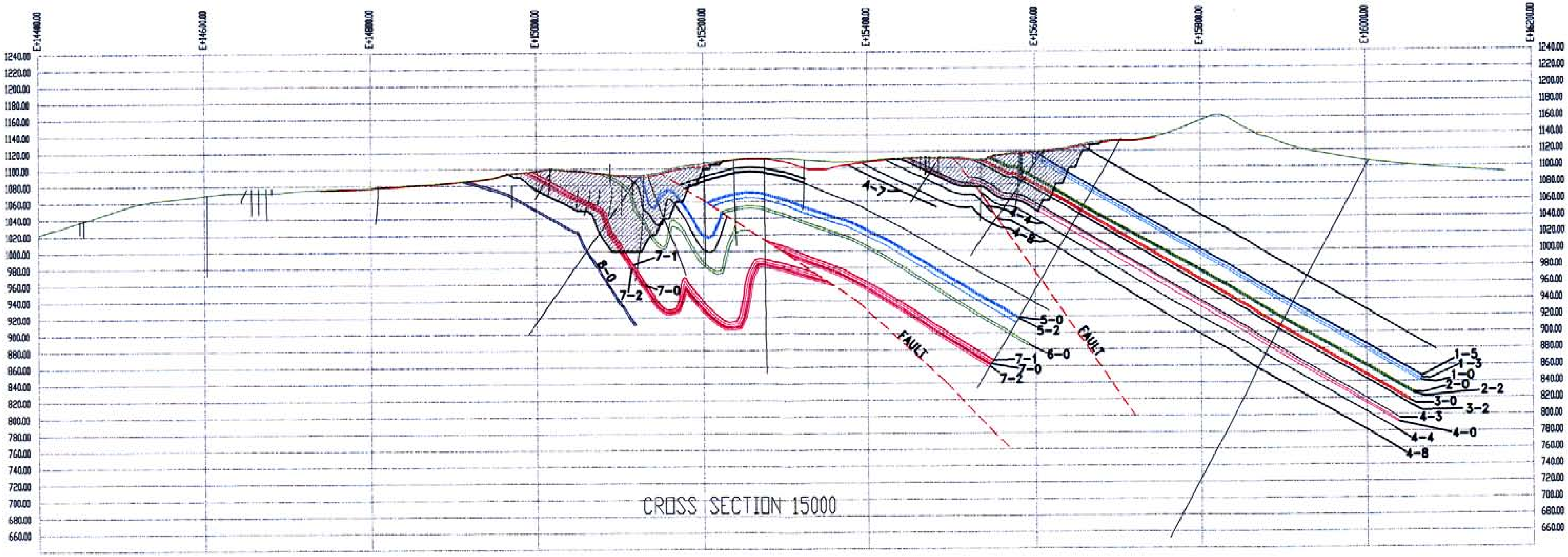
PINE VALLEY COAL LTD.

AUGUST 1997

FIGURE 2.2-1

NORECOL DAMES & MOORE and NORWEST MINE SERVICES

GROUP A DAMES & MOORE SUBSIDIARY



LEGEND

▨ Pit

5–0 Seam Number

N

SCALE: 1:5000
metres
0 100 200

NDM-33079-001-newaug97-fig22-2

WILLOW CENTRAL
SECTION 15000N
WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

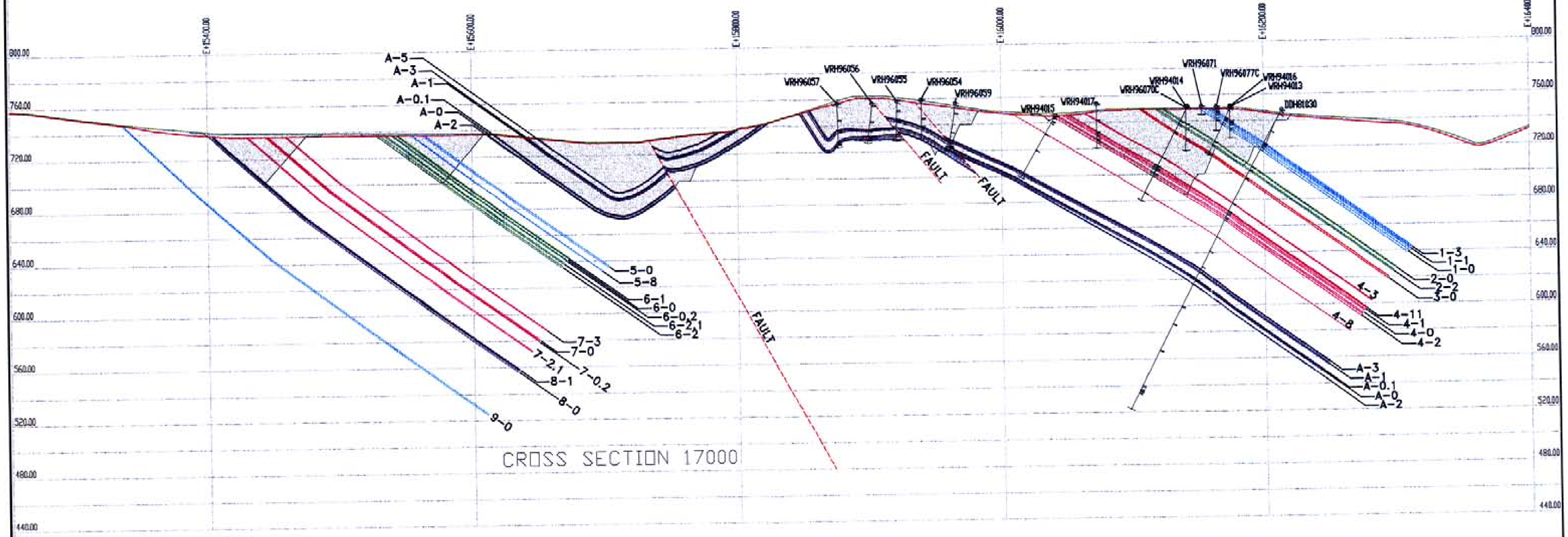
PINE VALLEY COAL LTD.

AUGUST 1997

FIGURE 2.2–2

NORECOL DAMES & MOORE and NORWEST MINE SERVICES

A DAMES & "DIARY



LEGEND

▨ Pit

5-0 Seam Number

N

SCALE: 1:3000
metres
0 60 120

NDM-33079-001-newaug97-fig22-3

NORTH AREA

SECTION 17000N

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

PINE VALLEY COAL LTD.

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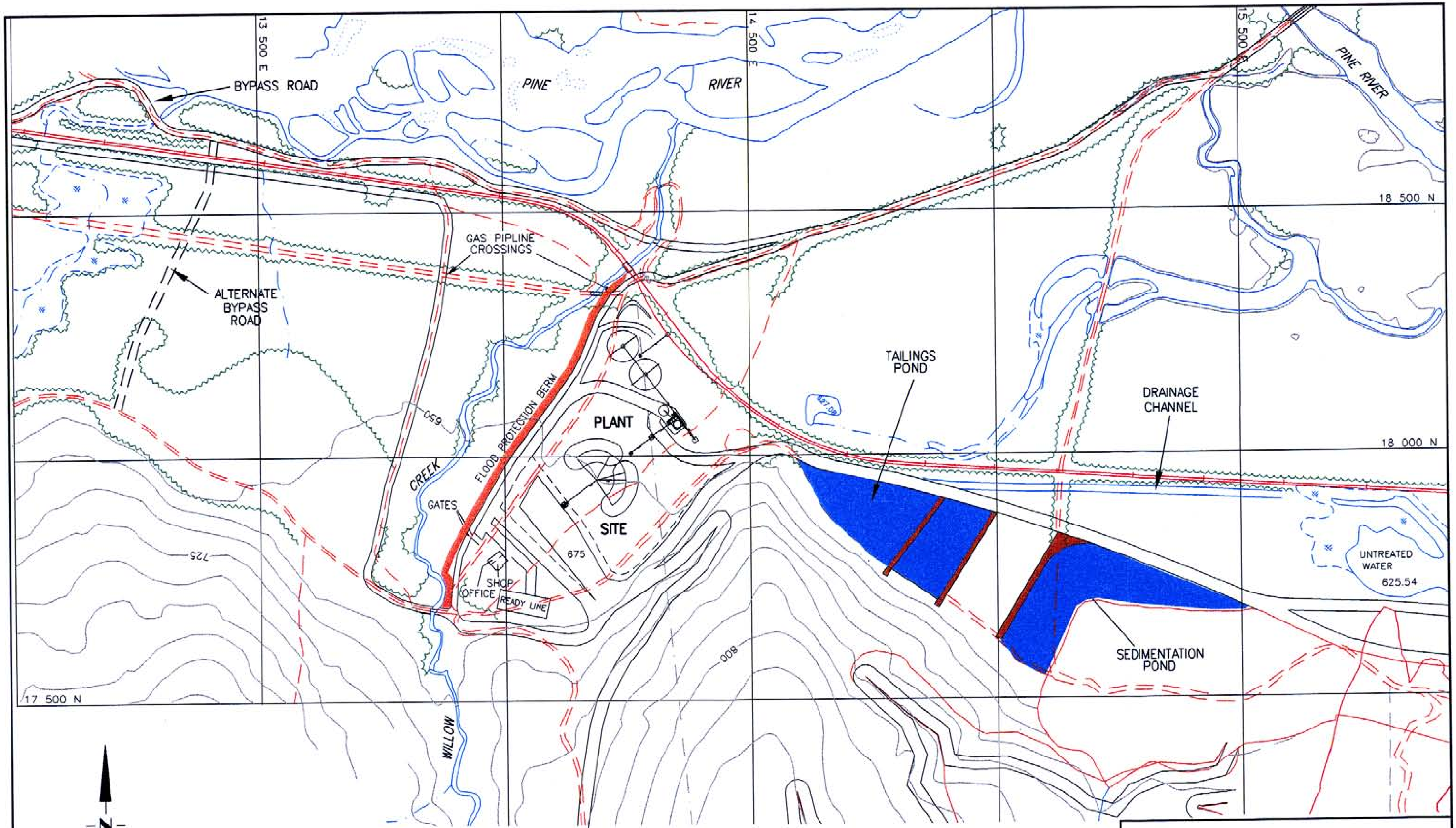
FIGURE 2.2-3

NORECOL DAMES & MOORE and NORWEST MINE SERVICES

GROUP A DAMES & MOORE SUBSIDIARY



LEGEND
- 🟦 CLEAN WATER
- TREE COVER
- CONTOURS in METRES
- RAILROAD

SCALE: 1:7500
metres
0 150 300

NDM-33079-001-newaug97-fig23-1

PLANT SITE LAYOUT

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

PINE VALLEY COAL LTD.

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FIGURE 2.3-1

NORECOL DAMES & MOORE and NORWEST MINE SERVICES

GROUP A DAMES & MOORE SUBSIDIARY

FIGURE 4.2-1

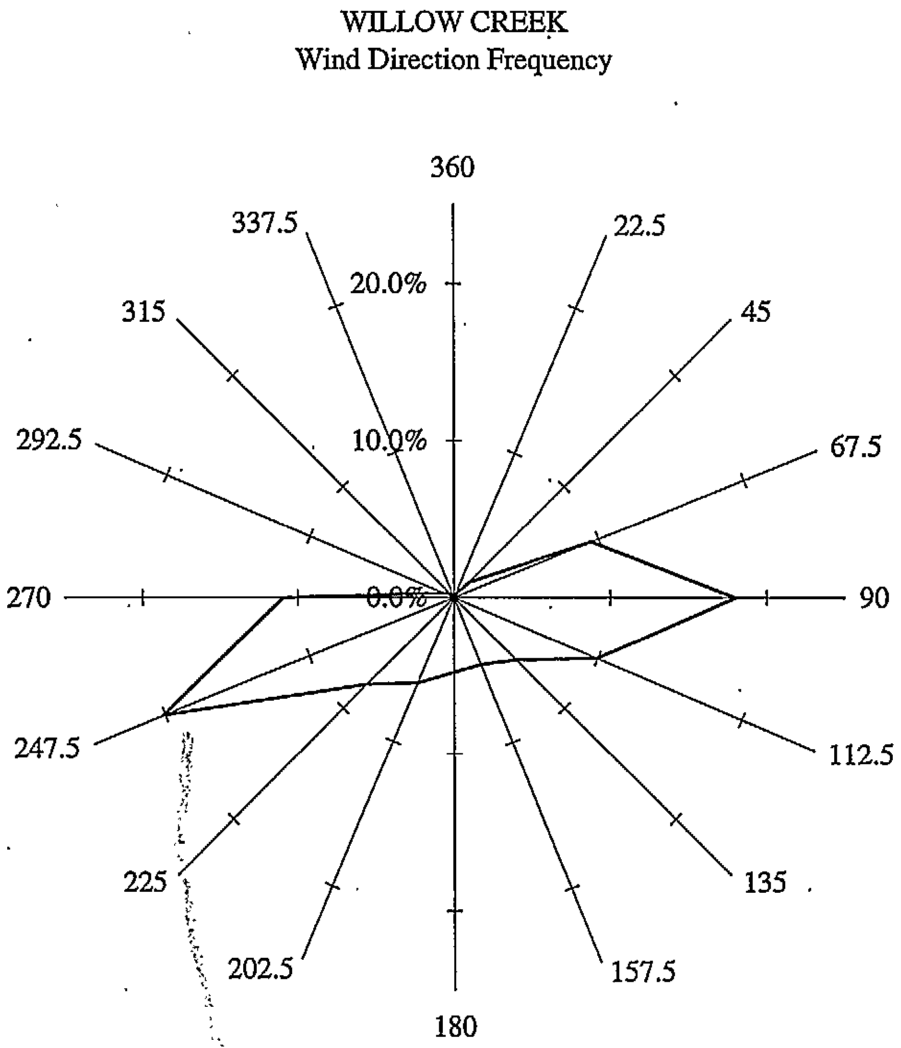
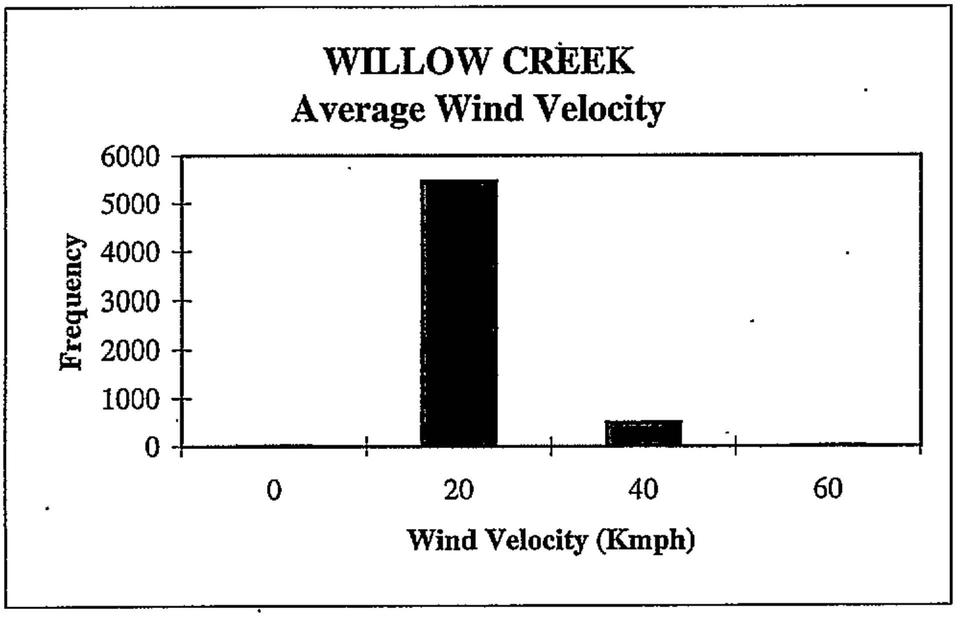
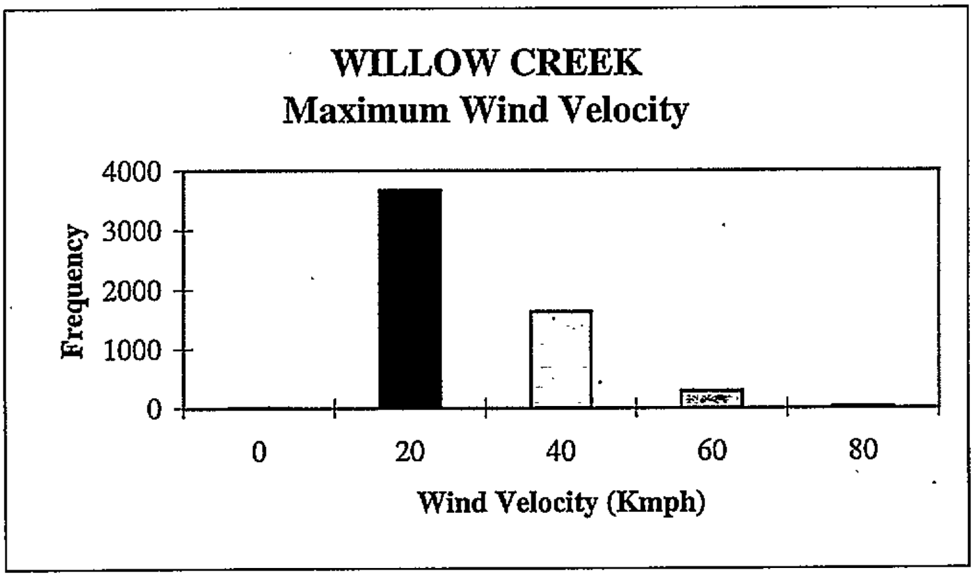
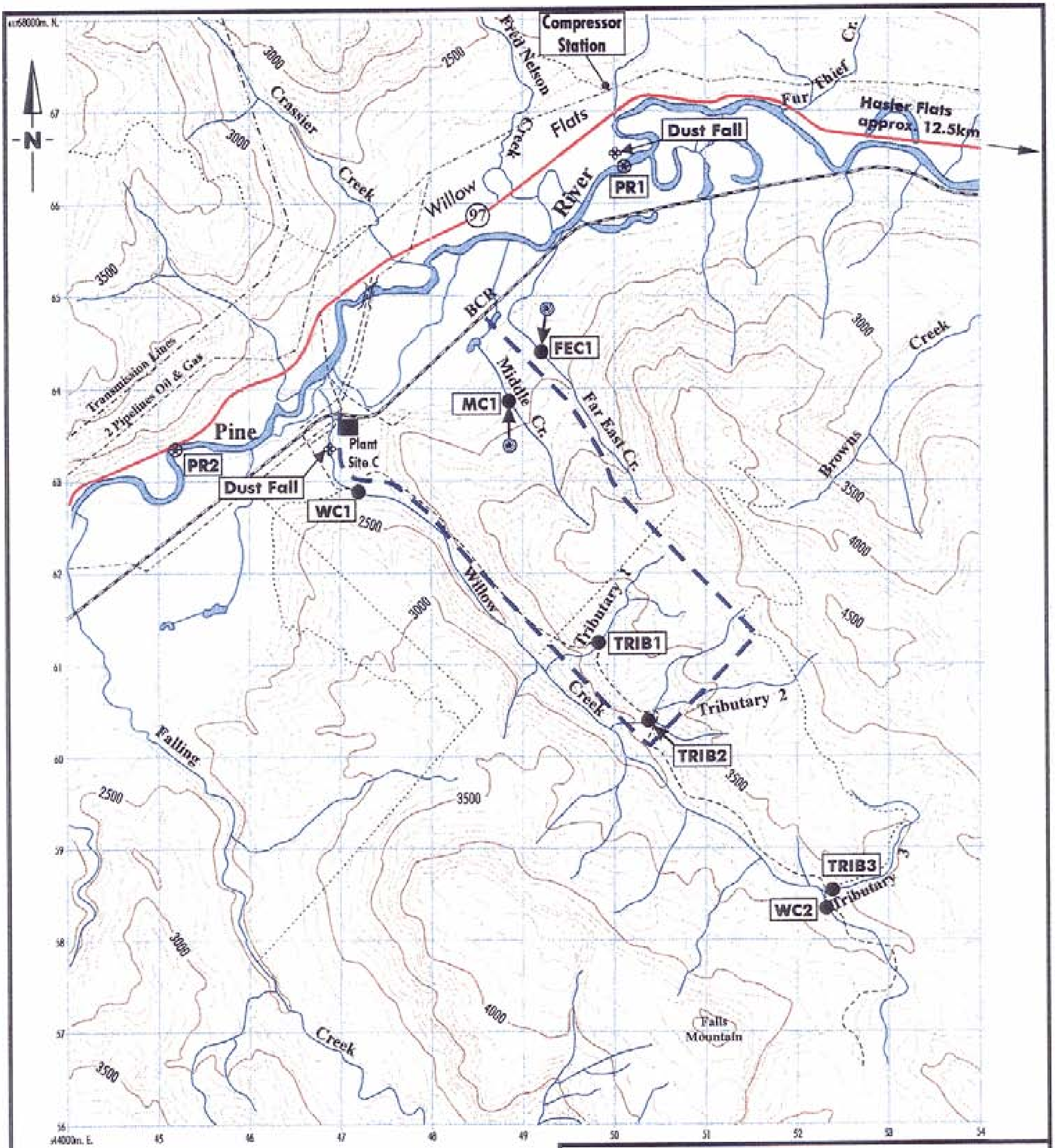

WILLOW CREEK
Wind Direction Frequency
360
22.5
45
67.5
90
112.5
135
157.5
180
202.5
225
247.5
270
292.5
315
337.5
20.0%
10.0%
0.0%

FIGURE 4.2-2


WILLOW CREEK
Average Wind Velocity
6000
5000
4000
3000
2000
1000
0
Frequency
0
20
40
60
Wind Velocity (Kmph)


WILLOW CREEK
Maximum Wind Velocity
4000
3000
2000
1000
0
Frequency
0
20
40
60
80
Wind Velocity (Kmph)



LEGEND

Willow Creek Project Area	— —
Water Quality Sampling Site	⊛
Hydrology/Water Quality Sampling Site	●
Dust Fall Sampling Site	⊕
Sediment Sampling Site	◉

METRES
0 1000 2000

WATER QUALITY/HYDROLOGY & DUST FALL SITES

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

PINE VALLEY COAL LTD.

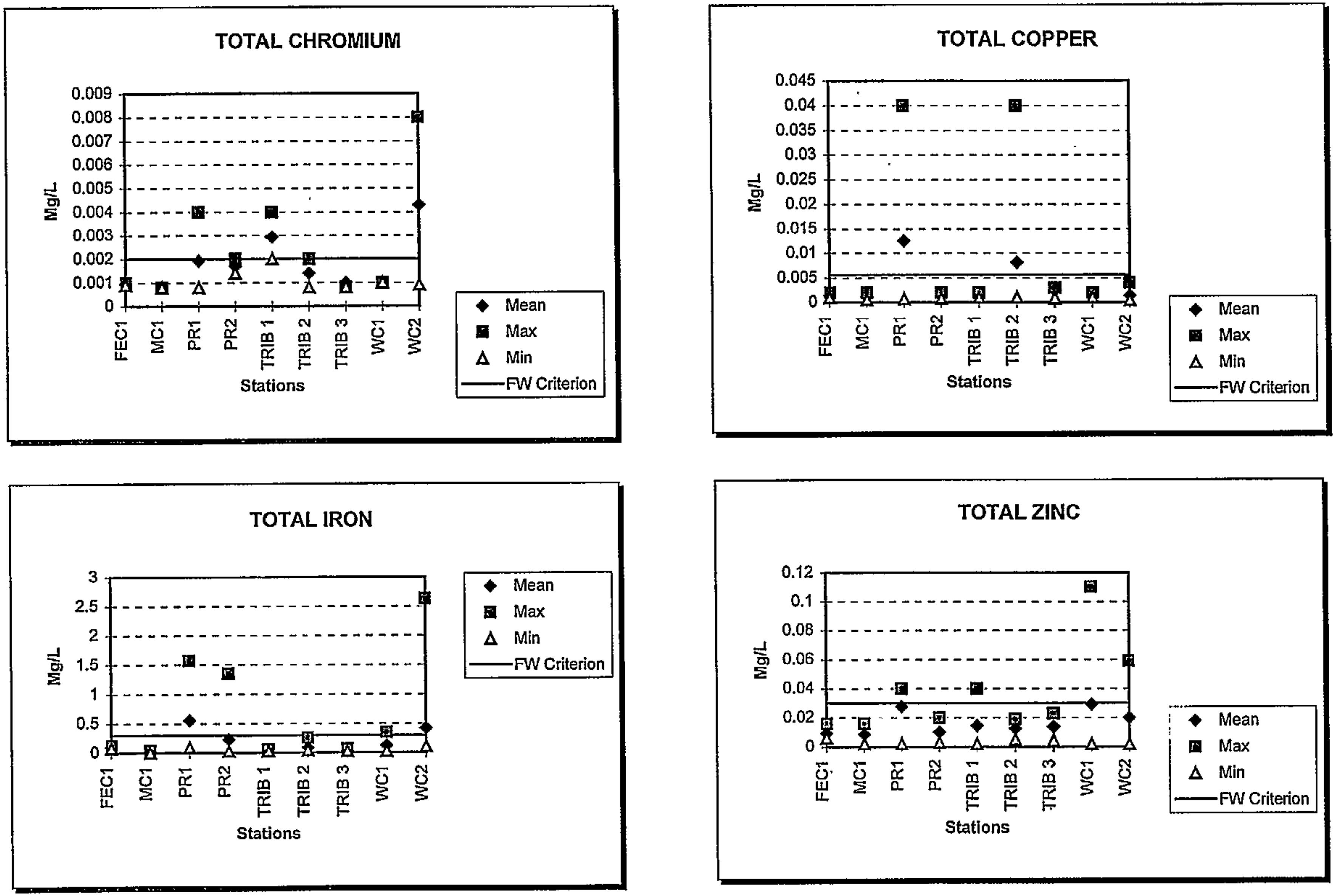
NORECOL DAMES & MOORE
GROUP A DAMES & MOORE SUBSIDIARY

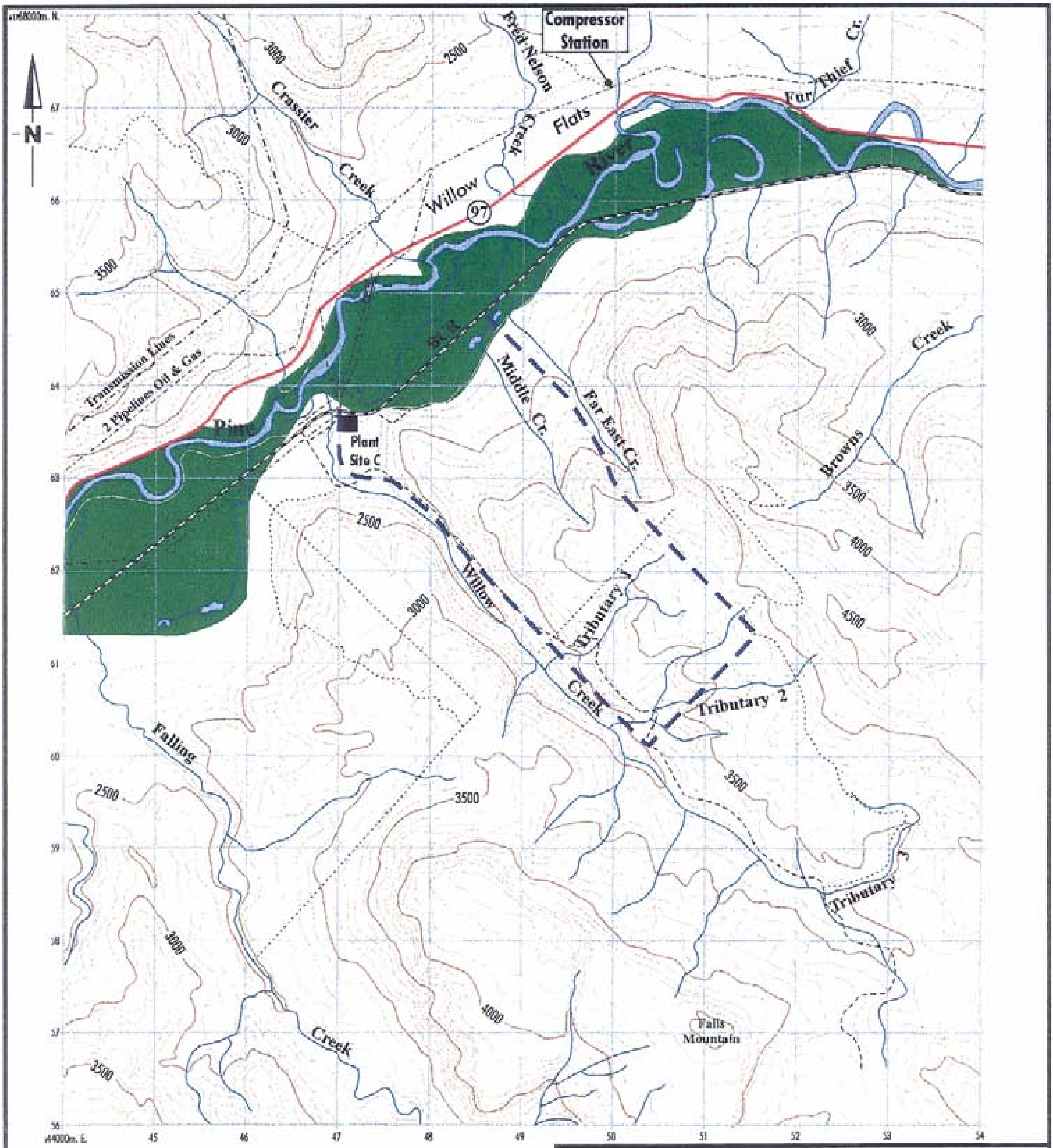
NDM-33079-001-cdr-f12h

JUNE 1997

FIGURE 4.4-1

FIGURE 4.4-2


TOTAL CHROMIUM
Mg/L
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
FEC1
MC1
PR1
PR2
TRIB 1
TRIB 2
TRIB 3
WC1
WC2
Stations
Mean
Max
Min
FW Criterion
TOTAL COPPER
Mg/L
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
FEC1
MC1
PR1
PR2
TRIB 1
TRIB 2
TRIB 3
WC1
WC2
Stations
Mean
Max
Min
FW Criterion
TOTAL IRON
Mg/L
3
2.5
2
1.5
1
0.5
0
FEC1
MC1
PR1
PR2
TRIB 1
TRIB 2
TRIB 3
WC1
WC2
Stations
Mean
Max
Min
FW Criterion
TOTAL ZINC
Mg/L
0.12
0.1
0.08
0.06
0.04
0.02
0
FEC1
MC1
PR1
PR2
TRIB 1
TRIB 2
TRIB 3
WC1
WC2
Stations
Mean
Max
Min
FW Criterion



LEGEND

Willow Creek Project Area — — —

Pine River Flood Plain 🟩

METRES

0 1000 2000

NORECOL DAMES & MOORE

GROUP A DAMES & MOORE SUBSIDIARY

NDM-33079-001-cdr-f06w

PINE VALLEY FLOOD PLAIN

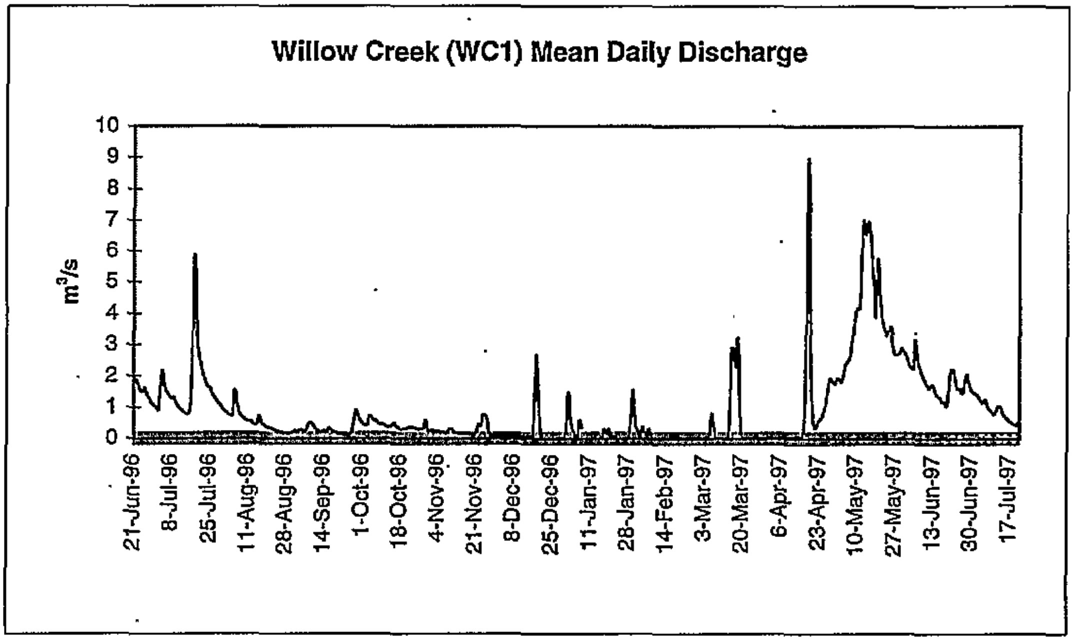
WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

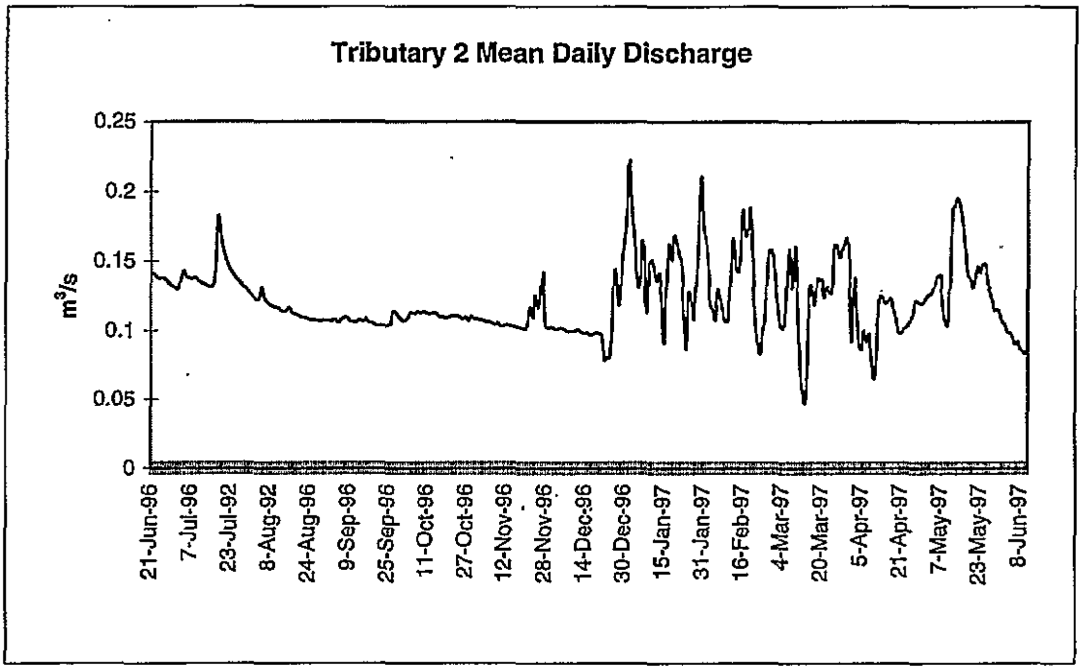
PINE VALLEY COAL LTD.

JUNE 1997

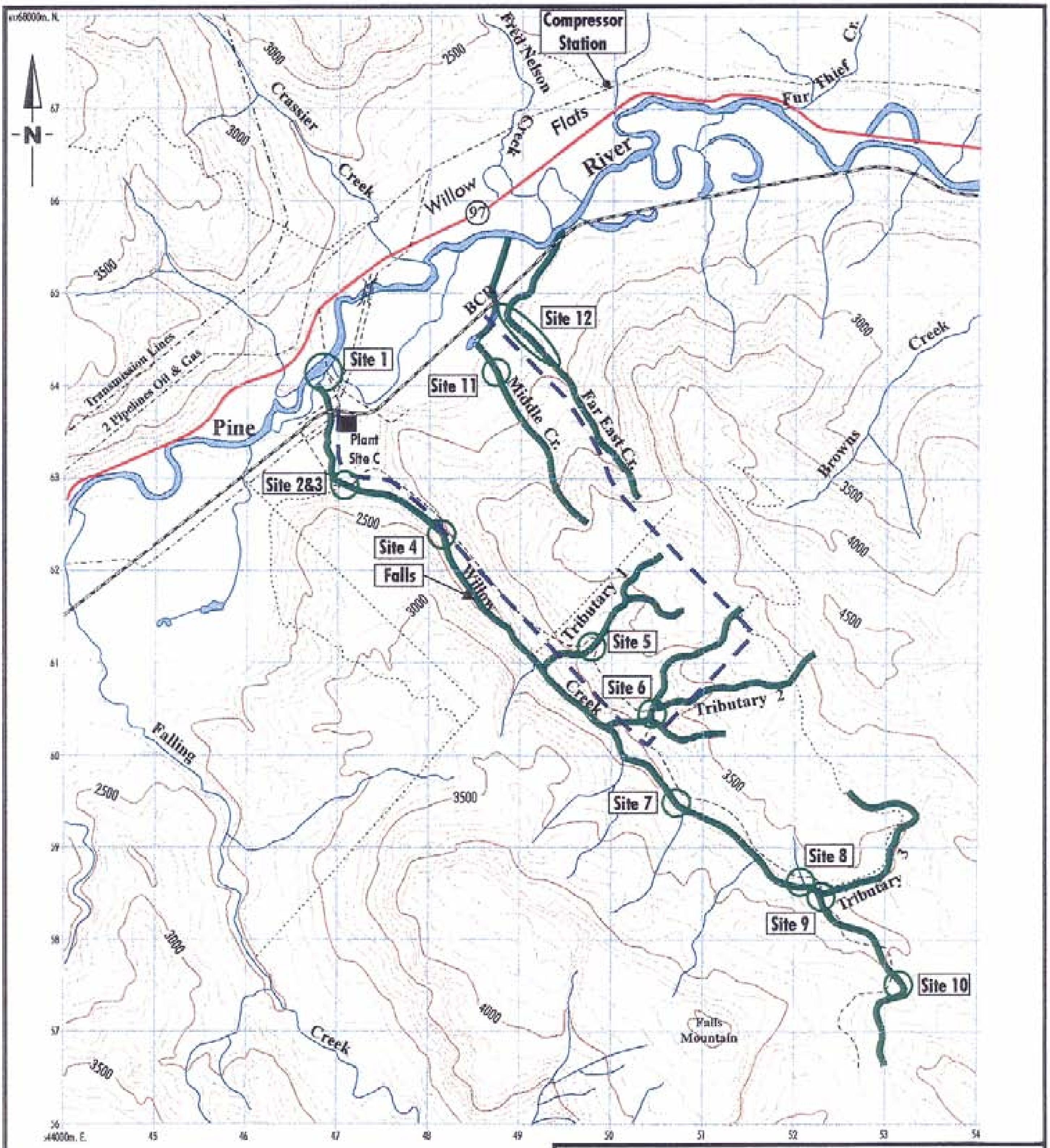
FIGURE 4.5-1

Figure 4.5-2





h:\ndm\33079\001\report\figures\fig452.xls



LEGEND

Willow Creek Project Area — — —
Fish Sampling Sites ○
Habitat Surveys along Rivers & Creeks ▬

METRES
0 1000 2000

NORECOL DAMES & MOORE

NDM-33079-001-cdr-f091

GROUP A DAMES & MOORE SUBSIDIARY

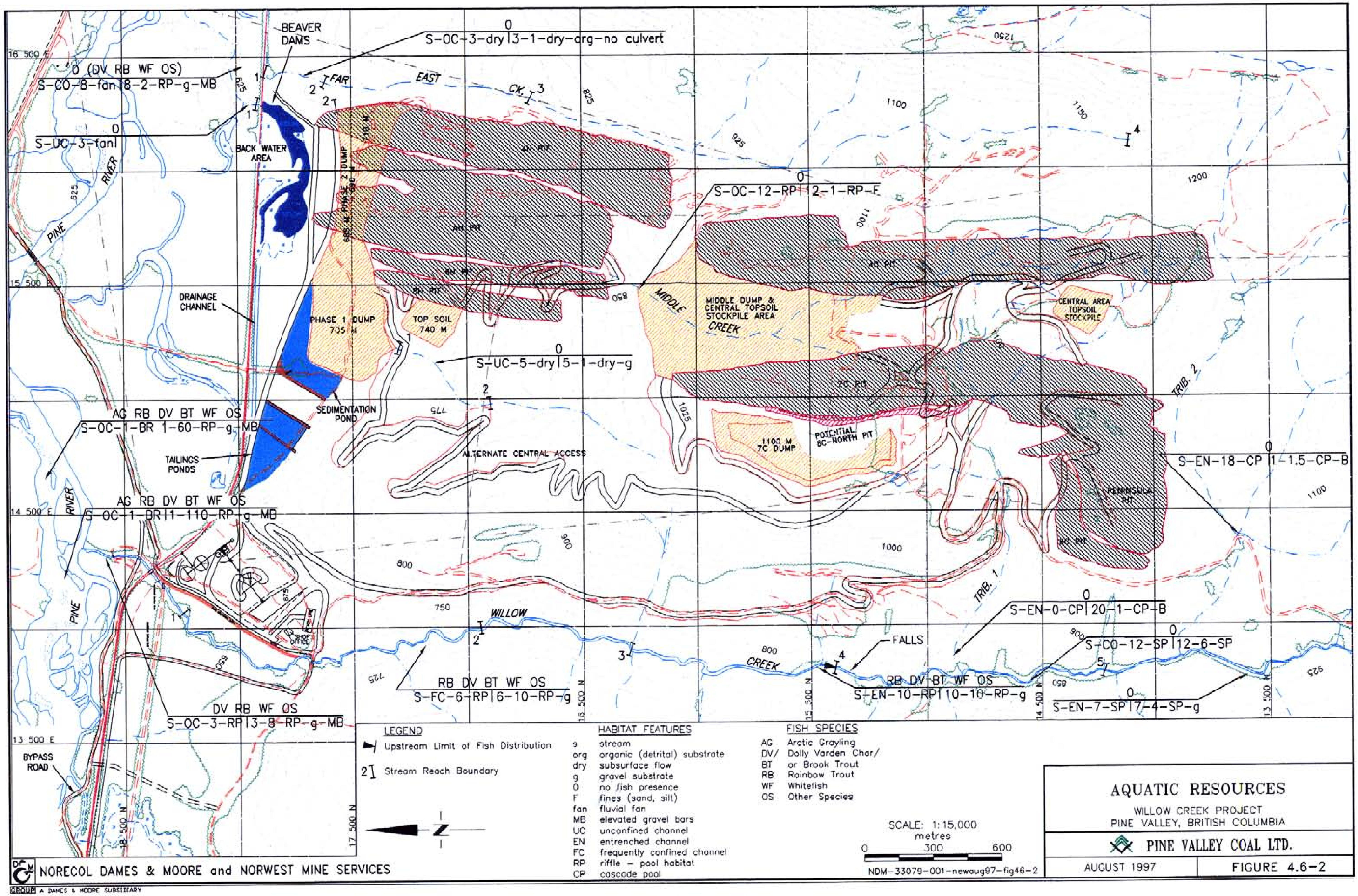
FISH
SAMPLING SITES

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

PINE VALLEY COAL LTD.

JUNE 1997

FIGURE 4.6-1



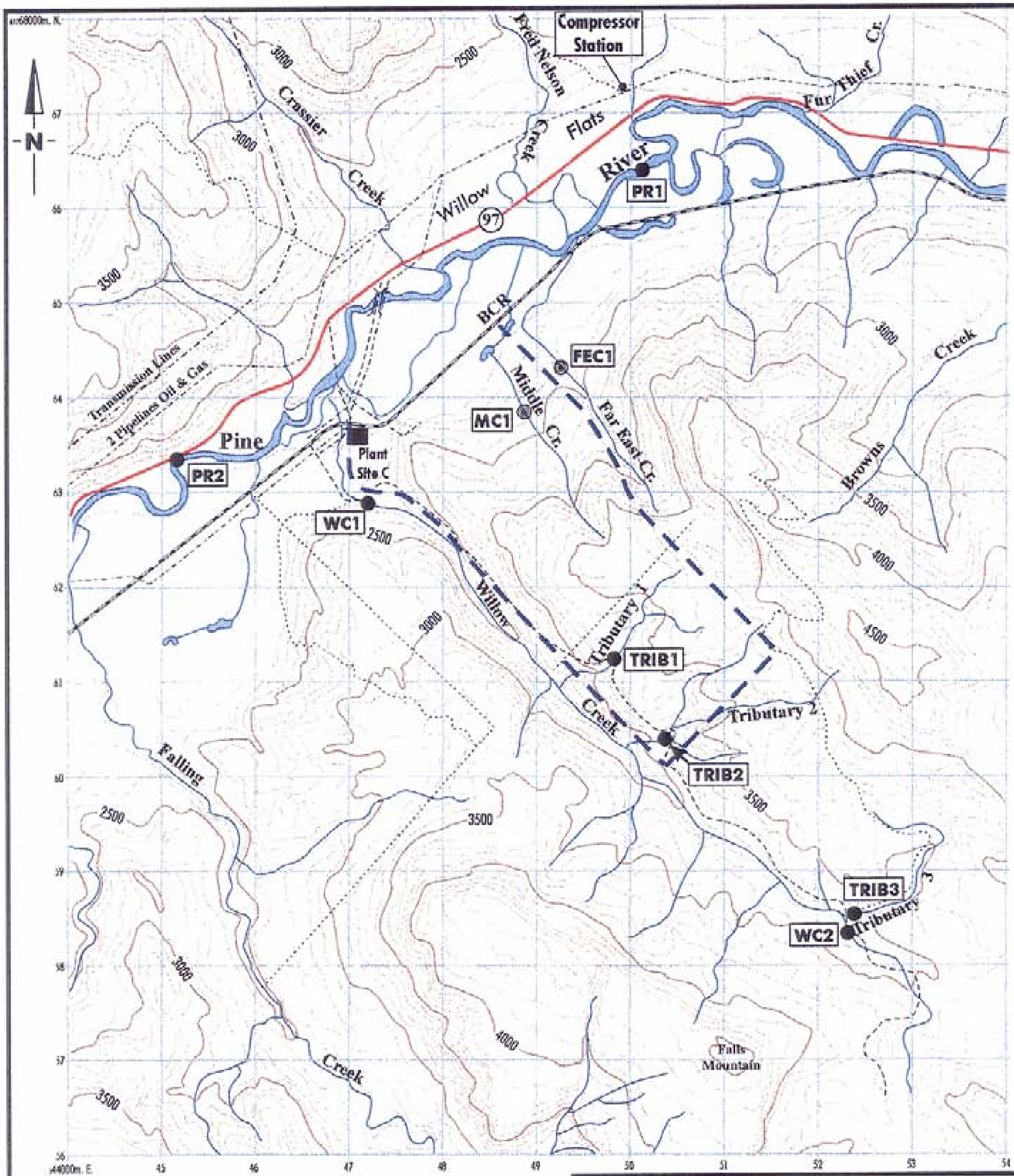
AQUATIC RESOURCES

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

PINE VALLEY COAL LTD.

AUGUST 1997

FIGURE 4.6-2



LEGEND

Willow Creek Project Area — —

Periphyton/Sediment Sampling Site ●

Sediment Sampling Site ◉

METRES
0 1000 2000

PERIPHYTON/SEDIMENT SAMPLING SITES

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

PINE VALLEY COAL LTD.

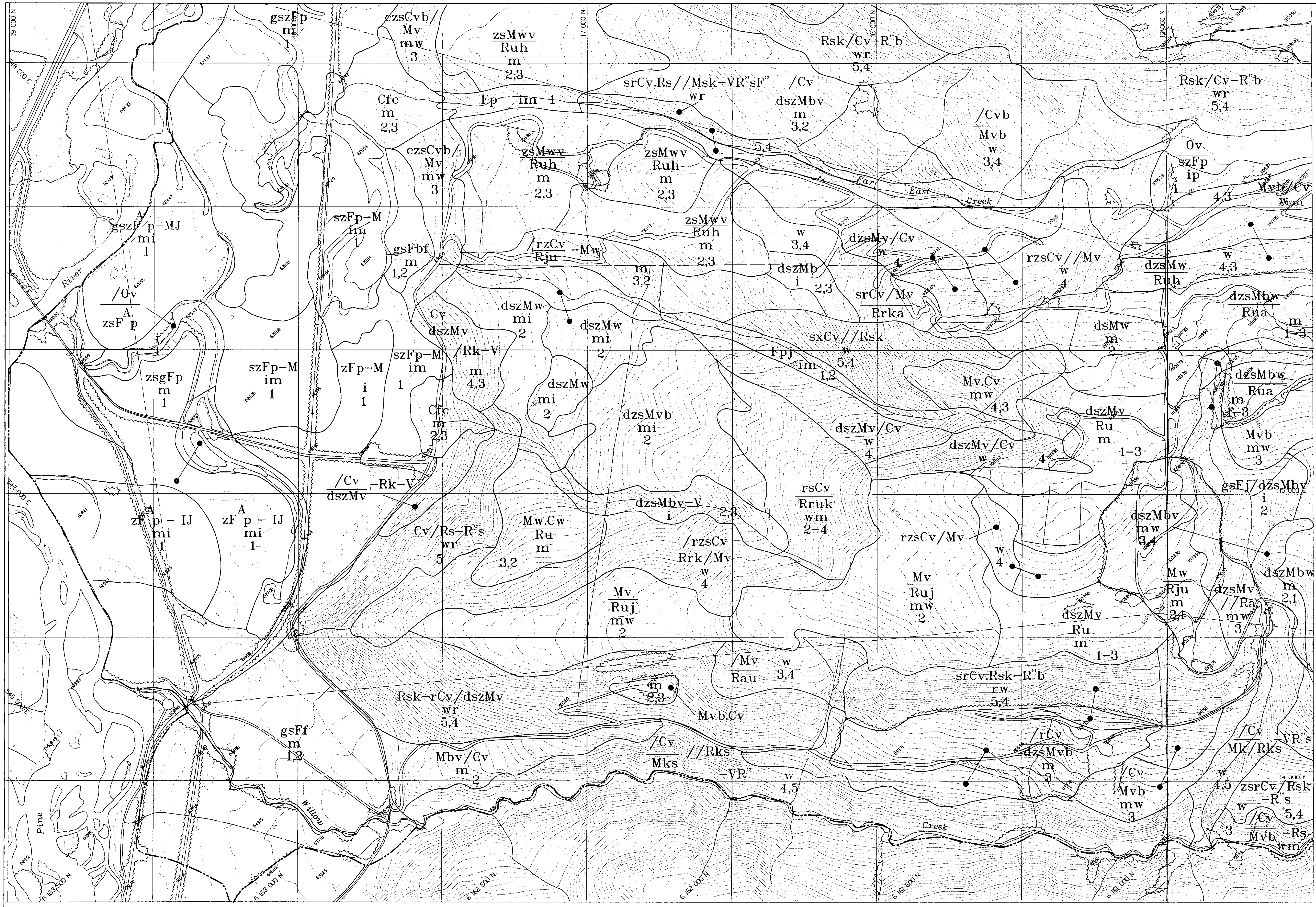
JUNE 1997

FIGURE 4.8-1

NORECOL DAMES & MOORE

NDM-33079-001-cdr-f08ws

GROUP A DAMES & MOORE SUBSIDIARY



Date of Photography: May 20. 1994.
Scale of Photography: 1:20 000
Photo Indentifiable Survey Control supplied by: Globaltex Coal Corporation
Survey Control based on: UTM NAD27 (crosses)
Mine Grid (lines) based on: Supplied common survey points
Compiled by The ORTHOSHOP. Calgary. October 1994
VO 4652

Limits of Survey Control.
Mapping beyond limits may not meet
normal mapping accuracy.

PINE VALLEY COAL CORPORATION

British Columbia

Scale 1:5000

meters 50 0 50 100 150 200 250 meters

contour interval 5m

UTM
Mine Grid

2

Paved Road
Gravel Road
Trail
Railway
Fence
Retaining Wall
River
Stream
Ditch
Index Contour
Intermediate Contour
Depression

Pole
Post
Light Standard
Manhole
Fire Hydrant
Catch Basin
Culvert

Intermittent Lake
Swamp or Marsh
Trees
Single Tree
Building

LEGEND

TERRAIN UNIT SYMBOLS

Simple Terrain Units

e.g. texture / surficial material **gFt–I** process / surface expression

NOTE: Two or three letters may be used to describe any characteristic othe than surficial material, or letters may be omitted if information lacking.

Composite Units: Two or three groups of letters are used to indicate that two or three kinds of terrain are present within a map unit.

e.g. **Mv . Rs** indicates that "Mv" and "Rs" are of roughly equal extent

Mv/Rs indicates that "Mv" is more extensive than "Rs" (about 2/1 or 3/2)

Mv//Rs indicates that "Mv" is much more extensive than "Rs" (about 3/1 or 4/1)

Stratigraphic Units: Groups of letters are arranged one above the other where one or more kinds of surficial material overlie a different material or bedrock:

e.g. $\frac{\mathbf{Mv}}{\mathbf{Rr}}$ indicates that "Mv" overlies "Rr"

$\frac{\mathbf{/Mv}}{\mathbf{Rr}}$ indicates that "Rr" is partially buried by "Mv"

MATERIALS

A	Anthropogenic materials	L	Glaciolacustrine sediments
C	Colluvium	M	Till
D	Weathered bedrock	M^{I}	Ablation till
E	Eolian sediments	O	Organic materials
F	Fluvial materials	R	Bedrock
F^{A}	"Active" fluvial materials	U	Undifferentiated materials
F^{G}	Glaciofluvial materials	V	Volcanic materials
I	Ice	W	Marine Sediments
L^{G}	Lacustrine sediments	W^{G}	Glaciomarine sediments

TEXTURE

Specific Clastic Terms

c	clay	(2um	k	cobbles	64 - 256mm
z	silt	62.5 - 2um	b	boulders	)256mm
s	sand	2mm - 62.5um	a	blocks	angular boulders
p	pebbles	2 - 64mm			

Common Clastic Terms

f	fines	any or all c. z. and fine s
d	mixed fragments	pebbles and larger clasts in a matrix of fines
g	gravel	any or both of p and k
r	rubble	angular gravel
x	angular fragments	mix of both r and a
m	mud	mix of both c and z
y	shells	shell or shell fragments

Organic Terms

e	fibric
u	mesic
h	humic

SURFACE EXPRESSION

a	moderate slope	p	plain
b	blanket	r	ridges
c	cone	s	steep slope(s)
d	depression	t	terrace(s)
f	fan	u	undulating topography
h	hummocky	v	veneer
j	gentle slope(s)	w	variable thickness
k	moderately steep slope	x	thin veneer
m	rolling topography		

GEOLOGICAL PROCESSES AND MASS MOVEMENT SUB-CLASS

A	Avalanches	J	Anastomosing channel
Af	Avalanches: major tracks	K	Karst processes
Am	Avalanches: minor tracks	L	Surface seepage
Aw	Avalanches: mixed	M	Meandering channel
Ao	Avalanches: old tracks	N	Nivation
B	Braiding channel	P	Piping
C	Cryoturbation	R	Rapid mass movement
D	Deflation	S	Solifuction
E	Glacial meltwater channels	U	Inundated
F	Falling	V	Gullying
H	Kettled	W	Washing
I	Irregularly sinuous channel	X	Permafrost processes
		Z	Periglacial processes

Mass Movement Sub-Classes

–F"	Slow m.m. (initiation zone)	–Fx	Slump-earthflow
–Fc	Soil creep	–R"	Rapid m.m. (initiation zone)
–Fe	Earthflow	–Rb	Rockfall
–Fg	Rock creep	–Rd	Debris flow
–Fj	Lateral spread in surficial materials	–Rf	Debris Fall
–Fk	Tension cracks	–Rr	Rockslide
–Fm	Slump in bedrock	–Rs	Debris slide
–Fp	Lateral spread in bedrock	–Rt	Debris torrent
–Fu	Slump in surficial material		

SOIL DRAINAGE CLASSES

r	rapidly drained	i	imperfectly drained
w	well drained	p	poorly drained
m	moderately drained	v	very poorly drained

Where two drainage classes are shown:

if the symbols are separated by a comma, e.g. "w,i", then no intermediate classes are present

if the symbols are separated by a dash, e.g. "w-i", then all intermediate classes are present

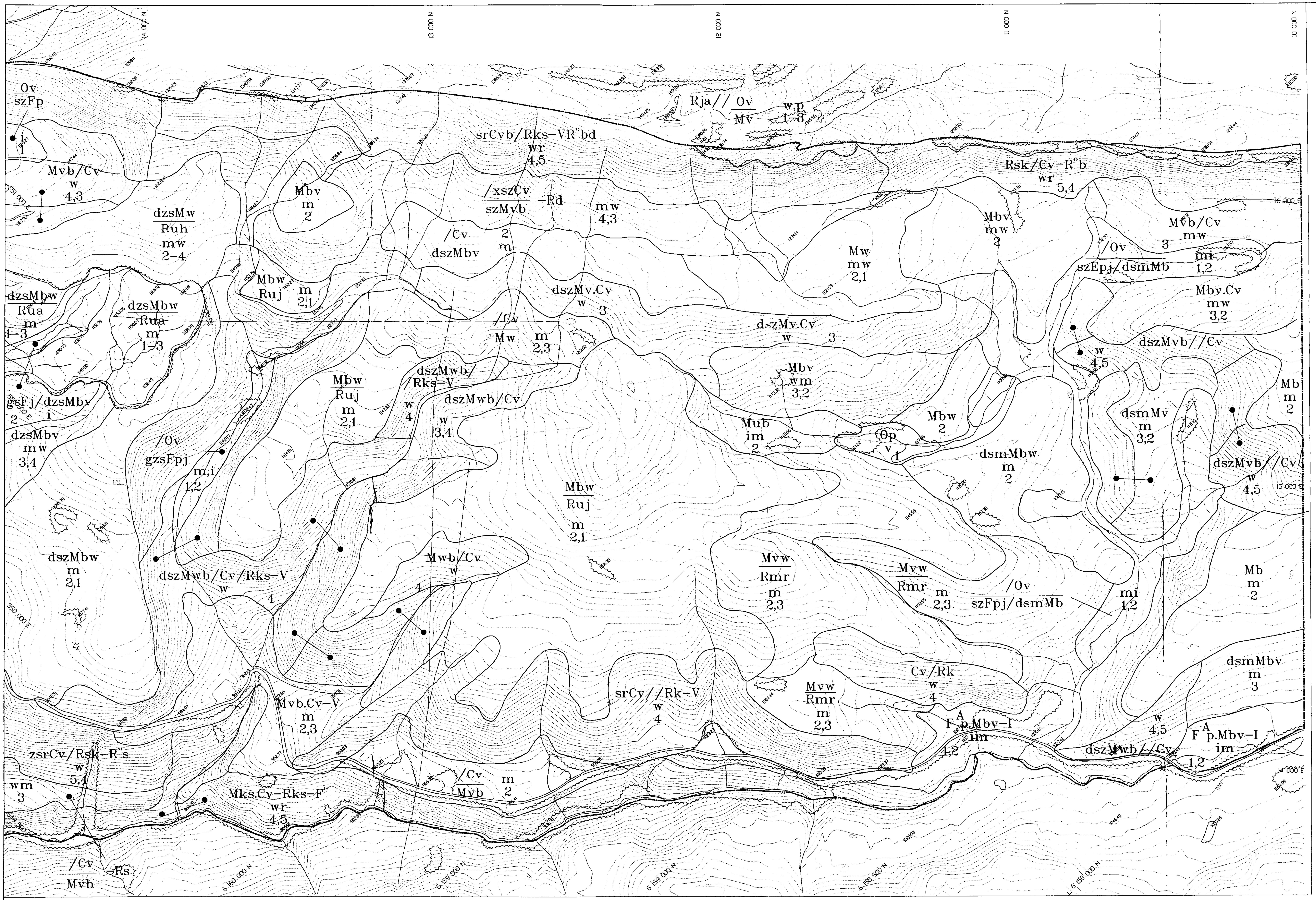
SLOPE CLASSES

1	0 - 3 degrees (0 - 5%)	4	26 - 35 degrees (49 - 70%)
2	3 - 15 degrees (5 - 27%)	5	)35 degrees ()70%)
3	15 - 26 degrees (27 - 49%)		

Extent of Mapping Boundary

Unit Boundary

FIGURE 4.9–1
TERRAIN UNITS OF PINE VALLEY COAL PROJECT AREA



LEGEND

TERRAIN UNIT SYMBOLS

Simple Terrain Units

e.g. texture / surficial material **gFt–J** process / surface expression

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Mv/Rs indicates that "Mv" is more extensive than "Rs" (about 2/1 or 3/2)

Mv//Rs indicates that "Mv" is much more extensive than "Rs" (about 3/1 or 4/1)

Stratigraphic Units: Groups of letters are arranged one above the other where one or more kinds of surficial material overlie a different material or bedrock:

e.g. $\frac{Mv}{Rr}$ indicates that "Mv" overlies "Rr"

$\frac{/Mv}{Rr}$ indicates that "Rr" is partially buried by "Mv"

MATERIALS

A	Anthropogenic materials	L	Glaciolacustrine sediments
C	Colluvium	M	Till
D	Weathered bedrock	M^{I}	Ablation till
E	Eolian sediments	O	Organic materials
F	Fluvial materials	R	Bedrock
F^{A}	"Active" fluvial materials	U	Undifferentiated materials
F^{G}	Glaciofluvial materials	V	Volcanic materials
I	Ice	W	Marine Sediments
L^{G}	Lacustrine sediments	W^{G}	Glaciomarine sediments

TEXTURE

Specific Clastic Terms

c	clay	<2um	k	cobbles	64 - 256mm
z	silt	62.5 - 2um	b	boulders	>256mm
s	sand	2mm - 62.5um	a	blocks	angular boulders
p	pebbles	2 - 64mm			

Common Clastic Terms

f	fines	any or all c, z, and fine s
d	mixed fragments	pebbles and larger clasts in a matrix of fines
g	gravel	any or both of p and k
r	rubble	angular gravel
x	angular fragments	mix of both r and a
m	mud	mix of both c and z
y	shells	shell or shell fragments

Organic Terms

e	fibric
u	mesic
h	humic

SURFACE EXPRESSION

a	moderate slope	p	plain
b	blanket	r	ridges
c	cone	s	steep slope(s)
d	depression	t	terrace(s)
f	fan	u	undulating topography
h	hummocky	v	veneer
j	gentle slope(s)	w	variable thickness
k	moderately steep slope	x	thin veneer
m	rolling topography		

GEOLOGICAL PROCESSES AND MASS MOVEMENT SUB-CLASS

A	Avalanches	J	Anastomosing channel
Af	Avalanches: major tracks	K	Karst processes
Am	Avalanches: minor tracks	L	Surface seepage
Aw	Avalanches: mixed	M	Meandering channel
Ao	Avalanches: old tracks	N	Nivation
B	Braiding channel	P	Piping
C	Cryoturbation	R	Rapid mass movement
D	Deflation	S	Solifuction
E	Glacial meltwater channels	U	Inundated
F	Failing	V	Gullying
H	Kettled	W	Washing
I	Irregularly sinuous channel	X	Permafrost processes
		Z	Periglacial processes

Mass Movement Sub-Classes

–F"	Slow m.m. (initiation zone)	–Fx	Slump-earthflow
–Fc	Soil creep	–R"	Rapid m.m. (initiation zone)
–Fe	Earthflow	–Rb	Rockfall
–Fg	Rock creep	–Rd	Debris flow
–Fj	Lateral spread in surficial materials	–Rf	Debris fall
–Fk	Tension cracks	–Rr	Rockslide
–Fm	Slump in bedrock	–Rs	Debris slide
–Fp	Lateral spread in bedrock	–Rt	Debris torrent
–Fu	Slump in surficial material		

SOIL DRAINAGE CLASSES

r	rapidly drained	i	imperfectly drained
w	well drained	p	poorly drained
m	moderately drained	v	very poorly drained

Where two drainage classes are shown:

if the symbols are separated by a comma, e.g. "w,i", then no intermediate classes are present

if the symbols are separated by a dash, e.g. "w-i", then all intermediate classes are present

SLOPE CLASSES

1	0 - 3 degrees (0 - 5%)	4	26 - 35 degrees (49 - 70%)
2	3 - 15 degrees (5 - 27%)	5	>35 degrees (>70%)
3	15 - 26 degrees (27 - 49%)		

Extent of Mapping Boundary —··—··— Unit Boundary ————

Date of Photography: May 20, 1994
Scale of Photography: 1:20 000
Photo Identifiable Survey Control supplied by: Globaltex Coal Corporation
Survey Control based on: UTM NAD27 (crosses)
Mine Grid (lines) based on: Supplied common survey points
Compiled by The ORTHOSHOP, Calgary, October 1994
WO 4652

—— - —— - —— Limits of Survey Control.
Mapping beyond limits may not meet
normal mapping accuracy.

PINE VALLEY COAL LTD.

British Columbia

Scale 1:5000

meters 50 0 50 100 150 200 250 meters

contour interval 5m

UTM

Mine Grid

Paved Road
Gravel Road
Trail
Railway
Fence
Retaining Wall
River
Stream
Ditch
Index Contour
Intermediate Contour
Depression

● Pole
○ Post
☼ Light Standard
⊗ Manhole
⊕ Fire Hydrant
□ Catch Basin
[Culvert

Intermittent Lake
Swamp or Marsh
Trees
Single Tree
Building

FIGURE 4.9–2
TERRAIN UNITS OF
PINE VALLEY COAL PROJECT
AREA

STANDARD TERRAIN MAPPING LEGEND

(1) TERRAIN UNIT SYMBOLS

Simple Terrain Units: e.g., texture gFt - J process
surficial material surface expression

Note: Two or three letters may be used to describe any characteristic other than surficial material, or letters may be omitted if information is lacking.

Composite Units: Two or three groups of letters are used to indicate that two or three kinds of terrain are present within a map unit.

e.g., Mv · Rs indicates that "Mv" and "Rs" are of roughly equal extent

Mv/Rs indicates that "Mv" is more extensive than "Rs" (about 2/1 or 3/2)

Mv//Rs indicates that "Mv" is much more extensive than "Rs" (about 3/1 or 4/1).

Stratigraphic Units: Groups of letters are arranged one above the other where one or more kinds of surficial material overlie a different material or bedrock:

e.g., $\frac{\text{Mv}}{\text{Rr}}$ indicates that "Mv" overlies "Rr".

$\frac{/\text{Mv}}{\text{Rr}}$ indicates that "Rr" is partially buried by "Mv"

(2) MATERIALS

A	Anthropogenic materials	Artificial materials, and materials modified by human actions such that their original physical appearance and properties have been drastically altered.
C	Colluvium	Products of gravitational slope movements; materials derived from local bedrock and major deposits derived from drift; includes talus and landslide deposits.
D	Weathered bedrock	Bedrock modified *in situ* by mechanical and chemical weathering.
E	Eolian sediments	Sand and silt transported and deposited by wind; includes loess.
F	Fluvial materials	Sands and gravels transported and deposited by streams and rivers; floodplains, terraces and alluvial fans.
F^A	"Active" fluvial materials	Active deposition zone on modern floodplains and fans; active channel zone.

(2) MATERIALS cont'd

F^G	Glaciofluvial materials	Sands and gravels transported and deposited by meltwater streams; includes kames, eskers and outwash plains.
I	Ice	Permanent snow and ice; glaciers.
L	Lacustrine sediments	Fine sand, silt and clay deposited in lakes.
L^G	Glaciolacustrine sediments	Fine sand, silt and clay deposited in ice-dammed lakes.
M	Till	Material deposited by glaciers without modification by flowing water. Typically consists of a mixture of pebbles, cobbles and boulders in a matrix of sand, silt and clay; diamicton.
M'	Ablation till	Material accumulated on top of a melting glacier; coarse textured and less consolidated than basal till.
O	Organic materials	Material resulting from the accumulation of decaying vegetative matter; includes peat and organic soils.
R	Bedrock	Outcrops, and bedrock within a few centimetres of the surface.
U	Undifferentiated materials	Different surficial materials in such close proximity that they cannot be separated at the scale of the mapping.
V	Volcanic materials	Unconsolidated pyroclastic sediments.
W	Marine sediments	Sediments deposited by settling and gravity flows in brackish or marine waters, and beach sands and gravels.
W^G	Glaciomarine sediments	Sediments laid down in marine waters in close proximity to glacier ice.

(3) TEXTURE

Specific Clastic Terms

c	clay	< 2μm	k	cobbles	64 - 256 mm
z	silt	62.5 - 2μm	b	boulders	> 256 mm
s	sand	2 mm - 62.5μm	a	blocks	angular boulders
p	pebbles	2 - 64 mm			

Common Clastic Terms

f	fines	any or all of c, z, and fine s
d	mixed fragments	pebbles and larger clasts in a matrix of fines
g	gravel	any or both of p and k
r	rubble	angular gravel
x	angular fragments	mix of both r and a
m	mud	mix of both c and z
y	shells	shell or shell fragments

Organic Terms

e	fibric
u	mesic
h	humic

(4) SURFACE EXPRESSION

a	moderate slope(s)	predominantly planar slopes; 15-26° (27-49%)
b	blanket	material >1-2m thick with topography derived from underlying bedrock (which may not be mapped) or surficial material

c	cone	a fan-shaped surface that is a sector of a cone; slopes 15° (27%) and steeper
d	depression	enclosed depressions
f	fan	a fan-shaped surface that is a sector of a cone; slopes 3-15° (5-27%)
h	hummocky	steep-sided hillocks and hollows; many slopes 15° (27%) and steeper
j	gentle slope(s)	predominantly planar slopes; 3-15° (5-27%)
k	moderately steep slope	predominantly planar slopes; 26-35° (49-70%)
m	rolling topography	linear rises and depressions; <15° (27%)
p	plain	0-3° (0-5%)
r	ridges	linear rises and depressions with many slopes 15° (27%) and steeper
s	steep slope(s)	slopes steeper than 35° (70%)
t	terrace(s)	stepped topography and benchlands
u	undulating topography	hillocks and hollows; slopes predominantly <15° (27%)
v	veneer	material <1-2m thick with topography derived from underlying bedrock (may not be mapped) or surficial material; may include outcrops of underlying material
w	variable thickness	material of variable thickness with topography derived from underlying bedrock (may not be mapped) or surficial material
x	thin veneer	a subset of v (veneer), where there is a dominance of surficial materials about 10-25 centimeters thick

(5) GEOLOGICAL PROCESSES AND MASS MOVEMENT SUB-CLASSES

A	Avalanches	Slopes modified by frequent snow avalanches.
Af	Avalanches: major tracks	In zones of coniferous forest: broad avalanche track(s) occupied by predominantly shrubby, deciduous vegetation.
Am	Avalanches: minor tracks	Similar to above, but generally narrower than the height of adjacent trees.
Aw	Avalanches: mixed	Includes both major and minor avalanche tracks.
Ao	Avalanches: old tracks	Clearly visible on air photos, but less well defined than active tracks because they are partly or completely occupied by young conifers.
B	Braiding channel	Channel zone with many diverging and rejoining channels; channels are laterally unstable.
C	Cryoturbation	Heaving and churning of soil and surficial materials due to frost action.
D	Deflation	Removal of sand and silt particles by wind action.
E	Glacial meltwater channels	Areas crossed by meltwater channels that are too small or too numerous to map individually.
F	Failing	Slope experiencing slow mass movement, such as sliding or slumping.
H	Kettled	Area includes numerous small depressions and/or lakes where buried blocks of ice melted.
I	Irregularly sinuous channel	Channel displays irregular turns and bends.
J	Anastamosing channel	Channels diverge and converge around semi-permanent islands.
K	Karst processes	Solution of carbonates (limestone, dolomite) resulting in development of collapse and subsidence features.
L	Surface seepage	Zones of active seepage often found along the base of slope positions.
M	Meandering channel	Channel characterized by regular turns and bends.
N	Nivation	Surface modified by hollows developed around semi-permanent snowbanks.
P	Piping	Subsurface erosion of silty sediments by flowing water resulting in the formation of underground conduits.
R	Rapid mass movement	Slope or parts of slope affected by processes such as debris flows, debris slides and avalanches, and rockfall.
S	Solifluction	Slope modified by slow downslope movement of seasonally unfrozen regolith.
U	Inundated	Areas submerged in standing water from a seasonally high watertable.
V	Gullying	Slope affected by gully erosion.
W	Washing	Winnowing of fines by flowing water resulting in development of lag deposits.
X	Permafrost processes	Processes related to the presence of permafrost; permafrost aggradation and degradation.
Z	Periglacial processes	Solifluction, nivation and cryoturbation occurring together in a single terrain unit.

Mass Movement Sub-Classes

-F"	Slow m.m. (initiation zone)	-Fx	Slump-earthflow
-Fc	Soil creep	-R"	Rapid m. m. (initiation zone)
-Fe	Earthflow	-Rb	Rockfall
-Fg	Rock creep	-Rd	Debris flow
-Fj	Lateral spread in surficial materials	-Rf	Debris fall
-Fk	Tension cracks	-Rr	Rockslide
-Fm	Slump in bedrock	-Rs	Debris slide
-Fp	Lateral spread in bedrock	-Rt	Debris torrent
-Fu	Slump in surficial material		

(6) SOIL DRAINAGE CLASSES

r	rapidly drained	water is removed from the soil rapidly in relation to supply
w	well drained	water is removed from the soil readily but not rapidly
m	moderately well drained	water is removed from the soil somewhat slowly in relation to supply
i	imperfectly drained	water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season
p	poorly drained	water is removed so slowly in relation to supply that the soil remains wet for a comparatively large part of the time the soil is not frozen
v	very poorly drained	water is removed from the soil so slowly that the water table remains at or on the surface for the greater part of the time the soil is not frozen

Where two drainage classes are shown:

if the symbols are separated by a comma, e.g., "w,i", then no intermediate classes are present;

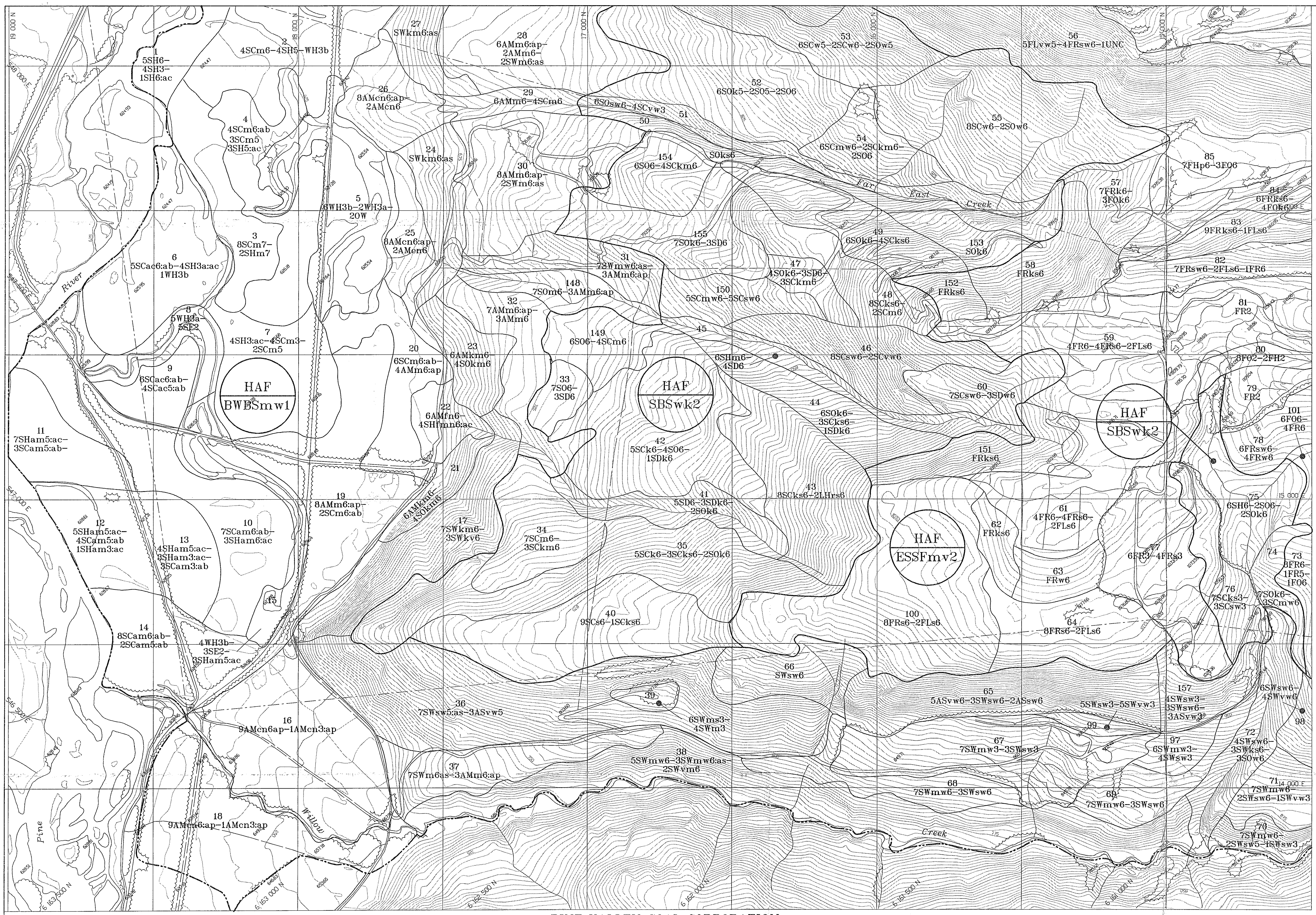
if the symbols are separated by a dash, e.g., "w-i", then all intermediate classes are present.

(7) SLOPE CLASSES

1	0-3° (0-5%)	3	15-26° (27-49%)	5	>35° (>70%)
2	3-15° (5-27%)	4	26-35° (49-70%)		

(8) BOUNDARY LINES AND SYMBOLS

Boundary lines:	definite boundary	indefinite boundary	assumed or arbitrary boundary	study area boundary
	————	- - - -	....	————



LEGEND

MAP LABEL

Ecosection Unit Label **HAF**

Biogeoclimatic Unit Labels **BWBSmw1, SBSwk2, ESSFmv2**

Biogeoclimatic Unit Label

BWBSmw1

Zone Subzone Variant

Pure map unit (polygon contains a single ecosystem unit)

Site Series — Site Modifier

FRs6

Structural Stage

Complex map unit (polygon contains up to three ecosystem units)

Site Series — Percent of Polygon Occupied

6FRw6 – 4FRsw6

Site Modifier — Structural Stage

MAP SYMBOLS

OW Shallow open water

MAP BOUNDARIES

Ecosystem Unit

Biogeoclimatic Unit

Ecosystem (Polygon) Unit

ECOSECTION UNITS

HAF	Hart Foothills Ecosection

BIOGEOCLIMATIC UNITS AND MAP SYMBOL

BWBSmw1	Bored White and Black Spruce Moist Warm. Peace Variant
SBSwk2	Sub-Bored Spruce Wet Cool. Finlay - Peace Variant
ESSFmv2	Engelmann Spruce - Subalpine Fir Moist Very Cold. Bullmoose Variant

ECOSYSTEM UNITS

Map Symbol	Biogeoclimatic unit/ Site Series	Name
AM	BWBSmwl/01	SwAT - Step moss
SW	BWBSmwl/03	Sw - Wildrye - Peavine
SO	BWBSmwl/05	Sw - Currant - Oak fern
SC	BWBSmwl/06	Sw - Currant - Bluebells
SH	BWBSmwl/07	Sw - Currant - Horsetail
AS	BWBSmwl/00	SwAt - Soopolallie
SE	BWBSmwl/00	Sedge Fen
WH	BWBSmwl/00	Willow - Horesetail - Sedge Riparian Wetland
LH	SBSwk2/02	Pl - Huckleberry - Cladina
SO	SBSwk2/01	Sxw - Oak fern
SC	SBSwk2/03	Sxw - Huckleberry - Highbush - cranberry
SD	SBSwk2/05	Sxw - Devil's club
SH	SBSwk2/06	Sxw - Horsetail
WS	SBSwk2/00	Willow - Sedge Fen
FR	ESSFmv2/01	Bl - Rhododendron - Feathmoss
FL	ESSFmv2/02	Bl - Lingonberry
BT	ESSFmv2/03	BlSb - Labrador tea
FO	ESSFmv2/04	Bl - Oak fern - Knight's plume
FH	ESSFmv2/06	Bl - Alder - Horsetail
SE	ESSFmv2/00	Sedge Fen
WS	ESSFmv2/00	Willow - Sedge Fen
UNC	ESSFmv2/00	Unclassified forb meadow

Site Modifiers

c	coarse textured soils (includes sandy loam. loamy sand. sand textures. fine matrix with over 70% coarse fragments and medium matrix with over 35% coarse fragments)
f	fine textured soils (heavy clay. silty clay. clay and sandy clay textures)
j	gentle slopes (less than 25% slope)
k	cool northerly or easterly aspect (285 - 135 degrees. slopes greater than 25%)
m	medium textured soils (includes silty clay loam. clay loam. silt. silt loam. loam. and sandy clay loam textures)
n	fan (colluvial. or fluvial) or cone
r	ridge or crest
w	warm. southerly or westerly aspect (135 - 285 degrees. slopes greater than 25%).
p	peaty soil
s	shallow soil (25-100cm to bedrock)
v	very shallow soil (less than 25cm mineral soil over bedrock)

STRUCTURAL STAGES

Description

1a	Non-vegetated: less than 5% vegetation cover
1b	Sparse: less than 10% vegetative cover
2	Herb: early successional stage disclimax or climax. dominated by herbaceous vegetation (tree cover (10%. herb cover)25% or)-33% of total cover)
3	Shrub/Herb: early successional stage disclimax or climax communities dominated by shrub vegetation (10m in height (tree cover (10%. shrub cover)25% or) - 33% of total cover). Used for communities that will be forested at climax
3a	Low Shrub: early successional stage disclimax or climax communities dominated by shrub cover (2m in height (tree cover (10%. shrub cover)25% or) - 33% of total cover)
3b	Tall Shrub: early successional stage disclimax or climax communities dominated by shrub cover 2 to 10m in height (tree cover (10%. shrub cover)25% or) - 33% total cover
4	Pole/Sapling: Trees)10m tall that have over topped the shrub and herb layers. Stands are typically dense.
5	Young forest: Self thinning is usually evident and the forest canopy has begun differentiation into distinct layers (40-80yrs).
6	Mature Forest: Trees that were established after the last disturbance have matured and a second cycle of shade tolerant trees may have established (80-250yrs for ESSFmv2: 80-140yrs for BWBSmwl and SBSwk2).
7	Old Forest: Old structurally complex stands ()250yrs ESSFmv2:)140yrs for BWBSmwl and SBSwk2).

SAMPLE LOCATION

Extent of Mapping Boundary

Date of Photography: May 20, 1994.
Scale of Photography: 1:20 000
Photo Indentifiable Survey Control supplied by: Globaltex Coal Corporation
Survey Control based on: UTM NAD27 (crosses)
Mine Grid (lines) based on: Supplied common survey points
Compiled by The ORTHOSHOP, Calgary, October 1994
VO 4652

Limits of Survey Control.
Mapping beyond limits may not meet
normal mapping accuracy.

PINE VALLEY COAL CORPORATION

British Columbia

Scale 1:5000

meters 50 0 50 100 150 200 250 meters

contour interval 5m

UTM
Mine Grid

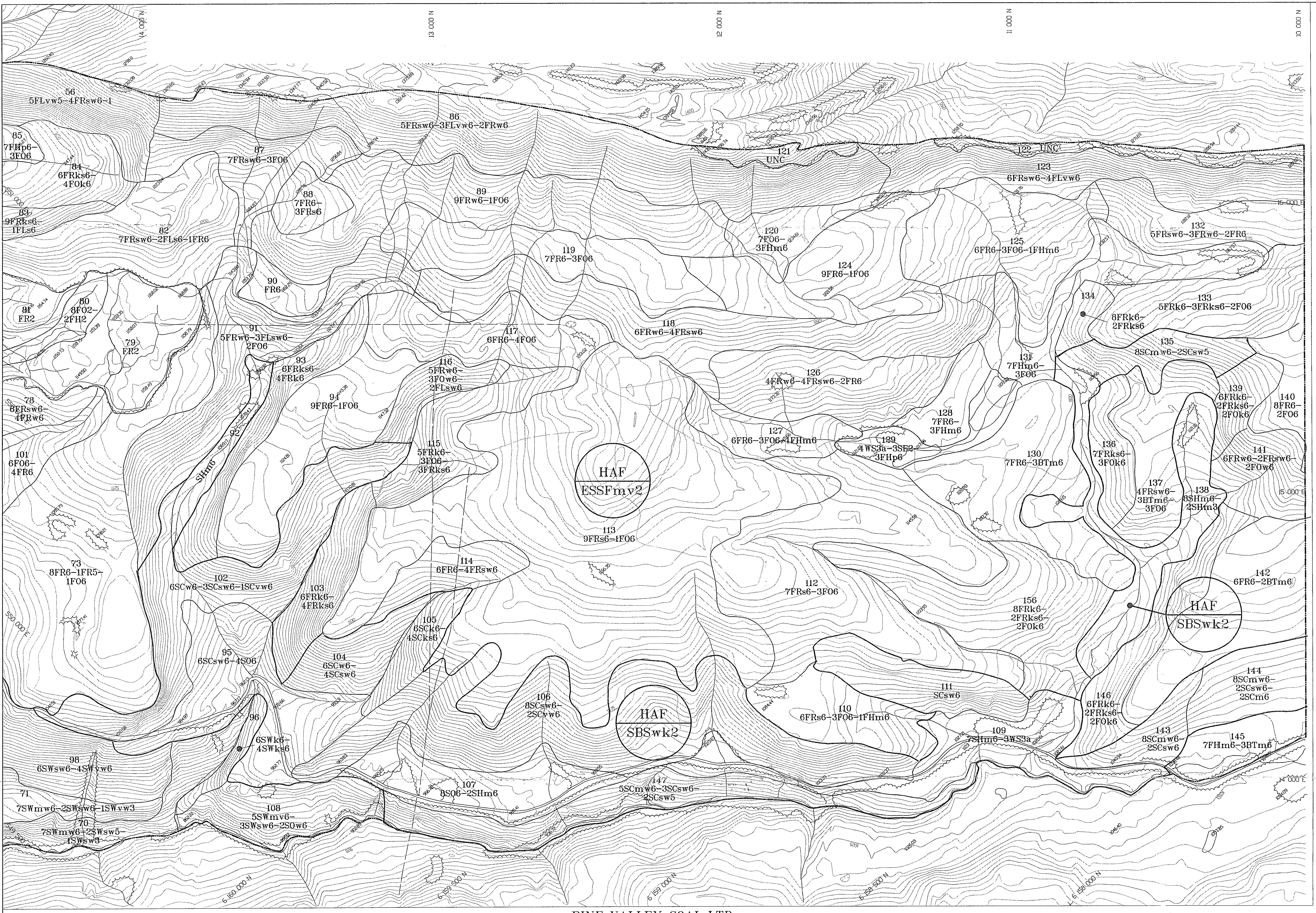
2

Paved Road
Gravel Road
Trail
Railway
Fence
Retaining Wall
River
Stream
Ditch
Index Contour
Intermediate Contour
Depression

Pole
Post
Light Standard
Manhole
Fire Hydrant
Catch Basin
Culvert

Intermittent Lake
Swamp or Marsh
Trees
Single Tree
Building

FIGURE 4.10–1
ECOSYSTEM UNITS OF
PINE VALLEY COAL PROJECT
AREA



LEGEND

MAP LABEL

Ecosection Unit Label **HAF**

Biogeoclimatic Unit Labels **BWBSmw1, SBSwk2, ESSFmv2**

Biogeoclimatic Unit Label

BWBSmw1
Zone Subzone Variant

Pure map unit (polygon contains a single ecosystem unit)

Site Series — Site Modifier
FRs6
Structural Stage

Complex map unit (polygon contains up to three ecosystem units)

Site Series — Percent of Polygon Occupied
6FRw6 – 4FRsw6
Site Modifier — Structural Stage

MAP SYMBOLS

OW Shallow open water

MAP BOUNDARIES

Ecosystem Unit ▬ ▬ ▬

Biogeoclimatic Unit ━━━

Ecosystem (Polygon) Unit ───

ECOSECTION UNITS

HAF	Hart Foothills Ecosection

BIOGEOCLIMATIC UNITS AND MAP SYMBOL

BWBSmw1	Boreal White and Black Spruce Moist Warm, Peace Variant
SBSwk2	Sub-Boreal Spruce Wet Cool, Finlay - Peace Variant
ESSFmv2	Engelmann Spruce - Subalpine Fir Moist Very Cold, Bullmoose Variant

ECOSYSTEM UNITS

Map Symbol	Biogeoclimatic unit/ Site Series	Name
AM	BWBSmwl/01	SwAT - Step moss
SW	BWBSmwl/03	Sw - Wildrye - Peavine
SO	BWBSmwl/05	Sw - Currant - Oak fern
SC	BWBSmwl/06	Sw - Currant - Bluebells
SH	BWBSmwl/07	Sw - Currant - Horsetail
AS	BWBSmwl/00	SwAt - Soopolallie
SE	BWBSmwl/00	Sedge Fen
WH	BWBSmwl/00	Willow - Horesetail - Sedge Riparian Wetland
LH	SBSwk2/02	Pl - Huckleberry - Cladina
SO	SBSwk2/01	Sxw - Oak fern
SC	SBSwk2/03	Sxw - Huckleberry - Highbush - cranberry
SD	SBSwk2/05	Sxw - Devil's club
SH	SBSwk2/06	Sxw - Horsetail
WS	SBSwk2/00	Willow - Sedge Fen
FR	ESSFmv2/01	Bl - Rhododendron - Feathmoss
FL	ESSFmv2/02	Bl - Lingonberry
BT	ESSFmv2/03	BlSb - Labrador tea
FO	ESSFmv2/04	Bl - Oak fern - Knight's plume
FH	ESSFmv2/06	Bl - Alder - Horsetail
SE	ESSFmv2/00	Sedge Fen
WS	ESSFmv2/00	Willow - Sedge Fen
UNC	ESSFmv2/00	Unclassified forb meadow

Site Modifiers

c	coarse textured soils (includes sandy loam, loamy sand, sand textures, fine matrix with over 70% coarse fragments and medium matrix with over 35% coarse fragments)
f	fine textured soils (heavy clay, silty clay, clay and sandy clay textures)
j	gentle slopes (less than 25% slope)
k	cool northerly or easterly aspect (285 - 135 degrees, slopes greater than 25%)
m	medium textured soils (includes silty clay loam, clay loam, silt, silt loam, loam, and sandy clay loam textures)
n	fan (colluvial, or fluvial) or cone
r	ridge or crest
w	warm, southerly or westerly aspect (135 - 285 degrees, slopes greater than 25%).
p	peaty soil
s	shallow soil (25-100cm to bedrock)
v	very shallow soil (less than 25cm mineral soil over bedrock)

STRUCTURAL STAGES

Description	
1a	Non-vegetated: less than 5% vegetation cover
1b	Sparse: less than 10% vegetative cover
2	Herb: early successional stage disclimax or climax, dominated by herbaceous vegetation (tree cover <10%, herb cover >25% or >-33% of total cover)
3	Shrub/Herb: early successional stage disclimax or climax communities dominated by shrub vegetation <10m in height (tree cover <10%, shrub cover >25% or > - 33% of total cover). Used for communities that will be forested at climax
3a	Low Shrub: early successional stage disclimax or climax communities dominated by shrub cover <2m in height (tree cover <10%, shrub cover >25% or > - 33% of total cover)
3b	Tall Shrub: early successional stage disclimax or climax communities dominated by shrub cover 2 to 10m in height (tree cover <10%, shrub cover >25% or > - 33% total cover
4	Pole/Sapling: Trees >10m tall that have over topped the shrub and herb layers. Stands are typically dense.
5	Young forest: Self thinning is usually evident and the forest canopy has begun differentiation into distinct layers (40-80yrs).
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7	Old Forest: Old structurally complex stands 0250yrs ESSFmv2: >140yrs for BWBSmwl and SBSwk2).

SAMPLE LOCATION

Extent of Mapping Boundary ━ • ━ • ━

Date of Photography: May 20, 1994.
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PINE VALLEY COAL LTD.

British Columbia

Scale 1:5000

meters 50 0 50 100 150 200 250 meters

contour interval 5m

UTM
Mine Grid

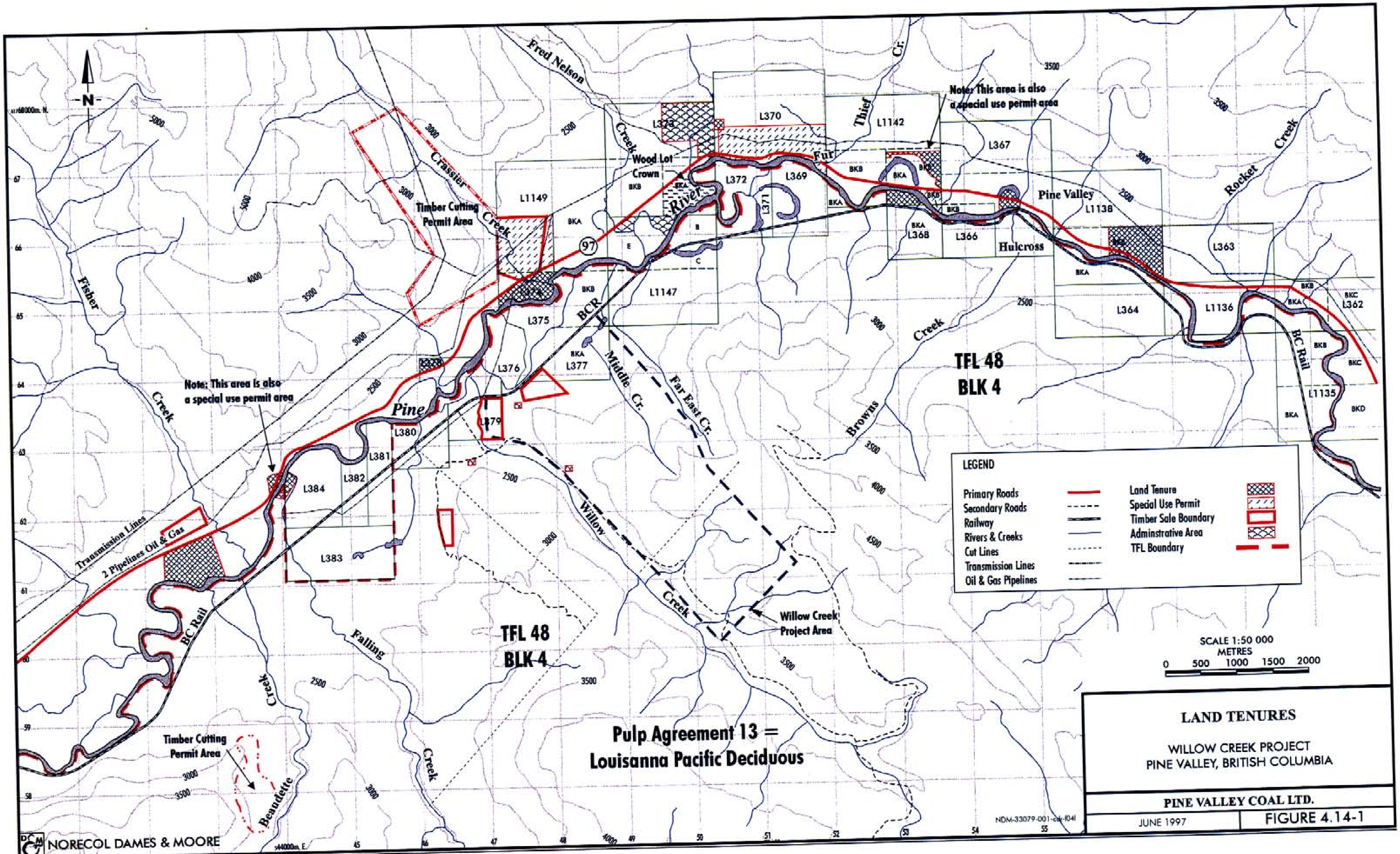
1 2

Paved Road
Gravel Road
Trail
Railway
Fence
Retaining Wall
River
Stream
Ditch
Index Contour
Intermediate Contour
Depression

Pole
Post
Light Standard
Manhole
Fire Hydrant
Catch Basin
Culvert

Intermittent Lake
Swamp or Marsh
Trees
Single Tree
Building

FIGURE 4.10–2
ECOSYSTEM UNITS OF
PINE VALLEY COAL PROJECT
AREA



LAND TENURES

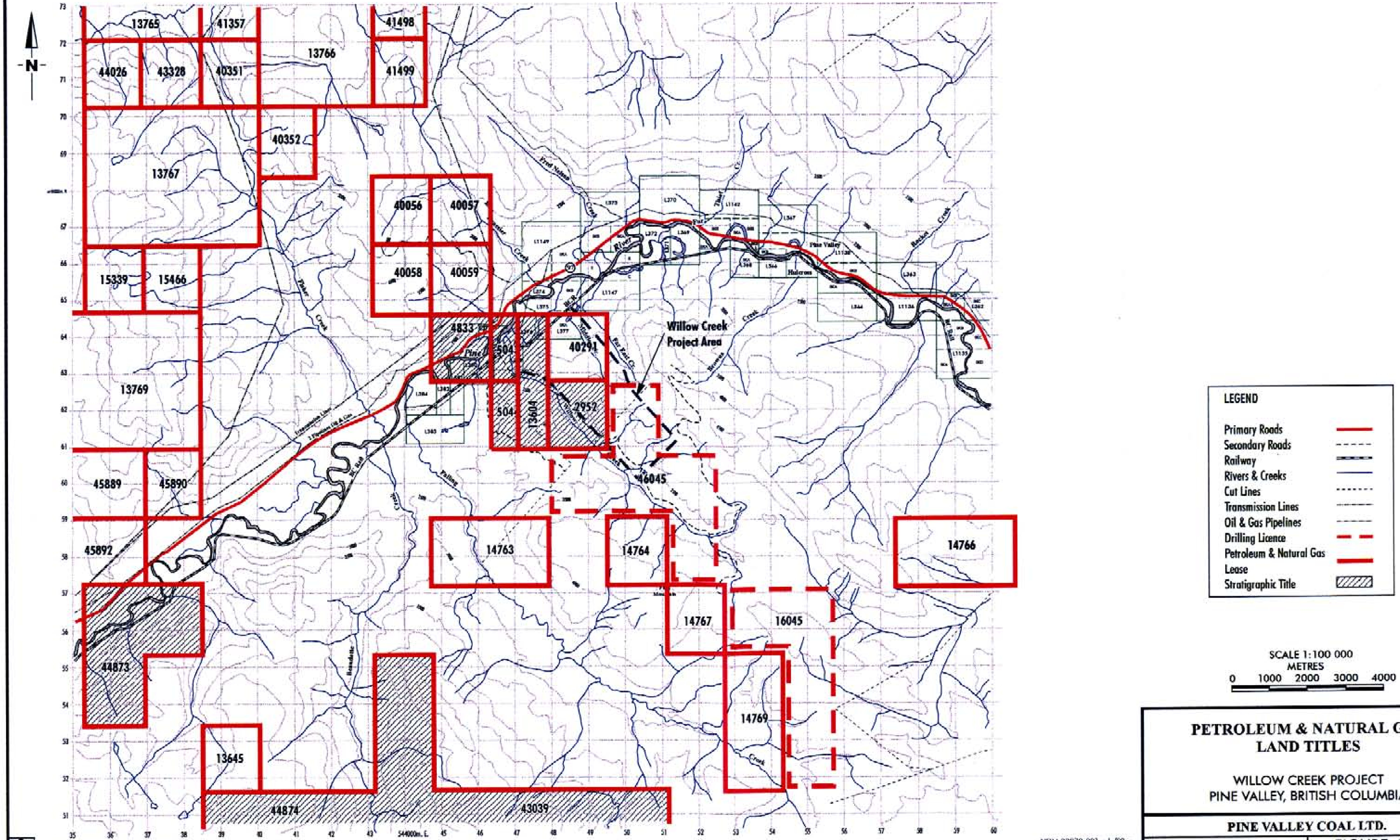
WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

PINE VALLEY COAL LTD.

JUNE 1997

FIGURE 4.14-1

NORECOL DAMES & MOORE
GROUP A DAMES & MOORE SUBSIDIARY



PETROLEUM & NATURAL GAS LAND TITLES

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

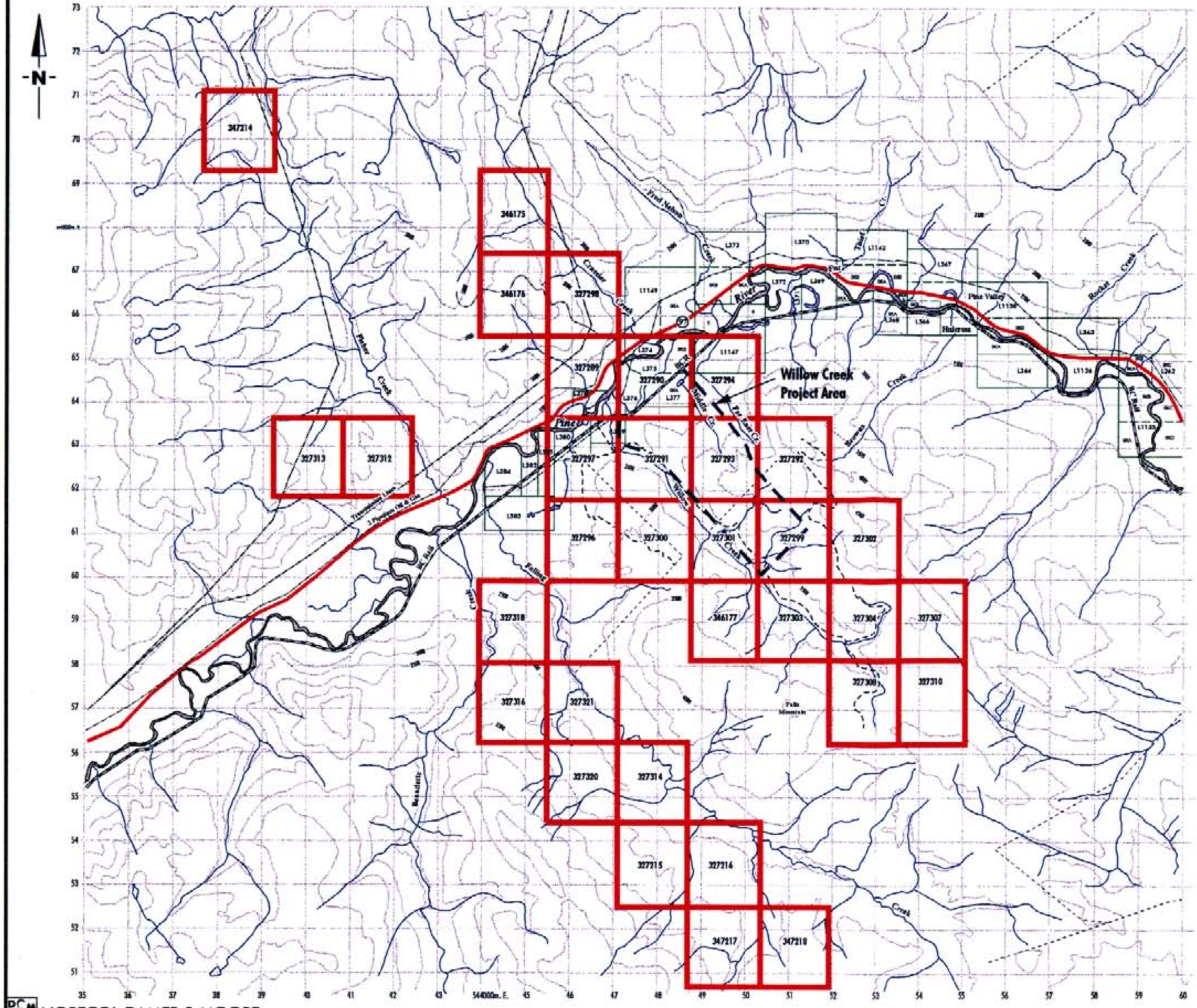
PINE VALLEY COAL LTD.

JUNE 1997

FIGURE 4.14-2

NDM-33079-001-cdr-f02pg

NORECOL DAMES & MOORE
GROUP A DAMES & MOORE SUBSIDIARY



LEGEND

Primary Roads	🟥
Secondary Roads	- - - -
Railway	━━━
Rivers & Creeks	───
Cut Lines	- - - -
Transmission Lines	-·-·-·-
Oil & Gas Pipelines	-··-··-

SCALE 1:100 000
METRES
0 1000 2000 3000 4000

PINE VALLEY COAL LTD.
COAL LICENCES

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

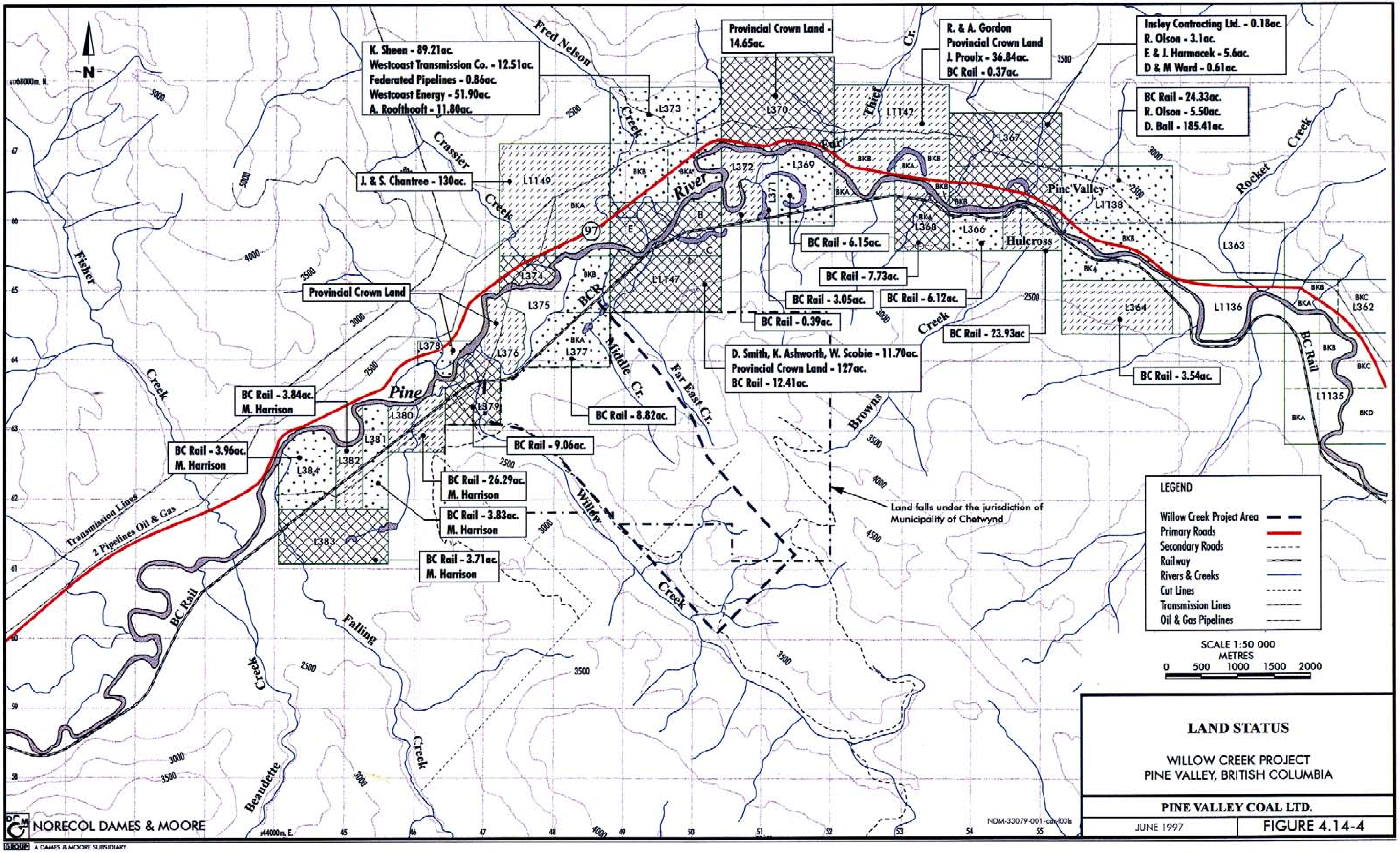
PINE VALLEY COAL LTD.

JUNE 1997

FIGURE 4.14-3

NDM-33079-001-cdr-f01d

NORECOL DAMES & MOORE
GROUP A DAMES & MOORE SUBSIDIARY



LAND STATUS

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

PINE VALLEY COAL LTD.

JUNE 1997

FIGURE 4.14-4

NORECOL DAMES & MOORE
GROUP A DAMES & MOORE SUBSIDIARY

Figure 4.15-1
pH vs NP
Willow Creek Coal

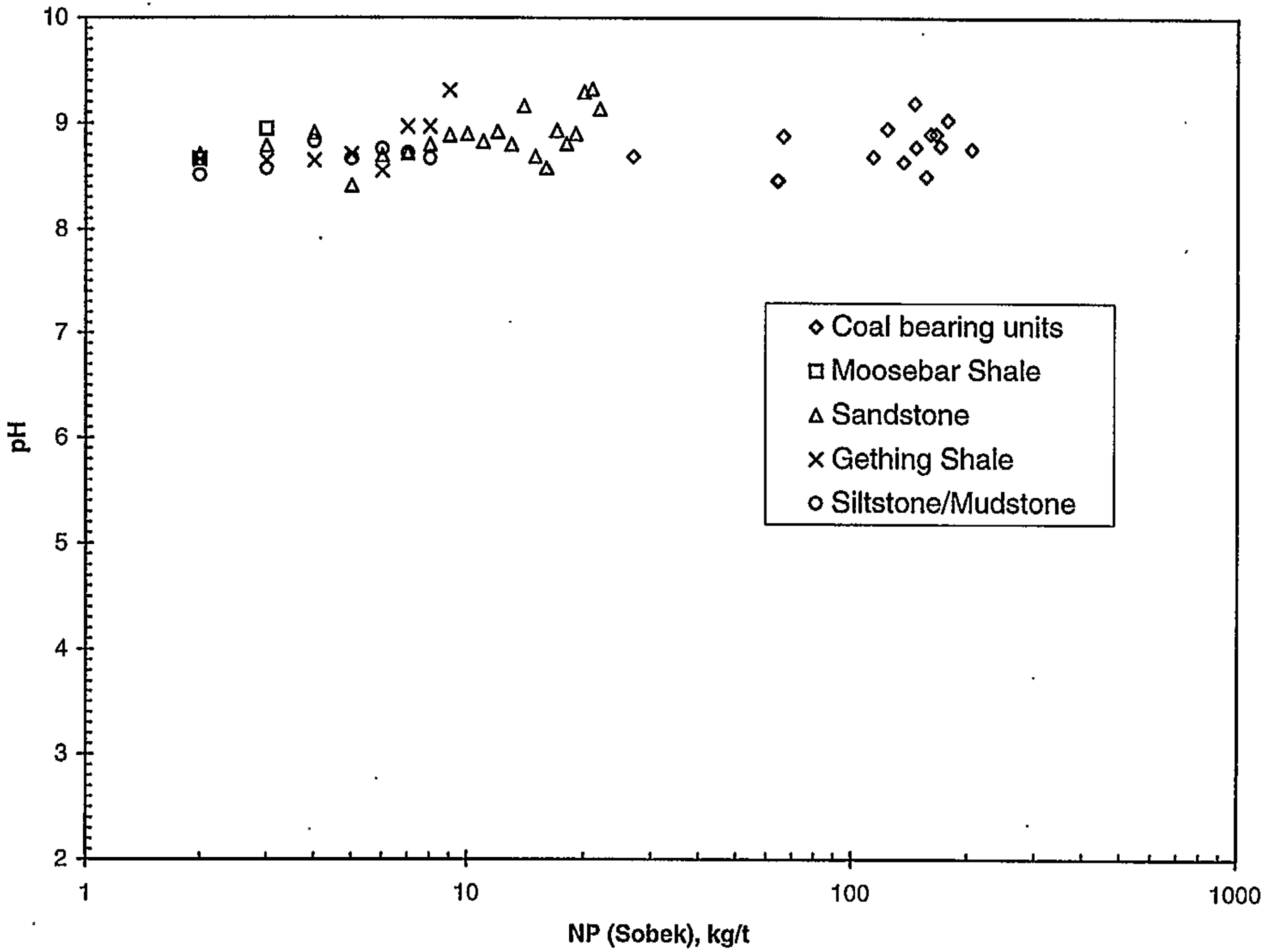


Figure 4.15-2
NP vs AP
Willow Creek Coal

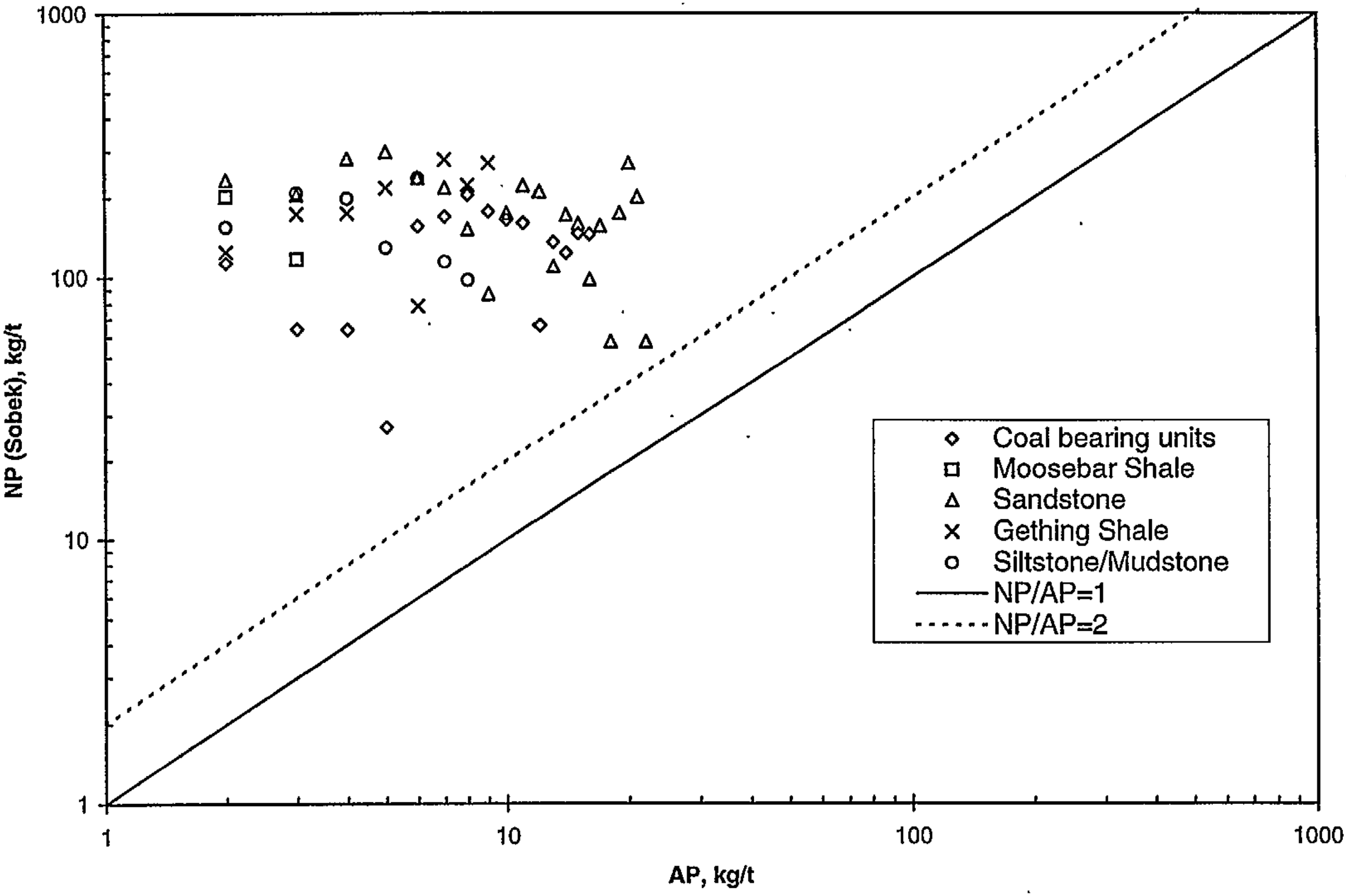


Figure 4.15-3
Acid Potential
Willow Creek Coal

(P10, Geometric Mean, P90)

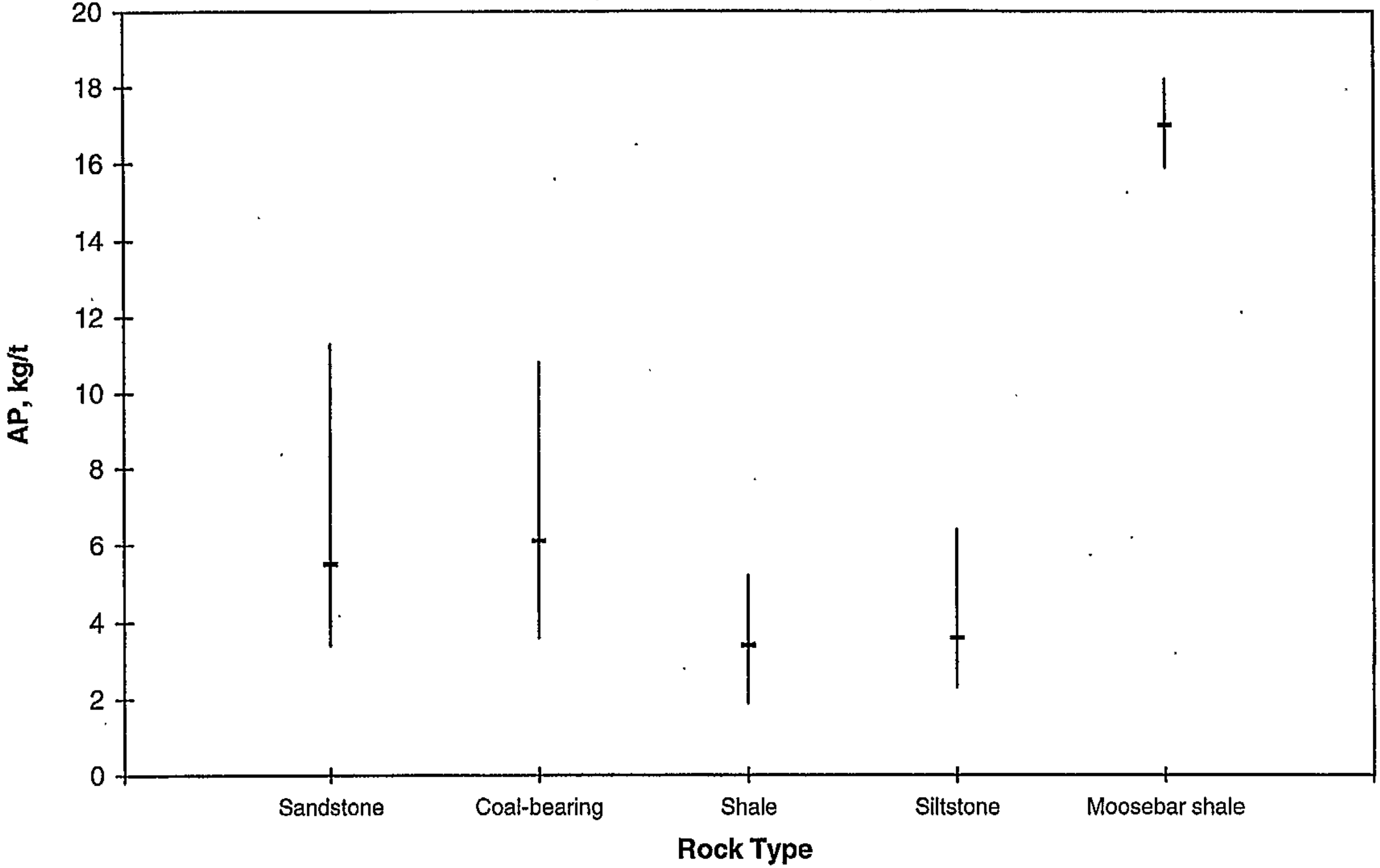


Figure 4.15-4
Neutralization Potential
Willow Creek Coal
(P10, Geometric Mean, P90)

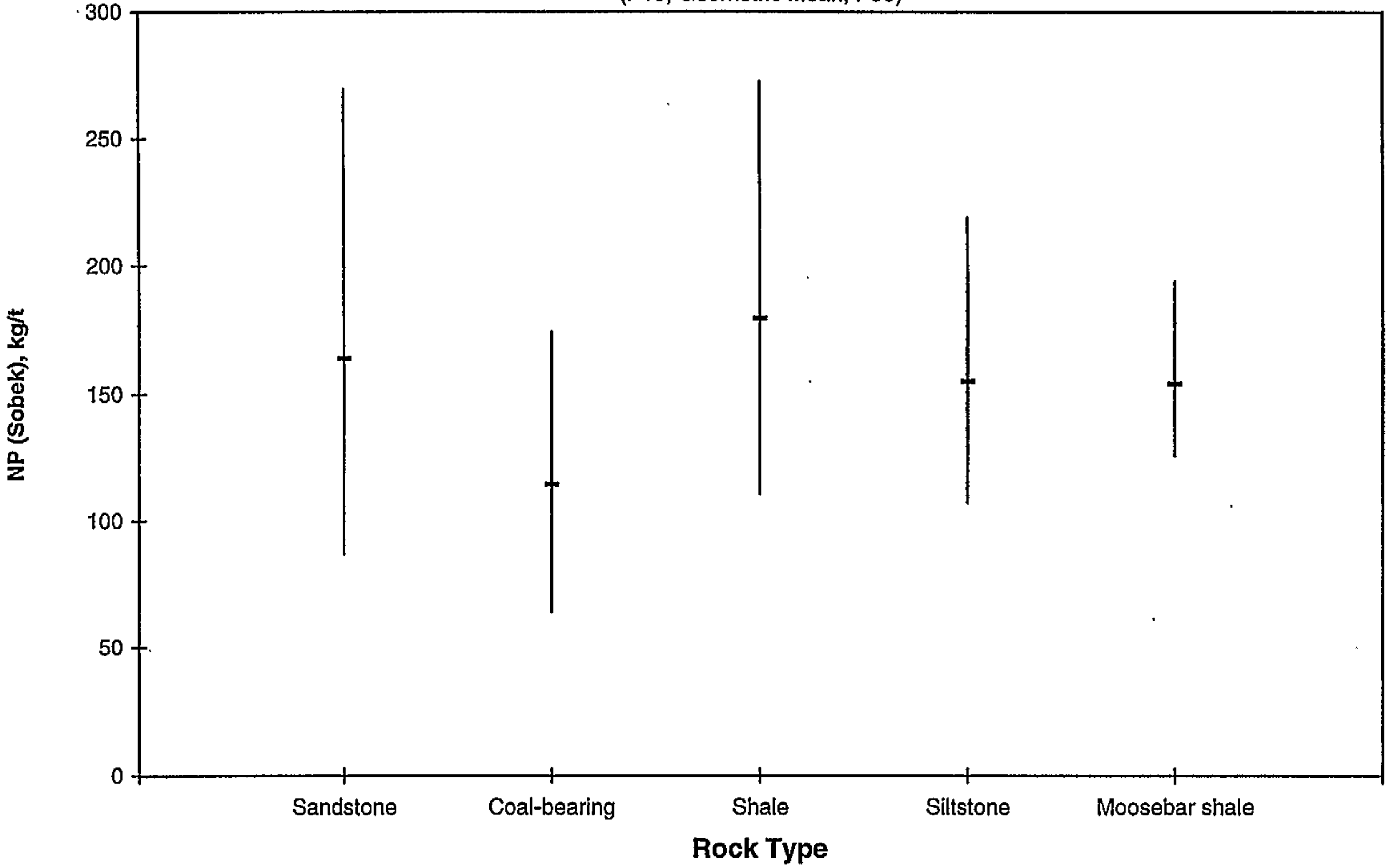


Figure 4.15-5
NP/AP
Willow Creek Coal

(P10, Geometric Mean, P90)

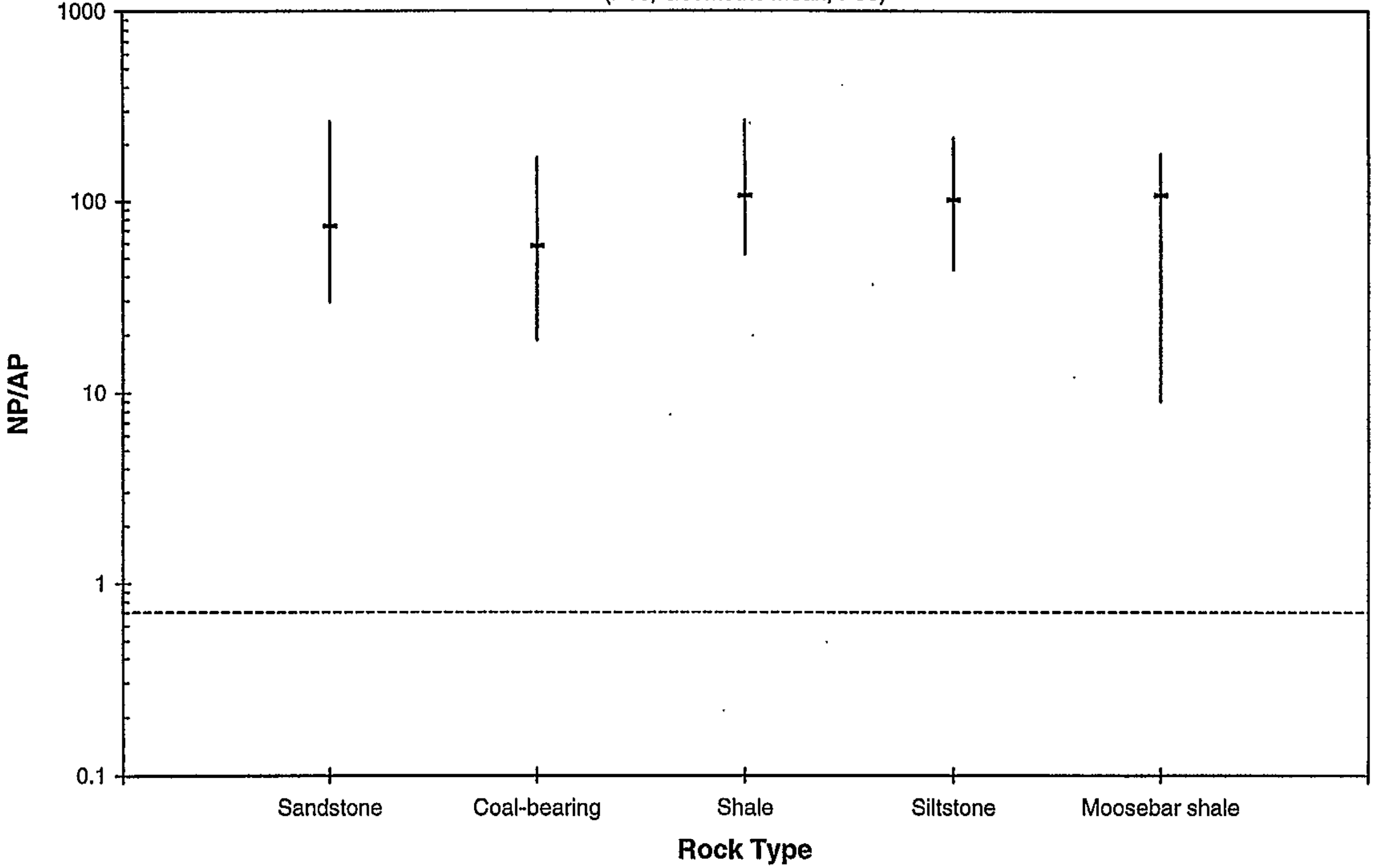


Figure 4.15-6
pH vs NP
Willow Creek Coal

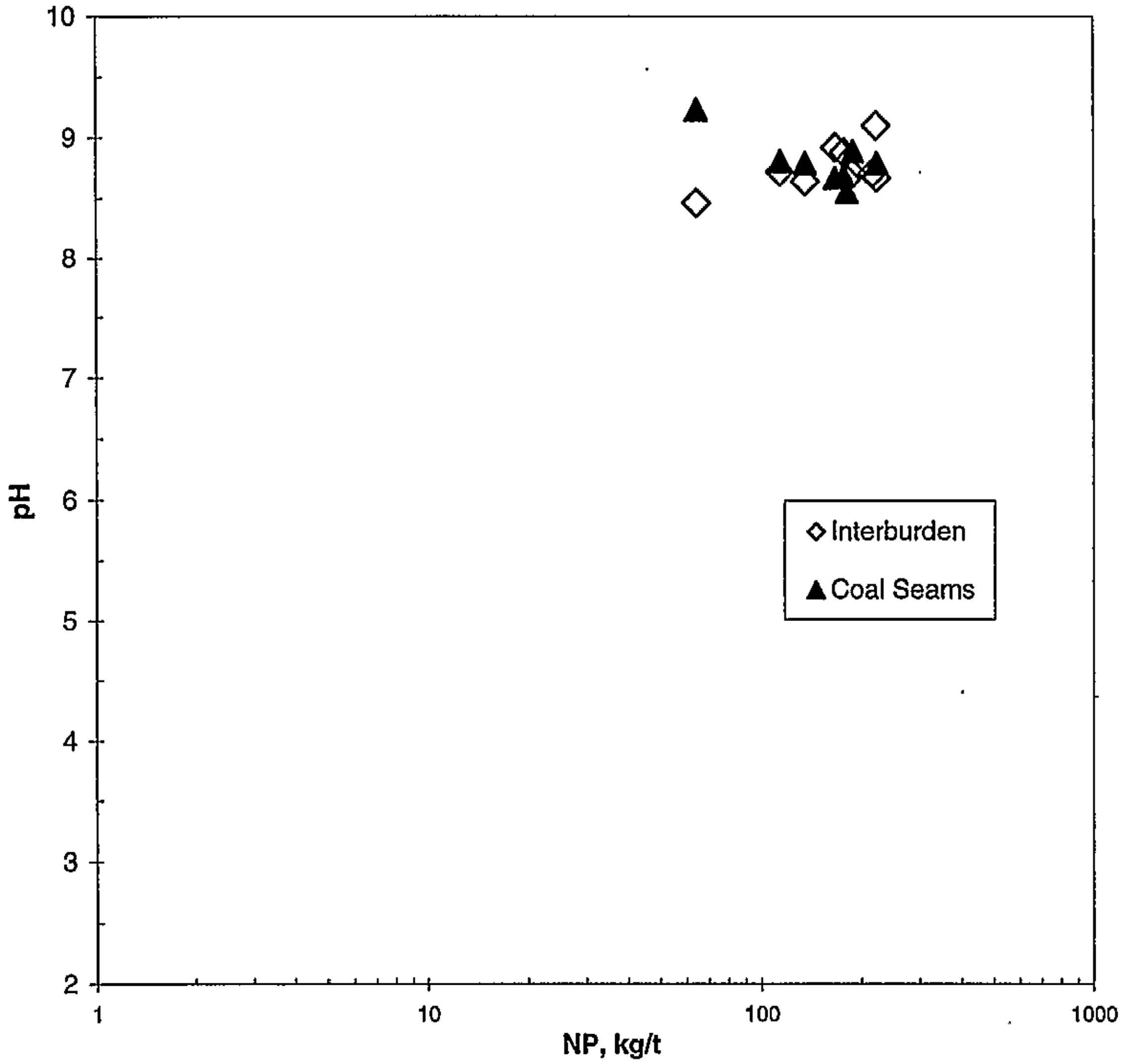


Figure 4.15-7
NP vs AP
Willow Creek Coal

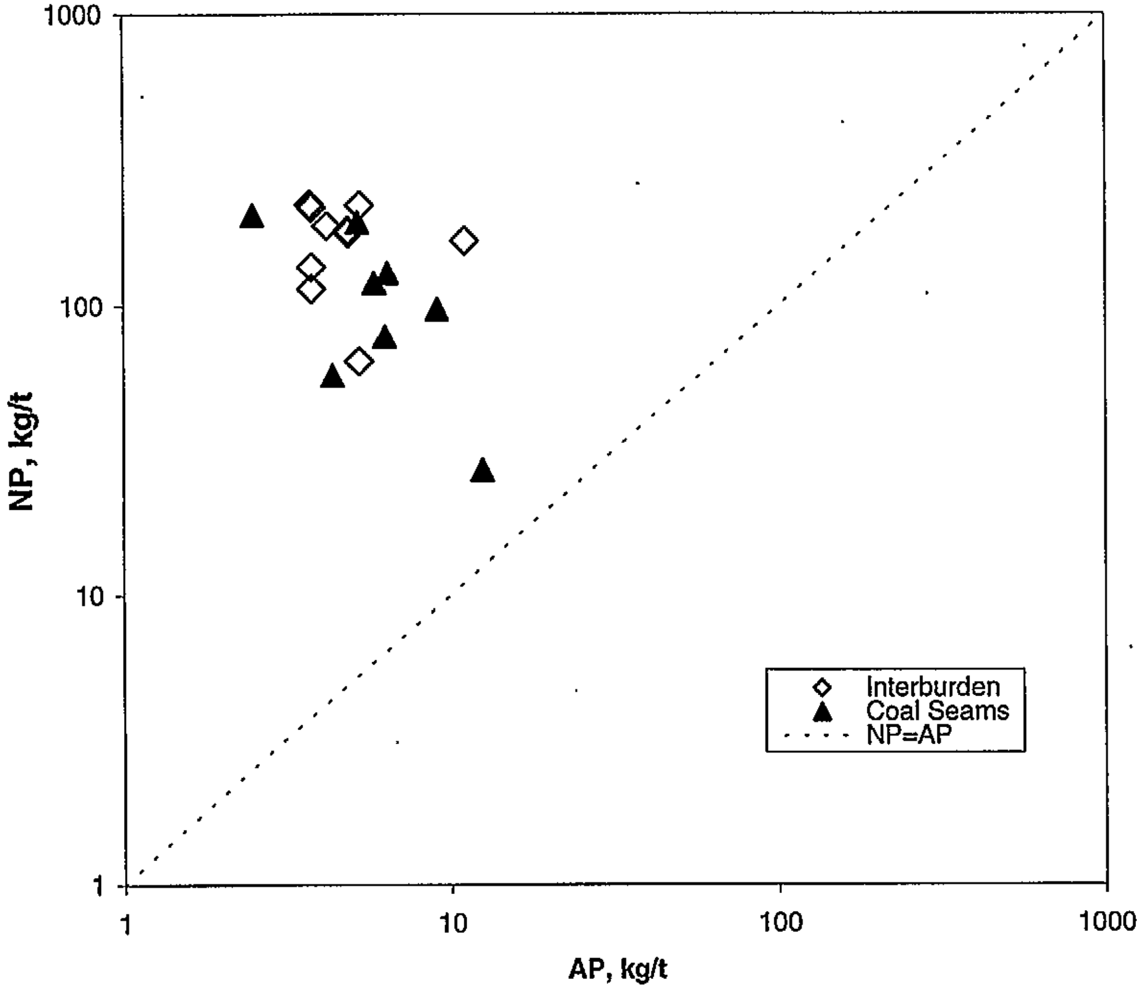
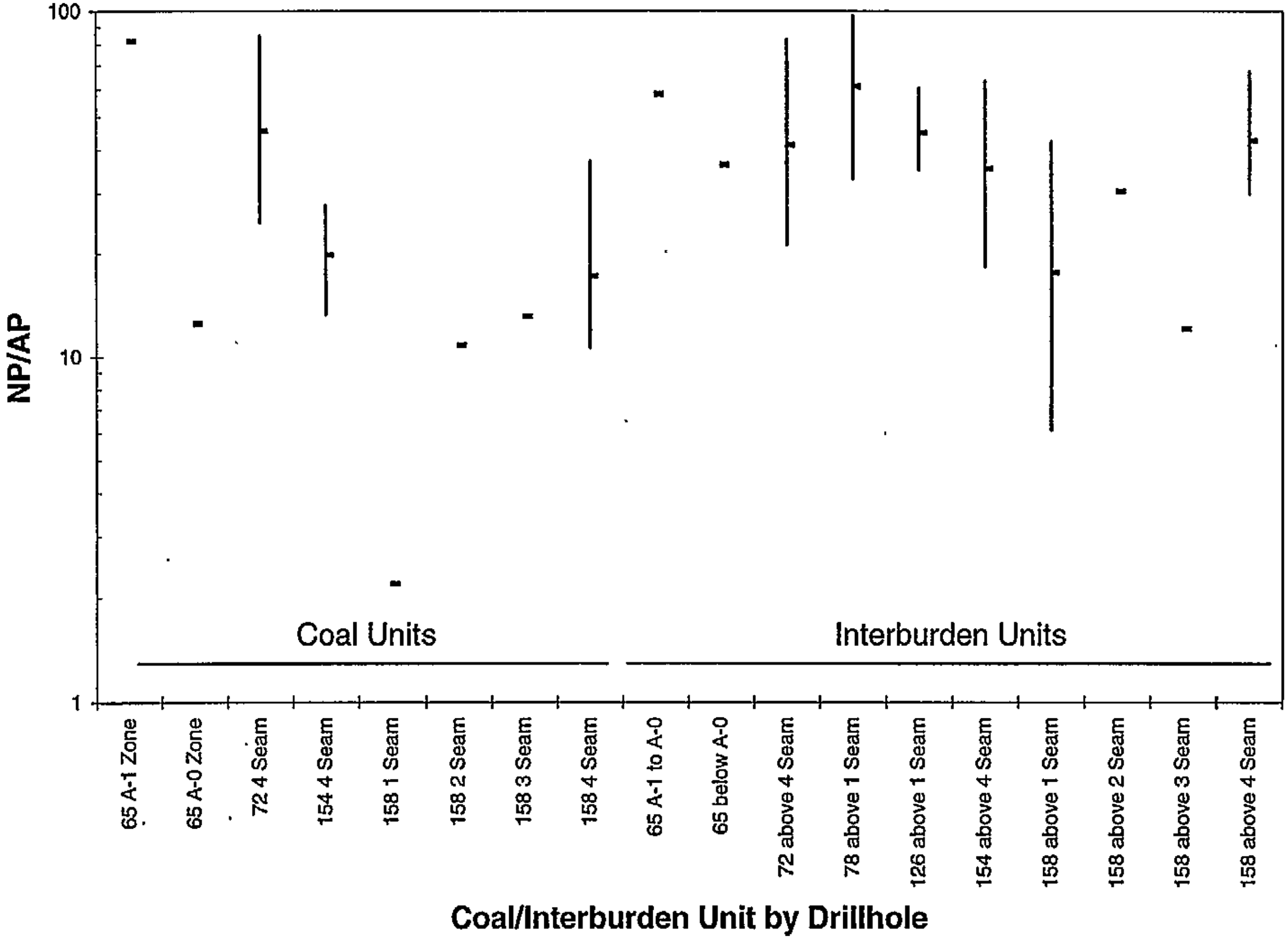


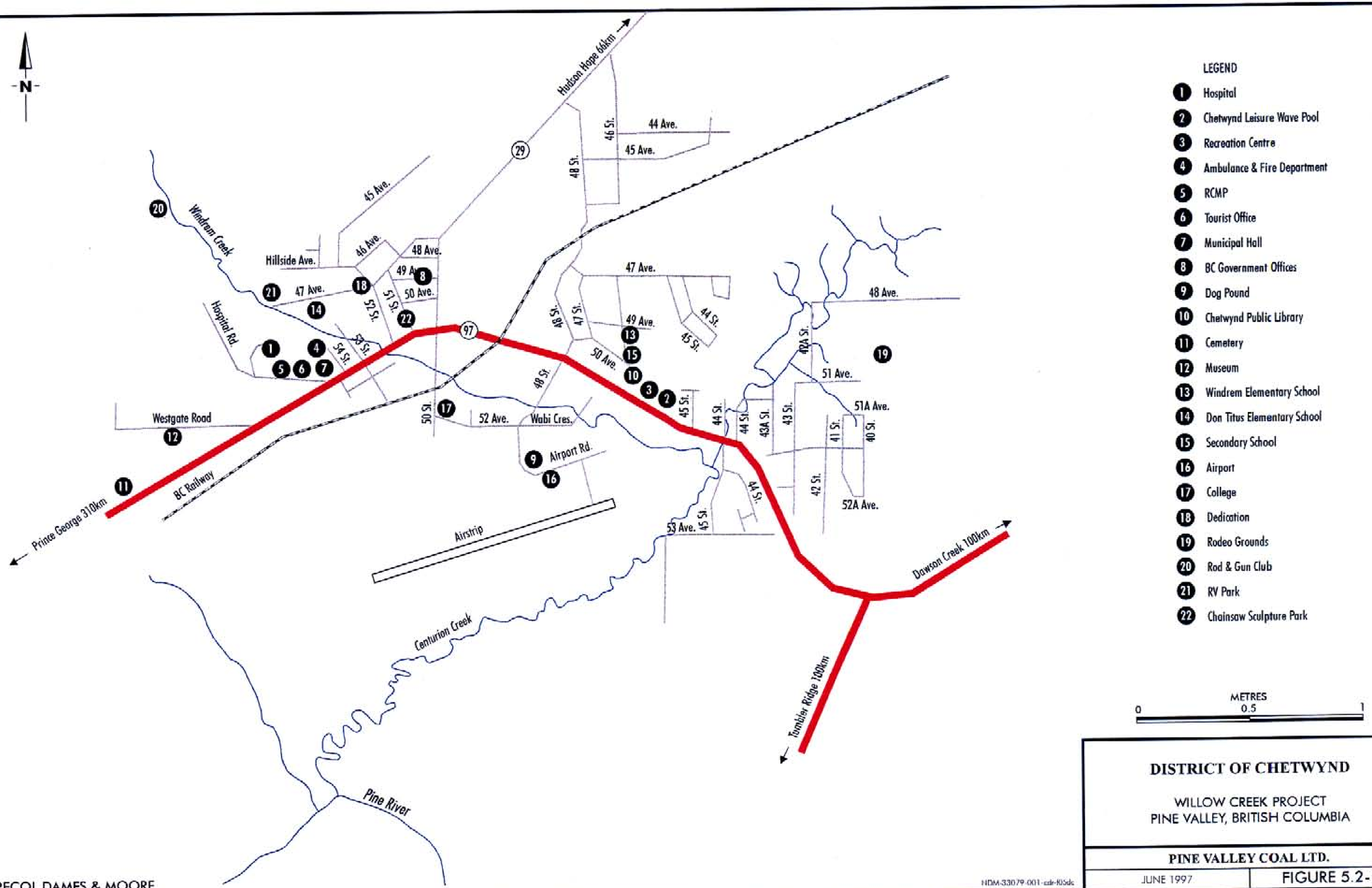
Figure 4.15-8

NP/AP by Coal/Interburden Unit

Willow Creek Coal

(P10, Geometric Mean, P90)





DISTRICT OF CHETWYND

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

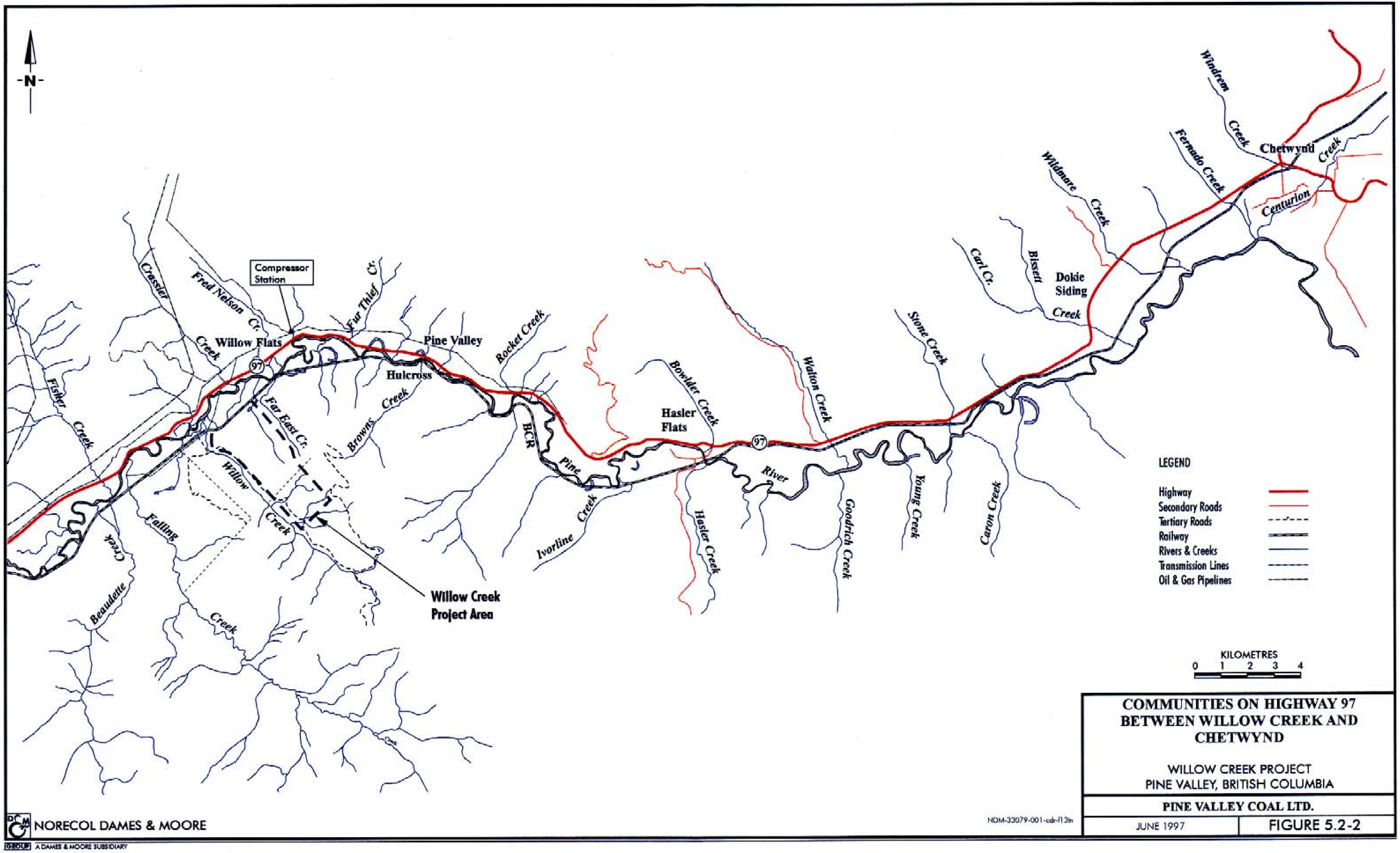
PINE VALLEY COAL LTD.

JUNE 1997

FIGURE 5.2-1

NDM-33079-001-cdr-f05dc

NORECOL DAMES & MOORE
GROUP A DAMES & MOORE SUBSIDIARY



COMMUNITIES ON HIGHWAY 97 BETWEEN WILLOW CREEK AND CHETWYND

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

PINE VALLEY COAL LTD.

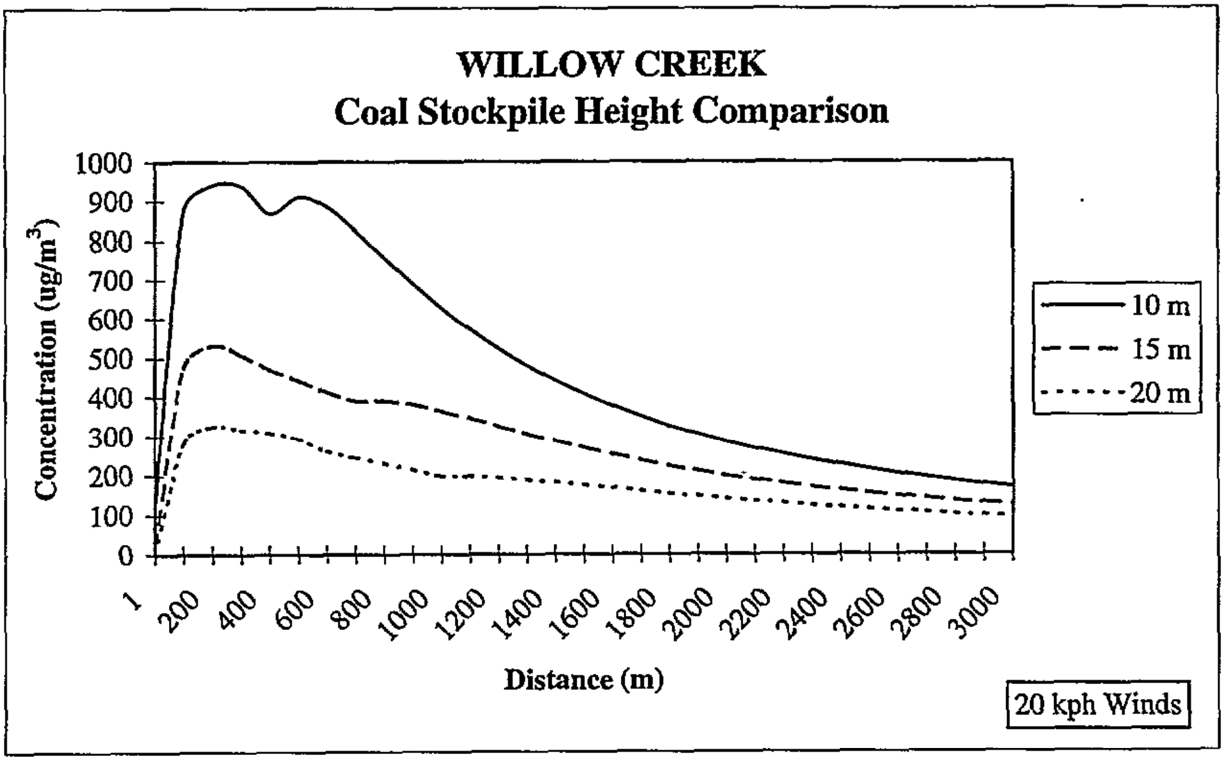
JUNE 1997

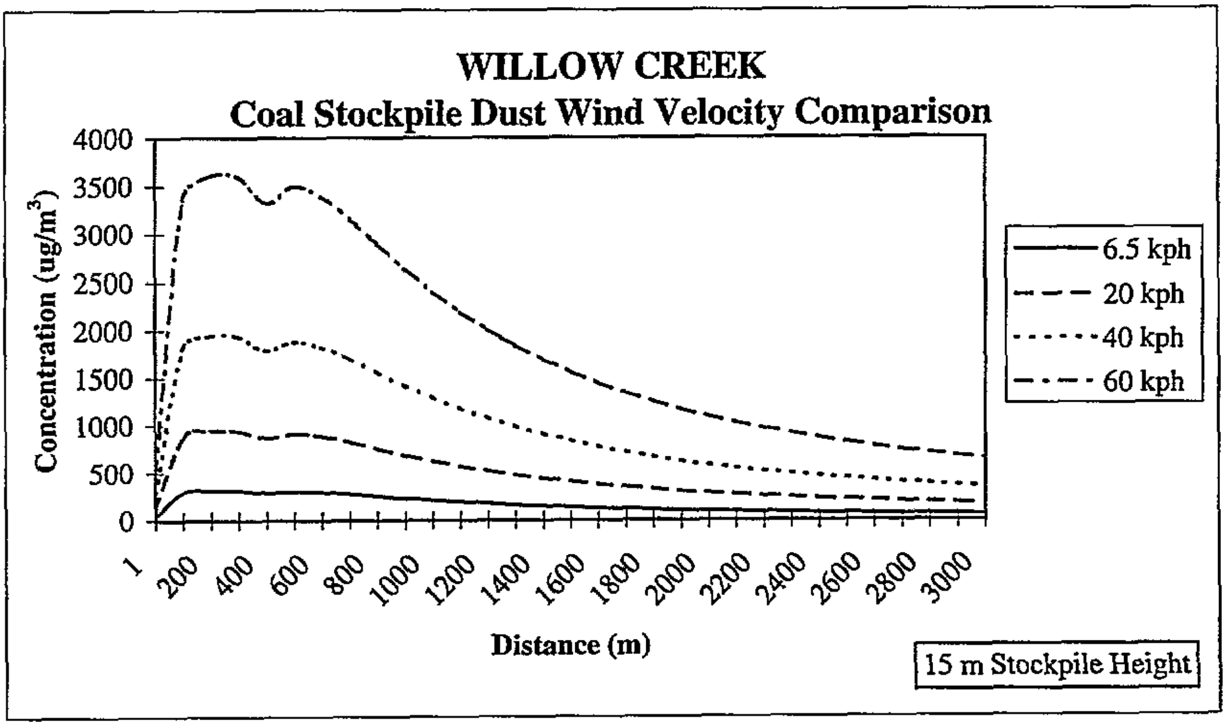
FIGURE 5.2-2

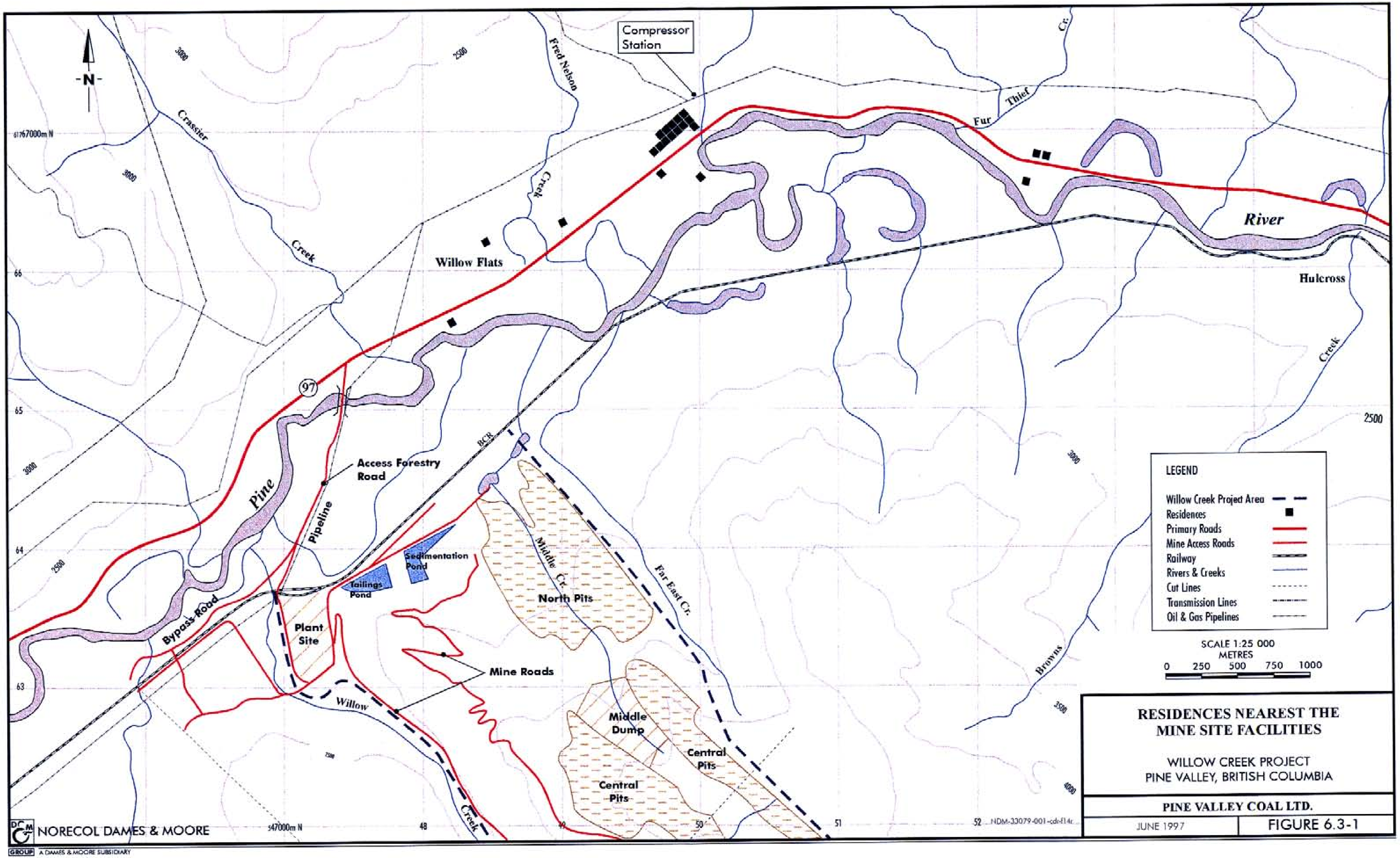
NDM-33079-001-cdr-f13m

NORECOL DAMES & MOORE
GROUP A DAMES & MOORE SUBSIDIARY

Figure 6.2-1


WILLOW CREEK
Coal Stockpile Height Comparison
Concentration (ug/m^3)
1000
900
800
700
600
500
400
300
200
100
0
1
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
Distance (m)
10 m
15 m
20 m
20 kph Winds


WILLOW CREEK
Coal Stockpile Dust Wind Velocity Comparison
Concentration (ug/m^3)
4000
3500
3000
2500
2000
1500
1000
500
0
1
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
Distance (m)
6.5 kph
20 kph
40 kph
60 kph
15 m Stockpile Height



RESIDENCES NEAREST THE MINE SITE FACILITIES

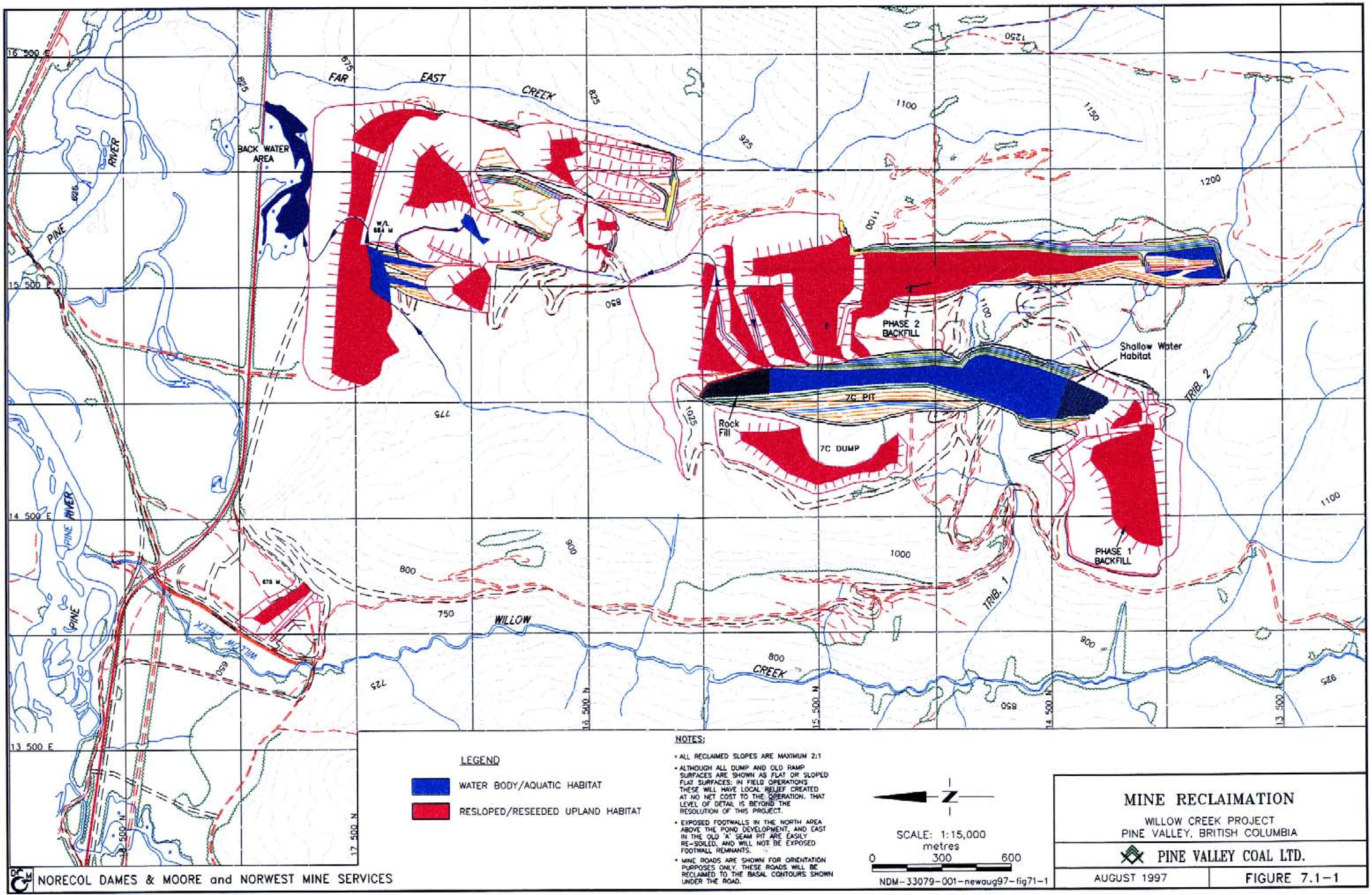
WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

PINE VALLEY COAL LTD.

JUNE 1997

FIGURE 6.3-1

NORECOL DAMES & MOORE
GROUP A DAMES & MOORE SUBSIDIARY



LEGEND

🟦 WATER BODY/AQUATIC HABITAT

🟥 RESLOPED/RESEEDED UPLAND HABITAT

NOTES:

- ALL RECLAIMED SLOPES ARE MAXIMUM 2:1
- ALTHOUGH ALL DUMP AND OLD RAMP SURFACES ARE SHOWN AS FLAT OR SLOPED FLAT SURFACES: IN FIELD OPERATIONS THESE WILL HAVE LOCAL RELIEF CREATED AT NO NET COST TO THE OPERATION. THAT LEVEL OF DETAIL IS BEYOND THE RESOLUTION OF THIS PROJECT.
- EXPOSED FOOTWALLS IN THE NORTH AREA ABOVE THE POND DEVELOPMENT, AND EAST IN THE OLD 'A' SEAM PIT ARE EASILY RE-SOILED, AND WILL NOT BE EXPOSED FOOTWALL REMNANTS.
- MINE ROADS ARE SHOWN FOR ORIENTATION PURPOSES ONLY. THESE ROADS WILL BE RECLAIMED TO THE BASAL CONTOURS SHOWN UNDER THE ROAD.

SCALE: 1:15,000
metres
0 300 600

NDM-33079-001-newaug97-fig71-1

MINE RECLAMATION

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

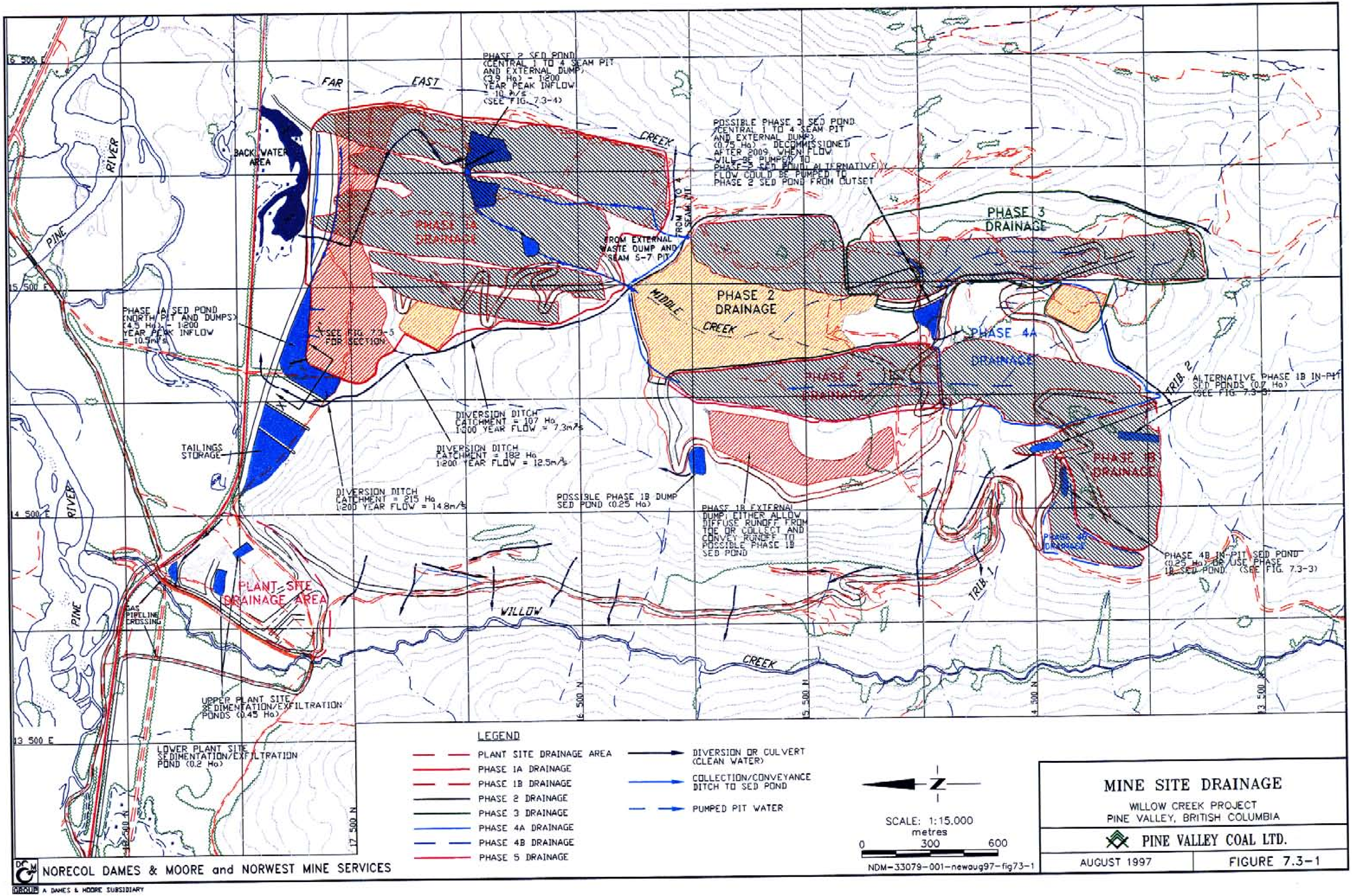
PINE VALLEY COAL LTD.

AUGUST 1997

FIGURE 7.1-1

NORECOL DAMES & MOORE and NORWEST MINE SERVICES

GROUP A DAMES & MOORE SUBSIDIARY



NDM-33079-001-newaug97-fig73-1

MINE SITE DRAINAGE

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

PINE VALLEY COAL LTD.

AUGUST 1997

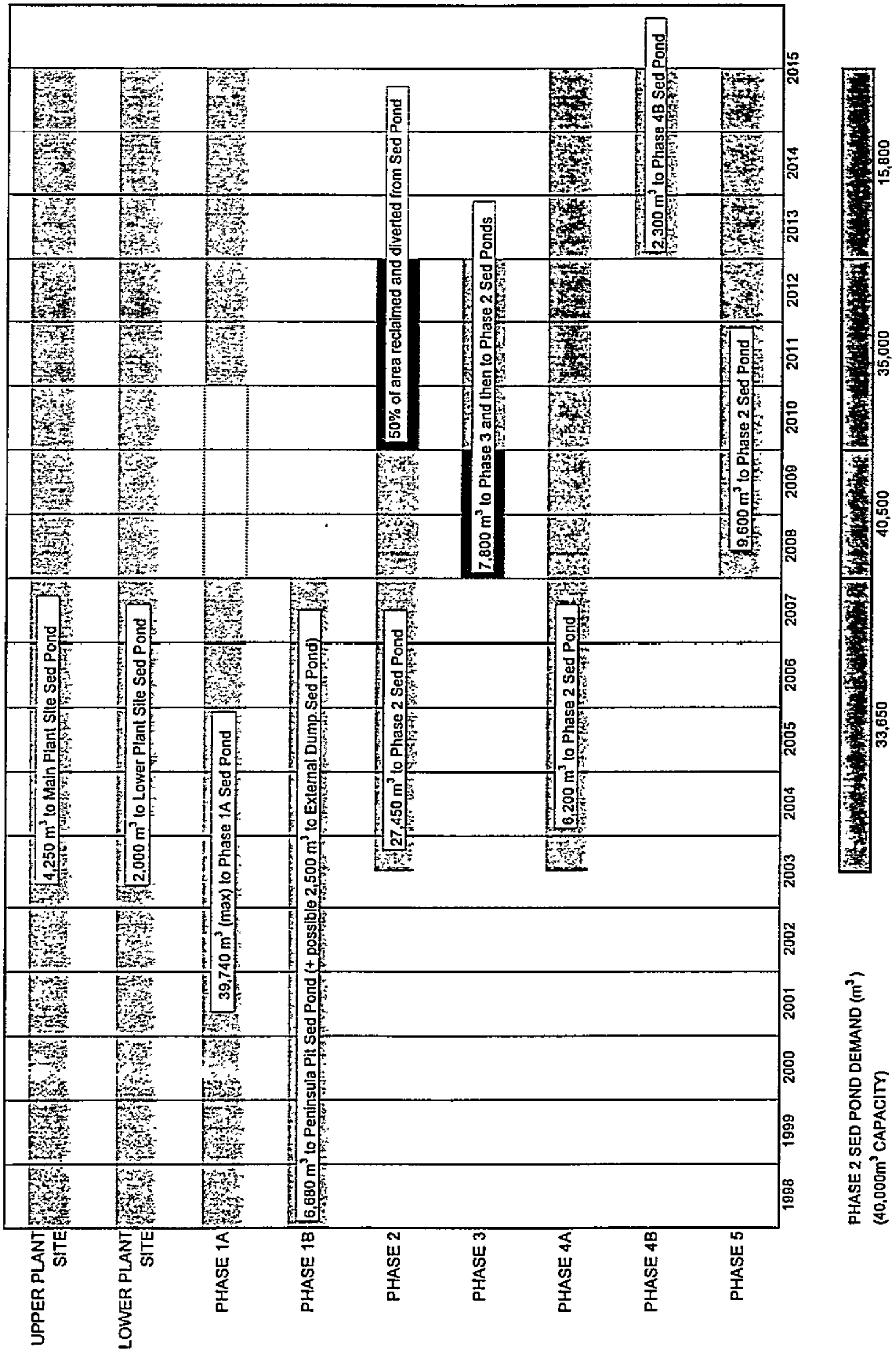
FIGURE 7.3-1

NORECOL DAMES & MOORE and NORWEST MINE SERVICES

GROUP A DAMES & MOORE SUBSIDIARY

DWG NUMBER: 1493

DESIGN STORM RETENTION VOLUMES AND SEDIMENTATION POND PHASING



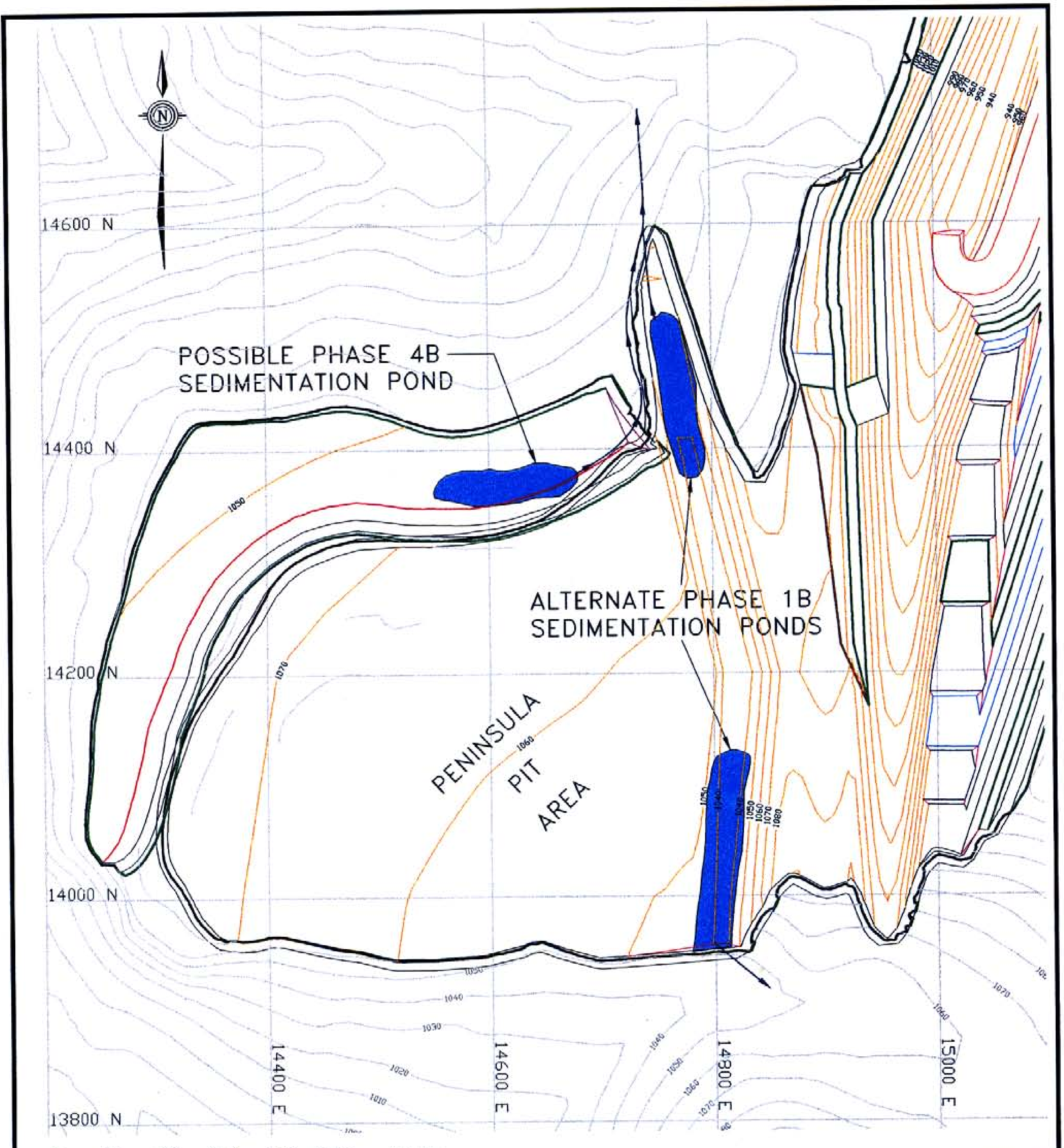
PINE VALLEY COALS LTD.
WILLOW CREEK PROJECT
PRELIMINARY GEOTECHNICAL STUDIES

PITEAU ASSOCIATES
GEOTECHNICAL & HYDROGEOLOGICAL CONSULTANTS
VANCOUVER CALGARY

SUMMARY OF CONCEPTUAL SEDIMENTATION PLAN PHASING

BY:	DATE:
ATH	JUL 97
APPROVED:	FIG:
	7.3-2

DWG. NUMBER: 1493-003



0 50 100 150 200 250m

NOTE:
ALTERNATIVE POND LOCATIONS SHOWN; ONLY ONE WOULD BE REQUIRED AT ANYTIME. NORTHERN POND COULD LIKELY SERVICE PENINSULA PIT AREA FOR ENTIRE MINE LIFE.

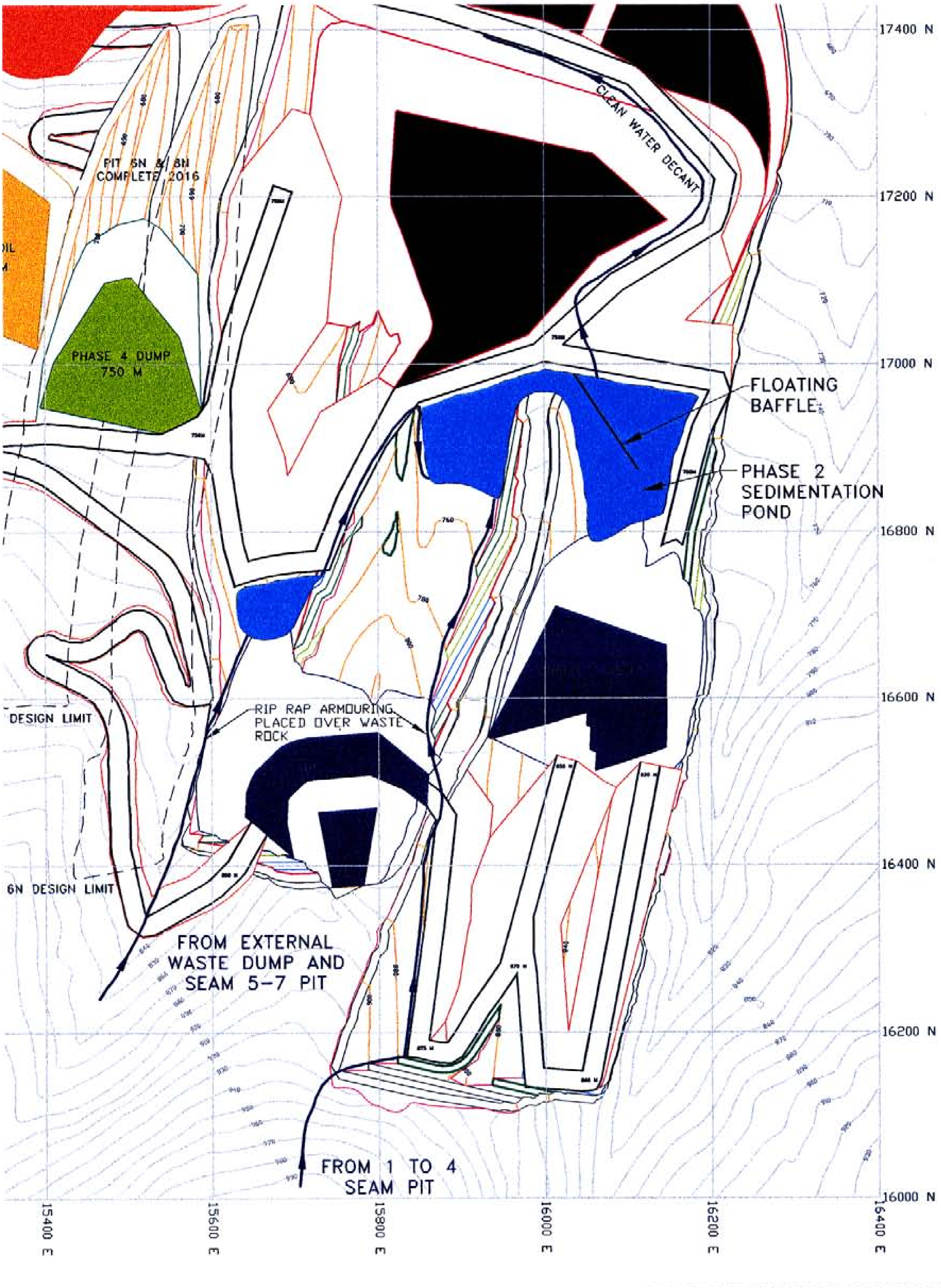
PINE VALLEY COAL LTD.
WILLOW CREEK PROJECT
PRELIMINARY GEOTECHNICAL STUDIES

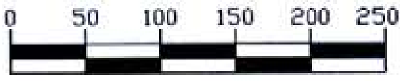
PITEAU ASSOCIATES
GEOTECHNICAL AND HYDROGEOLOGICAL CONSULTANTS
VANCOUVER CALGARY

CONCEPTUAL PLAN SHOWING PHASE 1B AND 4B (PENINSULA PIT) SEDIMENTATION POND LOCATIONS

BY:	DATE:
ATH/CV	JUL. 97
APPROVED:	FIG: 7.3-3

DWG. NUMBER: 1493-004





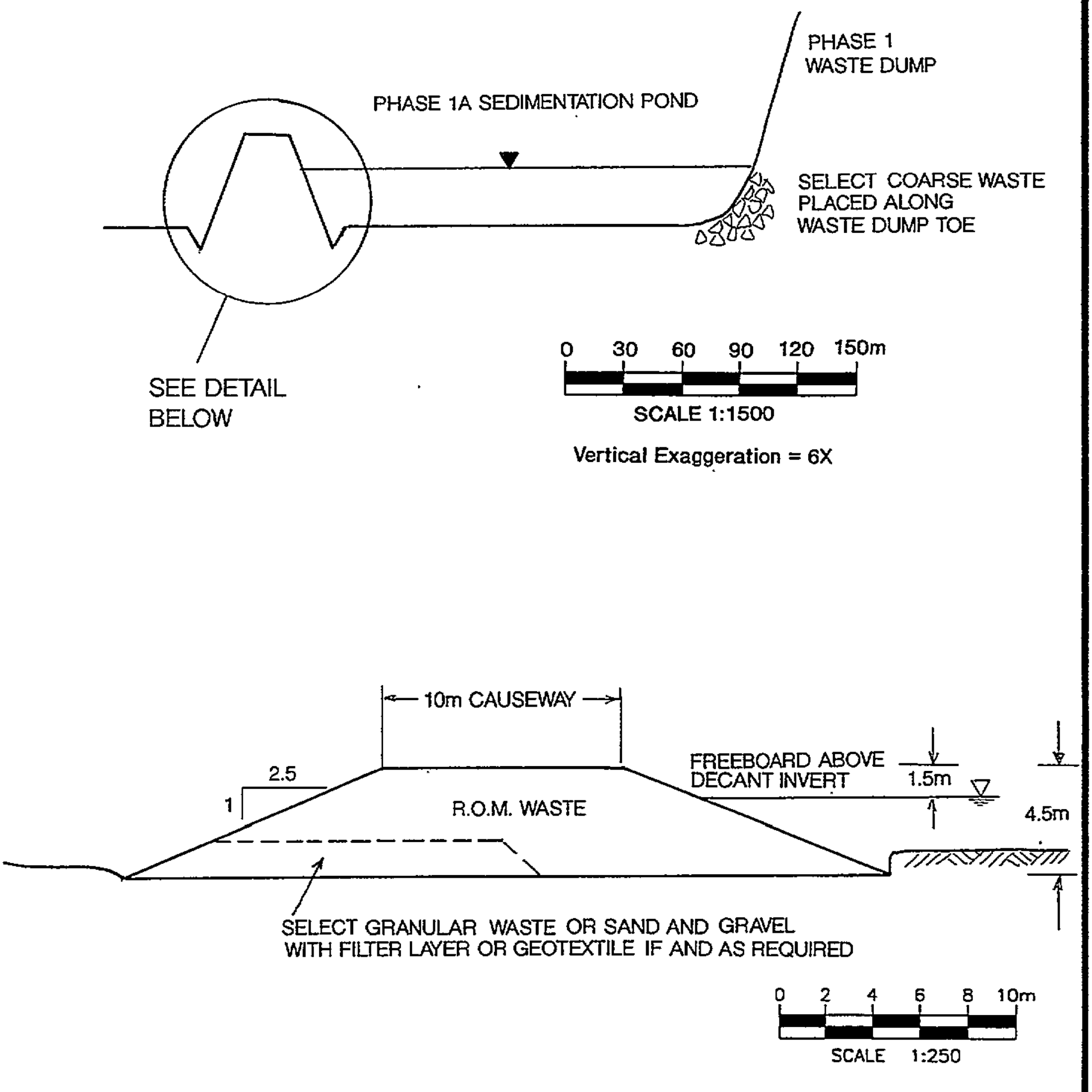
PINE VALLEY COAL LTD.
WILLOW CREEK PROJECT
PRELIMINARY GEOTECHNICAL STUDIES

PITEAU ASSOCIATES
GEOTECHNICAL AND HYDROGEOLOGICAL CONSULTANTS
VANCOUVER CALGARY

CONCEPTUAL LAYOUT FOR PHASE 2 SEDIMENTATION POND

BY: ATH/AB
DATE: JUL. 97
APPROVED:
DWG: 7.3-4

JOB NUMBER 1493



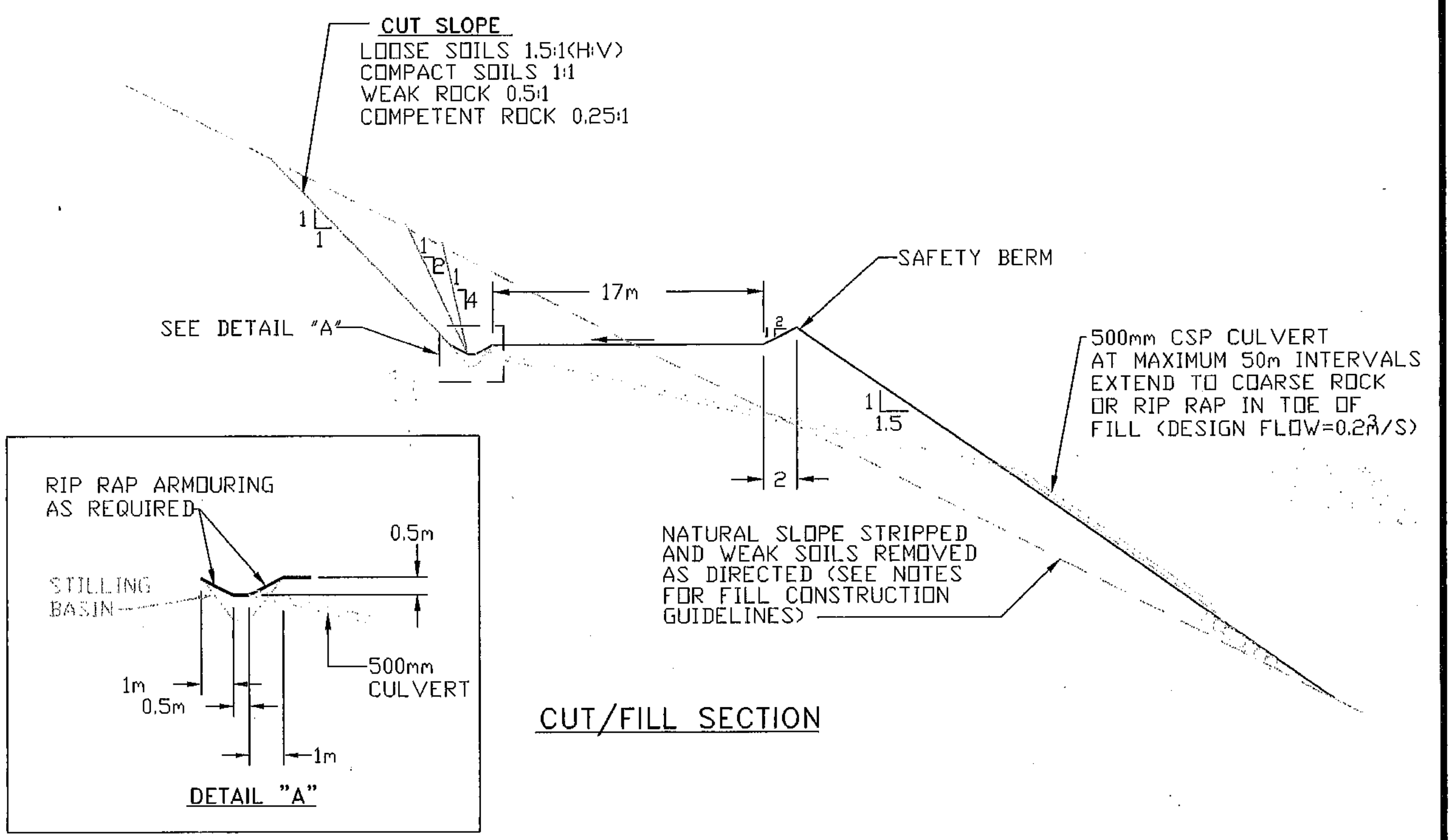
PINE VALLEY COAL LTD.
WILLOW CREEK PROJECT
PRELIMINARY GEOTECHNICAL STUDIES

PITEAU ASSOCIATES
GEOTECHNICAL CONSULTANTS
VANCOUVER CALGARY

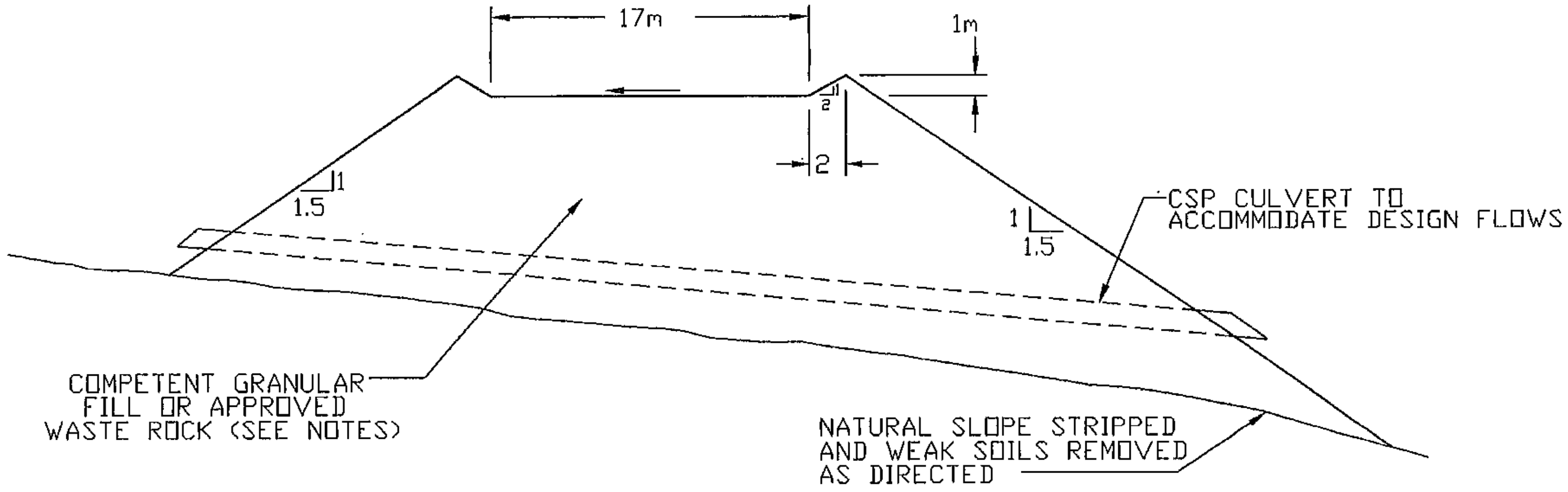
CONCEPTUAL DESIGN OF PHASE 1A SEDIMENTATION POND EMBANKMENTS

BY: ATH/BL
DATE: JULY 97
APPROVED:
FIG 7.3-5

DWG. NUMBER: 1493-006



CUT/FILL SECTION



FILL SECTION

NOTES:

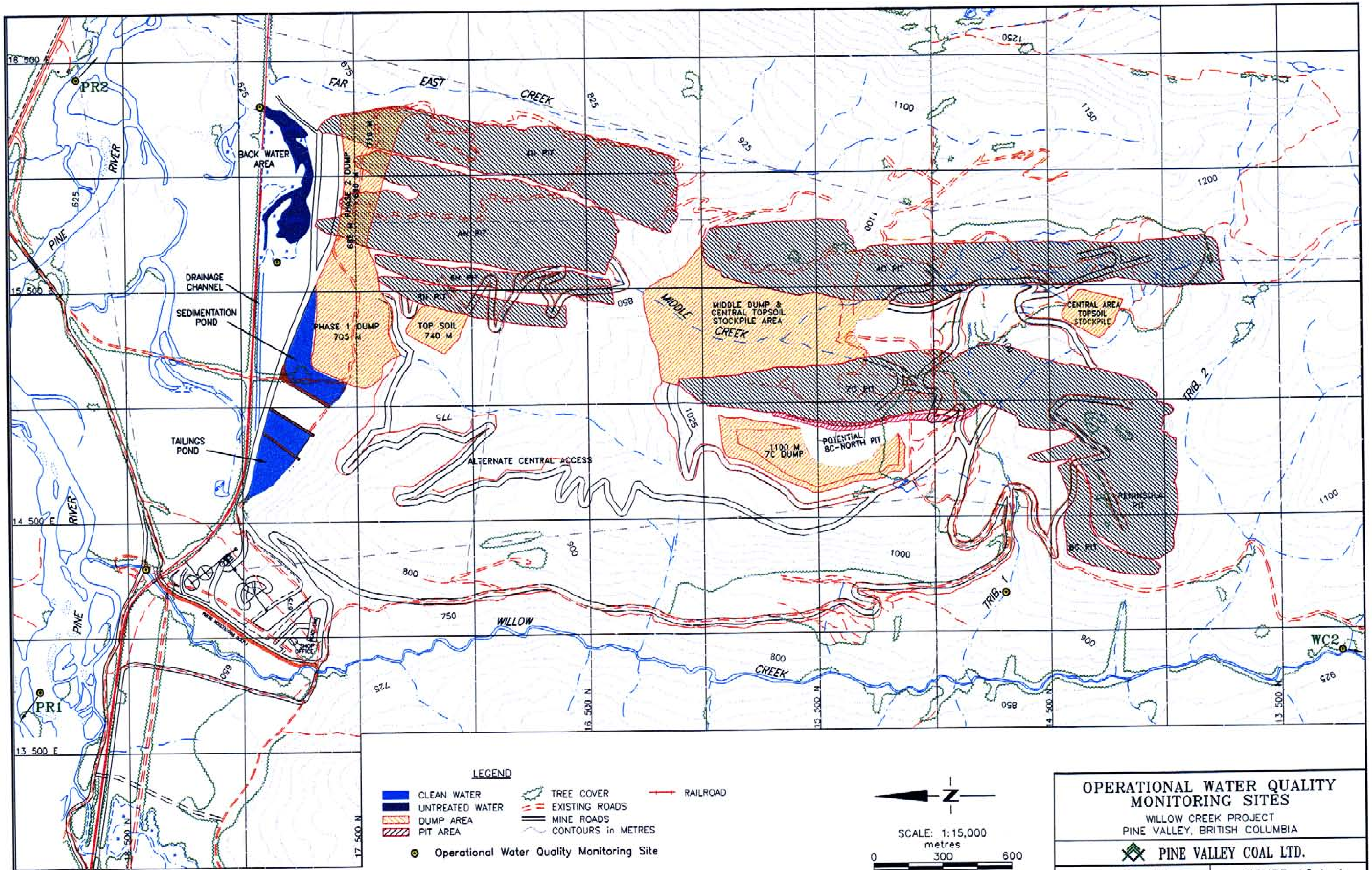
1. ALL CUT AND FILL AREAS TO BE CLEARED AND STRIPPED TO COMPETENT NATIVE SOILS AS DIRECTED BY THE GEOTECHNICAL ENGINEER.
2. FILLS CONSTRUCTED ON NATURAL SLOPES BETWEEN 2:1 AND 1.75:1 (H:V) WILL REQUIRE TOE AREAS TO BE EXCAVATED TO COMPETENT SOIL OR ROCK AND COARSE DURABLE GANULAR FILL OR APPROVED WASTE ROCK PLACED IN LIFTS AND COMPACTED TO FORM A SUITABLE FOUNDATION.
3. NATURAL SLOPES STEEPER THAN 1:75:1 WILL LIKELY REQUIRE CONSTRUCTION OF ROAD AS FULL BENCH CUT.
4. 500mm CSP CULVERTS OR APPROVED EQUIVALENT TO BE INSTALLED C/W STILLING BASIN AT MAXIMUM 50m INTERVALS ALONG ROAD WITH COARSE ROCK OR RIP RAP AT EXIT OF CULVERT.

PINE VALLEY COAL LTD.
WILLOW CREEK PROJECT
PRELIMINARY GEOTECHNICAL STUDIES

PITEAU ASSOCIATES
GEOTECHNICAL AND HYDROGEOLOGICAL CONSULTANTS
VANCOUVER CALGARY

PRELIMINARY GEOTECHNICAL DETAILS FOR HAULROAD CONSTRUCTION AND FORESTRY ROAD UPGRADE

BY: DCM/CV
DATE: JULY 97
APPROVED:
FIG: 7.3-6



OPERATIONAL WATER QUALITY MONITORING SITES

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA

PINE VALLEY COAL LTD.

AUGUST 1997

FIGURE 18.1-1

NDM-33079-001-newaug97-fig18-1

NORECOL DAMES & MOORE and NORWEST MINE SERVICES

GROUP A DAMES & MOORE SUBSIDIARY

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VOLUME 3 - APPENDICES

Willow Creek Project Report

Prepared for:

PINE VALLEY COAL LTD.

AUGUST 1997

Prepared by:

NORECOL DAMES & MOORE
A DAMES & MOORE SUBSIDIARY

NorWest
Mine Services Ltd.

PITEAU ASSOCIATES
GEOTECHNICAL AND
HYDROGEOLOGICAL CONSULTANTS

APPENDICES

2.0 PROJECT DESCRIPTION AND SCOPE OF REVIEW

Pine Valley Coal Ltd. (PVC) is a joint venture formed from Falls Mountain Coal Inc. (subsidiary of Globaltex Industries Inc.), BCR Ventures Ltd. (subsidiary of BC Rail Ltd.) and Mitsui Matsushima Canada Ltd. (subsidiary of Mitsui Matsushima of Japan). The operator is PVC. Exploration for coal in the general project area dates from construction of the John Hart Highway (Highway 97) through Pine Pass. The first serious attempt to develop coal at the Willow Creek site was made in the early 1980's by David Minerals Limited. David Minerals obtained an approval for an underground coal mine on the northern part of the project area through submission of a Stage II report. In 1994, Globaltex Coal Corporation (subsidiary of Globaltex Industries Inc.) began exploration efforts directed towards developing a small open-pit mining operation. The exploration and study work has continued from that time to the present.

The PVC properties are located within the Pine Pass area in the Peace River District of northeast British Columbia. The coal licenses flank the Pine River Valley approximately 45 km southwest of the town of Chetwynd, with the majority of the licenses situated on the south side of the Pine River. The approximate centre of the license area is located on NTS Map 93O/9 at longitude 122 17' west and latitude 55 36' north.

Primary road access to the general area (see illustration on page 11) is via the John Hart Highway (Highway 97) which is an all-weather paved highway connecting the Peace River District with the central interior city of Prince George, B.C. Near the property, the highway is located along the northern side of the Pine River Valley, with secondary and tertiary roads that branch off and provide ground access to most of the license area. During the early 1980s, a bridge was constructed over the Pine River providing access to the coal reserve areas now referred to as the Willow and Falling Creek Blocks. This bridge and approach will be upgraded by PVC and Canfor in 1999. This work had been planned by Canfor for 1998. Access within the Willow Creek portion of the property is currently via the Willow Creek forestry road, as well as exploration roads. The forestry road will be upgraded to service mining operations.

BC Rail operates a rail line through the Pine River Valley to service the Peace River District. The rail provides direct access to the port of Vancouver, B.C. or indirect access, via Canadian National Railway at Prince George, to the Ridley Island Coal Port at Prince Rupert, B.C. In the vicinity of the Willow Creek property, the rail line lies on the south side of the Pine River, immediately adjacent to sites suitable for plant and shop facility construction and coal shipment.

Natural gas supply is available about 2 km from the property and a connection to an electric power supply can be made about 2 km from the proposed site of the surface facilities; the powerline requires upgrading from single-phase to three-phase from Hasler to the site along Highway 97. Potable water supply is readily available through wells drilled in the gravels that lie in the valley adjacent to the Pine River.

The Peace River District is serviced by daily commercial airline flights to the cities of Dawson Creek and Fort St. John. These services have respective road distances to the Willow Creek Project properties of roughly 148 km and 203 km.

The property is situated in the Rocky Mountain Inner Foothills physiographical region. It is characterized by relatively low, rounded, northwest southeast-trending ridges and valleys, and is dissected by the 1.5 km wide Pine River Valley. The elevation difference relative to the Pine River Valley, within the license area, is approximately 670 m.

Elevations range from 630 m along the Pine River Valley to 1,300 m along the eastern property limits. The Pine River watershed cuts across and drains the property. In addition, glaciation appears to have had a large influence in shaping the topography of the license area.

The property is forested by jackpine and minor spruce. Poplar stands occur in low areas such as the Pine River Valley, and in wet areas adjacent to creeks and seepages. Most of the forested terrain may be classified as open forest (i.e., with little or no underbrush). The exceptions are the wet areas where willows and devil's club are common.

Wildlife noted in the area consist of grizzly bear, black bear, moose, caribou, deer and wolves. Fish present in the area have been reported to include dolly varden, northern pike, forage fish, mountain whitefish, Arctic grayling, and rainbow trout. Bull trout, a species related to dolly varden, has also been reported from this area. On the Willow Creek Block these species are
found in the Pine River. Some species, namely dolly varden, rainbow trout, mountain whitefish and forage fish, are also present in the lower reaches of Willow Creek for about 3.4 km, to a point where their upstream progress is impeded by a waterfall.

The climate of the region may be classified as northern temperate. Daily temperatures range from a mean maximum of 7 C to a mean minimum of minus 6 C, with a mean daily temperature of 1 C. Extreme temperatures range from a maximum of 32 C to a minimum of minus 48 C. The average annual number of days with frost is 210.

The mean total precipitation in the region is approximately 425 mm, which includes the rainfall equivalent of a mean snowfall of 165 cm. The average annual number of days with measurable precipitation is 95. The greatest recorded rainfall in 24 hours is 66.5 mm.

For the purposes of the environmental assessment review, the project was deemed to include the construction, operation/maintenance and abandonment of a new coal mine. More specifically, the scope of review included the following on-site and off-site facilities:

On-site facilities:

- an open pit coal mine with annual production of 900,000 tonnes;
- wash plant and related facilities;

- coal stockpile;
- tailing disposal ponds/sediment ponds and structures; and
- rail load-out facility.

Off-site facilities:

- access/haul roads and related infrastructure;
- power supply; and
- port facilities' capacity/capability to handle PVC's coal shipment.

APPENDIX 1.6-1

STUDY TERMS OF REFERENCE

APPENDIX

Detailed Ministry Information Requirements for the Globaltex Willow Creek Coal Project

Draft

1. Hydrology

A hydrological analysis and stream flow monitoring program is required for the Application Report. This will support Water and Waste Management planning and engineering design activities. An outline of data requirements for surface water quantity is presented below, for consideration.

1.1 Regional Hydrology

The submission should include a description of the regional surface water regimes of local Pine, Willow, "Middle" and "Far East" drainages in terms of:

- mean annual runoff;
- maximum and minimum annual runoff;
- mean monthly distribution;
- mean and return period annual maximum daily discharge (peak flow);
- mean and return period annual minimum daily, 7 day, monthly discharge.

These data should be summarized in the form of maps, graphs and histograms.

The Prospectus indicates that development may impact the Willow Creek drainage, west of the property during later stages of development. A hydrological review of the Willow must be included if pit or mine development or if mine related runoff will occur there.

In order to carry out regionalization or extrapolation of stream flows, some basic physiographic watershed characteristics should be compiled for gauged and project-related streams. The following are normally presented:

- drainage area
- elevation range
- median elevation
- channel profiles

If the existing stream flow/runoff data (ie. federal sites Pine River above Mountain Creek 07FB010 (terminated?) and Pine River at East Pine 07FB001) can be transposed to project related watersheds, estimates should be provided. The Pine River at Willow Creek should be correlated to East Pine. Available climate data will form an integral part of this analysis.

On the basis of this analysis, data gaps should be identified and the required monitoring program outlined. The program should indicate location, instrumentation (water level recorder, staff gauge, current meter or weir, etc.), observation frequency and period of observation. The program should emphasize the main impact areas, tributaries to Pine River.

1.2 Volume Runoff Estimates

Estimates of monthly and annual runoff are essential for water quality management and water supply design of:

- the pit, waste dump areas and ponds;
- the three Pine River tributaries in question;
- Pine River near the mine site;
- the proposed water supply.

1.3 Low Flow Estimates

The mean annual seven-day average flow is required to determine mean conditions on or all three tributary drainages, and specifically at the pit, waste dump and sediment pond sites.

A seven-day average low flow estimate for the ten-year recurrence interval is essential for all developed drainages in the mine area. This should be provided for the summer and winter low flow periods and the March pre-freshet period to help in determining water quality loads. It is recommended that these estimates be made from data collected during the monitoring period and be compared to regional data where possible.

1.4 Instantaneous Peak Flow

An instantaneous peak flow estimate for the 200-year recurrence interval is required for the design of diversion and interception ditches at the plant site, and for waste dumps and ponds. The sediment ponds are required to contain a 200-year, 24-hour precipitation event on the catchment area.

Peak flow estimates may require the use of precipitation data; using for example the Rational method. Rainfall intensity data may be available for the area but should also be provided for a station established within the project area. Regional information is available from charts available in the "Rainfall Frequency Atlas for Canada" by Hogg and Carr (1985) or the Hydrology Section manual, Water Management Branch. Estimates can also be provided using the Hydrology Section's regional peak flow frequency procedures.

1.5 Hydrometeorlogical Data Requirements

Data collection in support of Stage 1 Report preparation will require the following activities:

a) permanent hydrometric stations should be installed on:

- Willow, Middle and Far East Creeks at the BCR crossings;
- watercourses immediately downstream of proposed sediment ponds;
- watercourses immediately downstream of pit and waste dump areas;
- Pine River at Globaltex bridge crossing;

These stations should be constructed so that they are capable of measuring the full range of flow conditions expected at each site throughout the year (understanding that smaller flows may be frozen or dry during seasonal extremes). Data should be recorded at least twice weekly throughout the year and more frequently during extreme events.

Continuous flow recording devices are required in the area. The purpose of these stations is to provide continuous flow data of a quality equal to that provided by Water Survey of Canada. This information could then be used to generate daily discharges at other points. Location of the continuous recorder is open to discussion.

If a good correlation between Pine River flows at Globaltex bridge and East Pine can be proven, a long term site at Globaltex bridge may not be necessary.

Monitoring of the Willow Creek tributary downstream of the proposed upper waste rock dump should be commenced at least two years prior to development of that area of the pit.

b) a rain gauge and continuous recording device will be required at the proposed mine site to determine max/min monthly total precipitation (rain and snow). A manual rain gauge may be adequate if a high frequency of maintenance can be assured.

The direction and speed of prevailing wind should be recorded at the mine site to assist in determining pollutant dilution capability of the local airshed. Recorded air temperatures should be provided.

c) the Company should consider the establishment of a snowcourse recording station for the project area.

d) at least one full season of flow data should be included in the Application Report.

All measurement stations are to be installed to a standard such that they are capable of providing water record data throughout the life of the mine. These stations should be placed in a location where they will not be subject to disturbance. All hydrometric stations are to be metered for staff gauge calibration through the mine life on a frequency acceptable to the Ministry.

Staff gauges will be required on the sediment ponds. The gauges should be read during the collection of water quality samples, and will assist in providing a more complete impression of local watershed hydrology.

2. Water Management Plan

Based on the hydrological information collected, a plan for the management, use, and protection of surface and ground water is required for this project. The Water Management Branch and Environmental Protection offices in Prince George should be consulted if questions arise in the preparation of the plan.

Project information relative to site facilities and management of surface and ground water quantity and quality should be presented on a topographic map. For the mine site, the scale should be 1:5000 or better, with contour intervals of 5 meters or less. Project mapping should indicate:

- locations of sediment ponds, waste dumps, coal stockpiles, fuel and explosive storage, equipment service facilities, access roads, and other facilities;
- drainage areas, with natural, interception and contaminated drainage areas shown separately;
- water disposal system;
- potable water supply system;
- drainage for slope and waste dump stability;
- drainage ditches;
- delineation of the 200-year floodplain on all natural streams affected by the project;
- channel stabilization of existing water courses where required;
- locations at which aquifers will be intercepted;
- location of hydrometeorlogical stations;
- locations of all water sampling, hydrometric, and biological (periphyton, benthos, fisheries) stations.
- locations of all groundwater seeps.
- all access roads.

In addition, the Application Report should present:

- a water balance estimate (with diagrams) specifically for the sediment pond;
- draft applications for water licences conforming to the water balance;
- preliminary design of the sediment pond berms;
- design flows, velocities and cross-sectional details for all proposed changes to natural stream channels, drainage ditches, stream crossings by roads, etc.;
- a description of surface runoff and drainage control systems proposed at the mine, plant, pond and dump sites to minimize the impact of suspended solids on the environment;
- a description of any measures necessary to prevent damage to any facilities from flooding;
- an analysis of local water availability at all proposed points of diversion;
- details of the location and type of water storage works necessary for the project.
- the maximum and minimum dilution capabilities of local drainages;
- surface and subsurface drainage patterns based on topographical surveys, geological and geotechnical investigations in both the underground and pond areas;

Note that quality at the downstream licence points of any diversions must meet water quality guidelines of the Water Management Branch for the licensed purposes.

The use of reclaim water is supported. Use of recycled pit water and supernates from sediment impoundments will not require water licences. The Application Report should include details of water supply storage and distribution system and quantities used for various purposes. A Water Licence will be required for initial mine supply water from surface supplies. Draft copies of water licence applications and approvals should be included in the Application Report.

Approvals for short term use of water (not exceeding 6 months) may be required for temporary camps, pilot plants, and the like. Furthermore, approvals for changes in and about a stream may be required for stream crossings and other changes to watercourses.

Inquiries regarding licences and approvals should be directed to Regional Water Management Branch staff in Prince George.

3. Aquatic Baseline Studies

Maintenance of Pine River water quality is very important due to the river's recreational significance and its use as a potable supply by the District of Chetwynd. The basin is exposed to an increasing amount of industrial development, most of which has the potential to impact water quality. The existing biological diversity of the river, necessary to sustain these and future human uses, must be maintained.

Surface and ground water hydrology is crucial to any project of this nature. The company is advised to review sections 1 and 2 of these terms of reference for their relevance to an acceptable water quality presentation.

A receiving environment data collection program was implemented by David Minerals in 1981. The Ministry expects any of this relevant data, collected by either the Proponent or the Ministry to be included in the Application Report.

3.1 Program Objectives

The objectives of the Aquatic Baseline Monitoring Program stem from the impact assessment process, and are:

1. To provide a water quality database that can be used to formulate sub-basin specific water quality objectives; and
2. To provide a physical, chemical and biological database that can be used to predict and to monitor the significance of impacts from the proposed development.

Both objectives require reliable measurement of background water quality. If detection limits are too close to provincial water quality criteria, overly stringent water quality objectives may be set. **Values near the detection limit also may not provide an adequately reliable baseline on which to calculate allowable waste loadings. Accordingly, water quality** sampling of surface water is to include parameters on the attached Table 1, using the detection levels listed.

A great deal of cooperation will be required between the Proponent and its field and lab consultants in order to attain quality data at these low detection levels. **If, however, it is not feasible to provide reliable, detectable background values, then the implications for impact assessment should be identified by the Proponent, and discussed with BCE as soon as** possible. Any improvement in the capability to detect water quality parameters, even on a reduced number of initial samples, would improve our confidence in other detected and undetected values.

It must be emphasized to the Proponent that completion of a database to the satisfaction of the Ministry will be a necessary pre-requisite to the assessment of an Application Report. Early characterization of water quality is also necessary to determine the need for analysis of the metal complexing capacity of local surface waters. **Thus, although we can provide**

general guidance on program design, the proponent must design a program proposal with sufficient detail to meet the program objectives.

The following process is usually recommended for program design, data collection and review:

1. Provision of general guidelines on data application and requirements by BCE;

2. Preparation of an Aquatic Impact Assessment and Monitoring Proposal by the Proponent;

3. Review of this Proposal by BCE, preferably followed by a meeting with the Proponent (or consultant) to finalize the Program design;

4. Revision of the Proposal by the Proponent;

5. Start of the Program;

6. Review of preliminary results by BCE, and provision of feedback to Proponent on final program design; and

7. Completion of the Program with reiterations of the BCE review mechanism.

The Proponent will experience difficulty in both following this format and collecting quality data for both the spring freshet and summer low flow conditions. It is suggested that step 3 be represented by a meeting or conference call in the near future to work out program details in order that the Proponent may commence sampling as soon as possible in April. It must be stressed that a cooperative approach with regard to program design is necessary to meet the development schedule desired by the Proponent.

3.2 Water Quality Criteria

The quality of discharged and exfiltrated waters must be adequate to protect aquatic life, potable supply and recreational use at a specified objective site (possibly site 6). Water quality at the objective site will be expected to meet established provincial and federal water quality criteria for the protection of aquatic life, drinking water and contact recreation. The current provincial criteria document is entitled "Approved and Working Criteria for Water Quality" L.W. Pommen. 1991. Water Quality Branch, Ministry of Environment.

If cases exist where background water quality exceeds established criteria for specific parameters, modified objectives will be established. For this reason, it is in the Company's interest to establish a thorough background data base prior to disruption of the area.

3.3 Water quality sites

The water quality site locations used by David Minerals in 1981 appear reasonable. The following comments can be offered:

Will the Pine River upstream site be affected by the discharge from a backwater channel immediately upstream? The control should be relocated to immediately upstream of Willow Creek.

- Is the downstream site free of contaminant sources below Far East Creek? Relocate the site to a narrow river section 350 m downstream of Far East Creek, or to the point of complete mixing.

Considering these issues, the sites are identified in these Terms of Reference as:

1 Pine River 50 m upstream of Willow Creek
2 Willow Creek immediately upstream of BCR crossing
3 Pine River immediately upstream of Globaltex bridge
4 Middle Creek immediately upstream of BCR crossing
5 Far East Creek immediately upstream of BCR crossing
6 Pine River 350 m downstream of Far East Creek
7 Willow Creek upstream of impacted tributaries (proposed)
8 Tributary to Willow Creek impacted by future development (proposed)
9 Far East Creek upstream of mine development (proposed)
10 Duplicate sample site name (fictitious)
11 Blank sample site name (fictitious)

Water quality monitoring at sites 7 and 8 should commence at least two years prior to any development that may impact that watershed. Site 9 will be established when needed to develop spatial control data during operation. All sites should be in flowing water, far from local influence such as springs, backwater, etc.

3.4 *Water sampling frequency for submission of Application*

The following frequency is recommended for water quality data collection prior to submission of the Application report:

- a minimum of ten 1994 pre-Application samples collected from sites 1 through 6, emphasizing both freshet and summer low flow conditions. Sampling is to continue into and beyond the Application period, with high frequency during critical low flow periods, including winter low flow;

- a minimum of five 1994 samples collected from ground water data for main seeps and piezometer holes in the sediment pond and waste dump areas;

Globaltex should be aware that further monitoring sites may be required as a result of the Application review. The operative monitoring program will be amended as needed, likely by reducing the number of sampling parameters required. This long term program should be submitted for review by BCE every six months so that adjustments can be made, if required.

3.5 Sediment Quality

Collection of a sediment chemical database will be required in order characterize existing mineralogy, to determine the source of any significant changes to invertebrate communities and to trigger benthic invertebrate monitoring. The feasibility of sediment collections should be evaluated at selected locations, with both bottom and suspended sediment samplers being considered. **The number of replicates taken should be based on a preliminary assessment of variability, or by initially collecting a large number of replicates for selective analysis until the desirable level of sensitivity is achieved for the most variable parameter.**

All sediment metal analyses should be done on a selected particle size class, preferably the fine silt/clay fraction (<63 um) to enable comparisons between sample sites. Measurement of total organic carbon on this fraction will enable more refined between-site comparisons to be made.

Although sediment quality data can not be used to set initial permit limits, it will be used to establish the cause of any significant effects on benthic invertebrate communities. The background database is to be established for sediments, with analysis for the parameters in Table 2. **Globaltex is requested to submit a proposal for baseline data collection.** Data and interpretation will be required in the Application report.

3.4 Biological Sampling

David Minerals submitted benthic invertebrate data with the original proposal. More baseline may be required in future; however, it is not considered a prerequisite of the Application report.

The presentation of existing benthos data should include:

- all relevant data;
- comparison of the site habitats (slope, substrate, velocities, depth, vegetative cover, etc.);
- sampling techniques used (sampler type, mesh size, replicate, etc.);
- data analysis (descriptive interpretations, statistical analysis, etc);
- proposal for operational monitoring.

As noted above, the main concern with this project is the potential for nutrient rich waters to discharge or seep into the Pine River. Nutrient loading will likely cause increased attached algal density and distribution in the Pine River. Water quality criteria exist for algae attached to natural substrates and will be applied to the Pine River, given its importance as a fisheries stream and a potable water supply for the District of Chetwynd. **The Proponent is requested to submit a plan for the development of a representative attached algal baseline for all surface water quality sites, with emphasis on the Pine River.** The Application is to include a review of available data.

Chlorophyll a will be the primary quantitative indicator of periphyton community response. The sampling program for species identification and enumeration may be qualitative, identifying larger scale changes in community composition and substrate coverage.

As with sediment collection, **we recommend that a pilot program be carried out to determine when and where the most effective baseline should be collected.** To maximize sensitivity for detecting change, areas with maximal homogeneity in community composition should be selected. If more than one distinct community is present at the most homogeneous sites, then relative (%) coverage should be estimated, and each community sampled with equal effort. A minimum level of replicate sampling should be done weekly at a few selected sites, for several weeks. **Following analysis of this pilot data, final selection of sites, number of replicates and statistical sensitivity should be done prior to collection of the baseline.**

A representative number of background metal samples in muscle and liver tissues of local fish species **is required prior to start of construction, but is not a condition of Application.** This should include coarse fish species which may used as sentinel indicators at a later time.

3.5 Data Quality Assurance Requirements

In order to monitor the quality of receiving water data collected during this baseline period, the Proponent is required to conduct an ongoing data quality program as follows:

> **Obtain laboratory precision, accuracy and blank quality criteria and procedures for each laboratory analyzed chemical parameter from the Proponent's analytical laboratory(ies).** Keep these criteria available and current. Submit these to BCE within 30 days of establishing the baseline monitoring program.
>
> **For these parameters, in both groundwater and receiving environment samples, the Proponent shall obtain from the analytical laboratory(ies) the precision and accuracy data for each sample set submitted.** For receiving environment parameters, the Proponent shall obtain the **bottle blank data to document the acceptability of the cleaned bottles.** The Proponent shall also obtain from the laboratory(ies) an evaluation of the data acceptability from each sample set, based on these criteria. Submit these with regular data results.
>
> **Duplicate sampling shall be used to assess the combined field and laboratory precision.** This precision criteria (expressed as percent standard deviation) for each of the duplicate samples shall be no greater than twice the laboratory precision criterion.
>
> To assess overall precision, the Proponent shall take each duplicate sample in the same way, and as close to the same time as possible. The location of duplicate sampling shall be selected randomly from the full list of water quality sites. The sites from which duplicate samples are taken shall be locations where concentrations of the main parameters are expected to be detected (to enable calculation of the relative standard deviation). One duplicate sample is to be collected during each sampling day. These duplicates shall be submitted to the laboratory(ies); one identified as the regular sample and one as a blind sample identified by a fictitious site and time.
>
> For receiving environment sampling, a sample collection blank shall be prepared, containing distilled water and preservative, if required, and submitted as a blind sample with all sample sets. *One blank sample is to be collected during each sampling day.*

Water sampling is to be conducted as per Bollans R.A. et al. 1989. Field criteria for sampling effluents and receiving waters. Data Standards Group, Waste Management Branch, Ministry of Environment, Victoria, with *necessary modifications included to attain* the clean techniques and detection levels requested.

Chemical analysis is to conducted as per McQuaker, N. 1989. A laboratory manual for the chemical analysis of waters, wastewaters, sediments and biological material (1976 edition including updates). Data Standards Group, Waste Management Branch, MoE, Victoria.

Copies of both documents may be obtained by contacting Data Standards Group, Ministry of Environment, 3800 Wesbrook Mall, Vancouver, BC, V6S 2L9

3.6 Data Review

Receiving environment water quality data should be fully reviewed, with emphasis on those parameters which may become problems during the mine's operational phase. This review should include discussion of:

- **operational mass loadings at all necessary sites (suggested at sites 2 through 6) using estimated sediment pond seepage/overflow rates and concentrations, background creek flows and concentrations, and established criteria;**

- **estimated nutrient impact on the receiving environment, specifically nitrogen loss from explosives, and potential sources of phosphorus;**

- **monitoring proposals for periods prior to and during construction and during operation.**

4. Effects on Ground water Quality and Quantity

The Application report should identify and map:

- depths to water table at the proposed sediment ponds and rock dumps;
- ground water sources, seepage rates, and water quality.
- soil data, including soil horizon percolation rate, density, permeability, acid generating/acid consuming potential test results, column leach test results.
- piezometer locations, specifically around tailings pond location.

Given the Proponent's intention to submit the Application report this August, the characterization of groundwater quality is critical. Unless summer flows are abnormally low, the proposed surface water program will not clearly define low flow water quality. A representative ground water data base will supplement surface water data.

The Company may wish to consider the attached guidelines entitled "Resource Development Environmental Impact Assessments - Suggested Framework for a Hydrogeologic Study." This information is provided as a guideline for the Company's evaluation of the ground water conditions in the area. Also attached is a "Suggested List of Parameters for Ground Water Quality Analyses."

5. Waste Management Planning

The Application report should present sufficiently comprehensive plans to show that waste treatment, handling and disposal systems will be able to reduce the operational effects on the receiving environment to acceptable levels. Major items to consider are outlined below.

5.1 Mill

The Ministry is aware that a site for the mill has not yet been confirmed. When a mill site is chosen, the Application report should identify why it is preferable to alternate sites.

A schematic diagram of the various plant processes is required. Information should be included in the text or diagram on items such as:

- solid and liquid balances;
- types and amounts of milling reagents to be added, if any, with related aquatic toxicities described;
- points at which wastes originate or where liquids will be recycled;
- specific materials (metals) which may be present in the waste at toxic concentrations;
- waste treatment systems to be employed, particularly for products of concern (suspended solids)
- mill make up water.

ROM ore will be trucked to a basic plant in which the ore will go through a breaker (minimizes production of fines) to free-up rock attached to the coal. The breaker product will then be washed to remove fines. It will then pass through a jig which will separate the heavier waste rock from the coal. The waste rock will be only be a small fraction of the plant feed and is essentially similar to the other waste rock. The jig "float" is final coal product (after drying). The washed coal waste will be piped to a thickener to recover water and produce an underflow which may be product coal or may be waste (to a tailings pond). Only a small fraction of the feed to the plant will be fines. The tailings pond is expected to be very minor compared to similar mining operations in which the mill tailings is essentially the same tonnage as what is being fed to the plant.

5.2 Solids Disposal

A clear rationale for the locating of sediment pond should be provided, including the inundation of natural ponds that exist on site. The Application report should provide a detailed outline of the manner in which sediment ponds will be constructed and operated, with diagrams of the impoundment design. The Ministry will require a thorough geotechnical and hydrogeological study of the sites, specifying the following:

- nature of soils and subsurface materials (permeability, depth, stability, fracturing, etc.);
- description of the ground water regime in the vicinity of the proposed pond location;
- initial berm designs, including dimensions, material content, anchoring, stability, permeability, required maintenance, etc.;
- acid generating potential of any borrow materials;
- pond water balances for different seasons. Include factors of evaporation, seepage, recycle, etc.;
- if the ponds are expected to seep, a proposal for the collection and recycling of seepage water. Location of seepage recovery ponds;
- assessment of the impact of the ponds on the quality and quantity of ground and surface waters during operation and after abandonment;
- provisions for the control of spills;

- post operating conditions - reclamation of sediment ponds;
- an inspection schedule and maintenance plan.

The main concern with this project is the potential for nutrient rich waters to discharge or seep into the Pine River. Due to the regionally high fisheries values of the Pine River drainage and its use by the District of Chetwynd for potable water supply, water quality must be maintained such that it meets the provincial and/or federal water quality for fisheries, aquatic life, drinking water and human contact recreation at an objective site, likely site 6 on the Pine River. To initiate this goal, the Proponent is to propose methods of phosphorus control to be put in place at the mine site.

Consideration must be given to the other water users in the drainage. Accordingly, the entire assimilative capacity of the local section of the Pine River cannot be granted to this one current project.

5.3 Acid Mine Drainage

The Application report should include a description of the chemical characteristics of all materials to be mined or produced. An assessment of the acid-producing/consuming characteristics of the coal, waste rock, sediment pond berm material, and any other materials to be used for construction purposes should be presented. The sources of all burrow materials should be mapped, with reference to the materials' acid generating potential. The nature of the mine site in terms of acid generating potential should be mapped. Appropriate plans for the management of any materials that have potential to generate acid should be presented, not only for the period of operations, but also upon abandonment.

The Proponent is requested to submit plans for column leach tests on representative samples of waste rock. Chemical analysis shall be as for ground water samples. Results are to be included in the Application.

The Application report should commit to an acid generation monitoring program ongoing through the mine life, including regular monitoring of the above mentioned materials, and the treatment of acid mine water, if generated.

As with ground water, the results of the multi-element analysis of waste rock, coal and soils will supplement a short surface monitoring program and are critical to this assessment. They must be presented in the Application report to assist in the evaluation of potential water quality problems.

Following a meeting with the company, and a review a review of existing documentation, the Ministry has the following comments.

Acid Generating Potential

The original Stage I report indicates:

Waste Type	%S	NP/AP
sandstone	0.05%	131
shale	0.07%	2400
siltstone	0.06%	1690
mudstone	0.15%	327
conglomerate	0.05%	1700
coal	0.78%	0.92

The above information suggests that there is no acid generating potential concern for the waste rock. The company should confirm if the S is present as sulphide or sulphate. If the latter, it will not generate acid.

The company should define how many more samples are required to be collected and tested to adequately represent the 22,500,00 of waste rock which would be produced from the proposed 15 year life of the operation. The graph on page 4-7 of the B.C. AMD Technical Guide indicates 100 samples are needed if the waste rock was all the same geological type. This guide is for hardrock mines. The number of samples required can be significantly reduced if the occurrence of the sulphides in the waste rock are uniformly distributed. Also, the "Guide" was designed for higher levels os S in the waste rock and a desire to define "hot spots". If the waste rock being tested has both a low S content and a high NP/AP, this is a sound reason to base a lower number of samples on.

While coal frequently contains pyrite, sedimentary waste rock of the types depicted above, frequently does not, since these sedimentary rocks have undergone previous exposure, size reduction, etc. providing opportunity for any reactive sulphides to be depleted. The company should provide MELP with an analysis of this issue from a geologist, with details of the number of samples required to firm up the initial indication that the waste rock is very low in sulphide content and has an extremely large excess of carbonate to neutralise any acid from oxidized sulphides. Also, the geologist should provide details of the number of samples required to perform multi-element scans to establish the metal content of the waste rock. Each sample collected may be used to perform ABA, metal content and what form the S is in the rock sample (is the S in the form of sulphide, Fe-sulphide, sulphate, etc.). At the other Northeast coal operations, it appears that the S is in the form of gypsum ($CaSO_4 2H_2O$) which has a slight solubility in water.

Metal Sampling (Receiving Water) and Waste Rock

The results from the multi-element scans required above may be used to de-emphasize metal sampling in the receiving water programs and in the Waste Management permit if they are low (i.e. if they are similar to "crustal averages"). The company may also perform sequential testing of the waste rock to provide a further level of confidence. Only the waste rock types of highest metal content need sequential testing. The metal analysis of leachate may be used to predict waste rock runoff quality. If the quality of runoff is similar to the Quintette/Bullmoose operations, it is likely that metal levels will be closer to receiving water criteria than "Level A" "Mining Objectives" - i.e. any toxicity from metals in the runoff from the waste is unlikely and therefore metals should not have an inverse impact on the receiving water and may not be detectable.

Nitrate in Waste Rock Runoff

Based on the operation being about one-twentieth the size of Quintette with a waste to ore ration of only 3:1 (as opposed to 7:1 at Quintette) there appears to be less potential for impact. Also, 75% of the waste rock will be added to the open pits.

5.4 Air Emissions

The Application report should provide detailed information on the project, including:

- identification of all potential sources of emission associated with mining, coal processing, auxiliary processes and camp/office site (eg. refuse incineration);
- flow diagrams of all unit processes with material balances and the quantities of contaminants to be emitted to the atmosphere;
- the type and rate of fuel consumption with sulphur content of the fuel;
- the amount of refuse to be incinerated;
- details of emission control equipment (eg. for baghouse provide the type, number of bags, air-to-cloth ratio, etc. and for scrubbers provide the design, liquid-to-gas ratio, reagent concentrations, sulphur balance, etc.).
- any other information pertinent to the management and control of both source and fugitive emission of contaminants, including dust originating from the tailings berms and/or mining operations.

5.5 Waste Management Branch - Permit Application Requirements

On a preliminary basis (based on the information supplied in the Prospectus and a meeting with the company), the company will be required to apply for the following permits:

Effluent Permit	- for tailings and sedimentation ponds; - for discharges from maintenance facilities (eg. shops, truck washes);
Air Permit	- for coal preparation plant; - for ammonium nitrate silos; - for other sources, such as stationary diesel engines.
Refuse Permit	- for coarse coal refuse and dryer ash; - for domestic refuse and non process industrial refuse.

It is the Ministry's understanding that no Special Wastes will be stored on site, consequently a Special Waste Permit is not required.

5.6 Environmental Safety Program

The Stage 1 Report should address various environmental safety concerns, such as:

- storage of potentially hazardous chemicals (diesel,etc);

- treatment/disposal of hazardous wastes;
- spill prevention and emergency response. The Company should identify how spills will be contained, and whether or not they will be reclaimed for processing;
- transport of concentrate and potentially hazardous chemicals to and from the mine site.

5.7 Sanitary Sewage

The Application report is to provide an sewage management plan, including location of sanitary facilities, sewage volumes and selected treatment methods.

5.8 Refuse Management

The Application report must present a refuse management plan. Incineration of putrescible wastes will be required to avoid the likelihood of bear/human conflict.

6. Fisheries

The Stage 1 Report should identify the potential impacts of the mine development and operation on fish habitat and populations, along with the identification of any measures proposed to mitigate these impacts. Impacts of access road development and maintenance, if any, should be discussed.

Fisheries Assessment

A full fisheries survey on all streams to be impacted should be carried out. Species presence and abundance, as well as fish habitat including spawning and rearing habitats on all fish bearing reaches should be identified, mapped and described. A plan clearly showing mine design in relation to fish bearing streams and all tributaries to these streams must be provided. The plan should show the habitat conservation measures to be implemented for the fish bearing streams and their tributaries. Use and control of surface run off and waste water as well as its associated problems such as sedimentation should be identified. All unavoidable impacts to any of the fish bearing streams should be clearly outlined as well as potential impacts and potential downstream impacts.

7. Wildlife

The Application should provide the following information.

Biophysical Mapping:

Biophysical mapping should be compiled/carried out for the area to be impacted by the development. Soil, vegetation/forest cover type and detailed terrain/drainage information should be included.

This information is necessary to design a reclamation/revegetation plan.

Wildlife and Wildlife Habitat Assessment:

Wildlife use of the area and wildlife habitat information should be compiled/collected. This information must be up to date based on changes to the area since the original assessment and based on the present open pit proposal. This information should be utilized to help design the mine and it's facilities. A plan should be developed to mitigate habitat disturbance and impacts. Also an assessment of potential wildlife habitat enhancement opportunities should be done and presented.

Identification and assessment of the wildlife habitat special features such as the existing ponds on the flood plain should be carried out.

Pine River Flood Plain/Riparian area.

The Pine River flood plain contains some of the most highly rated wildlife habitat in the project area. The Pine River valley presently is highly fragmented and disturbed by transportation and transmission corridors etc. The mine project should be designed to minimize any further disturbance to the Pine River valley. Only those facilities that must absolutely be located on the flood plain should be located on the flood plain. Those facilities that must be located on the flood plain such as the railway siding and stock piles should be designed recognizing the high habitat values of the valley.

Mine Design.

Collecting detailed biophysical, wildlife and fisheries baseline information is necessary for designing a mine which has the least impact on other resources. Incorporating this baseline data at the designing stage will go along way towards mitigating the long term impacts of the mine. For example all road system design and location, all soil stockpiles design and location, all over-burden pile location, all settling pond design and location should be assessed and chosen recognizing the special features and sensitive habitats of the area (ie Pine River flood plain) and with the objectives of mitigating impacts, minimizing total area disturbed and facilitating rapid effective reclamation.

The sequence in which the area is mined may affect the overall impact. For example designing the operational sequence so that one of the parallel pits can be filled and reclaimed as the other pit is being excavated may facilitate rapid reclamation and reduce the need for larger overburden stock piles. Also forest cover clearing and soil removal should occur progressively as the coal is mined rather then advanced total clearing.

Soil Conservation.

A commitment to conserve <u>all</u> of the soil resource from the site must be made. Soil surveys will facilitate the development of a soil conservation plan.

8. Miscellaneous

To the greatest extent possible, the Company should attempt to minimize visual and nuisance impacts resulting from the development (ie. millsite, dust, timber cutting, etc.) The Ministry is concerned that a failure to do so will unnecessarily impair the experience of those recreating in the area.

The Ministry is concerned about the existing bridge over the Pine River which provides access to the site, and was constructed by David Minerals. The bridge is not designed to meet 1 in 100 year flood requirements and has a recurrent debris problem at the wooden pile piers. It is assumed that Globaltex will be replacing this structure.

9. Construction Camp

Not applicable. No camp is planned.

10. Reclamation

The Application Report should identify, at least in a conceptual manner, the reclamation plan for the project, including objectives, sequencing and methods.

This section should include a program for long term inspection and, if needed, maintenance of the sediment pond berms and any other ongoing or anticipated problems.

Table 1 Globaltex Water Quality Sample Variables at all Sites

Variable(a)	Rationale	Water Quality Criterion(b,c,d)	Detection Limit(b)
Alkalinity, total	buffering	not applicable	0.5 mg/L
Aluminum, dissolved	mine drainage	20(AL, pH 6) 50(AL, pH>6.5)	2 5
Antimony	mine drainage	50(D, AL)?	5?
Arsenic	mine drainage	25(D), 50(AL)	2
Barium	coal drainage	1000(D,AL)	100
Beryllium	mine drainage	11(AL)	1
Boron	mine drainage	500(I),5000(D)	50
Cadmium	mine drainage	0.2-1.8(AL)	0.02-0.2
Chloride	nitrite toxicity	not applicable	0.5 mg/L
Chromium	mine drainage	2-20(AL)	0.2
Cobalt	mine drainage	50(AL,I)	5
Copper	mine drainage	2-10(AL)	0.2-1
Fluoride	mine drainage	200-300(AL)	20-30
Hardness	metal toxicity	not applicable	0.1 mg/L
Iron	mine drainage	300(D,AL)	30
Lead	mine drainage	3(AL)	0.3
Manganese	mine drainage	50(D)	5
Mercury	mine drainage	20 ng/L(AL)	2 ng/L(e)
Molybdenum	mine drainage	10-30(I)	1
Nickel	mine drainage	25-150(AL)	2

Table 2 Globaltex Sediment/fish tissue Sample Variables at all Sites

Aluminum - sed	mine drainage	not applicable	10 ug/g
Antimony - sed	mine drainage	2 ug/g dry	0.2 ug/g dry
-fish		?	1 ug/g dry
Arsenic - sed	mine drainage	33 ug/g dry	3 ug/g dry
-fish		3.5 ug/g wet	0.35 ug/g wet
Cadmium - sed	mine drainage	5 ug/g dry	0.5 ug/g dry
-fish		0.2 ug/g wet?	0.02 ug/g wet
Chromium - sed	mine drainage	80 ug/g dry	8 ug/g dry
-fish		?	1 ug/g dry
Copper - sed	mine drainage	70 ug/g dry	7 ug/g dry
Lead - sed	mine drainage	35 ug/g dry	3 ug/g dry
-fish		0.8 ug/g wet	0.08 ug/g wet
Mercury - sed	mine drainage	0.15 ug/g dry	0.015 ug/g dry
-fish		0.1-0.5 ug/g wet	0.01-0.05 ug/g wet
Nickel - sed	mine drainage	30 ug/g dry	3 ug/g dry
-fish		?	5 ug/g dry
Phosphorus: tot	nutrient loading	not applicable	5 ug/g
Selenium - sed	mine drainage	5 ug/g dry	0.5 ug/g dry
-fish		3 ug/g wet	0.3 ug/g wet
		(~15 ug/g dry)	(~1.5 ug/g dry)
Silver - sed	mine drainage	1 ug/g dry	0.1 ug/g dry
Zinc - sed	mine drainage	120 ug/g dry	10 ug/g dry

Resource Development Environmental Impact Assessments
Suggested Framework for a Hydrogeologic Study

The purpose of a hydrogeologic study for a proposed resource development (eg. coal, metal mine, etc.) is to define the potential impacts of development on the groundwater and inter-related surface water resources and to outline mitigative and monitoring measures to ensure that the quantitative and qualitative integrity of the groundwater resource is maintained for future use.

The following guidelines have been prepared to assist development proponents in British Columbia in addressing site specific groundwater concerns in their Stage I environmental impact assessment reports. It is recommended that the hydrogeologic study be conducted by a hydrogeologist/groundwater specialist. The British Columbia Ministry of Environment and Environment Canada can be contacted prior to commencement of a study for further advice or direction.

I. Inventory

Inventory and analyze available information on the groundwater resource in the area, including: published reports; geologic maps; publications; well record data; exploration test holes; test pits; geophysical data; aerial photographs.

II. Field Investigation

Conduct a field investigation and analyze hydrogeologic data, including:
- inventory of well users and groundwater use;
- locations and measurements of spring discharges;
- measurements of water levels and water quality (see attached list of parameters) from test pits, piezometers, exploration holes, adits, test/production wells, springs;
- pumping test data; permeability test data;
- geophysical surveys.

III. Report

1. Prepare a hydrogeologic report outlining results of office and site investigation and analysis of data including:
   - general description of physio/geographic setting, topography, drainage, climate, soils, geomorphological conditions.
   - general description of geologic setting, bedrock types (stratigraphy and structural features) and surficial geologic conditions.
   - description of aquifers;
   - hydraulic conductivities; transmissivities;
   - groundwater flow systems (local and regional) and flow patterns;

- rates of groundwater movement;
- flow quantities, including pit inflows and from adits;
- surface water-groundwater inter-relationship (ie. quantity and quality of groundwater flowing into/out of surface waters prior to development);
- the quantity and quality of groundwater to be encountered during development; how and where is groundwater to be disposed and/or used;
- hydrochemical characteristics including anomalies and variations of the groundwater quality in the area.

2. Prepare hydrogeologic maps and cross-sections outlining the extent of unconfined/confined unconsolidated aquifer and permeable bedrock formations; locations of water wells, exploration holes, piezometers, springs, test pits; (potentiometric) water level contours; directions of groundwater flows.

3. Identify potential impacts of development on the groundwater resource quantity and quality and inter-related surface water resource, and assess the significance of these impacts in terms of human and fisheries habitat needs. Include potential effects from open pit and/or underground mining development, dewatering, tailings storage facilities, waste rock dumps, ore stockpiles, settling ponds.

4. Identify measures to be taken to mitigate any significant short and long term potential groundwater resource degradation, including use of interceptor wells, grout curtains.

5. Outline details of purpose, locations and design of monitoring wells in relation to settling ponds, tailings dams, sewage disposal sites, waste dumps, raw material stockpiles, plant processing operations, including number of wells, zone(s) to be monitored, frequency and type of data collection (ie. water levels, water quality), method of reporting and analyzing data.

SUGGESTED LIST OF PARAMETERS FOR GROUNDWATER QUALITY ANALYSES

I **FIELD TESTS:**

pH
Conductivity
Temperature
Diss. Oxygen

II **LABORATORY TESTS:** initially for a wide variety of parameters as outlined, followed on a periodic basis by analysis for selected parameters, including anomalous values (ie. those exceeding Ministry of Environment water quality criteria guidelines).

General:

pH
Conductivity
Tot. Diss. Solids
Suspended Solids
Hardness

Anions:

Alkalinity (tot.)
Chlorides
Sulphates
Nitrates
Nitrites
Phosphates (tot. & ortho)
Fluorides
Cyanides

Cations:
(tot. & Diss.)

Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Mercury (tot.)
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silicon
Silver
Sodium
Strontium
Tin
Titanium
Vanadium
Zinc

Other:

C.O.D.
T.O.C.
Tot. Carbon
Ammonia-N
Tot. Kjeldahl-N
Tot. Phenol

Province of
British Columbia

Environmental
Assessment
Office

Third Floor
1810 Blanshard Street
Victoria, British Columbia
V8V 1X4

July 17, 1995

Mr. David Fawcett
President
Globaltex Coal Corporation
350 - 625 Howe Street
Vancouver, British Columbia
V6C 2T6

Dear Mr. Fawcett:

Please find attached a copy of Transition Order No. M351 made by the Honourable Elizabeth Cull with the concurrence of the Honourable Anne Edwards, on June 30, 1995. This order was necessary to continue the review of the Willow Creek Coal project under the *Environmental Assessment Act* which became effective June 30, 1995.

The order places the Willow Creek project in the review process at the *"Preparation and submission of project report"* step. Once your company submits a project report, a project committee will be established to co-ordinate the environmental assessment. However, if your company does not submit a project report by June 1, 1988 and continues to seek an approval certificate after that date, you will be required to submit an application under section 7 of the Act, thereby starting at the beginning of the review process.

Marcia Farquhar has been assigned responsibility for the coordination of the environmental assessment of this project on behalf of the Executive Director of the Environmental Assessment Office. Please do not hesitate to contact Marcia at 952-0573 to discuss any aspect of the order or the assessment.

Sincerely,

Norm Ringstad
Project Assessment Director

cc: Brian Parrott
Doug Dryden
Marcia Farquhar

M 351

IN THE MATTER OF THE ENVIRONMENTAL ASSESSMENT ACT
SBC 1994, c. 35 (the "Act")

and

IN THE MATTER OF A PROPOSAL BY GLOBALTEX COAL CORPORATION TO MODIFY THE WILLOW CREEK COAL PROJECT

TRANSITION ORDER

WHEREAS:

A. In January, 1994, Globaltex Coal Corporation. (the "proponent") submitted a prospectus pursuant to section 2 of the *Mine Development Assessment Act*, SBC 1990, c.55;

B. The purpose of the application was for an approval to develop a surface coal mine, near Chetwynd, British Columbia (the "project"), which development is a reviewable mine development under the *Mine Development Assessment Act*;

C. The application was undergoing review under the *Mine Development Assessment Act* immediately before June 30, 1995;

D. Section 93(3) of the Act requires that an application which is undergoing review as a reviewable mine development under the *Mine Development Assessment Act*, immediately before section 93(3) of the Act comes into force, be continued and disposed of under the Act as an application for a project approval certificate.

NOW THEREFORE:

Pursuant to section 93(5) of the Act, the Minister of Environment, Lands and Parks (the "Minister"), with the concurrence of the Minister of Energy, Mines and Petroleum Resources, as responsible minister, having considered the recommendations of the Executive Director of the Environmental Assessment Office attached as Schedule I, **ORDERS THAT**:

1. the project be accepted for review under section 24(b) of the Act; and,
2. the review of the project proceed from the step referred to in paragraph 1, above, as set out in the Act, subject to the variations in process set out in paragraphs (b) and (c), of the recommendations of the Executive Director, on page 4 of this document;

ON CONDITION THAT the proponent must not materially alter the project, as described in the application for a mine development certificate, unless the proposed modification is in accordance with sections 12 and 13 of the Act; and, the proponent must submit a project report to the Executive Director under section 26 of the Act by June 1, 1998, after which time, if the proponent has not submitted the report, any assessment of this project will start from the beginning of the review process under section 7 of the Act.

Pursuant to section 93(6) of the Act, the following are the reasons for the order:

1. The Minister and the Minister of Energy, Mines and Petroleum Resources have considered and accept the recommendations of the Executive Director attached as Schedule I to this order; and,

2. The continuance of the review of the project in accordance with this order will ensure a fair, orderly and prospective review of the effects of the project under the Act.

Honourable Elizabeth Cull
Minister of Environment, Lands and Parks

Anne Edwards

Honourable Anne Edwards
Minister of Energy, Mines and Petroleum Resources

Dated June 30, 1995 at Victoria, British Columbia.

SCHEDULE I

IN THE MATTER OF THE ENVIRONMENTAL ASSESSMENT ACT SBC 1994, c. 35 (the "Act")

and

IN THE MATTER OF A PROPOSAL BY GLOBALTEX COAL CORPORATION TO MODIFY THE WILLOW CREEK COAL PROJECT

RECOMMENDATIONS OF THE EXECUTIVE DIRECTOR OF THE ENVIRONMENTAL ASSESSMENT OFFICE

1. Globaltex Coal Corporation (the "proponent") submitted a proposal in January, 1994, to modify the 1983 approval in principle granted under the former policy mandated mine development review process (the "MDRP") to David Minerals for a 600,000 tonne per year underground coal development, to a 500,000 tonne per year surface mine, near Chetwynd, in northeastern British Columbia (the "project").

2. The proponent submitted a prospectus (the "proposal") under the mine development assessment process pursuant to section 2 of the *Mine Development Assessment Act*, SBC 1990, c.55.

3. The Northeast Mine Development Review Committee (the "committee"), established under the *Mines Act*, SBC 1989, c.56 and exercising the function of coordinating mine project reviews under the MDAP, and with membership from federal and provincial government agencies, coordinated the review of the proposal.

4. The committee has advised on and monitored proponent sponsored public consultation and consultation with First Nations in the area of the proposed project.

5. The proponent has been requested to prepare an application for a mine development certificate and has received the terms of reference. The committee is awaiting the submission of the further proposal.

On the basis of reviewing the terms of reference provided to the proponent under the MDAP, and in accordance with section 93(7) of the Act, I accept the terms of reference as meeting the requirements of project report specifications under section 24(a).

Based on the foregoing and pursuant to section 93(5) of the Act, I recommend to the Minister of Environment, Lands and Parks and the Minister of Energy, Mines and Petroleum Resources that:

a) the project be accepted for review under the Act, beginning at a step known as preparation and submission of project report according to specifications, under section 24(b), and subject to the variations in process referred to in paragraphs (b) and (c), and the condition set out in paragraph (d) below, the review proceed from that step under the Act,

b) the requirement of the Executive Director to deliver the final project report specifications to the proponent together with a request that the proponent prepare the project report in accordance with the project report specifications, under section 24(b), be dispensed with, since the proponent has received a request to prepare a submission under the MDAP,

c) a project committee be established under section 9 of the Act, to coordinate the review, once the proponent submits a project report, and

d) if the proponent does not submit a project report by June 1, 1998, and the proponent continues to seek a project approval certificate for the project after that date, the proponent submit an application under section 7 of the Act.

John Allan
Executive Director
Environmental Assessment Office

Dated June 30, 1995 at Victoria, British Columbia.

RECORDED TERMS OF REFERENCE AMENDMENTS

WILLOW CREEK COAL PROJECT
AMENDMENTS/CLARIFICATIONS TO THE TERMS OF REFERENCE
SUMMARY MATRIX

DATE	PROPOSED AMENDMENT/CLARIFICATION AND RESPONSE
April 21, 1994	MELP Northern Interior Region conveys to the MEMPR a document containing detailed information requirements for the (Mine Development Certificate) Application the proponent will be required to submit. These biophysical study requirements became the original Terms of Reference (TOR) for the original project.
May 9, 1994	Letter from proponent to MELP regarding clarification on the TOR. While some specific amendments to the environmental study included in the TOR are suggested in this letter, none of these changes had been accepted by agency reviewers at that time.
June 8, 1994	Letter from the proponent to MEMPR regarding clarification of the proposed aquatic baseline monitoring program Included in the TOR of April 21, 1997. Based on discussions with government agencies, detailed workplans are included for the following study components: • surface and groundwater quality and sediments; • hydrology; • fisheries.
July 28, 1994	MELP memorandum to MEMPR in response to the proponent's June 8, 1994 letter. *Site Selection:* proposal accepted *Quality Assurance:* duplicates and blanks to be submitted for each sampling day *Frequency:* proposal for three samples accepted reluctantly *Parameters:* both total and dissolved metals required. Proponent advised to delete mercury sampling in the water column and concentrate on groundwater seeps, sediment and fish tissues.
June 30, 1995	**Environmental Assessment Act Transition Order** (TO) signed. Schedule 1 to the TO states that the project's original TOR meet the requirements for Project Report specifications per the *EA Act*. However, the TO does not refer to the TOR by date (April 21, 1997) as constituting the terms of reference.

May 17, 1996	Fax memorandum from the proponent's consultant Norecol, Dames and Moore, Inc (NDM) to the Environmental Assessment Office (EAO). NDM requests further clarification in areas of the April 21, 1994 Terms of Reference. They are: 1. Scale of Ecosystem Mapping 2. Scope of the Hydrology Program 3. Scope of the Water Quality Monitoring Program 4. Scope of the Sediment Survey 5. Scope of the Algal Survey 6. Other Aspects of the Study
June 13, 1996	The following clarification of project specifications is in the minutes of this meeting: • MELP requires 1:5,000 TEM in directly impacted areas and 1:20,000 for other areas. • Consultant and MELP agreed to work together to refine the requirements of the water quality studies in the TOR. The fish tissue studies conducted for David Minerals Ltd. could possibly be used. The original TOR states that tissue samples are not required in the project report, but to be submitted before construction. • Proponent to provide a stratigraphic comparison between Quintet and Bull Moose to assist in the acid rock drainage study. • The proponent will conduct an impact assessment of tributaries 1 - 3 and a water management regime will be established.
July 12, 1996	Memorandum from NDM to MELP providing information update. NDM indicated that: • Background information is being collected to cover the entire Willow East area (north, central and south pits). • A staff gauge will be added to Tributary 3 to collect additional stream flow information. • Commitment to develop a program to characterize stream habitat on Willow Creek, Tributaries 1 - 3, Middle and Far East Creeks. • Proposal to identify groundwater seeps to collect groundwater data; testing proposed only for dissolved metals, major ions, N, P, and Cl.
July 16, 1996	Letter from MELP to proponent responding to meetings with proponent, exchanges of information and NDM's memo of July 12, 1996. The letter addresses in detail all pending items from NDM's memo of May 17, 1996 not previously responded to during the June 13 meeting and subsequent exchanges.
July 19, 1996	Two letters from NDM to MELP proposing plans for Willow Creek fisheries, periphyton and sediment quality studies. The proposed study program would serve as amendments to the original TOR.
August 8, 1996	Letter from MELP to proponent in response to July 19 proposal. MELP provided detailed adjustments to the program for periphyton and sediment baseline studies.

August 1, 1996	Letter to NDM from MELP regarding fish/fish habitat information requirements.
August 9, 1996	Memorandum from NDM to MELP Ft St. John which provided an update and proposed the following amendments to the fisheries program: • fish habitat assessments were conducted in Willow, Middle and Far East Creeks in 1994 according to attached map. No fishing was done. • the July 19, 1996 proposed fish program has been expanded to include (a) reach evaluation of Willow Creek above Tributary 2 to above Tributary 3; and, (b) reach evaluation of Tributaries 1, 2 and 3 to intermittent flow points or to where mining activities are proposed. • the July 19, 1996 proposed program will be completed coincidentally with these additional studies.
August 7, 1996	Letter from EAO (Kent) to Pine Valley Coal Ltd. (Fawcett) which pulled together a number of different aspects of the project specifications. Consensus of the Northeast Mine Development Review Committee on July 5, 1996 on the following areas for remediative measures or additional sampling, to be addressed and included in to the Project Report: • re-siting of the staff gauge on Middle Creek into the pool at the culvert inlet; • construction of a permanent/secure v-notched weir on East Creek; • need to sample the water quality of the groundwater expelling from the drill hole "81-???"; • establishment of a rain gauge at one of the proposed pit sites and an anemometer at the proposed plant site; • a reach description for Willow Creek and other tributaries to determine the probability of fish occurrence and follow-up assessment, if required, of sampling for fish species; • establishment of a staff gauge on Tributary 3; • the concern that one settling pond may not be adequate to handle potential sedimentation resulting from the proposed dump sites; • sampling/assessment program for Acid Rock Drainage. The South Pit proposal was tentatively accepted by the NEMDRC as part of the present application based upon: • proponent's assurance that disturbance would be 150 ha or less (given at June 21, 1996 meeting); • collection of water quality data for Tributary 3 and Willow Creek in the affected area; • the TEM work and wildlife information will cover the South Pit area; and • the area is part of the property designated as Willow East. *The proponent agreed to address the eight items listed above as well as the additional work involving the South Pit. EAO advised the proponent to proceed toward completion of the Project Report. The EAO indicated interest in the company's efforts to consult with First Nations.*

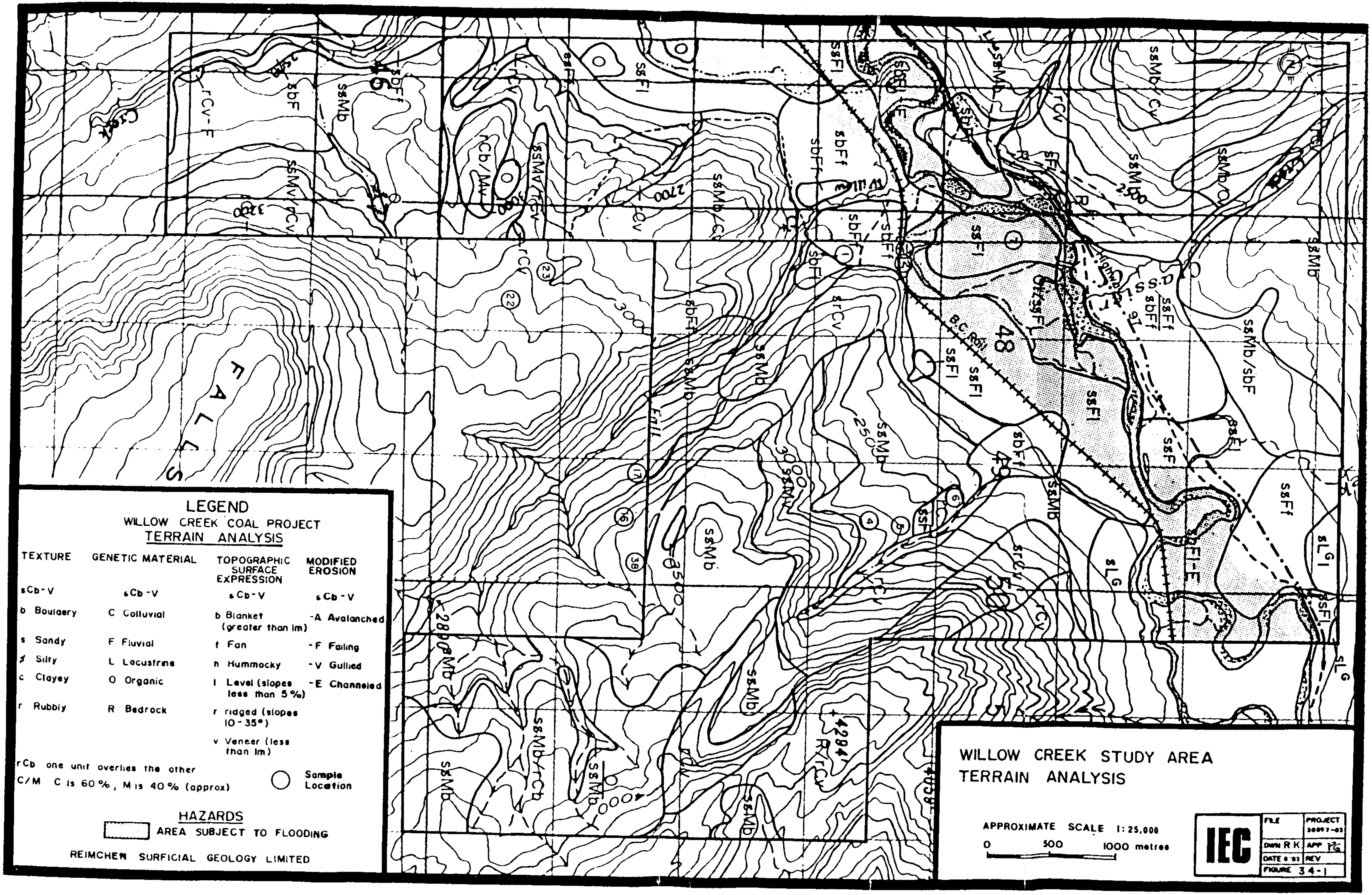
August 14, 1996	Letter from NDM to MELP Prince George seeking the following modifications to MELP requirements in their submission of August 8 (see above) Water Chemistry - relaxation of requirement to distinguish influence of Willow Creek on the Pine River. Periphyton - questions the utility of adding another periphyton sample site to the two proposed upstream and downstream of the project site because periphyton would be influenced principally by conditions in the Pine River. Stream Sediments - questions the utility of an additional aquatic site on the Pine River downstream of Willow Creek and upstream of Middle and Far East Creeks because of difficulty determining any measurable differences in sediment composition in the Pine River immediately downstream of Willow Creek. Site Relocation - suggestion to move the downstream Pine River sampling site to below Willow Creek because of little anticipated measurable effect of Middle and Far East Creeks on the Pine River baseline conditions.
August 23, 1996	MELP Prince George responds as follows: Water Chemistry - MELP maintains requirement for third monitoring site immediately downstream of Willow Creek. Periphyton - MELP maintains requirement for periphyton monitoring below Willow Creek to establish site specific baseline values. Sediments - MELP maintains requirement for this measurement to establish site specific baseline values. Site Relocation - MELP preference to maintain current location at least until the operational program is established.
August 14, 1996	Work Program on "TEM with Wildlife Ecosystem Mapping with Wildlife Interpretations for Willow Creek Project", authored by NDM, submitted for agency comments.
August 22, 1996	Letter from NDM to EAO voicing concern over extent and cost of TEM.
September 9, 1996	Letter from EAO to NDM confirming MELP's position on TEM components of the Willow Creek project.

August 20, 1996	Letter from MEI to Proponent regarding "Proposed Sampling and Analysis Program for Metal Leaching and ARD Prediction" by NDM. The sampling and analysis program set out by NDM is accepted with the following modifications: • sampling and analysis to predict metal leaching and ARD potential of Moosebar stratigraphy should be included in the NDM prediction program; • when submitting results for review, plan maps and cross sections displaying sample locations and geology should be provided; • comprehensive geological descriptions of samples should be included with analytical results.
August 30, 1996	MEI supplementary comments to August 20, 1996 letter and discussions with MELP: • requirement for a finalized, detailed report to be submitted as soon as possible as per approved NDM program. • ARD prediction information and analytical data should be reported to the MEI Reclamation Inspector on a quarterly basis with the initial report to be submitted on or before October 15, 1996. Verbal response that studies are in progress and will be included in project report.
January 28, 1997	Meeting between proponent, EAO, MELP. Minutes imply that the proponent requested reduction in the parameters list to those level metals that are of concern for the project. MELP indicated that a decision on parameter reduction would not occur before the Project Report is submitted. The meeting discussed a number of project issues, including specification issues such as socio-economic impacts. First Nation study requirements; archeological surveys to be addressed in the Project Report.
February 5, 1997	Letter from NDM to EAO which provides an update on the work program for the socio-economic studies (requested by EAO at January 28, 1997 meeting). The proponent indicates that both general public and First Nations consultation programs are being conducted parallel to this work.
March 14, 1997	Letter from EAO to NDM approving the proposed approach to the socio-economic study.
July 15, 1997	Meeting between the proponent, EAO, MEI, MELP and DFO discussing the content of the Project Report. The proponent was encouraged to cover items such as: • Socio-economic *impacts* from the mine development • Visual impact assessment/study • Consequences of an increase in coal production (600,000 - 900,000 t/year) • DFO additional requirements (see next box) • Traditional use study and First Nations concerns • Archeological assessment/study.

July 29, 1997	As a follow-up from the meeting on July 15, 1997 (see above) NDM sent a clarification letter to DFO. Main points: • Fisheries Act authorization and trigger of federal review • Compensation for lost fish habitat
August 7, 1997	Response from DFO to NDM. Outlining requirements for further input: • Extent of project's intrusion into the flood plain of the Pine River • Details of the plant design including footprints, fuel storage etc. • Details of waste water handling • Details of mitigation measures to control sediment release • Information on fish utilization of tributaries to Willow Creek below the falls.

APPENDIX 4.3-1

TERRAIN MAP - WILLOW CREEK FLATS AND PINE RIVER VALLEY



LEGEND
WILLOW CREEK COAL PROJECT
TERRAIN ANALYSIS

TEXTURE	GENETIC MATERIAL	TOPOGRAPHIC SURFACE EXPRESSION	MODIFIED EROSION
sCb-V	sCb-V	sCb-V	sCb-V
b Boulaery	C Colluvial	b Blanket (greater than lm)	-A Avalanched
s Sandy	F Fluvial	f Fan	-F Failing
ⱬ Silty	L Lacustrine	h Hummocky	-V Gullied
c Clayey	O Organic	l Level (slopes less than 5%)	-E Channeled
r Rubbly	R Bedrock	r ridged (slopes 10-35°)	
		v Veneer (less than lm)	

rCb one unit overlies the other

C/M C is 60%, M is 40% (approx)

○ Sample Location

HAZARDS

▭ AREA SUBJECT TO FLOODING

REIMCHEN SURFICIAL GEOLOGY LIMITED

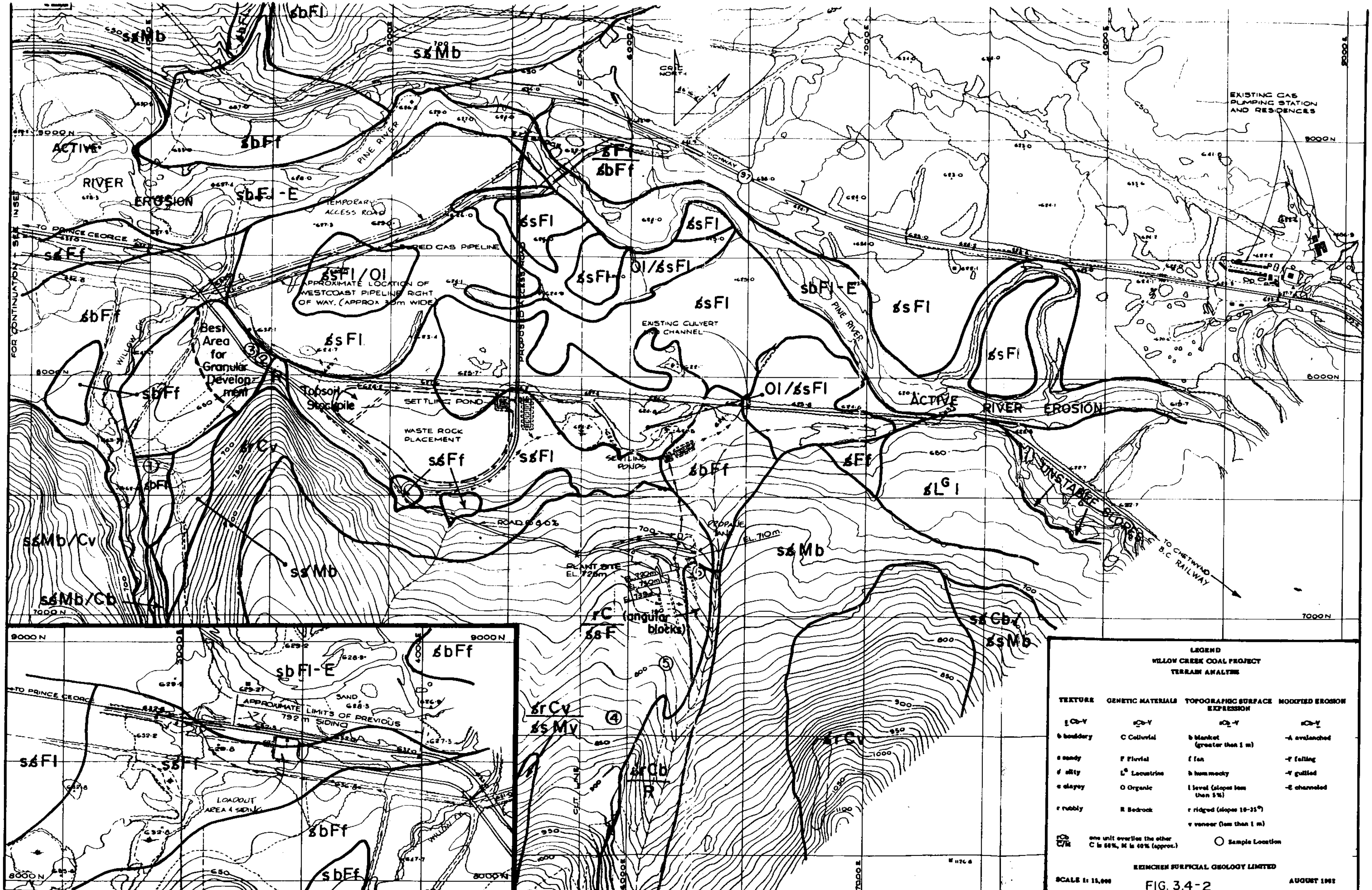
WILLOW CREEK STUDY AREA
TERRAIN ANALYSIS

APPROXIMATE SCALE 1:25,000

0 500 1000 metres

IEC

FILE	PROJECT 30097-02
DWN R.K.	APP PG
DATE 8 '82	REV
FIGURE 3.4-1	



LEGEND
WILLOW CREEK COAL PROJECT
TERRAIN ANALYSIS

TEXTURE	GENETIC MATERIALS	TOPOGRAPHIC SURFACE EXPRESSION	MODIFIED EROSION
sCb-V	sCb-V	sCb-V	sCb-V
b bouldery	C Colluvial	b blanket (greater than 1 m)	-A avalanched
s sandy	F Fluvial	f fan	-F falling
ś silty	L^G Lacustrine	h hummocky	-V gullied
c clayey	O Organic	l level (slopes less than 5%)	-E channeled
r rubbly	R Bedrock	r ridged (slopes 15-35°)	
		v veneer (less than 1 m)	

$\frac{rCb}{C/M}$ one unit overlies the other C is 60%, M is 40% (approx.)

○ Sample Location

REINCHEN SURFICIAL GEOLOGY LIMITED

SCALE 1: 15,000

AUGUST 1982

FIG. 3.4-2

SCALE 1:5000	CLIENT: DAVID MINERALS LIMITED	TITLE WILLOW CREEK PROJECT	PROJECT No. 7584
DRAWN BY: F.B. JAN.82	LOCATION: CHETWYND B.C	SEAM No1-OPERATIONS GENERAL AREA PLAN	DRAWING NUMBER 100-10-F2
CHECKED BY: RAH. JAN.82	KILBORN		

1	GENERAL	SEPT 1982

APPENDIX 4.4-1

PREVIOUS STREAM WATER QUALITY DATA

TABLE A
WATER QUALITY DATA COLLECTED BY ENVIRONMENT CANADA ON THE PINE RIVER AT HIGHWAY #97 BRIDGE, EAST PINE - 1966, 1967, 1969

Parameter	Aug-66	Sep-67	Aug-69	Average	SD
Temperature (deg C)	15.6	14.4	12.8	14.3	1.4
pH	8.1	8.1	7.9	8.0	0.1
Colour	5	< 5	< 5	5	0
Turbidity (NTU)	1.9	1.8	9.6	4.4	4.5
Specific Conductance	264	235	214	238	25
Total Dissolved Solids	147	124	89	120	29
Hardness	NT	118	10.8	64.4	75.8
Dissolved Calcium (calculated)	40.4	33.3	31.0	34.9	4.9
Dissolved Magnesium	NT	8.5	NT	---	---
Dissolved Potassium	0.6	0.5	0.4	0.5	0.1
Dissolved Sodium	2.1	2.0	1.6	1.9	0.3
Total Alkalinity	132	107	97	112	18
Bicarbonate (calculated)	161	130	119	137	22
Carbonate (calculated)	0	0	0	0	0
Dissolved Chloride	0.9	0.9	0.5	0.8	0.2
Dissolved Fluroide	0.10	0.08	< 0.05	0.08	0.03
Reactive Silica	2.7	3.6	1.9	2.7	0.9
Dissolved Sulphate	11.7	11.5	11.5	11.6	0.1
Total Organic Carbon	NT	NT	< 1	---	---
Nitrogen (NO_2, NO_3)	< 0.005	< 0.005	< 0.005	< 0.005	0.000
Total Phosphorus	NT	< 0.005	0.016	0.011	0.008
Total Inorganic Phosphate	NT	NT	< 0.005	---	---
Suspended Iron	NT	0.11	NT	---	---
Extractable Lead	NT	< 0.01	< 0.01	< 0.01	0.00
Extractable Manganese	NT	< 0.01	NT	---	---
Extractable Copper	NT	< 0.01	< 0.01	< 0.01	0.00
Extractable Zinc	NT	< 0.01	< 0.01	< 0.01	0.00
Free CO_2	2.0	1.6	2.4	2.0	0.4
Saturation Index (calc pH units)	0.4	0.2	-0.1	0.2	0.3
Stability Index (calc pH units)	7.3	7.7	8.0	7.7	0.4
Sodium Absorption Ratio (rel units)	0.08	0.08	0.21	0.12	0.08
Filterable Residue	152	NT	NT	---	---
Nonfilterable Fixed Residue	NT	NT	42	---	---
Filterable Fixed Residue	98	NT	NT	---	---

NT: Not Tested   <: Less Than   Averages calculated with less than set equal to.

Source: IEC 1982

TABLE B
SUMMARY OF WATER QUALITY DATA FOR PINE RIVER AT HASLER CREEK COLLECTED BY MINISTRY OF ENVIRONMENT - 1976

Parameter	May	July	August	November	Average	SD
pH	7.6	7.9	8.1	8.3	8.0	0.26
Conductivity (umhos/cm)	177	154	240	300	217.8	57.0
Turbidity (NTU)	16	23	9.3	1.7	12.5	7.9
Colour (TAC)	8	8	12	3	8	3
Alkalinity (Total)	82.0	72.5	120.0	129.0	100.9	24.1
Organic Carbon	< 1	1	5	2	2	2
Fluoride	< 0.1	< 0.1	< 0.1	NT	< 0.1	0.0
Hardness	90.6	74.1	125.0	147.0	109.2	28.5
Ammonia	0.010	0.009	0.005	0.006	0.008	0.002
Nitrogen (NO_2/NO_3)	0.09	NT	0.02	0.04	0.050	0.029
Nitrate (NO_3)	0.09	0.03	0.20	0.04	0.09	0.07
Nitrite (NO_2)	NT	< 0.005	< 0.005	< 0.005	< 0.005	0.000
Organic Nitrogen	0.27	0.63	0.07	0.02	0.25	0.24
Kjedahl Nitrogen	0.28	0.64	0.08	0.03	0.26	0.24
Total Nitrogen	0.37	NT	0.10	0.07	0.18	0.13
Ortho-Phosphorus	< 0.003	0.003	< 0.003	< 0.003	0.003	0.000
Total Phosphorus	0.040	0.052	0.022	0.005	0.030	0.018
Sulphate	7.0	5.8	14.0	19.7	11.6	5.6
Tannin and Lignins	0.3	0.2	0.4	0.1	0.3	0.1
Inorganic Carbon	23	NT	29	34	29	4
TOTAL METALS						
Arsenic	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.000
Cadmium (ppb)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.00
Chromium	< 0.005	0.014	< 0.005	< 0.005	0.007	0.004
Copper	0.003	0.005	< 0.001	< 0.001	0.003	0.002
Iron	2.0	1.4	0.4	0.2	1.0	0.7
Lead	0.002	0.004	< 0.001	< 0.001	0.002	0.001
Magnesium	NT	NT	NT	9.8	—	—
Manganese	0.03	0.04	0.03	< 0.02	0.03	0.01
Mercury (ppb)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.00
Molybdenum	0.0008	0.001	0.0007	0.0017	0.0011	0.0004
Nickel	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.00
Zinc	0.012	0.011	< 0.005	< 0.005	0.008	0.003
Aluminum	< 0.01	< 0.01	NT	< 0.01	< 0.01	0.00
Vanadium	0.003	0.002	NT	NT	0.003	0.001
DISSOLVED METALS						
Calcium	27.7	23.4	37		29	6
Magnesium	5.2	3.8	7.7	9.6	6.6	2.2

NT: Not Tested <: Less Than Averages calculated equating less than to equal to

Source: IEC 1982

TABLE C
IEC PINE RIVER WATER QUALITY RESULTS 1981-82

	Upstream of Mine						EZ Bridge	Dowstream of Mine					
Parameter	**02/05/81**	**05/02/82**	**03/06/82**	**29/07/82**	**Mean**	**SD**	**03/06/83**	**05/02/82**	**03/06/82**	**29/07/82**	**Mean**	**SD**
PHYSICAL TESTS												
pH	8.00	8.30	6.80	8.10	7.80	0.68	7.00	8.25	7.00	8.10	7.78	0.68
Conductivity (umhos/cm)	285	363	140	280	267	93	150	373	150	280	238	109
Turbidity (JTU)	8.00	0.75	21.00	2.60	8.09	9.14	30.00	0.78	36.00	2.70	17.37	18.23
Hardness (mg/L as $CaCO_3$)	136	202	75	140	138	52	78	205	75	140	125	61
SOLIDS (mg/L)												
Total Dissolved	232	322	94	162	203	98	110	326	100	170	177	104
Total	260	345	170	172	237	83	220	328	270	178	249	65
Suspended	28	23	76	10	34	29	110	2	170	8	73	82
ANIONS (mg/L)												
Total Alkalinity	161	198	70	130	140	54	70	193	71	130	116	58
Sulphate	13.0	39.5	10.0	17.0	19.9	13.4	14.0	49.0	16.0	17.0	24.0	16.7
NUTRIENTS (Mg/L)												
Total Phosphates	0.208	0.021	0.140	0.015	0.096	0.094	0.170	0.010	0.190	0.019	0.097	0.096
Dissolved Phosphates	NT	0.004	0.003	0.004	0.004	0.001	< 0.003	0.004	< 0.003	0.003	0.003	0.0005
Total Kjeldahl Nitrogen	NB	0.06	0.58	0.32	0.32	0.26	0.61	< 0.05	0.06	0.32	0.26	0.26
Ammonia Nitrogen	0.12	< 0.05	< 0.01	0.01	0.05	0.05	< 0.01	< 0.05	< 0.01	0.03	0.03	0.02
NO_2/NO_3 Nitrogen	0.024	< 0.012	0.020	0.040	0.024	0.012	0.010	0.010	0.010	0.050	0.020	0.020
DISSOLVED METALS (mg/L)												
Aluminum	< 0.15	< 0.15	0.10	0.05	0.11	0.05	0.08	< 0.15	0.10	0.05	0.10	0.04
Barium	0.074	0.120	0.100	0.100	0.099	0.019	0.100	0.100	0.100	0.100	0.100	0.000
Cadmium	< 0.025	< 0.025	< 0.001	< 0.001	< 0.013	0.014	< 0.001	< 0.001	< 0.025	< 0.001	< 0.007	0.012
Chromium	< 0.03	< 0.03	< 0.025	< 0.025	< 0.028	0.003	< 0.025	< 0.03	< 0.025	< 0.025	< 0.026	0.002
Copper	< 0.015	< 0.005	< 0.001	0.001	0.006	0.007	< 0.001	0.05	< 0.001	0.002	0.014	0.024
Iron	0.079	0.044	0.195	0.028	0.087	0.075	0.500	< 0.068	0.140	0.028	0.184	0.216
Lead	< 0.08	< 0.001	0.003	0.001	0.021	0.039	0.004	< 0.001	0.002	0.001	0.002	0.001
Zinc	< 0.015	< 0.015	0.001	< 0.001	0.008	0.008	0.002	0.015	0.002	0.003	0.006	0.006
TOTAL METALS (mg/L)												
Aluminum	0.49	< 0.15	1.70	0.15	0.62	0.74	2.00	< 0.15	2.20	0.20	1.14	1.11
Barium	0.089	0.120	0.150	0.100	0.115	0.027	0.150	0.100	0.150	0.150	0.138	0.025
Cadmium	< 0.025	< 0.001	< 0.001	< 0.001	< 0.007	0.012	< 0.001	< 0.025	< 0.001	< 0.001	< 0.007	0.012
Chromium	< 0.03	< 0.03	< 0.025	< 0.025	< 0.028	0.003	< 0.025	< 0.03	< 0.025	< 0.025	< 0.026	0.002
Copper	0.026	0.005	0.004	< 0.001	0.009	0.011	0.005	0.004	0.005	< 0.001	0.004	0.002
Iron	0.86	0.20	3.900	0.225	1.296	1.762	4.7	0.14	5.250	0.240	2.583	2.772
Lead	< 0.08	< 0.001	0.003	0.001	0.021	0.039	0.004	< 0.001	0.004	< 0.001	0.003	0.002
Mercury	NT	< 0.00005	CS	CS	---	---	CS	< 0.0005	CS	CS	---	---
Zinc	0.46	< 0.015	0.22	< 0.003	0.175	0.215	0.022	< 0.015	0.026	0.003	0.017	0.010

< Less Than NT: Not Tested NB: Lost sample in testing CS: Contaminated Sample < treated as equal to for mean and standard deviation

Source: IEC 1982

TABLE C

	Willow Creek			Middle Creek					Far East Creek		
Parameter	02/05/81	29/07/82	Mean	02/05/81	03/06/82	29/07/82	Mean	SD	03/06/82	29/07/82	Mean
PHYSICAL TESTS											
pH	8.45	8.30	8.38	8.15	7.30	7.60	7.68	0.43	7.20	8.00	7.60
Conductivity (micromhos/cm)	311	270	291	385	330	320	345	35	310	410	360
Turbidity (JTU)	34	76	55	0.72	1.10	0.40	0.74	0.35	1.30	2.10	1.7
Hardness (mg/L as $CaCO_3$)	155	280	218	191	170	170	177	12	150	210	180
SOLIDS (mg/L)											
Total Dissolved	264	226	245	310	190	257	252	60	190	204	197
Total	320	344	332	331	220	260	270	56	220	206	213
Suspended	56	118	87	1	30	3	11	16	30	2	16
ANIONS (mg/L)											
Total Alkalinity	194	140	167	235	170	170	192	38	150	220	185
Sulphate	6.0	9.0	7.5	< 5.0	9.0	5.0	6.3	2.3	14.0	11.0	12.5
NUTRIENTS (Mg/L)											
Total Phosphates	< 0.030	0.140	0.085	0.130	0.035	0.080	0.082	0.048	0.025	0.019	0.022
Dissolved Phosphates	NT	0.01	---	NT	0.003	< 0.001	0.002	---	< 0.003	< 0.001	< 0.002
Total Kjeldahl Nitrogen	0.39	0.74	0.57	0.30	0.63	0.70	0.54	0.21	0.57	0.46	0.52
Ammonia Nitrogen	0.15	0.14	0.15	0.09	0.01	0.06	0.05	0.04	< 0.01	0.01	0.01
NO_2/NO_3 Nitrogen	0.016	0.030	0.023	0.012	< 0.010	0.020	0.014	0.005	< 0.010	0.020	0.015
DISSOLVED METALS (mg/L)											
Aluminum	< 0.15	0.100	0.125	< 0.15	0.05	< 0.05	0.08	0.06	0.05	0.01	0.03
Barium	0.110	0.150	0.130	0.099	0.200	0.150	0.150	0.051	0.100	0.200	0.150
Cadmium	< 0.025	< 0.001	< 0.013	< 0.025	< 0.001	< 0.001	< 0.009	0.014	< 0.001	< 0.001	< 0.001
Chromium	< 0.03	< 0.025	< 0.028	< 0.03	< 0.025	< 0.025	< 0.027	0.003	< 0.025	< 0.025	< 0.025
Copper	< 0.015	< 0.005	< 0.010	< 0.015	< 0.001	0.002	0.006	0.008	< 0.001	< 0.001	< 0.001
Iron	0.054	0.076	0.065	0.047	0.245	0.128	0.140	0.100	0.105	0.084	0.095
Lead	< 0.08	0.002	0.041	< 0.08	0.002	0.005	0.029	0.044	0.002	0.001	0.002
Zinc	< 0.015	0.019	0.017	< 0.015	0.002	0.005	0.007	0.007	0.007	0.001	0.004
TOTAL METALS (mg/L)											
Aluminum	0.82	0.280	0.550	< 0.15	0.220	0.150	0.173	0.040	0.080	0.200	0.140
Barium	0.27	0.300	0.285	0.10	0.200	0.150	0.150	0.050	0.150	0.200	0.175
Cadmium	< 0.025	< 0.001	< 0.013	< 0.025	< 0.001	< 0.001	< 0.009	0.014	< 0.001	< 0.001	< 0.001
Chromium	< 0.03	< 0.025	< 0.028	< 0.03	< 0.025	< 0.025	< 0.027	0.003	< 0.025	< 0.025	< 0.025
Copper	< 0.015	0.007	0.011	< 0.015	0.002	< 0.001	0.006	0.008	0.003	< 0.001	0.002
Iron	1.03	4.750	2.890	0.048	0.400	0.160	0.203	0.180	0.350	0.350	0.350
Lead	< 0.08	0.002	0.041	< 0.08	0.002	< 0.001	0.028	0.045	0.002	0.001	0.002
Mercury	NT	CS	---	NT	CS	CS	---	---	CS	CS	---
Zinc	< 0.015	0.025	0.020	< 0.015	0.004	0.004	0.008	0.006	0.012	0.003	0.008

< Less Than NT: Not Tested CS: Contaminated Sample < treated as equal to for mean and standard deviation
Source: IEC 1982

TABLE D
BASELINE WATER QUALITY FOR WILLOW CREEK PROJECT

	Surface Water					Ground Water	
	Pine River						
	Below Willow Ck	At Hasler Ck	At #97 Br East Pine	Middle Creek	Willow Creek	No. 2 Seam	DDH 81-15
PHYSICAL TESTS							
pH	8.00	7.97	8.03	8.15	8.45	8.20	8.00
Colour (Pt-Co Scale)	18	8	5	16	53	30	20
Turbidity (JTU)	8.00	12.50	4.40	0.72	34.00	0.39	0.19
Hardness (mg/L)	136.00	109	64	191	155	169	215
Conductivity (umhos/cm)	285	220	238	385	311	335	483
SOLIDS (mg/L)							
Total Suspended	29.0	29.5	NT	<0.5	53.5	24.0	9.0
Total Dissolved	232	110	120	311	264	272	380
Total	260	156	NT	310	320		
DISSOLVED ANIONS (mg/L)							
Total Alkalinity		101	112		197		
Alkalinity (Bicarbonate)	161	NT	136	235	194	200	293
Chloride	2.60	NT	0.70	0.67	0.77		
Sulphate	13.00	11.63	11.60	<5.00	6.00	4.00	<1.00
Nitrate	0.023	0.45	<0.005	0.006	0.015	0.056	0.029
Nitrite	0.001	0.005	<0.005	0.006	0.011	Above: NO_2 +NO_3	
Fluoride	0.035	NT	0.090	0.047	0.042		
Total Phenol	NT	0	NT	NT	NT		
DISSOLVED METALS (mg/L)							
Barium	0.099	NT	NT	0.099	0.110	<0.080	0.150
Calcium	57.10	32.88	34.90	57.10	43.70	51.90	52.70
Iron	0.047	NT	NT	0.047	0.054	0.048	0.37
Magnesium	11.70	6.58	8.50	11.70	11.10	9.30	19.70
Manganese	0.008	NT	<0.010	0.008	0.003	<0.003	0.028
Potasium	0.94	NT	0.50	0.94	0.67	0.38	0.86
Silicon	4.02	NT	2.70	5.02	4.54	4.17	4.62
Sodium	1.50	NT	1.90	1.50	2.68	0.88	8.61
Strontium	0.086	NT	NT	0.086	0.098	0.096	0.23
TOTAL METALS (mg/L)							
Aluminum	0.49	0.01	NT	<0.015	0.82	0.56	0.16
Barium	0.10	NT	NT	0.10	0.27	0.093	0.17
Chromium	<0.03	0.007	NT	<0.03	<0.03	<0.03	<0.03
Copper	0.026	0.002	NT	<0.015	<0.015	<0.015	<0.015
Calcium	59.30	NT	NT	59.30	45.20	56.80	60.60
Iron	0.048	1.00	0.11	0.048	1.03	0.30	0.44
Lead	<0.08	0.002	NT	<0.08	<0.08	<0.08	<0.08
Magnesium	17.10	9.80	NT	12.10	11.70	10.20	22.70
Manganese	0.025	0.03	NT	<0.003	0.016	0.005	0.019
Molybdenum	<0.04	0.001	NT	<0.04	<0.04	<0.04	<0.04
Potassium	0.97	NT	NT	0.97	1.16	NT	NT
Silicon	4.23	NT	MT	4.23	7.34	7 5.8	
Sodium	2.48	NT	NT	1.52	2.75	1.20	10.60
Strontium	0.22	NT	NT	0.088	0.10	0.11	0.27
Vanadium	<0.01	0.002	NT	<0.010	<0.010	0.010	0.010
ORGANIC TESTS (mg/L)							
Total Organic Carbon		5.30	28.67	NT	26.00	NT	NT
Total Phosphate	0.208	0.024	0.016	0.130	<0.03	NT	NT
Ammonia Nitrogen	0.120	0.008	NT	0.090	0.150	<0.005	0.250
Total Kjeldal Nitrogen	NT	0.258	NT	0.300	0.390	0.280	0.450
Tannins and Lignins	<0.10	0.250	NT	<0.10	<0.10	NT	NT

NT: Not Tested <: Less Than
Source: IEC 1982.

Data for Pine River Below Willow Creek and Middle Creek suspect because of extensive identical values.

TABLE E
NDM WATER SAMPLING - 1994

				94011096	94012012	94012932	94011097	94012010	94012931
			ID:	FEC-1	FE-1	FEC-1	MC-1	MC-1	MC-1
			SITE	FEC-1	FEC-1	FEC-1	MC-1	MC-1	MC-1
				94/05/17	94/05/30	94/06/08	94/05/17	94/05/30	94/06/08
Parameter	MDC	Criterion	Unit						
pH	0.1	None	su	NA	NA	NA	NA	NA	NA
Specific Conductance	1.	None	uS/cm	NA	NA	NA	NA	NA	NA
Residue Nonfilt.	1.	None	mg/L	168.	4.	<1.	110.	<1.	38.
Turbidity	0.1	+1 to 5	NTU	NA	NA	NA	NA	NA	NA
Hardness Total		None	mg/L	154.	182.	174.	217.	208.	215.
Hardness Dissolved		None	mg/L	124.	170.	173.	181.	207.	222.
HCO3 as CaCO3	0.1	None	mg/L	NA	NA	NA	NA	NA	NA
Alkalinity Phen. 8.3	0.1	None	mg/L	NA	NA	NA	NA	NA	NA
Alkalinity Total 4.5	0.5	None	mg/L	NA	NA	NA	NA	NA	NA
Chloride Dissolved	0.5	None	mg/L	NA	NA	NA	NA	NA	NA
Fluoride Dissolved	0.01	0.2-0.3	mg/L	NA	NA	NA	NA	NA	NA
Carbon Total Organic	1.	None	mg/L	NA	NA	NA	NA	NA	NA
Nitrogen Amm.Diss(N)	0.005	0.1	mg/L	0.008	<0.005	<0.005	<0.005	<0.005	<0.005
Nitro NO3+NO2 D	0.02		mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrogen NO3 Diss(N)	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrogen NO2 Diss(N)	0.005	0.02-0.2	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nitro.Dis(NO2) LL	0.001	0.02-0.2	mg/L	NA	NA	NA	NA	NA	NA
Phosphorus Ort.Dis-P	0.001	None	mg/L	NA	NA	NA	NA	NA	NA
Phosphorus Tot. Diss	0.001	.005-.015	mg/L	NA	NA	NA	NA	NA	NA
Phosphorus	0.001	.005-.015	mg/L	NA	NA	0.008	NA	NA	0.006
Sulfate	1.	100	mg/L	9.4	12.7	12.9	3.1	4.7	4.8
Dissolved Oxygen	0.1	6-11	mg/L	NA	NA	NA	NA	NA	NA
Silver	0.03	0.0001	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Silver	0.00001	0.0001	mg/L	NA	NA	NA	NA	NA	NA
Aluminum	0.06	0.05	mg/L	1.25	<0.06	<0.06	0.38	<0.06	<0.06
Aluminum	0.002	0.05	mg/L	NA	NA	NA	NA	NA	NA
Arsenic	0.04	0.05	mg/L	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Arsenic	0.0005	0.05	mg/L	NA	NA	NA	NA	NA	NA
Boron	0.04	0.5 - 5	mg/L	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Barium	0.001	1	mg/L	0.217	0.087	0.083	0.137	0.111	0.113(1)
Beryllium	0.001	0.011	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bismuth	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Calcium	0.05	None	mg/L	43.3	50.6	48.5	69.7	64.6	66.5(1)
Cadmium	0.002	0.0002	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	0.00002	0.0002	mg/L	NA	NA	NA	NA	NA	NA
Cobalt	0.004	0.05	mg/L	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Chromium	0.002	0.002-0.02	mg/L	<0.002	<0.002	0.008	<0.002	<0.002	<0.002
Chromium	0.0002	0.002-0.02	mg/L	NA	NA	NA	NA	NA	NA
Copper	0.002	0.002-0.02	mg/L	0.009	<0.002	<0.002	0.003	<0.002	<0.002
Copper	0.0002	0.002-0.02	mg/L	NA	NA	NA	NA	NA	NA
Iron	0.05	0.03	mg/L	3.22	0.07	0.1	0.77	<0.05	<0.05
Iron	0.0003	0.03	mg/L	NA	NA	NA	NA	NA	NA
Mercury	0.00001	0.00001	mg/L	NA	NA	NA	NA	NA	NA
Potassium	0.4	None	mg/L	1.5	0.7(1)	0.7	0.8	0.6	0.6
Magnesium	0.02	None	mg/L	11.2	13.5	12.9	10.5	11.3(1)	11.8(1)
Manganese	0.002	0.05	mg/L	0.049	<0.002	<0.002	0.033	<0.002	<0.002
Molybdenum	0.004	0.01-0.03	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Molybdenum	0.0004	0.01-0.03	mg/L	NA	NA	NA	NA	NA	NA
Sodium	0.4	None	mg/L	3.3	6.2(1)	5.8(1)	0.9	1.1(1)	1.1(1)
Nickel	0.01	0.025-0.15	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	0.0008	0.025-0.15	mg/L	NA	NA	NA	NA	NA	NA
Phosphorus	0.04	.005-.015	mg/L	0.24	<0.04	<0.04	0.11	<0.04	<0.04
Lead	0.03	0.003	mg/L	<0.03	<0.03	<0.03	<0.03	0.03	<0.03
Lead	0.0003	0.003	mg/L	NA	NA	NA	NA	NA	NA
Sulphur	0.1	100	mg/L	3.	3.8	4.	1.3	1.4	1.5(1)
Antimony	0.02	0.05	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Antimony	0.0005	0.05	mg/L	NA	NA	NA	NA	NA	NA
Selenium	0.03	0.001	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Selenium	0.0001	0.001	mg/L	NA	NA	NA	NA	NA	NA
Silicon	0.8	None	mg/L	3.3	2.1	2.1	2.4	2.1	2.2(1)

TABLE E
NDM WATER SAMPLING - 1994

				94011096	94012012	94012932	94011097	94012010	94012931
			ID:	FEC-1	FE-1	FEC-1	MC-1	MC-1	MC-1
			SITE	FEC-1	FEC-1	FEC-1	MC-1	MC-1	MC-1
				94/05/17	94/05/30	94/06/08	94/05/17	94/05/30	94/06/08
Parameter	MDC	Criterion	Unit						
Tin	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Strontium	0.001	None	mg/L	0.096	0.113	0.109	0.081	0.083	0.086(1
Tellurium	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Titanium	0.003	None	mg/L	0.006	<0.003	<0.003	0.004	<0.003	<0.003
Thallium	0.03	None	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Uranium	0.0002	0.01-0.1	mg/L	NA	NA	NA	NA	NA	NA
Vanadium	0.003	0.1	mg/L	0.007	<0.003	<0.003	<0.003	<0.003	<0.003
Zinc	0.01	0.01-0.03	mg/L	0.03	<0.01	<0.01	0.01	<0.01	<0.01
Zinc	0.0002	0.01-0.03	mg/L	NA	NA	NA	NA	NA	NA
Zirconium	0.003	None	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Silver Dissolved	0.01	0.0001	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver Dissolved	0.00001	0.0001	mg/L	NA	NA	NA	NA	NA	NA
Aluminum Dissolved	0.02	0.05	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Aluminum Dissolved	0.002	0.05	mg/L	NA	NA	NA	NA	NA	NA
Arsenic Dissolved	0.04	0.05	mg/L	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Arsenic Dissolved	0.0005	0.05	mg/L	NA	NA	NA	NA	NA	NA
Boron Dissolved	0.008	0.5 - 5	mg/L	0.015	0.023	0.023	0.009	0.011	0.013
Barium Dissolved	0.001	1	mg/L	0.058	0.08	0.079	0.09	0.11	0.115
Beryllium Dissolved	0.001	0.011	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bismuth Dissolved	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Calcium Dissolved	0.01	None	mg/L	35.	47.	48.2	56.8	64.	68.6
Cadmium Dissolved	0.002	0.0002	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium Dissolved	0.00002	0.0002	mg/L	NA	NA	NA	NA	NA	NA
Cobalt Dissolved	0.003	0.05	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium Dissolved	0.002	0.002-0.02	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium Dissolved	0.0002	0.002-0.02	mg/L	NA	NA	NA	NA	NA	NA
Copper Dissolved	0.001	0.002-0.02	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper Dissolved	0.0001	0.002-0.02	mg/L	NA	NA	NA	NA	NA	NA
Iron Dissolved	0.003	0.03	mg/L	0.043	0.01	0.006	0.003	<0.003	<0.003
Iron Dissolved	0.0003	0.03	mg/L	NA	NA	NA	NA	NA	NA
Mercury Dissolved	0.00001	0.00001	mg/L	NA	NA	NA	NA	NA	NA
Potassium Dissolved	0.4	None	mg/L	0.6	0.8	0.5	0.8	0.6	<0.4
Magnesium Dissolved	0.02	None	mg/L	8.85	12.8	12.8	9.61	11.4	12.2
Manganese Dissolved	0.002	0.05	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Molybdenum Dissolved	0.004	0.01-0.03	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Molybdenum Dissolved	0.0004	0.01-0.03	mg/L	NA	NA	NA	NA	NA	NA
Sodium Dissolved	0.01	None	mg/L	2.98	6.37	5.97	0.87	1.19	1.25
Nickel Dissolved	0.008	0.025-0.15	mg/L	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
Nickel Dissolved	0.0008	0.025-0.15	mg/L	NA	NA	NA	NA	NA	NA
Phosphorus Dissolved	0.04	.005-.015	mg/L	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Lead Dissolved	0.02	0.003	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Lead Dissolved	0.0003	0.003	mg/L	NA	NA	NA	NA	NA	NA
Sulfur Dissolved	0.03	100	mg/L	2.81	3.57	3.94	1.26	2.47	1.55
Antimony Dissolved	0.015	0.05	mg/L	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Antimony Dissolved	0.0005	0.05	mg/L	NA	NA	NA	NA	NA	NA
Selenium Dissolved	0.03	0.001	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Selenium Dissolved	0.0001	0.001	mg/L	NA	NA	NA	NA	NA	NA
Silicon Dissolved	0.03	None	mg/L	1.71	1.9	2.07	1.96	2.08	2.27
Tin Dissolved	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Strontium Dissolved	0.001	None	mg/L	0.073	0.105	0.106	0.068	0.083	0.088
Tellurium Dissolved	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Titanium Dissolved	0.003	None	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Thallium Dissolved	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Uranium Dissolved	0.0002	0.01-0.1	mg/L	NA	NA	NA	NA	NA	NA
Vanadium Dissolved	0.003	0.1	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Zinc Dissolved	0.002	0.01-0.03	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Zinc Dissolved	0.0002	0.01-0.03	mg/L	NA	NA	NA	NA	NA	NA
Zirconium Dissolved	0.003	None	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003

TABLE E
NDM WATER SAMPLING - 1994

				94011102	94012933	94011100	94012013	94012936	94011101
			ID:	ME BLANK	ME BLANK	PR-3	PR-3	PR-3	TR BLANK
			SITE	ME BLANK	ME BLANK	PR-3	PR-3	PR-3	TR BLANK
				94/05/17	94/06/08	94/05/17	94/05/30	94/06/08	94/05/17
Parameter	MDC	Criterion	Unit						
pH	0.1	None	su	5.4	5.7	8.1	8.	7.9	5.6
Specific Conductance	1.	None	uS/cm	1.	3.	156.	201.	155.	1.
Residue Nonfilt.	1.	None	mg/L	<1.	<1.	162.	32.	57.	<1.
Turbidity	0.1	+1 to 5	NTU	0.1	0.1	300.	NA	15.	0.2
Hardness Total		None	mg/L	<0.1	<0.1	84.1	100.	84.6	<0.1
Hardness Dissolved		None	mg/L	<0.1	<0.1	77.5	99.4	76.1	<0.1
HCO3 as CaCO3	0.1	None	mg/L	NA	2.	NA	92.8	74.	NA
Alkalinity Phen. 8.3	0.1	None	mg/L	NA	<0.1	NA	<0.1	<0.1	NA
Alkalinity Total 4.5	0.5	None	mg/L	<0.5	2.	86.1	92.8	74.	<0.5
Chloride Dissolved	0.5	None	mg/L	<0.5	<0.5	1.	1.1	0.8	<0.5
Fluoride Dissolved	0.01	0.2-0.3	mg/L	<0.01	<0.01	0.06	<0.5	<0.01	<0.01
Carbon Total Organic	1.	None	mg/L	<1.	<1.	6.7	2.4	3.2	<1.
Nitrogen Amm.Diss(N)	0.005	0.1	mg/L	<0.005	<0.005	0.012	<0.005	<0.005	<0.005
Nitro NO3+NO2 D	0.02		mg/L	<0.02	<0.02	0.03	0.03	<0.02	<0.02
Nitrogen NO3 Diss(N)	0.02	None	mg/L	<0.02	<0.02	0.03	0.03	<0.02	<0.02
Nitrogen NO2 Diss(N)	0.005	0.02-0.2	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nitro.Dis(NO2) LL	0.001	0.02-0.2	mg/L	<0.001	<0.001	0.004	<0.001	0.002	0.001
Phosphorus Ort.Dis-P	0.001	None	mg/L	0.006	<0.001	0.006	0.006	<0.001	<0.001
Phosphorus Tot. Diss	0.001	.005-.015	mg/L	0.004	<0.001	0.014	<0.001	0.005	0.004
Phosphorus	0.001	.005-.015	mg/L	0.004	<0.001	0.19	0.006	0.016	0.005
Sulfate	1.	100	mg/L	1.3	<1.	5.1	10.3	6.3	<1.
Dissolved Oxygen	0.1	6-11	mg/L	8.8	8.8	11.	11.	10.	8.8
Silver	0.03	0.0001	mg/L	NA	NA	NA	NA	NA	NA
Silver	0.00001	0.0001	mg/L	<0.00001	0.00005	0.00007	0.0001	0.00001	<0.00001
Aluminum	0.06	0.05	mg/L	NA	NA	NA	NA	NA	NA
Aluminum	0.002	0.05	mg/L	<0.002	<0.002	0.51	0.377	0.684	<0.002
Arsenic	0.04	0.05	mg/L	NA	NA	NA	NA	NA	NA
Arsenic	0.0005	0.05	mg/L	<0.0005	<0.0005	0.0021	<0.0005	<0.0005	<0.0005
Boron	0.04	0.5 - 5	mg/L	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Barium	0.001	1	mg/L	<0.001	<0.001	0.057	0.055	0.05	<0.001
Beryllium	0.001	0.011	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bismuth	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Calcium	0.05	None	mg/L	<0.05	<0.05	25.5	30.5	25.7	<0.05
Cadmium	0.002	0.0002	mg/L	NA	NA	NA	NA	NA	NA
Cadmium	0.00002	0.0002	mg/L	<0.00002	<0.00002	0.0002	0.00008	0.00009	<0.00002
Cobalt	0.004	0.05	mg/L	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Chromium	0.002	0.002-0.02	mg/L	NA	NA	NA	NA	NA	NA
Chromium	0.0002	0.002-0.02	mg/L	<0.0002	<0.0002	0.0036	0.0039	0.0013	<0.0002
Copper	0.002	0.002-0.02	mg/L	NA	NA	NA	NA	NA	NA
Copper	0.0002	0.002-0.02	mg/L	<0.0002	0.0001	0.0034	0.0016	0.0017	<0.0002
Iron	0.05	0.03	mg/L	NA	NA	NA	NA	NA	NA
Iron	0.0003	0.03	mg/L	<0.0003	0.0032	0.631	0.88	1.57	<0.0003
Mercury	0.00001	0.00001	mg/L	<0.00001	<0.00001	0.00073	0.000015	<0.00001	0.00005
Potassium	0.4	None	mg/L	<0.4	<0.4	0.4	0.4(1)	0.4	<0.4
Magnesium	0.02	None	mg/L	<0.02	<0.02	4.95	5.85	4.96	<0.02
Manganese	0.002	0.05	mg/L	<0.002	<0.002	0.018	0.025	0.045	<0.002
Molybdenum	0.004	0.01-0.03	mg/L	NA	NA	NA	NA	NA	NA
Molybdenum	0.0004	0.01-0.03	mg/L	<0.0004	<0.0004	<0.0004	<0.0004	0.0007	<0.0004
Sodium	0.4	None	mg/L	<0.4	<0.4	0.9	1.5(1)	0.9	<0.4
Nickel	0.01	0.025-0.15	mg/L	NA	NA	NA	NA	NA	NA
Nickel	0.0008	0.025-0.15	mg/L	<0.0008	<0.0008	0.0055	0.003	0.0023	<0.0008
Phosphorus	0.04	.005-.015	mg/L	<0.04	<0.04	<0.04	<0.04	0.06	<0.04
Lead	0.03	0.003	mg/L	NA	NA	NA	NA	NA	NA
Lead	0.0003	0.003	mg/L	<0.0003	<0.0003	0.001	0.0026	0.0013	<0.0003
Sulphur	0.1	100	mg/L	<0.1	<0.1	1.9	3.0(1)	2.2	<0.1
Antimony	0.02	0.05	mg/L	NA	NA	NA	NA	NA	NA
Antimony	0.0005	0.05	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Selenium	0.03	0.001	mg/L	NA	NA	NA	NA	NA	NA
Selenium	0.0001	0.001	mg/L	<0.0001	0.00008	0.0007	0.00037	0.00024	<0.0001
Silicon	0.8	None	mg/L	<0.08	<0.08	2.	1.6	2.	<0.08

TABLE E
NDM WATER SAMPLING - 1994

				94011102	94012933	94011100	94012013	94012936	94011101
			ID:	ME BLANK	ME BLANK	PR-3	PR-3	PR-3	TR BLANK
			SITE	ME BLANK	ME BLANK	PR-3	PR-3	PR-3	TR BLANK
				94/05/17	94/06/08	94/05/17	94/05/30	94/06/08	94/05/17
Parameter	MDC	Criterion	Unit						
Tin	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Strontium	0.001	None	mg/L	<0.001	<0.001	0.095	0.135	0.107	<0.001
Tellurium	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Titanium	0.003	None	mg/L	<0.003	<0.003	0.008	0.004	0.004	<0.003
Thallium	0.03	None	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Uranium	0.0002	0.01-0.1	mg/L	<0.0002	<0.0002	0.0002	0.00022	<0.0002	<0.0002
Vanadium	0.003	0.1	mg/L	<0.003	<0.003	0.003	<0.003	0.003	<0.003
Zinc	0.01	0.01-0.03	mg/L	NA	NA	NA	NA	NA	NA
Zinc	0.0002	0.01-0.03	mg/L	<0.002	0.0004	0.0197	0.0053	0.0112	<0.002
Zirconium	0.003	None	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Silver Dissolved	0.01	0.0001	mg/L	NA	NA	NA	NA	NA	NA
Silver Dissolved	0.00001	0.0001	mg/L	<0.00001	0.00002	<0.00001	0.0001	0.00001	<0.00001
Aluminum Dissolved	0.02	0.05	mg/L	NA	NA	NA	NA	NA	NA
Aluminum Dissolved	0.002	0.05	mg/L	<0.002	<0.002	0.26	0.08	0.004	<0.002
Arsenic Dissolved	0.04	0.05	mg/L	NA	NA	NA	NA	NA	NA
Arsenic Dissolved	0.0005	0.05	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Boron Dissolved	0.008	0.5 - 5	mg/L	<0.008	<0.008	<0.008	0.009	<0.008	<0.008
Barium Dissolved	0.001	1	mg/L	<0.001	<0.001	0.045	0.049	0.034	<0.001
Beryllium Dissolved	0.001	0.011	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bismuth Dissolved	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Calcium Dissolved	0.01	None	mg/L	<0.01	0.03	23.4	30.3	23.3	<0.01
Cadmium Dissolved	0.002	0.0002	mg/L	NA	NA	NA	NA	NA	NA
Cadmium Dissolved	0.00002	0.0002	mg/L	<0.00002	<0.00002	0.00003	0.00003	0.00002	<0.00002
Cobalt Dissolved	0.003	0.05	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium Dissolved	0.002	0.002-0.02	mg/L	NA	NA	NA	NA	NA	NA
Chromium Dissolved	0.0002	0.002-0.02	mg/L	<0.0002	<0.0002	<0.0002	0.0008	0.0004	<0.0002
Copper Dissolved	0.001	0.002-0.02	mg/L	NA	NA	NA	NA	NA	NA
Copper Dissolved	0.0001	0.002-0.02	mg/L	<0.0001	0.0001	0.0012	0.0008	0.0009	<0.0001
Iron Dissolved	0.003	0.03	mg/L	NA	NA	NA	NA	NA	NA
Iron Dissolved	0.0003	0.03	mg/L	<0.0003	<0.0003	0.2	0.157	0.026	<0.0003
Mercury Dissolved	0.00001	0.00001	mg/L	0.00006	<0.00005	0.00008	<0.00005	<0.00005	0.00005
Potassium Dissolved	0.4	None	mg/L	<0.4	<0.4	0.4	0.6	<0.4	<0.4
Magnesium Dissolved	0.02	None	mg/L	<0.02	<0.02	4.64	5.76	4.36	<0.02
Manganese Dissolved	0.002	0.05	mg/L	<0.002	<0.002	0.002	0.007	0.005	<0.002
Molybdenum Dissolved	0.004	0.01-0.03	mg/L	NA	NA	NA	NA	NA	NA
Molybdenum Dissolved	0.0004	0.01-0.03	mg/L	<0.0004	<0.0004	<0.0004	<0.0004	0.0004	<0.0004
Sodium Dissolved	0.01	None	mg/L	0.02	0.02	0.98(2)	1.62	0.89	0.01
Nickel Dissolved	0.008	0.025-0.15	mg/L	NA	NA	NA	NA	NA	NA
Nickel Dissolved	0.0008	0.025-0.15	mg/L	<0.0008	<0.0008	0.0017	0.002	<0.0008	<0.0008
Phosphorus Dissolved	0.04	.005-.015	mg/L	<0.04	<0.04	0.04	<0.04	<0.04	<0.04
Lead Dissolved	0.02	0.003	mg/L	NA	NA	NA	NA	NA	NA
Lead Dissolved	0.0003	0.003	mg/L	<0.0003	<0.0003	0.0014	0.0009	0.0005	<0.0003
Sulfur Dissolved	0.03	100	mg/L	<0.03	<0.03	1.81	3.04	2.05	<0.03
Antimony Dissolved	0.015	0.05	mg/L	NA	NA	NA	NA	NA	NA
Antimony Dissolved	0.0005	0.05	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Selenium Dissolved	0.03	0.001	mg/L	NA	NA	NA	NA	NA	NA
Selenium Dissolved	0.0001	0.001	mg/L	<0.0001	<0.0001	0.0006	0.00036	0.0001	<0.0001
Silicon Dissolved	0.03	None	mg/L	<0.03	<0.03	1.46	1.28	1.13	<0.03
Tin Dissolved	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Strontium Dissolved	0.001	None	mg/L	<0.001	<0.001	0.087	0.133	0.098	<0.001
Tellurium Dissolved	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Titanium Dissolved	0.003	None	mg/L	<0.003	<0.003	0.006	<0.003	<0.003	<0.003
Thallium Dissolved	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Uranium Dissolved	0.0002	0.01-0.1	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Vanadium Dissolved	0.003	0.1	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Zinc Dissolved	0.002	0.01-0.03	mg/L	NA	NA	NA	NA	NA	NA
Zinc Dissolved	0.0002	0.01-0.03	mg/L	<0.0002	0.0007	0.0036	0.0047	0.0007	<0.0002
Zirconium Dissolved	0.003	None	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003

TABLE E
NDM WATER SAMPLING - 1994

				94012016	94012937	94012011	94012987	94011098	94011099
			ID:	TR BLANK	TR BLANK	T-1A	TRIB-1	WC-1	DC-1
			SITE	TR BLANK	TR BLANK	TRIB-1	TRIB-1	WC-1	WC-1
				94/05/30	94/06/08	94/05/30	94/06/08	94/05/17	94/05/17
Parameter	MDC	Criterion	Unit						
pH	0.1	None	su	5.7	5.6	NA	NA	8.2	8.1
Specific Conductance	1.	None	uS/cm	2.	2.	NA	NA	159.	156.
Residue Nonfilt.	1.	None	mg/L	<1.	4.	<1.	99.	359.	364.
Turbidity	0.1	+1 to 5	NTU	0.4	0.2	NA	NA	320.	95.
Hardness Total		None	mg/L	0.1	<0.1	161.	163.	95.7	93.7
Hardness Dissolved		None	mg/L	0.5	<0.1	156.	170.	83.6	84.
HCO3 as CaCO3	0.1	None	mg/L	<0.1	1.9	NA	NA	NA	NA
Alkalinity Phen. 8.3	0.1	None	mg/L	<0.1	<0.1	NA	NA	NA	NA
Alkalinity Total 4.5	0.5	None	mg/L	0.7	1.9	NA	NA	87.3	78.
Chloride Dissolved	0.5	None	mg/L	<0.5	<0.5	NA	NA	0.7	0.6
Fluoride Dissolved	0.01	0.2-0.3	mg/L	<0.01	<0.01	NA	NA	0.11	0.11
Carbon Total Organic	1.	None	mg/L	<1.	<1.	<1.	NA	17.	17.
Nitrogen Amm.Diss(N)	0.005	0.1	mg/L	<0.005	<0.005	<0.005	<0.005	0.009	0.007
Nitro NO3+NO2 D	0.02		mg/L	<0.02	<0.02	<0.02	<0.02	0.05	0.06
Nitrogen NO3 Diss(N)	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	0.04	0.06
Nitrogen NO2 Diss(N)	0.005	0.02-0.2	mg/L	<0.005	<0.005	<0.005	<0.005	0.008	<0.005
Nitro.Dis(NO2) LL	0.001	0.02-0.2	mg/L	<0.001	<0.001	NA	NA	0.006	0.005
Phosphorus Ort.Dis-P	0.001	None	mg/L	<0.001	<0.001	NA	NA	0.013	0.006
Phosphorus Tot. Diss	0.001	.005-.015	mg/L	<0.001	<0.001	NA	NA	0.012	0.014
Phosphorus	0.001	.005-.015	mg/L	<0.001	<0.001	NA	0.005	0.296	0.055
Sulfate	1.	100	mg/L	<1.	<1.	4.6	5.3	5.	4.8
Dissolved Oxygen	0.1	6-11	mg/L	11.	10.	NA	NA	11.	11.
Silver	0.03	0.0001	mg/L	NA	NA	<0.03	<0.03	NA	NA
Silver	0.00001	0.0001	mg/L	<0.00001	0.00001	NA	NA	0.00026	0.00026
Aluminum	0.06	0.05	mg/L	NA	NA	<0.06	<0.06	NA	NA
Aluminum	0.002	0.05	mg/L	<0.002	0.003	NA	NA	1.79	1.68
Arsenic	0.04	0.05	mg/L	NA	NA	<0.04	<0.04	NA	NA
Arsenic	0.0005	0.05	mg/L	<0.0005	<0.0005	NA	NA	0.0013	0.0055
Boron	0.04	0.5 - 5	mg/L	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Barium	0.001	1	mg/L	<0.001	<0.001	0.113	0.116(1)	0.112	0.11
Beryllium	0.001	0.011	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bismuth	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Calcium	0.05	None	mg/L	0.14	<0.05	50.9	51.3(1)	27.5	26.9
Cadmium	0.002	0.0002	mg/L	NA	NA	<0.002	<0.002	NA	NA
Cadmium	0.00002	0.0002	mg/L	<0.00002	<0.00002	NA	NA	0.00012	0.00015
Cobalt	0.004	0.05	mg/L	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Chromium	0.002	0.002-0.02	mg/L	NA	NA	<0.002	<0.002	NA	NA
Chromium	0.0002	0.002-0.02	mg/L	0.001	<0.0002	NA	NA	0.0059	0.0063
Copper	0.002	0.002-0.02	mg/L	NA	NA	<0.002	<0.002	NA	NA
Copper	0.0002	0.002-0.02	mg/L	0.0002	<0.0002	NA	NA	0.0077	0.0089
Iron	0.05	0.03	mg/L	NA	NA	<0.05	<0.05	NA	NA
Iron	0.0003	0.03	mg/L	0.007	0.0049	NA	NA	2.45	2.26
Mercury	0.00001	0.00001	mg/L	<0.00001	<0.00001	NA	NA	0.00013	0.00011
Potassium	0.4	None	mg/L	<0.4	<0.4	0.7(1)	0.8	1.2	1.2
Magnesium	0.02	None	mg/L	0.02	<0.02	8.34	8.44(1)	6.57	6.45
Manganese	0.002	0.05	mg/L	<0.002	<0.002	0.002	<0.002	0.029	0.026
Molybdenum	0.004	0.01-0.03	mg/L	NA	NA	<0.004	<0.004	NA	NA
Molybdenum	0.0004	0.01-0.03	mg/L	<0.0004	<0.0004	NA	NA	<0.0004	<0.0004
Sodium	0.4	None	mg/L	<	<0.4	0.7(1)	0.7(1)	1.6	1.8
Nickel	0.01	0.025-0.15	mg/L	NA	NA	<0.01	<0.01	NA	NA
Nickel	0.0008	0.025-0.15	mg/L	0.0013	<0.0008	NA	NA	0.012	0.015
Phosphorus	0.04	.005-.015	mg/L	<0.04	<0.04	<0.04	<0.04	0.11	0.1
Lead	0.03	0.003	mg/L	NA	NA	<0.03	<0.03	NA	NA
Lead	0.0003	0.003	mg/L	<0.0003	0.0006	NA	NA	0.002	0.0045
Sulphur	0.1	100	mg/L	<0.1	<0.1	1.0(1)	1.	1.3	1.3
Antimony	0.02	0.05	mg/L	NA	NA	<0.02	<0.02	NA	NA
Antimony	0.0005	0.05	mg/L	<0.0005	<0.0005	NA	NA	<0.0005	<0.0005
Selenium	0.03	0.001	mg/L	NA	NA	<0.03	<0.03	NA	NA
Selenium	0.0001	0.001	mg/L	<0.0001	0.00006	NA	NA	0.0009	0.0014
Silicon	0.8	None	mg/L	<0.08	<0.08	1.8	1.9(1)	4.2	4.

TABLE E
NDM WATER SAMPLING - 1994

				94012016	94012937	94012011	94012987	94011098	94011099
			ID:	TR BLANK	TR BLANK	T-1A	TRIB-1	WC-1	DC-1
			SITE	TR BLANK	TR BLANK	TRIB-1	TRIB-1	WC-1	WC-1
				94/05/30	94/06/08	94/05/30	94/06/08	94/05/17	94/05/17
Parameter	MDC	Criterion	Unit						
Tin	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Strontium	0.001	None	mg/L	<0.001	<0.001	0.072	0.074(1)	0.061	0.06
Tellurium	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Titanium	0.003	None	mg/L	<0.003	<0.003	<0.003	<0.003	0.005	0.005
Thallium	0.03	None	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Uranium	0.0002	0.01-0.1	mg/L	<0.0002	<0.0002	NA	NA	<0.0002	<0.0002
Vanadium	0.003	0.1	mg/L	<0.003	<0.003	<0.003	<0.003	0.009	0.006
Zinc	0.01	0.01-0.03	mg/L	NA	NA	<0.01	<0.01	NA	NA
Zinc	0.0002	0.01-0.03	mg/L	0.0008	0.0004	NA	NA	0.038	0.0469
Zirconium	0.003	None	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Silver Dissolved	0.01	0.0001	mg/L	NA	NA	<0.01	<0.01	NA	NA
Silver Dissolved	0.00001	0.0001	mg/L	<0.00001	0.00001	NA	NA	<0.00001	<0.00001
Aluminum Dissolved	0.02	0.05	mg/L	NA	NA	<0.02	<0.02	NA	NA
Aluminum Dissolved	0.002	0.05	mg/L	<0.002	0.003	NA	NA	1.4	1.07
Arsenic Dissolved	0.04	0.05	mg/L	NA	NA	<0.04	<0.04	NA	NA
Arsenic Dissolved	0.0005	0.05	mg/L	<0.0005	<0.0005	NA	NA	<0.0005	<0.0005
Boron Dissolved	0.008	0.5 - 5	mg/L	<0.008	<0.008	0.009	<0.008	0.011	0.011
Barium Dissolved	0.001	1	mg/L	<0.001	<0.001	0.109	0.119	0.08	0.076
Beryllium Dissolved	0.001	0.011	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bismuth Dissolved	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Calcium Dissolved	0.01	None	mg/L	0.02	0.04	49.	53.7	24.	24.1
Cadmium Dissolved	0.002	0.0002	mg/L	NA	NA	<0.002	<0.002	NA	NA
Cadmium Dissolved	0.00002	0.0002	mg/L	<0.00002	<0.00002	NA	NA	0.00006	0.00006
Cobalt Dissolved	0.003	0.05	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium Dissolved	0.002	0.002-0.02	mg/L	NA	NA	<0.002	<0.002	NA	NA
Chromium Dissolved	0.0002	0.002-0.02	mg/L	0.0023	0.0005	NA	NA	0.0014	0.001
Copper Dissolved	0.001	0.002-0.02	mg/L	NA	NA	<0.001	<0.001	NA	NA
Copper Dissolved	0.0001	0.002-0.02	mg/L	0.0023	<0.0001	NA	NA	0.0031	0.0028
Iron Dissolved	0.003	0.03	mg/L	NA	NA	0.016	0.015	NA	NA
Iron Dissolved	0.0003	0.03	mg/L	<0.0003	0.0014	NA	NA	0.745	0.625
Mercury Dissolved	0.00001	0.00001	mg/L	<0.00005	<0.00005	NA	NA	0.0001	0.0001
Potassium Dissolved	0.4	None	mg/L	0.4	<0.4	1.	0.7	1.2	1.
Magnesium Dissolved	0.02	None	mg/L	0.02	<0.02	8.12	8.83	5.76	5.78
Manganese Dissolved	0.002	0.05	mg/L	<0.002	<0.002	<0.002	<0.002	0.005	0.004
Molybdenum Dissolved	0.004	0.01-0.03	mg/L	NA	NA	<0.004	<0.004	NA	NA
Molybdenum Dissolved	0.0004	0.01-0.03	mg/L	<0.0004	<0.0004	NA	NA	<0.0004	<0.0004
Sodium Dissolved	0.01	None	mg/L	0.02	0.03	0.78	0.82	1.65(2)	1.68
Nickel Dissolved	0.008	0.025-0.15	mg/L	NA	NA	<0.008	<0.008	NA	NA
Nickel Dissolved	0.0008	0.025-0.15	mg/L	0.0025	<0.0008	NA	NA	0.004	0.0037
Phosphorus Dissolved	0.04	.005-.015	mg/L	<0.04	<0.04	<0.04	<0.04	0.04	<0.04
Lead Dissolved	0.02	0.003	mg/L	NA	NA	<0.02	<0.02	NA	NA
Lead Dissolved	0.0003	0.003	mg/L	<0.0003	0.0003	NA	NA	0.0007	<0.0003
Sulfur Dissolved	0.03	100	mg/L	<0.03	<0.03	1.06	0.95(1)	1.28	1.31(2)
Antimony Dissolved	0.015	0.05	mg/L	NA	NA	<0.015	<0.015	NA	NA
Antimony Dissolved	0.0005	0.05	mg/L	<0.0005	<0.0005	NA	NA	<0.0005	<0.0005
Selenium Dissolved	0.03	0.001	mg/L	NA	NA	<0.03	<0.03	NA	NA
Selenium Dissolved	0.0001	0.001	mg/L	<0.0001	<0.0001	NA	NA	0.0009	0.0007
Silicon Dissolved	0.03	None	mg/L	<0.03	<0.03	1.73	1.95	3.59	3.15
Tin Dissolved	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Strontium Dissolved	0.001	None	mg/L	<0.001	<0.001	0.069	0.076	0.054	0.054
Tellurium Dissolved	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Titanium Dissolved	0.003	None	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Thallium Dissolved	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Uranium Dissolved	0.0002	0.01-0.1	mg/L	<0.0002	<0.0002	NA	NA	<0.0002	<0.0002
Vanadium Dissolved	0.003	0.1	mg/L	<0.003	<0.003	<0.003	<0.003	0.005	0.004
Zinc Dissolved	0.002	0.01-0.03	mg/L	NA	NA	<0.002	<0.002	NA	NA
Zinc Dissolved	0.0002	0.01-0.03	mg/L	0.0006	0.0009	NA	NA	0.0097	0.0083
Zirconium Dissolved	0.003	None	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003

TABLE E
NDM WATER SAMPLING - 1994

				94012014	94012015	94012934	94012935
			ID:	DC-1	WC-1	WC-1	DC-1
			SITE	WC-1	WC-1	WC-1	WC-1
				94/05/30	94/05/30	94/06/08	94/06/08
Parameter	MDC	Criterion	Unit				
pH	0.1	None	su	8.2	8.2	8.3	8.3
Specific Conductance	1.	None	uS/cm	262.	262.	245.	252.
Residue Nonfilt.	1.	None	mg/L	<1.	4.	<1.	<1.
Turbidity	0.1	+1 to 5	NTU	NA	NA	4.8	4.8
Hardness Total		None	mg/L	141.	146.	146.	146.
Hardness Dissolved		None	mg/L	138.	138.	146.	146.
HCO3 as CaCO3	0.1	None	mg/L	135.	135.	139.	139.
Alkalinity Phen. 8.3	0.1	None	mg/L	<0.1	<0.1	<0.1	<0.1
Alkalinity Total 4.5	0.5	None	mg/L	135.	135.	139.	139.
Chloride Dissolved	0.5	None	mg/L	0.7	0.9	0.9	0.6
Fluoride Dissolved	0.01	0.2-0.3	mg/L	0.08	0.08	0.12	0.1
Carbon Total Organic	1.	None	mg/L	7.9	8.1	9.7	10.3
Nitrogen Amm.Diss(N)	0.005	0.1	mg/L	<0.005	<0.005	<0.005	<0.005
Nitro NO3+NO2 D	0.02		mg/L	<0.02	<0.02	<0.02	<0.02
Nitrogen NO3 Diss(N)	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02
Nitrogen NO2 Diss(N)	0.005	0.02-0.2	mg/L	<0.005	<0.005	<0.005	<0.005
Nitro.Dis(NO2) LL	0.001	0.02-0.2	mg/L	<0.001	<0.001	0.001	0.002
Phosphorus Ort.Dis-P	0.001	None	mg/L	0.005	0.004	0.004	<0.001
Phosphorus Tot. Diss	0.001	.005-.015	mg/L	0.005	0.003	0.01	0.005
Phosphorus	0.001	.005-.015	mg/L	0.011	0.01	0.014	0.011
Sulfate	1.	100	mg/L	7.1	7.1	6.2	6.1
Dissolved Oxygen	0.1	6-11	mg/L	11.	11.	11.	10.
Silver	0.03	0.0001	mg/L	NA	NA	NA	NA
Silver	0.00001	0.0001	mg/L	0.00011	0.00017	<0.00001	<0.00001
Aluminum	0.06	0.05	mg/L	NA	NA	NA	NA
Aluminum	0.002	0.05	mg/L	0.127	0.1	0.112	0.114
Arsenic	0.04	0.05	mg/L	NA	NA	NA	NA
Arsenic	0.0005	0.05	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
Boron	0.04	0.5 - 5	mg/L	<0.04	<0.04	<0.04	<0.04
Barium	0.001	1	mg/L	0.097	0.099	0.099	0.098
Beryllium	0.001	0.011	mg/L	<0.001	<0.001	<0.001	<0.001
Bismuth	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02
Calcium	0.05	None	mg/L	40.9	42.2	42.3(1)	42.4
Cadmium	0.002	0.0002	mg/L	NA	NA	NA	NA
Cadmium	0.00002	0.0002	mg/L	<0.00002	0.00002	0.00002	0.00003
Cobalt	0.004	0.05	mg/L	<0.04	<0.04	<0.04	<0.04
Chromium	0.002	0.002-0.02	mg/L	NA	NA	NA	NA
Chromium	0.0002	0.002-0.02	mg/L	0.0069	0.002	0.0008	0.001
Copper	0.002	0.002-0.02	mg/L	NA	NA	NA	NA
Copper	0.0002	0.002-0.02	mg/L	0.0013	0.0011	0.0012	0.0012
Iron	0.05	0.03	mg/L	NA	NA	NA	NA
Iron	0.0003	0.03	mg/L	0.21	0.16	0.185	0.197
Mercury	0.00001	0.00001	mg/L	<0.00001	0.000013	<0.00001	<0.00001
Potassium	0.4	None	mg/L	0.6(1)	0.7(1)	0.5	0.6
Magnesium	0.02	None	mg/L	9.49	9.81	9.73(1)	9.68(1)
Manganese	0.002	0.05	mg/L	0.004	0.003	0.002	0.004
Molybdenum	0.004	0.01-0.03	mg/L	NA	NA	NA	NA
Molybdenum	0.0004	0.01-0.03	mg/L	<0.0004	<0.0004	<0.0004	<0.0004
Sodium	0.4	None	mg/L	2.5	2.7	2.8	2.7(1)
Nickel	0.01	0.025-0.15	mg/L	NA	NA	NA	NA
Nickel	0.0008	0.025-0.15	mg/L	0.0034	0.0025	0.0013	0.0013
Phosphorus	0.04	.005-.015	mg/L	<0.04	<0.04	<0.04	<0.04
Lead	0.03	0.003	mg/L	NA	NA	NA	NA
Lead	0.0003	0.003	mg/L	0.0004	0.0008	0.0003	0.0005
Sulphur	0.1	100	mg/L	1.9	2.	1.9	1.9
Antimony	0.02	0.05	mg/L	NA	NA	NA	NA
Antimony	0.0005	0.05	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
Selenium	0.03	0.001	mg/L	NA	NA	NA	NA
Selenium	0.0001	0.001	mg/L	0.0021	0.00063	<0.0001	0.00018
Silicon	0.8	None	mg/L	2.3	2.4	2.3	2.3

TABLE E
NDM WATER SAMPLING - 1994

				94012014	94012015	94012934	94012935
			ID:	DC-1	WC-1	WC-1	DC-1
			SITE	WC-1	WC-1	WC-1	WC-1
				94/05/30	94/05/30	94/06/08	94/06/08
Parameter	MDC	Criterion	Unit				
Tin	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02
Strontium	0.001	None	mg/L	0.085	0.09	0.089	0.088(1)
Tellurium	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02
Titanium	0.003	None	mg/L	<0.003	<0.003	<0.003	<0.003
Thallium	0.03	None	mg/L	<0.03	<0.03	<0.03	<0.03
Uranium	0.0002	0.01-0.1	mg/L	<0.0002	<0.0002	<0.0002	<0.0002
Vanadium	0.003	0.1	mg/L	<0.003	<0.003	<0.003	<0.003
Zinc	0.01	0.01-0.03	mg/L	NA	NA	NA	NA
Zinc	0.0002	0.01-0.03	mg/L	0.0024	0.0026	0.0018	0.0016
Zirconium	0.003	None	mg/L	<0.003	<0.003	<0.003	<0.003
Silver Dissolved	0.01	0.0001	mg/L	NA	NA	NA	NA
Silver Dissolved	0.00001	0.0001	mg/L	0.00001	0.00004	<0.00001	<0.00001
Aluminum Dissolved	0.02	0.05	mg/L	NA	NA	NA	NA
Aluminum Dissolved	0.002	0.05	mg/L	0.059	0.075	<0.002	<0.002
Arsenic Dissolved	0.04	0.05	mg/L	NA	NA	NA	NA
Arsenic Dissolved	0.0005	0.05	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
Boron Dissolved	0.008	0.5 - 5	mg/L	0.014	0.015	0.014	0.014
Barium Dissolved	0.001	1	mg/L	0.091	0.091	0.095	0.096
Beryllium Dissolved	0.001	0.011	mg/L	<0.001	<0.001	<0.001	<0.001
Bismuth Dissolved	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02
Calcium Dissolved	0.01	None	mg/L	39.9	39.8	42.5	42.2
Cadmium Dissolved	0.002	0.0002	mg/L	NA	NA	NA	NA
Cadmium Dissolved	0.00002	0.0002	mg/L	<0.00002	<0.00002	0.00002	0.00003
Cobalt Dissolved	0.003	0.05	mg/L	<0.003	<0.003	<0.003	<0.003
Chromium Dissolved	0.002	0.002-0.02	mg/L	NA	NA	NA	NA
Chromium Dissolved	0.0002	0.002-0.02	mg/L	0.0006	0.0008	0.0005	0.0009
Copper Dissolved	0.001	0.002-0.02	mg/L	NA	NA	NA	NA
Copper Dissolved	0.0001	0.002-0.02	mg/L	0.0006	0.0008	0.0014	0.001
Iron Dissolved	0.003	0.03	mg/L	NA	NA	NA	NA
Iron Dissolved	0.0003	0.03	mg/L	0.08	0.109	0.029	0.026
Mercury Dissolved	0.00001	0.00001	mg/L	<0.00005	<0.00005	<0.00001	<0.00001
Potassium Dissolved	0.4	None	mg/L	0.8	0.8	<0.4	0.5
Magnesium Dissolved	0.02	None	mg/L	9.35	9.28	9.76	9.83
Manganese Dissolved	0.002	0.05	mg/L	<0.002	<0.002	<0.002	<0.002
Molybdenum Dissolved	0.004	0.01-0.03	mg/L	NA	NA	NA	NA
Molybdenum Dissolved	0.0004	0.01-0.03	mg/L	<0.0004	<0.0004	<0.0004	<0.0004
Sodium Dissolved	0.01	None	mg/L	2.7	2.68	2.8	2.87
Nickel Dissolved	0.008	0.025-0.15	mg/L	NA	NA	NA	NA
Nickel Dissolved	0.0008	0.025-0.15	mg/L	0.0023	0.0084	0.001	<0.0008
Phosphorus Dissolved	0.04	.005-.015	mg/L	<0.04	<0.04	<0.04	<0.04
Lead Dissolved	0.02	0.003	mg/L	NA	NA	NA	NA
Lead Dissolved	0.0003	0.003	mg/L	0.0004	0.0005	0.0003	<0.0003
Sulfur Dissolved	0.03	100	mg/L	1.83	1.81	1.86	1.87
Antimony Dissolved	0.015	0.05	mg/L	NA	NA	NA	NA
Antimony Dissolved	0.0005	0.05	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
Selenium Dissolved	0.03	0.001	mg/L	NA	NA	NA	NA
Selenium Dissolved	0.0001	0.001	mg/L	0.0004	0.00057	<0.0001	0.00005
Silicon Dissolved	0.03	None	mg/L	2.03	2.02	2.14	2.15
Tin Dissolved	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02
Strontium Dissolved	0.001	None	mg/L	0.082	0.082	0.088	0.089
Tellurium Dissolved	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02
Titanium Dissolved	0.003	None	mg/L	<0.003	<0.003	<0.003	<0.003
Thallium Dissolved	0.02	None	mg/L	<0.02	<0.02	<0.02	<0.02
Uranium Dissolved	0.0002	0.01-0.1	mg/L	<0.0002	<0.0002	<0.0002	<0.0002
Vanadium Dissolved	0.003	0.1	mg/L	<0.003	<0.003	<0.003	<0.003
Zinc Dissolved	0.002	0.01-0.03	mg/L	NA	NA	NA	NA
Zinc Dissolved	0.0002	0.01-0.03	mg/L	0.0034	0.0033	0.0007	0.0003
Zirconium Dissolved	0.003	None	mg/L	<0.003	<0.003	<0.003	<0.003

APPENDIX 4.4-2

WILLOW CREEK COAL PROJECT
1996 MONTHLY WATER QUALITY DATA

APPENDIX 4.4-2, TABLE A

MONTHLY SURFACE WATER QUALITY

Parameter	Unit Name	FEC 1 Monthly	FEC 1 Monthly	FEC 1 Monthly	FEC 1 Monthly	FEC1 Monthly	FEC1 Monthly	FEC1 Monthly	FEC1 Monthly	FEC1 Monthly	FEC1 Monthly	FEC1 Monthly	Arithmetic Mean	Standard Deviation
Date Sampled		96/05/14	96/06/12	96/07/10	96/08/07	96/09/11	96/10/09	96/11/06	96/12/11	97/01/15	97/02/12	97/03/18		
pH	pH units	8.23	8.22	7.93	8.3	8.43	8.29	8.31	8.39	8.28	8.26	8.33	8.27	0.13
Conductivity	uS/cm	384	296	324	362	411	363	393	444	469	480	473	400	62
Turbidity	NTU	1.5	2.8	2.4	1.42	0.66	0.49	0.25	0.29	0.38			1.13	0.95
Hardness CaCO3	mg/L	191	141	159		200	168	198	231	237			191	34
Hardness (Total) CaCO3	mg/L	193	147	175	183	214	186	207	232	243			198	30
Total Dissolved Solids	mg/L				164						291	284		
Total Suspended Solids	mg/L	3	3	< 1	<1	< 1	< 1	< 1	< 1	< 1	2	2	3	1
Alkalinity Phen. 8.3	mg/L				< 0.5									
Total Alkalinity CaCO3	mg/L	205	156	169	178	211	176	202	230	253			198	31
Carbonate	mg/L				< 0.5									
Bicarbonate	mg/L				217									
Hydroxide	mg/L				< 0.5									
Fluoride F	mg/L	0.19	0.2	0.27	0.13	0.28	0.12	< 0.05	< 0.05	0.1			0.18	0.07
Chloride Cl	mg/L	0.6	0.6	0.7		0.7	0.4	0.3	2.8	0.6	0.6	0.7	0.8	0.7
Nitrate+Nitrite (N)	mg/L				0.02									
Nitrate N	mg/L	0.11	< 0.05	< 0.05	< 0.02	< 0.05	< 0.05	< 0.05	0.21	0.19	0.18	0.17	0.17	0.04
Nitrite N	mg/L	< 0.002	< 0.002	< 0.002	< 0.005	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002		
Sulphate SO4	mg/L	16.3	10	13	12.5	16	15	18	19	20			16	3
Total Organic Carbon C	mg/L	7.1	10	9	6.6	7.4	7	7.7	5.6	6.2			7.4	1.4
Ammonia Nitrogen N	mg/L	0.05	< 0.02	< 0.02	< 0.005	0.04	0.02	0.08	0.05	0.06	0.03	0.02	0.04	0.02
Ortho Phosphorus P	mg/L	< 0.02	< 0.02	< 0.02		< 0.02	< 0.02	< 0.02	< 0.02	< 0.02				
Total Phosphorus P	mg/L	< 0.02	0.04	0.02		< 0.02	< 0.02	< 0.02	< 0.02	< 0.02			0.03	0.01
Total Aluminum Al	mg/L	0.089	0.13	0.078	0.056	0.022	0.017	0.01	0.005	0.007			0.046	0.045
Total Antimony Sb	mg/L	< 0.001	< 0.001	< 0.001	0.00017	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0002	0
Total Arsenic As	mg/L	< 0.001	< 0.001	< 0.001	0.00006	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0001	0
Total Barium Ba	mg/L	0.094	0.083	0.094	0.091	0.12	0.093	0.1	0.11	0.12			0.10	0.01
Total Beryllium Be	mg/L	< 0.001	< 0.001	< 0.001	< 0.00001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001				
Total Boron B	mg/L	0.04	0.07	0.05	0.033	0.032	0.032	0.02	0.018	0.044			0.038	0.016
Total Bismuth Bi	mg/L				< 0.002									
Total Cadmium Cd	mg/L	< 0.0002	0.0011	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002			0.001	0
Total Calcium Ca	mg/L	51.5	40.2	48.1	51	56.9	50.2	53.7	60.5	63.5			52.84	6.93
Total Chromium Cr	mg/L	< 0.001	0.001	< 0.001	0.0009	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.00	0.00
Total Cobalt Co	mg/L	< 0.001	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001				
Total Copper Cu	mg/L	0.001	0.001	0.002	0.0015	0.002	0.001	< 0.001	< 0.001	< 0.001			0.0014	0.0005
Total Iron Fe	mg/L	0.13	0.12	0.1	0.081	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03			0.11	0.02
Total Lead Pb	mg/L	< 0.001	0.003	< 0.001	0.0002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.00	0.00
Total Magnesium Mg	mg/L	15.5	11.2	13.3	14	17.5	14.8	17.7	19.6	20.5			16.01	3.05
Total Manganese Mn	mg/L	0.002	0.001	0.001	0.0006	< 0.001	< 0.001	0.003	< 0.001	< 0.001			0.00	0.00
Total Mercury Hg	ug/L	< 0.05	< 0.05	< 0.05	0.01	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05			0.01	0
Total Molybdenum Mo	mg/L	< 0.001	< 0.001	0.001	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001	0
Total Nickel Ni	mg/L	0.002	0.002	0.002	0.002	0.003	0.002	< 0.001	0.001	< 0.001			0.002	0.001
Total Phosphorus PO4	mg/L	< 0.4	< 0.4	< 0.4	0.01	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4			0.01	0
Total Potassium K	mg/L	0.78	0.68	0.8	0.73	1.01	0.91	0.78	0.81	0.83			0.81	0.10
Total Selenium Se	mg/L	< 0.001	< 0.001	0.001	0.00052	< 0.001	< 0.001	< 0.001	< 0.001	0.001			0.001	0.0003
Total Silicon SiO2	mg/L	4.5	4.8	6	2.5	4.7	4.6	4.2	4.5	4.5			4.48	0.90
Total Silver Ag	mg/L	< 0.0001	< 0.0001	< 0.0001	0.00017	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001			0.0002	0
Total Sodium Na	mg/L	8.2	5.4	6.2	6.5	10.2	8.2	9.3	12.4	13.2			8.84	2.71
Total Sulphur S	mg/L				4.3									
Total Strontium Sr	mg/L	0.13	0.1	0.12	0.12	0.16	0.13	0.14	0.16	0.17			0.14	0.02
Total Tellurium Te	mg/L	< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001				

APPENDIX 4.4-2, TABLE A
MONTHLY SURFACE WATER QUALITY

Parameter	Unit Name	FEC 1 Monthly	FEC 1 Monthly	FEC 1 Monthly	FEC 1 Monthly	FEC1 Monthly	FEC1 Monthly	FEC1 Monthly	FEC1 Monthly	FEC1 Monthly	FEC1 Monthly	FEC1 Monthly	Arithmetic Mean	Standard Deviation
Total Thallium Tl	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.003	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001				
Total Thorium Th	mg/L	< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005				
Total Tin Sn	mg/L	< 0.001	< 0.001	< 0.001	< 0.002 (1)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001				
Total Titanium Ti	mg/L	0.001	0.001	0.002	0.0011	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001	0.0005
Total Uranium U	mg/L	< 0.0005	< 0.0005	< 0.0005	0.0011	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0006			0.001	0.0004
Total Vanadium V	mg/L	< 0.001	< 0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001				
Total Zinc Zn	mg/L	0.007	0.009	0.011	0.008	0.016	< 0.005	< 0.005	< 0.005	0.006			0.01	0.004
Total Zirconium Zr	mg/L	< 0.001	0.001	0.001	< 0.0003	0.001	< 0.001	< 0.001	< 0.001	0.002			0.001	0.001
Dissolved Aluminum Al	mg/L	0.012	< 0.005	0.015	0.008	0.005	0.007	< 0.005	< 0.005	0.007			0.01	0.00
Dissolved Antimony Sb	mg/L	< 0.001	< 0.001	< 0.001	0.00017	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0002	0
Dissolved Arsenic As	mg/L	< 0.001	< 0.001	< 0.001	0.00007 (1)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001				
Dissolved Barium Ba	mg/L	0.09	0.076	0.085	0.088	0.11	0.091	0.097	0.1	0.12			0.10	0.01
Dissolved Beryllium Be	mg/L	< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001				
Dissolved Bismuth	mg/L				< 0.002									
Dissolved Boron B	mg/L	0.02	0.02	0.03	0.031	0.019	0.019	0.014	0.018	0.032			0.02	0.01
Dissolved Cadmium Cd	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002				
Dissolved Calcium Ca	mg/L	50.9	38.8	43.7	50	53.5	44.6	51.1	60.3	61.9			50.5	7.5
Dissolved Chromium Cr	mg/L	< 0.001	0.001	< 0.001	0.0006	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0008	0.0003
Dissolved Cobalt Co	mg/L	< 0.001	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001				
Dissolved Copper Cu	mg/L	0.001	0.001	0.001	0.0007	< 0.001	0.001	< 0.001	< 0.001	< 0.001			0.0009	0.0001
Dissolved Iron Fe	mg/L	< 0.03	< 0.03	< 0.03	0.011	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03			0.01	0
Dissolved Lead Pb	mg/L	< 0.001	0.003	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.003	0
Dissolved Magnesium Mg	mg/L	15.4	10.8	12	14	16.2	13.6	17.1	19.4	19.9			15.4	3.1
Dissolved Manganese Mn	mg/L	< 0.001	0.005	< 0.001	< 0.0002	< 0.001	< 0.001	0.001	< 0.001	< 0.001			0.003	0.003
Dissolved Mercury Hg	ug/L	< 0.05	< 0.05	< 0.05	0.01	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05			0.01	0
Dissolved Molybdenum Mo	mg/L	< 0.001	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001				
Dissolved Nickel Ni	mg/L	0.002	0.002	0.003	0.001	0.001	0.002	< 0.001	0.001	< 0.001			0.00	0
Dissolved Phosphorus PO4	mg/L	< 0.4	< 0.4	< 0.4	0.006	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4			0.01	0
Dissolved Potassium K	mg/L	0.66	0.54	0.7	0.67	0.86	0.77	0.68	0.78	0.71			0.71	0.09
Dissolved Selenium Se	mg/L	< 0.001	< 0.001	< 0.001	0.0006	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001	0
Dissolved Silicon SiO2	mg/L	4	3.9	4.1	2.2	4.3	4.2	3.9	4.4	4.4			3.93	0.68
Dissolved Silver Ag	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.00001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001				
Dissolved Sodium Na	mg/L	8.1	5.2	5.7	6.4	9.3	7.9	8.9	12.3	12.7			8.50	2.66
Dissolved Sulfur S	mg/L				4.3									
Dissolved Strontium Sr	mg/L	0.13	0.096	0.11	0.12	0.15	0.13	0.13	0.15	0.17			0.13	0.02
Dissolved Tellurium Te	mg/L	< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001				
Dissolved Thallium Tl	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.003	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001				
Dissolved Thorium Th	mg/L	< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005				
Dissolved Tin Sn	mg/L	< 0.001	< 0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.002	0
Dissolved Titanium Ti	mg/L	< 0.001	0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001	0
Dissolved Uranium U	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0001	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0005			0.001	0
Dissolved Vanadium V	mg/L	< 0.001	< 0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001				
Dissolved Zinc Zn	mg/L	0.012	0.017	0.011	0.002	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005			0.01	0.01
Dissolved Zirconium Zr	mg/L	< 0.001	< 0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001				

APPENDIX 4.4-2, TABLE A

MONTHLY SURFACE WATER QUALITY

Parameter	Unit Name	Coefficient of Variation	MC 1 Monthly	MC 1 Monthly	MC 1 Monthly	MC 1 Monthly	MC1 Monthly	MC1 Monthly	MC1 Monthly	MC1 Monthly	MC1 Monthly	MC1 Monthly	MC1 Monthly	Arithmetic Mean
Date Sampled			96/05/14	96/06/12	96/07/10	96/08/07	96/09/11	96/10/09	96/11/06	96/12/11	97/01/15	97/02/12	97/03/18	
pH	pH units	1.6%	8.31	8.14	7.78	8.2	7.97	8.22	8.07	8.31	8.38	8.21	8.22	8.16
Conductivity	uS/cm	15.5%	385	362	398	406	445	434	443	444	439	443	470	424
Turbidity	NTU	84.3%	0.28	0.22	0.36	0.24	0.26	0.22	0.16	0.13	0.17			0.23
Hardness CaCO3	mg/L	17.6%	192	184	209		238	221	240	247	233			221
Hardness (Total) CaCO3	mg/L	15.0%	203	196	215	226	246	242	258	249	242			231
Total Dissolved Solids	mg/L					240						266	266	
Total Suspended Solids	mg/L	23%	< 1	< 1	2	< 4	< 1	< 1	< 1	< 1	< 1	< 1	1	1.50
Alkalinity Phen. 8.3	mg/L					< 0.5								
Total Alkalinity CaCO3	mg/L	15.8%	210	199	159	213	237	227	243	249	254			221
Carbonate	mg/L					< 0.5								
Bicarbonate	mg/L					260								
Hydroxide	mg/L					< 0.5								
Fluoride F	mg/L	39.0%	0.18	0.22	0.28	0.14	0.28	0.11	0.09	0.08	0.1			0.16
Chloride Cl	mg/L	89.4%	0.6	0.6	< 0.2		0.6	< 0.2	< 0.2	0.3	0.5	0.3	0.3	0.5
Nitrate+Nitrite (N)	mg/L					< 0.02								
Nitrate N	mg/L	21.9%	< 0.05	< 0.05	< 0.05	< 0.02	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	
Nitrite N	mg/L		< 0.002	< 0.002	< 0.002	< 0.005	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	
Sulphate SO4	mg/L	21.0%	5.4	5.1	5.7	4.1	5.9	4.8	1.3	6.1	5.4			4.9
Total Organic Carbon C	mg/L	18.5%	5.7	6.5	6.8	4.6	2.9	8.1	5.2	6.5	4			5.6
Ammonia Nitrogen N	mg/L	47.2%	0.03	< 0.02	< 0.02	< 0.005	0.05	0.03	0.13	0.02	0.1	0.02	< 0.02	0.05
Ortho Phosphorus P	mg/L		< 0.02	< 0.02	< 0.02		< 0.02	< 0.02	< 0.02	< 0.02	< 0.02			
Total Phosphorus P	mg/L	47.1%	0.03	0.03	< 0.02		< 0.02	< 0.02	< 0.02	< 0.02	< 0.02			0.03
Total Aluminum Al	mg/L	97.1%	0.018	0.017	0.025	0.009	0.027	0.008	0.013	0.005	< 0.005			0.02
Total Antimony Sb	mg/L	0%	< 0.001	< 0.001	< 0.001	0.00018	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0002
Total Arsenic As	mg/L	0%	< 0.001	< 0.001	< 0.001	< 0.00005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Total Barium Ba	mg/L	13.1%	0.12	0.12	0.13	0.13	0.16	0.15	0.15	0.15	0.14			0.14
Total Beryllium Be	mg/L		< 0.001	< 0.001	< 0.001	< 0.00001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Total Boron B	mg/L	42.3%	0.02	0.02	0.04	0.023	0.037	0.045	0.012	0.012	0.019			0.025
Total Bismuth Bi	mg/L					< 0.002								
Total Cadmium Cd	mg/L	0%	< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002			
Total Calcium Ca	mg/L	13.1%	61.8	59.6	66.3	70	74.8	73.4	76.7	74.8	72.3			70.0
Total Chromium Cr	mg/L	7.4%	< 0.001	< 0.001	< 0.001	0.0008	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0008
Total Cobalt Co	mg/L		< 0.001	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Total Copper Cu	mg/L	34.7%	< 0.001	< 0.001	0.002	0.0006	0.001	< 0.001	0.001	< 0.001	< 0.001			0.001
Total Iron Fe	mg/L	20.2%	0.05	< 0.03	< 0.03	0.009	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03			0.03
Total Lead Pb	mg/L	123.7%	< 0.001	< 0.001	< 0.001	0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0004
Total Magnesium Mg	mg/L	19.0%	11.8	11.3	11.9	13	14.4	14.1	16.2	15	14.8			13.6
Total Manganese Mn	mg/L	64.2%	< 0.001	< 0.001	< 0.001	< 0.0002	< 0.001	< 0.001	0.002	< 0.001	< 0.001			0.002
Total Mercury Hg	ug/L	0%	< 0.05	< 0.05	< 0.05	0.01	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05			0.01
Total Molybdenum Mo	mg/L	0%	< 0.001	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	0.003	< 0.001	< 0.001			0.003
Total Nickel Ni	mg/L	28.9%	< 0.001	< 0.001	0.001	< 0.001	0.002	0.001	< 0.001	< 0.001	< 0.001			0.001
Total Phosphorus PO4	mg/L	0%	< 0.4	< 0.4	< 0.4	0.004 (1)	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4			
Total Potassium K	mg/L	11.9%	0.53	0.53	0.55	0.52	0.62	0.76	0.56	0.5	0.57			0.57
Total Selenium Se	mg/L	33.0%	< 0.001	< 0.001	< 0.001	0.00079	< 0.001	< 0.001	< 0.001	< 0.001	0.001			0.0009
Total Silicon SiO2	mg/L	20.1%	4.4	4.5	5.1	2.4 (1)	6	5.4	5.4	5	5.2			5.1
Total Silver Ag	mg/L	0%	< 0.0001	< 0.0001	< 0.0001	< 0.00001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001			
Total Sodium Na	mg/L	30.7%	1.3	1.1	1.5	1.3	1.6	1.8	1.7	1.8	1.6			1.5
Total Sulphur S	mg/L					1.5								
Total Strontium Sr	mg/L	16.8%	0.089	0.088	0.093	0.092	0.11	0.11	0.1	0.11	0.11			0.10
Total Tellurium Te	mg/L		< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			

APPENDIX 4.4-2, TABLE A
MONTHLY SURFACE WATER QUALITY

Parameter	Unit Name	Coefficient of Variation	MC 1 Monthly	MC 1 Monthly	MC 1 Monthly	MC 1 Monthly	MC1 Monthly	MC1 Monthly	MC1 Monthly	MC1 Monthly	MC1 Monthly	MC1 Monthly	MC1 Monthly	Arithmetic Mean
Total Thallium Tl	mg/L		< 0.0001	< 0.0001	< 0.0001	< 0.003	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001			
Total Thorium Th	mg/L		< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005			
Total Tin Sn	mg/L		< 0.001	< 0.001	< 0.001	0.003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.003
Total Titanium Ti	mg/L	38.1%	< 0.001	< 0.001	< 0.001	0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0003
Total Uranium U	mg/L	41.6%	< 0.0005	< 0.0005	< 0.0005	0.0002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005			0.0002
Total Vanadium V	mg/L		< 0.001	< 0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Total Zinc Zn	mg/L	38.1%	0.006	0.01	0.016	0.002	0.01	< 0.005	< 0.005	< 0.005	< 0.005			0.009
Total Zirconium Zr	mg/L	40.0%	< 0.001	< 0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	0.002			0.002
Dissolved Aluminum Al	mg/L	41.6%	0.014	0.009	0.054	< 0.006	< 0.005	0.007	< 0.005	< 0.005	< 0.005			0.021
Dissolved Antimony Sb	mg/L	0%	< 0.001	< 0.001	< 0.001	0.00013	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0001
Dissolved Arsenic As	mg/L		< 0.001	< 0.001	< 0.001	< 0.00005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Dissolved Barium Ba	mg/L	14.0%	0.11	0.11	0.13	0.13	0.15	0.15	0.15	0.14	0.14			0.13
Dissolved Beryllium Be	mg/L		< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Dissolved Bismuth	mg/L					< 0.002								
Dissolved Boron B	mg/L	29.3%	0.01	< 0.005	0.01	0.02	0.006	0.008	< 0.005	0.008	0.019			0.012
Dissolved Cadmium Cd	mg/L		< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002			
Dissolved Calcium Ca	mg/L	14.9%	58.5	56.2	64.2	69	72.5	66.7	71	74.8	69.1			66.9
Dissolved Chromium Cr	mg/L	35.4%	< 0.001	< 0.001	< 0.001	0.0008	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001
Dissolved Cobalt Co	mg/L		< 0.001	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Dissolved Copper Cu	mg/L	14.3%	0.001	< 0.001	0.001	0.0005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0008
Dissolved Iron Fe	mg/L	0%	< 0.03	< 0.03	< 0.03	< 0.005	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03			
Dissolved Lead Pb	mg/L	0%	< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Dissolved Magnesium Mg	mg/L	20.3%	11.2	10.5	11.8	13	13.8	13.2	15.2	14.6	14.6			13.1
Dissolved Manganese Mn	mg/L	94.3%	< 0.001	< 0.001	< 0.001	< 0.0002	< 0.001	< 0.001	0.002	< 0.001	< 0.001			0.002
Dissolved Mercury Hg	ug/L	0%	< 0.05	< 0.05	< 0.05	0.01	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05			0.01
Dissolved Molybdenum Mo	mg/L		< 0.001	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Dissolved Nickel Ni	mg/L	44.1%	0.001	< 0.001	0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001			0.001
Dissolved Phosphorus PO4	mg/L	0.0%	< 0.4	< 0.4	< 0.4	0.005	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4			0.01
Dissolved Potassium K	mg/L	12.7%	0.39	0.46	0.53	0.51	0.58	0.61	0.49	0.45	0.4			0.49
Dissolved Selenium Se	mg/L	0.0%	< 0.001	< 0.001	< 0.001	0.0007	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001
Dissolved Silicon SiO2	mg/L	17.2%	4.1	4.1	4.6	2.5	5	5.2	4.8	5	5.1			4.49
Dissolved Silver Ag	mg/L		< 0.0001	< 0.0001	< 0.0001	< 0.00001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001			
Dissolved Sodium Na	mg/L	31.3%	1.2	1	1.3	1.3	1.4	1.5	1.5	1.8	1.6			1.40
Dissolved Sulfur S	mg/L					1.5								
Dissolved Strontium Sr	mg/L	17.0%	0.083	0.082	0.093	0.091	0.11	0.11	0.1	0.099	0.1			0.10
Dissolved Tellurium Te	mg/L		< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Dissolved Thallium Tl	mg/L		< 0.0001	< 0.0001	< 0.0001	< 0.003	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001			
Dissolved Thorium Th	mg/L		< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005			
Dissolved Tin Sn	mg/L	0%	< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Dissolved Titanium Ti	mg/L	0%	< 0.001	< 0.001	0.002	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.002
Dissolved Uranium U	mg/L	0%	< 0.0005	< 0.0005	< 0.0005	0.0002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005			0.0002
Dissolved Vanadium V	mg/L		< 0.001	< 0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Dissolved Zinc Zn	mg/L	59.5%	0.011	0.008	0.012	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005			0.01
Dissolved Zirconium Zr	mg/L		< 0.001	< 0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			

APPENDIX 4.4-2, TABLE A
MONTHLY SURFACE WATER QUALITY

Parameter	Unit Name	Standard Deviation	Coefficient of Variation	PR 1 Monthly	PR 1 Monthly	PR 1 Monthly	PR 1 Monthly	PR1 Monthly	PR1 Monthly	PR1 Monthly	PR1 Monthly	PR1 Monthly	PR1 Monthly	PR1 Monthly	Arithmetic Mean
Date Sampled				96/05/14	96/06/12	96/07/10	96/08/07	96/09/11	96/10/09	96/11/06	96/12/11	97/01/15	97/02/12	97/03/18	
pH	pH units	0.17	2.1%	8.12	8	7.9	8.2	8.28	8.11	8.14	8.19	8.11	8.15	8.2	8.13
Conductivity	uS/cm	32	7.6%	293	169	177	257	293	248	304	348	350	373	356	288
Turbidity	NTU	0.07	30.8%	1.3	9.6	4	0.98	0.34	1.2	0.35	0.35	0.32			2.05
Hardness CaCO3	mg/L	23	10.6%	139	79	84		135	114	154	183	179			133
Hardness (Total) CaCO3	mg/L	22	9.5%	142	91	89	137	151	125	163	184	183			141
Total Dissolved Solids	mg/L						168						223	231	
Total Suspended Solids	mg/L	0	0	< 1	46	22	< 4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	34
Alkalinity Phen. 8.3	mg/L						< 0.5								
Total Alkalinity CaCO3	mg/L	30	13.5%	133	89	17.7	117	129	178	135	153	156			123
Carbonate	mg/L						< 0.5								
Bicarbonate	mg/L						143								
Hydroxide	mg/L						< 0.5								
Fluoride F	mg/L	0.08	48.3%	< 0.05	< 0.05	< 0.05	< 0.10	0.25	< 0.05	0.08	< 0.05	< 0.05			0.17
Chloride Cl	mg/L	0.2	33.1%	2	0.8	1		1.5	0.9	1.7	1.9	2.2	2	2.5	1.7
Nitrate+Nitrite (N)	mg/L						< 0.02								
Nitrate N	mg/L			0.14	< 0.05	0.17	< 0.02	< 0.05	< 0.05	< 0.05	0.08	< 0.05	0.08	0.08	0.11
Nitrite N	mg/L			< 0.002	< 0.002	< 0.002	< 0.005	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	
Sulphate SO4	mg/L	1.5	30.1%	19.2	8.2	9.4	16.5	21	15	24	31	37			20
Total Organic Carbon C	mg/L	1.6	28.5%	2.3	4.5	2.9	1.6	2.2	3.1	3	1.8	2.2			2.6
Ammonia Nitrogen N	mg/L	0.04	80.2%	0.04	< 0.02	< 0.02	< 0.005	0.05	0.05	0.15	0.05	0.08	0.04	0.04	0.06
Ortho Phosphorus P	mg/L			< 0.02	< 0.02	0.02		< 0.02	< 0.02	< 0.02	< 0.02	< 0.02			0.02
Total Phosphorus P	mg/L	0	0%	< 0.02	0.09	0.04		< 0.02	< 0.02	< 0.02	< 0.02	< 0.02			0.07
Total Aluminum Al	mg/L	0.01	52.3%	0.11	1	0.2	0.042	0.016	0.02	0.01	0.005	0.005			0.156
Total Antimony Sb	mg/L			< 0.001	< 0.001	< 0.001	0.00012	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0001
Total Arsenic As	mg/L			< 0.001	< 0.001	< 0.001	0.00012	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0001
Total Barium Ba	mg/L	0.01	10.5%	0.07	0.059	0.042	0.063	0.065	0.062	0.071	0.08	0.076			0.065
Total Beryllium Be	mg/L			< 0.001	< 0.001	< 0.001	< 0.00001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Total Boron B	mg/L	0.012	48.3%	0.03	0.05	0.02	0.018	0.026	0.02	0.015	0.016	0.03			0.03
Total Bismuth Bi	mg/L						0.002								
Total Cadmium Cd	mg/L			0.0005	< 0.0002	< 0.0002	0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002			0.0003
Total Calcium Ca	mg/L	6.1	8.7%	42.1	27.6	27.4	41	45.6	37.6	47.3	54.2	54.2			41.9
Total Chromium Cr	mg/L			0.001	0.004	< 0.001	0.0008	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.002
Total Cobalt Co	mg/L			< 0.001	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Total Copper Cu	mg/L	0.001	51.9%	0.019	0.04	0.001	0.0007	< 0.001	< 0.001	< 0.001	0.002	< 0.001			0.013
Total Iron Fe	mg/L	0.03	98.3%	0.24	1.57	0.33	0.094	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03			0.56
Total Lead Pb	mg/L			0.003	0.002	< 0.001	0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.002
Total Magnesium Mg	mg/L	1.7	12.4%	8.81	5.42	5	8.3	9.08	7.59	10.8	11.7	11.6			8.7
Total Manganese Mn	mg/L	0	0%	0.005	0.038	0.01	0.0084	0.004	0.002	0.01	0.007	0.004			0.010
Total Mercury Hg	ug/L	0	0%	< 0.05	< 0.05	< 0.05	< 0.01	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05			
Total Molybdenum Mo	mg/L	0	0%	0.051	0.002	0.001	0.0009	0.001	0.001	< 0.001	0.002	< 0.001			0.008
Total Nickel Ni	mg/L	0	0%	0.002	0.003	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.002
Total Phosphorus PO4	mg/L			< 0.4	< 0.4	< 0.4	0.008	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4			0.01
Total Potassium K	mg/L	0.08	13.8%	0.62	0.59	0.38	0.49	0.54	0.54	0.65	0.59	0.59			0.55
Total Selenium Se	mg/L	0.0001	16.6%	< 0.001	< 0.001	< 0.001	0.00036	< 0.001	< 0.001	< 0.001	< 0.001	0.001			0.001
Total Silicon SiO2	mg/L	0.5	10.0%	3.2	5.6	3.1	1.5	3.2	3.1	3.3	3.7	3.8			3.4
Total Silver Ag	mg/L			< 0.0001	< 0.0001	< 0.0001	< 0.00001	< 0.0001	< 0.0001	0.001	< 0.0001	< 0.0001			0.001
Total Sodium Na	mg/L	0.2	16.0%	2.5	1	1.1	1.8	2.3	1.7	2.4	3	2.9			2.1
Total Sulphur S	mg/L						5.7								
Total Strontium Sr	mg/L	0.01	9.8%	0.26	0.13	0.12	0.22	0.26	0.22	0.3	0.38	0.42			0.26
Total Tellurium Te	mg/L			< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			

APPENDIX 4.4-2, TABLE A
MONTHLY SURFACE WATER QUALITY

Parameter	Unit Name	Standard Deviation	Coefficient of Variation	PR 1 Monthly	PR 1 Monthly	PR 1 Monthly	PR 1 Monthly	PR1 Monthly	PR1 Monthly	PR1 Monthly	PR1 Monthly	PR1 Monthly	PR1 Monthly	PR1 Monthly	Arithmetic Mean
Total Thallium Tl	mg/L			< 0.0001	< 0.0001	< 0.0001	< 0.003	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001			
Total Thorium Th	mg/L			< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005			
Total Tin Sn	mg/L	0	0%	< 0.001	< 0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.002
Total Titanium Ti	mg/L	0	0%	< 0.001	0.007	0.002	0.0008	< 0.001	< 0.001	< 0.001	< 0.001	0.001			0.003
Total Uranium U	mg/L	0	0%	< 0.0005	< 0.0005	< 0.0005	0.0011	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005			0.001
Total Vanadium V	mg/L			< 0.001	0.005	0.001	0.0005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.002
Total Zinc Zn	mg/L	0.005	59.3%	0.036	0.04	0.03	0.002	< 0.005	< 0.005	< 0.005	< 0.005	0.031			0.028
Total Zirconium Zr	mg/L	0	0%	< 0.001	0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001
Dissolved Aluminum Al	mg/L	0.022	105.7%	0.012	0.031	0.01	0.012	0.008	0.007	0.008	0.005	0.005			0.011
Dissolved Antimony Sb	mg/L	0	0%	< 0.001	< 0.001	< 0.001	0.00014	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0001
Dissolved Arsenic As	mg/L			< 0.001	< 0.001	< 0.001	0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0001
Dissolved Barium Ba	mg/L	0.02	11.8%	0.066	0.038	0.04	0.062	0.067	0.06	0.068	0.078	0.072			0.061
Dissolved Beryllium Be	mg/L			< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Dissolved Bismuth	mg/L						< 0.002								
Dissolved Boron B	mg/L	0.006	48.3%	0.02	< 0.005	< 0.005	0.022	0.009	0.007	0.015	0.014	0.03			0.02
Dissolved Cadmium Cd	mg/L			< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002			
Dissolved Calcium Ca	mg/L	6.2	9.3%	41.3	24.3	25.6	41	40.6	34	44.8	54.1	53			40
Dissolved Chromium Cr	mg/L	0	0%	< 0.001	< 0.001	< 0.001	0.0008	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001
Dissolved Cobalt Co	mg/L			< 0.001	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Dissolved Copper Cu	mg/L	0.0003	34.6%	< 0.001	< 0.001	< 0.001	0.0006	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001
Dissolved Iron Fe	mg/L			< 0.03	< 0.03	< 0.03	0.023	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03			0.02
Dissolved Lead Pb	mg/L			< 0.001	< 0.001	< 0.001	0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0003
Dissolved Magnesium Mg	mg/L	1.6	12.5%	8.72	4.51	4.76	8.3	8.24	7.05	10.3	11.7	11.4			8.3
Dissolved Manganese Mn	mg/L	0	0%	0.002	0.003	0.001	0.0062	0.004	0.001	0.008	0.007	0.003			0.004
Dissolved Mercury Hg	ug/L	0	0%	< 0.05	< 0.05	< 0.05	< 0.01	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05			
Dissolved Molybdenum Mo	mg/L			0.001	< 0.001	< 0.001	0.0007	0.001	< 0.001	< 0.001	0.002	< 0.001			0.001
Dissolved Nickel Ni	mg/L	0	0%	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001
Dissolved Phosphorus PO4	mg/L	0	0%	< 0.4	< 0.4	< 0.4	0.006	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4			0.01
Dissolved Potassium K	mg/L	0.08	15.3%	0.51	0.26	0.27	0.42	0.52	0.44	0.54	0.57	0.51			0.45
Dissolved Selenium Se	mg/L	0	0%	< 0.001	< 0.001	< 0.001	< 0.0005	0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001
Dissolved Silicon SiO2	mg/L	0.85	18.9%	2.9	2.3	2.3	1.4	2.7	2.7	3.1	3.7	3.8			2.77
Dissolved Silver Ag	mg/L			< 0.0001	< 0.0001	< 0.0001	< 0.00001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001			
Dissolved Sodium Na	mg/L	0.23	16.8%	2.5	0.8	0.9	1.8	1.9	1.5	2.2	3	2.9			1.9
Dissolved Sulfur S	mg/L						5.7								
Dissolved Strontium Sr	mg/L	0.01	10.6%	0.26	0.11	0.12	0.22	0.28	0.21	0.29	0.35	0.4			0.25
Dissolved Tellurium Te	mg/L			< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Dissolved Thallium Tl	mg/L			< 0.0001	< 0.0001	< 0.0001	< 0.003	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001			
Dissolved Thorium Th	mg/L			< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005			
Dissolved Tin Sn	mg/L			< 0.001	< 0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.002
Dissolved Titanium Ti	mg/L	0	0%	< 0.001	< 0.001	< 0.001	0.0006	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001
Dissolved Uranium U	mg/L	0	0%	< 0.0005	< 0.0005	< 0.0005	0.0002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005			0.0002
Dissolved Vanadium V	mg/L			< 0.001	< 0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Dissolved Zinc Zn	mg/L	0.003	35.1%	0.025	0.013	0.008	0.002	0.008	< 0.005	< 0.005	< 0.005	< 0.005			0.011
Dissolved Zirconium Zr	mg/L			< 0.001	< 0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			

APPENDIX 4.4-2, TABLE A
MONTHLY SURFACE WATER QUALITY

Parameter	Unit Name	Standard Deviation	Coefficient of Variation	PR 2 Monthly	PR 2 Monthly	PR 2 Monthly	PR 2 Monthly	PR2 Monthly	PR2 Monthly	PR2 Monthly	PR2 Monthly	PR2 Monthly	PR2 Monthly	PR2 Monthly	Arithmetic Mean
Date Sampled				96/05/14	96/06/12	96/07/10	96/08/07	96/09/11	96/10/09	96/11/06	96/12/11	97/01/15	97/02/12	97/03/18	
pH	pH units	0.10	1.3%	8.15	7.93	7.44	8.1	8.29	8.09	8.14	8.15	8.16	8.1	8.13	8.06
Conductivity	uS/cm	70	24.2%	298	169	178	261	295	248	297	350	402	376	362	294
Turbidity	NTU	3.06	149.4%	1.5	17	4.9	1.81	0.53	1.5	0.7	0.67	5.5			3.8
Hardness CaCO3	mg/L	39	29.4%	142	77	83		132	115	154	186	200			136
Hardness (Total) CaCO3	mg/L	35	24.7%	145	81	89	139	158	127	162	187	207			144
Total Dissolved Solids	mg/L						166						229	237	
Total Suspended Solids	mg/L	17	49.9%	< 1	52	20	< 4	< 1	2	< 1	< 1	27	< 1	< 1	25
Alkalinity Phen. 8.3	mg/L						< 0.5								
Total Alkalinity CaCO3	mg/L	47	38.1%	141	83	84.8	116	134	89.1	136	162	187			126
Carbonate	mg/L						< 0.5								
Bicarbonate	mg/L						141								
Hydroxide	mg/L						< 0.5								
Fluoride F	mg/L	0.12	72.9%	< 0.05	< 0.05	< 0.05	< 0.10	0.25	< 0.05	< 0.05	0.07	0.11			0.14
Chloride Cl	mg/L	0.6	35.4%	2	0.8	1		1.5	0.8	1.6	2	2.6	1.9	2.5	1.7
Nitrate+Nitrite (N)	mg/L						< 0.02								
Nitrate N	mg/L	0.04	38.6%	0.14	< 0.05	< 0.05	< 0.02	< 0.05	< 0.05	< 0.05	0.08	0.16	0.08	0.07	0.11
Nitrite N	mg/L			< 0.002	< 0.002	< 0.002	< 0.005	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	
Sulphate SO4	mg/L	9	47.0%	18.8	8.2	9.3	15.7	21	15	22	30	42			20
Total Organic Carbon C	mg/L	0.9	33.5%	2.4	3.8	3.6	1.7	1.6	2.8	2.9	1.1	2.1			2.4
Ammonia Nitrogen N	mg/L	0.04	60.3%	0.04	< 0.02	< 0.02	< 0.005	0.04	0.24	0.04	0.03	0.06	< 0.02	0.05	0.07
Ortho Phosphorus P	mg/L	0	0%	< 0.02	0.03	< 0.02		< 0.02	< 0.02	< 0.02	< 0.02	< 0.02			0.03
Total Phosphorus P	mg/L	0.04	54.4%	< 0.02	0.09	0.04		< 0.02	< 0.02	< 0.02	< 0.02	< 0.02			0.07
Total Aluminum Al	mg/L	0.323	206.4%	0.046	0.79	0.089	0.06	0.016	0.022	0.012	0.006	0.005			0.116
Total Antimony Sb	mg/L	0	0%	< 0.001	< 0.001	< 0.001	0.00013	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0001
Total Arsenic As	mg/L	0	0%	< 0.001	< 0.001	< 0.001	0.00021	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0002
Total Barium Ba	mg/L	0.011	17.0%	0.074	0.049	0.042	0.068	0.067	0.064	0.073	0.084	0.092			0.068
Total Beryllium Be	mg/L			< 0.001	< 0.001	< 0.001	< 0.00001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Total Boron B	mg/L	0.01	43.7%	0.03	0.02	0.04	0.023	0.018	0.044	0.016	0.016	0.027			0.026
Total Bismuth Bi	mg/L						< 0.002								
Total Cadmium Cd	mg/L	0.0003	135.9%	< 0.0002	< 0.0002	< 0.0002	0.00002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002			0.00002
Total Calcium Ca	mg/L	9.9	23.6%	43.2	24.9	27.2	43	47.5	38.2	47.2	55	60.1			42.9
Total Chromium Cr	mg/L	0.002	92.7%	< 0.001	0.002	< 0.001	0.0014	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0017
Total Cobalt Co	mg/L			< 0.001	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Total Copper Cu	mg/L	0.017	137.0%	0.001	0.002	< 0.001	0.0008	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001
Total Iron Fe	mg/L	0.68	122.0%	0.08	1.35	0.15	0.15	0.03	0.03	0.03	0.04	< 0.03			0.23
Total Lead Pb	mg/L	0.001	77.3%	< 0.001	0.001	< 0.001	0.0048	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.003
Total Magnesium Mg	mg/L	2.4	28.1%	9.1	4.61	5	8.6	9.5	7.69	10.7	11.9	13.7			9.0
Total Manganese Mn	mg/L	0.011	111.3%	0.007	0.034	0.005	0.012	0.007	0.003	0.013	0.01	0.012			0.011
Total Mercury Hg	ug/L			< 0.05	< 0.05	< 0.05	0.01	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05			0.01
Total Molybdenum Mo	mg/L	0.019	223.2%	0.002	0.001	< 0.001	0.0005 (1)	0.002	0.001	0.001	0.001	0.001			0.0013
Total Nickel Ni	mg/L	0.001	50.0%	< 0.001	0.003	0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.002
Total Phosphorus PO4	mg/L	0	0%	< 0.4	< 0.4	< 0.4	0.007	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4			0.01
Total Potassium K	mg/L	0.08	14.6%	0.62	0.52	0.35	0.49	0.57	0.55	0.62	0.62	0.7			0.6
Total Selenium Se	mg/L	0.0005	66.6%	< 0.001	< 0.001	< 0.001	0.00031 (1)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Total Silicon SiO2	mg/L	1.1	31.2%	3.4	4.8	3.7	1.6	3.5	3.1	3.3	3.8	4.7			3.5
Total Silver Ag	mg/L	0	0%	< 0.0001	< 0.0001	< 0.0001	0.00004	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001			0.00004
Total Sodium Na	mg/L	0.7	34.9%	2.6	0.9	1.1	1.9	2.4	1.8	2.4	3	3.3			2.2
Total Sulphur S	mg/L						5.7								
Total Strontium Sr	mg/L	0.10	39.3%	0.26	0.11	0.13	0.22	0.26	0.22	0.3	0.37	0.44			0.26
Total Tellurium Te	mg/L			< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			

APPENDIX 4.4-2, TABLE A
MONTHLY SURFACE WATER QUALITY

Parameter	Unit Name	Standard Deviation	Coefficient of Variation	PR 2 Monthly	PR 2 Monthly	PR 2 Monthly	PR 2 Monthly	PR2 Monthly	PR2 Monthly	PR2 Monthly	PR2 Monthly	PR2 Monthly	PR2 Monthly	PR2 Monthly	Arithmetic Mean
Total Thallium Tl	mg/L			< 0.0001	< 0.0001	< 0.0001	< 0.003	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0002			0.0002
Total Thorium Th	mg/L			< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005			
Total Tin Sn	mg/L	0	0%	< 0.001	0.001	< 0.001	< 0.002 (1)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001
Total Titanium Ti	mg/L	0.003	107.9%	< 0.001	0.007	0.002	0.0018	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.004
Total Uranium U	mg/L	0	0%	< 0.0005	< 0.0005	< 0.0005	0.0014	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005			0.001
Total Vanadium V	mg/L	0.002	113.8%	< 0.001	0.004	< 0.001	0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.002
Total Zinc Zn	mg/L	0.015	53.9%	0.01	0.02	< 0.005	0.003	< 0.005	< 0.005	< 0.005	0.008	< 0.005			0.010
Total Zirconium Zr	mg/L	0	0%	0.002	0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.002
Dissolved Aluminum Al	mg/L	0.008	73.2%	0.01	0.022	0.01	0.009	0.005	0.006	0.005	< 0.005	0.005			0.009
Dissolved Antimony Sb	mg/L	0	0%	< 0.001	< 0.001	< 0.001	0.00011	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0001
Dissolved Arsenic As	mg/L	0	0%	< 0.001	< 0.001	< 0.001	0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0001
Dissolved Barium Ba	mg/L	0.014	22.3%	0.07	0.039	0.041	0.066	0.067	0.063	0.071	0.081	0.085			0.065
Dissolved Beryllium Be	mg/L			< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Dissolved Bismuth	mg/L						< 0.002								
Dissolved Boron B	mg/L	0.01	47.6%	0.02	< 0.005	< 0.005	0.017	0.019	0.007	0.014	0.014	0.027			0.017
Dissolved Cadmium Cd	mg/L			< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002			
Dissolved Calcium Ca	mg/L	11	26.4%	42.3	23.4	25.5	42	39.6	34.2	44.8	54.9	58.2			40.5
Dissolved Chromium Cr	mg/L	0	0%	< 0.001	< 0.001	< 0.001	0.0008	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001
Dissolved Cobalt Co	mg/L			< 0.001	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Dissolved Copper Cu	mg/L	0	0%	< 0.001	< 0.001	< 0.001	0.0006	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001
Dissolved Iron Fe	mg/L	0	0%	< 0.03	0.03	< 0.03	0.024	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03			0.027
Dissolved Lead Pb	mg/L	0	0%	< 0.001	< 0.001	< 0.001	0.0014	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001
Dissolved Magnesium Mg	mg/L	2.6	31.1%	8.88	4.55	4.7	8.4	8.04	7.1	10.3	11.8	13.3			8.6
Dissolved Manganese Mn	mg/L	0.003	66.3%	0.004	0.003	< 0.001	0.0092	0.006	0.002	0.009	0.01	0.01			0.01
Dissolved Mercury Hg	ug/L			< 0.05	< 0.05	< 0.05	< 0.01	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05			
Dissolved Molybdenum Mo	mg/L	0.001	48.3%	0.001	0.001	< 0.001	0.0008	0.001	0.001	< 0.001	0.001	< 0.001			0.001
Dissolved Nickel Ni	mg/L	0	0%	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001
Dissolved Phosphorus PO4	mg/L	0	0%	< 0.4	< 0.4	< 0.4	0.006	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4			0.01
Dissolved Potassium K	mg/L	0.11	25.4%	0.49	0.26	0.26	0.45	0.49	0.47	0.48	0.51	0.18			0.40
Dissolved Selenium Se	mg/L	0	0%	< 0.001	< 0.001	< 0.001	< 0.0005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Dissolved Silicon SiO2	mg/L	0.74	26.7%	3	2.4	2.3	1.5	2.6	2.7	3	3.7	4.5			2.9
Dissolved Silver Ag	mg/L			< 0.0001	< 0.0001	< 0.0001	< 0.00001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001			
Dissolved Sodium Na	mg/L	0.8	40.7%	2.5	0.8	0.9	1.8	1.8	1.4	2.2	3	3.2			2.0
Dissolved Sulfur S	mg/L						5.6								
Dissolved Strontium Sr	mg/L	0.10	38.7%	0.25	0.11	0.12	0.22	0.27	0.21	0.28	0.34	0.42			0.25
Dissolved Tellurium Te	mg/L			< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Dissolved Thallium Tl	mg/L			< 0.0001	< 0.0001	< 0.0001	< 0.003	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0002			0.0002
Dissolved Thorium Th	mg/L			< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005			
Dissolved Tin Sn	mg/L	0	0%	< 0.001	< 0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.002
Dissolved Titanium Ti	mg/L	0	0%	< 0.001	< 0.001	< 0.001	0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0004
Dissolved Uranium U	mg/L	0	0%	< 0.0005	< 0.0005	< 0.0005	0.0002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005			0.0002
Dissolved Vanadium V	mg/L			< 0.001	< 0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			
Dissolved Zinc Zn	mg/L	0.009	77.2%	0.024	< 0.005	< 0.005	0.002	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005			0.01
Dissolved Zirconium Zr	mg/L			< 0.001	< 0.001	< 0.001	< 0.0003	0.003	< 0.001	< 0.001	< 0.001	< 0.001			0.003

APPENDIX 4.4-2, TABLE A

MONTHLY SURFACE WATER QUALITY

Parameter	Unit Name	Standard Deviation	Coefficient of Variation	TRIB 1 Monthly	Trib 1 Monthly	TRIB 1 Monthly	TRIB 1 Monthly	TRIB1 Monthly	TRIB1 Monthly	TRIB1 Monthly	TRIB1 Monthly	TRIB1 Monthly	TRIB1 Monthly	TRIB1 Monthly
Date Sampled				96/05/14	96/06/12	96/07/10	96/08/07	96/09/11	96/10/09	96/11/06	96/12/11	97/01/15	97/02/12	97/03/18
pH	pH units	0.22	2.8%	8.1	8.17	7.9	8.2	8.29	8.23	8.2	8.29	8.16	8.12	8.2
Conductivity	uS/cm	76	26.0%	251	270	309	316	368	349	360	374	396	405	440
Turbidity	NTU	5.3	139.3%	0.43	0.27	0.26	0.55	0.41	0.25	0.49	0.18	0.23		
Hardness CaCO3	mg/L	44	32.5%	124	139	149		183	175	202	211	220		
Hardness (Total) CaCO3	mg/L	41	28.7%	128	145	160	182	214	195	204	212	222		
Total Dissolved Solids	mg/L						196						237	268
Total Suspended Solids	mg/L	21	82.0%	< 1	< 1	< 1	< 4	< 1	< 1	6	< 1	9	< 1	< 1
Alkalinity Phen. 8.3	mg/L						< 0.5							
Total Alkalinity CaCO3	mg/L	36	28.7%	147	148	169	172	198	183	194	204	226		
Carbonate	mg/L						< 0.5							
Bicarbonate	mg/L						210							
Hydroxide	mg/L						< 0.5							
Fluoride F	mg/L	0.09	65.9%	< 0.05	< 0.05	< 0.05	< 0.10	0.25	< 0.05	0.06	< 0.05	0.08		
Chloride Cl	mg/L	0.7	39.0%	0.5	0.5	< 0.2		0.6	0.2	< 0.2	0.2	0.5	0.3	0.3
Nitrate+Nitrite (N)	mg/L						< 0.02							
Nitrate N	mg/L	0.04	38.7%	0.11	< 0.05	< 0.05	< 0.02	< 0.05	< 0.05	0.07	0.1	0.13	0.13	0.2
Nitrite N	mg/L			< 0.002	< 0.002	< 0.002	< 0.005	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Sulphate SO4	mg/L	11	52.1%	4	4.2	4.3	2.3	4.3	2.7	3.4	2.8	3.4		
Total Organic Carbon C	mg/L	0.9	37.4%	12	.11	11	9	10	8.2	8.7	6.7	5.3		
Ammonia Nitrogen N	mg/L	0.07	104.9%	0.04	< 0.02	< 0.02	< 0.005	0.06	< 0.02	0.14	0.05	0.05	< 0.02	< 0.02
Ortho Phosphorus P	mg/L	0	0%	< 0.02	0.05	< 0.02		< 0.02	< 0.02	< 0.02	< 0.02	< 0.02		
Total Phosphorus P	mg/L	0.04	54.4%	< 0.02	0.05	< 0.02		< 0.02	< 0.02	< 0.02	< 0.02	< 0.02		
Total Aluminum Al	mg/L	0.254	218.8%	0.045	0.028	0.027	0.022	0.013	0.056	0.02	0.008	0.009		
Total Antimony Sb	mg/L	0	0%	< 0.001	< 0.001	< 0.001	0.00015	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Total Arsenic As	mg/L	0	0%	< 0.001	< 0.001	< 0.001	< 0.00005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Total Barium Ba	mg/L	0.016	22.9%	0.099	0.12	0.13	0.12	0.16	0.16	0.15	0.15	0.16		
Total Beryllium Be	mg/L			< 0.001	< 0.001	< 0.001	< 0.00001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Total Boron B	mg/L	0.010	39.6%	0.1	0.03	0.04	0.016	< 0.005	0.052	0.016	0.011	0.034		
Total Bismuth Bi	mg/L						< 0.002							
Total Cadmium Cd	mg/L	0	0%	< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002		
Total Calcium Ca	mg/L	11.6	27.0%	39.7	45.4	50.1	52	66.3	60.4	61	64	66.3		
Total Chromium Cr	mg/L	0.0004	25.0%	0.002	0.004	< 0.001	0.0028	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Total Cobalt Co	mg/L			< 0.001	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Total Copper Cu	mg/L	0.001	50.8%	0.002	< 0.001	0.001	0.0004 (1)	< 0.001	0.001	0.001	< 0.001	< 0.001		
Total Iron Fe	mg/L	0.45	195.5%	0.06	0.06	< 0.03	0.028	< 0.03	0.04	< 0.03	0.06	< 0.03		
Total Lead Pb	mg/L	0.003	92.7%	0.002	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Total Magnesium Mg	mg/L	3.0	33.1%	6.95	7.65	8.52	8.8	11.7	10.8	12.5	12.6	13.6		
Total Manganese Mn	mg/L	0.009	79.7%	< 0.001	0.001	< 0.001	0.0006	< 0.001	< 0.001	0.004	< 0.001	< 0.001		
Total Mercury Hg	ug/L	0	0%	< 0.05	< 0.05	< 0.05	0.01	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05		
Total Molybdenum Mo	mg/L	0.0005	38.0%	< 0.001	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Total Nickel Ni	mg/L	0.001	69.3%	0.004	0.003	0.001	< 0.001 (1)	< 0.001	0.001	< 0.001	< 0.001	0.011		
Total Phosphorus PO4	mg/L	0	0%	< 0.4	< 0.4	< 0.4	0.006 (1)	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4		
Total Potassium K	mg/L	0.1	18.0%	0.6	0.64	0.59	0.41	0.52	0.7	0.58	0.5	0.54		
Total Selenium Se	mg/L			< 0.001	< 0.001	< 0.001	0.00024	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Total Silicon SiO2	mg/L	0.9	25.8%	4	3.7	3.9	1.7	4.4	4.8	4.3	4.1	4.4		
Total Silver Ag	mg/L	0	0%	< 0.0001	< 0.0001	< 0.0001	< 0.00001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001		
Total Sodium Na	mg/L	0.8	37.5%	0.8	0.8	1	0.84	1.4	1.2	1.1	1.9	1.3		
Total Sulphur S	mg/L						0.88							
Total Strontium Sr	mg/L	0.11	41.0%	0.064	0.072	0.079	0.076	0.087	0.1	0.098	0.097	0.1		
Total Tellurium Te	mg/L			< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		

APPENDIX 4.4-2, TABLE A
MONTHLY SURFACE WATER QUALITY

Parameter	Unit Name	Standard Deviation	Coefficient of Variation	TRIB 1 Monthly	Trib 1 Monthly	TRIB 1 Monthly	TRIB 1 Monthly	TRIB1 Monthly	TRIB1 Monthly	TRIB1 Monthly	TRIB1 Monthly	TRIB1 Monthly	TRIB1 Monthly	TRIB1 Monthly
Total Thallium Tl	mg/L	0	0%	< 0.0001	< 0.0001	< 0.0001	< 0.003	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001		
Total Thorium Th	mg/L			< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005		
Total Tin Sn	mg/L	0	0%	< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Total Titanium Ti	mg/L	0	81.8%	0.001	< 0.001	< 0.001	0.0004	< 0.001	0.003	< 0.001	< 0.001	< 0.001		
Total Uranium U	mg/L	0	0%	< 0.0005	< 0.0005	< 0.0005	0.0011	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005		
Total Vanadium V	mg/L	0.003	115.7%	< 0.001	< 0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Total Zinc Zn	mg/L	0.007	69.6%	0.015	0.01	0.04	0.002	< 0.005	< 0.005	0.006	< 0.005	< 0.005		
Total Zirconium Zr	mg/L	0.001	47.1%	0.001	< 0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Dissolved Aluminum Al	mg/L	0.006	63.4%	0.017	0.012	0.016	0.017	0.013	0.011	0.007	0.006	0.007		
Dissolved Antimony Sb	mg/L	0	0%	< 0.001	< 0.001	< 0.001	0.00019	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Dissolved Arsenic As	mg/L	0	0%	< 0.001	< 0.001	< 0.001	< 0.00005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Dissolved Barium Ba	mg/L	0.02	24.3%	0.094	0.11	0.12	0.13	0.16	0.15	0.15	0.14	0.15		
Dissolved Beryllium Be	mg/L			< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Dissolved Bismuth	mg/L						< 0.002							
Dissolved Boron B	mg/L	0.006	36.8%	0.007	0.01	< 0.005	0.015	< 0.005	0.008	< 0.005	0.007	< 0.005		
Dissolved Cadmium Cd	mg/L			< 0.0002	< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002		
Dissolved Calcium Ca	mg/L	11.7	29.0%	38.5	43.6	46.5	57	56.8	53.6	60.6	63.9	65.8		
Dissolved Chromium Cr	mg/L	0	0%	< 0.001	< 0.001	< 0.001	0.0033	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Dissolved Cobalt Co	mg/L			< 0.001	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Dissolved Copper Cu	mg/L	0	0%	< 0.001	< 0.001	0.001	0.0005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Dissolved Iron Fe	mg/L	0.004	15.7%	< 0.03	< 0.03	< 0.03	0.019	< 0.03	< 0.03	< 0.03	0.06	< 0.03		
Dissolved Lead Pb	mg/L	0	0%	< 0.001	< 0.001	< 0.001	< 0.0001	0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Dissolved Magnesium Mg	mg/L	2.9	34.4%	6.82	7.34	7.87	9.6	10	9.85	12.2	12.5	13.4		
Dissolved Manganese Mn	mg/L	0.003	49.8%	< 0.001	< 0.001	< 0.001	0.0002	< 0.001	< 0.001	0.001	< 0.001	< 0.001		
Dissolved Mercury Hg	ug/L			< 0.05	< 0.05	< 0.05	0.01	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05		
Dissolved Molybdenum Mo	mg/L	0.0001	8.4%	< 0.001	< 0.001	0.004	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Dissolved Nickel Ni	mg/L	0	0%	0.001	< 0.001	0.001	0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001		
Dissolved Phosphorus PO4	mg/L	0	0%	< 0.4	< 0.4	< 0.4	0.008	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4		
Dissolved Potassium K	mg/L	0.13	31.9%	0.52	0.55	0.49	0.45	0.49	0.54	0.43	0.43	0.45		
Dissolved Selenium Se	mg/L			< 0.001	< 0.001	< 0.001	< 0.0005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Dissolved Silicon SiO2	mg/L	0.9	30.1%	3.7	3.3	3.5	1.8	3.6	3.9	4.2	4.1	4.4		
Dissolved Silver Ag	mg/L			< 0.0001	< 0.0001	< 0.0001	< 0.00001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001		
Dissolved Sodium Na	mg/L	0.9	43.5%	0.8	0.7	0.7	0.91	0.9	1	1.2	1.8	1.3		
Dissolved Sulfur S	mg/L						0.97							
Dissolved Strontium Sr	mg/L	0.10	39.8%	0.062	0.07	0.077	0.083	0.095	0.099	0.092	0.091	0.1		
Dissolved Tellurium Te	mg/L			< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Dissolved Thallium Tl	mg/L	0	0%	< 0.0001	< 0.0001	< 0.0001	< 0.003	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001		
Dissolved Thorium Th	mg/L			< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005		
Dissolved Tin Sn	mg/L	0	0%	< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Dissolved Titanium Ti	mg/L	0	0%	< 0.001	< 0.001	< 0.001	0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Dissolved Uranium U	mg/L	0	0%	< 0.0005	< 0.0005	< 0.0005	< 0.0001	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005		
Dissolved Vanadium V	mg/L			< 0.001	< 0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Dissolved Zinc Zn	mg/L	0.02	119.7%	0.011	< 0.005	0.015	0.002	0.012	< 0.005	< 0.005	< 0.005	< 0.005		
Dissolved Zirconium Zr	mg/L	0	0%	< 0.001	< 0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		

APPENDIX 4.4-2, TABLE A
MONTHLY SURFACE WATER QUALITY

Parameter	Unit Name	Arithmetic Mean	Standard Deviation	Coefficient of Variation	TRIB 2 Monthly	TRIB 2 Monthly	TRIB 2 Monthly	TRIB 2 Monthly	TRIB2 Monthly	TRIB2 Monthly	TRIB2 Monthly	TRIB2 Monthly	TRIB2 Monthly	TRIB2 Monthly
Date Sampled					96/05/14	96/06/12	96/07/10	96/08/07	96/09/11	96/10/09	96/11/06	96/12/11	97/01/15	97/02/12
pH	pH units	8.17	0.11	1.3%	8.08	8.03	7.49	8.2	8.38	8.31	8.25	8.31	8.19	8.18
Conductivity	uS/cm	349	58	16.5%	293	204	251	284	346	327	337	362	382	392
Turbidity	NTU	0.34	0.13	38.3%	4	1.5	0.68	1.3	1.4	0.76	0.72	0.82	1.6	
Hardness CaCO3	mg/L	175	35	20.1%	135	98	124		163	151	180	197	196	
Hardness (Total) CaCO3	mg/L	185	33	18.0%	138	100	131	154	193	174	183	198	202	
Total Dissolved Solids	mg/L							178						231
Total Suspended Solids	mg/L	8	2	28.3%	5	< 1	< 1	< 4	< 1	< 1	< 1	< 1	3	< 1
Alkalinity Phen. 8.3	mg/L							< 0.5						
Total Alkalinity CaCO3	mg/L	182	26	14.3%	157	107	131	150	184	170	174	190	215	
Carbonate	mg/L							< 0.5						
Bicarbonate	mg/L	210	0	0%				183						
Hydroxide	mg/L							< 0.5						
Fluoride F	mg/L	0.13	0.104403065	80.3%	0.16	0:18	0.24	0.1	0.25	0.09	0.08	0.06	0.1	
Chloride Cl	mg/L	0.4	0.2	40.1%	0.5	0.5	0.7		0.6	< 0.2	0.3	0.3	0.5	0.3
Nitrate+Nitrite (N)	mg/L							< 0.02						
Nitrate N	mg/L	0.12	0.04	35.4%	0.13	< 0.05	< 0.05	< 0.02	< 0.05	< 0.05	0.05	0.1	0.13	0.14
Nitrite N	mg/L				< 0.002	< 0.002	< 0.002	< 0.005	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Sulphate SO4	mg/L	3.5	0.8	21.8%	5.8	5	5.9	4.5	6.9	6.8	6.7	7.5	7.3	
Total Organic Carbon C	mg/L	9.1	2.2	23.8%	7.5	11	8.7	6.5	7.1	6.3	6.8	4.4	4.3	
Ammonia Nitrogen N	mg/L	0.07	0.04	60.1%	0.03	< 0.02	< 0.02	< 0.005	0.07	< 0.02	0.14	0.02	0.12	0.03
Ortho Phosphorus P	mg/L	0.05	0	0%	< 0.02	0.02	< 0.02		< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	
Total Phosphorus P	mg/L	0.05	0	0%	0.03	0.04	< 0.02		< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	
Total Aluminum Al	mg/L	0.025	0.016	63.9%	0.15	0.081	0.047	0.052	0.035	0.023	0.029	0.013	0.022	
Total Antimony Sb	mg/L	0.0002	0	0%	< 0.001	< 0.001	< 0.001	0.00015	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Total Arsenic As	mg/L				< 0.001	< 0.001	< 0.001	0.00007	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Total Barium Ba	mg/L	0.14	0.02	16.0%	0.11	0.086	0.1	0.11	0.15	0.13	0.14	0.13	0.15	
Total Beryllium Be	mg/L				< 0.001	< 0.001	< 0.001	< 0.00001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Total Boron B	mg/L	0.037	0.029	77.1%	0.04	0.03	0.03	0.023	0.011	0.025	0.023	0.018	< 0.005	
Total Bismuth Bi	mg/L							< 0.002						
Total Cadmium Cd	mg/L				< 0.0002	0.0004	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	
Total Calcium Ca	mg/L	56.1	9.7	17.2%	41.4	30	39.1	46	57.3	51.3	52.5	57.8	58.9	
Total Chromium Cr	mg/L	0.003	0.001	34.3%	< 0.001	0.002	< 0.001	0.0008	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Total Cobalt Co	mg/L				< 0.001	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Total Copper Cu	mg/L	0.001	0.001	40.0%	0.004	0.04	0.002	0.0006 (1)	0.001	0.001	0.001	< 0.001	< 0.001	
Total Iron Fe	mg/L	0.05	0.01	30.0%	0.26	0.09	0.07	0.083	0.09	0.06	0.06	0.04	0.07	
Total Lead Pb	mg/L	0.002	0	0%	< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Total Magnesium Mg	mg/L	10.3	2.4	23.4%	8.43	6.13	8.11	9.4	12	11	12.6	13	13.2	
Total Manganese Mn	mg/L	0.002	0.002	99.6%	0.004	0.002	0.001	0.0022	0.005	0.004	0.006	0.004	0.01	
Total Mercury Hg	ug/L	0.01	0	0%	< 0.05	< 0.05	< 0.05	0.02	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	
Total Molybdenum Mo	mg/L				< 0.001	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	0.001	< 0.001	< 0.001	
Total Nickel Ni	mg/L	0.004	0.004	103.1%	0.002	0.002	0.001	0.001	0.002	0.001	< 0.001	< 0.001	< 0.001	
Total Phosphorus PO4	mg/L				< 0.4	< 0.4	< 0.4	0.01	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	
Total Potassium K	mg/L	0.6	0.1	14.9%	0.46	0.4	0.45	0.42	0.58	0.58	0.45	0.45	0.53	
Total Selenium Se	mg/L	0.0002	0	0%	< 0.001	< 0.001	< 0.001	0.00034	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Total Silicon SiO2	mg/L	3.9	0.9	22.8%	4.5	4.4	4.7	2.2	4.9	4.8	4.6	4.6	4.6	
Total Silver Ag	mg/L				< 0.0001	< 0.0001	< 0.0001	< 0.00001 (1)	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	
Total Sodium Na	mg/L	1.1	0.4	31.0%	3.1	2.1	2.8	2.8	4.7	4.8	4.7	5.8	6.6	
Total Sulphur S	mg/L							1.6 (1)						
Total Strontium Sr	mg/L	0.1	0.01	15.9%	0.08	0.064	0.079	0.086	0.11	0.1	0.1	0.11	0.12	
Total Tellurium Te	mg/L				< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	

APPENDIX 4.4-2, TABLE A
MONTHLY SURFACE WATER QUALITY

Parameter	Unit Name	Arithmetic Mean	Standard Deviation	Coefficient of Variation	TRIB 2 Monthly	TRIB 2 Monthly	TRIB 2 Monthly	TRIB 2 Monthly	TRIB2 Monthly	TRIB2 Monthly	TRIB2 Monthly	TRIB2 Monthly	TRIB2 Monthly	TRIB2 Monthly
Total Thallium Tl	mg/L				< 0.0001	< 0.0001	< 0.0001	< 0.003	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	
Total Thorium Th	mg/L				< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	
Total Tin Sn	mg/L				< 0.001	< 0.001	< 0.001	< 0.002 (1)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Total Titanium Ti	mg/L	0.001	0.001	92.6%	0.002	0.001	< 0.001	0.0012	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Total Uranium U	mg/L	0.0011	0	0%	< 0.0005	< 0.0005	< 0.0005	0.0003	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	
Total Vanadium V	mg/L				< 0.001	< 0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Total Zinc Zn	mg/L	0.015	0.015	102.7%	0.019	0.012	< 0.005	0.004 (1)	0.005	< 0.005	0.009	< 0.005	0.019	
Total Zirconium Zr	mg/L	0.001	0	0%	0.002	< 0.001	< 0.001	0.0006	< 0.001	< 0.001	0.002	< 0.001	< 0.001	
Dissolved Aluminum Al	mg/L	0.012	0.004	37.2%	0.018	0.03	0.019	0.018	0.009	0.009	0.007	< 0.005	0.006	
Dissolved Antimony Sb	mg/L	0.0002	0	0%	< 0.001	< 0.001	< 0.001	0.00014	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Dissolved Arsenic As	mg/L				< 0.001	< 0.001	< 0.001	< 0.00005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Dissolved Barium Ba	mg/L	0.13	0.02	16.4%	0.1	0.081	0.1	0.11	0.13	0.13	0.12	0.13	0.14	
Dissolved Beryllium Be	mg/L				< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Dissolved Bismuth	mg/L							< 0.002						
Dissolved Boron B	mg/L	0.009	0.003	35.8%	< 0.005	0.01	< 0.005	0.026	0.006	0.011	< 0.005	0.008	< 0.005	
Dissolved Cadmium Cd	mg/L				< 0.0002	0.0003	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	
Dissolved Calcium Ca	mg/L	54.0	9.4	17.3%	40.1	29.3	37.3	46	48.2	44.2	51.7	57.6	57.2	
Dissolved Chromium Cr	mg/L	0.003	0	0%	< 0.001	< 0.001	< 0.001	0.0011	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Dissolved Cobalt Co	mg/L				< 0.001	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Dissolved Copper Cu	mg/L	0.001	0.000	47.1%	0.001	< 0.001	0.001	0.0007	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Dissolved Iron Fe	mg/L	0.04	0.03	73.4%	< 0.03	0.05	0.03	0.071	0.04	0.04	0.04	< 0.03	< 0.03	
Dissolved Lead Pb	mg/L	0.001	0	0%	< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Dissolved Magnesium Mg	mg/L	10.0	2.4	23.7%	8.43	6.1	7.49	9.4	10.2	9.79	12.4	12.9	12.8	
Dissolved Manganese Mn	mg/L	0.0006	0.0006	94.3%	0.001	< 0.001	< 0.001	0.0019	0.005	0.004	0.006	0.004	0.006	
Dissolved Mercury Hg	ug/L	0.01	0	0%	< 0.05	< 0.05	< 0.05	0.01	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	
Dissolved Molybdenum Mo	mg/L	0.004	0	0%	< 0.001	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	0.001	< 0.001	< 0.001	
Dissolved Nickel Ni	mg/L	0.001	0	0%	0.002	0.001	0.001	0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	
Dissolved Phosphorus PO4	mg/L	0.008	0	0%	< 0.4	< 0.4	< 0.4	0.008	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	
Dissolved Potassium K	mg/L	0.48	0.05	9.5%	0.36	0.34	0.42	0.38	0.46	0.48	0.37	0.37	0.39	
Dissolved Selenium Se	mg/L				< 0.001	< 0.001	< 0.001	< 0.0005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Dissolved Silicon SiO2	mg/L	3.6	0.8	21.2%	3.7	3.8	4	2.1	3.8	4.1	4.3	4.4	4.5	
Dissolved Silver Ag	mg/L				< 0.0001	< 0.0001	< 0.0001	0.00002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	
Dissolved Sodium Na	mg/L	1	0	34.1%	2.8	2	2.6	2.8	3.8	4.3	4.5	5.8	6.4	
Dissolved Sulfur S	mg/L							1.6						
Dissolved Strontium Sr	mg/L	0.09	0.01	15.6%	0.078	0.063	0.077	0.086	0.098	0.1	0.096	0.099	0.11	
Dissolved Tellurium Te	mg/L				< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Dissolved Thallium Tl	mg/L				< 0.0001	< 0.0001	< 0.0001	< 0.003	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	
Dissolved Thorium Th	mg/L				< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	
Dissolved Tin Sn	mg/L				< 0.001	< 0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Dissolved Titanium Ti	mg/L	0.0003	0	0%	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Dissolved Uranium U	mg/L				< 0.0005	< 0.0005	< 0.0005	0.0003	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	
Dissolved Vanadium V	mg/L				< 0.001	< 0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
Dissolved Zinc Zn	mg/L	0.010	0.006	56.0%	0.011	0.006	0.012	0.005	0.005	< 0.005	0.008	< 0.005	0.006	
Dissolved Zirconium Zr	mg/L				< 0.001	< 0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	

APPENDIX 4.4-2, TABLE A
MONTHLY SURFACE WATER QUALITY

Parameter	Unit Name	Arithmetic Mean	Standard Deviation	Coefficient of Variation	TRIB3 Monthly	TRIB3 Monthly	TRIB3 Monthly	TRIB3 Monthly	TRIB3 Monthly	TRIB3 Monthly	Arithmetic Mean	Standard Deviation	Coefficient of Variation	WC 1 Monthly
Date Sampled					96/08/07	96/09/11	96/10/09	96/11/06	96/12/11	97/03/18				96/05/14
pH	pH units	8.14	0.25	3.1%	8.1	8.27	8.15	8.07	8.27	8.31	8.214	0.10	1.2%	8.23
Conductivity	uS/cm	318	60	18.8%	242	298	238	262	294	348	288	42	14.4%	275
Turbidity	NTU	1.42	1.03	72.8%	0.38	0.27	0.33	0.26	0.22		0.27	0.05	16.8%	5.2
Hardness CaCO3	mg/L	156	35	22.7%		141	109	135	151		134	18	13.4%	127
Hardness (Total) CaCO3	mg/L	164	35	21.5%	134	159	124	137	151		143	15	10.8%	133
Total Dissolved Solids	mg/L				164					211				
Total Suspended Solids	mg/L	4	1	35.4%	< 4	< 1	< 1	< 1	< 1	< 1				< 1
Alkalinity Phen. 8.3	mg/L				< 0.5									
Total Alkalinity CaCO3	mg/L	164	32	19.7%	126	153	122	136	157		142	16	11.4%	149
Carbonate	mg/L				< 0.5									
Bicarbonate	mg/L				154									
Hydroxide	mg/L				< 0.5									
Fluoride F	mg/L	0.14	0.07	50.4%	< 0.10	0.25	< 0.05	0.06	< 0.05		0.16	0.13	86.7%	0.16
Chloride Cl	mg/L	0.5	0.2	32.6%		0.6	0.4	0.6	0.4	0.6	0.52	0.1	21.1%	0.6
Nitrate+Nitrite (N)	mg/L				< 0.02									
Nitrate N	mg/L	0.11	0.04	33.4%	< 0.02	< 0.05	< 0.05	0.13	0.16	0.22	0.17	0.05	27.0%	0.17
Nitrite N	mg/L				< 0.005	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002				< 0.002
Sulphate SO4	mg/L	6.3	1.0	16.5%	3.2	5.3	6.2	6.5	6.2		6.1	0.5	8.6%	6.3
Total Organic Carbon C	mg/L	7.0	2.1	29.6%	10.2	10	11	9.4	6.9		9.3	1.7	18.7%	9.6
Ammonia Nitrogen N	mg/L	0.07	0.05	74.9%	< 0.005	0.05	0.02	0.13	0.05	0.02	0.05	0.05	83.4%	0.03
Ortho Phosphorus P	mg/L	0.02	0	0%		< 0.02	< 0.02	< 0.02	< 0.02					< 0.02
Total Phosphorus P	mg/L	0.04	0.01	20.2%		< 0.02	< 0.02	< 0.02	< 0.02					< 0.02
Total Aluminum Al	mg/L	0.050	0.043	84.8%	0.027	0.015	0.024	0.023	0.01		0.02	0.01	37.1%	0.19
Total Antimony Sb	mg/L	0.0002	0	0%	0.00009	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001
Total Arsenic As	mg/L	0.00007	0	0%	< 0.00005	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001
Total Barium Ba	mg/L	0.12	0.02	18.4%	0.098	0.11	0.1	0.1	0.11		0.1	0.01	5.5%	0.095
Total Beryllium Be	mg/L				< 0.00001	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001
Total Boron B	mg/L	0.025	0.009	34.7%	0.020 (1)	0.012	0.053	0.026	0.01		0.025	0.020	78.5%	0.02
Total Bismuth Bi	mg/L				< 0.002									
Total Cadmium Cd	mg/L	0.0004	0	0%	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002					< 0.0002
Total Calcium Ca	mg/L	48.3	9.9	20.5%	40	46.8	36.5	38.8	44		41.5	4.7	11.3%	37.7
Total Chromium Cr	mg/L	0.001	0.001	60.6%	0.0008	< 0.001	< 0.001	< 0.001	< 0.001					0.001
Total Cobalt Co	mg/L				< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001
Total Copper Cu	mg/L	0.008	0.016	191.5%	0.0008	< 0.001	0.002	0.003	< 0.001		0.003	0.001	28.3%	0.002
Total Iron Fe	mg/L	0.09	0.07	71.3%	0.071	0.03	0.04	0.03	< 0.03		0.03	0.01	17.3%	0.35
Total Lead Pb	mg/L				0.0028	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001
Total Magnesium Mg	mg/L	10	3	24.1%	8.4	10.1	8.02	9.7	10		9.46	0.97	10.3%	9.31
Total Manganese Mn	mg/L	0.004	0.003	62.7%	0.0006	< 0.001	< 0.001	0.003	< 0.001		0.003			0.004
Total Mercury Hg	ug/L	0.02	0	0%	0.02	< 0.05	< 0.05	< 0.05	< 0.05					< 0.05
Total Molybdenum Mo	mg/L	0.001	0	0%	< 0.0004	< 0.001	< 0.001	0.001	< 0.001		0.001	0	0%	< 0.001
Total Nickel Ni	mg/L	0.002	0.001	36.5%	0.001	< 0.001	0.002	0.002	< 0.001		0.002	0	0%	0.004
Total Phosphorus PO4	mg/L	0.01	0	0%	0.007 (1)	< 0.4	< 0.4	< 0.4	< 0.4					< 0.4
Total Potassium K	mg/L	0.48	0.07	13.9%	0.15 (1)	0.27	0.4	0.31	0.27		0.3	0.1	19.6%	0.63
Total Selenium Se	mg/L	0.0003	0	0%	0.00017	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001
Total Silicon SiO2	mg/L	4.4	0.8	18.9%	1.8	3.9	4.2	4.2	4.4		4.2	0.2	4.9%	4.5
Total Silver Ag	mg/L				0.00002	< 0.0001	< 0.0001	< 0.0001	< 0.0001					< 0.0001
Total Sodium Na	mg/L	4.2	1.5	36.8%	2.9	4.9	4.6	5	7.3		5.5	1.2	22.8%	2.8
Total Sulphur S	mg/L				1.3									
Total Strontium Sr	mg/L	0.1	0.02	19.3%	0.089	0.094	0.091	0.095	0.1		0.095	0.004	3.9%	0.084
Total Tellurium Te	mg/L				< 0.002	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001

APPENDIX 4.4-2, TABLE A
MONTHLY SURFACE WATER QUALITY

Parameter	Unit Name	Arithmetic Mean	Standard Deviation	Coefficient of Variation	TRIB3 Monthly	TRIB3 Monthly	TRIB3 Monthly	TRIB3 Monthly	TRIB3 Monthly	TRIB3 Monthly	Arithmetic Mean	Standard Deviation	Coefficient of Variation	WC 1 Monthly
Total Thallium Tl	mg/L				< 0.003	< 0.0001	< 0.0001	< 0.0001	< 0.0001					< 0.0001
Total Thorium Th	mg/L					< 0.0005	< 0.0005	< 0.0005	< 0.0005					< 0.0005
Total Tin Sn	mg/L				0.002 (1)	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001
Total Titanium Ti	mg/L	0.001	0.001	37.8%	0.0008	< 0.001	< 0.001	< 0.001	< 0.001					0.005
Total Uranium U	mg/L	0.0003	0	0%	0.0011	< 0.0005	< 0.0005	< 0.0005	< 0.0005					< 0.0005
Total Vanadium V	mg/L				< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001					0.001
Total Zinc Zn	mg/L	0.013	0.006	48.3%	0.004	0.005	< 0.005	0.023	< 0.005		0.014	0.013	90.9%	0.11
Total Zirconium Zr	mg/L	0.002	0.001	52.7%	< 0.0003	< 0.001	< 0.001	0.002	< 0.001		0.002	0	0%	0.002
Dissolved Aluminum Al	mg/L	0.015	0.008	56.8%	0.019	0.01	0.013	0.014	0.006		0.011	0.004	33.4%	0.028
Dissolved Antimony Sb	mg/L	0.0001	0	0%	0.00011	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001
Dissolved Arsenic As	mg/L				< 0.00005	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001
Dissolved Barium Ba	mg/L	0.12	0.02	16.6%	0.097	0.11	0.095	0.098	0.1		0.101	0.006	6.5%	0.091
Dissolved Beryllium Be	mg/L				< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001
Dissolved Bismuth	mg/L				< 0.002									
Dissolved Boron B	mg/L	0.012	0.008	65.2%	0.022	0.006	0.008	< 0.005	0.008		0.007	0.001	15.7%	0.011
Dissolved Cadmium Cd	mg/L	0.0003	0	0%	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002					< 0.0002
Dissolved Calcium Ca	mg/L	45.7	9.3	20.3%	40	41.5	31.8	38.5	43.9		38.9	5.2	13.5%	36
Dissolved Chromium Cr	mg/L	0.001	0	0%	0.0008	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001
Dissolved Cobalt Co	mg/L				< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001
Dissolved Copper Cu	mg/L	0.0009	0.0002	19.2%	0.0006	< 0.001	< 0.001	< 0.001	< 0.001					0.001
Dissolved Iron Fe	mg/L	0.05	0.01	31.3%	0.039	< 0.03	0.03	0.03	< 0.03		0.03	0	0%	0.04
Dissolved Lead Pb	mg/L				< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001
Dissolved Magnesium Mg	mg/L	9.95	2.41	24.2%	8.4	8.97	7.22	9.52	10		8.93	1.21	13.6%	8.97
Dissolved Manganese Mn	mg/L	0.004	0.002	48.5%	0.0004	< 0.001	< 0.001	0.002	< 0.001		0.002	0	0%	0.001
Dissolved Mercury Hg	ug/L	0.01	0	0%	0.01	< 0.05	< 0.05	< 0.05	< 0.05					< 0.05
Dissolved Molybdenum Mo	mg/L	0.001	0	0%	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001
Dissolved Nickel Ni	mg/L	0.001	0.0004	37.3%	< 0.001	< 0.001	0.002	0.001	< 0.001		0.002	0.001	47.1%	0.002
Dissolved Phosphorus PO4	mg/L	0.008	0	0%	0.008	< 0.4	< 0.4	< 0.4	< 0.4					< 0.4
Dissolved Potassium K	mg/L	0.40	0.05	11.9%	0.18	0.27	0.33	0.25	0.23		0.27	0.04	16.0%	0.5
Dissolved Selenium Se	mg/L				< 0.0005	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001
Dissolved Silicon SiO2	mg/L	3.9	0.7	18.6%	1.7	3.3	3.7	4	4.3		3.8	0.4	11.2%	3.9
Dissolved Silver Ag	mg/L	0.00002	0	0%	< 0.00001	< 0.0001	< 0.0001	< 0.0001	< 0.0001					< 0.0001
Dissolved Sodium Na	mg/L	3.9	1.5	38.7%	2.9	4.2	4.1	4.9	7.2		5.1	1.4	28.3%	2.7
Dissolved Sulfur S	mg/L				1.3									
Dissolved Strontium Sr	mg/L	0.09	0.01	16.4%	0.088	0.093	0.087	0.089	0.093		0.091	0.003	3.3%	0.083
Dissolved Tellurium Te	mg/L				< 0.002	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001
Dissolved Thallium Tl	mg/L				< 0.003	< 0.0001	< 0.0001	< 0.0001	< 0.0001					< 0.0001
Dissolved Thorium Th	mg/L					< 0.0005	< 0.0005	< 0.0005	< 0.0005					< 0.0005
Dissolved Tin Sn	mg/L	0.002	0	0%	0.003	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001
Dissolved Titanium Ti	mg/L	0.001	0	0%	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001					0.002
Dissolved Uranium U	mg/L	0.0003	0	0%	< 0.0001	< 0.0005	< 0.0005	< 0.0005	< 0.0005					< 0.0005
Dissolved Vanadium V	mg/L				< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001
Dissolved Zinc Zn	mg/L	0.008	0.003	38.0%	0.002	< 0.005	< 0.005	< 0.005	< 0.005					0.013
Dissolved Zirconium Zr	mg/L				< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001					< 0.001

APPENDIX 4.4-2, TABLE A
MONTHLY SURFACE WATER QUALITY

Parameter	Unit Name	WC 1 Monthly	WC 1 Monthly	WC1 Monthly	WC 1 Monthly	WC 1 Monthly	WC 1 Monthly	WC 1 Monthly	WC1 Monthly	WC1 Monthly	WC1 Monthly	Arithmetic Mean	Standard Deviation	Coefficient of Variation
Date Sampled		96/06/12	96/07/10	96/08/07	96/09/11	96/10/09	96/11/06	96/12/11	97/01/15	97/02/12	97/03/18			
pH	pH units	8.2	7.72	8.3	8.39	8.28	8.28	8.26	8.3	8.3	8.28	8.23	0.18	2.1%
Conductivity	uS/cm	227	267	291	357	308	340	371	401	412	414	333	64	19.2%
Turbidity	NTU	6	3.7	3.76	1	2	0.88	0.65	0.55			2.6	2.1	79.0%
Hardness CaCO3	mg/L	110	131		169	151	182	189	203			158	33	21.1%
Hardness (Total) CaCO3	mg/L	119	145	163	196	162	184	189	210			167	31	18.3%
Total Dissolved Solids	mg/L			190						247	263			
Total Suspended Solids	mg/L	4	2	< 4	2	< 1	< 1	< 1	2	< 1	< 1	3	1	40.0%
Alkalinity Phen. 8.3	mg/L			0.7										
Total Alkalinity CaCO3	mg/L	124	140	156	185	160	174	200	225			168	31	18.7%
Carbonate	mg/L			0.8										
Bicarbonate	mg/L			188										
Hydroxide	mg/L			< 0.5										
Fluoride F	mg/L	0.19	0.25	0.13	0.27	0.08	0.08	0.09	0.07			0.15	0.08	51.8%
Chloride Cl	mg/L	0.5	0.7		0.7	0.3	0.3	0.5	0.5	0.5	0.6	0.5	0.1	26.9%
Nitrate+Nitrite (N)	mg/L			< 0.02										
Nitrate N	mg/L	< 0.05	< 0.05	< 0.02	< 0.05	< 0.05	0.1	0.16	0.2	0.19	0.22	0.2	0.04	24.1%
Nitrite N	mg/L	< 0.002	< 0.002	< 0.005	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002			
Sulphate SO4	mg/L	5.9	6.4	4.7	7.6	7.2	8.2	8.9	9.8			7.2	1.6	22.0%
Total Organic Carbon C	mg/L	12	11	8.5	7.7	7.4	9	7.3	5.7			8.7	2.0	22.6%
Ammonia Nitrogen N	mg/L	< 0.02	< 0.02	< 0.005	0.06	< 0.02	0.12	0.04	0.06	0.02	0.03	0.05	0.03	65.9%
Ortho Phosphorus P	mg/L	< 0.02	< 0.02		< 0.02	< 0.02	< 0.02	< 0.02	< 0.02					
Total Phosphorus P	mg/L	0.03	0.03		< 0.02	< 0.02	< 0.02	< 0.02	< 0.02			0.03	0	0%
Total Aluminum Al	mg/L	0.4	0.063	0.17	0.027	0.035	0.035	0.011	0.012			0.105	0.129	123.3%
Total Antimony Sb	mg/L	< 0.001	< 0.001	0.00012	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0001	0	0%
Total Arsenic As	mg/L	< 0.001	< 0.001	0.00012	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0001	0	0%
Total Barium Ba	mg/L	0.098	0.11	0.11	0.13	0.12	0.13	0.13	0.15			0.12	0.02	14.8%
Total Beryllium Be	mg/L	< 0.001	< 0.001	< 0.00001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001					
Total Boron B	mg/L	0.02	0.02	0.025	0.021	0.021	0.02	0.014	0.01			0.019	0.004	23.1%
Total Bismuth Bi	mg/L			< 0.002										
Total Cadmium Cd	mg/L	< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002					
Total Calcium Ca	mg/L	34.2	41.8	47	56	46.5	50.6	53.3	58.5			47.3	8.2	17.4%
Total Chromium Cr	mg/L	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001	0	0.0%
Total Cobalt Co	mg/L	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001					
Total Copper Cu	mg/L	0.001	0.002	0.0011	0.001	0.002	0.002	0.001	< 0.001			0.002	0.001	34.5%
Total Iron Fe	mg/L	0.29	0.09	0.13	0.03	0.05	0.03	0.07	< 0.03			0.13	0.12	94.5%
Total Lead Pb	mg/L	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001					
Total Magnesium Mg	mg/L	8.23	9.72	11	13.6	11	13.9	13.7	15.5			11.8	2.5	21.1%
Total Manganese Mn	mg/L	0.003	< 0.001	0.0013	< 0.001	< 0.001	0.003	< 0.001	< 0.001			0.003	0.001	39.7%
Total Mercury Hg	ug/L	< 0.05	< 0.05	0.02	< 0.05	0.025	< 0.05	< 0.05	< 0.05			0.023	0.004	15.7%
Total Molybdenum Mo	mg/L	0.002	< 0.001	< 0.0004	0.003	0.001	< 0.001	< 0.001	< 0.001			0.002	0.001	50.0%
Total Nickel Ni	mg/L	0.002	0.002	0.001 (1)	0.001	0.002	0.001	< 0.001	< 0.001			0.002	0.001	54.8%
Total Phosphorus PO4	mg/L	< 0.4	< 0.4	0.011	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4			0.011	0	0%
Total Potassium K	mg/L	0.67	0.61	0.6	0.71	0.77	0.68	0.63	0.72			0.67	0.06	8.5%
Total Selenium Se	mg/L	< 0.001	< 0.001	0.0003	0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001	0.0005	76.1%
Total Silicon SiO2	mg/L	5.7	4.8	2.5	5.4	5.1	5.1	4.9	5.3			4.8	0.9	19.4%
Total Silver Ag	mg/L	< 0.0001	< 0.0001	< 0.00001 (1)	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001					
Total Sodium Na	mg/L	2.4	3	3	4.7	4.1	4.6	6	7.3			4.2	1.6	38.8%
Total Sulphur S	mg/L			1.7										
Total Strontium Sr	mg/L	0.081	0.095	0.098	0.11	0.11	0.12	0.12	0.14			0.11	0.02	17.8%
Total Tellurium Te	mg/L	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001					

APPENDIX 4.4-2, TABLE A
MONTHLY SURFACE WATER QUALITY

Parameter	Unit Name	WC 1 Monthly	WC 1 Monthly	WC1 Monthly	WC 1 Monthly	WC 1 Monthly	WC 1 Monthly	WC 1 Monthly	WC1 Monthly	WC1 Monthly	WC1 Monthly	Arithmetic Mean	Standard Deviation	Coefficient of Variation
Total Thallium Tl	mg/L	< 0.0001	< 0.0001	< 0.003	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001					
Total Thorium Th	mg/L	< 0.0005	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005					
Total Tin Sn	mg/L	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001					
Total Titanium Ti	mg/L	0.01	< 0.001	0.0053	< 0.001	0.001	< 0.001	< 0.001	< 0.001			0.005	0.004	69.1%
Total Uranium U	mg/L	< 0.0005	< 0.0005	0.0011	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005			0.001	0	0%
Total Vanadium V	mg/L	0.001	< 0.001	0.0008	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001	0.0001	12.4%
Total Zinc Zn	mg/L	0.03	0.013	0.002	0.006	< 0.005	0.015	< 0.005	< 0.005			0.029	0.041	138.7%
Total Zirconium Zr	mg/L	0.001	0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001	0.001	43.3%
Dissolved Aluminum Al	mg/L	0.044	0.031	0.013	0.027	0.007	0.006	0.006	< 0.005			0.02025	0.014	70.3%
Dissolved Antimony Sb	mg/L	< 0.001	< 0.001	0.00013	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0001	0	0%
Dissolved Arsenic As	mg/L	< 0.001	< 0.001	0.00009	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0001	0	0%
Dissolved Barium Ba	mg/L .	0.086	0.1	0.11	0.13	0.12	0.12	0.13	0.14			0.11	0.02	16.4%
Dissolved Beryllium Be	mg/L	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001					
Dissolved Bismuth	mg/L			< 0.002										
Dissolved Boron B	mg/L	0.01	0.02	0.022	0.021	0.008	0.016	0.014	0.009			0.015	0.005	37.3%
Dissolved Cadmium Cd	mg/L	< 0.0002	< 0.0002	< 0.00001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002					
Dissolved Calcium Ca	mg/L	31.6	37.8	47	48.2	42.7	50.5	53.1	56.7			44.8	8.4	18.7%
Dissolved Chromium Cr	mg/L	< 0.001	< 0.001	0.0007	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.0007	0	0%
Dissolved Cobalt Co	mg/L	< 0.001	< 0.001	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001					
Dissolved Copper Cu	mg/L	< 0.001	0.002	0.001	< 0.001	0.001	< 0.001	0.001	< 0.001			0.001	0.0004	37.3%
Dissolved Iron Fe	mg/L	0.05	0.03	0.022	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03			0.04	0.01	34.2%
Dissolved Lead Pb	mg/L	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001					
Dissolved Magnesium Mg	mg/L	7.57	8.88	11	11.7	10.7	13.5	13.6	14.8			11.2	2.5	21.9%
Dissolved Manganese Mn	mg/L	< 0.001	< 0.001	0.0003	< 0.001	< 0.001	0.002	< 0.001	< 0.001			0.0011	0.0009	77.7%
Dissolved Mercury Hg	ug/L	< 0.05	< 0.05	0.02	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05			0.02	0	0%
Dissolved Molybdenum Mo	mg/L	< 0.001	< 0.001	< 0.0004	0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001	0	0%
Dissolved Nickel Ni	mg/L	0.001	0.002	0.001	0.001	0.002	0.001	< 0.001	< 0.001			0.001	0.001	37.4%
Dissolved Phosphorus PO4	mg/L	< 0.4	< 0.4	0.006	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4			0.006	0	0%
Dissolved Potassium K	mg/L	0.48	0.56	0.55	0.68	0.57	0.54	0.54	0.6			0.56	0.06	10.4%
Dissolved Selenium Se	mg/L	< 0.001	< 0.001	0.00038	0.002	< 0.001	< 0.001	< 0.001	< 0.001			0.001	0.001	96.3%
Dissolved Silicon SiO2	mg/L	3.9	4.1	2.2	4.3	4.6	4.9	4.9	5.2			4.2	0.9	21.1%
Dissolved Silver Ag	mg/L	< 0.0001	< 0.0001	0.00001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001			0.00001	0	0%
Dissolved Sodium Na	mg/L	2.1	2.6	2.9	4	4	4.6	5.9	7			4	2	41.2%
Dissolved Sulfur S	mg/L			1.7										
Dissolved Strontium Sr	mg/L	0.077	0.089	0.097	0.12	0.11	0.11	0.11	0.13			0.10	0.02	17.1%
Dissolved Tellurium Te	mg/L	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001					
Dissolved Thallium Tl	mg/L	< 0.0001	< 0.0001	< 0.003	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001					
Dissolved Thorium Th	mg/L	< 0.0005	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005					
Dissolved Tin Sn	mg/L	< 0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.002	0	0%
Dissolved Titanium Ti	mg/L	0.001	0.001	0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001			0.001	0.001	65.1%
Dissolved Uranium U	mg/L	< 0.0005	< 0.0005	0.0011	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005			0.001	0	0%
Dissolved Vanadium V	mg/L	< 0.001	< 0.001	< 0.0003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001					
Dissolved Zinc Zn	mg/L	0.008	0.011	< 0.001	0.007	< 0.005	< 0.005	< 0.005	< 0.005			0.010	0.003	28.2%
Dissolved Zirconium Zr	mg/L	< 0.001	0.002	< 0.0003	0.002	< 0.001	< 0.001	< 0.001	< 0.001			0.002	0	0%

APPENDIX 4.4-2, TABLE B
MONTHLY TRIP AND FIELD BLANK RESULTS

Parameter	Unit Name	Trip Blank	Trip Blank	Trip Blank	Field Blank	Trip Blank	Trip Blank	Trip Blank	Field Blank	Field Blank	Trip Blank
Date Sampled		96/06/12	96/07/10	96/08/07	96/08/07	96/09/11	96/09/11	96/10/09	96/10/09	96/11/06	96/11/06
pH	pH units	5.45	5.43	5.5	n/a						
Conductivity	uS/cm	< 1	1	< 1	< 1						
Turbidity	NTU	0.11	0.1	0.3	< 0.10						
Hardness CaCO3	mg/L	< 1									
Hardness (Total) CaCO3	mg/L	< 1		< 0.1				< 1	< 1	< 1	< 1
Total Dissolved Solids	mg/L				8						
Total Suspended Solids	mg/L	< 1	< 1	< 4	< 4						
Alkalinity Phen. 8.3	mg/L			< 0.5	< 0.5						
Total Alkalinity CaCO3	mg/L	1.5	1	1.8	2.2						
Carbonate	mg/L			< 0.5							
Bicarbonate	mg/L			2.2							
Hydroxide	mg/L			< 0.5							
Fluoride F	mg/L	< 0.05	< 0.05	< 0.10	< 0.10						
Chloride Cl	mg/L	< 0.2	< 0.2								
Nitrate+Nitrite (N)	mg/L			< 0.02	< 0.02						
Nitrate N	mg/L	< 0.05	< 0.05	< 0.02							
Nitrite N	mg/L	< 0.002	< 0.002	< 0.005	< 0.005						
Sulphate SO4	mg/L	< 1	< 1	< 1.0	< 1.0						
Total Organic Carbon C	mg/L	< 1		< 1.0	< 1.0						
Ammonia Nitrogen N	mg/L	< 0.02		< 0.005	< 0.005						
Ortho Phosphorus P	mg/L	< 0.02	< 0.02								
Total Phosphorus P	mg/L	0.02									
Total Aluminum Al	mg/L	0.006		< 0.006	< 0.006	< 0.2	< 0.2	< 0.005	< 0.005	< 0.005	< 0.005
Total Antimony Sb	mg/L	< 0.001		0.00031		< 0.2	< 0.2	< 0.001	< 0.001	< 0.001	< 0.001
Total Arsenic As	mg/L	< 0.001		< 0.00005	< 0.00005	< 0.3	< 0.3	< 0.001	< 0.001	< 0.001	< 0.001
Total Barium Ba	mg/L	< 0.001		0.0001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Total Beryllium Be	mg/L	< 0.001		< 0.00001	< 0.00001	< 0.003	< 0.003	< 0.001	< 0.001	< 0.001	< 0.001
Total Boron B	mg/L	< 0.005		0.006 (1)	< 0.004	< 0.01	< 0.01	< 0.005	< 0.005	< 0.005	< 0.005
Total Bismuth Bi	mg/L			< 0.002	< 0.002						
Total Cadmium Cd	mg/L	< 0.0002		< 0.00001	< 0.00001	< 0.025	< 0.025	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Total Calcium Ca	mg/L	< 0.01		0.009 (1)	< 0.005	< 0.01	< 0.01	0.02	0.02	< 0.01	< 0.01
Total Chromium Cr	mg/L	< 0.001		0.0008	0.0003	< 0.03	< 0.03	< 0.001	< 0.001	< 0.001	< 0.001
Total Cobalt Co	mg/L	< 0.001		< 0.0004	< 0.0004	< 0.02	< 0.02	< 0.001	< 0.001	< 0.001	< 0.001
Total Copper Cu	mg/L	< 0.001		0.0004	< 0.0002	< 0.02	< 0.02	0.006	< 0.001	< 0.001	< 0.001
Total Iron Fe	mg/L	< 0.03		0.008 (1)	< 0.005	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Total Lead Pb	mg/L	< 0.001		0.0005	< 0.0001	< 0.08	< 0.08	< 0.001	< 0.001	< 0.001	< 0.001
Total Magnesium Mg	mg/L	< 0.05		< 0.002	< 0.002	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total Manganese Mn	mg/L	< 0.001		< 0.0002	< 0.0002	< 0.003	< 0.003	< 0.001	< 0.001	< 0.001	< 0.001
Total Mercury Hg	ug/L	< 0.05		0.02 (1)	0.01			< 0.05	< 0.05	< 0.05	< 0.05
Total Molybdenum Mo	mg/L	< 0.001		< 0.0004	< 0.0004	< 0.04	< 0.04	< 0.001	< 0.001	< 0.001	< 0.001
Total Nickel Ni	mg/L	< 0.001		< 0.001 (1)	< 0.001	< 0.03	< 0.03	< 0.001	< 0.001	< 0.001	< 0.001
Total Phosphorus PO4	mg/L	< 0.4		< 0.004	< 0.004	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total Potassium K	mg/L	< 0.01		< 0.04	< 0.04	< 0.01	< 0.01	0.014	0.015	< 0.01	< 0.01
Total Selenium Se	mg/L	< 0.001		< 0.00005	< 0.00005			< 0.001	< 0.001	< 0.001	< 0.001
Total Silicon SiO2	mg/L	< 0.1		0.28	< 0.08	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total Silver Ag	mg/L	< 0.0001		0.00001 (1)	0.00001	< 0.03	< 0.03	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Total Sodium Na	mg/L	< 0.1		< 0.04	< 0.04	< 0.1	< 0.1	0.1	0.2	< 0.1	< 0.1
Total Sulphur S	mg/L			< 0.01	< 0.01						
Total Strontium Sr	mg/L	< 0.001		< 0.0001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

APPENDIX 4.4-2, TABLE B
MONTHLY TRIP AND FIELD BLANK RESULTS

Parameter	Unit Name	Trip Blank	Trip Blank	Trip Blank	Field Blank	Trip Blank	Trip Blank	Trip Blank	Field Blank	Field Blank	Trip Blank
Total Tellurium Te	mg/L	< 0.001		< 0.002	< 0.002			< 0.001	< 0.001	< 0.001	< 0.001
Total Thallium Tl	mg/L	< 0.0001		< 0.003	< 0.003			< 0.0001	< 0.0001	< 0.0001	< 0.0001
Total Thorium Th	mg/L	< 0.0005						< 0.0005	< 0.0005	< 0.0005	< 0.0005
Total Tin Sn	mg/L	< 0.001		< 0.002	< 0.002	< 0.03	< 0.03	< 0.001	< 0.001	< 0.001	< 0.001
Total Titanium Ti	mg/L	< 0.001		< 0.0003 (1)	< 0.0003	< 0.006	< 0.006	< 0.001	< 0.001	< 0.001	< 0.001
Total Uranium U	mg/L	< 0.0005		0.0002	< 0.0002			< 0.0005	< 0.0005	< 0.0005	< 0.0005
Total Vanadium V	mg/L	< 0.001		< 0.0003	< 0.0003	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001
Total Zinc Zn	mg/L	< 0.005		0.002 (1)	0.002	< 0.02	< 0.02	< 0.005	< 0.005	< 0.005	< 0.005
Total Zirconium Zr	mg/L	< 0.001		< 0.0003	< 0.0003	< 0.02	< 0.02	< 0.001	< 0.001	< 0.001	< 0.001
Dissolved Aluminum Al	mg/L	0.012		< 0.006	< 0.006						
Dissolved Antimony Sb	mg/L	< 0.001		0.00011							
Dissolved Arsenic As	mg/L	< 0.001		< 0.00005	< 0.00005						
Dissolved Barium Ba	mg/L	< 0.001		0.0001	< 0.0001						
Dissolved Beryllium Be	mg/L	< 0.001		< 0.0001	< 0.0001						
Dissolved Bismuth	mg/L			< 0.002	< 0.002						
Dissolved Boron B	mg/L	< 0.005		0.006	< 0.004						
Dissolved Cadmium Cd	mg/L	< 0.0002		< 0.00001	< 0.00001						
Dissolved Calcium Ca	mg/L	< 0.01		0.009	< 0.005						
Dissolved Chromium Cr	mg/L	< 0.001		0.0005	0.0002						
Dissolved Cobalt Co	mg/L	< 0.001		< 0.0004	< 0.0004						
Dissolved Copper Cu	mg/L	< 0.001		0.0003	< 0.0002						
Dissolved Iron Fe	mg/L	< 0.03		0.011	< 0.005						
Dissolved Lead Pb	mg/L	< 0.001		0.0003	< 0.0001						
Dissolved Magnesium Mg	mg/L	< 0.05		< 0.002	< 0.002						
Dissolved Manganese Mn	mg/L	< 0.001		< 0.0002	< 0.0002						
Dissolved Mercury Hg	ug/L	< 0.05		0.02	0.01						
Dissolved Molybdenum Mo	mg/L	< 0.001		< 0.0004	< 0.0004						
Dissolved Nickel Ni	mg/L	< 0.001		0.001	< 0.001						
Dissolved Phosphorus PO4	mg/L	< 0.4		< 0.004	< 0.004						
Dissolved Potassium K	mg/L	< 0.01		< 0.04	< 0.04						
Dissolved Selenium Se	mg/L	< 0.001		< 0.0005	< 0.00005						
Dissolved Silicon SiO2	mg/L	< 0.1		0.27	< 0.08						
Dissolved Silver Ag	mg/L	< 0.0001		0.00002	< 0.00001						
Dissolved Sodium Na	mg/L	< 0.1		< 0.04	< 0.04						
Dissolved Sulfur S	mg/L			< 0.01	< 0.01						
Dissolved Strontium Sr	mg/L	< 0.001		< 0.0001	< 0.0001						
Dissolved Tellurium Te	mg/L	< 0.001		< 0.002	< 0.002						
Dissolved Thallium Tl	mg/L	< 0.0001		< 0.003	< 0.003						
Dissolved Thorium Th	mg/L	< 0.0005									
Dissolved Tin Sn	mg/L	< 0.001		< 0.002	< 0.002						
Dissolved Titanium Ti	mg/L	< 0.001		0.0006	< 0.0003						
Dissolved Uranium U	mg/L	< 0.0005		< 0.0001	< 0.0001						
Dissolved Vanadium V	mg/L	< 0.001		< 0.0003	< 0.0003						
Dissolved Zinc Zn	mg/L	< 0.005		0.003	0.001						
Dissolved Zirconium Zr	mg/L	< 0.001		< 0.0003	< 0.0003						

APPENDIX 4.4-2, TABLE B
MONTHLY TRIP AND FIELD BLANK RESULTS

Parameter	Unit Name	Field Blank	Trip Blank	Field Blank	Trip Blank	Field Blank	Trip Blank
Date Sampled		96/12/11	96/12/11	97/01/15	97/01/15	97/02/12	02/12/97
pH	pH units					5.11	5.59
Conductivity	uS/cm					1	< 1
Turbidity	NTU						
Hardness CaCO3	mg/L						
Hardness (Total) CaCO3	mg/L	2.16	< 1	< 1	< 1		
Total Dissolved Solids	mg/L						
Total Suspended Solids	mg/L					< 1	< 1
Alkalinity Phen. 8.3	mg/L						
Total Alkalinity CaCO3	mg/L						
Carbonate	mg/L						
Bicarbonate	mg/L						
Hydroxide	mg/L						
Fluoride F	mg/L						
Chloride Cl	mg/L					< 0.2	< 0.2
Nitrate+Nitrite (N)	mg/L						
Nitrate N	mg/L					< 0.05	< 0.05
Nitrite N	mg/L					< 0.002	< 0.002
Sulphate SO4	mg/L						
Total Organic Carbon C	mg/L						
Ammonia Nitrogen N	mg/L						
Ortho Phosphorus P	mg/L						
Total Phosphorus P	mg/L						
Total Aluminum Al	mg/L	< 0.005	< 0.005	< 0.005	0.006		
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	< 0.001	< 0.001	< 0.001	< 0.001		
Total Beryllium Be	mg/L	< 0.001	< 0.001	< 0.001	< 0.001		
Total Boron B	mg/L	< 0.005	< 0.005	0.008	0.007		
Total Bismuth Bi	mg/L						
Total Cadmium Cd	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002		
Total Calcium Ca	mg/L	0.6	0.21	0.04	< 0.01		
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	< 0.001	< 0.001		
Total Iron Fe	mg/L	< 0.03	< 0.03	< 0.03	< 0.03		
Total Lead Pb	mg/L	< 0.001	< 0.001	< 0.001	< 0.001		
Total Magnesium Mg	mg/L	0.16	0.07	< 0.05	< 0.05		
Total Manganese Mn	mg/L	< 0.001	< 0.001	< 0.001	< 0.001		
Total Mercury Hg	ug/L	< 0.05	< 0.05	< 0.05	< 0.05		
Total Molybdenum Mo	mg/L	< 0.001	< 0.001	< 0.001	< 0.001		
Total Nickel Ni	mg/L	< 0.001	< 0.001	< 0.001	< 0.001		
Total Phosphorus PO4	mg/L	< 0.4	< 0.4	< 0.4	< 0.4		
Total Potassium K	mg/L	0.01	0.02	0.03	0.03		
Total Selenium Se	mg/L	< 0.001	< 0.001	< 0.001	< 0.001		
Total Silicon SiO2	mg/L	< 0.1	< 0.1	< 0.1	< 0.1		
Total Silver Ag	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001		
Total Sodium Na	mg/L	0.1	0.1	< 0.1	< 0.1		
Total Sulphur S	mg/L						
Total Strontium Sr	mg/L	< 0.001	< 0.001	< 0.001	< 0.001		

APPENDIX 4.4-2, TABLE B
MONTHLY TRIP AND FIELD BLANK RESULTS

Parameter	Unit Name	Field Blank	Trip Blank	Field Blank	Trip Blank	Field Blank	Trip Blank
Total Tellurium Te	mg/L	< 0.001	< 0.001	< 0.001	< 0.001		
Total Thallium Tl	mg/L	< 0.0001	< 0.0001	< 0.0001	0.0002		
Total Thorium Th	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005		
Total Tin Sn	mg/L	< 0.001	< 0.001	< 0.001	0.004		
Total Titanium Ti	mg/L	< 0.001	< 0.001	< 0.001	< 0.001		
Total Uranium U	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005		
Total Vanadium V	mg/L	< 0.001	< 0.001	< 0.001	< 0.001		
Total Zinc Zn	mg/L	< 0.005	< 0.005	< 0.005	< 0.005		
Total Zirconium Zr	mg/L	< 0.001	< 0.001	< 0.001	< 0.001		
Dissolved Aluminum Al	mg/L						
Dissolved Antimony Sb	mg/L						
Dissolved Arsenic As	mg/L						
Dissolved Barium Ba	mg/L						
Dissolved Beryllium Be	mg/L						
Dissolved Bismuth	mg/L						
Dissolved Boron B	mg/L						
Dissolved Cadmium Cd	mg/L						
Dissolved Calcium Ca	mg/L						
Dissolved Chromium Cr	mg/L						
Dissolved Cobalt Co	mg/L						
Dissolved Copper Cu	mg/L						
Dissolved Iron Fe	mg/L						
Dissolved Lead Pb	mg/L						
Dissolved Magnesium Mg	mg/L						
Dissolved Manganese Mn	mg/L						
Dissolved Mercury Hg	ug/L						
Dissolved Molybdenum Mo	mg/L						
Dissolved Nickel Ni	mg/L						
Dissolved Phosphorus PO4	mg/L						
Dissolved Potassium K	mg/L						
Dissolved Selenium Se	mg/L						
Dissolved Silicon SiO2	mg/L						
Dissolved Silver Ag	mg/L						
Dissolved Sodium Na	mg/L						
Dissolved Sulfur S	mg/L						
Dissolved Strontium Sr	mg/L						
Dissolved Tellurium Te	mg/L						
Dissolved Thallium Tl	mg/L						
Dissolved Thorium Th	mg/L						
Dissolved Tin Sn	mg/L						
Dissolved Titanium Ti	mg/L						
Dissolved Uranium U	mg/L						
Dissolved Vanadium V	mg/L						
Dissolved Zinc Zn	mg/L						
Dissolved Zirconium Zr	mg/L						

APPENDIX 4.4-2, TABLE C
MONTHLY TRIP AND FIELD BLANK RESULTS

Parameter	Unit Name	WC 1 Monthly	D 1 Monthly (WC1)	WC1 % Difference	Trib 1 Monthly	D 1 Monthly (TRIB 1)	Trib 1 % Difference	TRIB 1 Monthly	D 1 Monthly (TRIB 1)	Trib 1 % Difference	WC1 Monthly	D 1 Monthly (WC1)	WC1 % Difference
Date Sampled		96/05/14	96/05/14	96/05/14	96/06/12	96/06/12	96/06/12	96/07/10	96/07/10	96/07/10	96/08/07	96/08/07	96/08/07
pH	pH units	8.23	8.25	0.24%	8.17	8.18	0.12%	7.9	8.00	1.25%	8.3	8.4	1.19%
Conductivity	uS/cm	275	275	0.00%	270	272	0.74%	309	309	0.00%	291	294	1.02%
Turbidity	NTU	5.2	5	3.85%	0.27	0.3	10.00%	0.26	0.24	7.69%	3.76	3.92	4.08%
Hardness CaCO3	mg/L	127	135	5.93%	139	138	0.72%	149	156	4.49%			
Hardness (Total) CaCO3	mg/L	133	138	3.62%	145	141	2.76%	160	173	7.51%	163	163	0.00%
Total Dissolved Solids	mg/L										190	146	23.16%
Total Suspended Solids	mg/L	< 1	< 1		< 1	< 1		< 1	< 1		< 4	< 4	
Alkalinity Phen. 8.3	mg/L										0.7	0.9	22.22%
Total Alkalinity CaCO3	mg/L	149	150	0.67%	148	156	5.13%	169	70.7	58.17%	156	154	1.28%
Carbonate	mg/L										0.8	1.1	27.27%
Bicarbonate	mg/L										188	186	1.06%
Hydroxide	mg/L										< 0.5	< 0.5	
Fluoride F	mg/L	0.16	0.15	6.25%	< 0.05	< 0.05		< 0.05	< 0.05		0.13	0.12	7.69%
Chloride Cl	mg/L	0.6	0.7	14.29%	0.5	0.5	0.00%	< 0.2	< 0.2				
Nitrate+Nitrite (N)	mg/L										< 0.02	< 0.02	
Nitrate N	mg/L	0.17	0.17	0.00%	< 0.05	< 0.05		< 0.05	< 0.05		< 0.02	< 0.02	
Nitrite N	mg/L	< 0.002	< 0.002		< 0.002	< 0.002		< 0.002	< 0.002		< 0.005	< 0.005	
Sulphate SO4	mg/L	6.3	6.3	0.00%	4.2	4.2	0.00%	4.3	4.3	0.00%	4.7	4.7	0.00%
Total Organic Carbon C	mg/L	9.6	10	4.00%	11	11	0.00%	11	12	8.33%	8.5	8.3	2.35%
Ammonia Nitrogen N	mg/L	0.03	0.03	0.00%	< 0.02	0.04		< 0.02	< 0.02		< 0.005	< 0.005	
Ortho Phosphorus P	mg/L	< 0.02	< 0.02		0.05	< 0.02		< 0.02	< 0.02				
Total Phosphorus P	mg/L	< 0.02	0.02		0.05	< 0.02		< 0.02	< 0.02				
Total Aluminum Al	mg/L	0.19	0.16	15.79%	0.028	0.035	20.00%	0.027	0.021	22.22%	0.17	0.17	0.00%
Total Antimony Sb	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		0.00012	0.00037	67.57%
Total Arsenic As	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		0.00012	0.00014	14.29%
Total Barium Ba	mg/L	0.095	0.097	2.06%	0.12	0.12	0.00%	0.13	0.14	7.14%	0.11	0.11	0.00%
Total Beryllium Be	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.00001	0.00001	
Total Boron B	mg/L	0.02	0.04	50.00%	0.03	0.02	33.33%	0.04	0.04	0.00%	0.025	0.023	8.00%
Total Bismuth Bi	mg/L										< 0.002	< 0.002	
Total Cadmium Cd	mg/L	< 0.0002	0.0008		< 0.0002	< 0.0002		< 0.0002	< 0.0002		< 0.00001	0.00001	
Total Calcium Ca	mg/L	37.7	39.2	3.83%	45.4	44.1	2.86%	50.1	54.1	7.39%	47	48	2.08%
Total Chromium Cr	mg/L	0.001	< 0.001		0.004	< 0.001		< 0.001	< 0.001		0.001	0.001	0.00%
Total Cobalt Co	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.0004	< 0.0004	
Total Copper Cu	mg/L	0.002	0.002	0.00%	< 0.001	< 0.001		0.001	< 0.001		0.0011	0.0013	15.38%
Total Iron Fe	mg/L	0.35	0.17	51.43%	0.06	0.04	33.33%	< 0.03	< 0.03		0.13	0.14	7.14%
Total Lead Pb	mg/L	< 0.001	< 0.001		< 0.001	0.001		< 0.001	< 0.001		< 0.0001	0.0059	
Total Magnesium Mg	mg/L	9.31	9.63	3.32%	7.65	7.58	0.92%	8.52	9.13	6.68%	11	11	0.00%
Total Manganese Mn	mg/L	0.004	0.003	25.00%	0.001	0.001	0.00%	< 0.001	< 0.001		0.0013	0.0014	7.14%
Total Mercury Hg	ug/L	< 0.05	< 0.05		< 0.05	< 0.05		< 0.05	< 0.05		0.02	0.02	0.00%
Total Molybdenum Mo	mg/L	< 0.001	< 0.001		< 0.001	0.001		< 0.001	< 0.001		< 0.0004	< 0.0004	
Total Nickel Ni	mg/L	0.004	0.002	50.00%	0.003	< 0.001		0.001	0.001	0.00%	0.001 (1)	0.002	
Total Phosphorus PO4	mg/L	< 0.4	< 0.4		< 0.4	< 0.4		< 0.4	< 0.4		0.011	0.012	8.33%
Total Potassium K	mg/L	0.63	0.65	3.08%	0.64	0.63	1.56%	0.59	0.6	1.67%	0.6	0.62	3.23%
Total Selenium Se	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		0.0003	0.00033	9.09%
Total Silicon SiO2	mg/L	4.5	4.4	2.22%	3.7	3.6	2.70%	3.9	4.1	4.88%	2.5	2.6	3.85%
Total Silver Ag	mg/L	< 0.0001	< 0.0001		< 0.0001	< 0.0001		< 0.0001	< 0.0001		< 0.00001 (1)	0.00001 (1)	
Total Sodium Na	mg/L	2.8	2.8	0.00%	0.8	0.7	12.50%	1	1.1	9.09%	3	3	0.00%
Total Sulphur S	mg/L										1.7	1.8	5.56%
Total Strontium Sr	mg/L	0.084	0.085	1.18%	0.072	0.073	1.37%	0.079	0.084	5.95%	0.098	0.1	2.00%
Total Tellurium Te	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.002	< 0.002	
Total Thallium Tl	mg/L	< 0.0001	< 0.0001		< 0.0001	< 0.0001		< 0.0001	< 0.0001		< 0.003	< 0.003	
Total Thorium Th	mg/L	< 0.0005	< 0.0005		< 0.0005	< 0.0005		< 0.0005	< 0.0005				
Total Tin Sn	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.002	< 0.002 (1)	
Total Titanium Ti	mg/L	0.005	0.005	0.00%	< 0.001	< 0.001		< 0.001	< 0.001		0.0053	0.0055	3.64%
Total Uranium U	mg/L	< 0.0005	< 0.0005		< 0.0005	< 0.0005		< 0.0005	< 0.0005		0.0011	0.0003	72.73%
Total Vanadium V	mg/L	0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		0.0008	0.0008	0.00%

APPENDIX 4.4-2, TABLE C
MONTHLY TRIP AND FIELD BLANK RESULTS

Parameter	Unit Name	WC 1 Monthly	D 1 Monthly (WC1)	WC1 % Difference	Trib 1 Monthly	D 1 Monthly (TRIB 1)	Trib 1 % Difference	TRIB 1 Monthly	D 1 Monthly (TRIB 1)	Trib 1 % Difference	WC1 Monthly	D 1 Monthly (WC1)	WC1 % Difference
Total Zinc Zn	mg/L	0.11	0.012	89.09%	0.01	0.007	30.00%	0.04	0.01	75.00%	0.002	0.003	33.33%
Total Zirconium Zr	mg/L	0.002	0.001	50.00%	< 0.001	< 0.001		< 0.001	0.001		< 0.0003	< 0.0003	
Dissolved Aluminum Al	mg/L	0.028	0.032	12.50%	0.012	0.015	20.00%	0.016	0.011	31.25%	0.013	0.015	13 33%
Dissolved Antimony Sb	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		0.00013	0.00072	81.94%
Dissolved Arsenic As	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		0.00009	0.00013	30.77%
Dissolved Barium Ba	mg/L	0.091	0.094	3.19%	0.11	0.11	0.00%	0.12	0.13	7.69%	0.11	0.11	0.00%
Dissolved Beryllium Be	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.0001	< 0.0001	
Dissolved Bismuth	mg/L										< 0.002	< 0.002	
Dissolved Boron B	mg/L	0.011	0.01	9.09%	0.01	< 0.005		< 0.005	0.01		0.022	0.029	24.14%
Dissolved Cadmium Cd	mg/L	< 0.0002	< 0.0002		< 0.0002	< 0.0002		< 0.0002	< 0.0002		< 0.00001	< 0.00001	
Dissolved Calcium Ca	mg/L	36	38.3	6.01%	43.6	43.1	1.15%	46.5	48.7	4.52%	47	47	0.00%
Dissolved Chromium Cr	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		0.0007	0.0008	12.50%
Dissolved Cobalt Co	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.0004	< 0.0004	
Dissolved Copper Cu	mg/L	0.001	0.001	0.00%	< 0 001	< 0.001		0.001	< 0.001		0.001	0.0012	16.67%
Dissolved Iron Fe	mg/L	0.04	0.05	20.00%	< 0.03	< 0.03		< 0.03	< 0.03		0.022	0.043	48.84%
Dissolved Lead Pb	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.0001	0.0002	
Dissolved Magnesium Mg	mg/L	8.97	9.45	5.08%	7.34	7.36	0.27%	7.87	8.32	5.41%	11	11	0.00%
Dissolved Manganese Mn	mg/L	0.001	< 0.001		< 0.001	0.001		< 0.001	< 0.001		0.0003	0.0003	0.00%
Dissolved Mercury Hg	ug/L	< 0.05	< 0.05		< 0.05	< 0.05		< 0.05	< 0.05		0.02	0.02	0.00%
Dissolved Molybdenum Mo	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		0.004	< 0.001		< 0.0004	< 0.0004	
Dissolved Nickel Ni	mg/L	0.002	0.002	0.00%	< 0.001	0.001		0.001	< 0.001		0.001	0.001	0.00%
Dissolved Phosphorus PO4	mg/L	< 0.4	< 0.4		< 0.4	< 0.4		< 0.4	< 0.4		0.006	0.009	33.33%
Dissolved Potassium K	mg/L	0.5	0.51	1.96%	0.55	0.53	3.64%	0.49	0.58	15.52%	0.55	0.56	1.79%
Dissolved Selenium Se	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		0.00038	< 0.0005	
Dissolved Silicon SiO2	mg/L	3.9	4	2.50%	3.3	3.3	0.00%	3.5	3.7	5.41%	2.2	2.2	0.00%
Dissolved Silver Ag	mg/L	< 0.0001	< 0.0001		< 0.0001	< 0.0001		< 0.0001	< 0.0001		0.00001	0.00002	50.00%
Dissolved Sodium Na	mg/L	2.7	2.7	0.00%	0.7	0.6	14.29%	0.7	0.8	12.50%	2.9	2.9	0.00%
Dissolved Sulfur S	mg/L										1.7	1.7	0.00%
Dissolved Strontium Sr	mg/L	0.083	0.085	2.35%	0.07	0.07	0.00%	0.077	0.079	2.53%	0.097	0.097	0.00%
Dissolved Tellurium Te	mg/L	< 0.001	< 0.001		< 0.001	< 0 001		< 0.001	< 0.001		< 0.002	< 0 002	
Dissolved Thallium Tl	mg/L	< 0.0001	< 0.0001		< 0.0001	< 0.0001		< 0.0001	< 0.0001		< 0.003	< 0.003	
Dissolved Thorium Th	mg/L	< 0.0005	< 0.0005		< 0.0005	< 0.0005		< 0.0005	< 0.0005				
Dissolved Tin Sn	mg/L	< 0 001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		0.002	0.002	0.00%
Dissolved Titanium Ti	mg/L	0.002	0.002	0.00%	< 0.001	< 0.001		< 0.001	< 0.001		0.0003	0.0007	57.14%
Dissolved Uranium U	mg/L	< 0.0005	< 0.0005		< 0.0005	< 0.0005		< 0.0005	< 0.0005		0.0011	0.0002	81.82%
Dissolved Vanadium V	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.0003	0.0003	
Dissolved Zinc Zn	mg/L	0.013	0.028	53.57%	< 0.005	< 0.005		0.015	0.01	33 33%	< 0 001	0.002	
Dissolved Zirconium Zr	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	0.002		< 0 0003	< 0.0003	

APPENDIX 4.4-2, TABLE C
MONTHLY TRIP AND FIELD BLANK RESULTS

Parameter	Unit Name	WC 2 Monthly	D1 Monthly (WC2)	WC2 % Difference	PR1 Monthly	D1 Monthly (PR1)	PR1 % Difference	WC 1 Monthly	D1 Monthly (WC1)	WC1 % Difference	WC 1 Monthly	D1 Monthly (WC1)	WC1 % Difference
Date Sampled		96/09/11	96/09/11	96/09/11	96/10/09	96/10/09	96/10/09	96/11/06	96/11/06	96/11/06	96/12/11	96/12/11	96/12/11
pH	pH units	8.25	8.31	0.72%	8.11	8.1	0.12%	8.28	8.28	0.00%	8.26	8.37	1.31%
Conductivity	uS/cm	305	303	0.66%	248	249	0.00%	340	334	1.76%	371	373	0.54%
Turbidity	NTU	0.95	0.93	2.11%	1.2	0.77	35.83%	0.88	0.89	1.12%	0.65	0.63	3.08%
Hardness CaCO3	mg/L	145	143	1.38%	114	111	2.63%	182	181	0.55%	189	204	7.35%
Hardness (Total) CaCO3	mg/L	166	162	2.41%	125	126	0.79%	184	184	0.00%	189	206	8.25%
Total Dissolved Solids	mg/L												
Total Suspended Solids	mg/L	< 1	< 1		< 1	< 1		< 1	< 1		< 1	< 1	
Alkalinity Phen. 8.3	mg/L												
Total Alkalinity CaCO3	mg/L	160	161	0.62%	178	109	38.76%	174	174	0.00%	200	205	2.44%
Carbonate	mg/L												
Bicarbonate	mg/L												
Hydroxide	mg/L												
Fluoride F	mg/L	0.25	0.25	0.00%	< 0.05	< 0.05		0.08	0.08	0.00%	0.09	0.08	11.11%
Chloride Cl	mg/L	0.6	< 0.2		0.9	0.8	11.11%	0.3	0.3	0.00%	0.5	0.4	20.00%
Nitrate+Nitrite (N)	mg/L												
Nitrate N	mg/L	< 0.05	< 0.05		< 0.05	< 0.05		0.1	< 0.05		0.16	0.16	0.00%
Nitrite N	mg/L	< 0.002	< 0.002		< 0.002	< 0.002		< 0.002	< 0.002		< 0.002	< 0.002	
Sulphate SO4	mg/L	4.9	4.8	2.04%	15	15	0.00%	8.2	8.7	5.75%	8.9	8.8	1.12%
Total Organic Carbon C	mg/L	11	10	9.09%	3.1	2.8	9.68%	9	7.8	13.33%	7.3	7.4	1.35%
Ammonia Nitrogen N	mg/L	0.05	< 0.02		0.05	0.38	86.84%	0.12	0.05	58.33%	0.04	0.04	0.00%
Ortho Phosphorus P	mg/L	< 0.02	< 0.02		< 0.02	< 0.02		< 0.02	< 0.02		< 0.02	< 0.02	
Total Phosphorus P	mg/L	< 0.02	< 0.02		< 0.02	< 0.02		< 0.02	< 0.02		< 0.02	< 0.02	
Total Aluminum Al	mg/L	0.033	0.036	8.33%	0.02	0.027	25.93%	0.035	0.045	22.22%	0.011	0.009	18.18%
Total Antimony Sb	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Total Arsenic As	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Total Barium Ba	mg/L	0.095	0.11	13.64%	0.062	0.062	0.00%	0.13	0.12	7.69%	0.13	0.13	0.00%
Total Beryllium Be	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Total Boron B	mg/L	0.02	0.01	50.00%	0.02	0.047	57.45%	0.02	0.023	13.04%	0.014	0.01	28.57%
Total Bismuth Bi	mg/L												
Total Cadmium Cd	mg/L	< 0.0002	0.0003		< 0.0002	< 0.0002		< 0.0002	< 0.0002		< 0.0002	< 0.0002	
Total Calcium Ca	mg/L	45.7	44.5	2.63%	37.6	37.9	0.79%	50.6	50.4	0.40%	53.3	57.2	6.82%
Total Chromium Cr	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Total Cobalt Co	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Total Copper Cu	mg/L	0.001	0.001	0.00%	< 0.001	< 0.001		0.002	0.002	0.00%	0.001	0.001	0.00%
Total Iron Fe	mg/L	0.13	0.12	7.69%	< 0.03	0.04		0.03	0.04	25.00%	0.07	< 0.03	
Total Lead Pb	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Total Magnesium Mg	mg/L	12.5	12.2	2.40%	7.59	7.6	0.13%	13.9	14	0.71%	13.7	15.2	9.87%
Total Manganese Mn	mg/L	0.003	0.003	0.00%	0.002	0.003	33.33%	0.003	0.005	40.00%	< 0.001	< 0.001	
Total Mercury Hg	ug/L	< 0.05	< 0.05		< 0.05	< 0.05		< 0.05	< 0.05		< 0.05	< 0.05	
Total Molybdenum Mo	mg/L	< 0.001	< 0.001		0.001	0.001	0.00%	< 0.001	< 0.001		< 0.001	< 0.001	
Total Nickel Ni	mg/L	< 0.001	0.001		< 0.001	< 0.001		0.001	0.001	0.00%	< 0.001	< 0.001	
Total Phosphorus PO4	mg/L	< 0.4	< 0.4		< 0.4	< 0.4		< 0.4	< 0.4		< 0.4	< 0.4	
Total Potassium K	mg/L	0.34	0.4	15.00%	0.54	0.54	0.00%	0.68	0.64	5.88%	0.63	0.62	1.59%
Total Selenium Se	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Total Silicon SiO2	mg/L	4.7	4.2	10.64%	3.1	3.2	3.13%	5.1	5.1	0.00%	4.9	5.2	5.77%
Total Silver Ag	mg/L	< 0.0001	< 0.0001		< 0.0001	< 0.0001		< 0.0001	< 0.0001		< 0.0001	< 0.0001	
Total Sodium Na	mg/L	4.3	4.2	2.33%	1.7	1.7	0.00%	4.6	4.6	0.00%	6	6.3	4.76%
Total Sulphur S	mg/L												
Total Strontium Sr	mg/L	0.12	0.14	14.29%	0.22	0.22	0.00%	0.12	0.12	0.00%	0.12	0.12	0.00%
Total Tellurium Te	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Total Thallium Tl	mg/L	< 0.0001	< 0.0001		< 0.0001	< 0.0001		< 0.0001	< 0.0001		< 0.0001	< 0.0001	
Total Thorium Th	mg/L	< 0.0005	< 0.0005		< 0.0005	< 0.0005		< 0.0005	< 0.0005		< 0.0005	< 0.0005	
Total Tin Sn	mg/L	< 0.001	0.004		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Total Titanium Ti	mg/L	< 0.001	0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Total Uranium U	mg/L	< 0.0005	< 0.0005		< 0.0005	< 0.0005		< 0.0005	< 0.0005		< 0.0005	< 0.0005	
Total Vanadium V	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	

APPENDIX 4.4-2, TABLE C
MONTHLY TRIP AND FIELD BLANK RESULTS

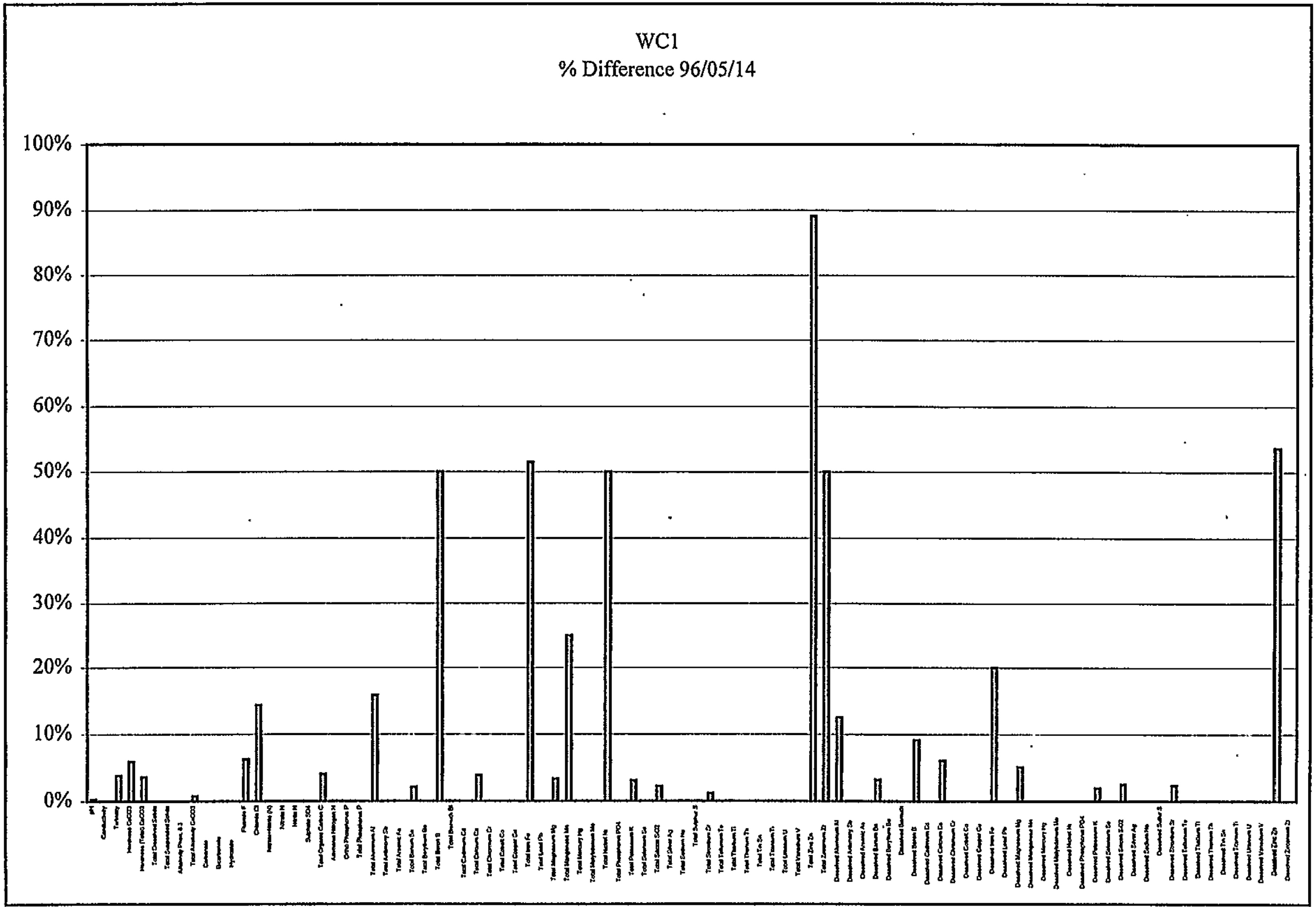
Parameter	Unit Name	WC 2 Monthly	D1 Monthly (WC2)	WC2 % Difference	PR1 Monthly	D1 Monthly (PR1)	PR1 % Difference	WC 1 Monthly	D1 Monthly (WC1)	WC1 % Difference	WC 1 Monthly	D1 Monthly (WC1)	WC1 % Difference
Total Zinc Zn	mg/L	< 0.005	0.007		< 0.005	< 0.005		0.015	0.007	53.33%	< 0.005	< 0.005	
Total Zirconium Zr	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Dissolved Aluminum Al	mg/L	0.011	0.012	8.33%	0.007	0.018	61.11%	0.006	0.007	14.29%	0.006	< 0.005	
Dissolved Antimony Sb	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Dissolved Arsenic As	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Dissolved Barium Ba	mg/L	0.095	0.095	0.00%	0.06	0.059	1.67%	0.12	0.11	8.33%	0.13	0.13	0.00%
Dissolved Beryllium Be	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Dissolved Bismuth	mg/L												
Dissolved Boron B	mg/L	0.006	0.006	0.00%	0.007	0.006	14.29%	0.016	0.009	43.75%	0.014	0.01	28.57%
Dissolved Cadmium Cd	mg/L	< 0.0002	< 0.0002		< 0.0002	< 0.0002		< 0.0002	< 0.0002		< 0.0002	< 0.0002	
Dissolved Calcium Ca	mg/L	40	39.3	1.75%	34	33.2	2.35%	50.5	49.8	1.39%	53.1	56.9	6.68%
Dissolved Chromium Cr	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Dissolved Cobalt Co	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Dissolved Copper Cu	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		0.001	0.001	0.00%
Dissolved Iron Fe	mg/L	0.08	0.08	0.00%	< 0.03	< 0.03		< 0.03	< 0.03		< 0.03	< 0.03	
Dissolved Lead Pb	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Dissolved Magnesium Mg	mg/L	10.9	10.9	0.00%	7.05	6.9	2.13%	13.5	13.8	2.17%	13.6	15	9.33%
Dissolved Manganese Mn	mg/L	0.002	0.002	0.00%	0.001	0.001	0.00%	0.002	0.001	50.00%	< 0.001	< 0.001	
Dissolved Mercury Hg	ug/L	< 0.05	< 0.05		< 0.05	< 0.05		< 0.05	< 0.05		< 0.05	< 0.05	
Dissolved Molybdenum Mo	mg/L	< 0.001	< 0.001		< 0.001	0.001		< 0.001	< 0.001		< 0.001	< 0 001	
Dissolved Nickel Ni	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		0.001	0.001	0.00%	< 0.001	< 0.001	
Dissolved Phosphorus PO4	mg/L	< 0.4	< 0.4		< 0.4	< 0.4		< 0.4	< 0.4		< 0.4	< 0.4	
Dissolved Potassium K	mg/L	0.3	0 33	9.09%	0.44	0.41	6.82%	0.54	0.49	9.26%	0.54	0.58	6.90%
Dissolved Selenium Se	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Dissolved Silicon SiO2	mg/L	3.5	3.5	0.00%	2.7	2.6	3.70%	4.9	4.7	4.08%	4.9	5.2	5.77%
Dissolved Silver Ag	mg/L	< 0.0001	< 0 0001		< 0.0001	< 0.0001		< 0.0001	< 0.0001		< 0.0001	< 0.0001	
Dissolved Sodium Na	mg/L	3.6	3.5	2.78%	1.5	1.3	13 33%	4.6	4.5	2.17%	5.9	6.3	6.35%
Dissolved Sulfur S	mg/L												
Dissolved Strontium Sr	mg/L	0.12	0.12	0.00%	0.21	0.21	0.00%	0.11	0.11	0.00%	0.11	0.12	8.33%
Dissolved Tellurium Te	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Dissolved Thallium Tl	mg/L	< 0.0001	< 0.0001		< 0.0001	< 0.0001		< 0.0001	< 0.0001		< 0.0001	< 0.0001	
Dissolved Thorium Th	mg/L	< 0.0005	< 0.0005		< 0.0005	< 0.0005		< 0.0005	< 0.0005		< 0.0005	< 0.0005	
Dissolved Tin Sn	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Dissolved Titanium Ti	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Dissolved Uranium U	mg/L	< 0.0005	< 0.0005		< 0.0005	< 0.0005		< 0.0005	< 0.0005		< 0.0005	< 0.0005	
Dissolved Vanadium V	mg/L	< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0.001	
Dissolved Zinc Zn	mg/L	< 0 005	0.013		< 0.005	0.006		< 0.005	< 0.005		< 0.005	< 0.005	
Dissolved Zirconium Zr	mg/L	< 0.001	0.002		< 0.001	< 0.001		< 0.001	< 0.001		< 0.001	< 0 001	

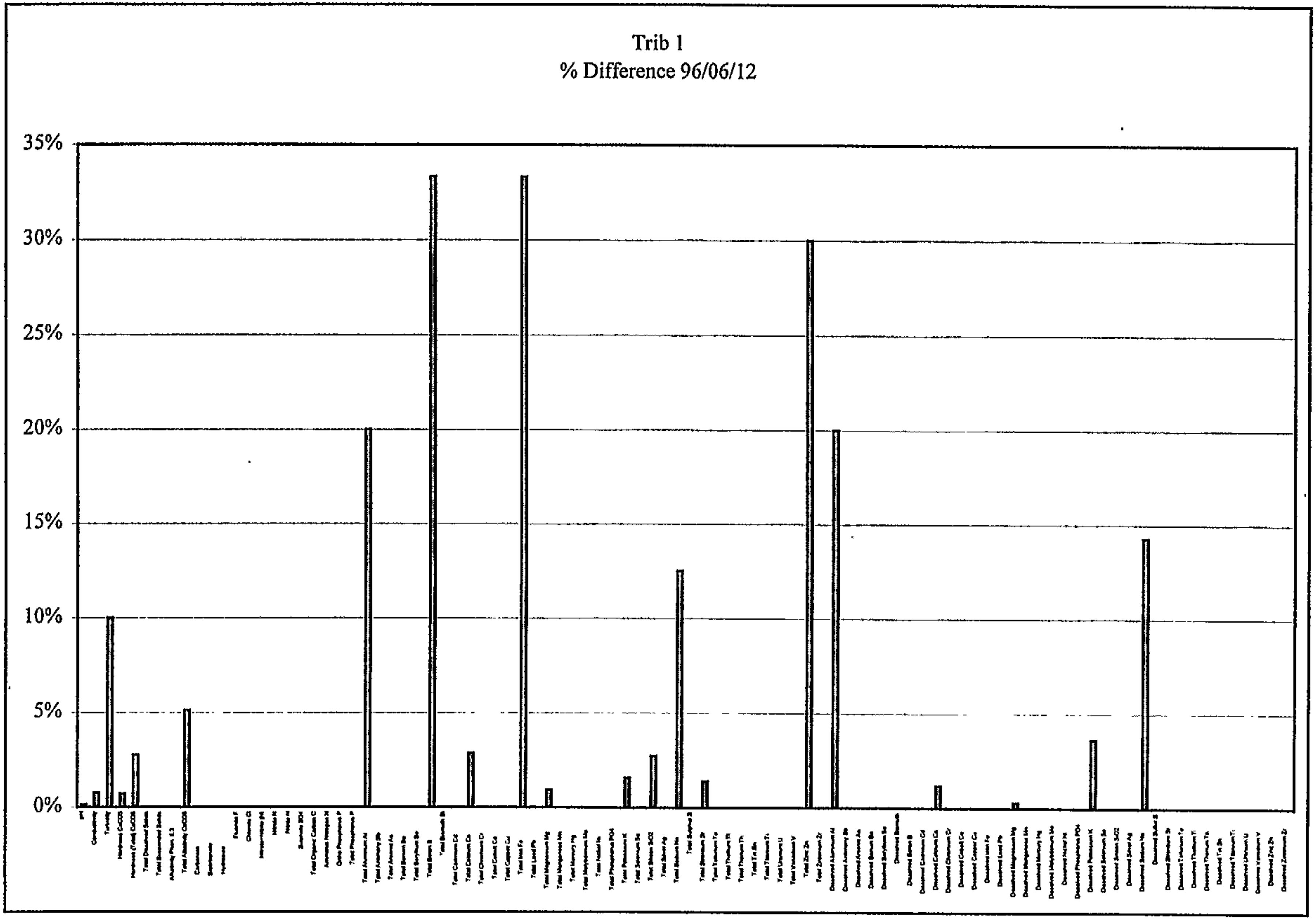
APPENDIX 4.4-2, TABLE C
MONTHLY TRIP AND FIELD BLANK RESULTS

Parameter	Unit Name	PR1 Monthly	D1 Monthly (PR1)	PR1 % Difference	TRIB1 Monthly	DC1	Trib 1 % Difference	MC1 Monthly	DC1
Date Sampled		97/01/15	97/01/15	97/01/15	97/02/12	97/02/12	97/02/12	97/03/18	97/03/18
pH	pH units	8.11	8.12	0.12%	8.12	8.13	0.12%	8.22	8.2
Conductivity	uS/cm	350	348	0.57%	405	412	1.70%	470	474
Turbidity	NTU	0.32	0.3	6.25%					
Hardness CaCO3	mg/L	179	178	0.56%					
Hardness (Total) CaCO3	mg/L	183	184	0.54%					
Total Dissolved Solids	mg/L				237	247		266	279
Total Suspended Solids	mg/L	< 1	2		< 1	< 1		1	2
Alkalinity Phen. 8.3	mg/L								
Total Alkalinity CaCO3	mg/L	156	154	1.28%					
Carbonate	mg/L								
Bicarbonate	mg/L								
Hydroxide	mg/L								
Fluoride F	mg/L	< 0.05	0.11						
Chloride Cl	mg/L	2.2	2.2	0.00%	0.3	0.3	0.00%	0.3	0.4
Nitrate+Nitrite (N)	mg/L								
Nitrate N	mg/L	< 0.05	0.09		0.13	0.13		< 0.05	< 0.05
Nitrite N	mg/L	< 0.002	< 0.002		< 0.002	< 0.002		< 0.002	< 0.002
Sulphate SO4	mg/L	37	37	0.00%					
Total Organic Carbon C	mg/L	2.2	2.5	12.00%					
Ammonia Nitrogen N	mg/L	0.08	0.11	27.27%	< 0.02	0.02		< 0.02	0.02
Ortho Phosphorus P	mg/L	< 0.02	< 0.02						
Total Phosphorus P	mg/L	< 0.02	< 0.02						
Total Aluminum Al	mg/L	0.005	0.01	50.00%					
Total Antimony Sb	mg/L	< 0.001	< 0.001						
Total Arsenic As	mg/L	< 0.001	< 0.001						
Total Barium Ba	mg/L	0.076	0.077	1.30%					
Total Beryllium Be	mg/L	< 0.001	< 0.001						
Total Boron B	mg/L	0.03	0.024	20.00%					
Total Bismuth Bi	mg/L								
Total Cadmium Cd	mg/L	< 0.0002	< 0.0002						
Total Calcium Ca	mg/L	54.2	54.4	0.37%					
Total Chromium Cr	mg/L	< 0.001	< 0.001						
Total Cobalt Co	mg/L	< 0.001	< 0.001						
Total Copper Cu	mg/L	< 0.001	< 0.001						
Total Iron Fe	mg/L	< 0.03	< 0.03						
Total Lead Pb	mg/L	< 0.001	< 0.001						
Total Magnesium Mg	mg/L	11.6	11.7	0.85%					
Total Manganese Mn	mg/L	0.004	0.005	20.00%					
Total Mercury Hg	ug/L	< 0.05	< 0.05						
Total Molybdenum Mo	mg/L	< 0.001	< 0.001						
Total Nickel Ni	mg/L	< 0.001	< 0.001						
Total Phosphorus PO4	mg/L	< 0.4	< 0.4						
Total Potassium K	mg/L	0.59	0.6	1.67%					
Total Selenium Se	mg/L	0.001	< 0.001						
Total Silicon SiO2	mg/L	3.8	3.8	0.00%					
Total Silver Ag	mg/L	< 0.0001	< 0.0001						
Total Sodium Na	mg/L	2.9	2.9	0.00%					
Total Sulphur S	mg/L								
Total Strontium Sr	mg/L	0.42	0.41	2.38%					
Total Tellurium Te	mg/L	< 0.001	< 0.001						
Total Thallium Tl	mg/L	< 0.0001	0.0002						
Total Thorium Th	mg/L	< 0.0005	< 0.0005						
Total Tin Sn	mg/L	< 0.001	< 0.001						
Total Titanium Ti	mg/L	0.001	< 0.001						
Total Uranium U	mg/L	< 0.0005	< 0.0005						
Total Vanadium V	mg/L	< 0.001	< 0.001						

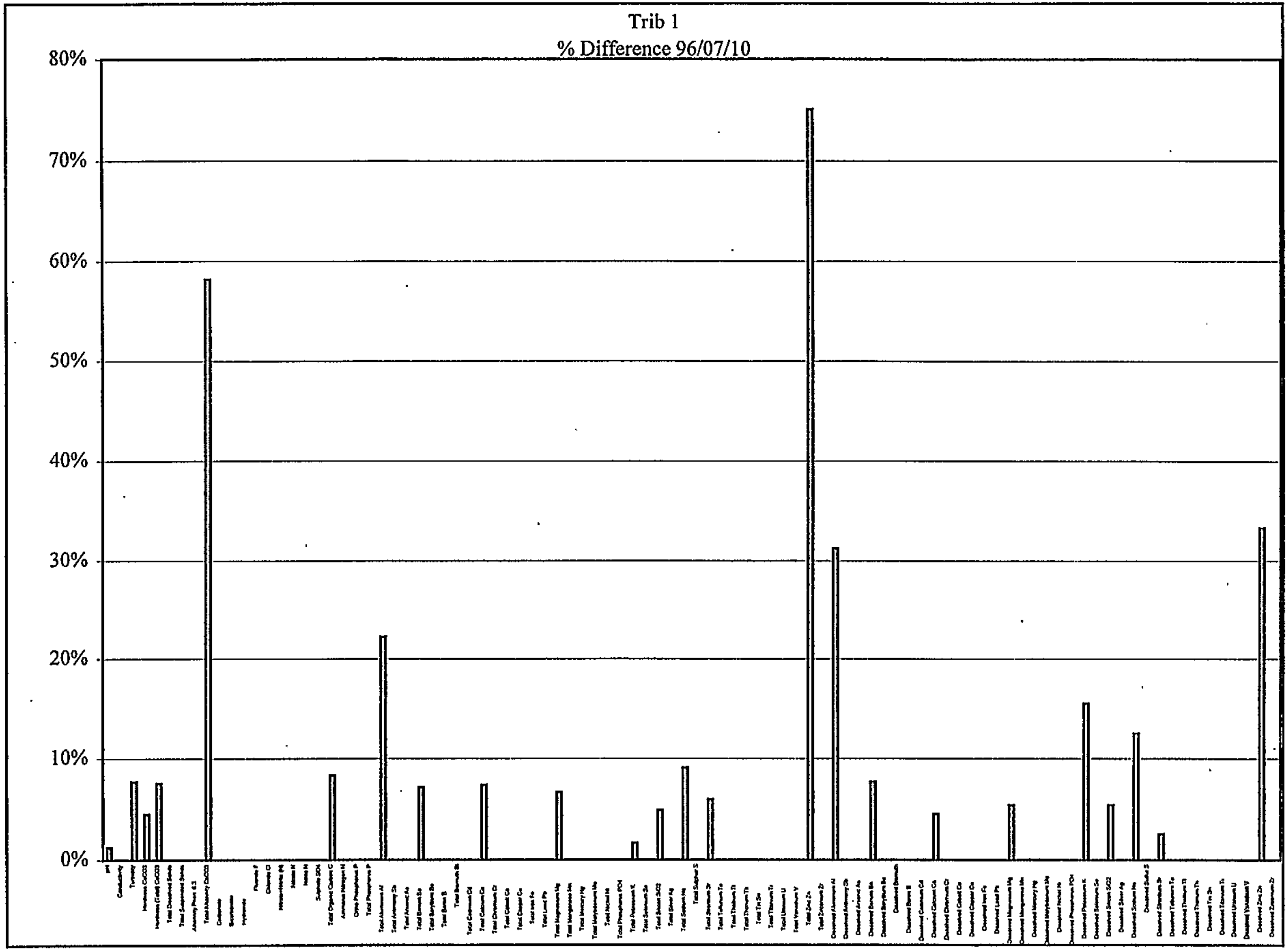
APPENDIX 4.4-2, TABLE C
MONTHLY TRIP AND FIELD BLANK RESULTS

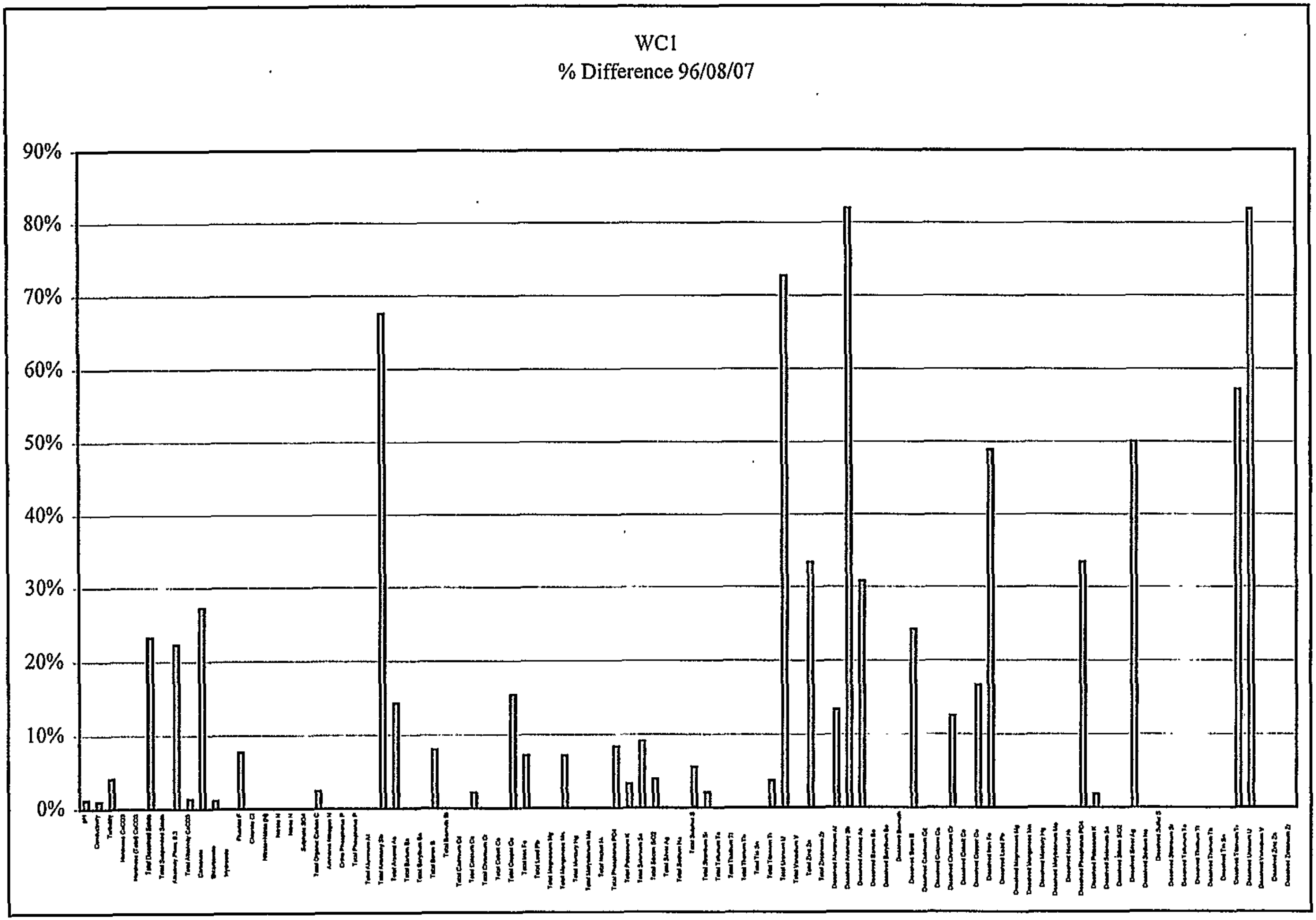
Parameter	Unit Name	PR1 Monthly	D1 Monthly (PR1)	PR1 % Difference	TRIB1 Monthly	DC1	Trib 1 % Difference	MC1 Monthly	DC1
Total Zinc Zn	mg/L	0.031	< 0.005						
Total Zirconium Zr	mg/L	< 0.001	< 0.001						
Dissolved Aluminum Al	mg/L	0.005	0.007	28.57%					
Dissolved Antimony Sb	mg/L	< 0.001	< 0.001						
Dissolved Arsenic As	mg/L	< 0.001	< 0.001						
Dissolved Barium Ba	mg/L	0.072	0.073	1.37%					
Dissolved Beryllium Be	mg/L	< 0.001	< 0.001						
Dissolved Bismuth	mg/L								
Dissolved Boron B	mg/L	0.03	0.023	23.33%					
Dissolved Cadmium Cd	mg/L	< 0.0002	< 0.0002						
Dissolved Calcium Ca	mg/L	53	52.6	0.75%					
Dissolved Chromium Cr	mg/L	< 0.001	< 0.001						
Dissolved Cobalt Co	mg/L	< 0.001	< 0.001						
Dissolved Copper Cu	mg/L	< 0.001	< 0.001						
Dissolved Iron Fe	mg/L	< 0.03	< 0.03						
Dissolved Lead Pb	mg/L	< 0.001	< 0.001						
Dissolved Magnesium Mg	mg/L	11.4	11.2	1.75%					
Dissolved Manganese Mn	mg/L	0.003	0.004	25.00%					
Dissolved Mercury Hg	ug/L	< 0.05	< 0.05						
Dissolved Molybdenum Mo	mg/L	< 0.001	< 0.001						
Dissolved Nickel Ni	mg/L	< 0.001	< 0 001						
Dissolved Phosphorus PO4	mg/L	< 0.4	< 0.4						
Dissolved Potassium K	mg/L	0.51	0.48	5.88%					
Dissolved Selenium Se	mg/L	< 0.001	< 0.001						
Dissolved Silicon SiO2	mg/L	3 8	3.7	2.63%					
Dissolved Silver Ag	mg/L	< 0.0001	< 0 0001						
Dissolved Sodium Na	mg/L	2.9	2.8	3.45%					
Dissolved Sulfur S	mg/L								
Dissolved Strontium Sr	mg/L	0.4	0.4	0.00%					
Dissolved Tellurium Te	mg/L	< 0.001	< 0.001						
Dissolved Thallium Tl	mg/L	< 0.0001	< 0.0001						
Dissolved Thorium Th	mg/L	< 0.0005	< 0.0005						
Dissolved Tin Sn	mg/L	< 0.001	< 0.001						
Dissolved Titanium Ti	mg/L	< 0.001	< 0.001						
Dissolved Uranium U	mg/L	< 0.0005	< 0.0005						
Dissolved Vanadium V	mg/L	< 0.001	< 0.001						
Dissolved Zinc Zn	mg/L	< 0.005	< 0.005						
Dissolved Zirconium Zr	mg/L	< 0.001	< 0.001						

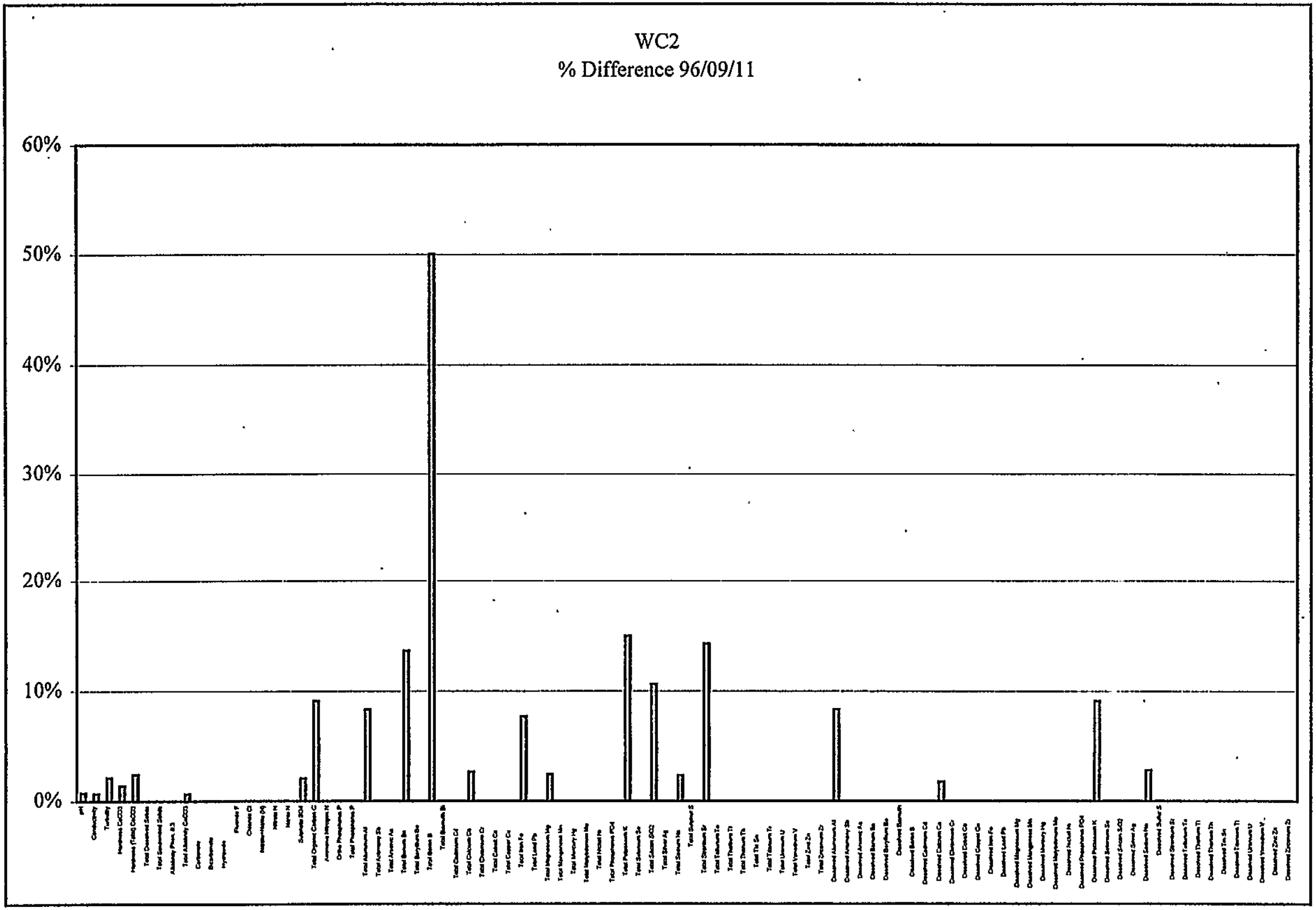

WC1
% Difference 96/05/14

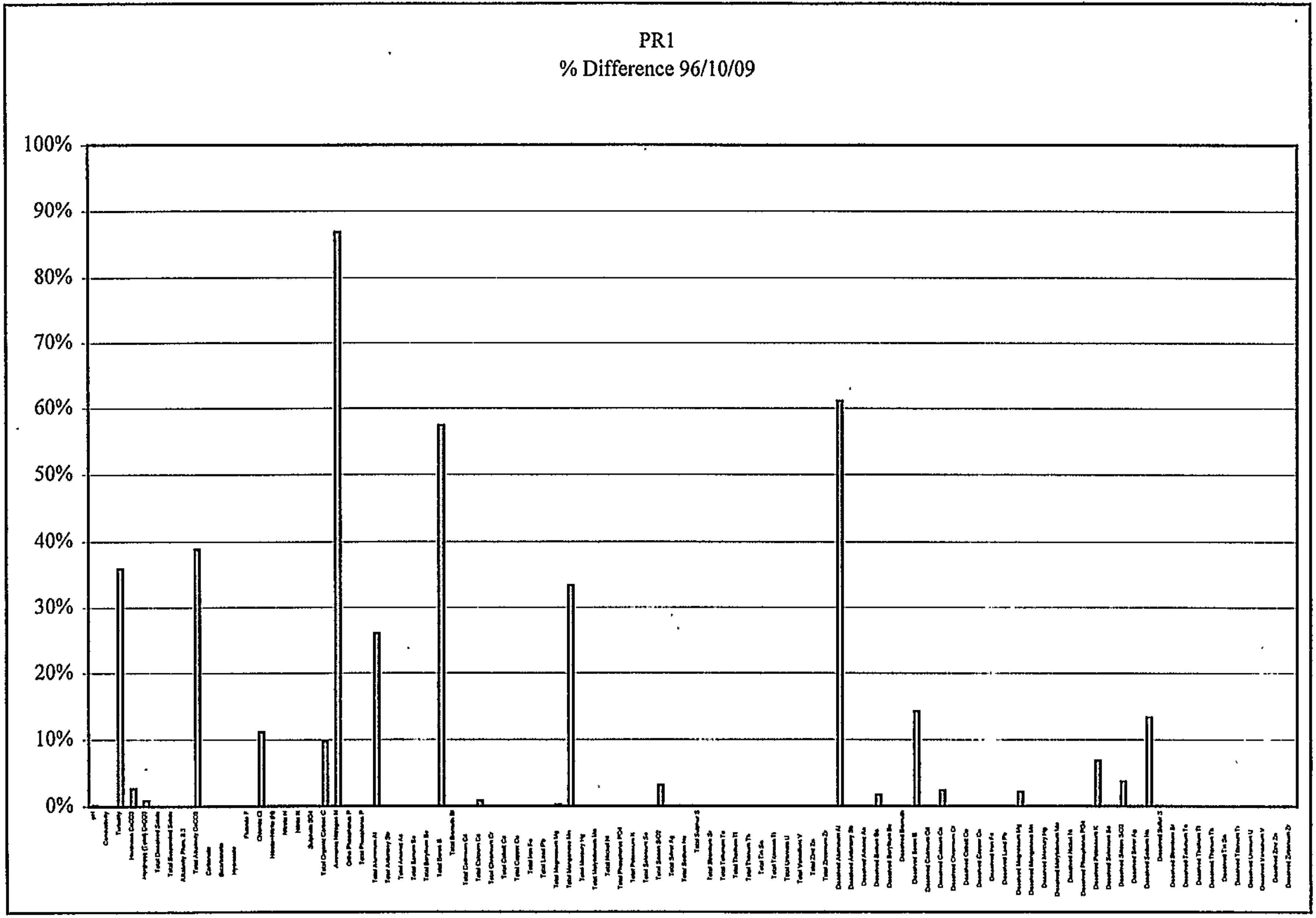


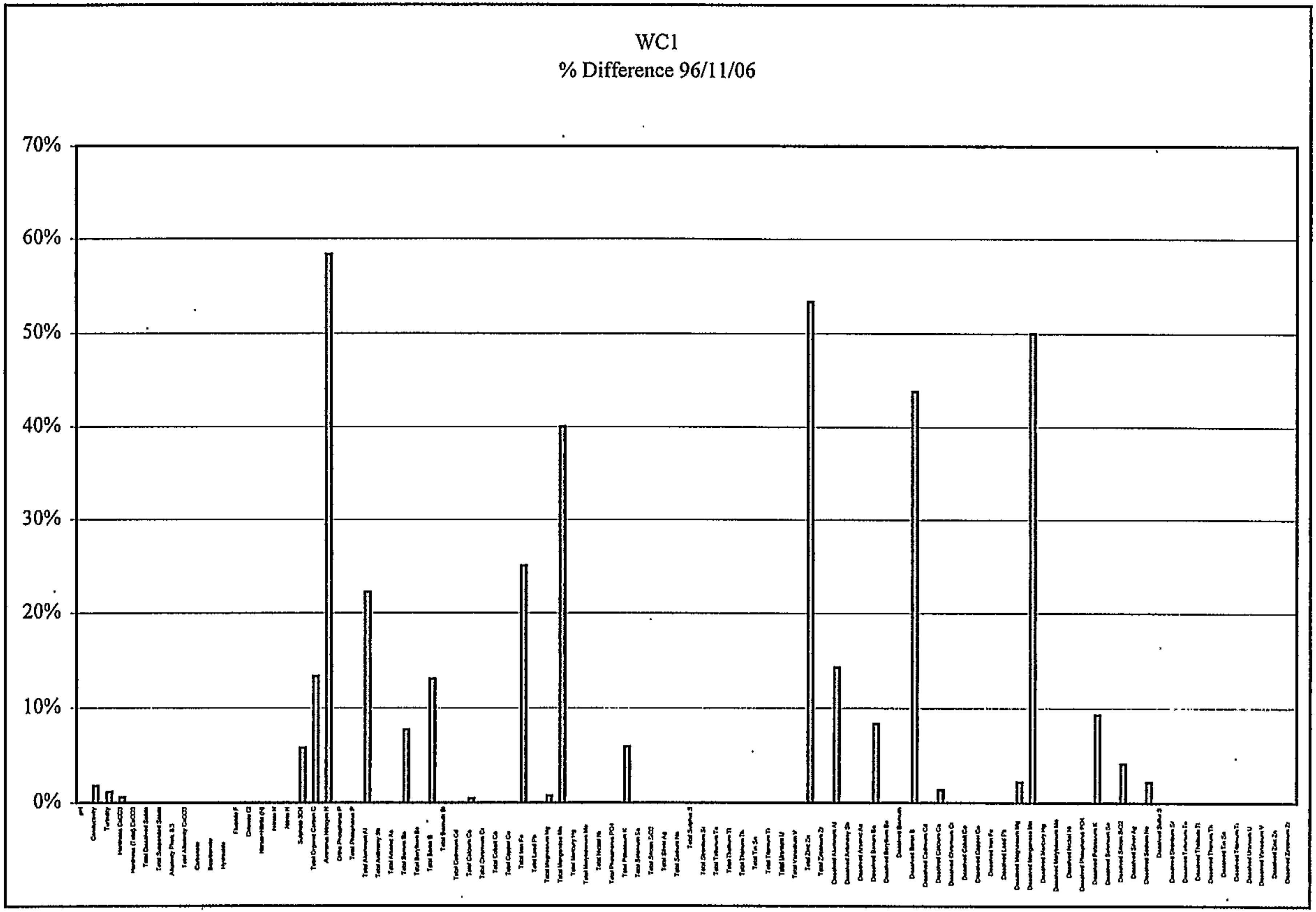
Trib 1
% Difference 96/06/12

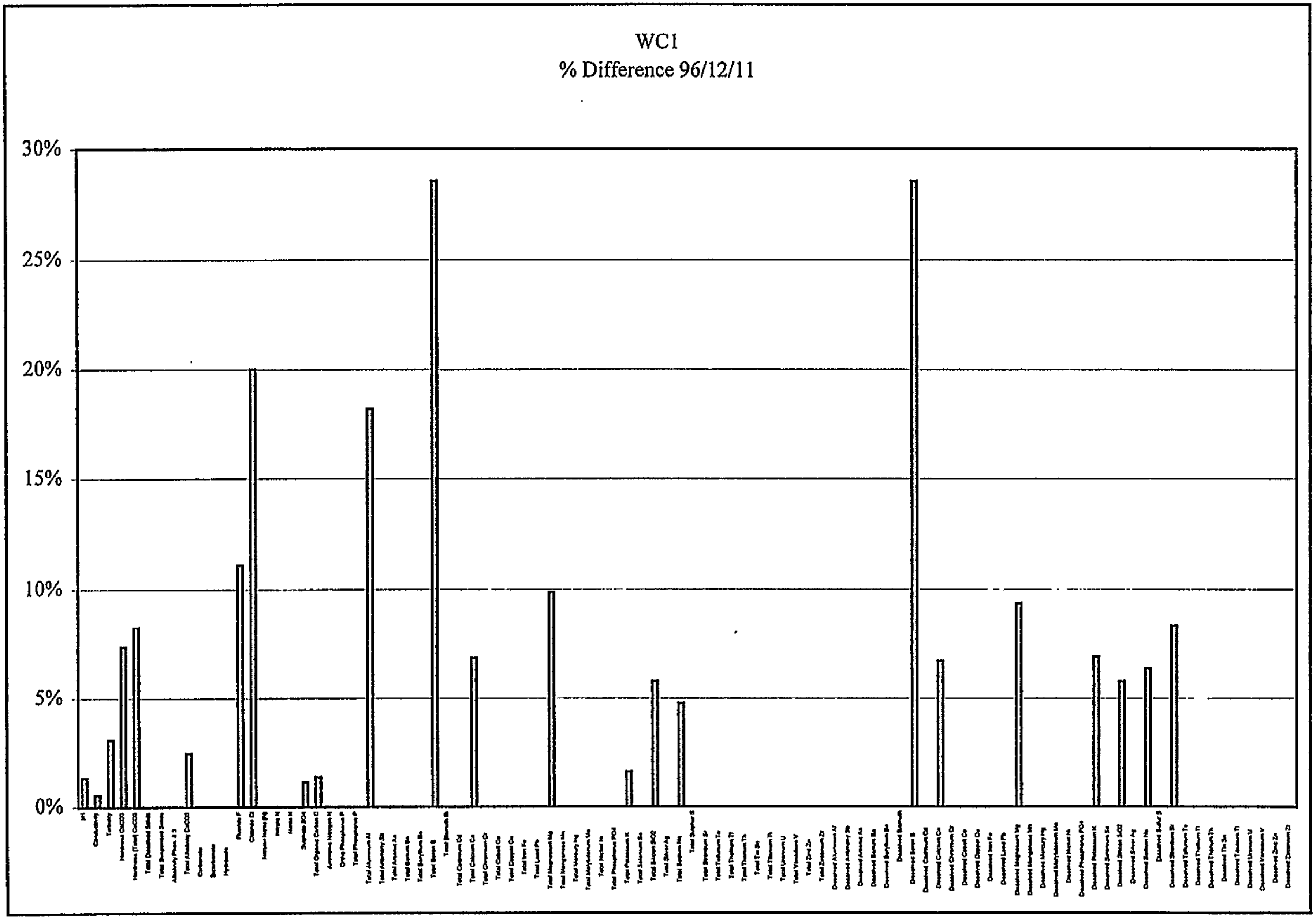

Trib 1
% Difference 96/07/10
80%
70%
60%
50%
40%
30%
20%
10%
0%
pH
Conductivity
Turbidity
Hardness CaCO3
Hardness (Total) CaCO3
Total Dissolved Solids
Total Suspended Solids
Alkalinity Phen. 8.3
Total Alkalinity CaCO3
Carbonate
Bicarbonate
Hydroxide
Fluoride F
Chloride Cl
Nitrate+Nitrite (N)
Nitrite N
Nitrate N
Sulphate SO4
Total Organic Carbon C
Ammonia Nitrogen N
Ortho Phosphorus P
Total Phosphorus P
Total Aluminum Al
Total Antimony Sb
Total Arsenic As
Total Barium Ba
Total Beryllium Be
Total Boron B
Total Bismuth Bi
Total Cadmium Cd
Total Calcium Ca
Total Chromium Cr
Total Cobalt Co
Total Copper Cu
Total Iron Fe
Total Lead Pb
Total Magnesium Mg
Total Manganese Mn
Total Mercury Hg
Total Molybdenum Mo
Total Nickel Ni
Total Phosphorus PO4
Total Potassium K
Total Selenium Se
Total Silicon SiO2
Total Silver Ag
Total Sodium Na
Total Sulphur S
Total Strontium Sr
Total Tellurium Te
Total Thallium Tl
Total Thorium Th
Total Tin Sn
Total Titanium Ti
Total Uranium U
Total Vanadium V
Total Zinc Zn
Total Zirconium Zr
Dissolved Aluminum Al
Dissolved Antimony Sb
Dissolved Arsenic As
Dissolved Barium Ba
Dissolved Beryllium Be
Dissolved Bismuth
Dissolved Boron B
Dissolved Cadmium Cd
Dissolved Calcium Ca
Dissolved Chromium Cr
Dissolved Cobalt Co
Dissolved Copper Cu
Dissolved Iron Fe
Dissolved Lead Pb
Dissolved Magnesium Mg
Dissolved Manganese Mn
Dissolved Mercury Hg
Dissolved Molybdenum Mo
Dissolved Nickel Ni
Dissolved Phosphorus PO4
Dissolved Potassium K
Dissolved Selenium Se
Dissolved Silicon SiO2
Dissolved Silver Ag
Dissolved Sodium Na
Dissolved Sulphur S
Dissolved Strontium Sr
Dissolved Tellurium Te
Dissolved Thallium Tl
Dissolved Thorium Th
Dissolved Tin Sn
Dissolved Titanium Ti
Dissolved Uranium U
Dissolved Vanadium V
Dissolved Zinc Zn
Dissolved Zirconium Zr


WC1
% Difference 96/08/07
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%

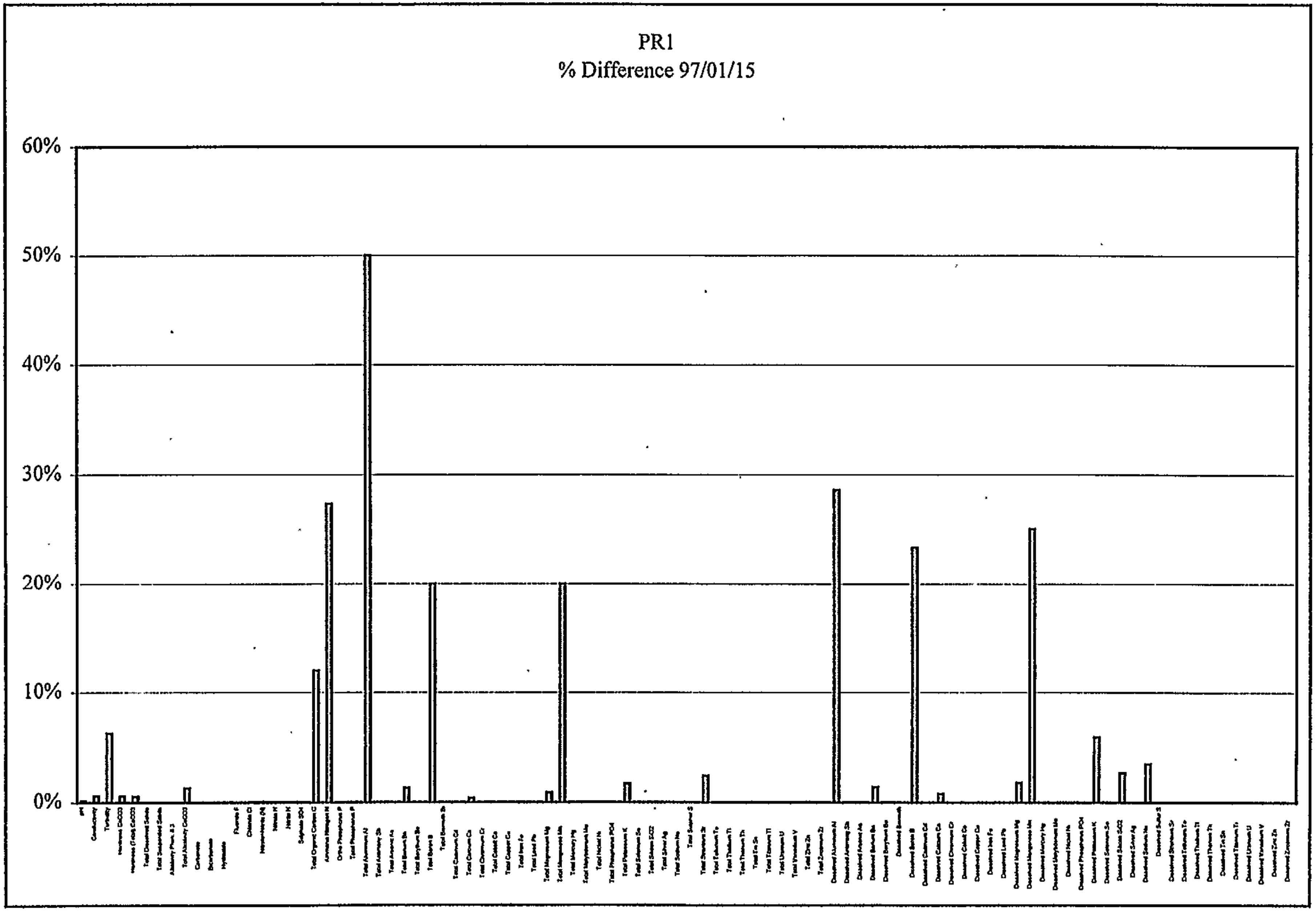

WC2
% Difference 96/09/11
60%
50%
40%
30%
20%
10%
0%
pH
Conductivity
Turbidity
Hardness CaCO3
Hardness (Total) CaCO3
Total Dissolved Solids
Total Suspended Solids
Alkalinity Phen. 8.3
Total Alkalinity CaCO3
Carbonate
Bicarbonate
Hydroxide
Fluoride F
Chloride Cl
Nitrate+Nitrite (N)
Nitrate N
Nitrite N
Sulphate SO4
Total Organic Carbon C
Ammonia Nitrogen N
Ortho Phosphorus P
Total Phosphorus P
Total Aluminum Al
Total Antimony Sb
Total Arsenic As
Total Barium Ba
Total Beryllium Be
Total Boron B
Total Bismuth Bi
Total Cadmium Cd
Total Calcium Ca
Total Chromium Cr
Total Cobalt Co
Total Copper Cu
Total Iron Fe
Total Lead Pb
Total Magnesium Mg
Total Manganese Mn
Total Mercury Hg
Total Molybdenum Mo
Total Nickel Ni
Total Phosphorus PO4
Total Potassium K
Total Selenium Se
Total Silicon SiO2
Total Silver Ag
Total Sodium Na
Total Sulphur S
Total Strontium Sr
Total Tellurium Te
Total Thallium Tl
Total Thorium Th
Total Tin Sn
Total Titanium Ti
Total Uranium U
Total Vanadium V
Total Zinc Zn
Total Zirconium Zr
Dissolved Aluminum Al
Dissolved Antimony Sb
Dissolved Arsenic As
Dissolved Barium Ba
Dissolved Beryllium Be
Dissolved Bismuth Bi
Dissolved Boron B
Dissolved Cadmium Cd
Dissolved Calcium Ca
Dissolved Chromium Cr
Dissolved Cobalt Co
Dissolved Copper Cu
Dissolved Iron Fe
Dissolved Lead Pb
Dissolved Magnesium Mg
Dissolved Manganese Mn
Dissolved Mercury Hg
Dissolved Molybdenum Mo
Dissolved Nickel Ni
Dissolved Phosphorus PO4
Dissolved Potassium K
Dissolved Selenium Se
Dissolved Silicon SiO2
Dissolved Silver Ag
Dissolved Sodium Na
Dissolved Sulphur S
Dissolved Strontium Sr
Dissolved Tellurium Te
Dissolved Thallium Tl
Dissolved Thorium Th
Dissolved Tin Sn
Dissolved Titanium Ti
Dissolved Uranium U
Dissolved Vanadium V
Dissolved Zinc Zn
Dissolved Zirconium Zr


PR1
% Difference 96/10/09
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%

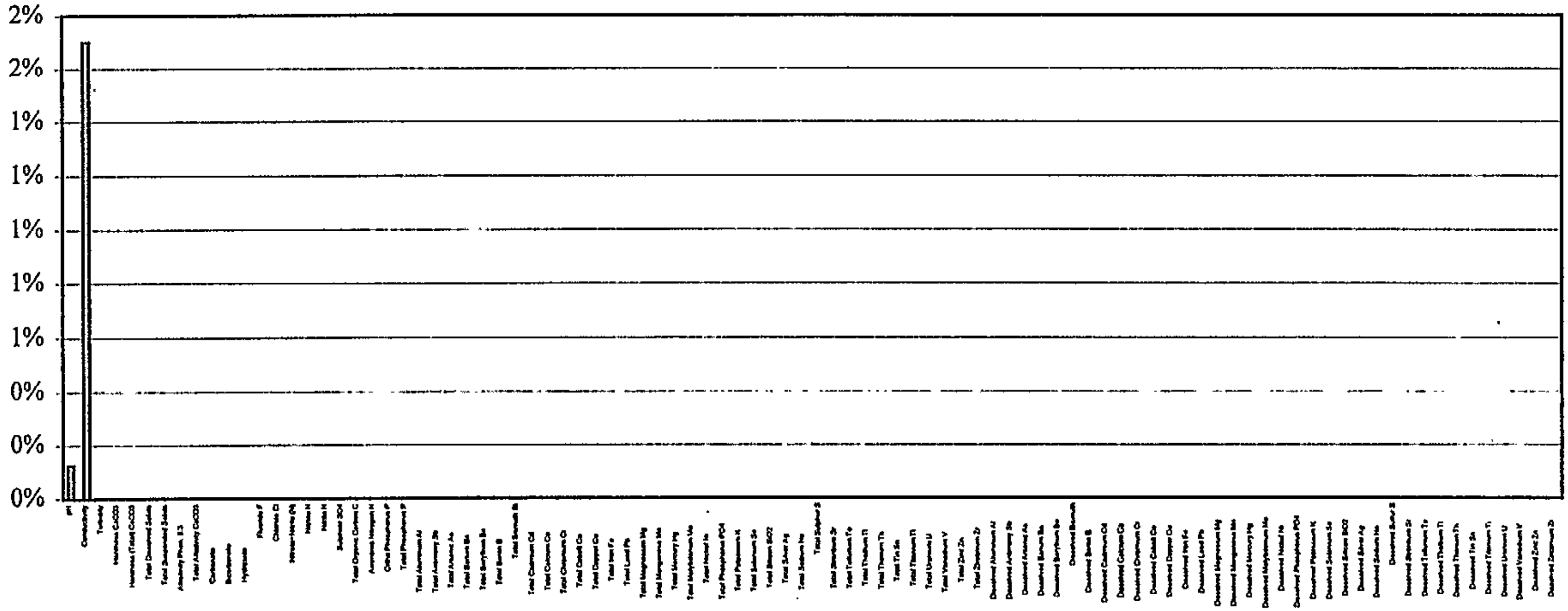

WC1
% Difference 96/11/06
70%
60%
50%
40%
30%
20%
10%
0%

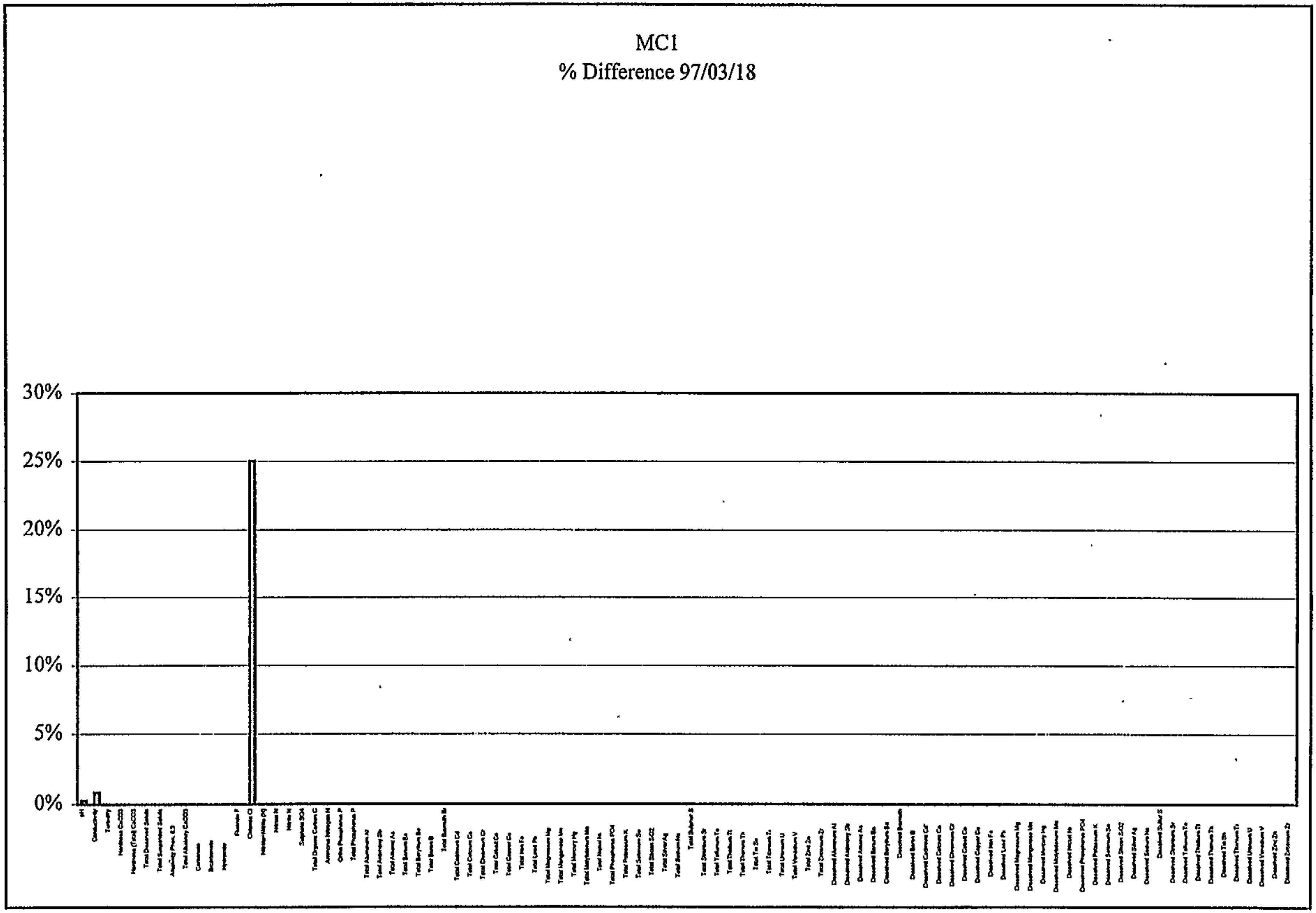


WC1
% Difference 96/12/11


PR1
% Difference 97/01/15
60%
50%
40%
30%
20%
10%
0%

Trib 1
% Difference 97/02/12





MC1
% Difference 97/03/18

APPENDIX 4.4-3

WILLOW CREEK COAL PROJECT
1996 STREAM SEDIMENT QUALITY

WILLOW CREEK COAL PROJECT - 1996 STREAM SEDIMENT QUALITY

ELEMENT	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
QA/QC																	
STANDARD C2/HG-500/CSA	20	58	37	145	6.7	71	35	1118	3.95	39	24	9	32	48	17.9	13	18
STANDARD C2/HG-500/CSA	20	59	39	144	7.2	71	35	1179	4.05	39	24	8	36	51	18.1	16	17
SAMPLES																	
FEC/S	1	25	24	134	0.4	40	9	122	2.56	13	< 5	< 2	4	56	< .2	< 2	< 2
RE FEC/S	1	27	26	145	0.4	43	10	131	2.71	14	< 5	< 2	5	61	0.2	< 2	< 2
RE FEC/S	1	26	25	134	0.3	39	9	123	2.58	12	< 5	< 2	4	56	< .2	< 2	< 2
RE FEC/S	1	27	26	137	0.4	40	9	122	2.61	15	< 5	< 2	4	58	< .2	< 2	< 2
RE FEC/S	1	26	25	136	0.3	40	9	123	2.61	13	< 5	< 2	4	55	0.2	< 2	< 2
MC1/S	1	9	6	67	< .3	17	4	190	1.04	< 2	< 5	< 2	2	54	0.9	< 2	< 2
RE MC1/S	1	10	7	72	< .3	19	4	204	1.13	3	< 5	< 2	3	57	1.1	< 2	2
RE MC1/S	1	9	7	68	< .3	17	4	191	1.05	2	< 5	< 2	2	53	0.9	< 2	< 2
RE MC1/S	1	9	7	67	< .3	17	4	189	1.05	2	< 5	< 2	2	53	0.9	< 2	< 2
RE MC1/S	1	9	6	68	< .3	17	4	187	1.05	2	< 5	< 2	2	52	0.9	< 2	< 2
PR1/S	2	16	12	114	< .3	25	7	294	2.13	6	7	< 2	4	48	0.9	< 2	< 2
RE PR1/S	2	17	12	123	< .3	27	8	311	2.26	7	< 5	< 2	5	51	0.8	< 2	< 2
RE PR1/S	2	17	11	120	< .3	27	8	302	2.21	8	< 5	< 2	4	48	0.8	< 2	< 2
RE PR1/S	2	20	10	119	< .3	27	7	300	2.21	7	< 5	< 2	4	48	0.8	< 2	< 2
RE PR1/S	2	17	10	118	< .3	26	8	293	2.18	7	< 5	< 2	5	48	0.8	< 2	< 2
PR2/S	1	14	8	99	< .3	23	6	272	1.86	6	< 5	< 2	4	49	0.6	< 2	< 2
RE PR2/S	1	14	9	98	< .3	23	6	264	1.83	5	5	< 2	4	47	0.6	< 2	< 2
RE PR2/S	1	13	9	97	< .3	23	6	260	1.82	7	5	< 2	4	47	0.6	< 2	< 2
RE PR2/S	1	13	8	98	< .3	22	6	256	1.82	7	< 5	< 2	4	47	0.5	< 2	< 2
RE PR2/S	1	13	9	95	< .3	22	6	251	1.80	6	< 5	< 2	3	46	0.5	< 2	< 2
TRIB1	1	9	6	69	< .3	20	4	213	1.34	3	< 5	< 2	2	32	0.7	< 2	< 2
RE TRIB1	1	10	7	82	< .3	23	5	244	1.57	2	< 5	< 2	2	38	0.9	< 2	< 2
RE TRIB1	1	9	6	72	< .3	20	4	208	1.37	3	< 5	< 2	2	33	0.9	< 2	< 2
RE TRIB1	1	10	6	79	< .3	23	4	227	1.49	2	< 5	< 2	2	36	0.8	< 2	< 2
RE TRIB1	1	10	7	81	< .3	23	5	228	1.53	4	< 5	< 2	2	36	0.9	< 2	< 2
TRIB2	1	7	5	64	< .3	16	3	184	1.05	3	< 5	< 2	3	39	0.4	< 2	< 2
RE TRIB2	1	7	6	67	< .3	17	4	192	1.09	5	< 5	< 2	3	41	0.3	2	< 2
RE TRIB2	1	8	4	65	< .3	17	4	183	1.05	3	< 5	< 2	3	39	0.3	< 2	< 2
RE TRIB2	1	8	7	66	< .3	16	4	182	1.06	4	< 5	< 2	3	39	0.4	< 2	< 2
RE TRIB2	1	8	6	66	< .3	17	4	181	1.08	4	< 5	< 2	2	39	0.3	< 2	< 2
TRIB3	1	8	7	77	< .3	19	4	199	1.51	3	< 5	< 2	2	40	0.5	< 2	< 2
RE TRIB3	1	8	7	78	< .3	18	4	200	1.54	4	< 5	< 2	3	40	0.5	< 2	< 2
RE TRIB3	< 1	8	8	81	< .3	19	5	202	1.58	5	< 5	< 2	3	41	0.5	< 2	< 2
RE TRIB3	1	8	5	75	< .3	17	4	188	1.48	2	< 5	< 2	2	38	0.4	< 2	< 2
RE TRIB3	1	8	8	82	< .3	19	5	200	1.60	4	< 5	< 2	3	40	0.4	< 2	< 2
WC1	1	8	6	65	< .3	16	4	158	1.12	6	< 5	< 2	3	42	0.4	< 2	< 2
RE WC1	1	8	6	66	< .3	17	4	159	1.15	5	< 5	< 2	3	43	0.3	< 2	< 2
RE WC1	1	9	6	63	< .3	17	4	159	1.16	5	< 5	< 2	3	42	0.3	< 2	< 2
RE WC1	1	8	6	63	0.3	16	4	153	1.13	6	< 5	< 2	3	40	0.4	< 2	< 2
RE WC1	1	8	5	62	< .3	17	4	150	1.13	5	< 5	< 2	3	40	0.4	< 2	< 2
WC2	1	9	10	71	< .3	22	9	387	1.50	4	< 5	< 2	3	31	0.4	< 2	< 2
RE WC2	< 1	8	8	70	< .3	21	8	370	1.46	4	< 5	< 2	2	29	0.3	< 2	< 2
RE WC2	< 1	9	9	77	< .3	23	9	406	1.62	5	< 5	< 2	2	33	0.5	< 2	< 2
RE WC2	1	9	10	73	< .3	22	9	389	1.55	5	< 5	< 2	3	30	0.3	< 2	< 2
RE WC2	< 1	9	9	75	< .3	22	9	385	1.57	5	< 5	< 2	2	31	0.4	< 2	< 2

APPENDIX 4.4-3
WILLOW CREEK COAL PROJECT - 1996 STREAM SEDIMENT QUALITY

ELEMENT	V	Ca	P	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Se	Hg	ORG/C
	ppm	%	%	ppm	ppm	%	ppm	%	ppm	%	%	%	ppm	ppm	ppb	%
QA/QC																
STANDARD C2/HG-500/CSA	68	0.52	0.107	38	63	0.97	183	0.08	27	1.87	0.06	0.12	10	< 5	435	0.98
STANDARD C2/HG-500/CSA	72	0.53	0.110	39	64	0.99	201	0.08	27	2.02	0.06	0.13	11	5	475	0.97
SAMPLES																
FEC/S	23	2.52	0.089	5	9	0.67	281	< .01	6	0.33	0.01	0.07	< 2	< 5	155	0.88
RE FEC/S	26	2.72	0.096	6	11	0.73	284	< .01	6	0.38	0.01	0.09	< 2	< 5	165	0.92
RE FEC/S	23	2.56	0.090	5	9	0.68	268	< .01	6	0.33	0.01	0.07	< 2	< 5	175	0.85
RE FEC/S	24	2.57	0.090	5	10	0.68	265	< .01	5	0.38	0.01	0.08	< 2	< 5	170	0.9
RE FEC/S	23	2.56	0.090	5	9	0.68	242	< .01	5	0.32	0.01	0.07	< 2	< 5	180	0.93
MC1/S	15	4.91	0.093	8	11	0.50	166	< .01	4	0.36	< .01	0.03	< 2	< 5	170	1.74
RE MC1/S	17	5.35	0.099	9	13	0.55	175	< .01	4	0.4	0.01	0.04	< 2	< 5	170	1.71
RE MC1/S	15	5.04	0.092	7	11	0.51	163	< .01	3	0.36	< .01	0.02	< 2	< 5	160	1.79
RE MC1/S	16	5.00	0.092	7	12	0.50	166	< .01	4	0.36	< .01	0.03	< 2	< 5	185	1.85
RE MC1/S	15	5.02	0.092	7	11	0.51	163	< .01	3	0.35	< .01	0.03	< 2	< 5	175	1.8
PR1/S	31	2.29	0.121	10	13	0.99	160	< .01	4	0.67	< .01	0.04	< 2	< 5	120	0.76
RE PR1/S	34	2.38	0.124	11	16	1.03	166	< .01	4	0.73	< .01	0.05	< 2	< 5	115	0.74
RE PR1/S	31	2.23	0.118	10	14	0.97	156	< .01	3	0.7	< .01	0.04	< 2	< 5	110	0.8
RE PR1/S	32	2.22	0.117	11	15	0.97	162	< .01	3	0.71	< .01	0.05	< 2	< 5	115	0.82
RE PR1/S	30	2.22	0.118	10	14	0.97	155	< .01	3	0.67	< .01	0.04	< 2	< 5	120	0.79
PR2/S	28	2.25	0.118	10	11	0.93	168	< .01	4	0.58	< .01	0.04	< 2	< 5	70	0.75
RE PR2/S	28	2.19	0.115	10	11	0.91	167	< .01	4	0.57	< .01	0.05	< 2	< 5	75	0.74
RE PR2/S	27	2.19	0.115	9	12	0.91	157	< .01	3	0.55	< .01	0.04	< 2	< 5	65	0.71
RE PR2/S	27	2.14	0.113	9	11	0.88	158	< .01	3	0.56	< .01	0.04	< 2	< 5	75	0.72
RE PR2/S	26	2.14	0.112	9	12	0.88	160	< .01	3	0.54	0.01	0.04	< 2	< 5	65	0.76
TRIB1	21	1.03	0.086	6	14	0.22	226	< .01	4	0.4	< .01	0.04	< 2	< 5	100	2.24
RE TRIB1	25	1.21	0.099	7	18	0.26	270	< .01	5	0.49	< .01	0.05	< 2	< 5	90	2.23
RE TRIB1	22	1.06	0.086	6	16	0.22	228	< .01	4	0.41	0.01	0.04	< 2	< 5	75	2.37
RE TRIB1	24	1.16	0.093	7	17	0.25	252	< .01	4	0.47	< .01	0.04	< 2	< 5	95	2.16
RE TRIB1	24	1.20	0.095	7	17	0.26	256	< .01	4	0.47	< .01	0.05	< 2	< 5	90	2.24
TRIB2	17	1.85	0.107	6	10	0.57	235	< .01	4	0.3	0.01	0.04	< 2	< 5	75	0.95
RE TRIB2	18	1.92	0.108	6	11	0.58	252	< .01	5	0.33	0.01	0.05	< 2	< 5	80	1.04
RE TRIB2	17	1.85	0.104	6	12	0.56	230	< .01	3	0.31	0.01	0.04	< 2	< 5	70	1.02
RE TRIB2	18	1.88	0.104	7	11	0.57	239	< .01	3	0.31	0.01	0.05	< 2	< 5	80	0.99
RE TRIB2	18	1.91	0.102	6	12	0.58	238	< .01	3	0.32	0.01	0.05	< 2	< 5	65	1
TRIB3	24	0.83	0.098	7	14	0.23	263	< .01	5	0.49	0.01	0.06	< 2	< 5	110	2
RE TRIB3	26	0.85	0.099	7	15	0.24	265	< .01	5	0.51	0.01	0.06	< 2	< 5	110	2.02
RE TRIB3	26	0.88	0.101	8	15	0.25	273	< .01	5	0.53	0.01	0.07	< 2	< 5	115	2.01
RE TRIB3	24	0.82	0.093	6	13	0.23	253	< .01	4	0.47	0.01	0.05	< 2	< 5	105	1.98
RE TRIB3	26	0.89	0.098	7	15	0.25	265	< .01	5	0.52	0.01	0.06	< 2	< 5	105	1.92
WC1	17	2.10	0.107	6	11	0.70	272	< .01	4	0.34	0.01	0.05	< 2	< 5	185	0.6
RE WC1	18	2.15	0.108	6	12	0.72	277	< .01	4	0.36	0.01	0.06	< 2	5	170	0.6
RE WC1	18	2.17	0.107	6	12	0.72	268	< .01	4	0.36	0.01	0.06	< 2	< 5	170	0.54
RE WC1	17	2.12	0.106	6	11	0.71	253	< .01	3	0.33	0.01	0.05	< 2	< 5	180	0.53
RE WC1	18	2.15	0.105	6	11	0.72	262	< .01	4	0.35	0.01	0.05	< 2	< 5	175	0.55
WC2	23	0.90	0.093	7	14	0.37	278	< .01	4	0.52	0.01	0.06	< 2	< 5	125	1.07
RE WC2	21	0.88	0.089	6	13	0.35	268	< .01	4	0.49	< .01	0.05	< 2	< 5	100	1.09
RE WC2	25	1.00	0.101	7	15	0.40	291	< .01	4	0.57	0.01	0.07	< 2	< 5	125	1.03
RE WC2	23	0.95	0.094	7	14	0.38	276	< .01	4	0.53	0.01	0.06	< 2	< 5	115	1.09
RE WC2	24	0.96	0.096	7	14	0.39	280	< .01	4	0.55	0.01	0.06	< 2	< 5	120	1.11

APPENDIX 4.5-1

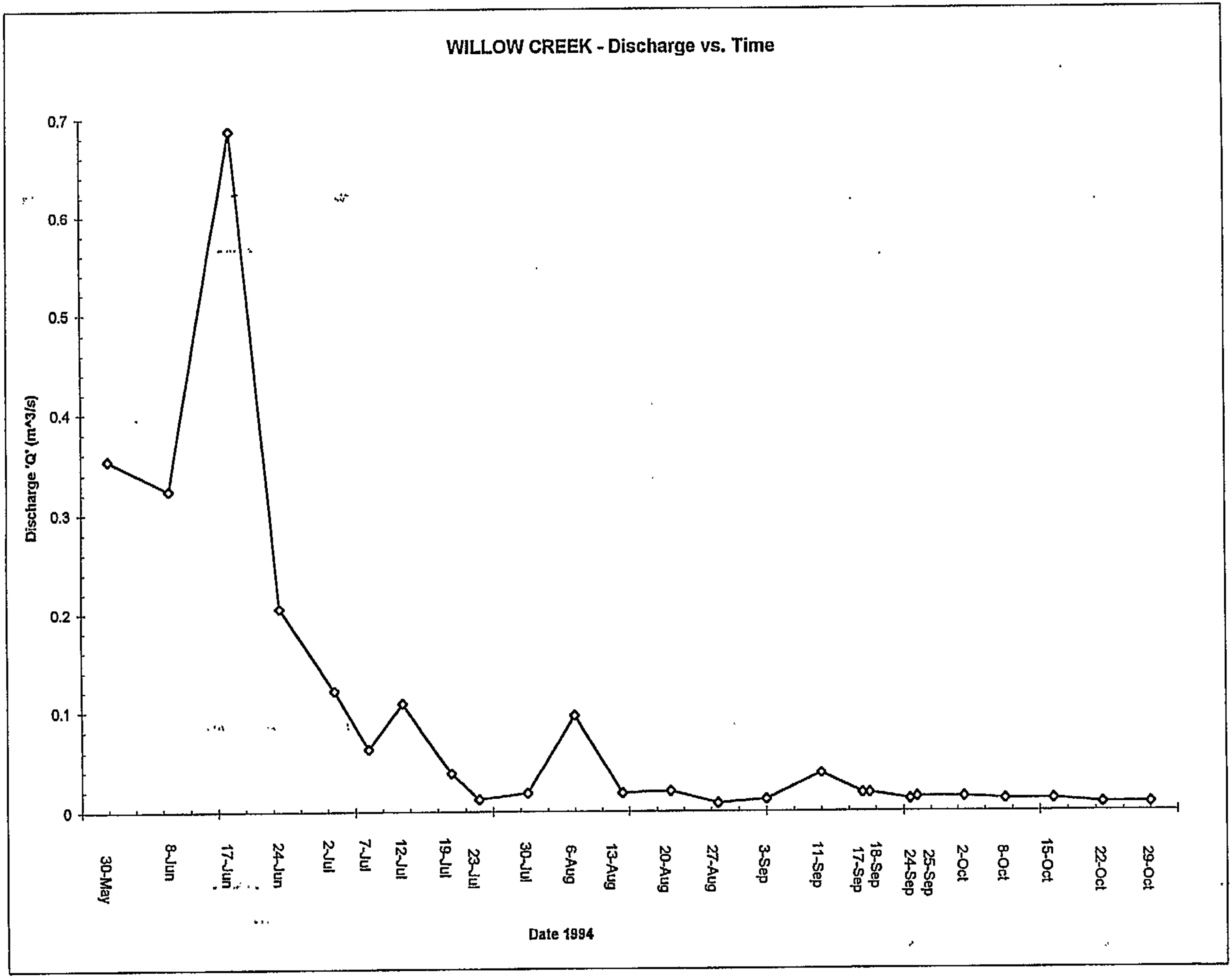
WILLOW CREEK COAL PROJECT
1994 HYDROLOGY DATA

Source: Sumit Environmental Consultants Ltd.

WILLOW CREEK:

Record of Water Level and Discharge for 1994:
(Combining Discharge and water level for both Upper & Lower Stations)

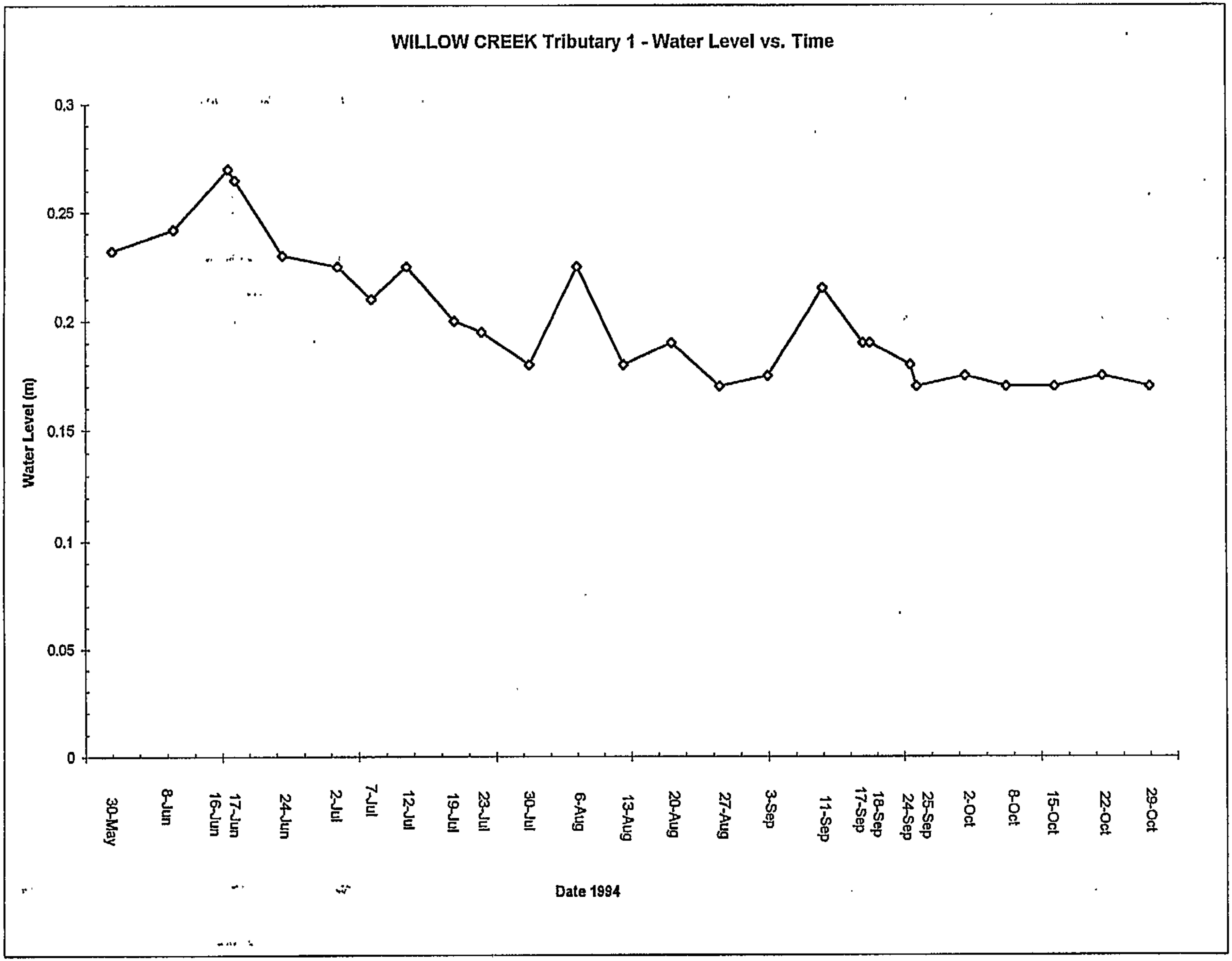
Date	Water Level (m)	Discharge'Q' (m^3/s)
30-May	0.244	0.354
8-Jun	0.239	0.324
17-Jun	0.285	0.687
24-Jun	0.215	0.205
2-Jul	0.190	0.121
7-Jul	0.163	0.063
12-Jul	0.185	0.108
19-Jul	0.145	0.038
23-Jul	0.110	0.012
30-Jul	1.545 (bridge)	0.018
6-Aug	0.180	0.096
13-Aug	1.545 (bridge)	0.018
20-Aug	1.540 (bridge)	0.020
27-Aug	1.570 (bridge)	0.008
3-Sep	1.560 (bridge)	0.012
11-Sep	0.145	0.038
17-Sep	1.545 (bridge)	0.018
18-Sep	1.545 (bridge)	0.018
24-Sep	1.560 (bridge)	0.012
25-Sep	1.555 (bridge)	0.014
2-Oct	1.555 (bridge)	0.014
8-Oct	1.560 (bridge)	0.012
15-Oct	1.560 (bridge)	0.012
22-Oct	1.570 (bridge)	0.008
29-Oct	1.570 (bridge)	0.008
5-Nov	ice and snow	ice and snow

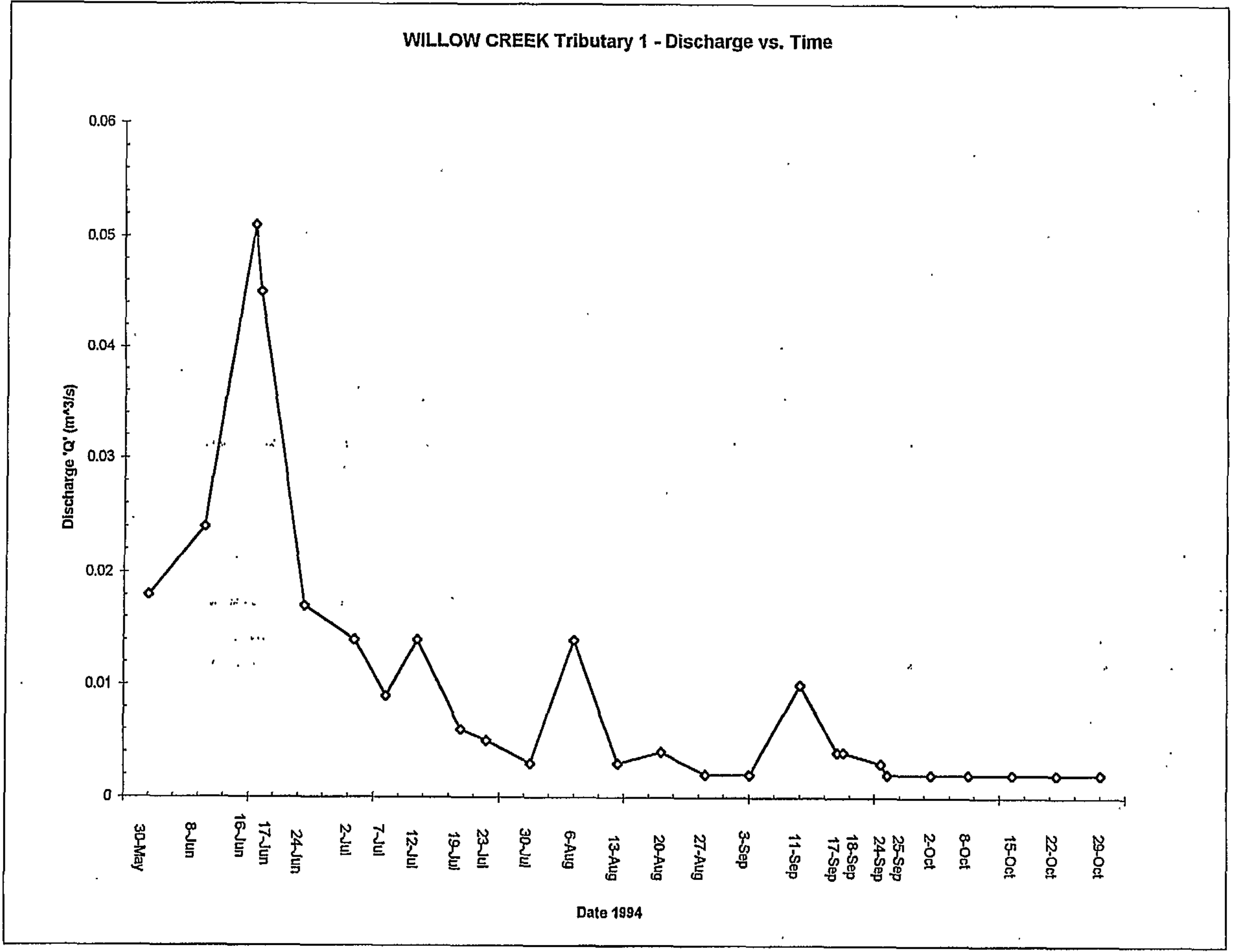

WILLOW CREEK - Discharge vs. Time
Discharge 'Q' (m^3/s)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
30-May
8-Jun
17-Jun
24-Jun
2-Jul
7-Jul
12-Jul
19-Jul
23-Jul
30-Jul
6-Aug
13-Aug
20-Aug
27-Aug
3-Sep
11-Sep
17-Sep
18-Sep
24-Sep
25-Sep
2-Oct
8-Oct
15-Oct
22-Oct
29-Oct
Date 1994

WILLOW CREEK Tributary 1:

Record of Water Level and Discharge for 1994:

Date	Water Level (m)	Discharge'Q' (m^3/s)
30-May	0.232	0.018
8-Jun	0.242	0.024
16-Jun	0.270	0.051
17-Jun	0.265	0.045
24-Jun	0.230	0.017
2-Jul	0.225	0.014
7-Jul	0.210	0.009
12-Jul	0.225	0.014
19-Jul	0.200	0.006
23-Jul	0.195	0.005
30-Jul	0.180	0.003
6-Aug	0.225	0.014
13-Aug	0.180	0.003
20-Aug	0.190	0.004
27-Aug	0.170	0.002
3-Sep	0.175	0.002
11-Sep	0.215	0.010
17-Sep	0.190	0.004
18-Sep	0.190	0.004
24-Sep	0.180	0.003
25-Sep	0.170	0.002
2-Oct	0.175	0.002
8-Oct	0.170	0.002
15-Oct	0.170	0.002
22-Oct	0.175	0.002
29-Oct	0.170	0.002
5-Nov	snow and ice	snow and ice


WILLOW CREEK Tributary 1 - Water Level vs. Time
Water Level (m)
0.3
0.25
0.2
0.15
0.1
0.05
0
30-May
8-Jun
16-Jun
17-Jun
24-Jun
2-Jul
7-Jul
12-Jul
19-Jul
23-Jul
30-Jul
6-Aug
13-Aug
20-Aug
27-Aug
3-Sep
11-Sep
17-Sep
18-Sep
24-Sep
25-Sep
2-Oct
8-Oct
15-Oct
22-Oct
29-Oct
Date 1994

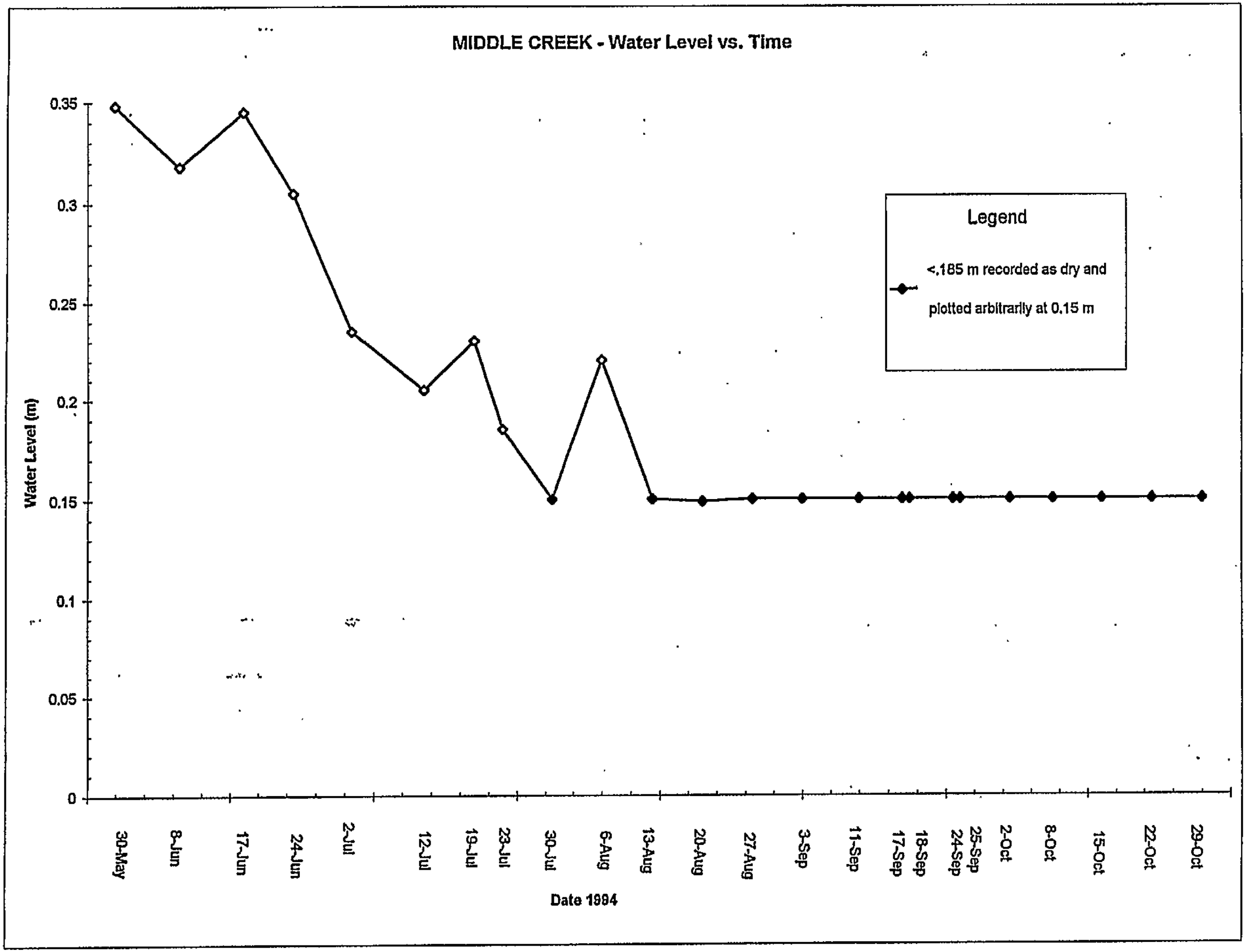

WILLOW CREEK Tributary 1 - Discharge vs. Time
Discharge 'Q' (m^3/s)
0.06
0.05
0.04
0.03
0.02
0.01
0
30-May
8-Jun
16-Jun
17-Jun
24-Jun
2-Jul
7-Jul
12-Jul
19-Jul
23-Jul
30-Jul
6-Aug
13-Aug
20-Aug
27-Aug
3-Sep
11-Sep
17-Sep
18-Sep
24-Sep
25-Sep
2-Oct
8-Oct
15-Oct
22-Oct
29-Oct
Date 1994

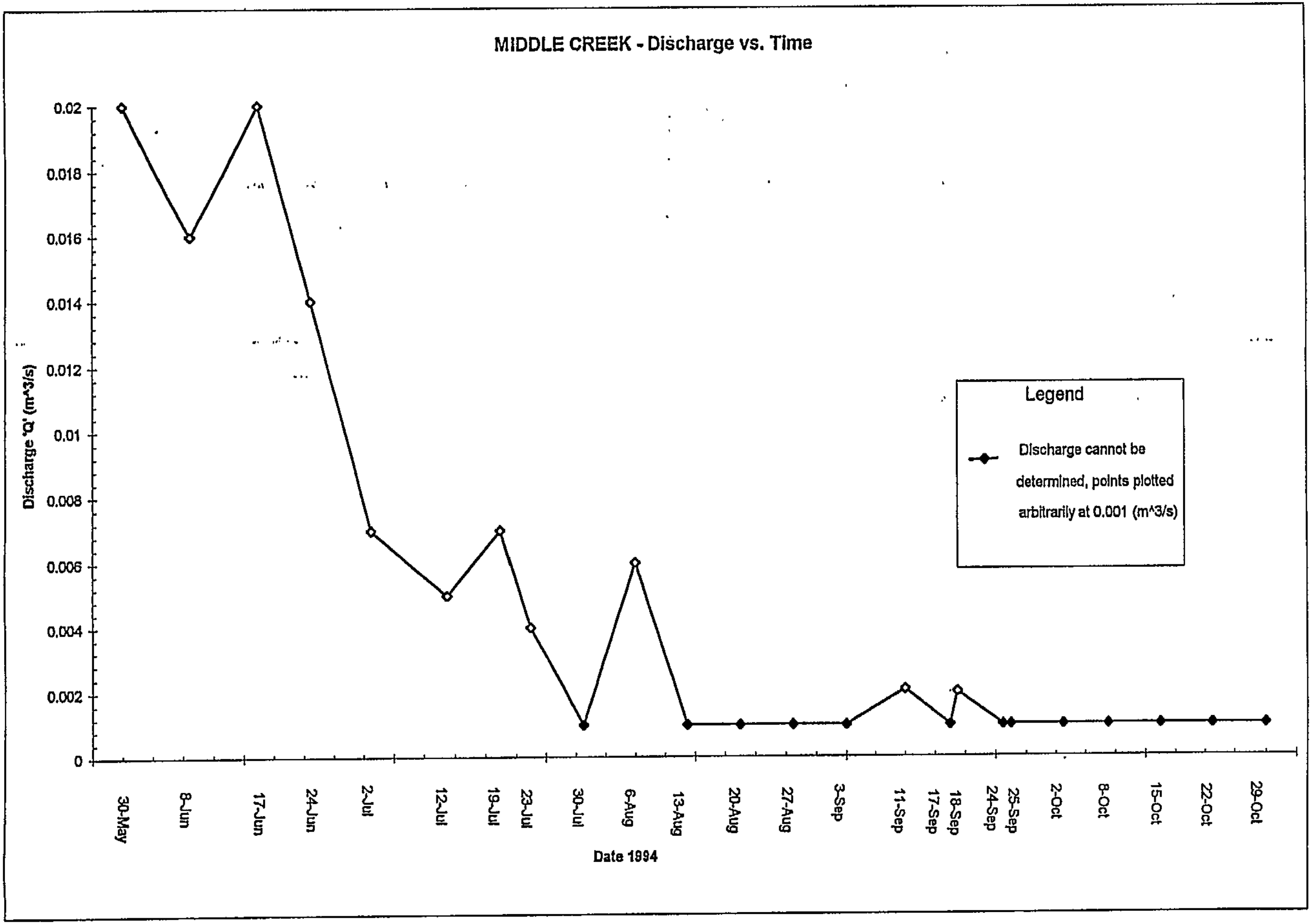
MIDDLE CREEK:

Record of Water Level and Discharge for 1994:

Date Recorded	Water Level (m)	Total Discharge'Q' (m^3/s)	Comments
30-May	0.348	0.020	
8-Jun	0.318	0.016	
17-Jun	0.345	0.020	
24-Jun	0.305	0.014	
2-Jul	0.235	0.007	
12-Jul	0.205	0.005	
19-Jul	0.230	0.007	
23-Jul	0.185	0.004	
30-Jul	dry	?	Water Level < .185
6-Aug	0.220	0.006	
13-Aug	dry	?	Water Level < .185
20-Aug	dry	?	Water Level < .185
27-Aug	dry	?	Water Level < .185
3-Sep	dry	?	Water Level < .185
11-Sep	dry	0.002	Water Level < .185
17-Sep	dry	?	Water Level < .185
18-Sep	dry	0.002	Water Level < .185
24-Sep	dry	?	Water Level < .185
25-Sep	dry	0.001	Water Level < .185
2-Oct	dry	?	Water Level < .185
8-Oct	dry	?	Water Level < .185
15-Oct	dry	?	Water Level < .185
22-Oct	dry	?	Water Level < .185
29-Oct	dry	?	Water Level < .185
5-Nov	ice and snow	?	Water Level < .185

N.B. : Discharge indicated by "?" cannot be determined since water level < .185 (below range of rating curve)

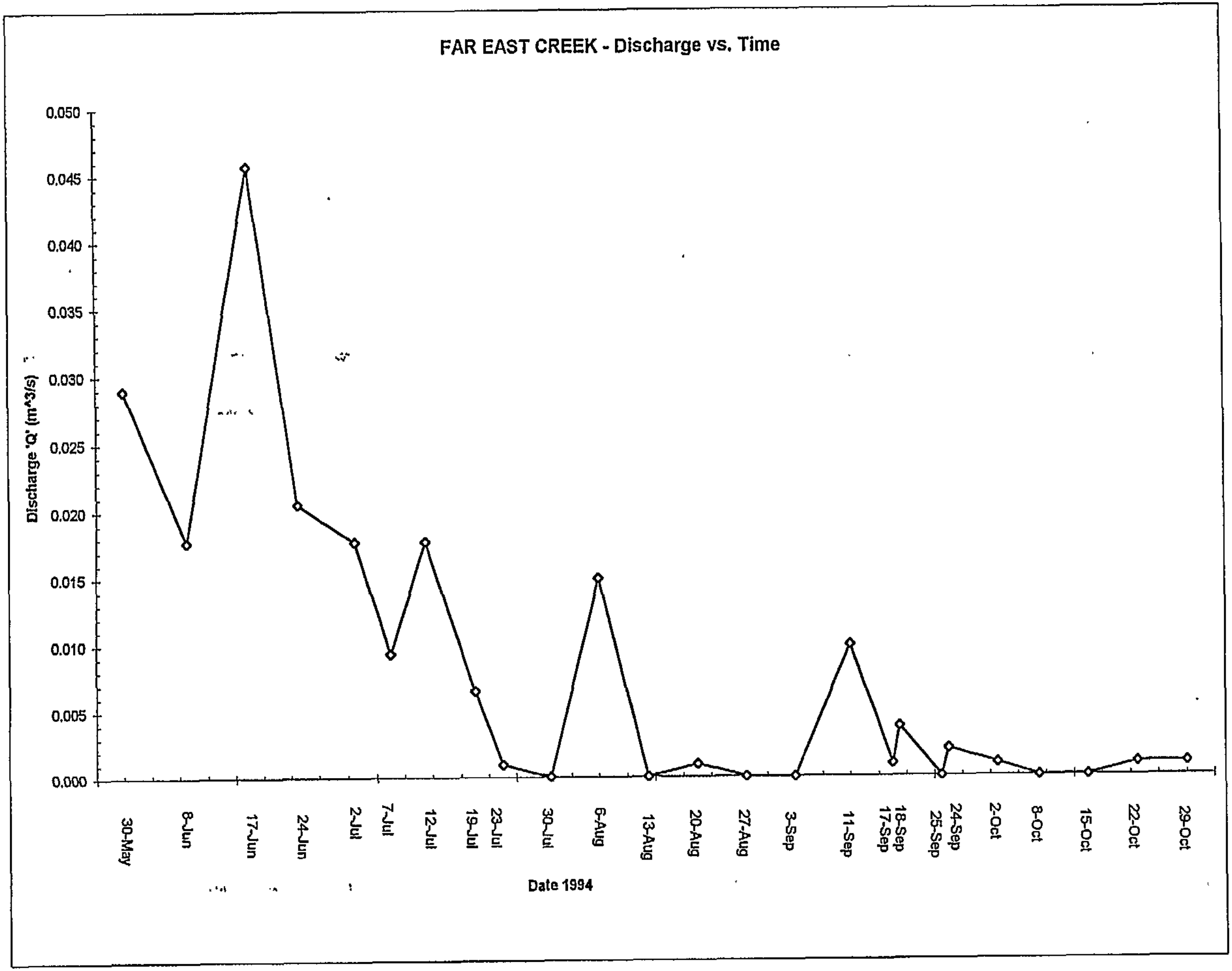

MIDDLE CREEK - Water Level vs. Time
Legend
<.185 m recorded as dry and plotted arbitrarily at 0.15 m
Water Level (m)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
30-May
8-Jun
17-Jun
24-Jun
2-Jul
12-Jul
19-Jul
23-Jul
30-Jul
6-Aug
13-Aug
20-Aug
27-Aug
3-Sep
11-Sep
17-Sep
18-Sep
24-Sep
25-Sep
2-Oct
8-Oct
15-Oct
22-Oct
29-Oct
Date 1994


MIDDLE CREEK - Discharge vs. Time
Discharge 'Q' (m^3/s)
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
30-May
8-Jun
17-Jun
24-Jun
2-Jul
12-Jul
19-Jul
23-Jul
30-Jul
6-Aug
13-Aug
20-Aug
27-Aug
3-Sep
11-Sep
17-Sep
18-Sep
24-Sep
25-Sep
2-Oct
8-Oct
15-Oct
22-Oct
29-Oct
Date 1994
Legend
◆ Discharge cannot be determined, points plotted arbitrarily at 0.001 (m^3/s)

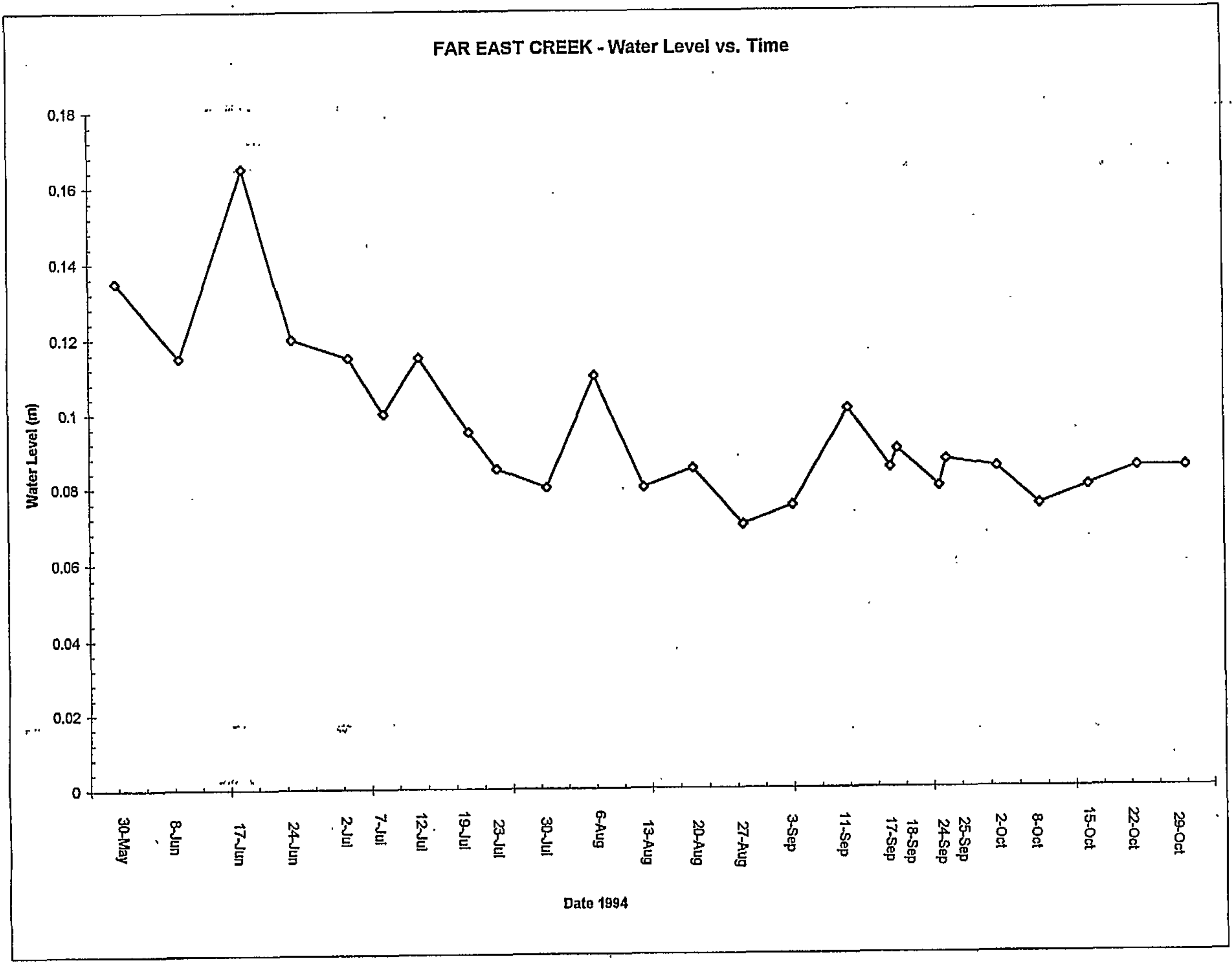
FAR EAST CREEK:

Record of Water Level and Discharge for 1994:

Date	Water Level (m)	Total Discharge'Q' (m /sec)
30-May	0.135	0.029
8-Jun	0.115	0.018
17-Jun	0.165	0.046
24-Jun	0.120	0.021
2-Jul	0.115	0.018
7-Jul	0.100	0.009
12-Jul	0.115	0.018
19-Jul	0.095	0.007
23-Jul	0.085	0.001
30-Jul	0.080	0.000
6-Aug	0.110	0.015
13-Aug	0.080	0.000
20-Aug	0.085	0.001
27-Aug	0.070	0.000
3-Sep	0.075	0.000
11-Sep	0.101	0.010
17-Sep	0.085	0.001
18-Sep	0.090	0.004
18-Sep	0.090	0.004
24-Sep	0.080	0.000
25-Sep	0.087	0.002
2-Oct	0.085	0.001
8-Oct	0.075	0.000
15-Oct	0.080	0.000
22-Oct	0.085	0.001
29-Oct	0.085	0.001
5-Nov	snow and ice	snow and ice



FAR EAST CREEK - Discharge vs. Time



FAR EAST CREEK - Water Level vs. Time
Water Level (m)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
30-May
8-Jun
17-Jun
24-Jun
2-Jul
7-Jul
12-Jul
19-Jul
23-Jul
30-Jul
6-Aug
13-Aug
20-Aug
27-Aug
3-Sep
11-Sep
17-Sep
18-Sep
24-Sep
25-Sep
2-Oct
8-Oct
15-Oct
22-Oct
29-Oct
Date 1994

APPENDIX 4.5-2

EXISTING HYDROLOGY DATA

Source: IEC. 1982.

TABLE 3.7-1
HYDROMETRIC STATIONS NEAR THE WILLOW CREEK PROJECT AREA
(Source: Inland Waters Directorate, Surface Water Data Reference Index, 1981)

British Columbia

Station No.		Drainage Area (km^2)	Gauge Location	Discharge Records (*-Stage Only #-Misc. Meas.) Type of Gauge, Operation			Remarks
07FB008	Moberly River near Fort St. John		56 05 35 121 20 49	80-81 RC			NAT
07FB001	Pine River at East Pine	12 100	55 43 12 121 12 28	61-63 MS	64-76 MC	77-81 RC	NAT
07FB007	Sukunka River above Chamberlain Creek	927	55 10 14 121 45 30	77-81 RC			6 NAT
07FB003	Sukunka River near the mouth	2 510	55 32 34 121 37 28	77-81 RC			6 NAT
07FB004	Dickebusch Creek near the mouth	85.5	55 32 07 121 35 40	78-81 RC			NAT
07FB006	Murray River above Wolverine River	2 410	55 03 55 121 01 00	77-81 RC			6 NAT
07FB002	Murray River near the mouth	5 620	55 34 15 121 11 19	77-81 RC			6 NAT
07FB005	Quality Creek near the mouth	29.5	55 08 45 120 55 24	78-81 RC			NAT
07FA003	Halfway River above Graham River	3 780	56 30 30 122 14 28	77-81 RC			NAT
07FA006	Halfway River near Farrell Creek (upper station)		56 15 04 121 37 39	81*RC			NAT
07EF001	Peace River at Hudson Hope	70 200	56 01 39 121 53 56	17-22 MS 69-81 RC	47-48 M#	49-68 MC	5 REV 60 8 REG 67
07FA004	Peace River above Pine River	83 900	56 12 13 120 48 48	79-81 RC			REG 67
07FD002	Peace River near Taylor	97 400	56 08 09 120 40 13	44-48 MS 52-59 MC	49 MC 60-81 RC	50-51 MS	REV 60 8 REG 67
07FD010	Peace River above Alces River	118 000	56 07 32 120 03 32	74-81*RC			REG 67
10CC002	Fort Nelson River above Muskwa River	22 800	58 40 15 122 38 15	78-81 RC			NAT
10CC001	Fort Nelson River at Fort Nelson	43 500	58 49 20 122 32 30	60-61 MS 65-72 MC	62 MC 73-78 RC	63-64 MS	NAT
10CB001	Sikanni Chief River near Fort Nelson	2 160	57 14 03 122 41 39	44-46 MS 60-62 MC 78-81 RC	47-49 MC 63-64 MS	50-59 MS 65-77 MC	REV 60 5 NAT
10CD001	Muskwa River near Fort Nelson	20 300	58 47 18 122 39 33 65-76 MC	44-46 MC 50-59 MS 77-31 RC	47-48 MS 60-62 MC	49 MC 63-64 MS	REV 60 NAT
10CD003	Raspberry Creek near the mouth		58 53 38 123 19 09	79-81 RC			NAT
10CD002	Parker Creek near the mouth	60.6	58 14 33 122 48 05	79-81 RC			
07GA001	Smoky River Above Hells Creek	3 830	53 57 00 119 09 00	66-67 #	68-81 RC		5 6 NAT
07GJ002	Smoky River near Bezanson	33 600	55 14 13 118 15 26	65 MS			1 NAT
07GJ001	Smoky River at Watino	50 200	55 42 56 117 37 19 SE34-77-24-W5	15-21 MC	22 MS	55-91 RC	REV 60 5 NAT
07GA002	Muskeg River near Grande Cache	715	53 55 32 118 48 52 SW15-57-06 W6	71 R#	72-81 RC		
07GB002	Kakwa River near Grande Prairie	3 290	54 22 20 118 35 40	75-81 RS			NAT
07GB001	Cutbank River near Grande Prairie	842	54 31 20 118 56 00	70-81 RS			NAT
07GE001	Wapiti River near Grande Prairie	11 300	55 04 20 118 48 10 SW23-70-06-W6	17-18 MS	60-71 MC	72-91 RC	NAT 8
07GD001	Beaverlodge River near Beaver-Lodge	1 610	55 11 21 119 26 08 SE34-71-10-W6	68-78 RS	79-81 RC		NAT
07GE003	Grande Prairie Creek near Sexsmith	152	55 22 28 118 54 50 SW06-74-06-W6	69-81 RS			NAT
07GE002	Kleskun Hills main drain near Grande Prairie	31.6	55 13 29 118 27 37 NE12-72-04-W6	66-81 RS			REG

M - Manual Gauge
R - Recording Gauge

C - Continuous operation
S - Seasonal operation

1 - Data not published

5 - Water Quality data available

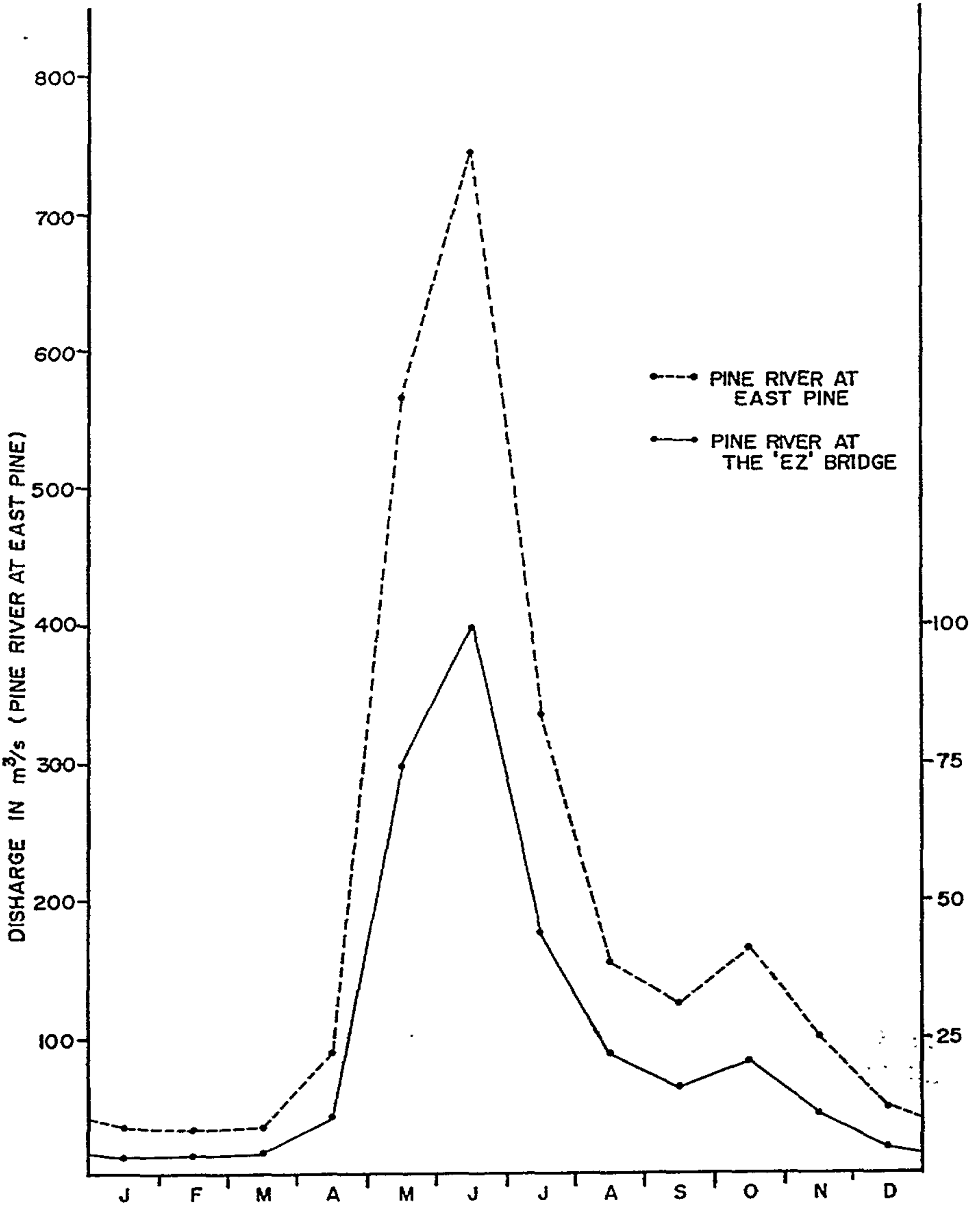
6 - Sediment Data Available

8 - Telemetering Device available

REV - Data to 19 . . have been reviewed

NAT - Natural Flow

REG - Regulated since 19 . . (year shown if known)

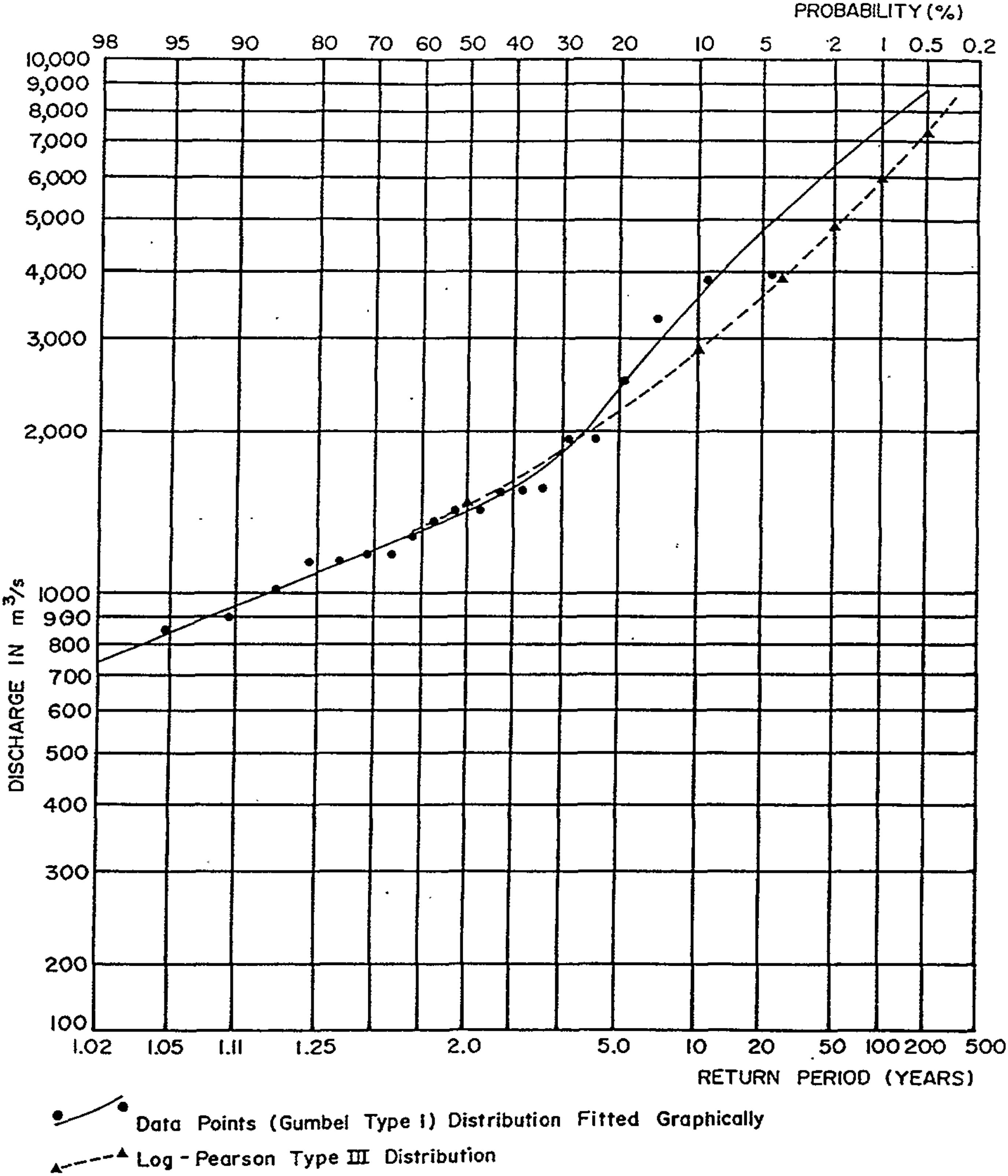


3089.7-04

MEAN ANNUAL HYDROGRAPHS FOR THE PINE RIVER

IEC

DRAWN R.K.	DATE 8/82
CHECKED	APPROVED
FIGURE: 3.7-4	



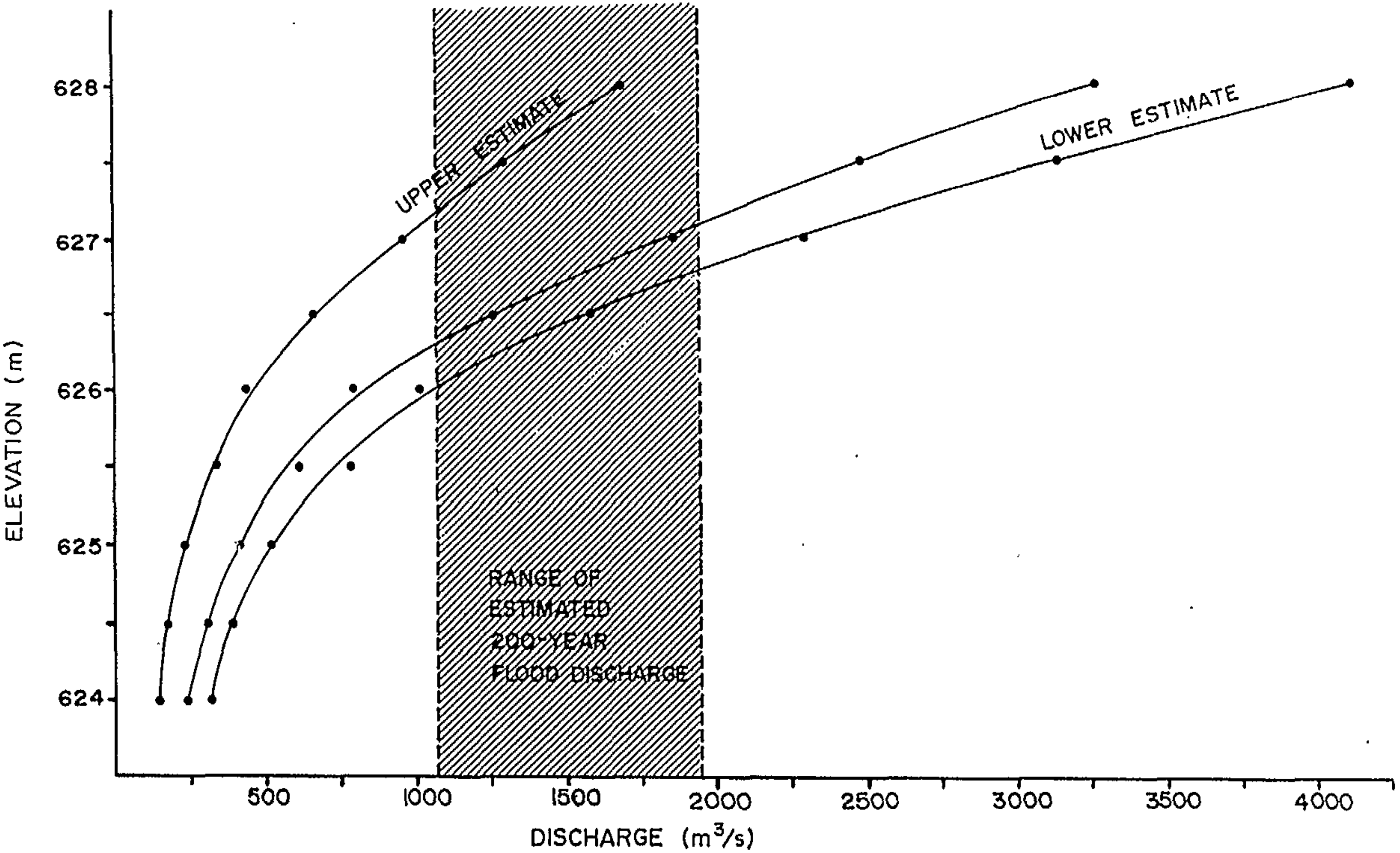
3089.7-04

DRAWN	DATE
R.K.	8/82
CHECKED	APPROVED

FLOOD FREQUENCY DISTRIBUTIONS
FOR THE PINE RIVER AT EAST PINE

IEC

FIGURE: 3.7-5



3089.7-04

FLOOD STAGE - DISCHARGE CURVES FOR THE PINE RIVER AT THE 'EZ' BRIDGE

IEC Consultants Inc.	DRAWN R.K.	DATE 8/82
	CHECKED	APPROVED
	FIG. 3.7-7	REV.

TABLE A

SUMMARY OF PINE RIVER FLOWS

Flow	Units	Pine River at East Pine[a]	Pine River at EZ Bridge[b]
Mean Annual Runoff	dam^3	6,310,000	830,000
Maximum Annual Runoff	dam^3	8,570,000	1,162,000
% of Mean	%	136	140
Minimum Annual Runoff	dam^3	4,550,000	581,000
% of Mean	%	72	70
Mean Annual Maximum Daily Discharge	m^3/s	1,550	340
	$l/s/km^2$	127	223
200 Year Maximum Daily Discharge[c]			
i. Gumbell Type I, fitted graphically	m^3/s	8,650	1,948
	$l/s/km^2$	712	1,247
ii. Gumbell Type I, maximum likelihood	m^3/s	4,778	1,076
	$l/s/km^2$	393	689
iii. Log-Pearson Type III	m^3/s	7,212	1,624
	$l/s/km^2$	594	1,040
Mean Annual 7 Day Low Flow	m^3/s	24.0	2.8
	$l/s/km^2$	2.0	1.8
200 Year 7 Day Low Flow	m^3/s	12.3	0.9
	$l/s/km^2$	1.0	0.6

[a] Based on WSC data for station 07FB001

[b] Estimates based on site data, WSC records and regional streamflow correlations

[c] A range of flow values were found, depending on the methode of calculation. Three procedures are shown.

TABLE B

WATER SURFACE ELEVATIONS ON THE PINE RIVER

Return Period (Years)	**Water Surface Elevation (m)**		
	Downstream	**EZ Bridge**	**Upstream**
10	622.2	625.2	629.0
25	622.5	625.7	629.3
50	622.8	626.1	629.7
100	623.2	626.3	630.0
200	623.3	626.6	630.2

Source: IEC 1982

TABLE C

PINE RIVER MONTHLY AND ANNUAL MEAN DISCHARGES

	Pine River at East Pine[a]		Pine River at EZ Bridge[b]	
	Discharge (m^3/s)	Percent	Discharge (m^3/s)	Percent
Jan	35.3	1.4	3.7	1.2
Feb	32.8	1.3	3.8	1.2
Mar	36.2	1.5	4.0	1.3
Apr	89.7	3.7	10.3	3.2
May	565	23.2	74.4	24.0
Jun	746	30.6	99.3	31.0
Jul	334	13.7	43.4	14.0
Aug	157	6.4	22.4	7.0
Sep	126	5.2	16.1	5.2
Oct	167	6.8	21.1	6.8
Nov	100	4.1	11.8	3.8
Dec	49.6	2.0	5.4	1.7
Year	200	100	26.3	100

[a] Based on WSC data for station 07FB001

[b] Estimated based on site data, WSC records and regional streamflow correlations

Source: IEC 1982

TABLE D

PINE RIVER FLOOD DISCHARGES

	Range of Estimated Discharges (m^3/s)[a]		
Elevation (m)	Channel	Overbank	Total
624.0	134 - 307	2 - 6	136 - 313
624.5	159 - 365	9 - 23	168 - 388
625.0	198 - 454	27 - 69	225 - 523
625.5	260 - 595	74 - 185	334 - 780
626.0	311 - 711	121 - 304	432 - 1015
626.5	372 - 851	297 - 744	669 - 1595
627.0	445 - 1018	512 - 1281	957 - 2300
627.5	514 - 1175	788 - 1970	1302 - 3145
628.0	590 - 1348	1109 - 2773	1699 - 4121

[a] Based on minimum and maximum values of Manning's "n".

Source: IEC 1982

TABLE E

MAXIMUM INSTANTANEOUS DISCHARGES FOR THE PIINE RIVER AT EŽ BRIDGE

Return Period (Years)	Ratio	Instantaneous Discharge (m^3/s)
10	1.84	736
25	2.39	956
50	3.10	1240
100	3.84	1536
200	4.65	1860

Source: IEC 1982

TABLE F

IEC STREAMFLOW MONITORING PROGRAM

Location	Drainage Area (km^2)	Date	Discharge (m^3/s)	Dis. at Pine River (East Pine - m^3/s)
Willow Creek below BCR Bridge	29.0	2-May-81	0.590	231 E
		30-Jul-81	0.124	180 E
		2-Jun-82	0.687	1130 P
Willow Creek at continuous recorder	28.2	29-Jul-82	0.406	N/A
Pine River at Hasler Bridge	1734	3-May-81	46.9	227 E
		31-Jul-81	12.8	161 E
Pine River at EZ Bridge	1562	30-Jul-81	12.7	180 E
		5-Feb-82	4.63B	N/A
		2-Jun-82	313	1130
		27-Jul-82	40.1	N/A
Middle Creek at BCR Culvert	3.5	3-May-81	0.0799	227 E
Far East Creek at BCR Culvert	3.8	28-Jul-82	0.00899	N/A

B - ice conditions
E - estimated
Source: IEC 1982

P - preliminary
N/A - not available

APPENDIX 4.6-1

STREAM AND HABITAT ASSESSMENTS FOR:

THE PROPOSED COAL MINE DEVELOPMENT FOR PINE VALLEY COAL, WILLOW CREEK PROJECT

OCTOBER 1996
MARLIM ECOLOGICAL CONSULTING LTD.
(Original document available for review)

STREAM AND HABITAT

ASSESSMENTS FOR:

THE PROPOSED
COAL MINE DEVELOPMENT
FOR PINE VALLEY COAL

(FORMERLY GLOBALTEX INDUSTRIES INC.)

WILLOW CREEK PROJECT

Prepared By:

MarLim Ecological Consulting Ltd.

October 1996

Copy 2 - Colour Photocopy
MarLim Ecological Consulting Ltd.

APPENDIX 4.6-2

STREAM SURVEY DATA CARDS

DFO / MOE
STREAM SURVEY FORM

Stream Name (gaz.) Pine River (local)
Access V2 Method
Watershed Code
Reach No. 1 Length(km)
Location Along South bank ~ 60 m U/S of Willow Creek Forestry Road bridge.
Map# 93/O
Site No. 1 Lth.surv.(m) 100 HC
U.T.M.
Fish Card [✓ Y] N C Field ☑ Hist. ☐
Date Y M D 91 08 27 Time 1310 Agency UDM Crew TP / LM / Photos 18,19,20,21 Air Photos

C	PARAMETER	VALUE	METH.	SPECIFIC DATA
	Ave.Chan.Width (m)	110	GE	
	Ave.Wet.Width (m)	30	GE	
	Ave.Max.Riffle Depth (cm)	40	GE	
	Ave.Max.Pool Depth (cm)	150	GE	
	Gradient %	0.5–1.0%	CL	
	%Pool 15 Riffle 15 Run 70 Other 0		GE	
	Side Chan.% 0☐ 0-10☑ 10-40☐ >40☐		GE	
	Debris Area% 0☐ 0-5☑ 5-15☐ >15☐		GE	
	Debris Stable %	20%	GE	
	COVER: Total %	20%	GE	
	Crown Closure %	0		

Aspect E

Comp. sum 100%	Dp Pool	L.O.D.	Boulder	In Veg	Over Veg	Cutbank
	35	25	10	2	3	25

OBSTRUCTIONS			
C	Ht(m)	Type	Loc'n

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	20
	Gravels	small (2-16mm)	20
		large (16-64mm)	30
	Larges	sm.cobble (64-128mm)	15
		lge.cobble (128-256mm)	10
		boulder (>256mm)	5
	Bedrock (R)		0

D₉₀(cm) 30 C Compaction L [✓ M] H

C	BANKS	
	Height(m) 2	%Unstable 70
	Texture [✓ F] [✓ G] L R	
	Confinement	EN CO FC [✓ OC] UC N/A
	Valley: Channel Ratio	0-2 2-5 5-10 [✓ 10] N/A
	Stage	Dry L [✓ M] H Flood
	Flood Signs Ht(m) 2.0	Braided [✓ Y] N
	Bars (%) 70	pH 7.8 O₂(ppm) /
	Water Temp.(°C) 12.5	Turb.(cm) / Cond.(25°C) /

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m³/s)			

REACH SYMBOL
(Fish)

RB MW SU CC

90,D,0.75 | 2,5,3,0

(Width,Valley:Channel,Slope) (Bed Material)

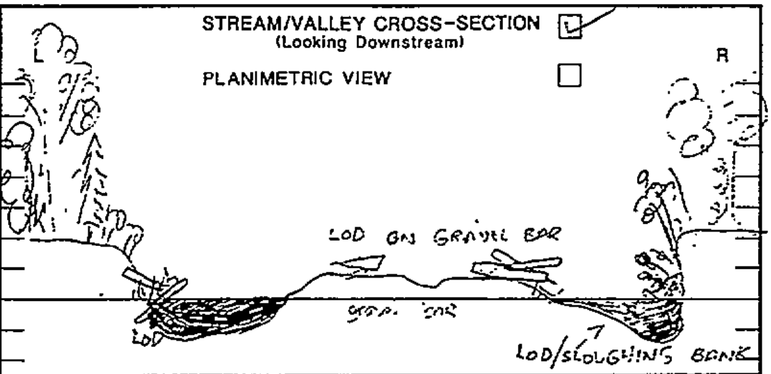
REVISED DEC 87 SS1 87

FISH SUMMARY

C	Species	No.	Size Range (mm)	Life Phase	Use	Method/Ref
1	RB	1	90 mm	J	R	EL
	MW	2	180-220 mm	J-A	R	EL
	SU	1	195 mm	J-A	R	EL
	CC	32	20 - 75	J-A	R	EL

STREAM/VALLEY CROSS-SECTION ☑
(Looking Downstream)

PLANIMETRIC VIEW ☐



COMMENTS

Channel Stability ☐, Debris ☐, Management Concerns ☐, Obstructions ☐, Riparian Zone ☐, Valley Wall Processes ☐, Etc.

1. Hard to spot electrofish as pools at base of bank hard to access due to sloughing. Water too deep to electrofish mainstem, could only fish favourable spots along right bank and some side channel habitat.
(Total Effort = 966 seconds)

No Gee Traps were set at this site. (Only U/S site)

Edited by:
Date Y M D:

DFO / MOE
STREAM SURVEY FORM

Stream Name (gaz.) Pine RiveR (local)		Access	V2	Method	
Watershed Code	Reach No. 1	Length(km)			
Location 50 m section along South Bank of Pine River immediately d/s of Confluence Willow Cr.	Map# 93/0	Site No. 2	Lthsurv.(m)	50	GE
U.T.M		Fish Card [✓ Y] N	C	Field ☑	Hist. ☐
Date Y M D 96 08 27	Time 1415	Agency NDH	Crew TP / LM /	Photos - /	Air Photos /

C	PARAMETER	VALUE	METH.	SPECIFIC DATA
	Ave.Chan.Width (m)	60m	GE	
	Ave.Wet.Width (m)	30m	GE	
	Ave.Max.Riffle Depth (cm)	45	T	
	Ave.Max.Pool Depth (~~c~~m)	1.5	GE	
	Gradient %	0.75	CL	
	% Pool 15 Riffle 30 Run 55 Other 0		GE	
	Side Chan.% 0 0 ☑ 0-10 ☐ 10-40 ☐ >40 ☐		GE	
	Debris Area% 03 0 ☐ 0-5 ☑ 5-15 ☐ >15 ☐		GE	
	Debris Stable %	10%	GE	
	COVER: Total %	15	GE	
	Comp: sum 100%: Dp Pool 35, L.O.D. 15, Boulder 10, In Veg 5, Over Veg 15, Cutbank 30			
	Crown Closure %	3	C	Aspect E

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	15
	Gravels	small (2-16mm)	20
		large (16-64mm)	20
	Larges	sm cobble (64-128mm)	25
		lge cobble (128-256mm)	10
		boulder (>256mm)	10
	Bedrock (R)		0
	D$_{90}$(cm) 40	C	Compaction [✓ L] [✓ M] H

C	BANKS			
	Height(m) 3.0	Unstable 40		
	Texture	[✓ F] [✓ G] L R		
	Confinement	EN CO FC [✓ OC] UC N/A		
	Valley Channel Ratio	0-2 2-5 5-10 [✓ 10+] N/A		
	Stage	Dry [✓ L] M H Flood		
	Flood Signs Ht(m)	1.8	Braided	Y [✓ N]
	Bars (%)	25	pH 7.8	O$_2$(ppm) /
	Water Temp (°C)	12.5	Turb (cm) /	Cond (25°C) /

OBSTRUCTIONS			
C	Ht(m)	Type	Loc'n

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m³/s)			

REACH SYMBOL
(Fish)

MW GR CC

60, D, 0.75 | 2, 4, 4, 0

(Width Valley Channel,Slope) (Bed Material)

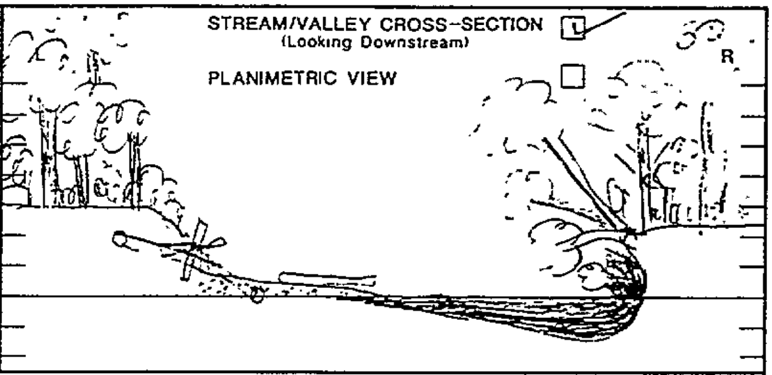
REVISED ... SS19

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	MW	1	40mm	J	R	EL
	GR	1	37mm	J	R	EL
	CC	18	25-75mm	J-A		EL
	MW	1	~300mm	A		VO
	MW	30	~25-60mm	J	R	VO
	CC	>50	~25-75mm	J-A		VO

STREAM/VALLEY CROSS-SECTION ☑
(Looking Downstream)

PLANIMETRIC VIEW ☐



COMMENTS

Channel Stability ☐, Debris ☐, Management Concerns ☐, Obstructions ☐, Riparian Zone ☐, Valley Wall Processes ☐, Etc.

- Difficult to shock mainstem. Spot shocked along undercut bank where bank and small poplars sloughing into river. (249 seconds effort)
- Gee traps set here Aug. 12 - 15, 1996. - NO FISH CAPTURED.

Edited by

Date Y M D

DFO / MOE
STREAM SURVEY FORM

Stream Name (gaz.) Willow Creek	(local)		Access	V2	Method
Watershed Code		Reach No. 1	Length(km)		
Location Confluence of Willow Creek & Pine River u/s TO SMALL BRIDGE ACROSS WILLOW CREEK 145m u/s.	Map# 93/0	Site No. 1	Lthsurv(m)	145	HC
	U.T.M.	Fish Card [✓ Y] N	C	Field ☑	Hist. ☐
Date Y M D 96 08 27 Time 1530 Agency NDM Crew TP/LM/	Photos 22,23,24,25,1,2	Air Photos			

C	PARAMETER	VALUE	METH.	SPECIFIC DATA
	Ave.Chan.Width (m)	6.0	SC	
	Ave.Wet.Width (m)	0.5	SC	Reach is rapidly drying up-(flowing underground)
	Ave.Max.Riffle Depth (cm)	4	T	Several sections drained during reach
	Ave.Max.Pool Depth (cm)	30	T	survey.
	Gradient %	1%-3%	CL	
	%Pool 10 Riffle 30 Run Other 60		GE	
	Side Chan.% 05 0☐ 0-10☑ 10-40☐ >40☐		GE	
	Debris Area% 05 0☐ 0-5☑ 5-15☐ >15☐		GE	
	Debris Stable %	95%	GE	
	COVER: Total %	30%	GE	

Comp. sum 100%	Dp Pool	L.O.D.	Boulder	In Veg	Over Veg	Cutbank
	15	5	30	5	15	30

Crown Closure % 10-15 C Aspect NW

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	5
	Gravels	small (2-16mm)	10
	Gravels	large (16-64mm)	30
	Larges	sm.cobble (64-128mm)	30
	Larges	lge.cobble (128-256mm)	20
	Larges	boulder (>256mm)	5
	Bedrock (R)		0
	D_{90}(cm) 35	C Compaction	L [✓ M] H

C	BANKS					
	Height(m) 1.2	%Unstable 15				
	Texture	[✓ F] [✓ G] L R				
	Confinement	EN	CO	[✓ FC]	OC	UC N/A
	Valley: Channel Ratio	0-2	2-5	5-10	[✓ 10+]	N/A
	Stage	[✓ Dry]	[✓ L]	M	H	Flood
	Flood Signs Ht(m) 1.1	Braided	Y [✓ N]			
	Bars (%) 85%	pH 8.5	O_2(ppm) N/A			
	Water Temp.(°C) 18	Turb.(cm) N/A	Cond.(25°C) N/A			

OBSTRUCTIONS

C	Ht(m)	Type	Loc'n
1			

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m³/s)			

REACH SYMBOL
(Fish)

RB MW CC

6,D,1.5 | 1,4,5,0

(Width,Valley:Channel,Slope) (Bed Material)

REVISED DEC 87 SS187

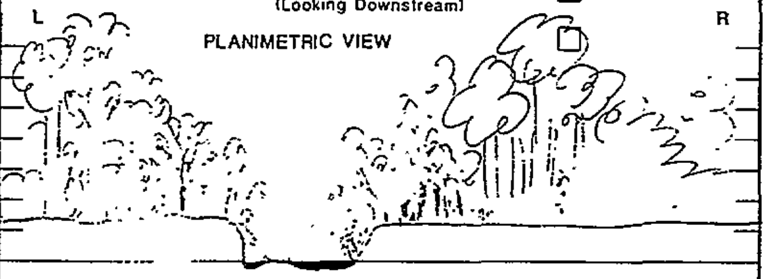
FISH SUMMARY

C	Species	No.	Size Range (mm)	[illegible]	Use	[illegible]
2	MW	1	90mm			MT
	CC	2	15-35			MT
	MW	~55	15-100			VO
	RB	1	155mm			EL
	MW	22	28-52mm			EL
	CC	6	25-60mm			EL

Total Effort = 829 seconds

STREAM/VALLEY CROSS-SECTION ☑
(Looking Downstream)

PLANIMETRIC VIEW ☐



COMMENTS

Channel Stability ☐, Debris ☐, Management Concerns ☑, Obstructions ☐, Riparian Zone ☐, Valley Wall Processes ☐, Etc.

1. Water table is dropping along this reach and flows are percolating into substrate. Remaining juvenile MW (~40) and sculpins are trapped throughout with majority in a pool ~7 m long and 20-30 cm deep.

2. Salvaged fish above, however hard to catch small juvenile mountain whitefish (~40) as conductivity appears high and fish escape into cobble substrate or further along channel in remaining water.

Edited by:

Date Y M D:

DFO / MOE
STREAM SURVEY FORM

Stream Name (gaz.) Willow Creek (local)
Access V2
Method
Watershed Code
Reach No.
Length(km)
Location Between points 50m and 200m d/s of Willow Creek Bridge (Road to Falling Creek)
Map# 93/0
U.T.M.
Site No. 2
Lthsurv(m) 120 HC
Fish Card [✓ Y] N
C
Field ☑ Hist. ☐
Date Y M D 96 08 28
Time 1245
Agency NDM
Crew TP/LM/
Photos 3,8A
Air Photos

C	PARAMETER	VALUE	METH.	SPECIFIC DATA
	Ave.Chan.Width (m)	25	SC	
	Ave.Wet.Width (m)	5	SC	
	Ave.Max.Riffle Depth (cm)	10	T	
	Ave.Max.Pool Depth (cm)	60	T	
	Gradient %	2.5-5%	CL	
	% Pool 10 Riffle 60 Run 20 Other 10		GE	
	Side Chan.% 0☐ 0-10☑ 10-20☐ [illegible]0☐		GE	
	Debris Area% 0☐ 0-5☐ 5-15☑ [illegible]5☐		GE	
	Debris Stable %	70%	GE	
	COVER: Total %	35%	GE	

Comp. sum 100%	Dp Pool	L.O.D.	Boulder	In Veg	Over Veg	Cutbank
	10	15	50	5	10	10

Crown Closure % 5% C Aspect NW

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	5
	Gravels	small (2-16mm)	5
	Gravels	large (16-64mm)	20
	Larges	sm.cobble (64-128mm)	25
	Larges	lge.cobble (128-256mm)	25
	Larges	boulder (>256mm)	20
	Bedrock (%)		0

D_{90}(cm) 85 C Compaction L M [✓ H]

C	BANKS			
	Height(m) 1.3	%Unstable 5		
	Texture	[✓ F] [✓ G] L R		
	Confinement	EN CO [✓ FC] OC UC N/A		
	Valley Channel Ratio	0-2 2-5 5-10 [✓ 10+] N/A		
	Stage	Dry [✓ L] M H Flood		
	Flood Signs Ht(m) 1.2	Braided Y [✓ N]		
	Bars (%) 70	pH 8.3	O_2(ppm) /	
	Water Temp (°C) 12.5	Turb.(cm) /	Cond (25°C) /	

C	Ht(m)	Type	Loc'n

OBSTRUCTIONS

DISCHARGE

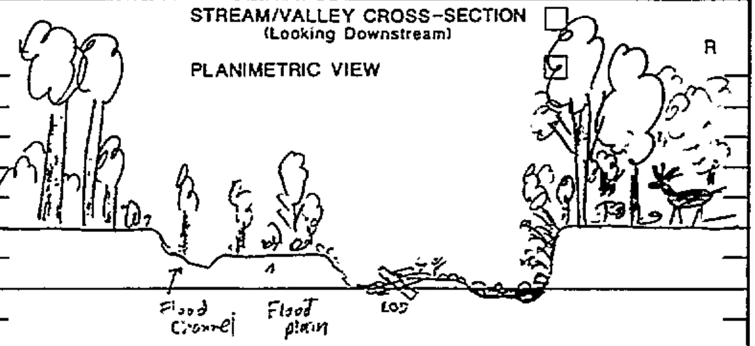
Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m^3/s)			

REACH SYMBOL
(Fish)
RB CC
25, D, 3 | 1, 2, 7, 0
(Width,Valley Channel,Slope) (Bed Material)

REVISED DEC 87 SS187

C	[illegible]	No.	Size Range(mm)	[illegible]	Use	[illegible]
	RB	7	87-165	J	R	EL
	CC	1	90 mm			EL
	RB	2	~80-100	J	R	VO
	CC	1	~30 mm			VO

STREAM/VALLEY CROSS-SECTION ☐
(Looking Downstream)
PLANIMETRIC VIEW ☑



COMMENTS

Channel Stability ☐; Debris ☐; Management Concerns ☐; Obstructions ☐; Riparian Zone ☐; Valley Wall Processes ☐; Etc.

- Electroshocked 120 metres (best habitat)
- 2319 seconds effort
- No success with Gee traps
- all fish robust and healthy looking.

Edited by:
Date Y M D:

DFO / MOE
STREAM SURVEY FORM

Stream Name (gaz.) WILLOW CREEK (local)
Access V4/FT Method
Watershed Code
Reach No.
Length(km)
Location Immediately below falls on Willow Creek - (120 m sampled)
Map# 93/0
Site No. 3
Lth.surv.(m) 120 HC
U T.M.
Fish Card [✓ Y] N
C
Field ☑ Hist. ☐
Date Y-M-D 96 08 28 Time 1500 Agency NDM Crew TP/LM/ Photos 4,4A,5A,7,8 Air Photos

C	PARAMETER	VALUE	METH.	SPECIFIC DATA
	Ave.Chan.Width (m)	10	SC	
	Ave.Wet.Width (m)	5	SC	
	Ave.Max.Riffle Depth (cm)	25	T	
	Ave.Max.Pool Depth (cm)	80	T	
	Gradient %	5-12%	CL	
	%Pool 15 Riffle 60 Run 15 Other 10		GE	
	Side Chan.% 0 ☑ 0-10 ☐ 10-40 ☐ >40 ☐		GE	
	Debris Area% 0 ☐ 0-5 ☑ 5-15 ☐ >15 ☐		GE	
	Debris Stable %	50%	GE	
	COVER: Total %	80%	GE	
	Comp. sum 100%	Dp Pool 25, L.O.D. 15, Boulder 45, In Veg 0, Over Veg 5, Cutbank 10		
	Crown Closure %	5		Aspect NW

OBSTRUCTIONS C	Ht(m)	Type	Loc'n
1	4-5	F	

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	5
	Gravels	small (2-16mm)	5
		large (16-64mm)	10
	Larges	sm.cobble (64-128mm)	15
		lge.cobble (128-256mm)	30
		boulder (>256mm)	30
	Bedrock (R)		5
	D₉₀(cm) 180	Compaction	L [✓ M] [✓ H]

BANKS

Height(m) 2.5 %Unstable 5
Texture F G [✓ L] R
Confinement [✓ EN] CO FC OC UC N/A
Valley: Channel Ratio 0-2 [✓ 2-5] 5-10 10- N/A
Stage Dry [✓ L] M H Flood
Flood Signs Ht(m) 1.2 Braided Y [✓ N]
Bars (%) 15 pH 8.2 O₂(ppm) /
Water Temp.(°C) 12 Turb.(cm) / Cond.(25°C) /

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m³/s)			

REACH SYMBOL (Fish) (* photos)

RB DV (BULLTROUT)

10, B, 8-5 | 1,1,7,1
(Width,Valley:Channel,Slope) Bed Material)

REVISED DEC 87 SS187

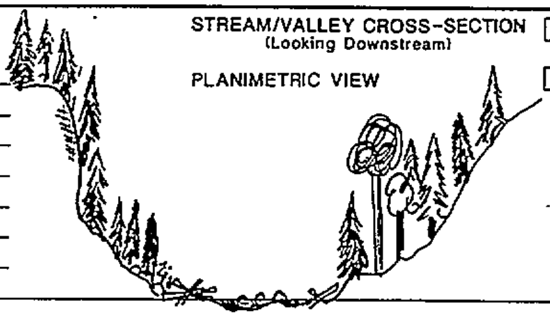
FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref.
	(BT)					
2	DV	4	222-330	J-A		EL
	RB	9	190-230	J-A		EL
	RB	2	~160-200	J-A		VO
3	RB	1	128	J		MT

1117 seconds effort

STREAM/VALLEY CROSS-SECTION ☐
(Looking Downstream)

PLANIMETRIC VIEW ☐



COMMENTS

Channel Stability ☐; Debris ☐; Management Concerns ☑; Obstructions ☐; Riparian Zone ☐; Valley Wall Processes ☐; Etc.

1. Willow Creek Falls at U/S limit of this reach. Falls approx 4-5 m vertical (ground Estimate, see photos) in two stages. Obstruction to all species.

2. 4 char captured (bull trout) → (222-330 mm) see photos, 9 RB (nose/fork 230-190 mm) All fish captured were robust & appeared healthy, Returned unharmed.

3. Gee Traps (2) set August 26-31; (1 RB (128 mm) on Aug-29)

Edited by:
Date Y M D:

DFO / MOE
STREAM SURVEY FORM

Stream Name (gaz.) WILLOW CREEK (local) | Access V4/FT | Method
Watershed Code | Reach No. | Length(km)
Location IMMEDIATELY UPSTREAM OF WILLOW CREEK FALLS | Map# 93/6 | Site No. 4 | Lnsurv(m) 330 HC
U.T.M. | Fish Card [✓ Y] N | C.# Field ☑ Hist. ☐
Date Y M D 960829 | Time 12:30 | Agency NDM | Crew TP/LM/ | Photos 9A, 11 | Air Photos

C	PARAMETER	VALUE	METH.	SPECIFIC DATA
	Ave.Chan.Width (m)	6	SC	
	Ave.Wet.Width (m)	3.5	SC	
	Ave.Max.Riffle Depth (cm)	25	T	
	Ave.Max.Pool Depth (cm)	70	T	
	Gradient %	2%-7%	CL	
	% Pool 20 Riffle 40 Run 20 Other 20		GE	
	Side Chan.%	Ø 0☐ 0-10☐ 10-40☐ >40☐	GE	
	Debris Area%	0☐ 0-5☑ 5-15☐ >15☐	GE	
	Debris Stable %	80%	GE	
	COVER: Total %	70%	GE	

OBSTRUCTIONS C	Ht(m)	Type	Loc'n
1	4-5	F	

Comp. sum 100%	Dp Pool	L.O.D.	Boulder	In Veg	Over Veg	Cutbank
	30	10	50	Ø	5	5

Crown Closure % 10 | Aspect NW

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	5
	Gravels	small (2-16mm)	5
		large (16-64mm)	10
	Larges	sm.cobble (64-128mm)	15
		lge.cobble (128-256mm)	25
		boulder (>256mm)	25
	Bedrock (R)		15

D_{90}(cm) 110 | Compaction L M [✓ H]

BANKS
Height(m) 2 | %Unstable 10
Texture F G [✓ L] R
Confinement [✓ EN] CO FC OC UC N/A
Valley: Channel Ratio 0-2 [✓ 2-5] 5-10 10+ N/A
Stage Dry [✓ L] M H Flood
Flood Signs Ht(m) 1.1 | Braided Y [✓ N]
Bars (%) Ø | pH 8.2 | O_2(ppm) /
Water Temp.(°C) 12 | Turb.(cm) / | Cond.(25°C) /

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m^3/s)			

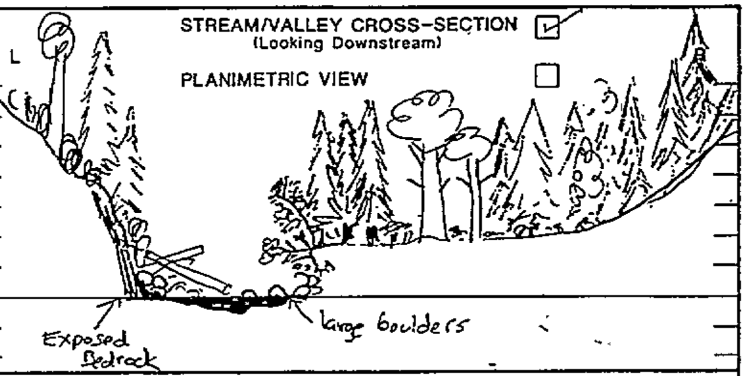
REACH SYMBOL
(Fish)
Ø
6, B, 5 | 1, 1, 6, 2
(Width,Valley:Channel,Slope) (Bed Material)

REVISED DEC 87 SS187

C	[illegible]	No.	Size Range(mm)	[illegible]	Use	[illegible]
	Ø	Ø				EL/MT

2443 seconds effort

STREAM/VALLEY CROSS-SECTION ☑
(Looking Downstream)
PLANIMETRIC VIEW ☐



COMMENTS

Channel Stability ☐; Debris ☐; Management Concerns ☐; Obstructions ☑; Riparian Zone ☐; Valley Wall Processes ☐; Etc.

1. Willow Creek Falls approx 4-5 m. vertical in two stages at downstream limit of this reach surveyed + electrofished (Gee Traps also).

2. Electrofished 330 metres (2443 seconds effort) directly above falls. NO FISH CAPTURED.

Two Gee traps set August 12-15, Ø FISH. (checked daily).

Edited by:
Date Y M D:

DFO / MOE
STREAM SURVEY FORM

Stream Name (gaz.) WILLOW CREEK (local)

Access V4/FT Method

Watershed Code

Reach No.

Length(km)

[illegible] 500 metres upstream of confluence with Tributary 2.

Map # 93/0

Site No. 5.

[illegible] 250 HC

U.T.M.

[illegible] [✓ Y] N.

[illegible] ✓ Est. ☐

[illegible] 96 08 30 [illegible] 1310 [illegible] NDM [illegible] TP/LM/

Photos 12A

Air Photos

C.	PARAMETER	VALUE	METH.	SPECIFIC DATA
	Ave.Chan.Width(m)	4	SC	
	Ave.Wet.Width(m)	2.5	SC	
	Ave.Max.Riffle Depth (cm)	12	T	
	Ave.Max.Pool Depth (cm)	65	T	
	Gradient %	5-10%	CL	
	Pool 20 Glide 40 Riffle 10 Other 30		GE	
	Side Chan %	0 ☑ 0-10 ☐ 10-40 ☐ >40 ☐	GE	
	Debris Area %	0 ☐ 0-5 ☑ 5-15 ☐ >15 ☐	GE	
	Stable %	75	GE	
	COVER: Total %	80	GE	

Comp. sum 100%	Dp Pool	L.O.D.	Boulder	In Veg	Over Veg	Cutbank
	25	10	55	0	5	5

Crown Closure % 5

Aspect NW

OBSTRUCTIONS			
C.	[illegible]	Type	Loc'n
	4.0	F	d/s
	1.4	X	.172

C.	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	5
	Gravels	small (2-16mm)	5
		large (16-64mm)	5
	Larges	sm.cobble (64-128mm)	10
		lge.cobble (128-256mm)	15
		boulder (>256mm)	60
	Bedrock		0

D_{90}(cm) 250

Compaction L [✓ M] H

C.	BANKS	
	Height(m) 1.5	%Unstable 50
	Texture	[✓ F] [✓ G] [✓ L] R
	Confinement	[✓ EN] CO; FC OC UC N/A
	Valley: Channel Ratio	[✓ 0-2] 2-5 5-10 10+ N/A
	Stage	Dry [✓ L] M H Flood
	Flood Signs Ht(m) 1.1	Braided Y [✓ N]
	Bars (%) 5	pH 8.2 O_2(ppm) 0
	Water Temp.(°C) 11.5	Turb.(cm) / Cond.(25°C) /

	DISCHARGE		
Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m³/s)			

REACH SYMBOL
(Fish)

0

4, A, 7.5 | 1,1,8,0

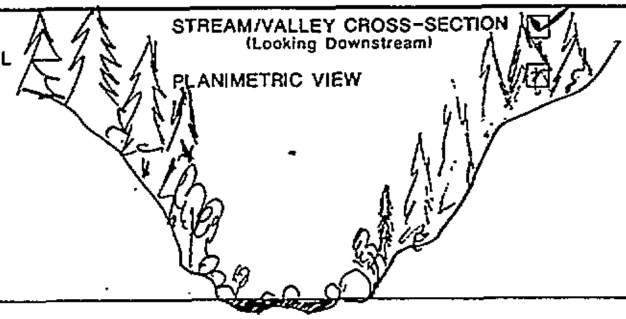
(Width,Valley:Channel,Slope) (Bed Material)

REVISED DEC. 87 SS187

C.	[illegible]	No.	Size Range(mm)	[illegible]	Use	[illegible]
1	0	0				EL
	1680 seconds effort					

STREAM/VALLEY CROSS-SECTION ☑
(Looking Downstream)

PLANIMETRIC VIEW ☐



COMMENTS

Channel Stability ☐, Debris ☐, Management Concerns ☐, Obstructions ☐, Riparian Zone ☐, Valley Wall Processes ☐, Etc.

1.) • Electrofished 250 m reach. 1680 seconds effort. NO fish captured or observed.

• NO Gee Traps were set at this site.

2.) much slumping along bank near and U/S of this site.

Edited by:

Date Y M D:

DFO / MOE
STREAM SURVEY FORM

Stream Name (gaz.) WILLOW CREEK (local) UPPER WILLOW CREEK | Access V4 | Method

Watershed Code | Reach No. | Length(km)

Location 100m u/s and 100m d/s of Forest Service Road Crossing at WC2 hydrology/waterquality site | Map# 93/0 | Site No. 7 | Lth.surv.(m) 200 HC

U.T.M. | Fish Card [✓ Y] N | C | Field ☑ Hist. ☐

Date Y M D 96 08 29 | Time 3:30 | [illegible] | Crew TP/LM/ | Photos 11A | Air Photos

C	PARAMETER	VALUE	METH.	SPECIFIC DATA
	Ave.Chan.Width(m)	3.0	SC	
	Ave.Wet.Width(m)	1.5	SC	
	Ave.Max.Riffle Depth (cm)	9.0	T	
	Ave.Max.Pool Depth (cm)	40	T	
	Gradient %	2-8%	CL	
	% Pool 35 Riffle 55 Run 10 Other		GE	
	Side Chan.% [✓ 0] ☐ 5-10 ☐ 10-20 ☐ >20 ☐		GE	
	Debris Area% 0 ☐ 0-5 ☑ 5-15 ☐ >15 ☐		GE	
	Debris Stable %	90%	GE	
	COVER: Total %	80%	GE	

Comp. sum 100%	Dp Pool	L.O.D.	Boulder	In Veg	Over Veg	Cutbank
	20	10	20	5	30	15

Crown Closure % 20 | Aspect NW

C	BED MATERIAL		%
1	Fines	clay,silt,sand (<2mm)	10
	Gravels	small (2-16mm)	10
		large (16-64mm)	15
	Larges	sm.cobble (64-128mm)	30
		lge.cobble (128-256mm)	20
		boulder (>256mm)	15
	Bedrock (R)		0

D_{90}(cm) 75 | Compaction L [✓ M] H

C	BANKS					
	Height(m)	13	%Unstable	5		
	Texture	[✓ F]	[✓ G]	[✓ L]	R	
	Confinement	EN	[✓ CO]	FC	OC	UC	N/A
	Valley: Channel Ratio	0-2	2-5	5-10	[✓ 10]	N/A
	Stage	Dry	[✓ L]	M	H	Flood
	Flood Signs Ht(m)	0.9	Braided	Y	[✓ N]	
	Bars (%)	0	pH	8.2	O2(ppm)	/
	Water Temp.(°C)	12	Turb.(cm)	/	Cond.(25°C)	/

OBSTRUCTIONS C	Ht(m)	Type	Loc'n
	4.0	F	d/s
	1.4	X	.172

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m^3/s)			

REACH SYMBOL
(Fish)
0

3,D,4 | 1,2,6,0
(Width,Valley:Channel,Slope) (Bed Material)

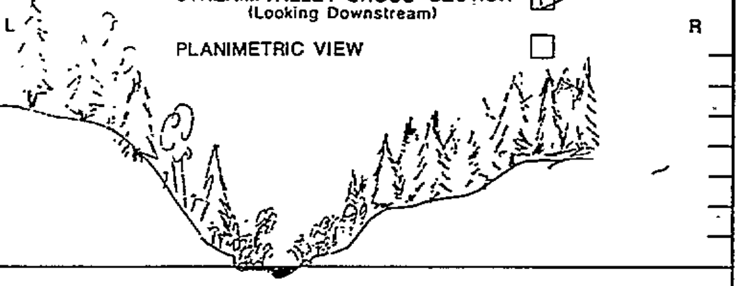
REVISED DEC 87 SS1 87

[illegible]

C	[illegible]	No.	Size Range(mm)	[illegible] Phase	Use	[illegible]
3	0	0				EL/MT
	863 seconds effort					

STREAM/VALLEY CROSS-SECTION ☑
(Looking Downstream)

PLANIMETRIC VIEW ☐



COMMENTS

Channel Stability ☐; Debris ☐; Management Concerns ☑; Obstructions ☐; Riparian Zone ☐; Valley Wall Processes ☐; Etc.

1. Recent removal of large diameter culvert from Forest Service Road Xing and stockpiled fill material at edge of stream is contributing silt to Willow Creek within this reach.

2. Electrofished 863 seconds within this site. NO FISH CAPTURED.

Two Gee Traps set August 12-15, NO FISH CAPTURED.

Edited by:
Date Y M D:

DFO / MOE
STREAM SURVEY FORM

[illegible] (gaz.) WILLOW CREEK (local)

Access V4/FT Method

[illegible] Length(km) 3.194 HC

[illegible] (0+876) 876 m u/s from confluence with Tributary 2. [illegible] 93-0 U.T.M.

[illegible] A [illegible] 3.194 HC

[illegible] Y [✓ N]

[illegible] 916 09 26 [illegible] 1745 [illegible] NDM [illegible] TP/LM/ Photos #7,6,8 Air Photos

C	PARAMETER	VALUE	METH.	SPECIFIC DATA
	[illegible]	4	GE	
	[illegible]	2.5	GE	
	Ave.Max.Riffle Depth (cm)	15	T	
	Ave.Max.Pool Depth (cm)	50	T	
	Gradient [illegible]	7	CL	
	[illegible] 30 [illegible] 25 [illegible] 15 Other 30		GE	
	[illegible] Ø 0 ☑ ☐ ☐ ☐		GE	
	[illegible] 03 ☐ ☑ ☐ ☐		GE	
	Stable %	40	GE	
	COVER: Total %	60	GE	

Comp. sum 100%	Dp Pool	L.O.D.	Boulder	In Veg	Over Veg	Cutbank
	30	20	30	Ø	15	5

Crown Closure % 15 Aspect NW

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	5
	Gravels	small (2-16mm)	5
		large (16-64mm)	10
	Larges	sm.cobble (64-128mm)	15
		lge.cobble (128-256mm)	20
		boulder (>256mm)	45
	Bedrock [illegible]		Ø

D_{90}(cm) 300 Compaction L [✓ M] H

C	BANKS			
	Height(m)	1.5	%Unstable	15
	Texture	F [✓ G] [✓ L] R		

Confinement [✓ EN] CO FC OC UC N/A

Valley: Channel Ratio [✓ 0-2] [✓ 2-5] 5-10 10+ N/A

[illegible] Dry L [✓ M] H Flood

Flood Signs Ht(m) 1.2 Braided Y [✓ N]

Bars (%) 5 pH / O₂(ppm) /

Water Temp.(°C) 4.5 Turb.(cm) / Cond.(25°C) /

C	OBSTRUCTIONS	Type	Loc'n
	4.0	F	d/s
	1.4	X	.172

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m³/s)			

REACH SYMBOL
(Fish)

4,B,7 | 1,2,7,0

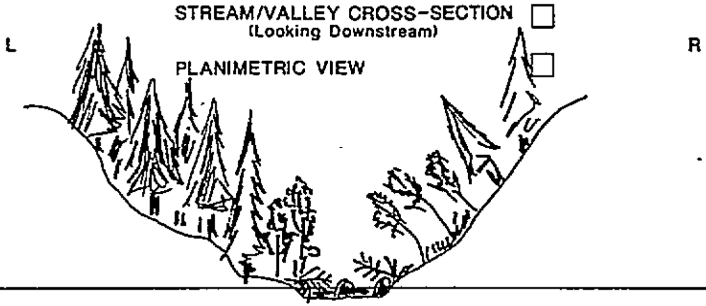
(Width,Valley:Channel,Slope) (Bed Material)

REVISED DEC 87 SS187

C	[illegible]	No.	Size Range (mm)	[illegible]	Use	[illegible]

STREAM/VALLEY CROSS-SECTION ☐
(Looking Downstream)

PLANIMETRIC VIEW ☐



COMMENTS

Channel Stability ☐; Debris ☐; Management Concerns ☐; Obstructions ☑; Riparian Zone ☐; Valley Wall Processes ☑; Etc.

- Electrofishing (250 m site) conducted in August approx 400 m d/s. No fish captured. See seperate card for that site
- Slumping along banks common along this reach. Several slumps have blocked creek temporarily earlier this year.
- Quite a few pools 30 - 50 cm deep, LOD and large boulders.

Edited by:

Date Y M D:

DFO/MOE
STREAM SURVEY FORM

Stream Name (gaz.) WILLOW CREEK (local)

Watershed Code

Location (2+240) 2240m v/s from Trib 2 confluence. (954m. d/s Trib 3 Confl.)

Map 93-0

U.T.M.

Date Y M D 9|6|0|9|2|9 Time 1100 Agency NDM Crew TP/ /

Photos 23 (24) Air Photos

Access	V4	FT
Length(km)	3.194	HC
	3.194	HC

B

Y [✓ N] ☑ ☐

PARAMETER	VALUE	METH.	SPECIFIC DATA
Ave.Chan.Width (m)	3.0	GE	Habitat mapping of Willow Creek v/s of
Ave.Wet Width (m)	2.5	GE	Trib 2 confluence started on Sept. 26.
Ave.Max.Riffle Depth (cm)	20	T	Finished v/s section today after significant
Ave.Max.Pool Depth (cm)	65	T	rain + snow-reflected in pool + riffle depths
Gradient %	5%	CL	
% Pool 25 Riffle 25 Run 10 Other 40		GE	
Side Chan % Ø 0☐ 0-20☐ 20-40☐ >40☐		GE	
Debris Area % 05 0☐ 0-5☐ 5-15☐ >15☐		GE	
Debris Stable %	25	GE	
COVER: Total %	70	GE	

OBSTRUCTIONS	Type	Loc'n
4.0	F	d/s
1.4	X	.172
1.2	C	1.034

Comp. sum 100%	Dp Pool	L.O.D.	Boulder	In Veg	Over Veg	Cutbank
	20	15	40	0	15	10

Crown Closure % 15 Aspect NW

BED MATERIALS		%
Fines	clay,silt,sand (<2mm)	10
Gravels	small (2-16mm)	10
	large (16-64mm)	10
Cobbles	sm.cobble (64-128mm)	20
	lge.cobble (128-256mm)	20
	boulder (>256mm)	30
		0

D_{90}(cm) 180 Compaction L (M) (H)

BANKS

Height(m) 1.6 %Unstable 30

Texture F (G) (L) R

Confinement [✓ EN] CO FC OC UC N/A

Valley: Channel Ratio 0-2 [✓ 2-5] 5-10 10+ N/A

Dry L [✓ M] H Flood

Flood Signs Ht(m) 1.1 Braided Y [✓ N]

Bars (%) 2% pH 8.1 O_2(ppm) /

Water Temp.(°C) 3.5 Turb.(cm) / Cond.(25°C) /

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)	2.0	GE	
Mean Depth (m)	0.40	GE	
Mean Velocity (m/s)	0.75	GE	
Discharge (m^3/s)			

REACH SYMBOL
(Fish)

3, B, 5 | 1, 2, 7, 0

(Width,Valley:Channel,Slope) (Bed Material)

REVISED DEC. 87 SS187

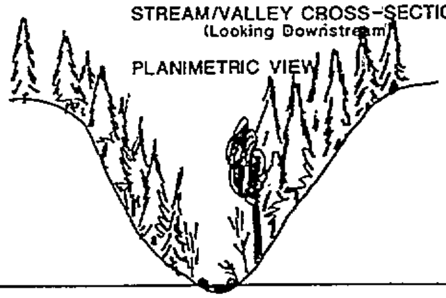
FISH SUMMARY

C	Species	No.	Size Range (mm)		Use	

STREAM/VALLEY CROSS-SECTION ☑
(Looking Downstream)

PLANIMETRIC VIEW ☐

L R



COMMENTS

Channel Stability ☐; Debris ☐; Management Concerns ☐; Obstructions ☐; Riparian Zone ☐; Valley Wall Processes ☑; Etc.

- Electrofishing and Gee traps set v/s in 100m section immediately above confluence of Trib 3 in August - no fish captured. No reach card @ that site.
- Also electrofishing + Gee traps (August) on Willow Creek at Forest Service Road Xing (no fish captured or observed). Reach card completed for that site.
- Many deeper pools v/s of this site., LOD & boulders instream.
- Slumping along banks common along this reach.

Edited by:

Date Y M D:

DFO / MOE
STREAM SURVEY FORM

Stream Name (gaz.)		(local) Tributary 1 (Trib. 1)		Access	V4
Watershed Code		[illegible]	1+2	Length(km)	
[illegible] 50 m. U/s and 120 m. d/s of culvert under Willow Creek Forest Service Road	[illegible] 93/0	[illegible]	1	[illegible]	170 HC
	U.T.M.	[illegible]	(Y) N	[illegible]	☑ ☐
[illegible] 9 6 0 8 3 1 0	[illegible] 1545	[illegible] NDM	[illegible] TP/LM/	Photos 17A	Air Photos

	PARAMETER	VALUE	METH.	SPECIFIC DATA
	Ave.Chan.Width (m)	1.2	SC	
	Ave.Wet.Width (m)	0.70	SC	
	Ave.Max.Riffle Depth (cm)	6	T	
	Ave.Max.Pool Depth (cm)	35	T	
3	Gradient %	15-22%	CL	
	% Pool 30 Riffle 15 Run 15 Other 40		GE	
	Side Chan % Ø ☑ ☐ ☐ ☐		GE	
	Debris Area % 0/8 ☐ ☐ ☑ ☐		GE	
	Stable %	65%	GE	
	COVER: Total %	85	GE	

Comp. sum 100%	Dp Pool	L.O.D.	Boulder	In Veg	Over Veg	Cutbank
	10	15	40	5	20	10

Crown Closure % 80 Aspect SW

	% BED MATERIAL	%
Fines	clay,silt,sand (<2mm)	10
Gravels	small (2-16mm)	10
	large (16-64mm)	30
Larges	sm.cobble (64-128mm)	30
	lge.cobble (128-256mm)	30
	boulder (>256mm)	70
Bedrock		Ø

D₉₀(cm) 40 Compaction L [✓ M] H

BANKS			
Height(m) 0.8	%Unstable 10		
Texture	[✓ F] [✓ G] [✓ L] R		
Confinement	[✓ EN] CO FC OC UC N/A		
Valley: Channel Ratio	[✓ 0-2] 2-5 5-10 10+ N/A		
Stage	Dry [✓ L] M H Flood		
Flood Signs Ht(m) 0.7	Braided Y [✓ N]		
Bars (%) Ø	pH 8.0	O₂(ppm) /	
Water Temp.(°C) 8.0	Turb.(cm) /	Cond.(25°C) /	

OBSTRUCTIONS			
C	Ht(m)	Type	Loc'n
1	0.3	CV	Road
	5.0	C	.637
	4.0	C	.582
	2.0	C	.286
	3.0	F	.195
	3.3	F	.160

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m³/s)			

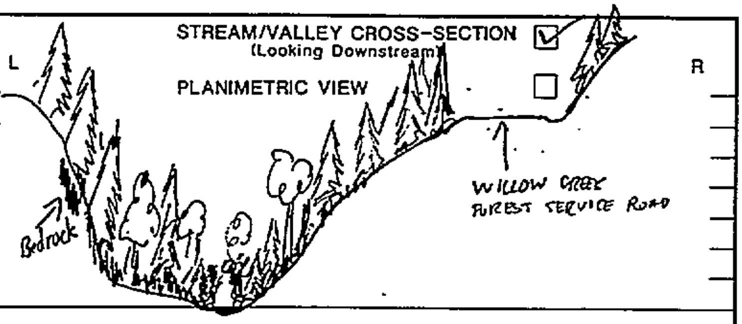
REACH SYMBOL
(Fish)
Ø
1, A, 20 | 1, 3, 6, 0
(Width, Valley:Channel, Slope) (Bed Material)

REVISED DEC. 87 SS187

C	[illegible]	No.	Size Range (mm)	[illegible]	Use	[illegible]
2	Ø	Ø				EL/MT

415 seconds effort

STREAM/VALLEY CROSS-SECTION ☑
(Looking Downstream)
PLANIMETRIC VIEW ☐



COMMENTS

Channel Stability ☐; Debris ☐; Management Concerns ☐; Obstructions ☑; Riparian Zone ☐; Valley Wall Processes ☐; Etc.

1. Culvert under Willow Creek Forest Service Road may be an obstruction to fish, especially during low flows or to juveniles. (30 cm. drop).

2. Electrofished 170 m (415 seconds effort) in best locations and no fish were captured or observed.

Two baited Gee Traps were set August 26-31, NO FISH CAPTURED. (checked daily)

3. Steep gradients throughout - primarily chutes and pools.

Edited by:
Date Y M D:

DFO / MOE
STREAM SURVEY FORM

Stream Name (gaz.)	(local) TRIBUTARY 1	Access	V4/FT
Watershed Code	Reach No. 1	Length(km)	.980 HC
Location (0+130) 130 m u/s from confluence with Willow Creek	Map 93-0	Sub-reach 1	.980 HC
	U.T.M.	Y [✓ N]	☑ ☐
Date 96 10 10	Time 1725	Agency NDM	Crew TP/ /
Photos 11A(19A,18A	Air Photos		

PARAMETER	VALUE	METH.	SPECIFIC DATA 17A, 16A, 15A, 14A.
Ave.Chan.Width (m)	2.5	GE	
Ave.Wet.Width (m)	1.2	GE	
Ave.Max.Riffle Depth (cm)	12	T	
Ave.Max.Pool Depth (cm)	35	T	
Gradient %	30-35	CL	
Pool 20 Riffle 15 Glide 05 Other 60		GE	
Side Chan. % 0 1 ☐ ☑ ☐ ☐		GE	
Debris Area % 25 ☐ ☐ ☐ ☐		GE	
Debris Stable %	75	GE	
COVER: Total %	80	GE	

Comp. sum 100%	Dp Pool	L.O.D.	Boulder	In Veg	Over Veg	Cutbank
	15	30	40	0	10	5

Crown Closure % 85 | Aspect W.

OBSTRUCTIONS			
No.	Ht.(m)	Type	Loc'n
1	1.7	C	.038
2	3.3	F	.160
3	3.0	F	.195
4	2.0	C	.286
5	4.0	C	.582
6	5.0	C	.637

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	5
	large (16-64mm)	10
Cobbles	sm.cobble (64-128mm)	15
Larges	lge.cobble (128-256mm)	30
	boulder (>256mm)	30
Bedrock		5
D_{90}(cm) 120	Compaction L [✓ M] [✓ H]	

BANKS			
Height(m) 2.5	%Unstable 20		
Texture	F G [✓ L] [✓ R]		
Confinement	[✓ EN] CO FC OC UC N/A		
Valley: Channel Ratio	[✓ 0-2] 2-5 5-10 10+ N/A		
Stage	Dry L [✓ M] H Flood		
Flood Signs Ht(m) 0.8	Braided Y [✓ N]		
Bars (%) /	pH /	O_2(ppm) /	
WaterTemp.(°C) 5.5	Turb.(cm) /	Cond.(25°C) /	

DISCHARGE			
Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m^3/s)			

REACH SYMBOL
(Fish)

2.5, A, 33 | 1,1,7,1

(Width,Valley:Channel,Slope) (Bed Material)

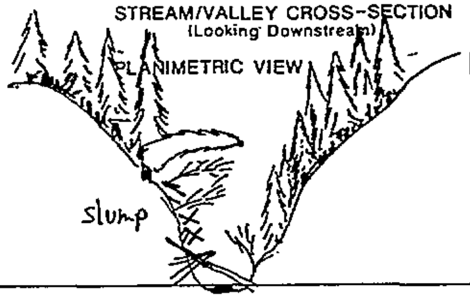
REVISED DEC 87 SS187

C	Species	No.	Size Range(mm)		Use	Method/Ref.

STREAM/VALLEY CROSS-SECTION ☑
(Looking Downstream)

PLANIMETRIC VIEW ☐

L R



COMMENTS

Channel Stability ☐; Debris ☑; Management Concerns ☐; Obstructions ☑; Riparian Zone ☐; Valley Wall Processes ☑; Etc.

1. Entire reach is steep (20-35%) with falls and chutes throughout. Only major obstructions noted on this form.

2. Large slump near 0+160 encroaching into channel. (30m u/s)

3. Electrofishing and Gee trapping conducted above and below 0+980 (Forest Service Road) in August, 96. No fish captured or observed. Results on seperate reach card.

Edited by:

Date Y M D:

DFO / MOE
STREAM SURVEY FORM

Stream Name (gaz.) (local) TRIBUTARY 2 | Access V2/FT | Method

Watershed Code | 1 | Length(km) 0.655 | HC

Location (0+225) - 225 metres u/s from Confluence with Willow Creek. | 93-0 | 1 | 0.655 | HC

U.T.M. | Y [✓ N] | ☑ ☐

Date Y M D 96 09 26 | 1615 | NDM | TP/LM/ | Photos 1,2,3 | Air Photos /

C	PARAMETER	VALUE	METH.	SPECIFIC DATA
	Ave.Chan.Width(m)	2.0	GE	
	Ave.Wet.Width(m)	1.5	GE	
	Ave.Max.Riffle Depth (cm)	12	GE	
	Ave.Max.Pool Depth (cm)	35	GE	
	Gradient	20-25%	CL	
	20 Riffle 20 10 50		GE	
	Side Chan % Ø ☑ ☐ ☐ ☐		GE	
	Debris Area % 7/5 ☐ ☐ ☐ ☑		GE	
	Stable %	80	GE	
	COVER: Total %	80	GE	

Comp. sum 100%	Dp Pool	L.O.D.	Boulder	In Veg	Over Veg	Cutbank
	10	25	40	0	20	5

Crown Closure % 50 | Aspect W

OBSTRUCTIONS		
Hgt(m)	Type	Loc'n
1.3	CV	.655
1.2	C	.450
3(1.0)	C	.275
1.1	C	.225
1.2	C	.165
1.6	C	0.073

C	BED MATERIAL		%
		clay,silt,sand (<2mm)	5
	Gravels	small (2-16mm)	10
		large (16-64mm)	15
		sm.cobble (64-128mm)	15
		lge.cobble (128-256mm)	20
		boulder (>256mm)	33
	Bedrock		2

D_{90}(cm) 90 | Compaction L [✓ M] H

C	BANKS			
	Height(m)	1.1	%Unstable	15
	Texture	F [✓ G] [✓ L] R		

Confinement [✓ EN] CO FC OC UC N/A

Valley: Channel Ratio [✓ 0-2] 2-5 5-10 10+ N/A

Stage: Dry [✓ L] M H Flood

Flood Signs Ht(m) 0.8 | Braided Y [✓ N]

Bars (%) 1-5 | pH / | O_2(ppm) /

Water Temp.(°C) 4 | Turb.(cm) / | Cond.(25°C) /

	DISCHARGE		
Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m³/s)			

REACH SYMBOL
(Fish)

2, A, 22.5 | 1,2,7,0

(Width,Valley:Channel,Slope) (Bed Material)

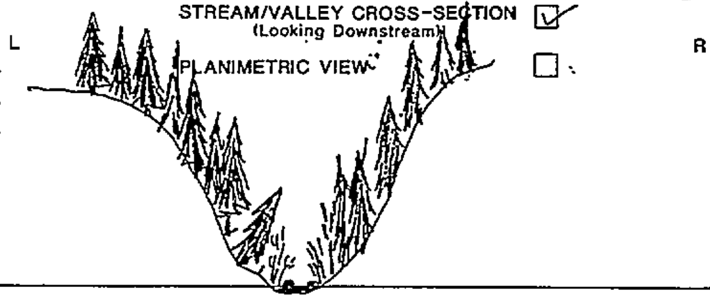
REVISED DEC 87 SS187

TRIB 2 Reach 1, SITE ONE

C	Species	No.	Size Range(mm)		Use	

STREAM/VALLEY CROSS-SECTION ☑
(Looking Downstream)

PLANIMETRIC VIEW ☐



COMMENTS

Channel Stability ☐; Debris ☐; Management Concerns ☐; Obstructions ☑; Riparian Zone ☐; Valley Wall Processes ☐; Etc.

- culverts at Forest Service road are u/s limit of this reach (obstruction).
- Reach is predominantly chutes and pools with much deadfall and windthrow across stream. Gradient ranges from 12-25%, averages 20-25%

- Only chutes and obstructions greater than 1 metre vertical were recorded and mapped. (Numerous chutes approx 1 m. vertical and less exist throughout this reach.)

- Electroshocking and Gee trap success noted on seperate reach card. during August Fisheries sampling work. No fish were captured.

Edited by:

Date Y M D:

DFO / MOE
STREAM SURVEY FORM

[illegible] (gaz.)	(local) Tributary 2	Access	V2/FT	Method	
[illegible]		[illegible] 1 (2+3)	Length(km)		
Location 100 m d/s of Forest Service Road and	[illegible] 93/0	[illegible] 2	[illegible]	.200	GE
50 m of each branch immediately above ROAD.	U.T.M.	[illegible] [✓ Y] N	[illegible] ☑	☐	
[illegible] 96 08 30	[illegible] 1430	[illegible] NDM [illegible] TP/LM/	Photos 15A, 16A	Air Photos	

C	PARAMETER	VALUE	METH.	SPECIFIC DATA
	[illegible]	1.2	SC	
	[illegible]	1.0	SC	
	Ave.Max.Riffle Depth (cm)	6	T	
	Ave.Max.Pool Depth (cm)	50	T	
1	Gradient %	8-23%	CL	
	[illegible] 30 [illegible] 10 [illegible] 10 [illegible] 50		GE	
	Side Chan. 0		GE	
	Area%		GE	
	Stable %	60%	GE	
	COVER: Total %	80%	GE	

Comp. sum 100%	Dp Pool	L.O.D.	Boulder	In Veg	Over Veg	Cutbank
	30	30	20	0	15	5

Crown Closure % 75 | Aspect SW

C	BED MATERIAL	%
	clay,silt,sand (<2mm)	5
	small (2-16mm)	10
	large (16-64mm)	15
	sm.cobble (64-128mm)	20
	lge.cobble (128-256mm)	20
	boulder (>256mm)	30
	Bedrock	0

D_{90}(cm) 60 | Compaction L [✓ M] H

C	BANKS					
	Height(m) 1.0	%Unstable 10				
	Texture	F	[✓ G]	[✓ L]	R	
	Confinement	[✓ EN]	CO	FC	OC	UC N/A
	Valley: Channel Ratio	[✓ 0-2]	2-5	5-10	10+	N/A
	Stage	Dry	[✓ L]	M	H	Flood
	Flood Signs Ht(m) 0.8	Braided	Y	[✓ N]		
	Bars (%) 0	pH 8.2	O_2(ppm) /			
	Water Temp.(°C) 9.0	Turb.(cm) /	Cond.(25°C) /			

OBSTRUCTIONS			
C	Ht(m)	Type	Loc'n
2	1.3	CV	ROAD
	1.2	C	.450
3	(1.6)	C	.275
	1.1	C	.225
	1.2	C	.165
	1.6	C	.073

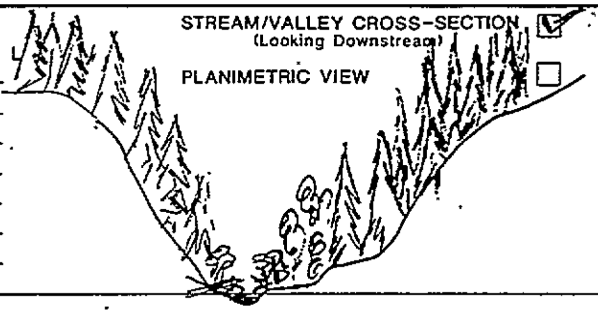
DISCHARGE			
Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m³/s)			

REACH SYMBOL
(Fish)
0
1, A, 20 | 1, 2, 8, 0
(Width,Valley:Channel,Slope) (Bed Material)

REVISED DEC 87 SS187

C	[illegible]	No.	Size Range(mm)	[illegible]	Use	[illegible]
3	0	0				EL/MT
698 seconds effort						

STREAM/VALLEY CROSS-SECTION ☑
(Looking Downstream)
PLANIMETRIC VIEW ☐



COMMENTS

Channel Stability ☐, Debris ☐, Management Concerns ☐, Obstructions ☑, Riparian Zone ☐, Valley Wall Processes ☐, Etc.

1. steep gradient with chutes and pools throughout.

2. Culverts under Willow Creek Forest Service Road are an obstruction to fish. (photo #16A)

~ 1.3 m drop from culvert(s) invert (outlet) to streambed

3. Electrofished 200 metres (698 seconds effort) - no fish captured OR observed.

Two Gee traps were baited and set August 26-31, NO FISH CAPTURED.

Edited by:
Date Y M D:

DFO / MOE
STREAM SURVEY FORM

Stream Name (gaz.)	(local) Tributary 2		Access	V4 FT	Method
Watershed Code		Reach No. 2	Length(km)	1.0	HC
Location 0+485 u/s Northerly Branch of Trib. 2 in u/s of Willow Creek Forest Service Road	Map	Site No. 1		1.0	HC
	U.T.M.	Y [✓ N]		Field ☑	☐
Date 96 10 10	Time 1330	Agency NDM	Crew TP /	Photos 5A, 9A, 10A	Air Photos

C	PARAMETER	VALUE	METH.	SPECIFIC DATA
	Ave.Chan.Width (m)	1.5	GE	
	Ave.Wet.Width (m)	1.2	GE	
	Ave.Max.Riffle Depth (cm)	12	GE	
	Ave.Max.Pool Depth (cm)	30	GE	
	Gradient %	20	CL	
	30 / 15 / 05 / 50		GE	
	Sid.Chan. % 0 ☐ ☐ ☐ ☐		GE	
	Area 15 ☐ ☐ ☑ ☐		GE	
	Debris Stable %	50	GE	
	COVER: Total %	80	GE	

Comp. sum 100%	Dp Pool	L.O.D.	Boulder	In Veg	Over Veg	Cutbank
	15	30	40	0	10	5

Crown Closure % 30 | Aspect W

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	10
	Gravels	small (2-16mm)	10
		large (16-64mm)	15
		sm.cobble (64-128mm)	20
		lge.cobble (128-256mm)	20
		boulder (>256mm)	20
	Bedrock		5

D_{90}(cm) 85 | Compaction L [✓ M] [✓ H]

C	BANKS			
	Height(m) 1.5	%Unstable 10		
	Texture	F [✓ G] [✓ L] [✓ R]		
	Confinement	[✓ EN] [✓ CO] FC OC UC N/A		
	Valley: Channel Ratio	[✓ 0-2] 2-5 5-10 10+ N/A		
	Stage	Dry L [✓ M] H Flood		
	Flood Signs Ht(m) 0.8	Braided	Y [✓ N]	
	Bars (%) 0	pH /	O_2(ppm) /	
	Water Temp.(°C) 5.5	Turb.(cm) /	Cond.(25°C) /	

OBSTRUCTIONS			
C	Ht(m)	Type	Loc'n
	1.3	CV	0+00
	1.2	C	.138
	1.5	C	.246
	1.0	C	.278
	1.2	C	.472
	1.2	C	.485

DISCHARGE

	Parameter	Value	Method	Specific Data
	Wetted Width (m)			
	Mean Depth (m)			
	Mean Velocity (m/s)			
	Discharge (m^3/s)			

REACH SYMBOL (Fish)

1.5, A, 20 | 1, 2, 6, 0

(Width,Valley:Channel,Slope) (Bed Material)

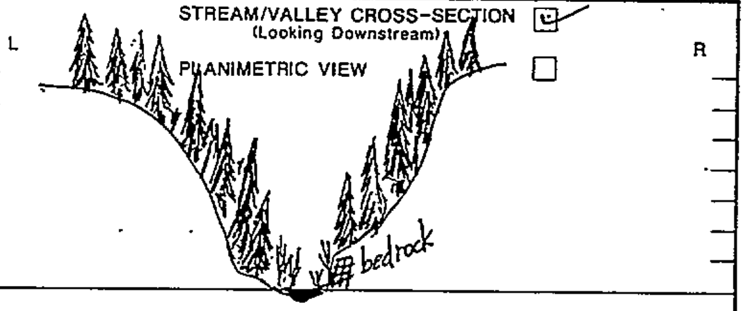
REVISED DEC 87 SS187

TRIB 2 REACH 2 SITE ONE

C	Species	No.	Size Range (mm)	Age	Use	Comments

STREAM/VALLEY CROSS-SECTION (Looking Downstream) ☑

PLANIMETRIC VIEW ☐



COMMENTS

Channel Stability ☐; Debris ☐; Management Concerns ☐; Obstructions ☑; Riparian Zone ☐; Valley Wall Processes ☐; Etc.

- Reach is predominantly chutes and pools with much deadfall across stream channel. Gradient averages ~25% (2%-30%)
- Only chutes and obstructions greater than 1 m vertical were mapped as numerous chutes near 1 m and less exist.
- Electrofishing / Gee traps set d/s August, 1996. No fish captured. Data on different reach card.

Edited by:

Date Y M D:

DFO / MOE
STREAM SURVEY FORM

Stream Name (gaz.)	(local) TRIBUTARY 2		Access	V4/FT	Method
Watershed Code		3	Length(km)	1460	HC
Location 0+260m u/s Southerly branch of Trib2	93-0	1		1460	HC
u/s of Willow Creek Forest Service Road	U.T.M.		Y [✓ N]	☑ ☐	
96 09 29	1700	NDM	TP/ /	Photos 6A, 8A	Air Photos

PARAMETER	VALUE	METH.	SPECIFIC DATA
	1.4	GE	
	1.2	GE	
Ave.Max.Riffle Depth (cm)	10	GE	
Ave.Max.Pool Depth (cm)	30	GE	
Gradient %	18	CL	
20 | 15 | 10 | 55		GE	
Side Chan. 0 ☐ ☐ ☐ ☐		GE	
Debris Area % 05 ☐ ☐ ☐ ☐		GE	
Stable %	80	GE	
COVER: Total %	75	GE	

Comp. sum 100%	Dp Pool	L.O.D.	Boulder	In Veg	Over Veg	Cutbank
	15	15	40	0	15	15

Crown Closure % 40 | Aspect W

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	5
	large (16-64mm)	15
	sm.cobble (64-128mm)	15
Larges	lge.cobble (128-256mm)	30
	boulder (>256mm)	30
Bedrock (R)		0

D_{90}(cm) 90 | Compaction L M [✓ H]

BANKS			
Height(m)	1.1	%Unstable	5
Texture	F G [✓ L] R		
Confinement	[✓ EN] CO FC OC UC N/A		
Valley: Channel Ratio	0-2 [✓ 2-5] 5-10 10+ N/A		
	Dry L [✓ M] H Flood		
Flood Signs Ht(m)	0.7	Braided	Y [✓ N]
Bars (%)	/	pH	8.0
O_2(ppm)	/		
Water Temp.(°C)	3.5	Turb.(cm)	/
Cond.(25°C)	/		

OBSTRUCTIONS	Type	Loc'n
1.3	CV	0+000
1.0	C	0+031
.5-1.0	C	0+065
.5-1.0	C	0+330
1.1	C	0+380

DISCHARGE			
Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m³/s)			

REACH SYMBOL (Fish)

1.4, B, 18 | 1,2,7,0

(Width,Valley:Channel,Slope) (Bed Material)

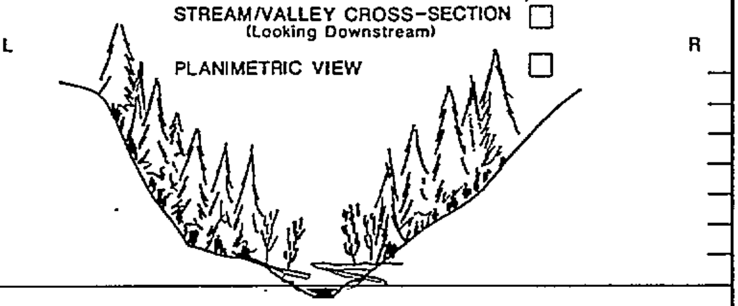
REVISED DEC 87 SS187

TRIB 2 REACH3 SITE ONE

C	Species	No.	Size Range(mm)		Use	

STREAM/VALLEY CROSS-SECTION ☐ (Looking Downstream)

PLANIMETRIC VIEW ☐



COMMENTS

Channel Stability ☐; Debris ☐; Management Concerns ☐; Obstructions ☑; Riparian Zone ☐; Valley Wall Processes ☐; Etc.

- Numerous chutes and pools throughout reach. Only larger chutes have been mapped ie: greater than 1.0 m vertical. Several locations with a series of 0.5 m chutes are noted
- Electrofishing / Gee traps set d/s August, 1996. No fish captured. Data on different reach card.
- Mapped this reach to 1460 metres u/s from road where it forks again and flows are intermittent above ground.

Edited by:
Date Y M D:

DFO / MOE
STREAM SURVEY FORM

Stream Name (gaz.) (local) Tributary 3 (Trib 3)
Access V4
Method
Watershed Code
1
Length(km)
Location 100 m u/s and 65 m d/s of Culvert under Willow Creek Forest Service Road
Map 93/0
1
165 HC
U.T.M.
[✓ Y] N
✓
Date Y M D 96 08 29
Time 1700
NDM TP/LM /
Photos 14A
Air Photos

C	PARAMETER	VALUE	METH.	SPECIFIC DATA
	Ave.Chan.Width (m)	2.0	SC	
	Ave.Wet.Width (m)	1.5	SC	
	Ave.Max.Riffle Depth (cm)	8	T	
	Ave.Max.Pool Depth (cm)	35	T	
	Gradient %	5-8%	CL	
	% Pool 20, Riffle 40, Run 20, Other 20		GE	
	Side Chan %	Ø	GE	
	Debris Area %	✓	GE	
	Debris Stable %	80%	GE	
	COVER: Total %	80%	GE	

Comp. sum 100%	Dp Pool	L.O.D.	Boulder	In Veg	Over Veg	Cutbank
	25	5	40	Ø	20	10

Crown Closure % 75
Aspect SW

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	5
	Gravels	small (2-16mm)	10
		large (16-64mm)	20
		sm.cobble (64-128mm)	20
		lge.cobble (128-256mm)	30
		boulder (>256mm)	15
	Bedrock		Ø

D$_{90}$(cm) 50
Compaction L [✓ M] H

C	BANKS			
	Height(m)	1.3	%Unstable	5
	Texture	F [✓ G] [✓ L] R		

Confinement EN [✓ CO] FC OC UC N/A
Valley: Channel Ratio 0-2 2-5 [✓ 5-10] 10+ N/A
Dry [✓ L] M H Flood
Flood Signs Ht(m) 1.0
Braided Y [✓ N]
Bars (%) Ø
pH 8.3
O$_2$(ppm) /
Water Temp.(°C) 9.0
Turb.(cm) /
Cond.(25°C) /

C	OBSTRUCTIONS	Type	Loc'n
	0.7	C	.152
	0.4	C	.436
	0.6	C	.538
	1.1	C	.993
	1.6	C	1.135

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m^3/s)			

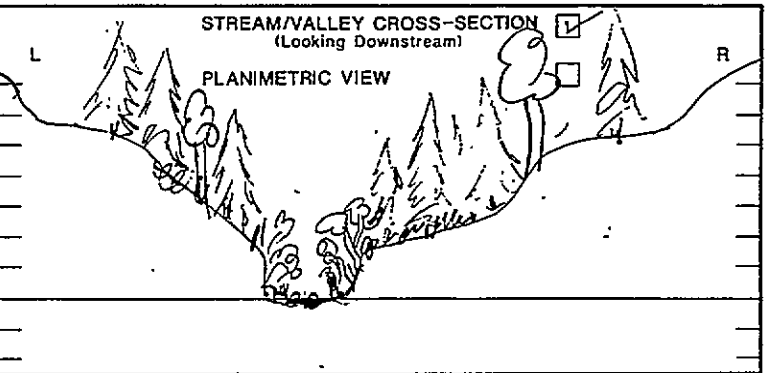
REACH SYMBOL
(Fish)
Ø
2, C, 6 | 1, 3, 6, 0
(Width,Valley:Channel,Slope) (Bed Material)

REVISED DEC. 87 SS187

FISH SUMMARY

C	Species	No.	Size Range (mm)	Age Class	Use	Method
1	Ø	Ø				EL/MT
	463 seconds effort					

STREAM/VALLEY CROSS-SECTION ☑
(Looking Downstream)
PLANIMETRIC VIEW ☐



COMMENTS

Channel Stability ☐; Debris ☐; Management Concerns ☐; Obstructions ☐; Riparian Zone ☐; Valley Wall Processes ☐; Etc.

1 • : Confluence of Trib 3 and Willow Creek is only 65 m downstream of culvert on Forest Service Road. (Confluence located downstream end of this reach.) Also electroshocked 100 m. section of Willow Creek immediately above confluence. - no fish captured or observed. (267 seconds)

- Two Gee traps set in this site August 26 - 31 resulted in no fish captured.

- Electrofished 463 seconds in Trib 3 - NO FISH CAPTURED

Edited by:
Date Y M D:

DFO / MOE
STREAM SURVEY FORM

(gaz.) (local) TRIBUTARY 3 | Access V4 | FT | Method

Length(km) 1500 | HC

1500 | HC

(0+995) .995 metres u/s from confluence with Willow Creek. | 93-0 | 1 | 2

U.T.M. | Y [✓ N]

91 09 29 | 1400 | NDM | TP/ / | Photos 2A, 3A | Air Photos

	PARAMETER	VALUE	METH.	SPECIFIC DATA
	[illegible]	1.8	GE	
	[illegible]	1.5	GE	
	Ave.Max.Riffle Depth (cm)	15	GE	
	Ave.Max.Pool Depth (cm)	40	GE	
	Gradient	6%	CL	
	40 Riffle 20 Pool 10 30		GE	
	01 ☐ ☐ ☑ ☐ ☐		GE	
	Debris Area 03 ☐ ☐ ☑ ☐ ☐		GE	
	Stable %	70	GE	
	COVER: Total %	80	GE	

Comp. sum 100%	Dp Pool	L.O.D.	Boulder	In Veg	Over Veg	Cutbank
	30	15	20	5	25	5

Crown Closure % 80 | Aspect W

OBSTRUCTIONS

C	[illegible]	Type	Loc'n
	0.7	C	.152
	0.4	C	.436
	0.6	C	.538
	1.1	C	.993
	1.0	C	1.135

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	5
	Gravels	small (2-16mm)	5
		large (16-64mm)	20
		sm.cobble (64-128mm)	20
	Larger	lge.cobble (128-256mm)	20
		boulder (>256mm)	29
	Bedrock		01

D_{90}(cm) 50 | Compaction [✓ L] [✓ M] H

C	BANKS			
	Height(m)	1.2	%Unstable	5

Texture [✓ F] [✓ G] L R

Confinement EN CO [✓ FC] OC UC N/A

Valley: Channel Ratio 0-2 2-5 [✓ 5-10] 10+ N/A

Stage Dry L [✓ M] H Flood

Flood Signs Ht(m) 1.0 | Braided Y [✓ N]

Bars (%) 0 | pH 8.0 | O_2(ppm) /

Water Temp.(°C) 3.5 | Turb.(cm) / | Cond.(25°C) /

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m³/s)		Staff gauge d/s @ Trib3 = 0.238m	

REACH SYMBOL
(Fish)

1.8, C, 6 | 1, 2, 7, 0

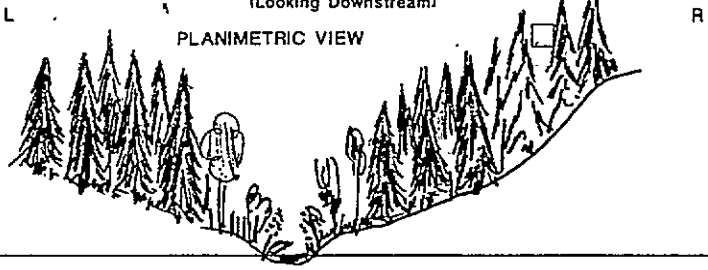
(Width,Valley:Channel,Slope) (Bed Material)

REVISED DEC. 87 SS187

C	[illegible]	No.	Size Range(mm)	[illegible]	Use	[illegible]

STREAM/VALLEY CROSS-SECTION ☑
(Looking Downstream)

PLANIMETRIC VIEW ☐



COMMENTS

Channel Stability ☐; Debris ☐; Management Concerns ☐; Obstructions ☑; Riparian Zone ☐; Valley Wall Processes ☐; Etc.

- Electrofishing, Gee traps set d/s from near staff gauge to confluence with Willow Creek. No fish captured or observed. (seperate reach card).
- Trib 3 not as steep as Trib 1 and Trib 3. Reach mapped has repetitious chutes and pools. Only larger chutes recorded on this form.

Edited by:

Date Y M D:

DFO / MOE
STREAM SURVEY FORM

[illegible] (gaz.)	(local) Middle Creek (MC1)		Access	V2	Method
[illegible]		[illegible]	Length(km)		
[illegible] 50m u/s and 180m d/s of road	[illegible] 93/0	[illegible] 1	[illegible]	230	GE
crossing at weir/water quality station	U.T.M.	[illegible]	[✓ Y] N	[illegible] ☐	[illegible] ☐
[illegible] 960830 [illegible] 1730	[illegible] TP/LM/	Photos 18A	Air Photos		

	PARAMETER	VALUE	METH.	SPECIFIC DATA
	[illegible]	1.0	GE	
	[illegible]	0.6	GE	Stream enters ground approx 70m from
	Ave.Max.Riffle Depth (cm)	7	T	Wetland backed up behind BCR tracks.
	Ave.Max.Pool Depth (cm)	40	T	
4	Gradient	5-20%	CL	
	[illegible] 50 [illegible] 10 [illegible] 10 [illegible] 30		GE	
	[illegible] 03 ☐ ☑ ☐ ☐		GE	
	[illegible] 00 ☐ ☐ ☐ ☑		GE	
	Stable %	85%	GE	
	COVER: Total %	80%	GE	

Comp. sum 100%	Dp Pool	L.O.D.	Boulder	In Veg	Over Veg	Cutbank
	20	20	10	5	20	25

Crown Closure % 70 | Aspect NW

OBSTRUCTIONS C	[illegible]	Type	Loc'n
5	3.0	CV	.25

BED MATERIAL		%
[illegible]	clay,silt,sand (<2mm)	20
Gravels	small (2-16mm)	25
	large (16-64mm)	20
[illegible]	sm.cobble (64-128mm)	15
Large	lge.cobble (128-256mm)	15
	boulder (>256mm)	5
[illegible]		0

D

D_{90}(cm) 40 | Compaction [✓ L] M H

BANKS			
Height(m) 1.2	%Unstable 5		
Texture	[✓ F] [✓ G] [✓ L] R		
Confinement	EN [✓ CO] FC OC UC N/A		
Valley: Channel Ratio	0-2 [✓ 2-5] 5-10 10+ N/A		
Stage	Dry [✓ L] M H Flood		
Flood Signs Ht(m) 0.5	Braided	Y [✓ N]	
Bars (%) 5	pH 8.1	O_2(ppm) /	
Water Temp.(°C) 8.0	Turb.(cm) /	Cond.(25°C) /	

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth(m)			
Mean Velocity (m/s)			Staff gauge = 0.215m
Discharge (m^3/s)			Head on weir = 0.060m

REACH SYMBOL

0

1,B,15 | 2,5,3,0

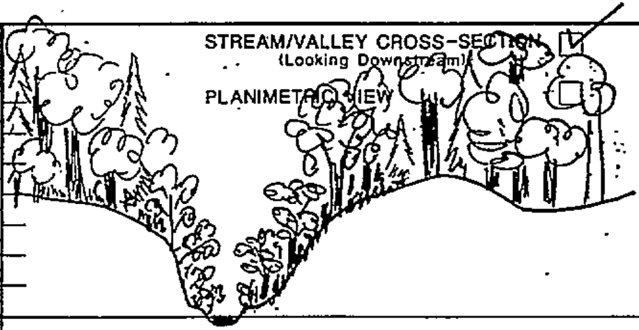
(Width,Valley:Channel,Slope) (Bed Material)

REVISED DEC. 87 SS187

C	Species	No.	Size Range(mm)	[illegible]	Use	[illegible]
2	0	0				EL/MT
3	C	69	25-90MM			MT
	0	0				EL

1 Gee trap set in Wetlands below creek outlet from August 12-16, 1996

Electoshocked margin of wetland 269 seconds - NO FISH CAPTURED



STREAM/VALLEY CROSS-SECTION ☑ (Looking Downstream)

PLANIMETRIC VIEW ☐ 5

R

COMMENTS

Channel Stability ☐, Debris ☐, Management Concerns ☑, Obstructions ☐, Riparian Zone ☐, Valley Wall Processes ☐, Etc.

1. - Stream enters silty fan approx 70 m. from wetland backed up beside BCR track and water disappears underground. (Several small channels entering Wetland appear to be used at freshet.)
2. Electroshocked 346 seconds - NO FISH / 1 BAITED GEE TRAP SET AUGUST 26-31 - NO FISH CAUGHT OR OBSERVED.
3. - * No habitat card for Wetland. Gee trap set in wetland caught 69 cyprinids (redside shiner or spottail) between Aug. 12-16. (checked daily)
4. Stream becomes steep near road and upstream/primarily chutes and pools.
5. Culvert at road definite obstruction (~3m drop)

Edited by:

Date Y M D:

DFO / MOE
STREAM SURVEY FORM

[illegible] (gaz.)	(local) FAR EAST CREEK (FEC1)	Access	V2/FT	Method	
[illegible]		[illegible]		Length(km)	
[illegible] 50m U/S and 80m d/s of	[illegible] 93/0	[illegible]	1	[illegible]	130 GE
Staff gauge/weir (water quality site)	U.T.M.	[illegible]	[✓ Y] N	[illegible]	☑ ☐
[illegible] 96/08/30 [illegible] 1630 [illegible] NDM [illegible] TP/LM/	Photos 19,20,21,22	Air Photos	/		

C	PARAMETER	VALUE	METH.	SPECIFIC DATA
	[illegible]	2	T	
	[illegible]	1.1	T	
	Ave.Max.Riffle Depth (cm)	8	T	
	Ave.Max.Pool Depth (cm)	45	T	
	[illegible]	5-12%	CL	
	[illegible] 30 [illegible] 25 [illegible] 15 [illegible] 30		GE	
	[illegible] 03 ☐ ☑ ☐ ☐		GE	
	[illegible] 15 ☐ ☐ ☑ ☐		GE	
	Stable %	30	GE	
	COVER: Total %	80		

Comp. sum 100%	Dp Pool	L.O.D.	Boulder	In Veg	Over Veg	Cutbank
	25	20	10	5	20	80

Crown Closure % 50 | Aspect N

C	BED MATERIAL		%
	[illegible]	clay,silt,sand (<2mm)	20
	[illegible]	small (2-16mm)	30
		large (16-64mm)	20
	[illegible]	sm.cobble (64-128mm)	10
		lge.cobble (128-256mm)	10
		boulder (>256mm)	10
	[illegible]		0

D₉₀(cm) 50 | Compaction [✓ L] M H

C	BANKS			
	Height(m)	1.1	%Unstable	10
	Texture	[✓ F] [✓ G] [✓ L] R		

Confinement [✓ EN] CO FC OC UC N/A

Valley: Channel Ratio 0-2 [✓ 2-5] 5-10 10+ N/A

[illegible] Dry [✓ L] M H Flood

Flood Signs Ht(m) 0.7 | Braided Y [✓ N]

Bars (%) 5 | pH 8.3 | O₂(ppm) /

Water Temp.(°C) 8.5 | Turb.(cm) / | Cond.(25°C) /

OBSTRUCTIONS			
C	[illegible]	Type	Loc'n
3	1.1	C	.75
3	0.7	Weir	1.1

DISCHARGE

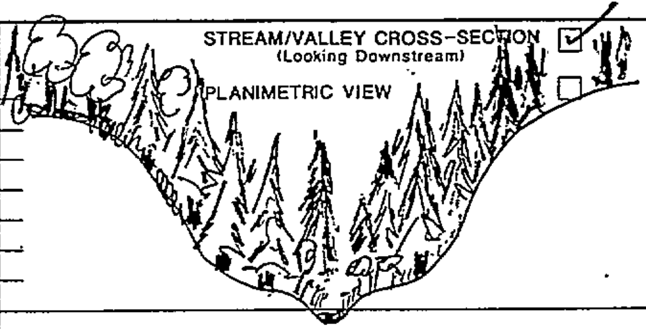
Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)		Sept.1	head on weir ≈ 0.103m
Discharge (m³/s)			staff gauge ≈ 0.150m

REACH SYMBOL
(Fish)
0
2, B, 8 | 2, 5, 3, 0
(Width,Valley:Channel,Slope) (Bed Material)

REVISED DEC. 87 SS187

C	[illegible]	No	Size Range(mm)	[illegible]	Use	[illegible]
4	0	0				EL/MT
	266 seconds effort					

STREAM/VALLEY CROSS-SECTION ☑
(Looking Downstream)
PLANIMETRIC VIEW ☐
R



COMMENTS

Channel Stability ☐, Debris ☐, Management Concerns ☐, Obstructions ☑, Riparian Zone ☐, Valley Wall Processes ☐, Etc.

4 • Electroshocked 266 seconds - NO FISH CAPTURED OR OBSERVED
• GEE TRAP SET 40 m d/s of log/chute obstruction in photo. (0.7 Km) FOR 6 DAYS (checked regularily) NO FISH CAPTURED

• CREEK ENTERS GROUND IN DENSE BUSH ~ 40 m. FROM BCR TRACKS/ 1 GEE TRAP SET ~ 80 m U/S OF THAT LOCATION AUGUST 12 - 15, NO FISH CAPTURED.

3 • Obstruction (large logs started dam on creek and filled with sediment.) (0.7 Km from outlet) Photo 19A, 20A.

3 • Weir noted as obstruction also at approx: 1.1 Km

Edited by:
Date Y M D:

APPENDIX 4.6-3

STREAM PHOTOGRAPHS

Willow Creek Site 1. Looking downstream from near small bridge. August 27, 1996.

PHOTO 1

Willow Creek Site 1. Looking downstream. August 27, 1996.

PHOTO 2

Willow Creek Site 2. Facing downstream. August 28, 1996.

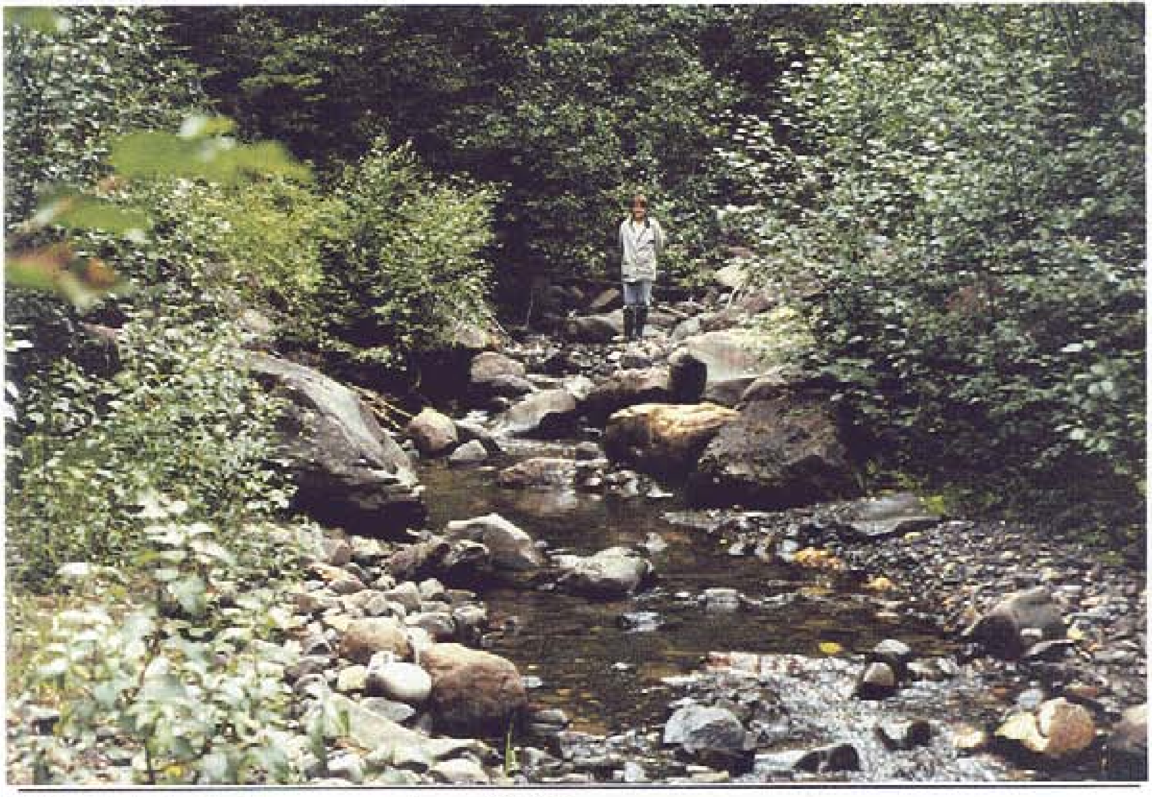
PHOTO 3

Willow Creek Site 3. Pool at base of falls. August 28, 1996.

PHOTO 4

Willow Creek Site 4. Immediately above falls. August 29, 1996.

PHOTO 5



Willow Creek Site 5 looking upstream. August 30, 1996.

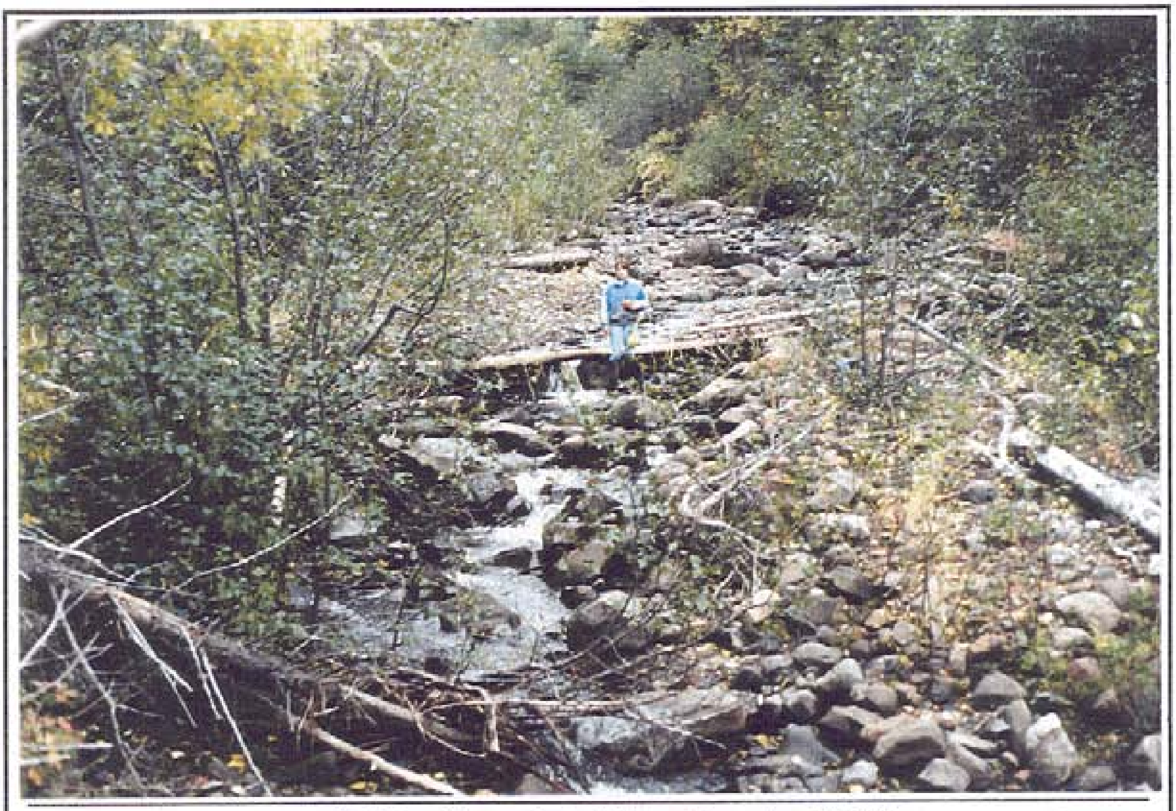
PHOTO 6

Willow Creek Site 7. WC2 site. Facing upstream just downstream of gauge.

PHOTO 7

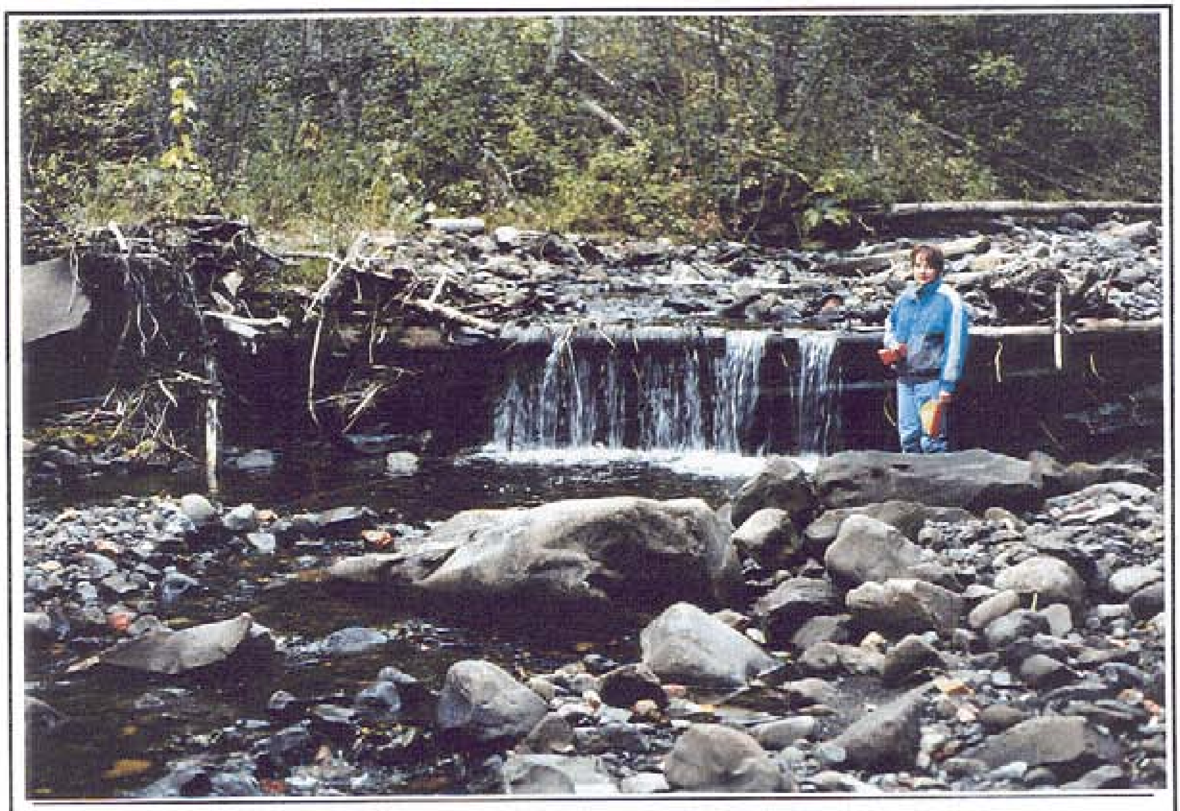
Willow Creek 876m above outlet. Site 'A'. Typical habitat for this part of the creek. September 26, 1996.

PHOTO 8



Willow Creek 112m upstream of Trib 2 confluence. Typical habitat. September 26, 1996.

PHOTO 9



Willow Creek 172m above Trib 2 showing 1.4m obstruction. September 26, 1996.

PHOTO 10

Willow Creek 2.24km upstream of Trib 2 facing upstream. September 29, 1996..

PHOTO 10

Willow Creek 2.6km upstream of Trib 2. September 29, 1996.

PHOTO 11

Trib 1 confluence with Willow Creek. Willow Creek (foreground) flows to the left. October 10, 1996.

PHOTO 13

Trib 1 50m upstream of confluence and 120m downstream of road culvert. August 30, 1996.

PHOTO 14

Trib 1, Reach 1, Site 1, 130m upstream of Willow Creek. Multiple chutes, much debris and large organic debris. October 10, 1996.

PHOTO 15

Trib 1, Reach 1. Falls at 160m above Willow Creek. 3.3m obstruction. October 10, 1996.

PHOTO 16

Trib 1, Reach 1, 195m above Willow Creek. 3m falls. October 10, 1996.

PHOTO 17

Trib 1, Reach 1, 250m above mouth. Facing downstream. October 10, 1996.

PHOTO 18

Trib 1, Reach 1, Site 1. 582m above mouth. October 10, 1996.

PHOTO 19

Trib 1, Reach 1, 637m above mouth. October 10, 1996.

PHOTO 20

Trib 1, Reach 1, Site 2, 980m above mouth. Obstruction at road, especially to juveniles. October 10, 1996.

PHOTO 21

Trib 2, Reach 1, confluence with Willow Creek. Willow Creek flows to the left. September 26, 1996.

PHOTO 22

Trib 2, Reach 1. 1.1m vertical obstruction 225m above mouth. September 26, 1996.

PHOTO 23

Trib 2, Reach 1, 450m above mouth. 1.2m drop from obstruction. September 26, 1996.

PHOTO 24

Trib 2, culverts at forest service road. August 30, 1996.

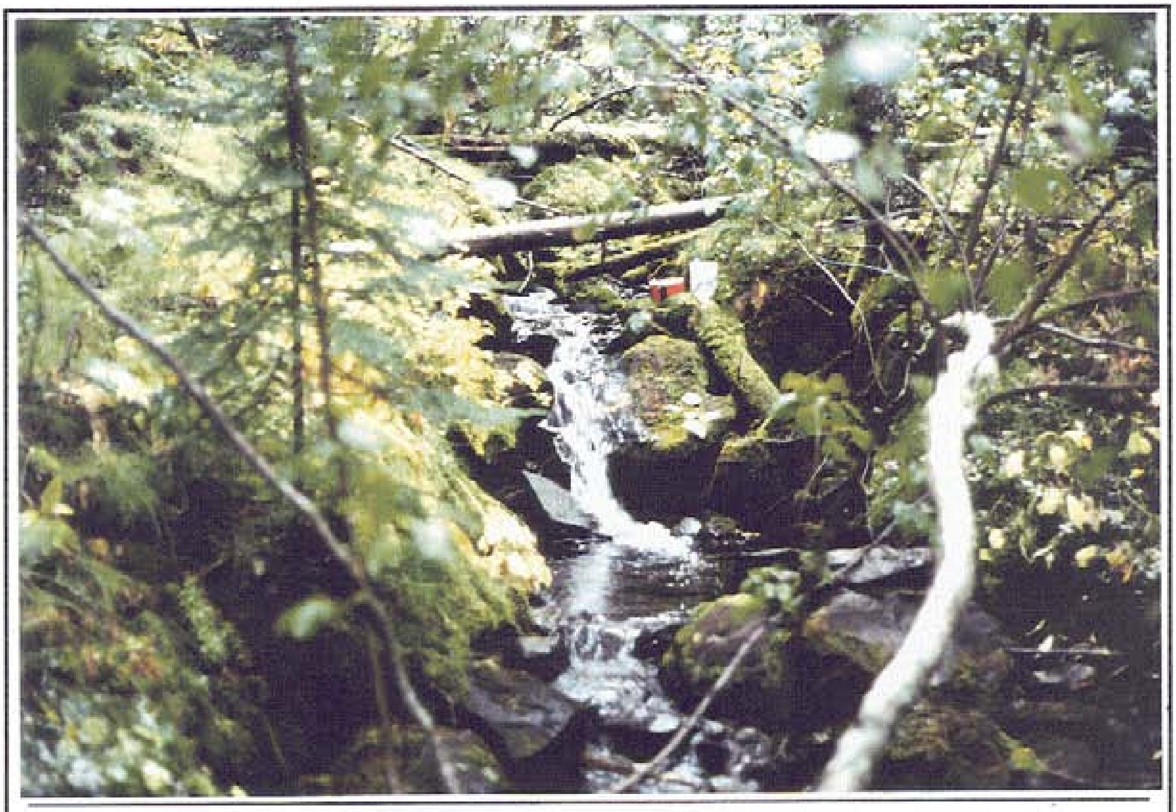
PHOTO 25

Trib 2 above forest service road , confluence of reaches 2 (N branch) and 3 (S branch). October 10, 1996.

PHOTO 26

Trib 2, Reach 2, Site 1, 30m upstream of staff gauge. August 30, 1996.

PHOTO 27

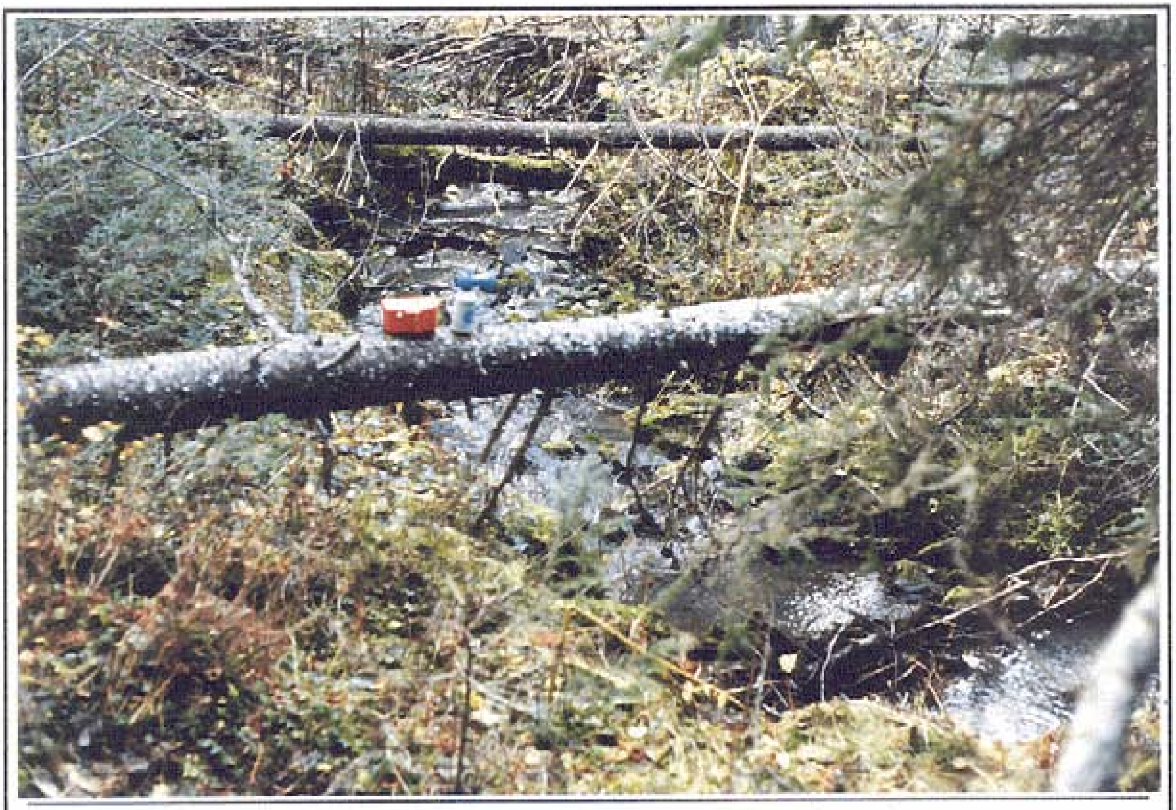


Trib 2, Reach 2, Site 2. 1.2m chute. October 10, 1996.

PHOTO 28

Trib 2, Reach 2, 246m above road. Series of chutes under vegetation. October 10, 1996.

PHOTO 29



Trib 2, Reach 2, 1000m upstream of road (1655m from Willow Creek confluence). October 10, 1996.

PHOTO 30

Trib 2, Reach 3, Site 1. Note chutes in background. September 29, 1996.

PHOTO 31

Trib 2, Reach 3, 450m from road (2115m upstream of confluence with Willow Creek). September 29, 1996.

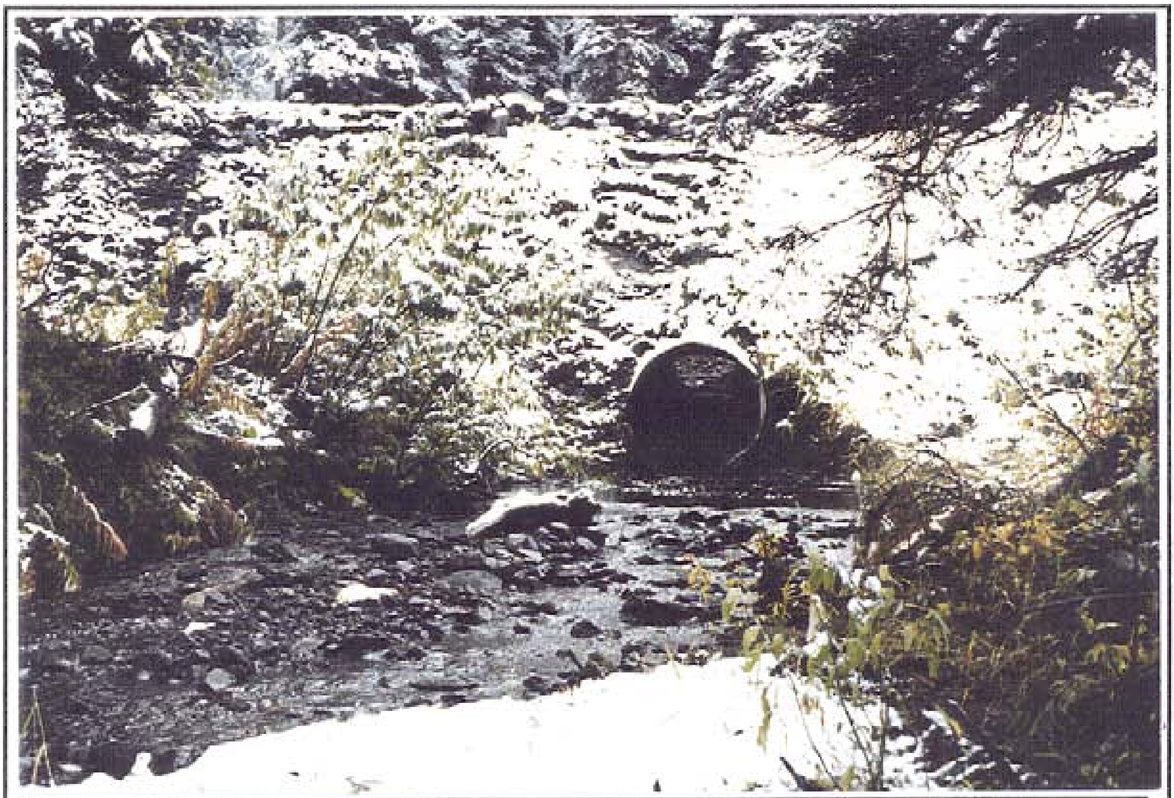
PHOTO 32

Confluence of Trib 3 and Willow Creek, looking upstream on Trib 3. September 29, 1996.

PHOTO 33

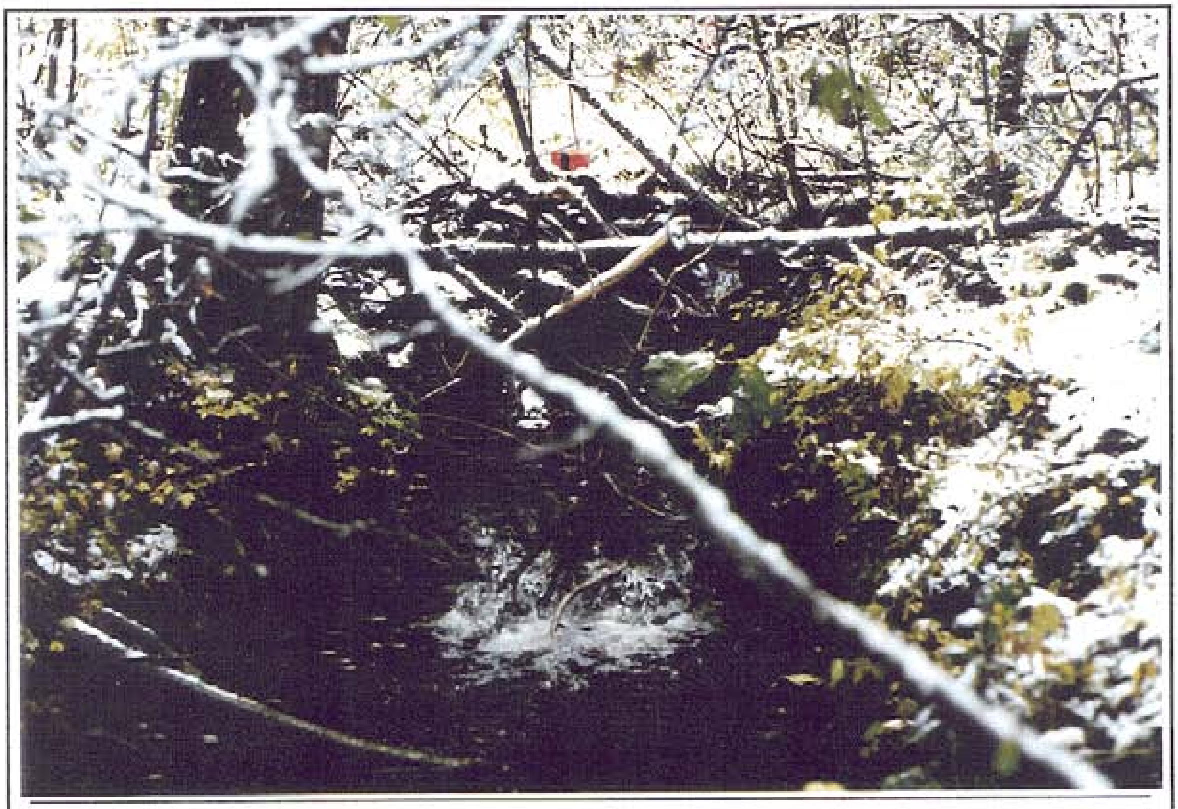
Trib 3, Site 1 electrofishing. Typical habitat. August 29, 1996.

PHOTO 34



Trib 3, Reach 1, downstream end of culvert under Forest Service Road. September 29, 1996.

PHOTO 35

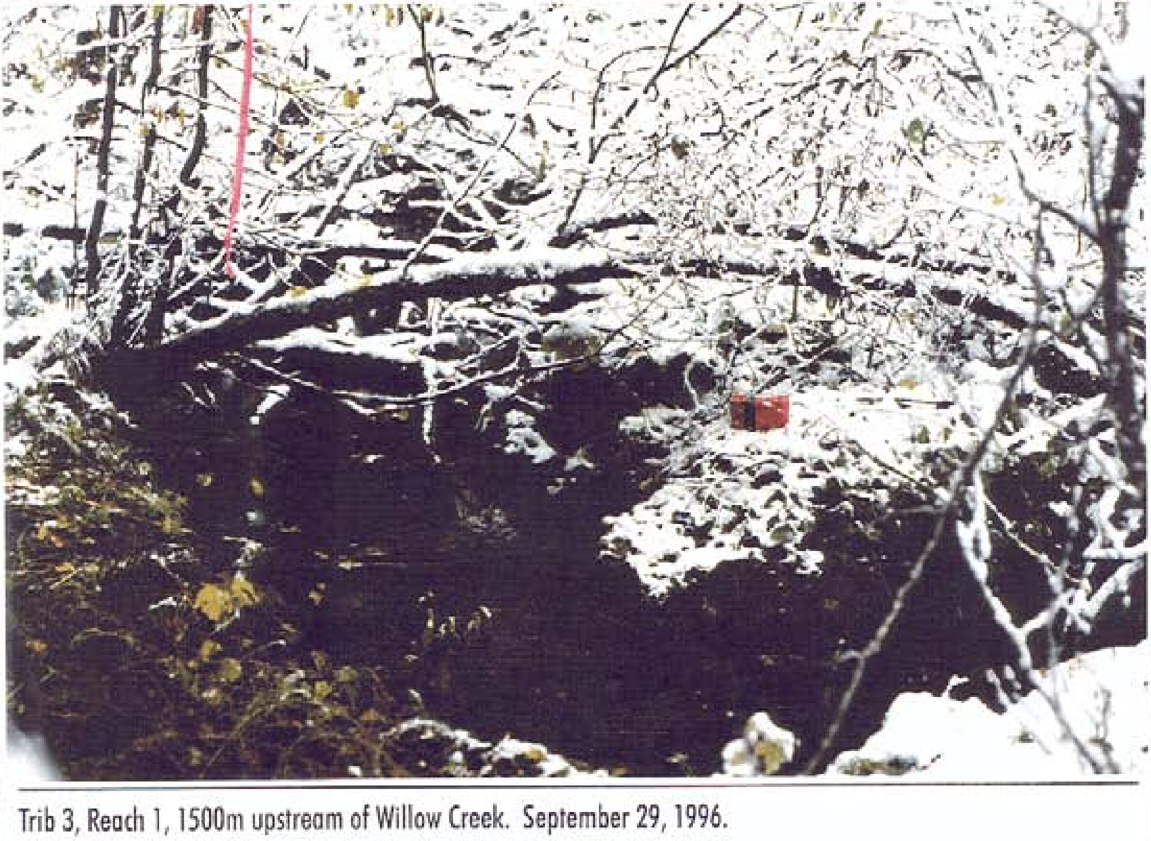


Trib 3, Reach 1, Site 2. 995m upstream of Willow Creek. September 29, 1996.

PHOTO 36

Trib 3, Reach 1, 1135m upstream of Willow Creek. 1.0m chute over bedrock. September 29, 1996.

PHOTO 37



Trib 3, Reach 1, 1500m upstream of Willow Creek. September 29, 1996.

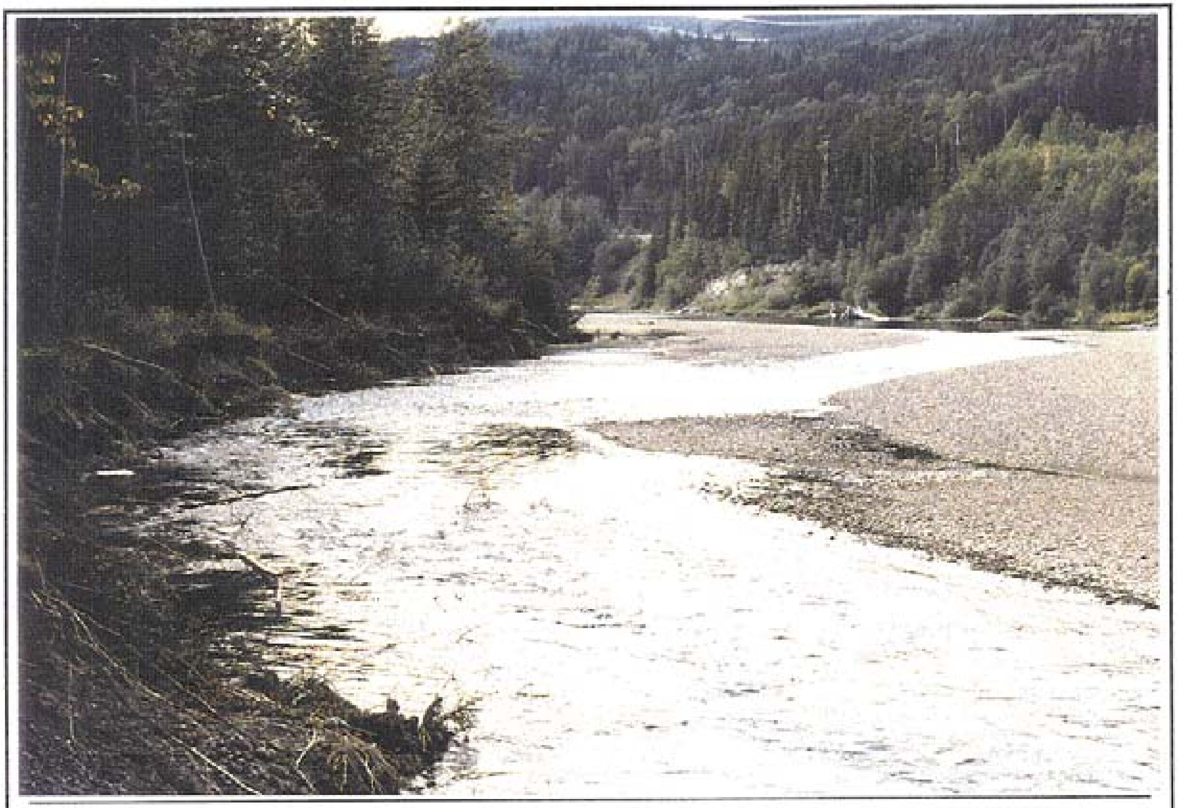
PHOTO 38

Far East Creek 0.75m from the outlet. Note obstruction to fish passage. August 30, 1996.

PHOTO 39

Far East Creek at Site 1. Flow weir at hydrology station. August 30, 1996.

PHOTO 40



Pine River at the Project Area. August 27, 1996.

PHOTO 41

Middle Creek, Site 1. Looking upstream from weir and 180m downstream from where the creek goes underground.

PHOTO 42

APPENDIX 4.7-1

EXISTING AQUATIC INVERTEBRATE DATA

Source: IEC 1982

TABLE 3.8-2
DETAILED IDENTIFICATION OF AQUATIC INVERTEBRATES FOR THE WILLOW CREEK PROJECT AREA
16-17 July 1981

Replicate A	Willow Creek			Pine River			Far East Creek
Station	I-1	I-2	I-3	4	5	6	I-7
GROUP III							
EPHEMEROPTERA							
Baetis sp.	7	12	6	3	23	18	
Ephemerella sp.	4	14	4	3	9		
Ephemerella doddsi	2				3		
Rhithrogena sp.	3	1			3		
Epeorus sp.	2	2	5		5		
Cinygmula sp.	6	5	3		9		
TRICHOPTERA							
Cheumatopsyche sp.							
Polycentropus sp.		1					
Rhyacophila sp.							
Brachycentrus sp.	1				5		
Hesperophylax sp.							
PLECOPTERA							
Alloperla sp.	12	17	7	11	10	3	
Perlesta sp.	1		1			1	
Nemoura sp.							
HEMIPTERA		1					
COLEOPTERA							1
ODONATA							1
GROUP II							
DIPTERA							
Chironomidae	4	154	9	35	16	103	10
Pupa & Adult		7	1			7	1
Ephydridae						2	
Empididae				2			
Simuliidae		6	1		5		
Ceratopogonidae							1
Tipula sp.				2			
Atherix sp.		1				1	
Dolichopodidae							
Culicidae							
GROUP I							
HYMENOPTERA							
HIRUDINEA							
MOLLUSCA							
Planorbidae							8
Sphaeriidae							1
TOTAL NO. OF ORGANISMS	42	221	37	56	88	135	23
TOTAL NO. OF TAXA	10	12	9	6	10	7	7

TABLE 3.8-2 (Continued)
DETAILED IDENTIFICATION OF AQUATIC INVERTEBRATES FOR THE WILLOW CREEK PROJECT AREA
16-17 July 1981

Replicate B		Willow Creek			Pine River		Far East Creek
Station	I-1	I-2	I-3	I-4	I-5	I-6	I-7
GROUP III							
EPHEMEROPTERA							
Baetis sp.	21	27	26		6	24	
Ephemerella sp.	4	1	6	1	1	2	
Ephemerella doddsi							
Rhithrogena sp.	7		4		4		
Epeorus sp.	6	1	7		3		
Cinygmula sp.	5		12		3	3	
TRICHOPTERA							
Cheumatopsyche sp.	1						
Polycentropus sp.		1	3				
Rhyacophila sp.	1		1		1		
Brachycentrus sp.							
Hesperophylax sp.	1				1		
PLECOPTERA							
Alloperla sp.	11	7	16	4	5	4	
Perlesta sp.	1		2		2		
Nemoura sp.	1						
HEMIPTERA			1				
COLEOPTERA	1						
ODONATA							
GROUP II							
DIPTERA							
Chironomidae	3	58	27	25	9	53	1
Pupa & Adult	2		2			2	1
Ephydridae	1					2	
Empididae				2		3	
Simuliidae	2	1					
Ceratopogonidae							
Tipula sp.							
Atherix sp.							1
Dolichopodidae							
Culicidae							

TABLE 3.8-2 (Continued)
DETAILED IDENTIFICATION OF AQUATIC INVERTEBRATES FOR THE WILLOW CREEK PROJECT AREA
16-17 July 1981

Replicate B	Willow Creek			Pine River			Far East Creek
Station	I-1	I-2	I-3	I-4	I-5	I-6	I-7
GROUP I							
HYMENOPTERA							
HIRUDINEA							
MOLLUSCA							
Planorbidae							1
Sphaeriidae							
TOTAL NO. OF ORGANISMS	68	96	107	32	35	93	4
TOTAL NO. OF TAXA	16	7	12	4	10	8	4
GROUP III							
EPHEMEROPTERA							
Baetis sp.	10	39	24	1	19	17	
Ephemerella sp.	2	24	2	1	5	1	
Ephemerella doddsi	3						
Rhithrogena sp.	7	3	1				
Epeorus sp.	16	26					
Cinygmula sp.	4	13	3	1	19	6	
TRICHOPTERA							
Cheumatopsyche sp.							
Polycentropus sp.	1	2	1				
Rhyacophila sp.					1		
Brachycentrus sp.						1	
Hesperophylax sp.				1			
PLECOPTERA							
Alloperla sp.	15	31	1	8	26	4	
Perlesta sp.	1					1	
Nemoura sp.	3	2					
HEMIPTERA	1						
COLEOPTERA			1				
ODONATA							

TABLE 3.8-2 (Continued)

DETAILED IDENTIFICATION OF AQUATIC INVERTEBRATES FOR THE WILLOW CREEK PROJECT AREA

16–17 July 1981

Replicate B		Willow Creek			Pine River		Far East Creek
Station	I-1	I-2	I-3	I-4	I-5	I-6	I-7
GROUP II							
DIPTERA							
Chironomidae	3	87	28	53	52	47	1
Pupa & Adult	1	6	1	2	1	1	2
Ephydridae			1				
Empididae				2	2	1	
Simuliidae	2	8					
Ceratopogonidae							
Tipula sp.				1	1	1	
Atherix sp.						4	2
Dolichopodidae					1		
Culicidae	1						
GROUP I							
HYMENOPTERA	1						
HIRUDINEA				1			
MOLLUSCA							
Planorbidae							4
Sphaeriidae							
TOTAL NO. OF ORGANISMS	71	241	63	71	127	84	9
TOTAL NO. OF TAXA	16	11	10	10	10	11	4

APPENDIX 4.8-1

PINE VALLEY WILLOW CREEK PROJECT PERIPHYTON IDENTIFICATION SUMMARY

APPENDIX 4.8-1
PERIPHYTON IDENTIFICATION SUMMARY

Sample Number	**6907**	**Station WC2, Samples A,B,C**	
Order	**% Total**	**Genus / Species**	**% Total**
Chaetophorales	68	Stigeoclonium lubricon	68
Oscillatociales	10	Oscillatoria tenuis	10
Pennales	19	Navicula spp.	8
		Achnanthes minutissima	3
		Cocconeis planceniula	2
		Synedra ulna	2
		Fragilaria	1
		Gomphonena	1
		Achnanthes flexella	1
		Diatoma	1
Chlorococcales	2	Sphaerocystis schroeteri	2
Other	1	Other	1
Total	100	Total	100

Sample Number	**6908**	**Station WC2, Samples D,E**	
Order	**% Total**	**Genus / Species**	**% Total**
Chaetophorales	74	Stigeoclonium lubricum	74
Pennales	16	Navicula spp.	12
		Cocconeis placentula	2
		Cymbella affluis	1
		Epithemia	1
Chlorococcales	4	Sphaerocystis schroeteri	4
Centrales	2	Meridiou	2
Other	4	Other	4
Total	94	Total	100

Sample Number	**6909**	**Station TRIB3, Sample A**	
Order	**% Total**	**Genus / Species**	***% Total***
Chaetophorales	83	Stigeoclonium lubricion	83
Pennales	9	Cocconois placennula	4
		Achnanthes minutissima	3
		Fragilaria	1
		Cymbella sp.	1
Oscillatoriales	2	Oseillatoria tenuis	2
Chlorococcales	4	Sphaerocystis schroeleri	2
		Anacystis	2
Centrales	1	Meridion	1
Other	1	Others	1
Total	100	Total	100

APPENDIX 4.8-1
PERIPHYTON IDENTIFICATION SUMMARY

Sample Number	**6910**	**Station TRIB2**	
Order	**% Total**	**Genus / Species**	**% Total**
Chaetophorales	62	Srigeoclonium lubricum	62
Oscillatoriales	15	Oseillatoria tenuis	15
Cryptomonedales	14	Chroomonas acuta	13
		Cryptomonas ovata	1
Pennales	9	Cocconeis placentula	4
		Navicula spp.	2
		Achnanthes minutissima	2
		Fragilaria	1
Total	100	Total	100

Sample Number	**6911**	**Station WC1, Samples A,B,C**	
Order	**% Total**	**Genus / Species**	**% Total**
Chaetophorales	61	Stigeoclonium lubricum	61
Pennales	22	Cocconeis placentula	11
		Navicula spp.	4
		Tabellaria flocculosa	2
		Synedra	2
		Cymbella affinis	1
		Pleurorigma	1
		Gyrosigma	1
Cryptomonadales	11	Chraomonas acuta	11
Oscillatoriales	6	Oscillatoria tenuis	6
Chloroccocales	1	Elakatothrix	1
Total	101	Total	101

Sample Number	**6912**	**Station WC1, Samples D,E**	
Order	**% Total**	**Genus / Species**	**% Total**
Chaetophorales	80	Stigeoclonium lubricum	80
Pennales	16	Achnanthes minutissima	13
		Cymbella affinis	2
		Epithonia turgida	1
Cryptomonadales	1	Chroomanas acuta	1
Oscillatoriales	1	Oscillatoria sp.	1
Ulothricales	1	Ulothrix tonata	1
Other	1	Other	1
Total	100	Total	100

APPENDIX 4.8-1
PERIPHYTON IDENTIFICATION SUMMARY

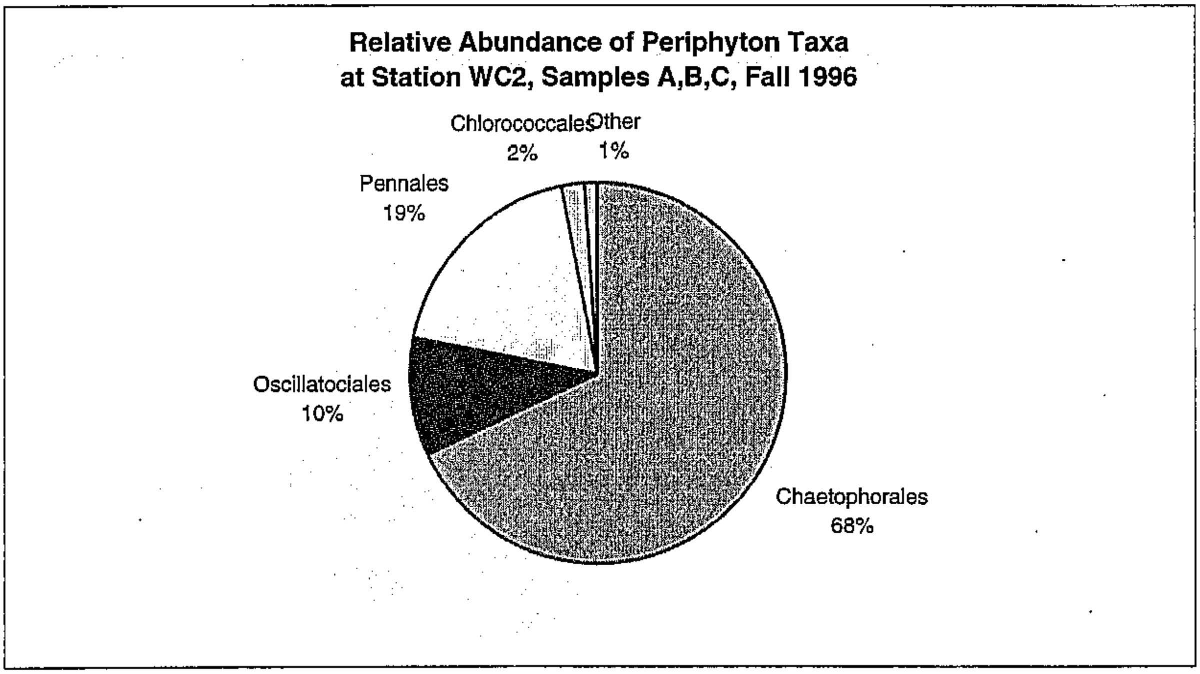
Sample Number	6913	Station T1	
Order	**% Total**	**Genus / Species**	**% Total**
Chaetophorales	71	Stigeoclonium lubricum	71
Cryptomonadales	10	Chroomonas acuta	10
Oscillatoriales	8	Oscillatoria sp.	8
Pennales	12	Cocconeis placenula	4
		Achnanthes minutissima	3
		Fragilaria	2
		Navieula	2
		Gomphonema	1
Centrales	1	Cyelotella	1
Total	102	Total	102

Sample Number	6914	Station PR1	
Order	**% Total**	**Genus / Species**	**% Total**
Pennales	64	Achnanthas minutissima	52
		Cymbella affinis	4
		Synedra ulna	2
		Fragilaria crotonensis	1
		Cocconeis placentula	1
		Navicula	1
		Fragilaria intermedia	1
		Navicula	1
		Cymbella sp.	1
Chaetophorales	30	Stigeoclonison lubricum	30
Cryptemonadales	5	Chroomonas acuta	5
Other	1	Other	1
Total	100	Total	100

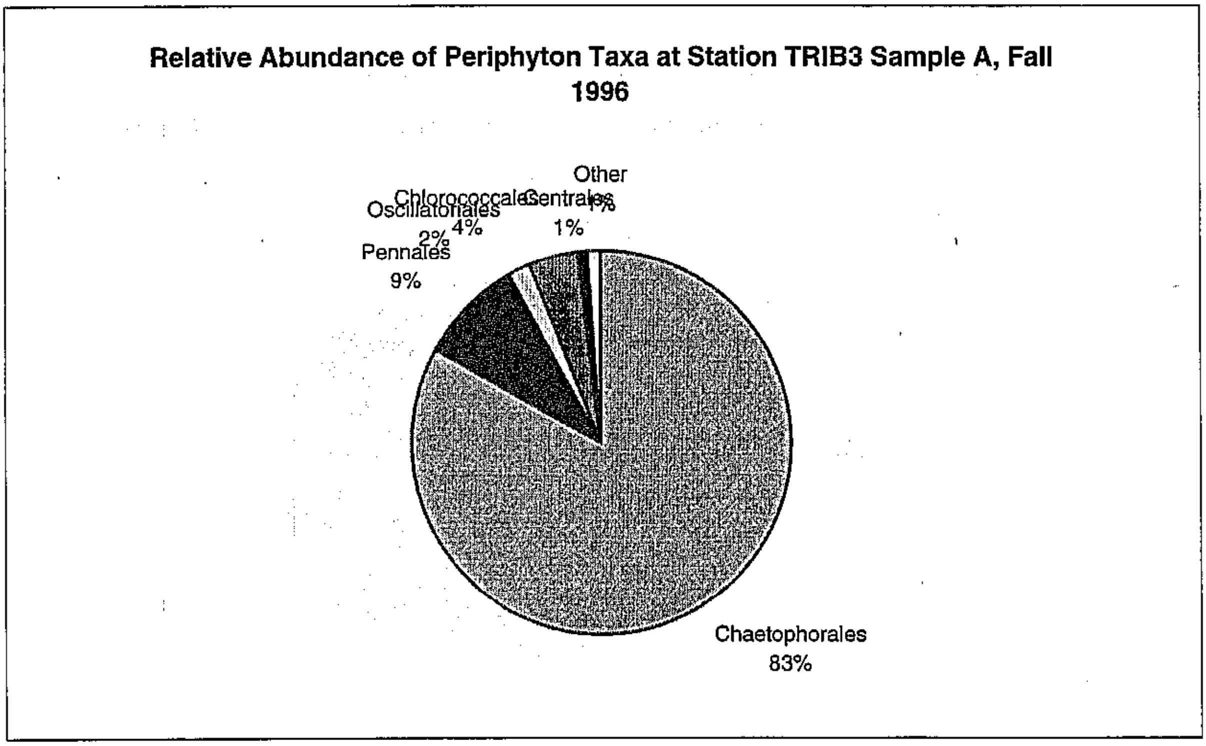
Sample Number	6915	Station PR2, Sample A	
Order	**% Total**	**Genus / Species**	**% Total**
Chaetopherales	71	Stigeoclonium lubricum	71
Pennales	29	Achnanthes minurissima	27
		Fragilaria intermedia	2
Total	100	Total	100

APPENDIX 4.8-1
PERIPHYTON IDENTIFICATION SUMMARY

Sample Number	**6916**	**Station PR2, Sample B**	
Order	**% Total**	**Genus / Species**	**% Total**
Pennales	78	Achnanthes minutissima	60
		Navicula spp.	6
		Gomplonema (olivaceum)	5
		Cymbella affinis	3
		Fragilaria intermedia	2
		Achnanthes flexella	1
Chaetophorales	14	Stigeoclannon lubricum	14
Crypromonadales	5	Chroomonas acuta	5
Oscillatoriales	2	Oscillatoria	2
		Synedra uba	1
Chlorococcales	1	Sphaerocystis schroeteri	1
Total	100	Total	100

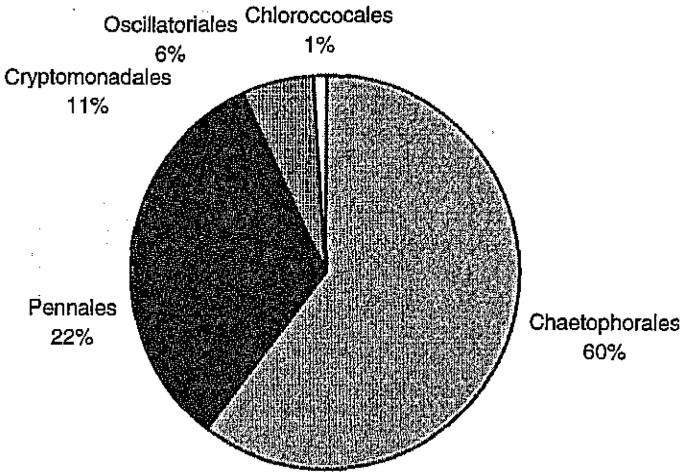


Relative Abundance of Periphyton Taxa at Station WC2, Samples A,B,C, Fall 1996

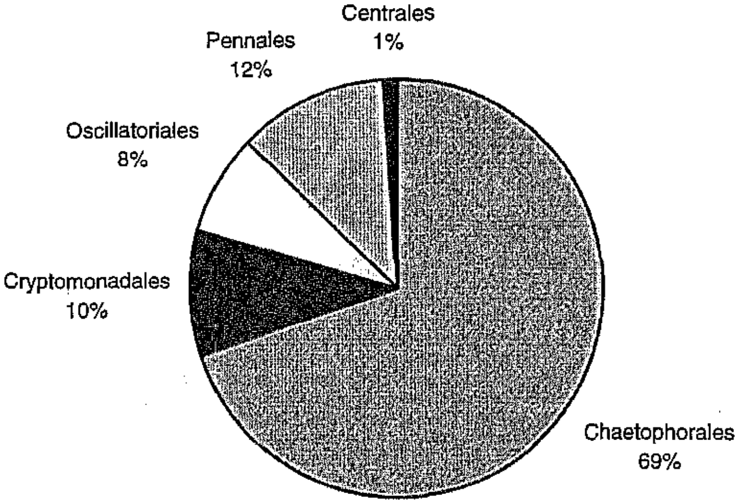


Relative Abundance of Periphyton Taxa at Station TRIB3 Sample A, Fall 1996

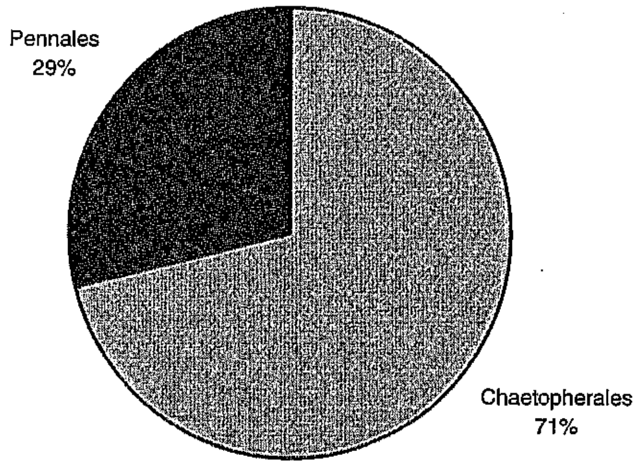
Relative Abundance of Periphyton Taxa at Station WC1, Samples A,B,C, Fall 1996



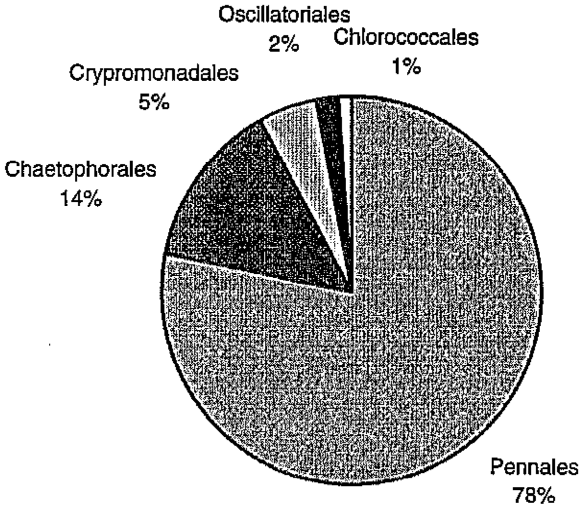
Relative Abundance of Periphyton Taxa at Station T1, Fall 1996



Relative Abundance of Periphyton Taxa at Station PR2, Sample A, Fall 1996



Relative Abundance of Periphyton Taxa at Station PR2, Sample B, Fall 1996



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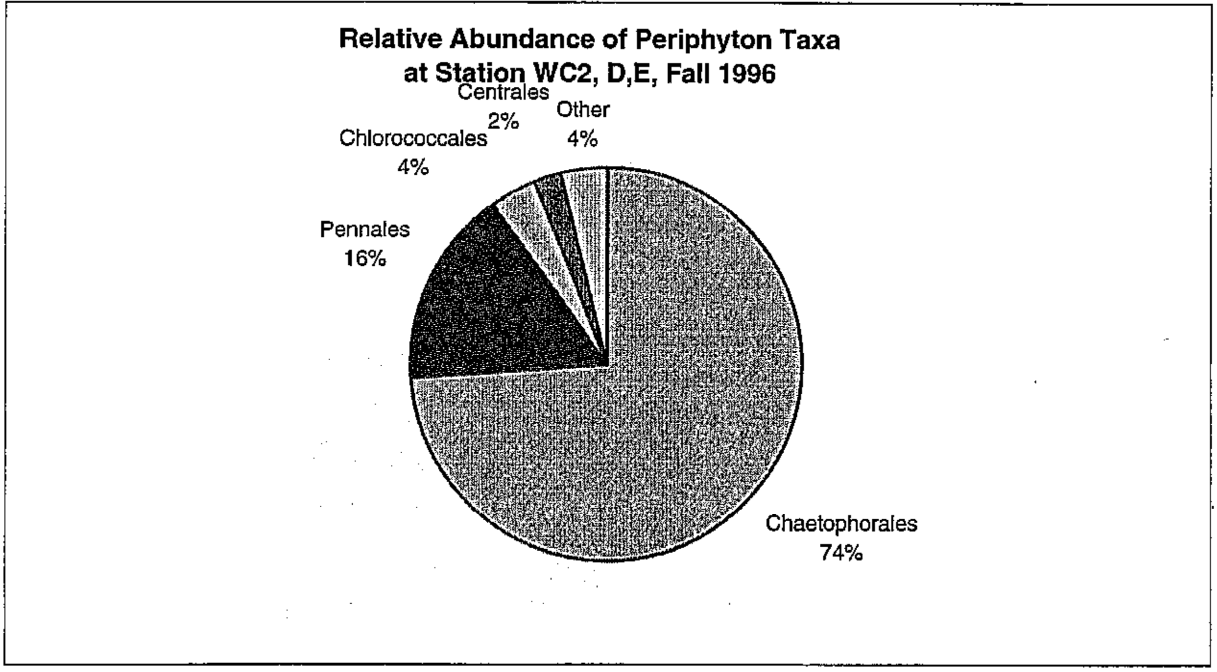
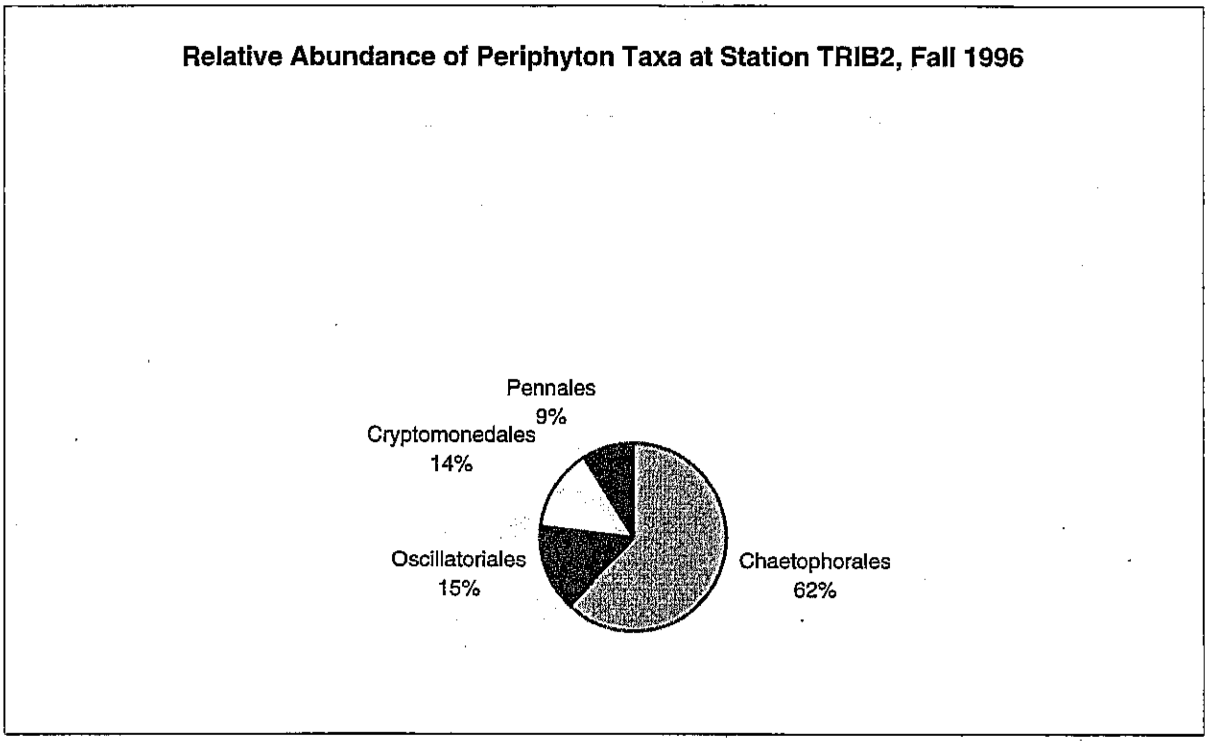
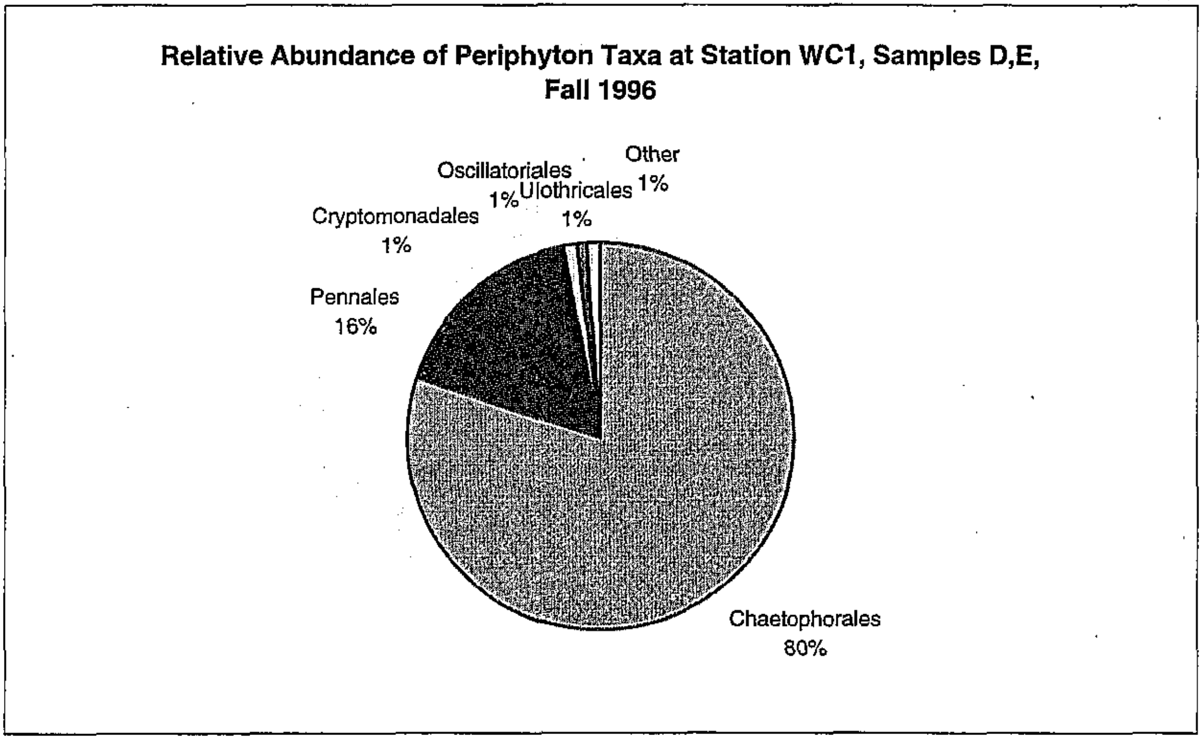
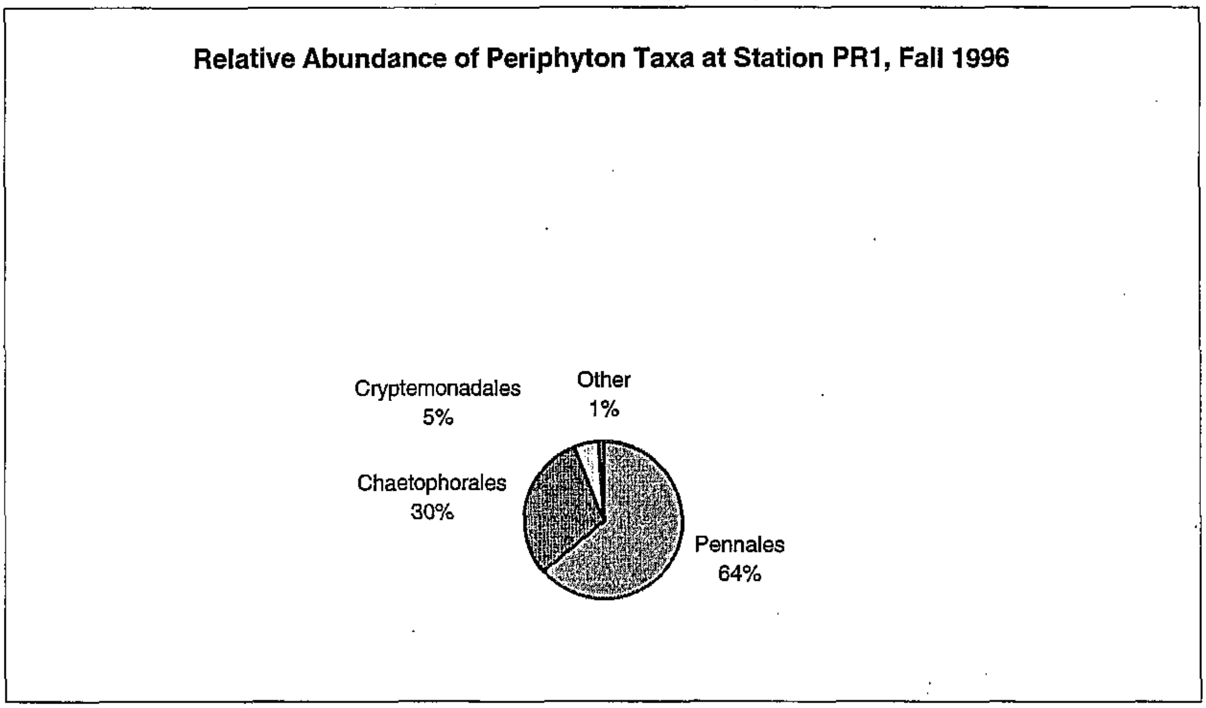

Relative Abundance of Periphyton Taxa at Station WC2, D,E, Fall 1996
Centrales 2%
Other 4%
Chlorococcales 4%
Pennales 16%
Chaetophorales 74%


Relative Abundance of Periphyton Taxa at Station TRIB2, Fall 1996
Pennales 9%
Cryptomonedales 14%
Oscillatoriales 15%
Chaetophorales 62%


Relative Abundance of Periphyton Taxa at Station WC1, Samples D,E, Fall 1996
Other 1%
Oscillatoriales 1%
Ulothricales 1%
Cryptomonadales 1%
Pennales 16%
Chaetophorales 80%


Relative Abundance of Periphyton Taxa at Station PR1, Fall 1996
Cryptemonadales 5%
Other 1%
Chaetophorales 30%
Pennales 64%

APPENDIX 4.10-1

BIOGEOCLIMATIC ZONES AND ECOSYSTEM UNITS

Table A: SwAt - Step moss

Map Symbol	Name	BEC
AM	SwAt - Step moss; deep, fine - textured soils, gently sloping sites, typic ecosystem unit	BWBSmw1/01
AMm	SwAt - Step moss; medium - textured soils, gently sloping ecosystem unit	
AMcn	SwAt - Step moss; coarse - textured soils, fluvial fan ecosystem unit	
AMmn	SwAt - Step moss; medium - textured soils, fluvial fan ecosystem unit	
AMkm	SwAt - Step moss; medium - textured soils, steeply sloping, cool aspect ecosystem unit	

Description

AM is the zonal site in the BWBSmw1. It is typically found on deep, fine - textured soils on gently sloping sites. These forests occur on morainal, glaciofluvial, and fluvial materials. AM forests are found on sites with mesic moisture regimes and poor to rich nutrient regimes. In the map area AM is also found on medium - textured soils (common), coarse-textured soils, fluvial fans and steep slopes on cool aspects. White spruce (Sw), lodgepole pine, trembling aspen and balsam poplar may be found in the tree layer. The herb layer is usually moderately rich. At - creamy peavine is the seral aspen ecosystem unit of AM site series. These units are denoted by the symbol :ap following the ecosystem label. Dominant and associate plants are described separately below.

AMm occurs on deep, medium - textured soils on gently sloping sites
AMcn occurs on deep, coarse - textured soils on fluvial fans
AMmn occurs on deep, medium - textured soils on fluvial fans
AMkm occurs on deep, medium - textured soils on steeply sloping, cool aspects

Map Symbol	AMm1b, AMcn1b, AMmn1b, AMkm1b	AMm2, AMcn2, AMmn2, AMkm2	AMm3a, AMcn3a, AMmn3a, AMkm3a	AMm3b, AMcn3b, AMmn3b, AMkm3b	AMm4, AMcn4, AMmn4, AMkm4	AMm5, AMcn5, AMmn5, AMkm5	AMm6, AMcn6, AMmn6, AMkm6	AMm7, AMcn7, AMmn7, AMkm7
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	fireweed, bluejoint, creamy peavine, showy aster, tall bluebells	highbush-cranberry, prickly rose, saskatoon, fireweed, bluejoint, creamy peavine, showy aster, tall bluebells, trailing raspberry	lodgepole pine, white spruce, trembling aspen, highbush-cranberry, saskatoon, prickly rose, creamy peavine, fireweed, bunchberry, showy aster, bluejoint, tall bluebells, trailing raspberry	lodgepole pine, trembling aspen, highbush-cranberry, creamy peavine, fireweed, bunchberry	lodgepole pine, white spruce, trembling aspen, highbush-cranberry, prickly rose, creamy peavine, fireweed, bunchberry, showy aster, tall bluebells, trailing raspberry	lodgepole pine, white spruce, trtembling aspen, highbush-cranberry, prickly rose, creamy peavine, fireweed, bunchberry, tall bluebells, trailing raspberry, twinflower, step moss, red-stemmed feathermoss, knight's plume	white spruce, lodgepole pine, highbush-cranberry, prickly rose, creamy peavine, bunchberry, tall bluebells, trailing raspberry, twinflower, step moss, red-stemmed feathermoss, knight's plume
Associates	fireweed, bluejoint	highbush-cranberry, prickly rose, saskatoon, trailing raspberry, fuzzy-spiked wildrye	trembling aspen, balsam poplar, lodgeploe pine, white spruce, black twinberry, red-osier dogwood, twinflower, bunchberry, fuzzy-spiked wildrye	balsam poplar, black twinberry, red-osier dogwood, twinflower, fuzzy-spiked wildrye	balsam poplar, showy aster, bluejoint, twinflower	balsam poplar, black twinberry, red-osier dogwood, saskatoon, twinflower, palmate coltsfoot, one-side wintergreen, pink wintergreen, fuzzy-spiked wildrye, step moss, red-stemmed feathermoss, knight's plume	balsam poplar, red-osier dogwood, saskatoon, showy aster, common mitrewort, palmate coltsfoot, one-side wintergreen, pink wintergreen	balsam poplar, trembling aspen, saskatoon, fireweed, showy aster, common mitrewort, palmate coltsfoot, one-side wintergreen, pink wintergreen, fuzzy spiked wildrye
Plots						V29		

Table A: SwAt - Step moss

Map Symbol	AMm1b:ap, AMcn1b:ap	AMm2:ap, AMcn2:ap	AMm3a:ap, AMcn3a:ap	AMm3b:ap, AMcn3b:ap	AMm4:ap, AMcn4:ap	AMm5:ap, AMcn5:ap	AMm6:ap, AMcn6:ap	AMm7:ap, AMcn7:ap
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	fireweed, bluejoint, creamy peavine, showy aster, tall bluebells	highbush-cranberry, prickly rose, saskatoon, fireweed, bluejoint, creamy peavine, showy aster, tall bluebells, trailing raspberry	trembling aspen, highbush-cranberry, saskatoon, prickly rose, creamy peavine, fireweed, bunchberry, showy aster, bluejoint, tall bluebells, trailing raspberry	trembling aspen, highbush-cranberry, creamy peavine, fireweed, bunchberry	trembling aspen, highbush-cranberry, prickly rose, creamy peavine, fireweed, bunchberry, showy aster, tall bluebells, trailing raspberry, twinflower	trembling aspen, highbush-cranberry, prickly rose, creamy peavine, fireweed, bunchberry, showy aster, tall bluebells, trailing raspberry, twinflower	trembling aspen, highbush-cranberry, prickly rose, creamy peavine, bunchberry, showy aster, tall bluebells, trailing raspberry, twinflower, wild lily-of-the-vallley
Associates	fireweed, bluejoint	highbush-cranberry, prickly rose, saskatoon, trailing raspberry, fuzzy-spiked wildrye	trembling aspen, black twinberry, red-osier dogwood, twinflower, bunchberry, fuzzy-spiked wildrye, wild strawberry, northern bedstraw	balsam poplar, black twinberry, red-osier dogwood, fuzzy-spiked wildrye, wild strawberry, northern bedstraw	balsam poplar, showy aster, bluejoint, twinflower	balsam poplar, black twinberry, red-osier dogwood, saskatoon, twinflower, palmate coltsfoot, one-side wintergreen, pink wintergreen, fuzzy-spiked wildrye, wild strawberry, northern bedstraw	balsam poplar, red-osier dogwood, black twinberry, palmate coltsfoot, one-side wintergreen, pink wintergreen, fuzzy-spiked wildrye, wild strawberry, northern bedstraw	balsam poplar, black twinberry, saskatoon, fireweed, palmate coltsfoot, one-side wintergreen, pink wintergreen, wild strawberry, northern bedstraw
Plots						P17, V31, V45, V46		

Table B: Sw - Wildrye - Peavine Ecosystem Unit

Map Symbol	Name	BEC
SW	Sw - Wildrye - Peavine; deep, coarse - textured soils, gently sloping ecosystem unit	BWBSmw1/03
SWm	Sw - Wildrye - Peavine; medium - textured soils, gently sloping ecosystem unit	
SWms	Sw - Wildrye - Peavine; shallow, medium - textured soils, gently sloping ecosystem unit	
SWmw	Sw - Wildrye - Peavine; medium - textured soils, steeply sloping, warm aspect ecosystem unit	
SWsw	Sw - Wildrye - Peavine; shallow, medium - textured soils, steeply sloping, warm aspect ecosystem unit	
SWvw	Sw - Wildrye - Peavine; very shallow, medium - textured soils, steeply sloping, warm aspect ecosystem unit	
SWkm	Sw - Wildrye - Peavine; medium - textured soils, steeply sloping, cool aspect ecosystem unit	
SWks	Sw - Wildrye - Peavine; shallow, medium - textured soils, steeply sloping, cool aspect ecosystem unit	
SWvm	Sw - Wildrye - Peavine; very shallow, medium - textured soils, gently sloping ecosystem unit	

Description

SW is typically found on deep, coarse - textured soils on gently sloping sites. These forests occur on morainal and glaciofluvial materials on sites with submesic moisture regimes and poor to medium nutrient regimes. In the map area SW is commonly found on medium - textured soils. These forests are also found on steep slopes (warm and cool aspects), with very shallow to deep soils. White spruce (Sw), lodgepole pine, and trembling aspen may be found in the tree layer. The herb layer is usually moderately rich.

At- soopolallie is the seral aspen ecosystem unit of the SW site series. These units are denoted by the :as symbol following the ecosystem label. Dominant and Associate plants for the seral and climax ecosystem units are described below.

SWm occurs on deep, medium - textured soils on gently sloping sites

SWms occurs on shallow, medium - textured soils on gently sloping sites

SWmw occurs on deep, medium - textured soils on steeply sloping warm aspects

SWsw occurs on shallow, medium - textured soils on steeply sloping warm aspects

SWvw occurs on very shallow, medium - textured soils on steeply sloping warm aspects

SWkm occurs on deep, medium - textured soils on steeply sloping cool aspects

SWks occurs on shallow, medium - textured soils on steeply sloping cool aspects

SWvm occurs on very shallow, medium - textured soils on gently sloping sites

Map Symbol	SWm1b, SWms1b, SWmw1b, SWsw1b, SWvw1b, SWkm1b, SWks1b, SWvm1b	SWm2, SWms2, SWmw2, SWsw2, SWvw2, SWkm2, SWks2, SWvm2	SWm3a, SWms3a, SWmw3a, SWsw3a, SWvw3a, SWkm3a, SWks3a, SWvm3a	SWm3b, SWms3b, SWmw3b, SWsw3b, SWvw3b, SWkm3b, SWks3b, SWvm3b	SWm4, SWms4, SWmw4, SWsw4, SWvw4, SWkm4, SWks4, SWvm4	SWm5, SWms5, SWmw5, SWsw5, SWvw5, SWkm5, SWks5, SWvm5	SWm6, SWms6, SWmw6, SWsw6, SWvw6, SWkm6, SWks6, SWvm6	SWm7, SWms7, SWmw7, SWsw7, SWvw7, SWkm7, SWks7, SWvm7
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	fireweed, fuzzy-spiked wildrye, creamy peavine, showy aster	prickly rose, saskatoon, soopolallie, fireweed, fuzzy-spiked wildrye, creamy peavine, showy aster, trailing raspberry	trembling aspen, lodgepole pine, white spruce, saskatoon, prickly rose, soopolallie, fireweed, fuzzy-spiked wildrye, creamy peavine, showy aster, trailing raspberry	trembling aspen, lodgepole pine, saskatoon, prickly rose, fireweed, fuzzy-spiked wildrye, creamy peavine, trailing raspberry	trembling aspen, lodgepole pine, white spruce, highbush-cranberry, prickly rose, soopolallie, birch-leaved spirea, fireweed, fuzzy-spiked wildrye, creamy peavine, showy aster, trailing raspberry	trembling aspen, lodgepole pine, white spruce, highbush-cranberry, prickly rose, soopolallie, birch-leaved spirea, twinflower, fuzzy-spiked wildrye, creamy peavine, showy aster, trailing raspberry, step moss, red-stemmed feathermoss, knight's plume	lodgepole pine, white spruce, highbush-cranberry, prickly rose, soopolallie, birch-leaved spirea, twinflower, fuzzy-spiked wildrye, creamy peavine, bunchberry, trailing raspberry, shaowy aster, step moss, red-stemmed feathermoss, knight's plume

Table B: Sw - Wildrye - Peavine Ecosystem Unit

Associates	fireweed, fuzzy-spiked wildrye	highbush-cranberry, prickly rose, saskatoon, soopolallie, trailing raspberry, bluejoint	trembling aspen, lodgeploe pine, white spruce, highbush-cranberry, birch-leaved spirea, twinflower, bunchberry, bluejoint	highbush cranberry, birch leaved spirea, twinflower, bunchberry, bluejoint, false-lily-of-the-vallley	white spruce, highbush cranberry, birch-leaved spirea, twinflower, bunchberry, showy aster, false-lily-of-the-vallley	saskatoon, twinflower, bunchberry, bluejoint, false-lily-of-the-vallley, tall bluebells, step moss, red-stemmed feathermoss, knight's plume	saskatoon, bunchberry, false-lily-of-the-vallley, tall bluebells, one-sided wintergreen, palmate coltsfoot	trembling aspen, false-lily-of-the-vallley, tall bluebells, one-sided wintergreen, palmate coltsfoot
Plots			V15				V43	

Map Symbol	SWm1b:as, SWmw1b:as, SWsw1b:as, SWkm1b:as	SWm2:as, SWmw2:as, SWsw2:as, SWkm2:as	SWm3a:as, SWmw3a:as, SWsw3a:as, SWkm3a:as	SWM3b:as, SWmw3b:as, SWsw3b:as, SWkm3b:as	SWm4:as, SWmw4:as, SWsw4:as, SWkm4:as	SWm5:as, SWmw5:as, SWsw5:as, SWkm5:as	SWm6:as, SWmw6:as, SWsw6:as, SWkm6:as	SWm7:as, SWmw7:as, SWsw7:as, SWkm7:as
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	fireweed, fuzzy-spiked wildrye, creamy peavine, showy aster, trailing raspberry	prickly rose, saskatoon, soopolallie, fireweed, fuzzy-spiked wildrye, creamy peavine, showy aster, trailing raspberry	trembling aspen, saskatoon, prickly rose, soopolallie, fireweed, fuzzy-spiked wildrye, creamy peavine, showy aster, trailing raspberry	trembling aspen, saskatoon, prickly rose, soopolallie, fireweed, fuzzy-spiked wildrye, creamy peavine, trailing raspberry	trembling aspen, highbush-cranberry, prickly rose, soopolallie, saskatoon, fireweed, fuzzy-spiked wildrye, creamy peavine, showy aster, trailing raspberry	trembling aspen, highbush-cranberry, prickly rose, soopolallie, saskatoon, fireweed, fuzzy-spiked wildrye, creamy peavine, showy aster, trailing raspberry, twinflower, pink wintergreen	trembling aspen, highbush-cranberry, prickly rose, soopolallie, saskatoon, fireweed, fuzzy-spiked wildrye, creamy peavine, showy aster, trailing raspberry, twinflower, pink wintergreen
Associates	fireweed, fuzzy-spiked wildrye	highbush-cranberry, prickly rose, saskatoon, soopolallie, bluejoint, American vetch, wild strawberry, northern bedstraw	trembling aspen, highbush-cranberry, birch-leaved spirea, bluejoint, twinflower, bunchberry, American vetch, wild strawberry, northern bedstraw	highbush cranberry, birch leaved spirea, bluejoint, twinflower, bunchberry, American vetch, wild strawberry, northern bedstraw	white spruce, highbush cranberry, birch-leaved spirea, twinflower, bunchberry, showy aster, American vetch, wild strawberry, northern bedstraw	white spruce, birch-leaved spirea, twinflower, bunchberry, American vetch, wild strawberry, northern bedstraw, palamate coltsfoot, pink wintergreen	white spruce, birch-leaved spirea, bunchberry, American vetch, wild strawberry, northern bedstraw, palamate coltsfoot	white spruce, birch-leaved spirea, bunchberry, American vetch, wild strawberry, northern bedstraw, palamate coltsfoot
Plots						P14	V30, V32	

Table C: Sw - Currant - Oak fern

Map Symbol	Name	BEC
SO	Sw - Currant - Oak fern; deep, fine - textured soils, gently sloping moisture receiving ecosystem unit	BWBSmw1/05
SOm	Sw - Currant - Oak fern; deep, medium - textured soils, gently sloping moisture receiving ecosystem unit	
SOkm	Sw - Currant - Oak fern; deep, medium - textured soils, steeply sloping moisture receiving ecosystem unit	

Description

SO is typically found on deep, fine - textured soils on gently sloping, moisture receiving sites (variable parent materials - morainal, glaciofluvial). SO forests ar mid to lower slope positions and sites with subhygric (mesic) moisture regimes and medium to rich nutrient regimes. In the map area SO is found on medium - on steep, cool aspects. White spruce (Sw), trembling aspen and balsam poplar may be found in the tree layer. The shrub layer is generally more diverse than zo forests.

SOm occurs on deep, medium - textured soils on gently sloping, moisture receiving sites
SOkm occurs on deep, medium - textured soils on steeply sloping, cool aspects

Map Symbol	SOm1b, SOkm1b	SOm2, SOkm2	SOm3a, SOkm3a	SOm3b, SOkm3b	SOm4, SOkm4	SOm5, SOkm5	SOm6, SOkm6	SOm7, SOkm7
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	fireweed, bluejoint, trailing raspberry, showy aster	highbush-cranberry, prickly rose, black twinberry, saskatoon, soopolallie, fireweed, bluejoint, creamy peavine, showy aster, tall bluebells, trailing raspberry	trembling aspen, white spruce, highbush-cranberry, prickly rose, black twinberry, saskatoon, soopolallie, fireweed, bluejoint, creamy peavine, showy aster, tall bluebells, trailing raspberry	trembling aspen, highbush-cranberry, prickly rose, black twinberry, fireweed, bluejoint, creamy peavine, trailing raspberry	trembling aspen, white spruce, highbush-cranberry, prickly rose, black twinberry, fireweed, bluejoint, creamy peavine, showy aster, tall bluebells, trailing raspberry, oak fern	trembling aspen, white spruce, highbush-cranberry, prickly rose, black twinberry, black gooseberry, devil's club, fireweed, bluejoint, creamy peavine, showy aster, tall bluebells, trailing raspberry, oak fern, step moss, red-	white spruce, highbush-cranberry, prickly rose, black twinberry, black gooseberry, devil's club, fireweed, bluejoint, creamy peavine, showy aster, tall bluebells, trailing raspberry, oak fern, step moss, red-stemmed feathermoss
Associates	fireweed, bluejoint	highbush-cranberry, prickly rose, black twinberry, saskatoon, soopolallie, creamy peavine, tall bluebells, wild strawberry, American vetch	trembling aspen, balsam poplar, white spruce, twinflower, bunchberry, baneberry, palmate coltsfoot, wild strawberry, American vetch	balsam poplar, twinflower, bunchberry, baneberry, palmate coltsfoot, oak fern	balsam poplar, twinflower, bunchberry, baneberry, palmate coltsfoot, showy aster, tall bluebells	balsam poplar, black gooseberry, saskatoon, soopollalie, Sitka alder, devil' s club, red swamp currant, twinflower, bunchberry, baneberry, palmate coltsfoot, sweet-scented bedstraw, step moss, red-	balsam poplar, Sitka alder, red swamp currant, western mountain-ash, twinflower, bunchberry, baneberry, palmate coltsfoot, sweet-scented bedstraw, sweet-cicely, false Solomon's-seal, common mitrewort	balsam poplar, Sitka alder, red swamp currant, western mountain-ash, . twinflower, bunchberry, baneberry, palmate coltsfoot, sweet-scented bedstraw, sweet-cicely, false Solomon's-seal, common mitrewort
Plots							P16, V27	

Table D: Sw - Currant - Bluebells

Map Symbol	Name	BEC
SC	Sw - Currant - Bluebells; deep, fine - textured soils, gently sloping moisture receiving ecosystem unit	BWBSmw1/06
SCm	Sw - Currant - Bluebells; deep, medium - textured soils, gently sloping moisture receiving ecosystem unit	
SCam	Sw - Currant - Bluebells; deep, medium - textured soils, active floodplain ecosystem unit	
SCc	Sw - Currant - Bluebells; deep, coarse - textured soils, gently sloping moisture receiving ecosystem unit	
SCac	Sw - Currant - Bluebells; deep, coarse - textured soils, active floodplain ecosystem unit	

Description

SC is typically found on deep, fine - textured soils on gently sloping, moisture receiving sites. Parent materials are generally morainal or fluvial. SC forests are
with subhygric moisture regimes and medium to rich nutrient regimes. In the map area SC is found on medium and coarse- textured soils and on similar soils i
White spruce (Sw), trembling aspen and balsam poplar may be found in the tree layer. The shrub layer is generally more diverse than zonal and drier forests. A
seral aspen ecosystem unit of the SC site series. It is denoted by the symbol :ab at the end of the ecosystem label.

SCm occurs on deep, medium - textured soils on gently sloping, moisture receiving sites
SCam occurs on deep, medium - textured soils on active floodplains
SCc occurs on deep, coarse - textured soils on gently sloping, moisture receiving sites
SCac occurs on deep, coarse - textured soils on active floodplains

Map Symbol	SCm1b, SCam1b, SCc1b, SCac1b	SCm2, SCam2, SCc2, SCac2	SCm3a, SCam3a, SCc3a, SCac3a	SCm3b, SCam3b, SCc3b, SCac3b	SCm4, SCam4, SCc4, SCac4	SCm5, SCam5, SCc5, SCac5	SCm6, SCam6, SCc6, SCac6	SCm7, SCam7, SCc7, SCac7
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	fireweed, bluejoint, trailing raspberry, showy aster	highbush-cranberry, prickly rose, black twinberry, bluejoint, creamy peavine, showy aster, tall bluebells, trailing raspberry	balsam poplar, white spruce, highbush-cranberry, prickly rose, black twinberry, bluejoint, creamy peavine, showy aster, tall bluebells, trailing raspberry	balsam poplar, highbush-cranberry, prickly rose, black twinberry, bluejoint, creamy peavine, tall bluebells, trailing raspberry	balsam poplar, white spruce, highbush-cranberry, prickly rose, black twinberry, red swamp currant, bluejoint, creamy peavine, showy aster, tall bluebells, trailing raspberry	white spruce, baslam popolar, highbush-cranberry, prickly rose, black twinberry, red swamp currant, bluejoint, creamy peavine, showy aster, tall bluebells, trailing raspberry, bunchberry, step moss, red-stemmed feathermoss, knight's plume	white spruce, highbush-cranberry, prickly rose, black twinberry, red swamp currant, bluejoint, creamy peavine, bunchberry, tall bluebells, trailing raspberry, step moss, red-stemmed feathermoss, knight's plume

Table D: Sw - Currant - Bluebells

Associates	fireweed, bluejoint	highbush-cranberry, prickly rose, black twinberry, creamy peavine, tall bluebells, cow parsnip, wild sarsaparilla	balsam poplar, trembling aspen, white spruce, red-osier dogwood, red swamp currant, cow parsnip, oak fern, palmate coltsfoot, sweet-scented bedstraw, wild sarsaparilla	trembling aspen, red-osier dogwood, red swamp currant, cow parsnip, oak fern, palmate coltsfoot, bunchberry, sweet-scented bedstraw, wild sarsaparilla	white spruce, trembling aspen, red swamp currant, cow parsnip, oak fern, palmate coltsfoot, bunchberry, sweet-scented bedstraw	balsam poplar, red-osier dogwood, red swamp currant, black gooseberry, cow parsnip, oak fern, palmate coltsfoot, bunchberry, sweet-scented bedstraw, pink wintergreen, wild sarsaparilla, step moss, red-stemmed feathermoss, knight's plume	trembling aspen, red-osier dogwood, red swamp currant, black gooseberry, coomon mitrewort, wild sarsaparilla, sweet-cicely, palmate coltsfoot, bunchberry, sweet-scented bedstraw, pink wintergreen	balsam poplar, red-osier dogwood, red swamp currant, black gooseberry, sweet-cicely, palmate coltsfoot, wild sarsaparilla, sweet-scented bedstraw, pink wintergreen, common mitrewort, leafy mosses
Plots								P20

Map Symbol	SCm1b:ab, SCam1b:ab, SCc1b:ab, SCac1b	SCm2:ab, SCam2:ab, SCc2:ab, SCac2:ab	SCm3a:ab, SCam3a:ab, SCc3a:ab, SCac3a:ab	SCm3b;ab, SCam3b:ab, SCc3b:ab, SCac3b:ab	SCm4:ab, SCam4:ab, SCc4:ab, SCac4:ab	SCm5:ab, SCam5:ab, SCc5:ab, SCac5:ab	SCm6;ab, SCam6:ab, SCc6:ab, SCac6:ab	SCm7:ab, SCam7:ab, SCc7:ab, SCac7:ab
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	fireweed, bluejoint, trailing raspberry, showy aster, tall bluebells	highbush-cranberry, prickly rose, black twinberry, bluejoint, creamy peavine, showy aster, tall bluebells, trailing raspberry	trembling aspen, highbush-cranberry, prickly rose, black twinberry, bluejoint, creamy peavine, showy aster, tall bluebells, trailing raspberry	trembling aspen, highbush-cranberry, prickly rose, black twinberry, bluejoint, creamy peavine, showy aster, tall bluebells, trailing raspberry, bunchberry	trembling aspen, highbush-cranberry, prickly rose, black twinberry, bluejoint, creamy peavine, showy aster, tall bluebells, trailing raspberry, bunchberry	trembling aspen, highbush-cranberry, prickly rose, black twinberry, bluejoint, creamy peavine, showy aster, tall bluebells, trailing raspberry, palmate coltsfoot, bunchberry	trembling aspen, highbush-cranberry, prickly rose, black twinberry, bluejoint, creamy peavine, showy aster, tall bluebells, trailing raspberry, palmate coltsfoot, bunchberry
Associates	fireweed, bluejoint	highbush-cranberry, prickly rose, black twinberry, creamy peavine, cow parsnip, wild sarsaparilla, American vetch	balsam poplar, trembling aspen, soopolallie, saskatoon, cow parsnip, palmate coltsfoot, northern bedstraw, wild sarsaparilla, American vetch, baneberry	balsam poplar, soopolallie, saskatoon, cow parsnip, palmate coltsfoot, northern bedstraw, wild sarsaparilla, American vetch, baneberry, wild strawberry, bunchberry	balsam poplar, soopolallie, saskatoon, palmate coltsfoot, northern bedstraw, American vetch, baneberry, wild strawberry	balsam poplar, soopolallie, saskatoon, cow parsnip, palmate coltsfoot, northern bedstraw, wild sarsaparilla, American vetch, baneberry, wild strawberry, pink wintergreen	balsam poplar, soopolallie, saskatoon, cow parsnip, northern bedstraw, wild sarsaparilla, American vetch, baneberry, wild strawberry, pink wintergreen, step moss	balsam poplar, soopolallie, saskatoon, northern bedstraw, American vetch, baneberry, wild strawberry, pink wintergreen, step moss
Plots						V44, V49		

Table E: Sw- Currant - Horsetail

Map Symbol	Name	BEC
SH	Sw - Currant - Horsetail; deep, coarse - textured soils, flat fluvial site ecosystem unit	BWBSmw1/07
SHa	Sw - Currant - Horsetail; deep, coarse - textured soils, active fluvial site ecosystem unit	BWBSmw1/07
SHm	Sw - Currant - Horsetail; deep, medium - textured soils, flat fluvial site ecosystem unit	
SHam	Sw - Currant - Horsetail; deep, medium - textured soils, active floodplian ecosystem unit	
SHmn	Sw - Currant - Horsetail; deep, medium - textured soils, fluvial fan ecosystem unit	

Description

SH is typically found on deep, coarse - textured soils on flat fluvial sites. SH units are found on sites with hygric (ocassional subhygric) misture regimes and me rich nutrient regimes. In the map area SH is found on medium textured soils and on active floodplains sites. SH units are characterized by a moderate to high c At - cow parsnip is the seral aspen ecosystem unit of the SH site series. It is denoted by the symbol :ac at the end of the ecosystem unit label.

SH occurs on deep, coarse - textured soils on flat, fluvial sites
SHa occurs on deep, coarse - textured soils on active fluvial sites
SHm occurs on deep, medium - textured soils on flat, fluvial sites
SHam occurs on deep, medium - textured soils on active fluvial sites
SHmn occurs on deep, medium - textured soils on fluvial fans

Map Symbol	SH1b, SHm1b,	SH2, SHm2, SHa2	SH3a, SHm3a,	SH3b, SHm3b,	SH4, SHm4, SHa4	SH5, SHm5, SHa5	SH6, SHm6, SHa6	SH7, SHm7, SHa7
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	bluejoint, wood horsetail, tall bluebells, fireweed, showy aster, fringed aster	willow spp., highbush-cranberry, prickly rose, black twinberry, bluejoint, wood horsetail, tall bluebells, fireweed, showy aster, fringed aster	white spruce, balsam poplar, willow spp., highbush-cranberry, prickly rose, black twinberry, bluejoint, horsetails, tall bluebells, fireweed	balsam poplar, highbush-cranberry, prickly rose, black twinberry, bluejoint, horsetails, tall bluebells	white spruce, balsam poplar, willow spp., highbush-cranberry, prickly rose, black twinberry, bluejoint, horsetails, tall bluebells, bunchberry	white spruce, balsam poplar, highbush-cranberry, prickly rose, black twinberry, red swamp currant, horsetails, trailing raspberry, tall bluebells, bunchberry, common mitrewort	white spruce, highbush-cranberry, prickly rose, black twinberry, red swamp currant, horsetails, trailing raspberry, tall bluebells, bunchberry, common mitrewort, step moss, knight's plume, red-
Associates	bluejoint, wood horsetail, fireweed	willow spp., prickly rose, highbush-cranberry, black twinberry, red raspberry, creamy peavine, ostrich fern	white spruce, balsam poplar, red-osier dogwood, red rasbberry, saskatoon, trailing raspberry, cow parsnip, common and meadow horsetail, ostrich fern	red-osier dogwood, trailing raspberry, red raspberry, saskatoon, cow parsnip, bunchberry, fireweed, showy aster, fringed aster, ostrich fern	white spruce, red-osier dogwood, red swamp currant, trailing raspberry, cow parsnip, bunchberry	red-osier dogwood, red swamp currant, black gooseberry, trailing raspberry, saskatoon, cow parsnip, common mitrewort, showy aster, fringed aster, twinflower, ostrich fern, step moss,	red-osier dogwood, black gooseberry, twinflower, palmate coltsfoot, step moss, knight's plume, red-stemmed feathermoss	red-osier dogwood, black gooseberry, twinflower, palmate coltsfoot
Plots								

Table E: Sw- Currant - Horsetail

Map Symbol	SH1b:ac, SHa1b:ac, SHam1b:ac, SHmn1b:ac	SH2:ac, SHa2:ac, SHam2:ac, SHmn2:ac	SH3a:ac, SHa3a:ac, SHam3a:ac, SHmn3a:ac	SH3b:ac, SHa3b:ac, SHam3b:ac, SHmn3b:ac	SH4:ac, SHa4:ac, SHam4:ac, SHmn4:ac	SH5:ac, SHa5:ac, SHam5:ac, SHmn5:ac	SH6:ac, SHa6:ac, SHam6:ac, SHmn6:ac	SH7:ac, SHa7:ac, SHam7:ac, SHmn7:ac
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	bluejoint, wood horsetail, tall bluebells, fireweed, showy aster, fringed aster, cow parsnip	highbush-cranberry, prickly rose, black twinberry, red raspberry, trailing raspberry, bluejoint, wood horsetail, tall bluebells, fireweed, showy aster, fringed aster, cow parsnip, creamy peavine	balsam poplar, highbush-cranberry, prickly rose, black twinberry, red raspberry, trailing raspberry, bluejoint, wood horsetail, tall bluebells, fireweed, showy aster, fringed aster, cow parsnip, creamy peavine	balsam poplar, highbush-cranberry, prickly rose, black twinberry, red raspberry, trailing raspberry, wood horsetail, tall bluebells, showy aster, fringed aster, cow parsnip	balsam poplar, highbush-cranberry, prickly rose, black twinberry, red raspberry, trailing raspberry, bluejoint, wood horsetail, tall bluebells, fireweed, showy aster, fringed aster, cow parsnip, creamy peavine,	balsam poplar, highbush-cranberry, prickly rose, black twinberry, red raspberry, trailing raspberry, wood horsetail, tall bluebells, showy aster, fringed aster, cow parsnip, creamy peavine, bunchberry	balsam poplar, highbush-cranberry, prickly rose, black twinberry, red raspberry, trailing raspberry, wood horsetail, tall bluebells, showy aster, fringed aster, cow parsnip, creamy peavine, bunchberry
Associates	bluejoint, wood horsetail, fireweed	willow spp., prickly rose, highbush-cranberry, black twinberry, red raspberry, creamy peavine, ostrich fern, American vetch	balsam poplar, willow spp., paper birch, northern gooseberry, red-osier dogwood, saskatoon, ostrich fern, baneberry, American vetch, bunchberry	willow spp., northern gooseberry, paper birch, red-osier dogwood, saskatoon, ostrich fern, baneberry, palmate coltsfoot, American vetch, wild strawberry, bunchberry	northern gooseberry, red-osier dogwood, saskatoon, ostrich fern, baneberry, palmate coltsfoot, American vetch, wild strawberry, bunchberry	willow spp., paper birch, northern gooseberry, paper birch, red-osier dogwood, saskatoon, ostrich fern, baneberry, palmate coltsfoot, American vetch, wild strawberry, common and meadow horsetail, pink	paper birch, northern gooseberry, paper birch, red-osier dogwood, saskatoon, ostrich fern, baneberry, palmate coltsfoot, American vetch, bluejoint, wild strawberry, fireweed, common and meadow horsetail, pink wintergreen	paper birch, northern gooseberry, paper birch, red-osier dogwood, saskatoon, ostrich fern, baneberry, palmate coltsfoot, American vetch, bluejoint, wild strawberry, fireweed, common and meadow horsetail, pink wintergreen,
Plots				V48				

Table F: AtSw - Soopolallie

Map Symbol	Name	BEC
ASsw	AtSw - Soopolallie; occurs on shallow soils on steep, warm aspects	BWBSmw1/00
ASvw	AtSw - Soopolallie; occurs on very shallow soils on steep, warm aspects	BWBSmw1/00

Description

AS is typically found on shallow soils on steeply sloping, warm aspects. These forests occur on colluvial materials on sites with xeric - subxeric moisture regimes (and poor to medium nutrient regimes). In the project area AS is mapped on steep, upper slopes above Willow Creek. It was found on very shallow to coarse - textured soils over bedrock. Lodgepole pine was found in the tree layer.

ASsw occurs on shallow, coarse - textured soils on steeply sloping warm aspects
ASvw occurs on shallow, coarse - textured soils on steeply sloping warm aspects

Map Symbol	ASsw1b, ASvw1b	ASsw2, ASvw2	ASsw3, ASvw3a	ASsw3b, ASvw3b	ASsw4, ASvw4	ASSw5, ASvw5	ASsw6, ASvw6	ASsw7, ASvw7
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	fuzzy-spiked wildrye, creamy peavine, American vetch, fireweed, asters	prickly rose, saskatoon, soopolallie, birch-leaved spirea, fuzzy-spiked wildrye, creamy peavine, American vetch, fireweed, asters	trembling aspen, prickly rose, saskatoon, soopolallie, birch-leaved spirea, fuzzy-spiked wildrye, creamy peavine, American vetch,	trembling aspen, prickly rose, birch-leaved spirea, fuzzy-spiked wildrye, creamy peavine, American vetch, fireweed, asters	trembling aspen, prickly rose, saskatoon, soopolallie, birch-leaved spirea, fuzzy-spiked wildrye, creamy peavine, asters, kinnicknnick	lodgepole pine, trembling aspen, saskatoon, soopolallie, birch-leaved spirea, fuzzy-spiked wildrye, creamy peavine, asters, kinnicknnick	lodgepole pine, saskatoon, soopolallie, birch-leaved spirea, common juniper, fuzzy-spiked wildrye, creamy peavine, asters, kinnicknnick
Associates	fireweed, fuzzy-spiked wildrye	prickly rose, saskatoon, soopolallie, birch-leaved spirea, willows, trembling aspen, kinnikinnick,	trembling aspen, lodgepole pine, highbush-cranberry, twinflower, hawkweed, yarrow	lodgepole pine, highbush-cranberry, twinflower, hawkweed, yarrow, kinnickinnick	lodgepole pine, highbush-cranberry, twinflower, hawkweed, yarrow	lodgepole pine, highbush-cranberry, Douglas maple, common juniper, twinflower, hawkweed, yarrow	highbush-cranberry, Douglas maple, common juniper, prickly rose, common snowberry, twinflower, hawkweed, yarrow, peltigera sp., haircapped moss	highbush-cranberry, Douglas maple, prickly rose, common snowberry, twinflower, hawkweed, yarrow, northern bedstraw, peltigera sp., haircapped moss
Plots						V47	P13	

Table G: Sedge Fen Ecosystem Unit

Map Symbol	Name BEC: BWBSmw1/00
SE	Sedge fen
Description	This herb dominated riparian ecosystem unit occurs in valley bottoms on water collecting sites with wet moisture regimes and moderate to rich nutrient regimes. They typically occur in back channels and old meander scars.
SE2	occurs on fluvial soils or organic veneers over fluvial soils
Map Symbol	SE2
Dominant Plant Species	turned sedge, water sedge, beaked sedge, common horsetail
Associate Plant Species	willow spp., red-osier dogwood, black twinberry, bluejoint
Plots	

Table H: Willow - Horsetail - Sedge Ecosystem Unit

Map Symbol	Name BEC: BWBSmw1/00
WH	Willow - Horsetail - Sedge ecosystem unit
Description	These shrub - herb riparian ecosystem units occur in valley bottoms on water collecting sites with wet moisture regimes and moderate to rich nutrient regimes. WH occurs on medium textured, fluvial soils and on organic veneers over fluvial materials.
WH3a	occurs on medium - textured fluvial soils or organic veneers over fluvial soils
WH3b	occurs on medium - textured fluvial soils or organic veneers over fluvial soils
Map Symbol	WH3a, WH3b
Dominant Plant Species	mountain alder, felt-leaved willow, willow spp., red-osier dogwood, turned sedge, water sedge, common horsetail
Associate Plant Species	black twinberry, prickly rose, beaked sedge, bluejoint, field mint, purple leaved willowherb, trailing raspberry
Plots	P21

Table I: Sxw - Oak fern Ecosystem Unit

Map Symbol	Name	BEC
SO	Sxw - Oak fern; deep, medium - textured soils, gently sloping sites, typic ecosystem unit	SBSwk2/01
SOk	Sxw - Oak fern; medium - textured soils, steeply sloping, cool aspect ecosystem unit	
SOks	Sxw - Oak fern; shallow, medium - textured soils, steeply sloping, cool aspect ecosystem unit	
SOw	Sxw - Oak fern; medium - textured soils, steeply sloping, warm aspect ecosystem unit	
SOsw	Sxw - Oak fern; shallow, medium - textured soils, steeply sloping, warm aspect ecosystem unit	

Description

SO is the zonal site in the SBSwk2. It is typically found on deep, medium - textured soils on gently sloping sites. These forests occur on morainal, glaciofluvial,
materials. SO forests are found sites with mesic moisture regimes and medium to rich (occasionally poor) nutrient regimes. In the map area SO is also found o
shallow to deep medium - textured soils. These forests usually occur on mid slope positions, but also occur on upper, northerly aspects. Hybrid white spruce (S
fir are the climax species, however lodgepole pine is also common due to forest fires. The herb layer is moderately well developed and rich.

SO occurs on deep, medium textured soils on gently sloping sites
SOk occurs on deep, medium textured soils on cool aspects
SOks occurs on shallow, medium textured soils on cool aspects
SOw occurs on deep, medium textured soils on warm aspects
SOsw occurs on shallow, medium textured soils on warm aspects

Table I: Sxw - Oak fern Ecosystem Unit

Map Symbol	SO1b, SOk1b, SOks1b, SOw1b, SOsw1b	SO2, SOk2, SOks2, SOw2, SOsw2	SO3a, SOk3a, SOks3a, SOw3a, SPsw3a	SO3b, SOk3b, SOks3b, SOw3b, SOsw3b	SO4, SOk4, SOks4, SOw4, SOsw4	SO5, SOk5, SOks5, SOw5, SOsw5	SO6, SOk6, SOks6, SOw6, SOsw6	SO7, SOk7, SOks7, SOw7, SOsw7
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	fireweed, bluejoint, bunchberry	highbush-cranberry, thimbleberry, fireweed, bunchberry	trembling aspen, highbush-cranberry, thimbleberry, bunchberry	trembling aspen, highbush-cranberry, thimbleberry, bunchberry	trembling aspen, highbush-cranberry, thimbleberry, bunchberry, oak fern, five-leaved bramble, palmate coltsfoot	hybrid white spruce, highbush-cranberry, black gooseberry, black huckleberry, bunchberry, oak fern, five-leaved bramble, palmate coltsfoot, red stemmed feathermoss, knight's plume, step moss	hybrid white spruce, subalpine fir, highbush-cranberry, black gooseberry, black huckleberry, Sitka alder, devils' club, bunchberry, oak fern, five-leaved bramble, palmate coltsfoot, red-stemmed feathermoss, knight's
Associates	fireweed, bunchberry, bluejoint	highbush-cranberry, thimbleberry, five-leaved bramble	trembling aspen, Douglas maple, bluejoint, five-leaved bramble, twinflower	lodgepole pine, hybrid white spruce, devil's club, Sitka alder, Douglas maple, bluejoint, five-leaved bramble, twinflower, oak fern	lodgepole pine, hybrid white spruce, five-leaved bramble, oak fern	lodgepole pine, hybrid white spruce, subalpine fir, devil's club, Douglas maple, thimbleberry, black gooseberry, Sitka alder, black huckleberry, twinflower, red-stemmed feathermoss, knight's plume, step moss	lodgepole pine, trembling aspen, subalpine fir, devil's club, Douglas maple, thimbleberry, Sitka alder, black gooseberry, one-sided wintergreen, stiff clubmoss, twinflower, palmate coltsfoot, three-leaved foamflower,	lodgepole pine, Douglas maple, thimbleberry, one-sided wintergreen, stiff clubmoss, twinflower, false Solomon's-seal, three leaved foamflower, clasping twistedstalk
Plots						V20	P7, P15, P18, V19, V23, V24, V28	

Table J: Pl - Huckleberry - Cladina Ecosystem Unit

Map Symbol	Name	BEC
LH LHrs	Pl - Huckleberry - Cladina; coarse - textured soils, gently sloping, ecosystem unit Pl - Huckleberry - Cladina; shallow, coarse - textured soils, ridge ecosystem unit	SBSwk2/02

Description

LH is typically found on deep, coarse - textured soils on flat to gently sloping sites. Parent materials are usually glaciofluvial or fluvial. LH forests are found on subxeric moisture regimes and soils with poor nutrient regimes. In the project area LH was mapped on shallow soils along a ridge. Lodgepole pine is dominant in the tree canopy. Black huckleberry and Sitka alder dominate the shrub layer. Herb layers are generally poorly developed and low in diversity.
This unit was mapped only within one location.

LHrs occurs on shallow, coarse - textured soils on ridges

Map Symbol	LHrs1b	LHrs2	LHrs3a	LHrs3b	LHrs4	LHrs5	LHrs6	LHrs7
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	twinflower, bunchberry	birch-leaved spirea, bunchberry, twinflower	lodgepole pine, Sitka alder, black huckleberry, bunchberry	lodgepole pine, Sitka alder, black huckleberry, bunchberry	lodgepole pine, Sitka alder, black huckleberry, bunchberry, red-stemmed feathermoss, knight's plume	lodgepole pine, Sitka alder, black huckleberry, bunchberry, one-sided wintergreen, red-stemmed feathermoss, knight's plume	lodgepole pine, Sitka alder, black huckleberry, bunchberry, one-sided wintergreen, red-stemmed feathermoss, knight's plume
Associates	twinflower, bunchberry, fireweed	birch-leaved spirea, black huckleberry, bluejoint, fireweed	lodgepole pine, Sitka alder, black huckleberry, bluejoint, fireweed, one-sided wintergreen	birch-leaved spirea, twinflower, one-sided wintergreen, bluejoint	birch-leaved spirea, twinflower, one-sided wintergreen, red-stemmed feathermoss, knight's plume	hybrid white spruce, subalpine fir, birch-leaved spirea, twinflower, one-sided wintergreen, freckled lichen, reindeer lichens	hybrid white spruce, subalpine fir, birch-leaved spirea, twinflower, freckled lichen, reindeer lichens	hybrid white spruce, subalpine fir, twinflower, freckled lichen, reindeer lichens
Plots						V16		

Table K: Sxw - Devil's club Ecosystem Unit

Map Symbol	Name	BEC
SD	Sxw - Devil's club; deep, medium - textured soils, gently sloping, moisture receiving sites ecosystem unit	SBSwk2/05
SDk	Sxw - Devil's club; deep, medium - textured soils, moisture receiving, steep cool aspect ecosystem unit	
SDw	Sxw - Devil's club; deep, medium - textured soils, moisture receiving, steep warm aspect ecosystem unit	

Description

SD is typically found on deep, medium - textured soils on gently sloping, moisture receiving sites. These forests occur on morainal, fluvial and colluvial materia are found sites with subhygric moisture regimes and medium to rich nutrient regimes. In the map area SD is also found on steep slopes on cool and warm aspec These forests occur on lower and toe of slope positions, These units contain a moderate to high cover of devil's club; the herb layer is generally well developed ,

SD occurs on deep, medium - textured soils on gently sloping, moisture receiving sites
SDk occurs on deep, medium - textured soils, moisiture receiving, steep cool aspects
SDw occurs on deep, medium - textured soils, moisiture receiving, steep warm aspects

Map Symbol	SD1b, SDk1b, SDw1b	SD2, SDk2, SDw2	SD3a, SDk3a, SDw3a	SD3b, SDk3b, SDw3b	SD4, SDk4, SDw4	SD5, SDk5, SDw5	SD6, SDk6, SDw6	SD7, SDk7, SDw7
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	fireweed, bluejoint, bunchberry	thimbleberry, fireweed, bunchberry	hybrid white spruce, thimbleberry, bunchberry, five-leaved bramble, oak fern	hybrid white spruce, thimbleberry, bunchberry, five-leaved bramble, oak fern	hybrid white spruce, thimbleberry, devil's club, bunchberry, five-leaved bramble, trailing raspberry, sweet-cicely, five-leaved bramble, oak fern	hybrid white spruce, thimbleberry, devil's club, bunchberry, five-leaved bramble, trailing raspberry, sweet-cicely, oak fern, knight's plume, red-stemmed feathermoss, leafy mosses	hybrid white spruce, subalpine fir, thimbleberry, devil's club, black gooseberry, bunchberry, five-leaved bramble, trailing raspberry, sweet-cicely, oak fern, knight's plume, red-stemmed feathermoss, leafy
Associates	fireweed, bunchberry, bluejoint	thimbleberry, five-leaved bramble	hybrid white spruce, balsam poplar, bluejoint, five-leaved bramble, clasping twistedstalk	devil's club, balsam poplar, bluejoint, trailing raspberry, clasping twistedstalk	devil's club, clasping twistedstalk, trailing raspberry	balsam poplar, subalpinr fir, black gooseberry, queen's cup, stiff clubmoss, clasping twistedstalk, knight's plume, red-stemmed feathermoss, leafy mosses	balsam poplar, subalpine fir, black gooseberry, queen's cup, stiff clubmoss, clasping twistedstalk, three-leaved foamflower, common and meadow horsetail, cow	queen's cup, stiff clubmoss, clasping twistedstalk, false Solomon's-seal, three leaved foamflower, common and meadow horsetail, cow parsnip
Plots							V18, V26	

Table L: Sxw - Horsetail Ecosystem Unit

Map Symbol	Name	BEC
SH	Sxw - Horsetail; deep, coarse - textured soils, gently sloping, moisture receiving sites ecosystem unit	SBSwk2/06
SHm	Sxw - Horsetail; deep, medium - textured soils, moisture receiving, steep cool aspect ecosystem unit	

Description

SH is typically found on deep, coarse - textured soils on level and depressional sites. These forests occur on fluvial (glacio-fluvial) parent materials. SH units a with hygric (occasionally subhygric) moisture regimes and medium to rich nutrient regimes. In the map area SH is also found on medium textured soils. SH f are characterized by a moderate to high cover of horsetails, and a rich herb layer. Devil's club is absent or present in low abundance.

SH occurs on deep, coarse - textured soils on depressional to level, moisture receiving sites
SHm occurs on deep, medium - textured soils on depressional to level, moisture receiving sites

Map Symbol	SH1b, SHm1b	SH2, SHm2	SH3a, SHm3a	SH3b, SHm3b	SH4, SHm4	SH5, SHm5	SH6, SHm6	SH7, SHm7
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	fireweed, bluejoint, horsetails	willow spp., black twinberry, fireweed, bluejoint, horsetails	hybrid white spruce, willow spp., black twinberry, red-osier dogwood, fireweed, bluejoint, horsetails	hybrid white spruce, black twinberry, horsetails	hybrid white spruce, black twinberry, black gooseberry, highbush-cranberry, trailing raspberry, oak fern, horsetails	hybrid white spruce, subalpine fir, black twinberry, black gooseberry, highbush cranberry, trailing raspberry, horsetails, tall bluebells, five-leaved bramble, red-stemmed feathermoss, knight's plume, leafy mosses	hybrid white spruce, subalpine fir, black twinberry, black gooseberry, highbush cranberry, trailing raspberry, horsetails, tall bluebells, five-leaved bramble, red-stemmed feathermoss, knight's plume, leafy mosses
Associates	fireweed, bluejoint, horsetails	willow spp., black twinberry	hybrid white spruce, red-osier dogwood, trailing raspberry, tall bluebells, cow parsnip	prickly rose, trailing raspberry, oak fern, five-leaved bramble, tall bluebells, cow parsnip, kneeling angelica (mountain alder near the ESSF boundary)	willow spp., prickly rose, bluejoint	subalpine fir, willow spp., prickly rose, tall bluebells, cow parsnip, clasping twistedstalk, common mitrewort, twinflower, knight's plume, red-stemmed feathermoss, leafy mosses (mountain alder near the ESSF boundary)	red-osier dogwood, willow spp., prickly rose, cow parsnip, clasping twistedstalk, bunchberry, sweet-scented bedstraw, common mitrewort, twinflower, mountain monkshood, step moss (mountain alder near the ESSF boundary)	red-osier dogwood, prickly rose, cow parsnip, clasping twistedstalk, bunchberry, sweet-scented bedstraw, common mitrewort, twinflower, mountain monkshood, step moss (mountain alder near the ESSF boundary)
Plots				V38			V6, V8, V33	

Table M: Willow - Sedge Fen Ecosystem Unit

Map Symbol	Name BEC: SBSwk2/00
WS	Willow - Sedge fen ecosystem unit
Description WS3a	These shrub - herb fen ecosystem units occur in level and depressional areas on water collecting sites with wet moisture regimes and moderate nutrient regimes. WS occurs on wet organic soils (and organic veneers over fluvial material). occurs organic soils (or veneers) on level or depressional sites
Map Symbol	WS3a
Dominant Plant Species	willow spp., scrub birch, soft-leaved sedge, bluejoint, drepanocladus sp.
Associate Plant Species	mountain alder, red swamp currant, Labrador tea, sedges, fowl managrass, great northern aster, small bedstraw, large-leaved avens, platanthera sp., sphagnum spp., leafy mosses
Plots	

Table N: Bl - Rhododendron - Feathermoss

Map Symbol	Name	BEC
FR	Bl - Rhododendron - Feathermoss; deep, medium - textured soils, gently sloping sites, typic ecosystem unit	ESSFmv2/01
FRs	Bl - Rhododendron - Feathermoss; shallow, medium - textured soils, gently sloping sites ecosystem unit	
FRk	Bl - Rhododendron - Feathermoss; medium - textured soils, steeply sloping, cool aspect ecosystem unit	
FRks	Bl - Rhododendron - Feathermoss; shallow, medium - textured soils, steeply sloping, cool aspect ecosystem unit	
FRw	Bl - Rhododendron - Feathermoss; medium - textured soils, steeply sloping, warm aspect ecosystem unit	
FRsw	Bl - Rhododendron - Feathermoss; shallow, medium - textured soils, steeply sloping, warm aspect ecosystem unit	

Description

FR is the zonal site in the ESSFmv2. It is typically found on deep, medium - textured soils on gently sloping sites. These forests occur on morainal and colluvia
FR forests are found on submesic to mesic sites with poor to moderate nutrient regimes. In the map area FR is also found on shallow, medium - textured soils a
steep aspects with shallow and deep soils. Engelmann spruce and subalpine fir are the climax species, however lodgepole pine is also common due to forest fir
Black huckleberry and white-flowered rhododendron dominate the shrub layer. The herb layer is generally poorly to moderately developed.

FR occurs on deep, medium textured soils on gently sloping sites
FRs occurs on shallow, medium textured soils on gently sloping sites
FRk occurs on deep, medium textured soils on cool aspects
FRks occurs on shallow, medium textured soils on cool aspects
FRw occurs on deep, medium textured soils on warm aspects
FRsw occurs on shallow, medium textured soils on warm aspects

Table N: BI - Rhododendron - Feathermoss

Map Symbol	FR1b, FRs1b, FRk1b, FRks1b, FRw1b, FRsw1b	FR2, FRs2, FRk2, FRks2, FRw2, FRsw2	FR3a, FRs3a, FRk3a, FRks3a, FRw3a, FRsw3a	FR3b, FRs3b, FRk3b, FRks3b, FRw3b, FRsw3b	FR4, FRs4, FRk4, FRks4, FRw4, FRsw4	FR5, FRs5, FRk5, FRks5, FRw5, FRsw5	FR6, FRs6, FRk6, FRks6, FRw6, FRsw6	FR7, FRs7, FRk7, FRks7, FRw7, FRsw7
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	fireweed, bluejoint, five-leaved bramble, bunchberry	white-flowered rhododendron, red raspberry, bunchberry, five-leaved bramble, fireweed	lodgepole pine, white flowered rhododendron, five-leaved bramble, fireweed	lodgepole pine, Engelmann spruce, white-flowered rhododendron, bunchberry	lodgepole pine, Engelmann spruce, white-flowered rhododendron, black huckleberry, bunchberry, one-sided wintergreen	lodgepole pine, Engelmann spruce, white-flowered rhododendron, black huckleberry, black gooseberry, bunchberry, stiff clubmoss, one-sided wintergreen, knight's plume, red-stemmed feathermoss	Engelmann spruce, subalpine fir, white-flowered rhododendron, black huckleberry, black gooseberry, bunchberry, one-sided wintergreen, stiff clubmoss, knight's plume, red-stemmed feathermoss
Associates	fireweed, bunchberry, bluejoint	white-flowered rhododendron, red raspberry	lodgepole pine, Engelmann spruce, red elderberry, skunk currant, bluejoint, twinflower, one-sided wintergreen	Englemann spruce, red raspberry, red elderberry, skunk currant, black huckleberry, twinflower, one-sided wintergreen	Englemann spruce, black huckleberry, five-leaved bramble, twinflower, one-sided wintergreen	subalpine fir, black huckleberry, black gooseberry, twinflower, five-leaved bramble, stiff clubmoss, step moss, knight's plume, red-stemmed feathermoss	subalpine fir, twinflower, five-leaved bramble, heart leaved arnica, step moss	five-leaved bramble, twinflower, heart-leaved arnica, step moss
Plots		P6					P2, P5, P6, P11, V3, V4, V5, V7, V10, V11, V12, V13, V14, V35, V39	

Table O: Bl - Lingonberry Ecosystem Unit

Map Symbol	Name	BEC
FL	Bl - Lingonberry; coars - textured soils, gently sloping, ecosystem unit	ESSFmv2/02
FLs	Bl - Lingonberry; shallow, coarse-textured soil, gently sloping ecosystem unit	
FLvw	Bl - Lingonberry; very shallow soils, warm aspect ecosystem unit	
FLsw	Bl - Lingonberry; shallow, coarse-textured soils, warm aspect ecosystem unit	

Description

FL is typically found on deep, coarse - textured soils on flat to gently sloping sites. These forests occur on morainal and colluvial materials on upper slope or cre
FL forests are found on subxeric to submesic sites on soils with poor to moderate nutrient regimes. FL is also found on steep slopes on warm aspects on shallo
shallow soils. Lodgepole pine is dominant in the tree canopy. White-flowered rhododendron, black huckleberry and Sitka alder dominate the shrub layer. Herb
generally poorly developed and low in diversity.

FL occurs on deep, coarse - textured soils on flat to gentle slopes
FLs occurs on shallow, coarse - textured soils on flat to gentle slopes
FLsw occurs on shallow, coarse - textured soils on warm aspects
FLvw occurs on very shallow, coarse - textured soils on warm aspects

Map Symbol	FL1b, FLs1b, FLsw1b, FLvw1b	FL2, FLs2, FLsw2, FLvw2	FL3a, FLs3a, FLsw3a, FLvw3a	FL3b, FLs3b, FLsw3b, FLvw3b	FL4, FLs4, FLsw4, FLvw4	FL5, FLs5, FLsw5, FLvw5	FL6, FLs6, FLsw6, FLvw6	FL7, FLs7, FLsw7, FLvw7
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	fireweed, twinflower, bunchberry	white-flowered rhododendron, Sitka and mountain alder, fireweed, bunchberry	lodgepole pine, white flowered rhododendron, Sitka and mountain alder, bunchberry	lodgepole pine, white flowered rhododendron, Sitka and mountain alder, bunchberry	lodgepole pine, white flowered rhododendron, Sitka and mountain alder, bunchberry, red-stemmed feathermoss	lodgepole pine, white flowered rhododendron, Sitka and mountain alder, black huckleberry, bunchberry, twinberry, red-stemmed feathermoss, knight's plume	lodgepole pine, Englemann spruce, white-flowered rhododendron, black huckleberry, Sitka and mountain alder, bunchberry, twinberry, knight's plume, red-stemmed feathermoss
Associates	fireweed, twinflower, bunchberry	white-flowered rhododendron, Sitka alder, mountain alder	lodgepole pine, twinflower, lingonberry	Englemann spruce, black huckleberry, twinflower	Englemann spruce, black huckleberry, twinflower, red-stemmed feathermoss, knight's plume	Englemann spruce, subalpine fir, black huckleberry, twinflower, one-sided wintergreen, lingonberry, peltigera spp.	Englemann spruce, subalpine fir, one-sided wintergreen, lingonberry, peltigera spp., cladonia lichens, dicranum mosses	subalpine fir, lingonberry, ,one-sided wintergreen, peltigera spp., cladonia lichens, dicarnum mosses
Plots							P3, P10, P12, V2	

Table P: Bl Sb - Labrador tea Ecosystem Unit

Map Symbol	Name	BEC
BT	BlSb - Labrador tea; deep, fine - textured soils, gently sloping to depressional sites ecosystem unit	ESSFmv2/03
BTm	BlSb - Labrador tea; deep, medium - textured soils, gently sloping to depressional sites ecosystem unit	

Description

Bt is typically found on deep, fine- textured soils on gently sloping to depressional sites. These forests occur on morainal and colluvial materials. Bt forests are f on submesic to hygric sites with very poor to poor nutrient regimes. In the map area BT is also found on medium - textured soils on level to depressional sites. both of black spruce or Labrador tea are found in this unit. The herb layer is generally poorly developed.

BT occurs on deep, fine - textured soils on gently sloping, level or depressional sites
BTm occurs on deep, medium - textured soils on gently sloping, level or depressional sites

Map Symbol	BT1b, BTm1b	BT2, BTm2	BT3a, BTm3a	BT3b, BTm3b	BT4, BTm4	BT5, BTm5	BT6, BTm6	BT7, BTm7
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	fireweed, bunchberry	white-flowered rhododendron, Labrador tea, bunchberry, fireweed	lodgepole pine, white flowered rhododendron, bunchberry, fireweed	lodgepole pine, black spruce, white-flowered rhododendron, Labrador tea, bunchberry	lodgepole pine, black spruce, white-flowered rhododendron, Labrador tea, bunchberry, lingonberry	lodgepole pine, black spruce, white-flowered rhododendron, Labrador tea, bunchberry, lingonberry, knight's plume, step moss, red stemmed feathermoss	lodgepole pine, black spruce, white-flowered rhododendron, Labrador tea, bunchberry, lingonberry, knight's plume, step moss, red stemmed feathermoss
Associates	fireweed, bunchberry	white-flowered rhododendron, Labrador tea	lodgepole pine, black spruce, Engelmann spruce, bunchberry	Englemann spruce, twinflower	Englemann spruce, black huckleberry, lingonberry, twinflower	Engelmann spruce, black huckleberry, twinflower, five-leaved bramble, stiff clubmoss, crowberry, knight's plume, step moss, red-stemmed feathermoss	Engelmann spruce, black huckleberry, twinflower, five-leaved bramble, stiff clubmoss, crowberry, cladonia lichens, peltigera spp.	Engelmann spruce, black huckleberry, twinflower, five-leaved bramble, stiff clubmoss, crowberry, cladonia lichens, peltigera spp.
Plots							V34	

Black spruce was not observed on the study area.

Table Q: Bl - Oak fern - Knight's plume Ecosystem Unit

Map Symbol	Name	BEC
FO	Bl - Oak fern - Knight's plume; deep, medium - textured soils, gently sloping, moisture receiving ecosystem unit	ESSFmv2/04
FOk	Bl - Oak fern - Knight's plume; deep, medium - textured soils, cool aspect, moisture receiving ecosystem unit	
FOw	Bl - Oak fern - Knight's plume; deep, medium - textured soils, warm aspect, moisture receiving ecosystem unit	

Description

FO is typically found on deep, medium - textured soils on gently sloping, moisture receiving sites. These forests occur on morainal and colluvial materials. FO forests are found on mesic to subhygric sites on soils with moderate to rich nutrient regimes. It is generally found on mid to toe of slope site positions. FO i on steep slopes on warm and cool aspects. Herb layers are better developed and richer than zonal forests.

FO occurs on deep, medium - textured soils on gentle sloping, moisture receiving sites
FOk occurs on deep, medium - textured soils, mositure receiving sites on cool aspects
FOw occurs on deep, medium - textured soils on moisture receiving sites on warm aspects

Map Symbol	FO1b, FOk1b, FOw1b	FO2, FOk2, FOw2	FO3a, FOk3a, FOw3a	FO3b, FOk3b, FOw3b	FO4, FOk4, FOw4	FO5, FOk5, FOw5	FO6, FOk6, FOw6	FO7, FOk7, FOw7
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	fireweed, bluejoint, five-leaved bramble	white-flowered rhododendron, thimbleberry, five-leaved bramble, fireweed	lodgepole pine, Engelmann spruce, white-flowered rhododendron, thimbleberry, five-leaved bramble, fireweed	lodgepole pine, Engelmann spruce, white-flowered rhododendron, five-leaved bramble	lodgepole pine, Engelmann spruce, white-flowered rhododendron, five-leaved bramble, oak fern, knight's plume, red-stemmed feathermoss	Engelmann spruce, lodgepole fir, white-flowered rhododendron, black huckleberry, black gooseberry, oak fern, five-leaved bramble, one-sided wintergreen, knight's plume, red-stemmed feathermoss	Engelmann spruce, subalpine fir, white-flowered rhododendron, black huckleberry, black gooseberry, oak fern, five-leaved bramble, one-sided wintergreen, knight's plume, red-stemmed feathermoss
Associates	fireweed, bluejoint, bunchberry, five-leaved bramble	white-flowered rhododendron, thimbleberry, bunchberry, oak fern	lodgepole pine, Engelmann spruce, black gooseberry, Indian hellebore, red elderberry, bunchberry	black gooseberry, Indian hellebore, red elderberry, bunchberry, oak fern	subalpine fir, black gooseberry, one-sided wintergreen, bunchberry, oak fern, red-stemmed feathermoss, knight's plume	subalpine fir, black gooseberry, black huckleberry, one-sided wintergreen, clasping twistedstalk, Sitka valerian, stiff clubmoss, Indian hellebore, step moss	subalpine fir, western mountain-ash, bunchberry, clasping twistedstalk, Sitka valerian, stiff clubmoss, Indian heelebore, pink wintergreen, step moss	lodgeploe pine, western mountain-ash, bunchberry, clasping twisted stalk, stiff clubmoss, Indian hellebore, pink wintergreen, step moss
Plots							P4, V37	

Table R: Bl - Alder - Horsetail

Map Symbol	Name	BEC
FH	Bl - Alder - Horsetail; deep, coarse - textured soils, level or depressional site, ecosystem unit	ESSFmv2/06
FHm	Bl - Alder - Horsetail; deep, medium - textured soils, level or depressional site, ecosystem unit	
FHp	Bl - Alder - Horsetail; peaty surface, level or depressional site ecosystem unit	

Description

FH is typically found on deep, medium - textured soils on level or depressional sites. These forests occur on morainal or fluvial parent materials. FO forests are subhygric to hygric sites on soils with moderate to rich nutrient regimes. It is generally found in valley bottoms near streams or wetlands. FO is also found on s medium - textured soils or peaty surfaces. Shrub and herb layers are moderately to well developed. Wet indicators such as horsetail are abundant.

FH occurs on deep, coarse - textured soils on level to depressional sites
FHm occurs on deep, medium - textured soils on level and depressional sites
FHp occurs on soils with peaty surface horizons on level and depressional sites

Map Symbol	FH1b, FHm1b, FHp1b	FH2, FHm2, FHp2	FH3a, FHm3a, FHp3a	FH3b, FHm3b, FHp3b	FH4, FHm4, FHp4	FH5, FHm5 FHp5	FH6, FHm6, FHp6	FH7, FHm7, FHp7
Plant Species	Sparsely Vegetated	Grass-forb	Low shrub	Tall shrub	Pole Sampling	Young forest	Mature forest	Old forest
Dominants	none	fireweed, bluejoint, five-leaved bramble, common and meadow horsetail	white-flowered rhododendron, black twinberry, bluejoint, five-leaved bramble, fireweed	lodgepole pine, Engelmann spruce, white-flowered rhododendron, mountain alder, black twinberry, red raspberry, five-leaved bramble, common and meadow horestail	lodgepole pine, Engelmann spruce, white-flowered rhododendron, five-leaved bramble	lodgepole pine, Engelmann spruce, white-flowered rhododendron, black twinberry, mountain alder, trailing raspberry, five-leaved bramble, common and meadow horsetail, knight's plume, ragged mosses	lodgepole pine, Engelmann spruce, white-flowered rhododendron, black twinberry, mountain alder, black gooseberry, trailing raspberry, oak fern, five-leaved bramble, common and meadow horsetail, knight's plume, ragged mosses, leafy	Engelmann spruce, white-flowered rhododendron, black twinberry, mountain alder, black gooseberry, oak fern, trailing raspberry, five-leaved bramble, common and meadow horsetail, knight's plume, ragged mosses, leafy mosses
Associates	fireweed, five-leaved bramble, bluejoint, common and meadow horsetail	white-flowered rhododendron, red raspberry, bunchberry, oak fern	Engelmann spruce, lodgepole pine, mountain alder, willows, black gooseberry, red raspberry, trailing raspberry, bunchberry, oak fern	black gooseberry, willows, trailing raspberry, bunchberry, oak fern, fireweed, bluejoint	black gooseberry, bunchberry, oak fern, knight's plume, ragged moss	subalpine fir, black gooseberry, red raspberry, willows, oak fern, bunchberry, step moss, leafy mosses	subalpine fir, willows, red raspberry, bunchberry, clasping twistedstalk, kneeling angelica, yellow monkey-flower, cow parsnip, mitreworts,	subalpine fir, willows, red raspberry, bunchberry, clasping twistedstalk, kneeling angelica, yellow monkey-flower, cow parsnip, mitreworts,
Plots							P8, V40	

Table S: Willow - Sedge Fen Ecosystem Unit

Map Symbol	Name BEC: ESSFmv2/00
WS	Willow - Sedge fen ecosystem unit
Description WS3a	These shrub - herb fen ecosystem units occur in level and depressional areas on water collecting sites with wet moisture regimes and moderate to rich nutrient regimes. WS occurs on wet organic soils (and organic veneers over fluvial material). occurs on organic soils (or veneers) on level or depressional sites
Map Symbol	WS3a
Dominant Plant Species	Athabasca-willow, willow spp., scrub birch, soft-leaved sedge, bluejoint, drepanocladus sp.
Associate Plant Species	mountain alder, red swamp currant, Labrador tea, sedges, fowl managrass, great northern aster, small bedstraw, large-leaved avens, platanthera sp., sphagnum spp., leafy mosses
Plots	P19

Table T: Sedge Fen Ecosystem Unit

Map Symbol	Name BEC: ESSFmv2/00
SE	Sedge fen ecosystem unit
Description SE	These fen ecosystem units occur in level and depressinal areas on water collecting sites with wet moisture regimes and moderate to rich nutrient regimes. SE occurs on wet organic soils (and possibly organic veneers over fluvial material). occurs on organic soils in level or depressional areas
Map Symbol	SE2
Dominant Plant Species	soft-leaved sedge, bluejoint, fowl managrass, drepanocladus sp.
Associate Plant Species	willow spp., scrub birch, Labrador tea, sedges, great northern aster, small bedstraw, platanthera sp., sphagnum spp., leafy mosses
Plots	

Table U: Unclassified Subalpine Forb Meadow

Map Symbol	Name BEC: ESSFmv2/00
UNC	Forb Meadow ecosystem unit (Vegetated, Non-treed, Upland, Herb Forb)
Description	These forb - grass meadows occur on upper, steep slopes on warm aspects. Parent materials are colluvium over bedrock. Soils are shallow to deep, and medium-textured. This unit appears to have a xeric moisture regime and a moderate nutrient regime. This unit does not fit into existing MOF classification; it has been left unclassifed until other mapping is completed in the area.
UNC	occurs on steep slopes on warm aspects
Map Symbol	UNC
Dominant Plant Species	kinnickinnick, poa sp., fuzzy-spiked wildrye, alpine sweet-vetch, locoweed, three-toothed saxifrage
Associate Plant Species	soopolallie, trembling aspen, prickly rose, common juniper, lance-leaved stonecrop, yarrow, creamy peavine, cut-leaved anenome, field pussytoes, small-flowered penstemon, bracted lousewort, commmon red paintbrush, fireweed, northern bedstraw
Plots	P1

APPENDIX 4.12-1

COMMON AND SCIENTIFIC NAMES, AND STATUS OF WILDLIFE OBSERVED OR EXPECTED TO OCCUR ON THE WILLOW CREEK SUBJECT PROPERTY

Appendix 4.12-1: Common and scientific names, and status of wildlife observed (in bold print) or expected to occur on the Willow Creek subject property. An ‘^{L}’ indicates wildlife reported in the Wildlife Log Book, ‘^{H}’ indicates wildlife observed by Hatler (1994) and ‘^{B}’ indicates wildlife observed by Axys Environmental Consulting (Hornbeck *et al.* 1994a, 1994b, 1994c; Van Egmond *et al.* 1994; Strom *et al.* 1995) in the nearby and similar Brazion Creek valley. General references include Cowan and Guiguet (1965), Nagorsen and Brigham (1993), Prince George Naturalists Club (1988), Siddle (1987), Campbell *et al.* (1990), Nagorsen (1990) and Peterson (1990).

COMMON NAME	**SCIENTIFIC NAME**	**APPARENT STATUS**
BIRDS		
Swans, Geese, Ducks		
American Wigeon	*Anas americana*	Migrant and possible breeder in wetlands of Pine River floodplain
Barrow’s Goldeneye	*Bucephala islandica*	Migrant in wetlands of Pine River floodplain
Blue-winged Teal	*Anas discors*	Migrant and possible breeder in wetlands of Pine River floodplain
^{H} Bufflehead	*Bucephala albeola*	Migrant and possible breeder in wetlands of Pine River floodplain
^{H} Canada Goose	*Branta canadensis*	Migrant and likely breeder in wetlands of Pine River floodplain
^{H} Common Goldeneye	*Bucephala clangula*	Migrant and likely breeder in wetlands of Pine River floodplain
^{H} Common Merganser	*Mergus merganser*	Migrant and possible breeder in wetlands of Pine River floodplain
Gadwall	*Anas strepera*	Possible migrant in wetlands of Pine River floodplain
Green-winged Teal	*Anas crecca*	Migrant and possible breeder in wetlands of Pine River floodplain
Harlequin Duck	*Histrionicus histrionicus*	Migrant and possible breeder in wetlands of Pine River floodplain
Hooded Merganser	*Lophodytes cucullatus*	Possible migrant in wetlands of Pine River floodplain
Lesser Scaup	*Aythya affinis*	Migrant and possible breeder in wetlands of Pine River floodplain
^{H} **Mallard**	***Anas platyrhynchos***	Migrant and breeder in wetlands of Pine River floodplain
Northern Pintail	*Anas acuta*	Migrant and possible breeder in wetlands of Pine River floodplain
Northern Shoveler	*Anas clypeata*	Migrant and possible breeder in wetlands of Pine River floodplain
Ring-necked Duck	*Aythya collaris*	Migrant in wetlands of Pine River floodplain
Ruddy Duck	*Oxyura jamaicensis*	Possible migrant in wetlands of Pine River floodplain
Tundra Swan	*Cygnus columbianus*	Possible migrant in wetlands of Pine River floodplain
Trumpeter Swan	*Cygnus buccinator*	Possible migrant in wetlands of Pine River floodplain
White-winged Scoter	*Melanitta fusca*	Possible migrant in wetlands of Pine River floodplain
Osprey, Eagles, Hawks, Falcons		
^{H} American Kestrel	*Falco sparverius*	Migrant and possible breeder in lowland areas
^{B} Bald Eagle	*Haliaeetus leucocephalus*	Migrant and possible breeder in lowland areas
Broad-winged Hawk	*Buteo platypterus*	Possible summer resident in lowland areas
Golden Eagle	***Aquila chrysaetos***	Likely resident throughout

Appendix 4.12-1: Continued.

COMMON NAME	SCIENTIFIC NAME	APPARENT STATUS
BIRDS CONT.		
Osprey, Eagles, Hawks, Falcons		
Merlin	*Falco columbarius*	Migrant and possible breeder throughout
Northern Goshawk	*Accipiter gentilis*	Likely resident throughout
Northern Harrier	*Circus cyaneus*	Possible migrant in lowland areas
[H] Osprey	*Pandion haliaetus*	Migrant in lowland areas
Peregrine Falcon	*Falco peregrinus*	Possible migrant throughout
[L] **Red-tailed Hawk**	***Buteo jamaicensis***	Summer resident throughout
Rough-legged Hawk	*Buteo lagopus*	Likely migrant throughout, especially open areas (e.g., clearcuts)
[B,H] **Sharp-shinned Hawk**	***Accipiter striatus***	Migrant and possible resident throughout
Grouse		
Blue Grouse	*Dendragapus obscurus*	Possible resident throughout
[H] **Ruffed Grouse**	***Bonasa umbellus***	Resident throughout
Sharp-tailed Grouse	*Tympanuchus phasianellus*	Possible resident in lowland areas
[L] Spruce Grouse	*Dendragapus canadensis*	Resident throughout
Rails and Coots		
American Coot	*Fulica americana*	Migrant and possible breeder in wetlands of Pine River floodplain
Sora	*Porzana carolina*	Migrant and possible breeder in wetlands of Pine River floodplain
Plovers, Sandpipers, Phalaropes		
[L] Common Snipe	*Gallinago gallinago*	Migrant and likely breeder in wetlands of Pine River floodplain
Greater Yellowlegs	*Tringa melanoleuca*	Migrant and possible breeder in wetlands of Pine River floodplain
Killdeer	*Charadrius vociferus*	Migrant and possible breeder in open areas
Least Sandpiper	*Calidris minutilla*	Likely migrant in wetlands of Pine River floodplain
Lesser Yellowlegs	*Tringa flavipes*	Likely migrant in wetlands of Pine River floodplain
Pectoral Sandpiper	*Calidris melanotos*	Possible migrant in wetlands of Pine River floodplain
Red-necked Phalarope	*Phalaropus lobatus*	Possible migrant in wetlands of Pine River floodplain
Solitary Sandpiper	*Tringa solitaria*	Possible migrant and breeder in wetlands of Pine River floodplain
[B] Spotted Sandpiper	*Actitis macularia*	Migrant and likely breeder in wetlands of Pine River floodplain
Wilson's Phalarope	*Phalaropus tricolor*	Possible migrant in wetlands of Pine River floodplain

Appendix 4.12-1: Continued.

COMMON NAME	SCIENTIFIC NAME	APPARENT STATUS
BIRDS CONT.		
Gulls and Terns		
Black Tern	*Chlidonias niger*	Possible migrant in wetlands of Pine River floodplain
Bonaparte's Gull	*Larus philadelphia*	Likely migrant in wetlands of Pine River floodplain
Herring Gull	*Laris argentatus*	Likely migrant in wetlands of Pine River floodplain
Mew Gull	*Larus canus*	Possible migrant in wetlands of Pine River floodplain
Ring-billed Gull	*Larus delawarensis*	Possible migrant in wetlands of Pine River floodplain
Owls		
Barred Owl	*Strix varia*	Likely resident throughout
Boreal Owl	*Aegolius funereus*	Possible resident in upland areas
Great Gray Owl	*Strix nebulosa*	Possible resident in upland areas
Great Horned Owl	*Bubo virginianus*	Likely resident throughout
Northern Hawk-Owl	*Surnia ulula*	Likely resident throughout
Northern Pygmy-Owl	***Glaucidium gnoma***	Resident throughout
Northern Saw-whet Owl	*Aegolius acadicus*	Resident throughout
Snowy Owl	*Nyctea scandiaca*	Possible migrant and winter resident in open areas
Nightjars and Hummingbirds		
Calliope Hummingbird	*Stellula calliope*	Possible summer resident in low to mid-elevation areas
Common Nighthawk	*Chordeiles minor*	Likely migrant and possible resident in low to mid-elevation areas
[B] Rufous Hummingbird	*Selasphorus rufus*	Likely summer resident throughout
Kingfisher		
[L] Belted Kingfisher	*Ceryle alcyon*	Summer resident in wetlands of Pine River floodplain
Woodpeckers		
Black-backed Woodpecker	***Picoides arcticus***	Resident throughout
Downy Woodpecker	*Picoides pubescens*	Resident in riparian and deciduous woodland throughout
[H] **Hairy Woodpecker**	***Picoides villosus***	Resident throughout
[H,L] **Northern Flicker**	***Colaptes auratus***	Resident throughout
[B] Pileated Woodpecker	*Dryocopus pileatus*	Possible resident throughout
Red-breasted Sapsucker	*Sphyrapicus ruber*	Possible resident throughout
Three-toed Woodpecker	***Picoides tridactylus***	Resident throughout
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Possible resident throughout

Appendix 4.12-1: Continued.

COMMON NAME	SCIENTIFIC NAME	APPARENT STATUS
BIRDS CONT.		
Flycatchers		
Alder Flycatcher	*Empidonax alnorum*	Likely summer resident in shrub habitats throughout
Dusky Flycatcher	*Empidonax oberholseri*	Possible summer resident in shrub and open, mixed species forests
Eastern Kingbird	*Tyrannus tyrannus*	Likely summer resident in lowland shrub habitats
Eastern Phoebe	*Sayornis phoebe*	Likely summer resident in lowland areas
Hammond's Flycatcher	*Empidonax hammondii*	Likely summer resident in coniferous forested areas throughout
^{H} Least Flycatcher	*Empidonax minimus*	Summer resident in deciduous and mixed species forests
Olive-sided Flycatcher	*Contopus borealis*	Likely summer resident in open and edge habitats throughout
Pacific-slope Flycatcher	*Empidonax difficilis*	Possible summer resident along creeks
Say's Phoebe	*Sayornis saya*	Possible summer resident in lowland areas
Western Wood-Pewee	*Contopus sordidulus*	Likely summer resident throughout
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Possible summer resident in spruce communities along Pine River
Swallows		
Bank Swallow	*Riparia riparia*	Likely migrant and possible summer resident in lowland areas
Barn Swallow	*Hirundo rustica*	Likely migrant and possible summer resident in lowland areas
Cliff Swallow	*Hirundo pyrrhonota*	Likely migrant and possible summer resident in lowland areas
Tree Swallow	*Tachycineta bicolor*	Likely migrant and summer resident in floodplain areas
Violet-green Swallow	*Tachycineta thalassina*	Likely migrant and possible summer resident in lowland areas
Jays, Magpies, Crows		
American Crow	*Corvus brachyrhynchos*	Summer resident throughout
^{H} Black-billed Magpie	*Pica pica*	Resident in shrubby, lowland areas
^{H,L} Common Raven	*Corvus corax*	Resident throughout
^{H} Gray Jay	*Perisoreus canadensis*	Resident throughout
Steller's Jay	*Cyanocitta stelleri*	Resident throughout
Chickadees, Nuthatch and Wrens		
^{H} Black-capped Chickadee	*Parus atricapillus*	Resident in shrubby lowland areas
Boreal Chickadee	*Parus hudsonicus*	Resident throughout
Red-breasted Nuthatch	*Sitta candensis*	Summer resident throughout
Brown Creeper	*Certhia americana*	Resident throughout
House Wren	*Troglodytes aedon*	Likely summer resident in lowland areas
Marsh Wren	*Cistothorus palustris*	Possible summer resident in marshy lowland areas

Appendix 4.12-1: Continued.

COMMON NAME	SCIENTIFIC NAME	APPARENT STATUS
BIRDS CONT.		
Chickadees, Nuthatch and Wrens		
White-breasted Nuthatch	*Sitta carolinensis*	Possible resident in lowland mixed deciduous forest
Winter Wren	*Troglodytes troglodytes*	Summer resident throughout
Dipper		
[L] American Dipper	*Cinclus mexicanus*	Resident along Pine River and creeks
Kinglets, Bluebird, Thrushes		
[L,H] American Robin	*Turdus migratorius*	Summer resident throughout
Golden-crowned Kinglet	*Regulus satrapa*	Resident throughout
[H] Hermit Thrush	*Catharus guttatus*	Summer resident in upland areas
Mountain Bluebird	*Sialia currucoides*	Possible migrant and summer resident (e.g., clearcut areas)
[H] Ruby-crowned Kinglet	*Regulus calendula*	Migrant and summer resident throughout
[H] Swainson's Thrush	*Catharus ustulatus*	Summer resident throughout
Townsend's Solitaire	*Myadestes townsendi*	Migrant and possible summer in open upland forests
[H,L] Varied Thrush	*Ixoreus naevius*	Summer resident throughout
Veery	*Catharus fuscescens*	Possible summer resident in riparian areas
Pipits		
American Pipit	*Anthus spinoletta*	Possible migrant in open areas
Waxwings		
Bohemian Waxwing	*Bombycilla garrulus*	Migrant and possible summer resident throughout
Cedar Waxwing	*Bombycilla cedrorum*	Likely summer resident in riparian areas throughout
Shrikes and Starling		
European Starling	*Sturnus vulgaris*	Possible summer resident in lowland areas
Northern Shrike	*Lanius excubitor*	Migrant and possible winter resident
Vireos		
Philadelphia Vireo	*Vireo philadelphicus*	Possible summer resident in lowland deciduous forest
Red-eyed Vireo	*Vireo olivaceus*	Likely summer resident in deciduous forest throughout
[H] Solitary Vireo	*Vireo solitarius*	Summer resident throughout
Warbling Vireo	*Vireo gilvus*	Likely summer resident in deciduous forest throughout

Appendix 4.12-1: Continued.

COMMON NAME	SCIENTIFIC NAME	APPARENT STATUS
BIRDS CONT.		
Wood-Warblers		
American Redstart	*Setophaga ruticilla*	Summer resident in shrubby, floodplain areas
Bay-breasted Warbler	*Dendroica castanea*	Possible summer resident in dense coniferous forest
Blackpoll Warbler	*Dendroica striata*	Possible summer resident throughout
Black-and-White Warbler	*Mniotilta varia*	Likely summer resident in shrubby, floodplain areas
[B] Black-throated Green Warbler	*Dendroica virens*	Likely summer resident in mature spruce forests throughout
Canada Warbler	*Wilsonia canadensis*	Possible summer resident in river bank, ravine and riparian habitats
Cape May Warbler	*Dendroica tigrina*	Possible summer resident in dense coniferous forests
Common Yellowthroat	*Geothlypis trichas*	Likely summer resident in lowland marsh and shrub areas
Connecticut Warbler	*Oporornis agilis*	Possible summer resident in mature deciduous forest
MacGillivray's Warbler	*Oporornis tolmiei*	Likely summer resident in shrub and edge habitats throughout
Magnolia Warbler	*Dendroica magnolia*	Likely summer resident in coniferous forests throughout
Mourning Warbler	*Oporornis philadelphia*	Likely summer resident in lowland shrub and edge habitats
Northern Waterthrush	*Seiurus noveboracensis*	Likely summer resident in riparian areas throughout
Orange-crowned Warbler	*Vermivora celata*	Likely summer resident in shrub and mixed forest habitats
Ovenbird	*Seiurus aurocapillus*	Likely summer resident in deciduous and mixed species forests
Tennessee Warbler	*Vermivora peregrina*	Possible summer resident in lowland riparian habitats
Townsend's Warbler	*Dendroica townsendi*	Possible summer resident in coniferous forest habitats
[H] Wilson's Warbler	*Wilsonia pusilla*	Likely summer resident in mixed forest habitats throughout
Yellow Warbler	*Dendroica petechia*	Likely summer resident in lowland shrub, marsh and riparian habitats
[H] **Yellow-rumped Warbler**	***Dendroica coronata***	Summer resident throughout
Sparrows and Grosbeak		
American Tree Sparrow	*Spizella arborea*	Likely migrant in shrub and edge habitats throughout
[H] Chipping Sparrow	*Spizella passerina*	Summer resident throughout
Clay-colored Sparrow	*Spizella pallida*	Possible summer resident in lowland shrub habitats
[B,H] **Dark-eyed Junco**	***Junco hyemalis***	Summer resident throughout
Fox Sparrow	*Passerella iliaca*	Possible summer resident in shrub habitats throughout
Golden-crowned Sparrow	*Zonotrichia atricapilla*	Possible migrant in shrubby and edge habitats throughout
Lapland Longspur	*Calcarius lapponicus*	Possible migrant in open areas throughout
Le Conte's Sparrow	*Ammodramus leconteii*	Possible summer resident in shrubby riparian areas
Lincoln's Sparrow	*Melospiza lincolnii*	Likely resident in shrubby and edge habitats throughout

Appendix 4.12-1: Continued.

COMMON NAME	SCIENTIFIC NAME	APPARENT STATUS
BIRDS CONT.		
Sparrows and Grosbeak Cont.		
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Possible summer resident in deciduous and mixed species forests
Savannah Sparrow	*Passerculus sandwichensis*	Possible migrant in lowland areas
[B] Snow Bunting	*Plectrophenax nivalis*	Likely winter resident in open areas throughout
Song Sparrow	*Melospiza melodia*	Likely summer resident in shrub and riparian habitats throughout
Swamp Sparrow	*Melospiza georgiana*	Possible summer resident in lowland marsh and riparian edge habitats
[L] Western Tanager	*Piranga ludoviciana*	Summer resident throughout
White-crowned Sparrow	*Zonotrichia leucophrys*	Likely migrant in shrubby and edge habitats throughout
[L] White-throated Sparrow	***Zonotrichia albicollis***	Summer resident in lowland shrub and mixed forest habitats
Blackbirds		
Baltimore Oriole	*Icterus galbula?*	Possible summer resident in lowland deciduous forest
Brewer's Blackbird	*Euphagus cyanocephalus*	Possible summer resident in lowland open and edge habitats
Brown-headed Cowbird	*Molothrus ater*	Summer resident throughout
Common Grackle	*Quiscalus quiscula*	Possible summer resident in lowland areas
Red-winged Blackbird	*Agelaius phoeniceus*	Possible summer resident in lowland marsh, shrub and riparian habitats
Rusty Blackbird	*Euphagus carolinus*	Possible summer resident in riparian edge habitats
Finches		
Common Redpoll	*Carduelis flammea*	Likely winter resident in shrub, riparian and deciduous forest habitats
Evening Grosbeak	*Coccothraustes vespertinus*	Possible resident throughout
Hoary Redpoll	*Carduelis hornemanni*	Possible winter resident in shrub, riparian and deciduous forest habitats
Pine Grosbeak	***Pinicola enucleator***	Resident throughout
[H] Pine Siskin	*Carduelis pinus*	Summer resident throughout
Purple Finch	*Carpodacus purpureus*	Possible summer resident throughout
Red Crossbill	*Loxia curvirostra*	Possible resident throughout
Rosy Finch	*Leucosticte arctoa*	Possible migrant and winter resident in open areas throughout
White-winged Crossbill	*Loxia leucoptera*	Possible irruptive resident throughout

Appendix 4.12-1: Continued.

COMMON NAME	SCIENTIFIC NAME	APPARENT STATUS
MAMMALS		
Shrews		
Black-backed Shrew	*Sorex arcticus arcticus*	Possible resident in lowland areas
[H] Common Shrew	*Sorex cinereus cinereus*	Resident throughout
Dusky Shrew	*Sorex monticolis obscurus*	Resident throughout
Pygmy Shrew	*Sorex hoyi hoyi*	Likely resident throughout
[H] Vagrant Shrew	*Sorex vagrans vagrans*	Resident throughout
Water Shrew	*Sorex palustris navigator*	Likely resident in proximity to wetland areas
Bats		
Big Brown Bat	*Eptesicus fuscus bernardinus*	Possible summer resident throughout
Little Brown Myotis	*Myotis lucifugus lucifugus*	Likely summer resident throughout
Northern Long-eared Myotis	*Myotis septentrionalis*	Possible summer resident throughout
Silver-haired Bat	*Lasionycteris noctivagans*	Possible summer resident throughout
Hares		
[B,H,L] **Snowshoe Hare**	***Lepus americanus dalli***	Resident throughout
Rodents		
[H,L] **Beaver**	***Castor canadensis canadensis***	Resident in wetland areas of Pine River floodplain
Bushy-tailed Woodrat	*Neotoma cinerea drummondi*	Possible resident throughout
[H] Deer Mouse	*Peromyscus maniculatus borealis*	Resident throughout
Heather Vole	*Phenacomys intermedius levis*	Possible resident throughout
[H] Least Chipmunk	*Tamias minimus borealis*	Resident throughout
[H] Long-tailed Vole	*Microtis longicaudis vellerosus*	Resident in forest edge habitats
Meadow Jumping Mouse	*Zapus hudsonius hudsonius*	Possible resident in wetland and riparian areas
Meadow Vole	*Microtis pennsylvanicus drummondi*	Possible resident in proximity to marsh and wetland areas
Muskrat	***Ondatra zibethica spatulata***	Resident in proximity to wetland areas throughout
Northern Flying Squirrel	*Glaucomys sabrinus alpinus*	Likely resident throughout
[B,H] **Porcupine**	***Erethizon dorsatum myops***	Resident throughout
[B,H,L] **Red Squirrel**	***Tamiasciurus hudsonicus preblei***	Resident throughout
[H] Southern Red-backed Vole	*Clethrionomys gapperi athabascae*	Resident throughout
[H] Western Jumping Mouse	*Zapus princeps saltator*	Resident in proximity to riparian and wetland habitats
Woodchuck	***Marmota monax canadensis***	Resident throughout

Appendix 4.12-1: Continued.

COMMON NAME	**SCIENTIFIC NAME**	**APPARENT STATUS**
MAMMALS CONT.		
Dogs		
[B,H] **Coyote**	***Canis latrans incolatus***	Resident throughout
Red Fox	***Vulpes vulpes abietorum***	Resident throughout
[B,H,L] **Wolf**	***Canis lupus columbianus***	Resident throughout
Bears		
[B,H,L] **Black Bear**	***Ursus americanus cinnamomum***	Resident throughout
[B,L] **Grizzly Bear**	***Ursus arctos***	Resident throughout
Weasels		
[B] Ermine	*Mustela erminea richardsoni*	Resident throughout
[B,H?] Fisher	*Martes pennanti columbiana*	Resident throughout
Least Weasel	*Mustela nivalis rixosa*	Possible resident throughout
[B] **Marten**	***Martes americana actuosa***	Resident throughout
[B] Mink	*Mustela vison energumenos*	Resident in proximity to wetland habitats
[L] River Otter	*Lontra canadensis pacifica*	Resident in proximity to wetland habitats
Striped Skunk	*Mephitis mephitis hudsonica*	Possible resident in lowland areas
[B] Wolverine	*Gulo gulo luscus*	Resident throughout
Cats		
Cougar	*Felis concolor missoulensis*	Possible resident throughout
[B,H] **Lynx**	***Lynx canadensis***	Resident throughout
Ungulates		
[B] Caribou	*Rangifer tarandus caribou*	Possible visitor to high elevation areas
[B,H,L] **Elk**	***Cervus elaphus nelsoni***	Resident throughout; moves to lowland areas in winter
[B,H,L] **Moose**	***Alces alces andersoni***	Resident throughout
[B,H,L] **Mule Deer**	***Odocoileus hemionus hemionus***	Resident throughout; moves to lowland areas in winter
[B,H,L] **White-tailed Deer**	***Odocoileus virginianus ochrourus***	Resident throughout; moves to lowland areas in winter

Appendix 4.12-1: Continued.

COMMON NAME	SCIENTIFIC NAME	APPARENT STATUS
AMPHIBIANS		
Long-toed Salamander	*Ambystoma macrodactylum*	Possible resident in proximity to wetland breeding habitats
Northern Chorus Frog	*Pseudacris triseriata*	Possible resident in proximity to wetland breeding habitats
Spotted Frog	*Rana pretiosa*	Likely resident in wetland and riparian habitats
[H,L] Western Toad	*Bufo boreas*	Resident throughout
[H] Wood Frog	*Rana sylvatica*	Resident throughout
REPTILES		
Common Garter Snake	*Thamnophis sirtalis*	Likely resident throughout
Western Terrestrial Garter Snake	*Thamnophis elegans*	Likely resident in proximity to wetland breeding habitats

APPENDIX 4.12-2

WILDLIFE CAPABILITY RATINGS FOR ECOSYSTEM UNITS AND STRUCTURAL STAGES ON A PROPOSED COAL MINE AT WILLOW CREEK NEAR CHETWYND

Appendix 4.12-2: Wildlife capability ratings for ecosystem units and structural stages on a proposed coal mine at Willow Creek near Chetwynd. (Rating system based on Demarchi 1996 - see Appendix 4.12-2a below). Structural stages currently occurring on the subject property are shaded.

ESSFmv2 Ecosystem Units and Structural Stages

	FR (01) - Subalpine Fir - Rhododendron - Feathermoss (FR, FRs, FRsw, FRw)								FR (01) - Subalpine Fir - Rhododendron - Feathermoss (FRk, FRks)							
Wildlife Species	**1**	**2**	**3a**	**3b**	**4**	**5**	**6**	**7**	**1**	**2**	**3a**	**3 b**	**4**	**5**	**6**	**7**
Bay-breast. Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black-t. G. Warbler	X	X	X	X	X	X	U	U	X	X	X	X	X	X	U	U
Broad-winged Hawk	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Canada Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cape May Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Connecticut Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Elk	6	4	5	5	5	5	5	5	6	4	5	5	5	5	5	5
Fisher	N	N	N	L	L	L	L	L	N	N	N	L	L	L	L	L
Grizzly Bear	6	4	5	5	5	5	5	5	6	4	5	5	5	5	5	5
Marten	N	N	N	N	L	L	M	M	N	N	N	N	L	L	L	L
Moose	6	3	3	2	3	4	4	4	6	4	3	3	4	5	5	5
Mule Deer	6	4	5	5	5	5	5	5	6	4	5	5	5	5	5	5
Northern Goshawk	N	N	L	L	L	L	L	M	N	N	L	L	L	L	L	M
Philadelphia Vireo	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trumpeter Swan	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
White-tailed Deer	6	4	5	5	5	5	5	5	6	4	5	5	5	5	5	5
Woodland Caribou	6	4	5	5	5	5	5	4	6	4	5	5	5	5	5	4
Yellow-b. Flycatcher	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

ESSFmv2 Ecosystem Units and Structural Stages

	FL (02) - Subalpine Fir - Lingonberry (FLs, FLsw, FLvw)								BT (03) - Subalpine Fir/ Black Spruce - Labrador Tea (BTm)							
Wildlife Species	1	2	3a	3b	4	5	6	7	1	2	3a	3b	4	5	6	7
Bay-breast. Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black-t. G. Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Broad-winged Hawk	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Canada Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cape May Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Connecticut Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Elk	6	4	5	5	5	5	5	5	6	5	5	5	5	5	5	5
Fisher	N	N	L	L	L	L	L	L	N	N	L	L	L	L	L	L
Grizzly Bear	6	4	5	5	5	5	5	5	6	5	5	5	5	5	5	5
Marten	N	N	N	N	N	N	L	L	N	N	N	N	N	L	L	L
Moose	6	5	4	4	5	5	5	5	6	5	4	4	5	5	5	5
Mule Deer	6	4	5	5	5	5	5	5	6	5	5	5	5	5	5	5
Northern Goshawk	N	N	L	L	L	L	L	L	N	N	L	L	L	L	L	L
Philadelphia Vireo	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trumpeter Swan	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
White-tailed Deer	6	4	5	5	5	5	5	5	6	5	5	5	5	5	5	5
Woodland Caribou	6	4	5	5	5	5	5	5	6	5	5	5	5	5	5	5
Yellow-b. Flycatcher	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

ESSFmv2 Ecosystem Units and Structural Stages

	FO (04) - Subalpine Fir - Oak Fern - Knight Plume (FO, FOw)								FO (04) - Subalpine Fir - Oak Fern - Knight Plume (FOk)							
Wildlife Species	1	2	3a	3b	4	5	6	7	1	2	3a	3b	4	5	6	7
Bay-breast. Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black-t. G. Warbler	X	X	X	X	X	X	U	U	X	X	X	X	X	X	U	U
Broad-winged Hawk	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Canada Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cape May Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Connecticut Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Elk	6	2	3	3	4	4	3	3	6	3	4	4	5	5	4	4
Fisher	N	N	L	L	L	L	L	L	N	N	L	L	L	L	L	L
Grizzly Bear	6	2	3	4	4	4	3	3	6	3	4	5	5	5	4	4
Marten	N	N	N	N	L	L	M	M	N	N	N	N	L	L	M	M
Moose	6	4	3	3	4	4	4	4	6	4	3	3	4	4	4	4
Mule Deer	6	2	3	3	4	4	3	3	6	3	4	4	5	5	4	4
Northern Goshawk	N	N	L	L	L	L	M	M	N	N	L	L	L	L	M	M
Philadelphia Vireo	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trumpeter Swan	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
White-tailed Deer	6	2	3	3	4	4	3	3	6	3	4	4	5	5	4	4
Woodland Caribou	6	3	4	5	5	4	3	3	6	4	5	5	5	5	4	4
Yellow-b. Flycatcher	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

ESSFmv2 Ecosystem Units and Structural Stages

	FH (06) - Subalpine Fir - Alder - Horsetail (FH, FHm, FHp)								(00) - Forb - Grass Meadow	
Wildlife Species	1	2	3a	3b	4	5	6	7	1	2
Bay-breast. Warbler	X	X	X	X	X	X	X	X	X	X
Black-t. G. Warbler	X	X	X	X	X	X	U	U	X	X
Broad-winged Hawk	N	N	N	N	N	N	N	N	N	N
Canada Warbler	X	X	X	X	X	X	X	X	X	X
Cape May Warbler	X	X	X	X	X	X	X	X	X	X
Connecticut Warbler	X	X	X	X	X	X	X	X	X	X
Elk	6	3	4	4	4	4	3	3	6	2
Fisher	N	N	L	L	L	L	L	M	N	N
Grizzly Bear	6	2	2	2	3	3	2	2	6	2
Marten	N	N	N	N	L	L	M	H	N	N
Moose	6	3	2	2	3	3	3	3	5	3
Mule Deer	6	3	4	4	4	4	3	3	6	2
Northern Goshawk	N	N	L	L	L	L	M	M	N	N
Philadelphia Vireo	X	X	X	X	X	X	X	X	X	X
Trumpeter Swan	N	N	N	N	N	N	N	N	N	N
White-tailed Deer	6	3	4	4	4	4	3	3	6	2
Woodland Caribou	6	3	4	5	5	5	5	4	6	3
Yellow-b. Flycatcher	X	X	X	X	X	U	U	U	X	X

ESSFmv2 Ecosystem Units and Structural Stages

	SE (00) - Sedge Fen Wetland (SE)		WS (00) - Willow - Sedge Fen Wetland (WS)			
Wildlife Species	1	2	1	2	3a	3 b
Bay-breast. Warbler	X	X	X	X	X	X
Black-t. G. Warbler	X	X	X	X	X	X
Broad-winged Hawk	N	N	N	N	N	N
Canada Warbler	X	X	X	X	X	X
Cape May Warbler	X	X	X	X	X	X
Connecticut Warbler	X	X	X	X	X	X
Elk	6	3	6	3	4	4
Fisher	N	N	N	N	L	L
Grizzly Bear	6	2	6	3	4	4
Marten	N	N	N	N	N	N
Moose	5	4	5	3	2	2
Mule Deer	6	3	6	3	4	4
Northern Goshawk	N	N	N	N	L	L
Philadelphia Vireo	X	X	X	X	X	X
Trumpeter Swan	N	N	N	N	N	N
White-tailed Deer	6	3	6	3	4	4
Woodland Caribou	6	3	6	4	5	5
Yellow-b. Flycatcher	X	X	X	X	U	U

SBSwk2 Ecosystem Units and Structural Stages

	SO (01) - Hybrid White Spruce - Oak Fern (SO, SOsw, SOw)								SO (01) - Hybrid White Spruce - Oak Fern (SOk, SOks)							
Wildlife Species	1	2	3a	3b	4	5	6	7	1	2	3a	3b	4	5	6	7
Bay-breast. Warbler	X	X	X	X	X	X	U	U	X	X	X	X	X	X	U	U
Black-t. G. Warbler	X	X	X	X	X	X	U	U	X	X	X	X	X	X	U	U
Broad-winged Hawk	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Canada Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cape May Warbler	X	X	X	X	X	X	U	U	X	X	X	X	X	X	U	U
Connecticut Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Elk	6	3	4	4	4	4	4	4	6	4	5	5	5	5	5	5
Fisher	N	N	L	L	L	L	L	L	N	N	L	L	L	L	L	L
Grizzly Bear	6	3	4	4	4	4	4	4	6	4	5	5	5	5	5	5
Marten	N	N	N	N	L	L	L	M	N	N	N	N	L	L	L	M
Moose	6	4	3	2	3	3	3	3	6	4	3	2	3	3	3	3
Mule Deer	6	3	4	4	4	4	4	4	6	4	5	5	5	5	4	4
Northern Goshawk	N	N	L	L	L	L	L	M	N	N	L	L	L	L	L	M
Philadelphia Vireo	X	X	X	X	U	U	X	X	X	X	X	X	U	U	X	X
Trumpeter Swan	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
White-tailed Deer	6	3	4	4	4	4	4	4	6	4	5	5	5	5	4	4
Woodland Caribou	6	4	5	5	5	5	5	4	6	4	5	5	5	5	5	4
Yellow-b. Flycatcher	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

SBSwk2 Ecosystem Units and Structural Stages

	LH (02) - Lodgepole Pine - Huckleberry - Cladina (LHrs)								SC (03) - Spruce - Huckleberry - Highbush Cranberry (SCm, SCmw, SCs, SCsw, SCw, SCvw)							
Wildlife Species	1	2	3a	3b	4	5	6	7	1	2	3a	3b	4	5	6	7
Bay-breast. Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	U	U
Black-t. G. Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	U	U
Broad-winged Hawk	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Canada Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cape May Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	U	U
Connecticut Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Elk	6	3	4	5	5	5	5	5	6	3	4	4	5	5	4	4
Fisher	N	N	L	L	L	L	L	L	N	N	L	L	L	L	L	L
Grizzly Bear	6	5	4	4	5	5	5	5	6	3	4	4	4	4	4	4
Marten	N	N	N	N	N	L	L	L	N	N	N	N	N	N	L	M
Moose	6	5	4	4	4	5	5	5	6	4	3	3	4	4	4	4
Mule Deer	6	5	5	5	5	5	5	5	6	3	4	4	5	5	4	4
Northern Goshawk	N	N	L	L	L	L	L	L	N	N	L	L	L	L	L	M
Philadelphia Vireo	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trumpeter Swan	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
White-tailed Deer	6	5	5	5	5	5	5	5	6	3	4	4	5	5	4	4
Woodland Caribou	6	5	5	5	5	5	4	4	6	5	5	5	5	5	4	4
Yellow-b. Flycatcher	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

SBSwk2 Ecosystem Units and Structural Stages

	SC (03) - Spruce - Huckleberry - Highbush Cranberry (SCk, SCkm, SCks)								SD (05) - Spruce - Devil's Club (SD, SDw)							
Wildlife Species	1	2	3a	3b	4	5	6	7	1	2	3a	3b	4	5	6	7
Bay-breast. Warbler	X	X	X	X	X	X	U	U	X	X	X	X	X	X	U	U
Black-t. G. Warbler	X	X	X	X	X	X	U	U	X	X	X	X	X	X	U	U
Broad-winged Hawk	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Canada Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cape May Warbler	X	X	X	X	X	X	U	U	X	X	X	X	X	X	U	U
Connecticut Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Elk	6	3	4	4	5	5	5	5	6	3	4	4	4	4	4	4
Fisher	N	N	L	L	L	L	L	L	N	N	L	L	L	L	L	L
Grizzly Bear	6	3	3	4	4	4	4	4	6	3	2	2	3	3	3	3
Marten	N	N	N	N	N	N	L	M	N	N	N	N	L	L	M	M
Moose	6	4	3	3	4	4	4	4	6	3	2	2	3	3	3	3
Mule Deer	6	3	4	4	5	5	5	5	6	3	4	4	4	4	4	4
Northern Goshawk	N	N	L	L	L	L	M	M	N	N	L	L	L	L	M	M
Philadelphia Vireo	X	X	X	X	X	X	X	X	X	X	X	X	U	U	U	X
Trumpeter Swan	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
White-tailed Deer	6	3	4	4	5	5	5	5	6	3	4	4	4	4	4	4
Woodland Caribou	6	4	5	5	5	5	5	4	6	4	4	5	5	4	4	4
Yellow-b. Flycatcher	X	X	X	X	X	X	X	X	X	X	X	X	X	U	U	U

SBSwk2 Ecosystem Units and Structural Stages

	SD (05) - Spruce - Devil's Club (SDk)								SH (06) - Spruce - Horsetail (SH, SHm)							
Wildlife Species	1	2	3a	3b	4	5	6	7	1	2	3a	3b	4	5	6	7
Bay-breast. Warbler	X	X	X	X	X	X	U	U	X	X	X	X	X	X	U	U
Black-t. G. Warbler	X	X	X	X	X	X	U	U	X	X	X	X	X	X	U	U
Broad-winged Hawk	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Canada Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cape May Warbler	X	X	X	X	X	X	U	U	X	X	X	X	X	X	U	U
Connecticut Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Elk	6	3	4	4	4	4	4	4	6	2	3	4	4	4	4	4
Fisher	N	N	L	L	L	L	L	L	N	N	L	L	L	L	M	M
Grizzly Bear	6	3	2	2	3	3	3	3	6	2	2	2	3	3	3	3
Marten	N	N	N	N	L	L	M	M	N	N	N	N	L	L	M	H
Moose	6	3	2	2	3	3	3	3	6	4	2	2	3	3	3	3
Mule Deer	6	3	4	4	4	4	4	4	6	2	3	4	4	4	4	4
Northern Goshawk	N	N	L	L	L	L	M	M	N	N	L	L	L	L	M	H
Philadelphia Vireo	X	X	X	X	U	U	U	X	X	X	X	X	X	X	X	X
Trumpeter Swan	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
White-tailed Deer	6	3	4	4	4	4	4	4	6	2	3	4	4	4	4	4
Woodland Caribou	6	4	4	5	5	4	4	4	6	4	4	4	4	4	4	3
Yellow-b. Flycatcher	X	X	X	X	X	U	U	U	X	X	X	X	X	U	U	U

SBSwk2 Ecosystem Units and Structural Stages

	WS (00) - Willow - Sedge Fen Wetland (WS)			
Wildlife Species	1	2	3a	3b
Bay-breast. Warbler	X	X	X	X
Black-t. G. Warbler	X	X	X	X
Broad-winged Hawk	N	N	N	N
Canada Warbler	X	X	X	X
Cape May Warbler	X	X	X	X
Connecticut Warbler	X	X	X	X
Elk	6	3	4	4
Fisher	N	N	L	L
Grizzly Bear	6	3	4	4
Marten	N	N	N	N
Moose	5	3	2	2
Mule Deer	6	3	4	4
Northern Goshawk	N	N	L	L
Philadelphia Vireo	X	X	X	X
Trumpeter Swan	N	N	N	N
White-tailed Deer	6	3	4	4
Woodland Caribou	6	3	4	4
Yellow-b. Flycatcher	X	X	U	U

BWBSmw1 Ecosystem Units and Structural Stages

	AM (01) - White Spruce/ Trembling Aspen - Step Moss (AMcn, AMm, AMmn)								AM (01) - White Spruce/ Trembling Aspen - Step Moss (AMkm)							
Wildlife Species	1	2	3a	3b	4	5	6	7	1	2	3a	3 b	4	5	6	7
Bay-breast. Warbler	X	X	X	X	X	X	X	U	X	X	X	X	X	X	X	U
Black-t. G. Warbler	X	X	X	X	X	X	X	U	X	X	X	X	X	X	X	U
Broad-winged Hawk	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Canada Warbler	X	X	X	X	X	U	U	X	X	X	X	X	X	U	U	X
Cape May Warbler	X	X	X	X	X	X	X	U	X	X	X	X	X	X	X	U
Connecticut Warbler	X	X	X	X	X	X	U	X	X	X	X	X	X	X	U	X
Elk	6	3	4	4	4	4	4	4	6	4	4	4	4	4	4	4
Fisher	N	N	L	L	L	L	L	L	N	N	L	L	L	L	L	L
Grizzly Bear	6	3	4	4	4	4	4	4	6	4	4	4	4	4	4	4
Marten	N	N	N	N	L	L	L	M	N	N	N	N	L	L	L	M
Moose	6	4	3	3	4	4	4	4	6	4	3	3	4	4	4	4
Mule Deer	6	3	4	4	4	4	4	4	6	4	4	4	4	4	4	4
Northern Goshawk	N	N	L	L	L	L	L	L	N	N	L	L	L	L	L	L
Philadelphia Vireo	X	X	X	X	U	U	U	X	X	X	X	X	U	U	U	X
Trumpeter Swan	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
White-tailed Deer	6	3	4	4	4	4	4	4	6	4	4	4	4	4	4	4
Woodland Caribou	6	3	5	5	5	5	5	4	6	4	5	5	5	5	5	4
Yellow-b. Flycatcher	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

BWBSmw1 Ecosystem Units and Structural Stages

	AM:ap (01 - seral stage of AM) - Trembling Aspen - Creamy Peavine (AMcn:ap, AMm:ap)								SW (03) - White Spruce - Wildrye - Peavine (SWm, SWms, SWmv, SWmw, SWsw, SWvw)							
Wildlife Species	1	2	3a	3b	4	5	6	7	1	2	3a	3b	4	5	6	7
Bay-breast. Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	U
Black-t. G. Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Broad-winged Hawk	N	N	N	N	N	N	L	L	N	N	N	N	N	N	L	N
Canada Warbler	X	X	X	X	X	U	U	U	X	X	X	X	X	U	U	X
Cape May Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Connecticut Warbler	X	X	X	X	X	U	U	U	X	X	X	X	X	X	U	X
Elk	6	3	4	4	4	4	4	4	6	3	3	3	3	3	3	3
Fisher	N	N	L	L	L	L	L	L	N	N	L	L	L	L	L	L
Grizzly Bear	6	3	4	4	4	4	4	4	6	4	5	5	5	5	5	5
Marten	N	N	N	N	N	N	L	L	N	N	N	N	L	L	L	L
Moose	6	4	3	3	4	4	4	4	6	4	3	3	4	4	4	4
Mule Deer	6	3	4	4	4	4	4	4	6	3	3	3	3	3	3	3
Northern Goshawk	N	N	L	L	L	L	L	M	N	N	L	L	L	L	L	M
Philadelphia Vireo	X	X	X	X	U	U	U	X	X	X	X	X	U	U	U	X
Trumpeter Swan	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
White-tailed Deer	6	3	4	4	4	4	4	4	6	3	3	3	3	3	3	3
Woodland Caribou	6	3	5	5	5	5	5	5	6	4	5	5	5	5	5	4
Yellow-b. Flycatcher	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

BWBSmw1 Ecosystem Units and Structural Stages

	SW (03) - White Spruce - Wildrye - Peavine (SWk, SWkm, SWks, SWkv)								SW: as (03 - seral stage of SW) - Trembling Aspen - Soopolallie (SWm:as, SWmw:as, SWsw:as)							
Wildlife Species	1	2	3a	3b	4	5	6	7	1	2	3a	3b	4	5	6	7
Bay-breast. Warbler	X	X	X	X	X	X	U	U	X	X	X	X	X	X	X	X
Black-t. G. Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Broad-winged Hawk	N	N	N	N	N	N	L	N	N	N	N	N	N	N	L	L
Canada Warbler	X	X	X	X	X	U	U	X	X	X	X	X	X	U	U	U
Cape May Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Connecticut Warbler	X	X	X	X	X	X	U	X	X	X	X	X	X	U	U	U
Elk	6	4	4	4	4	4	4	4	6	4	5	5	5	5	5	5
Fisher	N	N	L	L	L	L	L	L	N	N	L	L	L	L	L	L
Grizzly Bear	6	4	4	5	5	5	5	5	6	4	5	5	5	5	5	5
Marten	N	N	N	N	L	L	L	L	N	N	N	N	N	N	L	L
Moose	6	4	3	3	4	4	4	4	6	4	3	3	4	4	4	4
Mule Deer	6	4	4	4	4	4	4	4	6	4	5	5	5	5	5	5
Northern Goshawk	N	N	L	L	L	L	L	M	N	N	L	L	L	L	L	M
Philadelphia Vireo	X	X	X	X	U	U	U	X	X	X	X	X	U	U	U	X
Trumpeter Swan	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
White-tailed Deer	6	4	4	4	4	4	4	4	6	4	5	5	5	5	5	5
Woodland Caribou	6	4	5	5	5	5	5	4	6	4	5	5	5	5	5	5
Yellow-b. Flycatcher	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

BWBSmw1 Ecosystem Units and Structural Stages

	SW: as (03 - seral stage of SW) - Trembling Aspen - Soopolallie (SWkm:as)								SO (05) - White Spruce - Currant - Oak Fern (SOm, Somw)							
Wildlife Species	1	2	3a	3b	4	5	6	7	1	2	3a	3b	4	5	6	7
Bay-breast. Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	U	U	U
Black-t. G. Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	U	U
Broad-winged Hawk	N	N	N	N	N	N	L	L	N	N	N	N	N	N	L	N
Canada Warbler	X	X	X	X	X	U	U	U	X	X	X	X	X	U	U	X
Cape May Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	U	U
Connecticut Warbler	X	X	X	X	X	U	U	U	X	X	X	X	X	X	U	X
Elk	6	4	5	5	5	5	5	5	6	3	4	4	4	4	4	4
Fisher	N	N	L	L	L	L	L	L	N	N	L	L	L	L	M	M
Grizzly Bear	6	4	5	5	5	5	5	5	6	2	2	2	3	3	3	3
Marten	N	N	N	N	N	N	L	L	N	N	N	N	L	L	M	M
Moose	6	4	3	3	4	4	4	4	6	3	2	2	3	3	3	3
Mule Deer	6	4	5	5	5	5	5	5	6	3	4	4	4	4	4	4
Northern Goshawk	N	N	L	L	L	L	L	M	N	N	L	L	L	L	L	M
Philadelphia Vireo	X	X	X	X	U	U	U	X	X	X	X	X	U	U	U	X
Trumpeter Swan	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
White-tailed Deer	6	4	5	5	5	5	5	5	6	3	4	4	4	4	4	4
Woodland Caribou	6	4	5	5	5	5	5	5	6	3	4	4	4	4	4	3
Yellow-b. Flycatcher	X	X	X	X	X	X	X	X	X	X	X	X	X	U	U	U

BWBSmw1 Ecosystem Units and Structural Stages

	SO (05) - White Spruce - Currant - Oak Fern (SOkm)								SC (06) - White Spruce - Current - Bluebells (SCm)							
Wildlife Species	1	2	3a	3b	4	5	6	7	1	2	3a	3b	4	5	6	7
Bay-breast. Warbler	X	X	X	X	X	U	U	U	X	X	X	X	X	U	U	U
Black-t. G. Warbler	X	X	X	X	X	X	U	U	X	X	X	X	X	X	U	U
Broad-winged Hawk	N	N	N	N	N	N	L	N	N	N	N	N	N	N	L	N
Canada Warbler	X	X	X	X	X	U	U	X	X	X	X	X	X	U	U	X
Cape May Warbler	X	X	X	X	X	X	U	U	X	X	X	X	X	X	U	U
Connecticut Warbler	X	X	X	X	X	X	U	X	X	X	X	X	X	U	U	X
Elk	6	4	4	4	4	4	4	4	6	3	4	4	4	4	4	4
Fisher	N	N	L	L	L	L	L	L	N	N	L	L	L	L	L	L
Grizzly Bear	6	3	3	3	4	4	4	4	6	3	4	4	4	4	4	4
Marten	N	N	N	N	N	L	L	L	N	N	N	N	L	L	M	H
Moose	6	3	2	2	3	3	3	3	6	4	2	2	3	4	4	4
Mule Deer	6	3	4	4	4	4	4	4	6	3	4	4	4	4	4	4
Northern Goshawk	N	N	L	L	L	L	L	M	N	N	L	L	L	L	M	H
Philadelphia Vireo	X	X	X	X	U	U	U	X	X	X	X	X	U	U	U	X
Trumpeter Swan	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
White-tailed Deer	6	3	4	4	4	4	4	4	6	3	4	4	4	4	4	4
Woodland Caribou	6	3	4	4	4	4	4	3	6	3	4	4	4	4	4	3
Yellow-b. Flycatcher	X	X	X	X	X	U	U	U	X	X	X	X	X	U	U	U

BWBSmw1 Ecosystem Units and Structural Stages

Wildlife Species	SC: ab (06 - seral stage of SC) - Trembling Aspen - Black Twinberry (SCa:ab, SCac:ab, SCam:ab, SCm:ab)								SH (07) - White Spruce - Currant - Horestail (SH, SHa, SHm)							
	1	2	3a	3b	4	5	6	7	1	2	3a	3b	4	5	6	7
Bay-breast. Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	U	U	U
Black-t. G. Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	U	U
Broad-winged Hawk	N	N	N	N	N	N	M	M	N	N	N	N	N	N	L	N
Canada Warbler	X	X	X	X	X	U	U	U	X	X	X	X	X	U	U	X
Cape May Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	U	U
Connecticut Warbler	X	X	X	X	X	U	U	U	X	X	X	X	X	U	U	X
Elk	6	4	4	4	4	4	4	4	6	2	3	3	4	4	3	3
Fisher	N	N	L	L	L	L	L	L	N	N	L	L	L	L	M	H
Grizzly Bear	6	4	4	4	4	4	4	4	6	2	3	3	4	4	3	3
Marten	N	N	N	N	N	N	L	M	N	N	N	N	L	M	H	H
Moose	6	4	2	2	3	3	3	3	6	3	2	2	3	3	3	3
Mule Deer	6	4	4	4	4	4	4	4	6	2	3	3	4	4	3	3
Northern Goshawk	N	N	L	L	L	L	M	H	N	N	L	L	L	L	M	H
Philadelphia Vireo	X	X	X	X	U	U	U	X	X	X	X	X	U	U	U	X
Trumpeter Swan	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
White-tailed Deer	6	4	4	4	4	4	4	4	6	2	3	3	4	4	3	3
Woodland Caribou	6	4	5	5	5	5	5	5	6	3	4	4	4	3	3	3
Yellow-b. Flycatcher	X	X	X	X	X	X	X	X	X	X	X	X	X	U	U	U

BWBSmw1 Ecosystem Units and Structural Stages

Wildlife Species	SH: ac (07 - seral stage of SH) - Trembling Aspen - Cow Parsnip (SH:ac, SHa:ac, SHam:ac, SCmn:ac)								AS (00) - White Spruce/ Trembling Aspen - Soopolallie (ASsw, ASvw)							
	1	2	3a	3b	4	5	6	7	1	2	3a	3b	4	5	6	7
Bay-breast. Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black-t. G. Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Broad-winged Hawk	N	N	N	N	N	N	L	M	N	N	N	N	N	N	N	N
Canada Warbler	X	X	X	X	X	U	U	U	X	X	X	X	X	U	X	X
Cape May Warbler	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Connecticut Warbler	X	X	X	X	X	U	U	U	X	X	X	X	X	X	X	X
Elk	6	2	3	3	3	3	3	3	6	3	4	4	4	4	4	4
Fisher	N	N	L	L	L	L	L	L	N	N	N	L	L	L	L	L
Grizzly Bear	6	2	3	3	3	3	3	3	6	3	4	4	4	4	4	4
Marten	N	N	N	N	N	L	L	M	N	N	N	N	N	N	N	L
Moose	6	3	2	2	3	3	3	3	6	3	3	3	4	4	4	4
Mule Deer	6	2	3	3	3	3	3	3	6	3	4	4	4	4	4	4
Northern Goshawk	N	N	L	L	L	L	M	M	N	N	L	L	L	L	L	L
Philadelphia Vireo	X	X	X	X	U	U	U	X	X	X	X	X	U	U	X	X
Trumpeter Swan	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
White-tailed Deer	6	2	3	3	3	3	3	3	6	3	4	4	4	4	4	4
Woodland Caribou	6	3	4	4	4	4	4	4	6	4	5	5	5	5	5	4
Yellow-b. Flycatcher	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

BWBSmw1 Ecosystem Units and Structural Stages

	SE (00) - Sedge Wetland (SE)		WH (00) - Willow - Sedge - Horsetail Riparian Wetland (WH)			
Wildlife Species	**1**	**2**	**1**	**2**	**3a**	**3b**
Bay-breast. Warbler	X	X	X	X	X	X
Black-t. G. Warbler	X	X	X	X	X	X
Broad-winged Hawk	N	N	X	X	X	X
Canada Warbler	X	X	X	X	X	X
Cape May Warbler	X	X	X	X	X	X
Connecticut Warbler	X	X	X	X	X	X
Elk	6	3	6	2	3	3
Fisher	N	N	N	N	L	L
Grizzly Bear	6	3	6	2	3	3
Marten	N	N	N	N	N	N
Moose	5	2	5	2	2	2
Mule Deer	6	3	6	3	3	3
Northern Goshawk	N	N	N	N	L	L
Philadelphia Vireo	X	X	X	X	X	X
Trumpeter Swan	L	L	L	L	L	L
White-tailed Deer	6	3	6	3	3	3
Woodland Caribou	6	3	6	4	4	4
Yellow-b. Flycatcher	X	X	X	X	U	U

Appendix 4.12-2a: Habitat capability rating scheme for three levels of knowledge about a species use of habitat. Ratings are based on the habitat's potential (i.e., the carrying capacity under optimal conditions) to support a particular species and reflect the animal's use of the best habitat (i.e., ecosection, biogeoclimatic unit or ecosystem unit) in the province. Species use is determined by the number of each species using one square kilometre of habitat for a month (# animals/km2/month).

Carrying Capacity (under optimal conditions)	**Detailed Knowledge** Elk Grizzly Bear Moose Mule Deer White-tailed Deer Woodland Caribou		**Intermediate Knowledge** Broad-winged Hawk Fisher Marten Northern Goshawk Trumpeter Swan		**Limited Knowledge** Bay-breasted Warbler Black-t. Green Warbler Canada Warbler Cape May Warbler Connecticut Warbler Philadelphia Vireo Yellow-b. Flycatcher	
	Rating	**Code**	**Rating**	**Code**	**Rating**	**Code**
100-75%	High	1	High	H	Present	U
75-50%	Moderately High	2	Moderate	M		
50-25%	Moderate	3				
25-5%	Low	4	Low	L		
5-0%	Very Low	5	Nil	N	Absent	X
0%	Nil	6				

APPENDIX 4.12-3

MODELS AND CONCEPTS USED FOR DEVELOPING SUITABILITY AND CAPABILITY RATINGS FOR WILDLIFE AT WILLOW CREEK

Appendix 4.12-3: Models and concepts used for developing suitability and capability ratings for wildlife at Willow Creek.

Bay-breasted Warbler

a present/ absent rating was used because limited knowledge on habitat utilization is available for this species

- habitat suitability was only rated for the SBSwk2 and the BWBSmw1 biogeoclimatic zones since this species is not known to occur in the ESSFmv2
- productive and moist forests (generally age class 6 and 7) were generally considered to be of highest value because dense stands of mature spruce forest appear to be preferred habitat
- extremely dry, less productive sites were not considered to be suitable, although drier sites with dense spruce stands may be used

Black-throated Green Warbler

- a present/ absent rating was used because limited knowledge on habitat utilization is available for this species
- all biogeoclimatic zones were rated
- only mature or old growth forests (i.e., structural stage 6 and 7) on moist, productive sites were considered suitable

Broad-winged Hawk

- because intermediate knowledge is available on this species a four class rating system was used
- because all records in northeastern B.C. are from the BWBS biogeoclimatic zone, the SBS and ESSF zones were not rated
- because preferred nesting habitats are deciduous and open, mixed forests often near water, site series with a significant mature (i.e., structural stage 6 and 7), deciduous forest component were rated

Canada Warbler

- a present/ absent rating was used because only limited knowledge on habitat utilization is available for this species
- because all records in northeastern B.C. are from the BWBS biogeoclimatic zone, the SBS and ESSF zones were not rated
- because preferred habitats are mixed forest stands with well developed understorey, structural stages 5 and 6 were rated as having suitability for all site series except for the seral stage types where structural stage 7 was also rated

Cape May Warbler

- a present/ absent rating was used because limited knowledge on habitat utilization is available for this species
- habitat suitability was only rated for the SBSwk2 and the BWBSmw1 biogeoclimatic zones since this species is not known to occur in the ESSFmv2
- productive and moist forests (generally structural stage 6 and 7) were generally considered to be of highest value because mature stands of spruce forest appear to be preferred habitat
- extremely dry, less productive sites were not considered to be suitable, although drier sites with dense spruce stands may be used

Connecticut Warbler

- a present/ absent rating was used because limited knowledge on habitat utilization is available for this species
- because all records in northeastern B.C. are from the BWBS biogeoclimatic zone, the SBS and ESSF zones were not rated
- because preferred nesting habitats are deciduous and open, mixed forests often near water, site series with a significant mature (i.e., structural stage 5, 6 and 7), deciduous forest component were rated as being suitable

Elk

- because detailed information is available on habitat requirements a six class rating system was used
- because of similar habitat requirements, mule deer and white-tailed deer were rated the same; ratings were mostly similar to those for grizzly bear
- habitats were only rated for their value as foraging areas during the growing season; because of high snow depths, elk winter at lower elevations; value of mature and old-growth forests in the BWBSmw1 as cover and shelter in winter was not considered
- early seral stages (i.e., wetlands, clearcuts etc.) in moist and productive sites were generally rated as having higher suitability because of the abundance of herbaceous forage
- older structural stage forests in rich and moist sites were also rated higher because of the increased availability of forage

Fisher

- because intermediate knowledge is available on this species a four class rating system was used
- all biogeoclimatic zones were rated
- mature and old growth stands (i.e., structural stage 6 and 7) were considered to be of highest suitability for fisher for denning and foraging; structural stages 3a to 5 were generally considered to be of low value as foraging areas

Grizzly Bear

- because detailed information is available on habitat requirements a six class rating system was used
- all biogeoclimatic zones were rated for grizzly bear
- suitability ratings are for foraging in the growing season only, as grizzly bears are not expected to den within the site
- production of herbs and berries was the primary factor considered in developing the ratings
- younger seral stage habitats were generally rated higher than forested sites
- rich, moist sites were rated higher than drier sites
- mature and old-growth forests were rated higher than younger forest stands because of generally increased herb and shrub production in the understorey

Marten

- because intermediate knowledge is available on this species a four class rating system was used
- all biogeoclimatic zones were rated
- mature and old growth stands (i.e., structural stage 6 and 7) were considered to be of highest suitability for marten for denning and foraging; structural stages 4 and 5 were generally considered to be of low value as foraging areas

Moose

- because detailed information is available on habitat requirements a six class rating system was used
- all biogeoclimatic zones were rated for moose
- habitats of high shrub diversity and density were generally rated the highest (e.g., structural stages 3a, 3b); preferred shrub habitats generally occurred on rich and moist sites
- wetlands were rated highly because of the excellent foraging opportunities in the growing season

Mule Deer

- because detailed information is available on habitat requirements a six class rating system was used
- because of similar habitat requirements, elk and white-tailed deer were rated the same; ratings were qmostly similar to those for grizzly bear
- habitats were only rated for their value as foraging areas during the growing season; because of high snow depths, mule deer winter at lower elevations; value of mature and old-growth forests in the BWBSmw1 as cover and shelter in winter was not considered
- early seral stages (i.e., wetlands, clearcuts etc.) in moist and productive sites were generally rated as having higher suitability because of the abundance of herbaceous forage
- older structural stage forests in rich and moist sites were also rated higher because of the increased availability of forage

Northern Goshawk

- because intermediate knowledge is available on this species a four class rating system was used
- habitat suitability was not considered to be dependent on elevation or coniferous tree species composition of forests
- productive and moist, mature and old growth forests were considered to be of higher value to northern goshawk because of breeding opportunities
- most vegetated habitats (i.e., structural stage 3a and older) were rated as being of low suitability for foraging

Philadelphia Vireo

- a present/ absent rating was used because limited knowledge on habitat utilization is available for this species
- habitat suitability was only rated for the SBSwk2 and the BWBSmw1 biogeoclimatic zones since this species is not known to occur in the ESSFmv2
- because preferred breeding habitats are dense, rapidly growing aspen stands (~ 20 years of age) only structural stage 4 and 5 were considered suitable for most site series. For site series in the BWBSmw1, structural stage 6 was also considered to be suitable
- moister, productive sites in the SBSwk2 (i.e., SH/06) were not considered suitable because of the greater abundance of coniferous trees in early seral stages
- drier sites were not considered to be suitable

Trumpeter Swan

- because intermediate knowledge is available on this species a four class rating system was used
- only wetland habitats in the Pine River valley (i.e., BWBSmw1) were considered suitable as foraging areas; nesting is not expected to occur

White-tailed Deer

- because detailed information is available on habitat requirements a six class rating system was used
- because of similar habitat requirements, elk and mule deer were rated the same; ratings were mostly similar to those for grizzly bear
- habitats were only rated for their value as foraging areas during the growing season; because of high snow depths, white-tailed deer winter at lower elevations; value of mature and old-growth forests in the BWBSmw1 as cover and shelter in winter was not considered
- early seral stages (i.e., wetlands, clearcuts etc.) in moist and productive sites were generally rated as having higher suitability because of the abundance of herbaceous forage
- older structural stage forests in rich and moist sites were also rated higher because of the increased availability of forage

Woodland Caribou

- because detailed information is available on habitat requirements a six class rating system was used
- caribou are not known from the study area, however all habitats in all biogeoclimatic zones were rated
- highest rated habitats were mature, old-growth forests which are expected to carry heavy lichen loads
- because winter forage (i.e., lichens) are limiting, late structural forests were rated for food availability in winter and early structural stages were rated for availability of forage during the growing season
- early seral stage forests (i.e., 2) were also rated as higher than dense forest stands because of the availability of herbaceous plants for foraging

Yellow-bellied Flycatcher

- a present/ absent rating was used because limited knowledge on habitat utilization is available for this species
- all biogeoclimatic zones were rated
- because coniferous forest edge habitats along creeks, lakes or other waterbodies are preferred breeding habitats, only very moist and rich sites forested sites were rated
- open wetlands were also rated as potentially suitable because of foraging opportunities for flycatchers nesting in adjacent rich, moist sites

APPENDIX 4.13-1

ARCHAEOLOGY/HERITAGE/TRADITIONAL USE STUDY TERMS OF REFERENCE

PROPOSAL

WEST MOBERLY FIRST NATION
AND SAULTEAU FIRST NATION
LAND USE CONSULTATION

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA
PINE VALLEY COAL LTD.

Prepared for:

Norcol, Dames & Moore, Inc.
Suite 1900-650 West Georgia Street
P.O. BOX 11507
Vancouver, B.C.
V6B 4N7

Prepared by:

Fedirchuk McCullough & Associates Ltd.
200, 1719 - 10 Avenue S.W.
Calgary, Alberta
T3C 0K1

July 1997

WEST MOBERLY FIRST NATION
AND SAULTEAU FIRST NATION
LAND USE CONSULTATION

WILLOW CREEK PROJECT
PINE VALLEY, BRITISH COLUMBIA
PINE VALLEY COAL LTD.

INTRODUCTION

At the request of Norecol, Dames & Moore, Inc., Fedirchuk McCullough & Associates Ltd. (FMA) is submitting a proposal for a traditional land use consultation program with both the West Moberly First Nation and the Saulteau First Nation.

The proposed consultation program will update an archaeological overview assessment that was undertaken prior to Pine Valley Coal Ltd.'s proposed development of the Willow Creek Project in 1982. The archaeological overview assessment was part of an application submitted by David Minerals under the Mine Development Review Process for development of an underground mine and associated facilities. The archaeology was undertaken by Dr. R.L. Carlson, Professor of Archaeology at Simon Fraser University for the project consultants IEC. The assessment was conducted in July and August of 1981 and followed the Guidelines for Heritage Resources Impact Assessment in British Columbia. At that time, there was minimal, if any, consultation with First Nations.

Chief George Desjarlais of West Moberly First Nation and Pine Valley Coal representatives Dave Fawcett and Rob Hawes are in agreement that First Nations consultation is a necessary addition to the archaeological assessment. The West Moberly First Nation has identified the Willow Creek Project Area as existing within their "critical use area".

FIRST NATION LAND USE CONSULTATION

OBJECTIVES

1). Up-date the 1981 study in terms of any impacts from changes in location of mine facilities (using the proposed facility locations in the 1997 feasibility report). This may involve a re-assessment of the archaeological evaluation of the project area and a revised Archaeological Impact Assessment.

2) Identify and assess potential impacts on traditional land use areas and heritage resource sites. Traditional land use areas and heritage resource sites may include, but not be restricted to, traditional trails, camp sites, herbal/medicinal plant collecting areas, spiritual or sacred places and burial sites. We respect that this information may be confidential.

METHODOLOGY

1) The FMA consultant would be retained by Pine Valley Coal but work cooperatively with West Moberly First Nation (WMFN) and with the Saulteau First Nations.

2) WMFN would provide an environmental officer to assist in the field study.

3) The FMA consultant and WMFN will undertake the field study jointly. Field study may include traveling throughout the Pine Valley Coal (PVC) development area to locate and assess specific traditional land use areas and historic resource sites.

4) The FMA consultant would have two meetings with WMFN, a workshop at the beginning of the study to get input (oral history) from the Elders and at the conclusion of the study to present the study results.

5) Information on herbal/medicinal plants and other traditional land use issues may be kept confidential by WMFN.

6) The FMA consultant, with input from WMFN, will prepare a interim report on the study findings and recommendations for Pine Valley Coal Ltd. The report will address WMFN concerns about potential conflicts between PVC's development and traditional use areas and heritage resource sites.

7) A final report will be prepared by the FMA consultant.

PRELIMINARY MEETING

The traditional land use consultation program will consist of initial meetings with the West Moberly First Nation and the Saulteau First Nation. Participants at the initial meetings will discuss 1) the main objectives of the consultation program; 2) identify areas that could potentially be impacted by development and; 3) relevant First Nations individuals who should be consulted regarding these selected areas.

MAPPING AND CONSULTATION

The initial meeting will be followed by a sequence of meetings with members from the West Moberly First Nation and the Saulteau First Nation. The FMA consultant and a WMFN environmental officer will conduct these meetings jointly. The study may include trips throughout the PVC development area with First Nations participants.

REPORTING AND RECOMMENDATIONS

A verbal report would be made to Pine Valley Coal Ltd., West Moberly First Nation and Saulteau First Nation immediately upon completion of heritage resource mapping and First Nations consultation. An interim report and/or a final report would subsequently be prepared.

Recommendations concerning identified traditional use areas and/or heritage resource sites would be formulated on the basis of the results of the First Nations traditional land use consultation and mapping.

SCHEDULE

The First Nation Consultation would commence at the request of Pine Valley Coal Ltd. and at the convenience of the West Moberly First Nation and the Saulteau First Nation.

It is estimated that two days will be required for travel and an initial meeting with the Chief and Council of the West Moberly First Nation and the Saulteau First Nation.

An additional five days will be required for the consultation and mapping program. This five day estimate considers time spent meeting with various groups and individuals from the West Moberly First Nations and the Saulteau First Nation, and the recording of traditional use areas and heritage resource sites where necessary, as well as travel time to and from Calgary.

A verbal report will be made to Pine Valley Coal Ltd., West Moberly First Nation and Saulteau First Nation upon completion of the Land Use Consultation and Mapping. An interim report and/or a final report including detailed information on the nature, content and significance of the resources identified would subsequently be prepared on behalf of Pine Valley Coal and Norcol, Dames & Moore, Inc.

CORPORATE EXPERIENCE

Fedirchuk McCullough & Associates Ltd. is a privately owned Canadian heritage resources consulting firm with a specialized interest in the western and northern regions of Canada. Since its inception in 1981, the company has been engaged in the conduct of a wide range of archaeological, historical and paleontological studies related to resource, tourism and community development projects.

APPENDIX 4.14-1

WATER LICENCES FOR THE PINE RIVER

TABLE 3.7-2

WATER LICENCES FOR THE PINE RIVER

LICENCE			Source	Licensee	PEACE RIVER DISTRICT LAND WEST 6th MERIDIAN	Quantity	Pur-pose	Point of Diversion	COMPLETION TO		FILE NO. Comptroller	Remarks
Date	Condi-tional	Final							31st Dec	Extends to 31st Dec.		
20/9/61	27 160		Pine River	chetwynd	Lands w/in the bdy's of Chetwynd W wks. Dist.	150 000 g.a.d.	W wks	A93 P.062	1965		0238541	R/W
App.#35			Pine River	Hyws. Dpt.	Works cross L.365, 367, 368 & 1142	whole flow		93 O/NE (B-5)			0228829	
26/4/63	29097		Pine River	Westcoast Trans. Ltd.	Lot D of Blk.A, Pl.A 1538, Blk.C, Lot 373	10000 g.a.d. 10000 g.a.d.	Ind. W wks	93/O/NE (B-5)	1965		0249547	
App.#133			Pine River	Dept. Hwys	Encroach on & Diversion of P. River			93 O/NE (B-5)			0228829	
App.#407			Pine River	PGE Rlwy.	Chann. Imp. to Pine River in vicinity of lots 1913,2054 & 2021			E93. P. 062			0304407	
App.#641			Pine River	BC Rlwy. R/W	Chann. Diversion s/in Ls. 1913 x 2021			F93. P.062			0304641	
App.#798			Pine River	D. Nelson	Chann. Imp. w/in Lot 1136			93 O/NE (B-6)			0304798	
2/8/76	50129		Pine River	Chetwynd	all lands w/in the boundaries of Chetwynd	450,000 g.a.d.	W wks.	A93. P.062	1990		0330930	R/W Trib. to Peace River

APPENDIX 6.2-1

SCREEN3 DISPERSION MODEL RESULTS

APPENDIX 6.2-1
SCREEN 3 PREDICTIONS FOR AMBIENT PARTICULATES FROM COAL STOCKPLIES

	Ambient Particulate Concentration (ug/m^3)											
Distance	**10 m Stockpile Height**				**15 m Stockpile Height**				**20 m Stockpile Height**			
From Pile	**6.5**	**20**	**40**	**60**	**6.5**	**20**	**40**	**60**	**6.5**	**20**	**40**	**60**
(m)	**(kph)**				**(kph)**				**(kph)**			
1	44.02	132.1	272.4	506.3	6.842	20.53	42.34	78.69	0.8118	2.435	5.023	9.376
100	291.6	874.8	1804	3353	157.8	473.5	976.7	1815	93.12	279.4	576.2	1076
200	313.7	941	1941	3607	177	531.1	1095	2036	108.2	324.6	669.5	1250
300	312.5	937.6	1934	3594	169.1	507.2	1046	1944	105.4	316.1	651.9	1217
400	288.9	866.7	1788	3322	156.3	469	967.3	1798	102.5	307.4	634	1184
500	303.6	910.7	1878	3491	147.2	441.7	911.1	1693	97.4	292.2	602.7	1125
600	294.7	884	1823	3389	137.1	411.3	848.3	1577	86.64	259.9	536.1	1001
700	274.4	823.3	1698	3156	129.7	389.2	802.6	1492	81.03	243.1	501.4	935.9
800	251.6	754.7	1557	2893	130	390.1	804.7	1496	76.58	229.8	473.9	884.5
900	229.2	687.7	1418	2636	126.5	379.5	782.6	1455	71.05	213.2	439.6	820.7
1000	208.6	625.8	1291	2399	121	362.9	748.5	1391	65.82	197.5	407.2	760.2
1100	190.3	571	1178	2189	114.5	343.6	708.6	1317	65.62	196.8	406	757.9
1200	174.1	522.3	1077	2002	107.9	323.7	667.7	1241	64.45	193.4	398.8	744.4
1300	159.7	479	987.9	1836	101.4	304.3	627.7	1167	62.71	188.1	388	724.3
1400	146.9	440.6	908.8	1689	95.26	285.8	589.4	1095	60.61	181.8	375	700.1
1500	135.5	406.6	838.7	1559	89.47	268.4	553.6	1029	58.34	175	361	673.9
1600	125.4	376.3	776.2	1443	84.06	252.2	520.1	966.7	55.99	168	346.4	646.7
1700	116.5	349.4	720.6	1339	79.07	237.2	489.2	909.3	53.64	160.9	331.9	619.5
1800	108.4	325.2	670.8	1247	74.46	223.4	460.7	856.3	51.33	154	317.6	592.8
1900	101.2	303.7	626.4	1164	70.23	210.7	434.6	807.7	49.1	147.3	303.8	567.1
2000	94.74	284.2	586.2	1090	66.31	198.9	410.3	762.6	46.94	140.8	290.4	542.1
2100	89.16	267.5	551.7	1025	62.85	188.5	388.9	722.7	44.93	134.8	278	518.9
2200	84.15	252.4	520.7	967.7	59.69	179.1	369.3	686.4	43.05	129.1	266.3	497.2
2300	79.51	238.5	492	914.4	56.72	170.2	351	652.3	41.23	123.7	255.1	476.2
2400	75.33	226	466.1	866.3	54.02	162	334.2	621.2	39.55	118.7	244.7	456.8
2500	71.49	214.5	442.3	822.1	51.51	154.5	318.7	592.4	37.97	113.9	234.9	438.6
2600	67.96	203.9	420.5	781.5	49.18	147.5	304.3	565.6	36.48	109.4	225.7	421.3
2700	64.69	194.1	400.3	744	47.01	141	290.8	540.6	35.06	105.2	217	405
2800	61.69	185.1	381.7	709.4	44.99	135	278.4	517.4	33.74	101.2	208.7	389.6
2900	58.91	176.7	364.5	677.4	43.11	129.3	266.8	495.8	32.49	97.46	201	375.2
3000	56.35	169	348.7	648	41.37	124.1	256	475.8	31.31	93.94	193.8	361.7

APPENDIX 6.5-1

QUINTETTE COAL NITROGEN DATA

TABLE 1
MONTHLY NITROGEN LOADING DATA, QUINTETTE OPERATING CORPORATION
STATION: S-4 POND PE6739

MONTH	SAMPLING DATE	AMMONIA mg/L	NITRATE mg/L	NITRITE mg/L	TOTAL NITROGEN mg/L	AVG.DAILY FLOW RATE m^3/day	TOTAL LOAD g/d
1	14-Jan-91		2.13	0.004	2.134	259.2	553
1	22-Jan-92		2.61	0.01	2.62	346	907
1	13-Jan-93		2.34	<0.001	2.341	1210	2833
1	26-Jan-94		4.5	0.005	4.505	1123	5059
1	16-Jan-95	0.011	7.34	<0.001	7.352	907	6668
1	20-Jan-96		6.58		6.58	2592	17055
2	12-Feb-91		1.74	0.003	1.743	259.2	452
2	19-Feb-92		2.68	0.004	2.684	259	695
2	10-Feb-93		4.05	<0.001	4.051	1814	7349
2	14-Feb-94		4.84	0.004	4.844	907	4394
2	14-Feb-95		6.99		6.99	691	4830
3	5-Mar-91		2.29	<0.001	2.291	432	990
3	19-Mar-92		4.29	0.043	4.333	6532	28303
3	15-Mar-93		7.95	<0.001	7.951	864	6870
3	15-Mar-94		6.89	0.055	6.945	3283	22800
3	21-Mar-95	0.007	6.21	0.008	6.225	2073.6	12908
3	12-Mar-96	0.008	5.58	0.007	5.595	8640	48341
4	23-Apr-87	0.006	0.046	0.005	0.057	259.2	15
4	3-Apr-91		1.45	0.003	1.453	2678.4	3892
4	7-Apr-92		3.66	0.018	3.678	2799	10295
4	14-Apr-93		2.32	0.004	2.324	2074	4820
4	28-Apr-94		7.84	0.002	7.842	1296	10163
4	19-Apr-95		5.7		5.7	2048	11674
4	15-Apr-96		4.58		4.58	5788.8	26513
5	9-May-90	<0.005	1.14	<0.001	1.146	2332.8	2673
5	8-May-91		0.981	<0.001	0.982	3110.4	3054
5	5-May-92		2.35	0.005	2.355	4860	11445
5	11-May-93		2.48	0.006	2.486	950	2362
5	18-May-94		7.19	0.009	7.199	2073	14924
5	17-May-95		8		8	4147	33176
5	14-May-96		5.75		5.75	4752	27324
6	6-Jun-90	0.06	1.08	0.003	1.143	12096	13826
6	6-Jun-91		1.29	0.009	1.299	2592	3367
6	8-Jun-92		1.61	0.006	1.616	2765	4468
6	7-Jun-93		5.62	0.009	5.629	1382	7779
6	14-Jun-94		7.99	<0.001	7.991	12700.8	101492
6	11-Jun-96	0.015	5.24	0.009	5.264	4320	22740
7	11-Jul-90	0.028	1.86	0.002	1.89	2678.4	5062
7	11-Jul-91		1.94	0.007	1.947	1468.8	2860
7	14-Jul-92		2.3	0.01	2.31	544	1257
7	14-Jul-93		6.38	0.006	6.386	3974	25378
7	13-Jul-94		9.34		9.34	1451	13552
7	20-Jul-95	0.007	6.82	0.015	6.842	2160	14779
7	15-Jul-96		5.48		5.48	3715.2	20359
8	8-Aug-90	0.039	1.27	0.002	1.311	777.6	1019
8	10-Aug-92		2.03	0.005	2.035	1382	2812

TABLE 1
MONTHLY NITROGEN LOADING DATA, QUINTETTE OPERATING CORPORATION
STATION: S-4 POND PE6739

MONTH	SAMPLING DATE	AMMONIA mg/L	NITRATE mg/L	NITRITE mg/L	TOTAL NITROGEN mg/L	AVG.DAILY FLOW RATE m^3/day	TOTAL LOAD g/d
8	18-Aug-93		6.31	0.006	6.316	1210	7642
8	16-Aug-94		12.3		12.3	1728	21254
8	15-Aug-95		6.24		6.24	777	4848
8	12-Aug-96		6.22		6.22	3283.2	20422
9	13-Sep-90	0.093	0.49	<0.001	0.584	259.2	151
9	4-Sep-91	<0.005	2.88	0.011	2.896	345.6	1001
9	16-Sep-92	0.019	2.23	0.002	2.251	2212	4979
9	8-Sep-93	0.023	0.002	2.9	2.925	3024	8845
9	12-Sep-94	0.012	10.6	0.013	10.625	1089	11571
9	27-Sep-95	0.027	5.89	0.028	5.945	1555.2	9246
9	17-Sep-96	0.006	7.44	0.058	7.504	3888	29176
10	15-Oct-90		0.83	<0.001	0.831	259.2	215
10	8-Oct-91		1.79	0.001	1.791	345.6	619
10	19-Oct-92		12.1	0.254	12.354	4536	56038
10	13-Oct-93		0.008	6.9	6.908	1468	10141
10	19-Oct-94		9.94		9.94	1451	14423
10	18-Oct-95		6.31		6.31	1728	10904
10	10-Oct-96		6.45		6.45	5097.6	32880
11	14-Nov-90		1.52	<0.001	1.521	259.2	394
11	6-Nov-91		2.19	<0.001	2.191	345.6	757
11	18-Nov-92		5.43	<0.001	5.431	2212	12013
11	23-Nov-93		0.001	2.63	2.631	1641	4317
11	21-Nov-94		8.68		8.68	1469	12751
11	11-Nov-95		5.8		5.8	2160	12528
11	7-Nov-96		7.71		7.71	1641.6	12657
12	11-Dec-90		6.67	0.025	6.695	432	2892
12	11-Dec-91		0.812	0.001	0.813	345.6	281
12	9-Dec-92		3.73	<0.001	3.731	1210	4515
12	8-Dec-93		<0.001	5.68	5.681	1382	7851
12	13-Dec-94	0.013	7.9	0.001	7.914	864	6838
12	4-Dec-96	0.012	7.2	0.009	7.221	2160	15597

TABLE 2
MONTHLY NITROGEN LOADING SUMMARY
QUINTETTE COAL S-4 POND

Month	Average Load	St Dev Load	Average % Load
January	5,513	6,128	3.9%
February	3,544	2,938	2.5%
March	20,035	17,112	14.2%
April	9,624	8,548	6.8%
May	13,565	12,482	9.6%
June	25,612	37,855	18.2%
July	11,892	9,183	8.4%
August	9,666	8,933	6.9%
September	9,281	9,761	6.6%
October	17,888	20,048	12.7%
November	7,917	5,841	5.6%
December	6,329	5,295	4.5%
Total	140,868	-	-

TABLE 3
PERCENT COMPOSITION OF NITROGEN COMPOUNDS,
QUINTETTE OPERATING CORPORATION, STATION: S-4 POND PE6739

SAMPLING DATE	AMMONIA * mg/L	NITRATE * mg/L	NITRITE * mg/L	TOTAL NITROGEN mg/L	AMMONIA %	NITRATE %	NITRITE %
23-Apr-87	0.006	0.046	0.005	0.057	10.5%	80.7%	8.8%
5-May-87	0.0025	0.01	0.0005	0.013	19.2%	76.9%	3.8%
9-Jun-87	0.023	0.033	0.014	0.07	32.9%	47.1%	20.0%
29-Jul-87	0.013	0.011	0.0005	0.0245	53.1%	44.9%	2.0%
10-Aug-87	0.033	0.054	0.007	0.094	35.1%	57.4%	7.4%
21-Sep-87	0.01	0.0025	0.006	0.0185	54.1%	13.5%	32.4%
27-Oct-87	0.006	0.006	0.0005	0.0125	48.0%	48.0%	4.0%
10-Nov-87	0.011	0.069	0.006	0.086	12.8%	80.2%	7.0%
14-Mar-88	0.009	0.12	0.004	0.133	6.8%	90.2%	3.0%
21-Apr-88	0.0025	0.78	0.027	0.8095	0.3%	96.4%	3.3%
3-May-88	0.022	0.04	0.0005	0.0625	35.2%	64.0%	0.8%
16-Jun-88	0.042	2.55	0.042	2.634	1.6%	96.8%	1.6%
28-Jul-88	0.13	0.034	0.002	0.166	78.3%	20.5%	1.2%
9-Aug-88	0.0025	0.075	0.007	0.0845	3.0%	88.8%	8.3%
15-Sep-88	0.024	0.12	0.0005	0.1445	16.6%	83.0%	0.3%
17-Oct-88	0.01	0.13	0.001	0.141	7.1%	92.2%	0.7%
14-Nov-88	0.005	0.32	0.003	0.328	1.5%	97.6%	0.9%
14-Dec-88	0.011	0.97	0.028	1.009	1.1%	96.1%	2.8%
9-Jan-89	0.007	0.5	0.003	0.51	1.4%	98.0%	0.6%
8-Feb-89	0.089	0.42	0.062	0.571	15.6%	73.6%	10.9%
5-Apr-89	0.0025	2.32	0.025	2.3475	0.1%	98.8%	1.1%
2-May-89	0.033	0.0025	0.007	0.0425	77.6%	5.9%	16.5%
7-Jun-89	0.007	0.85	0.001	0.858	0.8%	99.1%	0.1%
6-Jul-89	0.029	3.34	0.014	3.383	0.9%	98.7%	0.4%
2-Aug-89	0.036	1.53	0.002	1.568	2.3%	97.6%	0.1%
12-Sep-89	0.025	2	0.001	2.026	1.2%	98.7%	0.0%
2-Oct-89	0.009	0.65	0.0005	0.6595	1.4%	98.6%	0.1%
1-Nov-89	0.005	0.7	0.0005	0.7055	0.7%	99.2%	0.1%
4-Dec-89	0.005	0.0025	0.0005	0.008	62.5%	31.3%	6.3%
8-Jan-90	0.018	1.36	0.0005	1.3785	1.3%	98.7%	0.0%
7-Feb-90	0.0025	1.17	0.0005	1.173	0.2%	99.7%	0.0%
8-Mar-90	0.0025	3.38	0.0005	3.383	0.1%	99.9%	0.0%
18-Apr-90	0.019	1.42	0.033	1.472	1.3%	96.5%	2.2%
9-May-90	0.0025	1.14	0.0005	1.143	0.2%	99.7%	0.0%
6-Jun-90	0.06	1.08	0.003	1.143	5.2%	94.5%	0.3%
11-Jul-90	0.028	1.86	0.002	1.89	1.5%	98.4%	0.1%
8-Aug-90	0.039	1.27	0.002	1.311	3.0%	96.9%	0.2%
13-Sep-90	0.093	0.49	0.0005	0.5835	15.9%	84.0%	0.1%
15-Oct-90		0.83	0.0005	0.8305		99.9%	0.1%
14-Nov-90		1.52	0.0005	1.5205		100.0%	0.0%
11-Dec-90		6.67	0.025	6.695		99.6%	0.4%
14-Jan-91		2.13	0.004	2.134		99.8%	0.2%
12-Feb-91		1.74	0.003	1.743		99.8%	0.2%
5-Mar-91		2.29	0.0005	2.2905		100.0%	0.0%
3-Apr-91		1.45	0.003	1.453		99.8%	0.2%
8-May-91		0.981	0.0005	0.9815		99.9%	0.1%

TABLE 3
PERCENT COMPOSITION OF NITROGEN COMPOUNDS,
QUINTETTE OPERATING CORPORATION, STATION: S-4 POND PE6739

SAMPLING DATE	AMMONIA * mg/L	NITRATE * mg/L	NITRITE * mg/L	TOTAL NITROGEN mg/L	AMMONIA %	NITRATE %	NITRITE %
6-Jun-91		1.29	0.009	1.299		99.3%	0.7%
11-Jul-91		1.94	0.007	1.947		99.6%	0.4%
14-Aug-91		2.46	0.016	2.476		99.4%	0.6%
4-Sep-91	0.0025	2.88	0.011	2.8935	0.1%	99.5%	0.4%
8-Oct-91		1.79	0.001	1.791		99.9%	0.1%
6-Nov-91		2.19	0.0005	2.1905		100.0%	0.0%
11-Dec-91		0.812	0.001	0.813		99.9%	0.1%
22-Jan-92		2.61	0.01	2.62		99.6%	0.4%
19-Feb-92		2.68	0.004	2.684		99.9%	0.1%
19-Mar-92		4.29	0.043	4.333		99.0%	1.0%
7-Apr-92		3.66	0.018	3.678		99.5%	0.5%
5-May-92		2.35	0.005	2.355		99.8%	0.2%
8-Jun-92		1.61	0.006	1.616		99.6%	0.4%
14-Jul-92		2.3	0.01	2.31		99.6%	0.4%
10-Aug-92		2.03	0.005	2.035		99.8%	0.2%
16-Sep-92	0.019	2.23	0.002	2.251	0.8%	99.1%	0.1%
19-Oct-92		12.1	0.254	12.354		97.9%	2.1%
18-Nov-92		5.43	0.0005	5.4305		100.0%	0.0%
9-Dec-92		3.73	0.0005	3.7305		100.0%	0.0%
13-Jan-93		2.34	0.0005	2.3405		100.0%	0.0%
10-Feb-93		4.05	0.0005	4.0505		100.0%	0.0%
15-Mar-93		7.95	0.0005	7.9505		100.0%	0.0%
14-Apr-93		2.32	0.004	2.324		99.8%	0.2%
11-May-93		2.48	0.006	2.486		99.8%	0.2%
7-Jun-93		5.62	0.009	5.629		99.8%	0.2%
14-Jul-93		6.38	0.006	6.386		99.9%	0.1%
18-Aug-93		6.31	0.006	6.316		99.9%	0.1%
26-Jan-94		4.5	0.005	4.505		99.9%	0.1%
14-Feb-94		4.84	0.004	4.844		99.9%	0.1%
15-Mar-94		6.89	0.055	6.945		99.2%	0.8%
28-Apr-94		7.84	0.002	7.842		100.0%	0.0%
18-May-94		7.19	0.009	7.199		99.9%	0.1%
14-Jun-94		7.99	0.0005	7.9905		100.0%	0.0%
12-Sep-94	0.012	10.6	0.013	10.625	0.1%	99.8%	0.1%
13-Dec-94	0.013	7.9	0.001	7.914	0.2%	99.8%	0.0%
16-Jan-95	0.011	7.34	0.0005	7.3515	0.1%	99.8%	0.0%
21-Mar-95	0.007	6.21	0.008	6.225	0.1%	99.8%	0.1%
20-Jul-95	0.007	6.82	0.015	6.842	0.1%	99.7%	0.2%
27-Sep-95	0.027	5.89	0.028	5.945	0.5%	99.1%	0.5%
15-Dec-95	0.044	5.75	0.012	5.806	0.8%	99.0%	0.2%
12-Mar-96	0.008	5.58	0.007	5.595	0.1%	99.7%	0.1%
11-Jun-96	0.015	5.24	0.009	5.264	0.3%	99.5%	0.2%
17-Sep-96	0.006	7.44	0.058	7.504	0.1%	99.1%	0.8%
4-Dec-96	0.012	7.2	0.009	7.221	0.2%	99.7%	0.1%

* Values < detection limit set equal to 0.5 times the detection limit

TABLE 3
PERCENT COMPOSITION OF NITROGEN COMPOUNDS,
QUINTETTE OPERATING CORPORATION, STATION: S-4 POND PE6739

SAMPLING DATE	AMMONIA * mg/L	NITRATE * mg/L	NITRITE * mg/L	TOTAL NITROGEN mg/L	AMMONIA %	NITRATE %	NITRITE %

SUMMARY STATISTICS

Statistic	Ammonia	Nitrate	Nitrite	100% - NO3 + NO2
Mean	12.0%	91.4%	1.8%	6.8%
SD	20.9%	19.9%	4.7%	
n	51	90	90	
Lower 95% C.L.	6.3%	87.3%	0.8%	
Upper 95% C.L.	17.8%	95.5%	2.7%	

APPENDIX 7.3-1

SPREADSHEET CALCULATION TABLES FOR *SEDIMENTATION POND SIZING*

TABLE B-1
PRELIMINARY CALCULATION OF 1:10 YEAR STORM RUNOFF FROM PLANT SITE

		TO LOWER PLANT SITE SED POND	TO UPPER PLANT SITE SED POND			
		LOWER PLANT SITE (ROADS, STOCKPILES AND NATIVE SOILS)	NATIVE ALLUVIAL SOIL SURFACE AND STOCKPILE AREAS	ROADS AND STRUCTURES	NON-DIVERTABLE NATIVE AREAS ABOVE PLANT SITE	TOTAL FLOW OR VOLUME
AREA	ha	10.0	10.0	5.0	3.0	
RUNOFF COEFFICIENT[1]		0.5	0.4	0.95	0.65	
ONE HOUR STORM						
Precipitation rate[2]	mm/hr	22	22	22	22	
Flow rate[3]	m^3/s	0.3	0.2	0.3	0.1	**0.7**
Volume	m^3	1100	880	1045	429	**2354**
SIX HOUR STORM						
Precipitation rate[2]	mm/hr	5.6	5.6	5.6	5.6	
Flow rate[3]	m^3/s	0.1	0.1	0.1	0.0	**0.17**
Volume	m^3	1687	1350	1603	658	**3611**
TWELVE HOUR STORM						
Precipitation rate[2]	mm/hr	3.9	3.9	3.9	3.9	
Flow rate[3]	m^3/s	0.05	0.04	0.05	0.02	**0.12**
Volume	m^3	2340	1872	2223	913	**5008**
TWENTY FOUR HOUR STORM						
Precipitation rate[2]	mm/hr	2.5	2.5	2.5	2.5	
Flow rate[3]	m^3/s	0.03	0.03	0.03	0.01	**0.07**
Volume	m^3	3000	2400	2850	1170	**6420**

POND DESIGN TO RETAIN TEN HOUR STORM

	Main Plant Site Pond	Lower Plant Site Sed Pond	
Volume	4256 m^3	1989 m^3	assume 85% retention of 12 hour storm
Pond depth	1.5 m	1.5 m	
Effective flow depth	1 m	1 m	assume flow in upper 1m of pond only
Required area	4256 m^2	1989 m^2	
Nominal width[4]	29 m	20 m	
Nominal Length	146 m	100 m	

NOTES:

1) Runoff coefficient estimation based on Table 2-23 in:
"The Water Encyclopedia", eds. van der Leeden *et al*., 1990
2) Precipitation intensity-duration from the "Rainfall Frequency Atlas of Canada", Hogg and Carr, 1985.
3) Flows calculated using Rational Method.
4) Based on 5:1 length to width ratio.

TABLE B-2
PRELIMINARY CALCULATION OF 1:200 YEAR STORM RUNOFF FROM PLANT SITE

		TO LOWER PLANT SITE SED POND	TO UPPER PLANT SITE SED POND			
		LOWER PLANT SITE (ROADS, STOCKPILES AND NATIVE SOILS)	NATIVE ALLUVIAL SOIL SURFACE AND STOCKPILE AREAS	ROADS AND STRUCTURES	NON-DIVERTABLE NATIVE AREAS ABOVE PLANT SITE	TOTAL FLOW OR VOLUME
AREA	ha	10.0	10.0	5.0	3.0	
RUNOFF COEFFICIENT[1]		0.5	0.4	0.95	0.65	
ONE HOUR STORM						
Precipitation rate[2]	mm/hr	38	38	38	38	
Flow rate[3]	m^3/s	0.5	0.4	0.5	0.2	**1.1**
Volume	m^3	1900	1520	1805	741	**4066**
TWENTY FOUR HOUR STORM						
Precipitation rate	mm/hr	4.3	4.3	4.3	4.3	
Flow rate[3]	m^3/s	0.1	0.05	0.06	0.02	**0.13**
Volume	m^3	5160	4128	4902	2012	**11042**

RETENTION PROVIDED BY PROPOSED POND DESIGN

	Main Plant Sed Pond	Lower Plant Site Sed Pond	
Pond volume	4256 m^3	1989 m^3	see previous table
Pond depth	2.5 m	1.5 m	
Effective flow depth	1 m	1 m	assume flow in upper 1m of pond only
Retention time	1.05 hr	1.05 hr	based on one hour duration storm

NOTES:

1) Runoff coefficient estimation based on Table 2-23 in: "The Water Encyclopedia", eds. van der Leeden *et al*., 1990

2) Precipitation intensity-duration from the "Rainfall Frequency Atlas of Canada", Hogg and Carr, 1985.

3) Flows calculated using Rational Method.

TABLE B-3
PRELIMINARY CALCULATION OF 1:10 YEAR STORM RUNOFF FROM NORTH PITS AND WASTE DUMPS (PHASE 1A DRAINAGE)

		TO PHASE 1A (NORTH PIT) SED POND				
		ACTIVE PIT AREAS	NATIVE PIT AREA (Prior to mining)	WASTE AND COAL REJECT DUMPS	TOTAL AREA	TOTAL FLOW OR VOLUME
AREA	ha	59.2	14.8	74.0	148.0	
RUNOFF COEFFICIENT[1]		0.9	0.65	0.5		
ONE HOUR STORM						
Precipitation rate[2]	mm/hr	22	22	22		
Flow rate[3]	m^3/s	3.3	0.6	2.3		**6.1**
Volume	m^3	11721.6	2116.4	8140		**21978**
SIX HOUR STORM						
Precipitation rate[2]	mm/hr	5.6	5.6	5.6		
Flow rate[3]	m^3/s	0.8	0.2	0.6		**1.6**
Volume	m^3	17978.8032	3246.1728	12485.28		**33710**
TWELVE HOUR STORM						
Precipitation rate[2]	mm/hr	3.9	3.9	3.9		
Flow rate[3]	m^3/s	0.6	0.1	0.4		**1.1**
Volume	m^3	24935.04	4502.16	17316		**46753**
TWENTY FOUR HOUR STORM						
Precipitation rate[2]	mm/hr	2.5	2.5	2.5		
Flow rate[3]	m^3/s	0.4	0.1	0.3		**0.69**
Volume	m^3	31968	5772	22200		**59940**

POND DESIGN TO RETAIN TEN HOUR STORM

Volume	39740 m^3	assume 85% retention of 12 hour storm
Pond depth	2.5 m	
Effective flow depth	1 m	assume flow in upper 1m of pond only
Required area	39740 m^2	
Width[4]	89 m	
Length	446 m	

NOTES:

1) *Runoff coefficient estimation based on Table 2-23 in:*
"The Water Encyclopedia", eds. van der Leeden *et al.*, 1990

2) Precipitation intensity-duration from the "Rainfall Frequency Atlas of Canada", Hogg and Carr, 1985.

3) Flows calculated using Rational Method.

4) *Based on 5:1 length to width ratio.*

TABLE B-4
PRELIMINARY CALCULATION OF 1:200 YEAR STORM RUNOFF FROM NORTH PITS AND WASTE DUMPS (PHASE 1A DRAINAGE)

		TO PHASE 1A (NORTH PIT) SED POND				
		ACTIVE PIT AREAS	NATIVE PIT AREA (Prior to mining)	WASTE AND COAL REJECT DUMPS	TOTAL AREA	TOTAL FLOW OR VOLUME
AREA	ha	59.2	14.8	74.0	148.0	
RUNOFF COEFFICIENT[1]		0.9	0.65	0.5		
ONE HOUR STORM						
Precipitation rate[2]	mm/hr	38	38	38		
Flow rate[3]	m^3/s	5.6	1.0	3.9		**10.5**
Volume	m^3	20246	3656	14060		**37962**
TWENTY FOUR HOUR STORM						
Precipitation rate	mm/hr	4.3	4.3	4.3		
Flow rate[3]	m^3/s	0.6	0.1	0.4		**1.2**
Volume	m^3	54985	9928	38184		**103097**

RETENTION PROVIDED BY PROPOSED POND DESIGN

Volume	39740 m^3	see previous table
Pond depth	2.5 m	
Effective flow depth	1 m	assume flow in upper 1m of pond only
Retention time	1.05 hr	based on one hour duration storm volume

NOTES:

1) Runoff coefficient estimation based on Table 2-23 in:
"The Water Encyclopedia", eds. van der Leeden *et al.*, 1990
2) Precipitation intensity-duration from the "Rainfall Frequency Atlas of Canada", Hogg and Carr, 1985.
3) Flows calculated using Rational Method.

TABLE B-5
PRELIMINARY CALCULATION OF 1:10 YEAR STORM RUNOFF FROM PHASE 1B DRAINAGE AREA (PENINSULA PIT)

		TO PHASE 1B (PENINSULA PIT) SED POND			TO PHASE IB EXTERNAL DUMP SED POND
		ACTIVE PIT AREAS	IN PIT DUMP AREAS	TOTAL FLOW OR VOLUME	EXTERNAL DUMP AREA
AREA	ha	12.0	12.0		13
RUNOFF COEFFICIENT[1]		0.9	0.5		0.5
ONE HOUR STORM					
Precipitation rate[2]	mm/hr	22	22		22
Flow rate[3]	m^3/s	0.7	0.4	**1.0**	**0.4**
Volume	m^3	2376	1320	**3696**	**1430**
SIX HOUR STORM					
Precipitation rate[2]	mm/hr	5.6	5.6		5.6
Flow rate[3]	m^3/s	0.2	0.1	**0.26**	**0.10**
Volume	m^3	3644	2025	**5669**	**2193**
TWELVE HOUR STORM					
Precipitation rate[2]	mm/hr	3.9	3.9		3.9
Flow rate[3]	m^3/s	0.1	0.1	**0.18**	**0.07**
Volume	m^3	5054	2808	**7862**	**3042**
TWENTY FOUR HOUR STORM					
Precipitation rate[2]	mm/hr	2.5	2.5		2.50
Flow rate[3]	m^3/s	0.1	0.04	**0.12**	**0.05**
Volume	m^3	6480	3600	**10080**	**3900**

POND DESIGN TO RETAIN TEN HOUR STORM

	Phase 1B Pit Sed Pond	Phase 1B External Dump Sed Pond	
Volume	6683 m^3	2586 m^3	assume 85% retention of 12 hr storm
Pond depth	2.5 m	2.5 m	
Effective flow depth	1 m	1 m	assume flow in upper 1m of pond only
Required area	6683 m^2	2586 m^2	
Width[4]	37 m	23 m	
Length	183 m	114 m	

NOTES:

1) Runoff coefficient estimation based on Table 2-23 in:
"The Water Encyclopedia", eds. van der Leeden *et al*., 1990
2) Precipitation intensity-duration from the "Rainfall Frequency Atlas of Canada", Hogg and Carr, 1985.
3) Flows calculated using Rational Method.
4) Based on 5:1 length to width ratio.

TABLE B-6
PRELIMINARY CALCULATION OF 1:200 YEAR STORM RUNOFF FROM PHASE 1B DRAINAGE AREA (PENINSULA PIT)

		TO PHASE 1B (PENINSULA PIT) SED POND			TO PHASE 1B EXTERNAL DUMP SED POND
		ACTIVE PIT AREAS	IN PIT DUMP AREAS	TOTAL FLOW OR VOLUME	EXTERNAL DUMP AREA
AREA	ha	12	12		13
RUNOFF COEFFICIENT[1]		0.9	0.5		0.5
ONE HOUR STORM					
Precipitation rate[2]	mm/hr	38	38		38
Flow rate[3]	m^3/s	1.1	0.6	**1.8**	**0.69**
Volume	m^3	4104	2280	**6384**	**2470**
TWENTY FOUR HOUR STORM					
Precipitation rate	mm/hr	4.3	4.3		4.3
Flow rate[3]	m^3/s	0.1	0.1	**0.20**	**0.08**
Volume	m^3	11146	6192	**17338**	**6708**

RETENTION PROVIDED BY PROPOSED POND DESIGN

	Phase 1B Pit Sed Pond	Phase 1B External Dump Sed Pond	
Volume	6683 m^3	2586 m^3	see previous table
Pond depth	2.5 m	2.5 m	
Effective flow depth	1 m	1 m	assume flow in upper 1m of pond only
Retention time	1.05 hr	1.05 hr	based on one hour duration storm

NOTES:

1) Runoff coefficient estimation based on Table 2-23 in:
"The Water Encyclopedia", eds. van der Leeden *et al.*, 1990

2) Precipitation intensity-duration from the "Rainfall Frequency Atlas of Canada", Hogg and Carr, 1985.

3) Flows calculated using Rational Method.

TABLE B-7
PRELIMINARY CALCULATION OF 1:10 YEAR STORM RUNOFF FROM PHASE 2 DRAINAGE AREAS (1 TO 4 SEAM PIT AND DUMPS)

		TO PHASE 2 (IN-PIT) SED POND				
		1 TO 4 SEAM PIT AREAS	NORTH PIT AREAS WHICH DRAIN TO SED POND	DUMP AREAS (NORTH AND CENTRAL PIT DUMPS)	NATIVE PIT AREA (Prior to mining)	TOTAL FLOW OR VOLUME
AREA	ha	23.3	19.0	56.0	4.5	
RUNOFF COEFFICIENT[1]		0.9	0.9	0.5	0.65	
ONE HOUR STORM						
Precipitation rate[2]	mm/hr	22	22	22	22	
Flow rate[3]	m^3/s	1.3	1.0	1.7	0.2	**4.2**
Volume	m^3	4613	3762	6160	644	**15179**
SIX HOUR STORM						
Precipitation rate[2]	mm/hr	5.6	5.6	5.6	5.6	
Flow rate[3]	m^3/s	0.3	0.3	0.4	0.0	**1.1**
Volume	m^3	7076	5770	9448	987	**23282**
TWELVE HOUR STORM						
Precipitation rate[2]	mm/hr	3.9	3.9	3.9	3.9	
Flow rate[3]	m^3/s	0.2	0.2	0.3	0.0	**0.75**
Volume	m^3	9814	8003	13104	1369	**32290**
TWENTY FOUR HOUR STORM						
Precipitation rate[2]	mm/hr	2.5	2.5	2.5	2.5	
Flow rate[3]	m^3/s	0.1	0.1	0.2	0.0	**0.48**
Volume	m^3	12582	10260	16800	1755	**41397**

POND DESIGN TO RETAIN TEN HOUR STORM

Volume	27446 m^3	assume 85% retention of 12 hour storm
Pond depth	2.5 m	
Effective flow depth	1 m	assume flow in upper 1m of pond only
Required area	27446 m^2	
Width[4]	74 m	
Length	370 m	

NOTES:

1) Runoff coefficient estimation based on Table 2-23 in:
"The Water Encyclopedia", eds. van der Leeden *et al.*, 1990

2) Precipitation intensity-duration from the "Rainfall Frequency Atlas of Canada", Hogg and Carr, 1985.

3) Flows calculated using Rational Method.

4) Based on 5:1 length to width ratio.

TABLE B-8
PRELIMINARY CALCULATION OF 1:200 YEAR STORM INFLOWS FROM PHASE 2 DRAINAGE AREAS (1 TO 4 SEAM PIT AND DUMPS)

		TO PHASE 2 (IN-PIT) SED POND				
		1 TO 4 SEAM PIT AREAS	NORTH PIT AREAS WHICH DRAIN TO SED POND	DUMP AREAS (NORTH AND CENTRAL PIT DUMPS)	NATIVE PIT AREA (Prior to mining)	TOTAL FLOW OR VOLUME
AREA	ha	23.3	19.0	56.0	4.5	
RUNOFF COEFFICIENT[1]		0.9	0.9	0.5	0.65	
ONE HOUR STORM						
Precipitation rate[2]	mm/hr	38	38	38	38	
Flow rate[3]	m^3/s	2.2	1.8	3.0	0.3	**7.3**
Volume	m^3	7969	6498	10640	1112	**26218**
TWENTY FOUR HOUR STORM						
Precipitation rate	mm/hr	4.3	4.3	4.3	4.3	
Flow rate[3]	m^3/s	0.3	0.2	0.3	0.0	**0.82**
Volume	m^3	21641	17647	28896	3019	**71203**

RETENTION PROVIDED BY PROPOSED POND DESIGN

Volume	27446 m^3	see previous table
Pond depth	2.5 m	
Effective flow depth	1 m	assume flow in upper 1m of pond only
Retention time	1.05 hr	based on one hour duration storm volume

NOTES:

1) Runoff coefficient estimation based on Table 2-23 in: "The Water Encyclopedia", eds. van der Leeden *et al.*, 1990
2) Precipitation intensity-duration from the "Rainfall Frequency Atlas of Canada", Hogg and Carr, 1985.
3) Flows calculated using Rational Method.

TABLE B-9
PRELIMINARY CALCULATION OF 1:10 YEAR STORM RUNOFF FROM PHASE 3 DRAINAGE AREA (1 TO 4 SEAM PITS)

		TO PHASE 3 SED POND OR PHASE 2 (IN-PIT) SED POND			
		ACTIVE PIT AREAS	NATIVE AREAS (Surrounding and above pit)	WASTE DUMP AND REJECT DISPOSAL	TOTAL FLOW OR VOLUME
AREA	ha	31.6	21.4	8.7	
RUNOFF COEFFICIENT[1]		0.9	0.65	0.5	
ONE HOUR STORM					
Precipitation rate[2]	mm/hr	22	22	22	
Flow rate[3]	m^3/s	1.7	0.9	0.3	**2.9**
Volume	m^3	6257	3060	957	**10274**
SIX HOUR STORM					
Precipitation rate[2]	mm/hr	5.6	5.6	5.6	
Flow rate[3]	m^3/s	0.4	0.2	0.1	**0.73**
Volume	m^3	9597	4694	1468	**15758**
TWELVE HOUR STORM					
Precipitation rate[2]	mm/hr	3.9	3.9	3.9	
Flow rate[3]	m^3/s	0.3	0.2	0.0	**0.51**
Volume	m^3	13310	6510	2035.8	**21856**
TWENTY FOUR HOUR STORM					
Precipitation rate[2]	mm/hr	2.5	2.5	2.5	
Flow rate[3]	m^3/s	0.2	0.1	0.0	**0.32**
Volume	m^3	17064	8346	2610	**28020**

POND DESIGN TO RETAIN TEN HOUR STORM

Pumped Flow[4]	0.22 m^3/s	assume runoff reports to pit sump for pumping
Volume	7783 m^3	
Pond depth	2.5 m	
Effective flow depth	1 m	assume flow in upper 1m of pond only
Required area	7783 m^2	
Width[5]	39 m	
Length	197 m	

NOTES:

1) Runoff coefficient estimation based on Table 2-23 in:
"The Water Encyclopedia", eds. van der Leeden *et al*., 1990
2) Precipitation intensity-duration from the "Rainfall Frequency Atlas of Canada", Hogg and Carr, 1985.
3) Flows calculated using Rational Method.
4) Pumps sized to remove 24 hour storm over 36 hour period.
5) Based on 5:1 length to width ratio.

TABLE B-10
PRELIMINARY CALCULATION OF 1:200 YEAR STORM INFLOWS FROM PHASE 3 DRAINAGE AREA (1 TO 4 SEAM PITS)

		TO PHASE 3 SED POND OR PHASE 2 (IN-PIT) SED POND			
		ACTIVE PIT AREAS	NATIVE AREAS (Surrounding and above pit)	WASTE DUMP AND REJECT DISPOSAL	TOTAL FLOW OR VOLUME
AREA	ha	31.6	21.4	8.7	
RUNOFF COEFFICIENT[1]		0.9	0.65	0.5	
ONE HOUR STORM					
Precipitation rate[2]	mm/hr	38	38	38	
Flow rate[3]	m^3/s	3.0	1.5	0.5	**4.9**
Volume	m^3	10807	5286	1653	**17746**
TWENTY FOUR HOUR STORM					
Precipitation rate	mm/hr	4.3	4.3	4.3	
Flow rate[3]	m^3/s	0.3	0.2	0.1	**0.56**
Volume	m^3	29350.08	14355.12	4489.2	**48194**

RETENTION PROVIDED BY PROPOSED POND DESIGN

Volume	7783 m^3	see previous table
Pond depth	2.5 m	
Effective flow depth	1 m	assume flow in upper 1m of pond only
Retention time	0.44 hr	based on one hour duration storm and gravity drainage

NOTES:

1) Runoff coefficient estimation based on Table 2-23 in: "The Water Encyclopedia", eds. van der Leeden *et al.*, 1990

2) Precipitation intensity-duration from the "Rainfall Frequency Atlas of Canada", Hogg and Carr, 1985.

3) Flows calculated using Rational Method.

TABLE B-11
PRELIMINARY CALCULATION OF 1:10 YEAR STORM RUNOFF FROM PHASE 4A DRAINAGE AREAS (SEAM 5 TO 7 PIT AND DUMPS)

		TO PHASE 2 (IN PIT) SED POND			
		ACTIVE PIT AREAS	NATIVE AREAS (Surrounding and above pit)	WASTE DUMP AND REJECT DISPOSAL	TOTAL FLOW OR VOLUME
AREA	ha	22.8	22.8	3.4	
RUNOFF COEFFICIENT[1]		0.9	0.65	0.5	
ONE HOUR STORM					
Precipitation rate[2]	mm/hr	22	22	22	
Flow rate[3]	m^3/s	1.3	0.9	0.1	**2.26**
Volume	m^3	4514	3260	374	**8149**
SIX HOUR STORM					
Precipitation rate[2]	mm/hr	5.6	5.6	5.6	
Flow rate[3]	m^3/s	0.3	0.2	0.0	**0.58**
Volume	m^3	6924	5001	574	**12499**
TWELVE HOUR STORM					
Precipitation rate[2]	mm/hr	3.9	3.9	3.9	
Flow rate[3]	m^3/s	0.2	0.2	0.0	**0.40**
Volume	m^3	9603	6936	796	**17335**
TWENTY FOUR HOUR STORM					
Precipitation rate[2]	mm/hr	2.5	2.5	2.5	
Flow rate[3]	m^3/s	0.1	0.1	0.0	**0.26**
Volume	m^3	12312	8892	1020	**22224**

POND DESIGN TO RETAIN TEN HOUR STORM

Pumped Flow[4]	0.17 m^3/s	assume runoff reports to pit sump for pumping
Volume	6173 m^3	
Pond depth	2.5 m	
Effective flow depth	1 m	assume flow in upper 1m of pond only
Required area	6173 m^2	
Width[5]	35 m	
Length	176 m	

NOTES:

1) Runoff coefficient estimation based on Table 2-23 in:
"The Water Encyclopedia", eds. van der Leeden *et al.*, 1990
2) Precipitation intensity-duration from the "Rainfall Frequency Atlas of Canada", Hogg and Carr, 1985.
3) Flows calculated using Rational Method.
4) Pumps sized to remove 24 hour storm over 36 hour period.
5) Based on 5:1 length to-width ratio.

TABLE B-12

PRELIMINARY CALCULATION OF 1:200 YEAR STORM RUNOFF FROM PHASE 4A DRAINAGE AREA (SEAM 5 TO 7 PIT AND DUMPS)

		TO PHASE 2 (IN PIT) SED POND			
		ACTIVE PIT AREAS	NATIVE AREAS (Surrounding and above pit)	WASTE DUMP AND REJECT DISPOSAL	TOTAL FLOW OR VOLUME
AREA	ha	22.8	22.8	3.4	
RUNOFF COEFFICIENT[1]		*0.9*	*0.65*	*0.5*	
ONE HOUR STORM					
Precipitation rate[2]	mm/hr	38	38	38	
Flow rate[3]	m^3/s	2.2	1.6	0.2	**3.91**
Volume	m^3	7797.6	5632	646	**14075**
TWENTY FOUR HOUR STORM					
Precipitation rate	mm/hr	4.3	4.3	4.3	
Flow rate[3]	m^3/s	0.2	0.2	0.0	**0.44**
Volume	m^3	21176.64	15294.24	1754.4	**38225**

RETENTION PROVIDED BY PROPOSED POND DESIGN

Volume	6173 m^3	see previous table
Pond depth	2.5 m	
Effective flow depth	1 m	assume flow in upper 1m of pond only
Retention time	0.44 hr	based on one hour storm duration and gravity flow

NOTES:

1) Runoff coefficient estimation based on Table 2-23 in: "The Water Encyclopedia", eds. van der Leeden *et al.*, 1990

2) Precipitation intensity-duration from the "Rainfall Frequency Atlas of Canada", Hogg and Carr, 1985.

3) Flows calculated using Rational Method.

TABLE B-13
PRELIMINARY CALCULATION OF 1:10 YEAR INFLOWS FROM PHASE 4B DRAINAGE AREA (8C PIT)

		PHASE 4B SED POND
		ACTIVE PIT AREAS
AREA	ha	6.4
RUNOFF COEFFICIENT[1]		0.9
ONE HOUR STORM		
Precipitation rate[2]	mm/hr	22
Flow rate[3]	m^3/s	**0.4**
Volume	m^3	**1267**
SIX HOUR STORM		
Precipitation rate[2]	mm/hr	5.6
Flow rate[3]	m^3/s	**0.09**
Volume	m^3	**1944**
TWELVE HOUR STORM		
Precipitation rate[2]	mm/hr	3.9
Flow rate[3]	m^3/s	**0.06**
Volume	m^3	**2696**
TWENTY FOUR HOUR STORM		
Precipitation rate[2]	*mm/hr*	2.5
Flow rate[3]	m^3/s	**0.04**
Volume	m^3	**3456**

POND DESIGN TO RETAIN TEN HOUR STORM

Volume	2291 m^3	assume 85% retention of 12 hour storm
Pond depth	2.5 m	
Effective flow depth	1 m	assume flow in upper 1m of pond only
Required area	2291 m^2	
Width[4]	21 m	
Length	107 m	

NOTES:

1) Runoff coefficient estimation based on Table 2-23 in: "The Water Encyclopedia", eds. van der Leeden *et al*., 1990
2) Precipitation intensity-duration from the "Rainfall Frequency Atlas of Canada", Hogg and Carr, 1985
3) Flows calculated using Rational Method.
4) Based on 5:1 length to width ratio.

TABLE B-14

PRELIMINARY CALCULATION OF 1:200 YEAR STORM RUNOFF FROM PHASE 4B DRAINAGE AREA (8C PIT)

		PHASE 4B SED POND
		ACTIVE PIT AREAS
AREA	ha	6.4
RUNOFF COEFFICIENT[1]		0.9
ONE HOUR STORM		
Precipitation rate[2]	mm/hr	38
Flow rate[3]	m^3/s	**0.61**
Volume	m^3	**2189**
TWENTY FOUR HOUR STORM		
Precipitation rate	mm/hr	4.3
Flow rate[3]	m^3/s	**0.07**
Volume	m^3	**5944**

RETENTION PROVIDED BY PROPOSED POND DESIGN

Volume	2291 m^3	see previous table
Pond depth	2.5 m	
Effective flow depth	1 m	assume flow in upper 1m of pond only
Retention time	1.05 hr	based on one hour duration storm

NOTES:

1) Runoff coefficient estimation based on Table 2-23 in:
"The Water Encyclopedia", eds. van der Leeden *et al.*, 1990

2) Precipitation intensity-duration from the "Rainfall Frequency Atlas of Canada", Hogg and Carr, 1985.

3) Flows calculated using Rational Method.

TABLE B-15
PRELIMINARY CALCULATION OF 1:10 YEAR STORM RUNOFF FROM PHASE 5 DRAINAGE AREA (SEAM 5 TO 7 PIT)

		T0 PHASE 2 (IN PIT) SED POND
		ACTIVE PIT AREAS AND ROADS
AREA	ha	26.9
RUNOFF COEFFICIENT[1]		0.9
ONE HOUR STORM		
Precipitation rate[2]	mm/hr	22
Flow rate[3]	m^3/s	**1.5**
Volume	m^3	**5326**
SIX HOUR STORM		
Precipitation rate[2]	mm/hr	5.6
Flow rate[3]	m^3/s	**0.38**
Volume	m^3	**8169**
TWELVE HOUR STORM		
Precipitation rate[2]	mm/hr	3.9
Flow rate[3]	m^3/s	**0.26**
Volume	m^3	**11330**
TWENTY FOUR HOUR STORM		
Precipitation rate[2]	mm/hr	2.5
Flow rate[3]	m^3/s	**0.17**
Volume	m^3	**14526**

POND DESIGN TO RETAIN TEN HOUR STORM

Volume	9631 m^3	assume 85% retention of 12 hour storm
Pond depth	2.5 m	
Effective flow depth	1 m	assume flow in upper 1m of pond only
Required area	9631 m^2	
Width[4]	44 m	
Length	219 m	

NOTES:

1) Runoff coefficient estimation based on Table 2-23 in:
"The Water Encyclopedia", eds. van der Leeden *et al*., 1990

2) *Precipitation intensity-duration from the "Rainfall Frequency Atlas of Canada", Hogg and Carr, 1985.*

3) Flows calculated using Rational Method.

4) Based on 5:1 length to width ratio.

TABLE B-16

PRELIMINARY CALCULATION OF 1:200 YEAR STORM RUNOFF FROM PHASE 5 DRAINAGE AREA (SEAM 5 TO 7 PIT)

		T0 PHASE 2 (IN PIT) SED POND
		ACTIVE PIT AREAS AND ROADS
AREA	ha	26.9
RUNOFF COEFFICIENT[1]		0.9
ONE HOUR STORM		
Precipitation rate[2]	mm/hr	38
Flow rate[3]	m^3/s	**2.6**
Volume	m^3	**9200**
TWENTY FOUR HOUR STORM		
Precipitation rate	mm/hr	4.3
Flow rate[3]	m^3/s	**0.29**
Volume	m^3	**24985**

RETENTION PROVIDED BY PROPOSED POND DESIGN

Volume	9631 m^3	see previous table
Pond depth	2.5 m	
Effective flow depth	1 m	assume flow in upper 1m of pond only
Retention time	1.05 hr	based on one hour duration storm

NOTES:

1) Runoff coefficient estimation based on Table 2-23 in:
"The Water Encyclopedia", eds. van der Leeden *et al.*, 1990

2) Precipitation intensity-duration from the "Rainfall Frequency Atlas of Canada", Hogg and Carr, 1985.

3) Flows calculated using Rational Method.

APPENDIX 8.2-1

DETAILED CALCULATION OF TAX REVENUES

KPMG

Project Report

ECONOMIC IMPACT ASSESSMENT OF THE WILLOW CREEK COAL MINING PROJECT IN NORTHEAST BRITISH COLUMBIA

Prepared for

Pine Valley Coal Ltd.
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Attention: David A. Fawcett
Chief Operating Officer

Submitted by

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Fiona Petersen, Consultant

Vancouver
August 15, 1997
77-07925/FP

Contents

I

Introduction and Summary

A. The Willow Creek mine project

Pine Valley Coal Ltd. holds coal mining licenses for an area of land within Pine Pass, in the Peace River District of northeast British Columbia. A group of these licenses on the south valley slope of the Pine River make up the Willow Creek Property. This property, located approximately 45 km west of the town of Chetwynd, has been explored and studied extensively over the last few years in efforts to develop a small open-pit coal mine. The prospective mine is referred to as the Willow Creek Project.

The proposed mine is expected to produce coal at a rate of approximately 900,000 tonnes per year with a workforce in the range of 100-120 employees. The life of the mine, based on projections from 1997, is fifteen years ending approximately by the year 2013.

1. British Columbia's Environmental Assessment Process

As a new coal mining operation with greater than 100,000 tonnes of production per year, the Willow Creek Project is subject to review under the *British Columbia Environmental Assessment Act*. However, because review of the project was initiated prior to the enactment of this legislation, the terms of reference for the project's review were generated under the previous Mine Development Assessment Process.

2. Socio-economic impact assessment

Although a comprehensive assessment of socio-economic effects is not required under the terms of reference for this project, Pine Valley recognizes the importance of these issues to the province and the public in the context of the Environmental Assessment Review. Consequently, a socio-economic baseline assessment has been prepared by the consulting firm of Norecol, Dames & Moore for the Chetwynd and Dawson Creek communities which are likely to be most affected by the new mine. In addition, KPMG has been retained to explore further the implications of the mine project in terms of economic impacts.

B. Study objectives

This KPMG study is intended to complement the work of Norecol, Dames & Moore by providing a quantitative assessment of the economic significance of the Willow Creek Project to the province of BC and to federal and provincial tax revenues.

The specific objectives of this study are to develop estimates of the direct, indirect and induced economic impacts of the project on:

- The provincial economy as a whole
- Employment
- Tax revenues accruing to the provincial and federal governments
- Other economic indicators relevant to the project.

C. Study methodology

The methodology for achieving the study objectives consisted of three parts.

1. Extract economic data

The BC Input-Output Model (BCIOM), a sophisticated econometric model of the BC economy maintained by the Ministry of Finance and Corporate Relations, provided the framework for determining which economic variables would be assessed. The specific financial and operations information on the project required to calculate those variables was then extracted from the feasibility analyses performed by NorWest Mine Services Ltd.

2. Assess impact on economic variables

Once the relevant economic variables had been calculated, the direct, indirect and induced impacts on the provincial economy were assessed using the BC Provincial Economic Multipliers (derived for the BCIOM by the Analysis and Evaluation Branch of the BC Ministry of Finance and Corporate Relations) for the coal mining industry.

3. Estimate tax revenues

Finally, using the NorWest discounted cash flow analysis for the 15 year duration of the project, taxation benefits accruing to both the federal and provincial governments were estimated for both personal and corporate income taxes and mineral taxes.

D. Summary of study results

The results of this study of economic benefits from the Willow Creek Project to the BC economy and both provincial and federal tax revenues are summarized in Exhibit I-1. All values are measured in Canadian dollars with the exception of employment which is measured in person years.

Exhibit I-1
Summary of economic impacts (15 year totals)

		Economic Impacts						
	Value	µ	Direct	µ	Indirect	µ	Induced	Totals
Industry Output								
Equipment Purchases	$5,601,283	1.00	5,601,283	0.41	2,296,526	0.00	0	$7,897,809
Wages & Benefits	$79,198,718	1.00	79,198,718	0.00	0	0.75	59,399,039	$138,597,757
Other Goods & Services	$122,440,358	1.00	122,440,358	0.41	50,200,547	0.00	0	$172,640,905
Operating Surplus	$63,939,758	1.00	63,939,758	0.41	26,215,301	0.00	0	$90,155,059
Gross Domestic Product								
Wages & Benefits	$79,198,718	0.48	38,015,385	0.19	15,047,756	0.00	0	$53,063,141
Operating Surplus	$60,144,631	0.48	28,869,423	0.19	11,427,480	0.00	0	$40,296,903
Employment								
(person years @2100 hrs/yr)	1,542	1.00	1,542	0.62	960	0.00	0	2,502
Government Revenues								
Fed: personal income tax	$20,591,667							$20,591,667
corporate income tax	$15,810,376							$15,810,376
Prov: personal income tax	$10,707,667							$10,707,667
corporate income tax	$10,789,201							$10,789,201
BC mineral tax	$8,673,972							$8,673,972

µ: BCIOM multiplier

II

Aggregate Economic Impacts

A. Measures of economic impacts

The BC Input-Output Model (BCIOM) is a sophisticated analytical model which can be used to assess the economic significance of specific changes in activity within the BC economy. Conceptually, the model is a simplified mathematical representation of relationships among industries and commodities within the economy. When activity in one industry changes, the model will estimate how that change impacts demand and supply for related industries. Although the relationships within the economy are simplified, the model itself is highly complex involving 216 industries and 627 commodities.

Since the level of detail provided by the BCIOM is not required for the Willow Creek project, the assessment undertaken here utilizes the economic multipliers inherent to the model to estimate the aggregate impacts of the project on a few key economic variables.

1. Measure 1—Industry output

Industry output is the economic measure of the value of an industry's total production or output. This value is calculated by summing the costs of all inputs to production (regardless of their source) and adding any operating surplus (or profit) earned on the sale of that output.

For the Willow Creek project, the variables used to calculate the value of output are the following:

- Equipment purchases
- Wages and benefits
- Other goods and services (required to carry out operations)
- Operating surplus

2. Measure 2—Gross Domestic Product (GDP)

GDP is a broad indicator of economic activity made up of four main components: personal consumption expenditures (spending), private domestic investment (made by businesses and nonprofit institutions in the local economy), net exports of goods and services; and government purchases. GDP is also referred to as the measure of value-added in the economy since these measures are derived from primary inputs to the economy. Primary inputs are those which are not directly linked to the production of commodities by other industries. For example, labour is a primary input because it is not a product of another production process. Heavy equipment, however, is produced by equipment manufacturers who in turn use the inputs of other industrial processes.

For the Willow Creek project, economic impact on GDP is calculated from the following values:

- Wages and benefits
- Operating surplus

3. Measure 3—Employment

Employment can be measured in a number of different ways. For the Willow Creek project, the employment effect is measured in terms of person-years of employment generated.

4. Measure 4—Tax revenues

Tax revenues accruing to all levels of government are examined in detail in Chapter III.

B. BC provincial economic multipliers

The estimated direct, indirect and induced impacts of the Willow Creek Project on the BC economy were calculated using multipliers derived for the BCIOM. The specific multipliers used were the large aggregation industry multipliers for coal mining operations. Use of these multipliers for the purposes of estimating the economic impacts of this project was guided by the instructions manual provided by the Analysis and Evaluation Branch of the BC Ministry of Finance and Corporate Relations.

Some of the key assumptions underlying the use of multipliers for this study include the following:

- British Columbia is an open economy. Therefore, the induced impacts of economic activity on the BC economy are extremely difficult to determine with confidence and have been omitted from this analysis. Many of the goods and services which go into producing the inputs to the mine production process may be imported. Moreover, the coal produced by the mine is expected to be almost entirely exported.

- The only exception in calculating induced economic effects involves the wages and benefits of the mine project's employees. These are expected to induce economic activity to a certain extent through spending on commodities produced in the BC economy. However, the indirect effects are expected to be zero in this case as employees would not generally be consumers of the output of a coal mine.

- Tax revenues accruing to governments are not calculated using the BCIOM multipliers. Instead, these revenues have been estimated using federal and BC tax rates and the discounted cash flow analysis prepared by NorWest. This approach allows for a more detailed assessment of tax revenues. Impacts of the project on tax revenues are discussed in detail in Chapter III.

C. Estimated aggregate economic impacts

Exhibit II-2 summarizes the results of the aggregate economic impact analysis.

Exhibit II-2
Estimated aggregate economic impacts (15 year totals)

		Economic Impacts						
	Value	µ	Direct	µ	Indirect	µ	Induced	Totals
Industry Output								
Equipment Purchases	$5,601,283	1.00	5,601,283	0.41	2,296,526	0.00	0	$7,897,809
Wages & Benefits	*$79,198,718*	*1.00*	*79,198,718*	*0.00*	*0*	*0.75*	*59,399,039*	*$138,597,757*
Other Goods & Services	$122,440,358	1.00	122,440,358	0.41	50,200,547	0.00	0	$172,640,905
Operating Surplus	$63,939,758	1.00	63,939,758	0.41	26,215,301	0.00	0	$90,155,059
Gross Domestic Product								
Wages & Benefits	$79,198,718	0.48	38,015,385	0.19	15,047,756	0.00	0	$53,063,141
Operating Surplus	$60,144,631	0.48	28,869,423	0.19	11,427,480	0.00	0	$40,296,903
Employment								
(person years @2100 hrs/yr)	1,542	1.00	1,542	0.62	960	0.00	0	2,502

µ: BCIOM multiplier

1. Impacts on industry output

The Project is expected to impact industry output in the BC economy by over $400 million during its fifteen year duration. The direct and induced effects arising from expenditures on wages and benefits are expected to total approximately $140 million. Expected direct and indirect effects from other production inputs total over $180 million and those arising from operating surplus near $85 million.

2. Impacts on GDP

The Project is also expected to impact the GDP of BC's economy by over $90 million over the course of its operation. Direct and indirect effects expected from expenditures on wages and benefits total $53 million while those from operating surplus total $40 million.

3. Impacts on employment

In terms of employment benefits, the direct and indirect impacts of jobs created by the project are expected to total approximately 2,500 person years of employment over the course of its operation.

III

Government Revenues

A. Calculating economic impacts of tax revenues

Tax values are important economic effects of the mine project. Tax revenues were estimated using federal and BC tax rates, employee wages and benefits and the discounted cash flow analysis prepared by NorWest for the fifteen year duration of the project.

The economic effects of tax revenues are estimated in terms of direct impacts only. The indirect and induced impacts on the BC economy of tax revenues are difficult to measure with confidence and have therefore been omitted from this analysis.

1. Personal income tax

Personal income taxes were estimated using average federal and provincial tax rates:

- **Federal tax**—estimated at 26% of total wages and benefits.
- **Provincial tax**—estimated at 52% of federal tax amount

2. Corporate income tax

Corporate income taxes were estimated using the federal and provincial corporate tax rates for taxable earnings. Taxable earnings, or annual operating surplus, was estimated using the annual revenue, operating cost and capital expenditure estimates contained in the cash flow analysis while depreciating capital assets according to the class 41 (mine assets) CCA rate. The tax rates used are as follows:

- **Federal tax**—estimated at 29.12% of annual taxable earnings until all capital expenditures are recouped, then at 21.84%.
- **Provincial tax**—estimated at 16% of annual taxable earnings.

3. Other taxes

Other notable sources of tax revenue include municipal taxes and the BC Mineral Tax. Municipal taxes have not been estimated here as no generic formula for such calculations presently exists. This source of tax revenue does represent a significant economic benefit to local governments and would be added to the federal and provincial tax estimates for a more complete estimate of government revenues.

- **Municipal tax**—not measured quantitatively.
- **BC Mineral Tax**—estimated at 2% of annual net revenue until all losses and capital expenditures are recouped (@100% per year), then at 13%.

B. Taxation benefits accruing to federal and provincial governments

The results of the tax revenue analysis are summarized in Exhibit III-1. A detailed calculation of these estimated tax revenues is provided in Appendix A.

Exhibit III-1
Government revenues (15 year totals)

	Direct Impacts		
	Federal	Provincial	Totals
• personal income tax	20,591,667	10,707,667	31,299,334
• corporate income tax	15,810,376	10,789,201	26,599,577
• BC Mineral Tax	—	8,673,972	8,673,972
Totals	**36,402,043**	**30,170,840**	**66,572,883**

1. Personal taxes

The Project is expected to generate a total of over $31 million in personal tax revenues for the federal and provincial governments during its lifetime. Although the greatest tax benefits will be accrued to the federal government, the benefits to provincial revenues are also significant at over $10 million.

2. Corporate taxes

In terms of corporate taxes, the Project is expected to generate a total of over $26 million in revenues for the federal and provincial governments. Benefits accrued to the province exceed $10 million while benefits to the federal government exceed $15 million.

3. BC Mineral Tax

The province will also accrue benefits through the BC Mineral Tax in excess of $8 million.

Appendix A

Tax Revenue Estimates

Tax Estimates

	1998	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*
cash flow before capital	*(3,036,202)*	*4,635,300*	*6,300,354*	*6,703,020*	*4,955,078*	*6,890,763*	*9,266,909*	*8,193,146*	*8,797,689*
less loss carried forward		1,599,098	6,300,354	6,703,020	4,955,078	6,890,763	9,266,909	8,193,146	8,797,689
Capital expenditures	19,221,795	19,221,795	14,586,495	10,939,871	8,204,903	6,153,678	4,615,258	3,461,444	2,596,083
allowable CCA deduction	4,805,449	4,805,449	3,646,624	2,734,968	2,051,226	1,538,419	1,153,815	865,361	649,021
CCA allowance used	0	4,635,300	3,646,624	2,734,968	2,051,226	1,538,419	1,153,815	865,361	649,021
taxable earnings [1]	***0***	***0***	***2,653,730***	***3,968,052***	***2,903,852***	***5,352,344***	***8,113,094***	***7,327,785***	***8,148,668***
Tax Revenues									
Federal income tax[2]	0	0	772,766	1,155,497	845,602	1,558,602	1,771,900	1,600,388	1,779,669
BC income tax[3]	0	0	424,597	634,888	464,616	856,375	1,298,095	1,172,446	1,303,787
BC Mineral Tax[4]	0	31,982	126,007	134,060	99,102	895,799	1,204,698	1,065,109	1,143,700

	2007	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*TOTAL*
cash flow before capital	*9,562,056*	*7,912,516*	*5,337,439*	*2,467,063*	*2,080,481*	*3,205,949*	*(3,492,745)*	
less loss carried forward	9,562,056	7,912,516	5,337,439	2,467,063	2,080,481	3,205,949	(3,492,745)	
Capital expenditures	1,947,062	1,460,297	1,095,222	821,417	616,063	462,047	346,535	
allowable CCA deduction	486,766	365,074	273,806	205,354	154,016	115,512	86,634	
CCA allowance used	486,766	365,074	273,806	205,354	154,016	115,512	0	
taxable earnings [1]	***9,075,290***	***7,547,442***	***5,063,633***	***2,261,709***	***1,926,465***	***3,090,437***	***(3,492,745)***	63,939,758
Tax Revenues								
Federal income tax[2]	*1,982,043*	*1,648,361*	*1,105,898*	*493,957*	*420,740*	*674,951*	0	*15,810,376*
BC income tax[3]	1,452,046	1,207,591	810,181	361,873	308,234	494,470	0	10,789,201
BC Mineral Tax[4]	1,243,067	1,028,627	693,867	320,718	270,463	416,773	0	8,673,972

[1] Cash net of capital expensed

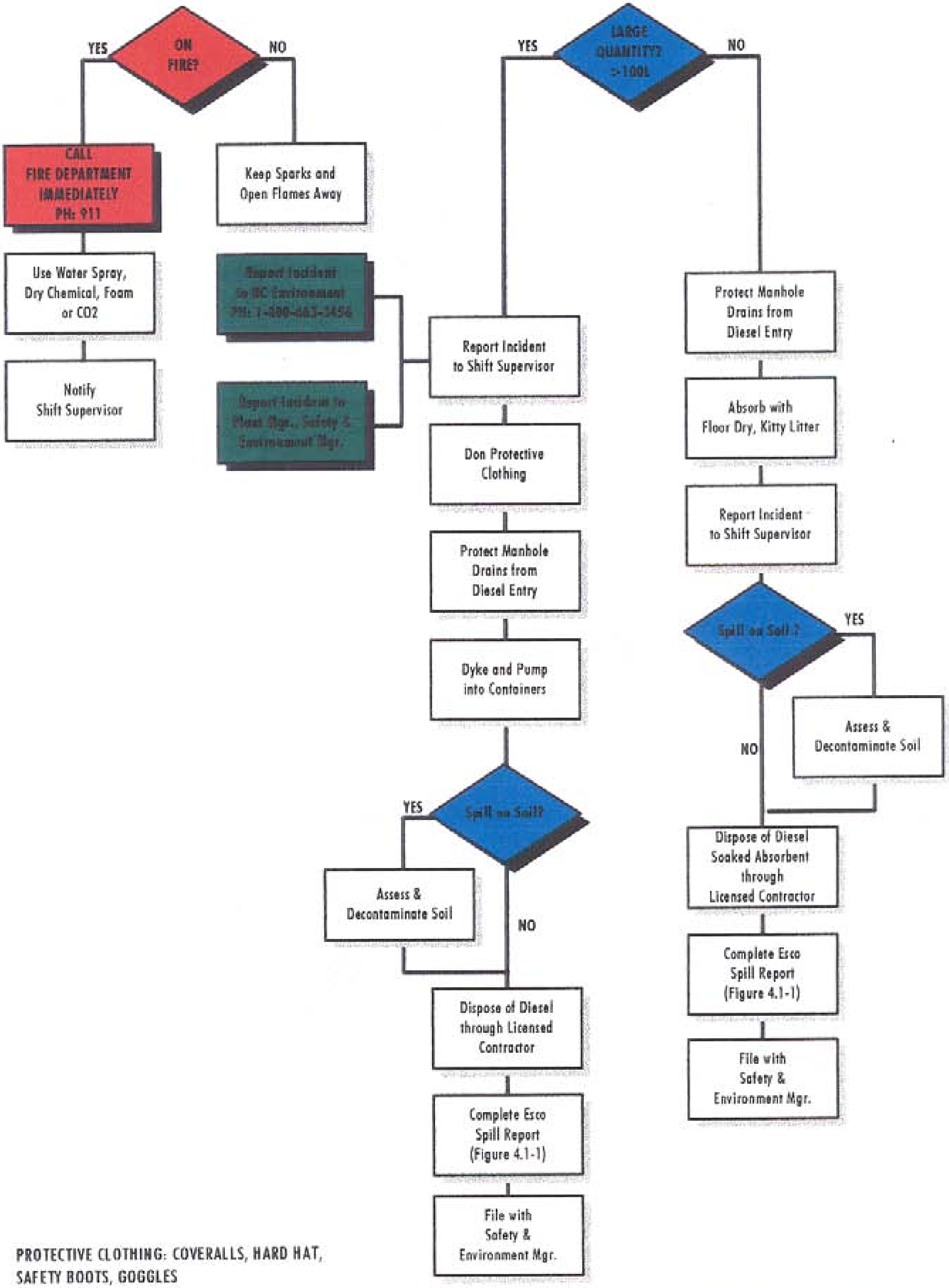
[2] 29.12% of taxable earnings until all capital expenditures recouped; 21.84% thereafter

[3] 16% of federal taxable earnings

[4] 2% of annual net proceeds until all losses and capital expenditures recouped at 100% per year;
13% of net revenue beginning in 2003

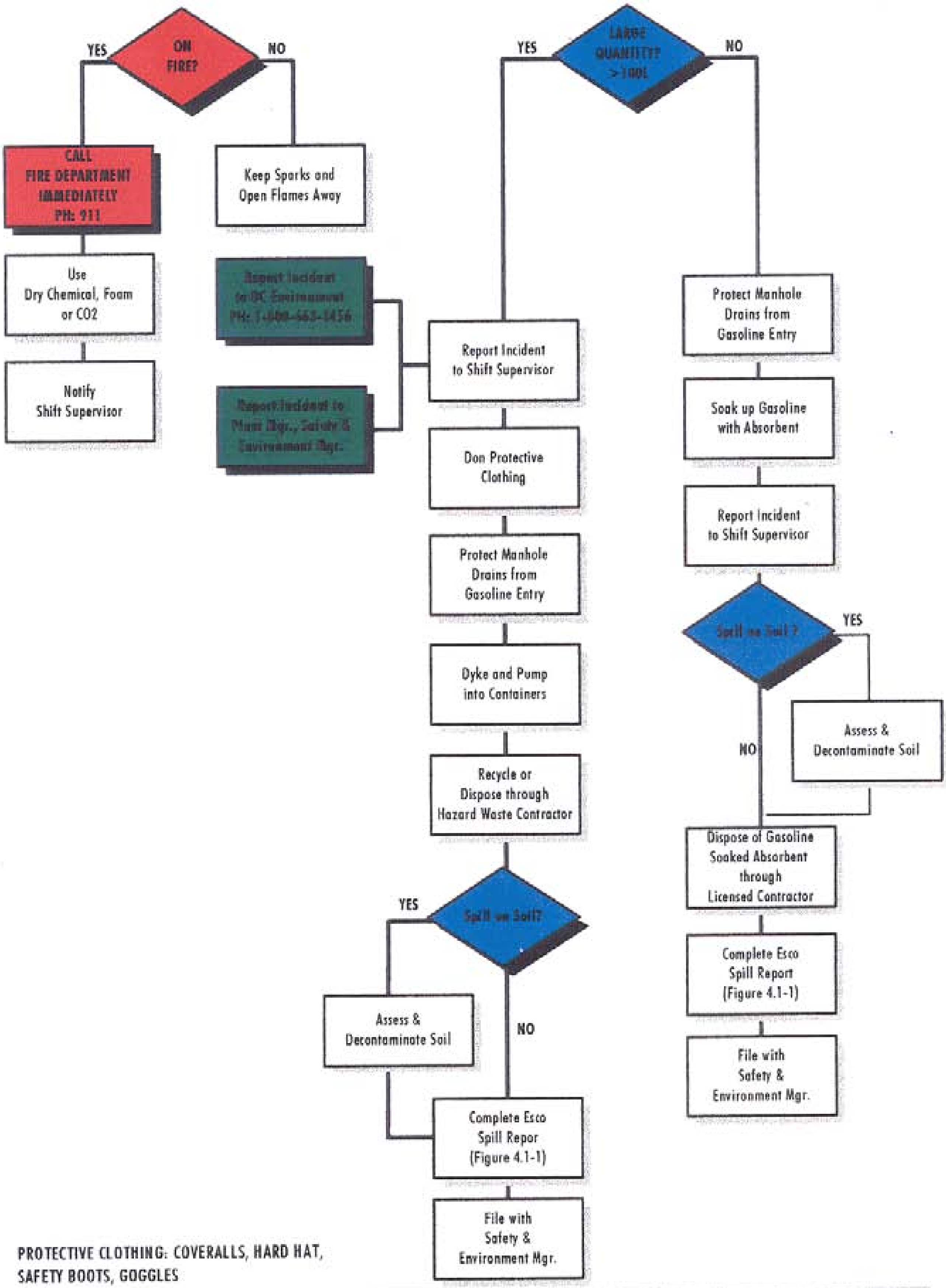
APPENDIX 12.2-1

SPILL RESPONSE MEASURES - FLOWCHARTS



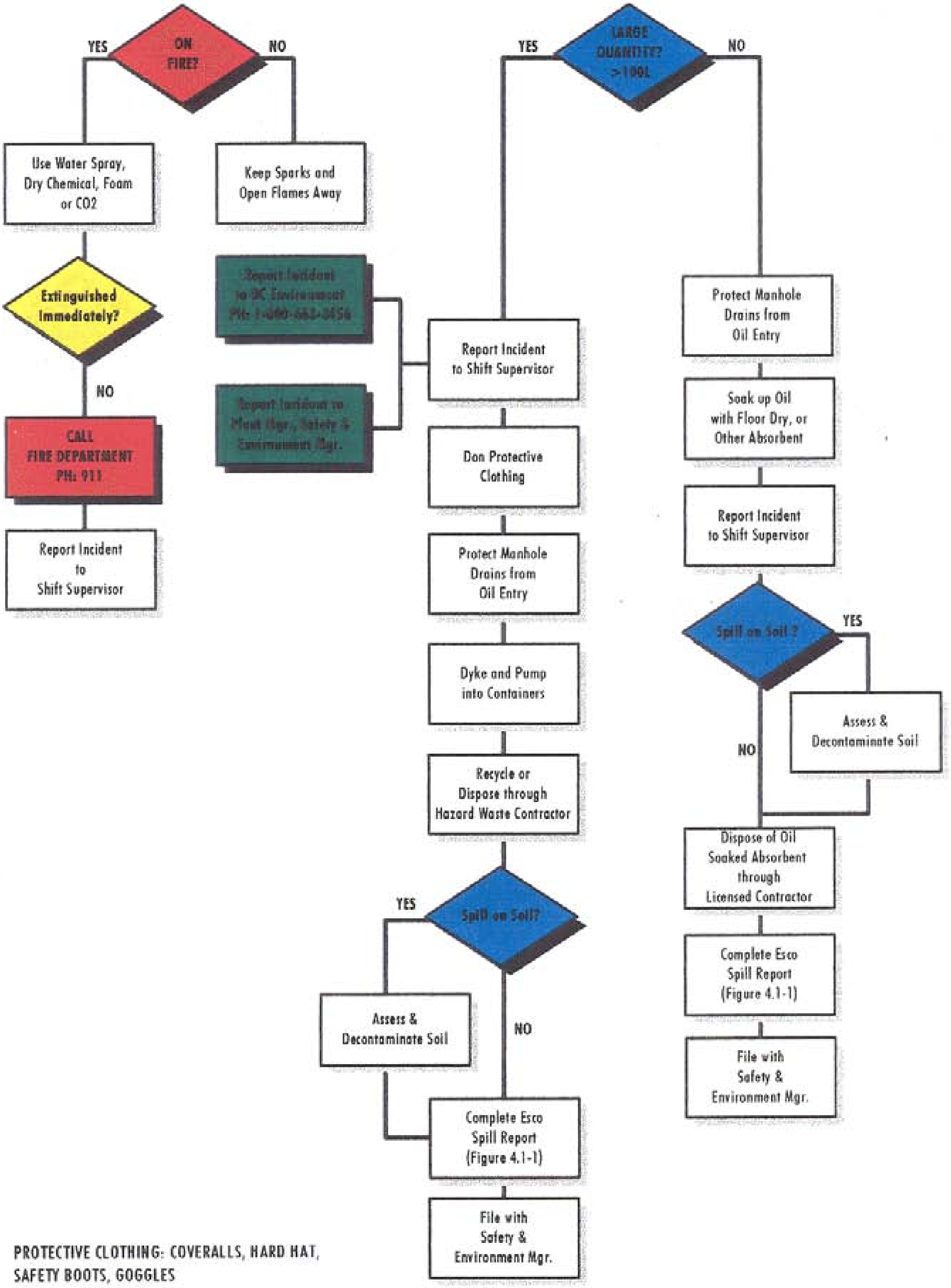
PROTECTIVE CLOTHING: COVERALLS, HARD HAT, SAFETY BOOTS, GOGGLES

DIESEL SPILL RESPONSE



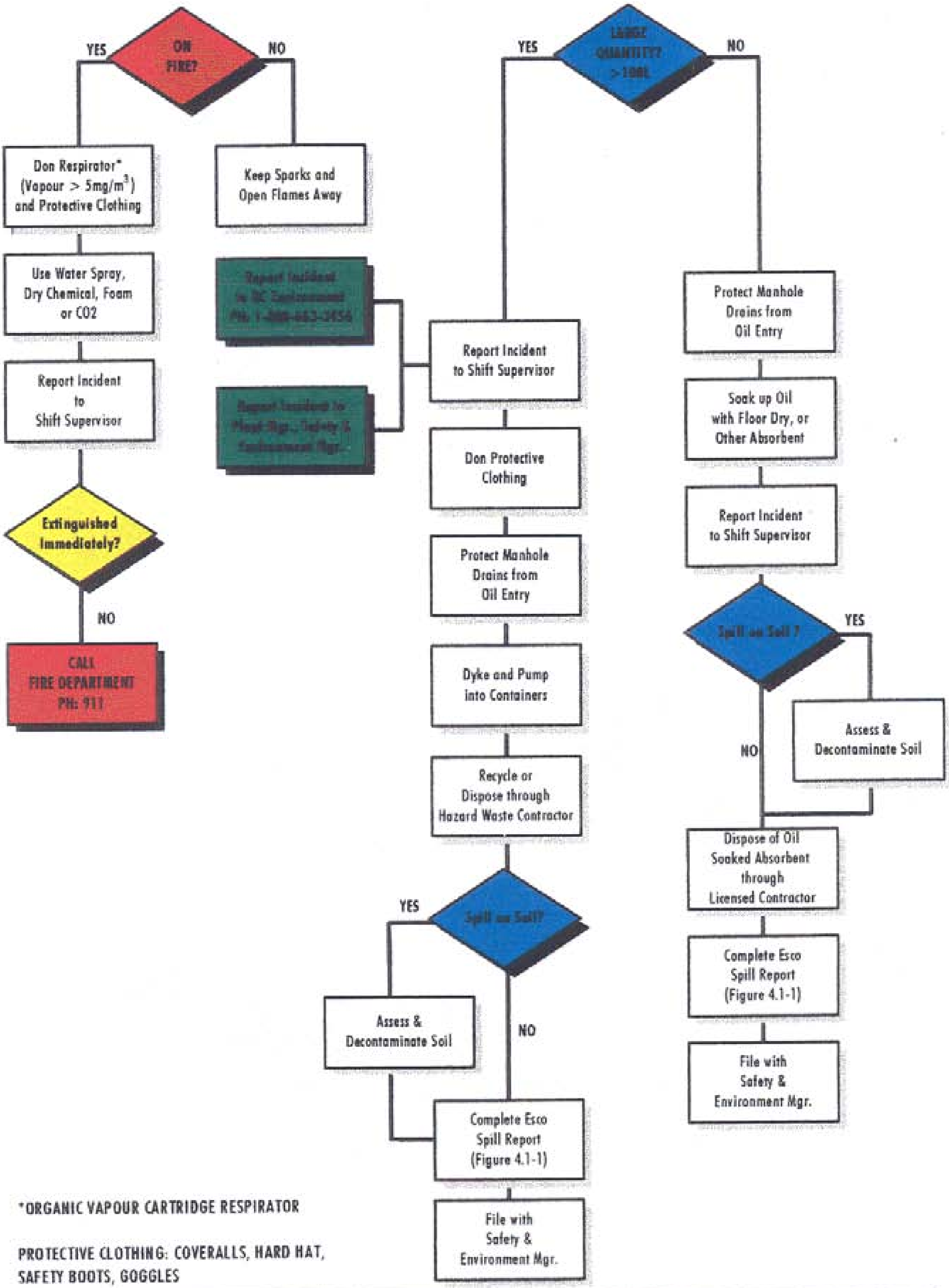
PROTECTIVE CLOTHING: COVERALLS, HARD HAT, SAFETY BOOTS, GOGGLES

GASOLINE SPILL RESPONSE



PROTECTIVE CLOTHING: COVERALLS, HARD HAT,
SAFETY BOOTS, GOGGLES

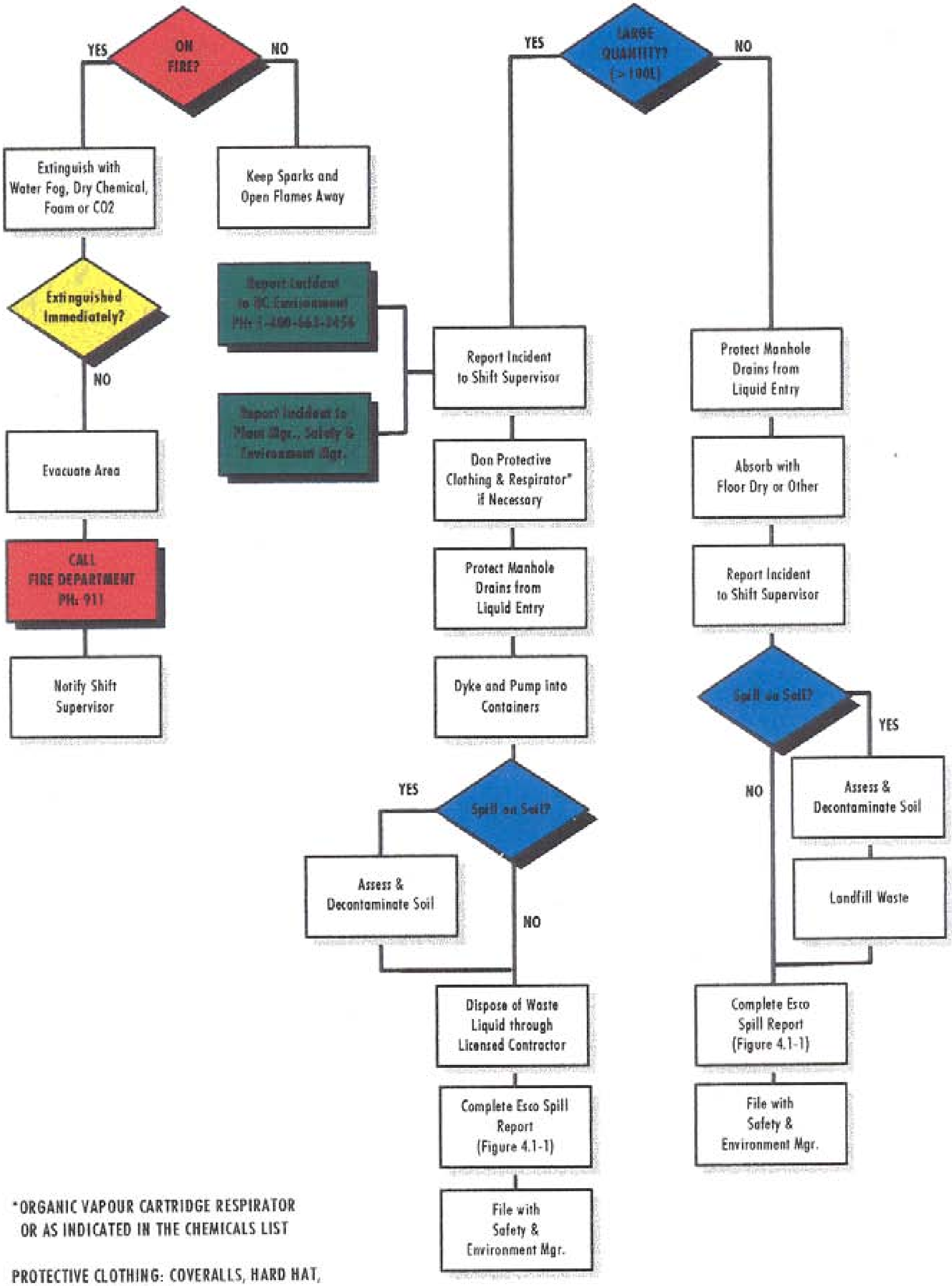
HYDRAULIC OIL SPILL RESPONSE



*ORGANIC VAPOUR CARTRIDGE RESPIRATOR

PROTECTIVE CLOTHING: COVERALLS, HARD HAT, SAFETY BOOTS, GOGGLES

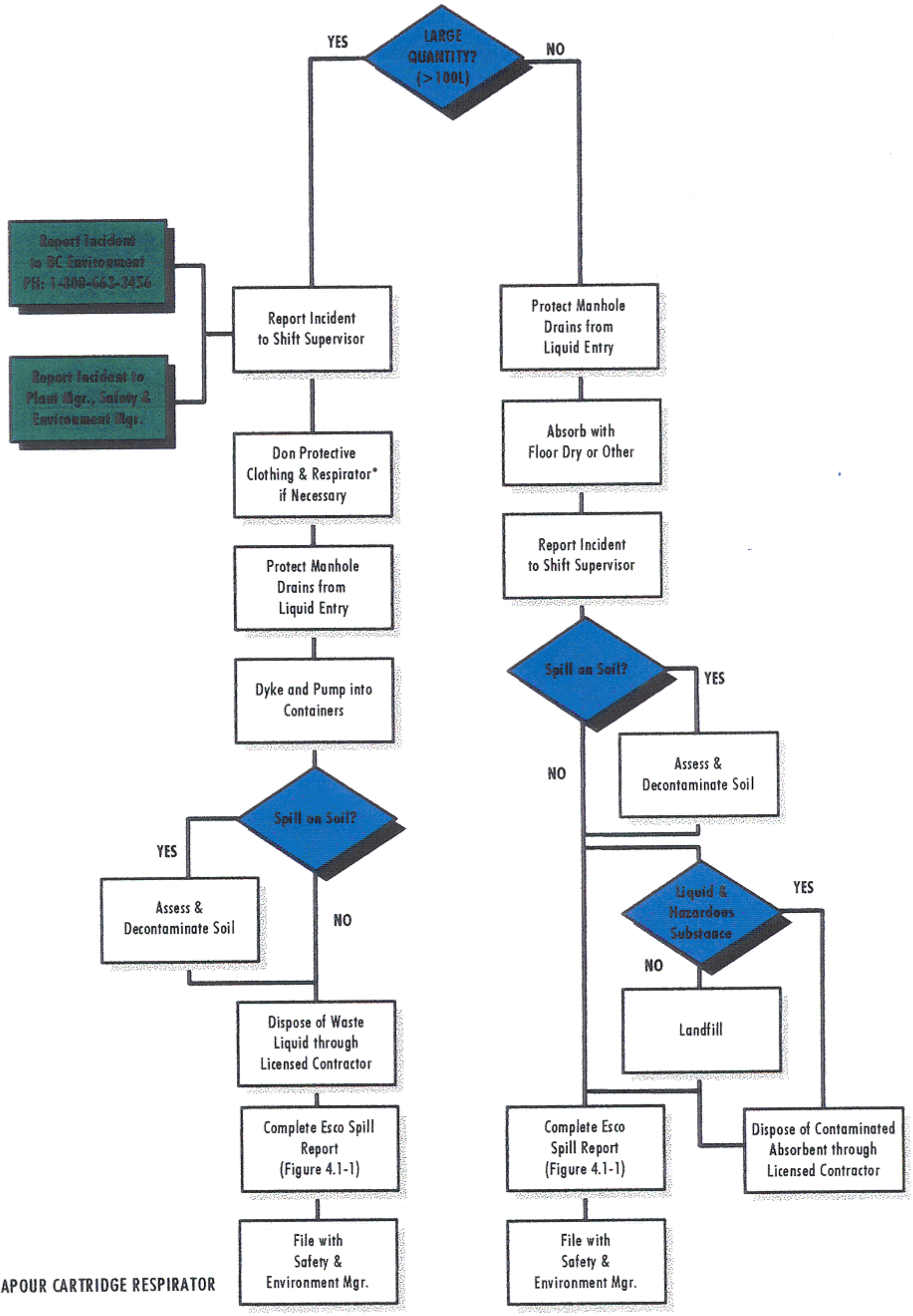
WASTE OIL SPILL RESPONSE



*ORGANIC VAPOUR CARTRIDGE RESPIRATOR
OR AS INDICATED IN THE CHEMICALS LIST

PROTECTIVE CLOTHING: COVERALLS, HARD HAT, SAFETY BOOTS, GOGGLES

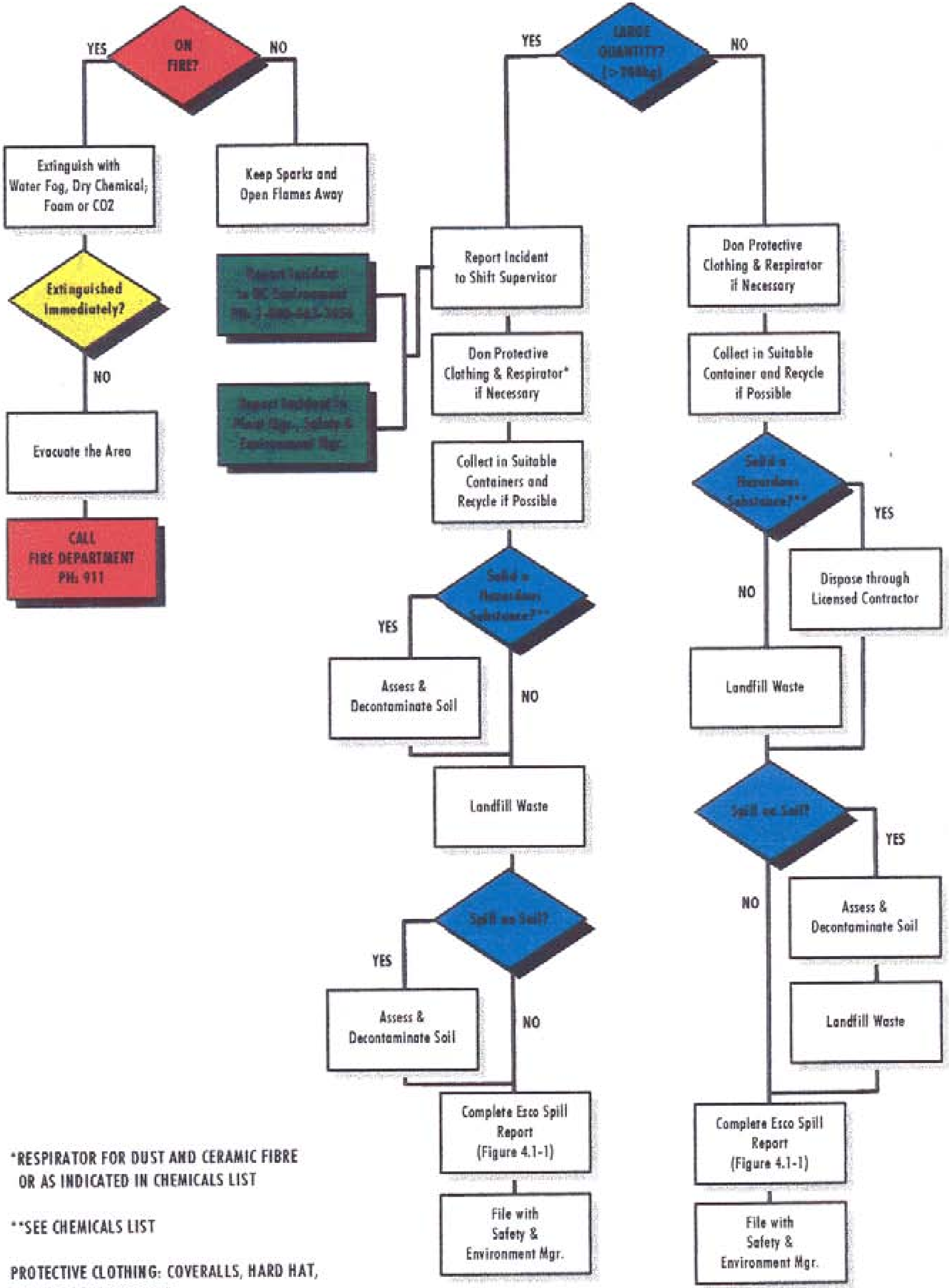
FLAMMABLE LIQUID SPILL RESPONSE



*ORGANIC VAPOUR CARTRIDGE RESPIRATOR

PROTECTIVE CLOTHING: COVERALLS, HARD HAT,
SAFETY BOOTS, GOGGLES

NON-FLAMMABLE LIQUID SPILL RESPONSE

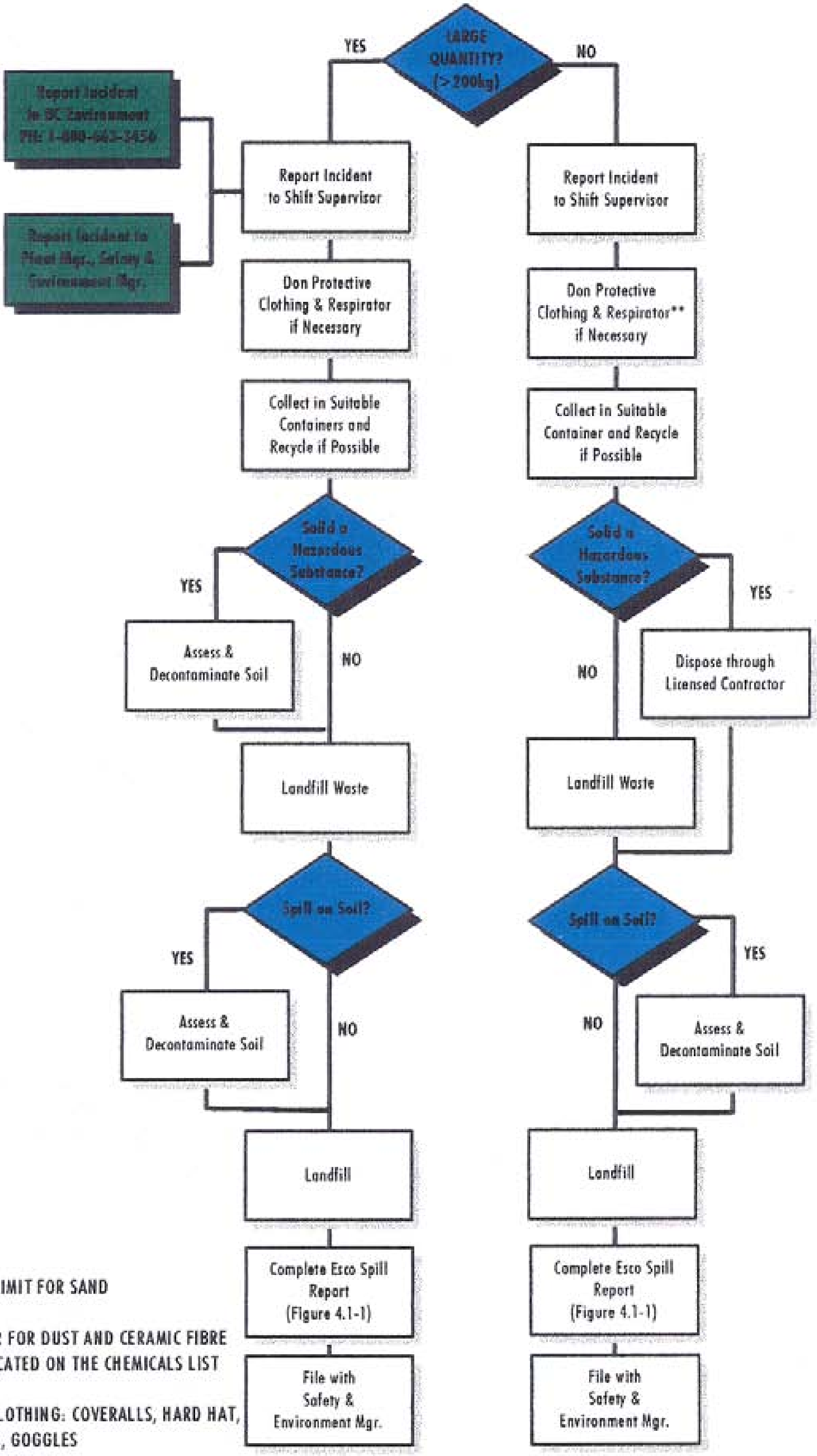


*RESPIRATOR FOR DUST AND CERAMIC FIBRE OR AS INDICATED IN CHEMICALS LIST

**SEE CHEMICALS LIST

PROTECTIVE CLOTHING: COVERALLS, HARD HAT, SAFETY BOOTS, GOGGLES

FLAMMABLE SOLIDS SPILL RESPONSE



*NO WEIGHT LIMIT FOR SAND

**RESPIRATOR FOR DUST AND CERAMIC FIBRE OR AS INDICATED ON THE CHEMICALS LIST

PROTECTIVE CLOTHING: COVERALLS, HARD HAT, SAFETY BOOTS, GOGGLES

NON-FLAMMABLE SOLIDS SPILL RESPONSE

APPENDIX 16.1-1

PUBLIC CONSULTATION DOCUMENTATION

ENVIRONMENTAL ASSESSMENT PROCESS

General Consultations

June 21, 1996	Telephone conversation with Lyle Mortensen of Louisiana Pacific about their logging plan for Willow Flats. Dave Fawcett arranged a meeting for further discusison in Chetwynd on 26th.
June 26, 1996	Meeting with Lyle Mortensen of Louisiana Pacific about logging plan for Willow Flats. Dave Fawcett gave him a plan of our disturbance areas and our preferred sites.
June 30, 1997	Phone conversation with Doug Halverson of Westcoast Energy.
July 1, 1997	Phone conversation with Carolyn McNabb of Westcoast Energy
July 3, 1997	Meeting with Westcoast Energy in Vancouver.

ENVIRONMENTAL ASSESSMENT PROCESS

Government Log

June 13, 1996	Meeting with EAO office (Mike Kent) in Victoria. Attended by Dave Fawcett, Pine Valley Coal; Bruce Ott, Norecol, Dames & Moore. EAO also had Bob Hart (Environment), Bruce Leslie (First Nations), in attendance. Minutes issued.
June 17, 1996	Dave Fawcett left message for Mike Kent to provide the contacts for the First Nations groups.
June 18, 1996	Received the requested contacts from Mike Kent.
June 21, 1996	Telephone call from Bruce Carmichael regarding the loction of water flow/quality stations - the map from Bruce Ott was not clear. I described locations and he said that the information was sufficient.
July 4, 1996	Site vist by Mike Kent, Ed Beswick, Bob Hart, Bruce Jamison, Rob Backmeyer, along with Bruce Ott (Norecol, Dames & Moore) and Kevin James (Pine Valley Coal).
July 11, 1996	Meeting at Pine Valley's offices with Mike Kent (EAO), Ed Beswick (MEI), and Bruce Ott (Norecol, Dames & Moore). Key items: Willow Soluth (to be included), staff gauge on Tributary #3, weather station and First Nations.

Additional information is attached in a memorandum issues by EAO.

PINE VALLEY COAL LTD.

501 - 1200 West Pender Street, Vancouver, B.C. Canada V6E 2S9 Tel: (604) 687-5833 Fax: (604) 682-4698

April 9, 1996

COPY

Michael J. Kent
Project Assessment Director
Environmental Assessment Office
2nd Floor, 836 Yates Street
Victoria, B.C.
V8V 1X4

Dear Mr. Kent:

Re: Willow Creek Project

For your information and records, please note that I recently had the following meetings with respect to the Willow Creek Project.

April 1st: Ministry of Employment and Investment
Prince George
Contact - Ed Beswick

General overview of the project and developments with respect to joint-venture.

April 2nd: Forestry - Dawson Creek
Contact - Paul Gevatkoff
General overview of the project

April 2nd: Chetwynd Town Council
Update on Willow Creek Project

April 2nd: Willow Flats
Informal "information meeting" on the status of Willow Creek Project including a question and answer session . List of attendees is attached. Other people came and left during the meeting without putting themselves on the list.

As discussed with you previously and with Mr. Beswick in Prince George, I would like to move ahead with a general meeting of the review committee in the near future. It was suggested that the "Terms of Reference" be circulated for review prior to the meeting; I believe that Mr. Beswick will be contacting you on this.

I am in the process of selecting an environmental firm and hope to have the firm selected by the 26th. It would appear that the best time for a meeting would be in early May after the consultant / coordinator has had an opportunity to become familiar with the project.

I will call you shortly for further discussion on the above.

Sincerely,

David Fawcett

David Fawcett
Chief Operating Officer

DF:fp

Enclosure

APPENDIX 16.1-1

PINE VALLEY COAL
PUBLIC CONSULTATION PROGRAM
APRIL 1996 TO JUNE 1997

PAST ACTIVITIES:

1996

April 15: - Letter of concern from Jackie Machalek and Andre Roofthooft; issues: major concerns re: impacts on life-style, trap line, water pollution, noise

May 23: - Letter from Sanda Ketsa, wanted to be kept informed; why only select a few residents; was Willow Flats contacted by company?;

May 29: - PVC letter reply to Sanda Ketsa; all people that left names at Willow Flats meeting were contacted, welcome more people to come forward; further meetings when additional information available;

July 9:
- PVC letter to Jackie Machalek and Andrew Roofthooft, Information Update, delays in site geological program;
- Similar letters sent to S&J Chantree, Tim&Edith Hurford, Bard&Sanda Ketsa, Bill&Marilyn Lamoureux, D&R Nielsen, Ken Sheen, and Don Smith;
- PVC letter to Major Barb Shirley of Chetwynd, Willow Creek Project Update, site geological program delayed;
- Letter to Jack Hannam, Director of Peace River Regional District, Willow Creek Project Update, site geological program delayed;

Sep 20: - Meeting with Dave Fawcett, Rob Hawes and Wayne Sawchuk of Friends of Northern Rockies. About (total) 50 members in group. Discussed feasibility study, design concept, and scheduling; concerns raised; visual impacts, water pollution in Willow Flats, dust with Chinook winds up to 40 to 50 miles/hr down the valley, noise from blasting, coal trains, and trucks loading; group not yet developed a position on PVC project; felt people of Willow Flats either opposed to the project or not supporting it;

Dec. 5: - Call from Brad Ketsa. He had heard rumours about things being approved and equipment being ordered. He had not read the notice in the Chetwynd Echo. PVC behind on the Feasibility Study and hence, did not have any new information to present. Informed again that PVC will have meetings once new information; this will occur before PVC is in the review process.

Dec. 6: - Letters to Brad Ketsa, S&J Chantree, Jackie Machalek & Andre Roofthooft, Don Smith and Ken Sheen, re: delays in environmental and feasibility studies, hope to complete in February; rumours re: approvals and project proceeding not true; Project Report not yet submitted; will call for meetings with Willow Flats resident when additional information available, possibly in January;

1997

Jan. 20: - Meeting with Willow Flats residents attending, Stu & Jan Chantray, Brad and Sanda Ketsa, Dave Fawcett and Rob Hawes. Issues raised include the schedule, noise, dust, how information is to be communicated.

Jan. 21: - Meeting with Mayor Charlie Lassar and Councilors of Chetwynd, issues raised: visual impacts, noise, dust, surface and groundwater quality, economic (job) opportunities for Chetwynd, transportation, local concerns re: Willow Flats, work opportunities to support new infrastructure, traffic problems, B.C. Rail, mine's economic stability; Chetwynd can handle growth, schools have capacities, has college campus; growth will not negatively impact on Chetwynd;

Jan. 28: - Meeting with Ministries of Economic Investment, and Environment, Lands, and Parks; general discussions re: project status, environmental study, public consultation, First Nations program, etc.;

Jan. 28: - Meeting with Environmental Assessment Office, project status, environmental study, public consultation, and First Nations program.

March 27: - Willow Creek Project Information Update sheet sent to Willow Flats residents, Mayor Charlie Lasser, Mr. Tom Caton (Director, Peace River Regional District), Mr. Wayne Sawchuk, Chief George Desjarlais and Chief Bud Napoleon.

May 3: - Rob Hawes' meeting with Willow Flats residents; attending Stu & Jan Chantree, Sanda & Brad Ketsa, Andrew Roofthooft, Jackie Machalek and Sandy Sheen. This was a project up-date meeting and to hear residents' concerns about schedule delays and effects from mine.

June 5: - letter by Dave Fawcett to Willow Flats residents with an up-date of Willow Creek project planning schedule and a commitment to on-going communication.

June 18: - Dave Fawcett called Stu Chantree to arrange a meeting for next week. He is very busy so agreed to postpone it until possibly the 2nd week of July. He said that he did not have any new questions at the moment.

June 18: - Dave Fawcett called Andre Roofthooft to postpone the meeting. They are not available during the 2nd week of July. He said that LP was planning to cut the poplar west of Willow Creek this fall, and had plans for other blocks (52043, 52045, 52046 and 52048). Dave Fawcett said that he would be talking to LP.

July 9: - Information letter sent to Willow Flats and area resident as follows: Mr. & Mrs. S. & J. Chantree, Mr. & Mrs. Tim & Edith Hurford, Mr. & Mrs. Brad & Sanda Ketsa, Mr. & Mrs. Bill & Marilyn Lamoureux, Jackie Machalek & Andrew Roofthooft, Mr. & Mrs. D. & R. Neilsen, Mr. Ken Sheen, Mr. Don Smith.

July 17: - Call from Andre Roofthooft. He said that he was on the site last week and found that we had holes that were not plugged or capped. Dave Fawcett would remind the site people to ensure that this was done (subsequently talked to Yaro Horachek and asked that they do this.)

PUBLIC NOTICES (Information Up-dates)

November 26, 1996: Chetwynd Echo

July 16, 1996: - Chetwynd Echo

ENVIRONMENTAL ASSESSMENT PROCESS

Public Notices

The following public notices were issued:

July 16, 1996	Chetwynd Echo
Nov 26, 1996	Chetwynd Echo

In conformance with requirements of the *BC Environmental Assessment Act*, notice will be given in local and provincial newspapers as well as other media outlets as appropriate and specified by the EAO of submission of the Willow Creek Project Report.

At least two week's notice will be given in local newspapers and radio stations of all public meetings to be held as part of the public consultation program undertaken by PVC once the Project Report is submitted.

ENVIRONMENTAL ASSESSMENT PROCESS

Willow Flats Log

June 18, 1996	Called Stu Chantree to arrange a meeting for next week. He is very busy so we agreed to postpone it until possibly the 2nd week of July.. He said that he did not have anhy new questions at the moment.
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July 17, 1996	Call from Andre Roofthooft. He said that he was on the site last week and found that Pine Valley Coal had holes that were not plugged or capped. Dave Fawcett said that he would remind the site people to ensure tht this was done. (Dave Fawcett subsequently talked with Yaro Horachek and asked that they do this.)
Dec 5, 1996	Call from Brad Ketsa. He had heard rumors about things being approved and equipment being ordered. He had not read the notice in the Chetwynd Echo. Dave Fawcett said that Pine Valley Coal were behind on the Feasibility Study and hence, did not have any new information to present. Dave Fawcett informed him again that Pine Valley Coak will be having meetings once the company have new information and that will occur before the company is in the review process.
May 3, 1997	Meeting with Willow Flats Residents. Rob Hawes in attendance from NDM. Stuart and Jan Chantree, Brad and Sandra Ketsa, Jackie Machalek, Andre Roofthooft, Sandy Sheen residents in attendance. Project update given by R. Hawes. Residents want a bi-monthly update on the project. Residents are looking for compensation, or perhaps property buyout.

WILLOW FLATS MEETING
April 2,1996

LIST OF ATTENDEES

Name		Address	Phone
Caton	Tim	Box 413 Chetwynd, B.C.V0C 1J0	788-2201
Chantree	S. & J.	Box 1623 Chetwynd, B.C.V0C 1J0	788-2314
Davison	Rick	Box 750 Chetwynd, B.C.V0C 1J0	788-2246
Derby	Jim	Box 366 Chetwynd, B.C.V0C 1J0	788-2046
Embree	David & Roz	Box 534 Chetwynd, B.C.V0C 1J0	788-3718
Embree	Karen	Box 2061 Chetwynd, B.C.V0C 1J0	788-1884
Evans	James	Box 2061 Chetwynd, B.C.V0C 1J0	788-1884
Gottselig	Rick & Carol	Box 1955 Chetwynd, B.C.V0C 1J0	788-2116
Horsman	Jeff	Box 612 Chetwynd, B.C.V0C 1J0	788-9693
Hunt	D. & K.	Box 2602 Chetwynd, B.C.V0C 1J0	788-8190
Hurford	Tim & Edith	Box 2295 Chetwynd, B.C. V0C 1J0	788-2562
Kelly	Glenn & Carolyn	Box 1029 Chetwynd, B.C.V0C 1J0	788-2715
Kesta	Brad & Sandra	Box 271 Chetwynd, B.C.V0C 1J0	788-3217
Lamoureux	Bill & Marilyn	Box 1171 Chetwynd, B.C.V0C 1J0	788-3005
Machalek	Jackie	Box 1316 Chetwynd, B.C.V0C 1J0	788-2830
Macrie	Alex & Susan	Box 1464 Chetwynd, B.C.V0C 1J0	788-3226
Mallia	George	Box 553 Chetwynd, B.C.V0C 1J0	788-9659
Nielsen	D. & R.	Box 2014 Chetwynd, B.C.V0C 1J0	788-2632
Roofthooft	Andre	Box 1316 Chetwynd, B.C.V0C 1J0	788-2830
Sawchuk	Wayne	Box 1876 Chetwynd, B.C.V0C 1J0	788-2685
Sheen	Ken	Box 2598 Chetwynd, B.C.V0C 1J0	788-7834
Simpson	Ernie	Box 867 Chetwynd, B.C.V0C 1J0	788-7884
Smith	Don	Box 1080 Chetwnd, B.C.V0C 1J0	788-2337
Williams	Kelle, Joanne & Ian	Box 35 Chetwynd, B.C.V0C 1J0	788-2592
Winland	Gene & Judy	Box 778 Chetwynd, B.C. V0C 1J0	788-1942

APPENDIX 17.1-1

PINE VALLEY COAL
FIRST NATIONS CONSULTATION PROGRAM
JUNE 1996 TO JUNE 1997

ENVIRONMENTAL ASSESSMENT PROCESS

First Nations Log

June 18, 1996	Called Judy Maas, Treaty 8 and set up meeting for June 25th.
June 18, 1996	Called Claire Gauthier, Kelly Lake. Left message for him to call regarding setting a meeting time.
June 19, 1996	Received call from Kelly Lake band confirming a meeting for Tuesday p.m.
June 19, 1996	Call and fax to Bud Napoleon, Saluteau band regarding meeting for next week. No response to message or fax.
June 19, 1996	Call from Terrance Armstrong, Treaty 8 regarding funding of documentary. General discussion of purpose; I said that I would discuss it with them next week.
June 25, 1996	Meeting at Treaty 8 Association office in Fort St. John - Judy Maas, Stu Cameron and others. Meeting with Kelly Lake Band - Claire Gauthier (Chief) and two councillors.
June 26, 1996	Meeting with West Moberly Band - George Desjarlais - Chief.
June 27, 1996	Meeting with Saulteau Band: Milton Wood - Councillor and economic development, Barb Loberg - Councillor, Geraldine Gauthier - Councillor, and Rhonda Lalonde - Council Executive.
Sept 20, 1996	Meeting with West Moberly and Saulteau. Dave Fawcett in atttendance from Pine Valley Coal. Rob Hawes in attendance from NDM. Chief George Desjarlais, Tim Davis and John Doike in attendance from West Moberly.
Jan 20, 1997	Meeting with West Moberly. Dave Fawcett in attendance from Pine Valley Coal. Rob Hawes in attendance from NDM. Chief George Desjarlais, Mike Ray in attendance from West Moberly. West Moberly noted legal obligations under Treaty 8 and the Band's desire for a protocol agreement. Dave Fawcett provided an update on the project.
May 5, 1997	Meeting with Saulteau. Rob Hawes in attendance from NDM. Chief Napoleon Bud, Geraldine Gauthier, Barb Lobert and Band Manager Renzo Caron in attendance from the Saulteau.
May 5, 1997	Meeting with McLeod Lake Band. Rob Hawes in attendance from NDM. Economic Development Officer Bob Inkpen in attendance from the Band.
July 28, 1997	Meeting with West Moberly FN, Mike Rae and Eli Nelson. Terms of reference for

a critical comunity use area assessment were agreed upon. Study to be in lieu of further archaeological impact assessments at the request of WMFN. Study to be conducted by Fedirchuk McCullough & Assoc. of Calgary.

Aug 11, 1997 Telephone conversation with Amy Gauthier, Councillor, Saluteau First Nations to set up a meeting Sepember 8, 1997 between Pine Valley Coal and Saulteau FN.