

AAFC-PFRA	Prairie Farm Rehabilitation Administration Branch of Agriculture and Agri-Food Canada
AENV	Alberta Environment
AMSL	above mean sea level
BGP	Base of Groundwater Protection
DEM	Digital Elevation Model
DST	drill stem test
EUB	Alberta Energy and Utilities Board
GCDWQ	Guidelines for Canadian Drinking Water Quality
IAAM	<i>Infinite Aquifer Artesian Model.</i> The mathematical model is used to calculate water levels at a given location. The model has been used for more than 17 years by HCL for several hundred groundwater monitoring projects. The model aquifer is based on a solution of the well function equation. The simulation calculates drawdown by solving the well function equation using standard approximation methods. The drawdown at any given point at any given time uses the method of superposition.
NPWL	non-pumping water level
TDS	Total Dissolved Solids
WSW	Water Source Well or Water Supply Well

10. Conversions

Multiply	by	To Obtain
Length/Area		
feet	0.304 785	metres
metres	3.281 000	feet
hectares	2.471 054	acres
centimetre	0.032 808	feet
centimetre	0.393 701	inches
acres	0.404 686	hectares
inchs	25.400 000	millimetres
miles	1.609 344	kilometres
kilometer	0.621 370	miles (statute)
square feet (ft ²)	0.092 903	metres (m ²)
metres (m ²)	10.763 910	square feet (ft ²)
metres (m ²)	0.000 001	kilometres (km ²)
Concentration		
grains/gallon (UK)	14.270 050	ppm
ppm	0.998 859	mg/L
mg/L	1.001 142	ppm
Volume (capacity)		
acre feet	1233.481 838	cubic metres
cubic feet	0.028 317	cubic metres
cubic metres	35.314 667	cubic feet
cubic metres	219.969 248	gallons (UK)
cubic metres	264.172 050	gallons (US liquid)
cubic metres	1000.000 000	litres
gallons (UK)	0.004 546	cubic metres
imperial gallons	4.546 000	litres
Rate		
litres per minute	0.219 974	ipgm
litres per minute	1.440 000	cubic metres/day (m ³ /day)
igpm	6.546 300	cubic metres/day (m ³ /day)
cubic metres/day (m ³ /day)	0.152 759	igpm
Pressure		
psi	6.894 757	kpa
kpa	0.145 038	psi
Miscellaneous		
Celsius	$F^{\circ} = 9/5 (C^{\circ} + 32)$	Fahrenheit
Fahrenheit	$C^{\circ} = (F^{\circ} - 32) * 5/9$	Celsius
degrees	0.017 453	radians

CARDSTON COUNTY

Appendix B

Maps and Figures on CD-ROM

1) General

- Index Map/Surface Topography
- River Sub-basins
- Surface Casing Types used in Drilled Water Wells
- Location of Water Wells and Springs
- Location of Dry Water Test Holes
- Depth of Existing Water Wells
- Depth to Base of Groundwater Protection
- Hydrogeological Map
- Generalized Cross-Section (for terminology only)
- Geologic Column
- Cross-Section A - A'
- Cross-Section B - B'
- Cross-Section C - C'
- Cross-Section D - D'
- Cross-Section E - E'
- Bedrock Topography
- Bedrock Geology
- E-Log Showing Base of Foremost Formation
- Relative Permeability
- Authorized Non-Exempt Groundwater Water Wells
- Estimated Water Well Use per Section
- Water Wells Recommended for Field Verification

2) Surficial Aquifers

a) Surficial Deposits

- Thickness of Surficial Deposits
- Non-Pumping Water-Level Surface in Surficial Deposits Based on Water Wells Less than 20 Metres Deep
- Total Dissolved Solids in Groundwater from Surficial Deposits
- Sulfate in Groundwater from Surficial Deposits
- Nitrate + Nitrite (as N) in Groundwater from Surficial Deposits
- Chloride in Groundwater from Surficial Deposits
- Total Hardness in Groundwater from Surficial Deposits
- Piper Diagram - Surficial Deposits
- Thickness of Sand and Gravel Deposits
- Amount of Sand and Gravel in Surficial Deposits
- Thickness of Sand and Gravel Aquifer(s)
- Water Wells Completed in Upper and Lower Surficial Deposits
- Apparent Yield for Water Wells Completed in Sand and Gravel Aquifer(s)
- Changes in Water Levels in Surficial Deposits

b) Upper Sand and Gravel

- Thickness of Upper Surficial Deposits
- Thickness of Upper Sand and Gravel (not all drill holes fully penetrate surficial deposits)
- Apparent Yield for Water Wells Completed through Upper Sand and Gravel Aquifer

c) Lower Sand and Gravel

- Structure-Contour Map - Top of Lower Surficial Deposits
- Depth to Top of Lower Surficial Deposits
- Thickness of Lower Surficial Deposits
- Thickness of Lower Sand and Gravel (not all drill holes fully penetrate surficial deposits)
- Apparent Yield for Water Wells Completed through Lower Sand and Gravel Aquifer
- Non-Pumping Water-Level Surface in Lower Sand and Gravel Aquifer

3) Bedrock Aquifers

a) General

Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s)
Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s)
Sulfate in Groundwater from Upper Bedrock Aquifer(s)
Chloride in Groundwater from Upper Bedrock Aquifer(s)
Fluoride in Groundwater from Upper Bedrock Aquifer(s)
Total Hardness of Groundwater from Upper Bedrock Aquifer(s)
Piper Diagram - Bedrock Aquifer(s)
Recharge/Discharge Areas between Surficial Deposits and Upper Bedrock Aquifer(s)
Non-Pumping Water-Level Surface in Upper Bedrock Aquifer(s)
Areas of Potential Groundwater Depletion - Upper Bedrock Aquifer(s)

b) Disturbed Belt Formation

Non-Pumping Water-Level Surface - Disturbed Belt Aquifer
Apparent Yield for Water Wells Completed through Disturbed Belt Aquifer
Total Dissolved Solids in Groundwater from Disturbed Belt Aquifer
Sulfate in Groundwater from Disturbed Belt Aquifer
Chloride in Groundwater from Disturbed Belt Aquifer
Fluoride in Groundwater from Disturbed Aquifer
Piper Diagram - Disturbed Belt Aquifer

c) Upper Lacombe Member

Depth to Top of Upper Lacombe Member
Structure-Contour Map - Upper Lacombe Member
Non-Pumping Water-Level Surface - Upper Lacombe Aquifer
Apparent Yield for Water Wells Completed through Upper Lacombe Aquifer
Total Dissolved Solids in Groundwater from Upper Lacombe Aquifer
Sulfate in Groundwater from Upper Lacombe Aquifer
Chloride in Groundwater from Upper Lacombe Aquifer
Fluoride in Groundwater from Upper Lacombe Aquifer
Piper Diagram - Upper Lacombe Aquifer

d) Lower Lacombe Member

Depth to Top of Lower Lacombe Member
Structure-Contour Map - Lower Lacombe Member

e) Haynes Member

Depth to Top of Haynes Member
Structure-Contour Map - Haynes Member
Piper Diagram - Haynes Aquifer

c) Upper Scollard Formation

Depth to Top of Upper Scollard Formation
Structure-Contour Map - Upper Scollard Formation
Non-Pumping Water-Level Surface - Upper Scollard Aquifer
Apparent Yield for Water Wells Completed through Upper Scollard Aquifer
Total Dissolved Solids in Groundwater from Upper Scollard Aquifer
Sulfate in Groundwater from Upper Scollard Aquifer
Chloride in Groundwater from Upper Scollard Aquifer
Fluoride in Groundwater from Upper Scollard Aquifer
Piper Diagram - Upper Scollard Aquifer

d) Lower Scollard Formation

Depth to Top of Lower Scollard Formation
Structure-Contour Map - Lower Scollard Formation
Non-Pumping Water-Level Surface - Lower Scollard Aquifer
Apparent Yield for Water Wells Completed through Lower Scollard Aquifer
Total Dissolved Solids in Groundwater from Lower Scollard Aquifer
Sulfate in Groundwater from Lower Scollard Aquifer
Chloride in Groundwater from Lower Scollard Aquifer
Fluoride in Groundwater from Lower Scollard Aquifer
Piper Diagram - Lower Scollard Aquifer

e) Upper Horseshoe Canyon Formation

Depth to Top of Upper Horseshoe Canyon Formation
Structure-Contour Map - Upper Horseshoe Canyon Formation
Non-Pumping Water-Level Surface - Upper Horseshoe Canyon Aquifer
Apparent Yield for Water Wells Completed through Upper Horseshoe Canyon Aquifer
Total Dissolved Solids in Groundwater from Upper Horseshoe Canyon Aquifer
Sulfate in Groundwater from Upper Horseshoe Canyon Aquifer
Chloride in Groundwater from Upper Horseshoe Canyon Aquifer
Fluoride in Groundwater from Upper Horseshoe Canyon Aquifer
Piper Diagram - Upper Horseshoe Canyon Aquifer

f) Middle Horseshoe Canyon Formation

Depth to Top of Middle Horseshoe Canyon Formation
Structure-Contour Map - Middle Horseshoe Canyon Formation
Non-Pumping Water-Level Surface - Middle Horseshoe Canyon Aquifer
Apparent Yield for Water Wells Completed through Middle Horseshoe Canyon Aquifer
Total Dissolved Solids in Groundwater from Middle Horseshoe Canyon Aquifer
Sulfate in Groundwater from Middle Horseshoe Canyon Aquifer
Chloride in Groundwater from Middle Horseshoe Canyon Aquifer
Fluoride in Groundwater from Middle Horseshoe Canyon Aquifer
Piper Diagram - Middle Horseshoe Canyon Aquifer

g) Lower Horseshoe Canyon Formation

Depth to Top of Lower Horseshoe Canyon Formation
Structure-Contour Map - Lower Horseshoe Canyon Formation
Non-Pumping Water-Level Surface - Lower Horseshoe Canyon Aquifer
Apparent Yield for Water Wells Completed through Lower Horseshoe Canyon Aquifer
Total Dissolved Solids in Groundwater from Lower Horseshoe Canyon Aquifer
Sulfate in Groundwater from Lower Horseshoe Canyon Aquifer
Chloride in Groundwater from Lower Horseshoe Canyon Aquifer
Fluoride in Groundwater from Lower Horseshoe Canyon Aquifer
Piper Diagram - Lower Horseshoe Canyon Aquifer

h) Bearpaw Formation

Depth to Top of Bearpaw Formation
Structure-Contour Map - Bearpaw Formation
Non-Pumping Water-Level Surface - Bearpaw Aquifer
Apparent Yield for Water Wells Completed through Bearpaw Aquifer
Total Dissolved Solids in Groundwater from Bearpaw Aquifer
Sulfate in Groundwater from Bearpaw Aquifer
Chloride in Groundwater from Bearpaw Aquifer
Fluoride in Groundwater from Bearpaw Aquifer
Piper Diagram - Bearpaw Aquifer

i) Oldman Formation

Depth to Top of Oldman Formation
Structure-Contour Map - Oldman Formation
Non-Pumping Water-Level Surface - Oldman Aquifer
Apparent Yield for Water Wells Completed through Oldman Aquifer
Total Dissolved Solids in Groundwater from Oldman Aquifer
Sulfate in Groundwater from Oldman Aquifer
Chloride in Groundwater from Oldman Aquifer
Fluoride in Groundwater from Oldman Aquifer
Piper Diagram - Oldman Aquifer

i) Foremost Formation

Depth to Top of Foremost Formation
Structure-Contour Map - Foremost Formation

j) Lea Park Formation

Depth to Top of Lea Park Formation
Structure-Contour Map - Lea Park Formation

4) Hydrographs and Observation Water Wells

Hydrographs

Precipitation vs Water Levels in AENV Obs WW Waterton Dam No. 5

Water-Level Measurements in AENV Obs WW No. 101

Annual Precipitation vs Water Levels in AENV Obs WW No. 101

5) Specific Study Areas

Specific Study Areas

Apparent Yield for Water Wells Completed in Sand and Gravel Aquifer(s) - Specific Study Areas

Bedrock Geology of Specific Study Areas

Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s) - Specific Study Areas

a) Study Area 1

Apparent Yield for Water Wells Completed through Lower Sand and Gravel Aquifer - Area 1

Changes in Water Levels in Surficial Deposits - Area 1

Iron in Groundwater from Surficial Deposits - Area 1

Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s) - Area 1

Areas of Potential Groundwater Depletion in Upper Bedrock Aquifer(s) - Area 1

Iron in Groundwater from Upper Bedrock Aquifer(s) - Area 1

b) Study Area 2

Apparent Yield for Water Wells Completed through Lower Sand and Gravel Aquifer - Area 2

Changes in Water Levels in Surficial Deposits - Area 2

Total Dissolved Solids in Groundwater from Surficial Deposits - Area 2

Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s) - Area 2

Areas of Potential Groundwater Depletion in Upper Bedrock Aquifer(s) - Area 2

Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s) - Area 2

c) Study Area 3

Apparent Yield for Water Wells Completed in Sand and Gravel Aquifer(s) - Area 3

Changes in Water Levels in Surficial Deposits - Area 3

Total Dissolved Solids in Groundwater from Surficial Deposits - Area 3

Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s) - Area 3

Areas of Potential Groundwater Depletion in Upper Bedrock Aquifer(s) - Area 3

Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s) - Area 3

d) Study Area 4

Apparent Yield for Water Wells Completed in Sand and Gravel Aquifer(s) - Area 4

Changes in Water Levels in Surficial Deposits - Area 4

Total Dissolved Solids in Groundwater from Surficial Deposits - Area 4

Apparent Yield for Water Wells Completed in Upper Bedrock Aquifer(s) - Area 4

Areas of Potential Groundwater Depletion in Upper Bedrock Aquifer(s) - Area 4

Total Dissolved Solids in Groundwater from Upper Bedrock Aquifer(s) - Area 4