WILLLOW CREEK WATERSHED
AQUIFER MAPPING AND GROUNDWATER MANAGEMENT PLANNING STUDY

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Presentation Outline

- Conceptual Hydrogeological Model
  - Hydrology
  - Surficial and Bedrock Geology
  - Aquifers and Conceptual Model
  - Water Diversion and Use
  - Groundwater Budget
  - Water Quality Assessment
- Knowledge and Data Gaps
ESRD Water Well Information Database Records

Water well records in watershed = 2,164
### How many live in the watershed?

<table>
<thead>
<tr>
<th>District</th>
<th>1996</th>
<th>2006</th>
<th>%Δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Claresholm</td>
<td>3,427</td>
<td>3,700</td>
<td>+8</td>
</tr>
<tr>
<td>Granum</td>
<td>337</td>
<td>415</td>
<td>+23</td>
</tr>
<tr>
<td>MD 26</td>
<td>5,106</td>
<td>5,337</td>
<td>+5</td>
</tr>
<tr>
<td>MD 66</td>
<td>108</td>
<td>86</td>
<td>-20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>8,737</td>
</tr>
<tr>
<td>Rural</td>
<td>5,665</td>
</tr>
</tbody>
</table>
Land Cover (in 2000)
## Total Precipitation by Year - Claresholm

### Where | Precipitation
--- | ---
Northern | 500-550 mm/yr
Prairie section | 450-480 mm/yr

**Diagram:**
- Line graph showing total precipitation by year from 1900 to 2000.
- Blue line represents precipitation at Claresholm (mm).
- Red line represents annual moving average.

**Table:**
- **Where** column lists Northern and Prairie section.
- **Precipitation** column lists precipitation ranges for each location.

**Legend:**
- Blue line: Precipitation Claresholm (mm)
- Red line: Annual Moving Average
Willow Creek monitoring

Gauging Station 05AB028
Willow Creek above Chain Lakes

Gauging Station 05AB021
Willow Creek Near Claresholm

Gauging Station 05AB002
Willow Creek Near Nolan

Data: 1965-1995

Source: AMEC, 2010
## Unconsolidated and Bedrock Water Well Records

<table>
<thead>
<tr>
<th>Lithology at Screen</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unconsolidated</td>
<td>161</td>
</tr>
<tr>
<td>Unconsol./Bedrock</td>
<td>40</td>
</tr>
<tr>
<td>Bedrock</td>
<td>679</td>
</tr>
<tr>
<td>No lithology</td>
<td>1,284</td>
</tr>
<tr>
<td>Formation</td>
<td>Apparent Transmissivity</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Unconsolidated</td>
<td>84.6</td>
</tr>
<tr>
<td>Porcupine Hills</td>
<td>14.3</td>
</tr>
<tr>
<td>Willow Creek</td>
<td>5.3</td>
</tr>
<tr>
<td>St. Mary River</td>
<td>3.6</td>
</tr>
</tbody>
</table>
Horizontal Hydraulic Gradients

Wells between 0 and 25 m deep

Wells between 25 and 50 m deep

Wells between 50 and 75 m deep

Wells between 75 and 100 m deep

Wells greater than 100 m deep

Water level elevation in m above sea level
Contour interval = 50 metres
Grey Arrows = groundwater gradient direction
Red circles show well record locations
Purple line is watershed boundary
Bounding line is 10 km buffer outside watershed boundary
Springs in the Watershed
Depth to Bedrock (mBG)
### Wells in Pre-Glacial Valley

<table>
<thead>
<tr>
<th></th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unconsolidated</td>
<td>56</td>
</tr>
<tr>
<td>Bedrock</td>
<td>94</td>
</tr>
<tr>
<td>No lithology</td>
<td>187</td>
</tr>
</tbody>
</table>
### Wells in Alluvial Aquifer

<table>
<thead>
<tr>
<th>Lithology</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unconsolidated</td>
<td>65</td>
</tr>
<tr>
<td>Bedrock</td>
<td>63</td>
</tr>
<tr>
<td><em>No lithology</em></td>
<td>180</td>
</tr>
</tbody>
</table>
Cross-Section Locations
Cross-Section C-C’
GOWN Wells

Water Level Elevation (masl)

Date (mmm-yyyy)

Well 111 - Orton

Well 112 - Mud Lake

Water Level Elevation (masl)

Date (mmm-yyyy)

Well 210 - STAVELY 85-4

Well 209 - STAVELY 85-1
PINE COULEE GROUNDWATER MONITORING PROJECT
Town of Stavely Observation Well

Source: Omni McCann, 2008

PINE COULEE GROUNDWATER MONITORING PROJECT
Hutterite Colony Well

Source: Omni McCann, 2008
Water Diversion

- **Surface Water**
  - Most common use = irrigation
  - Most in eastern portion of watershed – agriculture
  - Total allocated = 550,187,486 m³/yr

- **Groundwater**
  - Most common use = agriculture then municipal
  - Most likely from Alluvial aquifer and Willow Creek formation
  - Total allocated = 2,227,908 m³/yr
Crude Groundwater Budget

- Input – precipitation assumed recharge (5-15%) 54 to 150x10^6 m³/yr
- Licensed water use 2.2x10^6 m³/yr
- Domestic use 2.7x10^6 m³/yr
- 3-9% of recharge is used
High-Level Water Balance Analysis

- **Crude Groundwater Budget**: precipitation assumed recharge (5-15%) and water use indicates 3-9% of recharge is used;

- **Surface water balance model** is needed for the entire watershed in order to further assess aquifer recharge and use;

- **Insufficient data to integrate groundwater and surface water** (except alluvial aquifer). Surface water suspected to play major role in aquifer recharge in mid to upper reaches of the watershed. Extreme western part of the watershed groundwater appears to flow to the west;

- **Buried valley aquifers, and bedrock aquifers disconnected from surface** (except Stavely Aquifer); and

- **Confined aquifers may be managed separately** if individual water balances are being tracked over one year periods.
Springs

- TDS range 250-1,078 mg/L
  - low TDS = local
  - high TDS = regional source or Laurentide glacial till
- Porcupine Hills Fm – Ca+Mg/HCO₃
- Willow Creek Fm – Na/HCO₃

Groundwater

- Transforms from Ca+Mg/HCO₃ in Foothills/Mountains (Brazeau Fm and Alberta Group aquifer(s))
- To Na/SO₄ or Na/SO₄ & HCO₃ mixed in plains
Total Dissolved Solids

28
Data & Knowledge Gaps

- Water Well ID’s, GPS Locations and Tagging;
- Reconciliation of Approvals and Water Wells;
- Capturing Landowner Water Level and Quality Data;
- Chemical Analyses by Local Health Units (helps to further refine hydrochemistry and assess possible contamination sources);
- Need for Groundwater Monitoring – increase accuracy of conceptual model as it relates to recharge and GW-SW interaction;
- Refine the elements of the Water budget and surface water balance (including groundwater-surface water interactions); and
- Promoting Groundwater Stewardship