

State of the Watershed Presentation Groundwater Resources

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 Shell River (MD)
 Birdtail - Assiniboine (ME)
 Little Saskatchewan (MF)
 Arrow / Oak River (MG)

Graham Phipps
 Groundwater Management Section
 Water Stewardship



Groundwater Management Section

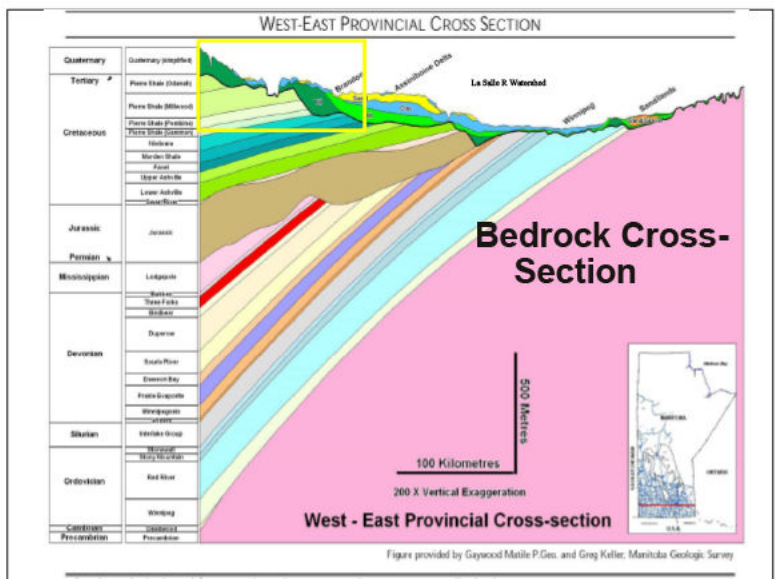
- The GMS advises on groundwater resource management issues: aquifer definition, allocation, groundwater quality and protection.
 - Operates a monitoring well network; collect, store & compile groundwater levels and groundwater quality data.
 - Conduct aquifer studies and problem specific investigations.
 - Regional groundwater resource mapping.
 - Regional stratigraphic drilling, pump testing, well data and quality compilations (60's - 80's) resulted in 11 maps 1:250,000 scale
 - Riding Mtn. Area (62-K) 1978 & Virden Area (62-F) 1983
 - Reports on hydrogeology and groundwater resources at various scales including town, drainage basins, municipal, planning district and watersheds.
- Administer *The Ground Water and Water Well Act* and Well Drilling Regulation.
 - Licence water well drillers: required to submit water well logs.

Aquifer Material Types

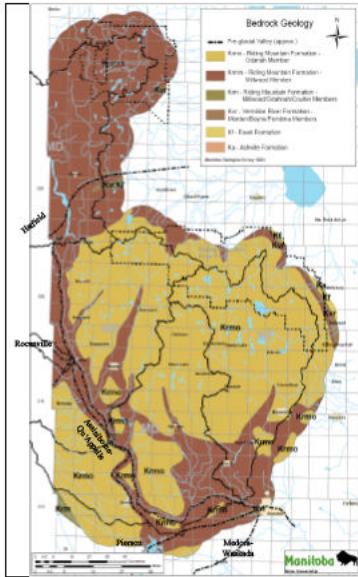
- Bedrock
 - Odanah Shale
 - Sandstone / unconsolidated sand
- Sand and gravel
 - Glacial sand and gravel
 - Buried valley (glacial or pre-glacial)

Primary Confining Materials

- Glacial till; clay
- Soft shale; evaporite



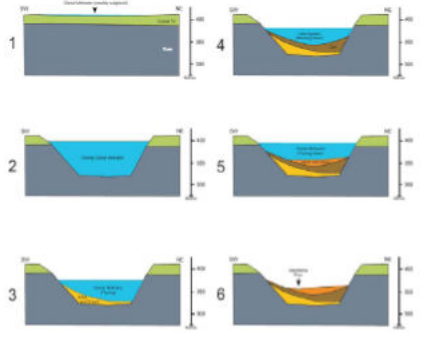
Figures provided by Gaywood Mathe P. Geol. and Greg Keller, Manitoba Geological Survey



- Reasonably well studied in AB&SK
- Variety of fill material
- May contain very productive S&Gr aquifers (municipal / industrial capacity)
- Narrow configuration (boundaries) and limited recharge may create high drawdown – require detailed work to prove sustainability
- Currently studying new methods for locating buried valleys in Manitoba

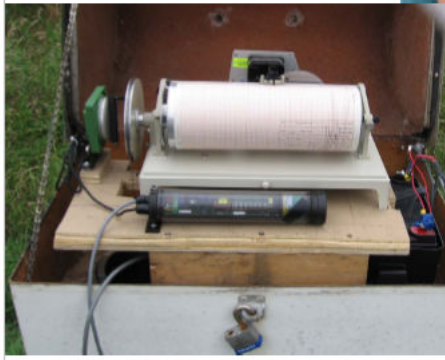
Buried Valleys

- Example of glacial melt forming valley in bedrock
- May also be pre-glacial – pre-existing river valley prior to glaciation
- Frequently not visible on surface
- Much of the infill material may have very similar characteristics as material cut into



Typical development of a buried valley system in the West Anorthine system (modified from Klassen, 1975)

Groundwater Management Section Observation Well Monitoring Site

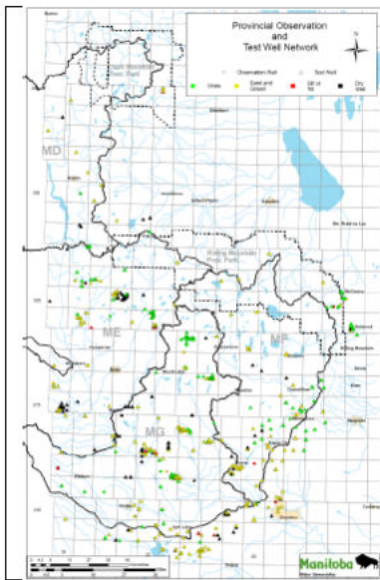


- Monitoring well with chart recorder and data logger provides continuous water level recording

Provincial Observation Wells and Test Drilling Within Watersheds

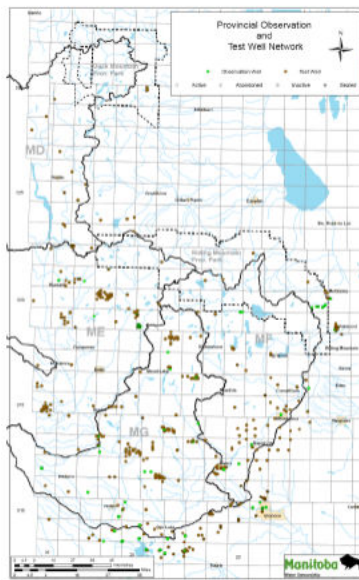
Type	Shell River MD	Birdtail R. ME ^A	L. Sask. R. MF ^B	Arrow/Oak MG ^C	Total #
Total Number of Test Wells and Test-holes	20	234*	84	210	548
Test-holes	19	126	76	186	407
Observation Wells (any period of record)	1	102	7	22	132
Observation Wells (active)	0	3	3	16	22

Test drilling began in 1958 (ME), 1959 (MF), 1960 (MG) and 1964 (MD)
 * - 97 Obs. wells & 8 test wells installed by MHWMC Rossburn study
 A. 6 test wells became community production wells
 B. 1 test well became a community production well
 C. 2 test wells became community production wells



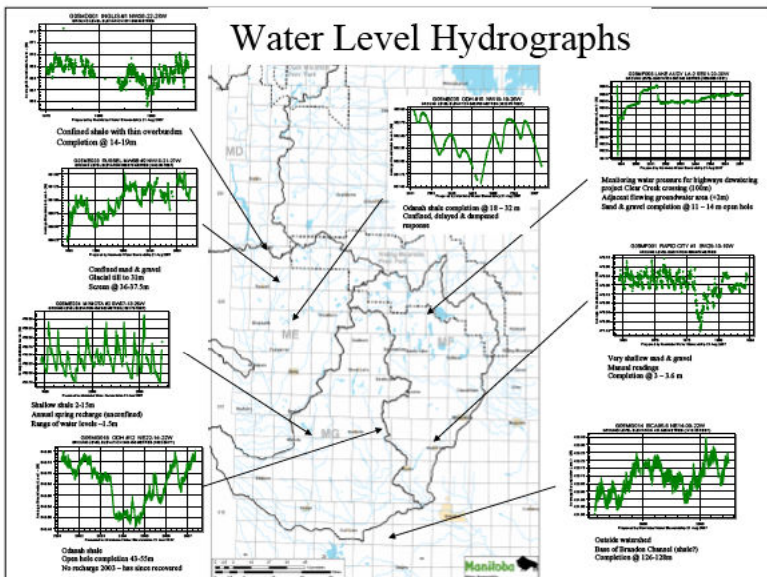
Provincial Drill Hole Logs

- Plotted by aquifer material or material at end of drill hole
- Locations highly clustered - most provincial investigations for community water source
- Rural water sources within L. Sask – RMs of Elton, Odanah, Sask., & Minto - Groundwater Availability Study No. 5



Location of Test Holes and Observation Wells with Status

- Early provincial test drilling completed in early 1900's
- Test drilling and observation wells installation began in watersheds in 1958
- Observation wells primarily installed for water level monitoring



Driller's Log

Manitoba Water Stewardship
Water Branch
WELL INFORMATION REPORT

2007 OCT 26

LOCATION - NML0-13-27W
Owner - WES
Driller - M & N Drilling Services Ltd.
Well Name - GOSMERE OGS #10
Well Use - OBSERVATION
Well Status - ACTIVE
Date Completed - 2000 Aug 15
Top of Casing - 0.92 m. above ground
Aquifer - SHALE

Remarks:
PUMPED WITH AIR

WELL LOG (Metric)

From To (m.)	Log
0.00 4.27	TILL, CLAYEY, BRICK, STONY
4.27 8.54	TILL, CLAYEY, GREY, STONY
8.54 10.07	SAND AND LIGHT GRAVEL, LIMESTONE AND SHALE
10.07 11.59	TILL, GREY, STONY
11.59 15.25	SAND AND LIGHT GRAVEL, LIMESTONE AND SHALE
15.25 22.33	TILL, GREY, STONY
22.33 32.48	GRANITE BOULDERS, RED
32.48 45.75	SHALE, BLACK, LAYERS OF BRITTLE AND SOFT

WELL CONSTRUCTION

From To (m)	Casing	Inside Dia. (mm)	Outside Dia. (mm)	Slot Size (mm)	Type	Material
0.00 16.60	CASING		127.00			INGERT BLACK IRON
16.60 45.75	OPEN HOLE					

PUMPING TEST
Date - 2000 Sep 16
Pumping 0.70 litres/second
Water level before test : 10.68 m below ground
Water level at end of test :
Test duration: Water temperature: degree (s) C
Test Zone: from 16.60 m to 45.75 m

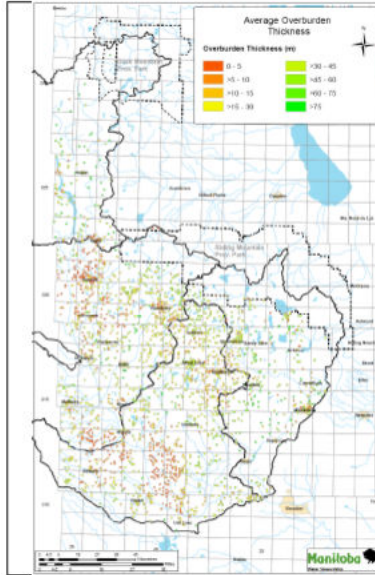
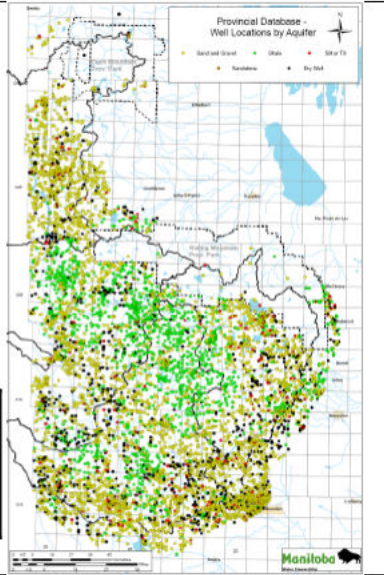
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- GMS maintains a database of well logs for the province
- Well drillers complete and submit a log of drilled materials, owner information, well completion and water level

Water-well Inventory by Aquifer Material Type

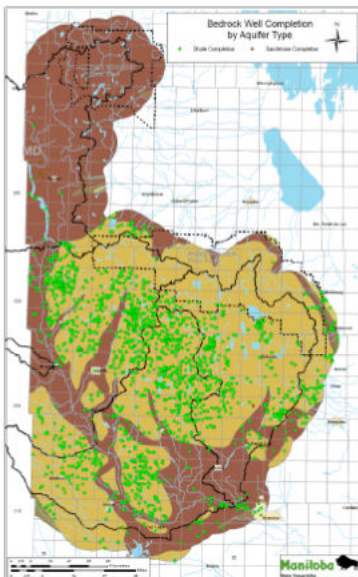
- Most well logs located to the quarter section
- Current well inventory for all logs within the database for watersheds (9708 logs)
- Shows areas of reliance on shale, sand & gravel, or either aquifer material and areas with greater prevalence of 'dry' wells

	Shell R MD	Birdtail Assiniboine W ME	L. Sask. MF	Arrow / Oak R. MG
Well Logs	1200	2543	2480	3485



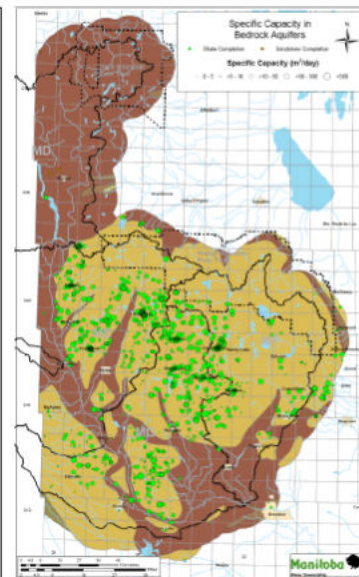
Depth to Bedrock

- Depth to bedrock based on first rock layer encountered in drill hole (average where more than one well exists assigned to quarter section)
- Indication of minimum exploration depth when sand & gravel are not present



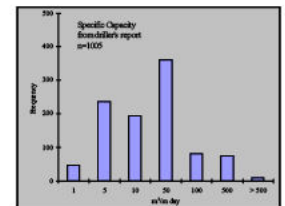
Bedrock Wells

- 1722 production wells completed in bedrock
- Uneven distribution



Bedrock Wells

- Well yields generally satisfactory for domestic and farm supplies for completed wells
- Generally no pumping information for wells shown completed within Millwood shale



- Based on information from well driller's reports
- Rate of discharge per unit drawdown

Shale Aquifers Water Quality

- Water quality is highly variable:

TDS 316 – 9100 mg/L

Cl 1 - 2206 mg/L

SO4 13 - 4920 mg/L

Na 4 - 2030 mg/L

- Water takes on chemistry of the material it moves through
- Low TDS indicate groundwater is closer to recharge
- High chloride indicates discharge from deeper old groundwater
- Most water sources have Mn, Fe, SO4 & Na above guideline

	TDS	Na	SO4	Cl	F	Al	Fe	Mn	NO3-N	Sb
Drinking Water Guide	AO	AO	AO	AO	MAC	MAC	AO	AO	MAC	MAC
DWG Concentration	500	200	500	250	1.5	0.06	0.3	0.05	10	0.006
Total # Samples	143	144	143	138	119	8	150	125	124	8
% of samples >DWG	90%	66%	52%	22%	1%	0%	56%	84%	6%	0%

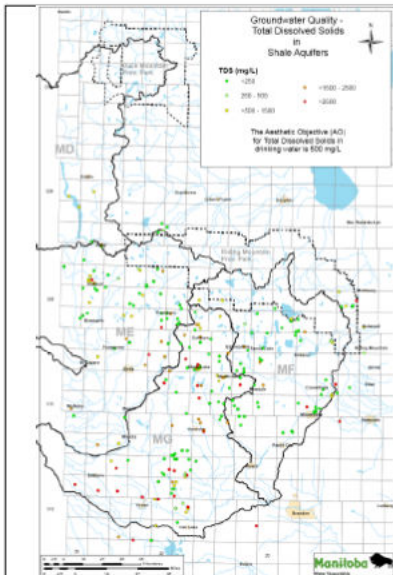
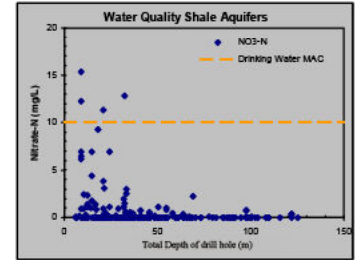
	As	Ba	B	Cd	Cr	Cu	Pb	Se	U	Zn
Drinking Water Guide	MAC	MAC	MAC	MAC	MAC	AO	MAC	MAC	MAC	AO
DWG Concentration	0.01	1	5	0.005	0.05	1	0.01	0.01	0.02	5
Total # Samples	9	6	9	6	6	9	9	6	6	9
% of samples >DWG	22%	0%	0%	0%	0%	0%	0%	0%	0%	0%

All concentrations in mg/L



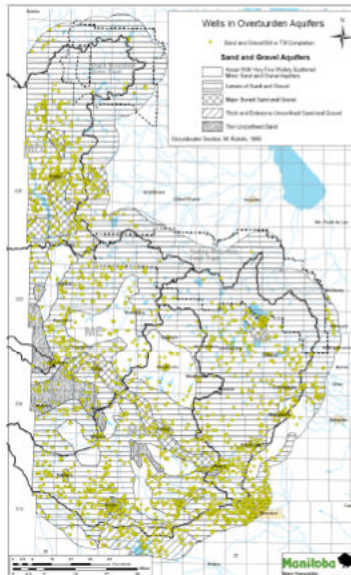
Shale Aquifers Water Quality Nitrate (MAC: 10mg/L as N)

- From private wells and observation wells



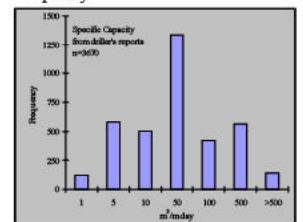
Shale Aquifers Water Quality: Total Dissolved Solids (AO: 500mg/L)

- From private wells and observation wells



Sand and Gravel Wells

- Much of the area lenses of sand and gravel form aquifers
- Well yields generally satisfactory for domestic and farm supplies for completed wells
- Quite a few wells capable of high capacity



- Based on information from well driller's reports
- Rate of discharge per unit drawdown

Sand & Gravel Aquifers Water Quality

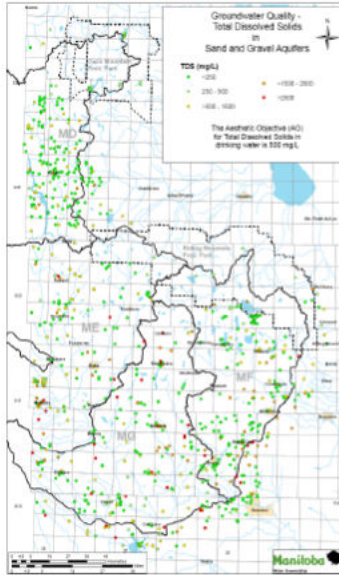


- Water quality is highly variable:
 - TDS 90 - 9000 mg/L
 - Cl <DL - 2075 mg/L
 - SO4 <DL - 4500 mg/L
 - Na 1 - 1700 mg/L
- Overall quality largely depends upon connection with till and shale and makeup of sand and gravel
- Low TDS, Cl, SO4 and Na indicate near recharge

	TDS	Na	SO4	Cl	F	Al	Fe	Mn	NO3-N	Sb
Drinking Water Guide	AO	AO	AO	AO	MAC	MAC	AO	AO	MAC	MAC
DWG Concentration	500	200	500	250	1.5	0.06	0.3	0.05	10	0.006
Total # Samples	401	408	397	396	358	17	418	391	387	17
% of samples >DWG	48%	15%	19%	5%	1%	0%	26%	42%	5%	0%

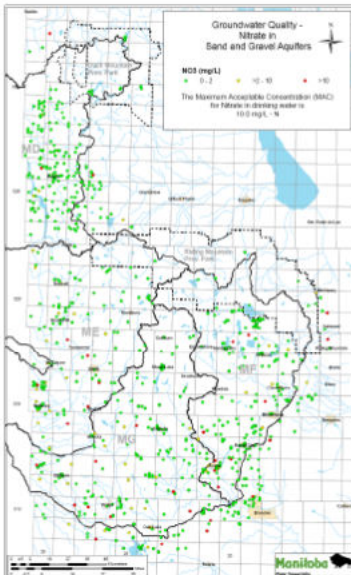
	As	Ba	B	Cd	Cr	Cu	Pb	Se	U	Zn
Drinking Water Guide	MAC	MAC	MAC	MAC	MAC	AO	MAC	MAC	MAC	AO
DWG Concentration	0.01	1	5	0.005	0.05	1	0.01	0.01	0.02	5
Total # Samples	23	18	21	18	17	29	21	18	18	28
% of samples >DWG	4%	0%	0%	0%	0%	0%	0%	6%	0%	0%

All concentrations in mg/L



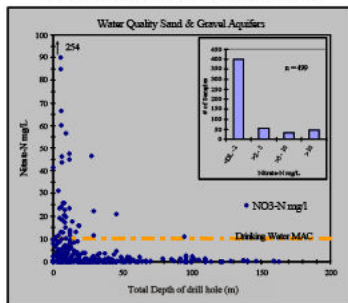
Shallow Sand & Gravel Aquifers Water Quality (all aquifers)– TDS (AO: 500mg/L)

- From private wells and observation wells
- High TDS waters distributed throughout region

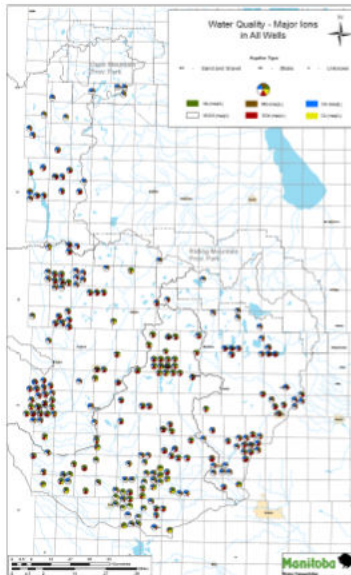


Shallow Sand & Gravel Aquifers Water Quality (all aquifers)– Nitrate (MAC: 10mg/L as N)

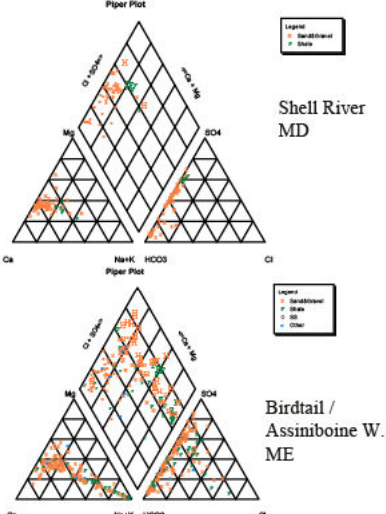
- From private and observation wells



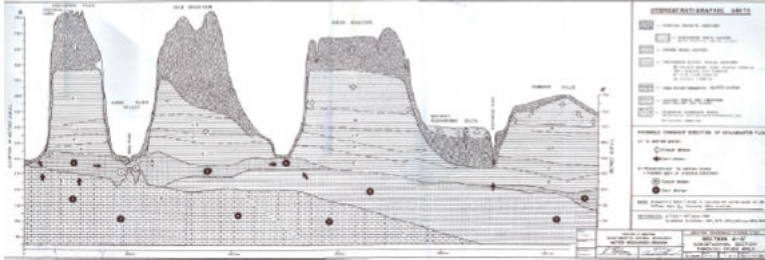
Well construction, location, maintenance are all important factors in preventing well contamination



Water Quality Major Ions

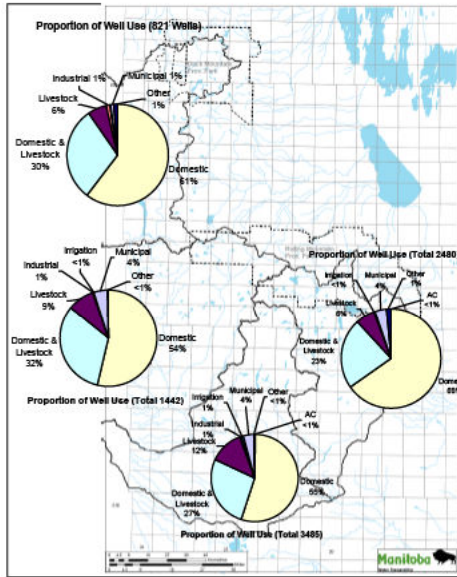


Bedrock Hydrostratigraphic Units



- N-S block diagram of geology through escarpment area
- ‘fresh’ water in upper bedrock – brackish / saline water in lower units

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Intended Water Use from Driller's Reports

- Proportion of wells not amount of water withdrawn

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Concluding Remarks



- Potable groundwater quality / quantity highly variable
- Monitoring continue as required – provincial wide review of monitoring well network will include these watersheds
- Other studies show there are many more wells than GMS records indicate
- In cooperation with CDs – propose well inventory, include GPS, construction with rudimentary water quality – select wells comprehensive chemistry
- Current Groundwater Availability Series maps 1:250,000 scale (primary groundwater information maps) were produced in 1978 (Riding Mtn) and 1983 (Virden) require updating
- Groundwater Management Section is committed to completing new set of groundwater map compilation based on the watershed scale – digital format
- GMS willing to provide support to well head protection

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