

Spatial Dry Deposition of Reactive Gaseous Mercury in West Central Alberta

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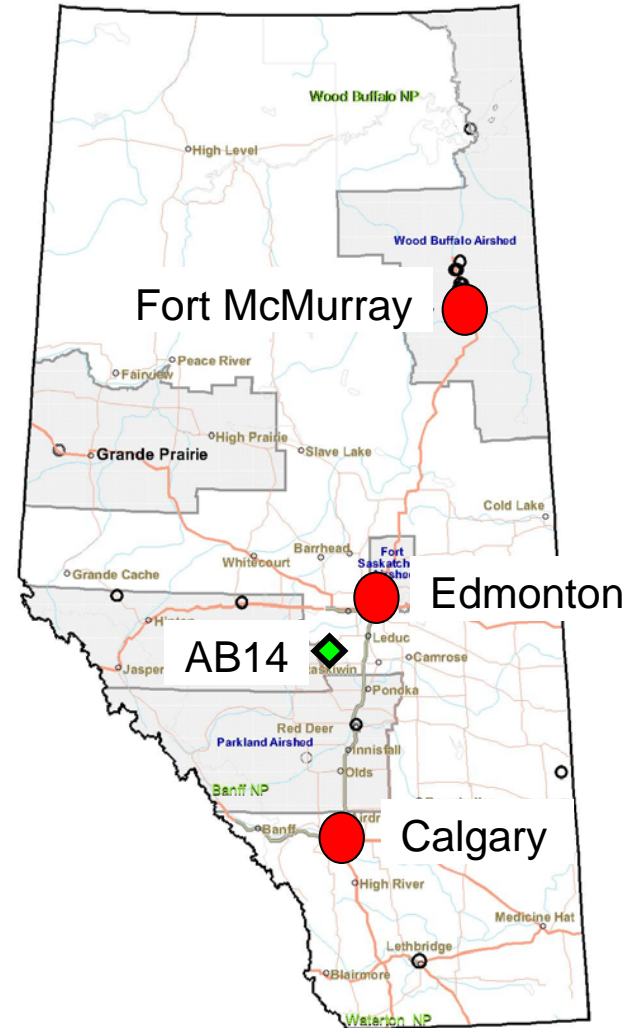
NADP 2008 Annual Meeting and Scientific Symposium

14-16 October, 2008

Madison , WI

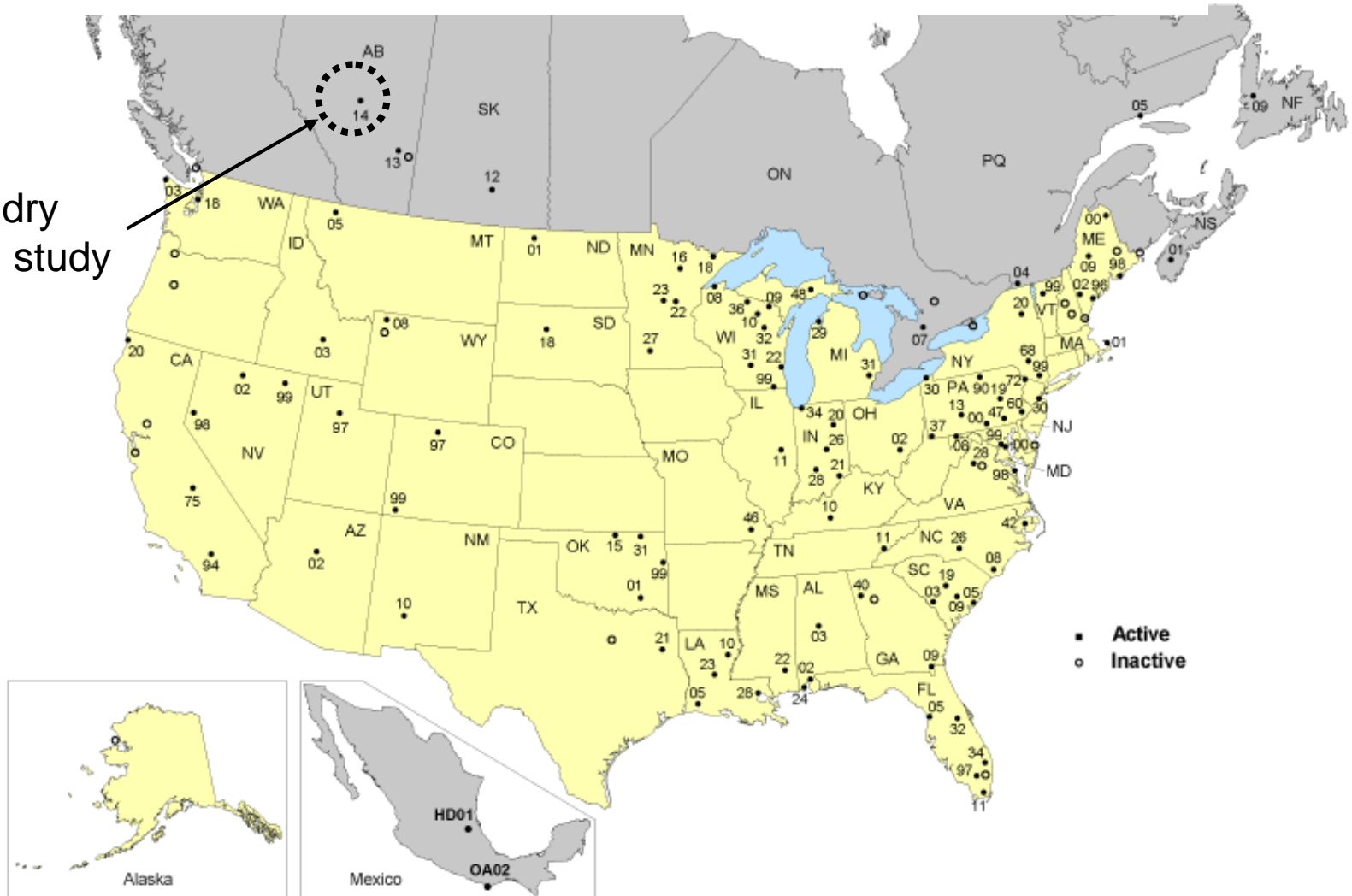
West Central Alberta

- Home to four generating plants utilizing sub-bituminous thermal coal operated by TransAlta Utilities and EPCOR:
 - net generating capacity ~4,000 MW
 - supplies almost two-thirds of electricity to Alberta
- TransAlta Utilities and EPCOR fund operation of MDN wet deposition site (AB14) and dry deposition program.
- Presentation will describe some characteristics of Hg in region and preliminary 2007 findings of dry deposition field program.

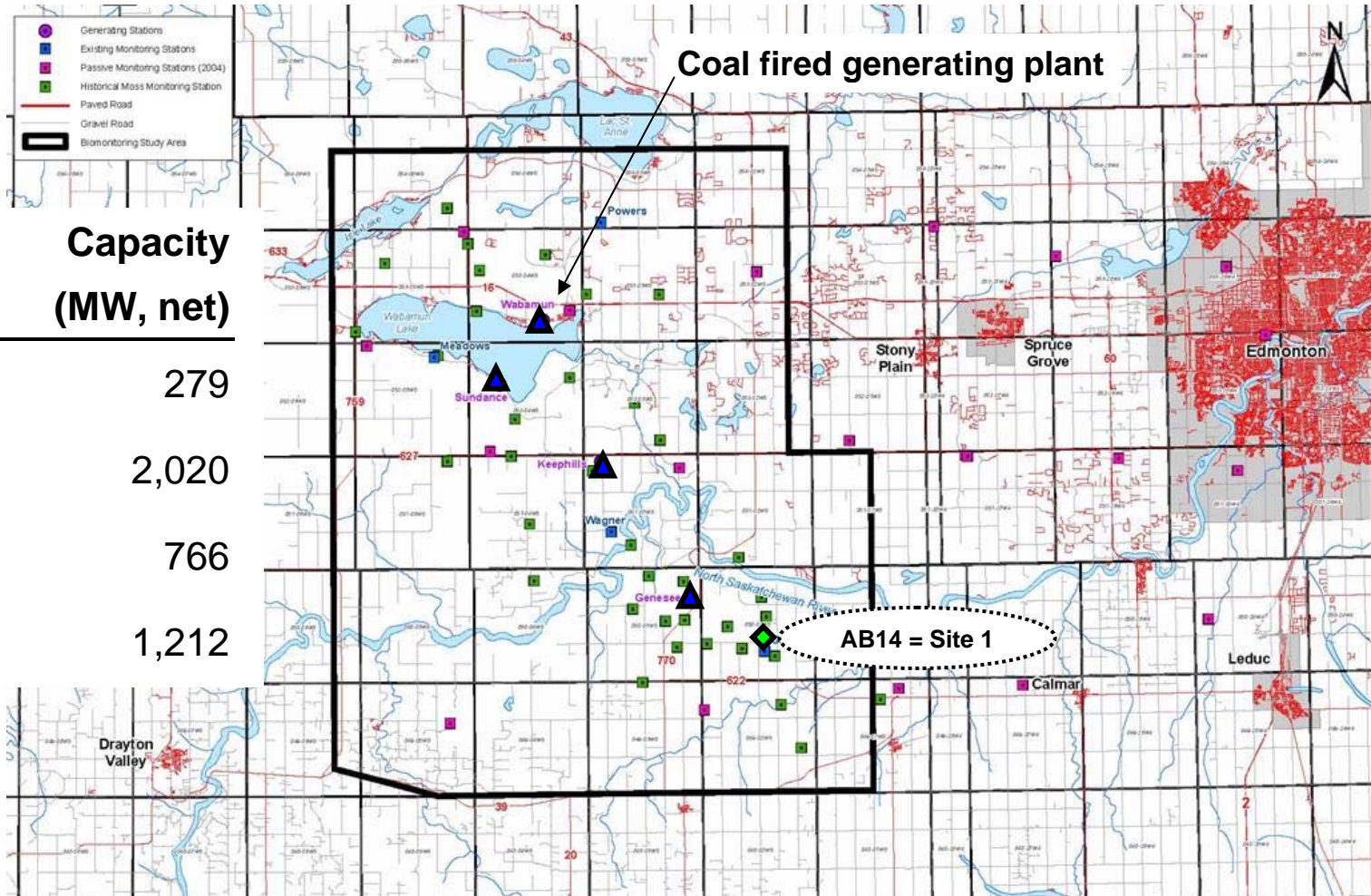


National Acid Deposition Program Mercury Deposition Network

Region of dry
deposition study

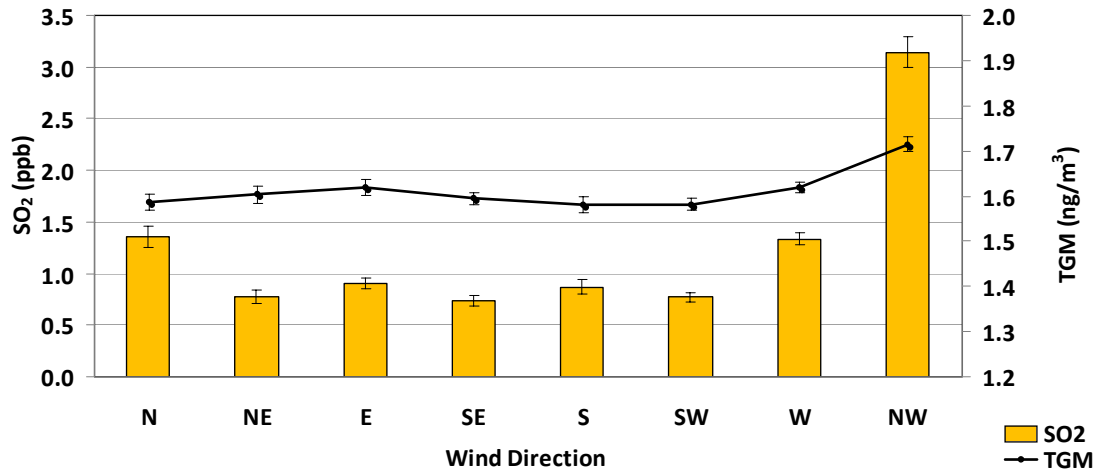


Location of Coal Fired Generating Plants in West Central Alberta

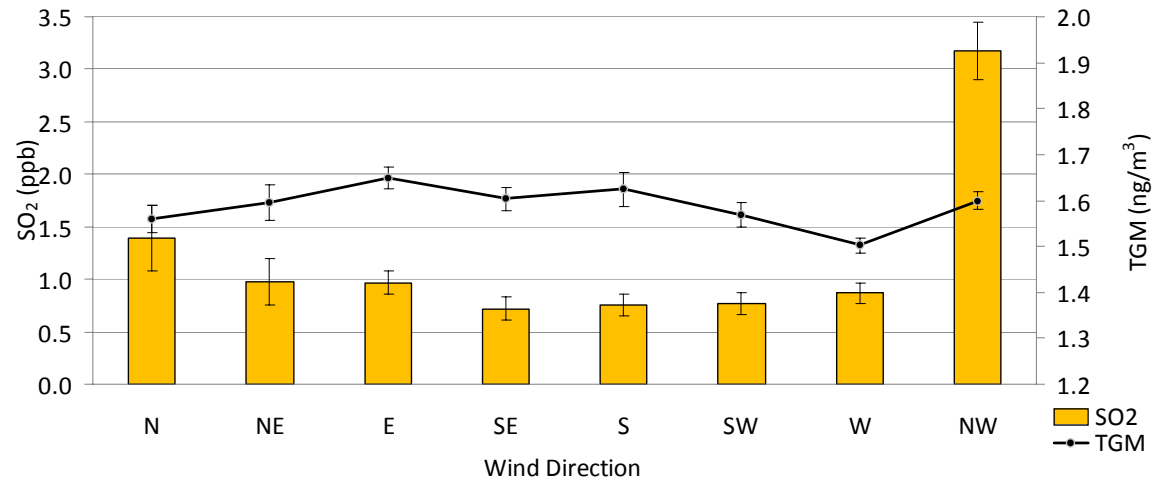


Hourly Mean (+ s.d.) for SO₂ and TGM at Site 1 for Different Wind Directions

Site 1 (2006)



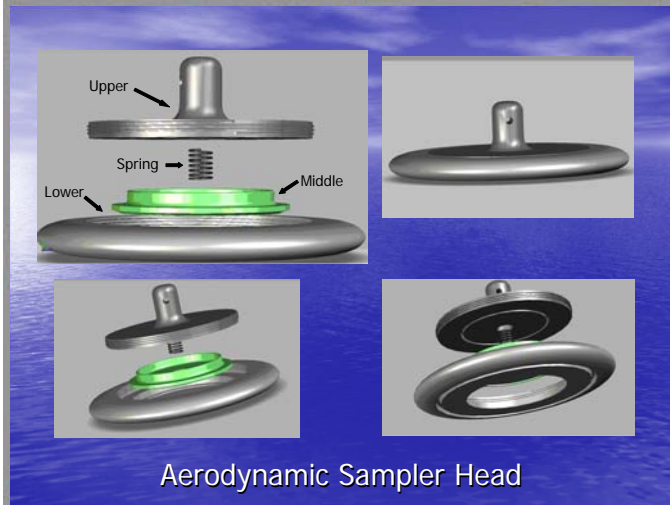
Site 1 (2007)



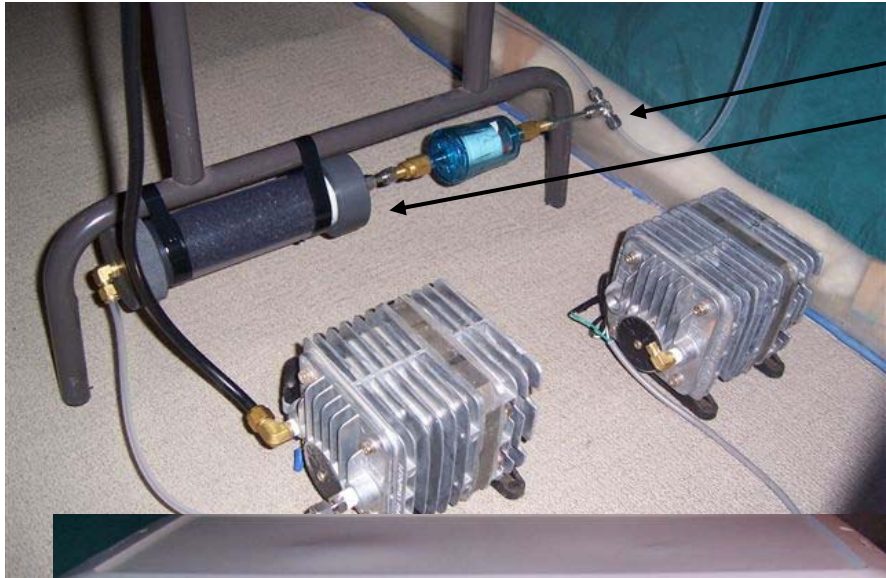
Hg Dry Deposition Program

- Objective to quantify Hg deposition patterns in regional air monitoring area around plants.
- Passive sampling approach at 6 sites around plants...
 - I.C.E. 450 cation-exchange (ion exchange) membrane mounted on acrylic holder in face-down position 3 m above ground
- Membranes cut into discs 5.375" in diameter using ultra clean techniques at Frontier GeoSciences (Seattle).
- Sampler heads developed by Frontier GeoSciences.
- Membranes loaded into heads in field lab (Edmonton) and heads exchanged in field.
- Membranes removed from loaded heads in field lab, placed in trace-cleaned shipping jars.
- CVAFS analysis (USEPA Method 1631).

Sampler Head and Typical Site Detail



Field Lab for Loading IX Membranes in Sampler Heads Prior to Deployment



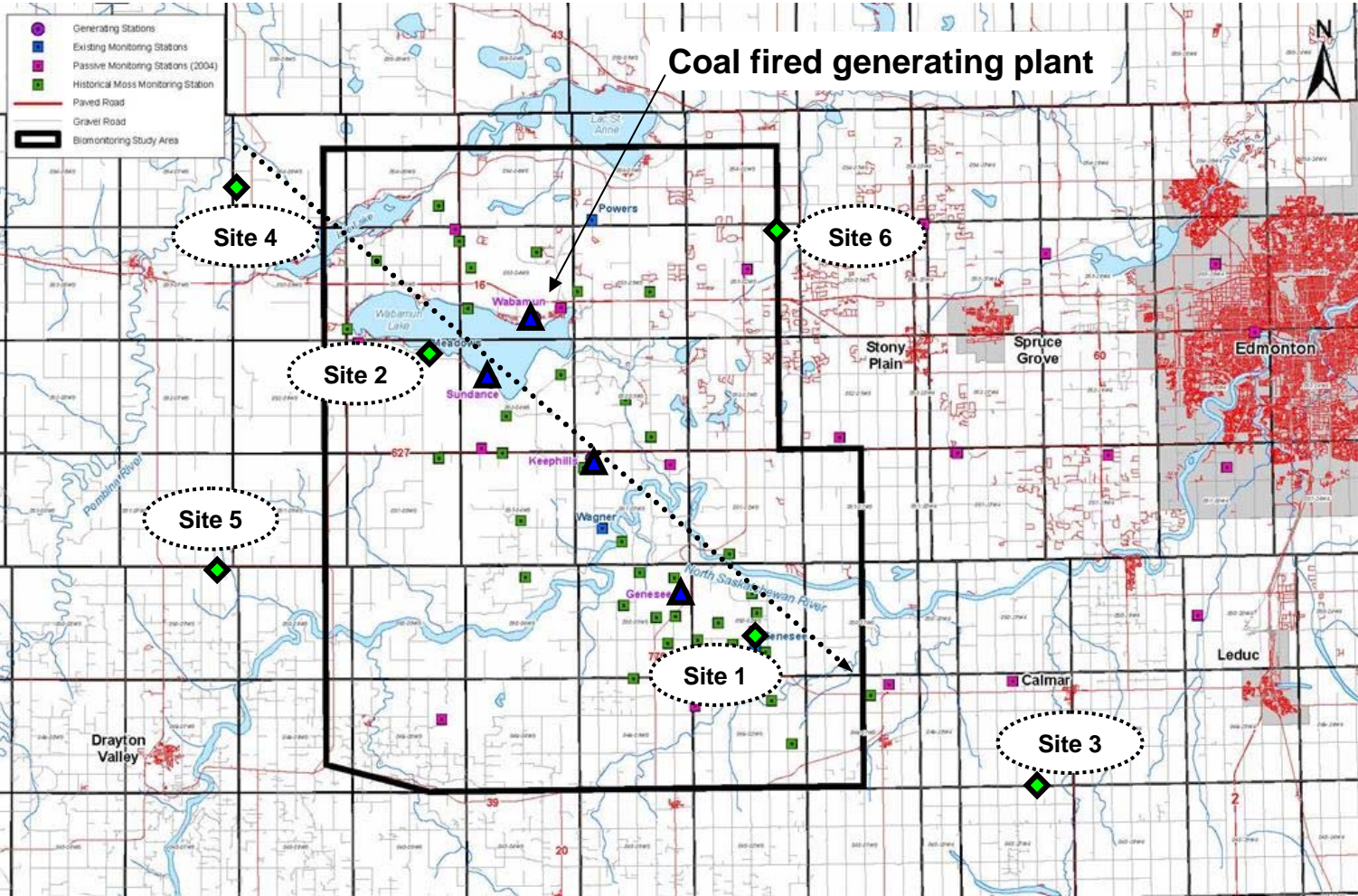
0.4- μm filter
activated carbon filter



clean air chamber



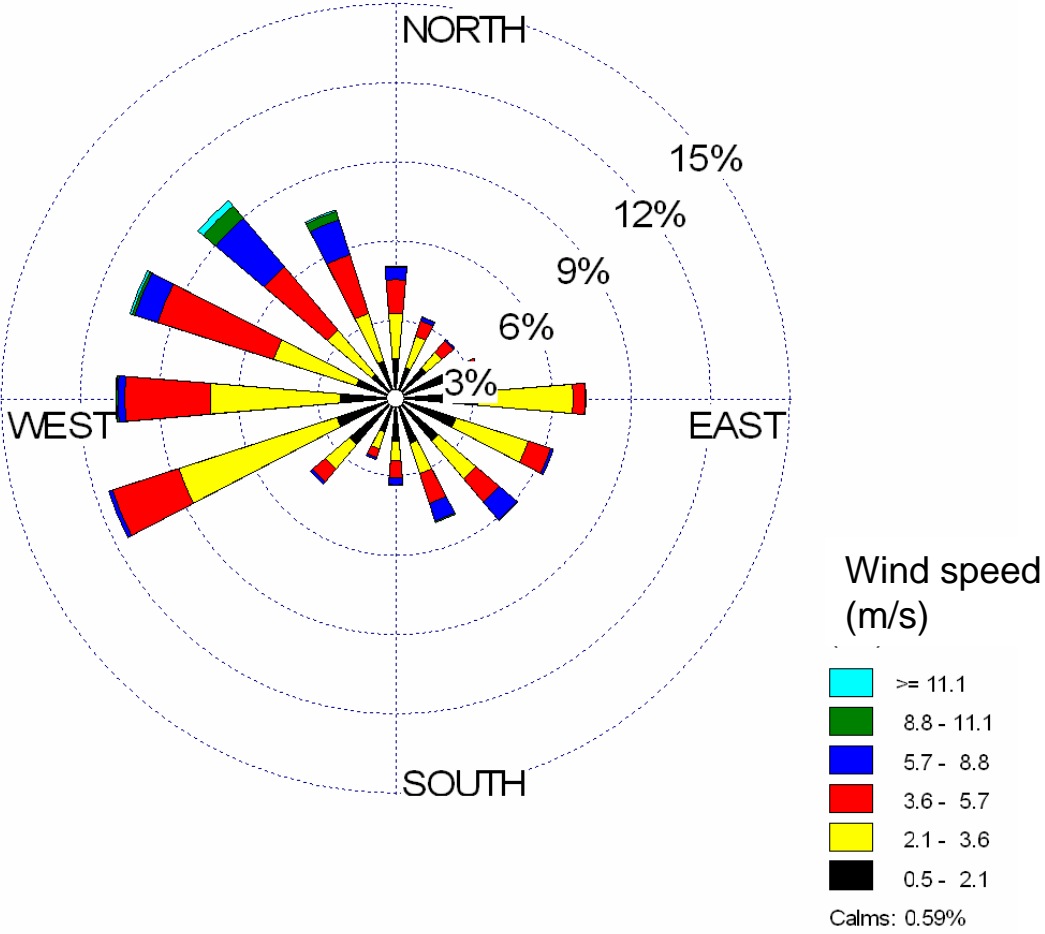
Location of Dry Deposition Sampler Sites



RGM Dry Deposition Sampler Site Details

Site 1	24 km to mid-location of four plants (8 km to nearest plant). Located downwind along principal axis of wind flow (winds from NW). <ul style="list-style-type: none">• MDN Hg wet deposition monitor.• Tekran continuous TGM monitor (Environment Canada).
Site 2	15 km to mid-location of four plants (8 km to nearest plant). Located upwind along principal axis of wind flow. <ul style="list-style-type: none">• Tekran continuous TGM monitor (Environment Canada).
Site 3	51 km to mid-location of four plants (35 km to nearest plant). Located downwind along principal axis of wind flow.
Site 4	36 km to mid-location of four plants (26 km to nearest plant). Located upwind along principal axis of wind flow.
Site 5	28 km to mid-location of four plants (25 km to nearest plant). Located off of principal axis of wind flow towards southwest.
Site 6	24 km to mid-location of four plants (20 km to nearest plant). Located off of principal axis of wind flow towards northeast.

2007 Results – Annual Wind Rose Plot for Site 1



QA/QC – Background RGM for Various Blank IX Membrane Samples (ng/membrane)

	n	Mean	s.d.
Analytical Lab Blank	12	0.36	0.17
Field Lab Blank	22	0.42	0.22
Field Blank	14	0.66	0.34

Definition:

Analytical Lab Blank:

Membrane taken immediately after cutting from bulk sheets at lab.

Field Lab Blank:

Membrane taken from stock after receipt in Edmonton from lab.

Field Blank:

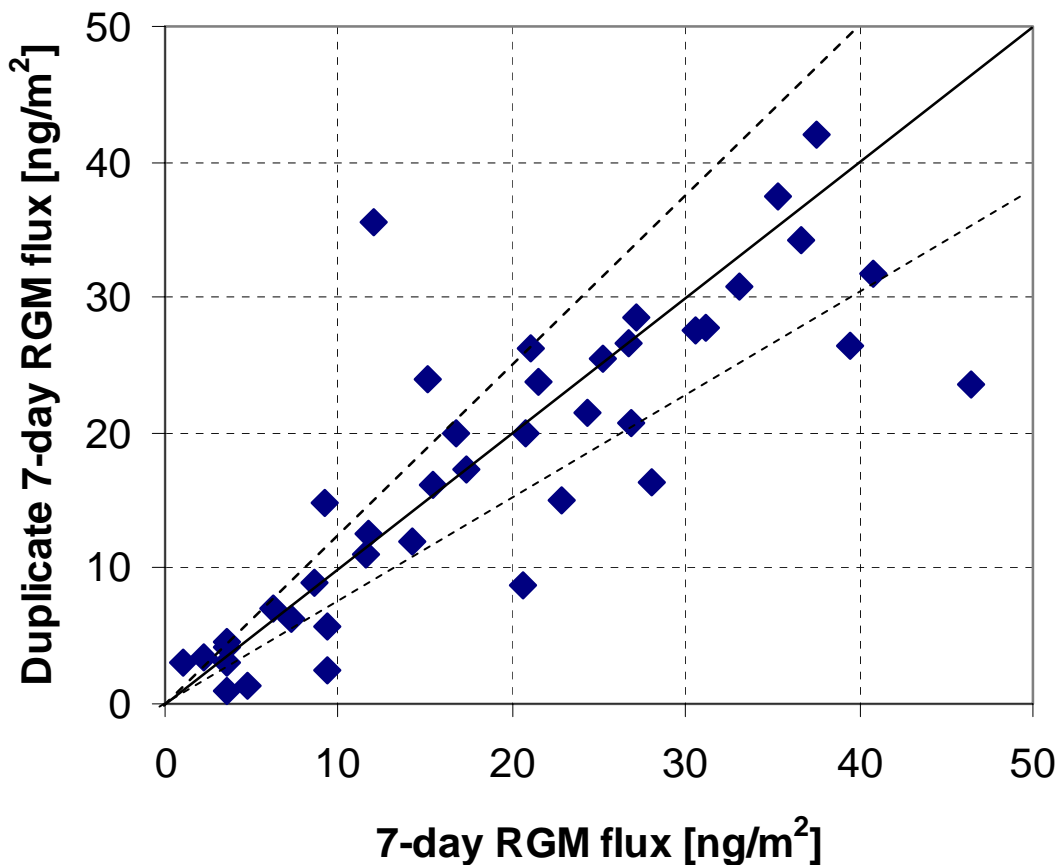
Membrane taken through all steps of deployment and recovery.

QA/QC – Precision Measurement for 7-day Duplicate Deployments (n=44)

Solid line shows 1:1 relationship.

Dashed lines show $\pm 25\%$ flux about the 1:1 relationship to assist in visual comparison.

Precision – relative standard deviation (RSD) = 31%.

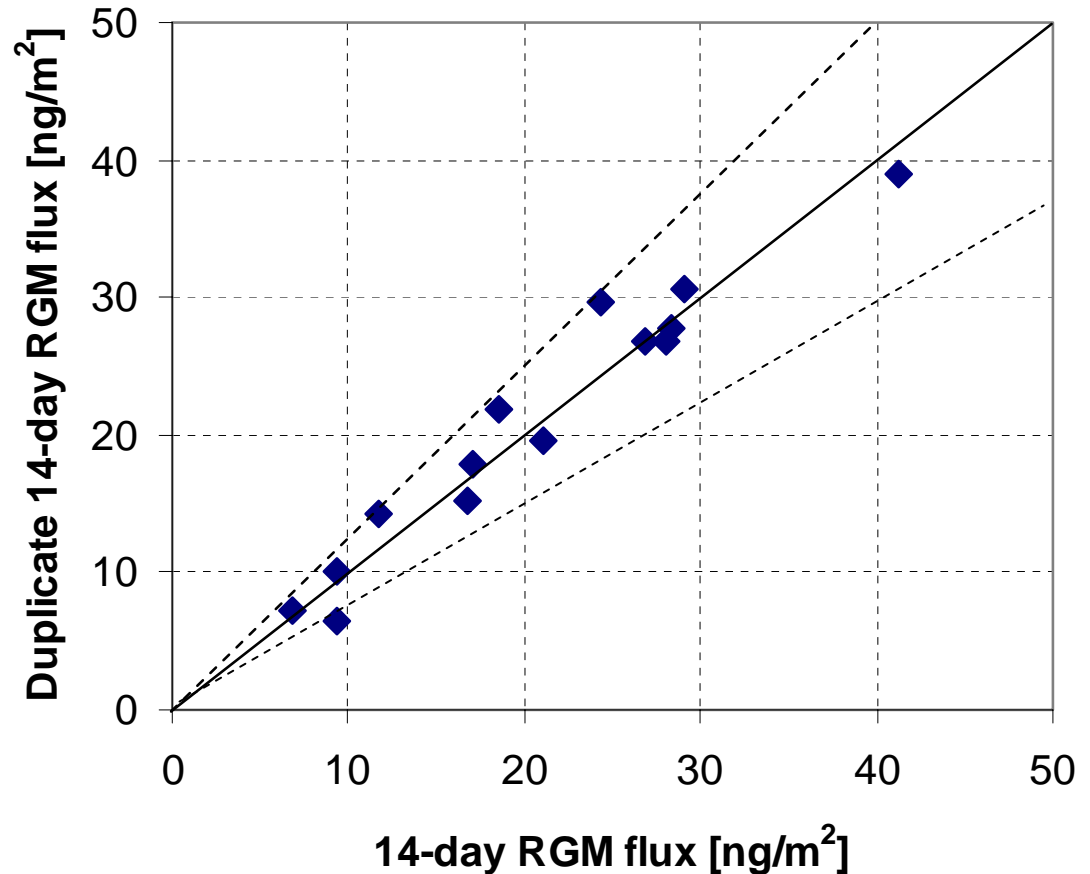


QA/QC – Precision Measurement for 14-day Duplicate Deployments (n=14)

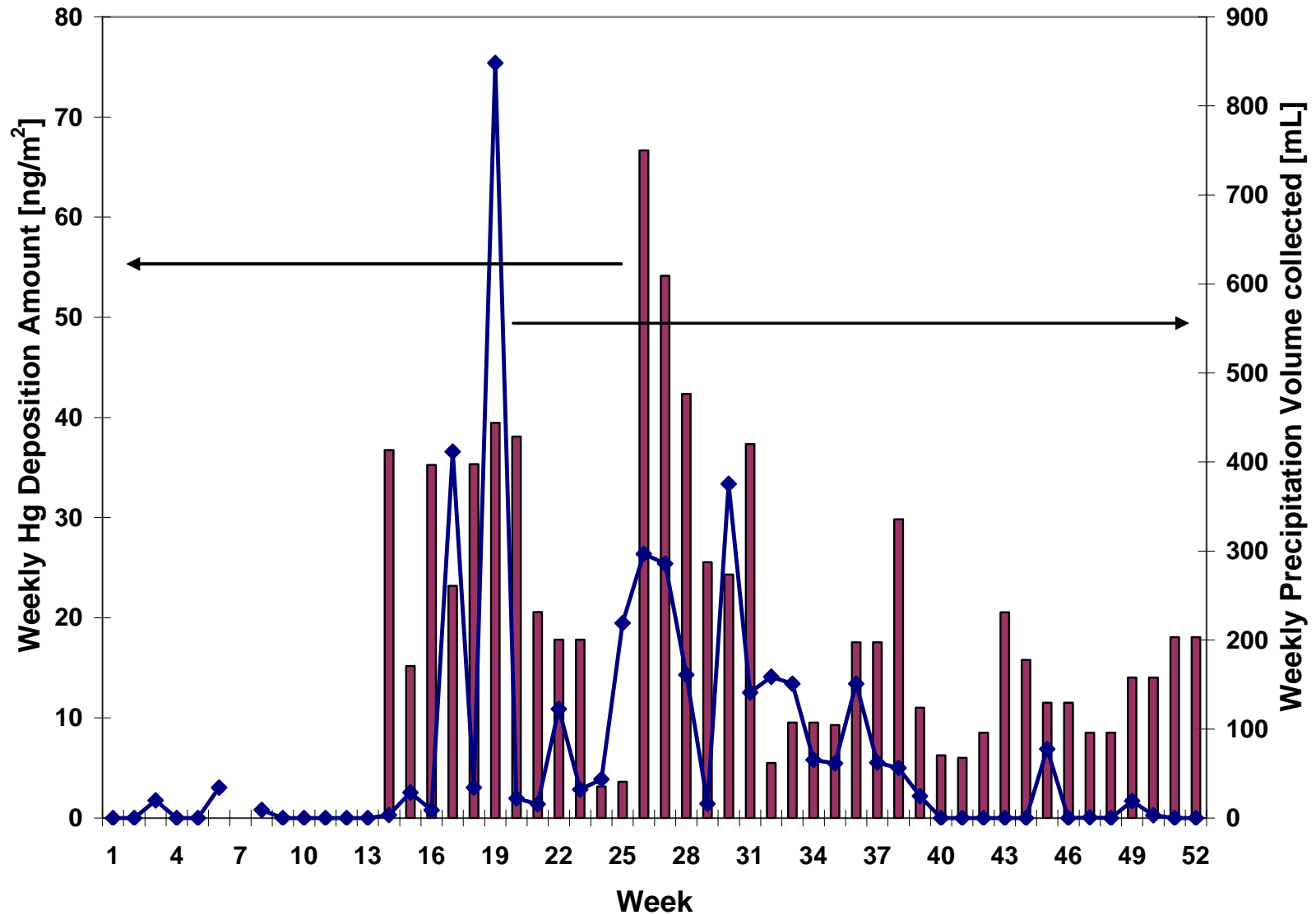
Solid line shows 1:1 relationship.

Dashed lines show $\pm 25\%$ flux about the 1:1 relationship to assist in visual comparison.

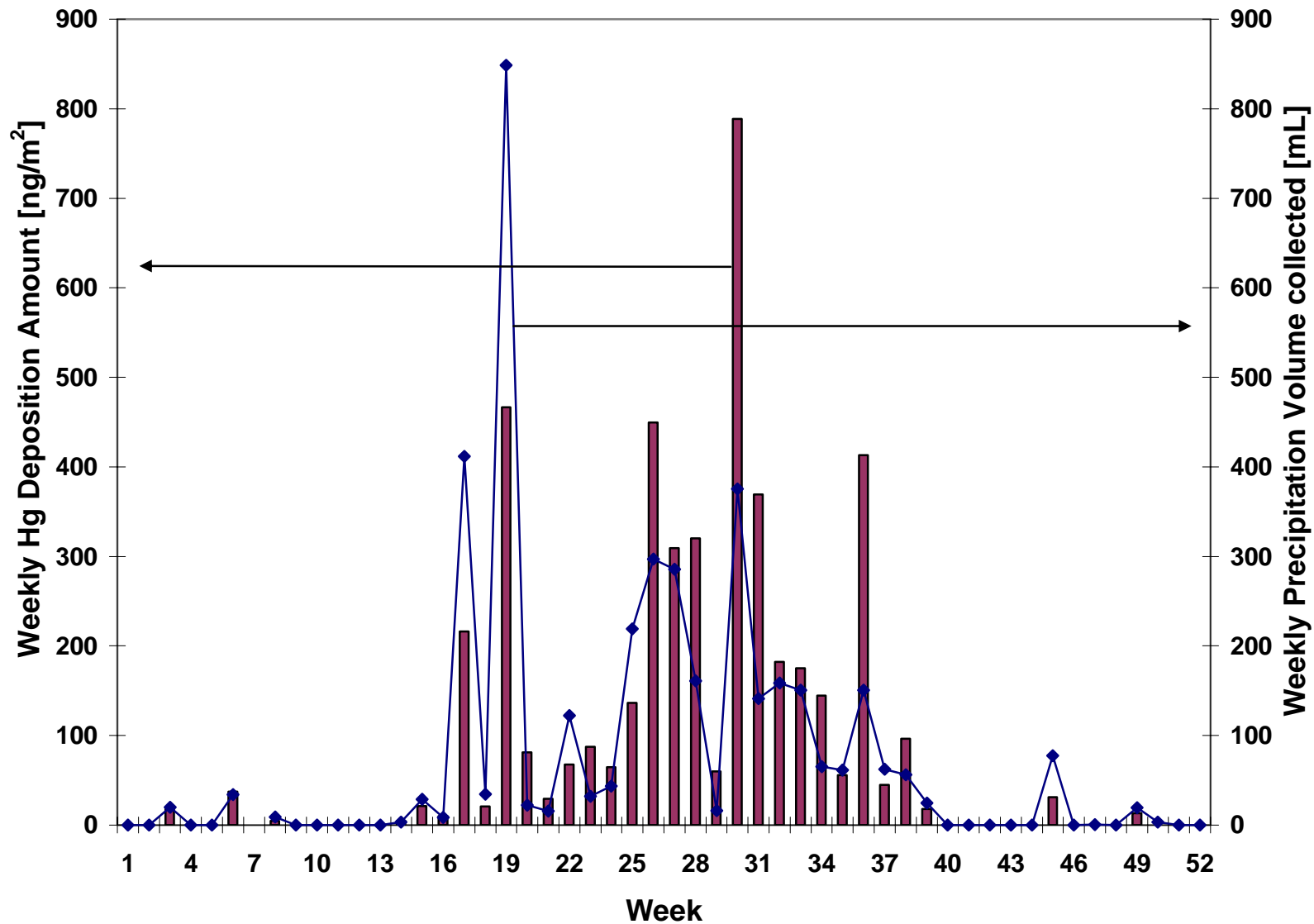
Precision – relative standard deviation (RSD) = 7.5%.



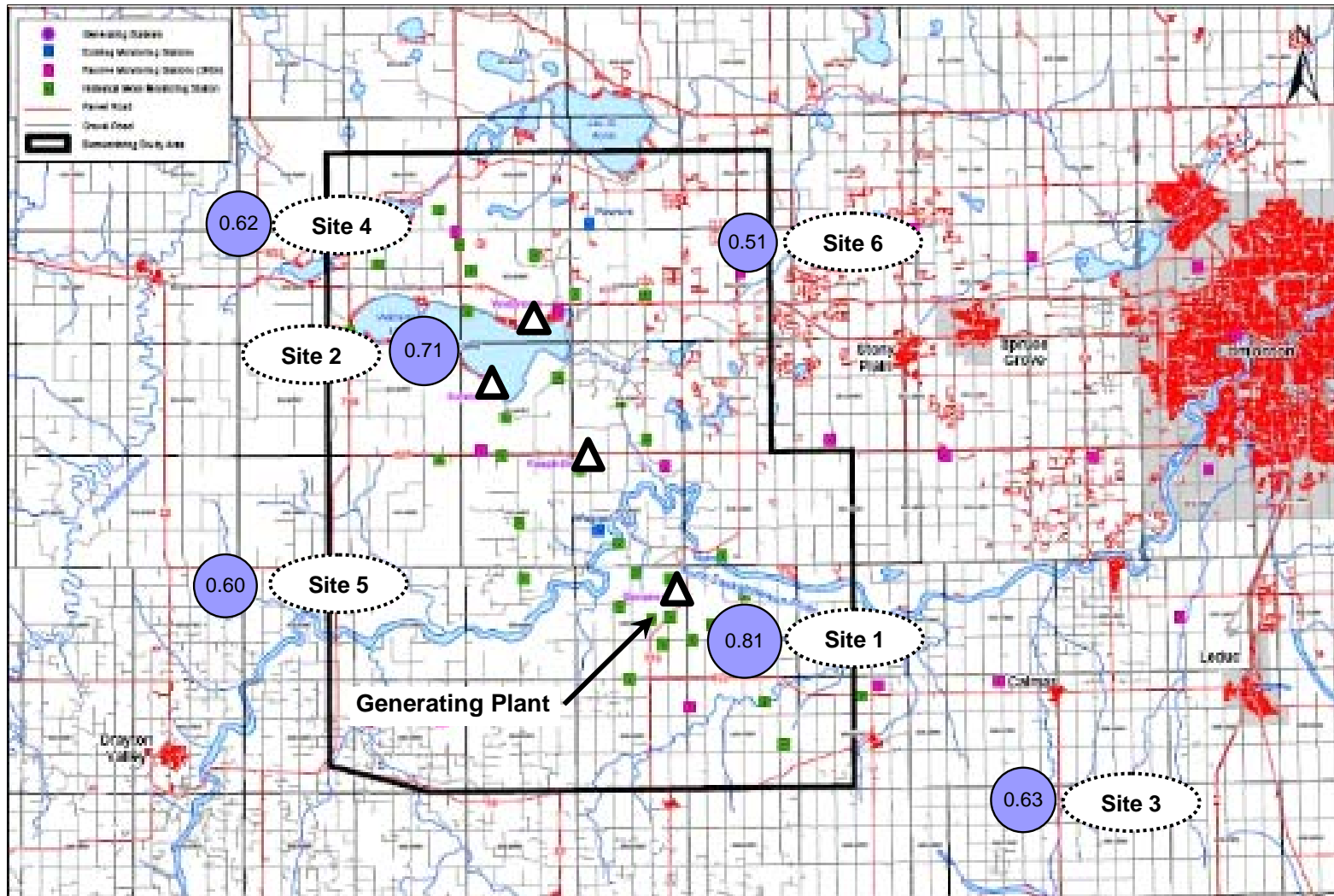
Inferred Weekly RGM Dry Deposition and Precipitation Volume at Site 1 over 39-week Period in 2007 [ng/m²]



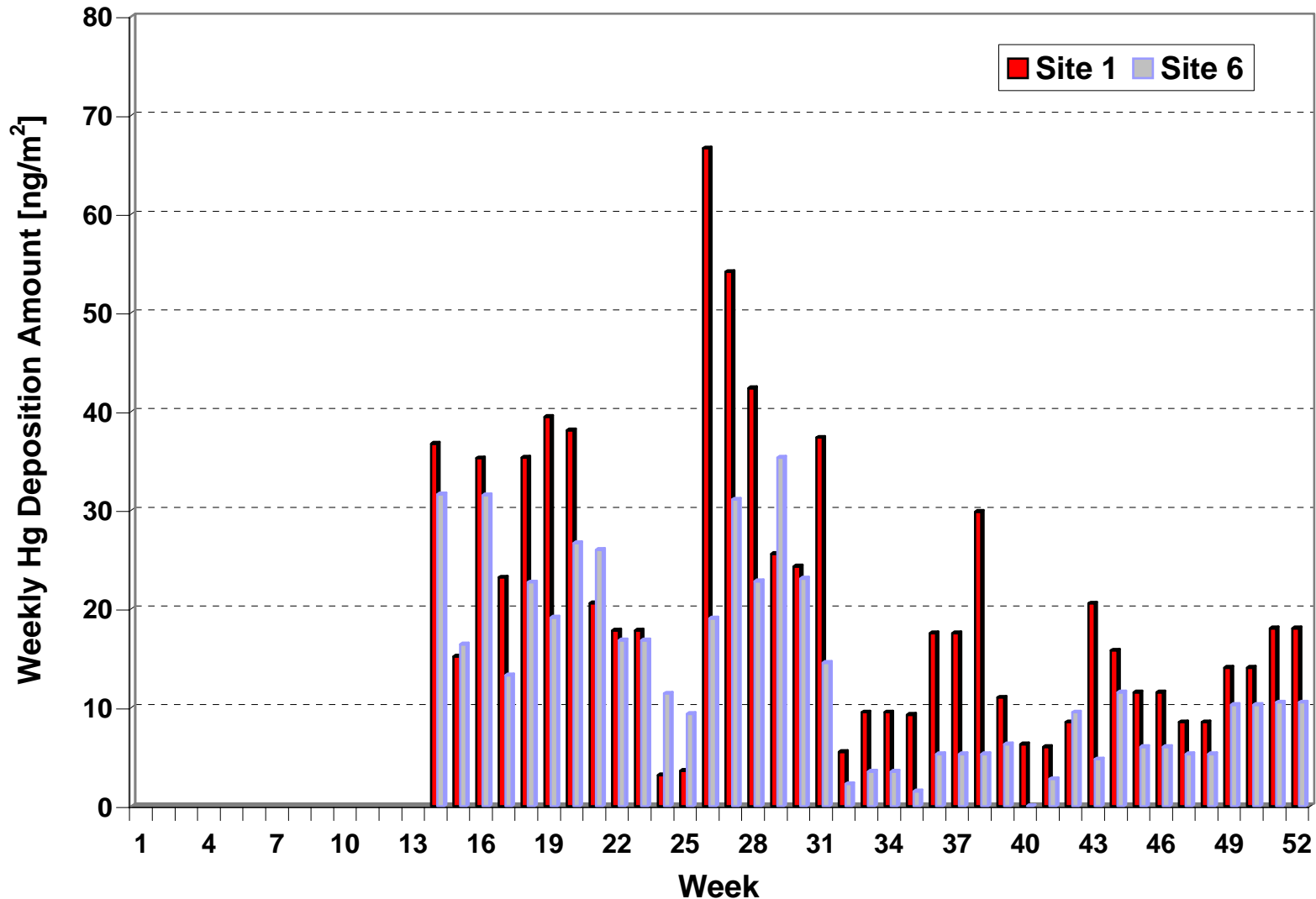
Weekly Hg Wet Deposition and Precipitation Volume at Site 1 in 2007



Inferred Net RGM Dry Deposition Flux at each Sampling Site over 39-week Period in 2007 [$\mu\text{g}/\text{m}^2$]



Inferred Weekly RGM Dry Deposition and Precipitation Volume at Site 1 and Site 6 in 2007 [ng/m²]



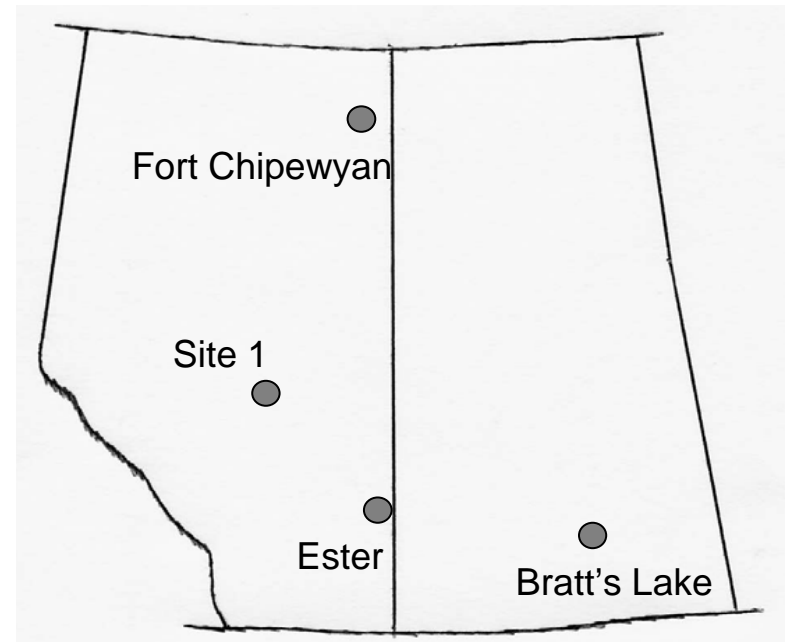
2008/09 Dry Deposition Program

- Phase I commenced April 2008:
 - all sites operational April thru September (6 months)
 - 7-day and 14-day deployments for IX membranes
 - two 7-day deployments with one 14-day deployment
 - additional field lab blanks, field blanks, and replicates
- Phase II to run October to April 2009:
 - only Sites 1 and 4 operational (6 months)
 - eventually provide 12 months data at both sites
 - Tekran instrument for speciating RGM operational at Site 1
 - 7-day deployments for IX membranes
 - additional field lab blanks, field blanks, and replicates

Questions?



Daily Average Total Gaseous Mercury (TGM) at Monitoring Locations in Alberta and Saskatchewan



Location	Year	n	Mean (s.d.) ng/m ³	Range ng/m ³	Closest Source
Fort Chipewyan	2000 - 01	305	1.36 (0.15)	0.95 - 1.77	n/a
Site 1	2006 - 07	621	1.60 (0.27)	1.09 - 2.45	8.3 km
Esther	1998 - 01	878	1.65 (0.15)	1.19 - 2.14	110 km
Bratts Lake	2001 - 05	1424	1.53 (0.24)	0.79 - 2.68	140 km