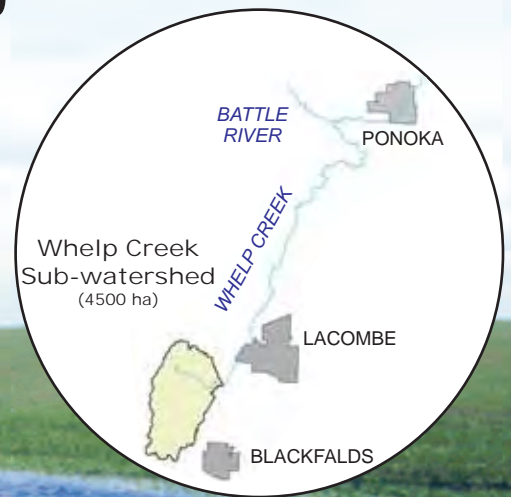
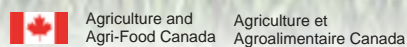


# Nutrient Beneficial Management Practices Evaluation Project

**Whelp Creek Sub-watershed Tour  
August 10, 2010**



**Government of Alberta** ■  
Agriculture and Rural Development

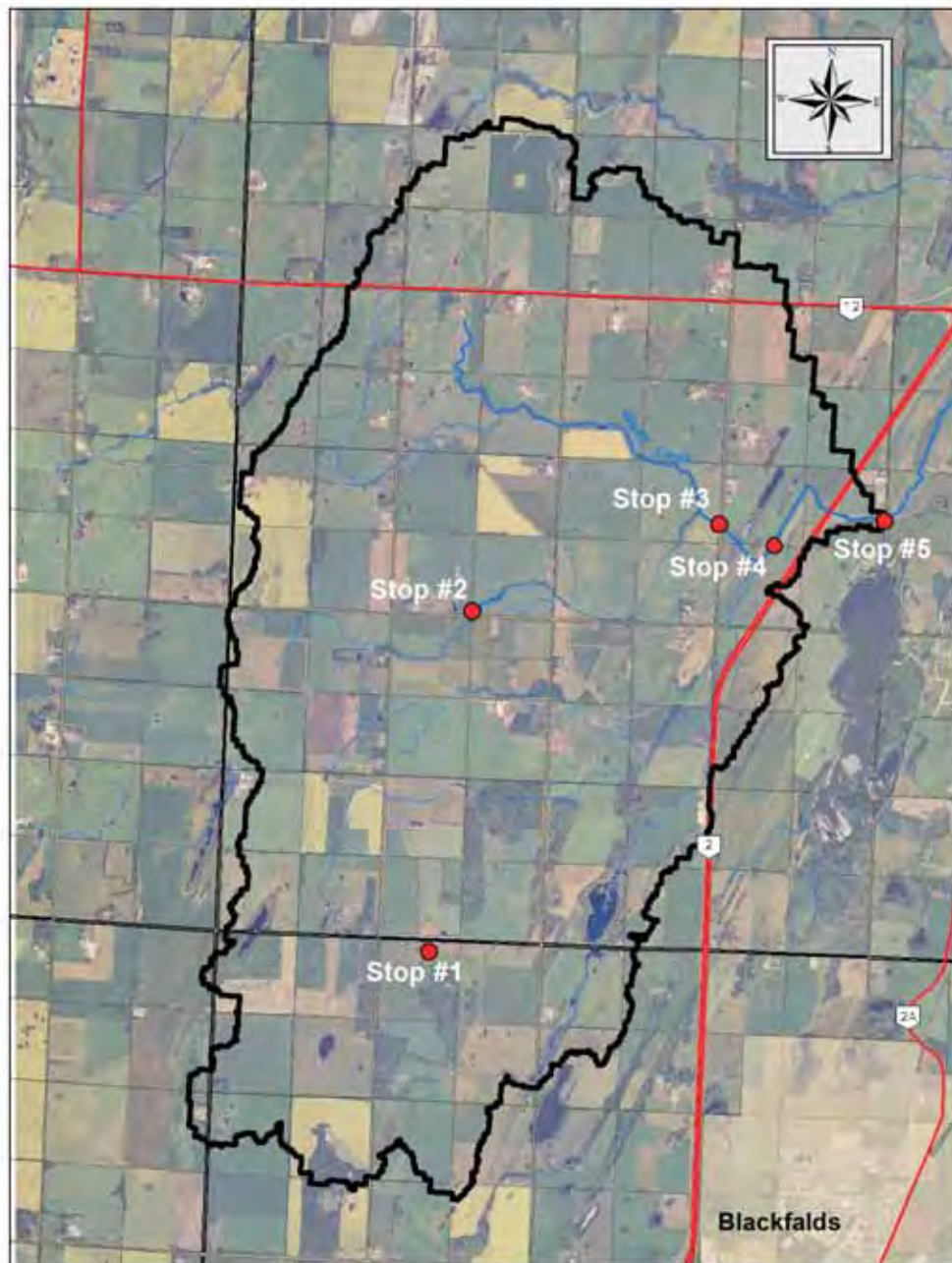


**Government of Alberta** ■  
Environment



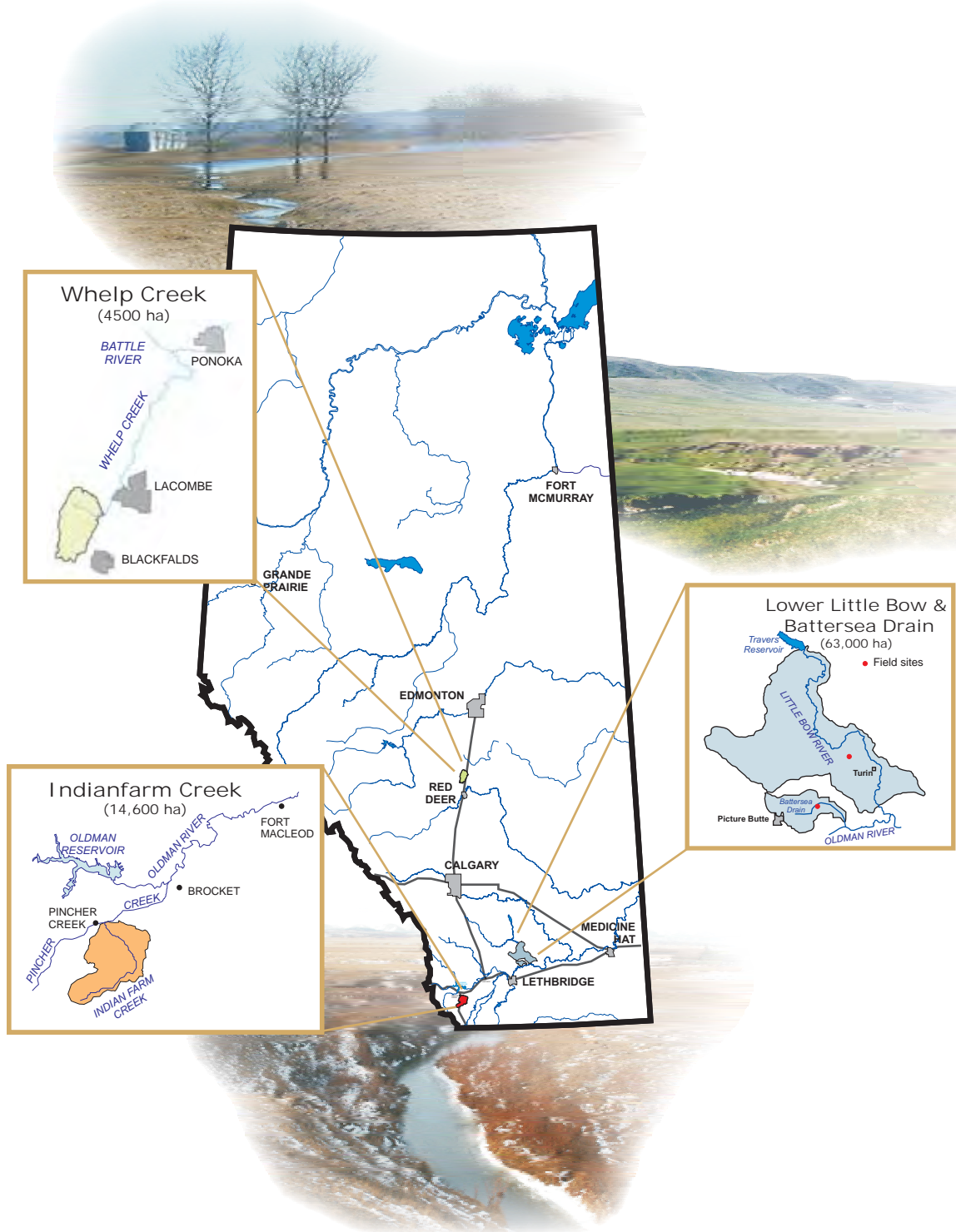
### Tour Route

- Stop 1. South Pasture BMP Site (SPS)
- Stop 2. East Field BMP site (EFD)
- Stop 3. North Pasture BMP Site (NPS)
- Stop 4. Groundwater Wells near the sub-watershed outlet (301)
- Stop 5. Whelp Creek Diversion to Lacombe Lake



### Nutrient Beneficial Management Evaluation Project 2007 to 2012

- ▶ Two watersheds: Whelp Creek and Indianfarm Creek
- ▶ Purpose: To evaluate the environmental effectiveness of BMPs with a focus on water quality. Also, to determine the cost to implement the BMPs.



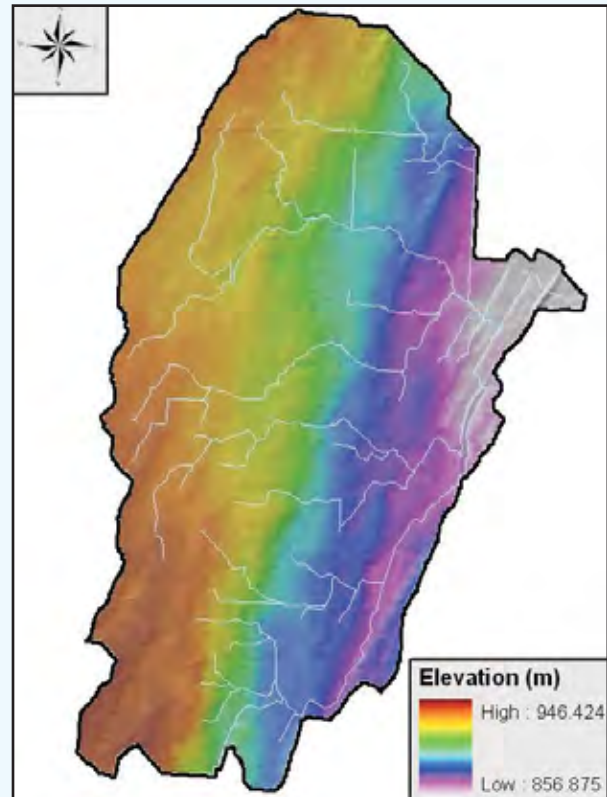
Location of study watersheds in Alberta.

## Characterization of Whelp Creek Sub-watershed

### Landscape Characterization

- ▶ Total Drainage Area: 4685 ha (47 km<sup>2</sup> or 18 sections of land)
- ▶ Watershed: Battle River
- ▶ Annual runoff: 38 mm
- ▶ Soil Zone: Black, generally medium texture, including loam and silty loam
- ▶ Parkland Region: Central Parkland Sub-region
- ▶ Land slope: 0.5 to 2.2%
- ▶ Elevation difference: 90 m

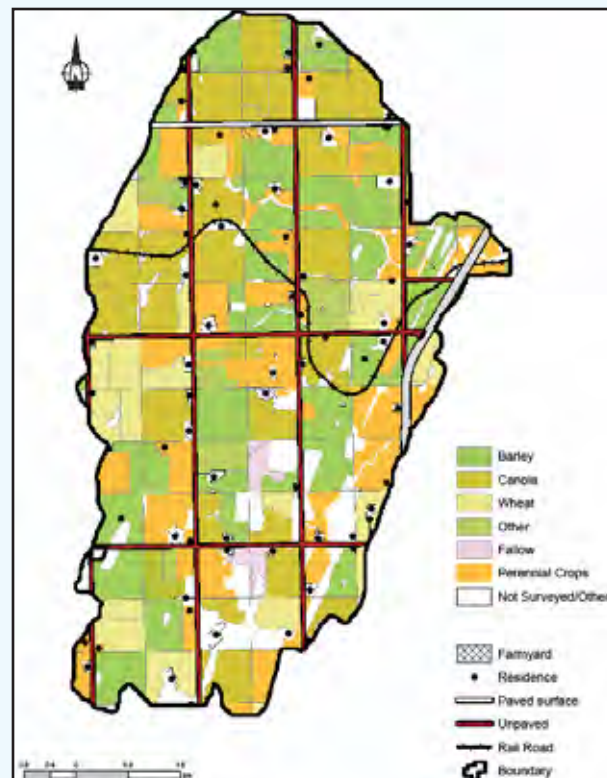
### Digital Elevation Model



### Land Use

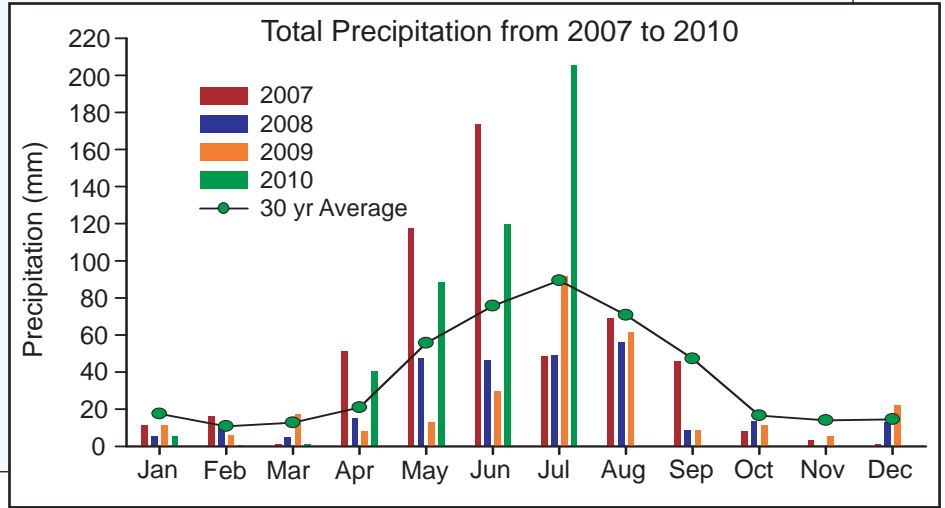
- ▶ Primarily agricultural (84% of the sub-watershed)
  - 60 homesteads with 50 active producers
  - 60% annual crop (barley, canola, wheat)
  - 20% perennial forage
  - Livestock production: 10 dairy, 7 beef (max 1800 head), 1 poultry
- ▶ Oil and gas production is active
- ▶ Future industrial development is expected in the eastern half

### AgCapture land cover map, 2009



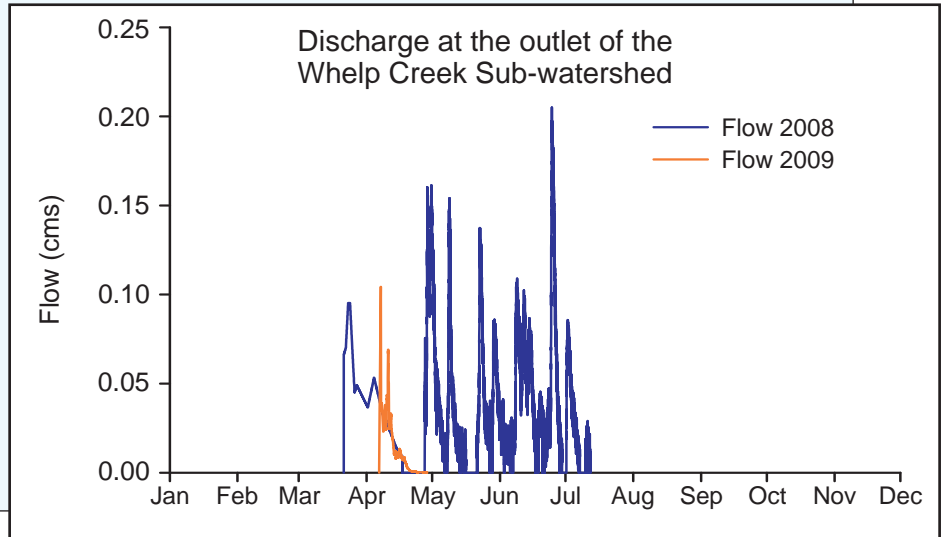
**Weather**

- ▶ 2007 total precipitation: 549 mm
- ▶ 2008 total precipitation: 272 mm
- ▶ 2009 total precipitation: 288 mm
- ▶ 2010 total precipitation (Jan to Jul): 462 mm
- ▶ 30-yr average annual total precipitation: 446 mm



**Water**

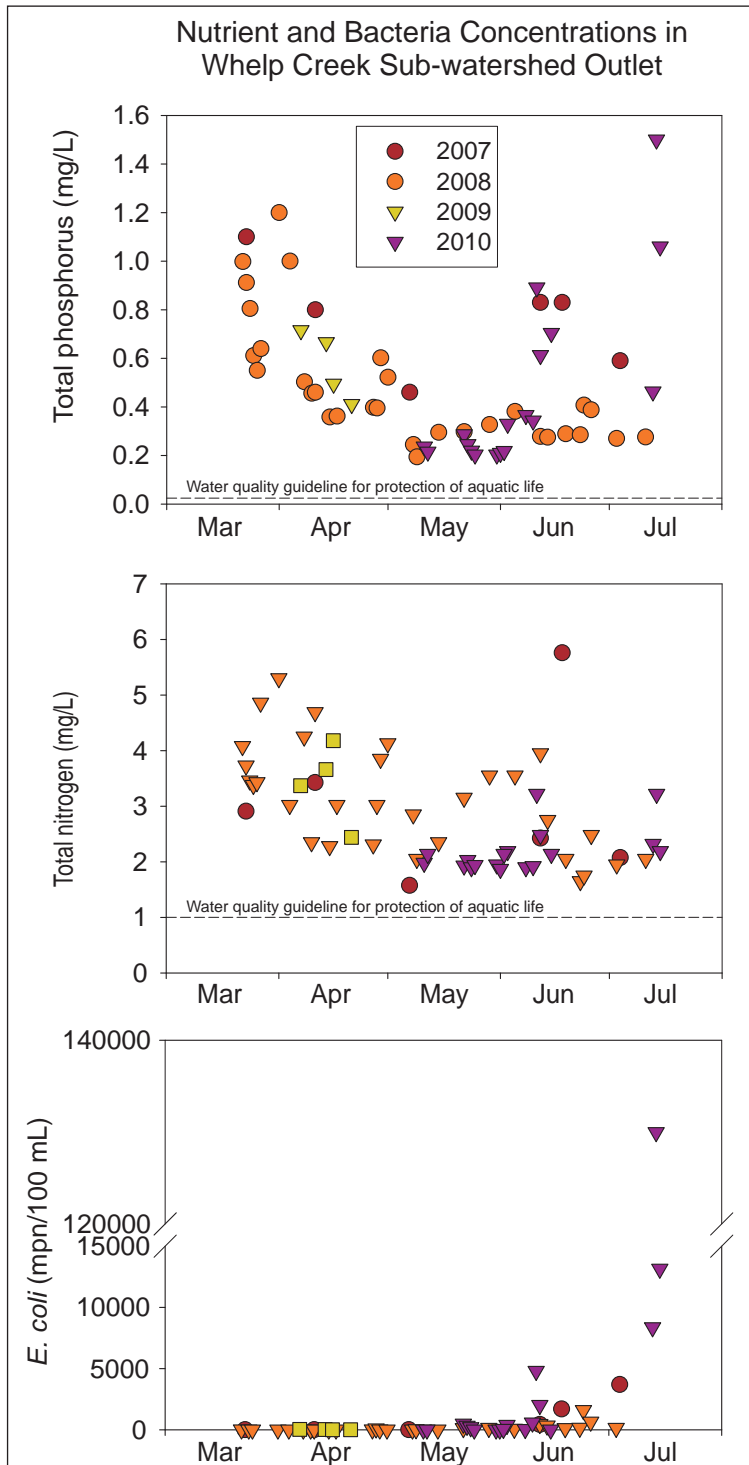
- ▶ Intermittent stream that generally flows into July
- ▶ Hydrology is primarily snowmelt driven
- ▶ Runoff is influenced by shallow water table (groundwater)
- ▶ Undefined shallow channels
- ▶ Low flows generally less than 0.1 m<sup>3</sup>/sec



Snowmelt is usually the predominant form of runoff in Whelp Creek.

### Whelp Creek Sub-watershed Outlet

- ▶ Nutrient concentrations are usually highest during snowmelt
- ▶ Bacteria concentrations tend to be low, although there are some peaks in mid to late June and July
- ▶ Nutrient concentrations exceeds water quality guidelines for the protection of aquatic life; this is expected and typical of a high intensity agricultural stream of this size



### Stop 1: South Pasture Site (SPS)

- ▶ 41 ha (100 acres) tame pasture that is rented
- ▶ 35 cow-calf pair graze from June to October and then 120 cows grazed for two weeks in November in 2009
- ▶ Two drainage channels flow west to east and one is monitored (station 324)
- ▶ BMP designed to address impact of cattle and includes:
  - Additional fences
  - Grazing management plan
  - Off-stream water development
  - Possibly other cattle distribution tools (e.g. windbreak)



The South Pasture site showing the new cross fencing and the new water line.

BMP installation  
May 2010



Fence post pounding



Water line installation



Water connection for trough



Trough for off stream water

## Stop 2: East Field Site (EFD)

### Field Management

- ▶ An annual crop field in 2007; an alfalfa and grass field in 2008 and 2009
- ▶ Historically, liquid dairy manure applied annually, but the most recent application was in fall 2007
- ▶ No additional nutrients are required for crop growth in 2010
- ▶ A small plot demonstration trial was completed in 2009 to determine alfalfa response to liquid manure application

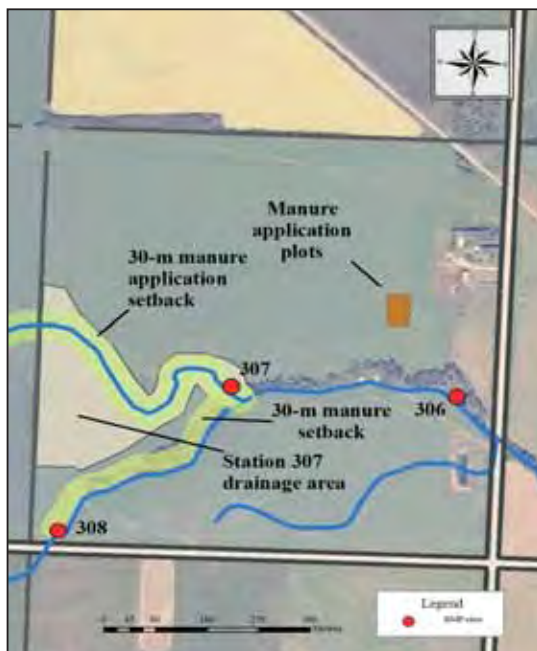
### Water quality monitoring

- ▶ Non connective flow at water quality monitoring stations
- ▶ Station 307 has a contributing area of 16 ha and will be used to evaluate water quality

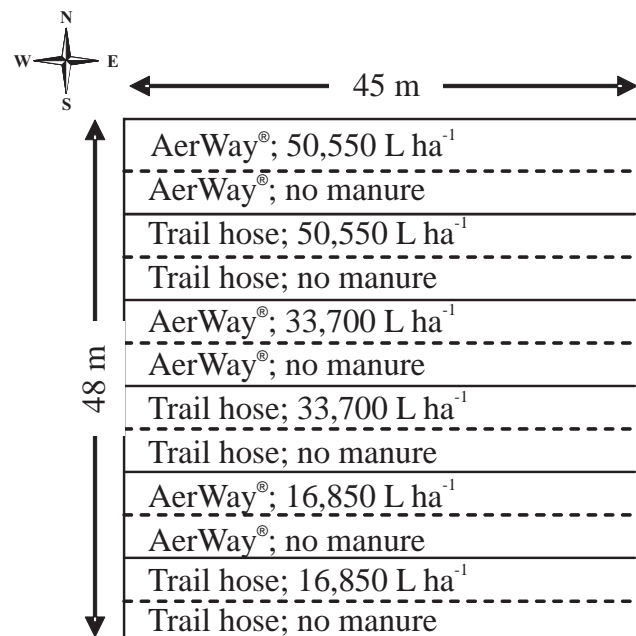
### Practice change evaluation (spring 2010)

*Rationale:* Forage crops may be an alternative land base for manure application, recognizing that producers may have a limited land base. The environmental risk of this practice will be assessed.

- ▶ Surface manure was applied in the drainage area of 307
- ▶ A 30 m setback from the drainage channel was used
- ▶ Manure was applied with AerWay® based on a 1-yr phosphorus removal



The East Field Site showing 3 water quality monitoring stations and the 16 ha drainage area to 307. Liquid dairy manure will be applied to the 16 ha and water quality will be monitored in 2010. The 2009 manure application plots are shown.



The manure plot trial showed a yield increase of about 10% when manure was applied at the highest concentration. Yield differences were less for the lower manure application rates and there was no clear difference between the two application implements.

### Stop 3: North Pasture Site (NPS)

- ▶ Historically, a 5 ha pasture used for grazing dairy cattle
- ▶ In 2009, the pasture was expanded to the NE for a total of 10 ha
- ▶ Off-stream water has traditionally been provided
- ▶ About 18 heifers grazed from June to August and then 5 beef cattle and 2 calves grazed from September to November in 2009
- ▶ Pasture was broadcast fertilized June 30, 2009 with 225 kg/ha nitrogen
- ▶ BMP designed to address cattle direct access and impact. It includes:
  - Bioengineering for bank erosion
  - Fencing to restrict cattle access
  - Continued increased pasture size for a sustainable stocking rate



The North Pasture site showing Whelp Creek and the water monitoring stations.



A small area of the creek was fenced off from cattle access in May, 2010

Pre-BMP (2008)



Post BMP (2009 and 2010)



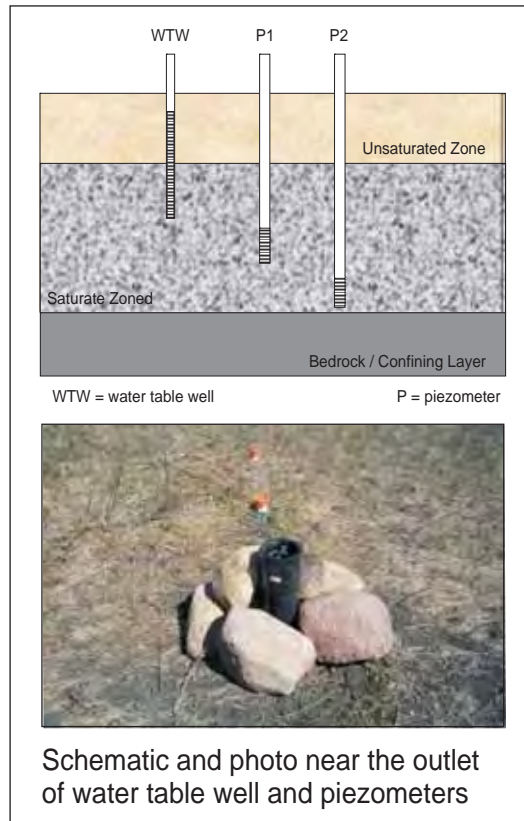
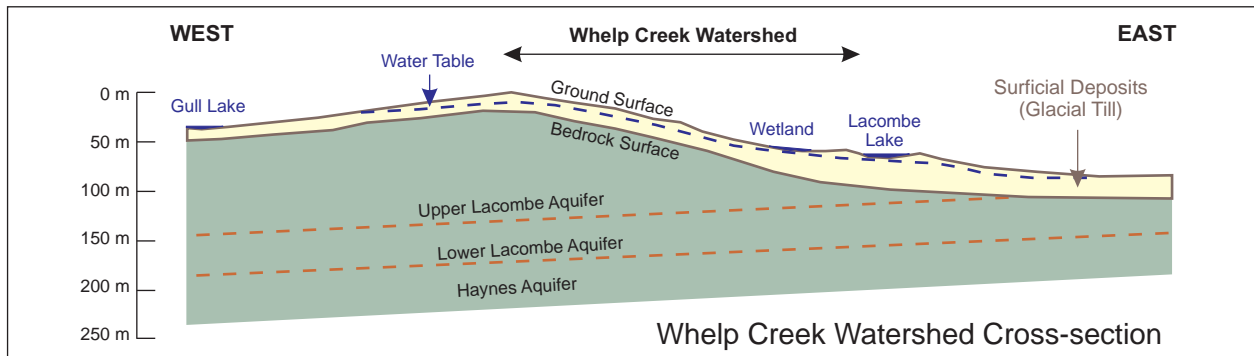
### Stop 4: Groundwater Study in Whelp Creek

Collaboration of University of Alberta and Alberta Agriculture and Rural Development

**Goal:** To understand the physical and chemical characteristics of groundwater in the Sub-watershed and its influence on surface water quality and flow.

#### Instrumentation in 2009

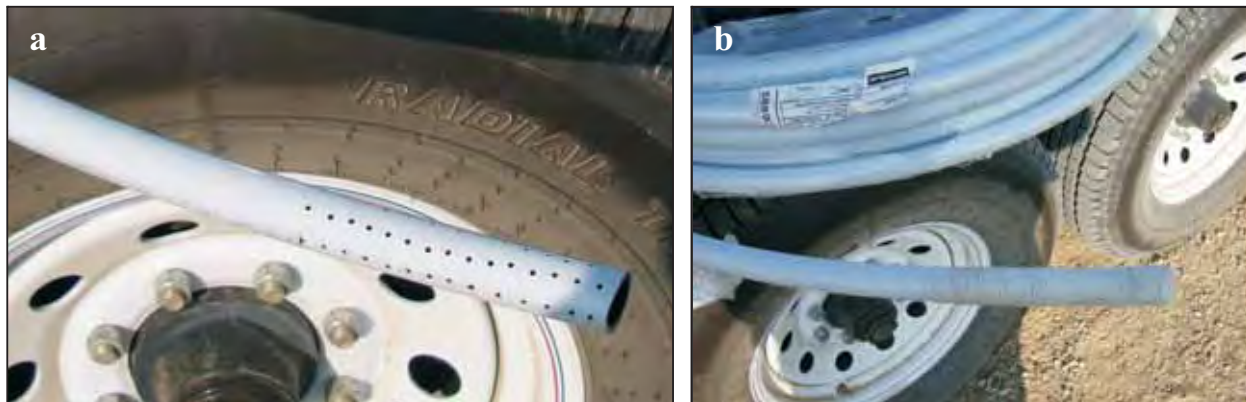
- ▶ 17 nests in the Sub-watershed plus 10 nests east of the Sub-watershed
- ▶ nest = 1 water table well + 2 piezometers



Map of the groundwater nests in the Whelp Creek area

### Well Installations

- ▶ Water table well depths range from 2.4 m to 7.3 m (average 4.1 m); 3 m slotted interval
- ▶ Piezometers were installed at two depths ranging from 2.8 m to 17.1 m (average 7.7 m); 0.11 m slotted interval



Stages of piezometer screen construction: (a) slotted interval (b) completed piezometer screen.

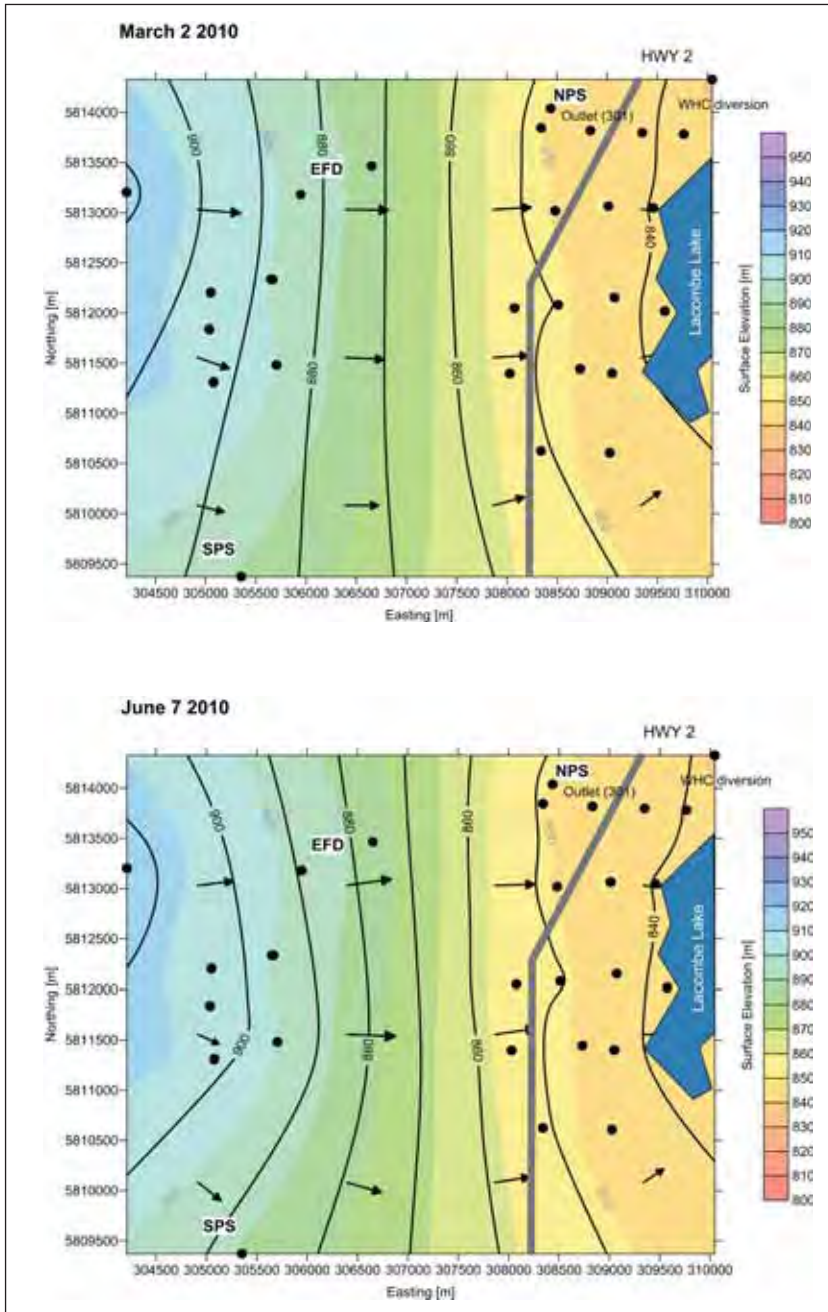


Groundwater wells were installed using a Geoprobe® 7730DT (a hydraulically powered soil probing unit), which allows installation with minimum soil disturbance.

**Preliminary Groundwater Findings from 2010**

**Flow**

- ▶ The water table becomes shallower moving from west to east across the watershed. This is consistent with the range of water level measurements for Lacombe County (Hydrogeological Consultants Ltd. 2001).
- ▶ General lateral flow within the basin, switching to upwards movement towards the eastern part (discharging).



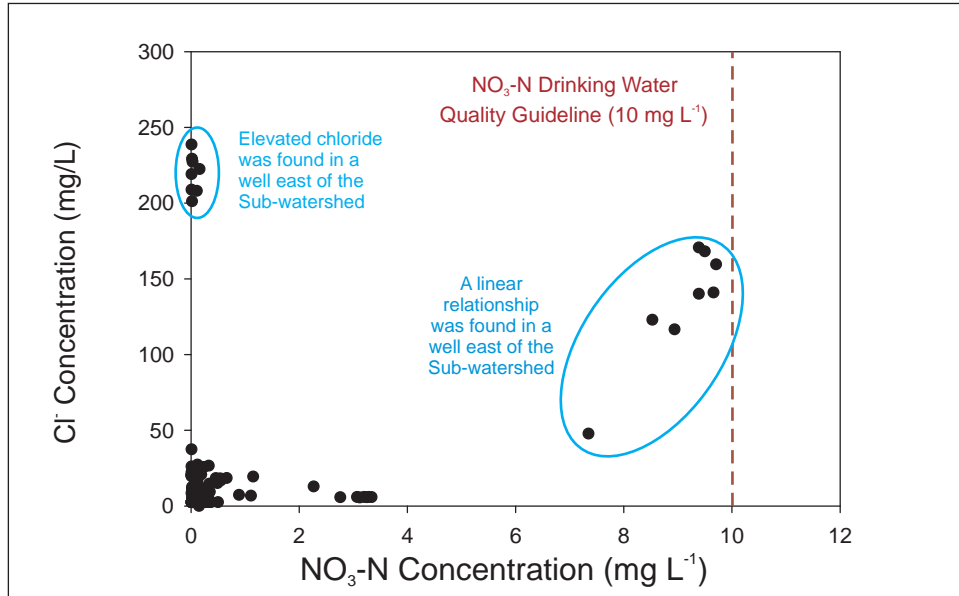
Levellogger in the groundwater well near the watershed outlet records water table height.

Groundwater flow in the Whelp Creek area.

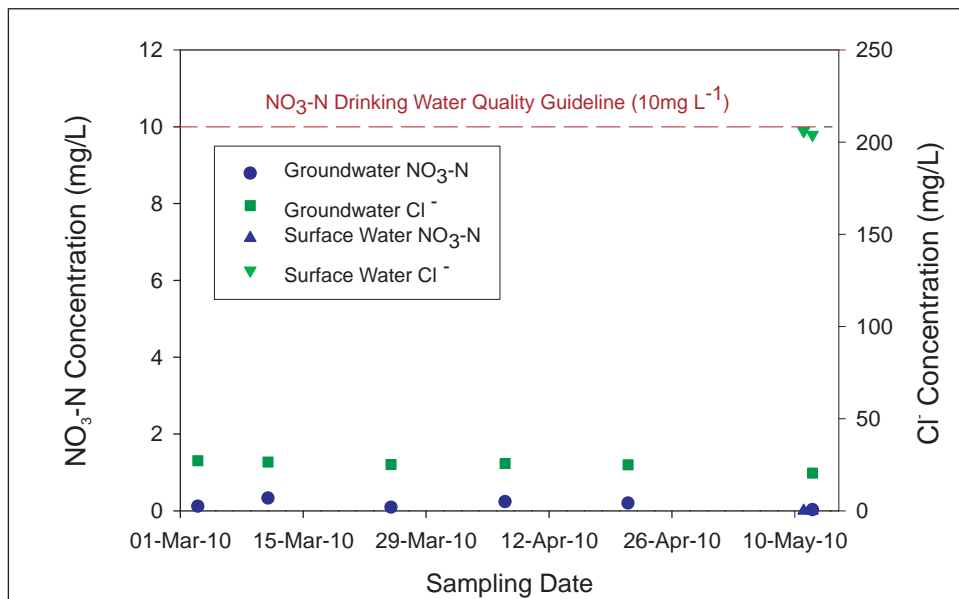
**Preliminary Groundwater Findings from 2010**

**Quality: Nitrogen and Chloride**

- ▶ Nitrate-nitrogen and chloride concentrations in the Whelp Creek Sub-watershed are generally low, and similar or less than surface water concentrations.
- ▶ The nitrate-nitrogen concentrations do not exceed the 10 mg/L drinking water quality guideline.



Nitrate-nitrogen ( $\text{NO}_3\text{-N}$ ) and chloride ( $\text{Cl}^-$ ) concentrations in groundwater from the Whelp Creek area in spring 2010.

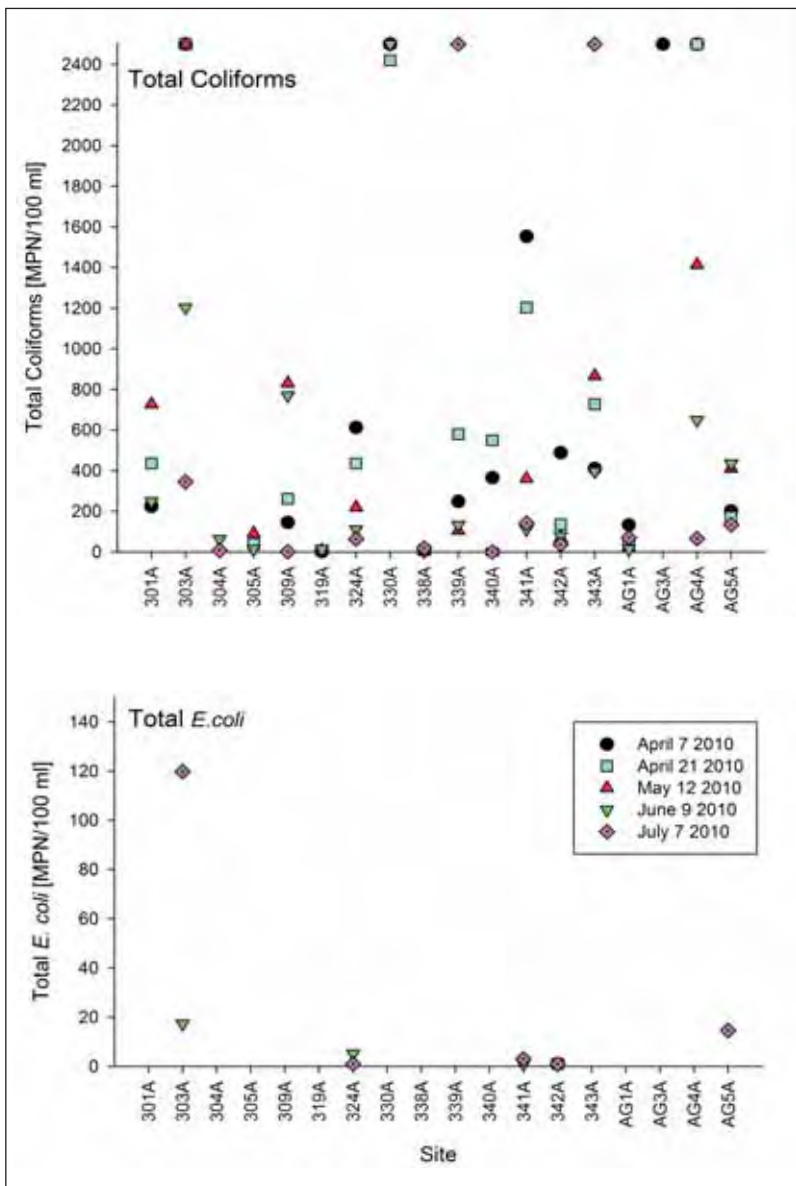


Nitrate-nitrogen and chloride concentrations in surface and groundwater near the Whelp Sub-watershed outlet in 2010.

**Preliminary Groundwater Findings from 2010**

**Quality: Bacteria**

- ▶ Collaboration with Alberta Provincial Laboratory for Public Health in Edmonton, AB (Dr. Neumann).
- ▶ Water table samples collected since April 2010 at all sites that provide enough sample volume (approximately 16 sites).
- ▶ Hot spots (high concentrations) for total coliforms in the eastern part of the Sub Watershed and east of the highway.
- ▶ Generally, *E. coli* in the groundwater is absent until June and July. Presence of *E. coli* (>1 MPN/100 mL) observed at a two sites (303 and 324) and in the south, east of the highway.



MPN= most probable number

Total coliforms are a group of closely related, mostly harmless bacteria from many sources including soil, vegetation, sediment, and animal waste (livestock, wildlife and humans).

*Escherichia coli* are indicators of fecal bacteria and their presence indicates fecal contamination from a warm blooded animal.

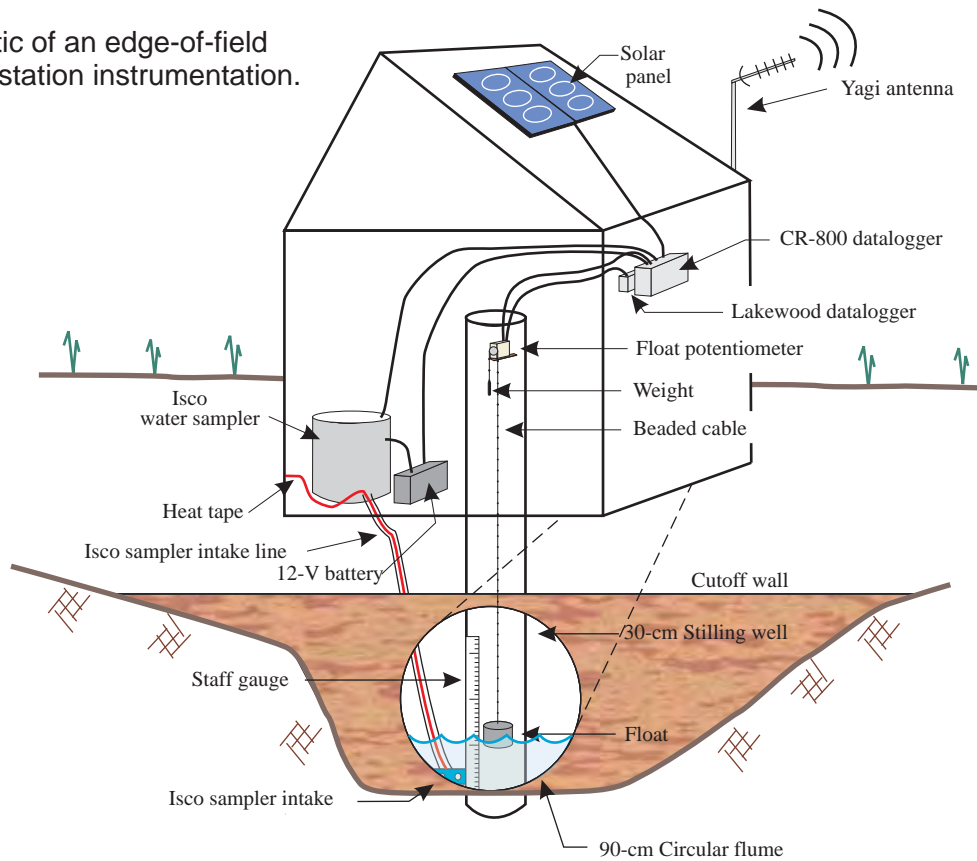
Bacteria concentrations in groundwater wells from the Whelp Creek area in 2010.

### Site Equipment in the Whelp Creek Sub-watershed

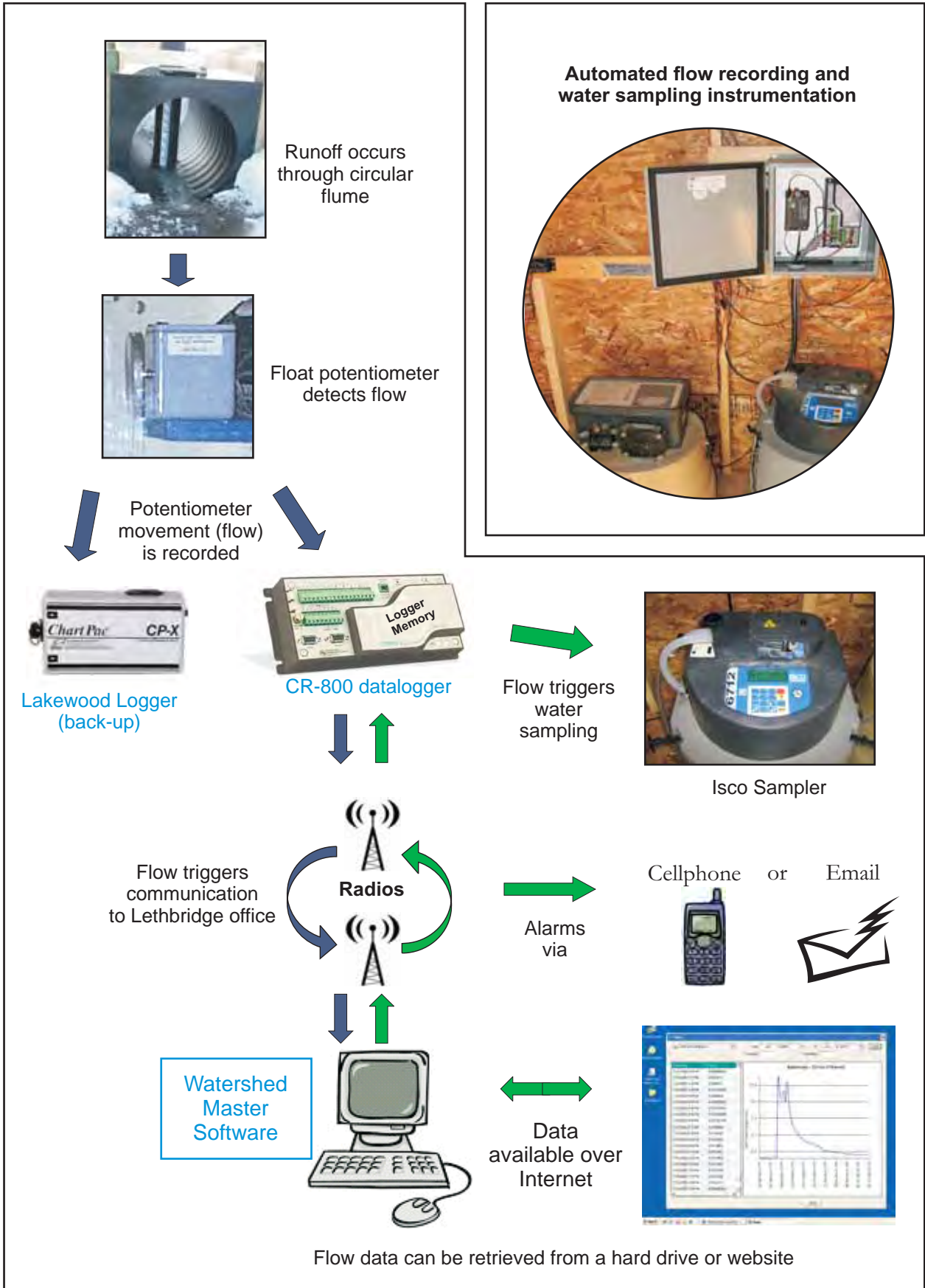
There are:

- ▶ 20 surface water quality and flow monitoring stations
- ▶ 2 weather stations

Schematic of an edge-of-field monitoring station instrumentation.



### Runoff Event Communication Diagram



### Stop 5: Whelp Creek Diversion to Lacombe Lake

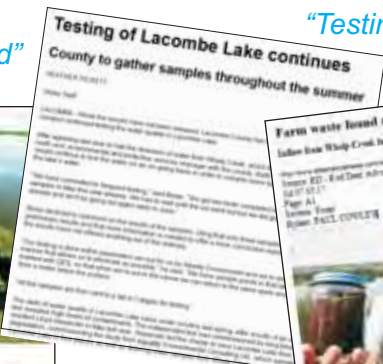
- ▶ Lacombe County, with the help of PFRA, constructed a water diversion project that redirected the flow of Whelp Creek into Lacombe Lake in 1970
- ▶ Intent of the project is uncertain but it was likely to stabilize lake levels and provide a domestic supply to users downstream of the lake in dry years; but, it may have also been done for flood control
- ▶ Residents around Lacombe Lake have been concerned about apparently deteriorating water quality in the lake as well as the high lake levels
- ▶ A preliminary study in 1999 suggested Whelp Creek water quality is of concern and agriculture has been implicated
- ▶ Lacombe County halted all diversions of Whelp Creek into the lake in 2008 and the county has been conducting tests to determine the background quality of the lake water with advice from Alberta Environment



**Whelp Creek diversion infrastructure**

Lacombe Lake is a relatively shallow water body. The quality of the lake is dependent on runoff from the watershed, including several inflowing streams, groundwater movement and natural processes such as eutrophication.

*“Water quality being probed”*



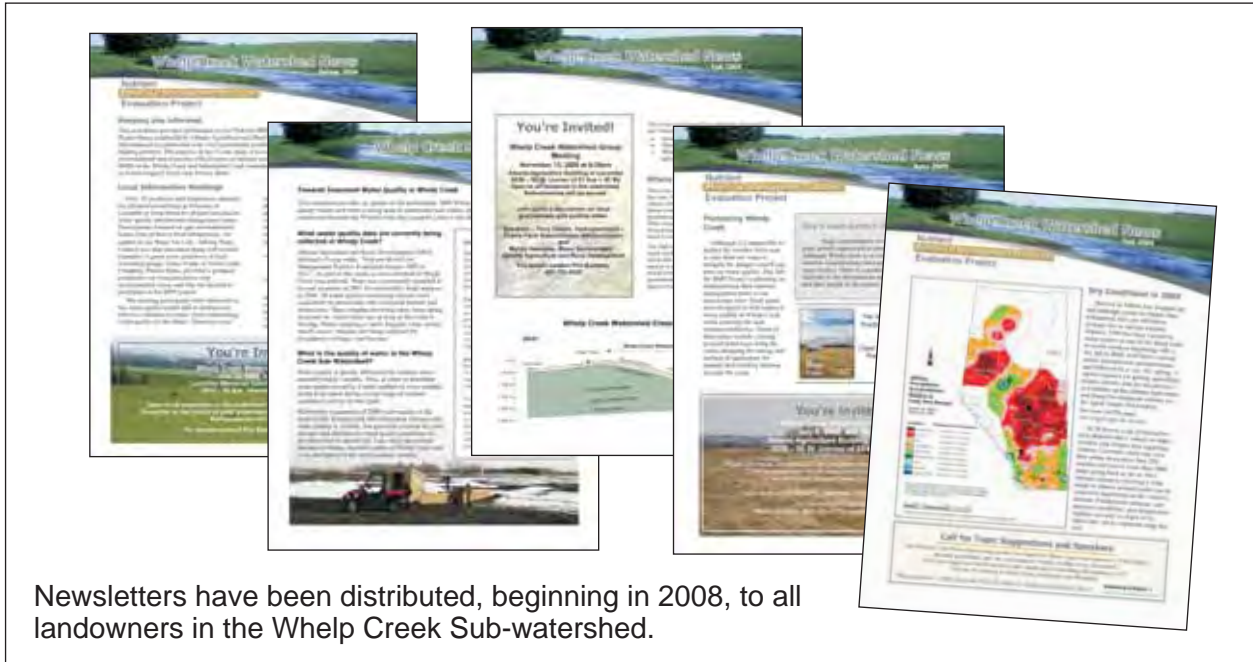
*“Testing of Lacombe Lake continues”*



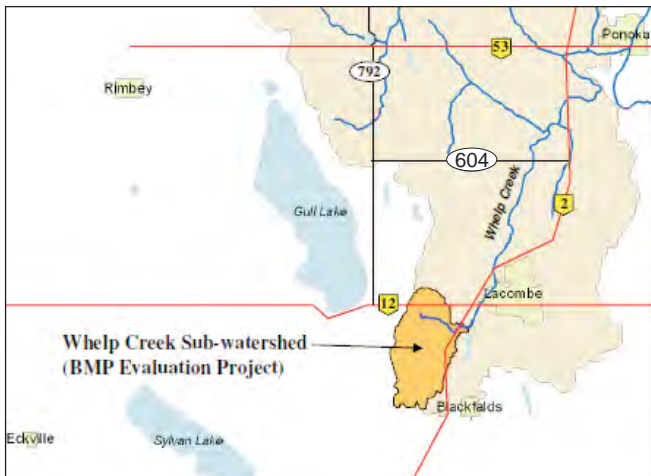
*“Farm waste found running into Lake”*

**Whelp Creek Watershed Group**

- ▶ Watershed group formation began in spring 2008
- ▶ Provides a forum for all watershed residents to address environmental concerns in their watershed
- ▶ Group may receive support for wetland restoration as a result of habitat loss from transportation improvements on Highway 604



Newsletters have been distributed, beginning in 2008, to all landowners in the Whelp Creek Sub-watershed.



Map showing proximity of highway 604 to Whelp Creek. Construction will result in the loss of wetland habitat along the highway.

**For more information on the BMP project go to the web site:**

[www.agric.gov.ab.ca](http://www.agric.gov.ab.ca)

Type the project title "Nutrient BMP Evaluation Project" in the search option