7.0 HYDROGEOLOGY OF BAY D'ESPOIR ADA

7.1 General Description of Area

7.1.1 Location & Extent

The Bay d'Espoir ADA is located at the north end of Bay d'Espoir in south central Newfoundland, and includes a main zone, and an immediately adjacent smaller satellite zone, covering a combined area of approximately 7,597 hectares. The boundary of the Bay d'Espoir ADA is shown on Drawing No. 1034406-7-1 in Appendix 7a.

No communities are present within the ADA.

The main access to the Bay d'Espoir ADA is provided by Provincial Highway Route 360, which leads south from the Trans Canada Highway near the community of Bishop's Falls to approximately 12 km northeast of the community of Head of Bay d'Espoir, where it continues as secondary Highway Route 361 into the community. In addition, various graveled roads and ATV trails leading from Highway Routes 360 and 361 also provide access to some areas within the ADA.

7.1.2 Physiography, Topography & Drainage

The Bay d'Espoir ADA is located within the physiographic region referred to as the South Coast Highlands. This physiographic region includes areas of higher elevation along the south coast of Newfoundland, as well as a few small outliers on the isthmus of the Avalon Peninsula and the Hawke Hills that are up to 300 m in elevation. The South Coast Highlands borders the Central Plateau to the north. Locally, the Bay d'Espoir ADA is located within a sheltered, low lying valley and is surrounded by upland regions to the east, west and north. Topography in the vicinity of the ADA is characterized by gently undulating to hummocky terrain that slopes south-westward towards the coast and is bisected by several north-south trending stream and river valleys that drain directly to the waters of Bay d'Espoir. Elevations within the ADA range from sea level in the southern portion of the ADA where it bounds the waters of Bay d'Espoir to 150 m above sea level in the northern portion of the ADA. Higher relief is present in upland regions north of the ADA, with maximum elevations of up to 300 m above sea level present in the Burnt Hills area, located approximately 30 km north of the ADA.

The Bay d'Espoir ADA encompasses the lower courses of several stream and river systems, the most significant of which is Conne River. The lower course of Southeast Brook is also present along the western boundary of the ADA. The headwaters of these stream and river systems originate in the upland regions north of the ADA. Numerous small, elongate ponds are also common in the area. The Jeddore Lake watershed, which supports two hydroelectric generating developments, is located east of the ADA, and does not contribute flow to the drainage catchment area of the ADA.

The boundaries of two Public Protected Water Supply Areas (PPWSA) overlap the southern portion of the ADA, including the Jersey Pond PPWSA, which serves the municipality of Milltown-Head of Bay d'Espoir, and the Morrisville Pond PPWSA, which serves the community of Morrisville, located approximately 5 km south of the ADA.

7.1.3 Climate, Vegetation & Agricultural Land Use

The Bay d'Espoir ADA is located within the Maritime Barrens ecoregion, which extends from the east to the west coast of Newfoundland along the south-central portion of the island. The Bay d'Espoir ADA is located within the South Coast Barrens subregion, and is characterized by cool summers with abundant fog and relatively mild winters. Climate data obtained from Environment Canada's Bay d'Espoir monitoring station dating back to 1971 indicates a monthly mean temperature in the area of 4.7°C, ranging from a high of 16.2°C in August to a low of -7°C in February. Average annual precipitation in the area is 1,584 mm, of which 85% falls as rainfall and 15% as snowfall. January is typically the wettest month, and May is typically the driest month (Environment Canada, 2008). In the ADA, there are an average of 1,336 growing degree days (base temperature 5^{o}C) for the year and 1,217 growing degree days for the vegetative season (i.e., May to September).

Vegetation in the Bay d'Espoir ADA consists of well developed stands of predominantly Balsam Fir broken by extensive open heath barrens. Small, bowl-like organic deposits are also numerous. Based on agricultural land use information provided by the NL Department of Natural Resources Agrifoods Division, approximately 4.89 hectares (i.e., <1% of the total landmass of the ADA) is currently utilized for agriculture, with vegetable crop land representing the most significant proportion of the ADA's agricultural land use.

7.2 Geology

7.2.1 Surficial Geology

The surficial geology of the Bay d'Espoir ADA is summarized in Drawing No. 1034406-7-2 in Appendix 7a, and is based on regional scale compilation by Liverman and Taylor (1990), as well as descriptions of surficial geology provided in Colman – Sadd (1980), Van de Hulst (1992) and Hender (1993). For the purposes of this study, surficial geological units on existing maps have been simplified into four (4) groups, including exposed bedrock, areas of bog, areas of till and areas of sand and gravel.

Till is present throughout the ADA occurring mainly as hummocky moraine deposits with local thicknesses up to 20 m, but also as thin discontinuous veneer (typically less than 1.5 m thick). The moraine and veneer till comprise a stony, loamy sand derived from the underlying volcaniclastic rocks. Within the ADA, sand and gravel deposits of glacial outwash and fluvial origin are limited and generally confined to stream and river valleys, with the most significant occurrences of these deposits present along Southeast Brook and Conne River. Along with glacial units, several areas of organic and peaty soils are present along the west side of the ADA, overlying either till or bedrock. Several ridges and knobs of bedrock outcrop are exposed within the till and various other surficial deposits that underlie the ADA, occurring as areas of high ground in the northern portion of the ADA. Bedrock outcrops may be partially or fully concealed by thin mat vegetation and sparse forest. However, where exposed bedrock outcrops are commonly streamlined and display glacial striations indicating a generally north to south direction of ice movement. Available well logs indicate an average overburden thickness in the Bay d'Espoir ADA and surrounding area of approximately 11 m.

7.2.2 Bedrock & Structural Geology

The bedrock geology of the Bay d'Espoir ADA is summarized in Drawing No. 1034406-7-3 in Appendix 7a, and is based on the regional 1:1,000,000 scale compilation mapping by Colman-Sadd, *et al.*, (1990), as well as descriptions of bedrock geology provided in Colman-Sadd (1976 & 1980).

The Bay d'Espoir ADA lies within the Dunnage tectonostratigraphic zone and is underlain by marine shale, siltstone and sandstone of the Cambrian to Middle Ordovician Baie d'Espoir Group. The Cambro-Ordovician rocks that underlie the ADA have undergone regional deformation attributed to Devonian Acadian orogenesis, which caused large-scale open to tight recumbent asymmetric folds, with an associated axial planar fabric that is generally subparallel to bedding. No significant faults have been identified in the vicinity of the ADA.

7.3 Hydrogeology

7.3.1 Hydrostratigraphy

The groundwater potential of the various geological units within the Bay d'Espoir ADA was assessed utilizing available records for water wells completed within each unit obtained from the NLDEC-Water Resources Management Division Drilled Water Well Database for wells drilled between 1950 and March, 2008. The data provided in the well records are organized by community and includes information on the well depth and yield, well casing depth and diameter, depths to water bearing zone(s), plus data on the quality and use of the water and the driller's description of the depth and lithology of the overburden and bedrock units encountered.

A total of 11 drilled bedrock wells and 2 drilled surficial wells from the community of Milltown-Head of Bay d'Espoir had adequate well data to evaluate the groundwater potential of various surficial and bedrock strata in the ADA. Since lithologic information provided in the well records was of insufficient detail to define the bedrock encountered in each individual drilled well, the wells were assigned to their respective geologic units based on the community in which the wells were located and the corresponding underlying geologic unit, as shown on the bedrock geology maps provided in Drawing Nos. 1034406-7-3 in Appendix 7a.

The groundwater potential of each geological unit was quantified by assessing the reported well yields and depths from the records of wells completed within each unit. Reported yields for drilled wells in the Bay d'Espoir ADA is based on airlift testing carried out by the driller at the time of well installation to obtain a rough estimate of well capacity, and does not necessarily represent the short or long term safe yield of the well, or the groundwater yield characteristics of the corresponding aquifer. To accurately determine such values, aquifer testing, including step drawdown and constant rate pump testing must be conducted, ideally with monitoring of groundwater levels in nearby observation wells. No aquifer testing has been carried out on any of the drilled wells in the ADA and surrounding area. Therefore, in the absence of this data, the groundwater potential of the various geological strata in the Bay d'Espoir ADA is defined based on the estimated well yields obtained from the driller's records.

7.3.1.1 Surficial Hydrostratigraphic Units

The surficial deposits within the Bay d'Espoir ADA have been subdivided into two broad hydrostratigraphic units, including one comprised of till deposits, and the other predominantly of sands

and gravels. The yield and depth characteristics of these units are summarized on Table 7.1. No water well information is available for the till deposits present in the ADA. Therefore groundwater potential for this unit was inferred based on well records for similar overburden material in the St. John's ADA.

Till Deposits

Till deposits are present throughout the ADA occurring as hummocky moraine and thin discontinuous veneer, and comprising stony, loamy sand. There is no documented data on the groundwater potential of the till deposits in the Bay D'Espoir ADA. However, based on records of water wells within similar till material in the St. John's ADA, the range of yields from wells within this unit can be expected to vary from 10 to 70 L/min at depths of 9.5 to 35 m. The average yield is estimated to be approximately 40 L/min at 21 m depth. However, median yield and depth estimates for the till material of 34 L/min at 20 m depth are more likely representative of the typical groundwater potential of this unit.

Sand and Gravel Deposits

Sand and gravel deposits of glacial outwash and fluvial origin occur sparingly within the ADA, and are limited to narrow tracts along Southeast Brook and Conne River. These deposits are potentially significant groundwater aquifers. Only two (2) wells from the community of Milltown-Head of Bay D'Espoir were available to characterize the groundwater potential of this unit in the ADA. Based on the two well records, the sand and gravel material is considered capable of providing wells with moderate to high yields, reporting yields of 70 L/min at 16 m depth, and 450 L/min at 24 m depth, respectively.

Table 7.1 Summary of Overburden Drilled Wells Information for Bay D'Espoir ADA

Overburden Unit	Communities	No. of Wells	Well Depth (m)		Well Yield (L/min)	
			Mean (Median)	Range	Mean (Median)	Range
Till*	St. John's ADA	6	21.3 (19.6)	9.5 - 35	39.5 (33.5)	10 - 70
Sand & Gravel	Milltown-Head of Bay d'Espoir	2	-	16, 24	-	70, 450

* Groundwater yield estimates for the till deposits based on well data from the St. John's ADA

Bedrock Hydrostratigraphic Units

Well record information is available for the volcanic and sedimentary rocks of the Bay d'Espoir Group that underlie the Bay d'Espoir ADA. The well yield and depth characteristics of this strata is summarized in Table 7.2.

Bay D'Espoir Group

A total of 11 well records from the community of Milltown-Head of Bay D'Espoir were used to characterize the groundwater potential of the Bay D'Espoir Group, which underlies all of the ADA. Based on well data, the Bay D'Espoir Group strata are considered capable of providing wells with low yields, having water yields ranging from 1 to 28 L/min at well depths of 36 to 72 m, and an average yield of 12 L/min at 54 m depth. However, median yield and depth estimates for the Bay D'Espoir Group of 7 L/min at 51 m depth are more likely representative of the typical groundwater potential of this unit.

Table 7.2 Summary of Bedrock Drilled Well Information for Bay D'Espoir ADA

Rock Group	Rock Type	Communities	No. of Wells	Well Depth (m)		Well Yield (L/min)	
				Mean (Median)	Range	Mean (Median)	Range
Bay D'Espoir	Marine siliciclastic sedimentary rocks	Milltown-Head of Bay D'Espoir	11	53.6 (50.9)	36.3–72.3	11.8 (6.8)	1-28

7.3.2 Groundwater Flow System

The Bay d'Espoir ADA and surrounding area is underlain by an unconfined aquifer system contained within the overburden material and underlying shallow bedrock. The movement of groundwater through the overburden material is controlled by primary porosity, while groundwater flow within the underlying bedrock can be expected to mainly occur within secondary openings, such as fractures and joints, and will be variable depending on the frequency and interconnection of these structural features.

Shallow groundwater flow within the ADA is controlled by water table conditions and local variations in topography. Groundwater is thought to be recharging along the topographic highs and discharging in various wet lowland areas, ponds, lakes and rivers. It is expected that the shallow groundwater system in the ADA will be largely controlled by surface runoff and local recharge, while at moderate depths the flow system may be influenced by lateral inflow of groundwater from up-gradient areas to the north. Based on a review of water well records for the area, groundwater levels are generally assumed to be within 10 m of the ground surface and to be a subdued reflection of the topography.

7.4 Water Quality

7.4.1 Surface Water Quality

Surface water quality data for the Bay d'Espoir ADA is limited to water analyses carried out by the NL Department of Environment - Water Resources Management Division of two protected public surface water supplies in the area since the mid-1980s, including:

- Milltown – Head of Bay d'Espoir - Jersey Pond (WS-S-0461), 1988 - 2006; and,
- Morrisville – Morrisville Pond (WS-S-0470), 1987 - 2006.

A summary of chemical data obtained from these surface water sources over their respective monitoring periods is provided in Tables 7.3 and 7.4 in Appendix 7b, and is compared to the Canadian Drinking Water Quality Guidelines (CDWQG) (Health Canada, 2007), as well as the Canadian Council of Ministers of the Environment (CCME) Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses (CWQG-AWU) (October, 2005).

Based on major ion chemistry, surface water in the vicinity of the ADA can be classified as both calcium-sodium- bicarbonate-chloride-sulfate (Ca-Na-HCO_3-Cl-SO_4) and calcium-sodium-chloride-sulfate-bicarbonate (Ca-Na-Cl-SO_4-HCO_3) type waters. Surface water in the area is soft, neutral to slightly acidic, and of moderately low alkalinity. Classification of surface water according to dissolved-solids and specific conductance indicates fresh conditions.

With the exception of iron in the Jersey Pond protected public surface water supply and pH, turbidity and color in both protected public surface water supplies, concentrations of all other parameters tested meet CDWQG. The guidelines for iron, pH, turbidity and color are aesthetic objectives only and levels

of these parameters detected at the surface water locations do not pose any health concerns, however problems may be experienced such as foul taste, deposition or staining in the case of iron, turbidity, and color, and corrosion in the case of pH.

Concentrations of all parameters tested in both protected public surface water supplies CCME CWQG-AWU for irrigation and/or livestock water use.

Based on chemical data, surface water quality within the ADA is considered good, returning an average Canadian Water Quality Index (CWQI) value of 94. However, a negative Langelier Index in both protected public surface water supplies indicates that water is unsaturated with calcium carbonate and it will tend to be corrosive, leading to potential leaks in the distribution system. Treatment would be required to improve the aesthetic quality of the water.

7.4.2 Groundwater Quality

Groundwater quality data for the Bay d'Espoir ADA is limited to two water wells in the community of Milltown - Head of Bay d'Espoir. A summary of chemical data obtained from these water wells is provided in Table 7.4 in Appendix 7b, and is compared to the Canadian Drinking Water Quality Guidelines (CDWQG) (Health Canada, 2007), as well as the Canadian Council of Ministers of the Environment (CCME) Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses (CWQG-AWU) (October, 2005).

Based on major ion chemistry, shallow groundwater in the ADA can be classified as calcium-sodium-bicarbonate-chloride-sulfate (Ca-Na-HCO_3-Cl-SO_4) type water. Groundwater in the area is moderately hard, slightly acidic to slightly basic, and of moderate alkalinity. Classification of groundwater according to dissolved-solids and specific conductance indicates fresh conditions.

With the exception of iron, manganese, and turbidity, concentrations of all other parameters tested in met CDWQG. The guidelines for iron, manganese, and turbidity are aesthetic objectives only and levels of these parameters detected in the wells do not pose any health concerns, however problems may be experienced such as foul taste, deposition or staining.

In addition, one private water well in Milltown - Head of Bay d'Espoir had a concentration of manganese that exceeded CCME CWQG-AWU for irrigation water use.

Insufficient monitoring data is available to determine Canadian Water Quality Index (CWQI) values for groundwater in the ADA. However, available chemical data indicates that shallow groundwater in the ADA and surrounding area is generally of good quality. However, treatment would be required to improve the aesthetic quality of the water. Further, the elevated concentration of manganese that exceeded CCME CWQG-AWU in the water well in Milltown - Head of Bay d'Espoir may limit usage of this groundwater water source as a potential agricultural water supply without appropriate treatment.

7.5 Groundwater Recharge & Availability

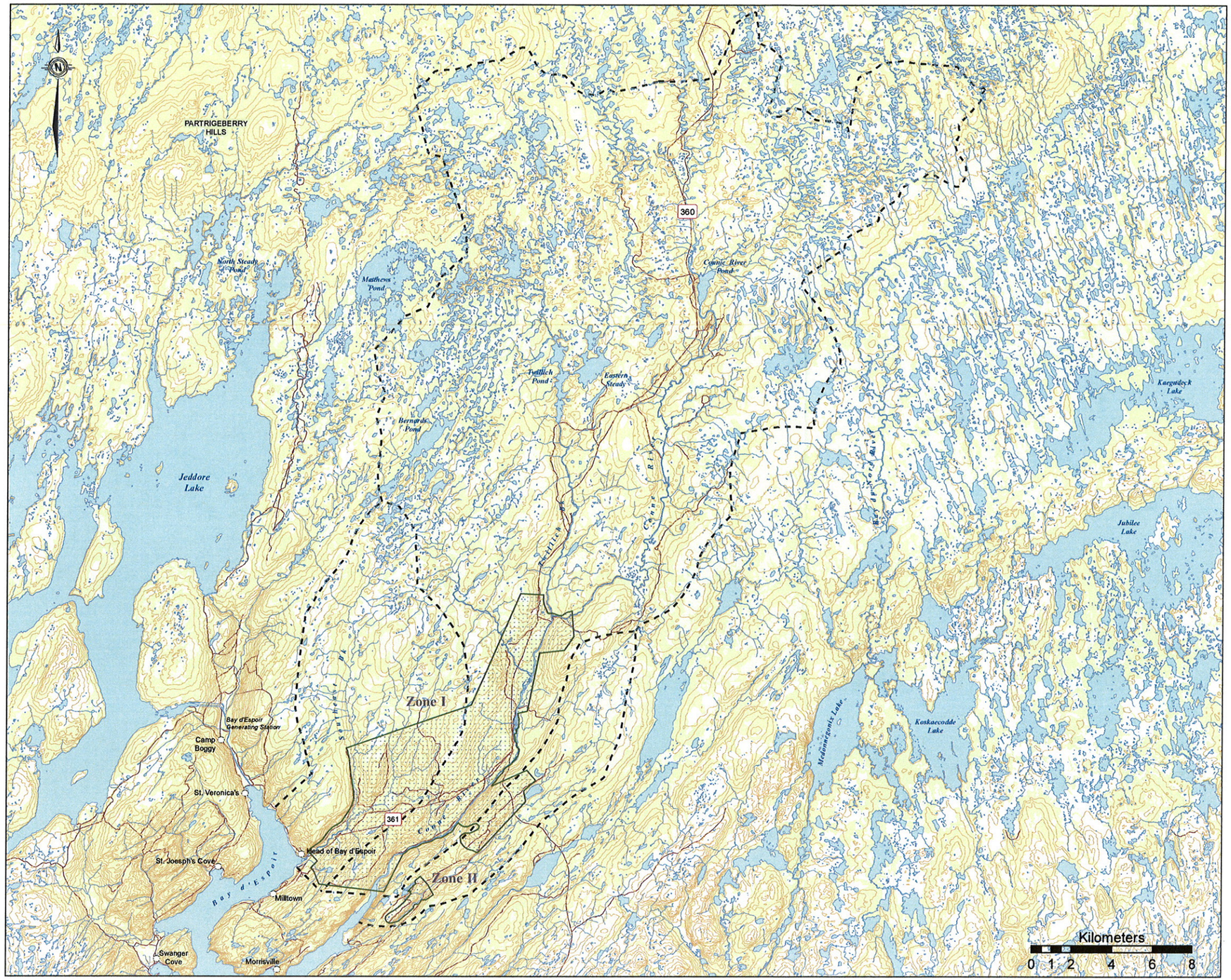
Recharge to the shallow groundwater system underlying the ADA is by direct infiltration of rainfall, after runoff and the requirements of evaporation and plant transpiration have been met, and is directly related to rainfall, infiltration characteristics and size of the recharge zone. A common practice in estimating the long term groundwater recharge for an area is to multiply the groundwater catchment area by the percent of precipitation estimated as able to infiltrate. The recharge to groundwater in the

Bay d'Espoir ADA is estimated on the basis of a local groundwater catchment area equivalent to the area of the ADA of approximately 7,597 hectares, and a conservative recharge coefficient of 10% of the mean annual rainfall (i.e., 10% of 1,584 mm, equivalent to 158 mm). Based on these values, the groundwater recharge to the Bay d'Espoir ADA is estimated at $1.2x10^7 m^3$/year or 1,584 m^3/hectares/yr.

Groundwater use in the area is currently limited to minor individual domestic, public supply and commercial wells. No information is available regarding existing agricultural (i.e., irrigation and livestock) water demands in the Bay d'Espoir ADA, thus preventing an accurate balance of groundwater supply and demand to be estimated, and making it difficult to evaluate groundwater supply potential for future agricultural development in the area. However, considering the current, overall under-utilization of groundwater in the area from other users, it is expected that an adequate supply of groundwater of sufficient quality is available to meet and/or augment water supply requirements for various existing and future agricultural needs in the ADA.

APPENDIX 7a

Drawings



- Drainage Catchment Area
- Agricultural Development Area
- Contour Line
- Transportation Route
- Waterbody
- Wetland/String Bog
- Vegetated Area

PROJECT TITLE:

HYDROGEOLOGY OF AGRICULTURAL DEVELOPMENT AREAS, NEWFOUNDLAND AND LABRADOR

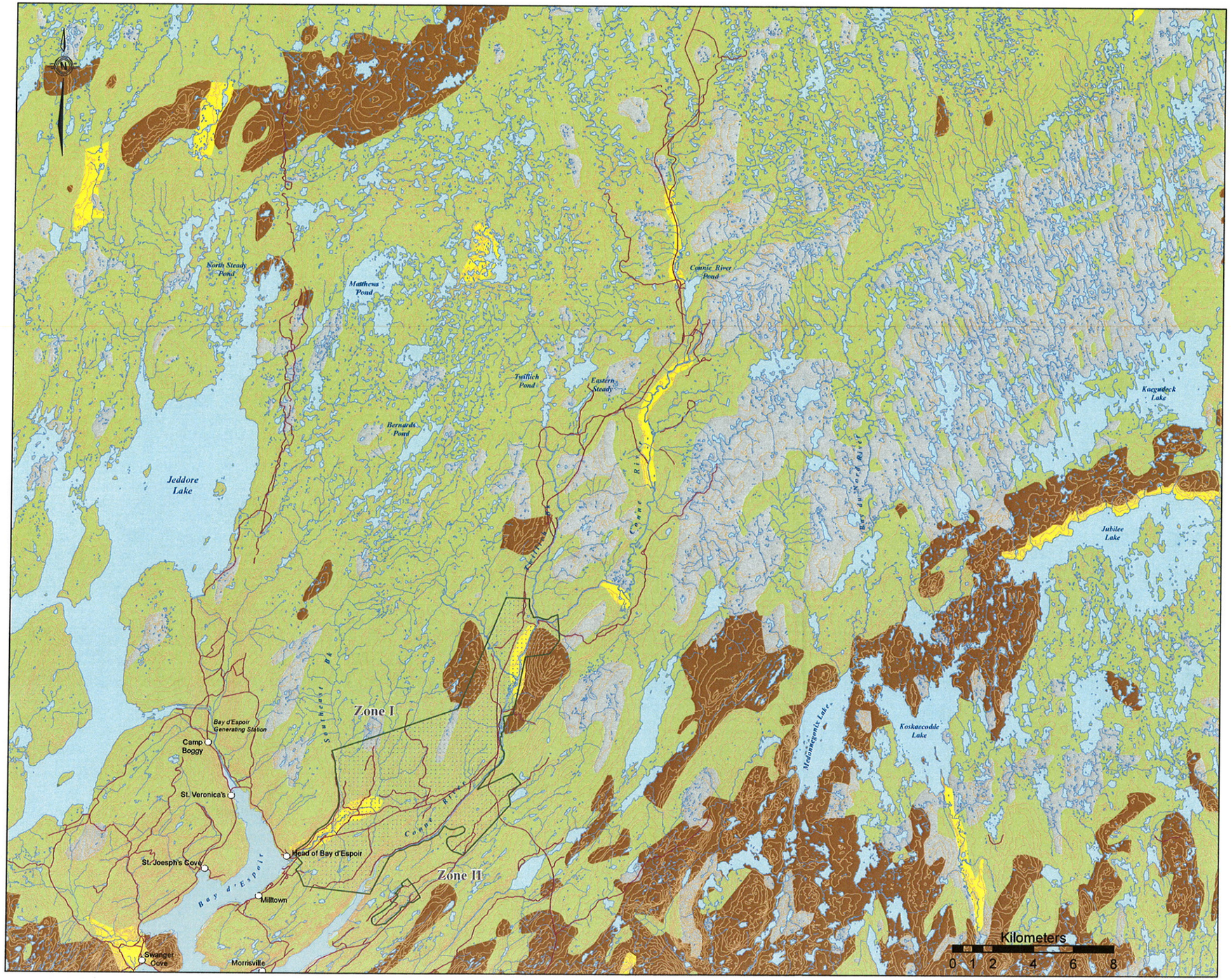
DRAWING TITLE:

BAY D'ESPOIR ADA LOCATION AND DRAINAGE

Jacques Whitford

SCALE: 1:200,000	DATE: 11/03/2008
DRAWN BY: JLB	CHECKED BY:
EDITED BY: JLB	REV. No. 0
DRAWING No.: 1034406-7-1	
MAP FILE: 1034406-XX.MXD	

DD/MM/YEAR



Surficial Geology Legend

- Bog: Poorly drained accumulations of peat, peat moss and other organic matter; developed in areas of poor drainage
- Sand & Gravel: Sands, gravels and silts of glaciofluvial, fluvial, lacustrine or marine terrace origin
- Glacial Till: Till veneer and moraine deposits of varying thickness overlying bedrock, Composed of diamicton (poorly sorted sediment containing a mixture of grain sizes from clay to boulders)
- Rock: Exposed Bedrock, includes areas concealed by vegetation, till veneer, as well as colluvium

- Transportation Route
- Stream
- Contour Line
- Waterbody
- Agricultural Development Area

PROJECT TITLE:

HYDROGEOLOGY OF AGRICULTURAL DEVELOPMENT AREAS, NEWFOUNDLAND AND LABRADOR

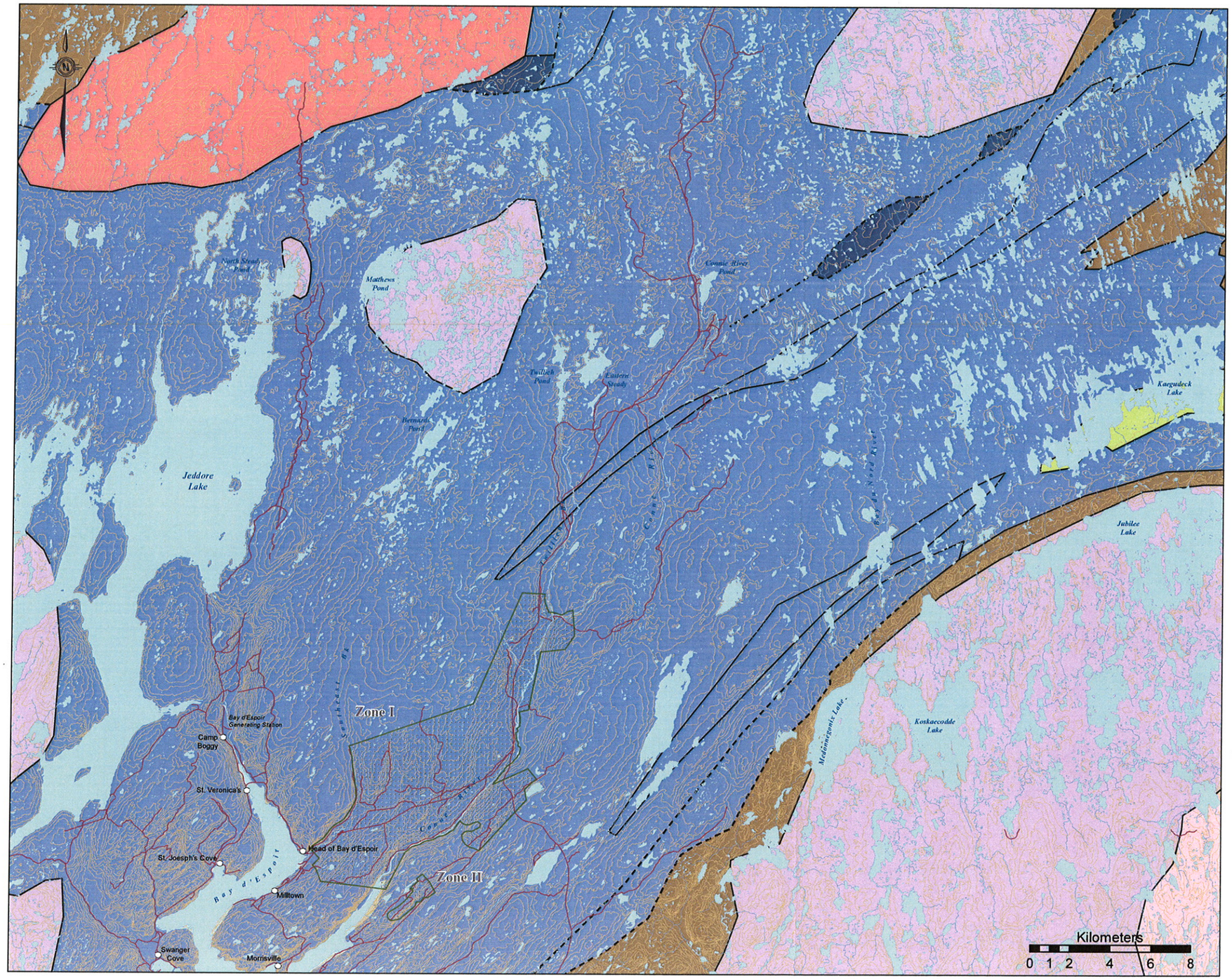
DRAWING TITLE:

BAY D'ESPOIR ADA SURFICIAL GEOLOGY

Jacques Whitford

SCALE: 1:200,000	DATE: 03/06/2008
DRAWN BY: JLB	CHECKED BY:
EDITED BY: MCH	REV. No. 0
DRAWING No.: 1034406-7-2	
MAP FILE: 1034406-XX.MXD	

DD/MM/YEAR



Generalized Bedrock Geology Legend

DUNNAGE ZONE

Stratified Rocks

Early Silurian to Early Devonian

Marine siliciclastic sedimentary rocks, including slate, shale, argillite, siltstone, sandstone, conglomerate, and minor unseparated carbonate, volcanic and intrusive rocks, and schist, gneiss and migmatite (Bay D'Espoir Group)

Intrusive Rocks

Cambrian Ordovician

Ultramafic rocks of ophiolite complexes

POST-ORDOVICIAN INTRUSIVE ROCKS

Devonian and Carboniferous

Granite and high silica granite (sensu stricto), and other granitoid intrusions that are posttectonic relative to mid-Paleozoic orogenies

Silurian to Devonian

Gabbro and diorite intrusions, including minor ultramafic phases

Posttectonic gabbro-syenite-granite-peralkaline granite suites and minor unseparated volcanic rocks (northwest of Red Indian Line); granitoid suites, varying from pretectonic to syntectonic, relative to mid-Paleozoic orogenies (southeast of Red Indian Line)

GANDER ZONE

Stratified Rocks

Cambrian(?) and Ordovician

Quartzite, psammite, semipelite and pelite, including minor black slate, conglomerate, limestone, mafic and felsic volcanic rocks, and unseparated migmatitic rocks

Intrusive Rocks

Granite Intrusions

- Syncline
- Anticline
- Contact
- Fault, Strike-Slip and High Angle
- Fault, Thrust
- Transportation Route
- Contour Line
- Stream
- Waterbody
- Agricultural Development Area

PROJECT TITLE:

HYDROGEOLOGY OF AGRICULTURAL DEVELOPMENT AREAS, NEWFOUNDLAND AND LABRADOR

DRAWING TITLE:

BAY D'ESPOIR ADA BEDROCK GEOLOGY

Jacques Whitford

SCALE: 1:200,000	DATE: 11/03/2008
DRAWN BY: JLB	CHECKED BY:
EDITED BY: JLB	REV. No. 0
DRAWING No.: 1034406-7-3	
MAP FILE: 1034406-XX.MXD	

DD/MM/YEAR

APPENDIX 7b

Water Chemistry Data

Table 7.3 Surface Water Chemistry, Public Water Supply, Bay D'Espoir
Hydrogeology of Agricultural Development Areas, Newfoundland & Labrador

Parameter	Units	CDWQG	CWQG-AWU		Milltown - Head of Bay D'Espoir Jersey Pond (WS-S-0461) 1988 - 2006[1]			Morrisville Morrisville Pond (WS-S-0470) 1987 - 2006[1]		
			Irrigation Water	Livestock Water	Min	Max	Mean	Min	Max	Mean
Alkalinity	mg/L $CaC0_3$	na	na	na	8.8	16	12.4	8.7	20	11.3
Aluminum	mg/L	na	5	5	0.04	0.58	0.15	0.01	0.09	0.04
Ammonia	mg/L	na	na	na	0	0.06	0.02	0.005	0.13	0.04
Antimony	mg/L	0.006	na	na	0	0.0005	0.0003	0	0.0005	0.0002
Arsenic	mg/L	0.01	0.1	0.025	0	0.005	0.001	0	0.003	0.001
Barium	mg/L	1	na	na	0	0.03	0.006	0	0.005	0.002
Beryllium	mg/L	na	0.1	0.1	-	-	-	-	-	-
Bicarbonate	mg/L $CaC0_3$	na	na	na	0	0.03	0.02			
Boron	mg/L	5	0.5 - 6	5	0	0.03	0.02	0	0.03	0.01
Bromide	mg/L	na	na	na	0	0.001	0.0002	0	0.03	0.02
Cadmium	mg/L	0.005	0.005	0.08	-	-	-	0	0.001	0.0003
Calcium	mg/L	na	na	na	2	4	3	2.85	9	4.24
Carbonate	mg/L $CaC0_3$	na	na	na	-	-	-	-	-	-
Chloride	mg/L	250*	100 - 700	na	3	4	4	4	10	7
Chromium	mg/L	0.05	na	na	0	0.005	0.001	0	0.005	0.001
Copper	mg/L	1*	0.2 - 1	0.5-5	0	0.009	0.004	0	0.04	0.01
Dissolved Organic Carbon	mg/L	na	na	na	5	9.6	7.3	2.7	8.1	4.8
Fluoride	mg/L	1.5	1	1 - 2	0	0.5	0.1	0	0.11	0.03
Hardness	mg/L $CaC0_3$	na	na	na	5	18	11.4	7	27	14
Iron	mg/L	0.3*	5	na	0.17	0.47	0.33	0.005	0.19	0.10
Kjeldahl Nitrogen	mg/L	na	na	na	0.23	0.36	0.28	0.1	0.32	0.18
Langelier Index	-	na	na	na	-5.43	-3.64	-4.36	-3.97	-2.56	-3.32
Lead	mg/L	0.01	0.2	0.1	0	0.001	0.001	0	0.001	0.001
Magnesium	mg/L	na	na	na	0	2	0.9	0	1.4	0.9
Manganese	mg/L	0.05*	0.2	na	0.02	0.04	0.03	0	0.022	0.009
Mercury	mg/L	0.001	na	0.003	0	0.0005	0.0001	0	0.0005	0.0002
Nickel	mg/L	na	0.2	1	0	0.005	0.003	0	0.005	0.003
Nitrate	mg/L N	45	na	na	-	-	-	-	-	-
Nitrate + Nitrite	mg/L N	na	na	100	0	0.05	0.03	0	0.126	0.028
Nitrite	mg/L	na	na	10	-	-	-	-	-	-
Orthophosphate	mg/L P	na	na	na	-	-	-	-	-	-
pH	Units	6.5-8.5*	na	na	6.3	7	6.6	6.4	7.3	6.8
Potassium	mg/L	na	na	na	0	0.5	0.3	0	0.5	0.2
Reactive Silica	mg/L SiO2	na	na	na	0	0.005	0.001	-	-	-
Selenium	mg/L	0.01	0.02 - 0.05	0.05	-	-	-	0	0.001	0.0004
Silver	mg/L	na	na	na	-	-	-	-	-	-
Sodium	mg/L	200*	na	na	0	4	2	3	5	4
Specific Conductance	uS/cm	na	na	na	29	47	40	49.9	69	56.0
Sulphate	mg/L	500*	na	1,000	2	9	5	3	5	4
Sulphide	mg/L H2S	0.05*	na	na	-	-	-	-	-	-
Thallium	mg/L	na	na	na	-	-	-	-	-	-
Tin	mg/L	na	na	na	-	-	-	-	-	-
Total Dissolved Solids	mg/L	500*	500 - 3,500	3,000	19	30	26	33	61	40
Total Organic Carbon	mg/L	na	na	na	-	-	-	-	-	-
Total Phosphorus	mg/L	na	na	na	0	0.02	0.01	0	0.14	0.02
Total Suspended Solids	mg/L	na	na	na	-	-	-	1	2	1
True Color	TCU	15*	na	na	34	105	68	5	61	33
Turbidity	NTU	0.3/1.0/0.1**	na	na	0.16	1.2	0.77	0	1	0.4
Uranium	mg/L	0.02	0.01	0.2	0	0	0	0	0	0
Vanadium	mg/L	na	0.1	0.1	-	-	-	-	-	-
Canadian Water	-	-	-	-	82	88	85.3	88	93	90.7
Zinc	mg/L	5*	1 - 5	50	0	0.005	0.003	0	0.01	0.004

Notes:

CDWQG = Health Canada Canadian Drinking Water Quality Guidelines (March, 2007)

CWQG-AWU = CCME Canadian Water Quaility Guidelines for the Protection of Agricultural Water Uses (Irrigation and Livestock Water) (October, 2005)

1 = Summary statisitics calculated using chemicial data obtained from the NL Department of Environment - Water Resources Management Division Drinking Water Quality Database. Note in the data base, prior to March 31, 2004 analytical results less than the detection limit were reported as half of the detection limit, while after March 31, 2004 analytical results less than the detection limit were reported as zero.

na = No applicable criteria

* = Aesthetic objective

** = Operational guideline value based on conventional treatment/slow sand or diatomaceous earth filtration/membrane filtration.

"-" = Not analyzed

Shaded = Value does not meet applicable criteria

Bolded = Value does not meet CWQG-AWU for irrigation and/or livestock water

Table 7.4 Groundwater Chemistry, Private Drilled Wells, Bay D'Espoir ADA
Hydrogeology of Agricultural Development Areas, Newfoundland & Labrador

Parameter	Units	CDWQG	CWQG-AWU		Community[1]	
					Milltown – Head of Bay D'Espoir	
			Irrigation Water	Livestock Water	14270	11445
Alkalinity	mg/L $CaC0_3$	na	na	na	128	44.9
Aluminum	mg/L	na	5	5	-	-
Ammonia	mg/L	na	na	na	0.02	-
Antimony	mg/L	0.006	na	na	-	-
Arsenic	mg/L	0.01	0.1	0.025	-	-
Barium	mg/L	1	na	na	-	-
Beryllium	mg/L	na	0.1	0.1	-	-
Bicarbonate	mg/L $CaC0_3$	na	na	na	-	-
Boron	mg/L	5	0.5 - 6	5	-	-
Bromide	mg/L	na	na	na	-	-
Cadmium	mg/L	0.005	0.005	0.08	0.0005	-
Calcium	mg/L	na	na	na	27	13
Carbonate	mg/L $CaC0_3$	na	na	na	-	-
Chloride	mg/L	250*	100 - 700	na	5.2	3
Chromium	mg/L	0.05	na	na	-	-
Copper	mg/L	1*	0.2 - 1	0.5-5	0.005	-
Dissolved Organic Carbon	mg/L	na	na	na	-	-
Fluoride	mg/L	1.5	1	1 - 2	-	0.05
Hardness	mg/L $CaC0_3$	na	na	na	109	43.5
Iron	mg/L	0.3*	5	na	0.01	0.98
Kjeldahl Nitrogen	mg/L	na	na	na	-	-
Langelier Index	-	na	na	na	-	-
Lead	mg/L	0.01	0.2	0.1	-	-
Magnesium	mg/L	na	na	na	10	2.7
Manganese	mg/L	0.05*	0.2	na	**0.21**	0.19
Mercury	mg/L	0.001	na	0.003	-	-
Nickel	mg/L	na	0.2	1	-	-
Nitrate	mg/L N	45	na	na	-	-
Nitrate + Nitrite	mg/L N	na	na	100	0.004	0.004
Nitrite	mg/L	na	na	10	0.001	-
Orthophosphate	mg/L P	na	na	na	0.02	-
pH	Units	6.5-8.5*	na	na	8.28	6.82
Potassium	mg/L	na	na	na	1.37	1.41
Reactive Silica	mg/L SiO2	na	na	na	-	-
Selenium	mg/L	0.01	0.02 - 0.05	0.05	-	-
Silver	mg/L	na	na	na	-	-
Sodium	mg/L	200*	na	na	5.1	3.46
Specific Conductance	uS/cm	na	na	na	262	124
Sulphate	mg/L	500*	na	1,000	12	6.8
Sulphide	mg/L H2S	0.05*	na	na	0.01	-
Thallium	mg/L	na	na	na	-	-
Tin	mg/L	na	na	na	-	-
Total Dissolved Solids	mg/L	500*	500 - 3,500	3,000	180	64
Total Organic Carbon	mg/L	na	na	na	0.7	-
Total Phosphorus	mg/L	na	na	na	0.02	0.007
Total Suspended Solids	mg/L	na	na	na	4	-
True Color	TCU	15*	na	na	-	-
Turbidity	NTU	0.3/1.0/0.1**	na	na	0.14	-
Uranium	mg/L	0.02	0.01	0.2	0.01	-
Vanadium	mg/L	na	0.1	0.1	-	-
Zinc	mg/L	5*	1 - 5	50	-	0.01

Notes:
CDWQG = Health Canada Canadian Drinking Water Quality Guidelines (March, 2007)
CWQG-AWU = CCME Canadian Water Quaility Guidelines for the Protection of Agricultural Water Uses (Irrigation and Livestock Water) (October, 2005)
1 = Chemicial data obtained
from the NL Department of
na = No applicable criteria
* = Aesthetic objective
** = Operational guideline
"-" = Not analyzed
Shaded = Value does not meet applicable criteria
Bolded = Value does not meet CWQG-AWU for irrigation and/or livestock water