

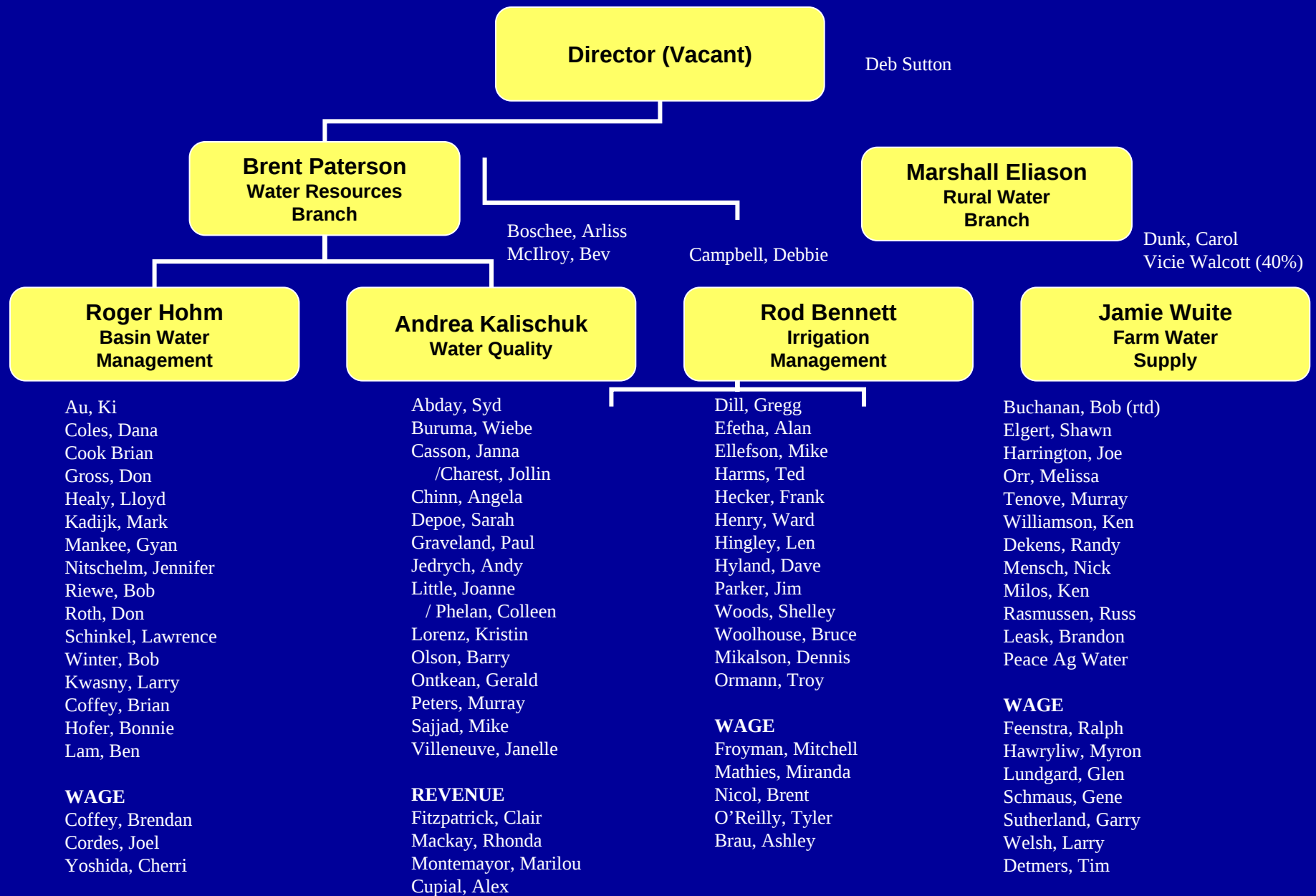
Alberta Agriculture Water Measurement

**“You can’t manage what you
don’t measure.”**



**Lawrence Schinkel
Senior Monitoring Tech.
Alberta Agriculture
and Rural Development
Agriculture Water Division
Water Resource Branch
Basin Water Management Section**

Agriculture Water Division



Flow Measurement:

Flow Metering

Weirs

Flumes

Control Structures

Pipeline Flow Meters

Water Quality

Demonstration Site

Key References:



**United States Bureau of
Reclamation (USBR)
Water Measurement Manual**

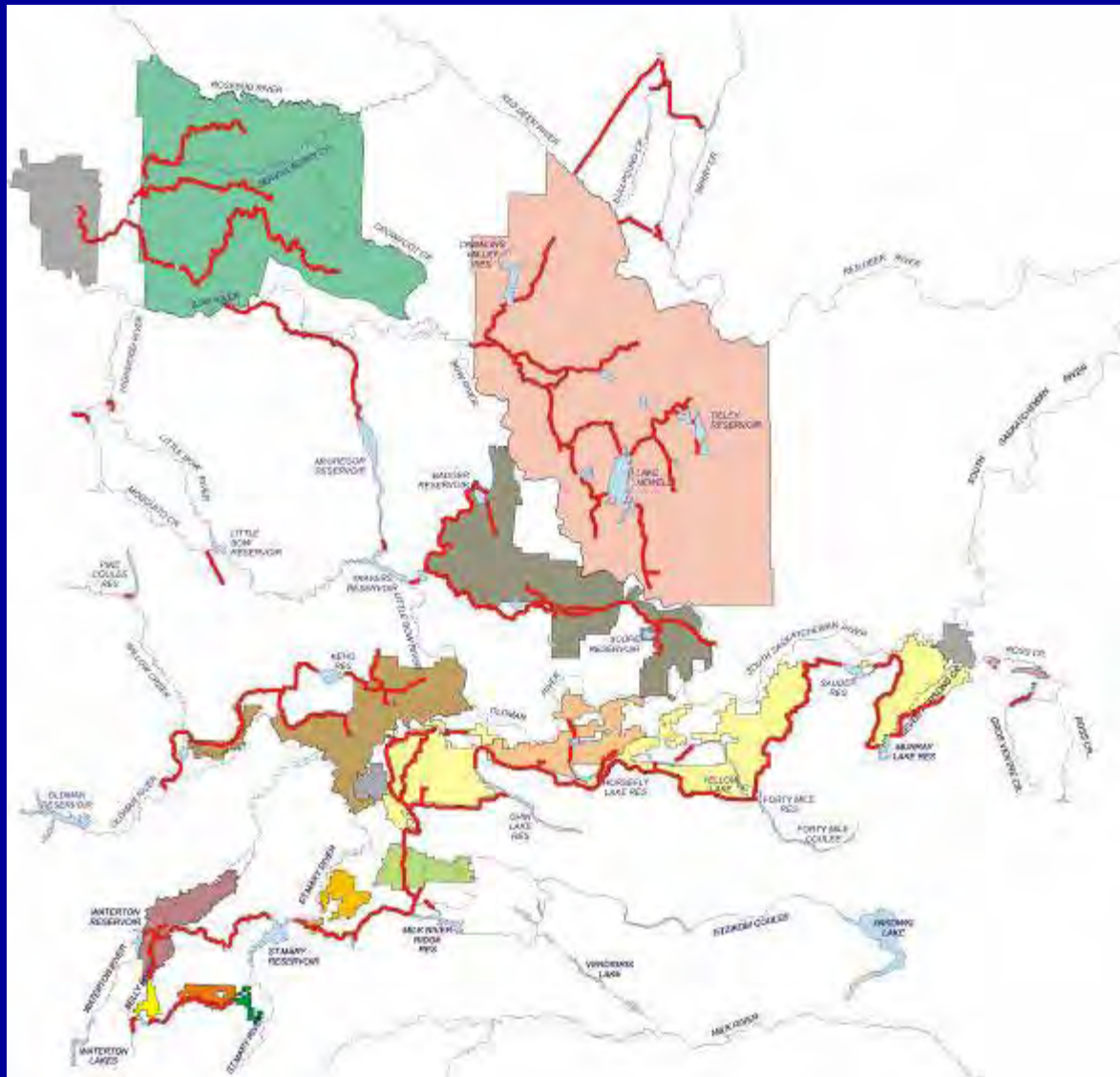


**United States Geological Survey
(USGS)
Environment Canada
Alberta Environment**

ARD Works closely with:

- 13 Irrigation Districts**
- Alberta Environment**
- Consultants**
- PFRA**
- Vendors**

Southern Alberta has over 8000 km's of conveyance systems to supply irrigation water to over 1.3 million acres



Alberta Agriculture flow measurement history

- Began with Current-Price AA Meter in the early 1980's
- Started with Alberta Environment and Environment Canada equipment and methodology
- In early 1990's started using Swiffer Velocity Meters (Fibre Optic Technology)
- References from USBR & Army Corps of Engineer



ARD Safety Procedure:

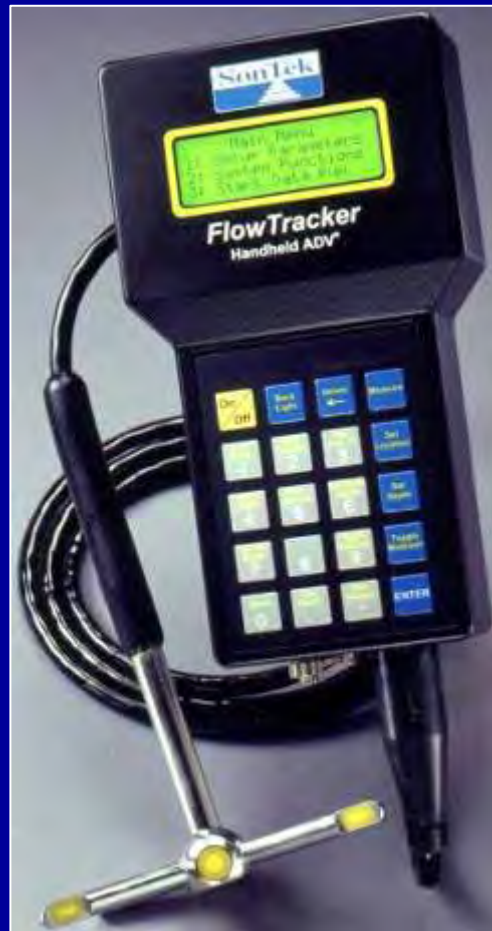
- 2 person team**
- Life jackets or float coats**
- Beacon for truck**
- Road / Bridge signage**
- Pylons**
- Use pulley system instead of bridges**
- Install small walkways to avoid wading**



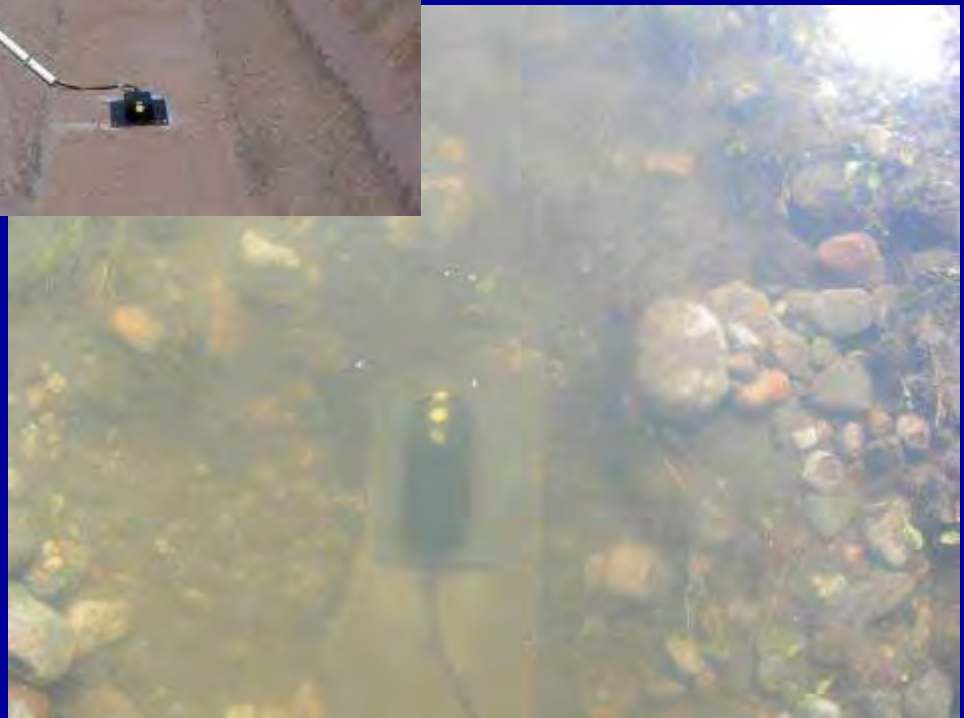
Manual Flow Metering with Swoffer Velocity Meter



Flow Metering with Doppler wading technology

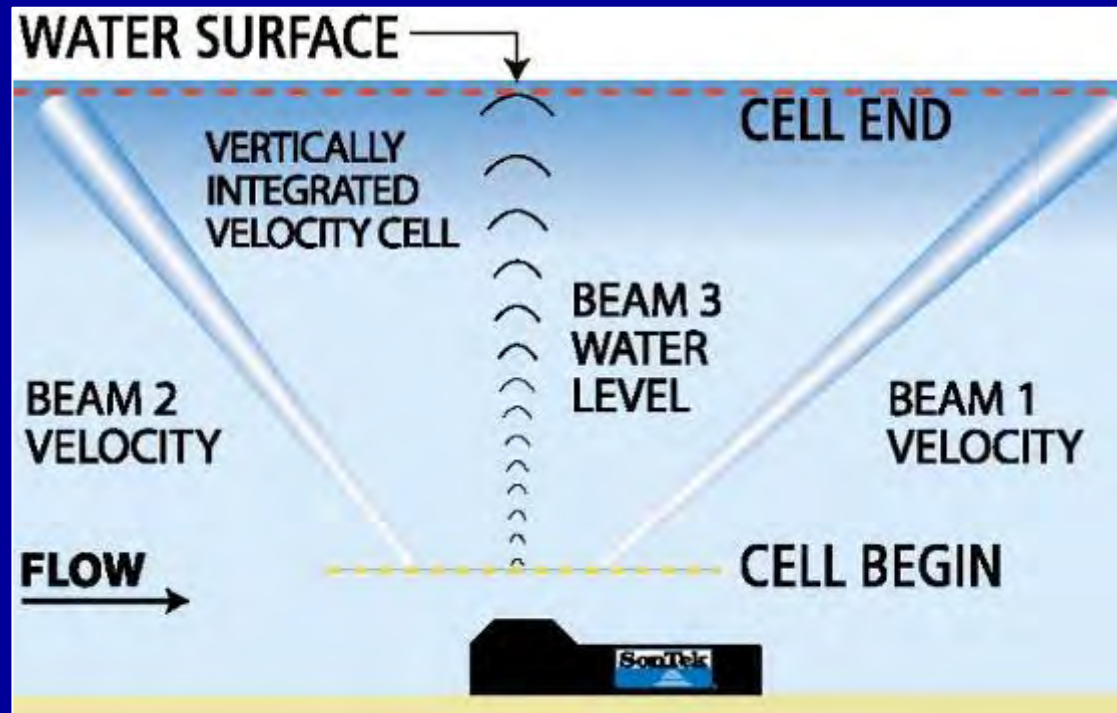


Flow Metering with Canal Bed Doppler Technology



SonTek Argonaut SW Test Results 2004

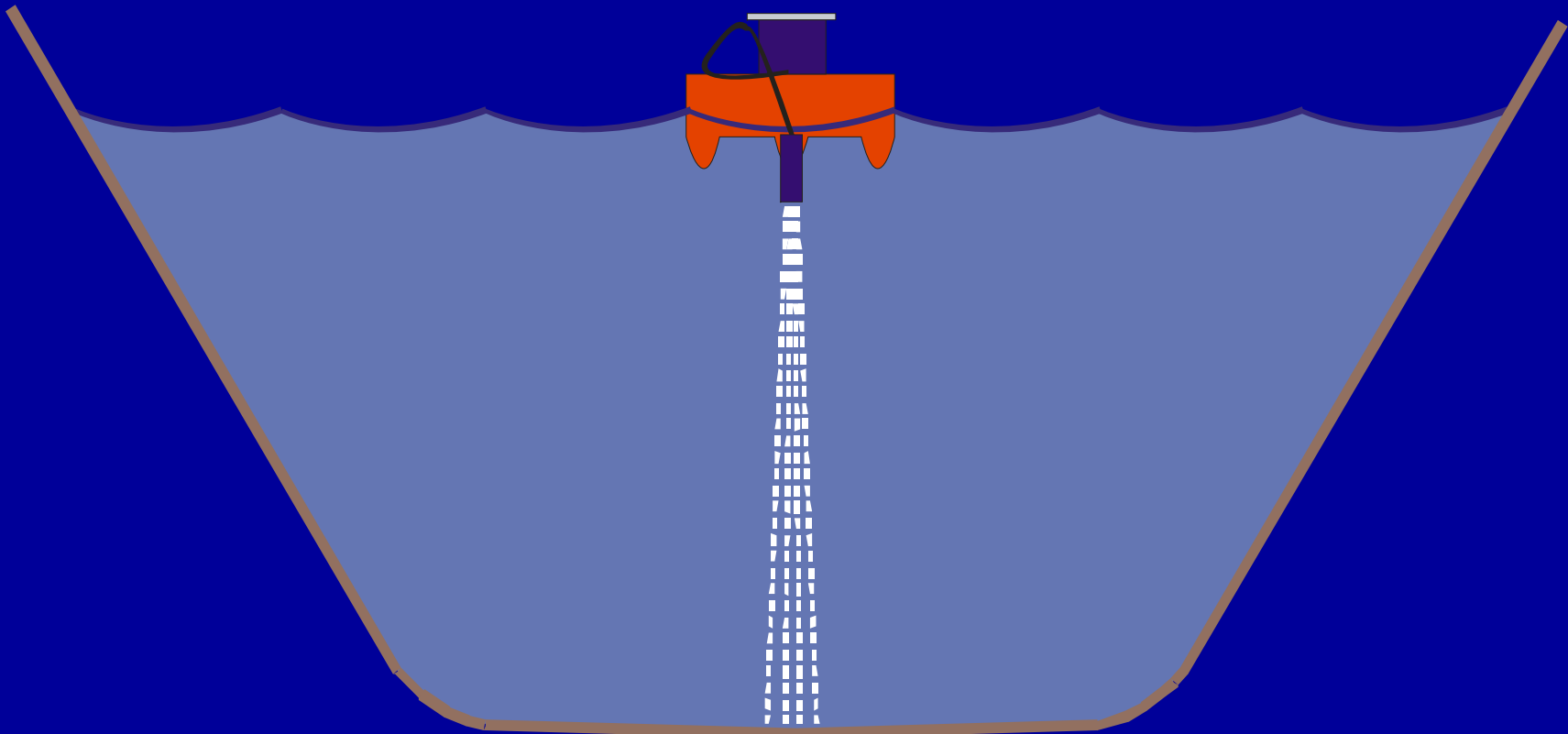
Flow in CFS	Reference Flow Difference (%)
4	2.5
15	1.72
165	10.72
560	2.53
Average	4.37



Acoustic Doppler Current Profiling (ADCP)



Acoustic Doppler Current Profiler (ADCP) Hydro Acoustic Measurement



Acoustic Doppler Current Profiling (ADCP) Testing



Alberta Agriculture Testing Protocols & Scenarios:

- High Flow High Velocity River
(3000-4000 cfs)**
- High Depth (10-13 ft) slow flows
(300-400 cfs)**
- Medium Flows (100-300 cfs)**
- Low Flows (under 30 cfs)**
- Heavy Weed bed**
- Concrete Canals**
- Terra-Nap Liner (Asphalt Liner)**

Stream Pro Test August 29th, 2007

South Saskatchewan River vs Environment Canada ADCP Workhorse

Earthen River – High Flow

Results:

WSC Workhorse = 3600 cfs

WSC StreamPro = 3600 cfs

Rating Curve = 3600 cfs



Difference to Workhorse = 0%

Difference to Rating Curve = 0%

Stream Pro Test August 17th, 2006 Oldman River at 811 vs Alberta Environment AA Current-Price Meter

Earthen River – Medium Flow

Results:

AENV Current-Price Meter = 400 cfs

ARD StreamPro = 405 cfs

Difference = 1%

2 hours vs 30 minutes



Stream Pro Test August 28th, 2007

SMRID Main Canal at 7 Persons

Armoured Canal – Medium Flow

VS AA Current Price Meter,

Workhorse & RiverCat

Results:

WSC AA Current-Price =125 cfs

WSC Workhorse =131 cfs

SASK RiverSurveyor =138 cfs

ARD Streampro =132 cfs

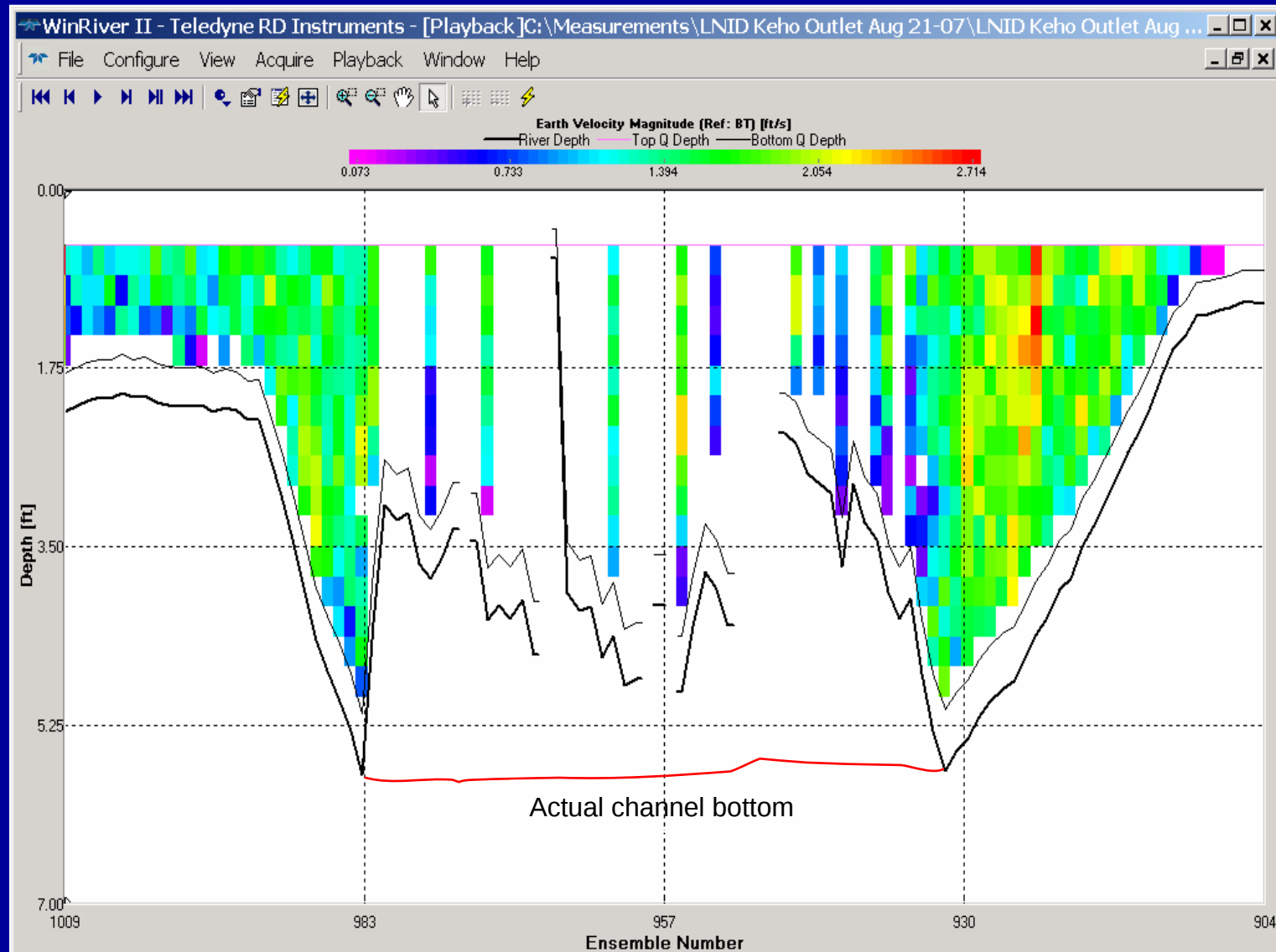
Difference vs AA = 5%

Diff vs Workhorse=1%

Diff vs RiverCat =5%



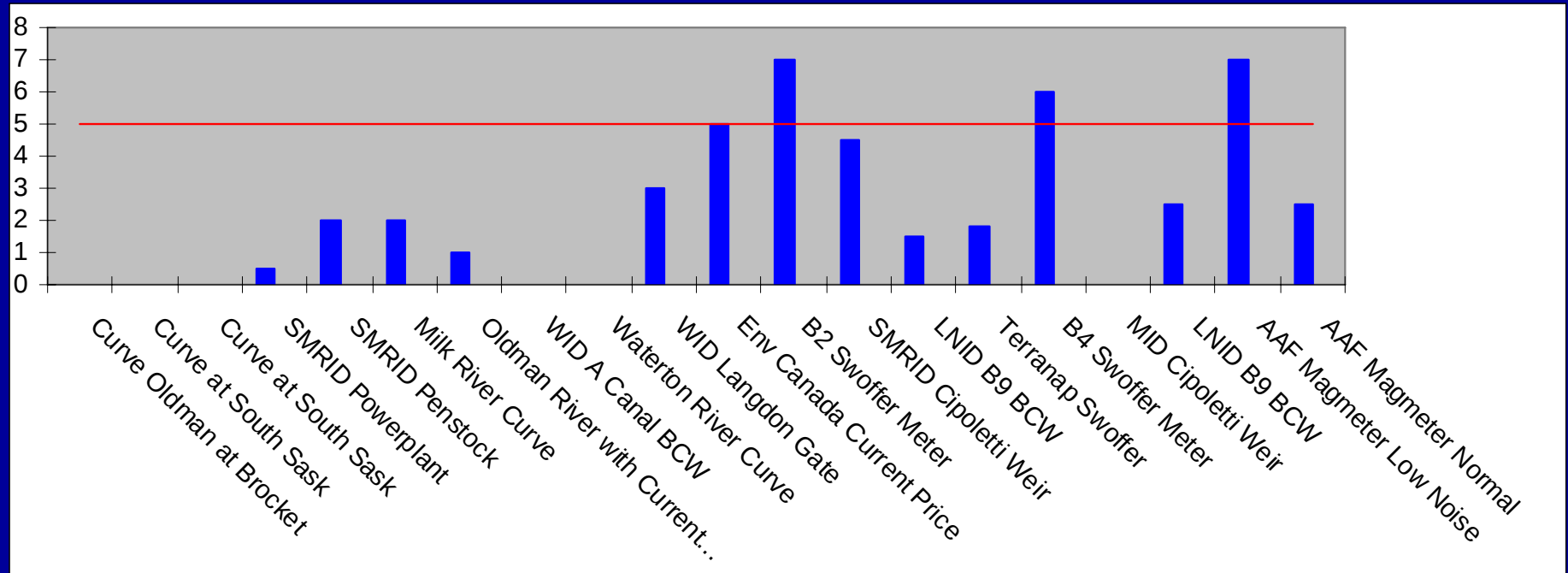
Weed growth test at LNID Keho Lake Outlet = Missing Data



StreamPro Testing Results:

Reference Flow Measurement	Flow Volume CFS	% difference
Curve Oldman at Brocket	4130	0
Curve at South Sask	2800	0
Curve at South Sask	2690	0
SMRID Powerplant	980	0.5
SMRID Penstock	945	2
Milk River Curve	565	2
Oldman River with Current Price	400	1
WID A Canal BCW	230	0
Waterton River Curve	150	0
WID Langdon Gate	150	3
Env Canada Current Price	125	5
B2 Swoffer Meter	70	7
SMRID Cipoletti Weir	55	4.5
LNID B9 BCW	33	1.5
Terranap Swoffer	16	1.8
B4 Swoffer Meter	15	6
MID Cipoletti Weir	15	0
LNID B9 BCW	6	2.5
AAF Magmeter Low Noise	3	7
AAF Magmeter Normal	3	2.5
Overall Average %		2.32

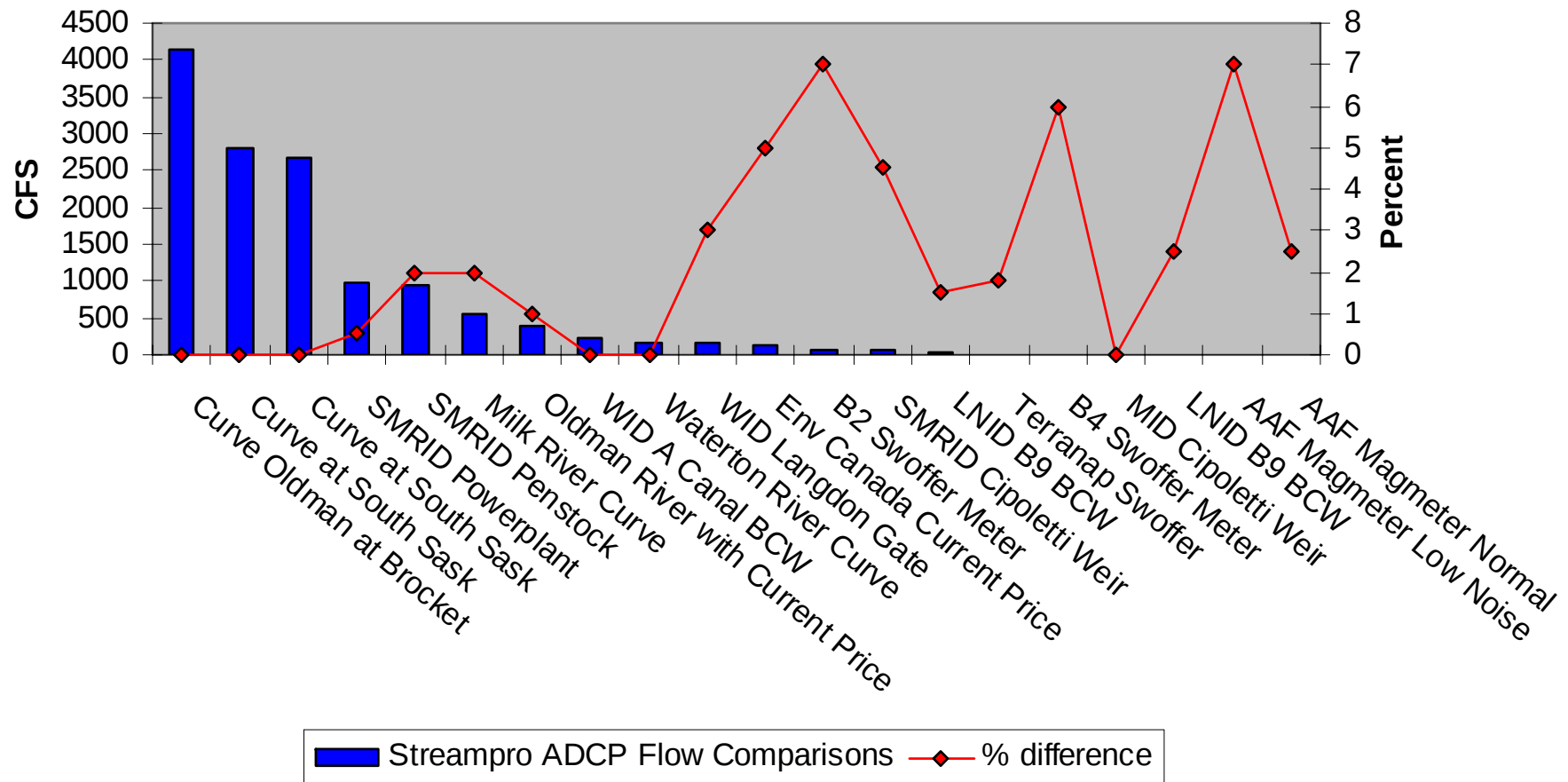
Stream Pro ADCP overall accuracy is 2.3 %



**Findings show better accuracy at
higher flows**

Stream Pro ADCP accuracy in relation to flow volume

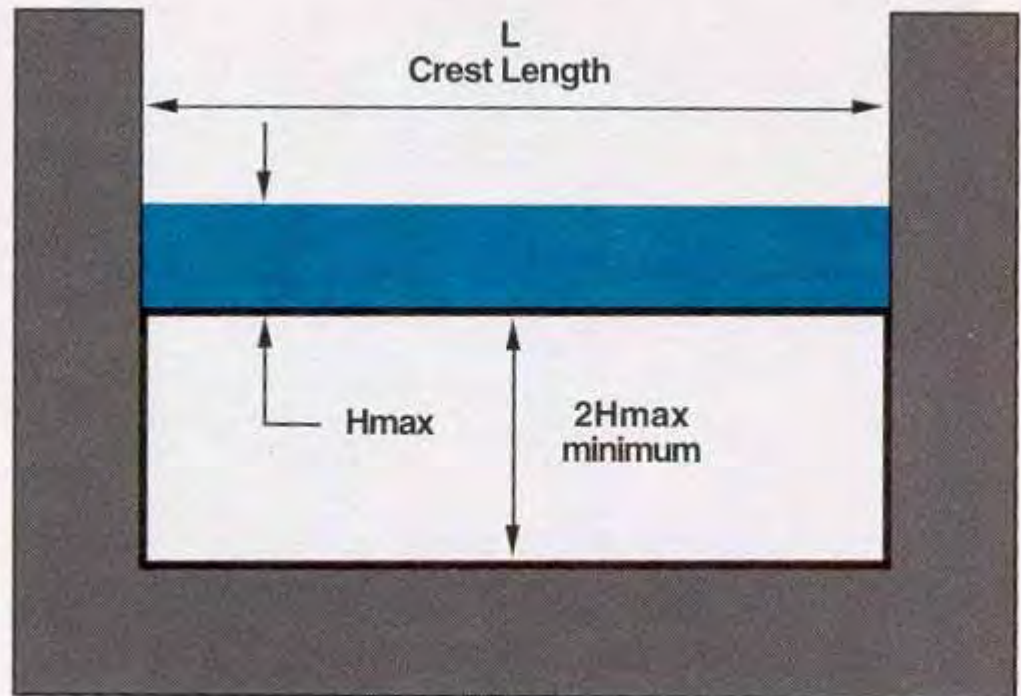
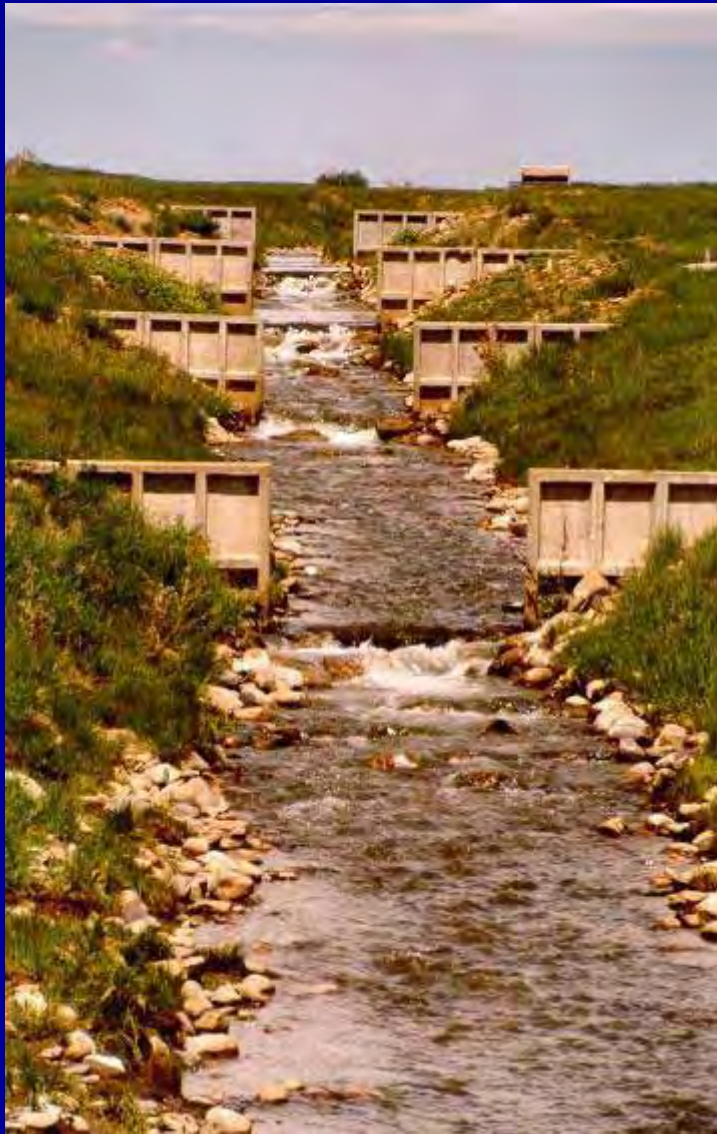
Streampro ADCP Flow Comparisons



Contracted Rectangular Weir

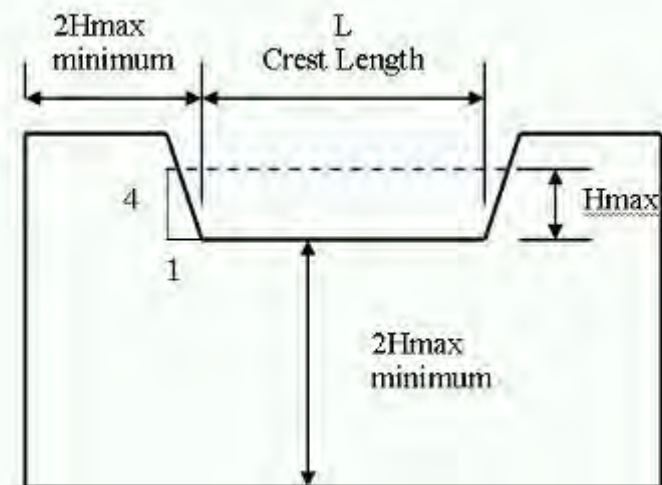
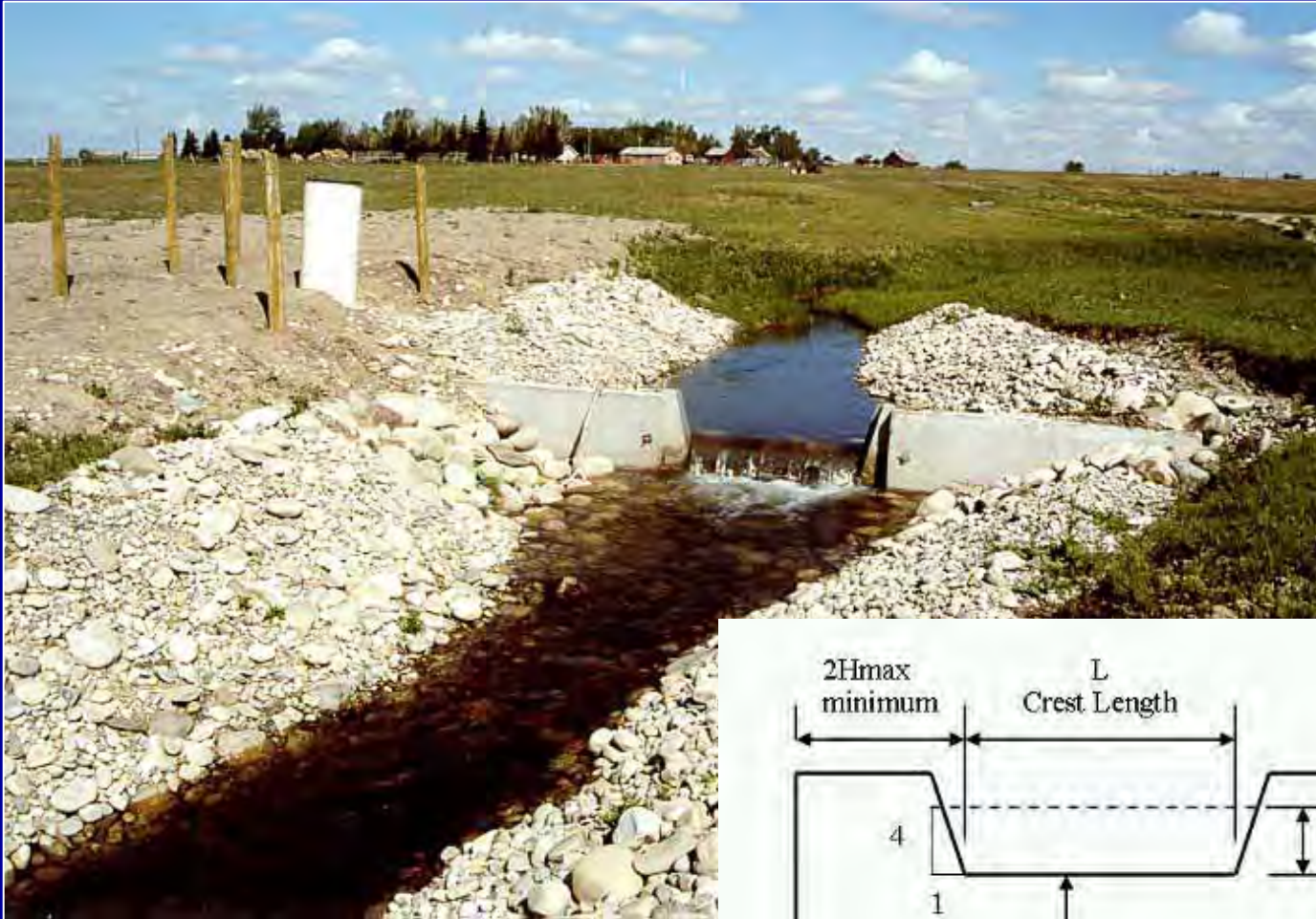


Suppressed Rectangular Weir



B. Suppressed (without end contractions)

Cipoletti Weir



V Notch Weir



Broad-Crested Weir aka Long Throated Flume or Replogle

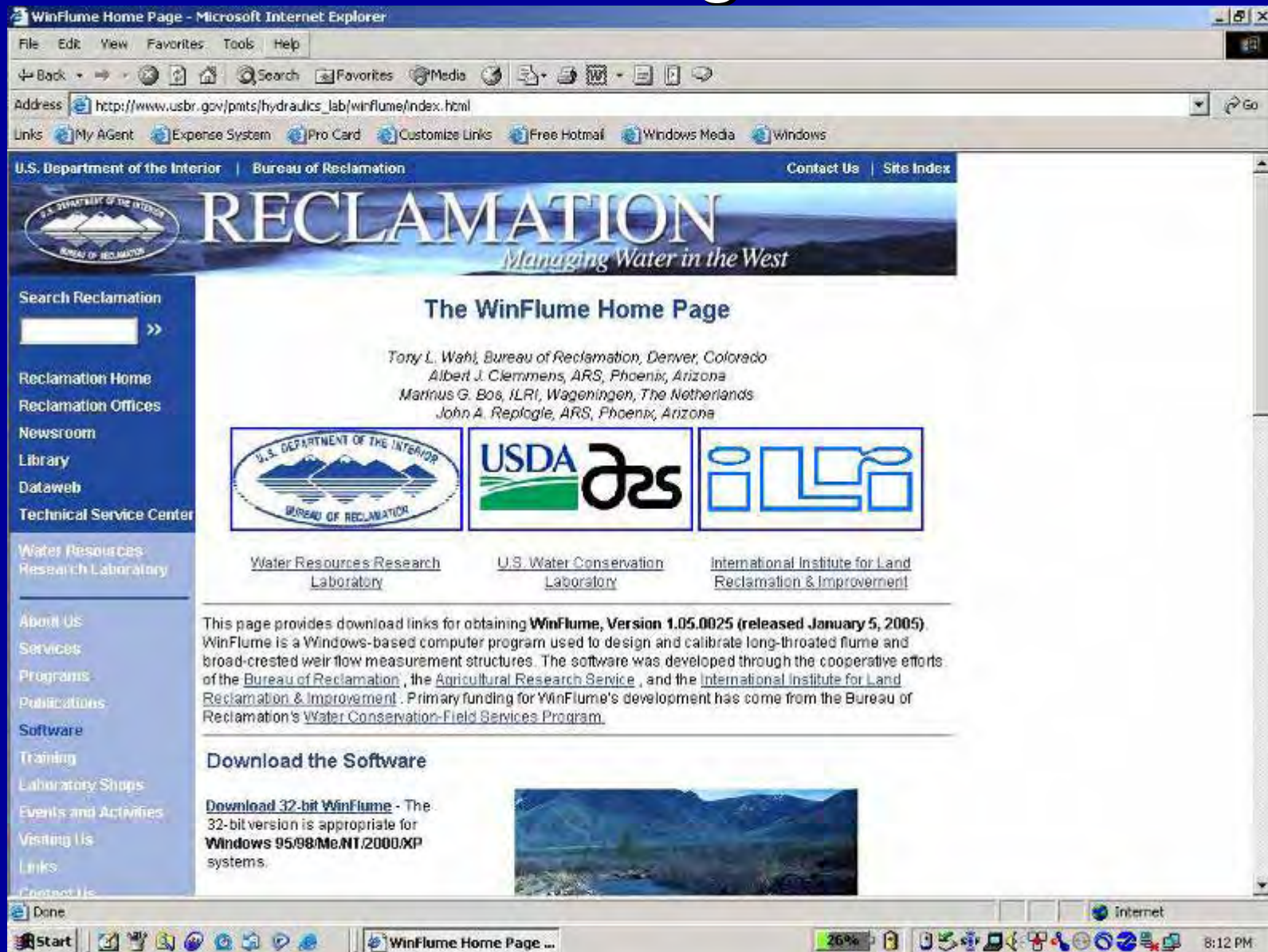


Broad-Crested Weir



WinFlume Software

www.usbr.gov



Circular Flume



Circular Flume Advantages:

- Accurate
- Easy to construct
- Use scrap PVC pipe
- Requires no elevation drop
- No pooling upstream
- Portable



Work Hazards!



Typical Flow Site:

- Measurement Device
- Stilling Well
- Instrumentation to record depth or flow volume every 15 minutes
- Can be datalogged or realtime
- Staff gauge must be upstream away from draw down
- Site is visited and metered



Instrumentation:

- Remote logging
- Records water level
- Logs it in 20 min or hourly intervals
- Realtime option:
transmit
to internet
via cell or
satellite
technology



An alternative to stilling wells:

- In-Situ Troll 500 or 700**
- Replaces logger, float & well**
- Measures depth & temp**
- Placed on canal bed (anchored)**
- Easy to use software**



AquaSystems 2000 Langemann Gate



Armtec Gate



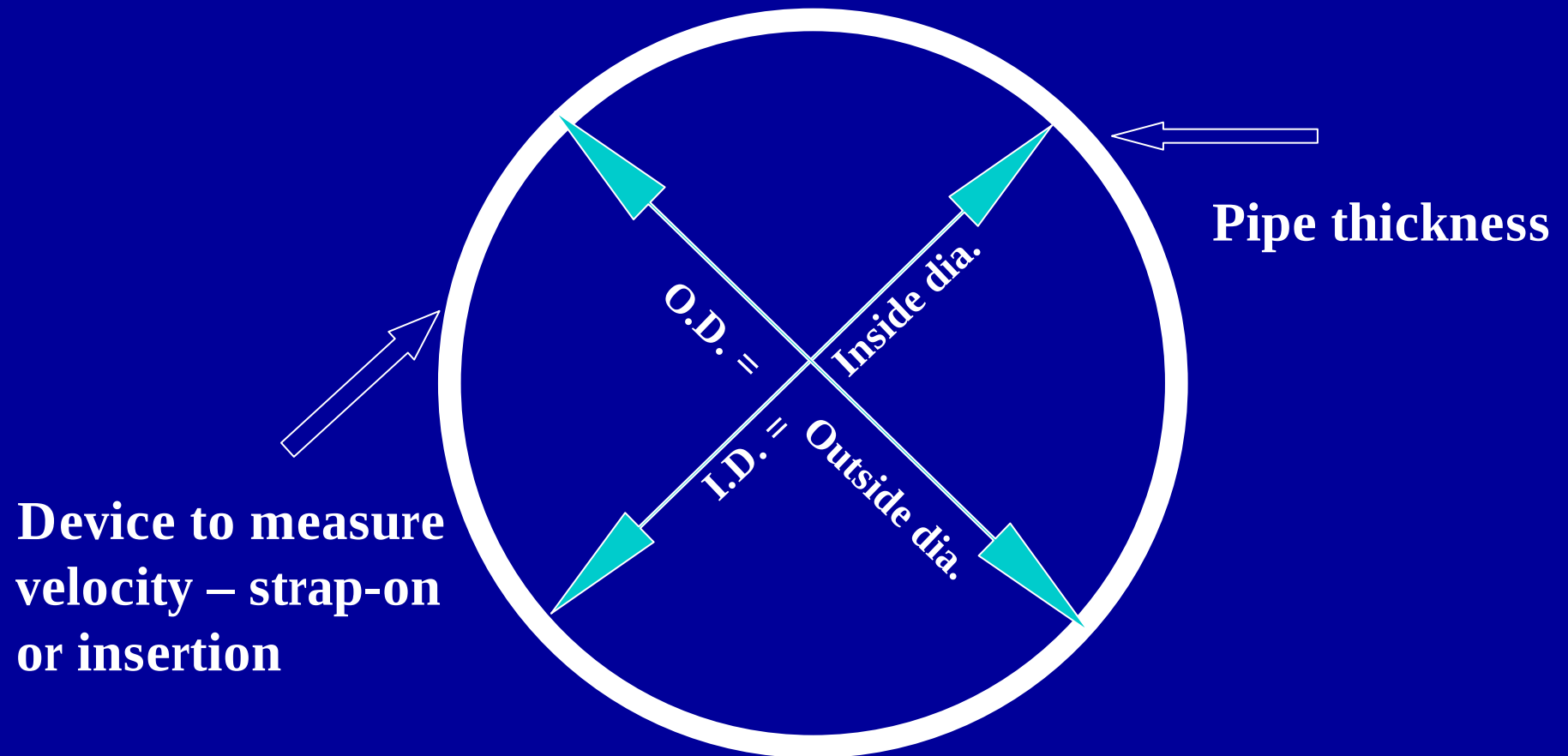
Flow Measurement in Pressurised Pipelines:

- **There are lots of choices! What to choose?**

Some practical considerations:

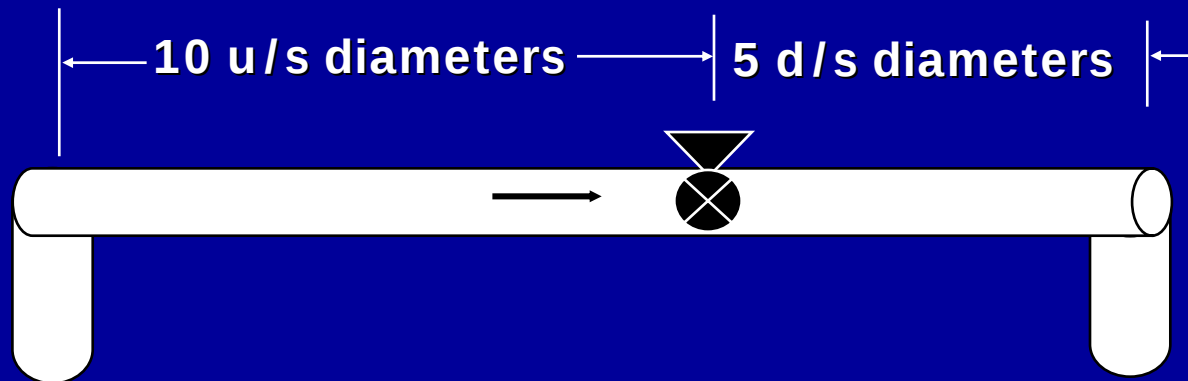
- **What's the application? (Why meter? Permanent v.s. spot check.)**
- **Meter placement: straight pipe?**
- **Accuracy?**
- **Cost?**
- **Installation Method?**
- **Which technology to choose?**

Discharge = velocity x area



Pipeline flow meters: Installation Considerations

- Straight pipe requirements!
Is there a suitable length of straight pipe available?



All pipe flow meters will specify a straight-pipe requirement.

Which Technology is best?

- Propeller**
- Paddlewheel**
- Electro magnetic meter**
- Vortex shedding**
- On-off switches**
- Others: Venturi-cone, elbow meters, etc.**

Electro-magnetic meters:

- ‘Mag’ meters create a magnetic field in the flowing water. The induced voltage in the water indicates the flowrate.



- **Advantages:** Very accurate. Considered to be the industry standard.



- **Disadvantages:**
High power requirements. Not economic for all applications (\$2500 – \$10,000)



McCrometer M0300 Bolt On Saddle Model

- rugged
- no power required
- requires large hole for install
- accurate



Doppler Flow Meters:

- Insertion:



- High accuracy

- Expensive ~\$2500



-Strap on:

- Doppler (~\$1700-\$4000)

- Transit Time (~\$2500)

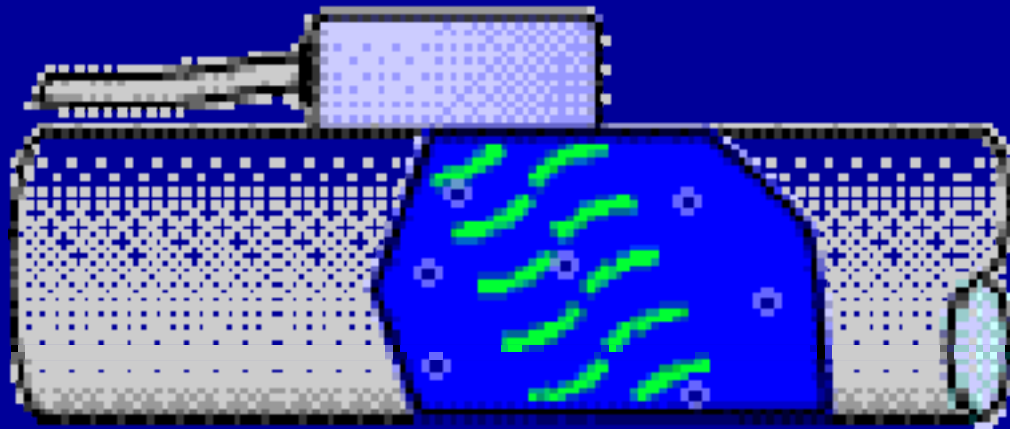
Advantages:

Non-invasive!

Greyline DFM-IV



- Acoustic Doppler Technology
- power required
- requires no holes for installation
- can install on any diameter pipe
- no moving parts



Typical Milk River Flowmeter Site



2007 Milk River Flowmeter Results Summary

Flow meter	# Meters Installed	# Meters Flow tested	# Meters Achieving Measurements Within Indicated Accuracy Standard	
			Less than +/- 5%	More than +/- 5%
McCrometer M0300	14	9	9	0
Seametrics EX 100/200	24	18	11	7
Greyline DFM IV	3	1	1	0

ARD Water Quality Projects utilizing flow measurement equipment:



BMP Projects:

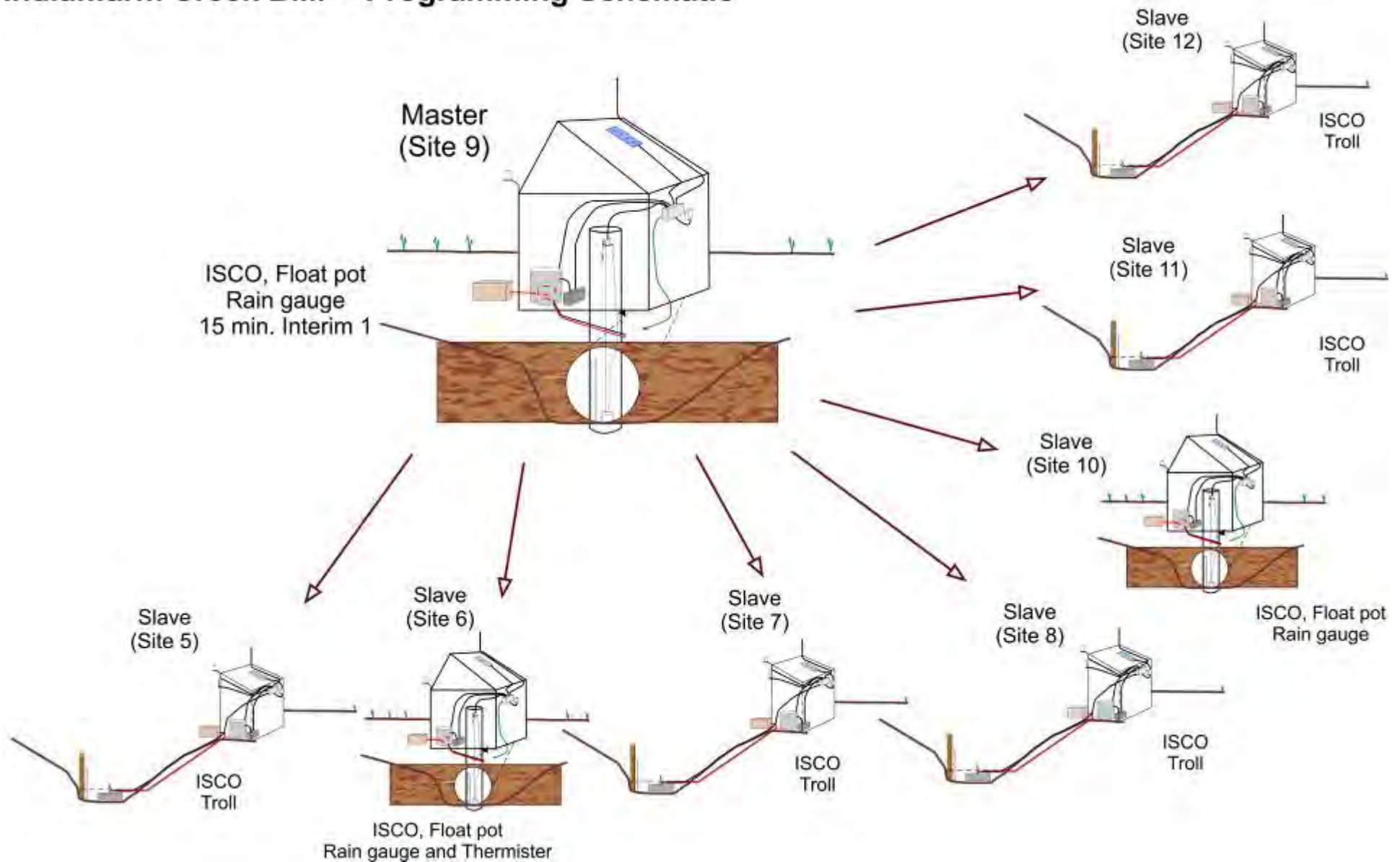
Indianfarm Creek Basin: 22 sites with Circular Flumes, Trolls, Realtime Communication, Streampro ADCP and FlowTracker



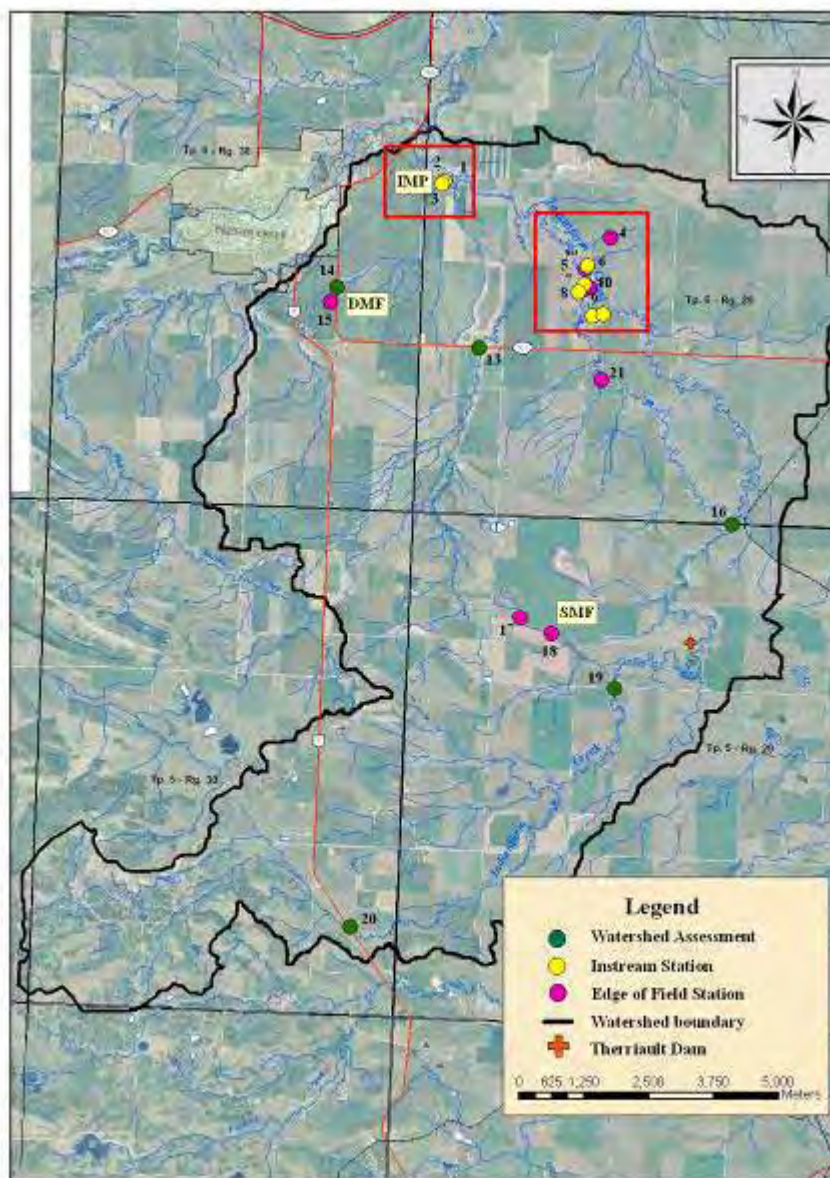
Whelp Creek Basin: 22 sites with Circular Flumes, Trolls, Realtime Communication and FlowTracker



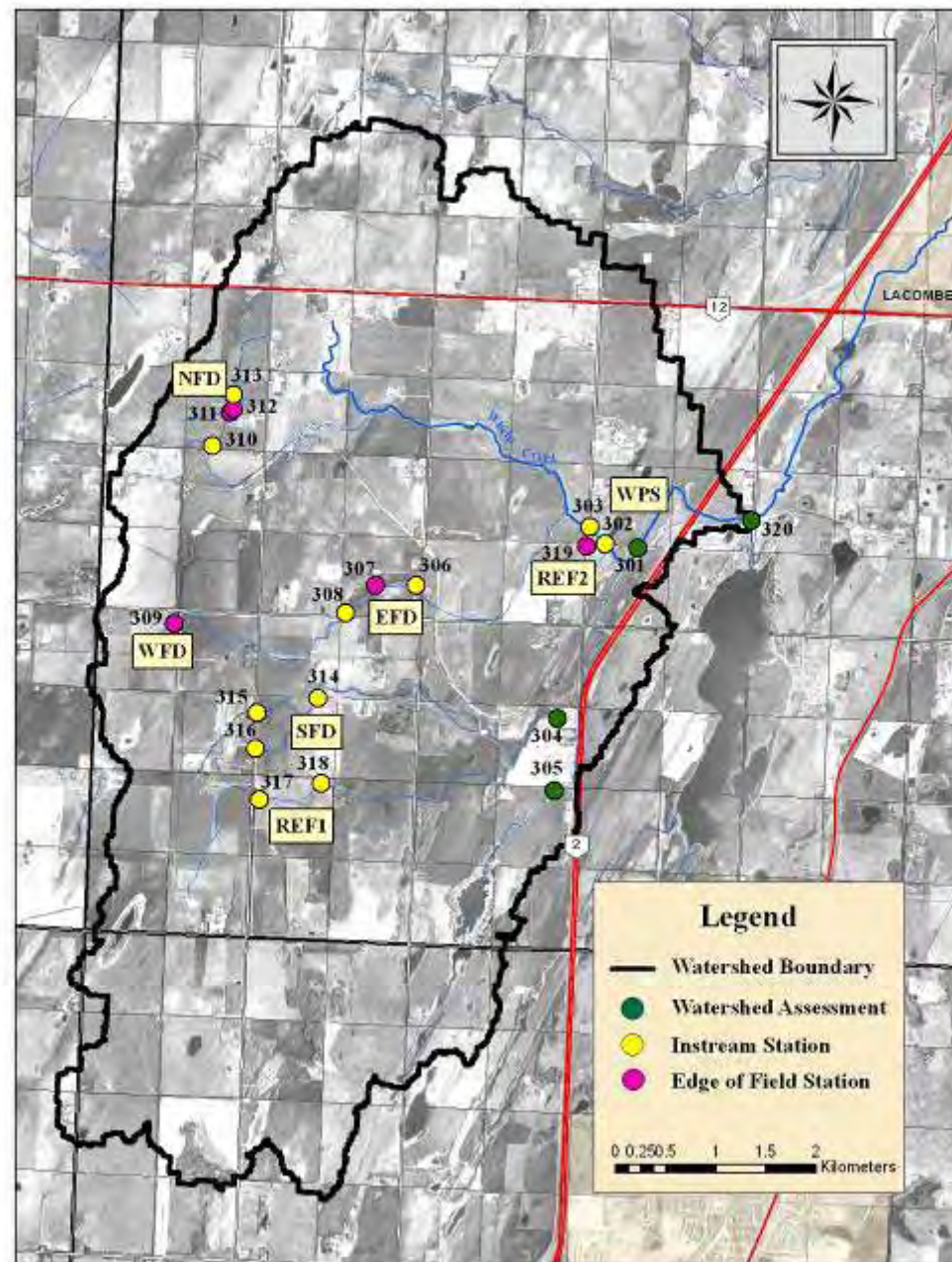
Indianfarm Creek BMP - Programming Schematic



Indianfarm Creek



Whelp Creek



Flow Demonstration Site:

- Demonstrate the latest in water control & measurement**
- Test existing and prototype equipment & technologies**
- Act as a 3rd party neutral test facility to verify accuracy**

ARD Flow Measurement Facility and Demonstration Site

“In Partnership with Industry”



Environment
Canada

Environnement
Canada



ARD Flow Measurement Team:

Branch Head: Brent Paterson

Section Head: Roger Hohm

Engineer: Lloyd Healy

Sr. Tech: Lawrence Schinkel

Instrumentation Tech: Brian Cook

Water Management Specialist:

Jennifer Nitschelm

Water Mmgmt Agrologist: Joel

Cordes

Summer Staff: Brendan Coffey

Thank You!

Questions?

