Phosphorus Filter Project

September 21, 2018




FARM STEWARDSHIP CENTRE

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Project Partners

COUNTY OF WARNER

OSU

Growing Forward 2

A federal-provincial-territorial initiative

USDA United States Department of Agriculture
Agricultural Research Service

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Oklahoma State University – Dr. Chad Penn

- Filters designed for the removal of dissolved phosphorus (P) from runoff water
- Industrial by-products used for phosphorus sorption
  - Acid mine drainage residuals
  - Drinking water treatment residuals
  - Steel slag
  - Gypsum
  - Fly-ash
- PhROG Model (Phosphorus Online Removal Guidance)
  - Model to aid in the design of filters based on:
    - Inflow P concentrations
    - Flow volumes
    - Retention time
    - Phosphorus sorbing characteristics (media)

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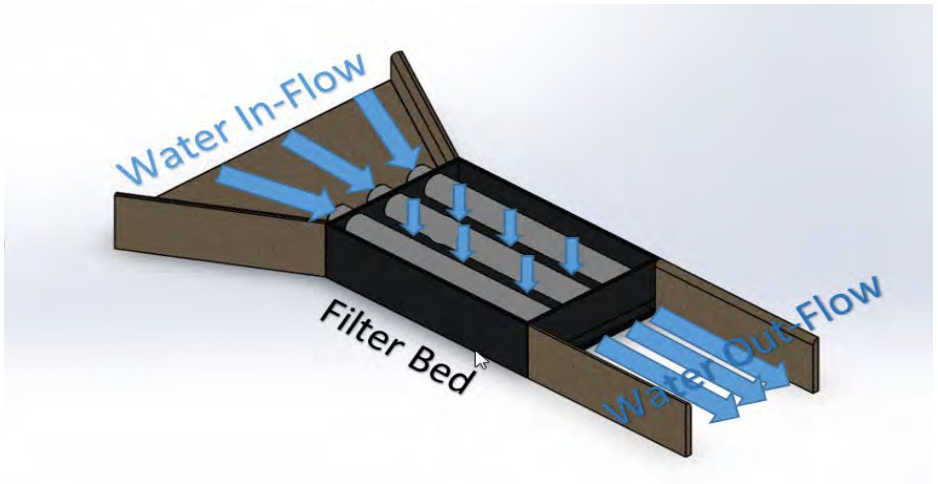
Current OSU applications

- Poultry Farm drainage
- Golf course drainage



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Project Purpose

- Verify effectiveness of technology in Alberta

Project Goals

- Test effectiveness for seasonal differences
- Identify and test local by-product materials as filter media sources
- Determine if technology is a cost effective management tool



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Project Background

- Milk River Ridge Reservoir – potable water source
- Deterioration in water quality of the reservoir
- Monitoring program by Warner County and Alberta Environment and Parks (AEP)
    - Milk River Ridge Reservoir Water Quality 2014 – 2015 (Cecilia Chung, AEP)
- Tributary 4 – high dissolved P (2014 max: 3.9 mg/L, median: 1.6 mg/L)

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Site selection and filter design

Important information:

- Drainage area
  - GPS – elevations
  - GIS – mapping
- Flow rates
  - Estimates based on culvert sizing and SCS runoff curve number method
  - Potential peak flow rate of ~1m^3/s
- Nutrient concentration
  - 4 mg/L (AEP report)
- Filter media and characteristics
  - Porosity
  - Phosphorus sorption capability
- PhROG model output

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Site selection and filter design

Controlled flow filter

Benefits:

- Economics
- Longer contact time
- Reduced chance of fouling/plugging
- Demonstration access

Other BMPs implemented:

- Perimeter fencing
- Off-stream watering system
- Perennial seeding of low areas

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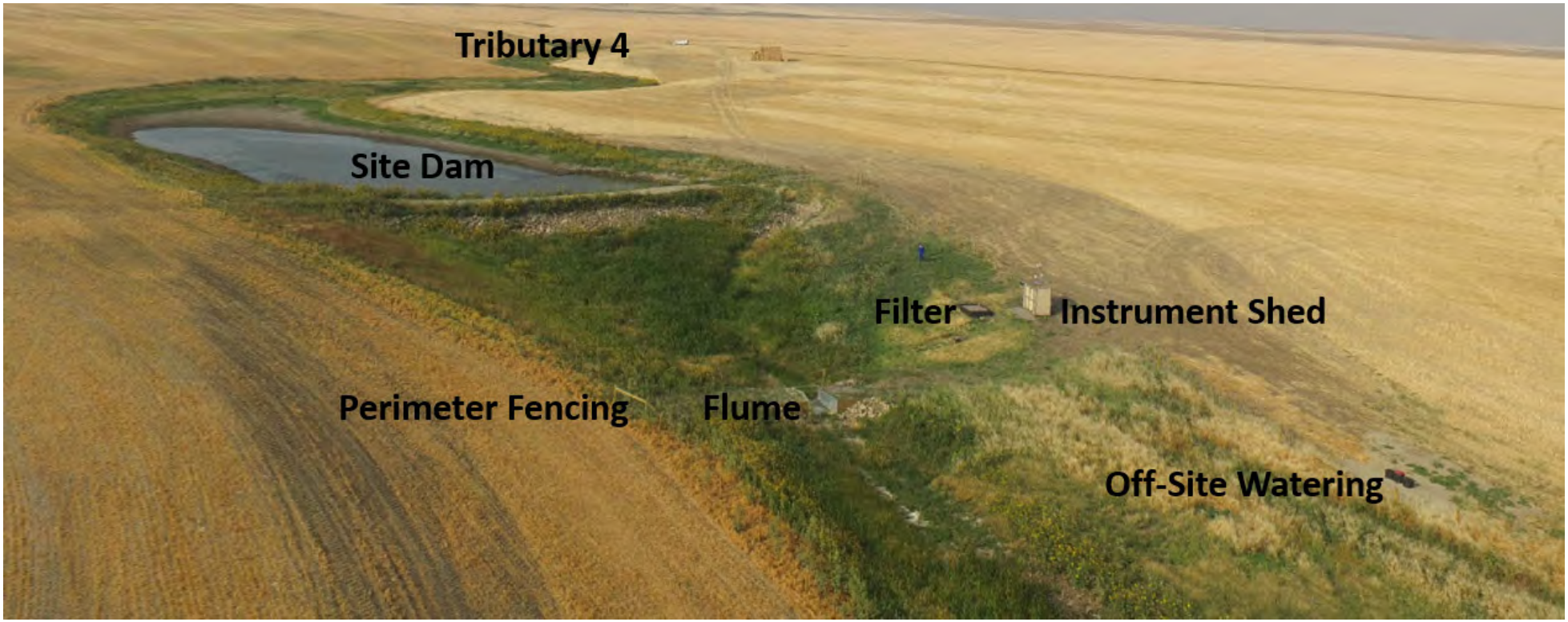

Filter Site August 17, 2017

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Monitoring and Sampling Equipment:

Channel flow

- Cut-throat flume
  - Pulsar DB3 Ultrasonic water level sensor
  - CR1000 data logger + remote access

Filter flow

- Tipping bucket flow gauge

Sampling

- 2 – ISCO 6712 auto-samplers

Weather

- Air temperature & RH
- Rainfall
- Solar radiation
- Wind Speed & Direction

Media

- Media temperature
- Inlet water temperature

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Cutthroat Flume to monitor total flow

(filter + tributary)

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Filter Construction



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Filter Construction

Upstream view – higher inlet, lower outlet

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Tipping Bucket – filter flow sensor

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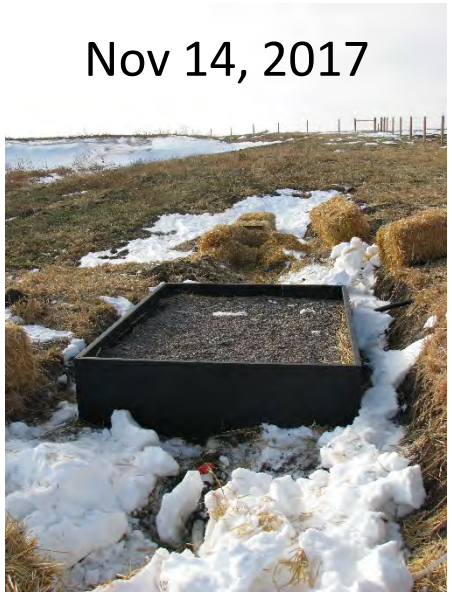
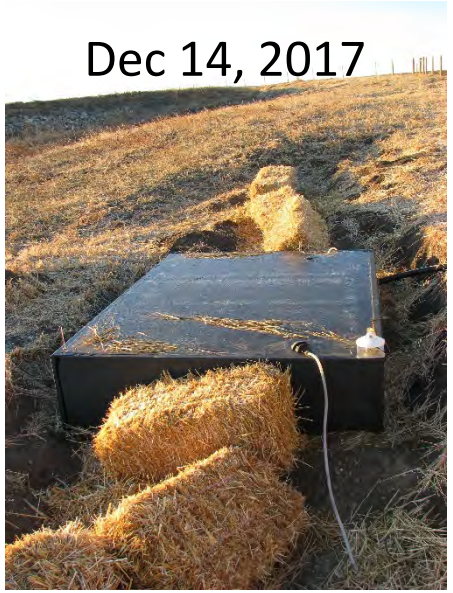
Cold Weather Testing

Nov 6, 2017

Nov 14, 2017

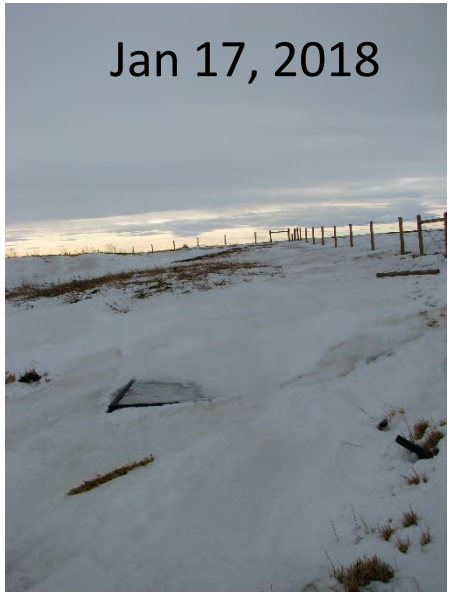


Dec 14, 2017



Dec 21, 2017

Jan 17, 2018



Apr 11, 2018

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Results to date

Phosphorus (P) Filter Performance					
Water Sample Date	Water Temperature	Water Flow Through	Dissolved P Inlet	Dissolved P Outlet	Dissolved P Removed
dd/mm/yy	Degrees C	L/Min	mg/L	mg/L	%
22-Jun-17	16	16	0.81	0.01	99
29-Jun-17	16	16	0.61	0.01	98
29-Jun-17	16	17	0.54	0.01	98
6-Jul-17	18	12	1.57	0.05	97
27-Jul-17	19	13	1.99	0.03	98
30-Oct-17	6	9	0.40	0.02	95
2-Nov-17	3	12	0.34	0.03	92
14-Nov-17	5	7	0.60	0.03	96
14-Nov-17	5	7	0.48	0.02	97
18-Dec-17	5	3	0.40	0.07	83
26-Jun-18	16	1	0.87	0.04	95
12-Jul-18	25	11	0.96	0.08	91

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Lessons learned to date:

- Need water
- AEP process
- Pre-data (flow)
- Drainage area
- Media sourcing/cost
- Mother Nature
  - Cold conditions – impacts on equipment
  - Rodents
  - Flume issues - undercut
- Plugging

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Contact Info:

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