10 GLOSSARY

Apparent Yield	a regional analysis term referring to the rate a properly completed water well could be pumped, if fully penetrating the aquifer.
Aquifer	a formation, group of formations, or part of a formation that contains saturated permeable rocks capable of transmitting groundwater to water wells or springs in economical quantities.
Aquitard	a confining bed that retards but does not prevent the flow of water to or from an adjacent aquifer.
Available Drawdown	in a confined aquifer, the distance between the non-pumping water level and the top of the aquifer. in an unconfined aquifer (water table aquifer), two thirds of the saturated thickness of the aquifer.
Deltaic	a depositional environment in standing water near the mouth of a river.
Facies	the aspect or character of the sediment within beds of one and the same age (Pettijohn, 1957).
Fluvial	produced by the action of a stream or river.
Hydraulic Conductivity	the rate of flow of water through a unit cross-section under a unit hydraulic gradient; units are length/time.
Kriging	a geo-statistical method for gridding irregularly-spaced data.
Lacustrine	fine-grained sedimentary deposits associated with a lake environment and not including shore-line deposits.
Surficial Deposits	includes all sediments above the bedrock.
Transmissivity	the rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient: a measure of the ease with which groundwater can move through the aquifer. Apparent Transmissivity: the value determined from a summary of aquifer test data, usually involving only two water-level readings. Effective Transmissivity: the value determined from late pumping and/or late recovery water-level data from an aquifer test. Aquifer Transmissivity: the value determined by multiplying the hydraulic conductivity of an aquifer by the thickness of the aquifer.

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Appendix B

MAPS AND FIGURES ON CD-ROM

CD-ROM

A) Database
B) ArcView Files
C) Query
D) Maps and Figures

1) General

- Index Map
- Surface Casing Types used in Drilled Water Wells
- Location of Water Wells
- Depth of Existing Water Wells
- Bedrock Topography
- Bedrock Geology
- Cross-Section A - A'
- Cross-Section B - B'
- Geologic Column
- Generalized Cross-Section
- Risk of Groundwater Contamination
- Relative Permeability
- Hydrographs - AEP Observation Water Wells

2) Surficial Aquifers

a) Surficial Deposits

- Thickness of Surficial Deposits
- Non-Pumping Water-Level Surface in Water Wells Completed in Surficial Aquifer(s)
- Total Dissolved Solids in Groundwater from Surficial Deposits
- Sulfate in Groundwater from Surficial Deposits
- Chloride in Groundwater from Surficial Deposits
- Fluoride in Groundwater from Surficial Deposits
- Piper Diagram - Surficial Deposits
- Amount of Sand and Gravel in Surficial Deposits
- Thickness of Sand and Gravel Aquifer(s)
- Apparent Yield for Water Wells Completed through Sand and Gravel Aquifer(s)

b) First Sand and Gravel

- Thickness of First Sand and Gravel
- First Sand and Gravel - Saturation

c) Upper Sand and Gravel

- Thickness of Upper Surficial Deposits
- Thickness of Upper Sand and Gravel
- Apparent Yield for Water Wells Completed through Upper Sand and Gravel Aquifer

d) Lower Sand and Gravel

- Structure-Contour Map - Top of Lower Surficial Deposits
- Depth to Top of Lower Sand and Gravel Aquifer
- Thickness of Lower Surficial Deposits
- Thickness of Lower Sand and Gravel Aquifer
- 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)
- Piper Diagram - Bedrock Aquifers
- Recharge/Discharge Areas between Surficial Deposits and Upper Bedrock Aquifer(s)
- Non-Pumping Water-Level Surface in Upper Bedrock Aquifer(s)

b) Paskapoo Aquifer

- Depth to Top of Paskapoo Formation
- Structure-Contour Map - Top of Paskapoo Formation
- Non-Pumping Water-Level Surface - Paskapoo Aquifer
- Apparent Yield for Water Wells Completed through Paskapoo Aquifer
- Total Dissolved Solids in Groundwater from Paskapoo Aquifer
- Sulfate in Groundwater from Paskapoo Aquifer
- Chloride in Groundwater from Paskapoo Aquifer
- Piper Diagram - Paskapoo Aquifer
- Recharge/Discharge Areas between Surficial Deposits and Paskapoo Aquifer

c) Upper Scollard Aquifer

- Depth to Top of Upper Scollard Formation
- Structure-Contour Map - Top of 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
- Piper Diagram - Upper Scollard Aquifer
- Recharge/Discharge Areas between Surficial Deposits and Upper Scollard Aquifer

d) Lower Scollard Aquifer

- Depth to Top of Lower Scollard Formation
- Structure-Contour Map - Top of 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
- Piper Diagram - Lower Scollard Aquifer
- Recharge/Discharge Areas between Surficial Deposits and Lower Scollard Aquifer

e) Upper Horseshoe Canyon Aquifer

- Depth to Top of Upper Horseshoe Canyon Formation
- Structure-Contour Map - Top of 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
- Piper Diagram - Upper Horseshoe Canyon Formation
- Recharge/Discharge Areas between Surficial Deposits and Upper Horseshoe Canyon Aquifer

f) Middle Horseshoe Canyon Aquifer

- Depth to Top of Middle Horseshoe Canyon Formation
- Structure-Contour Map - Top of 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
- Piper Diagram - Middle Horseshoe Canyon Formation
- Recharge/Discharge Areas between Surficial Deposits and Middle Horseshoe Canyon Aquifer

g) Lower Horseshoe Canyon Aquifer

- Depth to Top of Lower Horseshoe Canyon Formation
- Structure-Contour Map - Top of 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
- Piper Diagram - Lower Horseshoe Canyon Formation
- Recharge/Discharge Areas between Surficial Deposits and Lower Horseshoe Canyon Aquifer

h) Bearpaw Aquifer

- Depth to Top of Bearpaw Aquifer
- Structure-Contour Map - Top of Bearpaw Formation

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Appendix C

GENERAL WATER WELL INFORMATION

Domestic Water Well Testing

Purpose and Requirements

The purpose of the testing of domestic water wells is to obtain background data related to:

1) the non-pumping water level for the aquifer - Has there been any lowering of the level since the last measurement?
2) the specific capacity of the water well, which indicates the type of contact the water well has with the aquifer;
3) the transmissivity of the aquifer and hence an estimate of the projected long-term yield for the water well;
4) the chemical, bacteriological and physical quality of the groundwater from the water well.

The testing procedure involves conducting an aquifer test and collecting of groundwater samples for analysis by an accredited laboratory. The date and time of the testing are to be recorded on all data collection sheets. A sketch showing the location of the water well relative to surrounding features is required. The sketch should answer the question, "If this water well is tested in the future, how will the person doing the testing know this is the water well I tested?"

The water well should be taken out of service as long as possible before the start of the aquifer test, preferably not less than 30 minutes before the start of pumping. The non-pumping water level is to be measured 30, 10, and 5 minutes before the start of pumping and immediately before the start of pumping which is to be designated as time 0 for the test. All water levels must be from the same designated reference, usually the top of the casing. Water levels are to be measured during the pumping interval and during the recovery interval after the pump has been turned off; all water measurements are to be with an accuracy of $\pm$ 0.01 metres.

During the pumping and recovery intervals, the water level is to be measured at the appropriate times. An example of the time schedule for a 4-hour test is as follows, measured in minutes after the pump is turned on and again after the pump is turned off:

1,2,3,4,6,8,10,13,16,20,25,32,40,50,64,80,100,120.

For a four-hour test, the reading after 120 minutes of pumping will be the same as the 0 minutes of recovery. Under no circumstance will the recovery interval be less than the pumping interval.

Flow rate during the aquifer test should be measured and recorded with the maximum accuracy possible. Ideally, a water meter with an accuracy of better than $\pm$1% displaying instantaneous and total flow should be used. If a water meter is not available, then the time required to completely fill a container of known volume should be recorded, noting the time to the nearest 0.5 seconds or better. Flow rate should be determined and recorded often to ensure a constant pumping rate.

Groundwater samples should be collected as soon as possible after the start of pumping and within 10 minutes of the end of pumping. Initially only the groundwater samples collected near the end of the pumping interval need to be submitted to the accredited laboratory for analysis. All samples must be properly stored for transportation to the laboratory and, in the case of the bacteriological analysis, there is a maximum time allowed between the time the sample is collected and the time the sample is delivered to the laboratory. The first samples collected are only analyzed if there is a problem or a concern with the first samples submitted to the laboratory.

Procedure

Site Diagrams

These diagrams are a map showing the distance to nearby significant features. This would include things like a corner of a building (house, barn, garage etc.) or the distance to the half-mile or mile fence. The description should allow anyone not familiar with the site to be able to unequivocally identify the water well that was tested.

In lieu of a map, UTM coordinates accurate to within five metres would be acceptable. If a hand-held GPS is used, the post-processing correction details must be provided.

Surface Details

The type of surface completion must be noted. This will include such things as a pitless adapter, well pit, pump house, in basement, etc. Also, the reference point used for measuring water levels needs to be noted. This would include top of casing (TOC) XX metres above ground level; well pit lid, XX metres above TOC; TOC in well pit XX metres below ground level.

Groundwater Discharge Point

Where was the flow of groundwater discharge regulated? For example was the discharge through a hydrant downstream from the pressure tank; discharged directly to ground either by connecting directly above the well seal or by pulling the pump up out of the pitless adapter; from a tap on the house downstream from the pressure tank? Also note must be made if any action was taken to ensure the pump would operate continuously during the pumping interval and whether the groundwater was passing through any water-treatment equipment before the discharge point.

Water-Level Measurements

How were the water-level measurements obtained? If obtained using a contact gauge, what type of cable was on the tape, graduated tape or a tape with tags? If a tape with tags, when was the; last time the tags were calibrated? If a graduated tape, what is the serial number of the tape and is the tape shorter than its original length (i.e. is any tape missing)?

If water levels are obtained using a transducer and data logger, the serial numbers of both transducer and data logger are needed and a copy of the calibration sheet. The additional information required is the depth the transducer was set and the length of time between when the transducer was installed and when the calibration water level was measured, plus the length of time between the installation of the transducer and the start of the aquifer test.

All water levels must be measured at least to the nearest 0.01 metres.

Discharge Measurements

Type of water meter used. This could include such things as a turbine or positive displacement meter. How were the readings obtained from the meter? Were the readings visually noted and recorded or were they recorded using a data logger?

Water Samples

A water sample must be collected between the 4- and 6-minute water-level measurements, whenever there is an observed physical change in the groundwater being pumped, and 10 minutes before the end of the planned pumping interval. Additional water samples must be collected if it is expected that pumping will be terminated before the planned pumping interval.