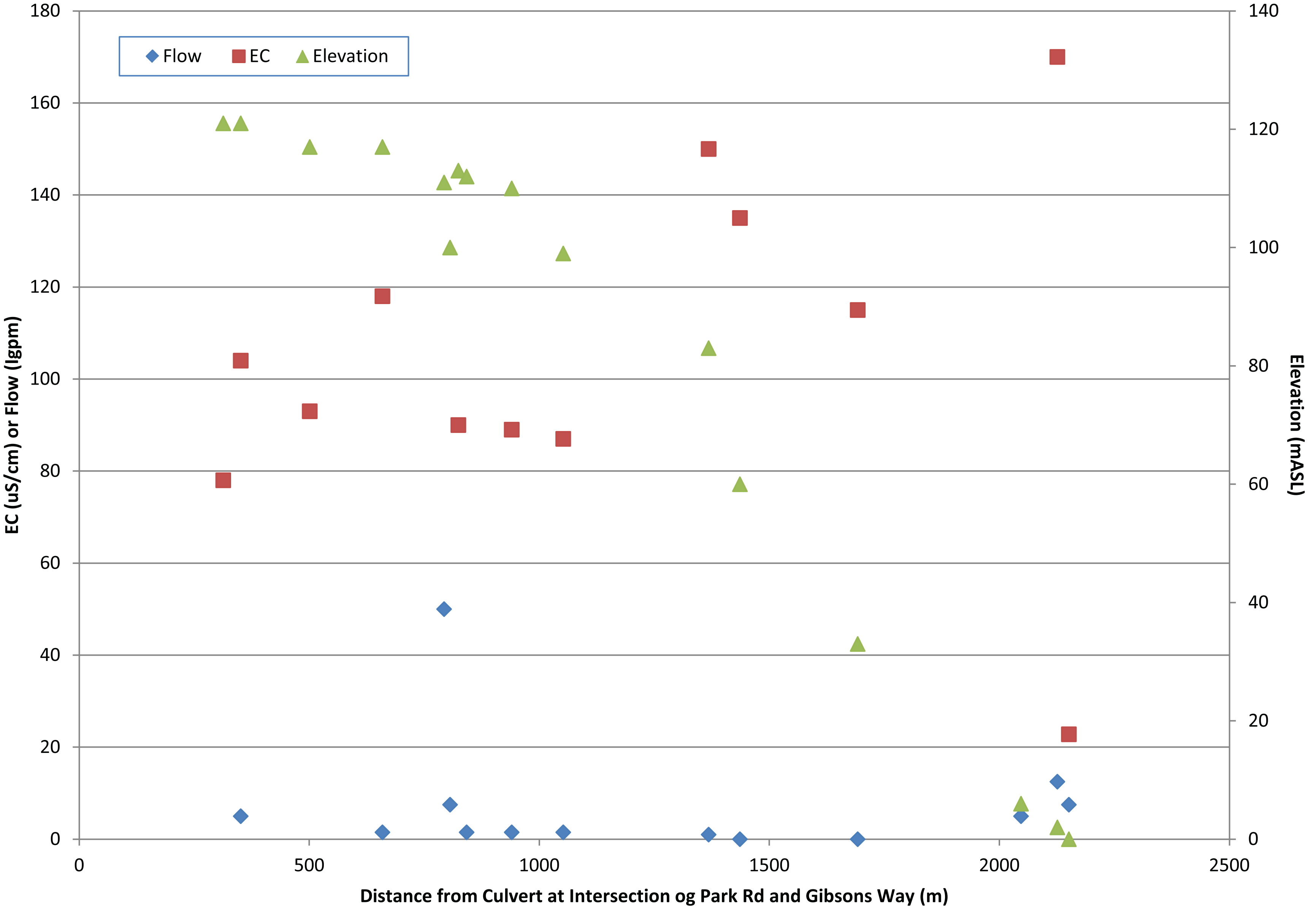
APPENDIX A:
Field Verified Well Survey

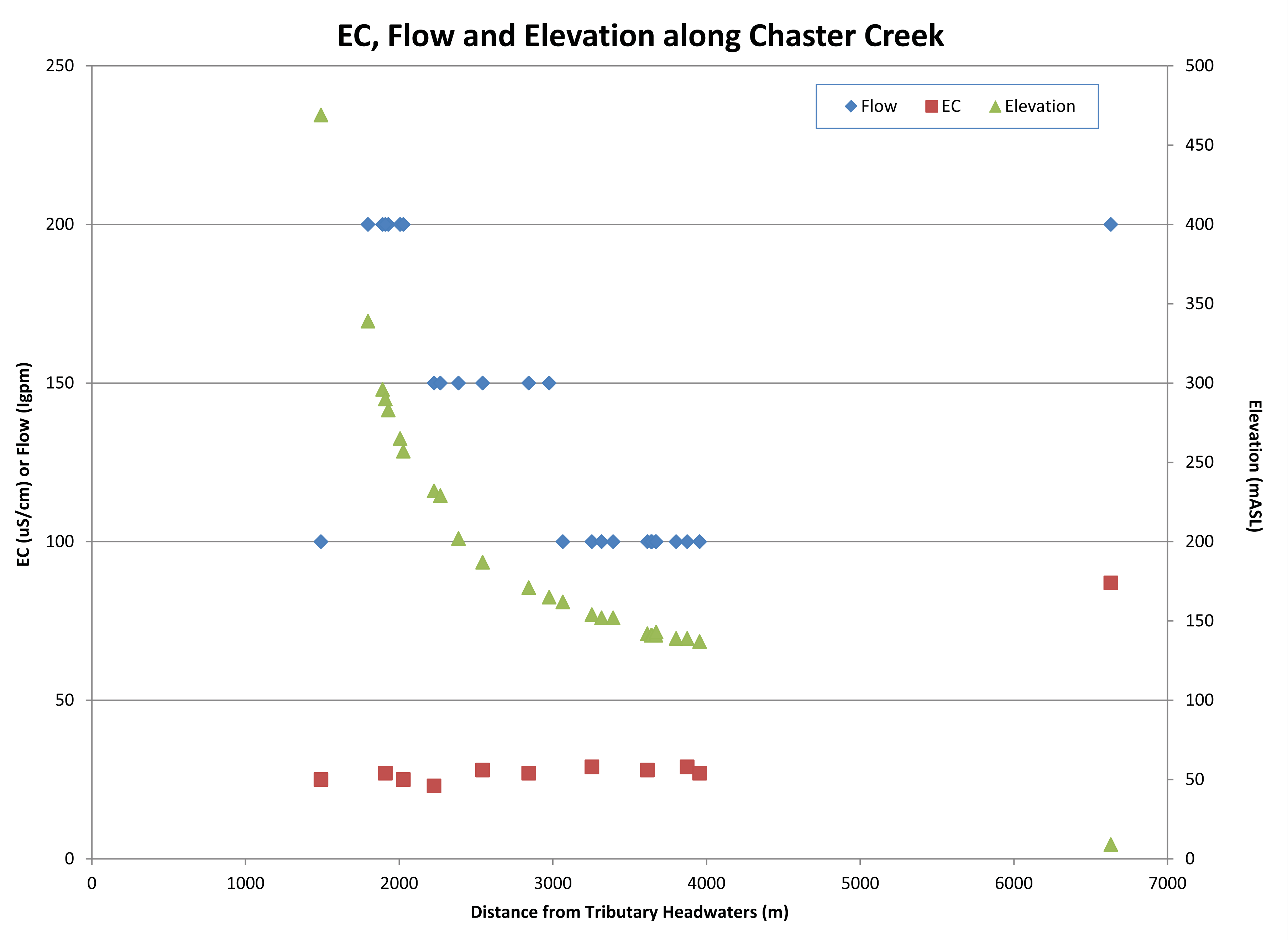
Station Name	GridZone	Northing	Easting	Elevation (masl)	Verification Status	Landowner	Address	Contact Phone Number	BC Well ID#	Waterline Well ID#	Personnel	Initial Visit Date	Description/Comments	Questionnaire Filled Out (y/n)	Signed Off (y/n)	SWL (m bTOC)	TD (m bTOC)	EC (uS/cm)	Temp (^{o}C)	Flow (L/min)	Verification Date
FVS1-1	10U NAD 83	5470708	462425	7	Verified	David Morton	869 Gower Point Road	604-886-8265	unknown	16-22-100	RB-22	02-Aug-09	Landowner did not want to sign off on verification form. Well not hooked up, could not collect field parameters.	y	n	3.77	5.23	na	na	na	2-Aug-09
FVS1-2	10U NAD 83	5470675	462427	7	Septic Field	David Morton	869 Gower Point Road	604-886-8265	na	na	RB-22	02-Aug-09		na	na	na	na				2-Aug-09
FVS2-1	10U NAD 83	5470687	462369	25	Verified	Robert & Julianne Hunt	889 Gower Point Road	604-886-9554	unknown	16-22-101	RB-22	02-Aug-09	Well not hooked up, could not collect field parameters.	y	y	3.76	7.96	na	na	na	2-Aug-09
FVS2-2	10U NAD 83	5470665	462375	17	Septic Field	Robert & Julianne Hunt	889 Gower Point Road	604-886-9554	na	na	RB-22	02-Aug-09		na	na	na	na				2-Aug-09
FVS4-1	10U NAD 83	5473553	460460	138	Verified	Hermann Ziltener	1369 Reed Road	604-224-0230	unknown	16-22-102	RB-22	03-Aug-09	Did not want me to take GPS of septic system. Well not hooked up, could not collect field parameters.	y	n	2.15	2.86	na	na	na	3-Aug-09
FVS6-1	10U NAD 83	5472030	463057		Verified	Town of Gibson (Well#1)	Park southeast of Town Hall				RB-22	03-Aug-09	Well #1 is connected to a free water distributor for the community so people can drive and fill up water jugs.	na	na	na	na	98	13.2	na	03-Aug-09
FVS8-1	10U NAD 83	5472142	463141		Verified	Town of Gibson (Well#4)	Park southeast of Town Hall				RB-22	03-Aug-09	Well #4 is connected to a fountain located near town compass located in the park below the Town Hall. Fountain turns on and off on an unknown schedule but is presumably overflow water from Well #4. GPS of Fountain is 5472160N, 463169E	na	na	na	na	84	9.6	18.18	3-Aug-09
FVS10-1	10U NAD 83	5471758	462924		Verified	Town of Gibson (Well#2)	Park Located on Gower Point and South Fletcher Road				RB-22	05-Aug-09	**Repeated as FVS0-25**	na	na	na	na	na	na	na	5-Aug-09
FVS12-1	10U NAD 83	5471079	461835	62	Verified	Walter Loitz	1019 Rossamond Road	604-886-9500	19352	16-22-103	RB-22	05-Aug-09	Well not hooked up, could not collect field parameters.	y	y	53.27	58.83	na	na	na	5-Aug-09
FVS9-1	10U NAD 83	5471715	462943		Verified	Town of Gibson (Well#3)	Park Located on Gower Point and South Fletcher Road				RB-22	05-Aug-09		na	na	na	na	na	na	na	5-Aug-09
FVS1-30	10U NAD 83	5473580	460353	152	Declined FVS by telephone.	Jim and Joanne Conway	814 Reed Road	604-886-8859	na	na	RB-22/CJD-04	03-Aug-09	Has well but would not let me do any work until she discussed it with her husband. She was very concerned and angry with the town with respect to her well. Call to follow-up. On 09/09/09 CJD spoke with Jim Conway by telephone, following a review of the questionnaire he has declined participation in the study. GPS is intersection of private drive and Reed Road.	na	n	na	na	na	na	na	9-Sep-09
FVS0-32	10U NAD 83				Abandoned	Lana LaBelle	1097 Reed Road	604-886-4157	5484		CJD-04	03-Aug-09	This well no longer exists, current owner assumes abandoned.	na	na	na	na	na	na	na	10-Sep-09
FVS1-33	10U NAD 83	5473535	462353	163	Verified	Lana LaBelle	1097 Reed Road	604-886-4157	na	16-04-104	CJD-04	09-Sep-09	Well not currently in use, plan to activate within one year.	y	y	1.39	4.93	145	14	na	10-Sep-09
FVS2-33	10U NAD 83	5473575	461503	167	Verified	Lana LaBelle	1097 Reed Road	604-886-4157	na	16-04-105	CJD-04	09-Sep-09	Well not currently in use, plan to deactivate within one year.	y	y	2.22	4.4	58	12.3	na	10-Sep-09
FVS3-33	10U NAD 83	5473535	461486	158	Septic Field	Lana LaBelle	1097 Reed Road	604-886-4157	na		CJD-04	09-Sep-09		y	y	na	na	na	na	na	10-Sep-09
FVS0-34	10U NAD 83	5473045	461628		Abandoned	Construction/Industrial Yard	700 Pratt Road		5489		RB-22	03-Aug-09	Not home. Revisit to confirm well. Well log says well caved in, property on municipal water supply.	na	na	na	na	na	na	na	11-Sep-09
FVS1-36	10U NAD 83	5474300	463623		Verified	Lisa Houle	1022 Chamberlin Road		6805	16-04-106	CJD-04	11-Sep-09	Well has a cap welded on, will need to get a saw. Owners want the well resealed after every visit. Need to get a well cap??? Unable to saw cap off.	y	y						11-Sep-09
FVS1-38	10U NAD 83	5474943	464675		Verified	Bruce Wallis	Bridgeman Place		70752	16-04-107	CJD-04	11-Sep-09	Spoke with L/O, he has been on SCRD water for 2 years now. His well is now inaccessable (in a garage and covered at ground level) with a inoperable vehicle parked over it. He says the well intersected granite bedrock at 185 ft bGL to the depth of exploration and the waterline was at 210 ft bGL. Well only produce at most 1 gpm.	n	n	64.02					11-Sep-09
FVS1-40	10U NAD 83	5474869	463925		Abandoned	Charlean Tang	1346 North Road		5438		CJD-04	12-Sep-09		y	na	na	na	na	na	na	12-Sep-09
FVS2-40	10U NAD 83	5474867	463977		Septic Field	Charlean Tang	1347 North Road				CJD-04	12-Sep-09		y	na	na	na	na	na	na	12-Sep-09
FVS0-39	10U NAD 83	5472062	462828		Abandoned	Angie Hamon	461 Abbs Road		74430		CJD-04	10-Sep-09	This well is located under a shed in the back yard, should be enough clearance to assess condition. Well is inactive. Have an appointment to verify the well at 11:00 am Monday. Owners are open to allowing the town to utilize for monitoring purposes. This well is determined to be abandoned, could not locate under the shed. Current owners have never seen the well but are aware of where it was originally.								14-Sep-09
FVS3-2	10U NAD 83	5473495	461537	132	Septic Field	Sara Brown	805 Payne Road	604-886-7186	na	na	RB-22	03-Aug-09	North septic field	na	na	na	na				na
FVS3-3	10U NAD 83	5473417	461550	126	Septic Field	Sara Brown	805 Payne Road	604-886-7186	na	na	RB-22	03-Aug-09	Middle Septic field	na	na	na	na				na
FVS3-4	10U NAD 83	5473321	461564	127	Septic Field	Sara Brown	805 Payne Road	604-886-7186	na	na	RB-22	03-Aug-09	South septic field	na	na	na	na				na
FVS0-1	10U NAD 83	5470843	462245		Abandoned	Marc Goodwin			1925		RB-22	03-Aug-09	Not home. Revisit to confirm well.								
FVS0-2	10U NAD 83	5473684	461292		Abandoned	Gunther Byser			5334		RB-22	03-Aug-09	Does not know of any wells on property.								
FVS0-3	10U NAD 83	5473278	460883		Abandoned	Stewarts			5359		RB-22	03-Aug-09	Well abandoned								
FVS0-4	10U NAD 83	5472055	463132		Abandoned	Town of Gibson			5468		RB-22	04-Aug-09	Talked with Greg Foss (Director of Public works) and he says well has been capped and concreted, lost or abandoned.								

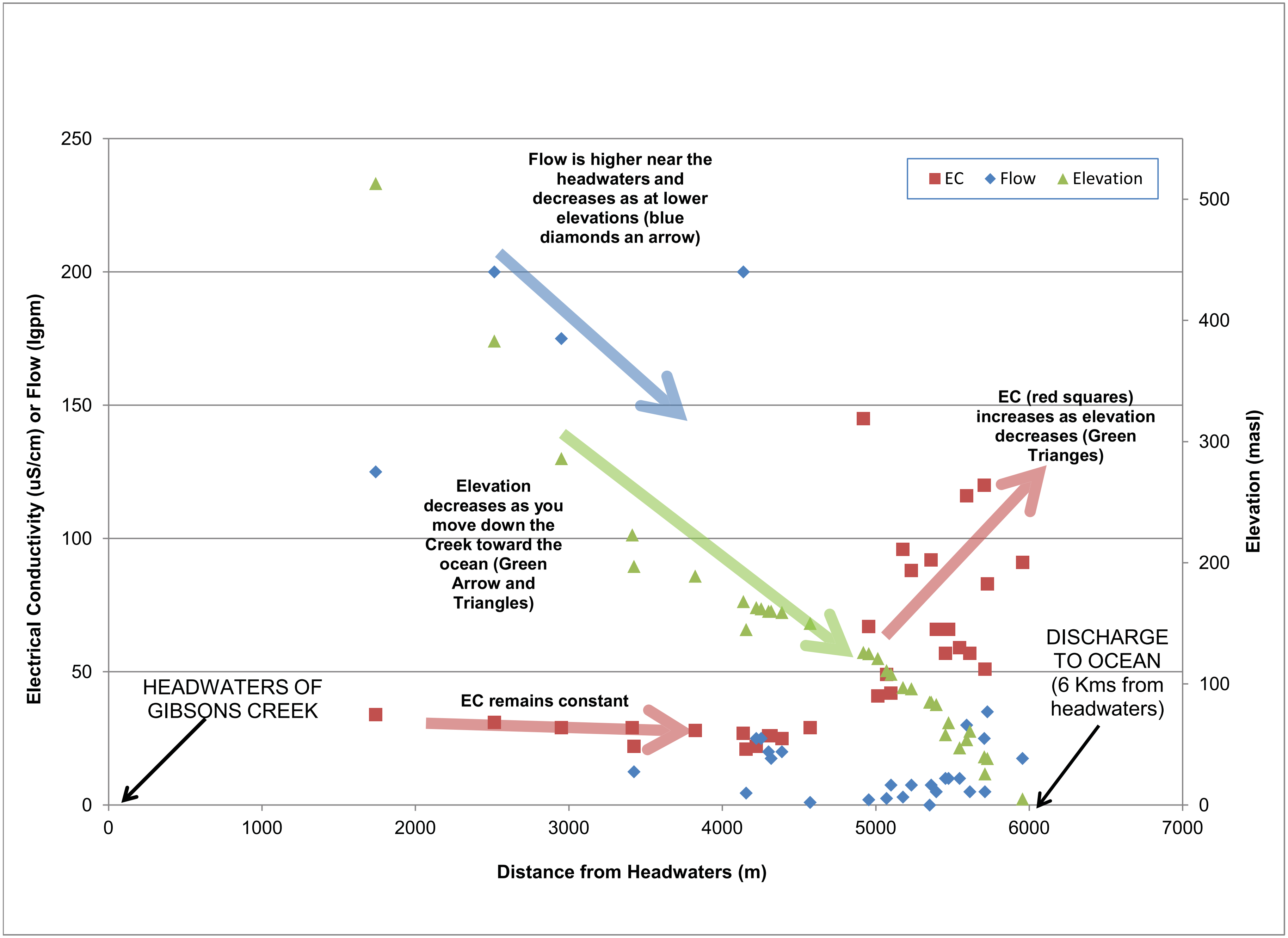
Station Name	GridZone	Northing	Easting	Elevation (masl)	Verification Status	Landowner	Address	Contact Phone Number	BC Well ID#	Waterline Well ID#	Personnel	Initial Visit Date	Description/Comments	Questionnaire Filled Out (y/n)	Signed Off (y/n)	SWL (m bTOC)	TD (m bTOC)	EC (uS/cm)	Temp (°C)	Flow (L/min)	Verification Date
FVS0-5	10U NAD 83	5473896	462261		Abandoned	Unknown			5487		RB-22	05-Aug-09	Landowner not home. Tenants say there are no wells on the property.								
FVS0-6	10U NAD 83	5470724	462133		Abandoned	Doug & Sharon Erichson	942 Gower Point Road	604-886-2270	15035		RB-22	03-Aug-09	Well abandoned								
FVS0-7	10U NAD 83	5470726	462396		Abandoned	Wilson			15040		RB-22	03-Aug-09	Nobody living in house. House is for sale. Owners live in town (possibly Vancouver).								
FVS0-8	10U NAD 83	5470662	462181		Abandoned	Vandersade	933 Gower Point Road	604-886-6647	15934		RB-22	03-Aug-09	Well abandoned								
FVS0-9	10U NAD 83	5470695	461949		Abandoned	Brian Peers	127 Mahan Road	604-886-4896	17915		RB-22	03-Aug-09	Tenant. Landlord said well is abandoned.								
FVS0-10	10U NAD 83	5470748	461933		Abandoned	Blair Davies & Susan Smart	139 Mahan Road	604-886-9863	18583		RB-22	03-Aug-09	Well abandoned								
FVS0-11	10U NAD 83	5473658	460673	157	Abandoned	Town of Gibson/SD 46			18774		RB-22	04-Aug-09	Well confirmed abandoned during site visit. Well nested with well 18775.								
FVS0-12	10U NAD 83	5473658	460673	157	Abandoned	Town of Gibson/SD 46			18775		RB-22	04-Aug-09	Well confirmed abandoned during site visit. Well nested with well 18774.								
FVS0-13	10U NAD 83	5473841	462048		Abandoned	Dale & Lawny Ingram	989 Cemetery Road	604-886-2953	19368		RB-22	05-Aug-09	Had well when they first moved in but is now abandoned.								
FVS0-14	10U NAD 83	5473800	462697		Abandoned	Clarence Sicotte	901 North Road	604-886-	19676		RB-22	05-Aug-09	Remembers well being on property but has since filled it in.								
FVS0-15	10U NAD 83	5472056	463035		Abandoned	Town of Gibson			19896		RB-22	04-Aug-09	Talked with Greg Foss (Director of Public works) and he says well has been capped and concreted, lost or abandoned.								
FVS0-16	10U NAD 83	5470629	461664		Abandoned	Melay Drasic	119 Head Road	604-828-1624	19942		RB-22	05-Aug-09	Found old pressure tank and pump wiring in the garage. Well head was unable to locate. New landowner therefore he didn't know much about the well. From the looks of it the well has been abandoned for some time.								
FVS0-17	10U NAD 83	5470631	462123		Abandoned	Unknown			20229		RB-22	03-Aug-09	Would not give name but says there is no well on the property								
FVS0-18	10U NAD 83				Abandoned	Bob & Willie Blake	945 Gower Point Road		20280		RB-22	03-Aug-09	Well abandoned								
FVS0-19	10U NAD 83	5470670	462309		Abandoned	Charles Russell	903 Gower Point Road	604-886-2117	20292		RB-22	03-Aug-09	Well filled in with gravel to protect grand kids. Get there water from the SCRD. Have a creek that runs through the property which is currently dry. It is known however to flow vigorously in the winter and spring.								
FVS0-20	10U NAD 83	5470520	461442		Abandoned	Caprice B&B	1111 Gower Point Road	604-886-4270	20518		RB-22	05-Aug-09	Living there for 15 years and have not see a well. Confirmed that Moorcroft was the original owner of the property. They are now on town water.								
FVS0-21	10U NAD 83	5472066	462317		Abandoned	Piero Papa	895 Inglis Road	604-886-9014	32292		RB-22	05-Aug-09	No well on property.								
FVS0-22	10U NAD 83	5471444	462809		Abandoned	Julia Wilkie	307 Glassford Road	604-886-8554	33950		RB-22	05-Aug-09	No well on property. Land used to be part of an old strawberry farm. Well might have been used for that operation. When Julia was digging the hole for her backyard pond, they found a number of broken pipes and such. Lots of water on property. If they dug down 8" they would hit water. Sign on street says Goosebird Creek runs through/near property.								
FVS0-23	10U NAD 83	5474075	461885		Abandoned	Graham Stones	101 Cemetery Road	604-886-1775	45127		RB-22	05-Aug-09	No well on property.								
FVS0-24	10U NAD 83	5474074	461942		Abandoned	Rob Heavens	988 Cemetery Road	604-886-5334	51808		RB-22	05-Aug-09	No well on property.								
FVS0-25	10U NAD 83	5471745	462924		Abandoned	Town of Gibson			**?53237?**		RB-22	04-Aug-09	Talked with Greg Foss (Director of Public works) and he says well has been capped and concreted, lost or abandoned. **Repeated as FVS10-1**								
FVS0-26	10U NAD 83	5471201	461815		Abandoned	David Macintosh	253 Ryan Drive	604-886-6849			RB-22	05-Aug-09	He developed his lot and the 3 to the north and discovered no well.								
FVS0-27	10U NAD 83	5472790	462683		Abandoned	School District			74695		RB-22	04-Aug-09	Talked with Greg Foss (Director of Public works) and he says well has been capped and concreted, lost or abandoned.								
FVS0-28	10U NAD 83	5472740	462699		Abandoned	School District			74055		RB-22	04-Aug-09	Talked with Greg Foss (Director of Public works) and he says well has been capped and concreted, lost or abandoned.								
FVS0-29	10U NAD 83				Abandoned	Donald McKay		604-886-2022	unknown		RB-22	03-Aug-09	No well on property. BC ID # is not labeled on map. Check database.								
FVS0-31	10U NAD 83	5473611	460684	156	Verified	Town of Gibsons/SD 46					CJD-04	09-Sep-09	Well is inactive. Details are also unknown. Acoustic sounding indicates depth to well bottom/waterlevel at 118.44 m bTOC. Cap was welded on, anticipate no debris inside well. No well record could be located.								
FVS0-35	10U NAD 83	5473344	463654		Abandoned	Bruno Huber	569 Harvey Road		14904		CJD-04	11-Sep-09	Well confirmed abandoned by current owner.								
FVS0-37	10U NAD 83	5475057	464135		Abandoned	Gregory Giersh	1395 North Road		14308		CJD-04	11-Sep-09	L/O is on SCRD water. Is unaware of this well and assumes abandoned. He has lived here for 50 years. Property once belonged to Otto Giersh.								
FVS3-1	10U NAD 83	5473486	461571	128	Spring	Sara Brown	805 Payne Road	604-886-7186	18963		RB-22	03-Aug-09	No well found on site. Landowner did know of a well on site before they bought the property. Might be located under the trailer on north end of property. Large amount of seepage has been noticed coming from this spot. Possible spring location. Property is connect to town water.	y	n						
FVS-41						Stewart Stinson	1304 North Road														

Station Name	GridZone	Northing	Easting	Elevation (masl)	Verification Status	Landowner	Address	Contact Phone Number	BC Well ID#	Waterline Well ID#	Personnel	Initial Visit Date	Description/Comments	Questionnaire Filled Out (y/n)	Signed Off (y/n)	SWL (m bTOC)	TD (m bTOC)	EC (uS/cm)	Temp (°C)	Flow (L/min)	Verification Date
FVS7-1	10U NAD 83	5473715	460623	148	Spring	Open Reservoir and Spring			na	na	RB-22	04-Aug-09	On Greg Foss' Public Works yard. Reservoir is feed by spring which flowed at about 50,000gal/day when measured in 15 years ago. Over flows through culvert pipe to the south. Inaccessible due to over growth. Maybe able to gain access if needed.								
Z-Delete this line, well does not belong here.	10U NAD 83	5473054	463221		Revisit to verify	Rob Paish	718 Crucil Road	604-886-4854	72237		RB-22	05-Aug-09	Not home. Revisit to confirm well.								
Z	10U NAD 83					Nick Vermeulen	Courtney Road	604-741-4150	72237		CJD-04	04-Sep-09	Confirmed to have an active well by a town employee (Mark Helt). Nick not home. Left a town letter with his wife with instructions to contact regarding the study. Left Nick a follow-up voicemail on 11-Sep-2009. Nick called back and said he is not interested in participating in the study and does not want the town obtaining details on his well through the FVS.								
Z	10U NAD 83	5475294	463219			Cruikshank	1290 Stewart Rd.		93201		CJD-04	12-Sep-09	Drove to residence but could not get out of vehicle due to large barking dog, nobody came outside. Left a town letter and permission form attached to their gate.								
Z	10U NAD 83					Roman Hladysh	RV Park at top of Keith Rd.				CJD-04	04-Sep-09	This well is dry and was measured at 105.80 m bTOC to bottom.								
Z	10U NAD 83	5473854	463552		Revisit to verify	H. Boyce	905 Chamberlin Road		5335		CJD-04	11-Sep-09	GPS coord and name on mailbox match well log. Not home, left info letter with instructions to call.								
Z	10U NAD 83	5474262	462898		Revisit to verify	Unknown			5347		RB-22	05-Aug-09	Not home. Revisit to confirm well.								
Z	10U NAD 83	5473784	460931		Revisit to verify	Mel's Father's	1216 Reed Road		5446		RB-22	03-Aug-09	Not home but has well on property. Revisit.								
Z	10U NAD 83	5474372	462995		Revisit to verify	Unknown			5477		RB-22	05-Aug-09	Not home. Revisit to confirm well.								
Z	10U NAD 83	5473947	461015		Revisit to verify	Mel Lyons	1216 Reed Road	604-886-7171	5493		RB-22	03-Aug-09	No well on property, but has spring in north corner. Location not verified. Revisit. Revisited on 10-Sep-09, was advised that the spring was unaccessable due to overgrowth of blackberry bushes. Well ID 5493 relates to the spring.								

EC, Flow and Elevation along Charman Creek




EC, Flow and Elevation along Chaster Creek
◆ Flow
■ EC
▲ Elevation
EC (uS/cm) or Flow (Igpm)
0
50
100
150
200
250
Elevation (mASL)
0
50
100
150
200
250
300
350
400
450
500
Distance from Tributary Headwaters (m)
0
1000
2000
3000
4000
5000
6000
7000



Flow is higher near the headwaters and decreases as at lower elevations (blue diamonds an arrow)

Elevation decreases as you move down the Creek toward the ocean (Green Arrow and Triangles)

EC (red squares) increases as elevation decreases (Green Trianges)

EC remains constant

HEADWATERS OF GIBSONS CREEK

DISCHARGE TO OCEAN (6 Kms from headwaters)

APPENDIX B

Town of Gibsons Well Logs, Reports, and MOE Guides for Well Maintenance and Drilling Artesian Aquifers

Report 1 - Detailed Well Record

Well Tag Number: 5468

Owner: VILLAGE OF GIBSONS

Address:

Area:

WELL LOCATION:
NEW WESTMINSTER Land District
District Lot: 686 Plan: Lot:
Township: Section: Range:
Indian Reserve: Meridian: Block:
Quarter:
Island:
BCGS Number (NAD 27): 092G043122 Well: 2

Class of Well:
Subclass of Well:
Orientation of Well:
Status of Well: New
Well Use: Unknown Well Use
Observation Well Number:
Observation Well Status:
Construction Method: Spring
Diameter: 0.0 inches
Casing drive shoe:
Well Depth: 0 feet
Elevation: 0 feet (ASL)
Final Casing Stick Up: inches
Well Cap Type:
Bedrock Depth: feet
Lithology Info Flag:
File Info Flag:
Sieve Info Flag:
Screen Info Flag:

Site Info Details:
Other Info Flag:
Other Info Details:

Construction Date: 1950-01-01 00:00:00.0

Driller: Unknown
Well Identification Plate Number:
Plate Attached By:
Where Plate Attached:

PRODUCTION DATA AT TIME OF DRILLING:
Well Yield: 0 (Driller's Estimate)
Development Method:
Pump Test Info Flag:
Artesian Flow:
Artesian Pressure (ft):
Static Level:

WATER QUALITY:
Character:
Colour:
Odour:
Well Disinfected: N
EMS ID:
Water Chemistry Info Flag:
Field Chemistry Info Flag:
Site Info (SEAM):

Water Utility:
Water Supply System Name:
Water Supply System Well Name:

SURFACE SEAL:
Flag:
Material:
Method:
Depth (ft):
Thickness (in):

WELL CLOSURE INFORMATION:
Reason For Closure:
Method of Closure:
Closure Sealant Material:
Closure Backfill Material:
Details of Closure:

Screen from	to feet	Type	Slot Size

Casing from	to feet	Diameter	Material	Drive Shoe

GENERAL REMARKS:

LITHOLOGY INFORMATION:
From 0 to 0 Ft. Springs

- Return to Main
- Return to Search Options
- Return to Search Criteria

BRITISH COLUMBIA

Report 1 - Detailed Well Record

Well Tag Number: 18774

Owner: VILLAGE OF GIBSONS

Address: HENRY RD

Area:

WELL LOCATION:
NEW WESTMINSTER Land District
District Lot: Plan: Lot:
Township: Section: Range:
Indian Reserve: Meridian: Block:
Quarter:
Island:
BCGS Number (NAD 27): 092G043123 Well: 1

Class of Well:
Subclass of Well:
Orientation of Well:
Status of Well: New
Well Use: Unknown Well Use
Observation Well Number:
Observation Well Status:
Construction Method: Drilled
Diameter: 10.0 inches
Casing drive shoe:
Well Depth: 120 feet
Elevation: 0 feet (ASL)
Final Casing Stick Up: inches
Well Cap Type:
Bedrock Depth: 118 feet
Lithology Info Flag:
File Info Flag:
Sieve Info Flag:
Screen Info Flag:

Site Info Details:
Other Info Flag:
Other Info Details:

Construction Date: 1964-08-01 00:00:00.0

Driller: G. & G. Well Drilling
Well Identification Plate Number:
Plate Attached By:
Where Plate Attached:

PRODUCTION DATA AT TIME OF DRILLING:
Well Yield: 0 (Driller's Estimate)
Development Method:
Pump Test Info Flag:
Artesian Flow:
Artesian Pressure (ft):
Static Level: 5 feet

WATER QUALITY:
Character:
Colour:
Odour:
Well Disinfected: N
EMS ID:
Water Chemistry Info Flag:
Field Chemistry Info Flag:
Site Info (SEAM):

Water Utility:
Water Supply System Name:
Water Supply System Well Name:

SURFACE SEAL:
Flag:
Material:
Method:
Depth (ft):
Thickness (in):

WELL CLOSURE INFORMATION:
Reason For Closure:
Method of Closure:
Closure Sealant Material:
Closure Backfill Material:
Details of Closure:

Screen from	to feet	Type	Slot Size

Casing from	to feet	Diameter	Material	Drive Shoe

GENERAL REMARKS:

LITHOLOGY INFORMATION:

From	0	to	7	Ft.	Gravel fill and topsoil
From	7	to	17	Ft.	Very hard gritty clay
From	17	to	26	Ft.	Med. to fine sand and fine gravel - W.B.
From	0	to	0	Ft.	S.L. 6'
From	26	to	47	Ft.	Heavily silted fine sand
From	0	to	0	Ft.	30 slot screen installed (bottom @ 24')
From	0	to	0	Ft.	After surging and pumping - S.W.L. 5'
From	0	to	0	Ft.	Pumped for 2 hrs. @ 4 gpm. 17' DD
From	0	to	0	Ft.	32 mins. for recovery. Pulled screen

```
From    47 to  69.5 Ft.   Coarse gravel and boulders with clay
From     0 to     0 Ft.   binder - very hard drilling
From  69.5 to   110 Ft.   Till - very hard drilling
From   110 to   118 Ft.   Coarse sand, tightly cemented with clay
From     0 to     0 Ft.   binder
From   118 to   120 Ft.   Bedrock
```

- Return to Main
- Return to Search Options
- Return to Search Criteria

Information Disclaimer

BRITISH COLUMBIA

Report 1 - Detailed Well Record

Well Tag Number: 18775

Owner: VILLAGE OF GIBSONS

Address: HENRY RD

Area:

WELL LOCATION:
NEW WESTMINSTER Land District
District Lot: Plan: Lot:
Township: Section: Range:
Indian Reserve: Meridian: Block:
Quarter:
Island:
BCGS Number (NAD 27): 092G043123 Well: 8

Class of Well:
Subclass of Well:
Orientation of Well:
Status of Well: New
Well Use: Unknown Well Use
Observation Well Number:
Observation Well Status:
Construction Method: Drilled
Diameter: 10.0 inches
Casing drive shoe:
Well Depth: 40 feet
Elevation: 0 feet (ASL)
Final Casing Stick Up: inches
Well Cap Type:
Bedrock Depth: feet
Lithology Info Flag:
File Info Flag:
Sieve Info Flag:
Screen Info Flag:

Site Info Details:
Other Info Flag:
Other Info Details:

Construction Date: 1964-08-01 00:00:00.0

Driller: G. & G. Well Drilling
Well Identification Plate Number:
Plate Attached By:
Where Plate Attached:

PRODUCTION DATA AT TIME OF DRILLING:
Well Yield: 0 (Driller's Estimate)
Development Method:
Pump Test Info Flag:
Artesian Flow:
Artesian Pressure (ft):
Static Level:

WATER QUALITY:
Character:
Colour:
Odour:
Well Disinfected: N
EMS ID:
Water Chemistry Info Flag:
Field Chemistry Info Flag:
Site Info (SEAM):

Water Utility:
Water Supply System Name:
Water Supply System Well Name:

SURFACE SEAL:
Flag:
Material:
Method:
Depth (ft):
Thickness (in):

WELL CLOSURE INFORMATION:
Reason For Closure:
Method of Closure:
Closure Sealant Material:
Closure Backfill Material:
Details of Closure:

Screen from	to feet	Type	Slot Size

Casing from	to feet	Diameter	Material	Drive Shoe

GENERAL REMARKS:
DRY HOLE

LITHOLOGY INFORMATION:

From	0	to	10	Ft.	Hardpan
From	10	to	11	Ft.	Fine gravel - little water
From	11	to	38	Ft.	Br. gritty clay
From	38	to	40	Ft.	Till

- Return to Main
- Return to Search Options

BRITISH COLUMBIA

Report 1 - Detailed Well Record

Well Tag Number: 19896

Owner: VILLAGE OF GIBSONS

Address:

Area:

WELL LOCATION:
NEW WESTMINSTER Land District
District Lot: Plan: Lot:
Township: Section: Range:
Indian Reserve: Meridian: Block:
Quarter:
Island:
BCGS Number (NAD 27): 092G043122 Well: 1

Class of Well:
Subclass of Well:
Orientation of Well:
Status of Well: New
Well Use: Unknown Well Use
Observation Well Number:
Observation Well Status:
Construction Method: Drilled
Diameter: 10.0 inches
Casing drive shoe:
Well Depth: 138 feet
Elevation: 0 feet (ASL)
Final Casing Stick Up: inches
Well Cap Type:
Bedrock Depth: feet
Lithology Info Flag: N
File Info Flag: N
Sieve Info Flag: N
Screen Info Flag: N

Site Info Details:
Other Info Flag:
Other Info Details:

Construction Date: 1966-04-01 00:00:00.0

Driller: Rural Well Drillers
Well Identification Plate Number:
Plate Attached By:
Where Plate Attached:

PRODUCTION DATA AT TIME OF DRILLING:
Well Yield: 40 (Driller's Estimate) Gallons per Minute (U.S./Imperial)
Development Method:
Pump Test Info Flag: N
Artesian Flow: .01 U.S. Gallons per Minute
Artesian Pressure (ft):
Static Level:

WATER QUALITY:
Character:
Colour:
Odour:
Well Disinfected: N
EMS ID:
Water Chemistry Info Flag: Y
Field Chemistry Info Flag:
Site Info (SEAM): N

Water Utility: N
Water Supply System Name:
Water Supply System Well Name:

SURFACE SEAL:
Flag: N
Material:
Method:
Depth (ft):
Thickness (in):

WELL CLOSURE INFORMATION:
Reason For Closure:
Method of Closure:
Closure Sealant Material:
Closure Backfill Material:
Details of Closure:

Screen from	to feet	Type	Slot Size

Casing from	to feet	Diameter	Material	Drive Shoe

GENERAL REMARKS:
PUMPED AT 110US GPM, FOR 2 HRS.   WATER LEVEL STABLIZED AT 40 FT. AFTER .5 HR. WELL FLOWED AGAIN IN 2 MIN 40 SECS. AFTER STOPPING PUMP

LITHOLOGY INFORMATION:

From	0	to	2	Ft.	Fill
From	2	to	4	Ft.	Soft organic top soil
From	4	to	8	Ft.	Cobbles interfilled with silty fine sand
From	8	to	21	Ft.	Boulders - interspaced with compact
From	0	to	0	Ft.	sandy silt - few isolated layers of
From	0	to	0	Ft.	gravel and sand
From	21	to	26	Ft.	Sandy gravel medium to coarse, few
From	0	to	0	Ft.	isolated layers of silt (3"-6" thick),
From	0	to	0	Ft.	W.B. flowing
From	26	to	33	Ft.	Sandy gravel (medium to coarse) W.B.
From	33	to	39	Ft.	Coarse sand and gravel. 2" to 4" and
From	0	to	0	Ft.	larger W.B.
From	39	to	42	Ft.	Coarse sand and fine gravel mostly sand
From	0	to	0	Ft.	(W.B.)
From	42	to	64	Ft.	Sand, medium to coarse with occasional
From	0	to	0	Ft.	seams of gravel
From	64	to	76	Ft.	Medium to coarse sand (W.B.)
From	76	to	83	Ft.	Coarse sand some fine gravel
From	83	to	96	Ft.	Silty sand fine to medium compact
From	96	to	98	Ft.	Sand fine to medium (W.B.)
From	98	to	101	Ft.	Compact silty sand
From	101	to	108	Ft.	Compact silt with peat stringers
From	108	to	110.5	Ft.	Sand fine to med., some silt
From	110.5	to	113	Ft.	Compact silty sand
From	113	to	115	Ft.	Silty sand medium
From	115	to	117	Ft.	Light grey fine silty sand
From	117	to	132	Ft.	Fine grey sand (very little silt) W.B.
From	132	to	138	Ft.	Fine grey sand with a little silt

- Return to Main
- Return to Search Options
- Return to Search Criteria

British Columbia

Report 1 - Detailed Well Record

Well Tag Number: 33950

Owner: VILLAGE OF GIBSON

Address: MUNICIPAL PARK

Area: GIBSONS

WELL LOCATION:
NEW WESTMINSTER Land District
District Lot: 685 Plan: 14412 Lot: 7
Township: Section: 4 Range:
Indian Reserve: Meridian: Block:
Quarter:
Island:
BCGS Number (NAD 27): 092G033344 Well: 4

Class of Well:
Subclass of Well:
Orientation of Well:
Status of Well: New
Well Use: Unknown Well Use
Observation Well Number:
Observation Well Status:
Construction Method: Drilled
Diameter: 10.0 inches
Casing drive shoe:
Well Depth: 48 feet
Elevation: 0 feet (ASL)
Final Casing Stick Up: inches
Well Cap Type:
Bedrock Depth: feet
Lithology Info Flag:
File Info Flag:
Sieve Info Flag:
Screen Info Flag:

Site Info Details:
Other Info Flag:
Other Info Details:

Construction Date: 1975-12-11 00:00:00.0

Driller: Rural Well Drillers
Well Identification Plate Number:
Plate Attached By:
Where Plate Attached:

PRODUCTION DATA AT TIME OF DRILLING:
Well Yield: 275 (Driller's Estimate) Gallons per Minute (U.S./Imperial)
Development Method:
Pump Test Info Flag:
Artesian Flow:
Artesian Pressure (ft):
Static Level:

WATER QUALITY:
Character:
Colour:
Odour:
Well Disinfected: N
EMS ID:
Water Chemistry Info Flag:
Field Chemistry Info Flag:
Site Info (SEAM):

Water Utility:
Water Supply System Name:
Water Supply System Well Name:

SURFACE SEAL:
Flag:
Material:
Method:
Depth (ft):
Thickness (in):

WELL CLOSURE INFORMATION:
Reason For Closure:
Method of Closure:
Closure Sealant Material:
Closure Backfill Material:
Details of Closure:

Screen from	to feet	Type	Slot Size

Casing from	to feet	Diameter	Material	Drive Shoe

GENERAL REMARKS:

LITHOLOGY INFORMATION:
From 0 to 7 Ft. Silty gravel, some dark organics
From 7 to 14 Ft. Bouldery organic silty gravel
From 14 to 15 Ft. Silty med. sand with little gravel
From 15 to 17 Ft. Organic silty medium sand
From 17 to 21 Ft. Organic silt with few boulders
From 21 to 36 Ft. Compact clayey silt with thin sand
From 0 to 0 Ft. interbeds and small amount of gravel
From 36 to 42 Ft. Compact silty gravel WB flow noted at
From 0 to 0 Ft. 42' about 40 gpm.
From 42 to 48 Ft. Coarse gravel up to 4" sand fraction
From 0 to 0 Ft. 10-15%

- Return to Main
- Return to Search Options
- Return to Search Criteria

Report 1 - Detailed Well Record

Well Tag Number: 74695

Owner: SCHOOL DISTRICT 46

Address: 783 SCHOOL RD

Area: GIBSONS

WELL LOCATION:
NEW WESTMINSTER Land District
District Lot: 686 Plan: 12195 Lot:
Township: Section: Range:
Indian Reserve: Meridian: Block: G
Quarter:
Island:
BCGS Number (NAD 27): 092G043122 Well: 8

Class of Well:
Subclass of Well:
Orientation of Well:
Status of Well: New
Well Use: Unknown Well Use
Observation Well Number:
Observation Well Status:
Construction Method: Drilled
Diameter: 8.0 inches
Casing drive shoe:
Well Depth: 67 feet
Elevation: 0 feet (ASL)
Final Casing Stick Up: inches
Well Cap Type:
Bedrock Depth: 67 feet
Lithology Info Flag:
File Info Flag:
Sieve Info Flag:
Screen Info Flag:

Site Info Details:
Other Info Flag:
Other Info Details:

Construction Date: 1987-03-12 00:00:00.0

Driller: Drillwell Enterprises
Well Identification Plate Number:
Plate Attached By:
Where Plate Attached:

PRODUCTION DATA AT TIME OF DRILLING:
Well Yield: 20 (Driller's Estimate) U.S. Gallons per Minute
Development Method:
Pump Test Info Flag:
Artesian Flow:
Artesian Pressure (ft):
Static Level: 24 feet

WATER QUALITY:
Character:
Colour:
Odour:
Well Disinfected: N
EMS ID:
Water Chemistry Info Flag:
Field Chemistry Info Flag:
Site Info (SEAM):

Water Utility:
Water Supply System Name:
Water Supply System Well Name:

SURFACE SEAL:
Flag:
Material:
Method:
Depth (ft):
Thickness (in):

WELL CLOSURE INFORMATION:
Reason For Closure:
Method of Closure:
Closure Sealant Material:
Closure Backfill Material:
Details of Closure:

Screen from	to feet	Type	Slot Size

Casing from	to feet	Diameter	Material	Drive Shoe

GENERAL REMARKS:
CASING: 8" FROM 0'TO 19', 6' FROM 0' TO 19' LEGAL: DISTRICT LOTS 686 AND 1328

LITHOLOGY INFORMATION:

From	0	to	2	Ft.	GRAVEL FILL
From	2	to	4	Ft.	GRAVEL
From	4	to	23	Ft.	GRAVEL, COARSE, WATERBEARING
From	23	to	28	Ft.	GRAVEL, VERY SILTY BROWN
From	28	to	49	Ft.	CLAY, GREY, SILT LAYERS
From	49	to	64	Ft.	SAND, GREY, VERY SILTY
From	64	to	67	Ft.	SAND, FINE, GREY, SILTY
From	67	to	0	Ft.	GRANITE BEDROCK

- Return to Main
- Return to Search Options
- Return to Search Criteria

APPENDIX B-1

WATER WELL DRILLERS ASSOCIATION

WELL LOG CONSTRUCTION RECORD

OWNER [illegible]
Address [illegible]
Well Location [illegible]
Date Started December 4, 1975
Date Completed December 11, 1975

RURAL WELL DRILLERS LTD.
13117-116th·AVE.
SURREY, B. C.
V3R 2S8

Drilling Method [illegible]
Driller [illegible] Helper [illegible]
File [illegible] Folio
Signed By Agnes M. Dicato

LOG OF FORMATIONS

Depth			Descriptions
0	to	7'	Silty gravel, some dark
	to		organics
7	to	14	Boulder organic silty
	to		gravel
14	to	15	Silty medium sand with
	to		little gravel
15	to	17	Organic silty medium
	to		sand
17	to	21	Organic silt with few
	to		boulders
21	to	36	Compact clayey silt with
	to		thin sand interbeds and
	to		small amount of gravel
36	to	42	Compact silty gravel
	to		water bearing, flow
	to		noted at 42 feet, flow
	to		about 40 gpm
42	to	48	Coarse gravel up to 4"
	to		sand fraction 10 - 15%
	to		
	to		
	to		
	to		
	to		
	to		
	to		
	to		
	to		

GENERAL REMARKS

CASING RECORD

Dia. 10 ins. Wt. #/ft. From 1 to 15
Dia. 8 ins. Wt 28. #/ft. From 1 to 48
Dia. ins. Wt. #/ft. From to
Shoe Yes Welded Yes Cemented Yes

SCREEN RECORD

Make Johnson Material Stainless
Slot opening #100 Length 5'
Top 43' ft. Bottom 48' ft.
Fittings Top Type "K" Fittings Bottom Bail
Gravel Pack Natural
Development Method Air-surge

ROCK WELL DATA

Open Bore Hole Dia. ins.
From ft. to ft.

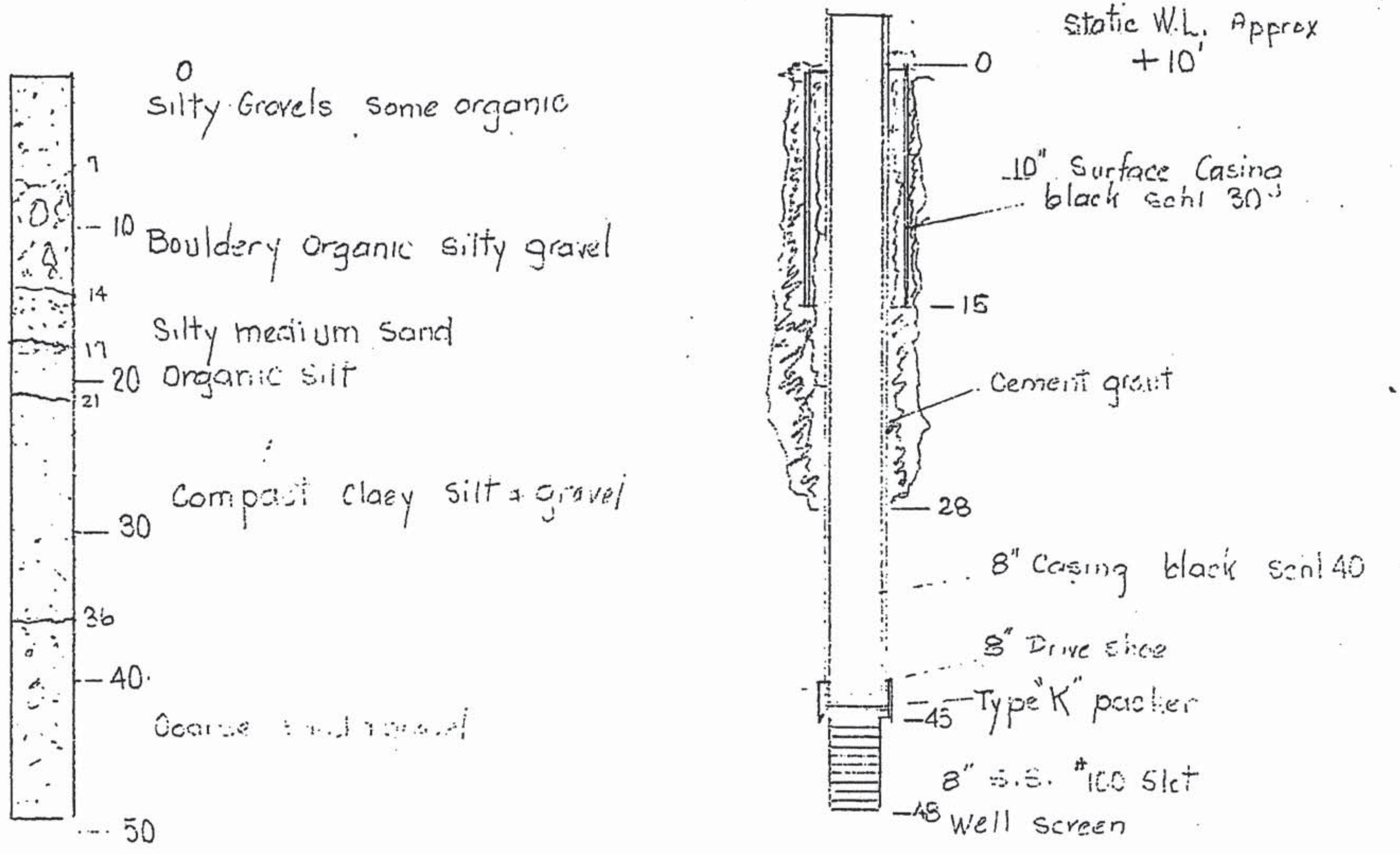
PRODUCTION DATA

Static Level Flowing well ft.
Measured from
Pumping Level ft. at GPM
ft. at GPM
Bail Test ft. at GPH
ft. at GPH
Recommended Pump Setting ft.
Recommended Max. Pump Output 275 GPM GPH
Duration of Test 24 Hrs.

PUMP DATA

Make Type
Model Serial No.
Size HP Drop Pipe ins.
GPM Head ft. RPM
Motor Volts PH
Well Seal
Water Analysis — Hardness PPM
PH Iron PPM

APPENDIX B-2



VILLAGE OF GIBSONS

Construction Details
Well - 2

Dec 22-197

REPORT

TO

TOWN OF GIBSONS

WELL NO. 3

TEST DRILLING PROGRAM

October 22, 1984

DAYTON & KNIGHT LTD.
Consulting Engineers

TOWN OF GIBSONS

WELL NO. 3

TEST DRILLING PROGRAM

CONTENTS

TOWN OF GIBSONS

WELL NO. 3

TEST DRILLING PROGRAM

LOCATION

The new Well No. 3 was drilled in Dougal Park approximately 250 feet east of South Fletcher Road and 9.5 feet north of the north property line of Gower Point Road. Well No. 3 is 151 feet south of production Well No. 2. The location of the well is shown on Figure No. 1.

DRILLING

Well No. 3 was drilled by A & H Construction Ltd. on August 29 and 30, 1984 with an air rotary drill rig. A 10-inch surface casing 22.2 ft. long was installed and grouted in place with neat cement. The 8-inch well casing was then drilled to a depth of 84 feet. The artesian aquifer was encountered at a depth of 54 feet and the static water level during drilling was approximately 2 feet above ground level. A temporary ditch was constructed by the Town from the well along the north side of Gower Point Road to the culvert on Aldersprings Road.

WELL LOG

The log of the soil encountered during drilling and a log of the well construction is shown on Figure 2.

As shown in the soil log, a relatively impervious layer of clayey silt occurred from 42 feet to 54 feet and then the artesian aquifer was encountered at 54 feet. In Well No. 2, the artesian aquifer was encountered at 42 feet depth.

The drilling in the water bearing material in Well No. 3 continued to 84 feet. Coarse sand and gravel occurred from 58 to 82 feet and then a medium to fine sand was noted from 82 feet to 84 feet.

An 8-inch diameter well screen was then installed from 69.0 feet to 79.6 feet and the 8-inch casing was pulled back to expose the screen and the screen was developed. The log of the well construction is shown on Figure 2.

WELL SCREEN AND DEVELOPMENT

Samples of the water bearing sands and gravels were sent to a laboratory for sieve analysis in order to determine a suitable opening for the well screen. The sieve analysis results for soil samples from the following depths are appended to this report.

66 - 68 feet
70 - 72 feet
74 - 76 feet
78 - 80 feet
82 - 84 feet

The 10 foot section of 150 slot 8-inch diameter telescopic stainless steel well screen was installed and then developed by surging with the air compressor on the drill rig. The screen development was continued for 8 hours and when the surging was completed, the well water was free of sand when pumping at a rate of over 400 Igpm.

The total length of the screen assembly is 13.0 feet and includes a blank piece of pipe and a type K packer measuring 2.3 feet long. The top of the type K packer on the screen is 68.08 feet below the top of the 10-inch well surface casing.

During developing of the well screen, an additional draw down of over 10 feet was noted in Well No. 2.

TEST PUMPING

Well No. 3 was test pumped for 24 hours on September 25 and September 26, 1984. The pumping commenced at 12:50 p.m. on September 25, 1984. The well was tested with a Berkley 2 stage submersible turbine pump Model 7S3H2 with 60 feet of 5-inch diameter pump column. The pump was powered by a 50 KVA 480 volt diesel generator.

The water levels in Well No. 2 and Well No. 3 were monitored during the pump test and for a recovery period after the pump test.

Samples of water were taken during the pump test for chemical and bacteriological analysis. It was noted that the temperature of the water was 43^{O}F at the point of discharge.

The log of the drawdown of Wells No. 2 and No. 3 are shown on Figure 3. Well No. 3 was test pumped at 200 Igpm for 6 hours and then at 400 Igpm for the remaining 18 hours. The drawdown readings in the wells were as follows:

	DRAWDOWN (FT.)	
	At 200 Igpm 6 hours after Start of Pumping	At 400 Igpm 24 hours after Start of Pumping
Well No. 3	27 ft.	57.5 ft.
Well No. 2	8.5 ft.	21 ft.

The specific capacity of Well No. 3 was found to be 7 Igpm per foot of drawdown which compares to 7 to 8 Igpm per foot for Well No. 2. The transmissibility was calculated at 15,200 USgpm/ft. which compares to 15,800 USgpm/ft. for Well No. 2.

The large amount of drawdown in Well No. 2 due to pumping in Well No. 3 will limit the pumping rate available from each of the wells. The Distance vs Drawdown graph showing the drawdown of the water table vs distance from Well No. 3 at 200 gpm and 400 gpm is noted in Figure 4. It is noted that significant additional drawdown at Well No. 1 could also be expected due to pumping at Well No. 3.

Well No. 2 has a maximum available drawdown of about 41 feet (31 ft. + 10 ft. above base plate to SWL) before the well shuts down due to low water. If Well No. 3 is pumped at 400 gpm for 24 hours, the available drawdown in Well No. 2 is reduced by over 50 percent. This would result in severely limiting the capacity of Well No. 2 to prevent low water shut-down during critical high demand conditions.

WATER QUALITY

Water samples were taken at 2 hours and 22 hours after the start of the pump test. Two samples were sent to the local Health Department for bacteriological analysis. The bacteriological test results both showed no contamination.

The 22 hour sample was sent to a laboratory for chemical analysis. The laboratory report is attached in Appendix 2. A comparison of the results to the Ministry of Health Standards is as follows:

	Sept. 26, 1984 Well Water Sample	B.C. Ministry of Health Standard (Recommended limit mg/L)
Colour	no colour	15
pH	7.5	6.5 to 8.5
Alkalinity	48 mg/L	-
Total Hardness (as $CaCO_3$)	42.8 mg/L	180
Chloride	3.5 mg/L	250
Iron	< 0.2 mg/L	0.3
Manganese	<0.03 mg/L	0.05
Nitrite	0.003 mg/L	1.0
Nitrate	2.5 mg/L	10.0
Total Solids	120 mg/L	500
Sodium	8.4 mg/L	20

The water sample meets the Ministry of Health Department Standards.

WELL CAPACITY

Well No. 3 could be developed for 250 to 300 gpm without consideration of Well No. 2. However, 300 gpm at Well No. 3 will cause at least 15 feet of additional drawdown at Well No. 2 and could result in low water shut down in Well No. 2.

Considering the effect on Well No. 2, the capacity at Well No. 3 should be limited to 200 Igpm.

The 200 Igpm capacity for Well No. 3 will limit the normal additional drawdown at Well No. 2 to about 10 feet which should prevent low water shutdown of Well No. 2 under normal conditions.

The pump capacity at Well No. 2 is 200 Igpm. Therefore, the Well No. 3 pump could be made interchangeable with No. 2 to provide a back-up for either pump or well problems.

DAYTON & KNIGHT LTD.
Consulting Engineers

D.R. Harrington, P.Eng.

9.90

BRITISH COLUMBIA

Report 1 - Detailed Well Record

Well Tag Number: 70651

Owner: BURGESS JIM

Address: 932 CHASTER RD

Area: GIBSON

WELL LOCATION:
NEW WESTMINSTER Land District
District Lot: 684 Plan: 4438 Lot:
Township: Section: Range:
Indian Reserve: Meridian: Block: 28
Quarter:
Island:
BCGS Number (NAD 27): 092G033344 Well: 14

Class of Well:
Subclass of Well:
Orientation of Well:
Status of Well: New
Well Use:
Observation Well Number:
Observation Well Status:
Construction Method: Drilled
Diameter: 0.0 inches
Casing drive shoe:
Well Depth: 380 feet
Elevation: 0 feet (ASL)
Final Casing Stick Up: inches
Well Cap Type:
Bedrock Depth: 117 feet
Lithology Info Flag: N
File Info Flag: N
Sieve Info Flag: N
Screen Info Flag: N

Site Info Details:
Other Info Flag:
Other Info Details:

Construction Date: 1987-11-19 00:00:00.0

Driller: Nor-West Drilling
Well Identification Plate Number:
Plate Attached By:
Where Plate Attached:

PRODUCTION DATA AT TIME OF DRILLING:
Well Yield: .3 (Driller's Estimate) Gallons per Minute (U.S./Imperial)
Development Method:
Pump Test Info Flag: N
Artesian Flow: .01 U.S. Gallons per Minute
Artesian Pressure (ft):
Static Level: 0 feet

WATER QUALITY:
Character:
Colour:
Odour:
Well Disinfected: N
EMS ID:
Water Chemistry Info Flag: N
Field Chemistry Info Flag:
Site Info (SEAM): N

Water Utility: N
Water Supply System Name:
Water Supply System Well Name:

SURFACE SEAL:
Flag: N
Material:
Method:
Depth (ft):
Thickness (in):

WELL CLOSURE INFORMATION:
Reason For Closure:
Method of Closure:
Closure Sealant Material:
Closure Backfill Material:
Details of Closure:

Screen from	to feet	Type	Slot Size

Casing from	to feet	Diameter	Material	Drive Shoe

GENERAL REMARKS:
CASING 3.5 TO 118.0, ARTESIAN..

LITHOLOGY INFORMATION:

From	0	to	8	Ft.	SILTY SAND & GRAVEL
From	8	to	70	Ft.	COBBLES SILTY SOFT CLAY GREY
From	70	to	80	Ft.	BROKEN GRANITE
From	80	to	90	Ft.	SILTY CLAY
From	90	to	110	Ft.	SILTY GRAVEL WET
From	110	to	117	Ft.	CLAY
From	0	to	0	Ft.	1/4 GPM at 340-345 FEET
From	140	to	180	Ft.	SANDSTONE
From	180	to	220	Ft.	SANDSTONE & GRANITE
From	220	to	340	Ft.	GRANITE
From	340	to	345	Ft.	GRANITE SOME WATER
From	345	to	370	Ft.	GRANITE
From	370	to	380	Ft.	HARD & SOFT LAYERS OF GRANITE
From	117	to	140	Ft.	BEDROCK

- Return to Main
- Return to Search Options
- Return to Search Criteria

BRITISH COLUMBIA

Report 1 - Detailed Well Record

Well Tag Number: 52733

Owner: TOWNSHIP OF GIBSONS

Address: KEITH RD

Area:

WELL LOCATION:
NEW WESTMINSTER Land District
District Lot: 3198 Plan: 3874 Lot: 44
Township: Section: Range:
Indian Reserve: Meridian: Block:
Quarter:
Island:
BCGS Number (NAD 27): 092G043123 Well: 2

Class of Well:
Subclass of Well:
Orientation of Well:
Status of Well: New
Well Use: Unknown Well Use
Observation Well Number:
Observation Well Status:
Construction Method: Drilled
Diameter: 8.0 inches
Casing drive shoe:
Well Depth: 124 feet
Elevation: 0 feet (ASL)
Final Casing Stick Up: inches
Well Cap Type:
Bedrock Depth: feet
Lithology Info Flag:
File Info Flag:
Sieve Info Flag:
Screen Info Flag:

Site Info Details:
Other Info Flag:
Other Info Details:

Construction Date: 1983-09-12 00:00:00.0

Driller: Nor-West Drilling
Well Identification Plate Number:
Plate Attached By:
Where Plate Attached:

PRODUCTION DATA AT TIME OF DRILLING:
Well Yield: 0 (Driller's Estimate)
Development Method:
Pump Test Info Flag:
Artesian Flow:
Artesian Pressure (ft):
Static Level: 92 feet

WATER QUALITY:
Character:
Colour:
Odour:
Well Disinfected: N
EMS ID:
Water Chemistry Info Flag:
Field Chemistry Info Flag:
Site Info (SEAM):

Water Utility:
Water Supply System Name:
Water Supply System Well Name:

SURFACE SEAL:
Flag:
Material:
Method:
Depth (ft):
Thickness (in):

WELL CLOSURE INFORMATION:
Reason For Closure:
Method of Closure:
Closure Sealant Material:
Closure Backfill Material:
Details of Closure:

Screen from	to feet	Type	Slot Size

Casing from	to feet	Diameter	Material	Drive Shoe

GENERAL REMARKS:

LITHOLOGY INFORMATION:
From 0 to 12 Ft. Dirty gravel and cobbles
From 12 to 38 Ft. Silty sand, gravel cobbles and boulders
From 38 to 40 Ft. Boulder

```
From    40 to    80 Ft.   Till, cobbles and boulders
From    80 to    95 Ft.   Silty, sharp gravel and cobbles
From    95 to    97 Ft.   Boulder
From    97 to    99 Ft.   Sharp gravel, silt and cobbles
From    99 to   121 Ft.   Sand, gravel cobbles (water bearing)
From   121 to   124 Ft.   Till
From     0 to     0 Ft.   Sources of water at 110 - 120'
```

- Return to Main
- Return to Search Options
- Return to Search Criteria

Information Disclaimer

PITEAU ASSOCIATES
GEOTECHNICAL AND HYDROGEOLOGICAL CONSULTANTS
VANCOUVER LIMA

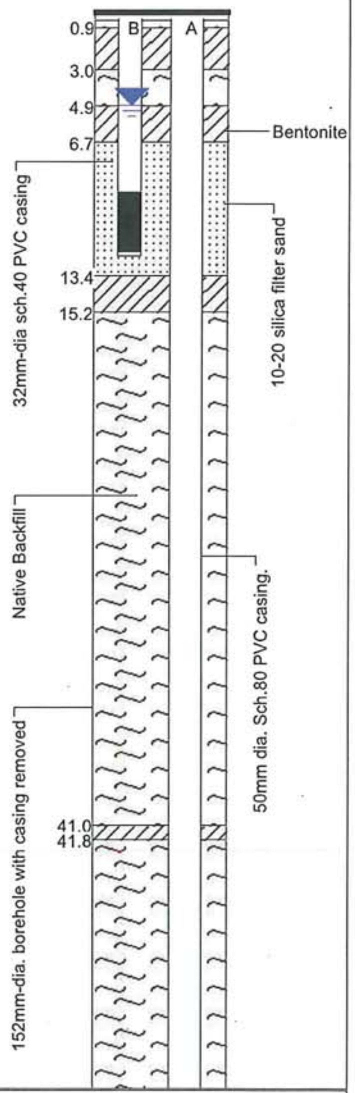
Client: Town of Gibsons
Coordinates: E 462812 N 5472468
Ground Elevation: 110m - asl

Page 1 of 2

Well Number: MW06-1
Project: Monitoring Well Installation
Location: Spyglass Place
Project Number: 2539
Logged By: Arnd Burgert
Borehole Diameter: 152mm

Depth (mbGL)	Lithologic Description	Remarks
0.0	Ground Surface Asphalt	Steel access cover at grade
	Sand and Silt 0.61m - Gray sand and silt with trace clay. Dry. 3.96m - Gray silt, some clay. Dry. 6.10m - Sandy silt. 6.7m - Silt and sand, trace gravel.	P2 water level Dec. 8, 2006 4.8m-BGS 9.3m-BGS - 12.3m-BGS Machine slotted pvc screen 0.010" openings
11.3	**Gravel, Silt, and Clay, wet**	
11.9	**Sand and Gravel** 11.9m-14.0m - Grey sand and gravel. 14.0m-21.3m - Grey sand and gravel. Wet, water. 21.3m-23.8m - Grey sand and gravel. Wet, no water. 23.8m-27.4m - Sand with trace gravel and trace silt. 27.4m-31.7m - Grey sand and gravel, trace of silt. Damp.	
31.7	**Sand and Silt** 31.7m-32.3m - Light grey very fine sand and silt. Dry. 32.3m-33.5m - Grey sand and silt. Some gravel. Damp. 33.5m-45.7m - Grey sand and silt. Some gravel. Damp.	
45.7	**Sand and Gravel** 45.7m-47.5m - Grey tan sand and gravel with trace silt. Damp. 47.5m-51.8m - Grey silty sand and gravel. Damp. 51.8m-76.2m - Grey sand and gravel with trace silt.	

Constructed Well



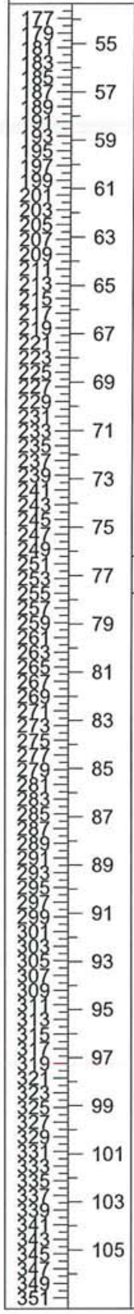
Drilling Contractor: Field Drilling Contractors Ltd.
Drilling Method: Dual Mode Air Rotary
Drilling Started: Dec 4th, 2006
Drilling Ended: Dec 7th, 2006

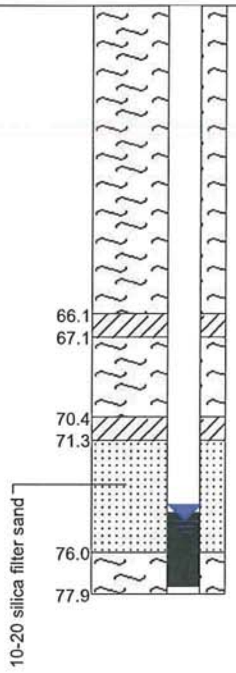
PITEAU ASSOCIATES
GEOTECHNICAL AND HYDROGEOLOGICAL CONSULTANTS
VANCOUVER LIMA

Well Number: MW06-1
Project: Monitoring Well Installation
Location: Spyglass Place

Page 2 of 2

Depth Below Ground Surface	Depth (mbGL)	Lithologic Description	Lithology	Remarks	Constructed Well
	76			Water Level at 74.7 mGBS (Dec 9, 2006)	
	78	**Sand and Silt** Wet grey very fine sand and silt.		74.4m-BGS - 77.4m-BGS Machine slotted PVC screen 0.010" openings	





Drilling Contractor: Field Drilling Contractors Ltd.
Drilling Method: Dual Mode Air Rotary
Drilling Started: Dec 4th, 2006
Drilling Ended: Dec 7th, 2006

Page 1 of 2

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VANCOUVER LIMA

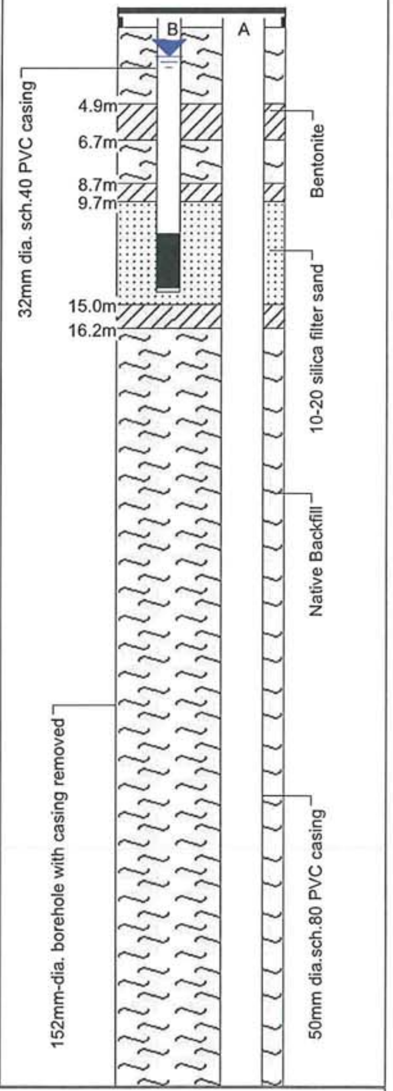
Well Number: MW06-2

Project: Monitoring Well Installation
Location: Behind Gibsons Aquatic Centre
Project Number: 2539
Logged By: Arnd Burgert
Borehole Diameter: 152mm

Client: Town of Gibsons
Coordinates: E 462130 N 5472688
Ground Elevation: 126m - asl

Depth (mbGL)	Lithologic Description	Remarks
0.0	Ground Surface	Steel access cover at grade
1.8	**Sand and Gravel**	
4.0	**Clay**	Water level at 2.45 mBGS (Dec 10, 06)
5.2	**Sand and Gravel**	
	Gravel, Silt, and Clay	
10.4	**Gravel, water**	14.3 to 11.3m/BGS machine slotted PVC screen 0.010" openings
13.7	**Sand and Gravel**	

Constructed Well



Drilling Contractor: Field Drilling Contractors Ltd.
Drilling Method: Dual Mode Air Rotary
Drilling Started: Dec 7, 2006
Drilling Ended: Dec 10, 2006

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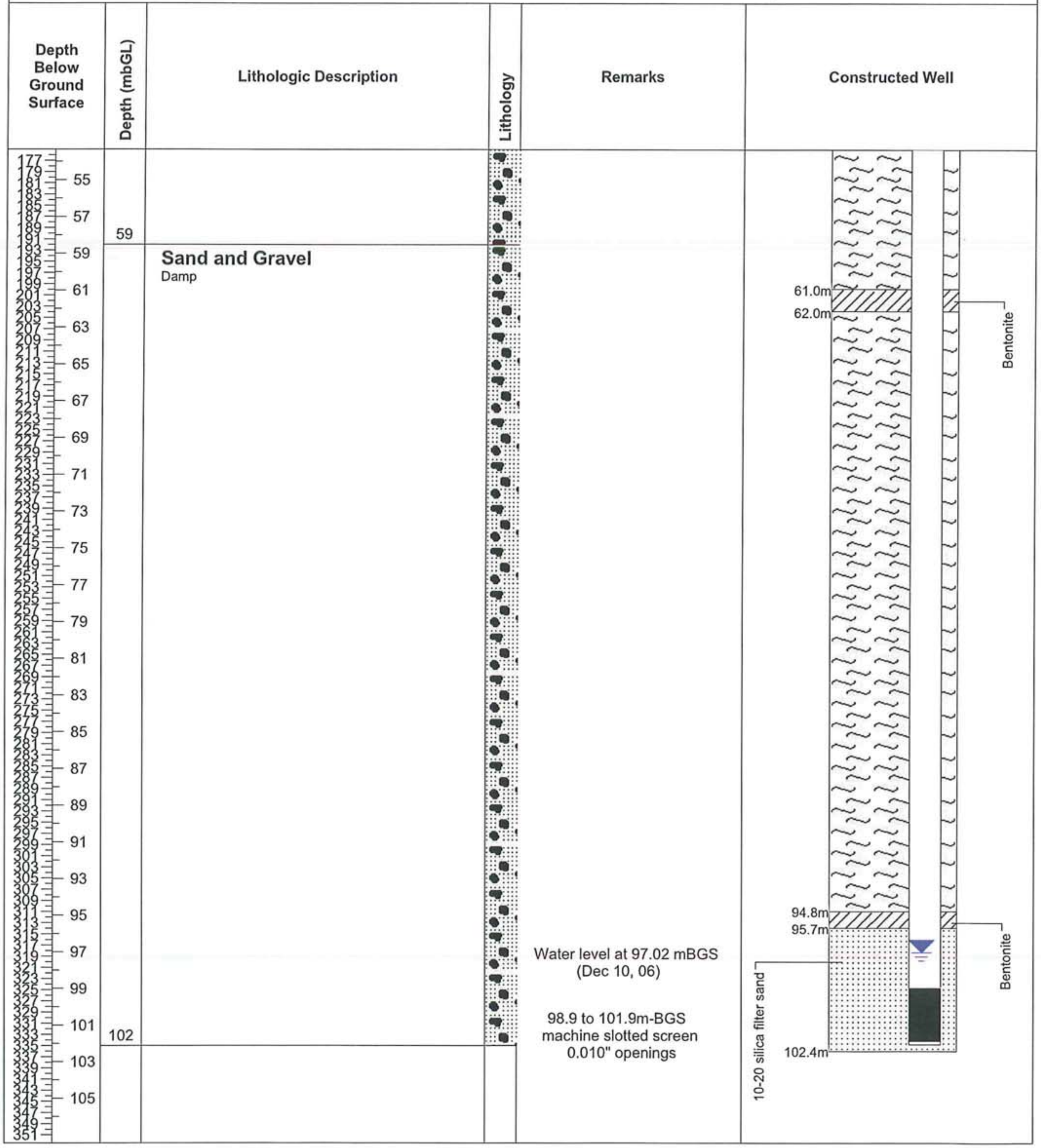
GEOTECHNICAL AND HYDROGEOLOGICAL CONSULTANTS
VANCOUVER LIMA

Well Number: MW06-2 **Page 2 of 2**
Project: Monitoring Well Installation
Location: Behind Gibsons Aquatic Centre



Sand and Gravel
Damp

Water level at 97.02 mBGS
(Dec 10, 06)

98.9 to 101.9m-BGS
machine slotted screen
0.010" openings

Drilling Contractor: Field Drilling Contractors Ltd.
Drilling Method: Dual Mode Air Rotary
Drilling Started: Dec 7, 2006
Drilling Ended: Dec 10, 2006

Flowing Artesian Wells

Water Stewardship Information Series

BRITISH COLUMBIA
The Best Place on Earth

Table of Contents

This booklet contains general information on flowing artesian wells for well drillers, groundwater consultants and well owners in British Columbia. The booklet provides general guidelines on flowing artesian wells and does not replace professional knowledge or experience.

What's the difference between a flowing artesian well and an artesian well?

An **artesian well** is a well that taps into a confined aquifer (see Figure 1). Under artesian pressure, water in the well rises above the top of the aquifer, but does not necessarily reach the land surface. A **flowing artesian well** is one that has been drilled into an aquifer where the pressure within the aquifer forces the groundwater to rise above the land surface naturally without using a pump. Flowing artesian wells can flow on an intermittent or continuous basis and originate from aquifers occurring in either unconsolidated materials such as sand and gravels or bedrock, at depths ranging from a few meters to several thousand meters. All flowing wells are artesian, but not all artesian wells are flowing wells.

Why do wells flow?

Flowing artesian wells can be found in two types of situations:

- the aquifer is confined by impermeable materials (i.e., confined beds where the static water level is above the top of the aquifer and land surface); or
- the aquifer is not confined, but the static water level is above the land surface.

Static water level is the level to which water will naturally rise in a well without pumping. For flowing artesian wells, the groundwater level or static water level can be expressed as a head (e.g., artesian head) and reported as a length (feet or meters above ground level) or pressure (pounds per square inch or psi).

Artesian conditions can be generated by geological and topographical controls (see Figure 1) or by topographical controls alone (Figure 2). In the former, water in an artesian well rises upward due to the pressure confined in the aquifer. Artesian wells are found in inclined confined aquifers sandwiched between layers of rock or overburden that are impervious or have low permeability. Water enters the exposed portion of the aquifer at a high elevation and percolates down through interconnected pore spaces. The water held in these spaces is under pressure (confining pressure or hydrostatic head) due to the high elevation from which it originally came. If a well is drilled from the land surface through the overlying impervious layer, the pressure inside the aquifer will cause the water to rise in the well. In areas where the pressure of the aquifer is great enough, the water rises above ground level resulting in a flowing artesian well.

Hydrostatic head (or confining pressure) is the vertical distance between the water level in the well and the top of the aquifer and is expressed in feet or meters of water or pressure (psi).

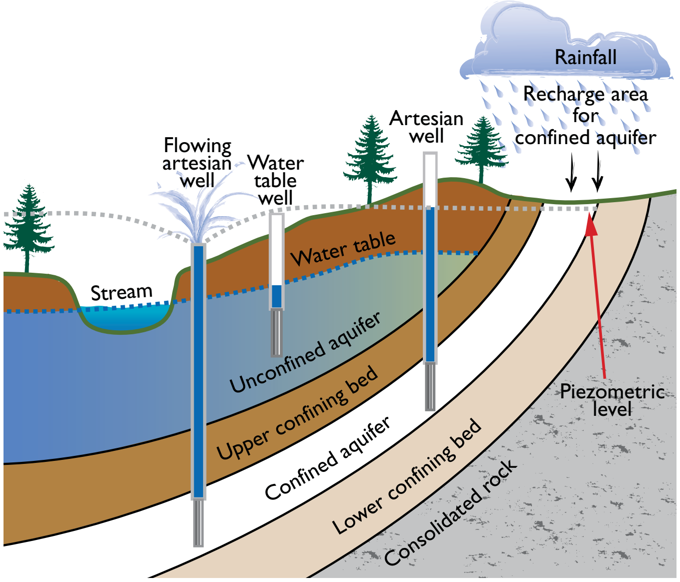


Figure 1. Geological and topographical controls affecting artesian and flowing artesian wells.

Topographical control situations can be found in unconfined aquifers where the well intake is deep enough to intercept a zone where the hydraulic head is higher than the land surface (see Figure 2). This situation typically occurs in groundwater discharge areas at lower elevations near rivers and lakes in valleys surrounded by steep slopes. The pressure of the groundwater typically increases with depth in the discharge areas where the slope of the water's flow path and its pressure are controlled by the topography. As the groundwater moves along the flow path, it can migrate

Hydraulic head is a measurement of the water level or total energy per unit weight above a datum such as sea level. It is commonly measured as water surface elevation in feet or meters.

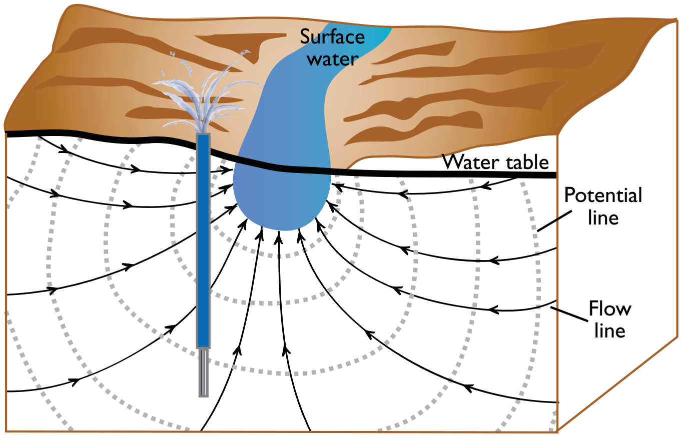


Figure 2. Topographically controlled flowing artesian well.

deep below ground where it can lie beneath shallow non-artesian groundwater. When a well is drilled into a deeper zone of higher hydraulic head, the groundwater can move upwards inside the well casing to a level that is higher than the levels of the land surface, resulting in a flowing artesian well.

Why is stopping or controlling artesian flow important?

Flow from artesian wells should be controlled to prevent wasting groundwater. For instance, an uncontrolled artesian well flowing at 10 USgpm (55 m^3/day) wastes 14,400 USgallons (55 m^3) every day and 5.25 million USgallons (2.0 x 10^4 m^3) per year. An uncontrolled flow of 1 USgpm wastes enough water to supply four homes. Wasting water may lower the confining pressure in the aquifer so that the well no longer flows or flows at a reduced rate and affects the yield of neighbouring wells and springs.

Figure 3. Erosion caused by flowing artesian well.

When groundwater breaks out on the outside of the well casing, flooding, damage and/or subsidence and sinkhole formation can occur. Another reason to control flow is to prevent groundwater flowing from an aquifer under artesian pressure into an overlying aquifer(s). If the flowing well breakout is not promptly contained, silt, clay, gravel, sand, and drilling fluids can be carried along with the artesian groundwater to the ground surface and eventually reach surface water. The quality of the surface water and the habitat of aquatic organisms can be impacted.

Flowing artesian wells can also cause erosion (see Figure 3). Flowing water that accumulates into ponds can also contribute to mosquito problems.

How can flowing artesian conditions be determined before drilling?

Before a well is drilled, it is important for the person responsible for drilling the well (qualified well driller or qualified professional[1]) to do a pre-drilling assessment to determine the range of pressures and flows that might be found during drilling, i.e., whether flowing artesian conditions are likely to be encountered.

The pre-drilling assessment should include gathering information about geological conditions, static water levels and any history of flowing artesian wells in the area. This information can be obtained from:

- reviewing available local well construction reports;
- reviewing hydrogeologic information (e.g., maps on the Water Resource Atlas http://www.env.gov.bc.ca/wsd/data_searches/wrbc/index.html showing flowing artesian well coverage (see Figure 4) or reports on Ecocat http://www.env.gov.bc.ca/ecocat/);
- consulting with the Ministry of Environment regional hydrogeologists; and
- consulting with well drillers and professional hydrogeologists or geotechnical engineers with knowledge of the local area.

If this information is not available, the person responsible for drilling the well should consider the proposed well depth in relation to relevant topographic and geologic information about the site (i.e., whether the proposed well is going to be deep in a valley-bottom location). Geophysical logs or an electric survey can also be used to better understand subsurface conditions. When knowledge is limited, a precautionary approach should be taken and planning should assume that flowing artesian conditions will be present.

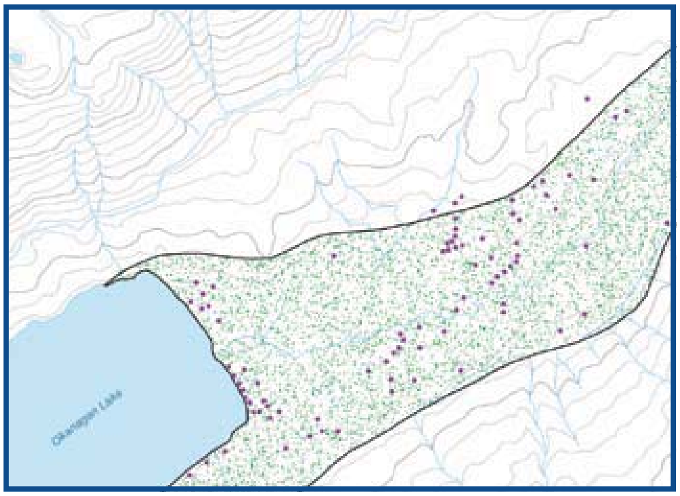


Figure 4. Map from the BC Water Resource Atlas showing provincial mapped and classified aquifers, contoured elevations and wells (purple dots) that were flowing artesian wells at the time drilling.

What are the provincial regulatory requirements for controlling or stopping artesian flow?

The provincial regulatory requirements for controlling flowing artesian wells are outlined in section 77 of the *Water Act*. If artesian conditions are encountered when constructing or supervising construction of a well, the qualified well driller

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[3] Qualified professionals who are registered with the Association of Professional Engineers and Geoscientists of British Columbia with competency in hydrogeology or geotechnical engineering.

or qualified professional must ensure the artesian flow is or will be stopped or controlled and advise the well owner (and the land owner, if applicable) of the steps taken to do so. It is also good practice to advise of any potential hazards associated with uncontrolled flow not being controlled (e.g., erosion, flooding, subsidence) and any associated costs. Agreement on these issues, prior to drilling can help prevent or minimize misunderstandings. For example, some issues can be addressed in a contract. If the qualified well driller or qualified professional fails to stop or control the flow, it is the well owner's responsibility to hire another qualified professional or qualified well driller to ensure that the flow is stopped or controlled. If the ownership of the well is not known, the land owner is responsible to have this done. If the flow cannot be controlled, the person responsible for drilling the well should advise the Ministry of Environment's regional hydrogeologist and must comply with any direction given.

A flowing artesian well must have a securely attached cap to provide access to the well, prevent entry of vermin and contaminants, and to prevent flow escaping from the well.

What does it mean to "control" artesian flow from a well?

A flowing artesian well is considered "under control" when the entire flow is through the production casing to the wellhead and the flow can be stopped indefinitely without leaking on the surface of the ground and with no leakage into any other aquifer penetrated by the well.

Will a flowing artesian well dry up if the flow is stopped or controlled?

Controlling the flow from a flowing artesian well should not stop the flow or dry up the well if the well has been properly constructed. In fact, the opposite is true as waste of artesian water will often eventually cause a decrease in artesian pressure. Controlling the flow from a flowing artesian well prevents unnecessary loss of groundwater from the aquifer upon which other wells rely.

Are there any water quality concerns with flowing artesian wells?

In general, the water quality of flowing artesian wells is excellent. However, some artesian waters may be very poor quality and cause serious damage on the surface or contaminate an overlaying aquifer. In general, water quality can be affected by the depth of the well, i.e., a deeper flowing artesian well may have poorer water quality than a shallower flowing well. Water from bedrock formations, such as deep sandstone formations, may contain concentrations of arsenic that could pose a health concern. Artesian wells with poor quality water should be permanently closed (see page 8).

Are there any other concerns with flowing artesian wells?

Most of the problems associated with flowing artesian wells result from improper discharge controls or improper well construction.

Casing corrosion (see Figure 5) and leakage can occur due to the constant flow of water, particularly if the water is corrosive or contains fine sand. Where artesian water is known to be corrosive, a smaller diameter flow pipe may be installed in the well. The pipe may be made of corrosion-resistant material or may be periodically replaced when it becomes corroded. Where the casing has been damaged, a slightly smaller diameter casing can be installed inside the old casing using packers if there is an existing surface seal and sealed in place with a cement grout. It is recommended to have the flowing artesian well checked periodically by a qualified well driller to verify the integrity of the well casing and to inspect the well screen, as the well can be difficult to repair once the casing has been corroded or breached. Thin-wall casing should not be used in flowing artesian wells.

Figure 5. Corroded well casing.

Failure of the casing/surface seal during construction or decades after well completion can be costly and may result in the eruption of large volumes of silt, sand, clay or gravel, causing unstable conditions and potential flooding, damage to nearby structures through erosion and subsidence and harm to the habitat of aquatic organisms.

Well screens for flowing artesian wells can yield water with sand or become plugged with sand if the well is not properly developed. This is an issue when a flowing artesian well in a fine-grained aquifer is shut off and the sand settles and clogs the area in and around the bottom of the casing. The screen size should be coarse enough to prevent pressure build-up in the aquifer and the well should be properly developed. Perforated casings for flowing artesian wells are not recommended. In some areas an unpleasant rotten egg smell (hydrogen sulphide gas) may be present and by reducing or stopping the artesian flow the smell can be brought under control.

What can be done with an existing flowing well?

Trying to stop or control the flow from older flowing wells may result in an uncontrolled discharge of water outside the well casing or at a distance from the well due to the lack of an adequate seal, a defective surface seal or corroded casings. If water does not appear to be flowing outside of the outer casing, then it may be advisable to leave the well alone and not restrict the flow. However, if water appears to be flowing outside the casing and/or the well is causing property or environmental damage, then the well should likely be closed. Alternatively, it may be possible to lower the water levels using a pump but care must be taken to keep the water flowing from the well relatively continuously to avoid additional uncontrolled discharge from occurring.

There are numerous special measures that may be applicable to controlling the flow of an existing flowing artesian well such as using well packers or a bridge to restrict the flow in the confining layer, adding polymers or plasticizers to keep the grout together during placement, using barite to reduce the confining pressure of the water, etc.

Any alteration to an existing flowing well to control the flow needs to be done in compliance with the *Water Act* and Ground Water Protection Regulation and any directions of a Ministry of Environment hydrogeologist. A qualified well driller or qualified professional must be hired. Before any work is done, the well owner should be made aware of the costs and complexities of the work involved with controlling the flowing artesian well, as well as the chances of successfully controlling the flow.

What if the flow is needed, for example, to increase the baseflow of a creek or stream?

In some instances, artesian flow is used to maintain water levels in ponds used for irrigation, fire protection, fish rearing, recreation or wetland enhancement. For existing wells, flow is permissible as long as property is not damaged and streams or aquatic habitats are not negatively impacted. If damage does or may occur, contact the local Ministry of Environment office (see back cover of this booklet).

Are there some general guidelines for constructing a flowing artesian well?

In constructing a well under flowing artesian conditions the potential pressure and flow and the permeability of the formation need to be taken into consideration. A pre-drilling assessment of local conditions may provide this information. If these conditions are known, the following provides general guidance for the design and construction of the well. If this information is not known the well should be designed conservatively for worse case conditions. Flowing artesian wells should not be constructed if the formation conditions are not favourable, i.e., in shallower situations where there is no suitable formation to seal into.

Green Zone (<5 psi)

If the pressure is or will be less than 5 psi (pounds per square inch), flow can usually be controlled by adding additional casing, except where permeability of the formation is extremely high, e.g., medium to coarse gravel. To determine the artesian head use the following conversion factors: 2.31 feet equals 1 psi, and one foot equals 0.3048 meters. For example, for a flowing well with 5 psi, there will be 11.6 ft or 3.5 meters of artesian head, therefore the casing would need to be extended more than 3.5 meters above the ground surface to contain all the artesian head. In general, a 30 per cent bentonite grout can be used for flowing well construction or repair.

Artesian head is the hydraulic pressure created within the confined aquifer that drives the water upward in a well to the piezometric level. The distance from the ground surface to the piezometric level, converted into equivalent pressure (expressed as pounds per square inch, or PSI), is the artesian head.

Yellow Zone (5 to 10 psi)

If the pressure is or will be between 5 and 10 psi, extending the well casing may reduce flow, but extreme care must be taken in highly permeable formations that produce significant volumes of water. Flows of 20 USgpm can potentially occur in this zone and the upward annular velocity resulting from this flow is high enough to begin separating grout mixtures as they are being pumped down. When the pressure is high and the formation highly permeable, it is recommended that an outer surface casing be installed before the permanent casing. The outer casing should end in the confining layer and should not penetrate the underlying artesian aquifer. Cement-type grout should be used.

Red Zone (>10 psi)

If the pressure is or will be greater than 10 psi, static head control or extending the well casing is not usually possible, especially in highly permeable, high-yielding formations. In this category the flow is great enough to make the grout placement very difficult. An outer casing or multiple casings should be installed before the production casing and set to the confining layer so the production casing can be cemented within the outer casing. Cement or cement plus barite (or other weighting additives) should be used as grouting materials.

What are the key issues to be aware of when drilling a flowing artesian well?

Flowing artesian wells under high pressure and with high flow rates (yellow and red zones) are challenging to construct. Flowing wells that are drilled deep (≥200 feet or ≥60 meters) in unconsolidated deposits or drilled into bedrock are less prone to flow problems and are generally easier to deal with. In bedrock environments (see page 7 for more information on bedrock wells), the competent rock allows for easier installation of the seal (i.e., no casing to wash out or concerns about an eroded annulus).

Drilling a well into a confined aquifer disturbs the overlying geologic confining layer and provides a potential pathway for the upward movement of the pressurized artesian water. Well construction must include restoring any damage to the confining layer. In general, the closer the top of the artesian formation is to the ground surface and the higher the pressure, the more difficult it is to control the flow.

In certain conditions (e.g., soft clay/silt formations), the formation will squeeze back in and set up around the well casing over a period of time. If this condition is likely to occur, it is advisable to let the well flow for a week or two to give the formation a chance to settle in before stopping or controlling the flow. This will result in a seal around the casing at deeper depths than the surface seal.

It is good practice for the qualified well driller to observe the condition of the flowing artesian well head for one or two weeks after construction and check for leakages outside the surface casing or between casings.

Materials and Equipment

One of the key factors to successfully controlling the flow is being prepared with the right tools and materials at the job site. Suggested materials and equipment include:

- drilling mud and additives of sufficient weight to deal with the pressures in the aquifer,
- surface and production casing appropriate to the water quality and geological conditions,
- grouting and sealing materials appropriate to the artesian pressure and anticipated flow,
- tremmie pipes,
- pumps suitable for delivering the grouting and sealing materials,
- well screens with adequate transmitting capacity,
- valves,
- inflatable packers,
- surge block, and
- shale traps.

Drilling Muds

To determine the extra weight of drilling mud needed to counteract the pressures of the artesian aquifer during rotary drilling, the estimated artesian head and the depth to the top of the aquifer is needed. The following formula can be used to estimate the additional weight of drilling mud needed to control the flow during the drilling process:

$$\text{Additional mud weight} = \left(\frac{8.34\ \text{lbs/USgal x height of water above ground level (ft)}}{\text{Depth to top of aquifer (ft)}}\right) + 0.4\ \text{lbs/USgal}$$

Where:
One USgallon of water weighs 8.34 pounds
0.4 lbs/USgallon is a safety factor

Example

If the depth to the top of the aquifer is 75 feet and the height of water above ground is estimated to be 10 feet, the additional weight of drilling mud needed would be (8.34 x 10/75) + 0.4 = 1.5 lbs/USgal.

Properly mixed, fresh drilling mud will normally weigh about 9 pounds per US gallon. Drilling mud can be made heavier by adding drilling clay, drilling gel and special solids such as barite. However, some drilling gels are treated with polymers to build viscosity and become difficult to pump before their weight significantly increases. Therefore, some drilling gels have limited ability for control of flows. Mud weights of up to 15 pounds per gallon can be achieved using weighting materials such as powdered barite.

Well Casings

Generally, in areas where flowing artesian conditions are known or suspected, at least one outer surface casing should be installed before installing the permanent/production casing or liner to allow for better control. It is not advisable to pull the surface casing within 20 feet (6 meters) of ground surface. Doing so may disturb the seals and cause water to flow around the surface casing as it is pulled, especially if bentonite is used. There should be at least a 4-inch (10 cm) gap or annulus between the outer surface casing and the production casing to allow for the insertion of a tremmie pipe to pump adequate grout volumes For example, if a 6-inch production casing is needed, a 14-inch outer surface casing would have to be installed to provide a 4-inch annulus.

In areas where the pressure is > 5 psi and the formation is highly permeable, a 4 to 6-inch (10 to 15 cm) annulus between the surface and permanent casing is recommended. Ensuring there is an adequate annulus is especially important where formations are highly permeable and high-density grout mixtures are required to adequately control the artesian flow.

Grouting Mixtures

Use of appropriate grouting material is key to constructing a flowing artesian well. Table 1 is useful for finding the hydrostatic head pressure (in psi) and for understanding the relationship between drilling fluid or grout density and their ability to successfully control the flow during drilling, plugging, or repair. Table 1 shows that heavy grouts, such as neat cement/bentonite slurry or cement slurry with additives, have a distinct advantage for flowing well work. Mixing neat cement with bentonite is recommended to avoid cracks from occurring.

It is important to allow for sufficient time for the cement or cement grout mixture to set before proceeding with drilling. Use of the appropriate drilling method to minimize impacting the integrity of the seal is also important. In addition, the flowing artesian well should be gradually sealed or shut-in to prevent rupturing the seal(s).

TABLE 1
TOTAL PRESSURE ABOVE TOP OF CONFINED AQUIFER (HYDROSTATIC PRESSURE) FOR FLOWING ARTESIAN WELLS

Depth to Top of Flowing Aquifer (feet)	Artesian Head Above Ground Surface (feet)					
	5	10	15	20	25	30
10	6.5	8.7	10.8	13.0	15.2	17.3
20	10.8	13.0	15.2	17.3	19.5	21.7
30	15.2	17.3	19.5	21.7	23.8	26.0
40	19.5	21.6	23.8	26.0	28.1	30.3
50	23.8	26.0	28.1	30.3	32.5	34.6
75	34.6	36.8	39.0	41.1	43.3	45.5
100	45.5	47.6	50.0	52.0	54.1	56.3
125	56.3	58.4	60.6	62.8	65.0	67.1
150	67.1	69.3	71.4	73.6	75.8	78.0
175	78.0	80.1	82.3	84.4	86.6	88.7
200	88.7	91.0	93.1	95.2	97.4	99.6
225	99.6	101.7	104.0	106.0	108.2	110.4
250	110.4	112.5	115.7	117.0	119.0	121.2

Adapted from the Michigan Department of Environmental Quality, Water Bureau, Lansing, Michigan

Material	Weight	Hydrostatic Pressure
Barite Slurry:	18 - 22 lb/USgal	.96 - 1.1 psi/ft
Neat Cement and Bentonite @ 6 gal water/sack:	15.0 lb/USgal	.78 psi/ft
Bentonite Slurry Grout:	10.4 lb/USgal	.54 psi/ft
Bentonite Slurry Grout:	9.5 lb/USgal	.49 psi/ft

GROUTING MATERIAL SUITABILITY

	Heavy Enough To Overcome Hydrostatic Pressure	Not Heavy Enough To Overcome Hydrostatic Pressure
▨	Neat Cement @ 15 lb/USgal	All Bentonite Grouts
░	Neat Cement @ 15 lb/USgal or Bentonite Grout @ 10.4 lb/USgal	Bentonite Grouts lighter than 10.4 lb/USgal
□	All standard grouts have enough weight to overcome hydrostatic pressure of the flow.	

The values in Table 1 correspond to the downhole head pressure (in psi) for different scenarios, e.g., if the depth to the top of the aquifer was 10 feet and the artesian head was 5 feet, the downhole head pressure will be 15 feet or 6.5 psi. To overcome the flow, the downhole grout pressure must be greater than the downhole head pressure.

The following example illustrates how Table 1 can be used to select drilling fluids or grout that are heavy enough to control the flow during drilling.

Example of how to use Table 1

Q. *The top of an artesian aquifer is found at 50 feet and wells in the area have about 15 feet of artesian head. What minimum weight drilling fluid would be needed to overcome the hydrostatic pressure during drilling?*

A. The following steps are used to solve the problem:

Step A: To determine the downhole hydrostatic head pressure look at **Table 1** and find the cell corresponding to depth of top of aquifer (50 ft) and artesian head (15 ft) which is 28.1 psi. This pressure represents the total head above the top of the confined aquifer (e.g., 15 + 50 = 65 ft or 28.1 psi).

Step B: Divide the downhole hydrostatic pressure (28.1 psi) by the depth to the top of the aquifer (50 ft) to determine the downhole grout pressure needed to equalize the flow (28.1 psi/50 ft = 0.56 psi/ft).

Step C: To determine the grout weight divide the downward pressure of the grout (0.56 psi/ft) by 0.052 (a factor to convert lb/USgal to psi/ft of depth). The minimum grout weight needed to control the flow is 10.8 lb/USgal.

Are there specific actions to avoid when flowing artesian conditions are present?

When a large volume, high pressure flow breaks out, the immediate situation can be serious and there is usually a concern to quickly move the drilling rig away from the borehole. Hastily made decisions can get in the way of successful future corrective actions. As up-flowing artesian water typically will erode fine sediments around a solid object that has been placed loosely below ground, the following actions should be avoided:

- dumping field stone or gravel into the annulus around the well casing as this can prevent the installation of grout pipes or a larger casing into the borehole and can collapse PVC well casing;
- pouring ready-mix concrete or bentonite chips into the annulus as it is likely that the concrete or bentonite will solidify above the depth where the flow is originating and

result in a plug that causes the flow to wash out around its perimeter; or

- jamming unopened bags of cement, bentonite chips, lumber, cardboard or other debris into the washed out annulus as these materials are ineffective and complicate further corrective action.

How can flowing artesian wells be constructed in bedrock aquifers?

When constructing an artesian well that is likely to flow in a **bedrock aquifer**, the final or outer well casing should be sealed at least 10 feet (0.3 meters) into competent bedrock. Figure 6 shows one possible method of completing a flowing artesian well in bedrock. Construction techniques and choice of sealant materials need to be determined by the qualified well driller based on site specific conditions, e.g., pressure and flow.

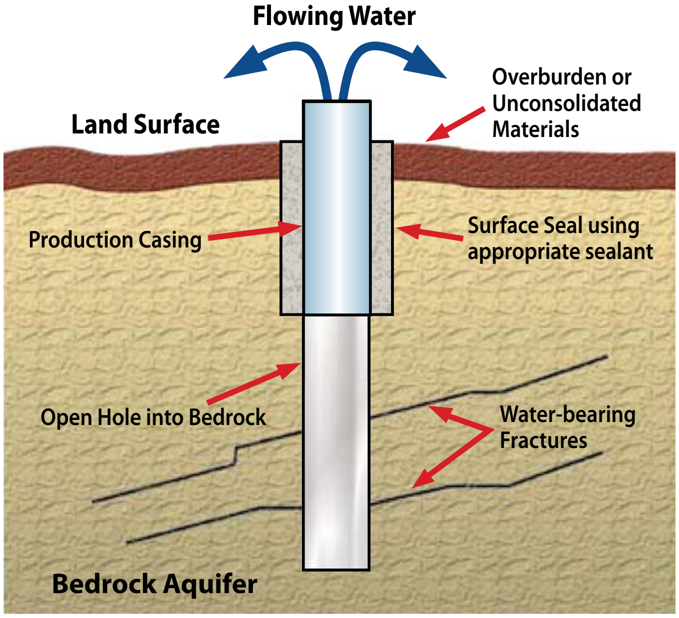

Figure 6. One possible method of completing a flowing artesian well in a bedrock aquifer.

How can flowing artesian wells be constructed in unconsolidated aquifers?

For **confined, unconsolidated aquifers** where flowing artesian conditions are likely, a cased oversized hole should be drilled into the confining layer, to allow a cement, or high solids bentonite seal to be placed between the final production casing and the outer casing (see Figure 7). This can be very complicated and expensive if the pre-drilling assessment indicates the confining layers are more than 100 ft (30 metres) deep. The size of the hole or casings and the depth of the seal must be determined on a site-by-site basis since choices are influenced by local geology and the specific artesian conditions encountered. A careful, conservative approach is recommended.

Figure 7. Bentonite cement grout seal between casings.

When constructing a well into a confined, unconsolidated flowing artesian aquifer, the appropriate sealant material between the outermost well casing and the confining layer must be of a sufficient depth and thickness to contain the flow.

Artesian conditions in **unconfined, unconsolidated aquifers** require special construction techniques such as using heavier drilling mud to counteract the pressure of the aquifer and a temporary surface casing to prevent hole collapse.

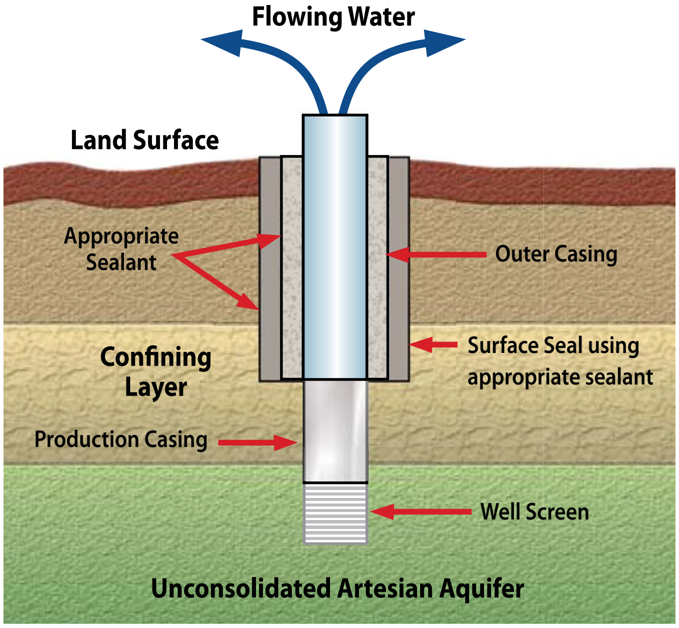

Figure 8. One possible method of completing a flowing artesian well in unconsolidated materials, e.g., sand and gravels.

What should be done if flowing artesian conditions are suddenly encountered?

When unexpected flowing artesian conditions are encountered (i.e., instant flow occurs), a qualified professional, or qualified well driller, should take control of the site and equipment should not be removed from the site until the artesian flow is under control. Contact the owner of the well and the land owner immediately to report the situation and provide plans to control the flow (see below). Steps to take include:

- control the flow,
- secure the casing or borehole, and
- protect the drill rig.

The flow may be brought under control by:

- increasing the weight of the drilling mud,
- using plugs,
- using a surge-blocking to restrict flow, or
- installing a drillable packer.

The drill pipes can be left in place in cases where the uncontrolled flow occurs in an uncased drill hole, to indicate the exact location of the hole.

If the flowing artesian well is discharging water into a wetland or surface water body, contact the local Ministry of Environment office.

It is important for the well owner (and land owner if applicable) to develop a clear understanding, potentially in the form of a contract, with the drilling contractor on how the well will be repaired and/or the flow stopped or controlled before any work on the well commences to avoid or minimize potential misunderstandings when artesian flow is encountered.

What are the key factors in completing and equipping a flowing artesian well?

Flowing artesian wells, when properly constructed, should be equipped with a device to completely stop or control the artesian flow from the well (see Figure 9). After flow is stopped, there should be no leakage up the annulus between the outermost casing and the borehole. If water does escape, the annulus should be sealed.

Figure 9. Completed high pressure flowing artesian well.

Flowing artesian wells, like all wells, need to be vented. Well caps should be equipped with a two-way vent that allows the well to inhale and exhale air as the water level changes during pumping cycles. The vent will seal the well when the pump is not in use.

Determine the shut-in pressure (see below) and record the measurement on the well construction report. The wellhead should also be designed and equipped to prevent any backflow into the well.

Where freezing conditions may occur, the wellhead of the new flowing artesian well should be covered, insulated and heated, where necessary, to prevent damage of the flow control device leading to an uncontrolled flow situation.

How is the pressure or static water level for a flowing artesian well measured?

It is important to determine and record the hydrostatic pressure of the flowing artesian well for future pre-drilling assessments. There are several ways to measure the hydrostatic pressure or static water level of a flowing artesian well:

1. Extend the well casing, or a smaller diameter pipe through a well seal on the top of the casing, high enough above the ground surface until water no longer flows out the top (without pumping). The water level in the casing extension can then be measured using a water-level sounder. The distance from the piezometric water level in the casing to the ground surface is the artesian head of the aquifer – this can be converted to pressure.

   2.31 feet equals 1 psi or
   0.433 psi equals 1 foot

Example

A static water level of 30 feet is converted to pressure by dividing 30 feet by 2.31 feet/psi = 13 psi.

2. A pressure gauge installed on a well seal at the top of the casing will provide the pressure reading which can be multiplied by 2.31 to find the artesian head at the gauge elevation.

How should flowing artesian wells be closed?

A qualified well driller and/or qualified professional should be hired to close a flowing artesian well and ensure that the well is closed in such a manner that there is no leakage at the surface of the ground (see Figure 10). The driller must be prepared to handle the flow from the well and the discharge of any plugging materials immediately on removal of the flow control device(s). The work site can be dangerous if the flow is not properly diverted. Closing a flowing artesian well is simplified if the flow can be overcome by extending the well casing above the artesian head. Alternatively, insert an inflatable packer or expandable rubber plug at the bottom of the casing. Physically stopping the flow may make things worse, however, which is why the rapid loading of drilling gel is often a better approach.

Another effective approach is lowering the water level by pumping from adjacent wells. A leaking annulus should be sealed (if possible) before proceeding with grouting the production casing.

Pump a high density grout such as neat cement or concrete grout with bentonite through a PVC pipe or drill rod which is lowered to the bottom of the well. The cement mixture is pumped until it reaches the land surface. Pressure grouting with a packer may be required. It may also be good to pull or perforate some of the casing to allow the grout to flow from the casing into the annulus, although this is not critical if the casing is already perforated or corroded.

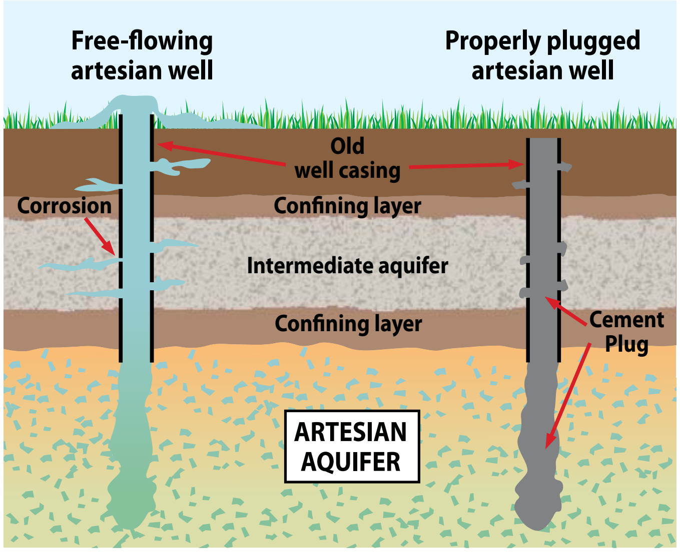

Figure 10. Example of a properly closed flowing artesian well.

How is a flowing artesian well disinfected?

Because of the protected nature of the confined artesian aquifer, flowing wells are generally less prone to bacterial contamination. Furthermore, the positive artesian pressure can minimize entry of surface contaminants into the well. Contamination introduced during the drilling process may be flushed out by the continuous discharge of water.

To disinfect a flowing well using chlorine, a temporary casing extension above the piezometric level or a tight well cap or seal can stop the flow and increase the chlorine contact time. A chlorine solution can also be pumped into the well via the secure well cap and hose connections. Once the casing extension or cap is removed, the well discharge will flush residual chlorine and inactivated bacteria from the well.

If the chlorinated water has a potential to harm the environment (e.g., fish), use an effective neutralizing agent, such as Vitamin C, to inactivate the chlorine. A solution of at least 1 per cent (by weight) of ascorbic acid is the most cost-effective form of Vitamin C. Added to the sump or a stream of chlorinated water, reaction time is nearly instantaneous.

Further Information

A registry of qualified well drillers can be found at: http://www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/wells/applications/well_drillers_reg.pdf.

A listing of groundwater consultants (qualified professionals) can be found at: http://www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/library/consultants.html.

Michigan Department of Environmental Quality, 2005. Flowing well handbook: http://www.michigan.gov/documents/deq/deq-wb-dwehs-wcu-flowwellhandbook_221323_7.pdf.

For further information on whether approvals are needed for discharging flowing artesian well water to surface water bodies, contact the local Ministry of Environment office:

Vancouver Island Region	Nanaimo	250-751-3100
Lower Mainland Region	Surrey	604-582-5200
Thompson and Cariboo Regions	Kamloops	250-371-6200
Kootenay and Okanagan Regions	Nelson	250-354-6333
	Penticton	250-490-8200
Omineca Peace and Skeena Regions	Prince George	250-565-6135

Photos by Jim Fyfe, David Martin, Mike Simpson, Peter Epp & Thierry Carriou.

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Water Well Disinfection

Using the Simple Chlorination Method

Water Stewardship Information Series

BRITISH COLUMBIA
The Best Place on Earth

Well disinfection is used to inactivate or control bacteria populations in a well and the distribution system. There are several methods used to disinfect water wells including simple chlorination, shock chlorination or bulk displacement and a procedure for wells that are difficult to disinfect. This brochure describes the simple chlorination method. For information on the treatment of wells that are hard to disinfect see (www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/wells/factsheets/PFRA_well_recovery.pdf).

Are there things I need to do before disinfecting my well?

A well should be tested regularly for water quality. If coliforms or *Escherichia coli (E. coli)* are repeatedly detected in your well water, the first step to take to eliminate them is to look for the following:

☐ Are there any potential contamination sources near the well, such as manure or compost piles, septic disposal fields, or hazardous materials storage?

☐ Does the ground slope promote drainage of surface water toward the well or ponding of water around the well?

☐ Is the well cap missing, cracked or damaged?

☐ Does the well cap allow water or vermin to enter into the well?

☐ Does the well casing stick up less than 30 cm (12 inches) from the ground surface (see Figure 1) or the floor of the pump house? Can surface or standing water easily flood over the top of the well casing?

☐ Is there an unfilled space or gap between the well casing and the ground around the well (see Figure 2) e.g. the surface seal is missing or incomplete?

☐ Is the well finished below grade?

☐ Are there noticeable cracks in the surface seal around the well casing?

If you answered ***"yes"*** to any of the above questions, fix the problem before proceeding with disinfection. Otherwise the well will continue to be vulnerable to contamination.

Figure 1. Well casing stick up less than 30 cm (12 inches) from the ground surface

Figure 2. Well with gap between casing and ground – no surface seal

Note: *A registered well driller must be hired to repair or install a surface seal for a well, or to add casing to increase the well stickup.*

Are there any safety precautions to take?

Chlorine is very volatile so it is dangerous to work with in confined areas where vapours can accumulate such as well houses, pits and crawl spaces. Caution should be used when working in these situations – WorkSafeBC rules for confined spaced entry should be followed.

Prepare the chlorine solution outside in a well-ventilated area and wear appropriate safety clothing and equipment to protect your eyes and skin from splashes and spills.

If you have any concerns or need help with disinfecting your well contact a registered well driller or pump installer.

What are the limitations of the simple chlorination method?

Simple chlorination only eliminates the bacteria present in the well, on the pumping equipment or in the distribution system. It will not kill bacteria in the aquifer beyond the immediate location of the well. If there is some external source of contamination, the problem will only be solved temporarily. A well must be protected from contamination through proper siting, construction and maintenance.

Nuisance bacteria such as iron-related or sulphate-reducing bacteria are often found in groundwater and water wells. If uncontrolled, these bacteria can colonize the intake area of a well. The colonies form a sticky, slimy substance called biofilm (see Figure 3 below) which can reduce well production and degrade water quality. Also, minerals in groundwater can settle out and accumulate on well screens over time. The simple chlorination method is not effective in penetrating or removing biofilm and mineral build-up. To prevent the accumulation of biofilm and minerals regular disinfection of the well is recommended in cases where bacteria have been detected.

Figure 3. Biofilm on well wiring

If the well has never or infrequently been disinfected or coliforms or *E. coli* continue to be detected in the water, hire a registered driller or pump installer to remove the pump and clean the casing and screen before repeating disinfection using either the shock chlorination procedure or the procedure for hard to disinfect wells.

What are the steps for disinfecting a water well?

STEP 1 – Before beginning

Notify all users of the well not to drink the water or bathe in it while the strong solution of chlorine is present in the system and to store sufficient water for use during a 12-hour period.

Bypass or disconnect any carbon filters or water treatment devices before disinfecting. Carbon filters will remove the chlorine from the water – distribution pipes located past these filters will not be disinfected if the filters are not removed.

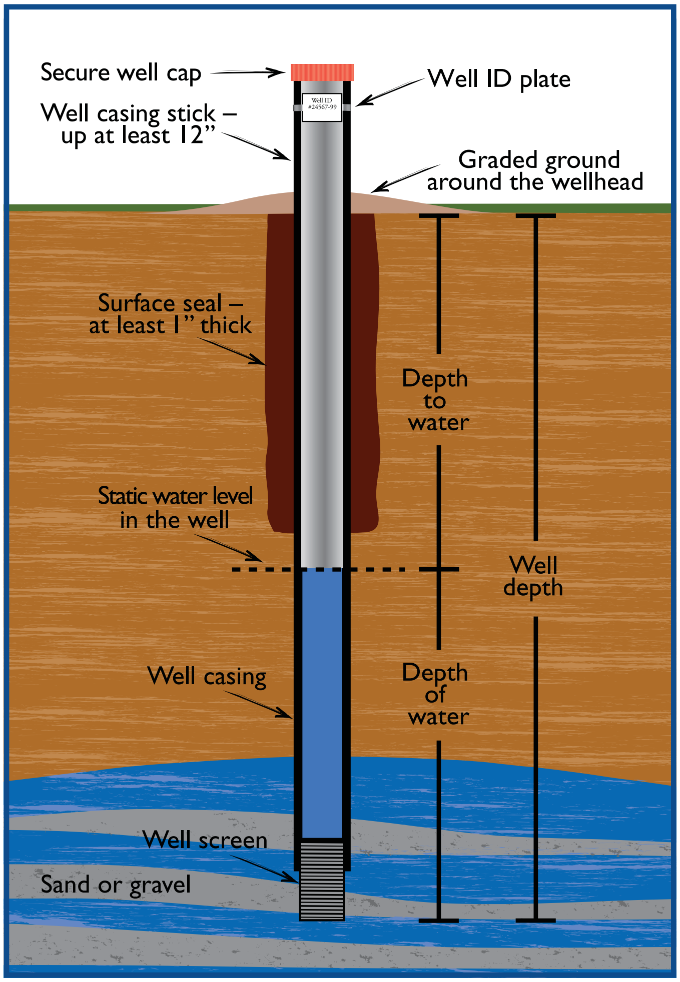

Figure 4. Cross-section of well showing main features and measurements

STEP 2 – Determine the diameter of the well, depth of water in the well and the pH of the well water

Measure or check the driller's well construction report to determine the diameter and depth of the well and the static water level. The depth of water = well depth – static water level (see Figure 4). If this information is not available contact a registered well driller or pump installer for help.

Test the pH of the well water. Ideally, the pH should be 7 or less. If it is above 7, add one litre of vinegar or citric acid to the well and re-test the pH in the well water before proceeding.

STEP 3 – Add chlorine solution to the well

Estimate the amount of domestic bleach (Table 1) or chlorine tablets or powder (Table 2) needed.

a. **For wells without a pump (e.g. new well) using domestic bleach**
Mix the volume of bleach needed with at least 45 litres (10 gallons) of water. Pour the solution into the well and leave it for approximately 12 hours. When the pump is installed, pump for at least one hour to remove the chlorine solution.

b. **For wells with a pump using domestic bleach**
Turn off power to the pump. Mix the volume of bleach needed with at least 45 litres (10 gallons) of water. Remove the well cap and lift the wires out and pull to one side. Clean the cap to remove debris, dirt and oil and place in a clean container. Pour or siphon the chlorine solution into the well between the drop pipes (pipes that carry water from a pump in a well to the surface) or pour the solution directly into the well. Some wells have a sanitary seal (see Figure 5) with either an air vent or plug that can be removed to add the chlorine mixture – contact a registered well driller or pump installer for assistance if required.

Caution: *Do not remove any of the bolts in the top of the sanitary well seal.*

Figure 5. Well with sanitary seal type cap

Figure 6. Well fitted with pitless adapter, cap has space for wiring

If possible, mix the water in the well by attaching a clean hose to a nearby water tap or hydrant, placing the other end of the hose into the top of the well casing, and then running the water from the well through the hose and back into the well. Note: the power to the pump will need to be turned back on. After mixing, let the water stand in the well for a couple hours before proceeding to the next step.

c. **For wells with a pump using chlorine tablets or powder**
Dissolve the required weight of tablets or powder in warm water, remove the well cap, pour the solution into the well, mix if possible and let stand for two hours (see instructions above).

STEP 4 – Move the chlorinated water into the distribution system

Turn the pump(s) on. Open all water taps one at a time, including outside hose bibs and cold and hot water taps. Flush toilets and fill washing machines and dishwashers. Allow the water to run until a chlorine smell is detected from each faucet or there is a slippery feeling to the water, then turn off each tap. Open the valve or plug at the top of the pressure tank just before stopping the pump to allow the solution to contact the entire inside surface of the tank. Then close the valve or plug. Back flush any water softener devices and all water filters (except carbon filters). Replace carbon filters to avoid reintroducing bacteria into the system. Plumbing grit and solid mineral particles may form during disinfection and may clog faucet aerators, flush valves and equipment using filters. Faucet aerators may need to be removed if clogging occurs. If a strong chlorine odour is not present, return to step 3, add half the amount of chlorine used for the initial treatment to the well and repeat step 4.

Replace the well cap and leave the chlorine solution in the distribution system for at least 12 hours.

STEP 5 – Flush the chlorine out of the well and distribution system

Open an outside tap and run the chlorinated water from the well to an area where plants won't be harmed. Do not run the water into your septic system as the chemicals and the amount of water required to flush the system may overload or damage the septic system. Do not drain the water into a stream, ditch or storm drain that connects with any fish-bearing streams.

When a chlorine smell is no longer present, run the indoor hot and cold water taps to flush out the hot water tank and plumbing (this small amount of chlorine will not harm the septic system). It may take as little as half an hour or as long as four days to completely remove the chlorine odour from the water system.

Do not overpump the well! *If the well is low-yielding or pumps silt or sand, slowly flush the well – watch the water coming from the hose to make sure there is no sediment in it. Over-pumping may worsen the sediment problem. It may be necessary to stop and start the pump if it is losing its prime.*

STEP 6 – Sample the well water

A water sample should be collected for analysis one week after chlorination to verify the water is safe to use. Do not drink the water without boiling it until test results show it is safe to drink. Retest again one month after disinfection to ensure the water is potable.

TABLE 1

Volumes of domestic bleach* needed for a 200 ppm chlorine solution

Well diameter		Domestic bleach* (5-6%) needed per 3 metres (10 feet) of water		
inches	mm	metric	US gallons	other
4	100	100 mL	0.02	5 tbsp
5	130	150 mL	0.04	10 tbsp
6	150	200 mL	0.05	13 tbsp
8	200	360 mL	0.09	1.5 cups
10	250	560 mL	0.15	2.5 cups
12	300	808 mL	0.21	3.5 cups
24	610	3.3 L	0.9	14.6 cups
36	914	7.5 L	2.0	
48	1219	13.3 L	3.5	

Note: *Domestic bleach has an expiry date and should be used before this date for effective disinfection. Purchase only the amount needed and use it all. Use only unscented plain domestic bleach without fabric softeners or other additives.*

TABLE 2

Dry weight of chlorine tablets* needed for a 200 ppm chlorine solution

Well diameter		Dry weight of chlorine tablets (65-75%) per 3 metres (10 feet) of water	
inches	mm	oz	grams
4	100	0.3	9
5	130	0.5	15
6	150	0.7	20
8	200	1.3	36
10	250	2.0	57
12	300	2.9	82
24	610	11.9	337
36	914	26.7	758
48	1219	47.4	1347

Note: *Make sure the chlorine tablets are for potable water, e.g. not for swimming pools or hot tubs.*

When should a well be disinfected?

The simple chlorination method is used:

- following construction of a new well,
- following alteration of an existing well,
- following pump installation, maintenance or repair, or
- by homeowners when the well has tested positive for coliforms or *E. coli*.

The bacteria and viruses found in the soil at or near the well site can be picked up on drilling tools, pipes and pumps during construction or servicing of a well. If disease-causing organisms are present they may be introduced into the well. Therefore, every well, after construction or repair, should be disinfected.

For further information

For further information on whether the well water is safe to drink contact your local Health Authority *(look for listings in your local phone directory)*. A list of registered well drillers and pump installers can be found at: www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/wells.html#reg.

BRITISH COLUMBIA
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The BRITISH COLUMBIA GROUND WATER ASSOCIATION

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Photos by Sylvia Kenny, Peter Epp and Greg Farley.

APPENDIX C

Frontier Geoscience Geophysical Survey Report

WATERLINE RESOURCES INC.

REPORT ON

TRANSIENT E.M. INVESTIGATION

GIBSONS AQUIFER MAPPING PROJECT

GIBSONS, B.C.

by

J.K. Porter, B.Sc.

Cliff Candy, P.Geo.

November 2009 **PROJECT FGI-1109**

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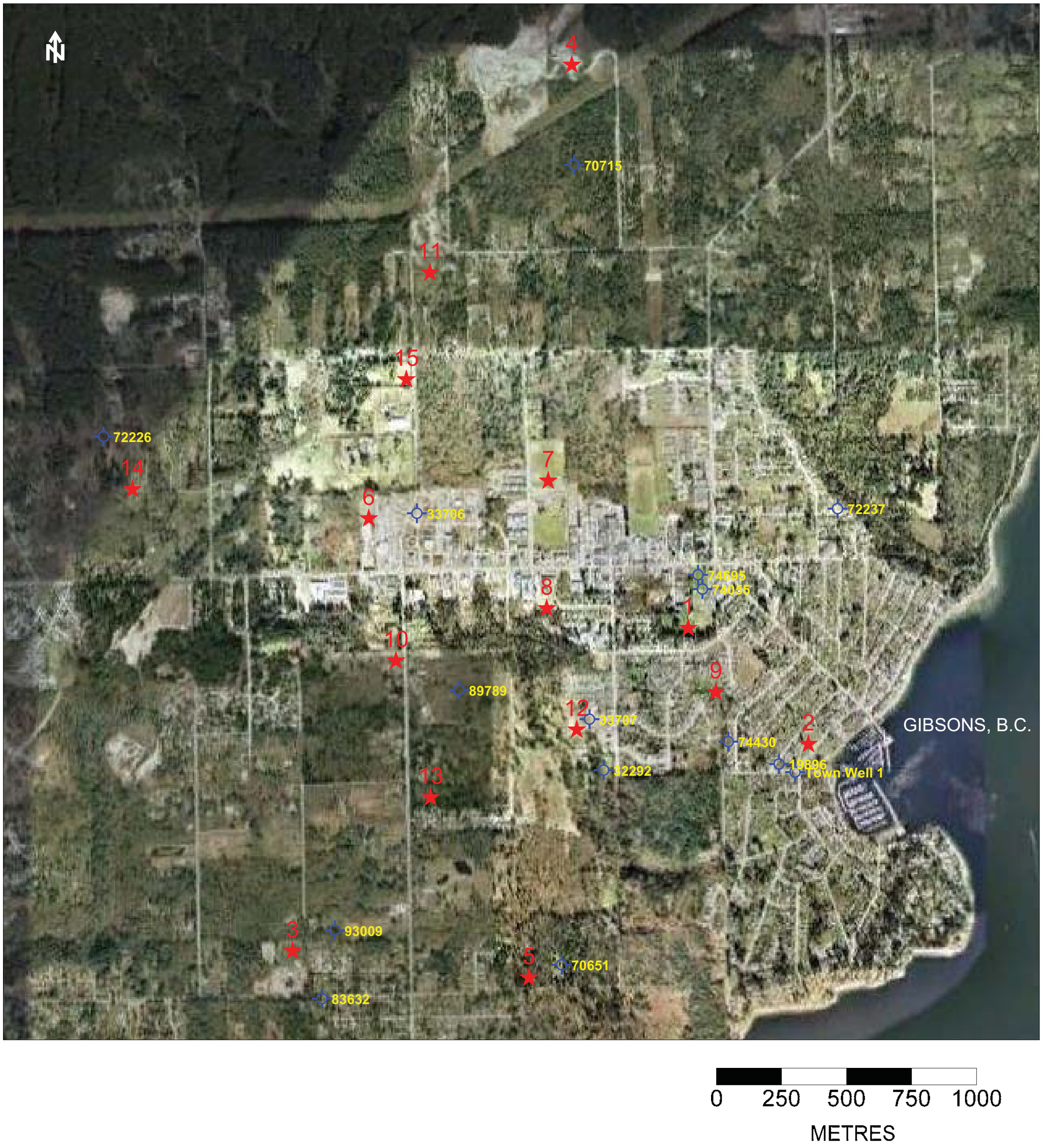
1. INTRODUCTION

On November 26 and 27, 2009, Frontier Geosciences Inc. carried out Phase 1 of a Transient Electromagnetic (TEM) profiling survey for Waterline Resources Inc. in the town of Gibsons, B.C. This investigation was carried out to provide subsurface geoelectric information as part of the Gibsons Aquifer Mapping Project. The initial survey sites were chosen for comparison and calibration with known boreholes. Phase 2 of the TEM profiling survey was on April 12 and 13, 2010 and was followed up by a Downhole logging survey on May 5, 2010. Well ID#33706 and ID#33707 were logged for natural gamma and resistivity.

A Site Plan showing the locations of the surveys sites is presented in Figure 1 at 1:35,000 scale. In total, 15 soundings were completed at different townsite locations. A transmitter loop size of 55 to 75 metres was employed.



★ SURVEY SITE

⌖ BOREHOLE

WATERLINE RESOURCES INC.
GIBSONS AQUIFER MAPPING PROJECT

TRANSIENT EM SURVEY

SITE PLAN

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009 | SCALE 1:25,000 | FIG. 1

2. THE TRANSIENT ELECTROMAGNETIC SOUNDING METHOD

Geoelectric sounding and profiling methods are used to determine the configuration of subsurface materials based upon their capacity to pass electrical current. The Transient Electromagnetic survey is an inductive method utilising the behavior of electromagnetic signals to determine ground resistivity. Detailed vertical and lateral variations in material resistivities are determined rapidly without the requirement for grounded electrodes. In this survey, the Transient EM method was employed to detail the behaviour of layering and groundwater conditions.

The electrical resistivity of a geological unit is determined by the amount of contained water, the distribution of the water within the unit, the quality of dissolved solids in the water, and the presence of minerals such as clays with conductive ion exchange properties. Thus the resistivity of most granular soils and rocks is controlled more by porosity, water content and water quality than by the conductivity of matrix materials.

The instrument utilised in this survey was the Geonics Ltd. Protem Transient EM system. This system is comprised of a Protem receiver used in conjunction with the TEM-47 and the TEM-57 transmitters which employ an ultra-high (285 Hz), very-high (75 Hz), high (30 Hz), medium (7.5 Hz) and low (3 Hz) frequency repetition rate.

In operation, a primary field is provided by the transmitter driving a transmitter loop appropriate for the depth of exploration. In this survey, a loop sizes of 55 by 55 metres, and 75 by 75 metres were utilised. The transmitter produces a bipolar rectangular current in the loop with a finely controlled linear ramp current shutoff. The rapid change of current in the loop results in the induction of a current circulation in the ground beneath the loop, often described as a "current filament". A multiturn coil connected to the receiver samples the secondary magnetic field resulting from this current filament during the primary off time, immediately following termination of the ramp. The variation in this magnetic field, as the current filament sweeps through the materials in the section, contains diagnostic information on the resistivities and thicknesses of the layers encountered.

The receiver coil, synchronized with the transmitter by means of a cable reference, is situated in the centre of the loop and at a known location outside the loop. The Protem receiver samples 20 channel windows on the secondary field decay. These samples are logarithmically distributed from 6.8 microseconds to 701 microseconds, for the 285 Hz repetition rate; 100 microseconds to 7.032 milliseconds, for the 30 Hz repetition rate; and 0.35 milliseconds to 27.9 milliseconds, for the 7.5 Hz repetition rate, where time zero is at the cessation of the primary field ramp. The controller stores 1000 data sets in memory together with labels, gain and other information for later download to the field computer for processing and display. Six readings were taken for each transmitter loop utilising the two transmitters; three different repetition rates for each transmitter together with the appropriate receiver coil with the receiver located inside the transmitter loops. Six more readings were taken with the receiver coil located outside the loop.

The data is provided by the instrument in gain-uncorrected millivolts and is normalized to convert to units of time derivative of the magnetic field (nanovolts/m^2). The data are converted to apparent resistivity which is plotted versus time in log-log format. The twenty channels record approximately two decades of coverage at ten points per decade. Three sets of data were used for each transmitter loop at repetition rates of 285 Hz, 30 Hz, and 7.5 Hz, providing sufficient information to resolve a multiple layer earth model. The data were then modelled using an inversion technique incorporated in the TEMIXGL program to produce an inverted section of true resistivities. The maximum contribution to the response results from materials in close proximity to and directly below the transmitter loop, so good lateral resolution of layering behavior is obtained.

3. THE GAMMA AND INDUCTION LOGGING SURVEY

3.1 Equipment

The Mount Sopris MGX II borehole system is a portable, digital instrument controlled by a notebook computer. This system uses Poly Probe technology allowing the acquisition of up to nine logs simultaneously on a single conductor. The motorised 4MXB-1000 winch enables logging to depths of 500 m with 0.125" diameter steel, armored, single conductor logging cable.

The downhole gamma instrument is a 2PGA-1000 polygamma probe. The probe measures natural gamma with a large sodium iodide scintillometer. As this survey was carried out without wall contact in plastic pipe-lined holes, only the natural gamma probe data could be obtained. Isolated 115vac power for the instruments is provided by a portable gasoline generator. The LOGSHELL acquisition software allows the operator to log in real time, to inspect the logs, and direct further surveying.

The principle radioactive elements that contribute to the natural gamma response of soils materials are naturally occuring Uranium, Thorium and Potassium isotopes. The last of these provides the main contribution to the response in most soils. A higher gamma count indicates a higher content of clay, as a result of the Potassium present in the clay minerals.

The downhole conductivity instrument is a 2PIA-1000 poly induction, EMP-2493 (Geonics EM39) probe. The EM39 provides measurements of the electrical conductivity of the soil and rock surrounding a borehole or monitoring well, using the inductive electromagnetic technique. The unit employs coaxial coil geometry with an intercoil spacing of 50 cm to provide a substantial radius of exploration into the formation while maintaining excellent vertical resolution. Measurement is unaffected by conductive borehole fluid or the presence of plastic casing. The instrument operates to a depth of 500 m. The combination of large conductivity range, high sensitivity and very low noise and drift, allows accurate measurement of subsurface conditions.

The 2PIA-1000 poly induction probe operates by transmitting an electromagnetic signal, which can pass through the plastic pipe wall of the borehole lining, and measuring the strength of the returned response of this signal. The response is calibrated to provide data in units of milliS/m.

3.2 Survey Procedure

The equipment was set up adjacent to the drillhole to be logged and calibrated to establish the datum at the top of casing. Boreholes were logged top to bottom at reading intervals of 2 cm except in cases where the instrument was located within the borehole casing. The records were monitored in real time for quality assurance during the logging operation.

4. GEOPHYSICAL RESULTS

4.1 General

A Site Plan of the survey area showing the location of the Transient E.M. survey loops in the town of Gibsons is illustrated at 1:35,000 scale in Figure 1. A limited number of sites were available that were sufficiently clear of metallic interference, such as power lines, pipelines etc. Sites were chosen to maximise the spatial distribution of the soundings, while minimising the impact of cultural interference. The results of the TEM survey are presented in Figures 2 through 16 of the Appendix.

Figures 2 through 16 of the Appendix show the inverted resistivities of the site compared against the nearest boreholes. Purple lines represent possible correlation to layers of differing resistive values with logged geologic units or interpreted borehole sections. Dashed lines are possible sediment and bedrock boundaries. The approximate distance between the survey site and the borehole has been indicated on each figure.

Figure 17 and 18 show the natural gamma and induction borehole logging results for borehole 33706 and 33707. The results of the interpreted bedrock elevations are compiled in contour map format on Figure 19.

4.2 Discussion

4.2.1 TEM Sounding

Site 1 was surveyed approximately 160 m from Borehole 74055. The transmitter loop was placed around a field southwest of Gibsons Elementary School. Results of data inversion indicate a surficial layer 27.7 m thick with resistivity of 215 Ωm. This corresponds with the surficial Capilano sediments logged in the borehole. Beneath these sediments is a resistive layer (1895 Ωm), consistent with the onset of granite bedrock.

The transmitter loop used at Site 2 was placed in the green space surrounding Gibsons' town hall and public buildings along Gower Point Road. An 11.5 metre thick resistive surficial layer 1677 Ωm resistive surficial layer correlates to logged Capilano sediments. Beneath this is a more conductive (2.9 Ωm) layer correlating to logged intersections of coarse sand. A resistive layer is interpreted to exist at -25.7 m elevation and may correspond to a competent bedrock surface.

Site 3 was at the Cedar Grove School field on Chaster Rd. Borehole 83632 and Borehole 93009 are located 215 m and 180 m from the centre of the transmitter loop, respectively. A surficial layer with a resistivity of 30 Ωm corresponds to a layer of clay with intermixed sands and gravel. Beneath this is a more resistive layer corresponding to layers of sand and gravel. This is underlain by a thin conductor associated with a Vashon clay layer with thicknesses consistent with borehole 93009. This is underlain by two layers with 215 Ωm and 55 Ωm associated with pre-Vashon sand and gravel layers. This is underlain by a conductive zone which may be associated with water bearing sands and gravels or the presence of a clay layer overlying bedrock.

The Site 4 survey area was conducted east of the operating gravel pit at the upper end of Gilmour Road. This site is nearly 385 m from the Borehole 70715 so direct correlation may not be appropriate. The upper 45 m is resistive layer (1650 Ωm) that may correlate to Capilano or Vashon sediments. Beneath this is a less resistive 50 m thick layer may be Vashon or Pre-Vashon sediments. Bedrock estimated at 158 m elevation at the boundary to a 2770 Ωm resistive layer.

Site 5 is located on an empty lot east of Ryan Drive on the north side of Chaster Road. A power line runs along the south side of Chaster Rd, potentially interfering with data collection. The top 1.7 m of surface material exhibits a resistivity of 343 Ωm. This correlates to the silty sands and gravels of the possible Capilano sediments. Beneath this is a resistive layer of 3001 Ωm that may represent logged intersections from Borehole 70651 of cobbles and grey clay. The resistivity however is quite high and may also represent the broken granite or sandstone bedrock logged deeper in the borehole. The highly resistive third layer correlates to logged sandstone and granite. There is a conductive layer beneath the interpreted bedrock layers. This may correlate with the water bearing granite layer logged in the borehole. Deeper conductive layers may indicate the presence of water within fissures, or shear zones within the bedrock. The confidence in events that are deeper than the top of interpreted bedrock is limited due to the weaker signals from these sources in the presence of interference from power lines, underground pipes and other metallic structures.

The Site 6 transmitter loop encircles an unpaved lot northwest of the corner of Payne Road and Gibsons Way. This lot contains several metallic objects and vehicles around its perimeter. There is a 1 m thick conductive layer overlaying a 30 m thick layer exhibiting a resistive value of 230 Ωm. These two layers may correspond to sediments of the Capilano and Vashon sediments. Beneath these is a 9.5 m thick conductive layer which corresponds well with a water bearing sand and gravel layer observed in Borehole 33706. This is underlain by a 37 m thick more resistive zone (300 Ωm) consistent with layers of sands and gravels (Till-like) observed in the borehole log. The resistivity profile sees strong conductors at depths below 60 m elevation. This appears to coincide with a strong thin conductive zone observed in the borehole induction profile (see Figure 17).

Site 7 is located on the Gibsons Area Community Centre soccer field on Park Road. The results show a conductive upper layer with thickness of approximately 7 m, which likely corresponds to Capilano sediments and fill. Beneath is layer is a 500 Ωm layer with a thickness of approximately 13 m. This is consistent with a layer composed of till-like sands and gravels. This is underlain by a 50 m thick layer with resistivity of 350 Ωm, interpreted to be Vashon or Pre-Vashon sediments. The onset of a conductive zone, which may be associated with the presence of water bearing sediments, occurs at elevation of 70 m. The depth of the onset of a strong conductor does however coincide well with the strong conductor observed in Borehole 33706 (see Figure 17), approximately 25 m above the standing water table. The sounding ends in a strong conductor (2.5 Ωm) which may represent a clay layer overlying and masking the bedrock surface. The estimated bedrock depth would be approximately 43 m elevation.

Site 8 is located south of the Gibsons Curling Centre. A 1.3 m thick conductive layer is observed at surface and likely represents clay-rich Capilano Sediments. This is underlain by a 40 m thick 300 Ωm layer consistent with sands and gravels (Till-like). A 800 Ωm layer with thickness of 57 m appears to coincide with gravel and sand layers observed in nearby boreholes. The nearest boreholes being 33707 and 89789, both approximately 460 m distance. A strong conductor is observed at 23.7 m elevation and this agrees with static water levels observed in borehole 33703 (at approximately 23 m elevation) and water bearing gravel and sands observed at 27.5 m in borehole 89789.

Site 9 is located east of Eaglecrest Drive. Figure 10 shows the profile together with borehole logs for 33707, located 500 m away and 74430, located 195 m away. There are closer boreholes than 33707, however, these are located in regions of shallow bedrock (74695, 74055) or located near borehole 74430. A thin surficial conductor is underlain by a thick resistive zone (1150 Ωm). This resistive zone is approximately 77 m in thickness and ends in a more conductive layer of 55 Ωm. The onset of the 55 Ωm zone correlates well with the static water level observed in 33707 and the water bearing sand and gravel layers observed in 74430. This 55 Ωm layers is underlain by a 22 m thick resistive layer which is underlain by a conductor. The presence of the resistive zone suggests the presence of bedrock at approximately 0 m elevation.

Site 10 is located west of Pratt Road, on a Produce Farm. The nearest borehole is 89789, approximately 270 m from the centre of the sounding loop. The profile consists of 5 layers. A shallow conductive layer, likely associated with clays and silts, underlain by two more resistive layers, 60 Ωm with thickness of approximately 40 m and 162 Ωm with thickness of approximately 50 m. The conductive layer of 0.2 Ωm correlates with the water bearing gravels and sands observed in 89789. This layer is underlain by a more resistive zone suggesting the presence of bedrock at elevations of -3.4 m.

The location of the 11th site was a horse corral just east of Payne Road and south of Cemetery Road. The nearest borehole is 695 m distance to the northeast. A resistive layer with thickness of 26.5 m is located near surface and is likely associated with sands and gravels. This is underlain by a more conductive zone (90 Ωm), possibly suggesting a more saturated environment or a increase in clay content. This is underlain by a 10 metre thick resistive zone indicating the presence of bedrock at approximately 103.5 m elevation.

Site 12 is located in close proximity to borehole 33707 just west of Oceanmount Blvd. The upper three layers are similar in resistivity; a 30 m thick surficial layer of 80 Ωm, a 29 m thick intermediate layer of 180 Ωm, and a 32 m thick lower layer with resistivity of 110 Ωm. The upper zone correlates well with increased near surface, clay content observed in borehole 33707 and 32292. The intermediate layer appears to be associated with more till-like material, while the lower layer correlates well sand and gravel layers observed beneath the tills. These three sections are underlain by a series of strong conductors. The onset of the conductors occurs at 25 m elevation and coincides with the static water level observed in borehole 33707 and water bearing gravely sand observed in borehole 32292.

Site 13 is located due north of Fircrest Road, east of Pratt Road. The nearest boreholes are 89789, approximately 430 m distance to the north, and 93009, approximately 630 m to the southwest. The sounding indicates a surficial layer with thickness of 51.6 m and resistivity of 248 Ωm underlain by a more conductive 40 m thick layer with resistivity of 20 Ωm. The surficially layer is likely associated with coarse sand and gravel layers, underlain by a till material. At 28.4 m elevation a strong conductor is observed and interpreted to be water bearing sands and gravels. This zone is estimated to be approximately 22 m in thickness. A more resistive layer (100 Ωm) is observed beneath the conductive zone suggesting the possible presence of more resistive bedrock.

Site 14 was located in a north of Russell Road. The site is in close proximity two overhead electrical wires which may have affected the data quality. The sounding shows a 3.8 m thick zone of 35 Ωm material likely associated with silty sands, gravel and clay observed in borehole log 72226 located approximately 235 m to the north west. The surficial layer is underlain by a 240 Ωm, 44.5 thick layer, likely associated with Vashon till deposits. A thin conductive zone, thickness of 4.2 m, is located beneath the till, and atop a 18 m thick resistive layer (800 Ωm). This resistive zone may be associated with the onset of bedrock or possibly the presence of a resistive, till-like aquitard.

The final survey area, Site 15, was located west of Payne Road, just south of Reed Road. The profile shows a 4 layer model, with a 11 m thick 275 Ωm surficial layer, underlain by a 58 m thick more conductive layer (55 Ωm). The surficial layer may be associated with till-like material while the underlying material could represent sands and gravels with increased clay content or water content. A 13 m thick resistive layer (1000 Ωm) is interpreted to represent the onset of bedrock.

4.2.2 Induction and Natural Gamma Logs

4.2.2.1 Borehole 33706

Borehole 33706 is located approximately 185 m from the Site 6 TEM sounding. The borehole was surveyed for natural gamma and induction from the top of the hole down to approximately 140 m depth. Natural gamma readings as well as conductivity and resistivity values are shown in Figure 17 in the Appendix. The profiles indicate a near surface conductor which is probably attributed in part to the casing and the sandy silty layer. Resistivities average approximately 150 Ωm to an elevation of 90 m. At 90 m elevation resistivities increase to approximately 300 Ωm for approximately 20 m. From 70 m elevation to 60 metres elevation a gradual increase in both conductivity and Gamma counts is seen. This is likely related to an increase in clay content with depth. Just below 60 metres, a very strong conductor is present. This zone does not correlate with any specific layering in the borehole log. This strong conductor limits the depth of exploration in the TEM sounding at site 6. Resistivities increase to around 300 to 600 Ωm from elevations of 48 m to 31 m. At 31 m elevation resistivities show a gradual decrease, which correlates well with the onset of the water table. A layer of clay associated with a second strong conductor, and high Gamma counts, overlies bedrock at the bottom of the borehole.

4.2.2.2 Borehole 33707

Borehole 33707 is located approximately 65 m from the centre of the Site 12 TEM sounding. The resistivity log starts at a elevation of approximately 32 m due to the presence of the casing. The strong conductor at 32 m elevation is likely associated with the casing, below which there is considerable variability in resistivity for approximately 8 m within sand, gravel and silt layers. Resistivities become stable around 80-120 Ωm below 22 m elevation at the onset of the static water level.

4.3 Summary

Figure 19 shows a map view of the estimated bedrock elevation contours as constrained by borehole and TEM sounding data. Sounding 14, in the extreme west of the survey area, was not included in the contour map due ambiguity as to the presence of bedrock as a basal layer. The data defines a northwesterly trending bedrock valley that attains depths of a much as 50 metres below sea level. The north valley wall is very steep in the east central survey area, becoming more gradually varying to the west.

5. LIMITATIONS

Transient electromagnetic (TEM) surveys are successful providing adequate contrasts exist in the subsurface in electrical conductivity between distinct geological materials. Also affecting conductivity are the degree of saturation of materials and the porosity, the concentration of dissolved electrolytes, the temperature and the amount and composition of colloids. Conductors identified in TEM surveying are diverse and depending on geological setting, may include mineralisation, graphite, argillite, shear or fault zones, clay beds, saturated materials, clay shale, clay till, mineralised leachate and zones of salt water intrusion.

Transient EM and other electromagnetic techniques have limitations for detecting thin resistive strata. Transient EM methods excel at mapping conductive targets. In deep surveys, large transmitter moments are required to produce sufficiently large signals at depth. Penetration depths may be affected by the presence of highly conductive surficial materials that may partially mask deeper geological layering. Man-made structures such as pipes, fences and power lines can have a significant influence on transient electromagnetic measurements.

The results are interpretive in nature and are considered to be a reasonably accurate representation of existing subsurface conditions within the limitations of the transient electromagnetic survey method.

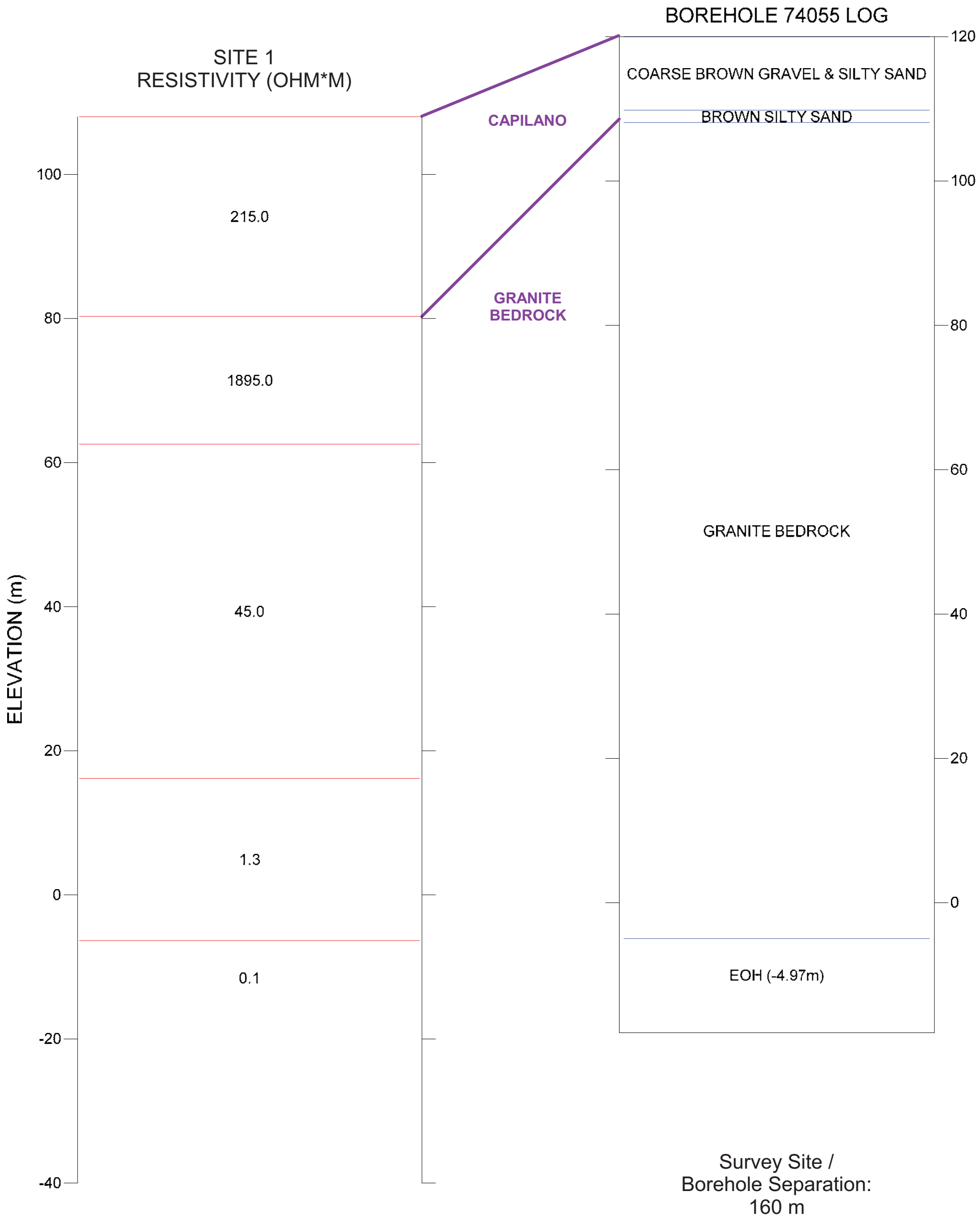
For: Frontier Geosciences Inc.

J.K. Porter, B.Sc.

Cliff Candy, P.Geo.

Table 1. TEM Soundings - Bedrock Elevations

Site	Easting (m)	Northing (m)	Elevation (m)
1	462,644	5,472,589	80.3
2	463,108	5,472,141	-25.7
3	461,117	5,471,342	53.1
4	462,195	5,474,763	158
5	462,030	5,471,239	63.2
6	461,411	5,473,012	-3
7	462,104	5,473,158	43
8	462,098	5,472,665	-
9	462,751	5,472,342	0
10	461,516	5,472,463	-3.4
11	461,647	5,473,961	103.5
12	462,214	5,472,197	-
13	461,650	5,471,935	6.4
14	460,499	5,473,125	-
15	461,556	5,473,549	92



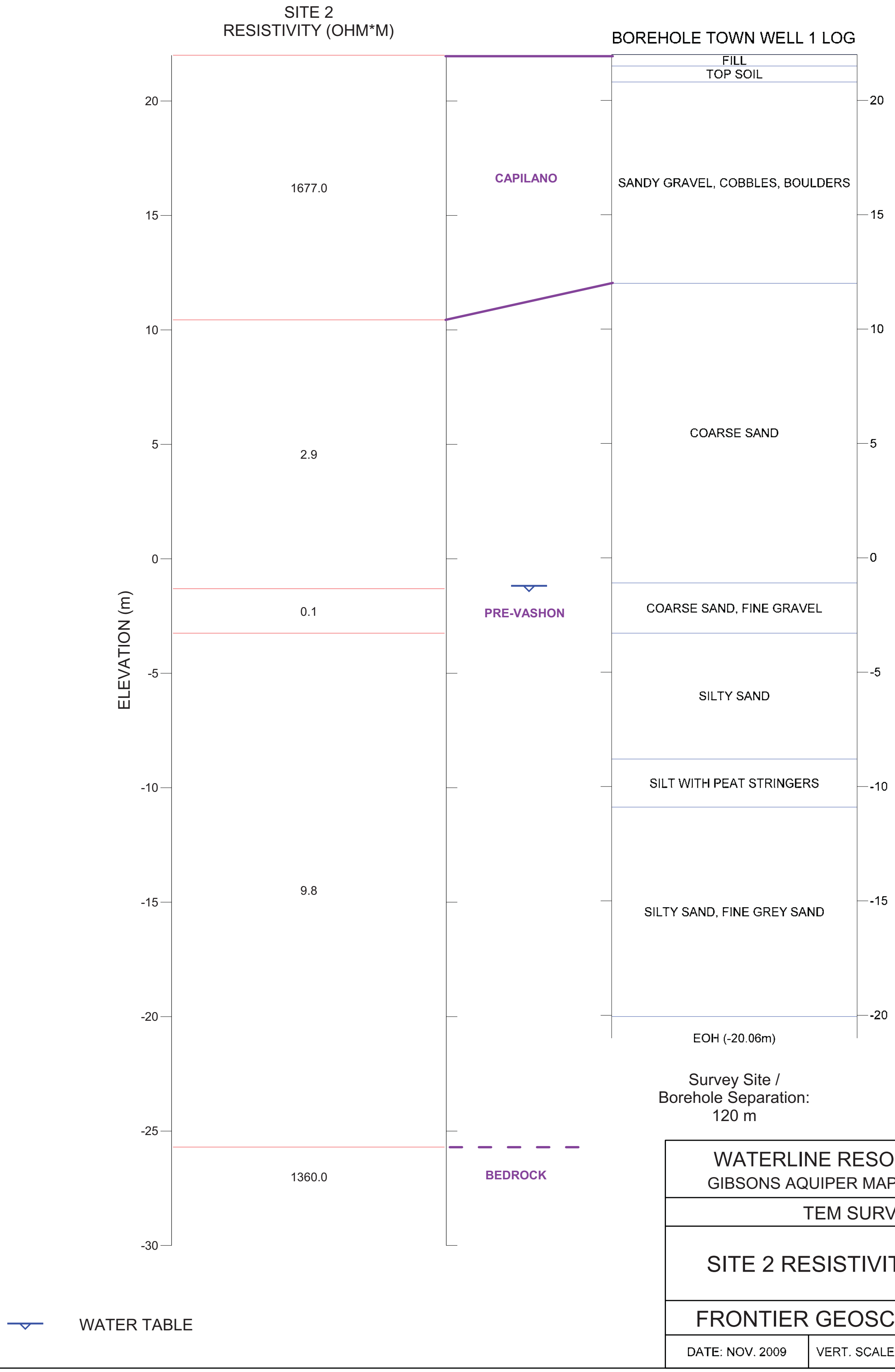
WATERLINE RESOURCES INC.
GIBSONS AQUIPER MAPPING PROJECT

TEM SURVEY

SITE 1 RESISTIVITY PROFILE

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009	VERT. SCALE 1:1,000	FIG. 2



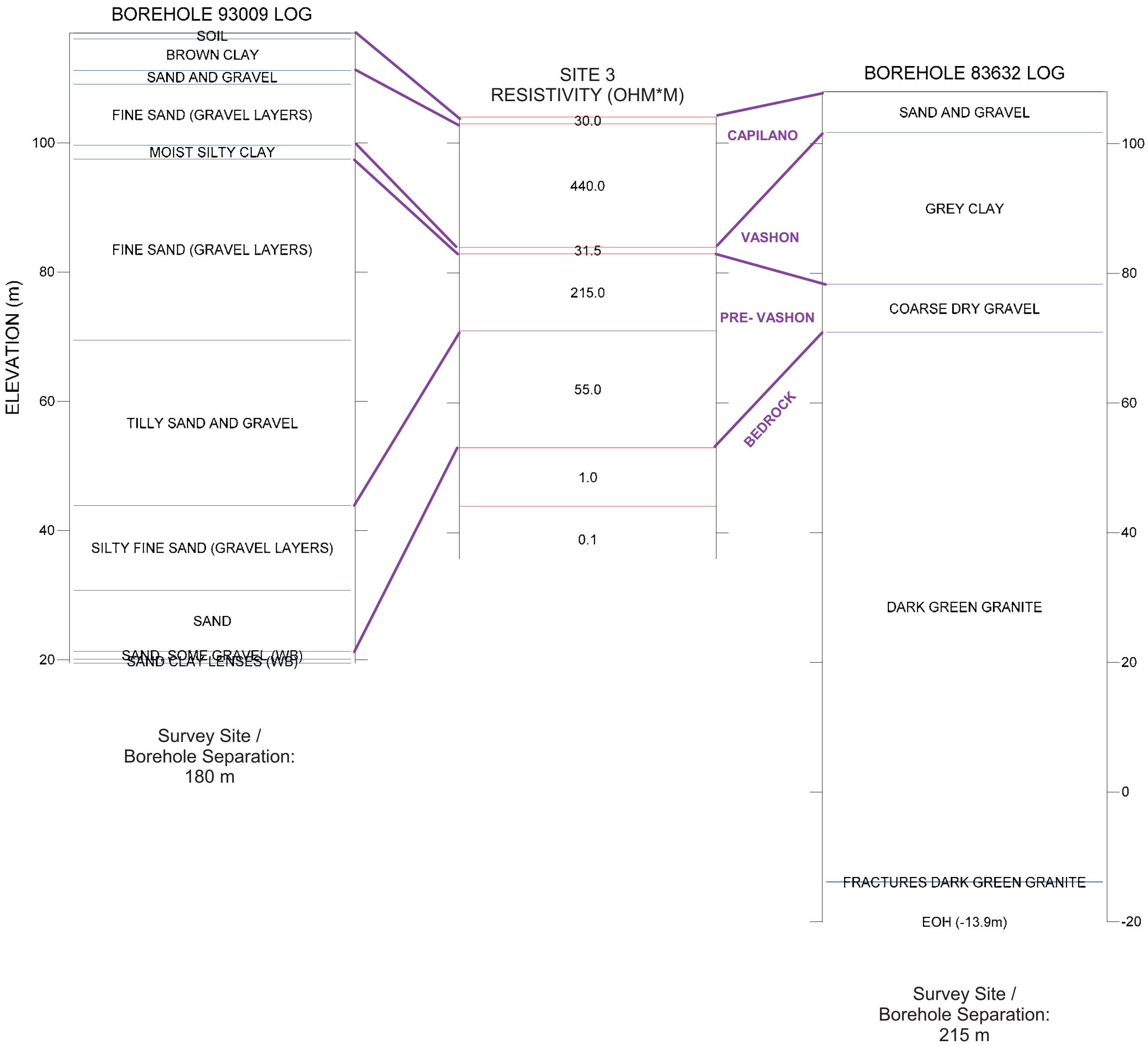
WATERLINE RESOURCES INC.
GIBSONS AQUIPER MAPPING PROJECT

TEM SURVEY

SITE 2 RESISTIVITY PROFILE

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009	VERT. SCALE 1:250	FIG. 3



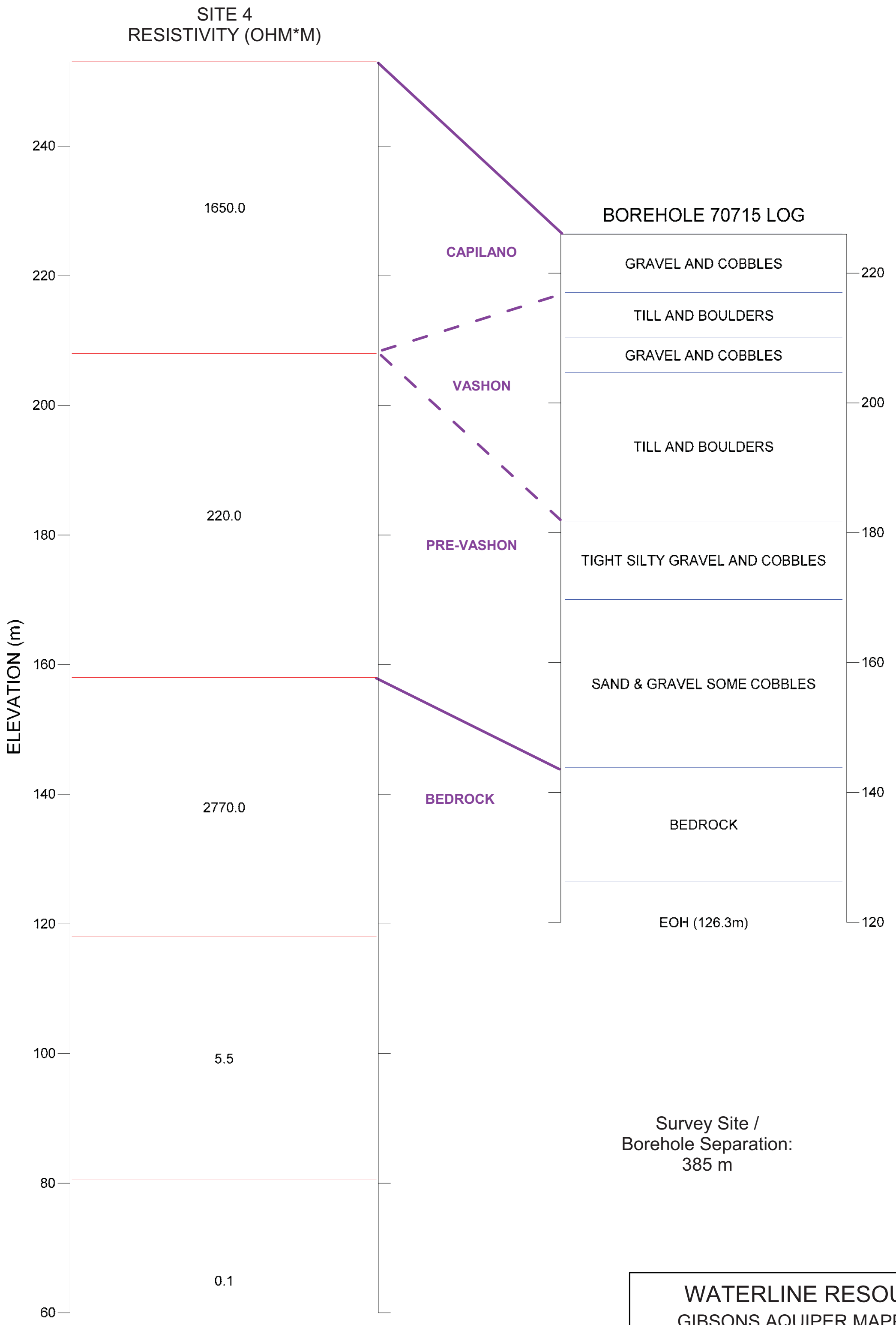
WATERLINE RESOURCES INC.
GIBSONS AQUIFER MAPPING PROJECT

TEM SURVEY

SITE 3 RESISTIVITY PROFILE

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009	VERT. SCALE 1:1,000	FIG. 4



Survey Site /
Borehole Separation:
385 m

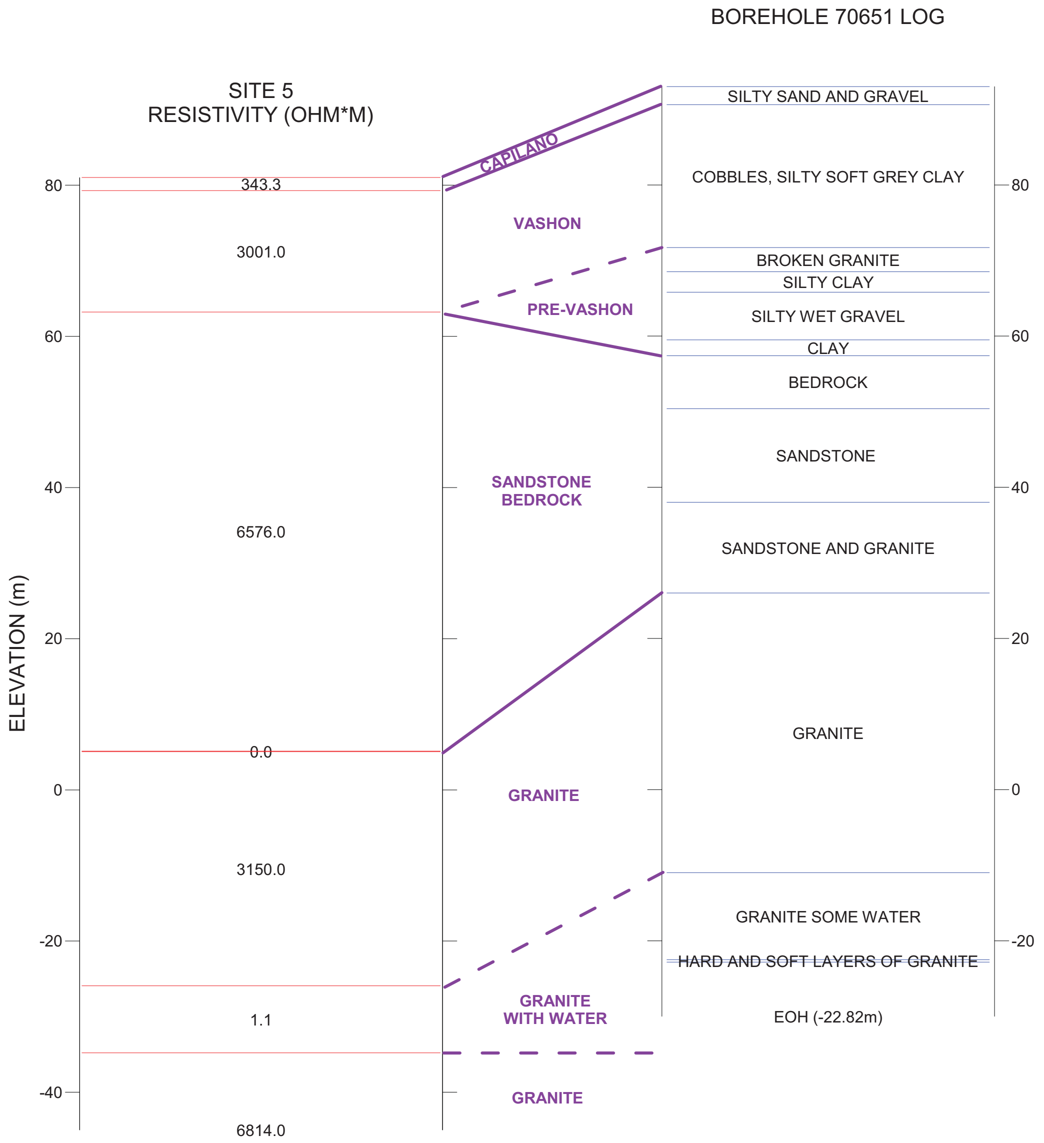
WATERLINE RESOURCES INC.
GIBSONS AQUIPER MAPPING PROJECT

TEM SURVEY

SITE 4 RESISTIVITY PROFILE

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009	VERT. SCALE 1:1,000	FIG. 5



Survey Site /
Borehole Separation:
120 m

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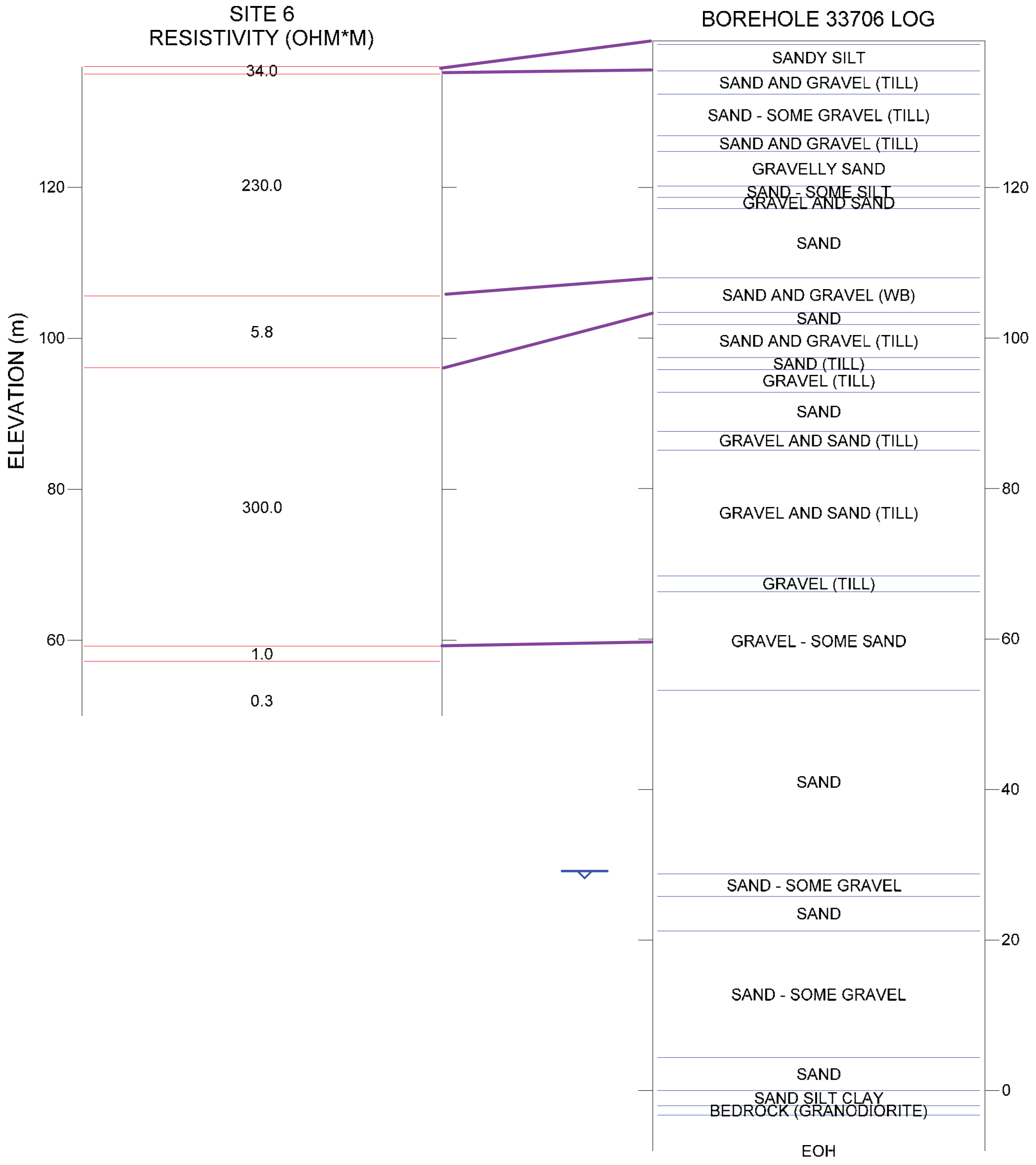
GIBSONS AQUIFER MAPPING PROJECT

TEM SURVEY

SITE 5 RESISTIVITY PROFILE

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009 | VERT. SCALE 1:1,000 | FIG. 6



Survey Site /
Borehole Separation:
185 m

▽ WATER TABLE

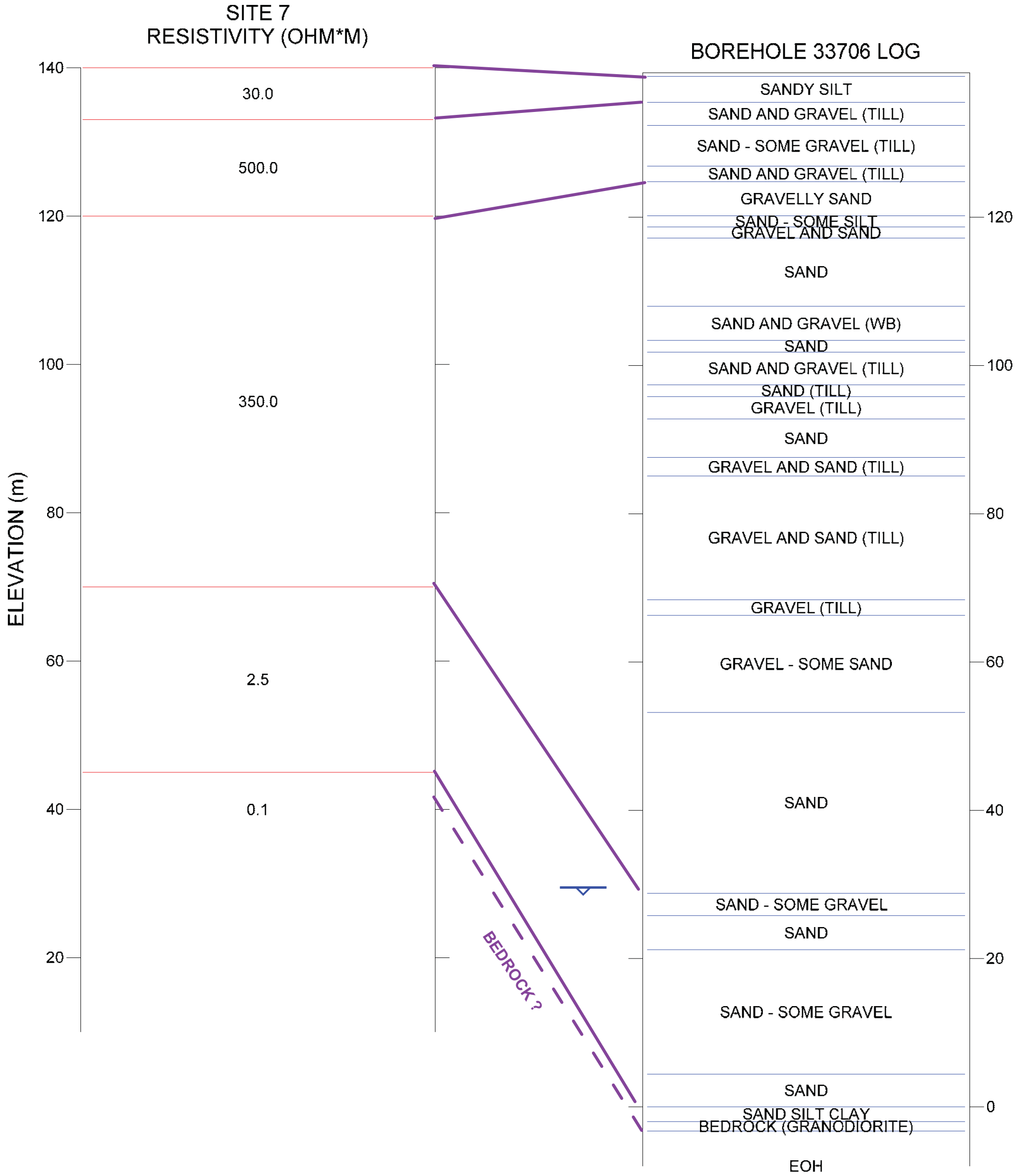
WATERLINE RESOURCES INC.
GIBSONS AQUIPER MAPPING PROJECT

TEM SURVEY

SITE 6 RESISTIVITY PROFILE

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009	VERT. SCALE 1:1,000	FIG. 7



Survey Site /
Borehole Separation
520 m

WATER TABLE

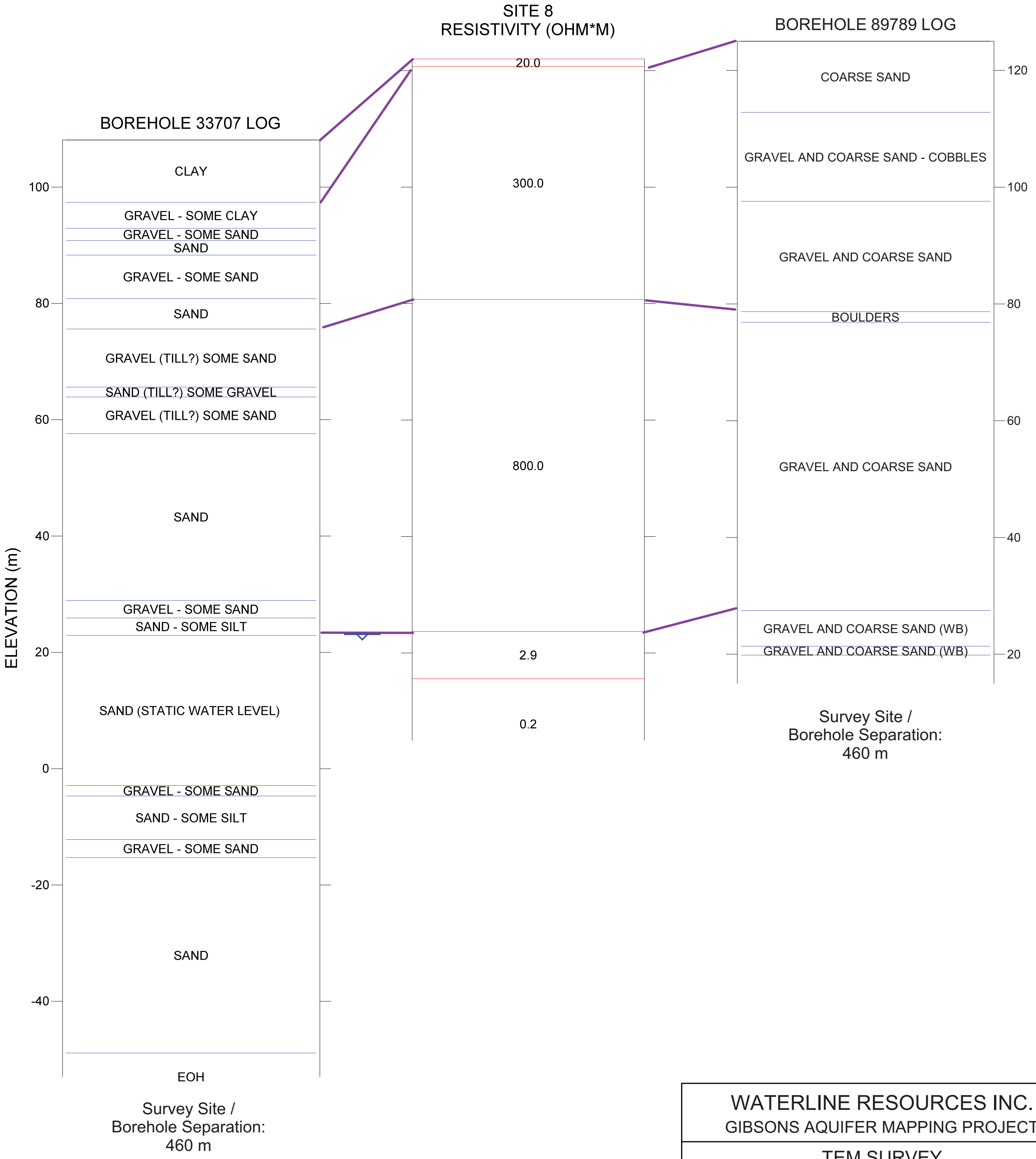
WATERLINE RESOURCES INC.
GIBSONS AQUIPER MAPPING PROJECT

TEM SURVEY

SITE 7 RESISTIVITY PROFILE

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009 | VERT. SCALE 1:1,000 | FIG. 8



WATERLINE RESOURCES INC.
GIBSONS AQUIFER MAPPING PROJECT

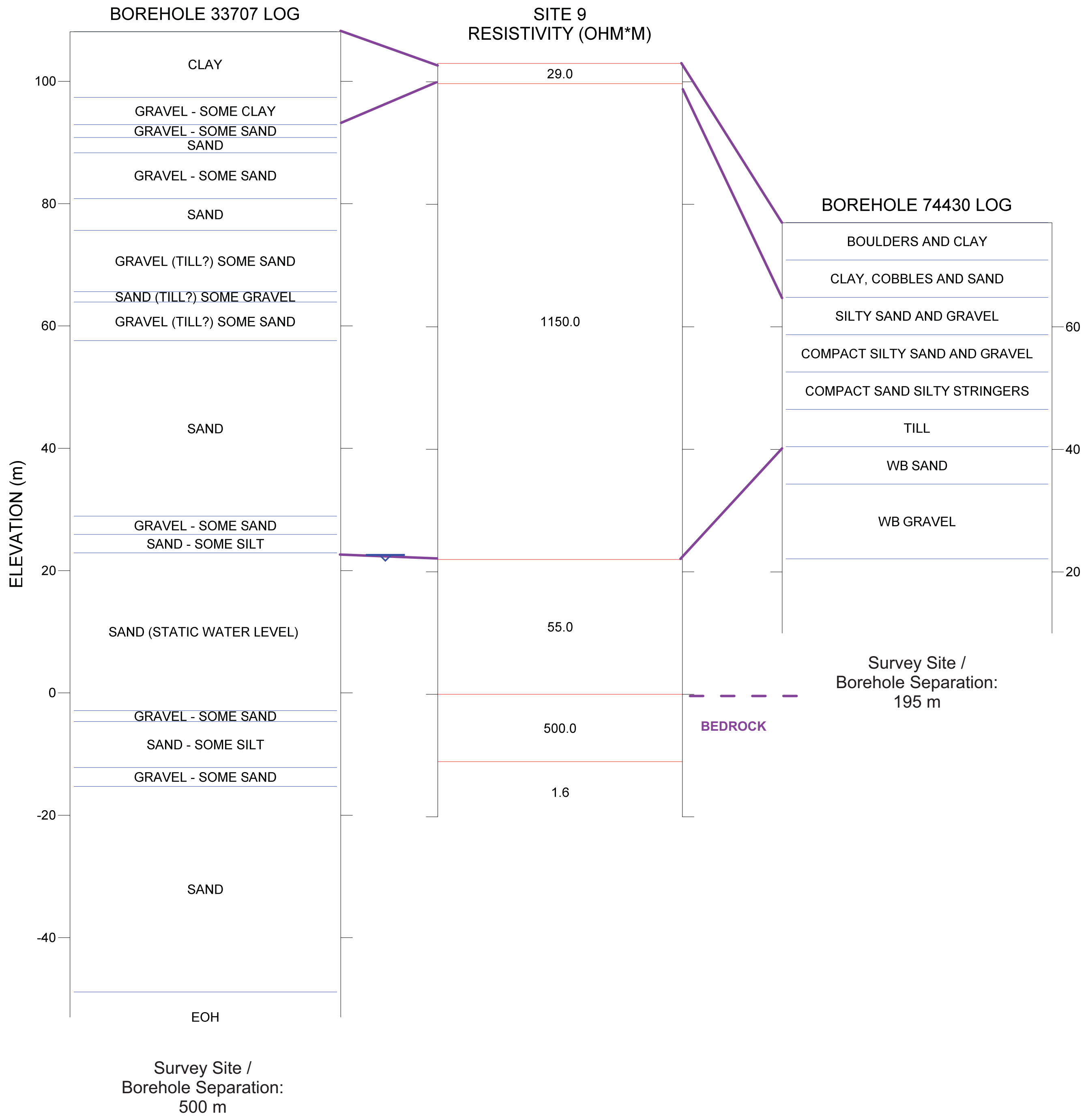
TEM SURVEY

SITE 8 RESISTIVITY PROFILE

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009	VERT. SCALE 1:1,000	FIG. 9

▽ WATER TABLE



▽ WATER TABLE

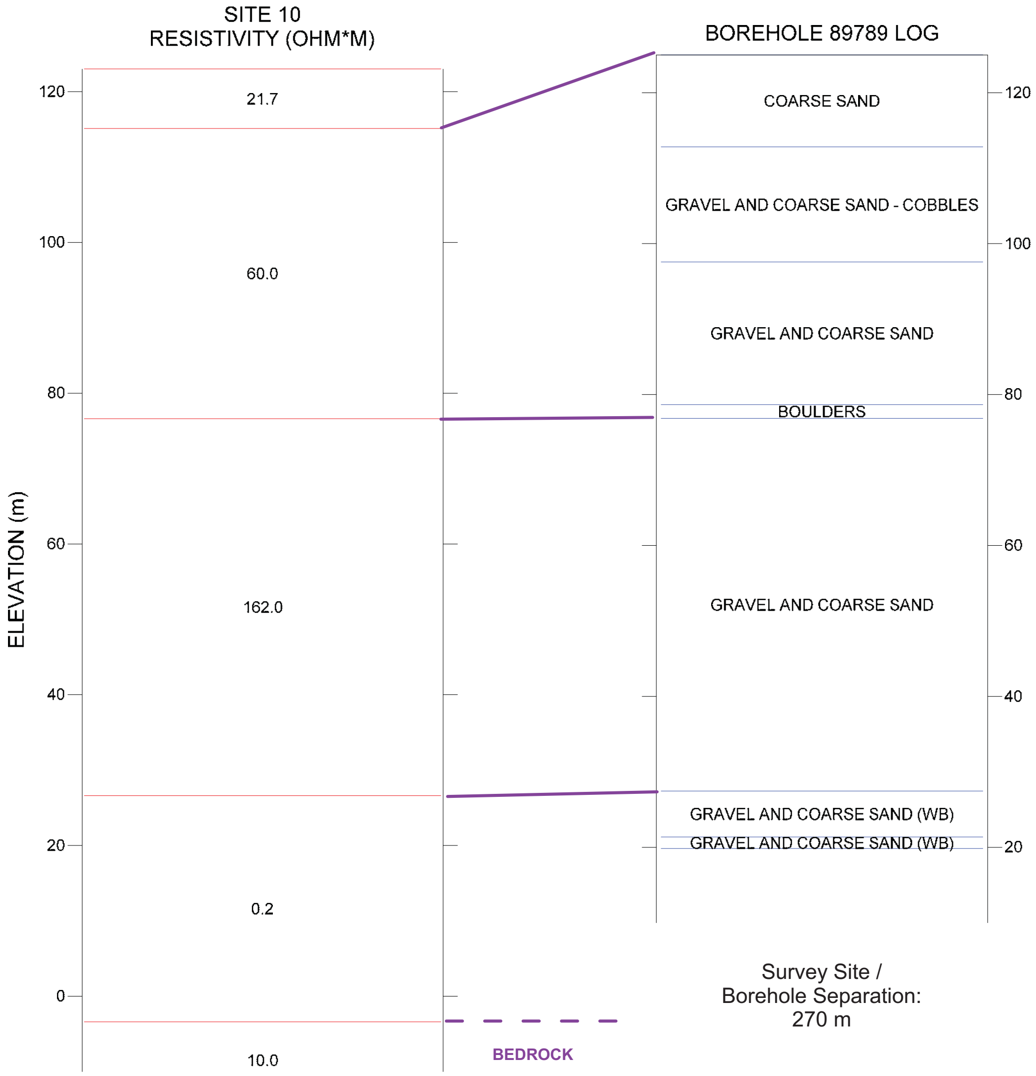
WATERLINE RESOURCES INC.
GIBSONS AQUIFER MAPPING PROJECT

TEM SURVEY

SITE 9 RESISTIVITY PROFILE

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009	VERT. SCALE 1:1,000	FIG. 10



Survey Site /
Borehole Separation:
270 m

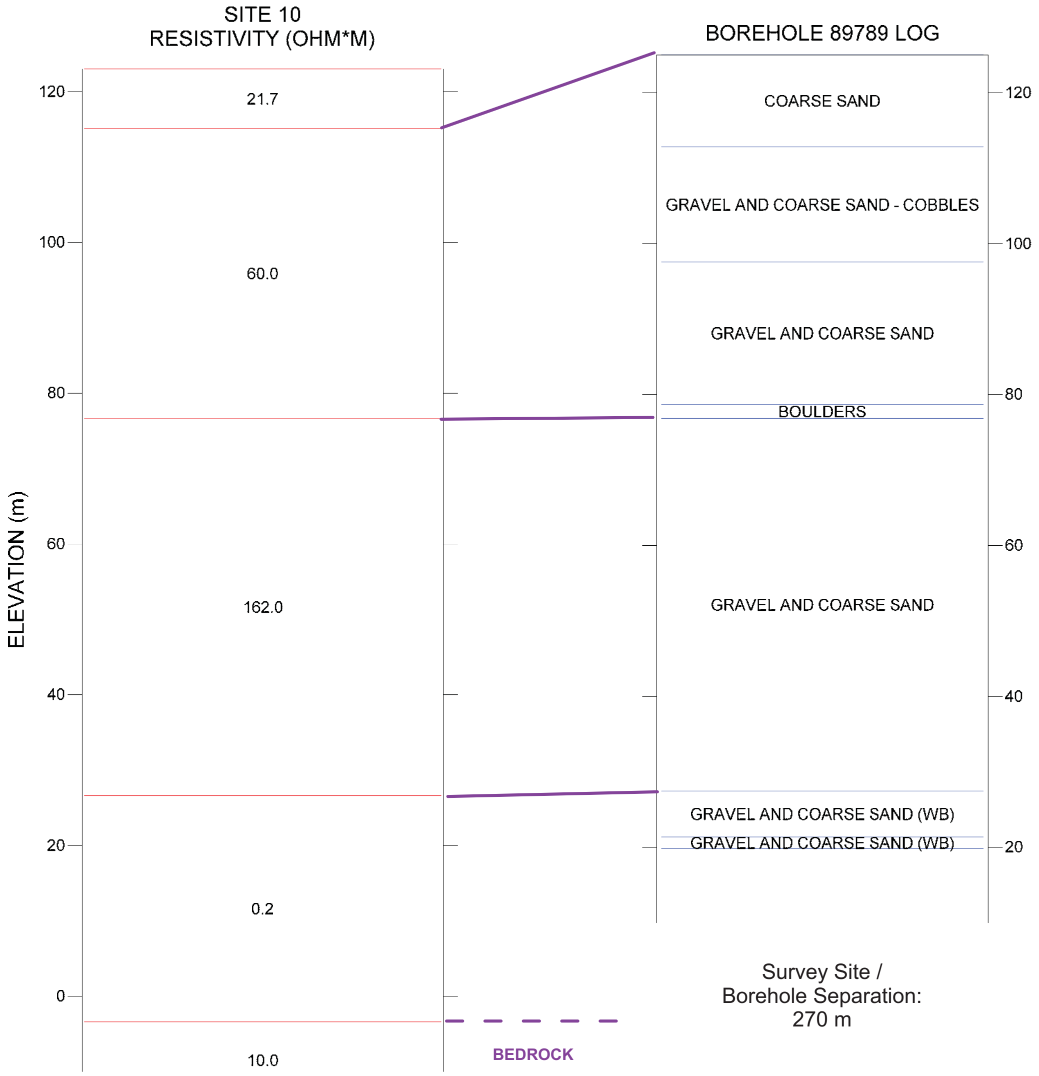
WATERLINE RESOURCES INC.
GIBSONS AQUIFER MAPPING PROJECT

TEM SURVEY

SITE 10 RESISTIVITY PROFILE

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009 | VERT. SCALE 1:1,000 | FIG. 11



Survey Site /
Borehole Separation:
270 m

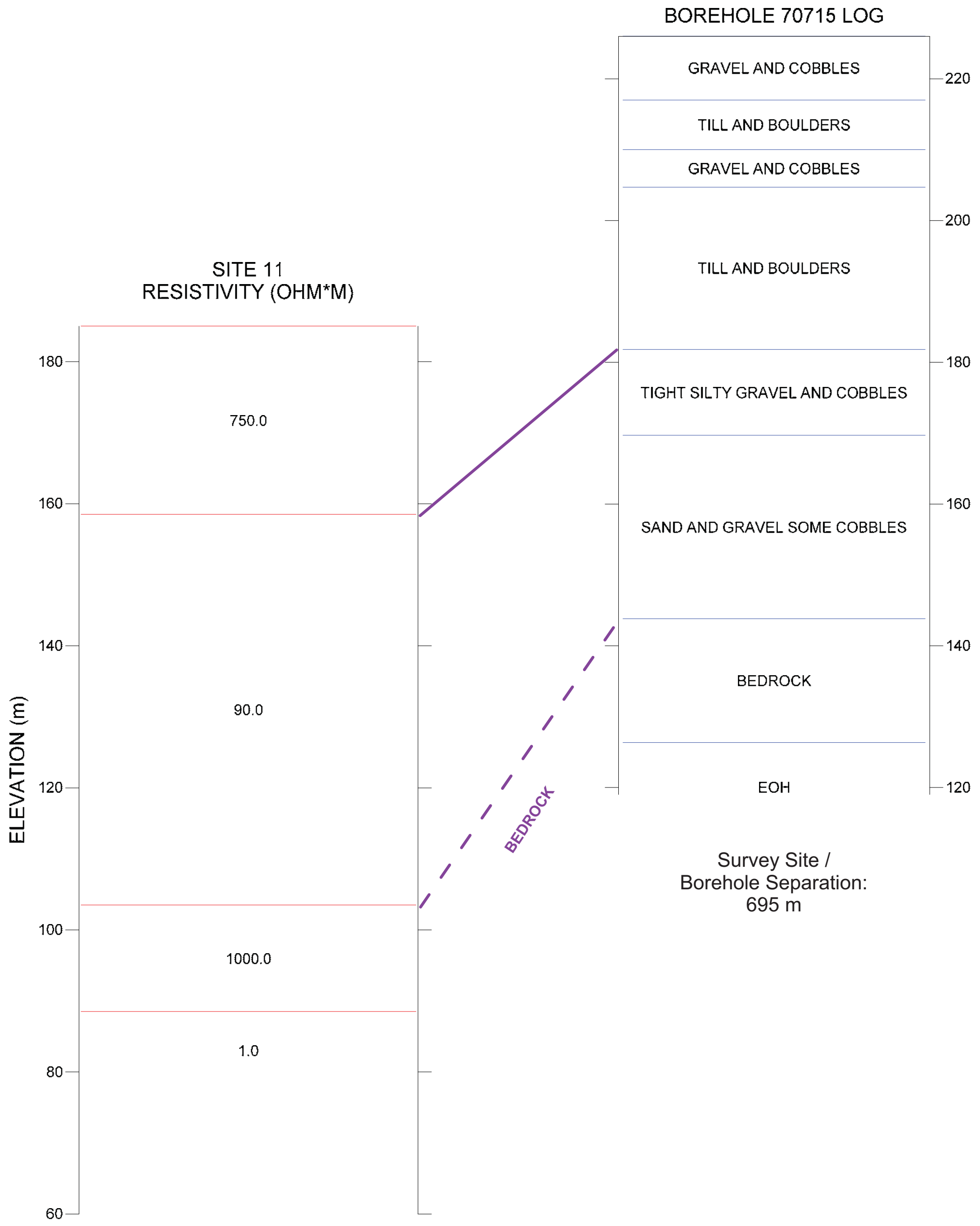
WATERLINE RESOURCES INC.
GIBSONS AQUIFER MAPPING PROJECT

TEM SURVEY

SITE 10 RESISTIVITY PROFILE

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009	VERT. SCALE 1:1,000	FIG. 11



Survey Site /
Borehole Separation:
695 m

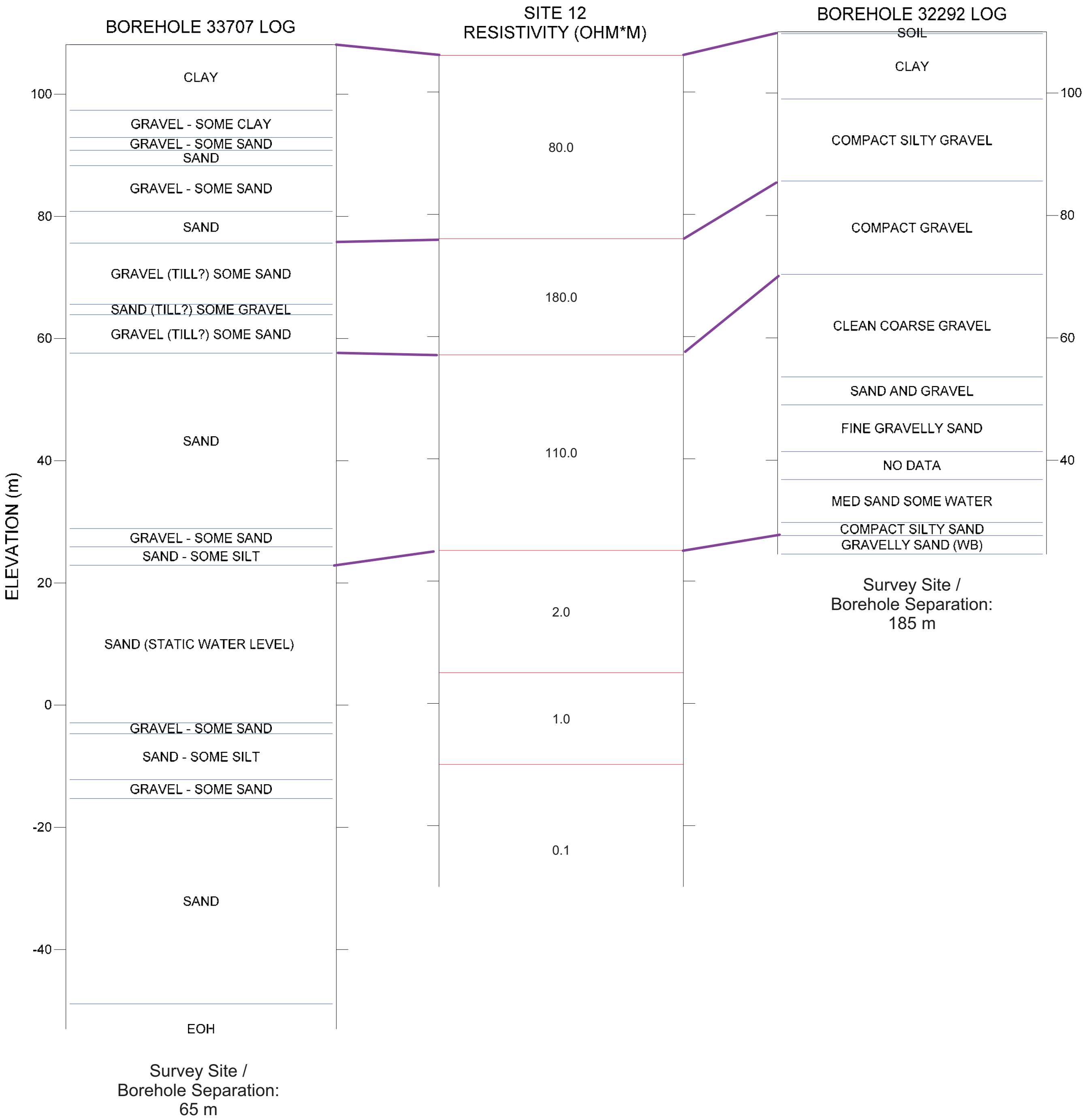
WATERLINE RESOURCES INC.
GIBSONS AQUIFER MAPPING PROJECT

TEM SURVEY

SITE 11 RESISTIVITY PROFILE

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009 | VERT. SCALE 1:1,000 | FIG. 12



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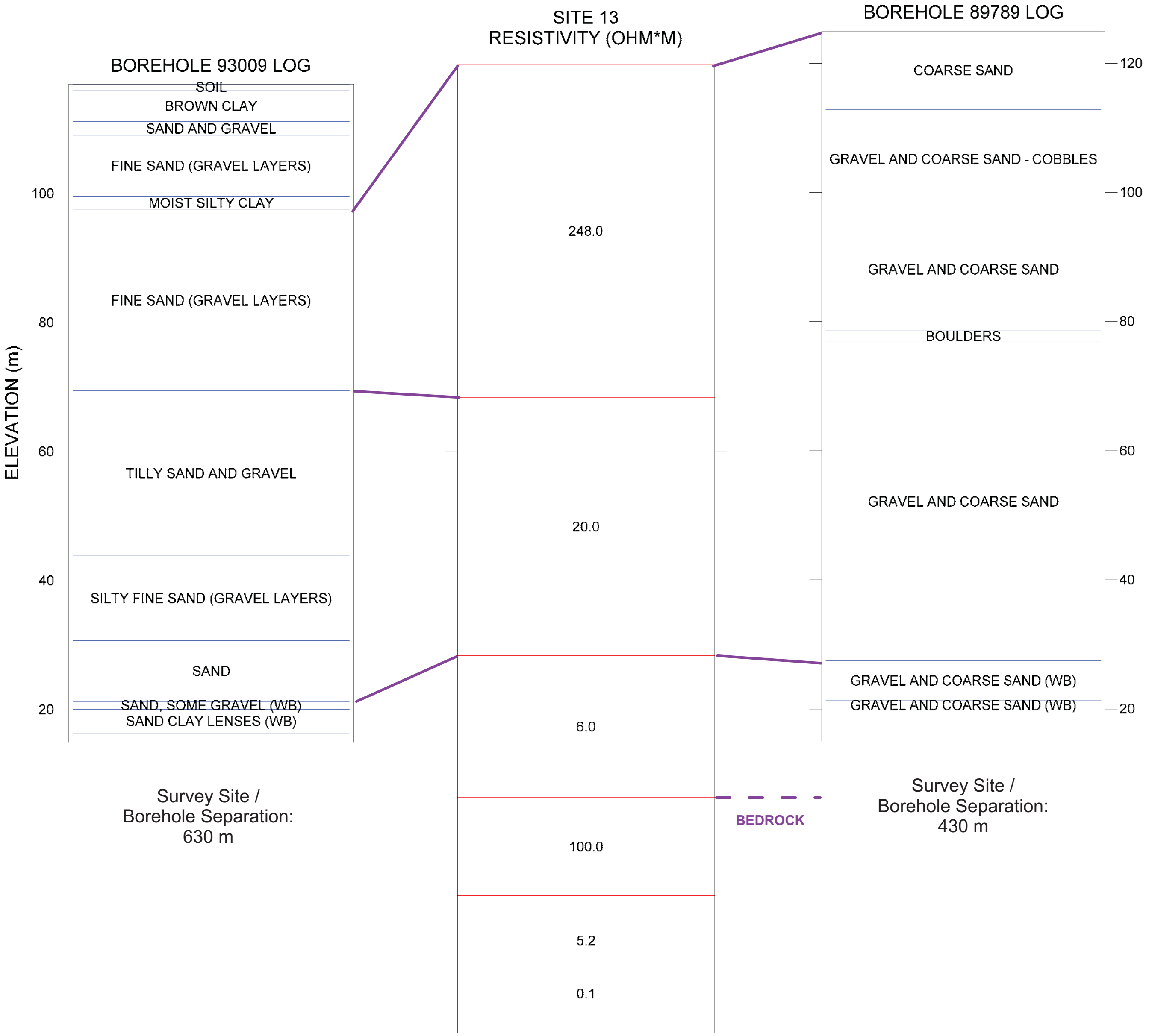
GIBSONS AQUIFER MAPPING PROJECT

TEM SURVEY

SITE 12 RESISTIVITY PROFILE

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009 | VERT. SCALE 1:1,000 | FIG. 13



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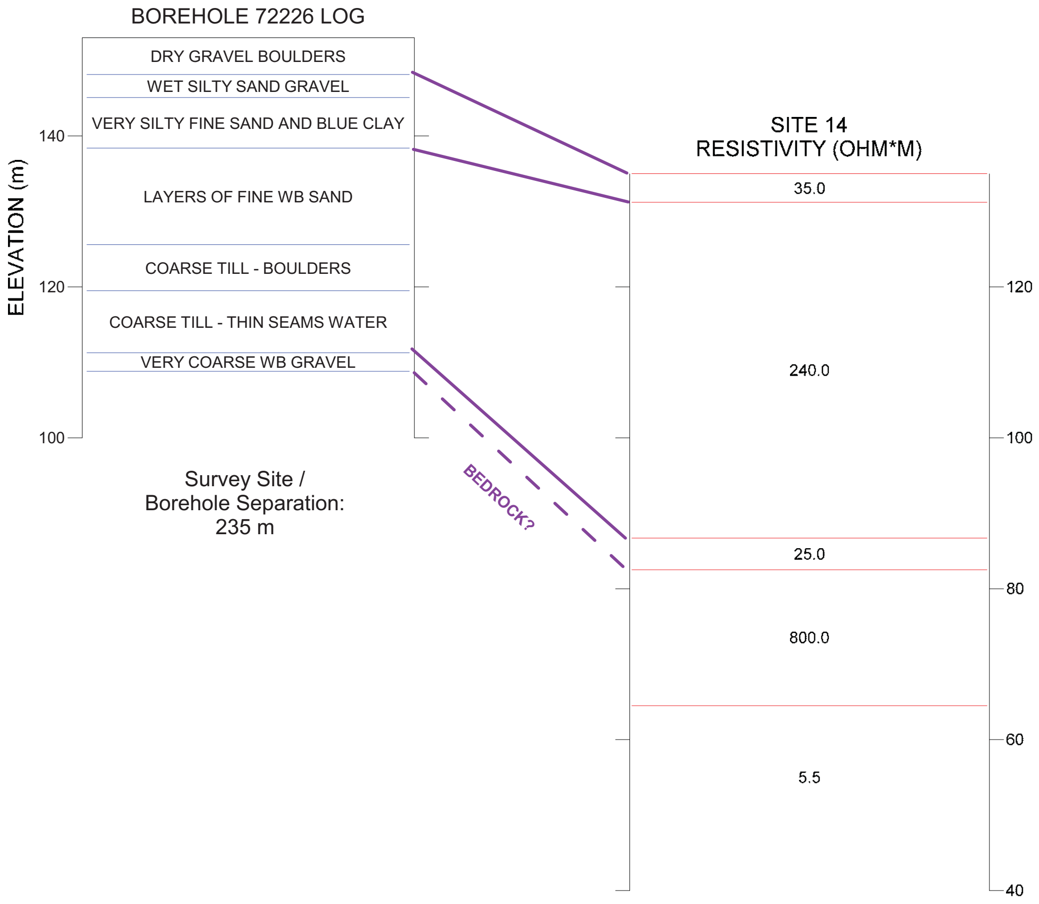
TEM SURVEY

SITE 13 RESISTIVITY PROFILE

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009	VERT. SCALE 1:1,000	FIG. 14



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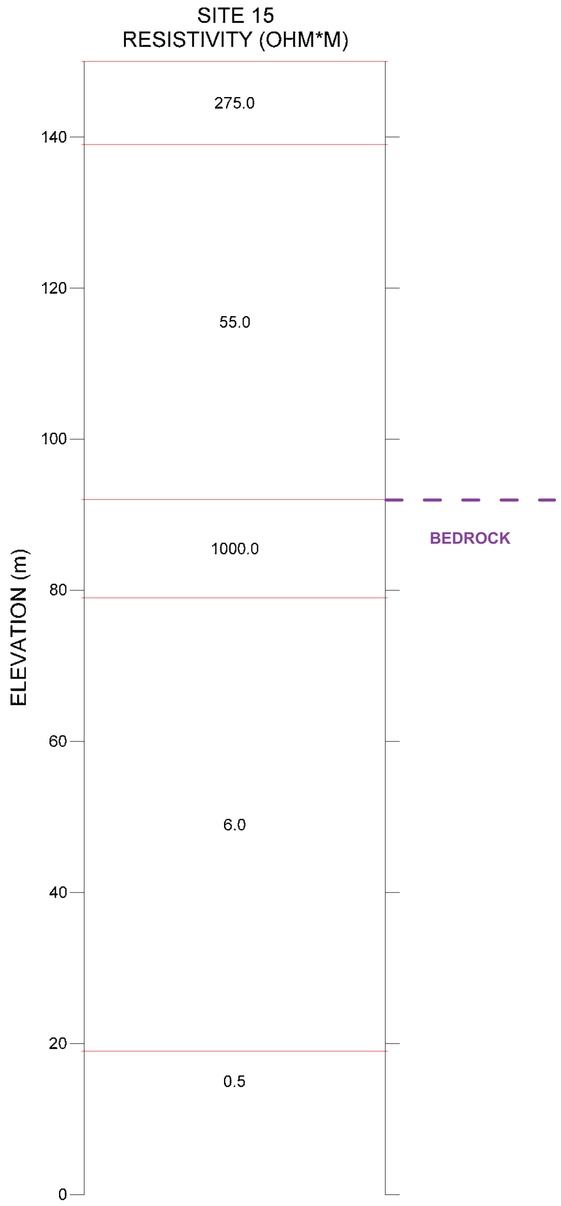
TEM SURVEY

SITE 14 RESISTIVITY PROFILE

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009	VERT. SCALE 1:1,000	FIG. 15



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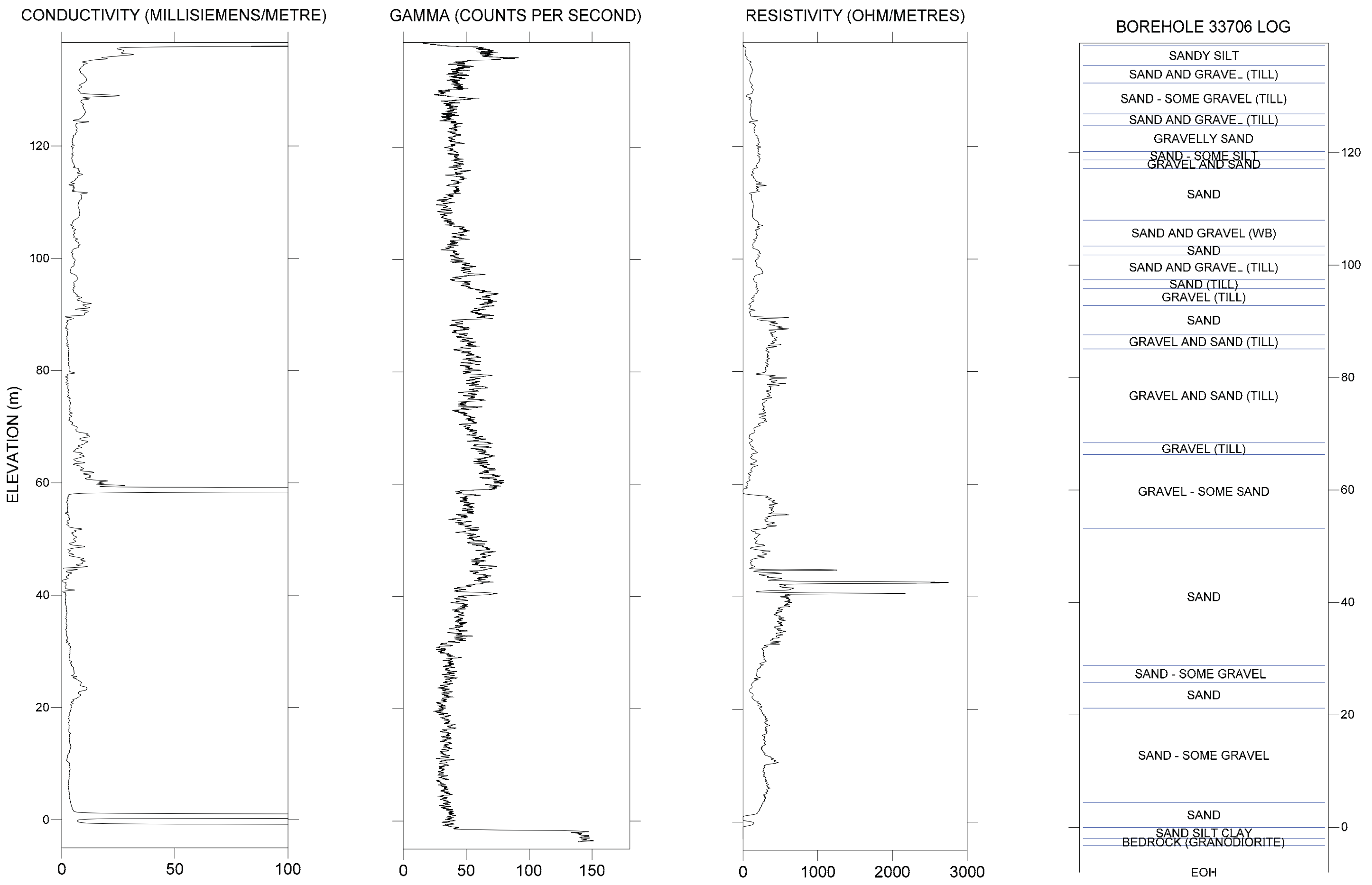
GIBSONS AQUIFER MAPPING PROJECT

TEM SURVEY

SITE 15 RESISTIVITY PROFILE

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009	VERT. SCALE 1:1,000	FIG. 16



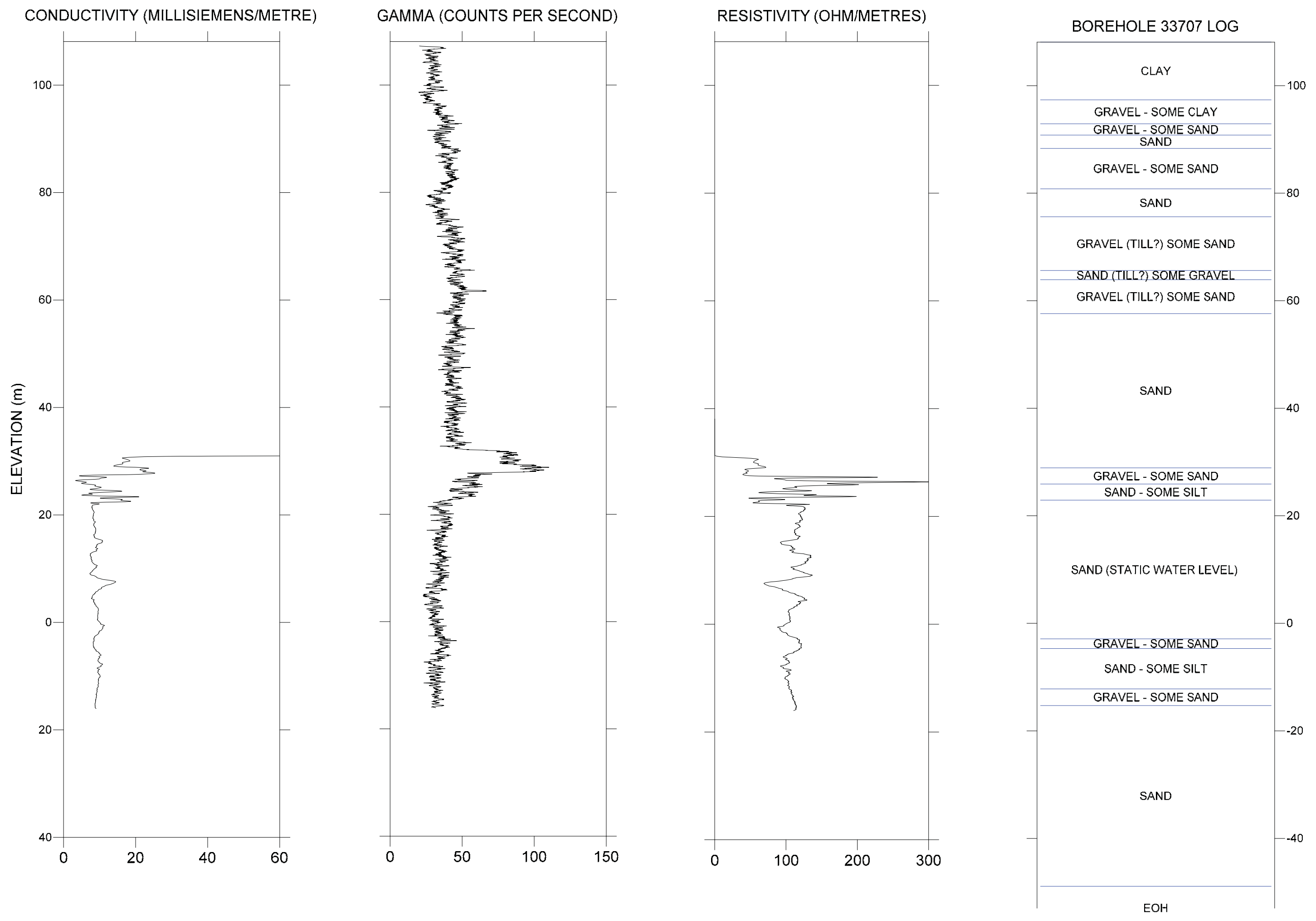
WATERLINE RESOURCES INC.
GIBSONS AQUIFER MAPPING PROJECT

DOWNHOLE SURVEY

BOREHOLE 33706 NATURAL
GAMMA AND INDUCTION LOG

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009	VERT. SCALE 1:1,000	FIG. 17



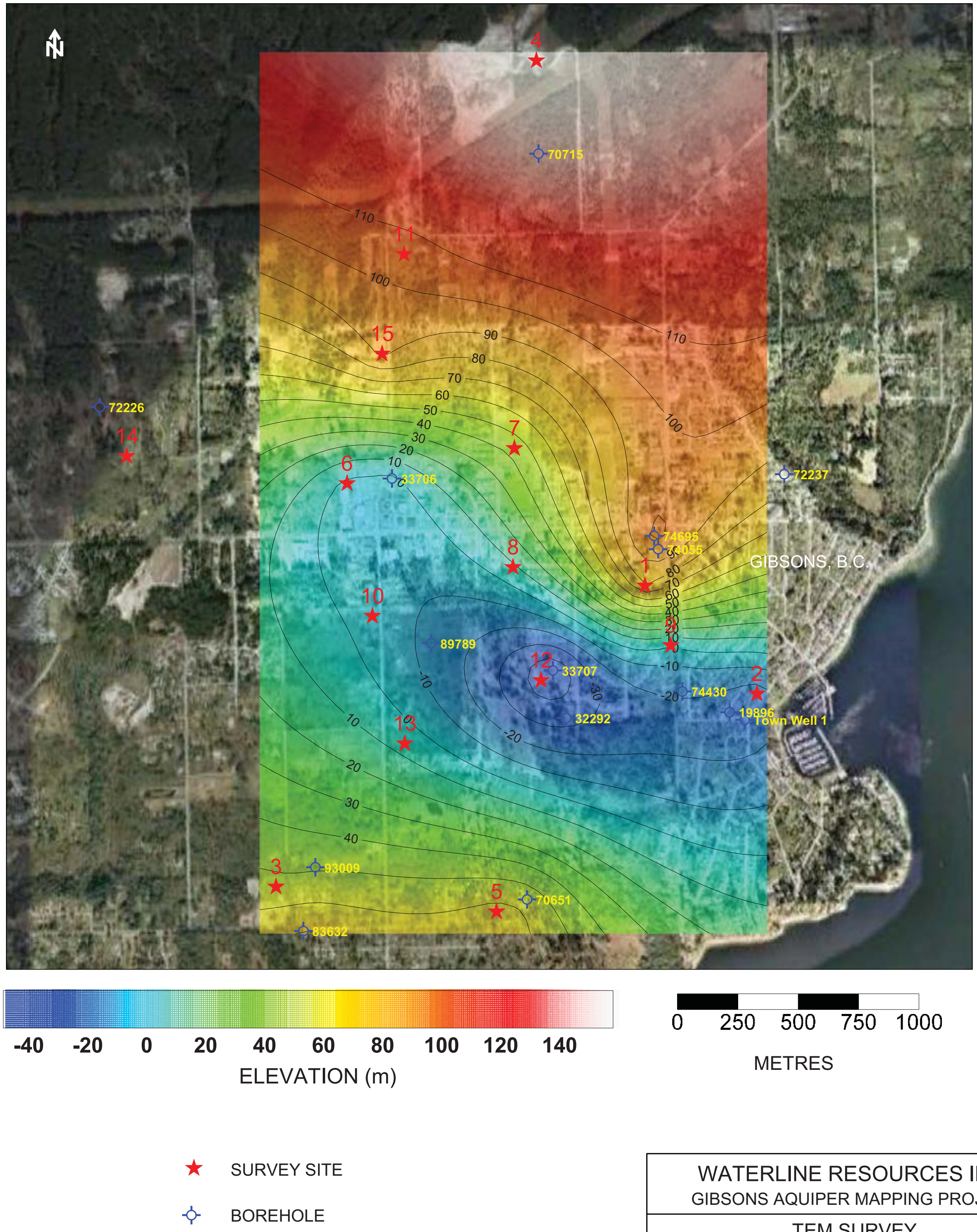
WATERLINE RESOURCES INC.
GIBSONS AQUIFER MAPPING PROJECT

DOWNHOLE SURVEY

BOREHOLE 33707 NATURAL GAMMA AND INDUCTION LOG

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009	VERT. SCALE 1:1,000	FIG. 18



WATERLINE RESOURCES INC.
GIBSONS AQUIPER MAPPING PROJECT

TEM SURVEY

BEDROCK CONTOUR MAP

FRONTIER GEOSCIENCES INC.

DATE: NOV. 2009	SCALE 1:25,000	FIG. 19

APPENDIX D

Monitoring Wells Reports and Grain Size Plots

Aquifer Mapping Program	Town of Gibsons	BOREHOLE: WL10-01 WID#33706
INSTALLED BY: Drillwell Enterprises Ltd.		PROJECT: WL09-1578
DRILL TYPE: Air Rotary	EAST: 461597.0 NORTH: 5473033.0	ELEVATION: 139.986 (masl)

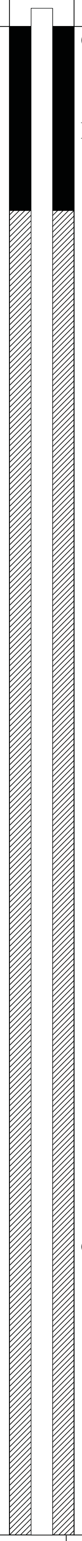
FILL TYPE: ▦ Slough ■ Bentonite ▨ Grout ▦ Backfill ░ Sand ▧ Peltonite ☐ Open Hole ■ Fill

SAMPLE TYPE: ■ Shelby Tube ▧ No Recovery ▦ Split Spoon ☰ Disturbed ▥ Dynamic Cone ▨ Core ☐ Grab Sample

Depth (ft)	Depth (m)	SOIL DESCRIPTION	SAMPLE NUMBER
		Hydrovac'd	
10	2 4	Sandy SILT, trace to some clay ... boulder @ 3.7 m bgl	
20	6	SAND and GRAVEL (TILL), trace silt, poorly graded, dense, brown-grey, moist	
30 40	8 10 12	SAND (TILL), some gravel, trace silt, poorly graded, dense, brown-grey, moist	25 30 35 40
	14	SAND and GRAVEL (TILL), very dense	42 45
50 60	16 18	Gravelly SAND, some water	50 55 60
	20	SAND, some silt	65
70	22	GRAVEL and SAND, trace silt	70
80 90 100	24 26 28 30	SAND, poorly graded, trace gravel and silt	75 80 85GS 90 95 100
110	32 34 36	SAND and GRAVEL, saturated, some water (water bearing zone)	105 110 115
120	38	SAND, trace to some gravel, well graded, grey-brown, wet	120 124
130	40	SAND and GRAVEL (TILL), trace silt, well graded, fine gravel, wet	125 130
140	42 44	SAND (TILL), trace gravel and silt, well graded, damp-moist, brown	133 135 140
150	46	GRAVEL (TILL), some sand, trace silt, well graded, subangular to subrounded, brownish grey	145 149 150
160	48	SAND, medium grained, loose, brownish grey	155 160

WELL INSTALLATION

Casing diam. = 0.076 m
Borehole diam. = 0.090 m



TYPE:	COMPLETION DEPTH: 140.21 (m)
LOGGED BY: Byron Molloy	COMPLETION DATE: 2010-Mar-23
CHECKED BY:	Page 1 of 3 Date printed: 31-May-2010

Waterline Resources Inc.

Aquifer Mapping Program	Town of Gibsons	BOREHOLE: WL10-01 WID#33706
INSTALLED BY: Drillwell Enterprises Ltd.		PROJECT: WL09-1578
DRILL TYPE: Air Rotary	EAST: 461597.0 NORTH: 5473033.0	ELEVATION: 139.986 (masl)

FILL TYPE: ▩ Slough ■ Bentonite ▨ Grout ▦ Backfill ▢ Sand ▧ Peltonite ☐ Open Hole ■ Fill

SAMPLE TYPE: ■ Shelby Tube ▧ No Recovery ▩ Split Spoon ▤ Disturbed ▥ Dynamic Cone ▨ Core ☐ Grab Sample

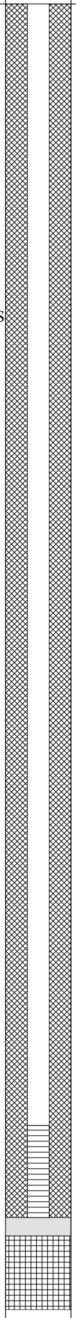
Depth (ft)	Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	WELL INSTALLATION Casing diam. = 0.076 m Borehole diam. = 0.090 m
				165	75 mm Schedule Solid PVC Casing
170	52			170	
	54	GRAVEL and SAND (TILL), trace silt, well graded, brownish grey, possible till, dry-damp		175GS	
180	56	SAND (TILL), trace gravel, dry damp		180	
		GRAVEL and SAND (TILL), trace silt, poorly graded, brownish grey, dry		185	
190	58			190	
	60			195	
200	62			200	
				205	
210	64			210	
	66			215	
220	68			220	
				225	
230	70	...rounded pebbles		230	
	72	GRAVEL (TILL), some sand, trace silt, poorly graded, brownish grey, dry		235 238	
240	74	SAND, trace gravel and silt, reddish brown, dry		240 242	
				245	
250	76	SAND, as above but grey colour			
		GRAVEL, some sand, trace silt, dry		250	
	78			255	
260	80			260	
	82	...decreasing gravel content		265	
270				270	
	84			275	
280	86			280	
	88	SAND, trace gravel, damp		285	
290	90			290	
				295	
300	92	... some gravel, trace silt @ 91.44 m		300	
	94	... well graded, brownish grey @92.96 m		305	
310	96			310	Bentonite Seal
320	98			315	

Waterline Resources Inc.	TYPE:	COMPLETION DEPTH: 140.21 (m)
	LOGGED BY: Byron Molloy	COMPLETION DATE: 2010-Mar-23
	CHECKED BY:	Page 2 of 3 Date printed: 31-May-2010

Aquifer Mapping Program	Town of Gibsons	BOREHOLE: WL10-01 WID#33706
INSTALLED BY: Drillwell Enterprises Ltd.		PROJECT: WL09-1578
DRILL TYPE: Air Rotary	EAST: 461597.0 NORTH: 5473033.0	ELEVATION: 139.986 (masl)

FILL TYPE: ▩ Slough ■ Bentonite ▨ Grout ▦ Backfill ░ Sand ▧ Peltonite ☐ Open Hole ■ Fill

SAMPLE TYPE: ■ Shelby Tube ▧ No Recovery ▩ Split Spoon ☰ Disturbed ▥ Dynamic Cone ▨ Core ☐ Grab Sample



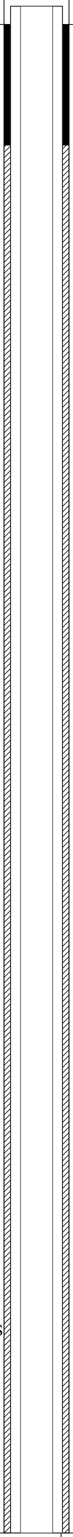
Depth (ft)	Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	WELL INSTALLATION Casing diam. = 0.076 m Borehole diam. = 0.090 m
					Slough
330					
		... interlayer sand, some gravel, occasional cobbles @ 100.58 m		330	
	102				
		... moist @ 102.11 m		335	
340	104				
				340	
	106			345	
350				350	
	108				
		... wet @ 108.20 m		355	
360	110				
				360GS	Static Water Level @ 110.64 m bgl
	112	SAND, some gravel, trace silt, well graded, brown grey, wet		365	
370				370	
	114				
		SAND, trace silt and clay, fine to very fine grained producing less water flow		375	
380	116				
				380	
	118				
390					
	120	SAND, some gravel, trace silt, producing water		390	
				395	
400	122				
				400	
	124			405	
410				410	
	126				
				415	
420	128				
		... lense of sand with trace silt @ 128 m		420	
	130			425	
430				430	
	132				
				435	
440	134				
				440	
	136				
		SAND, trace gravel, trace silt, producing water		445	Top of Screen @ 137.16 m bgl
450					75 mm Schedule 80 (20 Slot) PVC Screen
	138			450	
				455	Bottom of Screen @ 140.21 m bgl
460	140				Sand Pack
		... some silt and clay @ 141.12 m		460	
				463	
	142			465	
				467	
470		BEDROCK (Granodiorite)		470	Pea Gravel
	144				
		END OF HOLE AT 143.26 m Water Level Date 2010-Mar-27			
	146				
480					
	148				
490					

Waterline Resources Inc.	TYPE:	COMPLETION DEPTH: 140.21 (m)
	LOGGED BY: Byron Molloy	COMPLETION DATE: 2010-Mar-23
	CHECKED BY:	Page 3 of 3 Date printed: 31-May-2010

Aquifer Mapping Program	Town of Gibsons	BOREHOLE: WL10-02 WID#33707
INSTALLED BY: Drillwell Enterprises Ltd.		PROJECT: WL09-1578
DRILL TYPE: Air Rotary	EAST: 462263.0 NORTH: 5472238.0	ELEVATION: 108.102 (masl)

FILL TYPE: ▩ Slough ■ Bentonite ▨ Grout ▦ Backfill □ Sand ▧ Peltonite □ Open Hole ■ Fill

SAMPLE TYPE: ■ Shelby Tube ▧ No Recovery ▩ Split Spoon ▤ Disturbed ▥ Dynamic Cone ▨ Core □ Grab Sample



Depth (ft)	Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	WELL INSTALLATION
		CLAY, trace to some gravel, grey-brown, damp			Casing Stickup = 0.6 m
	2			5	Bentonite Seal
10	4			10	
				15	
20	6	... wet @ 6.1 m		20	
	8			25	
30	10	... damp @ 9.1 m		30	
		GRAVEL, some clay, trace silt, grey (producing water)		35	
40	12			40	
	14			45	
50	16	GRAVEL, some sand, trace silt and clay, grey, damp		50	
				55	
	18	SAND, trace to some gravel, grey, damp		57	
60				60	
	20	GRAVEL, some sand, trace silt, well graded, grey damp		65	
70	22			70	
				75	
80	24			80	
	26			85	
90	28	SAND, trace to some gravel, trace silt, brown-grey, moist		90	
	30			95	
100				100	152 mm Diameter Steel Casing
	32	GRAVEL (TILL?), some sand, trace silt and clay, grey-brown		105	
110	34			110	
	36			115	Grout
120				120	
	38			125	
130	40			130	
	42			135	
140		SAND (TILL?), some gravel, trace silt, grey-brown, damp		140GS	
	44	GRAVEL (TILL?), some sand, trace silt, grey-brown, damp		145	
150	46	... boulder @ 45.7 m		150	
	48	... lense, some gravel, grey-brown, damp @ 47.2 m		155	
160				160	

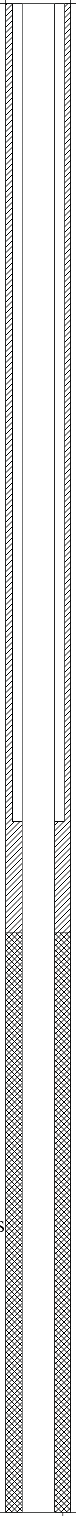
Waterline Resources Inc.	TYPE:	COMPLETION DEPTH: 123.40 (m)
	LOGGED BY: Byron Molloy	COMPLETION DATE: 8-Apr-2010
	CHECKED BY:	Page 1 of 4 Date printed: 31-May-2010

Aquifer Mapping Program	Town of Gibsons	BOREHOLE: WL10-02 WID#33707
INSTALLED BY: Drillwell Enterprises Ltd.		PROJECT: WL09-1578
DRILL TYPE: Air Rotary	EAST: 462263.0 NORTH: 5472238.0	ELEVATION: 108.102 (masl)

FILL TYPE: ▩ Slough ■ Bentonite ▨ Grout ▦ Backfill ▢ Sand ▧ Peltonite ☐ Open Hole ■ Fill

SAMPLE TYPE: ■ Shelby Tube ▧ No Recovery ▩ Split Spoon ▤ Disturbed ▥ Dynamic Cone ▨ Core ☐ Grab Sample

Depth (ft)	Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	WELL INSTALLATION
				165	75 mm Diameter Schedule 80 Solid PVC Pipe
170	52	SAND, fine grained, trace to some gravel, grey-brown, damp		170	
	54			175	
180	56			180	
				185	
190	58	... gravel lense, trace sand and silt, damp @ 57.9 m		190	
	60			195	
200	62			200	
				205	
210	64			210	
	66			215	
220	68			220	
				225	
230	70			230	
	72			235	
240	74			240	
				245	
250	76			250	
	78			255	
260	80	GRAVEL, some sand, trace silt, grey-brown, damp		260	
				265	
270	82	SAND, fine grained, some silt, dense, grey, dry		270	
	84			275	Static Water Level @ 84.43 m bgl
280	86	SAND, coarse grained, trace gravel, wet		280	
	88			285	
290	90			290	
				295GS	
300	92			300	
				302	
	94			305	
310	96			310	
				315	
320	98			320	
				325	



![Waterline Resources Inc.]

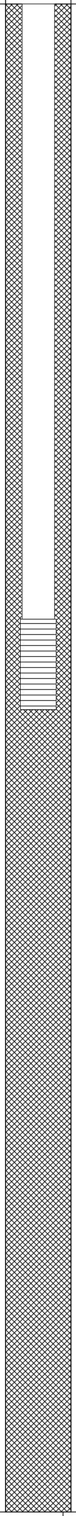
TYPE:	COMPLETION DEPTH: 123.40 (m)
LOGGED BY: Byron Molloy	COMPLETION DATE: 8-Apr-2010
CHECKED BY:	Page 2 of 4 Date printed: 31-May-2010

Aquifer Mapping Program	Town of Gibsons	BOREHOLE: WL10-02 WID#33707
INSTALLED BY: Drillwell Enterprises Ltd.		PROJECT: WL09-1578
DRILL TYPE: Air Rotary	EAST: 462263.0 NORTH: 5472238.0	ELEVATION: 108.102 (masl)

FILL TYPE: ▩ Slough ■ Bentonite ▨ Grout ▦ Backfill ☐ Sand ▧ Peltonite ☐ Open Hole ■ Fill

SAMPLE TYPE: ■ Shelby Tube ▧ No Recovery ▩ Split Spoon ☰ Disturbed ▥ Dynamic Cone ▨ Core ☐ Grab Sample

Depth (ft)	(m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	WELL INSTALLATION
330					Slough
				330	
	102	... well graded sand, some silt, trace gravel, producing water (~5 gpm) @ 102.1 m		335	
340	104	... fine to medium sand and sone silt @ 103.4 m		340	
	106			345	
350				350	
	108			353	
		GRAVEL, some sand (~5 gpm)		355	
360	110	SAND, some gravel (~5 gpm)		360	
	112	GRAVEL, some sand (~10 gpm)		365	
370	114	SAND, fine grained, some silt (~10 gpm)		370	
				375	
380	116	... gravel lense, some sand @ 115.8 m		380	
		... trace gravel @ 117.3 m			
	118			385	
390		... some gravel @ 118.9 m		390	
	120				Top of Casing @ 120.4 m bgl
		GRAVEL, some sand, trace silt and clay (10 gpm)		395	75 mm Diameter Schedule 80 Slotted PVC Screen
400	122			400	
					Bottom of Casing @ 123.4 m bgl
	124	SAND, well graded, trace silt and gravel		405	
410	126			410	
				415	
420	128			420	
	130	... fine to medium sand @ 131.1 m		425	
430	132			430	
		... fine grained, some sand, organics @ 132.6 m		435	
440	134			440	
	136			445	Slough
450	138			450	
	140			455	
460				460	
	142			465	
470	144			470	
	146			475	
480				480	
	148			485	
490					



TYPE:	COMPLETION DEPTH: 123.40 (m)
LOGGED BY: Byron Molloy	COMPLETION DATE: 8-Apr-2010
CHECKED BY:	Page 3 of 4 Date printed: 31-May-2010

Waterline Resources Inc.

Aquifer Mapping Program	Town of Gibsons	BOREHOLE: WL10-02 WID#33707
INSTALLED BY: Drillwell Enterprises Ltd.		PROJECT: WL09-1578
DRILL TYPE: Air Rotary	EAST: 462263.0 NORTH: 5472238.0	ELEVATION: 108.102 (masl)

FILL TYPE: ▩ Slough ■ Bentonite ▨ Grout ▦ Backfill ▯ Sand ▧ Peltonite ☐ Open Hole ■ Fill

SAMPLE TYPE: ■ Shelby Tube ▧ No Recovery ▩ Split Spoon ▤ Disturbed ▥ Dynamic Cone ▨ Core ☐ Grab Sample

Depth (ft)	Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER		WELL INSTALLATION
500 510	152 154 156	... no further organics @ 150.9 m		495 500 505 510 515	▩	
520 530 540 550 560 570 580 590 600 610 620 630 640 650	158 160 162 164 166 168 170 172 174 176 178 180 182 184 186 188 190 192 194 196 198	END OF HOLE AT 157.0 m Water Level Date 12-Apr-2010				

Waterline Resources Inc.	TYPE:	COMPLETION DEPTH: 123.40 (m)
	LOGGED BY: Byron Molloy	COMPLETION DATE: 8-Apr-2010
	CHECKED BY:	Page 4 of 4 Date printed: 31-May-2010

GRAIN SIZE DISTRIBUTION - SIEVE ANALYSIS

Project No.: WL09-1578
Facility / Site: Gibsons, Sunshine Coast BC
Project Description:
Client: Town of Gibsons
Sample ID: 320 Lower
Inv. Location:
Sample Depth (m): 0
Sampling Date: 2009-Nov-27
Sampled By: DvE/DD
Sample Type: Grab
Sample Description / Comments: Sand, medium brown, medium to coarse grained, Cobbles
Analysis Date: 2009-Dec-21
Analysis By: J. Foley

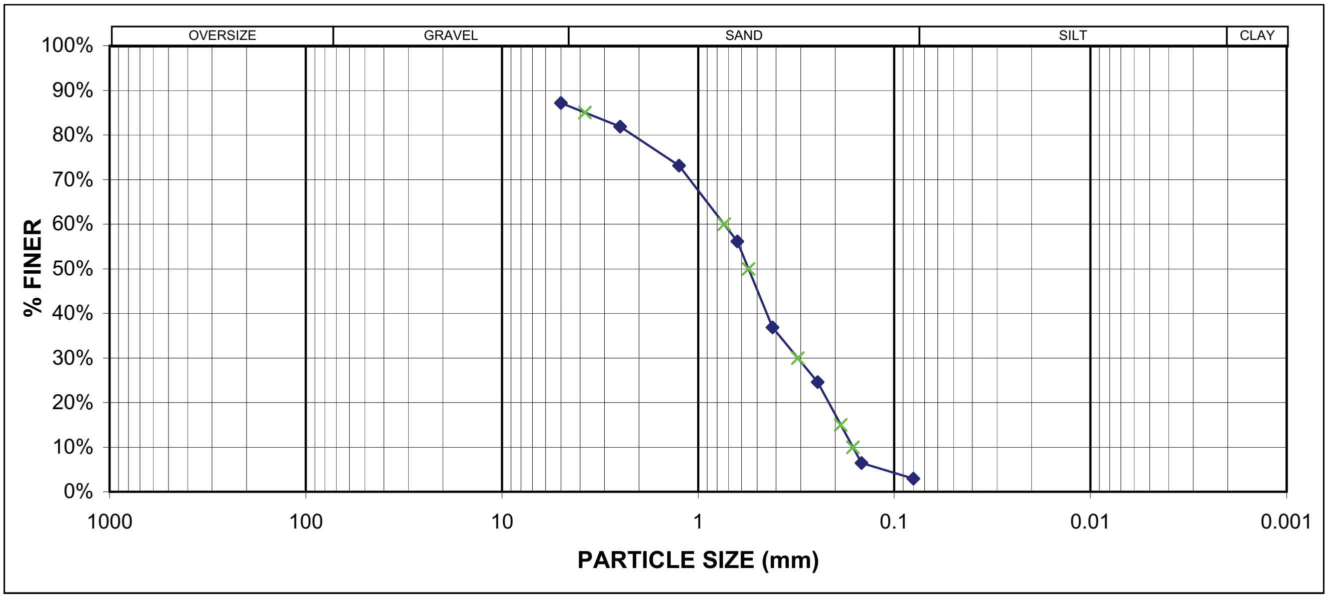
Weights (g)	
Pan	
Original Sample & Pan	
Dried Sample & Pan	

Maximum Particle Size (mm):
Dry Sample Weight (g): 0
Moisture Content: NA

Relative Percent	
Cobbles	0.0%
Gravel	13.4%
Sand	83.7%
Silt & Clay	2.9%

Sieve Size (mm)	Sieve #	Weight (g)			% Finer Than
		Clean Sieve	Sieve & Soil	Soil	
Oversize (>75 mm)					100.00%
5.000	NA	770	814	44	87.13%
2.500	NA	702	720	18	81.87%
1.250	NA	644	674	30	73.10%
0.630	NA	608	666	58	56.14%
0.417	NA	370	436	66	36.84%
0.246	60	376	418	42	24.56%
0.147	100	366	428	62	6.43%
0.080	180	624	636	12	2.92%
Pan	NA	484	494	10	0.00%
			Total	342	

Coefficients		
Percentage Smaller (mm)	d_{85}	3.775
	d_{60}	0.736
	d_{50}	0.552
	d_{30}	0.311
	d_{15}	0.187
	d_{10}	0.163
Uniformity: η = d_{60}/d_{10}		4.53
Curvature: C_c = $d_{30}^2/d_{60}d_{10}$		0.81



Hydraulic Conductivity Estimates (m/s)			
Hazen (Bear, 1972): K (m/s) = $10^{-2}(d_{10}\text{ (mm)})^2$	**Kozeny-Carman (Bear, 1972):** K (m/s) = $(\rho g/\mu)[n^3/(1-n)^2](d_m^2/180)$	**Slichter (Bear, 1972):** K (m/s) = $(10^{-2}g/\mu)[n^{3.287}](d_{10}^2)$	**Geometric Mean K =**
K = 2.6E-04 m/s	**K = 2.6E-04 m/s**	**K = 9.4E-05 m/s**	**1.9E-04**
Suited to fine to coarse sands (0.1 mm< d_{10} < 3 mm), with a η<5	Suited to a vriety of soils (d_{10} < 3 mm); not suited to clayey soils	Suited to silt and sand (0.01 mm< d_{10} < 5 mm)	(m/s)

Porosity (n) can be estimated from the uniformity (η) (Vukovic and Soro, 1992), where: n = 0.255(1+0.83η)
Porosity: n = 0.36471425 Viscosity: μ = 1

GRAIN SIZE DISTRIBUTION - SIEVE ANALYSIS

Project No.: WL09-1578 **Facility / Site:** Gibsons, Sunshine Coast BC
Project Description: **Client:** Town of Gibsons
Sample ID: 85ft **Inv. Location:** WL10-01 WID#33706 **Sample Depth (m):** 25.9
Sampling Date: 28-Mar-10 **Sampled By:** BM **Sample Type:** Grab
Sample Description / Comments:
Analysis Date: 31-May-10 **Analysis By:** J. Foley

Weights (g)	
Pan	
Original Sample & Pan	
Dried Sample & Pan	

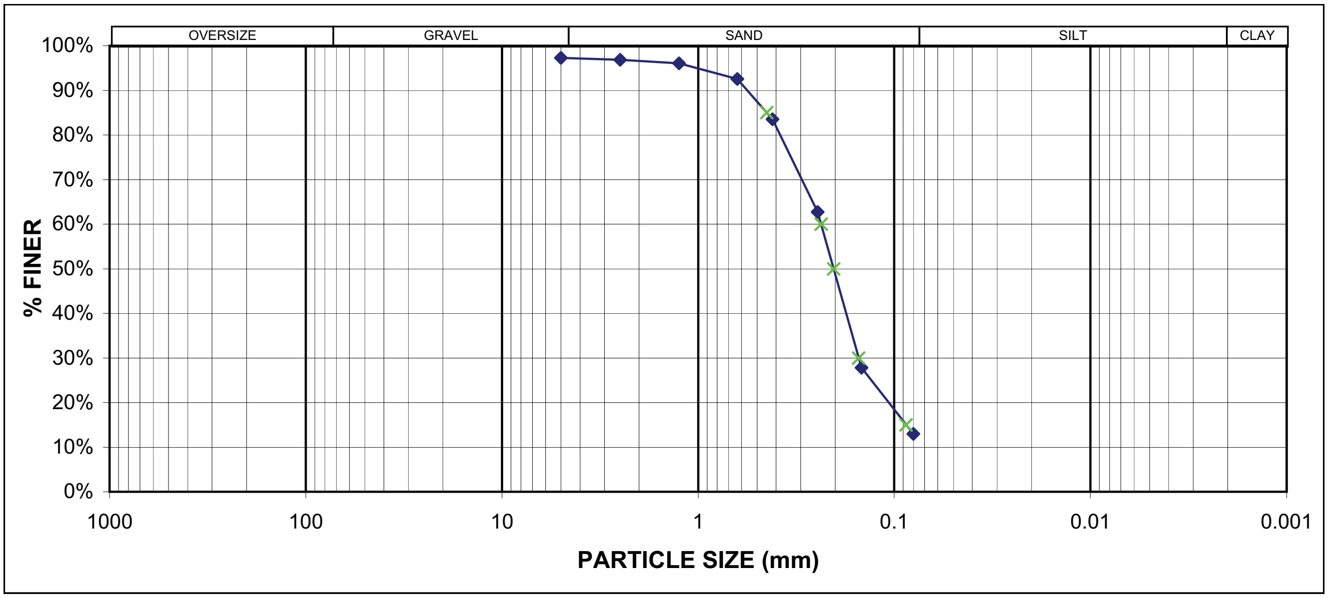
Maximum Particle Size (mm):

Dry Sample Weight (g): 0
Moisture Content: NA

Relative Percent	
Cobbles	0.0%
Gravel	2.8%
Sand	84.3%
Silt & Clay	12.9%

Sieve Size (mm)	Sieve #	Weight (g)			% Finer Than
		Clean Sieve	Sieve & Soil	Soil	
Oversize (>75 mm)					100.00%
5.000	NA	772	786	14	97.25%
2.500	NA	702	704	2	96.86%
1.250	NA	644	648	4	96.08%
0.630	NA	610	628	18	92.55%
0.417	NA	374	420	46	83.53%
0.246	NA	376	482	106	62.75%
0.147	NA	378	556	178	27.84%
0.080	NA	624	700	76	12.94%
Pan	NA	484	550	66	0.00%
			Total	510	

Coefficients		
Percentage Smaller (mm)	d_{85}	0.446
	d_{60}	0.236
	d_{50}	0.204
	d_{30}	0.152
	d_{15}	0.087
	d_{10}	#VALUE!
Uniformity: $\eta = d_{60}/d_{10}$		#VALUE!
Curvature: $C_c = d_{30}^2/d_{60}d_{10}$		#VALUE!



Hydraulic Conductivity Estimates (m/s)

Hazen (Bear, 1972):	Kozeny-Carman (Bear, 1972):	Slichter (Bear, 1972):	Geometric Mean K =
$K (m/s) = 10^{-2}(d_{10} (mm))^2$	$K (m/s) = (\rho g/\mu)[n^3/(1-n)^2](d_m^2/180)$	$K (m/s) = (10^{-2}g/\mu)[n^{3.287}](d_{10}^2)$	
K = #VALUE! m/s	**K = #VALUE! m/s**	**K = #VALUE! m/s**	**#VALUE!**
Suited to fine to coarse sands (0.1 mm< d_{10} < 3 mm), with a η<5	Suited to a variety of soils (d_{10} < 3 mm); not suited to clayey soils	Suited to silt and sand (0.01 mm< d_{10} < 5 mm)	(m/s)

Porosity (n) can be estimated from the uniformity (η) (Vukovic and Soro, 1992), where: n = 0.255(1+0.83η)
Porosity: n = #VALUE! Viscosity: μ = 1

GRAIN SIZE DISTRIBUTION - SIEVE ANALYSIS

Waterline Resources Inc.

Project No.: WL09-1578
Facility / Site: Gibsons, Sunshine Coast BC
Project Description:
Client: Town of Gibsons
Sample ID: 445 Upper
Inv. Location:
Sample Depth (m): 0
Sampling Date: 2009-Nov-27
Sampled By: DvE/DD
Sample Type: Grab
Sample Description / Comments: Sand, medium brown, medium to coarse grained, Cobbles
Analysis Date: 2009-Dec-21
Analysis By: J. Foley

Weights (g)	
Pan	
Original Sample & Pan	
Dried Sample & Pan	

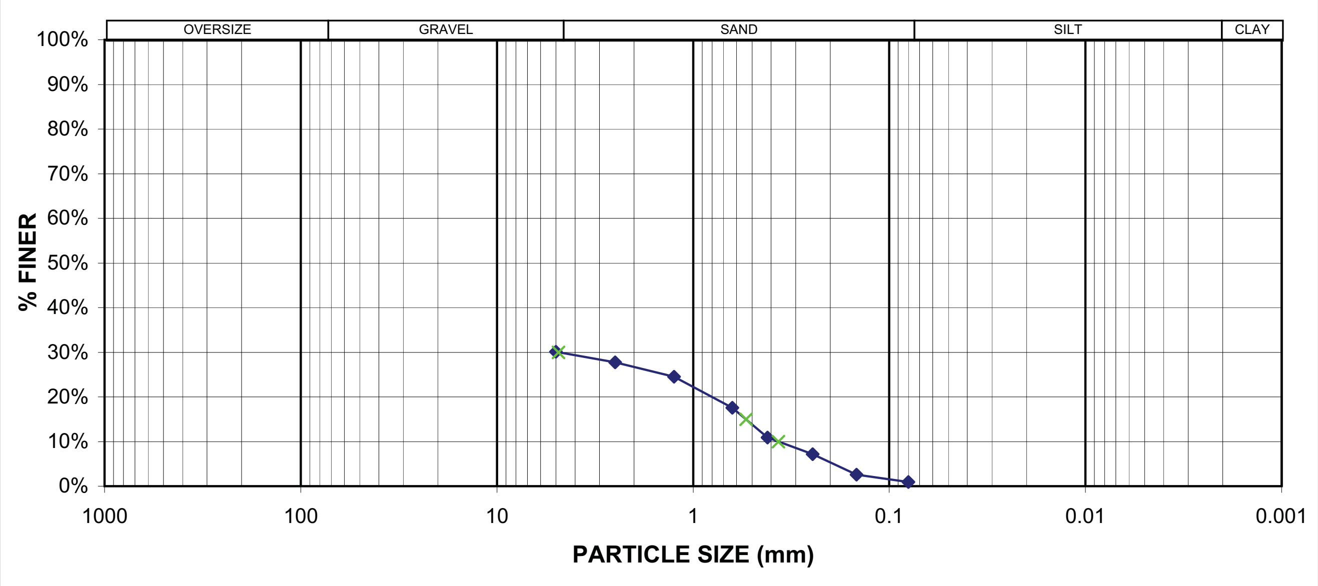
Maximum Particle Size (mm):

Dry Sample Weight (g): 0
Moisture Content: NA

Relative Percent	
Cobbles	0.0%
Gravel	70.1%
Sand	28.9%
Silt & Clay	0.9%

Sieve Size (mm)	Sieve #	Weight (g)			% Finer Than
		Clean Sieve	Sieve & Soil	Soil	
Oversize (>75 mm)					100.00%
5.000	NA	770	1374	604	30.09%
2.500	NA	702	722	20	27.78%
1.250	NA	644	672	28	24.54%
0.630	NA	608	668	60	17.59%
0.417	NA	372	430	58	10.88%
0.246	60	378	410	32	7.18%
0.147	100	368	408	40	2.55%
0.080	180	624	638	14	0.93%
Pan	NA	486	494	8	0.00%
			Total	864	

Coefficients		
Percentage Smaller (mm)	d_{85}	#N/A
	d_{60}	#N/A
	d_{50}	#N/A
	d_{30}	4.863
	d_{15}	0.537
	d_{10}	0.368
Uniformity: $\eta = d_{60}/d_{10}$		#N/A
Curvature: $C_c = d_{30}^2/d_{60}d_{10}$		#N/A



Hydraulic Conductivity Estimates (m/s)			
Hazen (Bear, 1972):	**Kozeny-Carman (Bear, 1972):**	**Slichter (Bear, 1972):**	**Geometric Mean K =**
K (m/s) = $10^{-2}(d_{10}\ (mm))^2$	K (m/s) = $(\rho g/\mu)[n^3/(1-n)^2](d_m^2/180)$	K (m/s) = $(10^{-2}g/\mu)[n^{3.287}](d_{10}^2)$	
K = 1.4E-03 m/s	**K = #N/A m/s**	**K = #N/A m/s**	**#N/A** (m/s)
Suited to fine to coarse sands (0.1 mm< d_{10} < 3 mm), with a η<5	Suited to a vriety of soils (d_{10} < 3 mm); not suited to clayey soils	Suited to silt and sand (0.01 mm< d_{10} < 5 mm)	

Porosity (n) can be estimated from the uniformity (η) (Vukovic and Soro, 1992), where: n = 0.255(1+0.83η)
Porosity: n = #N/A Viscosity: μ = 1

GRAIN SIZE DISTRIBUTION - SIEVE ANALYSIS

Project No.: WL09-1578
Facility / Site: Gibsons, Sunshine Coast BC
Project Description: Aquifer Mapping Program
Client: Town of Gibsons
Sample ID: 175ft
Inv. Location: WL10-01 WID#33706
Sample Depth (m): 53.3
Sampling Date: 28-Mar-10
Sampled By: BM
Sample Type: Grab
Sample Description / Comments:
Analysis Date: 31-May-10
Analysis By: J. Foley

Weights (g)	
Pan	
Original Sample & Pan	
Dried Sample & Pan	

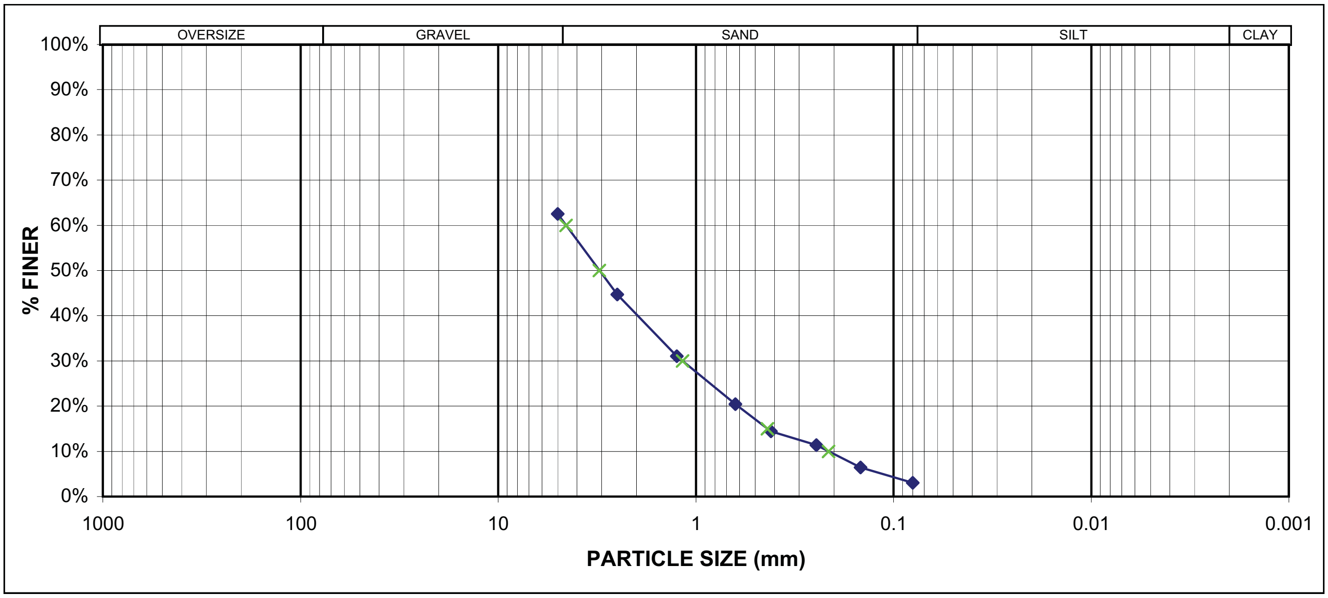
Maximum Particle Size (mm):

Dry Sample Weight (g): 0
Moisture Content: NA

Relative Percent	
Cobbles	0.0%
Gravel	39.6%
Sand	57.4%
Silt & Clay	3.0%

Sieve Size (mm)	Sieve #	Weight (g)			% Finer Than
		Clean Sieve	Sieve & Soil	Soil	
Oversize (>75 mm)					100.00%
5.000	NA	770	968	198	62.50%
2.500	NA	702	796	94	44.70%
1.250	NA	644	716	72	31.06%
0.630	NA	610	666	56	20.45%
0.417	NA	374	406	32	14.39%
0.246	NA	380	396	16	11.36%
0.147	NA	378	404	26	6.44%
0.080	NA	624	642	18	3.03%
Pan	NA	486	502	16	0.00%
			Total	528	

Coefficients		
Percentage Smaller (mm)	d_{85}	#N/A
	d_{60}	4.536
	d_{50}	3.073
	d_{30}	1.167
	d_{15}	0.435
	d_{10}	0.213
Uniformity: $\eta = d_{60}/d_{10}$		21.27
Curvature: $C_c = d_{30}^2/d_{60}d_{10}$		1.41



Hydraulic Conductivity Estimates (m/s)			
Hazen (Bear, 1972): K (m/s) = $10^{-2}(d_{10}\text{ (mm)})^2$ **K = 4.6E-04 m/s** Suited to fine to coarse sands (0.1 mm< d_{10} < 3 mm), with a η<5	**Kozeny-Carman (Bear, 1972):** K (m/s) = $(\rho g/\mu)[n^3/(1-n)^2](d_m^2/180)$ **K = 1.2E-04 m/s** Suited to a variety of soils (d_{10} < 3 mm); not suited to clayey soils	**Slichter (Bear, 1972):** K (m/s) = $(10^{-2}g/\mu)[n^{3.287}](d_{10}^2)$ **K = 5.3E-05 m/s** Suited to silt and sand (0.01 mm< d_{10} < 5 mm)	**Geometric Mean K =** **1.4E-04** (m/s)

Porosity (n) can be estimated from the uniformity (η) (Vukovic and Soro, 1992), where: n = 0.255(1+0.83η)
Porosity: n = 0.25984895 Viscosity: μ = 1

GRAIN SIZE DISTRIBUTION - SIEVE ANALYSIS

Project No.: WL09-1578 **Facility / Site:** Gibsons, Sunshine Coast BC
Project Description: **Client:** Town of Gibsons
Sample ID: 360ft **Inv. Location:** WL10-01 WID#33706 **Sample Depth (m):** 109.7
Sampling Date: 28-Mar-10 **Sampled By:** BM **Sample Type:** Grab
Sample Description / Comments:
Analysis Date: 31-May-10 **Analysis By:** J. Foley

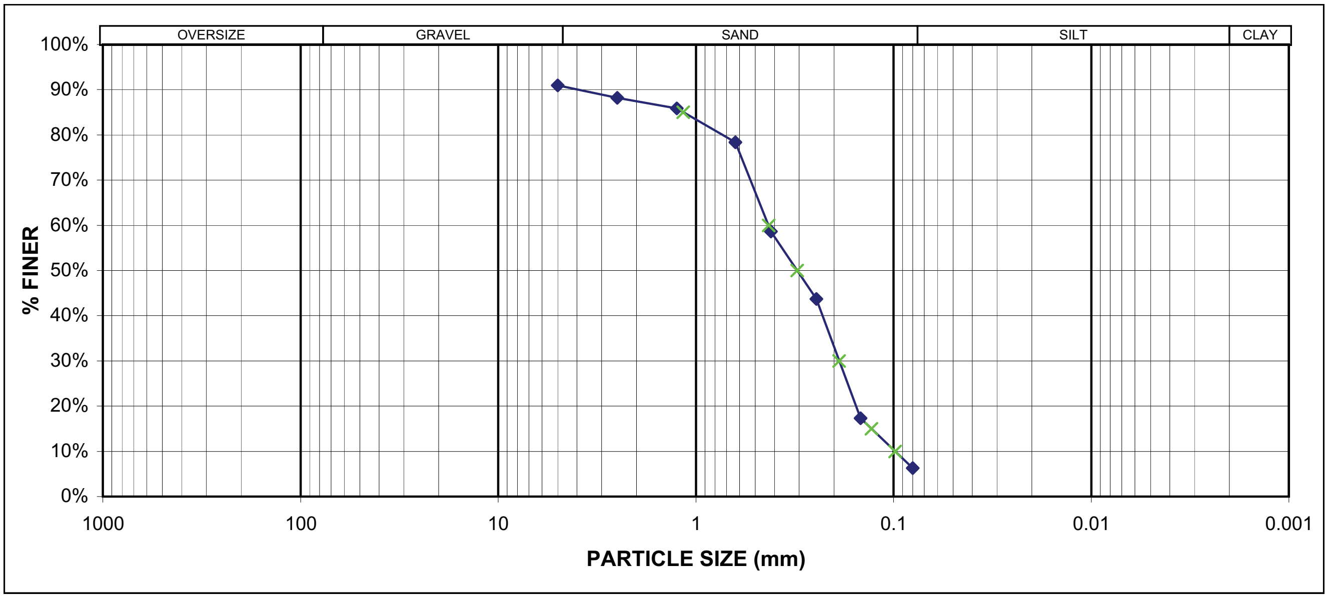
Weights (g)	
Pan	
Original Sample & Pan	
Dried Sample & Pan	

Maximum Particle Size (mm):
Dry Sample Weight (g): 0
Moisture Content: NA

Relative Percent	
Cobbles	0.0%
Gravel	9.3%
Sand	84.4%
Silt & Clay	6.3%

Sieve Size (mm)	Sieve #	Weight (g)			% Finer Than
		Clean Sieve	Sieve & Soil	Soil	
Oversize (>75 mm)					100.00%
5.000	NA	772	818	46	90.94%
2.500	NA	702	716	14	88.19%
1.250	NA	646	658	12	85.83%
0.630	NA	608	646	38	78.35%
0.417	NA	374	474	100	58.66%
0.246	NA	384	460	76	43.70%
0.147	NA	378	512	134	17.32%
0.080	NA	624	680	56	6.30%
Pan	NA	484	516	32	0.00%
			Total	508	

Coefficients		
Percentage Smaller (mm)	d_{85}	1.159
	d_{60}	0.429
	d_{50}	0.307
	d_{30}	0.188
	d_{15}	0.129
	d_{10}	0.098
Uniformity: $\eta = d_{60}/d_{10}$		4.37
Curvature: $C_c = d_{30}^2/d_{60}d_{10}$		0.84



Hydraulic Conductivity Estimates (m/s)

Hazen (Bear, 1972):	**Kozeny-Carman (Bear, 1972):**	**Slichter (Bear, 1972):**	**Geometric Mean K =**
K (m/s) = $10^{-2}(d_{10}\ (mm))^2$	K (m/s) = $(\rho g/\mu)[n^3/(1-n)^2](d_m^2/180)$	K (m/s) = $(10^{-2}g/\mu)[n^{3.287}](d_{10}^2)$	
K = 9.6E-05 m/s	**K = 9.8E-05 m/s**	**K = 3.5E-05 m/s**	**6.9E-05** (m/s)
Suited to fine to coarse sands (0.1 mm< d_{10} < 3 mm), with a η<5	Suited to a variety of soils (d_{10} < 3 mm); not suited to clayey soils	Suited to silt and sand (0.01 mm< d_{10} < 5 mm)	

Porosity (n) can be estimated from the uniformity (η) (Vukovic and Soro, 1992), where: n = 0.255(1+0.83η)
Porosity: n = 0.36794689 Viscosity: μ = 1

GRAIN SIZE DISTRIBUTION - SIEVE ANALYSIS

Project No.: WL09-1578 **Facility / Site:** Gibsons, Sunshine Coast BC
Project Description: **Client:** Town of Gibsons
Sample ID: 140ft **Inv. Location:** WL10-02 WID#33707 **Sample Depth (m):** 42.7
Sampling Date: 5-Apr-10 **Sampled By:** BM **Sample Type:** Grab
Sample Description / Comments:
Analysis Date: 31-May-10 **Analysis By:** J. Foley

Weights (g)	
Pan	
Original Sample & Pan	
Dried Sample & Pan	

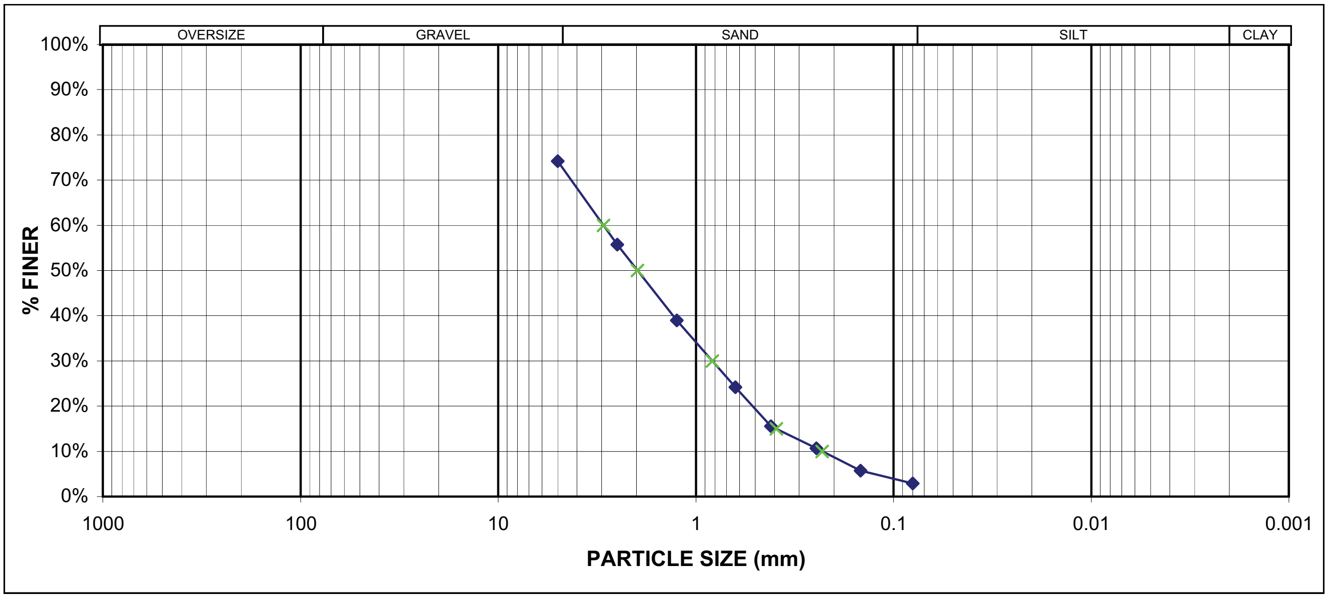
Maximum Particle Size (mm):

Dry Sample Weight (g): 0
Moisture Content: NA

Relative Percent	
Cobbles	0.0%
Gravel	27.9%
Sand	69.2%
Silt & Clay	2.9%

Sieve Size (mm)	Sieve #	Weight (g)			% Finer Than
		Clean Sieve	Sieve & Soil	Soil	
Oversize (>75 mm)					100.00%
5.000	NA	772	898	126	74.18%
2.500	NA	702	792	90	55.74%
1.250	NA	644	726	82	38.93%
0.630	NA	610	682	72	24.18%
0.417	NA	374	416	42	15.57%
0.246	NA	376	400	24	10.66%
0.147	NA	380	404	24	5.74%
0.080	NA	624	638	14	2.87%
Pan	NA	486	500	14	0.00%
			Total	488	

Coefficients		
Percentage Smaller (mm)	d_{85}	#N/A
	d_{60}	2.934
	d_{50}	1.973
	d_{30}	0.825
	d_{15}	0.392
	d_{10}	0.230
Uniformity: $\eta = d_{60}/d_{10}$		12.78
Curvature: $C_c = d_{30}^2/d_{60}d_{10}$		1.01



Hydraulic Conductivity Estimates (m/s)

Hazen (Bear, 1972):	Kozeny-Carman (Bear, 1972):	Slichter (Bear, 1972):	Geometric Mean K =
K (m/s) = $10^{-2}(d_{10}\ (mm))^2$	K (m/s) = $(\rho g/\mu)[n^3/(1-n)^2](d_m^2/180)$	K (m/s) = $(10^{-2}g/\mu)[n^{3.287}](d_{10}^2)$	
K = 5.3E-04 m/s	**K = 1.8E-04 m/s**	**K = 7.8E-05 m/s**	**1.9E-04** (m/s)
Suited to fine to coarse sands (0.1 mm< d_{10} < 3 mm), with a η<5	Suited to a variety of soils (d_{10} < 3 mm); not suited to clayey soils	Suited to silt and sand (0.01 mm< d_{10} < 5 mm)	

Porosity (n) can be estimated from the uniformity (η) (Vukovic and Soro, 1992), where: n = 0.255(1+0.83η)
Porosity: n = 0.27858788 Viscosity: μ = 1

GRAIN SIZE DISTRIBUTION - SIEVE ANALYSIS

Project No.: WL09-1578
Facility / Site: Gibsons, Sunshine Coast BC
Project Description:
Client: Town of Gibsons
Sample ID: 295ft
Inv. Location: WL10-02 WID#33707
Sample Depth (m): 89.9
Sampling Date: 5-Apr-10
Sampled By: BM
Sample Type: Grab
Sample Description / Comments:
Analysis Date: 31-May-10
Analysis By: J. Foley

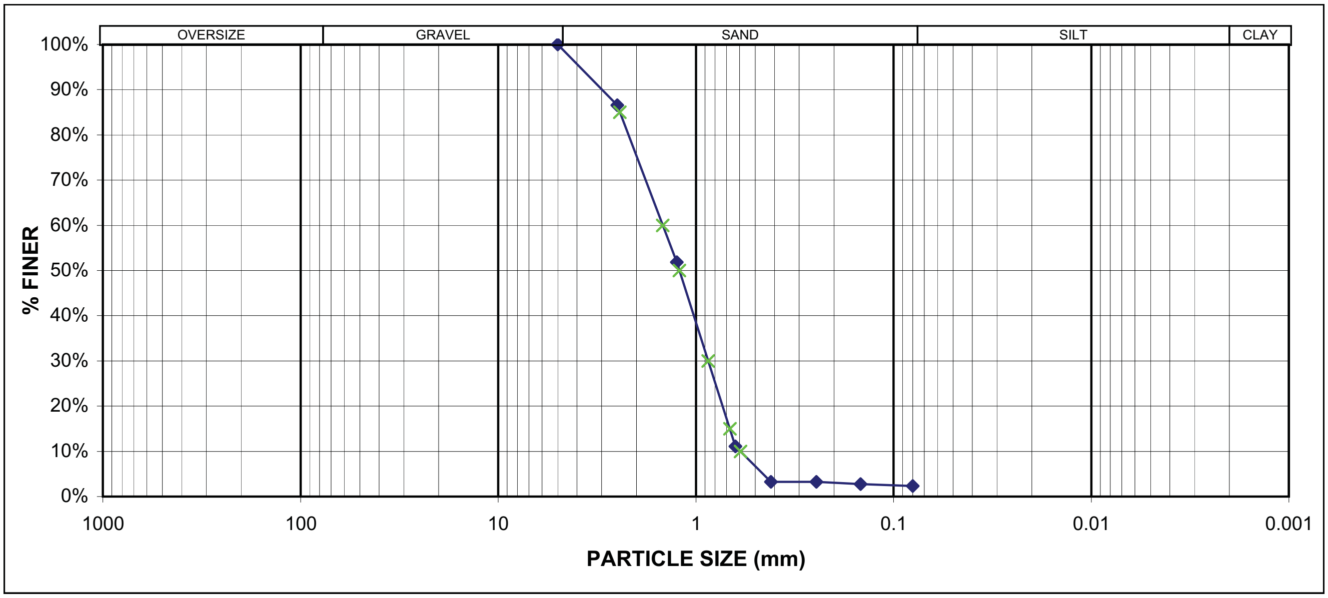
Weights (g)	
Pan	
Original Sample & Pan	
Dried Sample & Pan	

Maximum Particle Size (mm):
Dry Sample Weight (g): 0
Moisture Content: NA

Relative Percent	
Cobbles	0.0%
Gravel	1.4%
Sand	96.3%
Silt & Clay	2.3%

Sieve Size (mm)	Sieve #	Weight (g)			% Finer Than
		Clean Sieve	Sieve & Soil	Soil	
Oversize (>75 mm)					100.00%
5.000	NA	772	772	0	100.00%
2.500	NA	702	760	58	86.57%
1.250	NA	644	794	150	51.85%
0.630	NA	612	788	176	11.11%
0.417	NA	376	410	34	3.24%
0.246	NA	376	376	0	3.24%
0.147	NA	378	380	2	2.78%
0.080	NA	624	626	2	2.31%
Pan	NA	484	494	10	0.00%
			Total	432	

Coefficients		
Percentage Smaller (mm)	d_{85}	2.423
	d_{60}	1.471
	d_{50}	1.212
	d_{30}	0.866
	d_{15}	0.673
	d_{10}	0.594
Uniformity: $\eta = d_{60}/d_{10}$		2.47
Curvature: $C_c = d_{30}^2/d_{60}d_{10}$		0.86



Hydraulic Conductivity Estimates (m/s)			
Hazen (Bear, 1972): K (m/s) = $10^{-2}(d_{10}\text{ (mm)})^2$ **K = 3.5E-03 m/s** Suited to fine to coarse sands (0.1 mm< d_{10} < 3 mm), with a η<5	**Kozeny-Carman (Bear, 1972):** K (m/s) = $(\rho g/\mu)[n^3/(1-n)^2](d_m^2/180)$ **K = 6.1E-03 m/s** Suited to a variety of soils (d_{10} < 3 mm); not suited to clayey soils	**Slichter (Bear, 1972):** K (m/s) = $(10^{-2}g/\mu)[n^{3.287}](d_{10}^2)$ **K = 1.9E-03 m/s** Suited to silt and sand (0.01 mm< d_{10} < 5 mm)	**Geometric Mean K =** **3.5E-03** (m/s)
Porosity (n) can be estimated from the uniformity (η) (Vukovic and Soro, 1992), where: n = 0.255(1+0.83η) Porosity: n = 0.41580081 Viscosity: μ = 1			

APPENDIX E

Laboratory Analysis and Water Quality Evaluation

Table 3: Summary of Routine Surface Water and Groundwater Chemistry

Sample ID		WL10-01	WL10-01	WL10-01	WL10-02	WL10-02	WL10-02	School Board	MW06-1A	MW06-1A	MW06-1A	MW06-1A	MW06-1A	MW06-1B	MW06-1B	MW06-1B	MW06-1B	MW06-1B	MW06-2A	MW06-2A	MW06-2A	MW06-2A	GCDWQ[1]
Hydrostratigraphic Unit		Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Bedrock	Pre-Vashon	Pre-Vashon	Pre-Vashon	Vashon	Vashon	Vashon	Vashon	Vashon	Vashon	Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	
Date Sampled		8-Apr-10	16-Apr-11	10-Oct-12	12-Apr-10	17-Apr-11	10-Oct-12	23-Sep-09	24-Jan-07	16-Jan-09	22-Sep-09	13-Apr-11	10-Oct-12	24-Jan-07	28-Nov-08	22-Sep-09	13-Apr-11	10-Oct-12	24-Jan-07	16-Jan-09	23-Sep-09	14-Apr-11	
Parameter	**Units**																						
Conventional Parameters																	Dry						
pH, Laboratory	pH units	8	8.14	8.14	8.1	7.81	7.72	7.94	7.92	7.9	7.82	8.02	7.80	7.85	7.82	7.76		7.80	7.73	7.61	7.72	7.88	6.5:8.5
Conductivity	uS/cm	137	241	229	133	143	139	64	143	142	139	163	137	172	299	272		412	266	269	277	297	
True Color	CU	80			30			< 5	< 5	< 5	< 5			5.7	< 5	< 5			< 5	< 5	< 5		
Turbidity	NTU	49.1			25.8			12	111	45.5	2.8			>4000	0.64	260			66.6	14.2	0.35		
Hardness (Totalor dissolved) Ca	mg/L	33.3	23.6	24.9	47.2	43.8	44.5	17	50.8	49.2	51	51.6	51.0	97	108	234		157	91.4	91.5	98	98.9	
Total Dissolved Solids	mg/L	98	120		100	100		41	110	118	122	110		203	197	209			204	206	218	200	500
Total Alkalinity CaCO3	mg/L	62	110	111	51	43	45.9	33.4	64.4	58	56.3	59	57.8	75.1	101	101		130	62.3	49.8	51.6	52	
Bicarbonate Alkalinity HCO3	mg/L	76	140	136	63	52	56.0	40.8			68.7	72	70.5			124		158			62.9	63	
Carbonate Alkalinity CO3	mg/L	< 0.5	<0.5	<0.50	< 0.5	<0.5	<0.50	< 0.5			< 0.5	<0.5	<0.50			< 0.5		<0.50			< 0.5	<0.5	
Hydroxide Alkalinity OH	mg/L	< 0.5	<0.5	<0.50	< 0.5	<0.5	<0.50	< 0.5			< 0.5	<0.5	<0.50			< 0.5		<0.50			< 0.5	<0.5	
Dissolved Fluoride F	mg/L	0.15	0.32		0.05	0.08		< 0.05	0.085	0.086	< 0.05	0.12		0.205	0.108	< 0.05			0.042	0.035	< 0.05	0.06	1.5
Dissolved Chloride Cl	mg/L	3.9	5.1	3.9	2.6	3.3	5.0	1.06	3.52	3.38	3.73	4.4	3.5	4.91	28.7	3.73		47	43.8	47.5	50.8	49	250
Nitrate and Nitrite N	mg/L	0.02	<0.02 (1)	0.056	0.12	0.22 (1)	0.384	< 0.05			0.9	0.84 (1)	0.861			0.9		0.434			0.96	1.00 (1)	
Dissolved Nitrate N	mg/L	< 0.02	<0.02	0.056	0.11	0.22	0.384	< 0.05	0.868	0.945	0.9	0.83	0.861	0.715	0.776	0.9		0.428	0.969	0.967	0.96	1.00	10
Nitrite N	mg/L	0.006	<0.005 (1)	<0.0050	0.011	<0.005 (1)	<0.0050	< 0.002	0.0011	0.0094	< 0.002	0.011 (1)	<0.0050	0.0048	<0.0010	< 0.002		0.0063	0.0033	0.0095	< 0.002	<0.005 (1)	1
Dissolved Sulphate SO4	mg/L	4.8	6.2		16	17		< 0.5	7.15	6.4	6.35	7.4		9.78	8.2	6.35			4.86	4.02	3.73	3.8	500
Dissolved Bromide Br	mg/L																						
Metals Analysis (total or diss)		**Total**	**Dissolved**	**Dissolved**	**Total**	**Dissolved**	**Dissolved**	**Total**	**Dissolved**	**Dissolved**	**Total**	**Dissolved**	**Dissolved**	**Dissolved**	**Dissolved**	**Total**		**Dissolved**	**Dissolved**	**Dissolved**	**Total**	**Dissolved**	
Total Aluminum Al	mg/L	**0.619**	0.016	0.0136	**0.238**	0.008	0.0065	0.022	0.019	0.016	**0.5**	0.022	0.0041	**3.4**	<0.010	**16.4**		0.0038	0.013	<0.010	0.026	0.015	0.1
Total Antimony Sb	mg/L	0.0008	<0.0005	<0.00050	< 0.0005	<0.0005	<0.00050	< 0.0005	<0.0005	<0.0005	< 0.0005	<0.0005	<0.00050	<0.0005	<0.0005	< 0.0005		<0.00050	<0.0005	<0.0005	< 0.0005	<0.0005	0.006
Total Arsenic As	mg/L	0.0044	**0.0247**	**0.0298**	0.0033	0.0036	0.00386	< 0.001	0.00472	0.00477	0.003	0.0044	0.00451	0.00903	0.00553	0.01		0.00365	0.0016	0.00171	< 0.001	0.0015	0.01
Total Barium Ba	mg/L	0.03	0.010	0.0033	0.021	0.005	0.0037	0.001	<0.020	<0.020	0.01	0.031	0.0034	0.208	<0.020	0.24		0.0087	<0.020	<0.020	0.006	0.032	1
Total Beryllium Be	mg/L		<0.0001	<0.00010		<0.0001	<0.00010	< 0.0005			< 0.0005	<0.0001	<0.00010			0.0032		<0.00010			< 0.0005	<0.0001	
Total Bismuth Bi	mg/L		<0.001	<0.0010		<0.001	<0.0010	< 0.0005			< 0.0005	<0.001	<0.0010			0.0005		<0.0010			< 0.0005	<0.001	
Total Boron B	mg/L	<0.05	0.13	0.130	< 0.05	<0.05	<0.050	< 0.025	<0.10	<0.10	< 0.025	<0.05	<0.050	<0.10	<0.10	< 0.025		<0.050	<0.10	<0.10	< 0.025	<0.05	5
Total Cadmium Cd	mg/L	0.00004	0.00024	<0.000010	0.00001	0.00003	0.000023	< 0.00005	<0.00020	<0.00020	< 0.00005	0.00002	<0.000010	0.00033	<0.00020	0.0014		0.000031	<0.00020	<0.00020	< 0.00005	0.00002	0.005
Total Calcium Ca	mg/L	7.16	6.28	6.55	11.9	10.6	10.6	2.85	7.9	7.45	7.28	7.54	6.95	21.4	14.7	39.6		21.1	20	19.4	20.2	20.9	
Total Chromium Cr	mg/L	< 0.001	<0.001	<0.0010	< 0.001	<0.001	<0.0010	< 0.001	<0.0020	<0.0020	< 0.001	0.004	<0.0010	0.0043	<0.0020	0.011		<0.0010	<0.0020	<0.0020	< 0.001	<0.001	0.05
Total Cobalt Co	mg/L	0.0009	<0.0005	<0.00050	0.0007	<0.0005	<0.00050	< 0.0005			0.002	<0.0005	<0.00050			0.027		<0.00050			< 0.0005	<0.0005	
Total Copper Cu	mg/L	0.0086	0.0021	0.00100	0.0026	0.0011	0.00232	0.0018	0.0026	0.0034	0.0052	0.0043	0.00039	0.0254	<0.0010	0.051		0.00681	0.0046	0.0034	0.0014	0.0026	<1
Total Lanthanum La	mg/L							< 0.0005			0.0009					0.083					< 0.0005		
Total Iron Fe	mg/L	**1.73**	0.086	0.0489	**1.74**	0.014	0.0077	**0.71**	<0.030	0.033	**1.02**	0.050	0.0276	**7.230**	<0.030	**24.2**		<0.0050	<0.030	<0.030	< 0.05	0.027	0.3
Total Lead Pb	mg/L	0.0012	0.0003	<0.00020	0.0009	0.0004	0.00046	< 0.00025	<0.0010	<0.00050	0.0011	<0.0002	<0.00020	0.0081	<0.00050	0.055		<0.00020	<0.0010	<0.00050	0.0004	<0.0002	0.01
Total Lithium Li	mg/L							0.0008			0.0015					0.023					0.0012		
Total Magnesium Mg	mg/L	3.74	1.92	2.07	4.24	4.25	4.38	2.33	7.53	7.43	8.08	7.97	8.16	10.600	17.400	32.8		25.3	10.1	10.4	11.6	11.3	
Total Manganese Mn	mg/L	**0.056**	0.032	0.0178	0.019	0.002	<0.0010	**0.082**	0.0252	0.0053	**0.085**		0.0011	0.549	<0.0020	**2.77**		0.0033	0.0094	0.0112	0.0041	0.006	0.05
Total Mercury Hg	ug/L	< 0.0002	<0.00005	<0.000050	< 0.0002	<0.00005	<0.000050	< 0.02	<0.00020	<0.00020	< 0.02	<0.00005	<0.000050	<0.00020	<0.00020	< 0.02		<0.000050	<0.00020	<0.00020	< 0.02	<0.00005	0.001
Total Molybdenum Mo	mg/L	0.021	0.013	0.0127	0.004	0.004	0.0034	0.0014			0.0014	0.002	0.0017			0.0007		<0.0010			0.0009	<0.001	
Total Nickel Ni	mg/L	0.002	0.003	<0.0010	< 0.001	0.001	<0.0010	< 0.001			0.002	<0.001	<0.0010			0.047		0.0017			< 0.001	<0.001	
Total Phosphorus P	mg/L							< 0.075			0.19					2.92					< 0.075		
Total Rhenium Re	mg/L							< 0.0005			< 0.0005					< 0.0005					< 0.0005		
Total Potassium K	mg/L	3.15	1.58	1.45	2.68	3.26	3.51	2.43	2.39	2.48	1.99	3.18	2.34	4.18	2.94	5.32		4.53	3.96	3.88	3.29	4.03	
Total Rubidium Rb	mg/L							0.0007			0.0009					0.021					0.0008		
Total Sulphur S	mg/L	< 3		<3.0	4		5.2	< 5			< 5		<3.0			< 5		<3.0			< 5		
Total Selenium Se	mg/L	0.0003	<0.0001	<0.00010	0.0005	0.0006	0.00060	< 0.001	<0.0010	<0.0010	< 0.001	0.0005	0.00047	<0.0010	<0.0010	< 0.001		0.00011	<0.0010	<0.0010	< 0.001	0.0002	0.01
Total Silicon Si	mg/L		7.4	7.42		18.5	18.0	< 0.25			19.2	19.7	19.6			40.9		25.1			18.2	19.7	
Total Silver Ag	mg/L	< 0.00002	<0.00002	<0.000020	< 0.00002	<0.00002	<0.000020	< 0.0002			< 0.0002	<0.00002	<0.000020			0.0003		<0.000020			< 0.0002	<0.00002	
Total Sodium Na	mg/L	17.5	38.9	42.6	5.94	7.08	8.55	5.78	9.1	8.9	7.45	7.72	8.00	16.3	13.9	14.5		15.8	10.3	10	9.02	8.94	200
Total Strontium Sr	mg/L		0.041	0.0408		0.048	0.0473	0.0098			0.031	0.038	0.0306			0.372		0.133			0.094	0.105	
Total Tellurium Te	mg/L							< 0.001			< 0.001					< 0.001					< 0.001		
Total Thallium Tl	mg/L		<0.00005	<0.000050		<0.00005	<0.000050	< 0.0001			< 0.0001	<0.00005	<0.000050			0.0003		<0.000050			< 0.0001	<0.00005	
Total Thorium Th	mg/L							< 0.00025			< 0.00025					0.029					< 0.00025		
Total Tin Sn	mg/L		<0.005	<0.0050		<0.005	<0.0050	< 0.0005			< 0.0005	<0.005	<0.0050			< 0.0005		<0.0050			0.0006	<0.005	
Total Titanium Ti	mg/L		<0.005	<0.0050		<0.005	<0.0050	< 0.001			0.026	<0.005	<0.0050			0.057		<0.0050			< 0.001	<0.005	
Total Tungsten W	mg/L							< 0.0005			< 0.0005					< 0.0005					< 0.0005		
Total Uranium U	mg/L	0.0019	<0.0001	<0.00010	0.0004	0.0003	0.00025	< 0.00025	0.00018	0.00022	< 0.00025	0.0002	0.00017	0.00137	0.00049	0.013		0.00078	0.00027	0.00029	0.0003	0.0003	0.02
Total Cesium Cs	mg/L							< 0.0005			< 0.0005					0.002					< 0.0005		
Total Vanadium V	mg/L	0.014	<0.005	<0.0050	0.014	0.014	0.0118	< 0.0005			0.013	0.011	0.0112			0.04		0.0143			0.0054	0.006	
Total Zinc Zn	mg/L	0.011	0.177	0.0154	0.013	0.048	0.0098	< 0.005	<0.050	<0.050	0.011	0.025	<0.0050	<0.050	<0.050	0.16		0.0151	<0.050	<0.050	0.005	0.035	5
Total Zirconium Zr	mg/L		<0.0005	<0.00050		<0.0005	<0.00050	< 0.0005			< 0.0005	<0.0005	<0.00050			0.0005		<0.00050			< 0.0005	<0.0005	

Notes: 1. GCDWQ - Guidelines for Canadian Drinking Water Quality, August 2012.
Underlined and **bolded** values indicate exceedance of the GCDWQ.

Table 3: Summary of Routine Surfac

Sample ID		MW06-2A	MW06-2A	MW06-2B	MW06-2B	MW06-2B	MW06-2B	MW06-2B	Town Well 1	Town Well 1	Town Well 1	Town Well 1	Town Well 1	Town Well 1	Town Well 1	Town Well 1	Town Well 1	Town Well 1	Town Well 1	GCDWQ^1	Town Well 1
Hydrostratigraphic Unit		Pre-Vashon	Pre-Vashon	Vashon	Vashon	Vashon	Vashon	Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon		Pre-Vashon
Date Sampled		6-Jun-11	10-Oct-12	24-Jan-07	28-Nov-08	23-Sep-09	19-Apr-11	10-Oct-12	2-Apr-03	23-Jun-03	4-Aug-03	9-Dec-03	22-Mar-04	16-Jun-04	20-Sep-04	5-Jan-05	29-Mar-05	29-Jun-05	21-Sep-05		19-Jan-06
Parameter	**Units**																				
Conventional Parameters																					
pH, Laboratory	pH units		7.73	6.86	6.86	6.82		6.92	7.17	7.3	7.67	7.12	7.36	7.52	7.15	7.72	7.15	7.4	7.58	6.5:8.5	7.63
Conductivity	uS/cm		294	128	115	131		118	120	123	96	118	118	102	127	89	118	116	90		111
True Color	CU			< 5	< 5	< 5			< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5		< 5
Turbidity	NTU			>4000	3.41	917			< 0.1	< 0.1	0.16	< 0.1	< 0.1	< 0.1	0.17	< 0.1	< 0.1	< 0.1	0.1		0.11
Hardness (Totalor dissolved) Ca	mg/L		104	96.8	32.5	46		33.8	38	40	30	39	35	31	28	36	48	37	31		35
Total Dissolved Solids	mg/L			164	83	136			100	118	87	113	92	98	101	44	107	109	90	500	81
Total Alkalinity CaCO3	mg/L		54.8	26.8	24.8	27.4		25.1	46.7	46.7	35.3	42	45.2	49	45.2	40.9	42.2	48.1	35.2		38.7
Bicarbonate Alkalinity HCO3	mg/L		66.9			33.5		30.7	57	56.5	43.1	51.3	55.1	59	55.2	49.9	51.4	58.7	42.9		47.2
Carbonate Alkalinity CO3	mg/L		<0.50			< 0.5		<0.50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5		< 0.5
Hydroxide Alkalinity OH	mg/L		<0.50			< 0.5		<0.50	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5		< 0.5
Dissolved Fluoride F	mg/L	0.146		<0.020	<0.020	< 0.05	0.0769	**2.59**	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.09	0.06	0.1	0.1	< 0.05	0.06	1.5	0.06
Dissolved Chloride Cl	mg/L	3.823	53	13.4	11.2	17	16.64	12	5.9	5.3	2.2	8.2	4.8	4.5	2.2	2	5.4	4.4	2.09	250	3.6
Nitrate and Nitrite N	mg/L		0.990			1.89			0.91	0.82	0.26	1.2	0.74	0.73	0.31	0.28	0.84	0.69	0.29		0.53
Dissolved Nitrate N	mg/L	0.60	0.990	2.50	2.15	1.87	2.698	2.59	0.91	0.82	0.26	1.2	0.74	0.73	0.31	0.28	0.84	0.69	0.29	10	0.53
Nitrite N	mg/L	0.0234	<0.0050	<0.0010	<0.0010	0.021	0.0266	<0.0050	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	<0.002	< 0.002	< 0.002	1	< 0.002
Dissolved Sulphate SO4	mg/L	3.2		3.92	4.06	3.55	1.97		7	6.8	7.4	8	7.3	7.2	7.7	7.1	6.5	6.6	6.96	500	6.9
Dissolved Bromide Br	mg/L	0.0203					0.0468														
Metals Analysis (total or diss)			**Dissolved**	**Dissolved**	**Dissolved**	**Total**		**Dissolved**	**Total**	**Total**	**Total**	**Total**	**Total**	**Total**	**Total**	**Total**	**Total**	**Total**	**Total**		**Total**
Total Aluminum Al	mg/L		0.0033	**2.32**	<0.010	**4.14**		<0.0030	0.01	0.008	0.011	< 0.005	< 0.005	< 0.005	< 0.005	0.062	0.009	< 0.005	< 0.005	0.1	0.008
Total Antimony Sb	mg/L		<0.00050	<0.0005	<0.0005	< 0.0005		<0.00050	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001	< 0.001	< 0.001	0.006	< 0.001
Total Arsenic As	mg/L		0.00145	0.00163	0.00016	< 0.001		0.00013	0.002	0.003	0.004	0.002	0.003	0.003	0.004	0.004	0.003	0.003	0.004	0.01	0.003
Total Barium Ba	mg/L		0.0077	0.73	<0.020	0.049		0.0037	0.003	0.003	0.002	0.002	0.002	0.003	0.002	0.002	0.003	0.002	0.002	1	0.003
Total Beryllium Be	mg/L		<0.00010			< 0.0005		<0.00010													
Total Bismuth Bi	mg/L		<0.0010			< 0.0005		<0.0010													
Total Boron B	mg/L		<0.050	<0.10	<0.10	< 0.025		<0.050	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	5	< 0.05
Total Cadmium Cd	mg/L		0.000022	<0.00020	<0.00020	< 0.00005		0.000109	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.005	< 0.0002
Total Calcium Ca	mg/L		21.7	29.3	9.17	11.5		9.27	7.02 (diss)	7.42 (diss)	6.09 (diss)	7.27 (diss)	6.67 (diss)	5.9 (diss)	5.96 (diss)	7.87 (diss)	9.34 (diss)	7.13 (diss)	6.99 (diss)		7 (diss)
Total Chromium Cr	mg/L		<0.0010	<0.0020	<0.0020	0.004		<0.0010	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.05	< 0.001
Total Cobalt Co	mg/L		<0.00050			0.0021		<0.00050													
Total Copper Cu	mg/L		0.00491	0.0128	<0.0010	0.017		0.00057	0.014	0.012	0.007	0.007	0.006	0.008	0.004	0.004	0.004	0.007	0.003	<1	0.005
Total Lanthanum La	mg/L					0.0026															
Total Iron Fe	mg/L		0.0123	**1.89**	<0.030	**5.83**		0.0072	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.3	< 0.05
Total Lead Pb	mg/L		<0.00020	0.0058	<0.00050	0.003		<0.00020	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.01	< 0.001
Total Lithium Li	mg/L					0.0026															
Total Magnesium Mg	mg/L		12.2	5.72	2.34	4.21		2.58	5.67/5.02 (diss)	6.39/5.23 (diss)	3.91/3.56 (diss)	5.76/5.14 (diss)	5.3/4.49 (diss)	4.89/3.93 (diss)	3.8/3.22 (diss)	4/3.91 (diss)	6.14/5.86 (diss)	5.05/4.59 (diss)	3.57/3.35 (diss)		4.62/4.18 (diss)
Total Manganese Mn	mg/L		0.0036	0.0722	<0.0020	**0.101**		0.0012	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	0.05	< 0.001
Total Mercury Hg	ug/L		<0.000050	<0.00020	<0.00020	< 0.02		<0.000050	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.001	< 0.02
Total Molybdenum Mo	mg/L		<0.0010			< 0.0005		<0.0010													
Total Nickel Ni	mg/L		<0.0010			0.003		<0.0010													
Total Phosphorus P	mg/L					0.32															
Total Rhenium Re	mg/L					< 0.0005															
Total Potassium K	mg/L		4.43	3.98	1.06	1.68		1.22	2.31	2.41	2.08	2.32	2.1	1.6	1.9	2.3	2.7	2.1	2		1.6
Total Rubidium Rb	mg/L					0.004															
Total Sulphur S	mg/L		<3.0			< 5		<3.0													
Total Selenium Se	mg/L		0.00015	<0.0010	<0.0010	< 0.001		<0.00010	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.01	< 0.001
Total Silicon Si	mg/L		19.2			13.3		8.93	36.2	41.9	36.8	43.2	43.5	37.4	36.6	43.4	46	42.4	38.2		20.2
Total Silver Ag	mg/L		<0.000020			< 0.0002		<0.000020													
Total Sodium Na	mg/L		9.63	10	7.7	8.2		8.05	6.38	6.91	5.5	6.93	6.01	5.1	4.92	4.99	7.75	6.34	5.14	200	5.87
Total Strontium Sr	mg/L		0.102			0.165		0.125													
Total Tellurium Te	mg/L					< 0.001															
Total Thallium Tl	mg/L		<0.000050			< 0.0001		<0.000050													
Total Thorium Th	mg/L					0.0003															
Total Tin Sn	mg/L		<0.0050			0.0006		<0.0050													
Total Titanium Ti	mg/L		<0.0050			0.16		<0.0050													
Total Tungsten W	mg/L					< 0.0005															
Total Uranium U	mg/L		0.00030	0.00119	<0.00010	0.0003		<0.00010	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.02	< 0.0005
Total Cesium Cs	mg/L					< 0.0005															
Total Vanadium V	mg/L		0.0053			0.015		<0.0050													
Total Zinc Zn	mg/L		0.0113	<0.050	<0.050	0.035		0.0052	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	5	< 0.005
Total Zirconium Zr	mg/L		<0.00050			0.001		<0.00050													

Notes: 1. GCDWQ - Guidelines for Canadian

Underlined and **bolded** values indicate excee

Table 3: Summary of Routine Surfac

Sample ID		**Town Well 1**	**Town Well 1**	**Town Well 1**	**Town Well 1**	**Town Well 1**	**Town Well 1**	**Town Well 2**	**Town Well 2**	**Town Well 2**	**Town Well 2**	**Town Well 3**	**Town Well 3**	**Town Well 3**	**Town Well 3**	**Town Well 3**	**Town Well 3**	**Town Well 3**	**GCDWQ[1]**	**Town Well 3**	**Town Well 3**
Hydrostratigraphic Unit		Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Duplicate	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon		Pre-Vashon	Pre-Vashon
Date Sampled		11-Apr-06	24-Jan-07	24-Sep-09	13-Apr-11	10-Oct-12	10-Oct-12	16-Jan-76	13-Apr-11	9-Jun-11	10-Oct-12	26-Nov-84	2-Apr-03	23-Jun-03	4-Aug-03	9-Dec-03	22-Mar-04	16-Jun-04		20-Sep-04	5-Jan-05
Parameter	**Units**																				
Conventional Parameters																					
pH, Laboratory	pH units	7.5	7.49	7.75	7.81	7.69	7.69	7.3			7.74	7.5	7.2	7.23	7.41	6.76	7.41	7.69	6.5:8.5	7.17	7.46
Conductivity	uS/cm	121	98	125	104	98.4	97.4	104 (specific)			142		119	126	126	116	127	80		128	119
True Color	CU	< 5	< 5	< 5				<5				<5	< 5	< 5	< 5	< 5	< 5	< 5		< 5	< 5
Turbidity	NTU	0.12	< 0.1	0.1				0.1					< 0.1	0.11	0.11	0.12	0.11	< 0.1		0.35	0.2
Hardness (Totalor dissolved) Ca	mg/L	39	32	44	32.1	34.0	34.1	33.9			50.2	42.8	37	40	37	36	39	38		36	44
Total Dissolved Solids	mg/L	94	65	121	76							120	84	129	110	106	94	101	500	83	101
Total Alkalinity CaCO3	mg/L	40.8	38.8	45.7	35	38.5	37.3	41			54.0	48	46.1	46.2	42.9	41.7	46	43		45.4	50
Bicarbonate Alkalinity HCO3	mg/L	49.8	47.3	55.7	43	47.0	45.5				65.9		56.3	56.4	52.3	50.9	56.1	52		55.4	61
Carbonate Alkalinity CO3	mg/L	< 0.5	< 0.5	< 0.5	<0.5	<0.50	<0.50				<0.50		< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5		< 0.5	< 0.5
Hydroxide Alkalinity OH	mg/L	< 0.5	< 0.5	< 0.5	<0.5	<0.50	<0.50				<0.50		< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5		< 0.5	< 0.5
Dissolved Fluoride F	mg/L	0.08	< 0.05	< 0.05	0.09			<0.1	0.0769	0.155			< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.1	1.5	0.06	0.09
Dissolved Chloride Cl	mg/L	4.71	2.15	5.89	2.9	2.2	2.4	2.6	8.024	8.61	7.7	3.5	6	5.8	5.6	7.9	6	6.1	250	5.6	5.6
Nitrate and Nitrite N	mg/L	0.7	0.32	0.75	0.32 (1)	0.377	0.342				0.895	0.003	0.9	0.9	0.88	1.2	0.93	0.99		0.88	0.9
Dissolved Nitrate N	mg/L	0.7	0.32	0.75	0.32	0.377	0.342	0.5	0.88	0.896	0.895	2.5	0.9	0.9	0.88	1.2	0.93	0.99	10	0.88	0.9
Nitrite N	mg/L	< 0.002	< 0.002	< 0.002	<0.005 (1)	<0.0050	<0.0050	<0.005	0.014	0.016	<0.0050		< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	1	< 0.002	< 0.002
Dissolved Sulphate SO4	mg/L	6.63	6.94	6.13	7.0			5.0	2.3	2.3			7	6.7	6.8	8	7.2	6.9	500	6.8	6.8
Dissolved Bromide Br	mg/L								0.0	0.0											
Metals Analysis (total or diss)		**Total**	**Total**	**Total**	**Dissolved**			**Dissolved**				**Total**	**Total**	**Total**	**Total**	**Total**	**Total**	**Total**		**Total**	**Total**
Total Aluminum Al	mg/L	< 0.005	0.009	< 0.005	<0.003	<0.0030	<0.0030				<0.0030		< 0.005	0.007	0.009	< 0.005	< 0.005	< 0.005	0.1	< 0.005	0.063
Total Antimony Sb	mg/L	< 0.001	< 0.001	< 0.0005	<0.0005	<0.00050	<0.00050				<0.00050		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.006	< 0.001	< 0.001
Total Arsenic As	mg/L	0.003	0.004	< 0.001	0.0039	0.00393	0.00402				0.00214		0.002	0.002	0.002	0.002	0.002	0.002	0.01	0.002	0.003
Total Barium Ba	mg/L	0.003	0.003	0.003	0.002	0.0025	0.0023				0.0032		0.002	0.002	0.002	0.002	0.003	0.003	1	0.002	0.003
Total Beryllium Be	mg/L			< 0.0005	<0.0001	<0.00010	<0.00010				<0.00010										
Total Bismuth Bi	mg/L			< 0.0005	<0.001	<0.0010	<0.0010				<0.0010										
Total Boron B	mg/L	< 0.05	< 0.05	< 0.025	<0.05	<0.050	<0.050				<0.050		< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	5	< 0.05	< 0.05
Total Cadmium Cd	mg/L	< 0.0002	< 0.0002	< 0.00005	<0.00001	0.000042	0.000041				0.000193		< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.005	< 0.0002	< 0.0002
Total Calcium Ca	mg/L	6.92 (diss)	6.8 (diss)	8.53	6.95	7.37	7.42	6.5			9.27		6.76	7.31	6.53	6.64	6.98	6.73		6.52	8.24
Total Chromium Cr	mg/L	< 0.001	< 0.001	< 0.001	<0.001	<0.0010	<0.0010				<0.0010		< 0.001	< 0.001	< 0.001	< 0.001	0.001	< 0.001	0.05	< 0.001	< 0.001
Total Cobalt Co	mg/L			< 0.0005	<0.0005	<0.00050	<0.00050				<0.00050										
Total Copper Cu	mg/L	0.004	0.002	0.026	0.0006	0.00070	0.00072				0.00265		0.005	0.004	0.003	0.003	0.004	0.003	<1	0.005	0.004
Total Lanthanum La	mg/L			< 0.0005																	
Total Iron Fe	mg/L	< 0.05	< 0.05	< 0.05	<0.005	<0.0050	<0.0050	0.1/0.1			0.0122	<0.2	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.3	< 0.05	< 0.05
Total Lead Pb	mg/L	< 0.001	< 0.001	< 0.00025	0.0010	0.00160	0.00159				0.00386		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.01	< 0.001	< 0.001
Total Lithium Li	mg/L			0.0014																	
Total Magnesium Mg	mg/L	6.12/5.33 (diss)	3.77/3.57 (diss)	5.4	3.59	3.79	3.78	4.3			6.57		5.59/4.82	6.77/5.4	5.55/5.12	5.51/4.8	6.21/5.16	5.66/5.22		5.47/4.84	6.27/5.76
Total Manganese Mn	mg/L	< 0.001	< 0.001	0.0016	<0.001	<0.0010	<0.0010	<0.02			<0.0010	<0.03	< 0.001	0.001	0.001	< 0.001	0.001	0.001	0.05	0.002	0.002
Total Mercury Hg	ug/L	< 0.02	< 0.02	< 0.02	<0.00005	<0.000050	<0.000050				<0.000050		< 0.02	0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.001	< 0.02	< 0.02
Total Molybdenum Mo	mg/L			0.0016	0.002	0.0021	0.0020				0.0012										
Total Nickel Ni	mg/L			< 0.001	<0.001	<0.0010	<0.0010				<0.0010										
Total Phosphorus P	mg/L			< 0.075																	
Total Rhenium Re	mg/L			< 0.0005																	
Total Potassium K	mg/L	1.9	2.1	2.3	2.23	2.30	2.28	2.3			2.83		2.19	2.49	2.42	2.21	2.2	2		2.2	2.5
Total Rubidium Rb	mg/L			0.0006																	
Total Sulphur S	mg/L			< 5		<3.0	<3.0				<3.0										
Total Selenium Se	mg/L	< 0.001	< 0.001	< 0.001	0.0006	0.00053	0.00058				0.00026		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.01	< 0.001	< 0.001
Total Silicon Si	mg/L	20.3	19.3	19.1	17.6	17.3	17.5				20.3		35.9	42.7	39.8	42.6	44.5	40.5		41.8	47.2
Total Silver Ag	mg/L			< 0.0002	<0.00002	<0.000020	<0.000020				<0.000020										
Total Sodium Na	mg/L	7.32	5.37	6.66	5.00	5.44	5.46	6.3			7.60	8.4	6.27	6.89	6.69	6.4	6.6	6.35	200	6.16	6.4
Total Strontium Sr	mg/L			0.035	0.026	0.0261	0.0256				0.0450										
Total Tellurium Te	mg/L			< 0.001																	
Total Thallium Tl	mg/L			< 0.0001	<0.00005	<0.000050	<0.000050				<0.000050										
Total Thorium Th	mg/L			< 0.00025																	
Total Tin Sn	mg/L			< 0.0005	<0.005	<0.0050	<0.0050				<0.0050										
Total Titanium Ti	mg/L			< 0.001	<0.005	<0.0050	<0.0050				<0.0050										
Total Tungsten W	mg/L			< 0.0005																	
Total Uranium U	mg/L	< 0.0005	< 0.0005	< 0.00025	0.0002	0.00017	0.00016				0.00016		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.02	< 0.0005	< 0.0005
Total Cesium Cs	mg/L			< 0.0005																	
Total Vanadium V	mg/L			0.009	0.011	0.0105	0.0104				0.0079										
Total Zinc Zn	mg/L	< 0.005	< 0.005	0.006	<0.005	<0.0050	<0.0050				<0.0050		< 0.005	0.014	0.008	0.015	0.016	0.014	5	0.043	0.02
Total Zirconium Zr	mg/L			< 0.0005	<0.0005	<0.00050	<0.00050				<0.00050										

Notes: 1. GCDWQ - Guidelines for Canadian

Underlined and **bolded** values indicate excee

Table 3: Summary of Routine Surfac

Sample ID		Town Well 3	Town Well 3	Town Well 3	Town Well 3	Town Well 3	Town Well 3	Town Well 3	Town Well 3	Town Well 3	TW00-01 (TW4)	Town Well 4	Town Well 4	Town Well 4	Town Well 4	Town Well 4	Town Well 4	GCDWQ[1]	Town Well 4	Town Well 4	Town Well 4
Hydrostratigraphic Unit		Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon		Pre-Vashon	Pre-Vashon	Pre-Vashon
Date Sampled		29-Mar-05	29-Jun-05	21-Sep-05	19-Jan-06	11-Apr-06	24-Jan-07	24-Sep-09	13-Apr-11	10-Oct-12	8-Nov-00	2-Apr-03	23-Jun-03	4-Aug-03	9-Dec-03	22-Mar-04	16-Jun-04		20-Sep-04	5-Jan-05	29-Mar-05
Parameter	**Units**																				
Conventional Parameters																					
pH, Laboratory	pH units	7.18	7.39	7.43	7.61	7.56	7.37	7.7	7.88	7.71	7.89	7.42	7.44	7.63	6.78	7.62	7.68	6.5:8.5	7.1	7.57	7.41
Conductivity	uS/cm	123	127	117	133	133	132	134	142	135	98	87	92	94	83	93	80		127	85	91
True Color	CU	< 5	< 5	< 5	< 5	< 5	< 5	< 5			<5	< 5	< 5	< 5	< 5	< 5	< 5		< 5	< 5	< 5
Turbidity	NTU	0.19	0.17	0.11	0.12	0.15	0.1	< 0.1			0.2	< 0.1	< 0.1	0.11	0.4	0.1	< 0.1		0.3	0.25	0.31
Hardness (Totalor dissolved) C	mg/L	52	41	116	38	42	41	46	45.4	46.8	30.2	29	31	28	26	30	26		35	33	39
Total Dissolved Solids	mg/L	112	129	114	92	83	105	118	100		72	49	94	66	74	76	72	500	106	81	86
Total Alkalinity CaCO3	mg/L	42.9	47.7	43	43.7	43.6	47.8	47.1	47	47.9	39	39.8	39.7	38.3	35.1	40.5	42		44.9	43.3	37.7
Bicarbonate Alkalinity HCO3	mg/L	52.4	58.1	52.4	53.3	53.1	58.3	57.4	57	58.4		48.6	48.5	46.7	42.9	49.4	51		54.8	52.8	46
Carbonate Alkalinity CO3	mg/L	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	<0.5	<0.50		< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5		< 0.5	< 0.5	< 0.5
Hydroxide Alkalinity OH	mg/L	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	<0.5	<0.50		< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5		< 0.5	< 0.5	< 0.5
Dissolved Fluoride F	mg/L	0.11	< 0.05	0.1	0.06	0.08	< 0.05	< 0.05	0.08		0.04	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.1	1.5	0.06	0.06	0.1
Dissolved Chloride Cl	mg/L	6	5.7	5.98	6.2	6.23	6.4	7.43	7.5	7.0	2	2.5	2.2	2.4	2.6	2.4	2.4	250	5.6	2.3	2.3
Nitrate and Nitrite N	mg/L	0.95	0.94	0.9	0.94	0.96	0.99	0.94	0.96 (1)	0.974		0.27	0.25	0.25	0.21	0.27	0.3		0.87	0.48	0.28
Dissolved Nitrate N	mg/L	0.95	0.94	0.9	0.94	0.96	0.99	0.94	0.96	0.974	0.243	0.27	0.25	0.25	0.21	0.27	0.3	10	0.87	0.48	0.28
Nitrite N	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	<0.005 (1)	<0.0050	0.001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	1	< 0.002	< 0.002	< 0.002
Dissolved Sulphate SO4	mg/L	6.4	6.4	6.38	6.5	6.54	6.44	5.85	6.6		4	4.6	4.3	4.6	6	4.5	4.6	500	6.9	4.6	4.2
Dissolved Bromide Br	mg/L																				
Metals Analysis (total or diss)		**Total**	**Total**	**Total**	**Total**	**Total**	**Total**	**Total**	**Dissolved**	**Dissolved**	**Total**	**Total**	**Total**	**Total**	**Total**	**Total**	**Total**		**Total**	**Total**	**Total**
Total Aluminum Al	mg/L	0.009	< 0.005	< 0.005	0.005	< 0.005	0.007	0.007	<0.003	<0.0030	0.006	< 0.005	0.006	0.008	< 0.005	< 0.005	< 0.005	0.1	< 0.005	0.07	0.009
Total Antimony Sb	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0005	<0.0005	<0.00050		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.006	< 0.001	< 0.001	< 0.001
Total Arsenic As	mg/L	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.0024	0.00250	0.0038	0.003	0.003	0.003	0.002	0.004	0.004	0.01	0.002	0.004	0.004
Total Barium Ba	mg/L	0.003	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.0028	0.003	0.002	0.002	0.002	0.003	0.002	0.002	1	0.003	0.002	0.002
Total Beryllium Be	mg/L							< 0.0005	<0.0001	<0.00010											
Total Bismuth Bi	mg/L							< 0.0005	<0.001	<0.0010											
Total Boron B	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.025	<0.05	<0.050	<0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	5	< 0.05	< 0.05	< 0.05
Total Cadmium Cd	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.00005	0.00004	<0.000010	<0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.005	< 0.0002	< 0.0002	< 0.0002
Total Calcium Ca	mg/L	9.69	7.44	38.3	7.26	7.13	7.57	8.47	8.52	8.81	6.21	5.71	6.04	5.32	5.18	5.74	5.02		6.31	6.66	7.84
Total Chromium Cr	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001	<0.0010	0.001	0.001	< 0.001	< 0.001	< 0.001	0.002	< 0.001	0.05	< 0.001	< 0.001	< 0.001
Total Cobalt Co	mg/L							< 0.0005	<0.0005	<0.00050											
Total Copper Cu	mg/L	0.006	0.005	0.004	0.005	0.008	0.006	0.0023	0.0064	0.00332	<0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001	0.003	<1	0.003	0.002	0.007
Total Lanthanum La	mg/L							< 0.0005													
Total Iron Fe	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	<0.005	<0.0050	<0.03 (diss <0.03	< 0.05	< 0.05	< 0.05	0.12/0.11	< 0.05	< 0.05	0.3	0.08	< 0.05	0.1
Total Lead Pb	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.00025	0.0058	0.00021	<0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.01	< 0.001	< 0.001	0.002
Total Lithium Li	mg/L							0.0015													
Total Magnesium Mg	mg/L	7.03/6.69	5.81/5.33	5.31/5.04	5.26/4.83	6.81/5.94	5.66/5.43	6	5.85	6.03	3.57	3.95/3.53	4.31/3.83	4.13/3.62	3.63/3.26	4.46/3.71	4.08/3.33		5.7/4.58	4.36/4	4.74/4.61
Total Manganese Mn	mg/L	0.002	0.001	0.001	0.001	0.001	0.001	0.002	0.002	<0.0010	0.001 (diss <0.00	< 0.001	< 0.001	< 0.001	0.016	< 0.001	< 0.001	0.05	0.001	< 0.001	< 0.001
Total Mercury Hg	ug/L	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	<0.00005	<0.000050	<0.00005	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.001	< 0.02	< 0.02	< 0.02
Total Molybdenum Mo	mg/L							0.0015	0.001	0.0014											
Total Nickel Ni	mg/L							< 0.001	<0.001	<0.0010											
Total Phosphorus P	mg/L							< 0.075													
Total Rhenium Re	mg/L							< 0.0005													
Total Potassium K	mg/L	3	2.3	4.5	2.2	2	2.4	2.4	2.74	2.82	2.08	1.95	2.05	2.01	1.67	1.8	1.5		2.1	2	2.4
Total Rubidium Rb	mg/L							< 0.0005													
Total Sulphur S	mg/L							< 5		<3.0											
Total Selenium Se	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.0003	0.00028	<0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.01	< 0.001	< 0.001	< 0.001
Total Silicon Si	mg/L	50.8	43	41.9	21	21.8	22.4	19.8	20.5	20.1		32.1	38	33.9	35.5	41.2	33.6		36.6	41.8	45
Total Silver Ag	mg/L							< 0.0002	<0.00002	<0.000020											
Total Sodium Na	mg/L	8.68	7.08	6.96	6.29	7.47	6.79	7.2	6.95	7.33	5.8	4.89	5.34	5.13	5.01	5.1	4.51	200	5.84	4.53	6.53
Total Strontium Sr	mg/L							0.042	0.045	0.0456											
Total Tellurium Te	mg/L							< 0.001													
Total Thallium Tl	mg/L							< 0.0001	<0.00005	<0.000050											
Total Thorium Th	mg/L							< 0.00025													
Total Tin Sn	mg/L							< 0.0005	<0.005	<0.0050											
Total Titanium Ti	mg/L							< 0.001	<0.005	<0.0050											
Total Tungsten W	mg/L							< 0.0005													
Total Uranium U	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.00025	0.0001	0.00013	0.00011	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.02	< 0.0005	< 0.0005	< 0.0005
Total Cesium Cs	mg/L							< 0.0005													
Total Vanadium V	mg/L							0.0085	0.009	0.0088											
Total Zinc Zn	mg/L	0.028	0.016	0.017	0.016	0.011	0.005	0.011	<0.005	0.0085	<0.005	< 0.005	< 0.005	0.011	0.24	0.008	0.008	5	0.046	0.032	0.13
Total Zirconium Zr	mg/L							< 0.0005	<0.0005	<0.00050											

Notes: 1. GCDWQ - Guidelines for Canadian
<u>Underlined</u> and **bolded** values indicate excee

Table 3: Summary of Routine Surfac

Sample ID		Town Well 4	Town Well 4	Town Well 4	Town Well 4	Town Well 4	Town Well 4	Town Well 4	Town Well 4	STRATA	FIEDLER	CHASTER	TW97-01	TW99-02	CHST3	CHST2	GIBS2	GCDWQ[1]	CHAR2	CHAR1	GCDWQ[1]
Hydrostratigraphic Unit		Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Pre-Vashon	Capilano	Bedrock	Pre Vashon	Pre-Vashon?	Chaster Cr.	Chaster Cr.	909250104		Charmin Cr.	Charmin Cr.	
Date Sampled		29-Jun-05	21-Sep-05	19-Jan-06	11-Apr-06	24-Jan-07	24-Sep-09	9-Jun-11	10-Oct-12	6-Jun-11	15-Apr-11	22-Apr-11	10-Jul-97	11-Nov-99	17-Sep-09	17-Sep-09	18-Sep-09		21-Sep-09	21-Sep-09	
Parameter	**Units**																				
Conventional Parameters																					
pH, Laboratory	pH units	7.62	7.57	7.68	7.69	7.62	7.82		7.69				7.27	7.15	7.66	7.08	6.84	6.5:8.5	7.53	6.98	6.5:8.5
Conductivity	uS/cm	89	89	97	97	93	92		98.4				93	93	87	27	21		107	49	
True Color	CU	< 5	< 5	< 5	< 5	< 5	< 5							<5	8	8	35		12	35	
Turbidity	NTU	0.14	0.24	0.19	0.38	0.82	< 0.1							>2000	0.5	0.24	0.65		10	4.1	
Hardness (Totalor dissolved) Ca	mg/L	28	35	31	30	31	31		34.9					63.8	26	7	6		32	15	
Total Dissolved Solids	mg/L	86	80	85	81	70	88						82	93	86	37	13	500	85	50	500
Total Alkalinity CaCO3	mg/L	39.8	38.3	37.9	37.4	41.3	46.8		40.7				34	27	29.6	9.5	7.5		25.4	17.5	
Bicarbonate Alkalinity HCO3	mg/L	48.6	46.7	46.2	45.6	50.3	57.1		49.7						36.2	11.6	9.1		31	21.4	
Carbonate Alkalinity CO3	mg/L	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5		<0.50						< 0.5	< 0.5	< 0.5		< 0.5	< 0.5	
Hydroxide Alkalinity OH	mg/L	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5		<0.50						< 0.5	< 0.5	< 0.5		< 0.5	< 0.5	
Dissolved Fluoride F	mg/L	< 0.05	0.08	0.07	0.06	< 0.05	< 0.05	0.096		0.0769	0.0769	0.156		<0.02	< 0.05	< 0.05	< 0.05	1.5	< 0.05	< 0.05	1.5
Dissolved Chloride Cl	mg/L	2.1	2.25	2.4	2.34	2.3	2.51	2.902	2.9	3.287	2.95	3.309	2.2	1.9	6.15	1.53	0.96	250	12.2	3.48	250
Nitrate and Nitrite N	mg/L	0.27	0.29	0.3	0.29	0.29	0.3		0.381						0.78	0.26	0.17		0.71	< 0.05	
Dissolved Nitrate N	mg/L	0.27	0.29	0.3	0.29	0.29	0.3	0.356	0.381	0.567	0.24	0.0318	0.121	<0.1	0.78	0.26	0.17	10	0.71	< 0.05	10
Nitrite N	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.014	<0.0050	0.014	0.014	0.014		<0.1	< 0.002	< 0.002	< 0.002	1	< 0.002	< 0.002	1
Dissolved Sulphate SO4	mg/L	3.6	4.3	4.3	4.29	3.55	3.08	1.789		2.77	1.33	1.58	8	4	2.69	1.64	1.53	500	4.82	2.39	500
Dissolved Bromide Br	mg/L							0.02		0.02	0.02	0.02									
Metals Analysis (total or diss)		**Total**	**Total**	**Total**	**Total**	**Total**	**Total**						**Total**	**Total**	**Total**	**Total**	**Total**		**Total**	**Total**	
Total Aluminum Al	mg/L	< 0.005	< 0.005	0.01	< 0.005	0.067	< 0.005		<0.0030				<0.2	**18.8**	0.038	0.09	**0.17**	0.1	**0.4**	**0.38**	0.1
Total Antimony Sb	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0005		<0.00050						< 0.0005	< 0.0005	< 0.0005	0.006	< 0.0005	< 0.0005	0.006
Total Arsenic As	mg/L	0.004	0.003	0.004	0.003	0.003	0.002		0.00362				0.0046	**0.0189**	< 0.001	< 0.001	< 0.001	0.01	< 0.001	< 0.001	0.01
Total Barium Ba	mg/L	0.003	0.002	0.003	0.002	0.004	0.002		0.0027				<0.01	0.238	0.007	0.006	0.004	1	0.015	0.011	1
Total Beryllium Be	mg/L						< 0.0005		<0.00010						< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	
Total Bismuth Bi	mg/L						< 0.0005		<0.0010						< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	
Total Boron B	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.025		<0.050				<0.1	<0.05	< 0.025	< 0.025	< 0.025	5	< 0.025	< 0.025	5
Total Cadmium Cd	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.00005		<0.000010				<0.0002	0.0019	< 0.00005	< 0.00005	< 0.00005	0.005	< 0.00005	< 0.00005	0.005
Total Calcium Ca	mg/L	5.64	7.84	6.15	5.56	6.24	6.33		6.91				5.46	13.6	5.79	1.86	1.54		8.44	4.33	
Total Chromium Cr	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		0.0011				<0.01	**0.087**	< 0.001	< 0.001	< 0.001	0.05	< 0.001	< 0.001	0.05
Total Cobalt Co	mg/L						< 0.0005		<0.00050						< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	
Total Copper Cu	mg/L	< 0.001	0.001	0.003	0.006	0.003	< 0.0005		0.00262				<0.01	**1.06**	0.0007	0.0007	0.0007	<1	0.0041	0.0035	<1
Total Lanthanum La	mg/L						< 0.0005								< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	
Total Iron Fe	mg/L	< 0.05	< 0.05	< 0.05	0.14	0.09	< 0.05		0.0058				<0.03	**203 (diss 0.08)**	0.09	0.07	0.07	0.3	**0.33**	**0.34**	0.3
Total Lead Pb	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.00025		<0.00020				<0.001	**0.218**	< 0.00025	< 0.00025	< 0.00025	0.01	0.0009	0.0003	0.01
Total Lithium Li	mg/L						0.0006								0.0006	< 0.0005	< 0.0005		< 0.0005	< 0.0005	
Total Magnesium Mg	mg/L	3.9/3.28	3.82/3.65	4.31/3.76	4.51/4.02	3.75/3.66	3.7		4.27				3.32	7.22	2.9	0.56	0.44		2.63	1.05	
Total Manganese Mn	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	0.003	< 0.0005		<0.0010				<0.005	**.77 (diss 0.253**	0.0036	0.0031	0.0016	0.05	0.044	**0.082**	0.05
Total Mercury Hg	ug/L	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02		<0.000050				<0.00005	<0.00005	< 0.02	< 0.02	< 0.02	0.001	< 0.02	< 0.02	0.001
Total Molybdenum Mo	mg/L						0.0009		0.0013						< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	
Total Nickel Ni	mg/L						< 0.001		<0.0010						< 0.001	< 0.001	< 0.001		< 0.001	< 0.001	
Total Phosphorus P	mg/L						< 0.075								< 0.075	< 0.075	< 0.075		< 0.075	< 0.075	
Total Rhenium Re	mg/L						< 0.0005								< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	
Total Potassium K	mg/L	1.7	2.1	1.5	1.5	2.1	1.85		2.26					4.48	1.41	0.31	0.18		1.5	1.16	
Total Rubidium Rb	mg/L						< 0.0005								0.0009	< 0.0005	< 0.0005		0.0017	0.0015	
Total Sulphur S	mg/L						< 5		<3.0						< 5	< 5	< 5		< 5	< 5	
Total Selenium Se	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		0.00032				0.0007	<0.001	< 0.001	< 0.001	< 0.001	0.01	< 0.001	< 0.001	0.01
Total Silicon Si	mg/L	36.2	37.3	19.5	18	18.4	16.2		17.0						11.8	5.8	5.5		6.3	2.1	
Total Silver Ag	mg/L						< 0.0002		<0.000020						< 0.0002	< 0.0002	< 0.0002		< 0.0002	< 0.0002	
Total Sodium Na	mg/L	4.96	5.23	5.35	5.33	5.15	4.98		5.60				6	8.12	5.46	2.25	1.72	200	6.67	2.76	200
Total Strontium Sr	mg/L						0.021		0.0226						0.048	0.016	0.01		0.102	0.052	
Total Tellurium Te	mg/L						< 0.001								< 0.001	< 0.001	< 0.001		< 0.001	< 0.001	
Total Thallium Tl	mg/L						< 0.0001		<0.000050						< 0.0001	< 0.0001	< 0.0001		< 0.0001	< 0.0001	
Total Thorium Th	mg/L						< 0.00025								< 0.00025	< 0.00025	< 0.00025		< 0.00025	< 0.00025	
Total Tin Sn	mg/L						< 0.0005		<0.0050						< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	
Total Titanium Ti	mg/L						< 0.001		<0.0050						< 0.001	< 0.001	0.001		0.017	0.011	
Total Tungsten W	mg/L						< 0.0005								< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	
Total Uranium U	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.00025		0.00012					0.00088	< 0.00025	< 0.00025	< 0.00025	0.02	< 0.00025	< 0.00025	0.02
Total Cesium Cs	mg/L						< 0.0005								< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	
Total Vanadium V	mg/L						0.0079		0.0085						0.0022	< 0.0005	0.0006		0.0012	0.0012	
Total Zinc Zn	mg/L	0.011	0.061	0.009	0.055	0.01	< 0.005		0.0061				<0.005	1.41	< 0.005	< 0.005	< 0.005	5	0.01	0.01	5
Total Zirconium Zr	mg/L						< 0.0005		<0.00050						< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	

Notes: 1. GCDWQ - Guidelines for Canadian
Underlined and **bolded** values indicate excee

Analysis Report

CANTEST

REPORT ON: Analysis of Water Samples

REPORTED TO:
Waterline Resources Inc.
531-24 Ave NW
Calgary, AB
T2M 1X4

Att'n: David Van Everdingen

CHAIN OF CUSTODY: 2181033, 2181034, 2181035
PROJECT NAME: Gibs.Aqf.Map
PROJECT NUMBER: WL09-1578

NUMBER OF SAMPLES: 13

REPORT DATE: October 2, 2009

DATE SUBMITTED: September 25, 2009

GROUP NUMBER: 100925014

SAMPLE TYPE: Water

NOTE: Results contained in this report refer only to the testing of samples as submitted. Other information is available on request.

Aesthetic Objective Summary:

Aesthetic Objectives as set by "Guidelines for Canadian Drinking Water Quality Summary Table" -May 2008. Aesthetic objectives apply to certain substances or characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good quality water. For certain parameters, both aesthetic objectives and health-related guidelines have been derived. Where only aesthetic objectives are specified, these values are below those considered to constitute a health hazard

CLIENT SAMPLE ID	STATUS
School Board Reed+Henry	Unacceptable
MW06-1A	Unacceptable
MW06-1B	Unacceptable
MW06-2A	Acceptable
MW06-2B	Unacceptable
Town Well 1	Acceptable
Town Well 3	Acceptable
Town Well 4	Acceptable
CHST3	Acceptable
CHST2	Acceptable
GIBS2	Unacceptable
CHAR2	Unacceptable
CHAR1	Unacceptable

(Continued)

CANTEST LTD.

Anna Becalska, PhD
Trace Metals Coordinator
per

Max. Acceptable Concentration Summary:

Maximum Acceptable Concentrations (MAC) for both chemical and microbiological parameters are put forth in the "Guidelines for Canadian Drinking Water Quality Summary Table" - May 2008. For the parameters tested, results are generally categorized by health concerns. Some parameters have no limit value denoted because: a) currently available data indicates no health risk, b) the compound is not permitted in Canada, or c) it refers to a family of compounds.

CLIENT SAMPLE ID	HEALTH	HARDNESS
School Board Reed+Henry	Acceptable	Not tested
MW06-1A	Acceptable	Not tested
MW06-1B	Unacceptable	Not tested
MW06-2A	Acceptable	Not tested
MW06-2B	Acceptable	Not tested
Town Well 1	Acceptable	Not tested
Town Well 3	Acceptable	Not tested
Town Well 4	Acceptable	Not tested
CHST3	Acceptable	Not tested
CHST2	Acceptable	Not tested
GIBS2	Acceptable	Not tested
CHAR2	Acceptable	Not tested
CHAR1	Acceptable	Not tested

TEST METHODS:

Anions in Water by Ion Chromatography - was determined based on Method 4110 in Standard Methods (21st Edition) and EPA Method 300.0 (Revision 2.1).

Alkalinity in Water - was performed based on Method 2320 in Standard Methods (21st Edition).

Alkalinity in Water - was performed based on Method 2320 in Standard Methods (21st Edition).

Colour (True) in Water - was determined based on Method 2120 in Standard Methods (21st Edition) and Method X321 in the BC Laboratory Manual (2005 Edition).

Conductivity in Water - was performed based on Method 2510 in Standard Methods (21st Edition) and Method X322 in the BC Laboratory Manual (2005 Edition).

Nitrite in Water - was determined based on Method 4500-NO2 B in Standard Methods for the examination of Water and Wastewater (21st Edition) and from the BC Laboratory Methods Manual (2005).

(Continued)

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pH in Water - was determined based on Method 4500-H in Standard Methods (21st Edition) and Method X330 in the BC Laboratory Manual (2005).

Total Dissolved Solids in Water - was determined based on Method 2540 C in Standard Methods for the Examination of Water and Wastewater (21st Edition).

Turbidity in Water - was performed based on Method 2130 in Standard Methods (21st Edition) and Method X164 in the BC Laboratory Manual (2005 Edition).

Conventional Parameters - analyses were performed using procedures based on those described in the most current editions of "British Columbia Environmental Laboratory Manual for the Analysis of Water, Wastewater, Sediment and Biological Materials", (2005 edition) Province of British Columbia and "Standard Methods for the Examination of Water and Wastewater" (21st Edition), published by the American Public Health Association.

Mercury in Water - analysis was performed using procedures based on U. S. EPA Method 245.7, oxidative digestion using bromination, and analysis using Cold Vapour Atomic Fluorescence Spectroscopy.

Metals in Water - analysis was performed using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP), Inductively Coupled Plasma-Mass Spectroscopy (ICP/MS).

Microbiological Parameters - analyses were performed using procedures based on those described in "B. C. Environmental Laboratory Manual For the Analysis of Water, Wastewater, Sediment and Biological Materials" (2005 Edition) and "Standard Methods for the Examination of Water and Wastewater", 21st Edition (2005). Analysis was performed using Membrane Filtration (MF) Method (reported as "Colonies or CFU per unit volume").

TEST RESULTS:

(See following pages)

REPORTED TO: Waterline Resources Inc.

REPORT DATE: October 2, 2009

GROUP NUMBER: 100925014

CANTEST
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Potability (Aesthetic Criteria) in Water

CLIENT SAMPLE IDENTIFICATION:		**School Board Reed+Henry**	**MW06-1A**	**MW06-1B**	**MW06-2A**		
DATE SAMPLED:		Sep 23/09	Sep 22/09	Sep 22/09	Sep 23/09	Aesthetic Objective	UNITS
CANTEST ID:		909250094	909250095	909250096	909250097		
Conventional Parameters							
pH, Laboratory		7.94	7.82	7.76	7.72	6.5 - 8.5	pH units
True Color		< 5	< 5	< 5	< 5	15	CU
Turbidity		12	2.8	260	0.35	-	NTU
Total Dissolved Solids		41	122	209	218	500	mg/L
Total Alkalinity	CaCO3	33.4	56.3	101	51.6	-	mg/L
Bicarbonate Alkalinity	HCO3	40.8	68.7	124	62.9	-	mg/L
Carbonate Alkalinity	CO3	< 0.5	< 0.5	< 0.5	< 0.5	-	mg/L
Hydroxide Alkalinity	OH	< 0.5	< 0.5	< 0.5	< 0.5	-	mg/L
Dissolved Chloride	Cl	1.06	3.73	3.73	50.8	250	mg/L
Dissolved Sulphate	SO4	< 0.5	6.35	6.35	3.73	500	mg/L
Total Metals Analysis							
Copper	Cu	0.0018	0.0052	0.051	0.0014	1.0	mg/L
Iron	Fe	**0.71 X**	**1.02 X**	**24.2 X**	< 0.05	0.3	mg/L
Manganese	Mn	**0.082 X**	**0.085 X**	**2.77 X**	0.0041	0.05	mg/L
Sodium	Na	5.78	7.45	14.5	9.02	200	mg/L
Zinc	Zn	< 0.005	0.011	0.16	0.005	5	mg/L

CU = color units

mg/L = milligrams per liter

< = Less than reporting limit

X = Result is outside the Aesthetic Objective

NTU = nephelometric turbidity units

Potability (Aesthetic Criteria) in Water

CLIENT SAMPLE IDENTIFICATION:		**MW06-2B**	**Town Well 1**	**Town Well 3**	**Town Well 4**	Aesthetic Objective	UNITS
DATE SAMPLED:		Sep 23/09	Sep 24/09	Sep 24/09	Sep 24/09		
CANTEST ID:		909250098	909250099	909250100	909250101		
Conventional Parameters							
pH, Laboratory		6.82	7.75	7.70	7.82	6.5 - 8.5	pH units
True Color		< 5	< 5	< 5	< 5	15	CU
Turbidity		917	0.10	< 0.1	< 0.1	-	NTU
Total Dissolved Solids		136	121	118	88	500	mg/L
Total Alkalinity	CaCO3	27.4	45.7	47.1	46.8	-	mg/L
Bicarbonate Alkalinity	HCO3	33.5	55.7	57.4	57.1	-	mg/L
Carbonate Alkalinity	CO3	< 0.5	< 0.5	< 0.5	< 0.5	-	mg/L
Hydroxide Alkalinity	OH	< 0.5	< 0.5	< 0.5	< 0.5	-	mg/L
Dissolved Chloride	Cl	17.0	5.89	7.43	2.51	250	mg/L
Dissolved Sulphate	SO4	3.55	6.13	5.85	3.08	500	mg/L
Total Metals Analysis							
Copper	Cu	0.017	0.026	0.0023	< 0.0005	1.0	mg/L
Iron	Fe	**5.83 X**	< 0.05	< 0.05	< 0.05	0.3	mg/L
Manganese	Mn	**0.101 X**	0.0016	0.002	< 0.0005	0.05	mg/L
Sodium	Na	8.2	6.66	7.2	4.98	200	mg/L
Zinc	Zn	0.035	0.006	0.011	< 0.005	5	mg/L

CU = color units

mg/L = milligrams per liter

< = Less than reporting limit

X = Result is outside the Aesthetic Objective

NTU = nephelometric turbidity units

REPORTED TO: Waterline Resources Inc.

REPORT DATE: October 2, 2009

GROUP NUMBER: 100925014

Potability (Aesthetic Criteria) in Water

CLIENT SAMPLE IDENTIFICATION:		**CHST3**	**CHST2**	**GIBS2**	**CHAR2**		
DATE SAMPLED:		Sep 17/09	Sep 17/09	Sep 18/09	Sep 21/09	Aesthetic Objective	UNITS
CANTEST ID:		909250102	909250103	909250104	909250105		
Conventional Parameters							
pH, Laboratory		7.66	7.08	6.84	7.53	6.5 - 8.5	pH units
True Color		8	8	**35 X**	12	15	CU
Turbidity		0.50	0.24	0.65	10	-	NTU
Total Dissolved Solids		86	37	13	85	500	mg/L
Total Alkalinity	CaCO3	29.6	9.5	7.5	25.4	-	mg/L
Bicarbonate Alkalinity	HCO3	36.2	11.6	9.1	31.0	-	mg/L
Carbonate Alkalinity	CO3	< 0.5	< 0.5	< 0.5	< 0.5	-	mg/L
Hydroxide Alkalinity	OH	< 0.5	< 0.5	< 0.5	< 0.5	-	mg/L
Dissolved Chloride	Cl	6.15	1.53	0.96	12.2	250	mg/L
Dissolved Sulphate	SO4	2.69	1.64	1.53	4.82	500	mg/L
Total Metals Analysis							
Copper	Cu	0.0007	0.0007	0.0007	0.0041	1.0	mg/L
Iron	Fe	0.09	0.07	0.07	**0.33 X**	0.3	mg/L
Manganese	Mn	0.0036	0.0031	0.0016	0.044	0.05	mg/L
Sodium	Na	5.46	2.25	1.72	6.67	200	mg/L
Zinc	Zn	< 0.005	< 0.005	< 0.005	0.01	5	mg/L

CU = color units

mg/L = milligrams per liter

< = Less than reporting limit

X = Result is outside the Aesthetic Objective

NTU = nephelometric turbidity units

Potability (Aesthetic Criteria) in Water

CLIENT SAMPLE IDENTIFICATION:		**CHAR1**	Aesthetic Objective	UNITS
DATE SAMPLED:		Sep 21/09		
CANTEST ID:		909250106		
Conventional Parameters				
pH, Laboratory		6.98	6.5 - 8.5	pH units
True Color		**35 X**	15	CU
Turbidity		4.1	-	NTU
Total Dissolved Solids		50	500	mg/L
Total Alkalinity	CaCO3	17.5	-	mg/L
Bicarbonate Alkalinity	HCO3	21.4	-	mg/L
Carbonate Alkalinity	CO3	< 0.5	-	mg/L
Hydroxide Alkalinity	OH	< 0.5	-	mg/L
Dissolved Chloride	Cl	3.48	250	mg/L
Dissolved Sulphate	SO4	2.39	500	mg/L
Total Metals Analysis				
Copper	Cu	0.0035	1.0	mg/L
Iron	Fe	**0.34 X**	0.3	mg/L
Manganese	Mn	**0.082 X**	0.05	mg/L
Sodium	Na	2.76	200	mg/L
Zinc	Zn	0.01	5	mg/L

CU = color units

mg/L = milligrams per liter

< = Less than reporting limit

X = Result is outside the Aesthetic Objective

NTU = nephelometric turbidity units

REPORTED TO: Waterline Resources Inc.

REPORT DATE: October 2, 2009

GROUP NUMBER: 100925014

CANTEST

Potability (Health Criteria at Point of Use) in Water

CLIENT SAMPLE IDENTIFICATION:		**School Board Reed+Henry**	**MW06-1A**	**MW06-1B**	**MW06-2A**		
DATE SAMPLED:		Sep 23/09	Sep 22/09	Sep 22/09	Sep 23/09	Max. Acceptable Concentration	UNITS
CANTEST ID:		909250094	909250095	909250096	909250097		
Conventional Parameters							
Conductivity		64	139	272	277	-	µS/cm
Hardness (Total)	CaCO3	17	51	234	98	-	mg/L
Dissolved Fluoride	F	< 0.05	< 0.05	< 0.05	< 0.05	1.5	mg/L
Nitrate and Nitrite	N	< 0.05	0.90	0.90	0.96	10	mg/L
Dissolved Nitrate	N	< 0.05	0.90	0.90	0.96	10.0	mg/L
Nitrite	N	< 0.002	< 0.002	< 0.002	< 0.002	1.0	mg/L
Dissolved Sulphate	SO4	< 0.5	6.35	6.35	3.73	-	mg/L
Total Metals Analysis							
Aluminum	Al	0.022	0.5	16.4	0.026	-	mg/L
Antimony	Sb	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.006	mg/L
Arsenic	As	< 0.001	0.003	0.01	< 0.001	0.010	mg/L
Barium	Ba	0.001	0.01	0.24	0.006	1.0	mg/L
Boron	B	< 0.025	< 0.025	< 0.025	< 0.025	5	mg/L
Cadmium	Cd	< 0.00005	< 0.00005	0.0014	< 0.00005	0.005	mg/L
Calcium	Ca	2.85	7.28	39.6	20.2	-	mg/L
Chromium	Cr	< 0.001	< 0.001	0.011	< 0.001	0.05	mg/L
Lead	Pb	< 0.00025	0.0011	**0.055 X**	0.0004	0.01	mg/L
Magnesium	Mg	2.33	8.08	32.8	11.6	-	mg/L
Mercury	Hg	< 0.02	< 0.02	< 0.02	< 0.02	1	µg/L
Potassium	K	2.43	1.99	5.32	3.29	-	mg/L
Selenium	Se	< 0.001	< 0.001	< 0.001	< 0.001	0.01	mg/L
Silver	Ag	< 0.0002	< 0.0002	0.0003	< 0.0002	-	mg/L
Uranium	U	< 0.00025	< 0.00025	0.013	0.0003	0.02	mg/L

µS/cm = microsiemens per centimeter

mg/L = milligrams per liter

µg/L = micrograms per liter

< = Less than reporting limit

X = Result is outside the Max. Acceptable Concentration

REPORTED TO: Waterline Resources Inc.

REPORT DATE: October 2, 2009

GROUP NUMBER: 100925014

Potability (Health Criteria at Point of Use) in Water

CLIENT SAMPLE IDENTIFICATION:		**MW06-2B**	**Town Well 1**	**Town Well 3**	**Town Well 4**		
DATE SAMPLED:		Sep 23/09	Sep 24/09	Sep 24/09	Sep 24/09		
CANTEST ID:		909250098	909250099	909250100	909250101	Max. Acceptable Concentration	UNITS
Conventional Parameters							
Conductivity		131	125	134	92	-	µS/cm
Hardness (Total)	CaCO3	46	44	46	31	-	mg/L
Dissolved Fluoride	F	< 0.05	< 0.05	< 0.05	< 0.05	1.5	mg/L
Nitrate and Nitrite	N	1.89	0.75	0.94	0.30	10	mg/L
Dissolved Nitrate	N	1.87	0.75	0.94	0.30	10.0	mg/L
Nitrite	N	0.021	< 0.002	< 0.002	< 0.002	1.0	mg/L
Dissolved Sulphate	SO4	3.55	6.13	5.85	3.08	-	mg/L
Total Metals Analysis							
Aluminum	Al	4.14	< 0.005	0.007	< 0.005	-	mg/L
Antimony	Sb	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.006	mg/L
Arsenic	As	< 0.001	< 0.001	0.002	0.002	0.010	mg/L
Barium	Ba	0.049	0.003	0.003	0.002	1.0	mg/L
Boron	B	< 0.025	< 0.025	< 0.025	< 0.025	5	mg/L
Cadmium	Cd	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.005	mg/L
Calcium	Ca	11.5	8.53	8.47	6.33	-	mg/L
Chromium	Cr	0.004	< 0.001	< 0.001	< 0.001	0.05	mg/L
Lead	Pb	0.003	< 0.00025	< 0.00025	< 0.00025	0.01	mg/L
Magnesium	Mg	4.21	5.4	6	3.7	-	mg/L
Mercury	Hg	< 0.02	< 0.02	< 0.02	< 0.02	1	µg/L
Potassium	K	1.68	2.3	2.4	1.85	-	mg/L
Selenium	Se	< 0.001	< 0.001	< 0.001	< 0.001	0.01	mg/L
Silver	Ag	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-	mg/L
Uranium	U	0.0003	< 0.00025	< 0.00025	< 0.00025	0.02	mg/L
Microbiological Analysis							
Total Coliforms (Confirmed)		-	< 1	< 1	< 1	not detected	Col./100 mL
E. coli		-	< 1	< 1	< 1	not detected	Col./100 mL

µS/cm = microsiemens per centimeter
µg/L = micrograms per liter
< = Less than reporting limit

mg/L = milligrams per liter
Col./100 mL = Colonies per 100 mL

REPORTED TO: Waterline Resources Inc.

REPORT DATE: October 2, 2009

GROUP NUMBER: 100925014

CANTEST

Potability (Health Criteria at Point of Use) in Water

CLIENT SAMPLE IDENTIFICATION:		**CHST3**	**CHST2**	**GIBS2**	**CHAR2**		
DATE SAMPLED:		Sep 17/09	Sep 17/09	Sep 18/09	Sep 21/09	Max. Acceptable Concentration	UNITS
CANTEST ID:		909250102	909250103	909250104	909250105		
Conventional Parameters							
Conductivity		87	27	21	107	-	µS/cm
Hardness (Total)	CaCO3	26	7	6	32	-	mg/L
Dissolved Fluoride	F	< 0.05	< 0.05	< 0.05	< 0.05	1.5	mg/L
Nitrate and Nitrite	N	0.78	0.26	0.17	0.71	10	mg/L
Dissolved Nitrate	N	0.78	0.26	0.17	0.71	10.0	mg/L
Nitrite	N	< 0.002	< 0.002	< 0.002	< 0.002	1.0	mg/L
Dissolved Sulphate	SO4	2.69	1.64	1.53	4.82	-	mg/L
Total Metals Analysis							
Aluminum	Al	0.038	0.09	0.17	0.4	-	mg/L
Antimony	Sb	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.006	mg/L
Arsenic	As	< 0.001	< 0.001	< 0.001	< 0.001	0.010	mg/L
Barium	Ba	0.007	0.006	0.004	0.015	1.0	mg/L
Boron	B	< 0.025	< 0.025	< 0.025	< 0.025	5	mg/L
Cadmium	Cd	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.005	mg/L
Calcium	Ca	5.79	1.86	1.54	8.44	-	mg/L
Chromium	Cr	< 0.001	< 0.001	< 0.001	< 0.001	0.05	mg/L
Lead	Pb	< 0.00025	< 0.00025	< 0.00025	0.0009	0.01	mg/L
Magnesium	Mg	2.9	0.56	0.44	2.63	-	mg/L
Mercury	Hg	< 0.02	< 0.02	< 0.02	< 0.02	1	µg/L
Potassium	K	1.41	0.31	0.18	1.5	-	mg/L
Selenium	Se	< 0.001	< 0.001	< 0.001	< 0.001	0.01	mg/L
Silver	Ag	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-	mg/L
Uranium	U	< 0.00025	< 0.00025	< 0.00025	< 0.00025	0.02	mg/L

µS/cm = microsiemens per centimeter

mg/L = milligrams per liter

µg/L = micrograms per liter

< = Less than reporting limit

Potability (Health Criteria at Point of Use) in Water

CLIENT SAMPLE IDENTIFICATION:		**CHAR1**		
DATE SAMPLED:		Sep 21/09	Max. Acceptable Concentration	UNITS
CANTEST ID:		909250106		
Conventional Parameters				
Conductivity		49	-	µS/cm
Hardness (Total)	CaCO3	15	-	mg/L
Dissolved Fluoride	F	< 0.05	1.5	mg/L
Nitrate and Nitrite	N	< 0.05	10	mg/L
Dissolved Nitrate	N	< 0.05	10.0	mg/L
Nitrite	N	< 0.002	1.0	mg/L
Dissolved Sulphate	SO4	2.39	-	mg/L
Total Metals Analysis				
Aluminum	Al	0.38	-	mg/L
Antimony	Sb	< 0.0005	0.006	mg/L
Arsenic	As	< 0.001	0.010	mg/L
Barium	Ba	0.011	1.0	mg/L
Boron	B	< 0.025	5	mg/L
Cadmium	Cd	< 0.00005	0.005	mg/L
Calcium	Ca	4.33	-	mg/L
Chromium	Cr	< 0.001	0.05	mg/L
Lead	Pb	0.0003	0.01	mg/L
Magnesium	Mg	1.05	-	mg/L
Mercury	Hg	< 0.02	1	µg/L
Potassium	K	1.16	-	mg/L
Selenium	Se	< 0.001	0.01	mg/L
Silver	Ag	< 0.0002	-	mg/L
Uranium	U	< 0.00025	0.02	mg/L

µS/cm = microsiemens per centimeter

µg/L = micrograms per liter

< = Less than reporting limit

mg/L = milligrams per liter

Metals Analysis in Water

CLIENT SAMPLE IDENTIFICATION:		**School Board Reed+Henry**	**MW06-1A**	**MW06-1B**	**MW06-2A**	
SAMPLE PREPARATION:		TOTAL	TOTAL	TOTAL	TOTAL	
DATE SAMPLED:		Sep 23/09	Sep 22/09	Sep 22/09	Sep 23/09	REPORTING LIMIT
CANTEST ID:		909250094	909250095	909250096	909250097	
Beryllium	Be	<	<	0.0032	<	0.0005
Bismuth	Bi	<	<	0.0005	<	0.0005
Cesium	Cs	<	<	0.002	<	0.0005
Cobalt	Co	<	0.002	0.027	<	0.0005
Lanthanum	La	<	0.0009	0.083	<	0.0005
Lithium	Li	0.0008	0.0015	0.023	0.0012	0.0005
Molybdenum	Mo	0.0014	0.0014	0.0007	0.0009	0.0005
Nickel	Ni	<	0.002	0.047	<	0.001
Phosphorus	P	<	0.19	2.92	<	0.075
Rhenium	Re	<	<	<	<	0.0005
Rubidium	Rb	0.0007	0.0009	0.021	0.0008	0.0005
Silicon	Si	<	19.2	40.9	18.2	0.25
Strontium	Sr	0.0098	0.031	0.372	0.094	0.0005
Sulphur	S	<	<	<	<	5
Tellurium	Te	<	<	<	<	0.001
Thallium	Tl	<	<	0.0003	<	0.0001
Thorium	Th	<	<	0.029	<	0.00025
Tin	Sn	<	<	<	0.0006	0.0005
Titanium	Ti	<	0.026	0.057	<	0.001
Tungsten	W	<	<	<	<	0.0005
Vanadium	V	<	0.013	0.04	0.0054	0.0005
Zirconium	Zr	<	<	0.0005	<	0.0005

Results expressed as milligrams per liter (mg/L)
< = Less than reporting limit

REPORTED TO: Waterline Resources Inc.

REPORT DATE: October 2, 2009

GROUP NUMBER: 100925014

Metals Analysis in Water

CLIENT SAMPLE IDENTIFICATION:		**MW06-2B**	**Town Well 1**	**Town Well 3**	**Town Well 4**	
SAMPLE PREPARATION:		TOTAL	TOTAL	TOTAL	TOTAL	
DATE SAMPLED:		Sep 23/09	Sep 24/09	Sep 24/09	Sep 24/09	
CANTEST ID:		909250098	909250099	909250100	909250101	REPORTING LIMIT
Beryllium	Be	<	<	<	<	0.0005
Bismuth	Bi	<	<	<	<	0.0005
Cesium	Cs	<	<	<	<	0.0005
Cobalt	Co	0.0021	<	<	<	0.0005
Lanthanum	La	0.0026	<	<	<	0.0005
Lithium	Li	0.0026	0.0014	0.0015	0.0006	0.0005
Molybdenum	Mo	<	0.0016	0.0015	0.0009	0.0005
Nickel	Ni	0.003	<	<	<	0.001
Phosphorus	P	0.32	<	<	<	0.075
Rhenium	Re	<	<	<	<	0.0005
Rubidium	Rb	0.004	0.0006	<	<	0.0005
Silicon	Si	13.3	19.1	19.8	16.2	0.25
Strontium	Sr	0.165	0.035	0.042	0.021	0.0005
Sulphur	S	<	<	<	<	5
Tellurium	Te	<	<	<	<	0.001
Thallium	Tl	<	<	<	<	0.0001
Thorium	Th	0.0003	<	<	<	0.00025
Tin	Sn	0.0006	<	<	<	0.0005
Titanium	Ti	0.16	<	<	<	0.001
Tungsten	W	<	<	<	<	0.0005
Vanadium	V	0.015	0.009	0.0085	0.0079	0.0005
Zirconium	Zr	0.001	<	<	<	0.0005

Results expressed as milligrams per liter (mg/L)
< = Less than reporting limit

Metals Analysis in Water

CLIENT SAMPLE IDENTIFICATION:		**CHST3**	**CHST2**	**GIBS2**	**CHAR2**	
SAMPLE PREPARATION:		TOTAL	TOTAL	TOTAL	TOTAL	
DATE SAMPLED:		Sep 17/09	Sep 17/09	Sep 18/09	Sep 21/09	REPORTING LIMIT
CANTEST ID:		909250102	909250103	909250104	909250105	
Beryllium	Be	<	<	<	<	0.0005
Bismuth	Bi	<	<	<	<	0.0005
Cesium	Cs	<	<	<	<	0.0005
Cobalt	Co	<	<	<	<	0.0005
Lanthanum	La	<	<	<	<	0.0005
Lithium	Li	0.0006	<	<	<	0.0005
Molybdenum	Mo	<	<	<	<	0.0005
Nickel	Ni	<	<	<	<	0.001
Phosphorus	P	<	<	<	<	0.075
Rhenium	Re	<	<	<	<	0.0005
Rubidium	Rb	0.0009	<	<	0.0017	0.0005
Silicon	Si	11.8	5.8	5.5	6.3	0.25
Strontium	Sr	0.048	0.016	0.01	0.102	0.0005
Sulphur	S	<	<	<	<	5
Tellurium	Te	<	<	<	<	0.001
Thallium	Tl	<	<	<	<	0.0001
Thorium	Th	<	<	<	<	0.00025
Tin	Sn	<	<	<	<	0.0005
Titanium	Ti	<	<	0.001	0.017	0.001
Tungsten	W	<	<	<	<	0.0005
Vanadium	V	0.0022	<	0.0006	0.0012	0.0005
Zirconium	Zr	<	<	<	<	0.0005

Results expressed as milligrams per liter (mg/L)
< = Less than reporting limit

REPORTED TO: Waterline Resources Inc.

REPORT DATE: October 2, 2009

GROUP NUMBER: 100925014

CANTEST

Metals Analysis in Water

CLIENT SAMPLE IDENTIFICATION:		CHAR1	
SAMPLE PREPARATION:		TOTAL	
DATE SAMPLED:		Sep 21/09	REPORTING LIMIT
CANTEST ID:		909250106	
Beryllium	Be	<	0.0005
Bismuth	Bi	<	0.0005
Cesium	Cs	<	0.0005
Cobalt	Co	<	0.0005
Lanthanum	La	<	0.0005
Lithium	Li	<	0.0005
Molybdenum	Mo	<	0.0005
Nickel	Ni	<	0.001
Phosphorus	P	<	0.075
Rhenium	Re	<	0.0005
Rubidium	Rb	0.0015	0.0005
Silicon	Si	2.1	0.25
Strontium	Sr	0.052	0.0005
Sulphur	S	<	5
Tellurium	Te	<	0.001
Thallium	Tl	<	0.0001
Thorium	Th	<	0.00025
Tin	Sn	<	0.0005
Titanium	Ti	0.011	0.001
Tungsten	W	<	0.0005
Vanadium	V	0.0012	0.0005
Zirconium	Zr	<	0.0005

Results expressed as milligrams per liter (mg/L)
< = Less than reporting limit

University of Utah **Dissolved Noble Gas Lab** **Sample Report**

Sample I.D.	N2 total (ccSTP/g)	Ar total (ccSTP/g)	Ne total (ccSTP/g)	Kr total (ccSTP/g)	Xe total (ccSTP/g)	He4 (ccSTP/g)	R/Ra	Tritium (TU)	Tritium (error +/-)
MW06-1A	1.66E-02	4.38E-04	2.29E-07	9.43E-08	1.45E-08	5.26E-08	1.07	2.65	0.16
MW06-2A	1.71E-02	4.45E-04	2.27E-07	9.15E-08	1.45E-08	5.33E-08	1.09	4.86	0.28
MW06-2B	1.61E-02	4.19E-04	2.46E-07	1.02E-07	1.37E-08	5.69E-08	1.00	3.31	0.13
WL10-01	2.01E-02	4.88E-04	2.89E-07	1.11E-07	1.57E-08	1.00E-07	0.83	0.05	0.05
WL10-02	1.82E-02	4.67E-04	2.51E-07	1.03E-07	1.53E-08	6.79E-08	1.36	3.52	0.21
TW1		4.54E-04	2.39E-07	1.08E-07	1.55E-08	5.57E-08	1.59	3.93	0.23
TW2		4.41E-04	2.43E-07	9.88E-08	1.44E-08	5.23E-08	1.41	5.67	0.34
TW3		4.63E-04	2.46E-07	1.09E-07	1.56E-08	5.43E-08	1.34	4.28	0.25
TW4		4.13E-04	2.30E-07	1.02E-07	1.44E-08	5.37E-08	1.31	5.54	0.32
Chaster		4.97E-04	3.15E-07	1.16E-07	1.57E-08	7.79E-08	0.99	1.77	0.07
STRATA		4.45E-04	2.52E-07	1.08E-07	1.50E-08	5.42E-08	1.24	6.62	0.24
Blank	-	-	-	-	-		-	6.44	0.22

University of Utah Dissolved Noble Gas Lab Sample Report

Sample I.D.	Age - using Ne only (yrs)	Ne Age (error +/-)	Age - using EA (yrs)	EA Age (error +/-)	Rterr - assumed	Tot Dis Gas (atm)	Lab O2 (mg/l)	∆Ne (%)
MW06-1A	6.1	2.0	10.1	1.0	2.01E-07	1.00	6.0	13.7
MW06-2A	7.5	0.8	9.1	0.8	2.01E-07	1.01	5.8	10.8
MW06-2B	-9.9	4.3	-2.1	1.3	2.01E-07	1.07	6.2	22.1
WL10-01	>60	*	>60	*	2.01E-07	1.07	0.0	40.2
WL10-02	31.4	1.0	33.0	1.3	2.01E-07	0.97	0.0	24.3
TW1	31.3	1.3	31.8	1.2	2.01E-07			14.30
TW2	17.9	1.91	18.8	1.5	2.01E-07			19.04
TW3	20.3	1.89	21.4	1.5	2.01E-07			17.72
TW4	18.3	1.28	18.3	1.2	2.01E-07			11.83
Chaster	1.7	9.6	11.8	7.1	2.01E-07			52.04
STRATA	10.0	2.1	10.0	2.0	2.01E-07			21.79
Blank	-	-	-	-				-

Sample I.D.	Notes
MW06-1A	Kr appears low, good fit (remaining gases), contains O2
MW06-2A	Kr appears low, good fit (remaining gases), contains O2
MW06-2B	Looks atmospheric, appears modern, contains O2
WL10-01	Good fit, excess He4, sample age sensitive to Rterr
WL10-02	Good fit, excess He4, sample age sensitive to Rterr
TW1	
TW2	
TW3	
TW4	
Chaster	Sample might contain a mixture of old and new water
STRATA	Sample might be slightly stripped in He but looks OK
Blank	No dissolved gas sample

Client: Gibson/Tattrie
Alberta Research - Technology Futures
PO#:

ISO# 2010280
Location: T -
4 for E3H

Environmental Isotope Lab
5/11/2013

Tritium Results -Gibsons Aquifer Mapping Study

#	Sample	Lab#	E^3H	Result	± 1σ	Repeat	± 1σ
3	WL 10-01	235334	X	<0.8	0.5		
4	WL 10-02	235335	X	3.9	0.6		

Conductivity

Tritium is reported in Tritium Units.
1TU = 3.221 Picocurries/L per IAEA, 2000 Report.
1TU = 0.11919 Becquerels/L per IAEA, 2000 Report.

Rick Heemskerk
uwEILAB Manager
rkhmskrk@uwaterloo.ca
519 888 4567 ext 35838

To Contact uwEILAB:
519 888 4732

Stable Isotope Results - Gibsons Aquifer Mapping Study

Sample	dD average vs VSMOW	d18O average vs VSMOW	dD stdev	d18O stdev	dD vs VSMOW				d18O vs VSMOW			
					run1	run2	run3	run4	run1	run2	run3	run4
WL10-01	**-82.7**	**-11.68**	0.2		-82.8	-82.6			-11.68			
WL10-02	**-82.8**	**-11.63**		0.04	-82.8				-11.60	-11.66		

Stable Isotope Results - Gibsons Aquifer Mapping Study

Sample	dD average vs VSMOW	d18O average vs VSMOW	dD stdev	d18O stdev	dD vs VSMOW				d18O vs VSMOW			
					run1	run2	run3	run4	run1	run2	run3	run4
CHAR1	**-74.0**	**-10.01**			-74.0				-10.01			
CHAR2	**-68.6**	**-9.56**			-68.6				-9.56			
CHAR3	**-73.8**	**-10.04**			-73.8				-10.04			
CHST1	**-74.8**	**-10.76**	0.1	0.05	-74.9	-74.8			-10.73	-10.80		
CHST2	**-74.7**	**-10.82**			-74.7				-10.82			
CHST3	**-77.1**	**-10.94**			-77.1				-10.94			
GIBS1	**-76.2**	**-10.89**			-76.2				-10.89			
GIBS2	**-74.1**	**-10.76**			-74.1				-10.76			
GIBS3	**-74.1**	**-10.62**	0.2		-74.3	-73.9			-10.62			

Number	Name	dD	std dD	d 18O	std d 18O
1	WL10-02	-80.8	0.34	-11.6	0.15
2	TW#3	-80.0	0.35	-11.5	0.44
3	OC-SP-03	-51.7	0.74	-7.5	0.30
4	CHASTER	-79.4	0.40	-11.8	0.14
5	SP-01	-81.2	0.43	-12.0	0.15
6	MW06-1A dup	-80.6	0.50	-12.2	0.05
7	TW#4	-82.1	0.58	-11.7	0.10
8	SP-04	-83.9	0.54	-11.7	0.12
9	SRATA	-81.6	0.46	-11.8	0.12
Standard	Whistler	-117.9	0.05	-16.2	0.12
10	OC-SP-02	-64.1	0.27	-9.5	0.04
11	SP-05	-79.5	0.50	-11.4	0.10
12	FIELD BLK (TW#1)	-81.5	0.19	-12.0	0.23
13	SP-02	-80.9	0.49	-11.9	0.14
14	OC-SP-05	-33.6	0.46	-4.8	0.08
15	TW#2	-80.8	0.52	-11.9	0.11
16	FDLW	-77.3	0.49	-11.5	0.30
17	MW06-2A	-80.2	0.56	-11.7	0.28
18	SP-03	-77.5	0.31	-10.2	0.08
19	TW#1	-80.9	0.35	-11.3	0.13
20	WL10-01	-81.5	0.65	-11.5	0.17
21	OC-SP-04	-36.8	0.48	-5.9	0.21
22	MW06-2B	-81.8	0.44	-11.8	0.09
23	KELLY-1	-83.6	0.61	-12.0	0.12
24	SP-02 dup	-80.0	0.00	-11.8	0.00
25	MW06-1A	-81.1	0.58	-12.8	0.10
	Whistler	-118.4	0.41	-16.4	0.12
	Whistler	-117.9	0.57	-16.2	0.09
	Whistler	-118.4	0.45	-16.4	0.40

19	TW#1	-80.9	0.35	-11.3	0.13
12	FIELD BLK (TW#1)	-81.5	0.19	-12.0	0.23
		0.7	0.2	0.7	-0.1

25	MW06-1A	-81.1	0.58	-12.8	0.10
6	MW06-1A dup	-80.6	0.50	-12.2	0.05
		-0.5	0.1	-0.6	0.0

13	SP-02	-80.9	0.49	-11.9	0.14
24	SP-02 dup	-80.0	0.00	-11.8	0.00
		-0.9	0.5	-0.1	0.1

		-118		-16.1	
Standard	Whistler	-117.9	0.05	-16.2	0.12
		-0.1		0.1	
	Whistler	-118.4	0.41	-16.4	0.12
		0.4		0.3	
	Whistler	-117.9	0.57	-16.2	0.09
		-0.1		0.1	
	Whistler	-118.4	0.45	-16.4	0.40
		0.4		0.3	

Chlorofluorocarbon Analysis - Gibsons Aquifer

Sample	Date	CFC-11	CFC-12	CFC-113
Units	**mm/dd/yr**	**pptv**	**pptv**	**pptv**
TW#1	4/13/2011	37.7	25.1	2.8
TW#2	4/13/2011	57.5	1250.2	2.3
TW#3	4/13/2011	83.5	17585.4	6.2
TW#4	4/13/2011	62.2	74.5	3.0
Chaster	4/19/2011	3.9	80.4	2.4
STRATA	4/22/2011	40.8	24.1	0.3
TW#1 DUP	4/13/2011	33.6	29.7	2.4

UNIVERSITY OF MIAMI
ROSENSTIEL
SCHOOL of MARINE &
ATMOSPHERIC SCIENCE

Tritium Laboratory
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May 11, 2013

TRITIUM LABORATORY

Data Release #CFC11-10

University of British Columbia
CFC-097

Dr. James D. Happell
Associate Research Professor

Distribution:

Jessica Doyle
University of British Columbia
6339 Stores Road
Vancouver, BC V6T 1Z4

Data Release CFC11-10, Job # CFC0097

University of British Columbia
6339 Stores Road
Vancouver, BC V6T 1Z4
Atten: Jessica Doyle
604-741-4218
jessy_doyle@hotmail.com

Client ID	Bottle	Lab ID#	Samp. Date	Arrive Date	Anal. Date	Rec. Elev. (m)	Rec. Temp. ^{o}C
TW#2	1	0097.01	4/13/2011	5/2/2011	5/3/2011	350	10.20
TW#2	2	0097.01D	4/13/2011	5/2/2011	5/3/2011	350	10.20
TW#2	3	0097.D2	4/13/2011	5/2/2011	5/3/2011	350	10.20
Blank	1	0097.02	4/13/2011	5/2/2011	5/3/2011	350	10.20
Blank	2	0097.02D	4/13/2011	5/2/2011	5/3/2011	350	10.20
Blank	3	0097.02D2	4/13/2011	5/2/2011	5/3/2011	350	10.20
TW#4	1	0097.03	4/13/2011	5/2/2011	5/3/2011	350	10.20
TW#4	2	0097.03D	4/13/2011	5/2/2011	5/3/2011	350	10.20
TW#4	3	0097.03D2	4/13/2011	5/2/2011	5/3/2011	350	10.20
TW#1	1	0097.04	4/13/2011	5/2/2011	5/3/2011	350	10.20
TW#1	2	0097.04D	4/13/2011	5/2/2011	5/3/2011	350	10.20
TW#1	3	0097.04D2	4/13/2011	5/2/2011	5/3/2011	350	10.20
TW#3	1	0097.50	4/13/2011	5/2/2011	5/3/2011	350	10.20
TW#3	2	0097.5D	4/13/2011	5/2/2011	5/3/2011	350	10.20
TW#3	3	0097.05D2	4/13/2011	5/2/2011	5/3/2011	350	10.20
Chaster	1	0097.06	4/22/2011	5/2/2011	5/3/2011	350	10.20
Chaster	2	0097.06D	4/22/2011	5/2/2011	5/3/2011	350	10.20
Strata	1	0097.07	4/19/2011	5/2/2011	5/3/2011	350	10.20
Strata	2	0097.07D	4/19/2011	5/2/2011	5/3/2011	350	10.20
Strata	3	0097.07D2	4/19/2011	5/2/2011	5/3/2011	350	10.20

D in column three indicates duplicate sample,
there is no charge for this analysis.

Data Release CFC11-10, Job # CFC0097
University of British Columbia
6339 Stores Road
Vancouver, BC V6T 1Z4
Atten: Jessica Doyle
604-741-4218
jessy_doyle@hotmail.com

	Water Concentration Corrected for Stripping Efficiency							
Client ID	**SF_6**	**error**	**CFC12**	**error**	**CFC11**	**error**	**CFC113**	**error**
	fmol/kg		**pmol/Kg**		**pmol/Kg**		**pmol/Kg**	
TW#2	0.000	0.050	7.367	0.147	1.283	0.026	0.014	0.010
TW#2	0.000	0.050	7.490	0.150	1.338	0.027	0.019	0.010
TW#2	0.000	0.050	7.441	0.149	1.332	0.027	0.018	0.010
Blank	0.000	0.050	0.305	0.006	0.892	0.018	0.020	0.010
Blank	0.000	0.050	0.143	0.003	0.834	0.017	0.021	0.010
Blank	0.000	0.050	0.122	0.002	0.816	0.016	0.018	0.010
TW#4	0.128	0.050	0.420	0.008	1.347	0.027	0.025	0.010
TW#4	0.089	0.050	0.467	0.009	1.469	0.029	0.024	0.010
TW#4	0.122	0.050	0.416	0.008	1.401	0.028	0.014	0.010
TW#1	0.000	0.050	0.157	0.003	0.826	0.017	0.023	0.010
TW#1	0.000	0.050	0.150	0.003	0.865	0.017	0.021	0.010
TW#1	0.000	0.050	0.175	0.004	1.162	0.023	0.023	0.010
TW#3	0.179	0.050	117.858	2.357	2.053	0.041	0.052	0.010
TW#3	0.526	0.050	114.533	2.291	2.080	0.042	0.049	0.010
TW#3	0.071	0.050	98.941	1.979	1.983	0.040	0.045	0.001
Chaster	0.662	0.050	0.541	0.011	0.097	0.002	0.020	0.000
Chaster	0.177	0.050	0.540	0.011	0.108	0.002	0.021	0.000
Strata	0.000	0.050	0.163	0.003	0.983	0.020	0.002	0.000
Strata	0.000	0.050	0.142	0.003	0.991	0.020	0.002	0.000
Strata	0.000	0.050	0.143	0.003	0.964	0.019	0.004	0.000

Detection limit for SF_6 is 0.05 fmol/Kg
Detection limit for CFC-12 & CFC-113 is 0.010 pmol/Kg
Detection limit for CFC-11 is 0.005 pmol/Kg

Data Release CFC11-10, Job # CFC0097

University of British Columbia
6339 Stores Road
Vancouver, BC V6T 1Z4
Atten: Jessica Doyle
604-741-4218
jessy_doyle@hotmail.com

Equivalent Atmospheric Concentration

Client ID	SF_6 pmol/mol	error	CFC12 pmol/mol	error	CFC11 pmol/mol	error	CFC113 pmol/mol	error
TW#2	0.00	0.00	1432.5	28.6	64.8	1.3	2.4	0.0
TW#2	0.00	0.00	1456.5	29.1	67.6	1.4	3.1	0.1
TW#2	0.00	0.00	1446.9	28.9	67.3	1.3	3.0	0.1
Blank	0.00	0.00	59.3	1.2	45.1	0.9	3.3	0.1
Blank	0.00	0.00	27.8	0.6	42.2	0.8	3.5	0.1
Blank	0.00	0.00	23.7	0.5	41.2	0.8	2.9	0.1
TW#4	0.34	0.01	81.7	1.6	68.1	1.4	4.0	0.1
TW#4	0.24	0.00	90.9	1.8	74.2	1.5	4.0	0.1
TW#4	0.33	0.01	80.9	1.6	70.8	1.4	2.4	0.0
TW#1	0.00	0.00	30.4	0.6	41.8	0.8	3.8	0.1
TW#1	0.00	0.00	29.2	0.6	43.7	0.9	3.5	0.1
TW#1	0.00	0.00	34.1	0.7	58.7	1.2	3.8	0.1
TW#3	0.48	0.01	22918.8	458.4	103.7	2.1	8.5	0.2
TW#3	1.41	0.03	22272.2	445.4	105.1	2.1	8.0	0.2
TW#3	0.19	0.00	19240.1	384.8	100.2	2.0	7.4	0.1
Chaster	1.77	0.04	105.1	2.1	4.9	0.1	3.2	0.1
Chaster	0.47	0.01	105.1	2.1	5.5	0.1	3.5	0.1
Strata	0.00	0.00	31.7	0.6	49.7	1.0	0.4	0.0
Strata	0.00	0.00	27.6	0.6	50.1	1.0	0.3	0.0
Strata	0.00	0.00	27.8	0.6	48.7	1.0	0.6	0.0

current and max. value for SF_6 is ~ 7.2 pmol/mol
current value for CFC-12 is ~ 535 pmol/mol
max. value for CFC-12 was ~ 547 pmol/mol in 2003
current value for CFC-11 is ~ 242 pmol/mol
max. value for CFC-11 was ~ 268 pmol/mol in 1994
current value for CFC-113 is ~ 76 pmol/mol
max. value for CFC-113 was ~ 85 pmol/mol in 1994

Data Release CFC11-10, Job # CFC0097

University of British Columbia
6339 Stores Road
Vancouver, BC V6T 1Z4
Atten: Jessica Doyle
604-741-4218
jessy_doyle@hotmail.com

Client ID	**Recharge Age In years before sampling date**							
	SF_6 years	**error**	**CFC12 years**	**error**	**CFC11 years**	**error**	**CFC113 years**	**error**
TW#2	>41	2	Supersaturated		41	2	43	2
TW#2	>41	2	Supersaturated		40	2	42	2
TW#2	>41	2	Supersaturated		40	2	42	2
Blank	>41	2	47	2	43	2	42	2
Blank	>41	2	53	2	43	2	42	2
Blank	>41	2	54	2	44	2	43	2
TW#4	38	2	45	2	40	2	41	2
TW#4	41	2	44	2	40	2	41	2
TW#4	38	2	45	2	40	2	43	2
TW#1	>41	2	52	2	44	2	41	2
TW#1	>41	2	52	2	43	2	42	2
TW#1	>41	2	51	2	41	2	41	2
TW#3	35	2	Supersaturated		37	2	37	2
TW#3	27	2	Supersaturated		37	2	38	2
TW#3	43	2	Supersaturated		37	2	38	2
Chaster	25	2	43	2	55	2	42	2
Chaster	35	2	43	2	55	2	42	2
Strata	>41	2	52	2	42	2	48	2
Strata	>41	2	53	2	42	2	49	2
Strata	>41	2	53	2	43	2	48	2

Supersaturated indicates that there are additional non-atmospheric sources of the CFC or SF_6 making a valid age determination impossible.

Your C.O.C. #: V008395

Attention:
Shelley Bayne, M.Sc., P.Geo.
WATERLINE RESOURCES INC.
NANAIMO
UNIT D
2301 MCCULLOUGH RD.
Nanaimo, BC
CANADA V9S 4M8

Report Date: 2012/10/19

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B292313
Received: 2012/10/12, 13:55

Sample Matrix: Water
Samples Received: 11

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	11	2012/10/15	2012/10/15	BBY6SOP-00026	SM2320B
Chloride by Automated Colourimetry	11	N/A	2012/10/15	BBY6SOP-00011	SM-4500-Cl-
Conductance - water	11	N/A	2012/10/15	BBY6SOP-00026	SM-2510B
Hardness Total (calculated as CaCO3)	2	N/A	2012/10/18	BBY WI-00033	Calculated Parameter
Hardness Total (calculated as CaCO3)	3	N/A	2012/10/19	BBY WI-00033	Calculated Parameter
Hardness (calculated as CaCO3)	11	N/A	2012/10/19	BBY WI-00033	Calculated Parameter
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	11	N/A	2012/10/19	BBY7SOP-00002	EPA 6020A
Elements by CRC ICPMS (dissolved)	11	N/A	2012/10/18	BBY7SOP-00002	EPA 6020A
Na, K, Ca, Mg, S by CRC ICPMS (total)	2	2012/10/13	2012/10/18	BBY7SOP-00002	EPA 6020A
Na, K, Ca, Mg, S by CRC ICPMS (total)	3	2012/10/13	2012/10/19	BBY7SOP-00002	EPA 6020A
Elements by CRC ICPMS (total)	2	2012/10/16	2012/10/18	BBY7SOP-00002	EPA 6020A
Elements by CRC ICPMS (total)	3	2012/10/18	2012/10/19	BBY7SOP-00002	EPA 6020A
Nitrate + Nitrite (N)	11	N/A	2012/10/13	BBY6SOP-00010	USEPA 353.2
Nitrite (N) by CFA	11	N/A	2012/10/13	BBY6SOP-00010	EPA 353.2
Nitrogen - Nitrate (as N)	11	N/A	2012/10/15	BBY6SOP-00010	Based on EPA 353.2
Filter and HNO3 Preserve for Metals	9	N/A	2012/10/13	BBY6WI-00001	EPA 200.2
Filter and HNO3 Preserve for Metals	2	N/A	2012/10/15	BBY6WI-00001	EPA 200.2
pH Water	11	N/A	2012/10/15	BBY6SOP-00026	SM-4500H+B

* Results relate only to the items tested.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Tabitha Rudkin, Burnaby Project Manager
Email: TRudkin@maxxam.ca
Phone# (604) 638-2639

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		ES3842	ES3843	ES3844	ES3845	ES3846		
Sampling Date		2012/10/10 10:00	2012/10/10 10:30	2012/10/10 11:00	2012/10/10 11:00	2012/10/10 11:30		
	UNITS	**TW3**	**TW2**	**TW1**	**TW1 DUP**	**TW4**	**RDL**	**QC Batch**
ANIONS								
Nitrite (N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	6251628
Calculated Parameters								
Filter and HNO3 Preservation	N/A	FIELD	FIELD	FIELD	FIELD	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	0.974	0.895	0.377	0.342	0.381	0.020	6251358
Misc. Inorganics								
Alkalinity (Total as CaCO3)	mg/L	47.9	54.0	38.5	37.3	40.7	0.50	6255997
Alkalinity (PP as CaCO3)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	6255997
Bicarbonate (HCO3)	mg/L	58.4	65.9	47.0	45.5	49.7	0.50	6255997
Carbonate (CO3)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	6255997
Hydroxide (OH)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	6255997
Anions								
Dissolved Chloride (Cl)	mg/L	7.0	7.7	2.2	2.4	2.9	0.50	6254941
Nutrients								
Nitrate plus Nitrite (N)	mg/L	0.974	0.895	0.377	0.342	0.381	0.020	6251623
Physical Properties								
Conductivity	uS/cm	135	142	98.4	97.4	98.4	1.0	6256003
pH	pH Units	7.71	7.74	7.69	7.69	7.69		6256004

Maxxam ID		ES3847		ES3848	ES3848		ES3849		
Sampling Date		2012/10/11 09:30		2012/10/11 09:50	2012/10/11 09:50		2012/10/11 11:00		
	UNITS	**MW06-1A**	**QC Batch**	**MW06-1B***	**MW06-1B* Lab-Dup**	**QC Batch**	**WL10-01**	**RDL**	**QC Batch**
ANIONS									
Nitrite (N)	mg/L	<0.0050	6251628	0.0063		6251628	<0.0050	0.0050	6251628
Calculated Parameters									
Filter and HNO3 Preservation	N/A	FIELD	ONSITE	LAB		6252900	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	0.861	6251358	0.428		6251358	0.056	0.020	6251358
Misc. Inorganics									
Alkalinity (Total as CaCO3)	mg/L	57.8	6255997	130	127	6255997	111	0.50	6255997
Alkalinity (PP as CaCO3)	mg/L	<0.50	6255997	<0.50	<0.50	6255997	<0.50	0.50	6255997
Bicarbonate (HCO3)	mg/L	70.5	6255997	158	155	6255997	136	0.50	6255997
Carbonate (CO3)	mg/L	<0.50	6255997	<0.50	<0.50	6255997	<0.50	0.50	6255997
Hydroxide (OH)	mg/L	<0.50	6255997	<0.50	<0.50	6255997	<0.50	0.50	6255997
Anions									
Dissolved Chloride (Cl)	mg/L	3.5	6254941	47		6254941	3.9	0.50	6254941
Nutrients									
Nitrate plus Nitrite (N)	mg/L	0.861	6251623	0.434		6251623	0.056	0.020	6251623
Physical Properties									
Conductivity	uS/cm	137	6256003	412	407	6256003	229	1.0	6256003
pH	pH Units	7.80	6256004	7.80	7.96	6256004	8.14		6256004

N/A = Not Applicable
RDL = Reportable Detection Limit

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		ES3850	ES3851			ES3852	ES3852		
Sampling Date		2012/10/11 11:40	2012/10/11 12:55			2012/10/11 12:55	2012/10/11 12:55		
	UNITS	**WL10-02**	**MW06-2A**	**RDL**	**QC Batch**	**MW06-2B***	**MW06-2B* Lab-Dup**	**RDL**	**QC Batch**
ANIONS									
Nitrite (N)	mg/L	<0.0050	<0.0050	0.0050	6251628	<0.0050	<0.0050	0.0050	6251628
Calculated Parameters									
Filter and HNO3 Preservation	N/A	FIELD	FIELD	N/A	ONSITE	LAB		N/A	6252900
Nitrate (N)	mg/L	0.384	0.990	0.020	6251358	2.59		0.040	6251358
Misc. Inorganics									
Alkalinity (Total as CaCO3)	mg/L	45.9	54.8	0.50	6255997	25.1		0.50	6255997
Alkalinity (PP as CaCO3)	mg/L	<0.50	<0.50	0.50	6255997	<0.50		0.50	6255997
Bicarbonate (HCO3)	mg/L	56.0	66.9	0.50	6255997	30.7		0.50	6255997
Carbonate (CO3)	mg/L	<0.50	<0.50	0.50	6255997	<0.50		0.50	6255997
Hydroxide (OH)	mg/L	<0.50	<0.50	0.50	6255997	<0.50		0.50	6255997
Anions									
Dissolved Chloride (Cl)	mg/L	5.0	53	0.50	6254941	12		0.50	6254941
Nutrients									
Nitrate plus Nitrite (N)	mg/L	0.384	0.990	0.020	6251623	2.59	2.52	0.040	6251623
Physical Properties									
Conductivity	uS/cm	139	294	1.0	6256003	118		1.0	6256003
pH	pH Units	7.72	7.73		6256004	6.92			6256004

N/A = Not Applicable
RDL = Reportable Detection Limit

CSR DISSOLVED METALS IN WATER (WATER)

Maxxam ID		ES3842	ES3843	ES3844	ES3845	ES3846		
Sampling Date		2012/10/10 10:00	2012/10/10 10:30	2012/10/10 11:00	2012/10/10 11:00	2012/10/10 11:30		
	UNITS	**TW3**	**TW2**	**TW1**	**TW1 DUP**	**TW4**	**RDL**	**QC Batch**
Misc. Inorganics								
Dissolved Hardness (CaCO3)	mg/L	46.8	50.2	34.0	34.1	34.9	0.50	6251221
Dissolved Metals by ICPMS								
Dissolved Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0030	6257583
Dissolved Antimony (Sb)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00050	6257583
Dissolved Arsenic (As)	mg/L	0.00250	0.00214	0.00393	0.00402	0.00362	0.00010	6257583
Dissolved Barium (Ba)	mg/L	0.0028	0.0032	0.0025	0.0023	0.0027	0.0010	6257583
Dissolved Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00010	6257583
Dissolved Bismuth (Bi)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	6257583
Dissolved Boron (B)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	6257583
Dissolved Cadmium (Cd)	mg/L	<0.000010	0.000193	0.000042	0.000041	<0.000010	0.000010	6257583
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.0010	6257583
Dissolved Cobalt (Co)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00050	6257583
Dissolved Copper (Cu)	mg/L	0.00332	0.00265	0.00070	0.00072	0.00262	0.00020	6257583
Dissolved Iron (Fe)	mg/L	<0.0050	0.0122	<0.0050	<0.0050	0.0058	0.0050	6257583
Dissolved Lead (Pb)	mg/L	0.00021	0.00386	0.00160	0.00159	<0.00020	0.00020	6257583
Dissolved Manganese (Mn)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	6257583
Dissolved Mercury (Hg)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000050	6257583
Dissolved Molybdenum (Mo)	mg/L	0.0014	0.0012	0.0021	0.0020	0.0013	0.0010	6257583
Dissolved Nickel (Ni)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	6257583
Dissolved Selenium (Se)	mg/L	0.00028	0.00026	0.00053	0.00058	0.00032	0.00010	6257583
Dissolved Silicon (Si)	mg/L	20.1	20.3	17.3	17.5	17.0	0.10	6257583
Dissolved Silver (Ag)	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	0.000020	6257583
Dissolved Strontium (Sr)	mg/L	0.0456	0.0450	0.0261	0.0256	0.0226	0.0010	6257583
Dissolved Thallium (Tl)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000050	6257583
Dissolved Tin (Sn)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	6257583
Dissolved Titanium (Ti)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	6257583
Dissolved Uranium (U)	mg/L	0.00013	0.00016	0.00017	0.00016	0.00012	0.00010	6257583
Dissolved Vanadium (V)	mg/L	0.0088	0.0079	0.0105	0.0104	0.0085	0.0050	6257583
Dissolved Zinc (Zn)	mg/L	0.0085	<0.0050	<0.0050	<0.0050	0.0061	0.0050	6257583
Dissolved Zirconium (Zr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00050	6257583
Dissolved Calcium (Ca)	mg/L	8.81	9.27	7.37	7.42	6.91	0.050	6251356
Dissolved Magnesium (Mg)	mg/L	6.03	6.57	3.79	3.78	4.27	0.050	6251356
Dissolved Potassium (K)	mg/L	2.82	2.83	2.30	2.28	2.26	0.050	6251356
Dissolved Sodium (Na)	mg/L	7.33	7.60	5.44	5.46	5.60	0.050	6251356
Dissolved Sulphur (S)	mg/L	<3.0	<3.0	<3.0	<3.0	<3.0	3.0	6251356

RDL = Reportable Detection Limit

CSR DISSOLVED METALS IN WATER (WATER)

Maxxam ID		ES3847	ES3848	ES3849		
Sampling Date		2012/10/11 09:30	2012/10/11 09:50	2012/10/11 11:00		
	UNITS	**MW06-1A**	**MW06-1B***	**WL10-01**	**RDL**	**QC Batch**
Misc. Inorganics						
Dissolved Hardness (CaCO3)	mg/L	51.0	157	24.9	0.50	6251221
Dissolved Metals by ICPMS						
Dissolved Aluminum (Al)	mg/L	0.0041	0.0038	0.0136	0.0030	6257583
Dissolved Antimony (Sb)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	6257583
Dissolved Arsenic (As)	mg/L	0.00451	0.00365	0.0298	0.00010	6257583
Dissolved Barium (Ba)	mg/L	0.0034	0.0087	0.0033	0.0010	6257583
Dissolved Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	0.00010	6257583
Dissolved Bismuth (Bi)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	6257583
Dissolved Boron (B)	mg/L	<0.050	<0.050	0.130	0.050	6257583
Dissolved Cadmium (Cd)	mg/L	<0.000010	0.000031	<0.000010	0.000010	6257583
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	6257583
Dissolved Cobalt (Co)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	6257583
Dissolved Copper (Cu)	mg/L	0.00039	0.00681	0.00100	0.00020	6257583
Dissolved Iron (Fe)	mg/L	0.0276	<0.0050	0.0489	0.0050	6257583
Dissolved Lead (Pb)	mg/L	<0.00020	<0.00020	<0.00020	0.00020	6257583
Dissolved Manganese (Mn)	mg/L	0.0011	0.0033	0.0178	0.0010	6257583
Dissolved Mercury (Hg)	mg/L	<0.000050	<0.000050	<0.000050	0.000050	6257583
Dissolved Molybdenum (Mo)	mg/L	0.0017	<0.0010	0.0127	0.0010	6257583
Dissolved Nickel (Ni)	mg/L	<0.0010	0.0017	<0.0010	0.0010	6257583
Dissolved Selenium (Se)	mg/L	0.00047	0.00011	<0.00010	0.00010	6257583
Dissolved Silicon (Si)	mg/L	19.6	25.1	7.42	0.10	6257583
Dissolved Silver (Ag)	mg/L	<0.000020	<0.000020	<0.000020	0.000020	6257583
Dissolved Strontium (Sr)	mg/L	0.0306	0.133	0.0408	0.0010	6257583
Dissolved Thallium (Tl)	mg/L	<0.000050	<0.000050	<0.000050	0.000050	6257583
Dissolved Tin (Sn)	mg/L	<0.0050	<0.0050	<0.0050	0.0050	6257583
Dissolved Titanium (Ti)	mg/L	<0.0050	<0.0050	<0.0050	0.0050	6257583
Dissolved Uranium (U)	mg/L	0.00017	0.00078	<0.00010	0.00010	6257583
Dissolved Vanadium (V)	mg/L	0.0112	0.0143	<0.0050	0.0050	6257583
Dissolved Zinc (Zn)	mg/L	<0.0050	0.0151	0.0154	0.0050	6257583
Dissolved Zirconium (Zr)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	6257583
Dissolved Calcium (Ca)	mg/L	6.95	21.1	6.55	0.050	6251356
Dissolved Magnesium (Mg)	mg/L	8.16	25.3	2.07	0.050	6251356
Dissolved Potassium (K)	mg/L	2.34	4.53	1.45	0.050	6251356
Dissolved Sodium (Na)	mg/L	8.00	15.8	42.6	0.050	6251356
Dissolved Sulphur (S)	mg/L	<3.0	<3.0	<3.0	3.0	6251356

RDL = Reportable Detection Limit

CSR DISSOLVED METALS IN WATER (WATER)

Maxxam ID		ES3850	ES3851	ES3852		
Sampling Date		2012/10/11 11:40	2012/10/11 12:55	2012/10/11 12:55		
	UNITS	**WL10-02**	**MW06-2A**	**MW06-2B***	**RDL**	**QC Batch**
Misc. Inorganics						
Dissolved Hardness (CaCO3)	mg/L	44.5	104	33.8	0.50	6251221
Dissolved Metals by ICPMS						
Dissolved Aluminum (Al)	mg/L	0.0065	0.0033	<0.0030	0.0030	6257583
Dissolved Antimony (Sb)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	6257583
Dissolved Arsenic (As)	mg/L	0.00386	0.00145	0.00013	0.00010	6257583
Dissolved Barium (Ba)	mg/L	0.0037	0.0077	0.0037	0.0010	6257583
Dissolved Beryllium (Be)	mg/L	<0.00010	<0.00010	<0.00010	0.00010	6257583
Dissolved Bismuth (Bi)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	6257583
Dissolved Boron (B)	mg/L	<0.050	<0.050	<0.050	0.050	6257583
Dissolved Cadmium (Cd)	mg/L	0.000023	0.000022	0.000109	0.000010	6257583
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	6257583
Dissolved Cobalt (Co)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	6257583
Dissolved Copper (Cu)	mg/L	0.00232	0.00491	0.00057	0.00020	6257583
Dissolved Iron (Fe)	mg/L	0.0077	0.0123	0.0072	0.0050	6257583
Dissolved Lead (Pb)	mg/L	0.00046	<0.00020	<0.00020	0.00020	6257583
Dissolved Manganese (Mn)	mg/L	<0.0010	0.0036	0.0012	0.0010	6257583
Dissolved Mercury (Hg)	mg/L	<0.000050	<0.000050	<0.000050	0.000050	6257583
Dissolved Molybdenum (Mo)	mg/L	0.0034	<0.0010	<0.0010	0.0010	6257583
Dissolved Nickel (Ni)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	6257583
Dissolved Selenium (Se)	mg/L	0.00060	0.00015	<0.00010	0.00010	6257583
Dissolved Silicon (Si)	mg/L	18.0	19.2	8.93	0.10	6257583
Dissolved Silver (Ag)	mg/L	<0.000020	<0.000020	<0.000020	0.000020	6257583
Dissolved Strontium (Sr)	mg/L	0.0473	0.102	0.125	0.0010	6257583
Dissolved Thallium (Tl)	mg/L	<0.000050	<0.000050	<0.000050	0.000050	6257583
Dissolved Tin (Sn)	mg/L	<0.0050	<0.0050	<0.0050	0.0050	6257583
Dissolved Titanium (Ti)	mg/L	<0.0050	<0.0050	<0.0050	0.0050	6257583
Dissolved Uranium (U)	mg/L	0.00025	0.00030	<0.00010	0.00010	6257583
Dissolved Vanadium (V)	mg/L	0.0118	0.0053	<0.0050	0.0050	6257583
Dissolved Zinc (Zn)	mg/L	0.0098	0.0113	0.0052	0.0050	6257583
Dissolved Zirconium (Zr)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	6257583
Dissolved Calcium (Ca)	mg/L	10.6	21.7	9.27	0.050	6251356
Dissolved Magnesium (Mg)	mg/L	4.38	12.2	2.58	0.050	6251356
Dissolved Potassium (K)	mg/L	3.51	4.43	1.22	0.050	6251356
Dissolved Sodium (Na)	mg/L	8.55	9.63	8.05	0.050	6251356
Dissolved Sulphur (S)	mg/L	5.2	<3.0	<3.0	3.0	6251356

RDL = Reportable Detection Limit

CSR TOTAL METALS IN WATER (WATER)

Maxxam ID		ES3842	ES3843		ES3844	ES3845	ES3846		
Sampling Date		2012/10/10 10:00	2012/10/10 10:30		2012/10/10 11:00	2012/10/10 11:00	2012/10/10 11:30		
	UNITS	**TW3**	**TW2**	**QC Batch**	**TW1**	**TW1 DUP**	**TW4**	**RDL**	**QC Batch**
Calculated Parameters									
Total Hardness (CaCO3)	mg/L	47.7	50.5	6251355	34.7	35.4	36.9	0.50	6251355
Total Metals by ICPMS									
Total Aluminum (Al)	mg/L	<0.0030	0.0053	6257529	<0.0030	<0.0030	0.0039	0.0030	6265011
Total Antimony (Sb)	mg/L	<0.00050	<0.00050	6257529	<0.00050	<0.00050	<0.00050	0.00050	6265011
Total Arsenic (As)	mg/L	0.00243	0.00216	6257529	0.00401	0.00418	0.00377	0.00010	6265011
Total Barium (Ba)	mg/L	0.0028	0.0032	6257529	0.0023	0.0024	0.0029	0.0010	6265011
Total Beryllium (Be)	mg/L	<0.00010	<0.00010	6257529	<0.00010	<0.00010	<0.00010	0.00010	6265011
Total Bismuth (Bi)	mg/L	<0.0010	<0.0010	6257529	<0.0010	<0.0010	<0.0010	0.0010	6265011
Total Boron (B)	mg/L	<0.050	<0.050	6257529	<0.050	<0.050	<0.050	0.050	6265011
Total Cadmium (Cd)	mg/L	<0.000010	0.000209	6257529	0.000046	0.000047	<0.000010	0.000010	6265011
Total Chromium (Cr)	mg/L	<0.0010	<0.0010	6257529	<0.0010	<0.0010	<0.0010	0.0010	6265011
Total Cobalt (Co)	mg/L	<0.00050	<0.00050	6257529	<0.00050	<0.00050	<0.00050	0.00050	6265011
Total Copper (Cu)	mg/L	0.00377	0.00412	6257529	0.00096	0.00099	0.00317	0.00020	6265011
Total Iron (Fe)	mg/L	<0.0050	0.0594	6257529	<0.0050	<0.0050	0.0124	0.0050	6265011
Total Lead (Pb)	mg/L	0.00022	0.00454	6257529	0.00187	0.00193	<0.00020	0.00020	6265011
Total Manganese (Mn)	mg/L	<0.0010	0.0014	6257529	<0.0010	<0.0010	<0.0010	0.0010	6265011
Total Mercury (Hg)	mg/L	<0.000050	<0.000050	6257529	<0.000050	<0.000050	<0.000050	0.000050	6265011
Total Molybdenum (Mo)	mg/L	0.0015	0.0012	6257529	0.0023	0.0023	0.0013	0.0010	6265011
Total Nickel (Ni)	mg/L	<0.0010	<0.0010	6257529	0.0013	<0.0010	<0.0010	0.0010	6265011
Total Selenium (Se)	mg/L	0.00033	0.00023	6257529	0.00059	0.00067	0.00034	0.00010	6265011
Total Silicon (Si)	mg/L	21.9	21.8	6257529	17.8	18.2	18.3	0.10	6265011
Total Silver (Ag)	mg/L	<0.000020	<0.000020	6257529	<0.000020	<0.000020	<0.000020	0.000020	6265011
Total Strontium (Sr)	mg/L	0.0462	0.0458	6257529	0.0266	0.0274	0.0249	0.0010	6265011
Total Thallium (Tl)	mg/L	<0.000050	<0.000050	6257529	<0.000050	<0.000050	<0.000050	0.000050	6265011
Total Tin (Sn)	mg/L	<0.0050	<0.0050	6257529	<0.0050	<0.0050	<0.0050	0.0050	6265011
Total Titanium (Ti)	mg/L	<0.0050	<0.0050	6257529	<0.0050	<0.0050	<0.0050	0.0050	6265011
Total Uranium (U)	mg/L	0.00014	0.00017	6257529	0.00018	0.00018	0.00014	0.00010	6265011
Total Vanadium (V)	mg/L	0.0089	0.0083	6257529	0.0110	0.0113	0.0092	0.0050	6265011
Total Zinc (Zn)	mg/L	0.0082	0.0053	6257529	<0.0050	<0.0050	0.0060	0.0050	6265011
Total Zirconium (Zr)	mg/L	<0.00050	<0.00050	6257529	<0.00050	<0.00050	<0.00050	0.00050	6265011
Total Calcium (Ca)	mg/L	9.02	9.34	6251445	7.38	7.61	7.28	0.050	6251445
Total Magnesium (Mg)	mg/L	6.11	6.59	6251445	3.94	3.97	4.55	0.050	6251445
Total Potassium (K)	mg/L	2.89	2.84	6251445	2.34	2.38	2.33	0.050	6251445
Total Sodium (Na)	mg/L	7.41	7.58	6251445	5.71	5.71	5.90	0.050	6251445
Total Sulphur (S)	mg/L	<3.0	<3.0	6251445	<3.0	<3.0	<3.0	3.0	6251445

RDL = Reportable Detection Limit

General Comments

Sample ES3842-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample ES3843-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample ES3844-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample ES3845-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample ES3846-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample ES3847-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample ES3848-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample ES3849-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample ES3850-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample ES3851-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample ES3852-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**UNITS**
6251623	Nitrate plus Nitrite (N)	2012/10/13	106	80 - 120	102	80 - 120	<0.020	mg/L
6251628	Nitrite (N)	2012/10/13	111	80 - 120	97	80 - 120	<0.0050	mg/L
6254941	Dissolved Chloride (Cl)	2012/10/15	NC	80 - 120	104	80 - 120	<0.50	mg/L
6255997	Alkalinity (Total as CaCO3)	2012/10/15	NC	80 - 120	96	80 - 120	<0.50	mg/L
6255997	Alkalinity (PP as CaCO3)	2012/10/15					<0.50	mg/L
6255997	Bicarbonate (HCO3)	2012/10/15					<0.50	mg/L
6255997	Carbonate (CO3)	2012/10/15					<0.50	mg/L
6255997	Hydroxide (OH)	2012/10/15					<0.50	mg/L
6256003	Conductivity	2012/10/15			99	80 - 120	<1.0	uS/cm
6257529	Total Aluminum (Al)	2012/10/18	99	80 - 120	105	80 - 120	<0.0030	mg/L
6257529	Total Antimony (Sb)	2012/10/18	100	80 - 120	100	80 - 120	<0.00050	mg/L
6257529	Total Arsenic (As)	2012/10/18	101	80 - 120	99	80 - 120	<0.00010	mg/L
6257529	Total Barium (Ba)	2012/10/18	NC	80 - 120	102	80 - 120	<0.0010	mg/L
6257529	Total Beryllium (Be)	2012/10/18	100	80 - 120	97	80 - 120	<0.00010	mg/L
6257529	Total Bismuth (Bi)	2012/10/18	97	80 - 120	99	80 - 120	<0.0010	mg/L
6257529	Total Cadmium (Cd)	2012/10/18	100	80 - 120	100	80 - 120	<0.000010	mg/L
6257529	Total Chromium (Cr)	2012/10/18	98	80 - 120	100	80 - 120	<0.0010	mg/L
6257529	Total Cobalt (Co)	2012/10/18	97	80 - 120	100	80 - 120	<0.00050	mg/L
6257529	Total Copper (Cu)	2012/10/18	NC	80 - 120	100	80 - 120	<0.00020	mg/L
6257529	Total Iron (Fe)	2012/10/18	NC	80 - 120	107	80 - 120	<0.0050	mg/L
6257529	Total Lead (Pb)	2012/10/18	94	80 - 120	99	80 - 120	<0.00020	mg/L
6257529	Total Manganese (Mn)	2012/10/18	96	80 - 120	102	80 - 120	<0.0010	mg/L
6257529	Total Mercury (Hg)	2012/10/18	96	80 - 120	93	80 - 120	<0.000050	mg/L
6257529	Total Molybdenum (Mo)	2012/10/18	93	80 - 120	96	80 - 120	<0.0010	mg/L
6257529	Total Nickel (Ni)	2012/10/18	98	80 - 120	105	80 - 120	<0.0010	mg/L
6257529	Total Selenium (Se)	2012/10/18	102	80 - 120	105	80 - 120	<0.00010	mg/L
6257529	Total Silver (Ag)	2012/10/18	95	80 - 120	99	80 - 120	<0.000020	mg/L
6257529	Total Strontium (Sr)	2012/10/18	NC	80 - 120	99	80 - 120	<0.0010	mg/L
6257529	Total Thallium (Tl)	2012/10/18	94	80 - 120	99	80 - 120	<0.000050	mg/L
6257529	Total Tin (Sn)	2012/10/18	87	80 - 120	105	80 - 120	<0.0050	mg/L
6257529	Total Titanium (Ti)	2012/10/18	109	80 - 120	100	80 - 120	<0.0050	mg/L
6257529	Total Uranium (U)	2012/10/18	95	80 - 120	96	80 - 120	<0.00010	mg/L
6257529	Total Vanadium (V)	2012/10/18	99	80 - 120	101	80 - 120	<0.0050	mg/L
6257529	Total Zinc (Zn)	2012/10/18	NC	80 - 120	116	80 - 120	<0.0050	mg/L
6257529	Total Boron (B)	2012/10/18					<0.050	mg/L
6257529	Total Silicon (Si)	2012/10/18					<0.10	mg/L
6257529	Total Zirconium (Zr)	2012/10/18					<0.00050	mg/L
6257583	Dissolved Aluminum (Al)	2012/10/18	NC	80 - 120	106	80 - 120	<0.0030	mg/L
6257583	Dissolved Antimony (Sb)	2012/10/18	98	80 - 120	100	80 - 120	<0.00050	mg/L
6257583	Dissolved Arsenic (As)	2012/10/18	100	80 - 120	101	80 - 120	<0.00010	mg/L
6257583	Dissolved Barium (Ba)	2012/10/18	NC	80 - 120	98	80 - 120	<0.0010	mg/L
6257583	Dissolved Beryllium (Be)	2012/10/18	99	80 - 120	95	80 - 120	<0.00010	mg/L
6257583	Dissolved Bismuth (Bi)	2012/10/18	96	80 - 120	99	80 - 120	<0.0010	mg/L
6257583	Dissolved Cadmium (Cd)	2012/10/18	101	80 - 120	99	80 - 120	<0.000010	mg/L
6257583	Dissolved Chromium (Cr)	2012/10/18	93	80 - 120	96	80 - 120	<0.0010	mg/L
6257583	Dissolved Cobalt (Co)	2012/10/18	91	80 - 120	94	80 - 120	<0.00050	mg/L
6257583	Dissolved Copper (Cu)	2012/10/18	90	80 - 120	93	80 - 120	<0.00020	mg/L
6257583	Dissolved Iron (Fe)	2012/10/18	105	80 - 120	108	80 - 120	<0.0050	mg/L
6257583	Dissolved Lead (Pb)	2012/10/18	95	80 - 120	98	80 - 120	<0.00020	mg/L
6257583	Dissolved Manganese (Mn)	2012/10/18	97	80 - 120	97	80 - 120	<0.0010	mg/L
6257583	Dissolved Mercury (Hg)	2012/10/18	92	80 - 120	94	80 - 120	<0.000050	mg/L
6257583	Dissolved Molybdenum (Mo)	2012/10/18	103	80 - 120	95	80 - 120	<0.0010	mg/L
6257583	Dissolved Nickel (Ni)	2012/10/18	95	80 - 120	97	80 - 120	<0.0010	mg/L
6257583	Dissolved Selenium (Se)	2012/10/18	101	80 - 120	107	80 - 120	<0.00010	mg/L
6257583	Dissolved Silver (Ag)	2012/10/18	96	80 - 120	97	80 - 120	<0.000020	mg/L
6257583	Dissolved Strontium (Sr)	2012/10/18	NC	80 - 120	98	80 - 120	<0.0010	mg/L
6257583	Dissolved Thallium (Tl)	2012/10/18	98	80 - 120	101	80 - 120	<0.000050	mg/L
6257583	Dissolved Tin (Sn)	2012/10/18	NC	80 - 120	106	80 - 120	<0.0050	mg/L

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS
6257583	Dissolved Titanium (Ti)	2012/10/18	102	80 - 120	100	80 - 120	<0.0050	mg/L
6257583	Dissolved Uranium (U)	2012/10/18	95	80 - 120	96	80 - 120	<0.00010	mg/L
6257583	Dissolved Vanadium (V)	2012/10/18	95	80 - 120	97	80 - 120	<0.0050	mg/L
6257583	Dissolved Zinc (Zn)	2012/10/18	105	80 - 120	98	80 - 120	<0.0050	mg/L
6257583	Dissolved Boron (B)	2012/10/18					<0.050	mg/L
6257583	Dissolved Silicon (Si)	2012/10/18					<0.10	mg/L
6257583	Dissolved Zirconium (Zr)	2012/10/18					<0.00050	mg/L
6265011	Total Aluminum (Al)	2012/10/19	103	80 - 120	104	80 - 120	<0.0030	mg/L
6265011	Total Antimony (Sb)	2012/10/19	105	80 - 120	103	80 - 120	<0.00050	mg/L
6265011	Total Arsenic (As)	2012/10/19	107	80 - 120	103	80 - 120	<0.00010	mg/L
6265011	Total Barium (Ba)	2012/10/19	101	80 - 120	102	80 - 120	<0.0010	mg/L
6265011	Total Beryllium (Be)	2012/10/19	101	80 - 120	96	80 - 120	<0.00010	mg/L
6265011	Total Bismuth (Bi)	2012/10/19	100	80 - 120	101	80 - 120	<0.0010	mg/L
6265011	Total Cadmium (Cd)	2012/10/19	104	80 - 120	102	80 - 120	<0.000010	mg/L
6265011	Total Chromium (Cr)	2012/10/19	98	80 - 120	102	80 - 120	<0.0010	mg/L
6265011	Total Cobalt (Co)	2012/10/19	99	80 - 120	102	80 - 120	<0.00050	mg/L
6265011	Total Copper (Cu)	2012/10/19	NC	80 - 120	102	80 - 120	<0.00020	mg/L
6265011	Total Iron (Fe)	2012/10/19	107	80 - 120	107	80 - 120	<0.0050	mg/L
6265011	Total Lead (Pb)	2012/10/19	100	80 - 120	101	80 - 120	<0.00020	mg/L
6265011	Total Manganese (Mn)	2012/10/19	NC	80 - 120	105	80 - 120	<0.0010	mg/L
6265011	Total Mercury (Hg)	2012/10/19	95	80 - 120	94	80 - 120	<0.000050	mg/L
6265011	Total Molybdenum (Mo)	2012/10/19	108	80 - 120	100	80 - 120	<0.0010	mg/L
6265011	Total Nickel (Ni)	2012/10/19	102	80 - 120	103	80 - 120	<0.0010	mg/L
6265011	Total Selenium (Se)	2012/10/19	110	80 - 120	105	80 - 120	<0.00010	mg/L
6265011	Total Silver (Ag)	2012/10/19	99	80 - 120	96	80 - 120	<0.000020	mg/L
6265011	Total Strontium (Sr)	2012/10/19	NC	80 - 120	100	80 - 120	<0.0010	mg/L
6265011	Total Thallium (Tl)	2012/10/19	101	80 - 120	107	80 - 120	<0.000050	mg/L
6265011	Total Tin (Sn)	2012/10/19	111	80 - 120	109	80 - 120	<0.0050	mg/L
6265011	Total Titanium (Ti)	2012/10/19	99	80 - 120	103	80 - 120	<0.0050	mg/L
6265011	Total Uranium (U)	2012/10/19	102	80 - 120	100	80 - 120	<0.00010	mg/L
6265011	Total Vanadium (V)	2012/10/19	99	80 - 120	102	80 - 120	<0.0050	mg/L
6265011	Total Zinc (Zn)	2012/10/19	NC	80 - 120	106	80 - 120	<0.0050	mg/L
6265011	Total Boron (B)	2012/10/19					<0.050	mg/L
6265011	Total Silicon (Si)	2012/10/19					<0.10	mg/L
6265011	Total Zirconium (Zr)	2012/10/19					<0.00050	mg/L

QUALITY ASSURANCE REPORT

			RPD	
QC Batch	Parameter	Date	Value (%)	QC Limits
6251623	Nitrate plus Nitrite (N)	2012/10/13	2.6	25
6251628	Nitrite (N)	2012/10/13	NC	20
6254941	Dissolved Chloride (Cl)	2012/10/15	NC	20
6255997	Alkalinity (Total as CaCO3)	2012/10/15	1.8	20
6255997	Alkalinity (PP as CaCO3)	2012/10/15	NC	20
6255997	Bicarbonate (HCO3)	2012/10/15	1.9	20
6255997	Carbonate (CO3)	2012/10/15	NC	20
6255997	Hydroxide (OH)	2012/10/15	NC	20
6256003	Conductivity	2012/10/15	1.2	20
6257529	Total Aluminum (Al)	2012/10/18	NC	20
6257529	Total Antimony (Sb)	2012/10/18	NC	20
6257529	Total Arsenic (As)	2012/10/18	3.6	20
6257529	Total Barium (Ba)	2012/10/18	3.1	20
6257529	Total Beryllium (Be)	2012/10/18	NC	20
6257529	Total Bismuth (Bi)	2012/10/18	NC	20
6257529	Total Cadmium (Cd)	2012/10/18	NC	20
6257529	Total Chromium (Cr)	2012/10/18	NC	20
6257529	Total Cobalt (Co)	2012/10/18	NC	20
6257529	Total Copper (Cu)	2012/10/18	0.9	20
6257529	Total Iron (Fe)	2012/10/18	4.0	20
6257529	Total Lead (Pb)	2012/10/18	0.2	20
6257529	Total Manganese (Mn)	2012/10/18	NC	20
6257529	Total Mercury (Hg)	2012/10/18	NC	20
6257529	Total Molybdenum (Mo)	2012/10/18	NC	20
6257529	Total Nickel (Ni)	2012/10/18	NC	20
6257529	Total Selenium (Se)	2012/10/18	1	20
6257529	Total Silver (Ag)	2012/10/18	NC	20
6257529	Total Strontium (Sr)	2012/10/18	1.1	20
6257529	Total Thallium (Tl)	2012/10/18	NC	20
6257529	Total Tin (Sn)	2012/10/18	NC	20
6257529	Total Titanium (Ti)	2012/10/18	NC	20
6257529	Total Uranium (U)	2012/10/18	NC	20
6257529	Total Vanadium (V)	2012/10/18	NC	20
6257529	Total Zinc (Zn)	2012/10/18	NC	20
6257529	Total Boron (B)	2012/10/18	NC	20
6257529	Total Silicon (Si)	2012/10/18	1.9	20
6257529	Total Zirconium (Zr)	2012/10/18	NC	20
6265011	Total Aluminum (Al)	2012/10/19	NC	20
6265011	Total Antimony (Sb)	2012/10/19	NC	20
6265011	Total Arsenic (As)	2012/10/19	5.2	20
6265011	Total Barium (Ba)	2012/10/19	NC	20
6265011	Total Beryllium (Be)	2012/10/19	NC	20
6265011	Total Bismuth (Bi)	2012/10/19	NC	20
6265011	Total Cadmium (Cd)	2012/10/19	NC	20
6265011	Total Chromium (Cr)	2012/10/19	NC	20
6265011	Total Cobalt (Co)	2012/10/19	NC	20
6265011	Total Copper (Cu)	2012/10/19	1.1	20
6265011	Total Iron (Fe)	2012/10/19	NC	20
6265011	Total Lead (Pb)	2012/10/19	0.3	20
6265011	Total Manganese (Mn)	2012/10/19	1.9	20
6265011	Total Mercury (Hg)	2012/10/19	NC	20
6265011	Total Molybdenum (Mo)	2012/10/19	NC	20
6265011	Total Nickel (Ni)	2012/10/19	NC	20
6265011	Total Selenium (Se)	2012/10/19	NC	20
6265011	Total Silver (Ag)	2012/10/19	NC	20
6265011	Total Strontium (Sr)	2012/10/19	0.07	20
6265011	Total Thallium (Tl)	2012/10/19	NC	20
6265011	Total Tin (Sn)	2012/10/19	NC	20

QUALITY ASSURANCE REPORT

			RPD	
QC Batch	**Parameter**	**Date**	**Value (%)**	**QC Limits**
6265011	Total Titanium (Ti)	2012/10/19	NC	20
6265011	Total Uranium (U)	2012/10/19	NC	20
6265011	Total Vanadium (V)	2012/10/19	NC	20
6265011	Total Zinc (Zn)	2012/10/19	NC	20
6265011	Total Boron (B)	2012/10/19	NC	20
6265011	Total Silicon (Si)	2012/10/19	1	20
6265011	Total Zirconium (Zr)	2012/10/19	NC	20

N/A = Not Applicable

RPD = Relative Percent Difference

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.

NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

Validation Signature Page

Maxxam Job #: B292313

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Andy Lu, Data Validation Coordinator

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam

Suite 1104, SouthWing 4464 Markham Street, Victoria, B.C. V8Z 7X8 Ph: 250-385-6112 Toll Free: 1-800-385-6112 Fax: 250-382-6364

CHAIN OF CUSTODY RECORD

Page: ___ of ___

V008395

Maxxam Job#: B292313

Invoice To: Require Report? Yes ☒ No ☐

Company Name: Waterline Resources Inc.
Contact Name: Shelley Bayne
Address: ~~[illegible]~~ Unit D 2301 McCullough Rd
Nanaimo, BC PC: V9S 4N8
Phone / Fax#: Ph: 250-585-0801 Fax:
E-mail: sbayne@waterlineresources.com

Report To: SAME AS INVOICE

Company Name:
Contact Name:
Address:
PC:
Phone / Fax#: Ph: Fax:
E-mail

PO #:
Quotation #:
Project #:
Proj. Name:
Location:
Sampled By:

REGULATORY REQUIREMENTS SERVICE REQUESTED:

☐ CSR
☐ CCME
☐ BC Water Quality
☐ Other
DRINKING WATER

☒ Regular Turn Around Time (TAT)
(5 days for most tests)
☐ RUSH (Please contact the lab)
☐ 1 Day ☐ 2 Day ☐ 3 Day
Date Required:

Special Instructions:
Return Cooler ☐ Ship Sample Bottles (please specify) ☐

ANALYSIS REQUESTED

	Sample Identification	Lab Identification	Sample Type	Date/Time Sampled	BTEX/VPH ☐ MTBE ☐	VOC/VPH ☐	EPH ☐ TEH ☐	PAH ☐ LEPH/HEPH ☐	CCME-PHC (Fractions 1-4 Plus BTEX)	CCME-PHC (Fractions 2-4)	CCME BTEX (Fraction 1 Plus BTEX)	PCB ☐	Phenols by 4AAP ☐ Phenols by GCMS ☐	TOG ☐ MOG ☐ SWOG ☐	Dissolved Metals Field Filtered? Y ☒ N ☐	Dissolved Metals Field Acidified? Y ☒ N ☐	Totals Metals Field Acidified? Y ☒ N ☐	Nitrate ☒ Nitrite ☒ Ammonia ☐	Chloride ☒ Fluoride ☐ Sulphate ☐	Total Suspended Solids-TSS ☐ TDS ☐	pH ☒ Conductivity ☒ Alkalinity ☒	BOD ☐	COD ☐	Coliform, Total & E.coli ☐ Fecal ☐	Asbestos ☐				HOLD ☐	No. of Bottles Submitted
1	~~[illegible]~~ TW3	ES3842	GW*	Oct.10/2012 10:00AM											✓	✓	✓	✓	✓		✓									3
2	TW2	43	GW	2012/10/10 10:30 AM											✓	✓	✓	✓	✓		✓									3
3	TW1	44	GW	2012/10/10 11:00 AM											✓	✓	✓	✓	✓		✓									3
4	TW1 DUP	45	GW	2012/10/10 11:00 AM											✓	✓	✓	✓	✓		✓									3
5	TW4	46	GW	2012/10/10 11:30 AM											✓	✓	✓	✓	✓		✓									3
6	MW06-1A	47	GW	2012/10/11 9:30 AM											✓	✓	[illegible]	✓	✓		✓									2
7	MW06-1B *	48	GW	2012/10/11 9:50 AM	NEEDS TO BE FILTERED + ACIDIFIED										✓	✓		✓	✓		✓									2
8	WL10-01	49	GW	2012/10/11 11:00 AM											✓	✓		✓	✓		✓									2
9	WL10-02	50	GW	2012/10/11 11:40 AM											✓	✓		✓	✓		✓									2
10	MW06-2A	51	GW	2012/10/11 12:40PM ~~12:05 PM~~											✓	✓		✓	✓		✓									2
11	MW06-2B *	52	GW	2012/10/11 12:55PM	Needs to be filtered + acidified										○	○		✓	✓		✓									2
12			GW																											

B292313

Samples are from a Drinking Water Source? YES ☐ NO ☐
Does source supply multiple households? YES ☐ NO ☐

*Relinquished by:	Date (YY/MM/DD):	Time:	Received by:	Date (YY/MM/DD):	Time:	Time Sensitive	Temperature on Receipt (°C)	Custody Seal Intact on Cooler?
	12/10/12	13:55	WELLBERT PASCUAL	2012-10-12	13:55	☐	1,1,2	N/A Yes ☐ No ☐

*IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

White: Maxxam Yellow: Client

COC-1013 (10/11)

Maxxam International Corporation o/a Maxxam Analytics

Your C.O.C. #: G043890

Attention:
Shelley Bayne, M.Sc., P.Geo.
WATERLINE RESOURCES INC.
NANAIMO
5403 Bayshore Dr.
Nanaimo, BC
CANADA V9V 1G8

Report Date: 2011/05/03

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B132146
Received: 2011/04/21, 16:37

Sample Matrix: Water
Samples Received: 7

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	7	2011/04/30	2011/04/30	BBY6SOP-00026	Based on SM2320B
Chloride by Automated Colourimetry	3	N/A	2011/04/25	BBY6SOP-00011	Based on SM-4500-Cl-
Chloride by Automated Colourimetry	4	N/A	2011/04/26	BBY6SOP-00011	Based on SM-4500-Cl-
Carbon (DOC)	7	N/A	2011/04/27	BBY6SOP-00003	Based on SM-860-87T
Conductance - water	7	N/A	2011/05/02	BBY6SOP-00026	Based on SM-2510B
Fluoride	7	N/A	2011/04/29	BBY6SOP-00038	Based SM - 4500 F C
Hardness (calculated as CaCO3)	7	N/A	2011/04/27		
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	7	N/A	2011/04/27	BBY7SOP-00002	Based on EPA 200.8
Elements by CRC ICPMS (dissolved)	7	N/A	2011/04/26	BBY7SOP-00002	Based on EPA 200.8
Nitrate + Nitrite (N)	7	N/A	2011/04/23	BBY6SOP-00010	Based on USEPA 353.2
Nitrite (N) by CFA	7	N/A	2011/04/23	BBY6SOP-00010	EPA 353.2
Nitrogen - Nitrate (as N)	7	N/A	2011/04/25	BBY6SOP-00010	Based on EPA 353.2
Filter and HNO3 Preserve for Metals	7	N/A	2011/04/23	BBY6WI-00001	Based on EPA 200.2
pH Water	7	N/A	2011/04/30	BBY6SOP-00026	Based on SM-4500H+B
Sulphate by Automated Colourimetry	7	N/A	2011/04/26	BBY6SOP-00017	Based on EPA 375.4
Total Dissolved Solids (Filt. Residue)	7	2011/04/26	2011/04/27	BBY6SOP-00033	SM 2540C

* Results relate only to the items tested.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

TABITHA RUDKIN, Project Manager
Email: TRudkin@maxxam.ca
Phone# (604) 638-2639

==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		AJ6959	AJ6959		AJ6960		AJ6961		
Sampling Date		2011/04/13	2011/04/13		2011/04/14		2011/04/13		
	Units	**MW06-1A**	**MW06-1A Lab-Dup**	**QC Batch**	**MW06-2A**	**QC Batch**	**TW #3**	**RDL**	**QC Batch**
ANIONS									
Nitrite (N)	mg/L	0.011(1)		4805379	<0.005(1)	4805379	<0.005(1)	0.005	4805379
Calculated Parameters									
Filter and HNO3 Preservation	N/A	FIELD		ONSITE	FIELD	ONSITE	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	0.83		4805263	1.00	4805263	0.96	0.02	4805263
Misc. Inorganics									
Fluoride (F)	mg/L	0.12	0.12	4820662	0.06	4820662	0.08	0.01	4820662
Dissolved Organic Carbon (C)	mg/L	2.8		4813685	1.2	4813685	<0.5	0.5	4813685
Alkalinity (Total as CaCO3)	mg/L	59		4822640	52	4822640	47	0.5	4822640
Alkalinity (PP as CaCO3)	mg/L	<0.5		4822640	<0.5	4822640	<0.5	0.5	4822640
Bicarbonate (HCO3)	mg/L	72		4822640	63	4822640	57	0.5	4822640
Carbonate (CO3)	mg/L	<0.5		4822640	<0.5	4822640	<0.5	0.5	4822640
Hydroxide (OH)	mg/L	<0.5		4822640	<0.5	4822640	<0.5	0.5	4822640
Anions									
Dissolved Sulphate (SO4)	mg/L	7.4		4812325	3.8	4812325	6.6	0.5	4812325
Dissolved Chloride (Cl)	mg/L	4.4		4812284	49	4808855	7.5	0.5	4812284
Nutrients									
Nitrate plus Nitrite (N)	mg/L	0.84(1)		4805378	1.00(1)	4805378	0.96(1)	0.02	4805378
Physical Properties									
Conductivity	uS/cm	163		4822639	297	4822639	142	1	4822639
pH	pH Units	8.02		4822638	7.88	4822638	7.88		4822638
Physical Properties									
Total Dissolved Solids	mg/L	110		4811697	200	4811697	100	10	4811697

N/A = Not Applicable
RDL = Reportable Detection Limit
(1) - Samples arrived to laboratory past recommended hold time.

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		AJ6962	AJ6962		AJ6963		
Sampling Date		2011/04/17	2011/04/17		2011/04/16		
	Units	**WL10-02**	**WL10-02 Lab-Dup**	**QC Batch**	**WL10-01**	**RDL**	**QC Batch**
ANIONS							
Nitrite (N)	mg/L	<0.005(1)		4805379	<0.005(1)	0.005	4805379
Calculated Parameters							
Filter and HNO3 Preservation	N/A	FIELD		ONSITE	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	0.22		4805263	<0.02	0.02	4805263
Misc. Inorganics							
Fluoride (F)	mg/L	0.08		4820662	0.32	0.01	4820662
Dissolved Organic Carbon (C)	mg/L	1.2		4813685	2.8	0.5	4813685
Alkalinity (Total as CaCO3)	mg/L	43	44	4822640	110	0.5	4822640
Alkalinity (PP as CaCO3)	mg/L	<0.5	<0.5	4822640	<0.5	0.5	4822640
Bicarbonate (HCO3)	mg/L	52	53	4822640	140	0.5	4822640
Carbonate (CO3)	mg/L	<0.5	<0.5	4822640	<0.5	0.5	4822640
Hydroxide (OH)	mg/L	<0.5	<0.5	4822640	<0.5	0.5	4822640
Anions							
Dissolved Sulphate (SO4)	mg/L	17		4812325	6.2	0.5	4812325
Dissolved Chloride (Cl)	mg/L	3.3		4808855	5.1	0.5	4812284
Nutrients							
Nitrate plus Nitrite (N)	mg/L	0.22(1)		4805378	<0.02(1)	0.02	4805378
Physical Properties							
Conductivity	uS/cm	143	141	4822639	241	1	4822639
pH	pH Units	7.81	7.89	4822638	8.14		4822638
Physical Properties							
Total Dissolved Solids	mg/L	100		4811697	120	10	4811697

N/A = Not Applicable
RDL = Reportable Detection Limit
(1) - Samples arrived to laboratory past recommended hold time.

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		AJ6964		AJ6965		
Sampling Date		2011/04/13		2011/04/13		
	Units	**TW #1**	**QC Batch**	**BLANK**	**RDL**	**QC Batch**
ANIONS						
Nitrite (N)	mg/L	<0.005(1)	4805379	<0.005(1)	0.005	4805379
Calculated Parameters						
Filter and HNO3 Preservation	N/A	FIELD	ONSITE	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	0.32	4805263	0.32	0.02	4805263
Misc. Inorganics						
Fluoride (F)	mg/L	0.09	4820662	0.09	0.01	4820662
Dissolved Organic Carbon (C)	mg/L	<0.5	4813685	0.6	0.5	4813685
Alkalinity (Total as CaCO3)	mg/L	35	4822640	35	0.5	4822640
Alkalinity (PP as CaCO3)	mg/L	<0.5	4822640	<0.5	0.5	4822640
Bicarbonate (HCO3)	mg/L	43	4822640	43	0.5	4822640
Carbonate (CO3)	mg/L	<0.5	4822640	<0.5	0.5	4822640
Hydroxide (OH)	mg/L	<0.5	4822640	<0.5	0.5	4822640
Anions						
Dissolved Sulphate (SO4)	mg/L	7.0	4812325	7.9	0.5	4812325
Dissolved Chloride (Cl)	mg/L	2.9	4808855	2.1	0.5	4812284
Nutrients						
Nitrate plus Nitrite (N)	mg/L	0.32(1)	4805378	0.32(1)	0.02	4805378
Physical Properties						
Conductivity	uS/cm	104	4822639	103	1	4822639
pH	pH Units	7.81	4822638	7.80		4822638
Physical Properties						
Total Dissolved Solids	mg/L	76	4811697	82	10	4811697

N/A = Not Applicable
RDL = Reportable Detection Limit
(1) - Samples arrived to laboratory past recommended hold time.

CSR DISSOLVED METALS IN WATER (WATER)

Maxxam ID		AJ6959	AJ6960	AJ6961	AJ6962	AJ6963		
Sampling Date		2011/04/13	2011/04/14	2011/04/13	2011/04/17	2011/04/16		
	Units	**MW06-1A**	**MW06-2A**	**TW #3**	**WL10-02**	**WL10-01**	**RDL**	**QC Batch**
Misc. Inorganics								
Dissolved Hardness (CaCO3)	mg/L	51.6	98.9	45.4	43.8	23.6	0.5	4805261
Dissolved Metals by ICPMS								
Dissolved Aluminum (Al)	mg/L	0.022	0.015	<0.003	0.008	0.016	0.003	4809429
Dissolved Antimony (Sb)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	4809429
Dissolved Arsenic (As)	mg/L	0.0044	0.0015	0.0024	0.0036	0.0247	0.0001	4809429
Dissolved Barium (Ba)	mg/L	0.031	0.032	0.003	0.005	0.010	0.001	4809429
Dissolved Beryllium (Be)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	4809429
Dissolved Bismuth (Bi)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	4809429
Dissolved Boron (B)	mg/L	<0.05	<0.05	<0.05	<0.05	0.13	0.05	4809429
Dissolved Cadmium (Cd)	mg/L	0.00002	0.00002	0.00004	0.00003	0.00024	0.00001	4809429
Dissolved Chromium (Cr)	mg/L	0.004	<0.001	0.001	<0.001	<0.001	0.001	4809429
Dissolved Cobalt (Co)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	4809429
Dissolved Copper (Cu)	mg/L	0.0043	0.0026	0.0064	0.0011	0.0021	0.0002	4809429
Dissolved Iron (Fe)	mg/L	0.050	0.027	<0.005	0.014	0.086	0.005	4809429
Dissolved Lead (Pb)	mg/L	<0.0002	<0.0002	0.0058	0.0004	0.0003	0.0002	4809429
Dissolved Manganese (Mn)	mg/L	0.010	0.006	0.002	0.002	0.032	0.001	4809429
Dissolved Mercury (Hg)	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00005	4809429
Dissolved Molybdenum (Mo)	mg/L	0.002	<0.001	0.001	0.004	0.013	0.001	4809429
Dissolved Nickel (Ni)	mg/L	<0.001	<0.001	<0.001	0.001	0.003	0.001	4809429
Dissolved Selenium (Se)	mg/L	0.0005	0.0002	0.0003	0.0006	<0.0001	0.0001	4809429
Dissolved Silicon (Si)	mg/L	19.7	19.7	20.5	18.5	7.4	0.1	4809429
Dissolved Silver (Ag)	mg/L	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	0.00002	4809429
Dissolved Strontium (Sr)	mg/L	0.038	0.105	0.045	0.048	0.041	0.001	4809429
Dissolved Thallium (Tl)	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00005	4809429
Dissolved Tin (Sn)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	4809429
Dissolved Titanium (Ti)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	4809429
Dissolved Uranium (U)	mg/L	0.0002	0.0003	0.0001	0.0003	<0.0001	0.0001	4809429
Dissolved Vanadium (V)	mg/L	0.011	0.006	0.009	0.014	<0.005	0.005	4809429
Dissolved Zinc (Zn)	mg/L	0.025	0.035	<0.005	0.048	0.177	0.005	4809429
Dissolved Zirconium (Zr)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	4809429
Dissolved Calcium (Ca)	mg/L	7.54	20.9	8.52	10.6	6.28	0.05	4805262
Dissolved Magnesium (Mg)	mg/L	7.97	11.3	5.85	4.25	1.92	0.05	4805262
Dissolved Potassium (K)	mg/L	3.18	4.03	2.74	3.26	1.58	0.05	4805262
Dissolved Sodium (Na)	mg/L	7.72	8.94	6.95	7.08	38.9	0.05	4805262
Dissolved Sulphur (S)	mg/L	<3	<3	<3	5	<3	3	4805262

RDL = Reportable Detection Limit

CSR DISSOLVED METALS IN WATER (WATER)

Maxxam ID		AJ6964		AJ6965	AJ6965		
Sampling Date		2011/04/13		2011/04/13	2011/04/13		
	Units	**TW #1**	**QC Batch**	**BLANK**	**BLANK Lab-Dup**	**RDL**	**QC Batch**
Misc. Inorganics							
Dissolved Hardness (CaCO3)	mg/L	32.1	4805261	32.9		0.5	4805261
Dissolved Metals by ICPMS							
Dissolved Aluminum (Al)	mg/L	<0.003	4809429	<0.003		0.003	4814512
Dissolved Antimony (Sb)	mg/L	<0.0005	4809429	<0.0005	<0.0005	0.0005	4809429
Dissolved Arsenic (As)	mg/L	0.0039	4809429	0.0039	0.0040	0.0001	4809429
Dissolved Barium (Ba)	mg/L	0.002	4809429	0.002	0.002	0.001	4809429
Dissolved Beryllium (Be)	mg/L	<0.0001	4809429	<0.0001	<0.0001	0.0001	4809429
Dissolved Bismuth (Bi)	mg/L	<0.001	4809429	<0.001	<0.001	0.001	4809429
Dissolved Boron (B)	mg/L	<0.05	4809429	<0.05	<0.05	0.05	4809429
Dissolved Cadmium (Cd)	mg/L	<0.00001	4809429	0.00001	0.00001	0.00001	4809429
Dissolved Chromium (Cr)	mg/L	<0.001	4809429	<0.001	<0.001	0.001	4809429
Dissolved Cobalt (Co)	mg/L	<0.0005	4809429	<0.0005	<0.0005	0.0005	4809429
Dissolved Copper (Cu)	mg/L	0.0006	4809429	0.0006	0.0005	0.0002	4809429
Dissolved Iron (Fe)	mg/L	<0.005	4809429	<0.005	<0.005	0.005	4809429
Dissolved Lead (Pb)	mg/L	0.0010	4809429	0.0010	0.0010	0.0002	4809429
Dissolved Manganese (Mn)	mg/L	<0.001	4809429	<0.001	<0.001	0.001	4809429
Dissolved Mercury (Hg)	mg/L	<0.00005	4809429	<0.00005	<0.00005	0.00005	4809429
Dissolved Molybdenum (Mo)	mg/L	0.002	4809429	0.002	0.002	0.001	4809429
Dissolved Nickel (Ni)	mg/L	<0.001	4809429	<0.001	<0.001	0.001	4809429
Dissolved Selenium (Se)	mg/L	0.0006	4809429	0.0006	0.0006	0.0001	4809429
Dissolved Silicon (Si)	mg/L	17.6	4809429	17.8	17.6	0.1	4809429
Dissolved Silver (Ag)	mg/L	<0.00002	4809429	<0.00002	<0.00002	0.00002	4809429
Dissolved Strontium (Sr)	mg/L	0.026	4809429	0.026	0.026	0.001	4809429
Dissolved Thallium (Tl)	mg/L	<0.00005	4809429	<0.00005	<0.00005	0.00005	4809429
Dissolved Tin (Sn)	mg/L	<0.005	4809429	<0.005	<0.005	0.005	4809429
Dissolved Titanium (Ti)	mg/L	<0.005	4809429	<0.005	<0.005	0.005	4809429
Dissolved Uranium (U)	mg/L	0.0002	4809429	0.0002	0.0002	0.0001	4809429
Dissolved Vanadium (V)	mg/L	0.011	4809429	0.011	0.011	0.005	4809429
Dissolved Zinc (Zn)	mg/L	<0.005	4809429	<0.005	<0.005	0.005	4809429
Dissolved Zirconium (Zr)	mg/L	<0.0005	4809429	<0.0005	<0.0005	0.0005	4809429
Dissolved Calcium (Ca)	mg/L	6.95	4805262	7.23		0.05	4805262
Dissolved Magnesium (Mg)	mg/L	3.59	4805262	3.62		0.05	4805262
Dissolved Potassium (K)	mg/L	2.23	4805262	2.21		0.05	4805262
Dissolved Sodium (Na)	mg/L	5.00	4805262	5.00		0.05	4805262
Dissolved Sulphur (S)	mg/L	<3	4805262	<3		3	4805262

RDL = Reportable Detection Limit

Sample AJ6965, Elements by CRC ICPMS (dissolved): Test repeated.

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**Units**
4805378	Nitrate plus Nitrite (N)	2011/04/23	113	80 - 120	104	80 - 120	<0.02	mg/L
4805379	Nitrite (N)	2011/04/23	117	80 - 120	103	80 - 120	<0.005	mg/L
4808855	Dissolved Chloride (Cl)	2011/04/25	99	80 - 120	107	80 - 120	<0.5	mg/L
4809429	Dissolved Arsenic (As)	2011/04/26	99	80 - 120	99	80 - 120	<0.0001	mg/L
4809429	Dissolved Beryllium (Be)	2011/04/26	97	80 - 120	93	80 - 120	<0.0001	mg/L
4809429	Dissolved Cadmium (Cd)	2011/04/26	102	80 - 120	98	80 - 120	<0.00001	mg/L
4809429	Dissolved Chromium (Cr)	2011/04/26	98	80 - 120	101	80 - 120	<0.001	mg/L
4809429	Dissolved Cobalt (Co)	2011/04/26	98	80 - 120	100	80 - 120	<0.0005	mg/L
4809429	Dissolved Copper (Cu)	2011/04/26	98	80 - 120	101	80 - 120	<0.0002	mg/L
4809429	Dissolved Lead (Pb)	2011/04/26	101	80 - 120	100	80 - 120	<0.0002	mg/L
4809429	Dissolved Nickel (Ni)	2011/04/26	100	80 - 120	102	80 - 120	<0.001	mg/L
4809429	Dissolved Selenium (Se)	2011/04/26	106	80 - 120	104	80 - 120	<0.0001	mg/L
4809429	Dissolved Uranium (U)	2011/04/26	104	80 - 120	104	80 - 120	<0.0001	mg/L
4809429	Dissolved Vanadium (V)	2011/04/26	NC	80 - 120	100	80 - 120	<0.005	mg/L
4809429	Dissolved Zinc (Zn)	2011/04/26	99	80 - 120	98	80 - 120	<0.005	mg/L
4809429	Dissolved Aluminum (Al)	2011/04/26					<0.003	mg/L
4809429	Dissolved Antimony (Sb)	2011/04/26					<0.0005	mg/L
4809429	Dissolved Barium (Ba)	2011/04/26					<0.001	mg/L
4809429	Dissolved Bismuth (Bi)	2011/04/26					<0.001	mg/L
4809429	Dissolved Boron (B)	2011/04/26					<0.05	mg/L
4809429	Dissolved Iron (Fe)	2011/04/26					<0.005	mg/L
4809429	Dissolved Manganese (Mn)	2011/04/26					<0.001	mg/L
4809429	Dissolved Mercury (Hg)	2011/04/26					<0.00005	mg/L
4809429	Dissolved Molybdenum (Mo)	2011/04/26					<0.001	mg/L
4809429	Dissolved Silicon (Si)	2011/04/26					<0.1	mg/L
4809429	Dissolved Silver (Ag)	2011/04/26					<0.00002	mg/L
4809429	Dissolved Strontium (Sr)	2011/04/26					<0.001	mg/L
4809429	Dissolved Thallium (Tl)	2011/04/26					<0.00005	mg/L
4809429	Dissolved Tin (Sn)	2011/04/26					<0.005	mg/L
4809429	Dissolved Titanium (Ti)	2011/04/26					<0.005	mg/L
4809429	Dissolved Zirconium (Zr)	2011/04/26					<0.0005	mg/L
4811697	Total Dissolved Solids	2011/04/27	90	80 - 120	96	80 - 120	<10	mg/L
4812284	Dissolved Chloride (Cl)	2011/04/26	NC	80 - 120	105	80 - 120	<0.5	mg/L
4812325	Dissolved Sulphate (SO4)	2011/04/26	NC	80 - 120	97	80 - 120	<0.5	mg/L
4813685	Dissolved Organic Carbon (C)	2011/04/27	112	80 - 120	103	80 - 120	<0.5	mg/L
4814512	Dissolved Aluminum (Al)	2011/04/27					<0.003	mg/L
4820662	Fluoride (F)	2011/04/29	100	80 - 120	101	80 - 120	<0.01	mg/L
4822639	Conductivity	2011/05/02			101	80 - 120	<1	uS/cm
4822640	Alkalinity (Total as CaCO3)	2011/04/30	105	80 - 120	93	80 - 120	<0.5	mg/L
4822640	Alkalinity (PP as CaCO3)	2011/04/30					<0.5	mg/L
4822640	Bicarbonate (HCO3)	2011/04/30					<0.5	mg/L
4822640	Carbonate (CO3)	2011/04/30					<0.5	mg/L
4822640	Hydroxide (OH)	2011/04/30					<0.5	mg/L

QUALITY ASSURANCE REPORT

			RPD	
QC Batch	Parameter	Date	Value (%)	QC Limits
4805379	Nitrite (N)	2011/04/23	NC	20
4808855	Dissolved Chloride (Cl)	2011/04/25	11.4	20
4809429	Dissolved Arsenic (As)	2011/04/26	3.3	20
4809429	Dissolved Beryllium (Be)	2011/04/26	NC	20
4809429	Dissolved Cadmium (Cd)	2011/04/26	NC	20
4809429	Dissolved Chromium (Cr)	2011/04/26	NC	20
4809429	Dissolved Cobalt (Co)	2011/04/26	NC	20
4809429	Dissolved Copper (Cu)	2011/04/26	NC	20
4809429	Dissolved Lead (Pb)	2011/04/26	NC	20
4809429	Dissolved Nickel (Ni)	2011/04/26	NC	20
4809429	Dissolved Selenium (Se)	2011/04/26	1.3	20
4809429	Dissolved Uranium (U)	2011/04/26	NC	20
4809429	Dissolved Vanadium (V)	2011/04/26	NC	20
4809429	Dissolved Zinc (Zn)	2011/04/26	NC	20
4809429	Dissolved Antimony (Sb)	2011/04/26	NC	20
4809429	Dissolved Barium (Ba)	2011/04/26	NC	20
4809429	Dissolved Bismuth (Bi)	2011/04/26	NC	20
4809429	Dissolved Boron (B)	2011/04/26	NC	20
4809429	Dissolved Iron (Fe)	2011/04/26	NC	20
4809429	Dissolved Manganese (Mn)	2011/04/26	NC	20
4809429	Dissolved Mercury (Hg)	2011/04/26	NC	20
4809429	Dissolved Molybdenum (Mo)	2011/04/26	NC	20
4809429	Dissolved Silicon (Si)	2011/04/26	0.9	20
4809429	Dissolved Silver (Ag)	2011/04/26	NC	20
4809429	Dissolved Strontium (Sr)	2011/04/26	1	20
4809429	Dissolved Thallium (Tl)	2011/04/26	NC	20
4809429	Dissolved Tin (Sn)	2011/04/26	NC	20
4809429	Dissolved Titanium (Ti)	2011/04/26	NC	20
4809429	Dissolved Zirconium (Zr)	2011/04/26	NC	20
4811697	Total Dissolved Solids	2011/04/27	2.4	20
4812284	Dissolved Chloride (Cl)	2011/04/26	14.1	20
4812325	Dissolved Sulphate (SO4)	2011/04/26	1.5	20
4813685	Dissolved Organic Carbon (C)	2011/04/27	NC	20
4820662	Fluoride (F)	2011/04/29	0	20
4822639	Conductivity	2011/05/02	1.6	20
4822640	Alkalinity (Total as CaCO3)	2011/04/30	1.9	20
4822640	Alkalinity (PP as CaCO3)	2011/04/30	NC	20
4822640	Bicarbonate (HCO3)	2011/04/30	1.9	20
4822640	Carbonate (CO3)	2011/04/30	NC	20
4822640	Hydroxide (OH)	2011/04/30	NC	20

N/A = Not Applicable

RPD = Relative Percent Difference

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.

NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

Validation Signature Page

Maxxam Job #: B132146

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

David Huang, BBY Scientific Specialist

ROB REINERT, Data Validation Coordinator

==

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam

4606 Canada Way, Burnaby, BC Canada V5G 1K5 Ph: 604 734 7276 Toll Free: 1 800 665 8566 Fax: 604 731 2386

Maxxam Job#: B132146

CHAIN OF CUSTODY RECORD

Page: ___ of ___

G 043890

Invoice To: Require Report? Yes ☐ No ☐

Company Name: Waterline Resources
Contact Name: Shelley Bayne
Address: ~~#~~ 5403 Bayshore Dr.
~~[illegible]~~ Nanaimo BC V9V 1S8
Phone / Fax#: Ph: 250 585 0801 Fax:
E-mail: sbayne@waterlineresources.com

Report To:

Company Name:
Contact Name:
Address:
PC:
Phone / Fax#: Ph: Fax:
E-mail

PO #:
Quotation #:
Project #:
Proj. Name:
Location:
Sampled By:

B132146

REGULATORY REQUIREMENTS SERVICE REQUESTED:

☐ CSR
☐ CCME
☐ BC Water Quality
☐ Other
☐ DRINKING WATER

☑ Regular Turn Around Time (TAT) (5 days for most tests)
☐ RUSH (Please contact the lab)
☐ 1 Day ☐ 2 Day ☐ 3 Day
Date Required: ______

Special Instructions:
Return Cooler ☑ **Ship Sample Bottles (please specify)** ☐

ANALYSIS REQUESTED

	Sample Identification	Lab Identification	Sample Type	Date/Time Sampled	BTEX/VPH ☐ MTBE ☐	VOC/VPH ☐	EPH ☐ TEH ☐	PAH ☐ LEPH/HEPH ☐	CCME-PHC (Fractions 1-4 Plus BTEX)	CCME-PHC (Fractions 2-4)	CCME BTEX (Fraction 1 Plus BTEX)	PCB ☐	Phenols by 4AAP ☐ Phenols by GCMS ☐	TOG ☐ MOG ☐ SWOG ☐	Dissolved Metals Field Filtered? Y ☑ N ☐	Dissolved Metals Field Acidified? Y ☑ N ☐	Totals Metals Field Acidified? Y ☐ N ☐	Nitrate ☐ Nitrite ☐ Ammonia ☐	Chloride ☐ Fluoride ☐ Sulphate ☐	Total Suspended Solids-TSS ☐ TDS ☐	pH ☐ Conductivity ☐ Alkalinity ☐	BOD ☐	COD ☐	Coliform, Total & E.coli ☐ Fecal ☐	Asbestos ☐	DOC - filtered, preserved	Anions, (cations, fluoride					HOLD ☐
1	MW06-1A			~~1~~ April 13											✓											✓	✓					
2	MW06-2A			April 14											✓											✓	✓					
3	TW#3			April 13											✓											✓	✓					
4	WL10-02			April 17											✓											✓	✓					
5	WL10-01			April 16											✓											✓	✓					
6	~~Flo~~ TW#1			April 13											✓											✓	✓					
7	BLANK			April 13											✓											✓	✓					
8																																
9																																
10																																
11																																
12																																

No 250mL bottles were supplied for anions/cations/fluoride
Used own 250 nalgene bottles bought at UBC Chem. Stores

Samples are from a Drinking Water Source? YES ☐ NO ☐
Does source supply multiple households? YES ☐ NO ☐

Laboratory Use Only

*Relinquished by:	Date (YY/MM/DD):	Time:	Received by:	Date (YY/MM/DD):	Time:	Time Sensitive	Temperature on Receipt (°C)	Custody Seal Intact on Cooler?
	11/04/21	16:57	Shaliza Mohamed	11/04/21	16:57	☐	5, 11, 8	Yes ☐ NA No ☐

Page 11 of 11

*IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS

White: Maxxam Yellow: Client

COC-1020 (05/10)

Maxxam International Corporation o/a Maxxam Analytics

Your Project #: WL09-1578/TOWN OF GIBSONS
Your C.O.C. #: 2181037

Attention:
Shelley Bayne, M.Sc., P.Geo.
WATERLINE RESOURCES INC.
NANAIMO
229 Milton Street
Nanaimo, BC
CANADA V9R 2K5

Report Date: 2010/04/26

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B022410
Received: 2010/04/14, 08:00

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	1	2010/04/20	2010/04/20	BRN SOP-00264 R4.0	Based on SM2320B
Chloride by Automated Colourimetry	1	N/A	2010/04/18	BRN-SOP 00234 R3.0	Based on EPA 325.2
Colour (True)	1	N/A	2010/04/18	BRN SOP-00247 R1.0	Based on SM-2120B
Conductance - water	1	N/A	2010/04/20	BRN SOP-00264 R2.0	Based on SM-2510B
Fluoride	1	N/A	2010/04/24	BRN SOP-00282 R4.0	Based SM - 4500 F C
Hardness Total (calculated as CaCO3)	1	N/A	2010/04/20		
Na, K, Ca, Mg, S by CRC ICPMS (total)	1	N/A	2010/04/20	BRN SOP-00206	Based on EPA 200.8
Elements by CRC ICPMS (total) (1)	1	N/A	2010/04/20	BRN SOP-00206	Based on EPA 200.8
Nitrate + Nitrite (N)	1	N/A	2010/04/17	ING233 Rev.4.4	Based on EPA 353.2
Nitrite (N) by CFA	1	N/A	2010/04/17	BRN SOP-00233 R1.0	EPA 353.2
Nitrogen - Nitrate (as N)	1	N/A	2010/04/19		
pH Water	1	N/A	2010/04/20	BRN SOP-00264 R4.0	Based on SM-4500H+B
Sulphate by Automated Colourimetry	1	N/A	2010/04/18	BRN-SOP 00243 R1.0	Based on EPA 375.4
Total Dissolved Solids (Filt. Residue)	1	N/A	2010/04/26	BRN SOP 00276 R4.0	SM 2540C
Turbidity	1	N/A	2010/04/17	BRN SOP-00265 R6.0	SM - 2130B

* Results relate only to the items tested.

(1) SCC/CAEAL

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

VIREN THAKER, BBY Customer Service
Email: VIREN.THAKER@MaxxamAnalytics.com
Phone# (604) 638-5030

==

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

Maxxam Job #: B022410
Report Date: 2010/04/26

WATERLINE RESOURCES INC.
Client Project #: WL09-1578/TOWN OF GIBSONS

Sampler Initials: BM

DRINKING WATER PACKAGE - MUNICIPAL (WATER)

Maxxam ID					T60311		
Sampling Date					2010/04/12 16:50		
COC#					2181037		
	Units	**Criteria A**	**Criteria B**	**Criteria C**	**WL10-02**	**RDL**	**QC Batch**
Misc. Inorganics							
Fluoride (F)	mg/L	**1.5**			0.05	0.01	3909273
ANIONS							
Nitrite (N)	mg/L	**1.0**			0.011	0.005	3892369
Calculated Parameters							
Total Hardness (CaCO3)	mg/L		500		47.2	0.5	3888824
Nitrate (N)	mg/L				0.11	0.02	3889320
Misc. Inorganics							
Alkalinity (Total as CaCO3)	mg/L				51	0.5	3895746
Alkalinity (PP as CaCO3)	mg/L				<0.5	0.5	3895746
Bicarbonate (HCO3)	mg/L				63	0.5	3895746
Carbonate (CO3)	mg/L				<0.5	0.5	3895746
Hydroxide (OH)	mg/L				<0.5	0.5	3895746
Anions							
Dissolved Sulphate (SO4)	mg/L		500		16	0.5	3892741
Dissolved Chloride (Cl)	mg/L		250		2.6	0.5	3892740
MISCELLANEOUS							
True Colour	Col. Unit		15		30	5	3892694
Nutrients							
Nitrate plus Nitrite (N)	mg/L				0.12	0.02	3892360
Physical Properties							
Conductivity	uS/cm				133	1	3895744
pH	pH Units		6.5:8.5		8.1		3895732
Physical Properties							
Total Dissolved Solids	mg/L		500		100	10	3907201
Turbidity	NTU	**1.0**	0.3	0.1	25.8	0.1	3892485

RDL = Reportable Detection Limit
Criteria A, Criteria B, Criteria C: Guidelines for Chemical and Physical Parameters, Canadian Drinking Water Quality Summary Table, May 2008. It is recommended to consult these guidelines when interpreting data since there are non-numerical guidelines that are not included on this report.

Criteria A represents MAC Guidelines (Maximum Acceptable Concentration)
Criteria B and Criteria C represent AO or OG Guidelines (Aesthetic Objectives or Operational Guidance Values)

Maxxam Job #: B022410
Report Date: 2010/04/26

WATERLINE RESOURCES INC.
Client Project #: WL09-1578/TOWN OF GIBSONS

Sampler Initials: BM

DRINKING WATER PACKAGE - MUNICIPAL (WATER)

Maxxam ID					T60311		
Sampling Date					2010/04/12 16:50		
COC#					2181037		
	Units	**Criteria A**	**Criteria B**	**Criteria C**	**WL10-02**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total Aluminum (Al)	ug/L				238	3	3892722
Total Antimony (Sb)	ug/L				<0.5	0.5	3892722
Total Arsenic (As)	ug/L				3.3	0.1	3892722
Total Barium (Ba)	ug/L				21	1	3892722
Total Boron (B)	ug/L				<50	50	3892722
Total Cadmium (Cd)	ug/L				0.01	0.01	3892722
Total Chromium (Cr)	ug/L				<1	1	3892722
Total Cobalt (Co)	ug/L				0.7	0.5	3892722
Total Copper (Cu)	ug/L				2.6	0.2	3892722
Total Iron (Fe)	ug/L		300		1740	5	3892722
Total Lead (Pb)	ug/L				0.9	0.2	3892722
Total Manganese (Mn)	ug/L		50		19	1	3892722
Total Mercury (Hg)	ug/L				<0.02	0.02	3892722
Total Molybdenum (Mo)	ug/L				4	1	3892722
Total Nickel (Ni)	ug/L				<1	1	3892722
Total Selenium (Se)	ug/L				0.5	0.1	3892722
Total Silver (Ag)	ug/L				<0.02	0.02	3892722
Total Uranium (U)	ug/L				0.4	0.1	3892722
Total Vanadium (V)	ug/L				14	5	3892722
Total Zinc (Zn)	ug/L				13	5	3892722
Total Calcium (Ca)	mg/L				11.9	0.05	3889319
Total Magnesium (Mg)	mg/L				4.24	0.05	3889319
Total Potassium (K)	mg/L				2.68	0.05	3889319
Total Sodium (Na)	mg/L		200		5.94	0.05	3889319
Total Sulphur (S)	mg/L				4	3	3889319

RDL = Reportable Detection Limit
Criteria A, Criteria B, Criteria C: Guidelines for Chemical and Physical Parameters, Canadian Drinking Water Quality Summary Table, May 2008. It is recommended to consult these guidelines when interpreting data since there are non-numerical guidelines that are not included on this report.

Criteria A represents MAC Guidelines (Maximum Acceptable Concentration)
Criteria B and Criteria C represent AO or OG Guidelines (Aesthetic Objectives or Operational Guidance Values)

Maxxam Job #: B022410
Report Date: 2010/04/26

WATERLINE RESOURCES INC.
Client Project #: WL09-1578/TOWN OF GIBSONS

Sampler Initials: BM

DRINKING WATER PACKAGE - MUNICIPAL (WATER) Comments

Sample T60311-02 Colour (True): Analysis requested past recommended holding time

Sample T60311-02 Turbidity: Analysis requested past recommended holding time

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
3892360	Nitrate plus Nitrite (N)	2010/04/17	98	80 - 120	103	80 - 120	<0.02	mg/L	1.4	25
3892369	Nitrite (N)	2010/04/17	99	80 - 120	104	80 - 120	<0.005	mg/L	NC	20
3892485	Turbidity	2010/04/17			99	80 - 120	<0.1	NTU	1.2	20
3892694	True Colour	2010/04/18					<5	Col. Unit		
3892722	Total Arsenic (As)	2010/04/20	105	80 - 120	97	80 - 120	<0.1	ug/L		
3892722	Total Cadmium (Cd)	2010/04/20	111	80 - 120	101	80 - 120	<0.01	ug/L		
3892722	Total Chromium (Cr)	2010/04/20	104	80 - 120	99	80 - 120	<1	ug/L		
3892722	Total Cobalt (Co)	2010/04/20	102	80 - 120	97	80 - 120	<0.5	ug/L		
3892722	Total Copper (Cu)	2010/04/20	97	80 - 120	98	80 - 120	<0.2	ug/L		
3892722	Total Lead (Pb)	2010/04/20	103	80 - 120	101	80 - 120	<0.2	ug/L		
3892722	Total Nickel (Ni)	2010/04/20	99	80 - 120	98	80 - 120	<1	ug/L		
3892722	Total Selenium (Se)	2010/04/20	107	80 - 120	100	80 - 120	<0.1	ug/L		
3892722	Total Uranium (U)	2010/04/20	109	80 - 120	103	80 - 120	<0.1	ug/L		
3892722	Total Vanadium (V)	2010/04/20	107	80 - 120	97	80 - 120	<5	ug/L		
3892722	Total Zinc (Zn)	2010/04/20	NC	80 - 120	100	80 - 120	<5	ug/L		
3892722	Total Aluminum (Al)	2010/04/20					<3	ug/L		
3892722	Total Antimony (Sb)	2010/04/20					<0.5	ug/L		
3892722	Total Barium (Ba)	2010/04/20					<1	ug/L		
3892722	Total Boron (B)	2010/04/20					<50	ug/L		
3892722	Total Iron (Fe)	2010/04/20					<5	ug/L		
3892722	Total Manganese (Mn)	2010/04/20					<1	ug/L		
3892722	Total Mercury (Hg)	2010/04/20					<0.02	ug/L		
3892722	Total Molybdenum (Mo)	2010/04/20					<1	ug/L		
3892722	Total Silver (Ag)	2010/04/20					<0.02	ug/L		
3892740	Dissolved Chloride (Cl)	2010/04/18	NC	80 - 120	94	80 - 120	<0.5	mg/L	NC	20
3892741	Dissolved Sulphate (SO4)	2010/04/18	NC	80 - 120	94	80 - 120	<0.5	mg/L	NC	20
3895744	Conductivity	2010/04/20			103	80 - 120	<1	uS/cm	1.5	20
3895746	Alkalinity (Total as CaCO3)	2010/04/20	104	80 - 120	99	80 - 120	<0.5	mg/L	2.5	20
3895746	Alkalinity (PP as CaCO3)	2010/04/20					<0.5	mg/L	NC	20
3895746	Bicarbonate (HCO3)	2010/04/20					<0.5	mg/L	2.5	20
3895746	Carbonate (CO3)	2010/04/20					<0.5	mg/L	NC	20
3895746	Hydroxide (OH)	2010/04/20					<0.5	mg/L	NC	20

Maxxam Job #: B022410
Report Date: 2010/04/26

WATERLINE RESOURCES INC.
Client Project #: WL09-1578/TOWN OF GIBSONS

Sampler Initials: BM

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
3907201	Total Dissolved Solids	2010/04/26	NC	80 - 120	98	80 - 120	<10	mg/L	3.8	20
3909273	Fluoride (F)	2010/04/24	98	80 - 120	100	80 - 120	<0.01	mg/L	1.4	20

N/A = Not Applicable

RPD = Relative Percent Difference

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.

NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

Validation Signature Page

Maxxam Job #: B022410

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

DAVE HUANG, BBY Scientific Specialist

ROB REINERT, Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

AIN OF CUSTODY RECORD

CANTEST

0000
B022410
2181037

4606 Canada Way
Burnaby, B.C.
V5G 1K5

Tel: 604.734.7276
Fax: 604.731.2386
Toll Free: 800.665.8566

www.cantest.com

Client Name: Waterline Resources Ltd.

Postal Code V9R 2K5

Street Address (including suite number): 229 Milton st.

City: Nanaimo, BC

Telephone: 250 7416795

Fax:

E-Mail Address (Required for Electronic Reporting): sbayne@waterlineresources.com

Contact Name: Shelley Bayne

Sampler's Name: Byron Molloy

Quotation Number:

Project Number: WL09-1578

Project Name: Town of Gibsons.

P.O. Number

Page 1 of 1

RESULTS REQUESTED BY:

Day Month Year

(Surcharges May Apply)

Special Instructions: ☐ AutoFax ☑ AutoEmail

☐ Return Cooler ☐ Ship Sample Bottles (please specify)

Drinking water Package.

Note: Extra samples are precautionary.

Sample(s) are from a Drinking Water source servicing multiple households ☐

Group Number	Sample Identification	Date/Time Sampled (D/M/Y & 24hr clock)	Sample Type	Total Metals*	Dissolved Metals*	Field Filtered Metals*	Soil Metals*	pH	Conductivity	TSS	TDS	Alkalinity (total / spec.)	BOD	COD	Coliform, Total & E.coli	Coliform, Fecal	F Cl SO_4 NO_3	Nitrite	Oil & Grease (Total / Mineral)	Oil & Grease (Special Waste)	PCP (Tri, Tetra and Penta)	PCP (Mono and Di)	BETX/VPH	VOC	EPH (not PAH corrected)	PAH	LEPH/HEPH (PAH corrected)	PCB	Asbestos									HOLD - DO NOT ANALYZE	Number of Containers
T60311 L	WL10-02	D: 12/04/10 T: 16:50	Ground Water																																				1
A		D: T:																																					
B		D: T:																																					
U		D: T:																																					
S		D: T:																																					
E		D: T:																																					
O		D: T:																																					
N		D: T:																																					
L		D: T:																																					
Y		D: T:																																					

Relinquished by: Byron Molloy Date 13/04/10 Time Received by:

Relinquished by: Date Time Received by:

Total Number of Containers:

Method of Shipment: Waybill No.: Received for Lab by: Date Time

Shipped by: Shipment Condition: Cooler opened by: Date 09 14/10 Time 8:00

*Please indicate appropriate regulatory guidelines:

WATER
☐ CCME
☐ BC-CSR
☐ Other (please specify)

SOIL
☐ CCME
☐ BC-CSR
☐ Other (please specify)

FOR LABORATORY USE ONLY

Sample State at Receipt: ☐ Ambient ☐ Cold ☐ Frozen ☐ N/A Comments:

Temperature 9, 7, 7 °C Custody Seal Intact? ☐ Yes ☐ No ☐ n/a Number of Coolers/Shipping Containers:

CTT 119 Rev. 05/06 WHITE: FOLLOWS REPORT YELLOW: LAB COPY PINK: CLIENT COPY/GENERAL INFORMATION

Your Project #: WL09-5178
Site Location: TOWN OF GIBSONS AGUILER CHARACTERIZATION
Your C.O.C. #: 2181036

Attention:
Shelley Bayne, M.Sc., P.Geo.
WATERLINE RESOURCES INC.
NANAIMO
229 Milton Street
Nanaimo, BC
CANADA V9R 2K5

Report Date: 2010/06/03
This report supersedes all previous reports with the same Maxxam job number

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B021376
Received: 2010/04/10, 09:20

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	1	2010/04/14	2010/04/14	BRN SOP-00264 R4.0	Based on SM2320B
Chloride by Automated Colourimetry	1	N/A	2010/04/14	BRN-SOP 00234 R3.0	Based on EPA 325.2
Colour (True)	1	N/A	2010/04/13	BRN SOP-00247 R1.0	Based on SM-2120B
Coliform membrane filtration Potable W	1	N/A	2010/04/12	BRN SOP 00363 R2.0	Based on SM-9222
Carbon (DOC)	1	N/A	2010/04/16	BRN SOP-00224 R4.0	Based on M 860-87T
Conductance - water	1	N/A	2010/04/16	BRN SOP-00264 R2.0	Based on SM-2510B
Fluoride	1	N/A	2010/04/17	BRN SOP-00282 R4.0	Based SM - 4500 F C
Hardness Total (calculated as CaCO3)	1	N/A	2010/04/19		
Na, K, Ca, Mg, S by CRC ICPMS (total)	1	N/A	2010/04/19	BRN SOP-00206	Based on EPA 200.8
Elements by CRC ICPMS (total)	1	N/A	2010/04/18	BRN SOP-00206	Based on EPA 200.8
Nitrate + Nitrite (N)	1	N/A	2010/04/14		Based on USEPA 353.2
Nitrite (N) by CFA	1	N/A	2010/04/14	BRN SOP-00233 R1.0	EPA 353.2
Nitrogen - Nitrate (as N)	1	N/A	2010/04/15	BBY6SOP-00010	Based on EPA 353.2
pH Water	1	N/A	2010/04/16	BRN SOP-00264 R4.0	Based on SM-4500H+B
Sulphate by Automated Colourimetry	1	N/A	2010/04/14	BRN-SOP 00243 R1.0	Based on EPA 375.4
Total Dissolved Solids (Filt. Residue)	1	N/A	2010/04/23	BRN SOP 00276 R4.0	SM 2540C
Turbidity	1	N/A	2010/04/13	BRN SOP-00265 R6.0	SM - 2130B

* Results relate only to the items tested.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

VIREN THAKER, BBY Customer Service
Email: VIREN.THAKER@MaxxamAnalytics.com
Phone# (604) 638-5030

==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

Maxxam Job #: B021376
Report Date: 2010/06/03

WATERLINE RESOURCES INC.
Client Project #: WL09-5178
Site Reference: TOWN OF GIBSONS AGUILER CHARACTERIZATION

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		T55651		
Sampling Date		2010/04/08 18:30		
COC#		2181036		
	Units	**WL10-01**	**RDL**	**QC Batch**
Misc. Inorganics				
Dissolved Organic Carbon (C)	mg/L	1.5	0.5	3892083

RDL = Reportable Detection Limit

Maxxam Job #: B021376
Report Date: 2010/06/03

WATERLINE RESOURCES INC.
Client Project #: WL09-5178
Site Reference: TOWN OF GIBSONS AGUILER CHARACTERIZATION

DRINKING WATER PACKAGE - MUNICIPAL (WATER)

Maxxam ID					T55651		
Sampling Date					2010/04/08 18:30		
COC#					2181036		
	Units	**Criteria A**	**Criteria B**	**Criteria C**	**WL10-01**	**RDL**	**QC Batch**
Misc. Inorganics							
Fluoride (F)	mg/L	**1.5**			0.15	0.01	3892316
ANIONS							
Nitrite (N)	mg/L	**1.0**			0.006	0.005	3884914
Calculated Parameters							
Total Hardness (CaCO3)	mg/L		500		33.3	0.5	3875840
Nitrate (N)	mg/L				<0.02	0.02	3876328
Misc. Inorganics							
Alkalinity (Total as CaCO3)	mg/L				62	0.5	3884998
Alkalinity (PP as CaCO3)	mg/L				<0.5	0.5	3884998
Bicarbonate (HCO3)	mg/L				76	0.5	3884998
Carbonate (CO3)	mg/L				<0.5	0.5	3884998
Hydroxide (OH)	mg/L				<0.5	0.5	3884998
Anions							
Dissolved Sulphate (SO4)	mg/L		500		4.8	0.5	3885023
Dissolved Chloride (Cl)	mg/L		250		3.9	0.5	3885017
MISCELLANEOUS							
True Colour	Col. Unit		15		80	10	3880589
Nutrients							
Nitrate plus Nitrite (N)	mg/L				0.02	0.02	3884912
Physical Properties							
Conductivity	uS/cm				137	1	3884997
pH	pH Units		6.5:8.5		8.0		3884995
Physical Properties							
Total Dissolved Solids	mg/L		500		98	10	3902721
Turbidity	NTU	**1.0**	0.3	0.1	49.1	0.1	3880276

RDL = Reportable Detection Limit
Criteria A, Criteria B, Criteria C: Guidelines for Chemical and Physical Parameters, Canadian Drinking Water Quality Summary Table, May 2008. It is recommended to consult these guidelines when interpreting data since there are non-numerical guidelines that are not included on this report.

Criteria A represents MAC Guidelines (Maximum Acceptable Concentration)
Criteria B and Criteria C represent AO or OG Guidelines (Aesthetic Objectives or Operational Guidance Values)

DRINKING WATER PACKAGE - MUNICIPAL (WATER)

Maxxam ID					T55651		
Sampling Date					2010/04/08 18:30		
COC#					2181036		
	Units	**Criteria A**	**Criteria B**	**Criteria C**	**WL10-01**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total Aluminum (Al)	ug/L				619	3	3884320
Total Antimony (Sb)	ug/L				0.8	0.5	3884320
Total Arsenic (As)	ug/L				4.4	0.1	3884320
Total Barium (Ba)	ug/L				30	1	3884320
Total Boron (B)	ug/L				<50	50	3884320
Total Cadmium (Cd)	ug/L				0.04	0.01	3884320
Total Chromium (Cr)	ug/L				<1	1	3884320
Total Cobalt (Co)	ug/L				0.9	0.5	3884320
Total Copper (Cu)	ug/L				8.6	0.2	3884320
Total Iron (Fe)	ug/L		300		1730	5	3884320
Total Lead (Pb)	ug/L				1.2	0.2	3884320
Total Manganese (Mn)	ug/L		50		56	1	3884320
Total Mercury (Hg)	ug/L				<0.02	0.02	3884320
Total Molybdenum (Mo)	ug/L				21	1	3884320
Total Nickel (Ni)	ug/L				2	1	3884320
Total Selenium (Se)	ug/L				0.3	0.1	3884320
Total Silver (Ag)	ug/L				<0.02	0.02	3884320
Total Uranium (U)	ug/L				1.9	0.1	3884320
Total Vanadium (V)	ug/L				14	5	3884320
Total Zinc (Zn)	ug/L				11	5	3884320
Total Calcium (Ca)	mg/L				7.16	0.05	3877851
Total Magnesium (Mg)	mg/L				3.74	0.05	3877851
Total Potassium (K)	mg/L				3.15	0.05	3877851
Total Sodium (Na)	mg/L		200		17.5	0.05	3877851
Total Sulphur (S)	mg/L				<3	3	3877851
Microbiological Param.							
E. coli	CFU/100mL				<1	1	3878618
Total Coliforms	CFU/100mL				80(1)	1	3878618

RDL = Reportable Detection Limit
Criteria A, Criteria B, Criteria C: Guidelines for Chemical and Physical Parameters, Canadian Drinking Water Quality Summary Table, May 2008. It is recommended to consult these guidelines when interpreting data since there are non-numerical guidelines that are not included on this report.

Criteria A represents MAC Guidelines (Maximum Acceptable Concentration)
Criteria B and Criteria C represent AO or OG Guidelines (Aesthetic Objectives or Operational Guidance Values)
(1) - The sample was analyzed past the recommended hold time.

DRINKING WATER PACKAGE - MUNICIPAL (WATER) Comments

Sample T55651-01 Colour (True): Analysis requested past recommended holding time

Sample T55651-01 Turbidity: Analysis requested past recommended holding time

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
3878618	E. coli	2010/04/12					<1	CFU/100mL		
3878618	Total Coliforms	2010/04/12					<1	CFU/100mL		
3880276	Turbidity	2010/04/13			103	80 - 120	<0.1	NTU	3.5	20
3880589	True Colour	2010/04/13					<5	Col. Unit		
3884320	Total Arsenic (As)	2010/04/18	99	80 - 120	100	80 - 120	<0.1	ug/L	0.6	20
3884320	Total Cadmium (Cd)	2010/04/18	113	80 - 120	101	80 - 120	<0.01	ug/L	NC	20
3884320	Total Chromium (Cr)	2010/04/18	101	80 - 120	104	80 - 120	<1	ug/L	NC	20
3884320	Total Cobalt (Co)	2010/04/18	103	80 - 120	102	80 - 120	<0.5	ug/L	NC	20
3884320	Total Copper (Cu)	2010/04/18	NC	80 - 120	101	80 - 120	<0.2	ug/L	0.7	20
3884320	Total Lead (Pb)	2010/04/18	114	80 - 120	107	80 - 120	<0.2	ug/L	1.0	20
3884320	Total Nickel (Ni)	2010/04/18	99	80 - 120	104	80 - 120	<1	ug/L	NC	20
3884320	Total Selenium (Se)	2010/04/18	112	80 - 120	104	80 - 120	<0.1	ug/L	NC	20
3884320	Total Uranium (U)	2010/04/18	115	80 - 120	107	80 - 120	<0.1	ug/L	0.8	20
3884320	Total Vanadium (V)	2010/04/18	NC	80 - 120	97	80 - 120	<5	ug/L	NC	20
3884320	Total Zinc (Zn)	2010/04/18	NC	80 - 120	105	80 - 120	<5	ug/L	NC	20
3884320	Total Aluminum (Al)	2010/04/18					<3	ug/L	0.5	20
3884320	Total Antimony (Sb)	2010/04/18					<0.5	ug/L	NC	20
3884320	Total Barium (Ba)	2010/04/18					<1	ug/L	1.0	20
3884320	Total Boron (B)	2010/04/18					<50	ug/L	NC	20
3884320	Total Iron (Fe)	2010/04/18					<5	ug/L	1.1	20
3884320	Total Manganese (Mn)	2010/04/18					<1	ug/L	2.7	20
3884320	Total Mercury (Hg)	2010/04/18					<0.02	ug/L	NC	20
3884320	Total Molybdenum (Mo)	2010/04/18					<1	ug/L	0.5	20
3884320	Total Silver (Ag)	2010/04/18					<0.02	ug/L	NC	20
3884912	Nitrate plus Nitrite (N)	2010/04/14	97	80 - 120	99	80 - 120	<0.02	mg/L	NC	25
3884914	Nitrite (N)	2010/04/14	99	80 - 120	104	80 - 120	<0.005	mg/L	NC	20
3884997	Conductivity	2010/04/15			107	80 - 120	<1	uS/cm	0	20
3884998	Alkalinity (Total as CaCO3)	2010/04/14	NC	80 - 120	100	80 - 120	0.8, RDL=0.5	mg/L	0.8	20
3884998	Alkalinity (PP as CaCO3)	2010/04/14					<0.5	mg/L	NC	20
3884998	Bicarbonate (HCO3)	2010/04/14					0.9, RDL=0.5	mg/L	0.8	20
3884998	Carbonate (CO3)	2010/04/14					<0.5	mg/L	NC	20
3884998	Hydroxide (OH)	2010/04/14					<0.5	mg/L	NC	20
3885017	Dissolved Chloride (Cl)	2010/04/14	NC	80 - 120	95	80 - 120	<0.5	mg/L	NC	20
3885023	Dissolved Sulphate (SO4)	2010/04/14	NC	80 - 120	95	80 - 120	<0.5	mg/L	11.2	20
3892083	Dissolved Organic Carbon (C)	2010/04/16	NC	80 - 120	97	80 - 120	<0.5	mg/L	9.2	20

Maxxam Job #: B021376
Report Date: 2010/06/03

WATERLINE RESOURCES INC.
Client Project #: WL09-5178
Site Reference: TOWN OF GIBSONS AGUILER CHARACTERIZATION

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**Units**	**Value (%)**	**QC Limits**
3892316	Fluoride (F)	2010/04/17	98	80 - 120	105	80 - 120	<0.01	mg/L	1.6	20
3902721	Total Dissolved Solids	2010/04/23	NC	80 - 120	104	80 - 120	<10	mg/L	0.7	20

N/A = Not Applicable
RDL = Reportable Detection Limit
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

Validation Signature Page

Maxxam Job #: B021376

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

ROB REINERT, Scientific Specialist

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CHAIN OF CUSTODY RECORD

CANTEST

4606 Canada Way
Burnaby, B.C.
V5G 1K5

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Tel: 604.734.7276
Fax: 604.731.2386
Toll Free: 800.665.8566

2181036

www.cantest.com

Client Name: Water line Resources
Postal Code: V9R 2K5
Street Address (including suite number): 229 Milton st,
City: Nanaimo
Telephone: 250 741 6795
Fax:
E-Mail Address (Required for Electronic Reporting): Sbayne@waterlineresources.com
Contact Name: Shelley Bayne
Sampler's Name: Byron Malloy
Quotation Number: WL09-5178
Project Number:
Project Name: Town of Gibsons Aquifer Characterization
P.O. Number

Page 1 of 1

*RESULTS REQUESTED BY:
Day Month Year
(Surcharges May Apply)

Special Instructions: ☐ AutoFax ☑ AutoEmail
☑ Return Cooler ☐ Ship Sample Bottles (please specify)

Drinking water
1HG package 1coli
2 raw
3 TM

Sample(s) are from a Drinking Water source servicing multiple households Yes ☐

Group Number	Sample Identification	Date/Time Sampled (D/M/Y & 24hr clock)	Sample Type	Total Metals*	Dissolved Metals*	Field Filtered Metals*	Soil Metals*	pH	Conductivity	TSS	TDS	Alkalinity (total / spec.)	BOD	COD	Coliform, Total & E.coli	Coliform, Fecal	F Cl SO_4 NO_3	Nitrite	Oil & Grease (Total / Mineral)	Oil & Grease (Special Waste)	PCP (Tri, Tetra and Penta)	PCP (Mono and Di)	BETX/VPH	VOC	EPH (not PAH corrected)	PAH	LEPH/HEPH (PAH corrected)	PCB	Asbestos					HOLD - DO NOT ANALYZE	Number of Containers
	WL10-01	D: 08/04/10 T: 18:30	Ground water																																1
L A		D: T:																																	
B		D: T:																																	
U		D: T:																																	
S		D: T:																																	
E		D: T:																																	
O		D: T:																																	
N		D: T:																																	
L Y		D: T:																																	
		D: T:																																	

John Gibson:
· This water sample is for tritium, deterium + oxygen isotope analysis.
Please send results to:
Waterline Resources Atten: Shelley Bayne.
Nanaimo, BC ~~sbayne@waterlineresourc~~

Relinquished by: Byron Malloy Date: April 19, 2010 Time:
Relinquished by: Date Time

Method of Shipment: Waybill No.: Receiv
Time: 1.10.
Shipped by: Shipment Condition: Cooler opened by: Date Time

FOR LABORATORY USE ONLY
Sample State at Receipt: ☐ Ambient ☑ Cold ☐ Frozen ☐ N/A Comments: B021376
Temperature 5.8 °C Custody Seal Intact? ☐ Yes ☐ No ☑ N/a Number of Coolers/Shipping Containers: 1 med

WATER
☐ CCME
☐ BC-CSR
☐ Other (please specify)

SOIL
☐ CCME
☐ BC-CSR
☐ Other (please specify)

CTT 119 Rev. 05/06

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Mills Basics 604-254-7211

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Your Project #: WL09-5178
Site Location: TOWN OF GIBSONS AGUILER CHARACTERIZATION
Your C.O.C. #: 2181036

Attention:
Shelley Bayne, M.Sc., P.Geo.
WATERLINE RESOURCES INC.
NANAIMO
229 Milton Street
Nanaimo, BC
CANADA V9R 2K5

Report Date: 2010/04/23

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B021376
Received: 2010/04/10, 09:20

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	1	2010/04/14	2010/04/14	BRN SOP-00264 R4.0	Based on SM2320B
Chloride by Automated Colourimetry	1	N/A	2010/04/14	BRN-SOP 00234 R3.0	Based on EPA 325.2
Colour (True)	1	N/A	2010/04/13	BRN SOP-00247 R1.0	Based on SM-2120B
Coliform membrane filtration Potable W (1)	1	N/A	2010/04/12	BRN SOP 00363 R2.0	Based on SM-9222
Carbon (DOC)	1	N/A	2010/04/16	BRN SOP-00224 R4.0	Based on M 860-87T
Conductance - water	1	N/A	2010/04/16	BRN SOP-00264 R2.0	Based on SM-2510B
Fluoride	1	N/A	2010/04/17	BRN SOP-00282 R4.0	Based SM - 4500 F C
Hardness Total (calculated as CaCO3)	1	N/A	2010/04/19		
Na, K, Ca, Mg, S by CRC ICPMS (total)	1	N/A	2010/04/19	BRN SOP-00206	Based on EPA 200.8
Elements by CRC ICPMS (total) (1)	1	N/A	2010/04/18	BRN SOP-00206	Based on EPA 200.8
Nitrate + Nitrite (N)	1	N/A	2010/04/14	ING233 Rev.4.4	Based on EPA 353.2
Nitrite (N) by CFA	1	N/A	2010/04/14	BRN SOP-00233 R1.0	EPA 353.2
Nitrogen - Nitrate (as N)	1	N/A	2010/04/15		
pH Water	1	N/A	2010/04/16	BRN SOP-00264 R4.0	Based on SM-4500H+B
Sulphate by Automated Colourimetry	1	N/A	2010/04/14	BRN-SOP 00243 R1.0	Based on EPA 375.4
Total Dissolved Solids (Filt. Residue)	1	N/A	2010/04/23	BRN SOP 00276 R4.0	SM 2540C
Turbidity	1	N/A	2010/04/13	BRN SOP-00265 R6.0	SM - 2130B

* Results relate only to the items tested.

(1) SCC/CAEAL

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

VIREN THAKER, BBY Customer Service
Email: VIREN.THAKER@MaxxamAnalytics.com
Phone# (604) 638-5030

==

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Total cover pages: 1

Maxxam Job #: B021376
Report Date: 2010/04/23

WATERLINE RESOURCES INC.
Client Project #: WL09-5178
Site Reference: TOWN OF GIBSONS AGUILER CHARACTERIZATION

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		T55651		
Sampling Date		2010/04/08 18:30		
COC#		2181036		
	Units	**WL10-01**	**RDL**	**QC Batch**
Misc. Inorganics				
Dissolved Organic Carbon (C)	mg/L	1.5	0.5	3892083

RDL = Reportable Detection Limit

Maxxam Job #: B021376
Report Date: 2010/04/23

WATERLINE RESOURCES INC.
Client Project #: WL09-5178
Site Reference: TOWN OF GIBSONS AGUILER CHARACTERIZATION

DRINKING WATER PACKAGE - MUNICIPAL (WATER)

Maxxam ID					T55651		
Sampling Date					2010/04/08 18:30		
COC#					2181036		
	Units	**Criteria A**	**Criteria B**	**Criteria C**	**WL10-01**	**RDL**	**QC Batch**
Misc. Inorganics							
Fluoride (F)	mg/L	**1.5**			0.15	0.01	3892316
ANIONS							
Nitrite (N)	mg/L	**1.0**			0.006	0.005	3884914
Calculated Parameters							
Total Hardness (CaCO3)	mg/L		500		33.3	0.5	3875840
Nitrate (N)	mg/L				<0.02	0.02	3876328
Misc. Inorganics							
Alkalinity (Total as CaCO3)	mg/L				62	0.5	3884998
Alkalinity (PP as CaCO3)	mg/L				<0.5	0.5	3884998
Bicarbonate (HCO3)	mg/L				76	0.5	3884998
Carbonate (CO3)	mg/L				<0.5	0.5	3884998
Hydroxide (OH)	mg/L				<0.5	0.5	3884998
Anions							
Dissolved Sulphate (SO4)	mg/L		500		4.8	0.5	3885023
Dissolved Chloride (Cl)	mg/L		250		3.9	0.5	3885017
MISCELLANEOUS							
True Colour	Col. Unit		15		80	10	3880589
Nutrients							
Nitrate plus Nitrite (N)	mg/L				0.02	0.02	3884912
Physical Properties							
Conductivity	uS/cm				137	1	3884997
pH	pH Units		6.5:8.5		8.0		3884995
Physical Properties							
Total Dissolved Solids	mg/L		500		98	10	3902721
Turbidity	NTU	**1.0**	0.3	0.1	49.1	0.1	3880276

RDL = Reportable Detection Limit
Criteria A, Criteria B, Criteria C: Guidelines for Chemical and Physical Parameters, Canadian Drinking Water Quality Summary Table, May 2008. It is recommended to consult these guidelines when interpreting data since there are non-numerical guidelines that are not included on this report.

Criteria A represents MAC Guidelines (Maximum Acceptable Concentration)
Criteria B and Criteria C represent AO or OG Guidelines (Aesthetic Objectives or Operational Guidance Values)

Maxxam Job #: B021376
Report Date: 2010/04/23

WATERLINE RESOURCES INC.
Client Project #: WL09-5178
Site Reference: TOWN OF GIBSONS AGUILER CHARACTERIZATION

DRINKING WATER PACKAGE - MUNICIPAL (WATER)

Maxxam ID					T55651		
Sampling Date					2010/04/08 18:30		
COC#					2181036		
	Units	**Criteria A**	**Criteria B**	**Criteria C**	**WL10-01**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total Aluminum (Al)	ug/L				619	3	3884320
Total Antimony (Sb)	ug/L				0.8	0.5	3884320
Total Arsenic (As)	ug/L				4.4	0.1	3884320
Total Barium (Ba)	ug/L				30	1	3884320
Total Boron (B)	ug/L				<50	50	3884320
Total Cadmium (Cd)	ug/L				0.04	0.01	3884320
Total Chromium (Cr)	ug/L				<1	1	3884320
Total Cobalt (Co)	ug/L				0.9	0.5	3884320
Total Copper (Cu)	ug/L				8.6	0.2	3884320
Total Iron (Fe)	ug/L		300		1730	5	3884320
Total Lead (Pb)	ug/L				1.2	0.2	3884320
Total Manganese (Mn)	ug/L		50		56	1	3884320
Total Mercury (Hg)	ug/L				<0.02	0.02	3884320
Total Molybdenum (Mo)	ug/L				21	1	3884320
Total Nickel (Ni)	ug/L				2	1	3884320
Total Selenium (Se)	ug/L				0.3	0.1	3884320
Total Silver (Ag)	ug/L				<0.02	0.02	3884320
Total Uranium (U)	ug/L				1.9	0.1	3884320
Total Vanadium (V)	ug/L				14	5	3884320
Total Zinc (Zn)	ug/L				11	5	3884320
Total Calcium (Ca)	mg/L				7.16	0.05	3877851
Total Magnesium (Mg)	mg/L				3.74	0.05	3877851
Total Potassium (K)	mg/L				3.15	0.05	3877851
Total Sodium (Na)	mg/L		200		17.5	0.05	3877851
Total Sulphur (S)	mg/L				<3	3	3877851
Microbiological Param.							
E. coli	CFU/100mL				<1	1	3878618
Total Coliforms	CFU/100mL				80	1	3878618

RDL = Reportable Detection Limit
Criteria A, Criteria B, Criteria C: Guidelines for Chemical and Physical Parameters, Canadian Drinking Water Quality Summary Table, May 2008. It is recommended to consult these guidelines when interpreting data since there are non-numerical guidelines that are not included on this report.

Criteria A represents MAC Guidelines (Maximum Acceptable Concentration)
Criteria B and Criteria C represent AO or OG Guidelines (Aesthetic Objectives or Operational Guidance Values)

DRINKING WATER PACKAGE - MUNICIPAL (WATER) Comments

Sample	T55651-01 Colour (True): Analysis requested past recommended holding time
Sample	T55651-01 Turbidity: Analysis requested past recommended holding time

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
3878618	E. coli	2010/04/12					<1	CFU/100mL		
3878618	Total Coliforms	2010/04/12					<1	CFU/100mL		
3880276	Turbidity	2010/04/13			103	80 - 120	<0.1	NTU	3.5	20
3880589	True Colour	2010/04/13					<5	Col. Unit		
3884320	Total Arsenic (As)	2010/04/18	99	80 - 120	100	80 - 120	<0.1	ug/L	0.6	20
3884320	Total Cadmium (Cd)	2010/04/18	113	80 - 120	101	80 - 120	<0.01	ug/L	NC	20
3884320	Total Chromium (Cr)	2010/04/18	101	80 - 120	104	80 - 120	<1	ug/L	NC	20
3884320	Total Cobalt (Co)	2010/04/18	103	80 - 120	102	80 - 120	<0.5	ug/L	NC	20
3884320	Total Copper (Cu)	2010/04/18	NC	80 - 120	101	80 - 120	<0.2	ug/L	0.7	20
3884320	Total Lead (Pb)	2010/04/18	114	80 - 120	107	80 - 120	<0.2	ug/L	1.0	20
3884320	Total Nickel (Ni)	2010/04/18	99	80 - 120	104	80 - 120	<1	ug/L	NC	20
3884320	Total Selenium (Se)	2010/04/18	112	80 - 120	104	80 - 120	<0.1	ug/L	NC	20
3884320	Total Uranium (U)	2010/04/18	115	80 - 120	107	80 - 120	<0.1	ug/L	0.8	20
3884320	Total Vanadium (V)	2010/04/18	NC	80 - 120	97	80 - 120	<5	ug/L	NC	20
3884320	Total Zinc (Zn)	2010/04/18	NC	80 - 120	105	80 - 120	<5	ug/L	NC	20
3884320	Total Aluminum (Al)	2010/04/18					<3	ug/L	0.5	20
3884320	Total Antimony (Sb)	2010/04/18					<0.5	ug/L	NC	20
3884320	Total Barium (Ba)	2010/04/18					<1	ug/L	1.0	20
3884320	Total Boron (B)	2010/04/18					<50	ug/L	NC	20
3884320	Total Iron (Fe)	2010/04/18					<5	ug/L	1.1	20
3884320	Total Manganese (Mn)	2010/04/18					<1	ug/L	2.7	20
3884320	Total Mercury (Hg)	2010/04/18					<0.02	ug/L	NC	20
3884320	Total Molybdenum (Mo)	2010/04/18					<1	ug/L	0.5	20
3884320	Total Silver (Ag)	2010/04/18					<0.02	ug/L	NC	20
3884912	Nitrate plus Nitrite (N)	2010/04/14	97	80 - 120	99	80 - 120	<0.02	mg/L	NC	25
3884914	Nitrite (N)	2010/04/14	99	80 - 120	104	80 - 120	<0.005	mg/L	NC	20
3884997	Conductivity	2010/04/15			107	80 - 120	<1	uS/cm	0	20
3884998	Alkalinity (Total as CaCO3)	2010/04/14	NC	80 - 120	100	80 - 120	0.8, RDL=0.5	mg/L	0.8	20
3884998	Alkalinity (PP as CaCO3)	2010/04/14					<0.5	mg/L	NC	20
3884998	Bicarbonate (HCO3)	2010/04/14					0.9, RDL=0.5	mg/L	0.8	20
3884998	Carbonate (CO3)	2010/04/14					<0.5	mg/L	NC	20
3884998	Hydroxide (OH)	2010/04/14					<0.5	mg/L	NC	20
3885017	Dissolved Chloride (Cl)	2010/04/14	NC	80 - 120	95	80 - 120	<0.5	mg/L	NC	20
3885023	Dissolved Sulphate (SO4)	2010/04/14	NC	80 - 120	95	80 - 120	<0.5	mg/L	11.2	20
3892083	Dissolved Organic Carbon (C)	2010/04/16	NC	80 - 120	97	80 - 120	<0.5	mg/L	9.2	20

Maxxam Job #: B021376
Report Date: 2010/04/23

WATERLINE RESOURCES INC.
Client Project #: WL09-5178
Site Reference: TOWN OF GIBSONS AGUILER CHARACTERIZATION

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**Units**	**Value (%)**	**QC Limits**
3892316	Fluoride (F)	2010/04/17	98	80 - 120	105	80 - 120	<0.01	mg/L	1.6	20
3902721	Total Dissolved Solids	2010/04/23	NC	80 - 120	104	80 - 120	<10	mg/L	0.7	20

N/A = Not Applicable
RDL = Reportable Detection Limit
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

Validation Signature Page

Maxxam Job #: B021376

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

ROB REINERT, Scientific Specialist

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CANTEST

4606 Canada Way
Burnaby, B.C.
V5G 1K5

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Tel: 604.734.7276
Fax: 604.731.2386
Toll Free: 800.665.8566

2181036

www.cantest.com

Client Name: Water line Resources
Postal Code V9R 2K5
Street Address (including suite number): 229 Milton st,
City: Nanaimo
Telephone: 250 741 6795
Fax:
E-Mail Address (Required for Electronic Reporting): Sbayne@waterlineresources.com
Contact Name: Shelley Bayne
Sampler's Name: Byron Molloy
Quotation Number: WL09-5178
Project Number:
Project Name: Town of Gibsons Aquifer Characterization
P.O. Number

Page 1 of 1

***RESULTS REQUESTED BY:**
Day Month Year
(Surcharges May Apply)

Special Instructions: ☐ AutoFax ☑ AutoEmail
☑ Return Cooler ☐ Ship Sample Bottles (please specify)

Drinking water
1HG package 1 coli
2 raw
3 TM

Sample(s) are from a Drinking Water source servicing multiple households Yes ☐

Group Number	Sample Identification	Date/Time Sampled (D/M/Y & 24hr clock)	Sample Type
LAB USE ONLY	WL10-01	D: 08/04/10 T: 18:30	Ground water
		D: T:	
		D: T:	
		D: T:	
		D: T:	
		D: T:	
		D: T:	
		D: T:	
		D: T:	
		D: T:	

Sample Identification	Total Metals*	Dissolved Metals*	Field Filtered Metals*	Soil Metals*	pH	Conductivity	TSS	TDS	Alkalinity (total / spec.)	BOD	COD	Coliform, Total & E.coli	Coliform, Fecal	F Cl SO_4 NO_3	Nitrite	Oil & Grease (Total / Mineral)	Oil & Grease (Special Waste)	PCP (Tri, Tetra and Penta)	PCP (Mono and Di)	BETX/VPH	VOC	EPH (not PAH corrected)	PAH	LEPH/HEPH (PAH corrected)	PCB	Asbestos					HOLD - DO NOT ANALYZE	Number of Containers
WL10-01			½																													1

John Gibson:

- This water sample is for tritium, deterium & oxygen isotope analysis.

Please send results to:
Waterline Resources Atten: Shelley Bayne.
Nanaimo, BC ~~Sbayne@waterlineresource~~

Relinquished by: Byron Molloy Date April 9, 2010 Time
Relinquished by: Date Time

Method of Shipment: Waybill No.: Receiv

Shipped by: Shipment Condition: Cooler opened by: Date Time 1.10.

FOR LABORATORY USE ONLY
Sample State at Receipt: ☐ Ambient ☑ Cold ☐ Frozen ☐ N/A Comments: B021376
Temperature 5.8 °C Custody Seal Intact? ☐ Yes ☐ No ☑ N/a Number of Coolers/Shipping Containers: 1 med

WATER
☐ CCME
☐ BC-CSR
☐ Other (please specify)

SOIL
☐ CCME
☐ BC-CSR
☐ Other (please specify)

CTT 119 Rev. 05/06

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Mills Basics 604-254-7211

Appendix F
Proposed Groundwater Monitoring Plan

1.0 PROPOSED MONITORING PLAN

1.1 Monitoring Objectives

The objectives of a groundwater monitoring plan/program are to:

- Identify any long-term geochemical trends and potential cumulative effects from current and future development in the Gibsons Aquifer;
- Increase our understanding of background conditions;
- Detect any potential large scale groundwater quality and quantity effects;
- Provide appropriate baseline coverage (in areas of no anthropogenic effects) in each of the key aquifers for use in future development planning;
- Gain a better understanding of the background variability in the region;
- Gain further understanding of aquifer interactions and how the groundwater system is connected to surface environments;
- Verify and refine the regional conceptual hydrogeologic model;
- Identify high-risk areas that may require additional monitoring;
- Verify and refine local and regional conceptual hydrogeologic model which will serve as input data to numerical groundwater flow and transport models;
- Calibrate/verify predictive surface water and groundwater flow and contaminant transport models; and,
- Refine targets for indicator parameters for the Gibsons Aquifer through an adaptive management process.

The development of a monitoring plan is driven by pressures on the Gibsons Aquifer in terms of sustainability of water quality and quantity. Population growth and increasing development in the region will undoubtedly place the greatest pressure on the Gibsons Aquifer. The first steps toward a monitoring plan were taken in the preparation of this report. The availability of high quality monitoring data will serve to increase the accuracy and certainty of long-term groundwater resource management.

The recommended groundwater monitoring plan will help to establish present conditions in the watershed in terms of groundwater quantity and quality and serve as a baseline for future work. It should be noted that the monitoring system will undoubtedly answer some questions raised herein, but also may reveal other questions. The intent is to establish a baseline of groundwater information that is available to future users in the Gibsons area to help guide the use of groundwater (and surface water) resources.

1.2 Existing Monitoring Locations

The current Town monitoring well network with recommendations is attached in Table E1.

Table E1: Monitoring Summary Table

Well Name	Location	Northing	Easting	Ground Elev.	Well Depth	Well Dia. (cm)	Stratigraphic Unit	Screen Top	Screen Bottom	Pressure Transducer	Water Level
		m	m	mASL	mBG			mBGL	mBGL		mbtoc
18774	School Board Yard Henry Rd	5473736	460524	178	139	15.24	Bedrock Metasediment	NA	NA	Data Logger	101.5
52733	Fielder Well 967 Henry Rd.	5474249	460691	266	38	15.24	Capilano	NA	NA	Data Logger	29.6
MW06-1A	Spyglass Place	5472468	462812	110	78	5.08	Pre-Vashon	74.4	77.4	Data Logger	74.9
MW06-1B	Spyglass Place	5472468	462812	110	78	2.54	Capilano	9.3	12.3	Data Logger	3.9
MW06-2A	Behind Gibsons Aquatic Centre	5472688	462130	126	102	5.08	Pre-Vashon	98.9	101.9	Data Logger	97.2
MW06-2B	Behind Gibsons Aquatic Centre	5472688	462130	126	102	2.54	Capilano	11.3	14.3	Data Logger	2.9
Strata Condo	Behind Georgia Mirage condos near pond	5472360	462486	113		15.24	Pre-Vashon	NA	NA	Data Logger	87.6
Town Well 1	Gower Pt Rd	5472034	463057	13	42	30.48	Pre-Vashon	19.81	22.86	SCADA	NA
Town Well 2	Dougal Park	5471757	462924	18	15	30.48	Pre-Vashon	13.11	14.63		NA
Town Well 3	Dougal Park	5471715	462943	19	26	30.48	Pre-Vashon	21.03	24.26	SCADA	NA
Town Well 4	Gower Pt Rd	5472141	463143	13	20	30.48	Pre-Vashon	11.9	15.5	SCADA	NA
WL10-01 WID#33706	Payne Rd	5473033	461597	147	143	7.62	Pre-Vashon	137.16	140.21	Data Logger	106.7
WL10-02 WID#33707	Oceanmount Blvd	5472238	462263	115	157	7.62	Pre-Vashon	120.4	123.4	Data Logger	84.4
70651	Chaster Rd	5471290	462156	93	116	20.32	Bedrock Granite	NA	NA	Data Logger	NA

Notes: All coordinates at Zone 10, NAD 83, mASL means meters above mean sea level, mBGL means meters below ground level, m BTOC means meters below top of casing, NA mean not available

As shown, the Chaster Road and Fiedler wells should be discontinued as monitoring wells as the wells are difficult to access unless they could be properly retrofitted with access drop tubes.

Only a few production wells completed in the Gibsons Aquifer are actively being pumped. These include the Town wells and the Strata well. At present, water levels and groundwater discharge is being monitored in the Town wells, and only water level data is available for the Strata well. As previously indicated, the data logger installed by Waterline in the Strata well has become entangled in the pump wiring and the pump will need to be removed from the well to extract the logger.

The Georgia Mirage Strata council have requested that the data logger be permanently removed from the well. The Strata well is located directly upgradient of the Town wells and, as such, is considered to be in a highly valuable location. Waterline recommends that the Town approach the Georgia Mirage Strata council to discuss the potential to maintain the Strata well as a sentinel well for the Town. The entangled logger would have to be removed and a protective drop pipe should be installed to house the logger to prevent further entanglement. In addition, Waterline recommends that a flow meter and a sampling port be installed on the Strata well so that water level fluctuations can be reconciled to groundwater use, groundwater sampling may be easily conducted and further assessment of cumulative impacts of pumping multiple wells completed. This approach is in the best interest of both the Strata Condo and the Town as part of groundwater management.

1.2 Proposed New and Existing Monitoring Locations

No BC MOE observation wells exist in the Gibsons Aquifer. Waterline understands that BC MOE is currently undertaking to add another 80-100 observation wells to the provincial monitoring well network (pers. comm. with Kevin Ronneseth, BC MOE). It is recommended that the Town initiate communication with the BC MOE to determine if a case can be made for an observation well to be located in both the Gibsons and Capilano Aquifers to support future groundwater monitoring and aquifer management initiatives.

Identification of monitoring well locations should consider the following criteria:

- Population density and number of existing users;
- Vulnerable areas where the combination of environmental factors and land use may not be aligned. Industrial or commercial operations have the potential to impact water quality or perhaps unique aquifer conditions (e.g., unconfined aquifer) increase the sensitivity or risk to protecting groundwater quantity or quality and therefore consideration should be given to monitoring these existing areas.
- Multi-level monitoring wells should be installed along creek margins where aquifers and surface water systems are suspected to interact. Water levels in aquifers that feed base flow to creeks will need to be maintained to ensure the protection of aquatic ecosystems.
- Areas where insufficient data are available to fully characterize the geology or hydrogeology. A good example is in the northwestern and northeastern part of the study area where little groundwater monitoring information exists and recreational and

industrial (timber harvesting) can potentially impact aquifer recharge characteristics and surface water and potentially groundwater quality/quantity;

- Areas where future development is being proposed. The Town will have to work closely with the subdivision authority, or the Port Authority to understand future plans within the mapped areas of the Gibsons Aquifer. Collecting baseline data prior to development will help determine whether additional measures are require to protect groundwater resources in advance of approving such developments. A recent example of this cooperative approach is with the recent installation of support pilings for the waterfront development project that is currently underway. The Town was able to more baseline geology and groundwater data to help assess the risks associated with driving pilings through the Gibsons Aquitard in the seabed along the waterfront. A summary report of the results of this study is currently being compiled.

Based on the above criteria, Waterline has selected six possible future locations within the Gibsons Aquifer for installation of additional monitoring wells. These are presented below in Table E2 and shown on Figure E1 for consideration by the Town of Gibsons.

1.4 Process for Determining Water Quality Indicator Parameters

Indicator parameters are commonly used to measure the cause and effect relationship between human activities on the landscape and the environmental response to those activities. With respect to groundwater, measurement and tracking of indicator trends helps to ensure that quality and quantity conditions are maintained for human and ecosystem needs into the future. Suitable indicators include those that are:

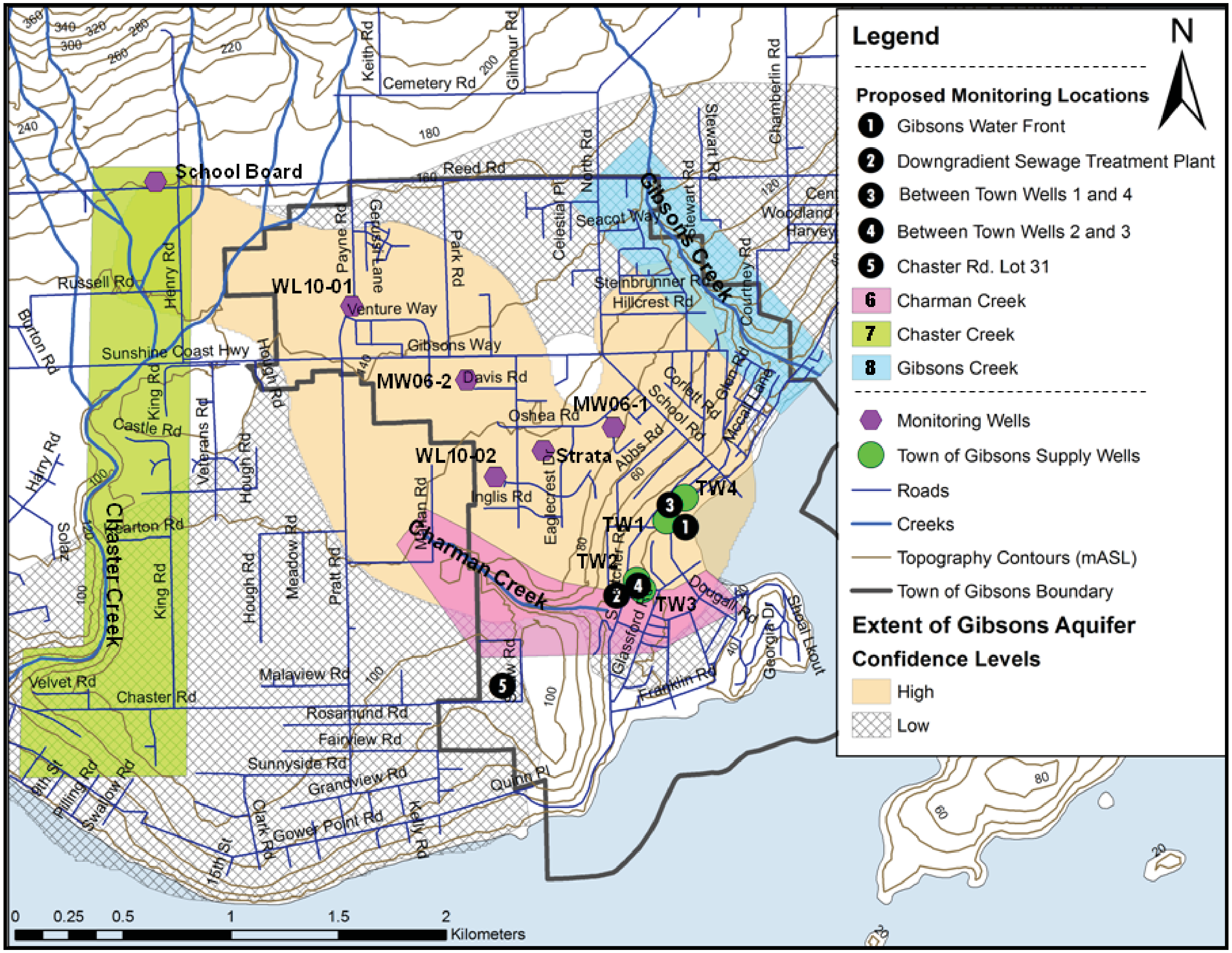
- commonly present in the environment;
- relatively easy and inexpensive to measure;
- sensitive to environmental change; and
- specific to disturbance impacts.

Indicators can be grouped as “condition” and “development” indicators. Condition indicators relate to the physical, chemical and biological aspects of the ecosystem, while development indicators relate to anthropogenic activities in a certain area. The indicators would be selected based on land use information

Primary indicators should ultimately be selected to address development issues as well as other human activities. Secondary indicators are intended to support any follow-up investigation required following the exceedance of an established target or identification of an unacceptable trend. If required, a tertiary level of assessment may be required. As such, the tertiary indicators tend to be more expensive and assess conditions from a very high level of refinement and should only be used if required.

Table E2: Proposed Additional Monitoring Locations

Location		Timeline	Status	Reason	Comments
1	Gibsons Water Front –	Short Term	No existing monitoring well(s)	Salt Water intrusion and potential effects from waterfront developments (i.e. pilings, dewatering for buildings, etc.)	Gibsons Aquifer extends into Howe sounds and the depth to the fresh/salt water interface is not known with certainty. Well would be used to asses the interface depth and to monitor the progression of salt water intrusion through geochemical observation. Artesian well drilling protocols must be followed.
2	Immediately downgradient of Gibsons Sewage Treatment Plant	Short Term	No existing wells	The treatment plant is in relatively close proximity upgradient of the Town wells and it is recommended to monitor that its current and future operation has no adverse impact to the aquifer	Well should be nested in both the Capilano and Gibsons Aquifers.
3	Between pumping wells 1 and 4	Short Term	No existing wells	To assess aquifer drawdown adjacent to pumping well and monitor artesian pressure.	Artesian well drilling protocols must be followed.
4	Between pumping wells 2 and 3	Short Term	No existing wells	To assess aquifer drawdown adjacent to pumping and monitor artesian pressure.	Artesian well drilling protocols must be followed.
5	Charman Creek	Medium to Long Term	No existing wells	To monitor surface water-groundwater interaction	Well should be nested in both the Capilano and Gibsons Aquifers.
6	Chaster Creek	Medium to Long Term	No existing monitoring wells	To monitor surface water-groundwater interaction	Well should be nested in both the Capilano and Gibsons Aquifers.
7	Gibsons Creek –	Medium to Long Term	No existing monitoring wells	To monitor surface water-groundwater interaction	Well should be nested in both the Capilano and Gibsons Aquifers.
8	Chaster Road Lot 31	Medium to Long Term	No existing monitoring wells	To assess aquifer boundary and interaction with bedrock	Single well completed in sand and gravel or bedrock.



Source: Base map provided by the Town of Gibsons

Figure E1: Map Showing Approximate Location of Future Monitoring Wells

A preliminary list of indicator parameters should set out to enable assessment of whether there are contaminant sources within the Gibsons Aquifer and whether there is deterioration of groundwater quality. These parameters must act as sentinels to assess changes in the water quality on a regional basis. Other parameters may be more useful on a local scale where contamination is suspected.

For the next five years, the following parameters have been recommended for sampling on an annual basis:

- Physical parameters (pH, EC, TDS, etc.),
- Major anions (i.e.., Bicarbonate, Carbonate, Chloride, Sulfate, including Fluoride;
- Major cations (i.e., Calcium, Magnesium, Potassium and Sodium);
- Microbiological (Total coliforms, E.Coli, Heterotrophic bacteria, etc.),
- Nutrients (i.e. Nitrate, Nitrite, etc.); and,
- Dissolved metals including mercury and arsenic.

It is also recommended that water samples be collected from monitoring wells and analyzed for organic contaminants. The contaminant/chemical inventory study recommended for the Town will help identify the analysis required but the following is a general list provided for consideration by the Town:

- Hydrocarbon compounds,
- Volatile organic compounds,
- Pesticides/herbicides, and
- Other synthetic compounds (E.g.: hormones, caffeine, and perhaps pharmaceuticals).

1.5 Monitoring Frequency

The frequency at which monitoring should be completed is dependent on establishing long term baseline trends, thus there should be sufficient data for this purpose. In order to be able to establish a statistical trend, a minimum of eight data points are preferred (Gibbons, 1994). Once a baseline is establish, sampling frequency could be reduced. It should be noted that depending on the trends observed, confirmatory sampling may be needed to verify the results. Some of the Town supply and monitoring wells have a sufficient data record to facilitate statistical trend analysis, while others (e.g. WL10-1 and WL10-2) do not yet have sufficient water quality data.

Land development has occurred within the Town over several decades. As such it may be difficult to assess natural baseline conditions. The purpose of the monitoring is to aid in assessing changes over time in the condition of the groundwater in the watershed and therefore groundwater monitoring should be initiated early. This is best assessed through monitoring of water levels in water wells on a regular or continuous basis either by hand measurements or, preferably, through the use of pressure transducers-data loggers.

Based on discussions with the Town, water level data will be collected using data loggers at the current frequency. Water quality sampling will be completed on an annual basis.

1.6 Establishing Target Water Quality Values

A brief description of the recommended approach to establish target water quantity values is provided here, where:

- **Target**: A target is a numerically-defined desired condition for a given indicator, and a management tool which is somewhere defined through the integrated process to identify a place between natural conditions (or variability) and an established threshold.

- **Threshold**: Value not to be exceeded, such that resource health may be maintained including resources with which the resource interacts (i.e. an exceedance of established or agreed-upon management criterion).

As more data become available for individual monitoring wells, statistical control charting may be used for each selected indicator parameter measured at a regional monitoring well to assess natural variability, and to track quality and quantity (i.e., water levels) conditions at each designated location. The control chart technique is used to determine whether or not an observed value is significantly different from historical values (Gibbons 1994). Once a statistically meaningful set of water quality data are available an upper concentration limit or a lower water level limit is established for each indicator parameter and water level. These limits represent the range of natural variability.

A data point that exceeds the upper concentration limit for a given parameter is an indication that something unusual may be occurring with respect to natural variability in the data. This knowledge should trigger confirmatory sampling followed by corrective action if the result is verified. Confirmatory sampling is done to ensure that the criteria exceedance is not the result of lab or sampling error. Corrective or remedial actions start with determining the source of contamination or cause of water level decline, and are followed by an assessment of available options.

Analyses of long-term trends in the data may be done using the Mann Kendall[9] test. This is a non-parametric statistical test that assesses the data for an upward or a downward trend. This works well with small data sets containing less than 48 data points that do not show seasonal trends.

Other statistical methods are available; however, the use of any statistical test must be preceded by an assessment of the method for its application and appropriateness to this context.

1.7 Water Quantity and Quality Data Analysis and Reporting

In terms of data analysis and reporting, the intent is to update the monitoring and sampling databases and screen for any obvious issues on an annual basis. This will include comparing the water quality data with up-to-date GCDWQ. A brief technical memorandum will be issued to the Town. It will present a summary of the data and highlight any issues.

Once every five years, or if the annual monitoring program results suggest a more frequent basis is appropriate, the databases will be reviewed in detail to confirm statistical trends, whether the target and threshold water quality values are met. The water level data will be assessed to confirm any changes that could indicate changes to the flow system as documented in this report. A water quantity and quality monitoring report will be issued that will summarize the findings and provide recommendations for changes to the existing groundwater management or monitoring plans, as appropriate.

1.8 Early Warning Monitoring and Cumulative Effects Analysis

Monitoring of surface water and groundwater use and its corresponding effects on creek/river flows and aquifer performance will provide an early warning system to help prevent over use. It is the only way that cumulative impacts to a watershed and underlying aquifers can be accurately quantified and appropriate water resource management strategies developed. In the absence of these data, unrestricted extraction of groundwater in particular, can lead to aquifer dewatering and supply wells running low or dry without much notice.

Typical groundwater studies submitted for subdivision approval in BC involves a 100 day predictive calculation to accommodate for seasonal fluctuations in water levels. Although these short-term predictive assessments may be adequate for addressing seasonal variations, the approach is inadequate for planning community water supply that extend over a lifetime (100 years or more).

It is imperative that cumulative effects analysis becomes standard hydrogeological practice for confirming water supply in advance of land development particular on the unserviced SCRD lands where water supply is being contemplated using water wells. Submission of groundwater monitoring and following up with submission of aquifer performance data, once a groundwater supply system becomes operational, should also be required to confirm theoretical predictions upon which the approval was granted. In the absence of regulatory guidance, there is limited opportunity to properly manage water resources such that sustainable use can be achieved.

Appendix G
Community Outreach Report
Gordon Groundwater Consultancy

SUSTAIN, PROTECT and PROMOTE
THE GIBSONS AQUIFER

Gibsons Aquifer Interpretative Tour
‘WALKING ON WATER’

Prepared by:
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Gordon Groundwater Consultancy
April 17, 2013

ACKNOWLEDGEMENTS

From initial discussions with the Town as to the merits of including groundwater outreach as part of the Phase 2 Aquifer Mapping project, through its evolution with many contributors' ideas and efforts, to the final focus on the Gibsons Aquifer Interpretative Tour (Walking on Water), all inputs are gratefully acknowledged. In particular, my thanks to the following:

- Dave Newman (Director of Engineering at the Town) - for so many aspects, including the 'Walking on Water' title;
- Town staff and councillors - for providing encouragement and direction;
- Waterline Resources (Darren David, Shelley Bayne and David van Everdingen) - for helpful insight on the hydrogeology of the Gibsons Aquifer;
- Kevin Ronneseth (BC Ministry of Environment) - for his efforts on the activities that promoted the Gibsons Aquifer provincially and nationally;
- Jan Beringer (Exhibit Design) - for his advice on designing interpretative tours;
- Carlie Laustrup, Sara Nabei, Yasaman Kazemi, and Dr. Mark Giltrow (BCIT), Jessica Doyle (UBC Master's Student), and Kim Munro (GGC intern) - for their help in the community questionnaires; and
- Friends and colleagues - for feedback on various outreach ideas.

TABLE OF CONTENTS

1 INTRODUCTION

For over two decades, the Town of Gibsons has proactively initiated water-related projects that strive to ensure the sustainability and protection of their highly valued, ample and untreated groundwater supply. Until recently, the lack of any obvious issue with groundwater quantity or quality has resulted in low community awareness of how their actions might affect the aquifer and the groundwater supply. Low attendance at an open house presentation on the Phase 1 Aquifer Mapping project prompted the Town to include the development of Groundwater Communications and Engagement Activities in Phase 2 of the project.

Gordon Groundwater Consultancy (GGC) was engaged under the Town's contract with Waterline Resources to undertake this project. The project developed a framework for groundwater communication and engagement, and undertook several activities to be incorporated into a Gibsons Aquifer Interpretative Tour ('the Tour'). The concept of the Tour was presented to the Town's Committee of the Whole on February 6, 2013 who recommended that funding from the 2013 budget be allocated. A phased Tour is proposed, with a pilot and a Phase 1 Tour conducted in 2013.

1.1 Vision

Groundwater science and water supply engineering, because they are underground create some unique challenges for community engagement. However, by framing the communication in terms of community values and everyday behaviour, engagement can evolve from their day-to-day activities. Further, engaging communication "connects the dots" from the Aquifer Mapping (groundwater science studies) and the Town's infrastructure initiatives, (water supply engineering) to a 'how it will affect us and why we should care'. By connecting the dots, it easier for us to recognize the connections between our every-day lives and various types of information about water that we are be receiving and thus maximize the value of the Town's ongoing water sustainability efforts.

Raise Awareness

Community has a **KEY** role in sustaining and protecting their (ground) water supply

❖AIDA: Awareness Interest Desire Action

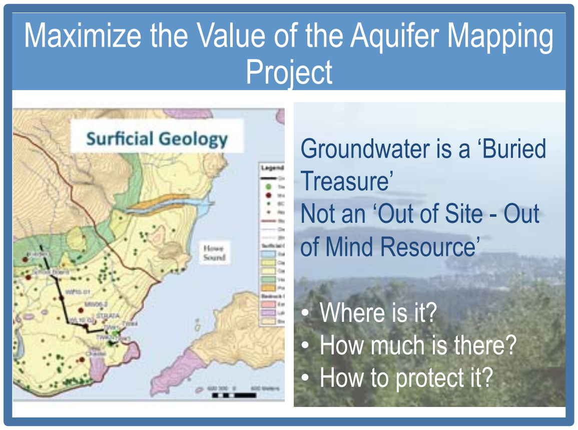
The long-term vision is that groundwater communication and engagement will lead to a community with:

1) Increased awareness about their role in the sustainability and protection of the groundwater resource; and ultimately

2) Enhanced consideration of their choices and behaviour such that the sustainability and protection of the Gibsons Aquifer is integrated into their day-to-day activities.

1.2 Guiding Principles

Guiding principles for the Groundwater Communication and Engagement activities are based on discussions with the Town staff and councillors, several key community engagement reference guides and GGC's first hand experience in the area of groundwater science communication. They all focus on raising awareness about the community's role in sustaining and protecting the Gibsons Aquifer and groundwater supply. They are:

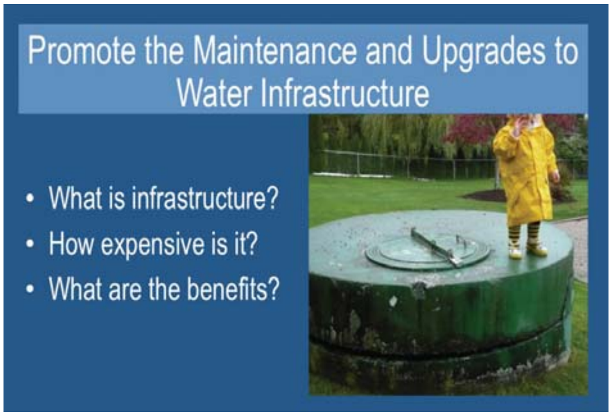


Maximize the Value of the Aquifer Mapping Project

Groundwater is a 'Buried Treasure'
Not an 'Out of Site - Out of Mind Resource'

- Where is it?
- How much is there?
- How to protect it?

- Maximize the value of the Aquifer Mapping project and Water Infrastructure Initiatives by 'translating' the science and engineering content into engaging communications using three key rules (Adapted from U.S. Environmental Protection Agency 2010):
  1) First, it must capture the attention of the audience. This alone is no easy task in a world saturated with media messages. Our messages need to cut through the din of information and stimuli that bombards us every day.
  2) Second, the messages have to be meaningful in the daily lives of the audience.
  3) Third, keep it simple.
- Emphasize that Groundwater is a 'Buried Treasure' not an 'Out of Site - Out of Mind Resource'



Promote the Maintenance and Upgrades to Water Infrastructure

- What is infrastructure?
- How expensive is it?
- What are the benefits?

- Promote the relevance of the maintenance and upgrades to the Town's Water Infrastructure
- Pilot test the activities and evaluate their effectiveness. Be mindful of the limited resources while recognizing the need for long-time horizons for behaviour changes to be measureable.
- Encourage collaborations with other initiatives such as the Town's internal communication initiatives, coast-wide tourist, environmental or nature tours, and learning institutes' student training programs.
- Be guided by the recognized social marketing[*] technique AIDA (**A**wareness, **I**nterest, **D**esire, **A**ction). For the initial Tour activities, the focus is on increased awareness and interest, in particular that the community has a key role in sustaining and protecting the Gibsons Aquifer. For the long term, more advanced social marketing techniques can focus on specific behavior changes (i.e. desire for new actions about water conservation) beyond awareness (U.S. Environmental Protection Agency 2003; New Hampshire Department Environmental Services 2008).

[*] At its most basic level, social marketing views the (ground)water-shed community as consumers. Social marketing incorporates proven commercial marketing principles into education about social issues. Instead of selling products or services, it sells ideas, attitudes, and behaviors. The goal of social marketing is not to make money, but to improve our society and the environment (US EPA, 2003).

1.3 Build on Existing Opportunities

The Town's current efforts to develop new approaches for communication, including updates to the website, branding and access to expertise could be a benefit to the Tour. It is recommended that before proceeding with the Phase 1 of the Tour, these collaboration opportunities be explored.

1.4 Benefits to the Town of Gibsons

Many of the management practices needed to sustain and protect the Town's water supply are based on approaches that tend to be voluntary and involve the people who live and work in the community. Therefore, one can view groundwater outreach as a key management tool to sustain and protect the Town’s water supply. In addition, by promoting the Tour as part of a tourist attraction, ancillary benefits are achieved.

The anticipated key benefits are expected to be:

- Maximize the value of the Aquifer Mapping Project;
- Development of communication and engagement activities that sustain and protect the Gibsons Aquifer and support the Town’s infrastructure water initiatives; and
- Reputation building leading to increased tourist and business opportunities.

2 STUDENT/INTERN AMBASSADORS – COMMUNITY QUESTIONNAIRES

We worked with five students/interns (three from BCIT, and one each from UBC and GGC) to help with preliminary community engagement. Community questionnaires (123 in total), collected by them over four events, served several functions. We were motivated by the need to gauge the community’s background knowledge of groundwater science and the Town’s water infrastructure initiatives, and preferences for communication of, and wiliness to participate in the Town’s ‘Groundwater Sustainability Initiatives’. We established an internship with three BCIT students through their professor Dr. Mark Giltrow. The BCIT business students designed and conducted two of the questionnaire surveys as their directed studies course.

The questionnaires development involved:

- Input and guidance by Dr. Sue Gordon (GGC) and Dave Newman (Town’s Director of Engineering);
- Feedback from background research in-person and phones interviews, (Michael Epp, past-Town Planner, Michelle Jansson, past -Town Corporate Officer, and Councilors Lee Ann Johnson and Charlene SanJenko);
- A critique of the questions and interview technique of the students by Kylie Hutchinson (Community Solutions), a Credentialed Evaluator;
- Informal pilot of the questionnaires by colleagues; and
- Two additional revisions of their questions with help from the UBC and GGC interns, who also conducted some of the interviews.

It is noted that a total 123 results is a reasonable sample size for a community the size of Gibsons. However, upon their evaluation, certain biases appeared to exist in the wording of the questions, such that in some cases, only general trends can be gleaned. Regardless, the insight presented here was useful for the design of the Tour content material and can be applied to any future evaluation of its effectiveness.

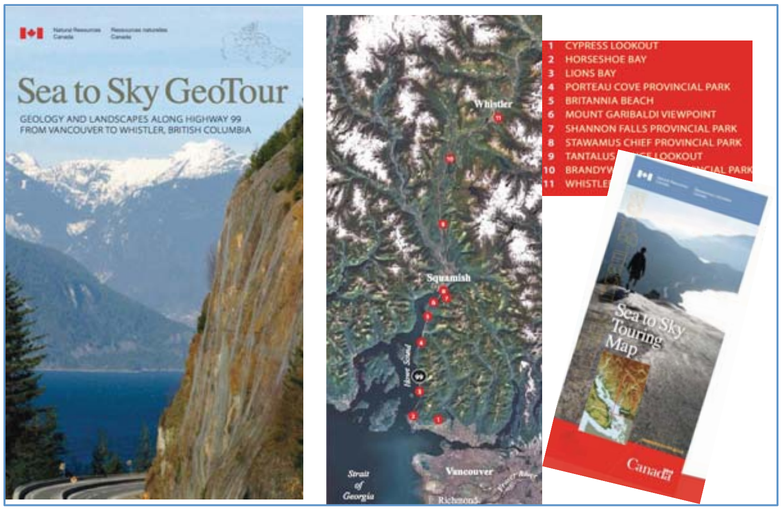
1) The main finding is that there appeared to be intuitive learning from the groundwater knowledge questions from one to the next (i.e. the previous question provided hints for the next question), which appears to create biases in the answers.
2) These biases confirm that simplifying quantity and quality concepts is critical to successful groundwater awareness campaigns. It is noted that we intentionally did not have any specific questions on the Gibsons Aquifer, as we first wanted to understand the community's general knowledge about groundwater.
3) There was poor knowledge of the Town's water infrastructure indicating the importance of this component as part of the Tour.
4) Approximately 40 % of the respondents indicated either 'maybe' or 'yes' to interest in participating in a community engagement activity related to groundwater sustainability.
5) The responses to their preferred communication medium suggested that outreach should be part of their daily routine, e.g. reading the paper, searching the web, walking or using cell phones.
6) Finally, interns are very helpful for conducting questionnaires because their energy and enthusiasm is well received by a potential participant.

3 GIBSONS AQUIFER INTERPRETIVE TOUR (WALKING ON WATER)

3.1 Concept

Mindful of the guiding principles and the qualitative results from the community questionnaires, we considered how best to profile the value of the Gibsons Aquifer and the proactive efforts by the Town to sustain and project their groundwater supply. It is envisioned that the Tour will help encourage the sustainability and protection of the Gibsons Aquifer for both the community and nature. At the same time, by marketing the Tour as a Town attraction it can also boost tourism, conventions and outdoor education opportunities in Gibsons and area.

The methodology behind interpretative nature tours and museum exhibits informed the development of the Gibsons Aquifer Interpretative Tour. We were inspired by the beautiful landscape and the dramatic geologic evolution of the Gibsons Aquifer, and motivated by our own experiences on nature and geologic tours similar to our neighbour's Sea-to-Sky Geology Tour.



In this case, the interpretative signage would be developed in phases and at two tour scales. The first tour will be encountered during day-to-day activity in Gibsons Landing and the second, during outdoor recreating around Mt. Elphinstone. Illustrative-only examples of these two tours were presented to The Town of Gibsons Committee-of-the-Whole on February 5, 2013.

Example Tour 1

Gibsons Landing

1. Visitor Centre
2. Seawalk
3. Fountain
4. Water Dispenser
5. Charman Creek
6. Town Wells
7. Town Hall

Example Tour 2

Gibsons to Mt. Elphinstone

Where is the Gibsons Aquifer?

For Tourists, Mountain Bikers, Hikers....

The concept is of a Self Guided Tour that will have different viewing options. The simplest form requires nothing more than an acknowledgement of the presence of the Tour sign, skillfully designed to evoke an emotion such as curiousity and awareness. Interpretative content will be part of the sign for the second level of engagement. Additional content could also be accessed on the web using either the website URL or a Quick Response (QR) code for smart phones, both of which will also be on the interpretative sign (or nearby). A brochure could also be produced for distribution at the Visitor Centre and the Town office.

The Committee-of-the-Whole endorsed the concept of the Phased Tour with interpretative signs as noted in the local paper*

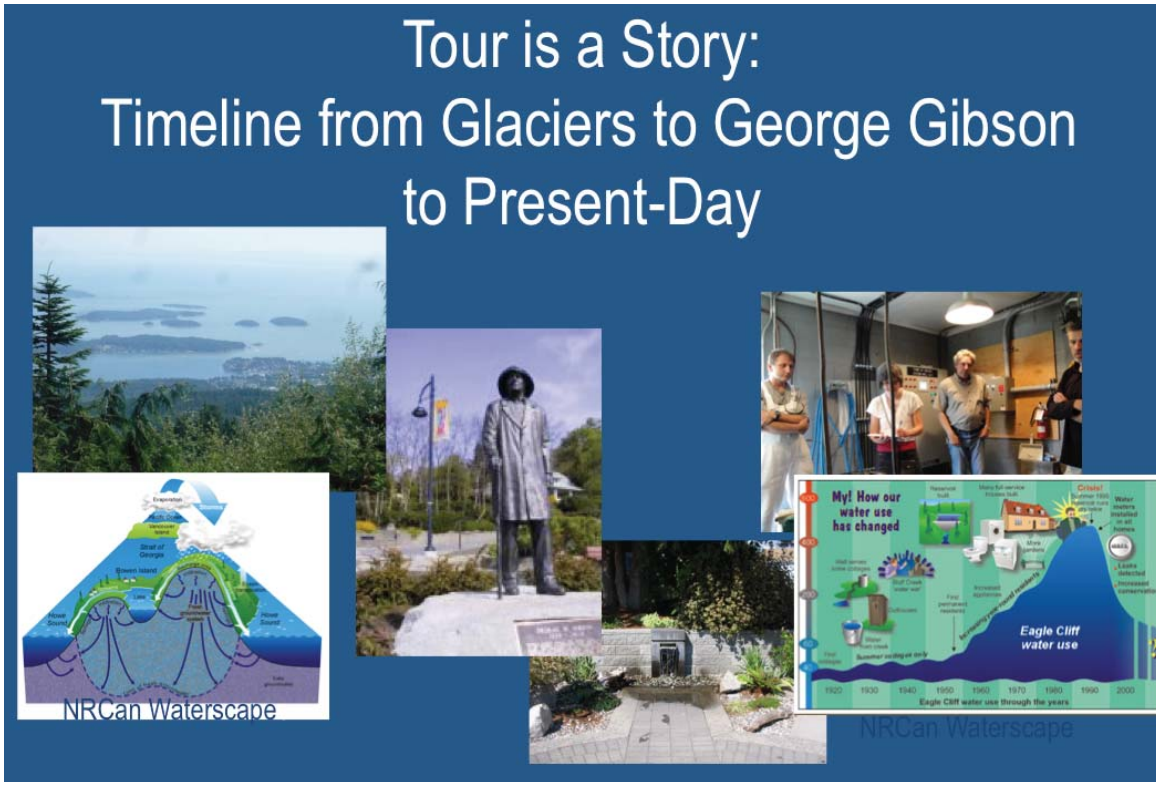
*'Responding to the proposal, Coun. Charlene SanJenko praised the way it combines water awareness with recreation. "I see it partnering with the museum, the art gallery and the library," SanJenko said. "That's what we're trying to do — give people something to walk around the community for."

Coun. Gerry Tretick suggested the Town could attract water conferences in the future. "I can see this developing into a plan where people would want to come and talk about water," Tretick said' (Coast Reporter Feb 17 2013).

3.2 Content = Storyline = Message

The content presented for the Tour, although based on facts, must reveal what an object, place, feature or event means and why it matters – why it is relevant. A key consideration in the development of the content for the Tour is the breadth of the audience's interest, from local residents of Gibsons to those across the Sunshine Coast to tourists and other visitors.

By using a storyline approach, subtle messaging about actions to sustain and protect groundwater can be incorporated. The storyline will present the fascinating history of the Gibsons aquifer from its formation before the reign of the last Glaciers, through the growth of our great forests and oceans, leading to the various settlements up to current time.



Tour is a Story:
Timeline from Glaciers to George Gibson
to Present-Day

The storyline needs to foster the connection between the community/visitors with the groundwater and infrastructure beneath them to encourage an increased sense of appreciation, respect, and stewardship for the Gibsons Aquifer. The connection will be subtle and not forced; rather the stories and messages are expected to augment day-to-day activity (or recreation) with awareness.

3.3 Interpretative Tour

The key difference between information and interpretation is "relevance." By taking the facts and asking questions such as "Why should I care?" "How can I interact with this information?" and "How can I connect with this information?" the information is transformed into interpretation. By turning information into a theme or experience, it provokes the viewer's curiosity, captures their interests and encourages more active involvement with the location, landscape, and environment. Ideally interpretative message makes them feel as if they are part of the story and allows them to understand the significance of the site or topic (Adapted from US National Park Service Chesapeake Bay Office 2011).

The excellent reference 'How-to-Guide for Outdoor Interpretative Signage' (Nova Scotia Department of Tourism 2008) clearly outlines the process for interpretative messaging including the actual design of signs. They strongly recommend using a professional interpretative designer and even provide guidance on an RFP and budget costs.

The addition of a QR code on the interpretative signage links something virtual to the real world. In this example, an interesting geological feature already with some interpretative signage is augmented through the QR code and their smartphone. However, for QR code technology to work, the audience must be directed to media that is engaging, interesting and requires little effort. The 'How To Guide' prepared by Association of Nova Scotia Museums for the Canadian Heritage Information Network's Professional Exchange has very useful and basic information about the use of QR codes with exhibits (or signs) (Association of Nova Scotia Museums: Viewed August 2012).

There is numerous guidance available online for help in optimizing website design for use with smart phones (e.g. http://webdesign.about.com/od/mobile/a/write-a-mobile-friendly-website.htm). Considerations include resolution and size of graphics, limitations on content and clear navigation for the smaller phone screen.

An example of affordable interpretative tour using QR code is the J.N. "Ding" Darling National Wildlife Refuge in Florida iNature Trail, a ten sign tour using two QR codes (one for kids and one for adults) linking to one to three min videos http://www.fws.gov/Refuges/refugeupdate/SeptemberOctober_2011/digitalsigns.html.

Our Sunshine Coast Museum uses a similar approach for a smart phone heritage walking tour but with specific apps that can be downloaded to access the information rather than through QR codes. Developed locally, sixteen videos about the heritage of the Sunshine Coast are available for viewing on smart phones as well as from computers http://www.coastreporter.net/article/20121012/SECHELT0501/310129997/-1/sechelt/time-travellers-visit-heritage-sites. The museum was able to use BC Time Travel site, run by a provincial museum association, to host the videos http://www.coastreporter.net/article/20121012/SECHELT0501/310129997/-1/sechelt/time-travellers-visit-heritage-sites.

A URL shortening service, like http://goo.gl keeps track of who is checking out the content through the QR code itself as opposed to people who are finding content by searching YouTube or clicking on browser links (Association of Nova Scotia Museums: Viewed August 2012).

3.4 Team Expertise

The team's main skill sets needs to include:

1) Subject Matter: Knowledge of the general facts about groundwater and water infrastructure generally and details specific to the Town;

2) Interpretive and visual engagement: Knowledge of how to integrate the relevant stories into a cohesive and engaging message; and

3) Communication (web and smartphone): Knowledge of the techniques to link signage and the Internet, e.g. QR codes.

3.5 Build on Aquifer Mapping Activities

Several key activities undertaken or initiated in Phase 2 serve as excellent initial content for the Tour.

1) *Where? How much? How to protect?* - The updated map and cross-sections of the aquifer and protective layers are available;

2) *Promote the name 'Gibsons' Aquifer* - Always use the locale and main user's name rather than the geological name;

3) *'Gibsons Aquifer' is in the BC Aquifer Database* – Started provincial process to have aquifer classed, ranked and stored in the BC Ministry of Environment database;

4) *Publication in 'Groundwater Canada'* – This online magazine published (Fall of 2012) a very positive story called 'Proactive protection, Taking active steps to sustain a pristine aquifer' (*http://www.groundwatercanada.com/content/view/1872/59/*).

5) *Town of Gibsons is a Pilot Study in a National and Provincial Initiative on Groundwater Sustainability Assessment* – The Town was one of five national pilots involved in this study where information from the Aquifer Mapping project (mapping and outreach) has been developed into groundwater sustainability indicators.

Further details on the information from these activities are provided in Appendix A. Given the technical nature of most of this material, it will need to be developed into 'Stories that Sell' for use in the Tour.

3.6 Benefits of Walking on Water Interpretative Tour

The benefits of the interpretative tour for raising awareness about the Gibsons Aquifer and the Town's water infrastructure initiatives include:

- Messaging: Facts are not enough: need meaning and why it matters to me!
- Delivery: Permanent, based on day-to-day activity and/or outdoor recreation.
- Updateable: Can change storyline, add new 'facts', new website/blog links.
- Participation: Message is reinforced!
- Recruiting groundwater outreach champions: It will be easier to find champions if they are already familiar with the issues.

3.7 Linkage with other Town Initiatives

The following linkages with other Town initiatives have been identified:

- Development of the Water Strategy;
- Key component of Integrated Asset Management Planning;
- Foreshore Protectio:n Strategy (Climate Change);
- Update website info and overall Communication Strategy;
- Charman Creek enhancement;
- Harbour Area Seawalk improvements; and
- Pedestrian trail network improvements.

4 FIVE-YEAR ACTION PLAN

A five-year action plan with high level details about proposed activities is provided here.

Year	Activity
Year 1	• Run pilot for BC Drinking Water Week May 20 – 26 (BC Drinking Water Week) • Evaluate the QR code functionality and community's feedback on the pilot • Look for partners/collaborators • Hire a professional interpretative designer • Develop content for Landing Tour • Develop evaluation program • Develop and install signage for Phase 1 (Landing Tour) • Implement Tour • Evaluate Landing Tour at end of December 2013
Year 2	▪ Design Phase 2 (Mt. Elphinstone Signage) based on evaluation results of Phase 1 ▪ Look for partners ▪ Implement Elphinstone Tour based on available 2014 budget
Year 3	• Update content in Landing Tour • Look for partners • Evaluate Landing and Mt. Elphinstone Tours in December 2015
Year 4	▪ Update content in both Tours ▪ Look for partners
Year 5	▪ Evaluate effectiveness of both Tours and revise accordingly

For the first year, a key action is to partner or collaborate with an organization (or individual) that has experience in developing exhibits and/or interpretation signage. We strongly recommend that the Town determine if there are opportunities to collaborate with the Sunshine Coast Museum on their smart phone heritage tours. As well, the recent signage installed in the Gibsons Landing, may present other opportunities for collaboration.

5 CLOSURE

Gordon Groundwater Consultancy is pleased to have worked on this component as part of the Aquifer Mapping Project. The Town's implementation of the Tour as the Key Communication and Engagement Activity will enhance the Sustainability and Protection of their valuable Gibsons Aquifer and tourism and business initiatives.

Respectively Submitted,

Sue Gordon

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APPENDIX A: FURTHER DETAILS: BUILD ON AQUIFER MAPPING ACTIVITIES

1) Where? How much? How to protect?

The maps, cross-sections, and other graphics from the Aquifer Mapping report focus on addressing these questions. In order to get the maximum value out of the project, these results should be interpreted into meaningful messages to the community.

2) Promote the name 'Gibsons' Aquifer

By promoting that the Town of Gibsons groundwater supply comes from an aquifer named for its locale, i.e. the Gibsons Aquifer, the sense of responsibility by the community should be increased.

Several options exist for the Town, themselves, to promote the 'Gibsons' aquifer name:

- Used in promotion of Town's water initiatives
- Linked with other branding/communication initiatives by the Town
- Promoted at community events

3) 'Gibsons Aquifer' is in the BC Aquifer Database

Another important opportunity to promote the results of the Phase 2 Aquifer Mapping is the official classification of the Gibsons Aquifer at a provincial level (provided by Kevin Ronneseth, BC Ministry of the Environment (BCMOE)). This activity was initiated during the Phase 2 Aquifer Mapping and will be finalized as part of the 2013 Outreach activities. The key aspects include:

- Aquifer classification and ranking (vulnerability and productivity) ranking evaluation; the aquifer class and the ranking value helps prioritize aquifers for groundwater protection and management at a Provincial level (Berardinucci and Ronneseth 2002);
- Gibsons Aquifer is added to the provincial inventory available as a database; a decision-making tool for potential developers of land designated as part of the Gibsons Aquifer http://www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/aquifers/.

It is important to note that the system is not intended to replace more detailed aquifer assessments (such as the aquifer mapping project) required to manage the resource. However, it does provide a useful communication tool to engage the community about the Town of Gibsons water resource and land use decisions.

4) Publication in Groundwater Canada

An outreach opportunity presented itself to the Town in the summer 2012. The Town's proactive efforts were showcased in Groundwater Canada, in an online journal article (Wallace Fall 2012) based on interviews with Dave Newman (Town of Gibsons), Darren David (Waterline Resources) and Sue Gordon (Gordon Groundwater).

Important outreach items were highlighted including:

'Planning for the program was a lengthy process. The first grant application took place in 2007, says Newman. In 2009, the town received a $400,000 provincial "Towns for Tomorrow" grant. The municipality then committed $100,000 and the project began that year.'

'The data related to the conceptual model is now being used to construct a numerical [computer] model to complete predictive estimates or simulations of aquifer performance under various future scenarios," David explains. Simulations being investigated include effects from climate change with corresponding sea-level rise, and increased future groundwater extraction to meet the water supply demand of the town.'

'One of the important issues is that even with the hydrogeological study and master's thesis providing all this great data, ultimately it's really the community values and behaviours that can have the most direct effect on sustainable groundwater management efforts, Gordon says. Based on the data collected by Waterline Resources and Gordon Groundwater, groundwater sustainability indicators are to be developed that will be comparable across these pilots, Gordon says. The town will have these indicators to show the community, politicians, businesses and visitors, how well they're doing, and to impress upon them the importance of continued efforts to sustain and protect their great groundwater supply.'

The article can be found at http://www.groundwatercanada.com/content/view/1872/59/.

5) *Town of Gibsons is a Pilot Study in a National and Provincial Initiative on Groundwater Sustainability Assessment*

The Town was selected to be one of five nation-wide pilots that evaluated the Council of Canadian Ministers of the Environment's (CCME[*]) decision-making framework to assess the sustainability of groundwater.

[*] CCME is comprised of the fourteen environment ministers from the federal, provincial and territorial governments. It is the primary minister-led intergovernmental forum for collective actions on environmental issues of national and international concern http://www.ccme.ca/about/.

The framework uses a policy-focused conceptual model, called DPSIR (**D**rivers, **P**ressures, **S**tate, **I**mpact and **R**esponse). Each element represents a key factor in policy decision-making and development:

- Drivers: human needs, typically thought of as fulfilled by economic sectors;
- Pressures: human activities to fulfill the needs that stress the environment (i.e. groundwater);
- States: changes in the condition of the environment (i.e. groundwater);
- Impacts: effects of a change in state on ecosystem (or groundwater) services; and

- Responses: reactions to losses of ecosystem (or groundwater) services

There are five integrated groundwater sustainability goals, taken (Council of Canadian Academies 2009). The overall achievement of sustainability relies on a careful analyses and balancing of all goals.

These integrated goals are:

I. Protection of groundwater supplies from depletion: Where sustainability requires that withdrawals be maintained indefinitely without creating significant long-term declines in regional water levels.

II. Protection of groundwater quality from contamination: Where sustainability requires that groundwater quality is not compromised by significant degradation of its chemical or biological character.

III. Protection of ecosystem viability: Where sustainability requires that withdrawals do not significantly impinge on the contribution of groundwater to surface water supply and the support of ecosystem.

IV. Achievement of economic and social well being: Where sustainability requires that allocation of groundwater maximizes its' potential contribution to the social well being (interpreted to reflect both economic and non-economic values).

V. Application of good governance: Where sustainability requires that decisions as to groundwater use are made transparently through informed public participation and with the full account of the ecosystem needs, intergenerational equity, and the precautionary principle.

The CCME approach, developed by GGC (2011), is intended to provide insight for Groundwater Sustainability policy at a local, regional or Canada- wide scale. Each CCME pilot was asked to evaluate the groundwater issues in the Town using the DPSIR analyses (Table A1).

Approved at the September 20th, 2011 Infrastructure Committee, the CCME pilot got underway the following year. The benefits of the Town's participation as a CCME pilot include:

- A common interest to bridge the information gap between science studies and the communication needs of decision-makers and choice-makers;
- Access to a nationally and provincially endorsed policy decision-making tool for future groundwater sustainability issues about the Gibsons Aquifer;
- Development of indicators to communicate information, particularly trends, in groundwater quantity and quality and about the Town's water infrastructure initiatives; and
- Opportunity to showcase the progressive efforts in groundwater sustainability within the community to raise awareness and on a national scale through the CCME network.

Ten groundwater sustainability indicators were developed in consultation with Dave Newman and with help from Waterline Resources for the Groundwater Quantity and Quality ones (Table A2).

It is recommended that these indicators be considered for use in the Tour. Also, that they be updated as more data is obtained from the proposed future activities.

A summary report of the pilots is expected from CCME later this year.

Table A1 – Evaluation of the Town of Gibsons Groundwater Sustainability Issues Using CCME Approach

		DPSIR Analysis				
Sustainability Goals (Relation to Pilot Project)	**Issue(s)**	Driver	Pressure	State	Impact	Response
Groundwater Quantity (Ample supply to be sustained)	Town requires greater certainty in recharge (location, processes and rates) and availability in order to plan for future development and infrastructure. Conservation awareness is also rising as an issue because Town is now metered.	✓		✓	✓	✓
Groundwater Quality (Internationally recognized high quality groundwater to be protected)	Town wants to continue with an untreated groundwater supply. It has completed numerous infrastructure upgrades to support the continuance of this design. Ongoing updates to land use and various subsurface disturbances bylaws and zoning controls provide additional protection.		✓		✓	✓
Ecosystems (Initiated but not the current focus)	NA			✓		
Socioeconomic (Town's development and identity tied to availability of good quality groundwater)	A key issue in this community is to balance growth (development) with sustainability of the groundwater supply. In the past few years, potential effects on the aquifer are now considered with larger proposed developments.		✓			✓
Good Governance (Recognition and action of/on the importance of process)	Greater importance as the community grows, and has changing demographics, from a resource-based culture to a more urban and older populace or a more politically active one. The Town is taking new initiatives to engage the community about their role in sustaining the aquifer.					✓

Table A2 - CCME Groundwater Sustainability Indicators for the Town of Gibsons

Goal, (Indicator), **Value**	Criteria
Quantity: (Renewable groundwater resources per capita) **4585 (m^3/day)**	None have been set yet. Require monitoring to establish the natural variation. Require management and conservation targets
Quantity [Total groundwater abstraction/ recharge] x 100) **50%**	None have been set yet. Require monitoring to establish the natural variation in both parameters. Require management/conservation targets to be set.
Quantity (Σ Areas with groundwater depletion problem/ Total studied area) x 100) **0%**	Value remains the same.
Quality ([Σ Areas with groundwater quality problem/ Total studied area] x 100) **0%**	Value remains the same.
Quality *(*Number of contaminated sites) **Unknown at this time**	Number of sites are reduced.
Quality [Σ Areas with a specific class of gw vulnerability/ Total studied area] x 100) **Unknown at this time**	Determine vulnerability.
Quantity/Quality (Resources for Water Infrastructure Upgrades) **Aquifer in Integrated Asset Management Plan**	Presence of such a plan. Reduce water losses by a certain % (still to be set). Drinking water quality guidelines are not exceeded
Socioeconomic (All water users connected to Town's infrastructure) **98 %**	100 %
Ecosystems (Groundwater contribution to base flow) **Not determined at this time**	NA
Socioeconomic *(*Efficiency of groundwater usage and Quantity) **Development and Implementation of a Water Conservation Plan**	Different types of users reduce water consumption by a set amount. Management/conservation targets to be set within two years (Town's Water Conservation Plan)
Governance (Public outreach on groundwater sustainability) **Development and Implementation of a Groundwater Outreach Program**	Program exists with specific behaviour change goals and evaluation methods to gauge effectiveness.