

A Candidate Approved Regional Method (ARM) for use in the Missouri Ambient Air Monitoring Networks

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Why apply for an ARM?

- We Have the Equipment - \$\$\$ Missouri has 8 TEOM FDMS continuous samplers deployed in the network to support real time data reporting for AirNow and other data users.
- Reduced Redundancy -Most FDMS TEOMS are “collocated” with FRMs since the FRMs are needed to support NAAQS comparisons.
- Reduced Operating Costs -If the FDMS TEOM data can be used for comparison to the NAAQS, FRM filter analysis could be reduced by approximately 1000 filters/year. (approximately 4000 weighing events! first weight, tare weight, exposed weight, re-weights, lab blanks, field blanks, working standards...) and reduced shipping costs!
- No Known Viable Alternative — Concurrent pilot testing of a commercially available continuous FEM indicated poor correlation with FRM at an MSA test site.

Some Requirements for the ARM

- Must meet PM_{2.5} Class III equivalency requirements of subpart C of part 53 for correlation, additive and multiplicative bias
- Must be tested at the site(s) in which it is intended to be used
- Test sites must be located at each MSA/CSA up to the first 2 highest population MSA/CSA and at least 1 rural area or MSA
- Testing must include a full year of data including all seasons, 90 valid sample pairs per site, and 20 valid sample pairs per season
- Precision requirements of subpart C of part 53 applies (CV 15%)
- Data transformations must be applied in the same way at all sites

The Proposed ARM

- Rupprecht & Patashnick Co. Filter Dynamics Measurement System (FDMS) with a manufacturer approved dryer and operated with the FDMS cooler set at 4 Deg. C during the winter months and 10 Deg. C during the late spring and summer months.
- A VSCC must be installed as the PM2.5 separation device.
- A real time data correction algorithm is used to correct the TEOM FDMS data. (algorithm courtesy of Tim Hanley of EPA OAQPS)

FORMULA SET FOR FDMS TEOMS

B = Raw TEOM Base Value
R = Raw TEOM Reference Value
K = Ambient Temp deg. Kelvin
FRM = Corrected TEOM Value

For Temperatures Above 293K (20°C, 68°F)

$$\mathbf{FRM = B}$$

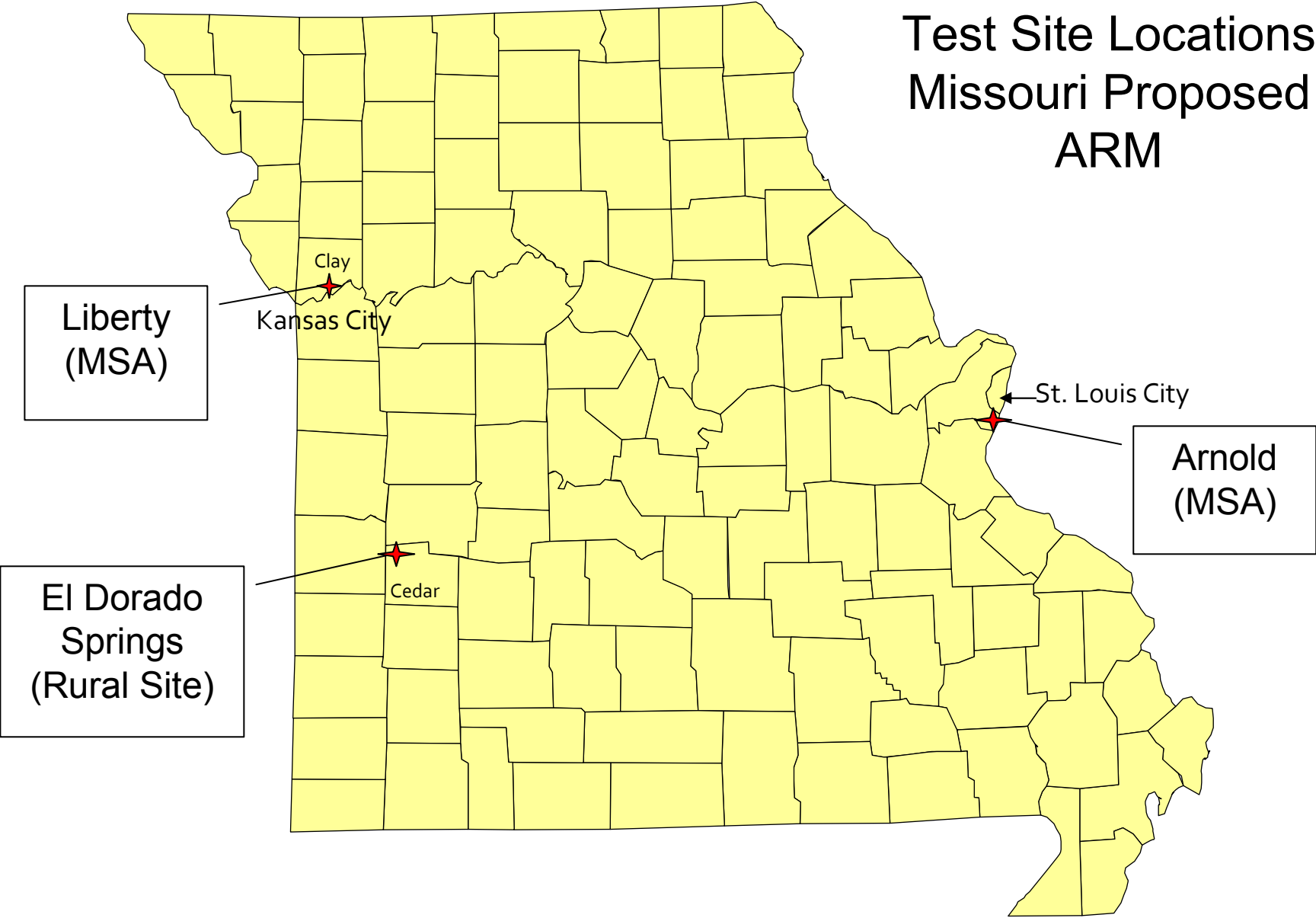
For Temperatures Between 271K(-2°C) and 293K(20°C)

$$\mathbf{FRM = B - (R * ((293 - K) / 22))}$$

For Temperatures Below 271K (-2°C, 28°F)

$$\mathbf{FRM = B - R}$$

Test Site Locations Missouri Proposed ARM



El Dorado Springs (Rural Site)



Arnold West (MSA Site)



Liberty (MSA Site)



What Constitutes a Valid Sample Pair?

A valid sample pair is included in the ARM Test if:

- Both the FRM and Candidate sampled for the complete 24hrs. (For TEOM data completeness, avoid performing quality control checks on FRM run days!)
- Both the FRM and Candidate samplers must be operating properly. (Even if only one hour of TEOM Data was lost, we did not include it in the Test.)
- Includes data where The FRM concentration was below $3 \mu\text{g}/\text{m}^3$. (There were only a few data pairs where the FRM was below $3 \mu\text{g}/\text{m}^3$.)

Data Reporting/Documenting for ARM

Set No.	Test Date	Candidate measurements, $\mu\text{g}/\text{m}^3$		Values Available	Mean $\mu\text{g}/\text{m}^3$	Precision $\mu\text{g}/\text{m}^3$	CV %	Comment regarding candidate data set
		Unit 1	Unit 2					
1	03/01/08	4.3	5.9	2	5.1	1.13	22.2%	
2	03/02/08	9.6	9.7	2	9.7	0.07	0.7%	
3	03/03/08	6.9	6.4	2	6.7	0.35	5.3%	
4	03/04/08	11.9	12.0	2	12.0	0.07	0.6%	
5	03/05/08	14.4	13.9	2	14.2	0.35	2.5%	
6	03/06/08	x17.9	x17.2					not 24 hour runs
7	03/07/08	x12.5	x24.4					Unit 2 not 24 hours
8	03/08/08	13.2	12.4	2	12.8	0.57	4.4%	
9	03/09/08	16.6	16.0	2	16.3	0.42	2.6%	
10	03/10/08	x	x13.1					not 24 hour runs
11	03/11/08	x	x17.1					primary off line, No FRM data for this day
12	03/12/08	x	x15.0					primary off line
13	03/13/08	x	x4.7					primary off line
14	03/14/08	x	x8.5					primary off line
15	03/15/08	x	x19.7					primary off line
16	03/16/08	x	x13.9					primary off line
17	03/17/08	x	x18.7					primary off line
18	03/18/08	x5.4	x13.0					not 24 hour runs
19	03/19/08	x12	x11.1					Unit 2 not 24 hours
20	03/20/08	9.2	9.0	2	9.1	0.14	1.6%	
21	03/21/08	11.8	11.3	2	11.6	0.35	3.1%	

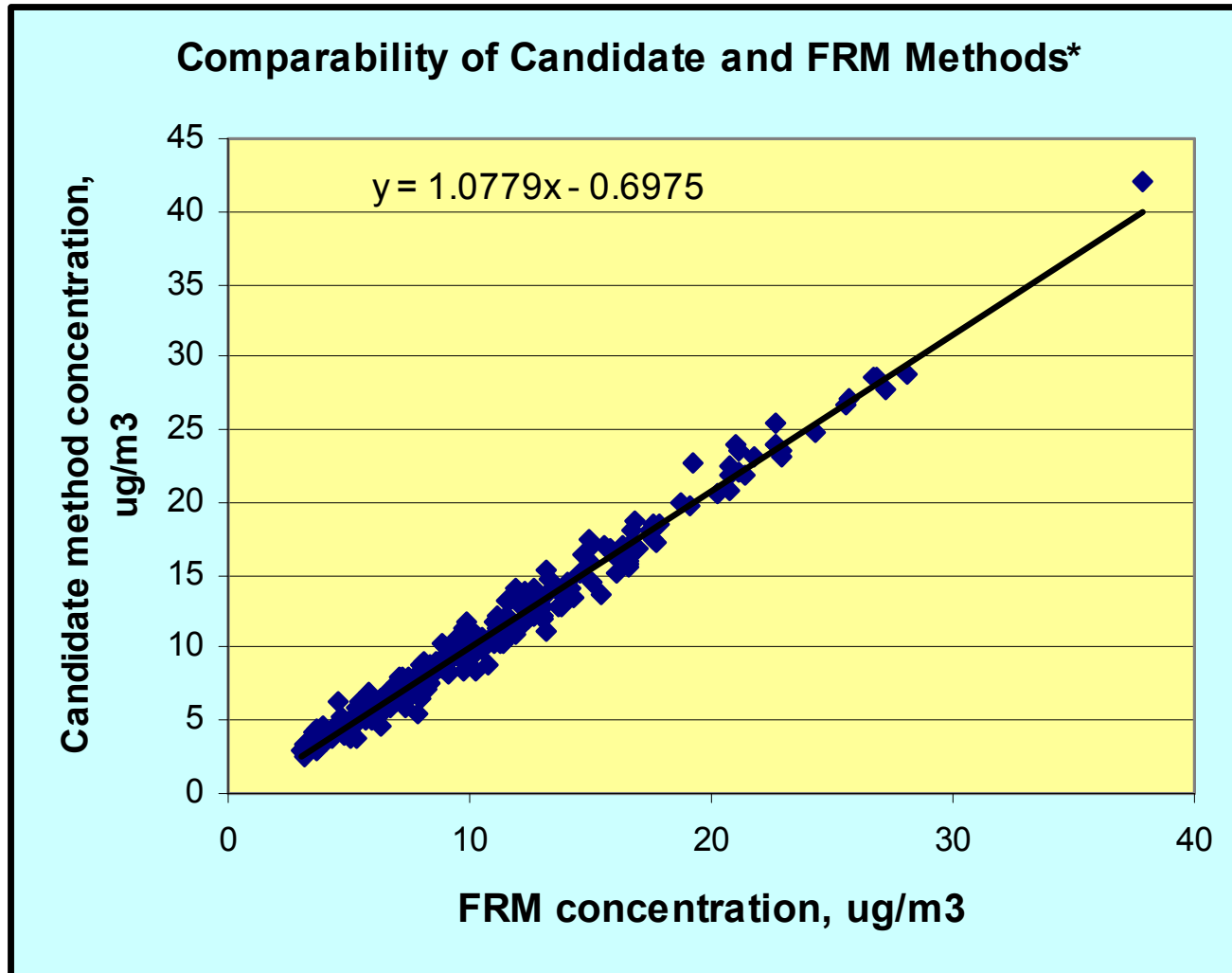
Progress Report

Data has been analyzed from
March 2008 through December 2008

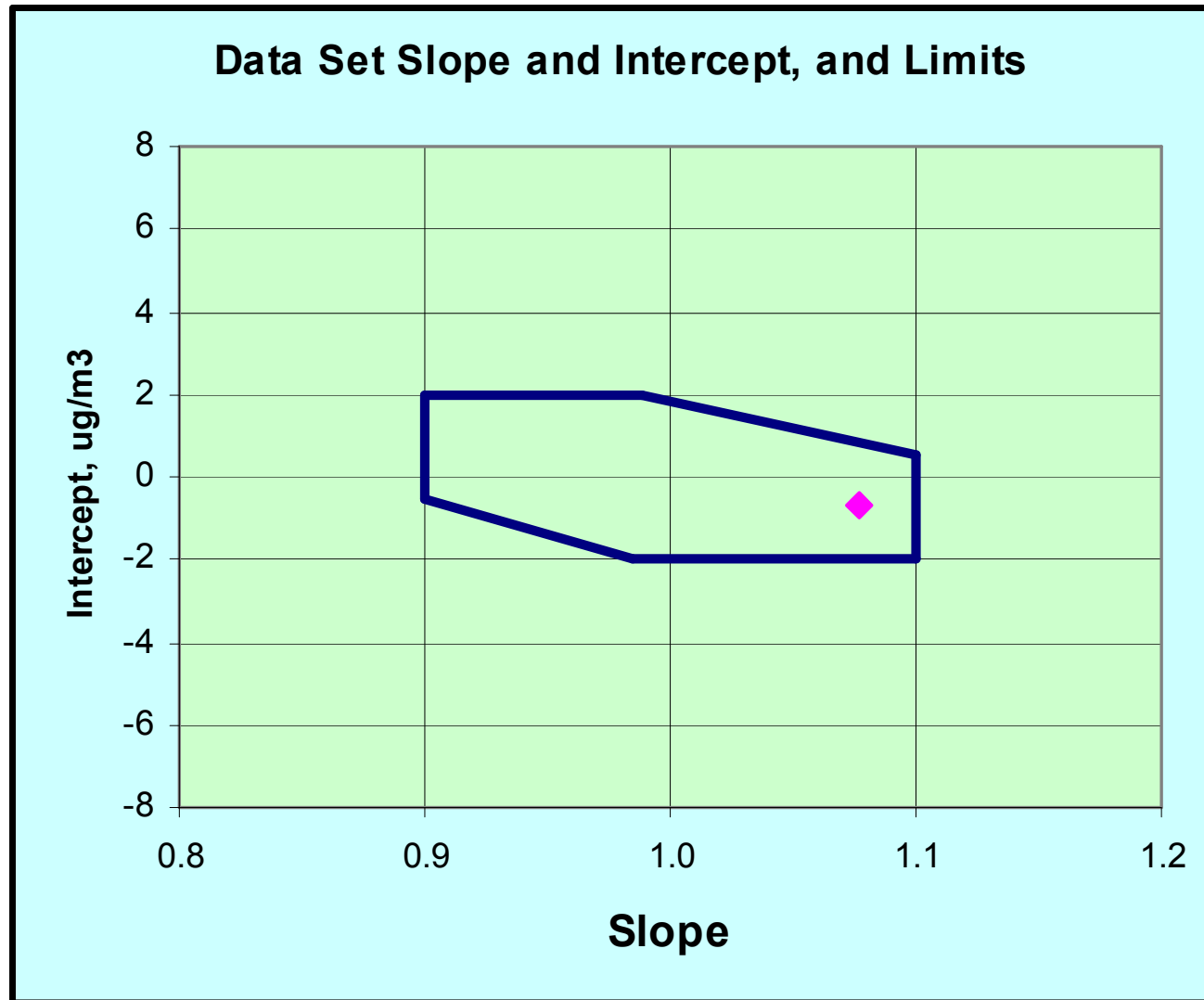
- All three sites meet the requirements for multiplicative and additive bias.
- Candidate method Precision is 7.1%.
- The two MSA sites meet the correlation (r) requirement. The rural site will likely meet this requirement when data pair completeness has been achieved.

Arnold West (St. Louis MSA)

(Every Day Sampling) N = 277 Correlation (r) = 0.9900

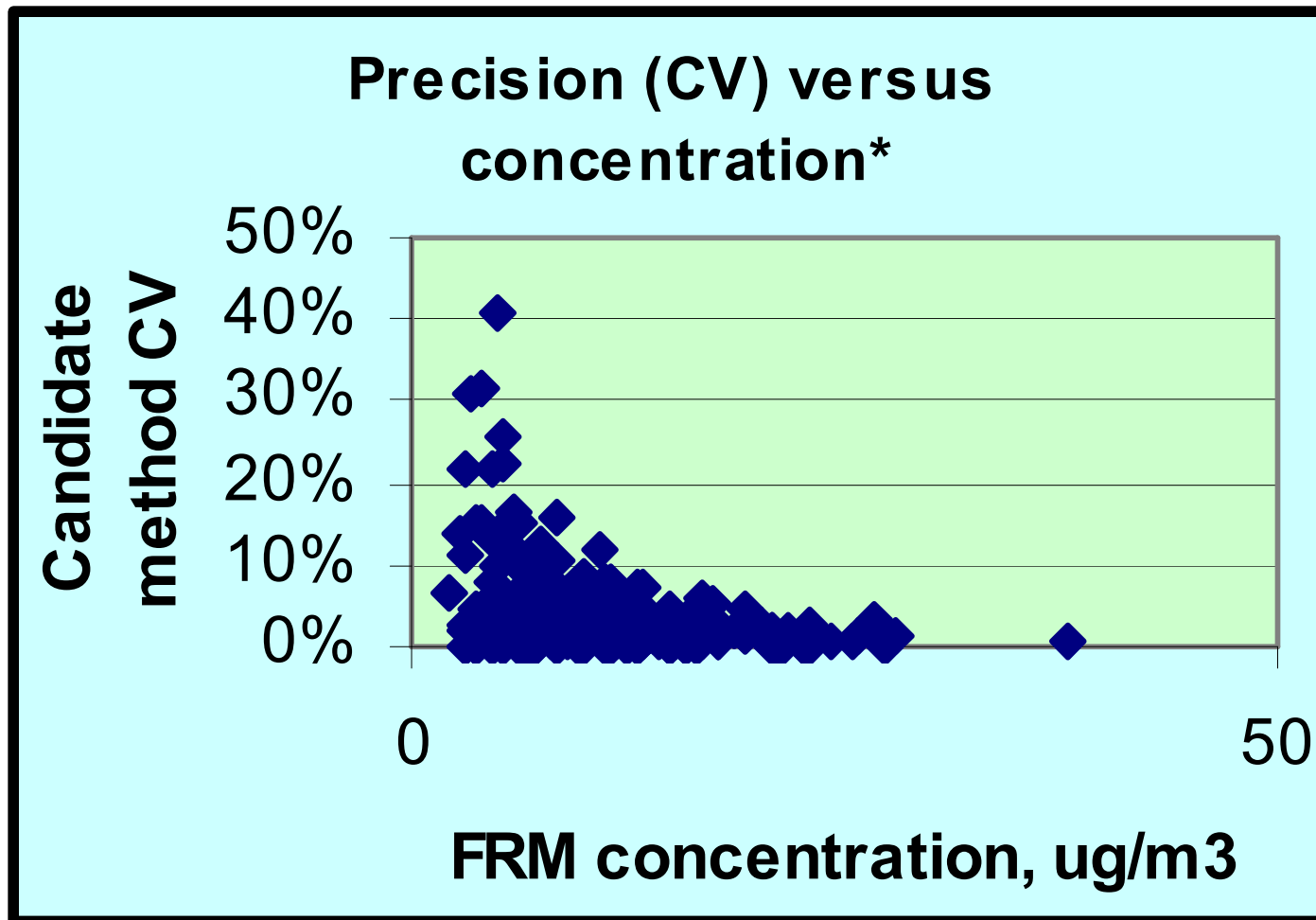


Arnold West (St. Louis MSA)



Arnold West (St. Louis MSA)

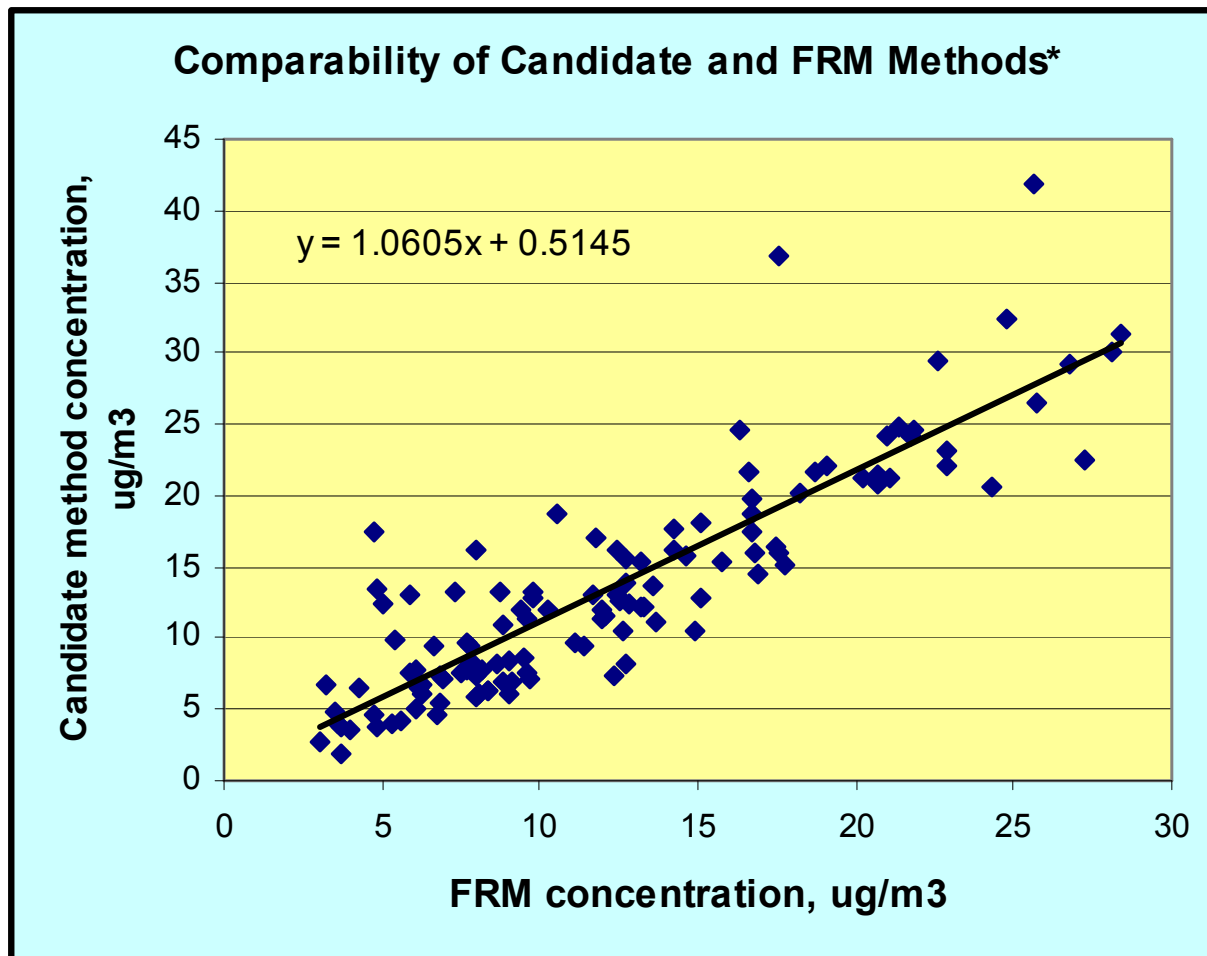
RMS Precision of Candidate Method 7.1%



Bata-Ray Monitor Pilot Test (Arnold West)

May 2008 through November 2008 (BAM 1020, uncorrected)

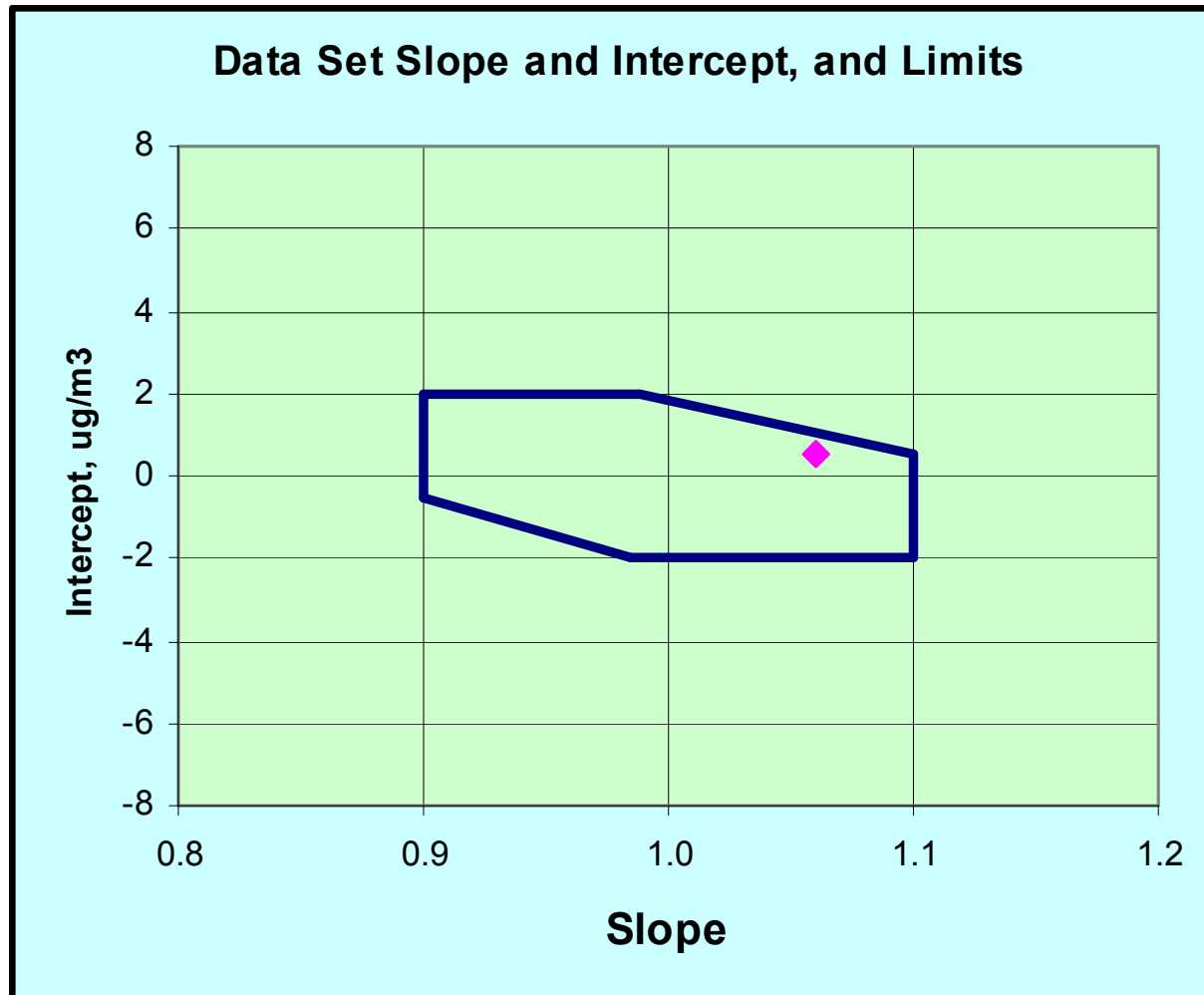
(Every Day Sampling) N = 118 Correlation (r) = 0.87588



Bata-Ray Monitor Pilot Test (Arnold West)

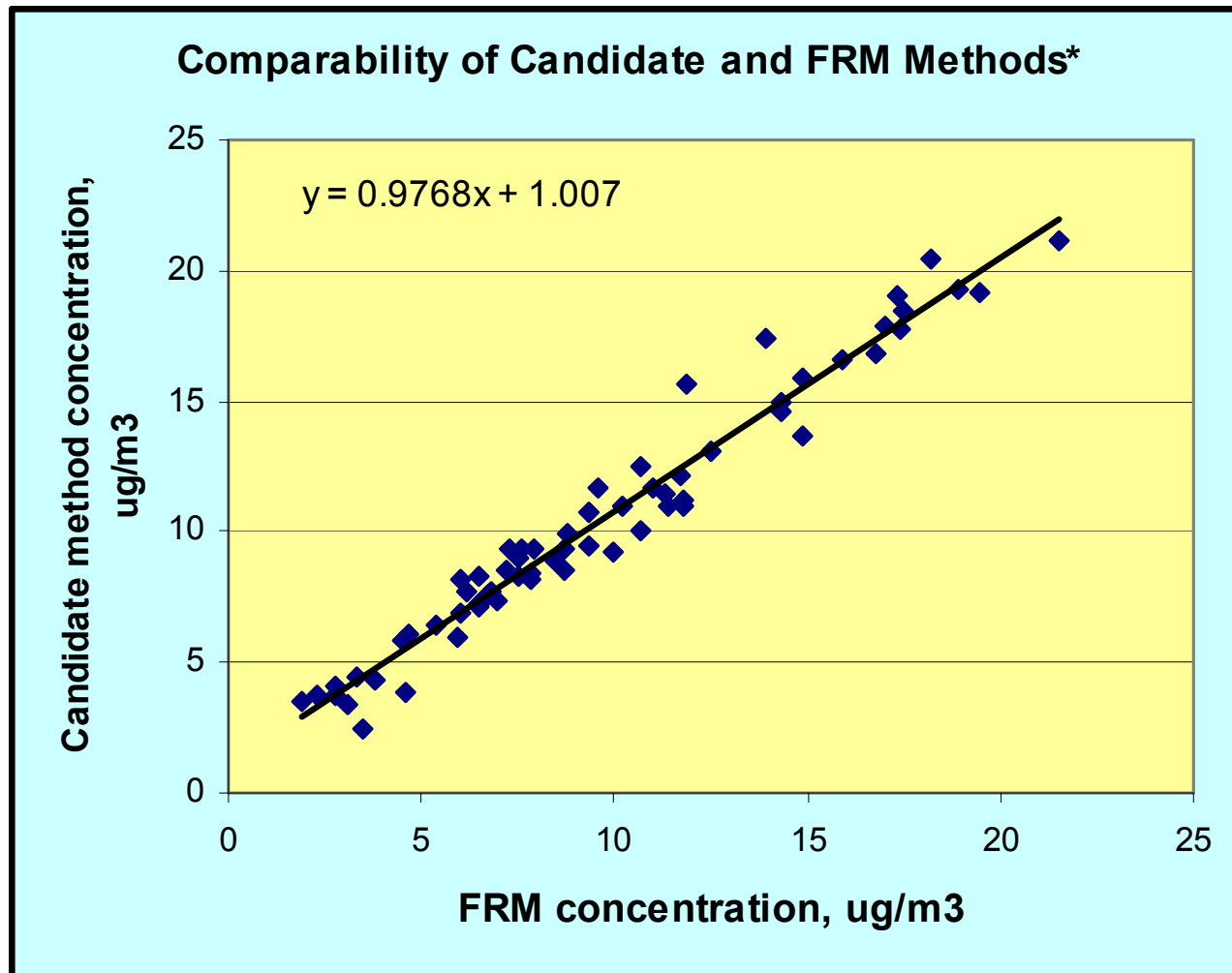
May 2008 through November 2008 (BAM 1020, uncorrected)

(Every Day Sampling) N = 118 Correlation (r) = 0.87588

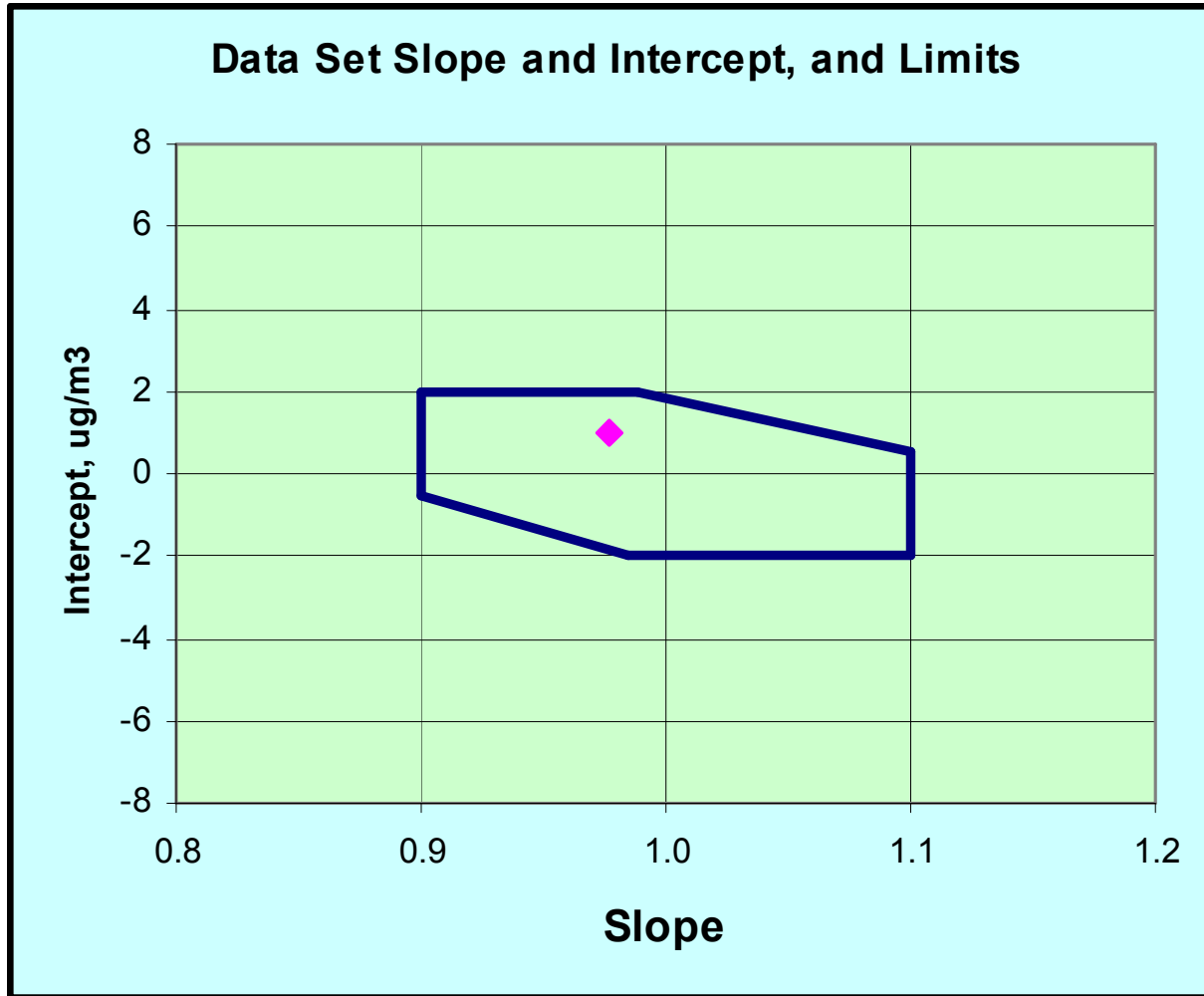


Liberty (Kansas City MSA)

(Every 3rd Day Sampling), N = 65, Correlation (r) = 0.97968

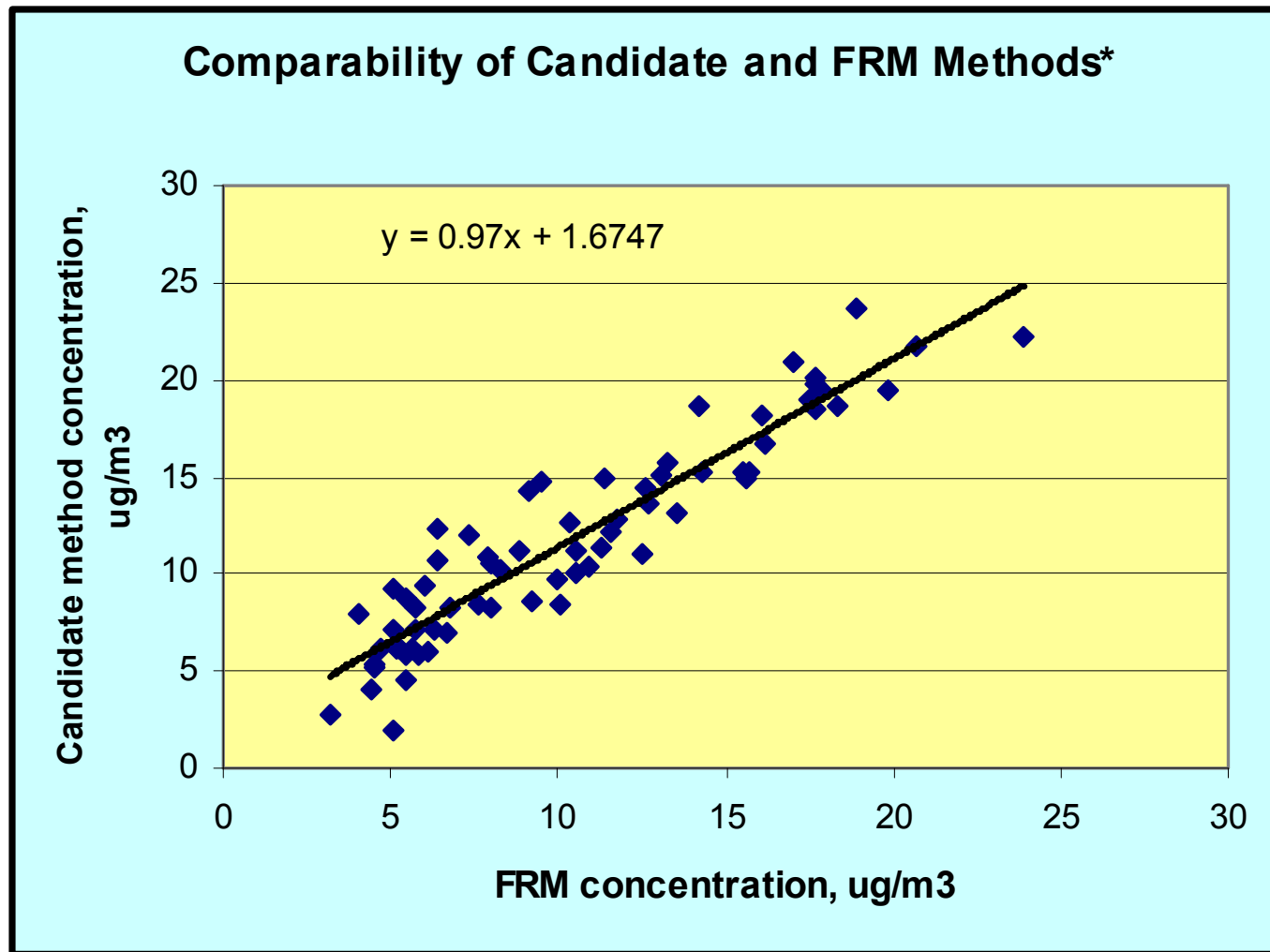


Liberty (Kansas City MSA)

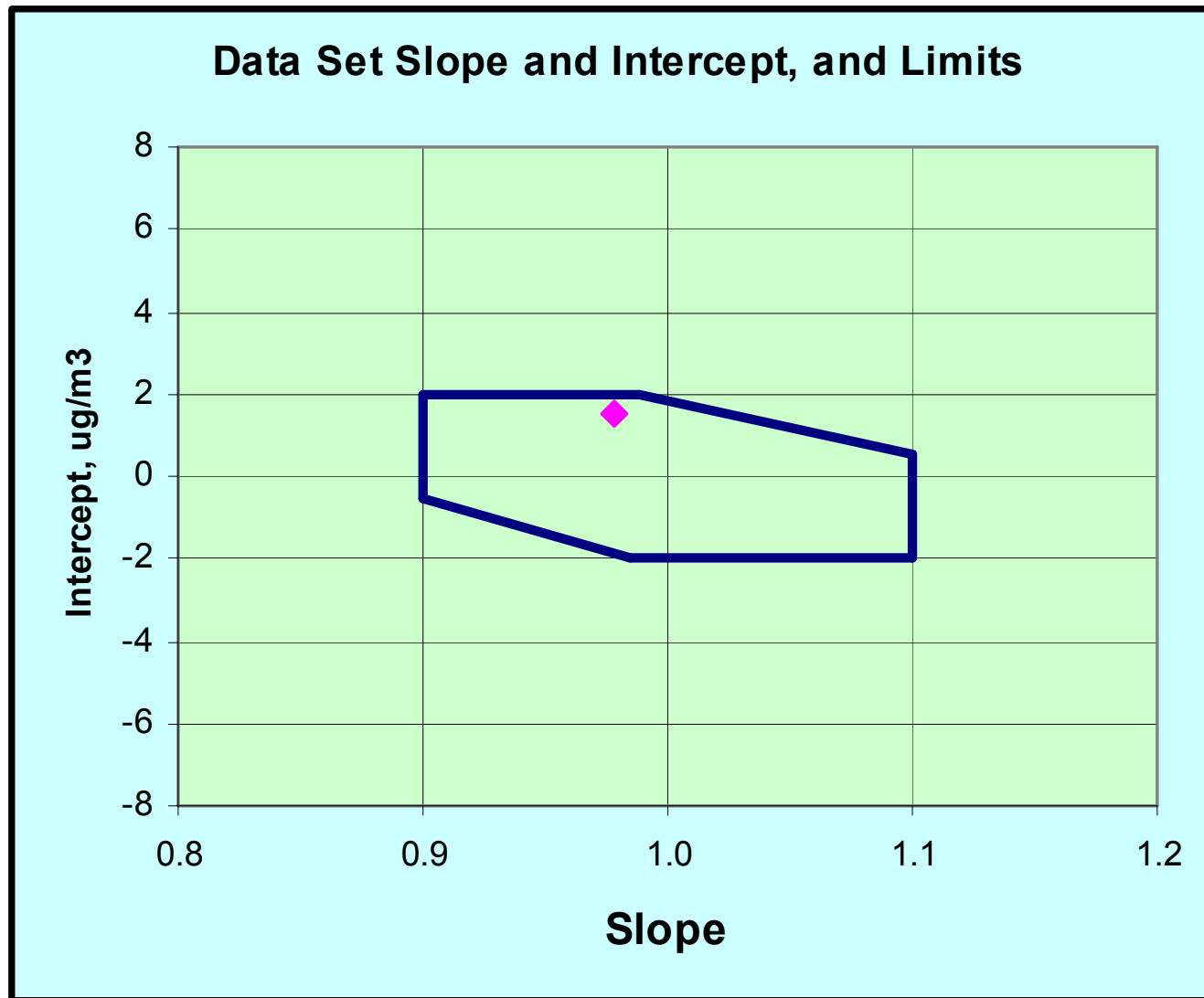


El Dorado Springs (Rural Site)

(Every 3rd Day Sampling) N= 69 Correlation (r) = 0.93528

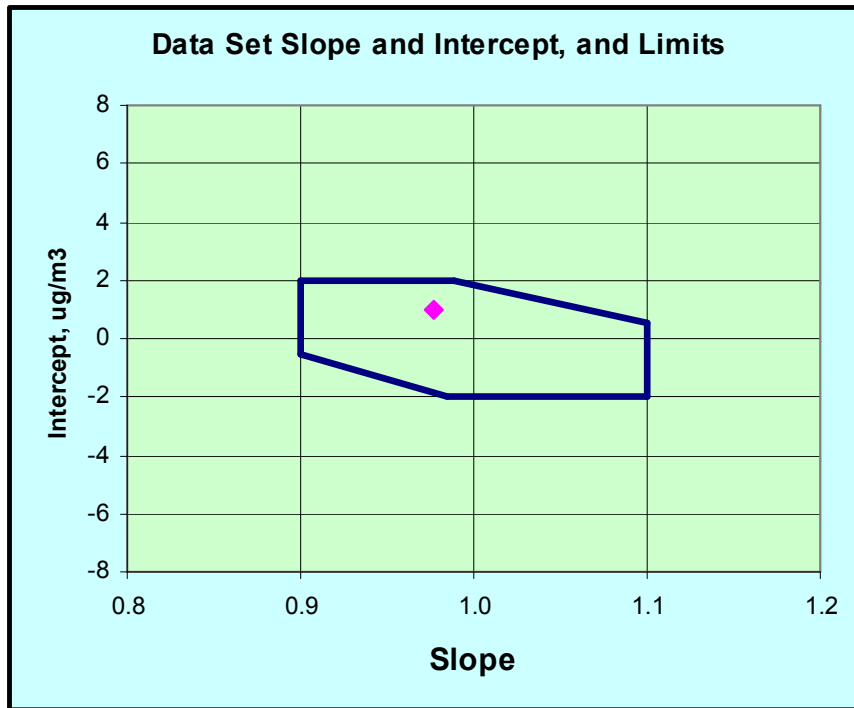


El Dorado Springs (Rural Site)



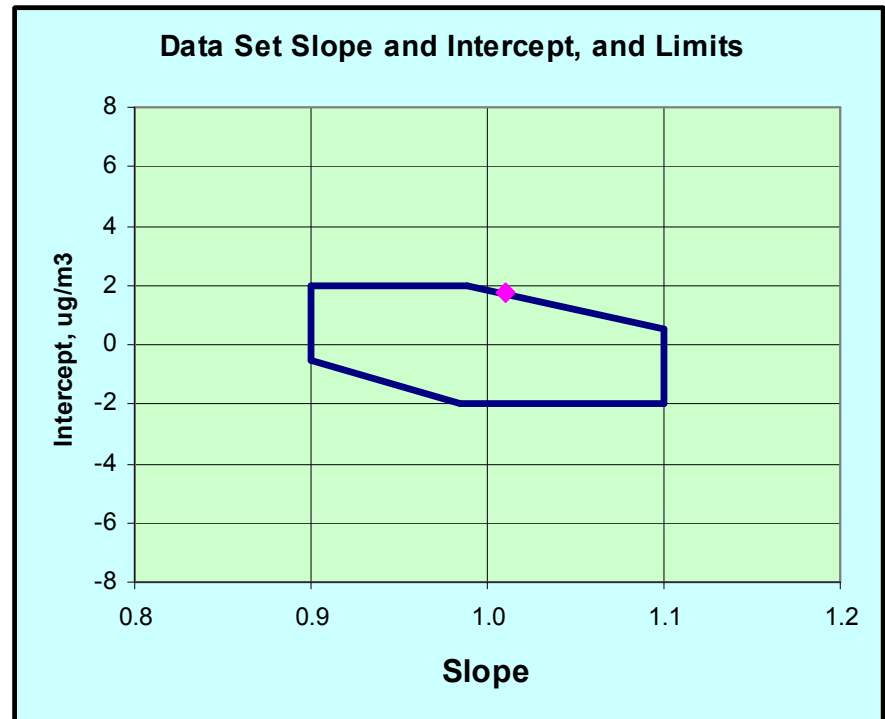
Would the Test have passed without the data correction algorithm?

Corrected: Pass



Uncorrected: Fail

(true for all test sites)



Site: Liberty (Kansas City MSA)

Conclusion

Passing the ARM Test appears likely assuming
“past performance is a potential indicator of future results.”

 **Think Positively!**

(Previous testing at the rural site from July 2005 through July 2006 passed the test. However, this test was performed with an SCC not VSCC.)

Any Questions?