National UST/LUST/Funds Meeting
Sacramento, CA.
April 1, 2009

Revenue in FY 2008

- Total revenue = $16.8 million
- Year of monthly highs and lows
- Sept., Dec. & June below 10 yr. low
- Jan., Feb., & May above 10 yr. high
- Surcharge in effect since Jan. 1, 2006
- FY2008 expenditures exceeded revenue by $2.4 million

FY 2008 State Assurance Fund

- Sharp decrease in GWF cash balance & inability to rebound
- July 1, 2007 - $4.9 million
- August 1, 2007 - $5.3 million
- December 1, 2007 - $1.4 million
- June 30, 2008 - $875,648

- NOTE: State FY 2008 = 7/1/07 to 6/30/08

Historical View of Clean-up Expenditures vs. Fee Revenue ($million)

FY	2003	2004	2005	2006	2007	2008
Clean-up	7.4	6.9	7.9	6.3	8.1	11.4
Fees	16.1	16.6	11.0	11.6	15.7	15.0
Ratio	0.46	0.41	0.72	0.54	0.52	0.76

Increasing Clean-up Costs: Trucking & Treatment Costs for Contaminated Soils

Contract prices – Bangor area

	2005	2008	% Increase
Truck (per hour)	$57	$65	+14
Treat (per ton)	$30	$44	+47

Lessons Learned from 2008

- Most of $ spent on small minority of sites: 67% of expenditures on 5% of sites (40 of 822)
- Cost of contaminated soil removal, transport, treatment & disposal single largest factor in overall project costs (17 sites more than 2000 tons)

To Do List

- Closer technical oversight/peer review
- Revised budgeting for all expenditures
- Reimburse in installments
- Review clean up standards
- Re-evaluate bio –treatment & asphalt batching technologies
- Evaluate cost recovery for negligent acts (General liability policies)
- Evaluate cost recovery for spills during loading and off loading . Bulk plants and overfills. (MCA 49 USC § 31139)

More To Do

- ***Reduce repeat clean ups***
- ***Assess accuracy of field analysis for soils***

PID Performance on Petroleum Hydrocarbons – Leveling the Playing Field

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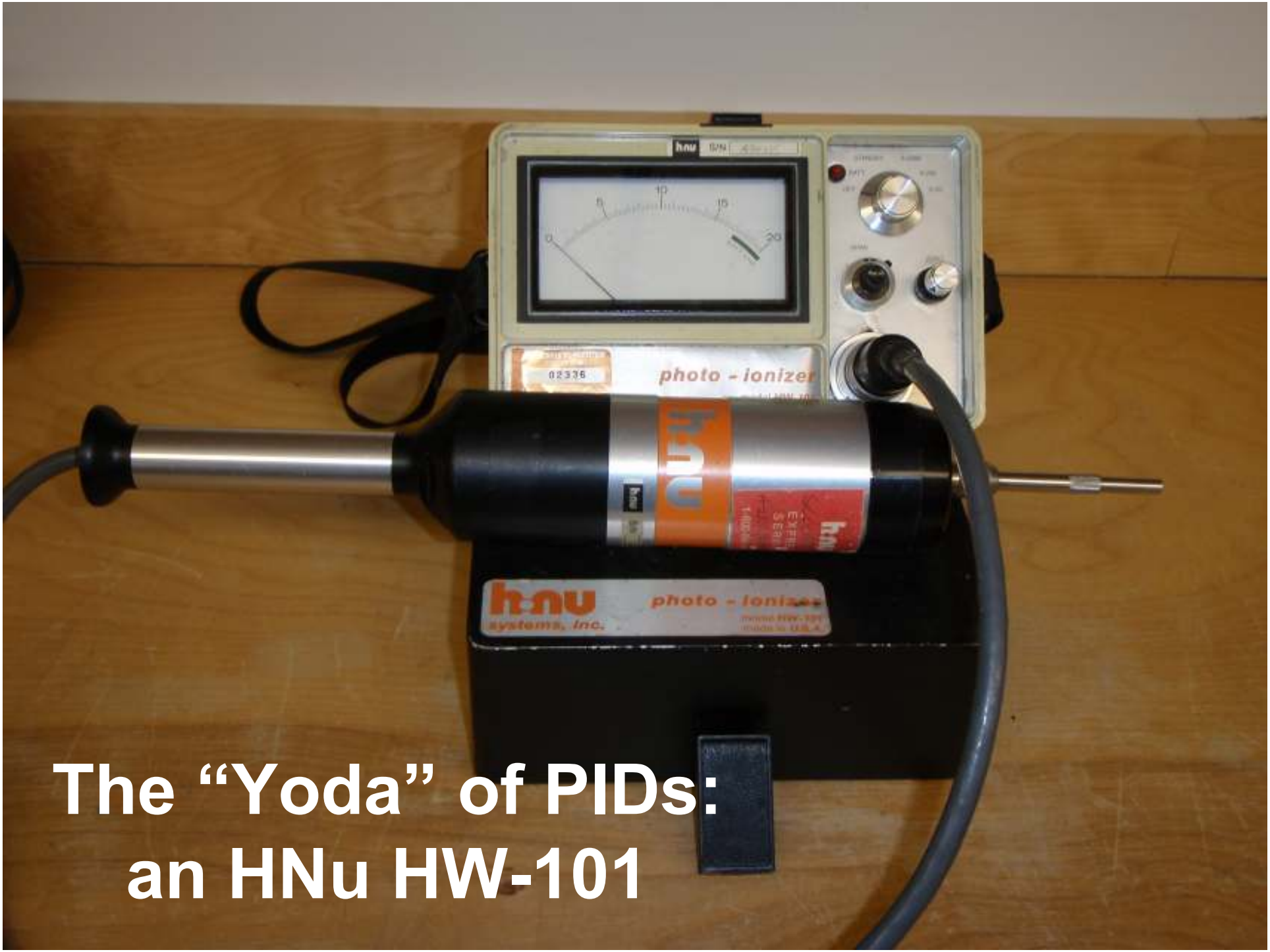
A Brief Walk Back in Time ….

- Maine's accelerated UST replacement program: late 1980's and early '90s;
- Extensive use of PIDs at tank pulls;
- HNu 101 series, MSA Photon, Photovac MicroTIP series, Photovac TIP II most commonly used



The “Yoda” of PIDs: an HNu HW-101

Inconsistencies Observed in Hydrocarbon Concentrations Measured By PIDs

- Large differences in results from different makes of instrument measuring same soil – discrepancies of x2 and x3 common
- Anecdotal reports of consultants bringing instrument which would produce desired result

The Issue ….

Instrument response to complex hydrocarbon mixtures not the same as response to single-component calibration gas

(isobutylene)

The Need ….

- A means to make valid comparisons between headspace measurements from different instruments at different times;
- Method should be valid for typical field conditions: wide range of headspace concentrations; weathered products; high relative humidity

The Fix ….

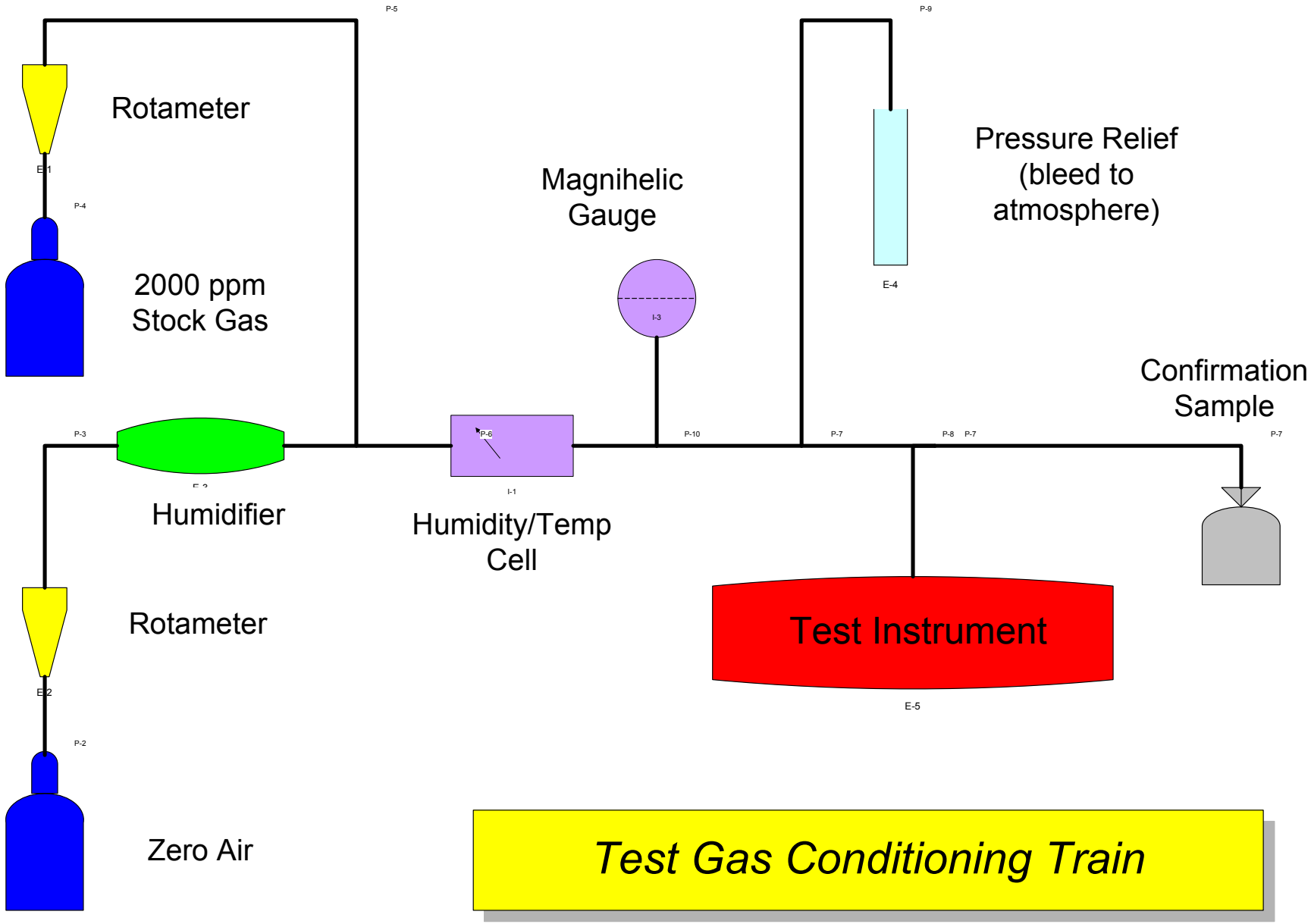
Normalize responses with instrument-specific set points determined on actual hydrocarbon mixtures

The Procedure ….

- Headspaces over weathered neat gasoline and fuel oil samples analyzed by laboratory methods;
- Assay separated into principal hydrocarbon groups (alkanes, alkenes, aromatics, etc);
- Single surrogate compound chosen to represent each group;
- Test gases “designed” with surrogates in same proportions as tested samples

Procedure (cont'd)

- Test gases intended to represent headspaces over contaminated soil;
- 2000 ppm "weathered gasoline" and "weathered fuel oil" stock gases prepared by specialty gas company;
- Conditioning train constructed to meter, humidify, and dilute stock gases with zero (pure) air;
- Stock gases and humidified zero air metered and mixed to produce test gases at concentrations targeting 100, 200, 500, and 1000 ppm;


Rotameter
2000 ppm
Stock Gas
Magnihelic
Gauge
Pressure Relief
(bleed to
atmosphere)
Confirmation
Sample
Humidifier
Humidity/Temp
Cell
Rotameter
Test Instrument
Zero Air
Test Gas Conditioning Train

Test Gas Conditioning Train

Procedure (concluded)

- Instruments calibrated with isobutylene and operated per manufacturers' instructions;
- Instruments used to measure series of test gas concentrations;
- Results plotted; best linear fit, forced through zero, determined; set point is reciprocal of the slope;
- Test gas samples analyzed by laboratory methods to determine actual concentrations.

An Example ….

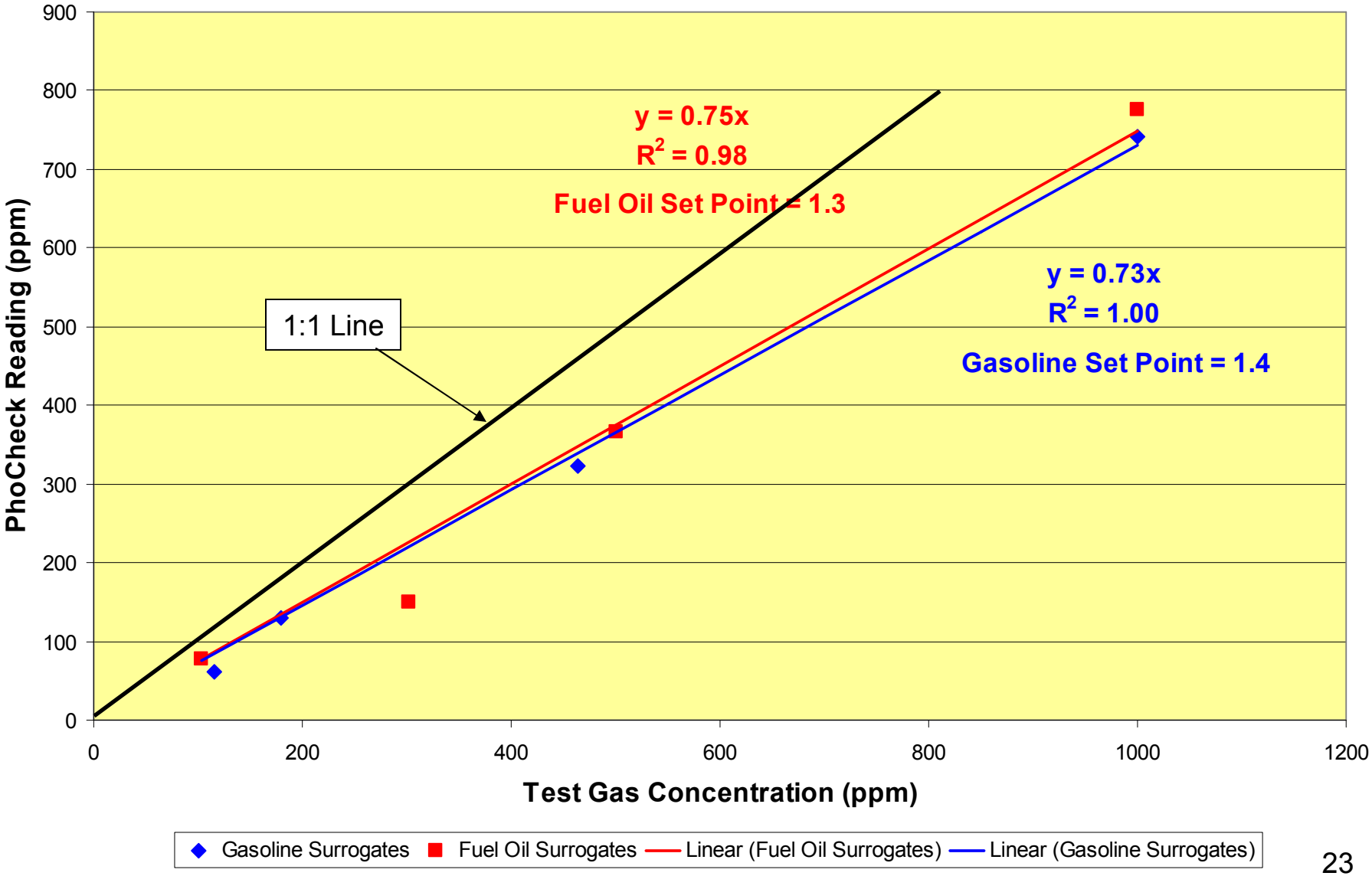
Evaluation of Ion Science PhoCheck 3000

May, 2008

Ion Science PhoCheck 3000 Evaluation

Target Test Gas Concentration (ppm)	Weathered Gasoline		Weathered Fuel Oil	
	Actual Concentration	Instrument Response	Actual Concentration	Instrument Response
100	116	61	103	77
200	179	129	302	149
500	464	322	501	366
1000	1000	741	1000	776
2000	2000	1470	2000	1420

PhoCheck Response To Petroleum Headspaces



And Finally, How To Use Them …

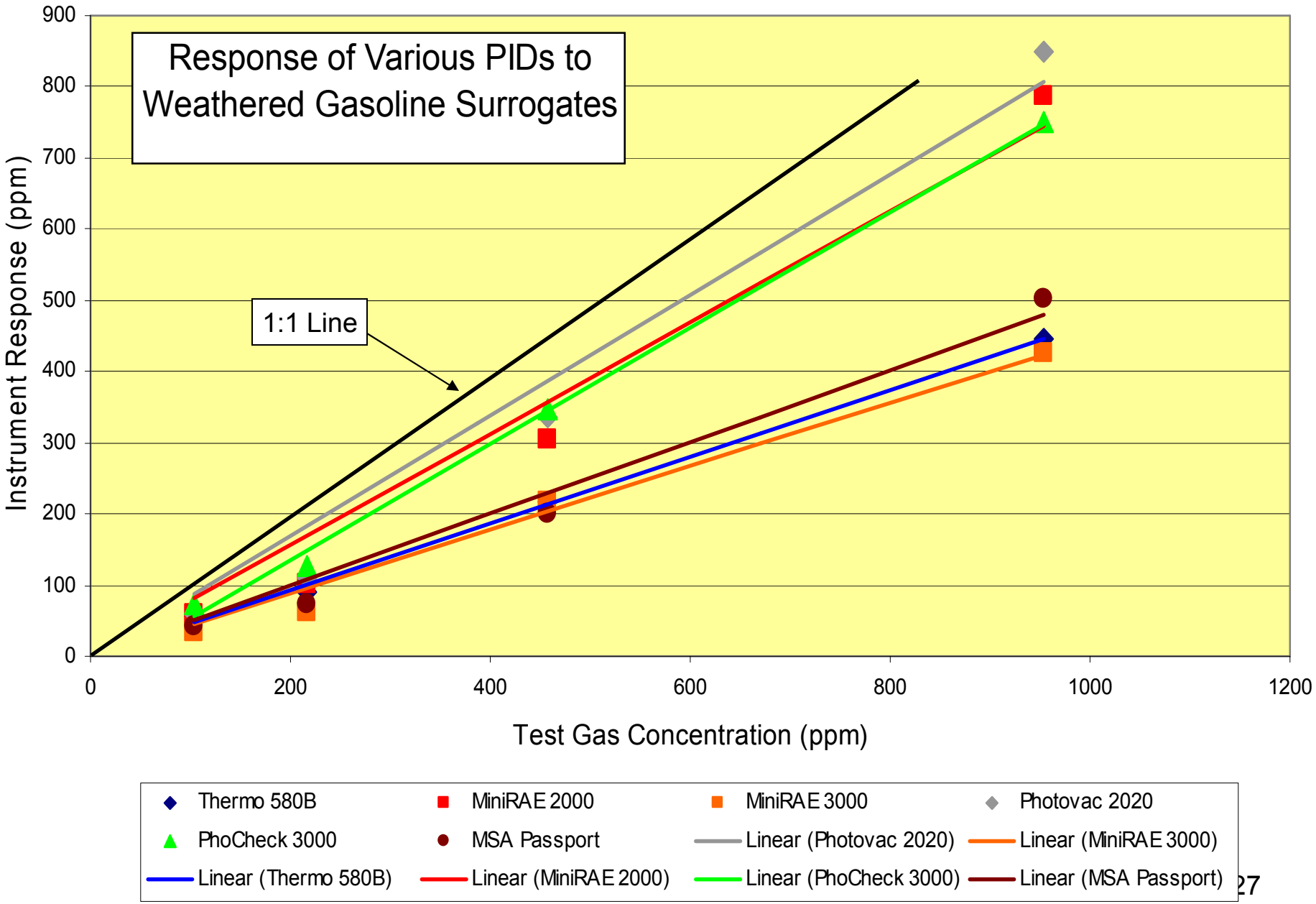
When Ion Science PhoCheck 3000 is calibrated to isobutylene, headspace measurements made over soils contaminated with:

- Weathered Gasoline, results must be multiplied by 1.4
- Weathered #2 Fuel Oil, results must be multiplied by 1.3

The Outcome …..

- Headspace concentrations measured on the same soil with different PIDs, when corrected by their respective set points, should be identical;
- Measurements made at a site by different personnel, using different instruments can be evaluated for changes over time.

So How Does the Current Generation of Instruments Compare?


Response of Various PIDs to Weathered Gasoline Surrogates
1:1 Line
Instrument Response (ppm)
Test Gas Concentration (ppm)
0
100
200
300
400
500
600
700
800
900
0
200
400
600
800
1000
1200
Thermo 580B
MiniRAE 2000
MiniRAE 3000
Photovac 2020
PhoCheck 3000
MSA Passport
Linear (Photovac 2020)
Linear (MiniRAE 3000)
Linear (Thermo 580B)
Linear (MiniRAE 2000)
Linear (PhoCheck 3000)
Linear (MSA Passport)

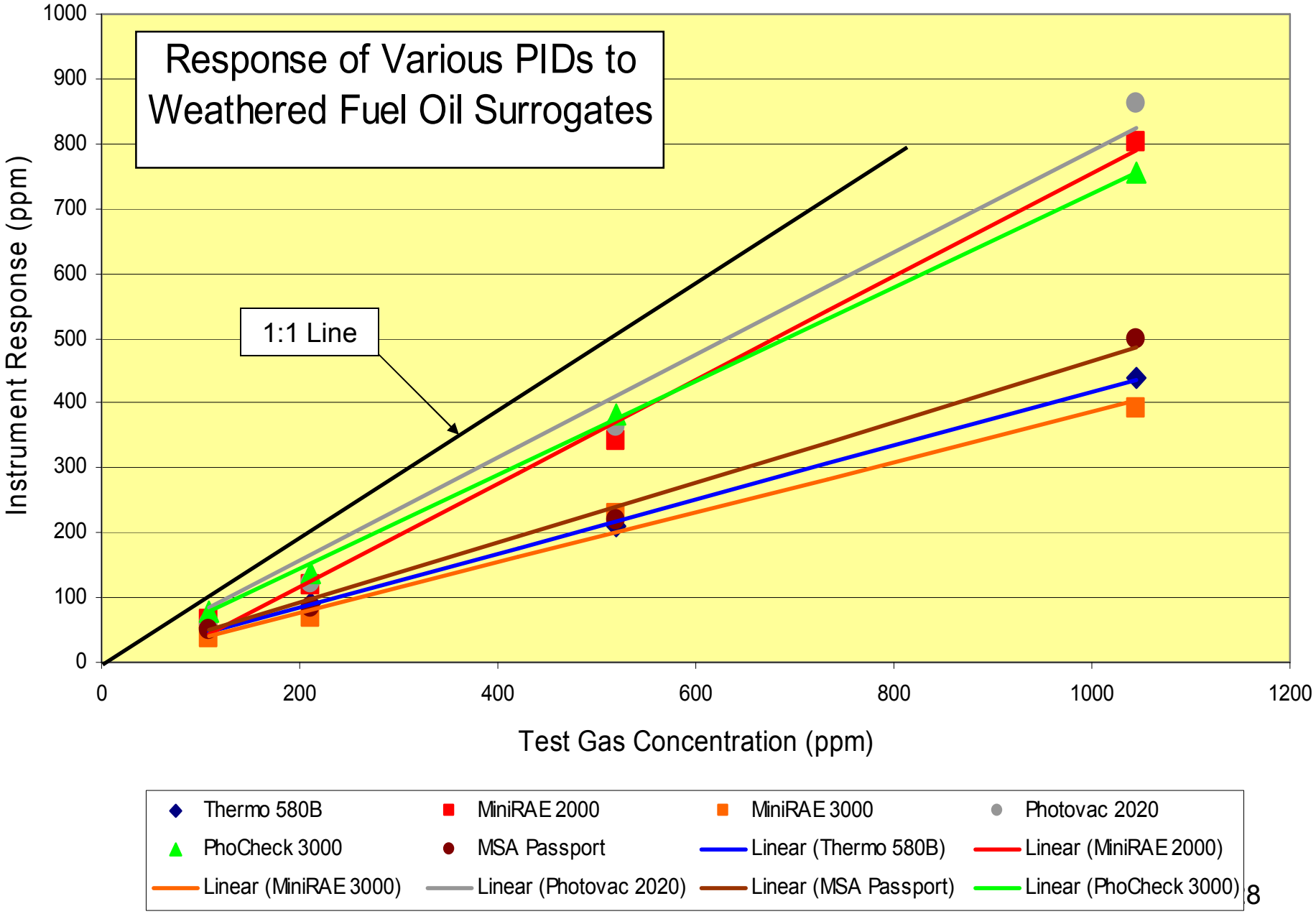

Response of Various PIDs to Weathered Fuel Oil Surrogates
1:1 Line
Instrument Response (ppm)
Test Gas Concentration (ppm)
0
100
200
300
400
500
600
700
800
900
1000
0
200
400
600
800
1000
1200
Thermo 580B
MiniRAE 2000
MiniRAE 3000
Photovac 2020
PhoCheck 3000
MSA Passport
Linear (Thermo 580B)
Linear (MiniRAE 2000)
Linear (MiniRAE 3000)
Linear (Photovac 2020)
Linear (MSA Passport)
Linear (PhoCheck 3000)

Table of Set Points for Selected PIDs

	Gasoline Set Point	Correlation Coefficient	Fuel Oil Set Point	Correlation Coefficient
MiniRAE 3000	2.2	0.98	2.6	0.98
Thermo 580B	2.1	1.00	2.4	0.99
TVA-1000	2.1	0.98	2.5	1.00
MSA Passport	2.0	0.98	2.2	0.99
PhoCheck 3000	1.4	0.99	1.3	1.00
MiniRAE 2000	1.3	0.97	1.4	0.99
Photovac 2020	1.2	0.97	1.3	0.98

Conclusions

- PID technology has improved significantly since the early 1990's: microprocessor-based; digital output; humidity-compensated;
- PID responses to complex petroleum mixtures continue to differ among makes and models;
- Use of empirically-determined response factors ("set points") can normalize readings measured with different instruments.

Thank You

Your comments and experiences welcomed !

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Headspace Data – And Where It Can Lead You …..

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Maine Petroleum Program

- Sites categorized Stringent (ST), Intermediate (IN), or Baseline (BL)
- Geological vulnerability, and
- Proximity of receptors
- Currently based on human health only

Maine Cleanup Decisions

- Maine standards currently based on GRO and DRO
- Lab analysis required for closure of ST and IN sites
- PID/Headspace data permitted at BL sites
- Default standards may be superseded based on professional judgment

Notification Level

- 100 ppm by field/headspace
- Never intended as a cleanup standard at any site
- However, 100 ppm has often come to be interpreted as a cleanup benchmark, both by DEP staff and consulting community

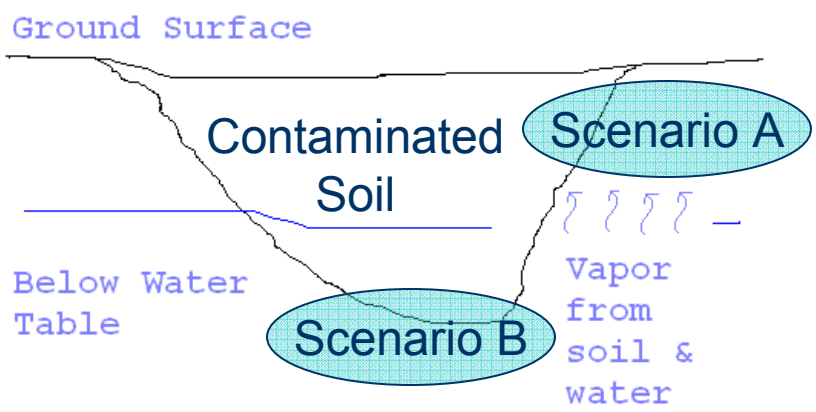
Maine Headspace Procedure

- Measured 6 ounce samples
- Performed in triplicate and averaged
- Ziplock quart sized bags
- Sample temperature adjusted as needed
- Headspace development time (15-60 min) observed
- Approved PID calibrated to DEP set points

How Site Conditions Can Fool the Headspace Evaluation

- Contaminated groundwater and soil vapor produce positive results downgradient and sidegradient, while soil is actually clean; can lead to overexcavation (A);
- Contaminated soil below water table produces low results and is left behind, which could lead to continued risk (B)

Influences on PID Response



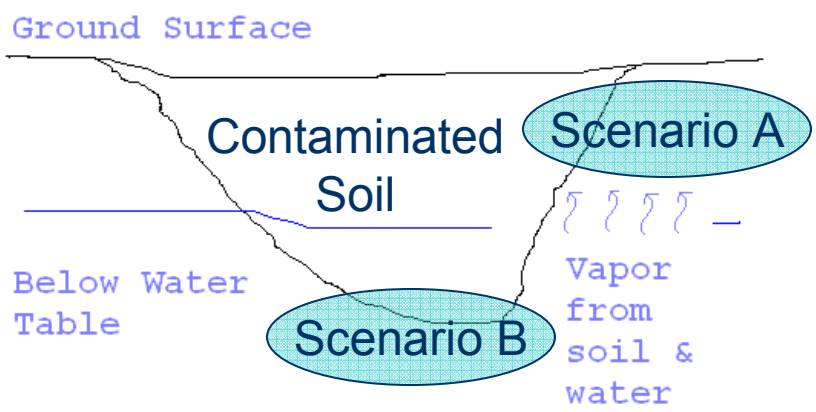
Scenario A

- Elevated PID response from soil and groundwater vapor

Scenario B

- Suppressed PID response due to wet soil

Relying on PID Readings Will:



Scenario A

- Results in excavating clean soil

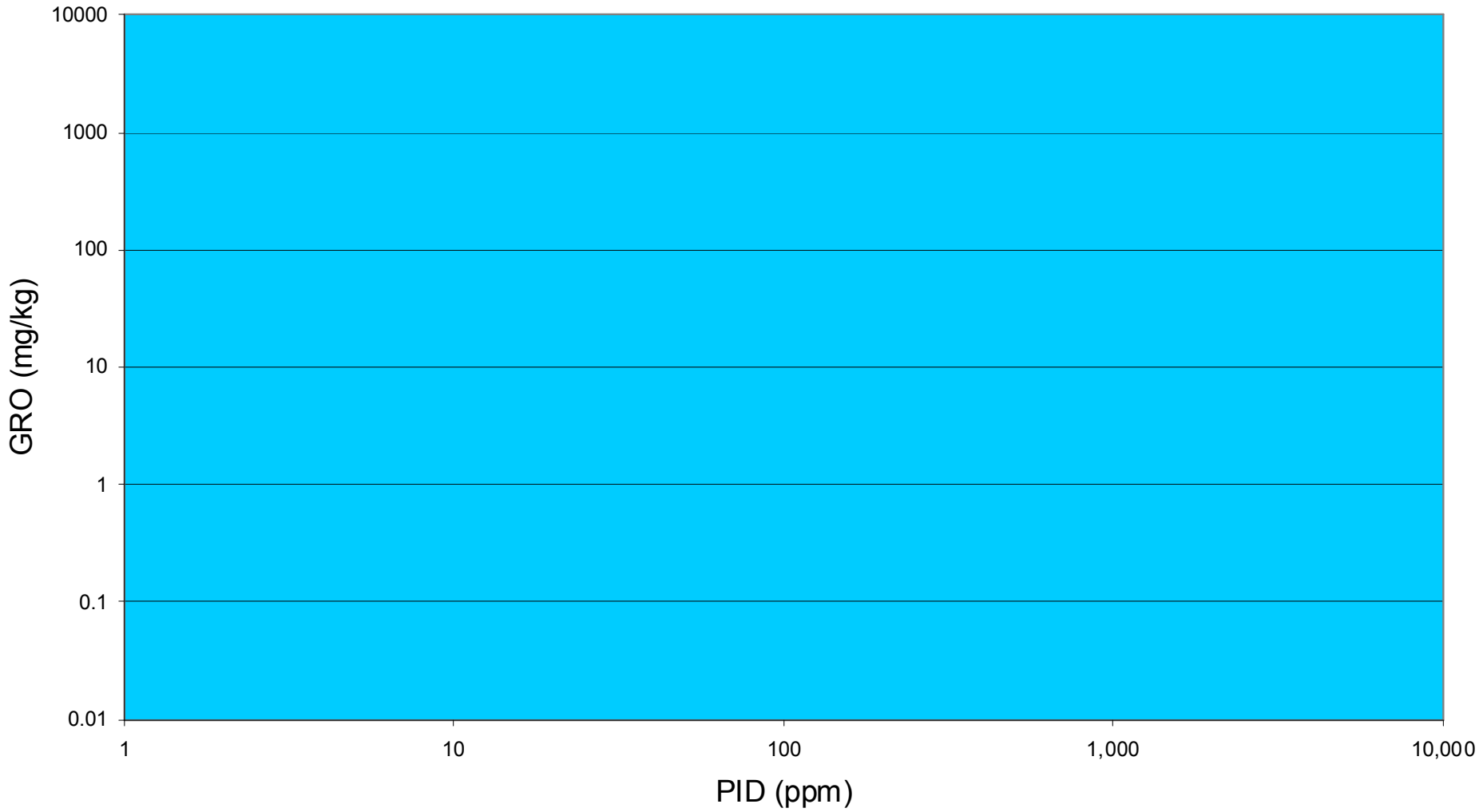
Scenario B

- Results in leaving contaminated soil below the water table

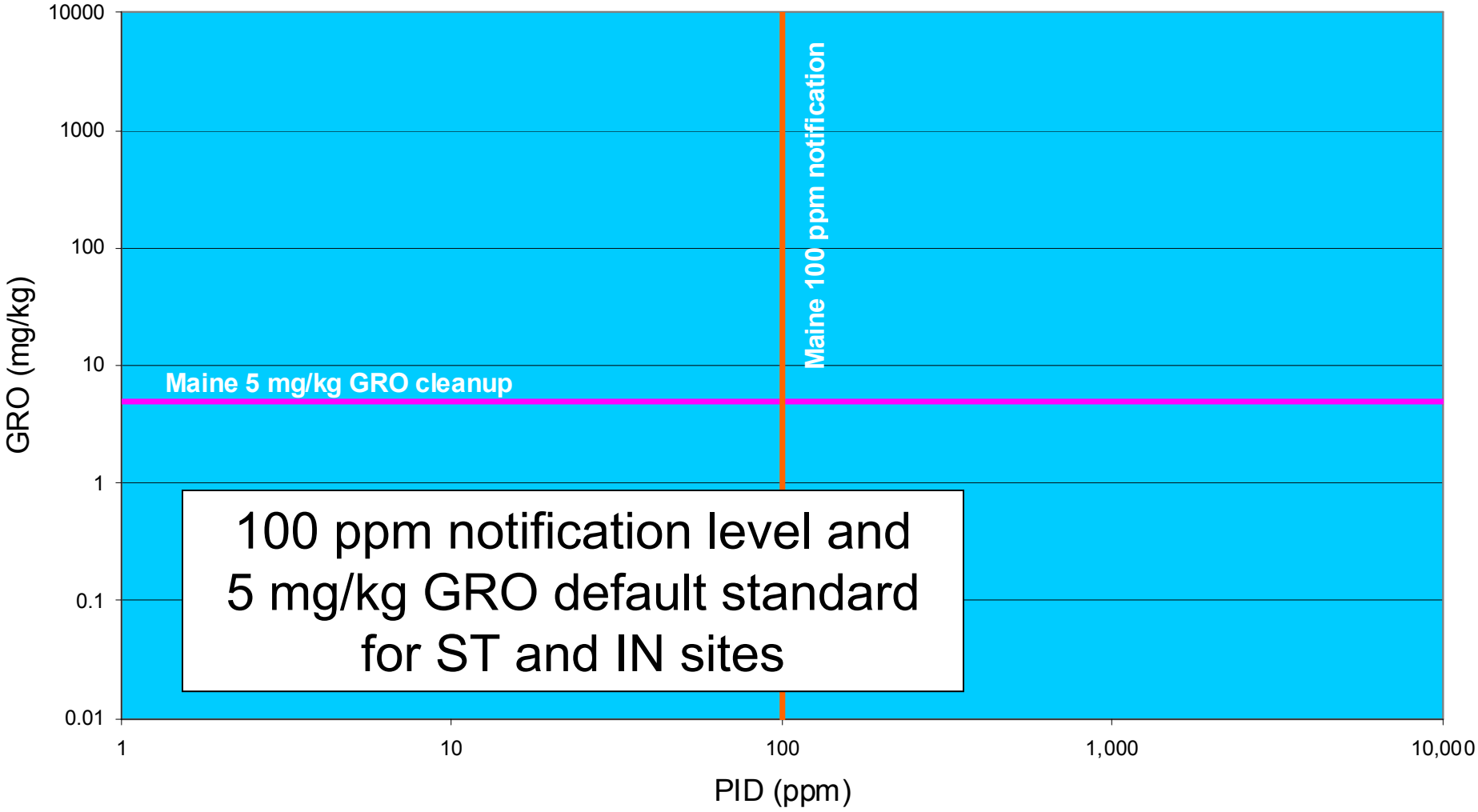
2007 Data From Five Remediation Sites

- Included mix of retail facilities, bulk plants, ASTs, USTs, one 1950's military fuel farm;
- Sites under remediation through VRAP;
- Conducted as any petroleum remediation - except (!) lab analysis done in parallel with headspace on many samples;
- Headspace measured per program SOP

Field PID vs Lab GRO in Soils

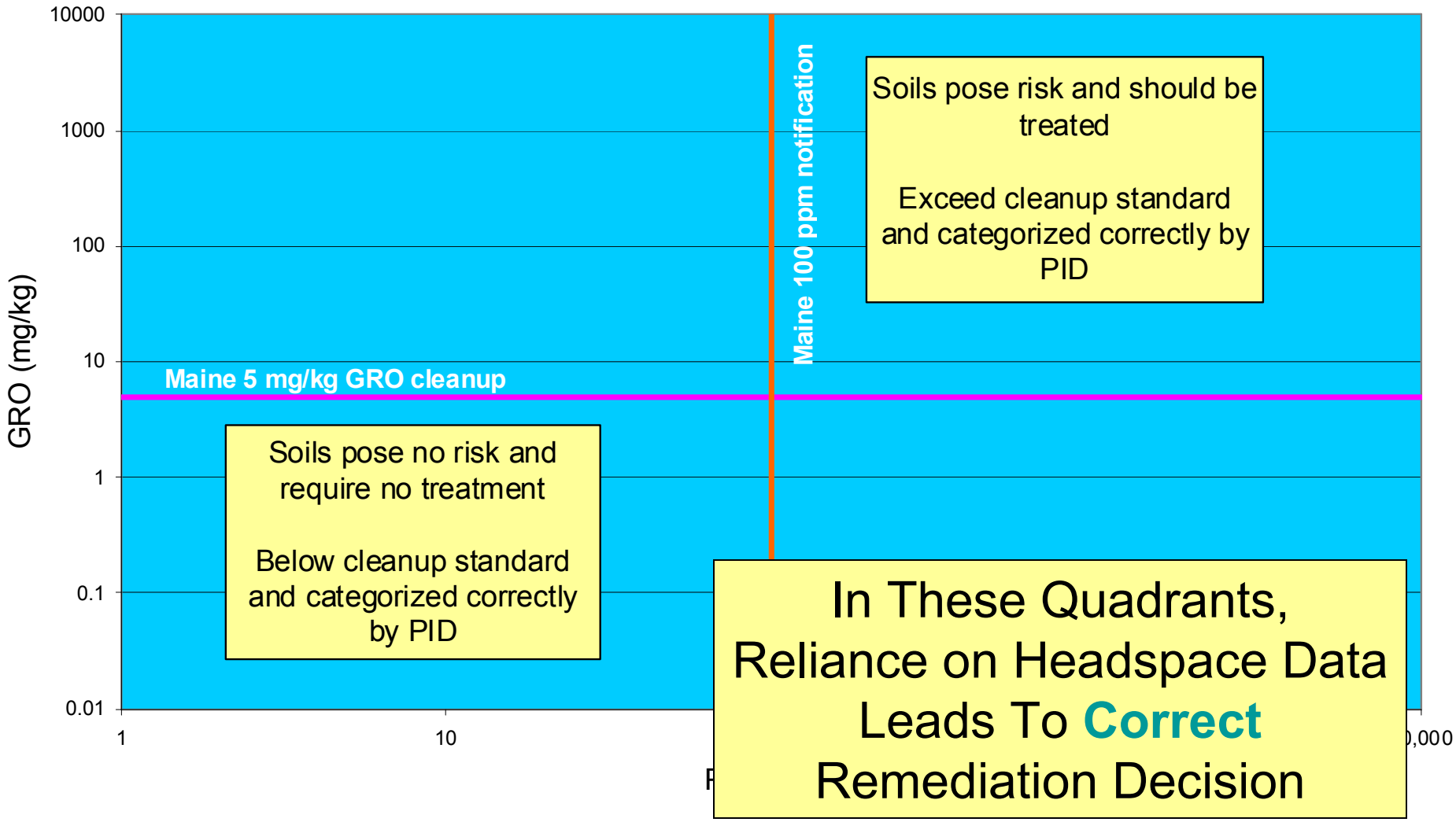


Field PID vs Lab GRO in Soils

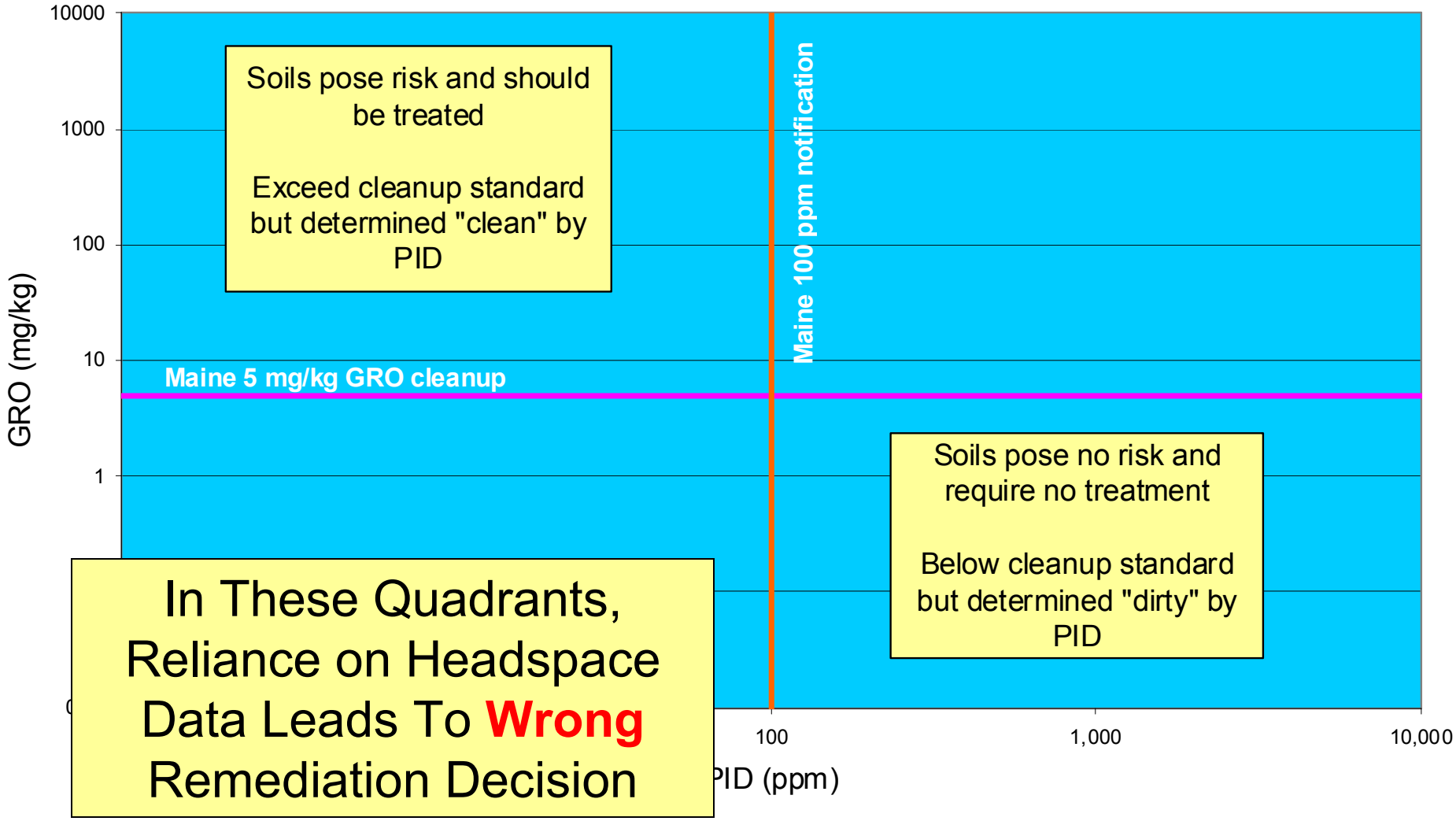


Default standard for DRO is 10 mg/kg at ST and IN sites

Field PID vs Lab GRO in Soils



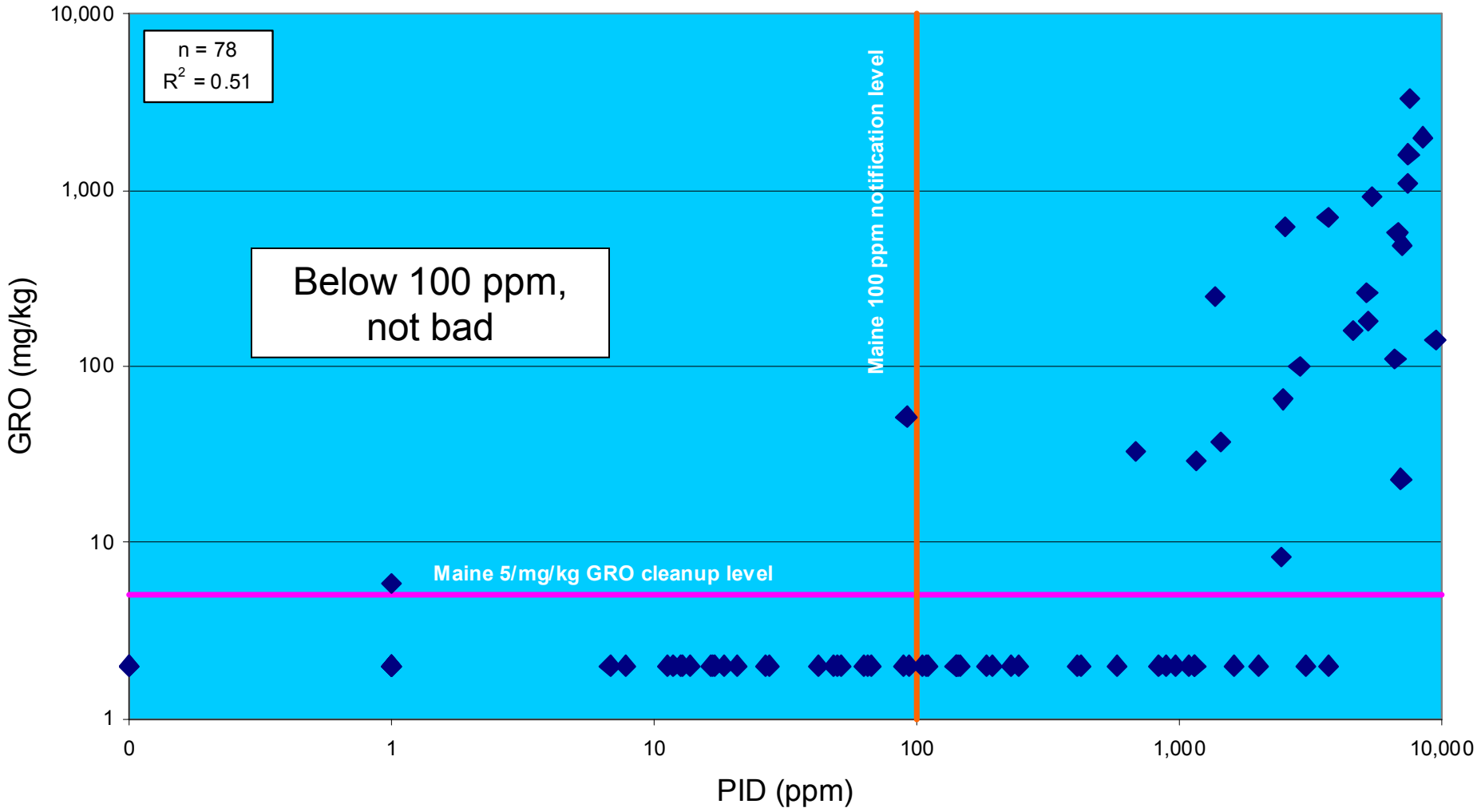
Field PID vs Lab GRO in Soils



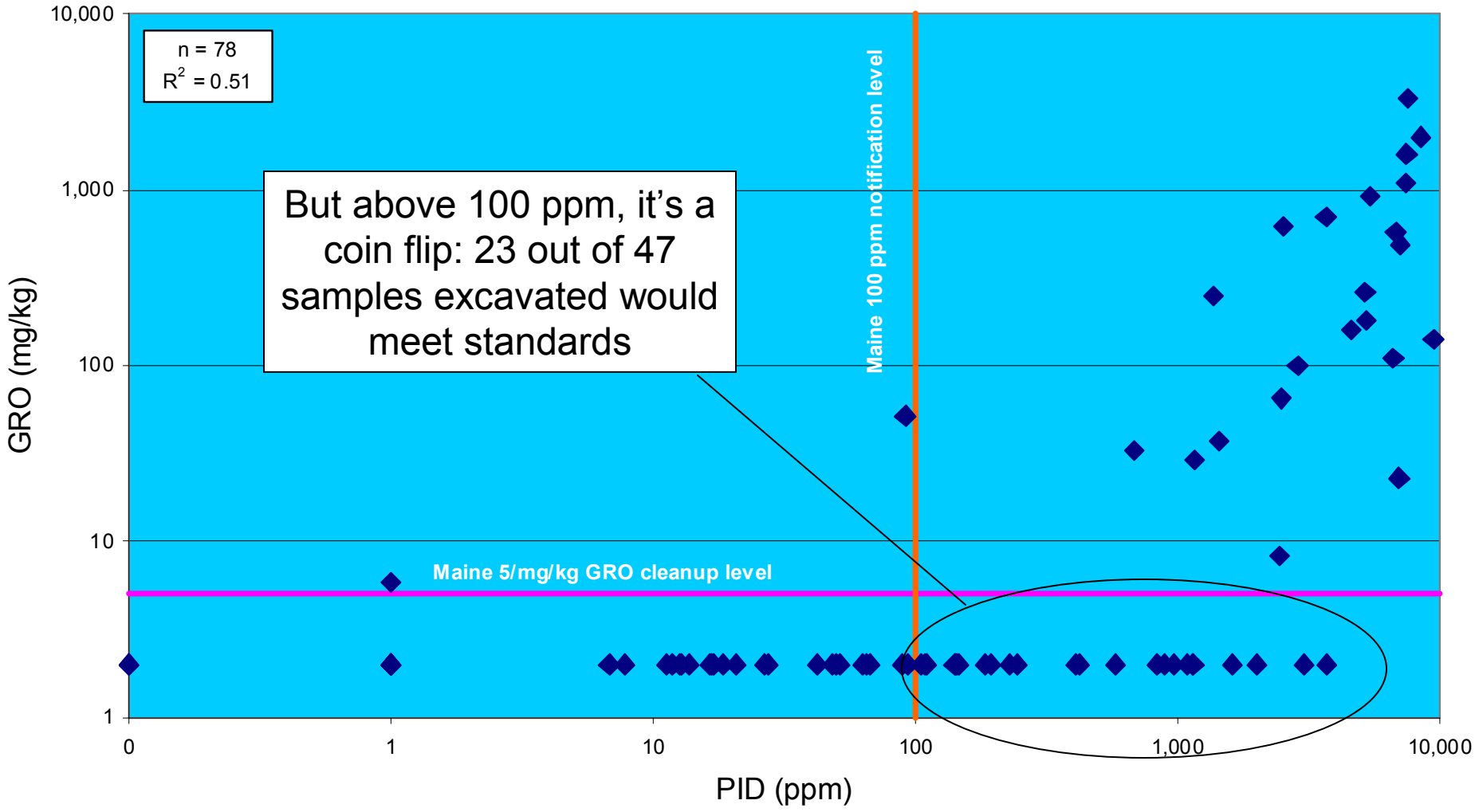
In These Quadrants, Reliance on Headspace Data Leads To **Wrong** Remediation Decision

The Envelope Please ….

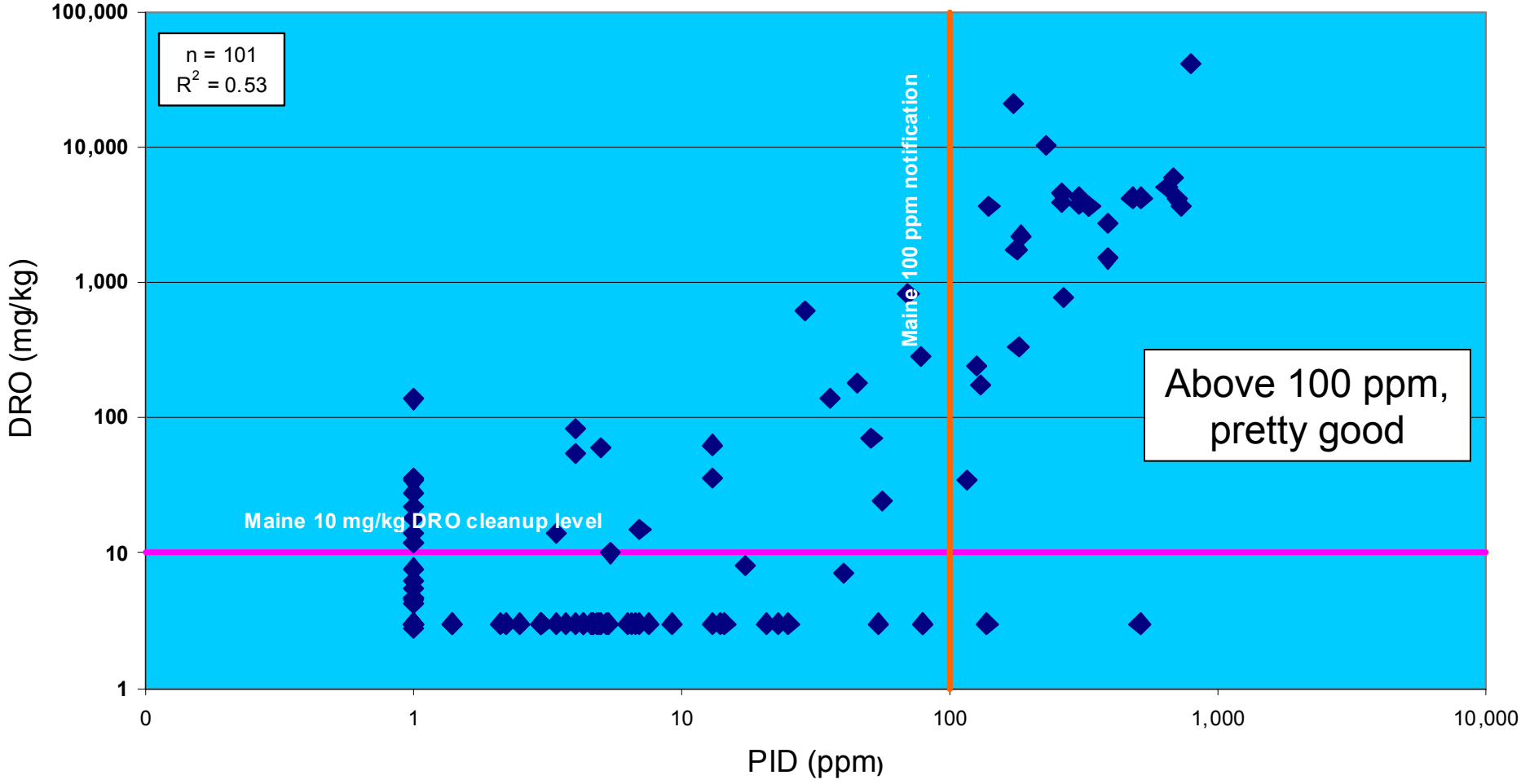
Field PID vs Lab GRO Concentrations in Soils at Parson Street MPG Gas



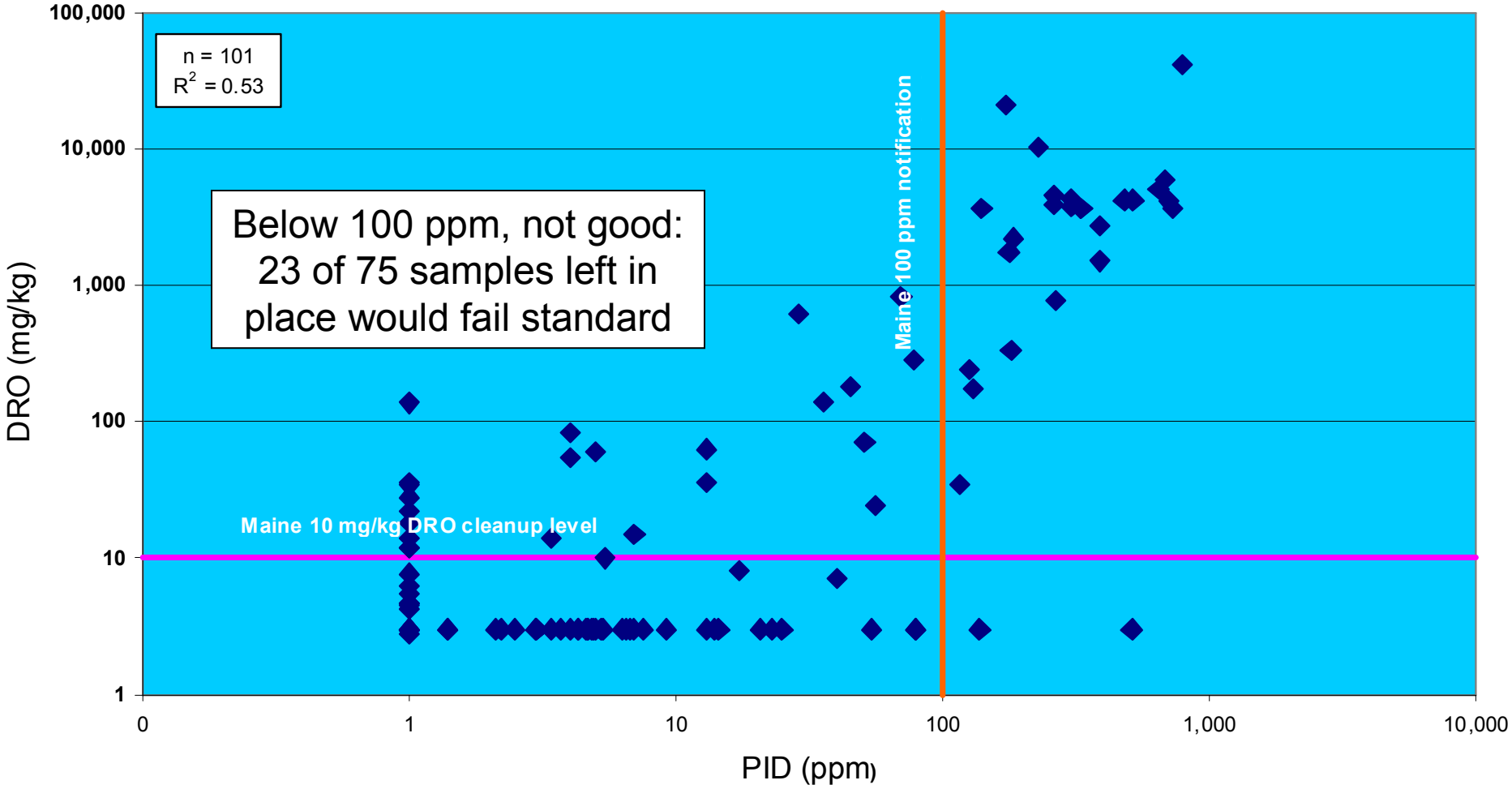
Field PID vs Lab GRO Concentrations in Soils at Parson Street MPG Gas



Field PID vs Lab DRO Concentrations In Soil At Long Island Fuel Farm

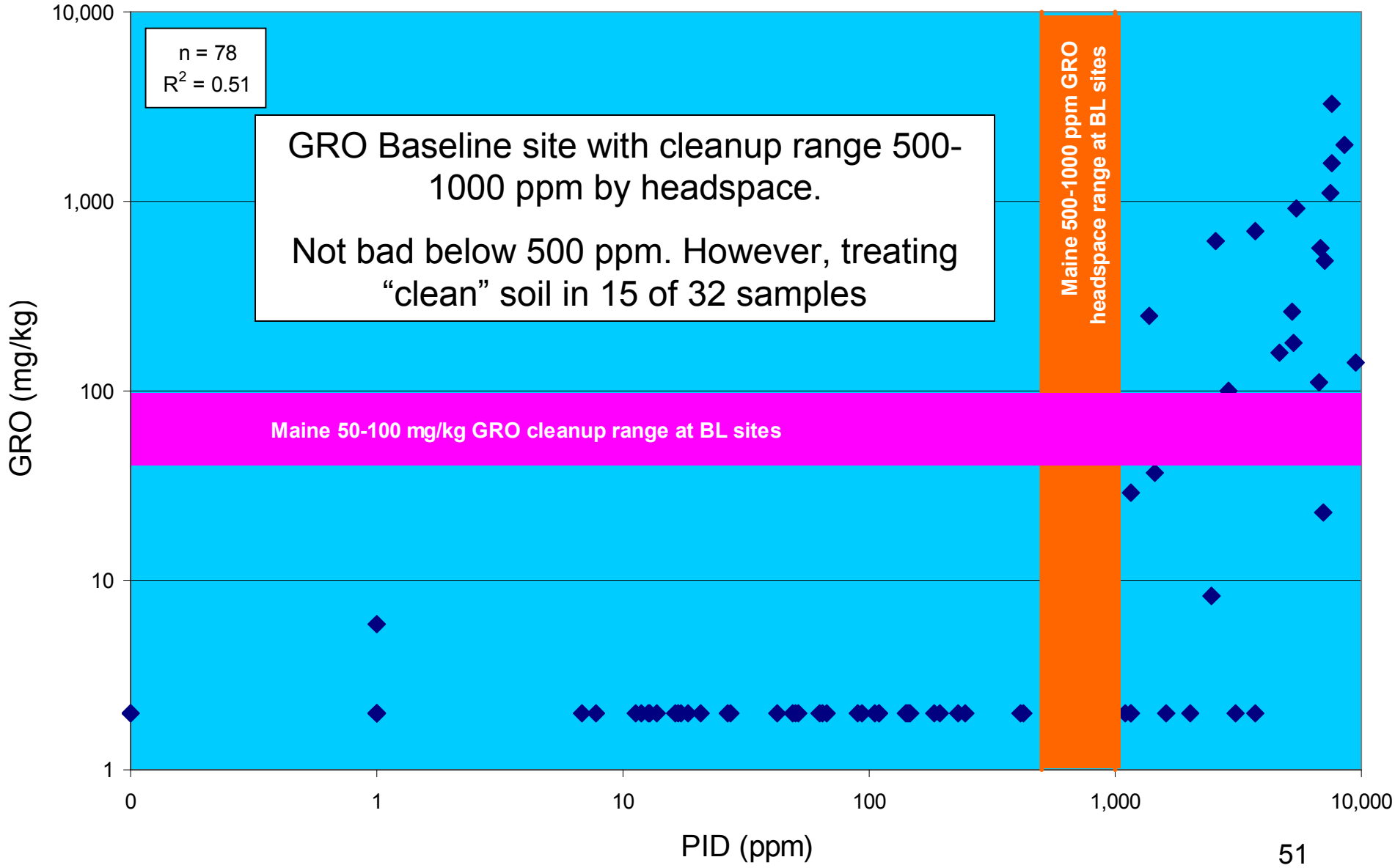


Field PID vs Lab DRO Concentrations In Soil At Long Island Fuel Farm

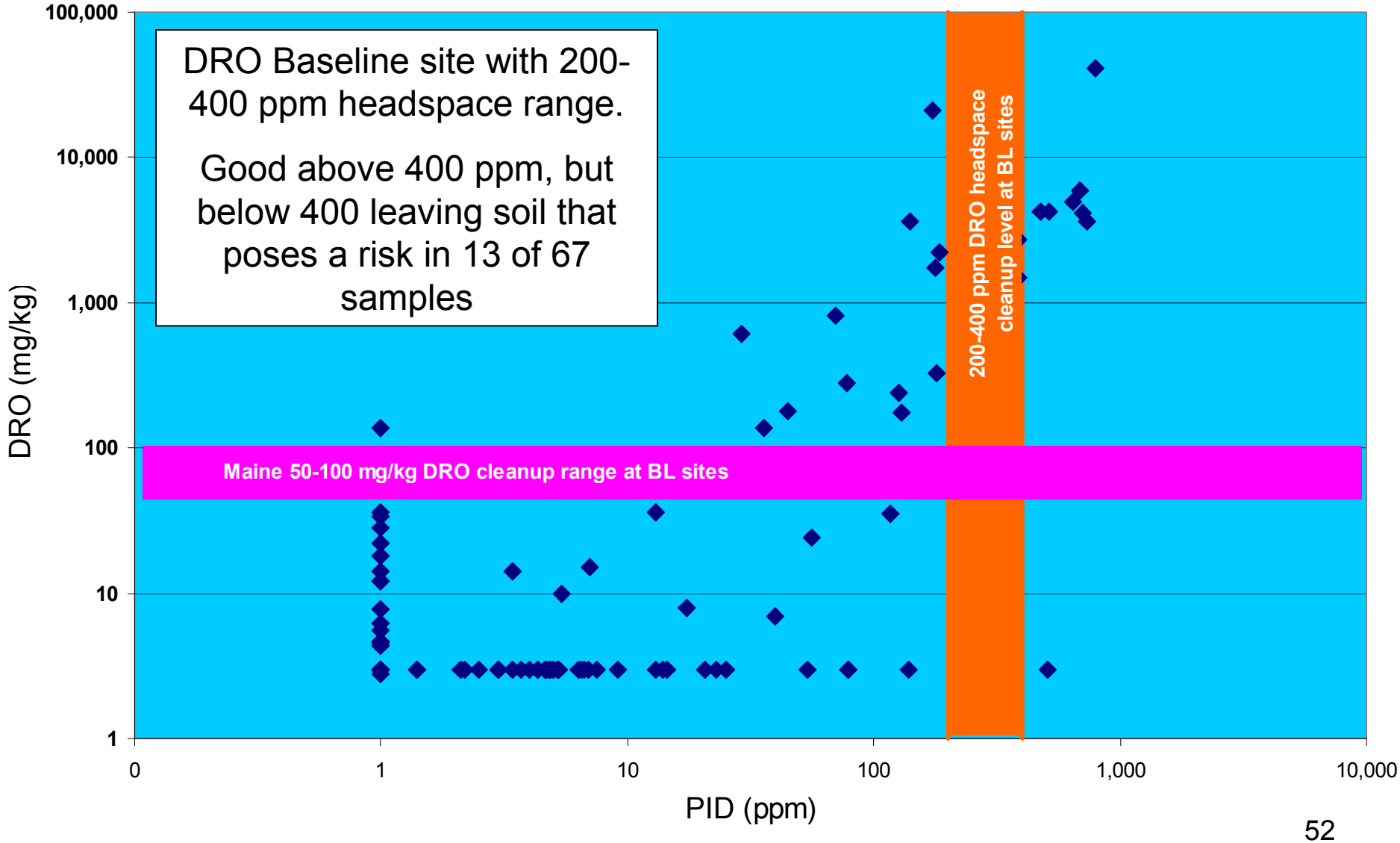


How about at Baseline (BL) sites, where a range of cleanup values is permitted ?

Field PID vs Lab GRO Concentrations in Soils at Parson Street MPG Gas



Field PID vs Lab DRO Concentrations In Soil At Long Island Fuel Farm

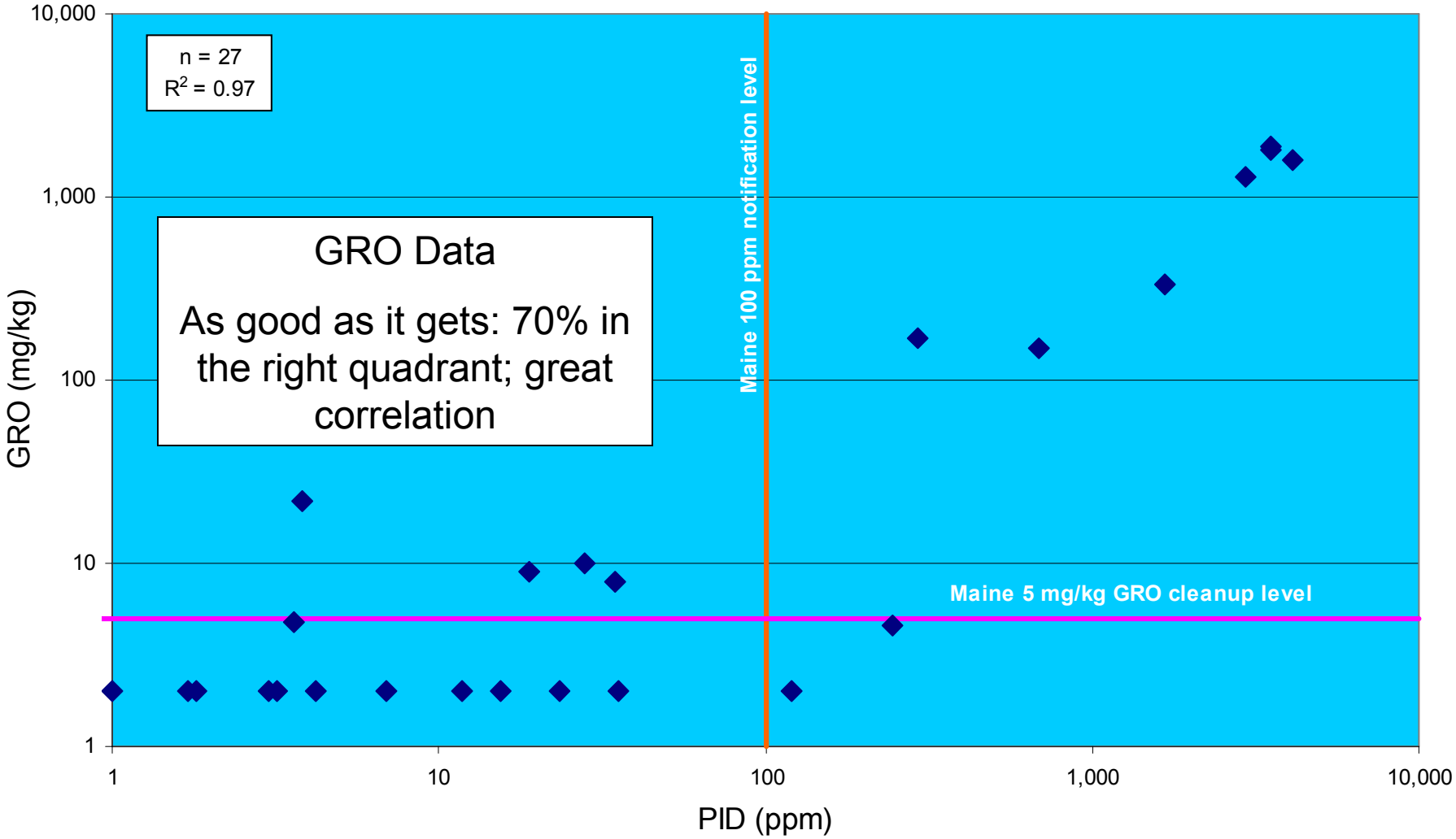


GRO/DRO – Scenario A and B

- At sites with contamination above and below the water table, and
- At sites with both GRO and DRO contamination

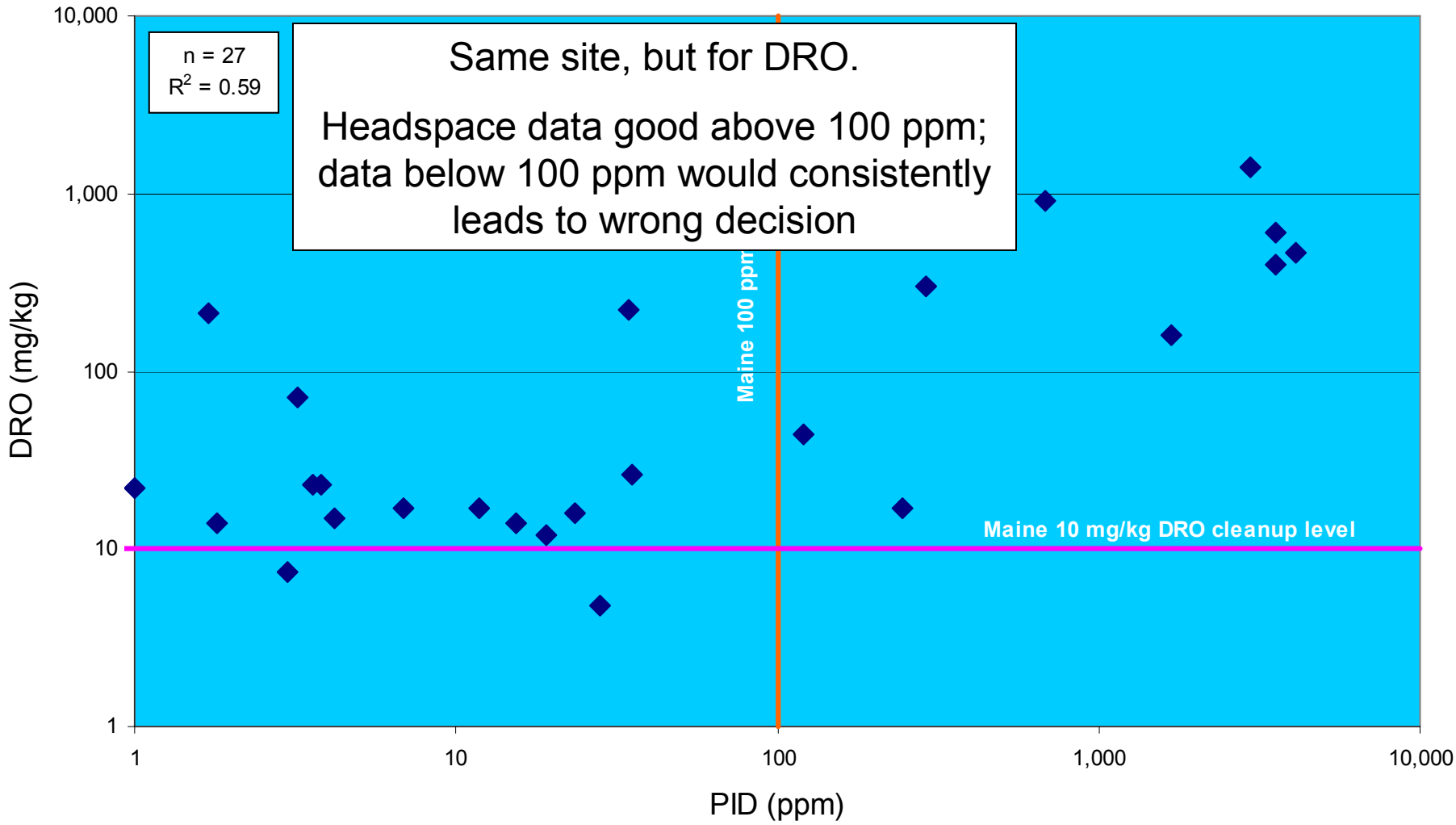
You may encounter both scenario A and B conditions !

Field PID vs Lab GRO in Soils at Kingfield Cash Fuel

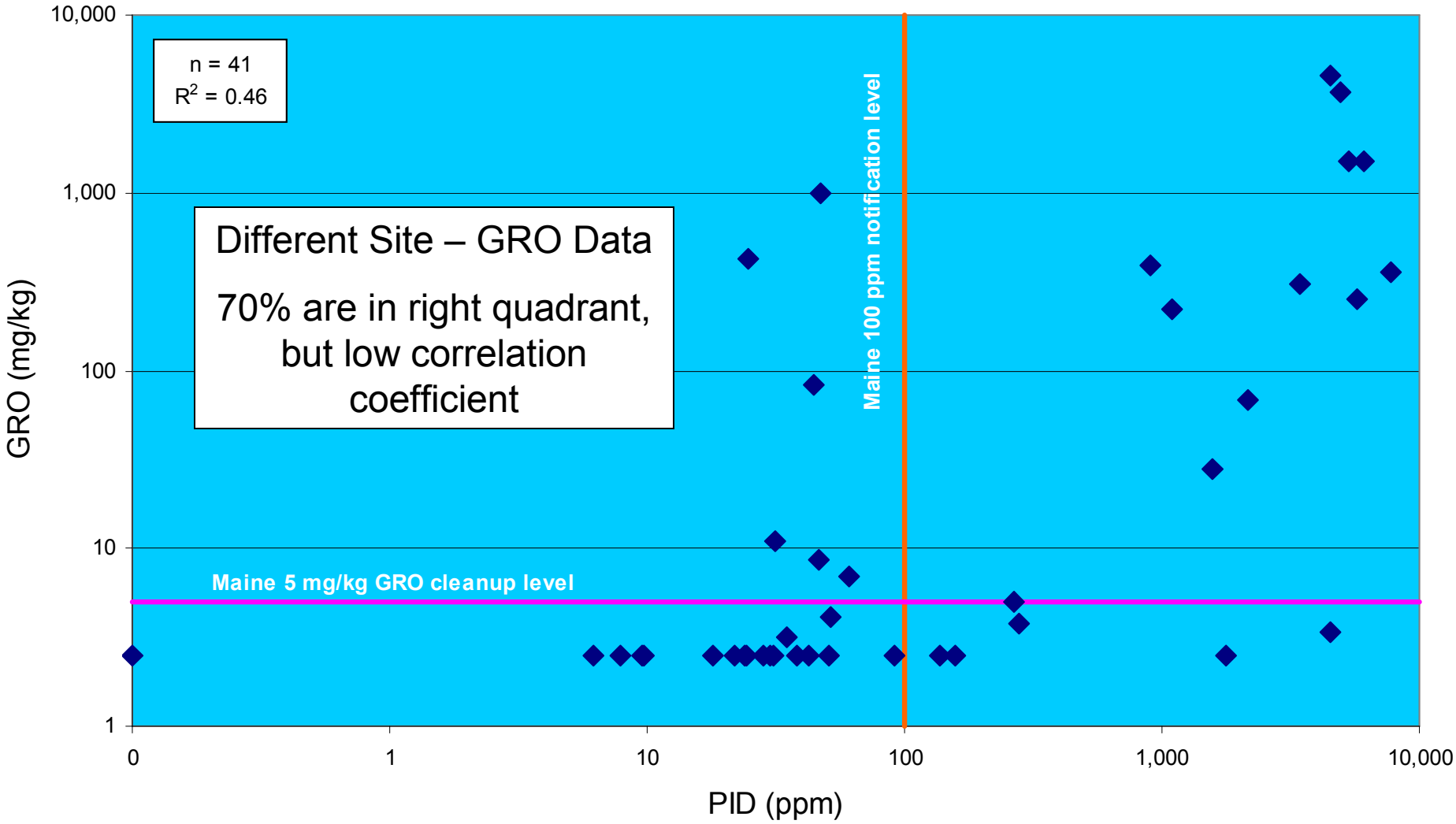


But just when things were looking good ….

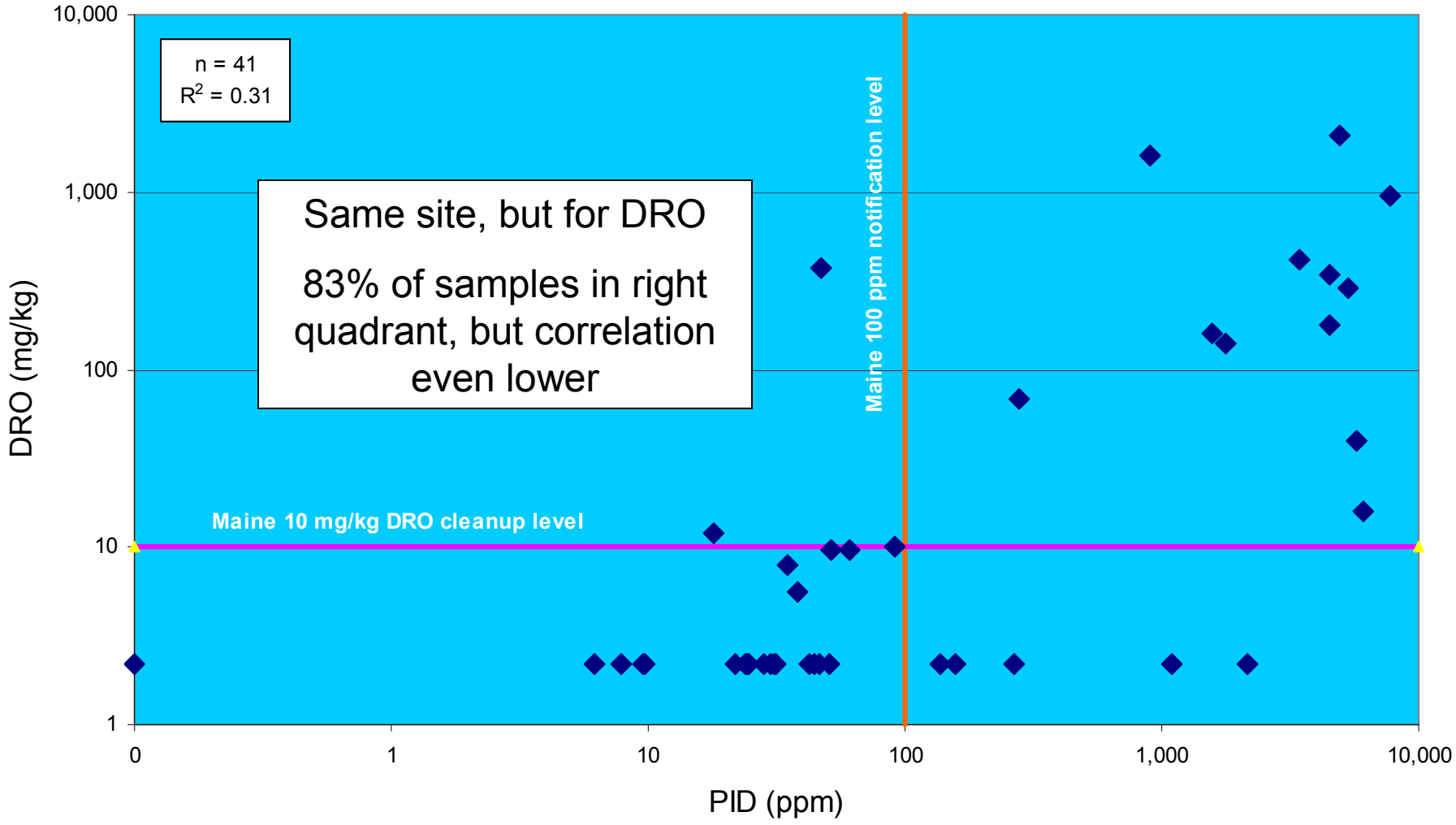
Field PID vs Lab DRO in Soils at Kingfield Cash Fuel



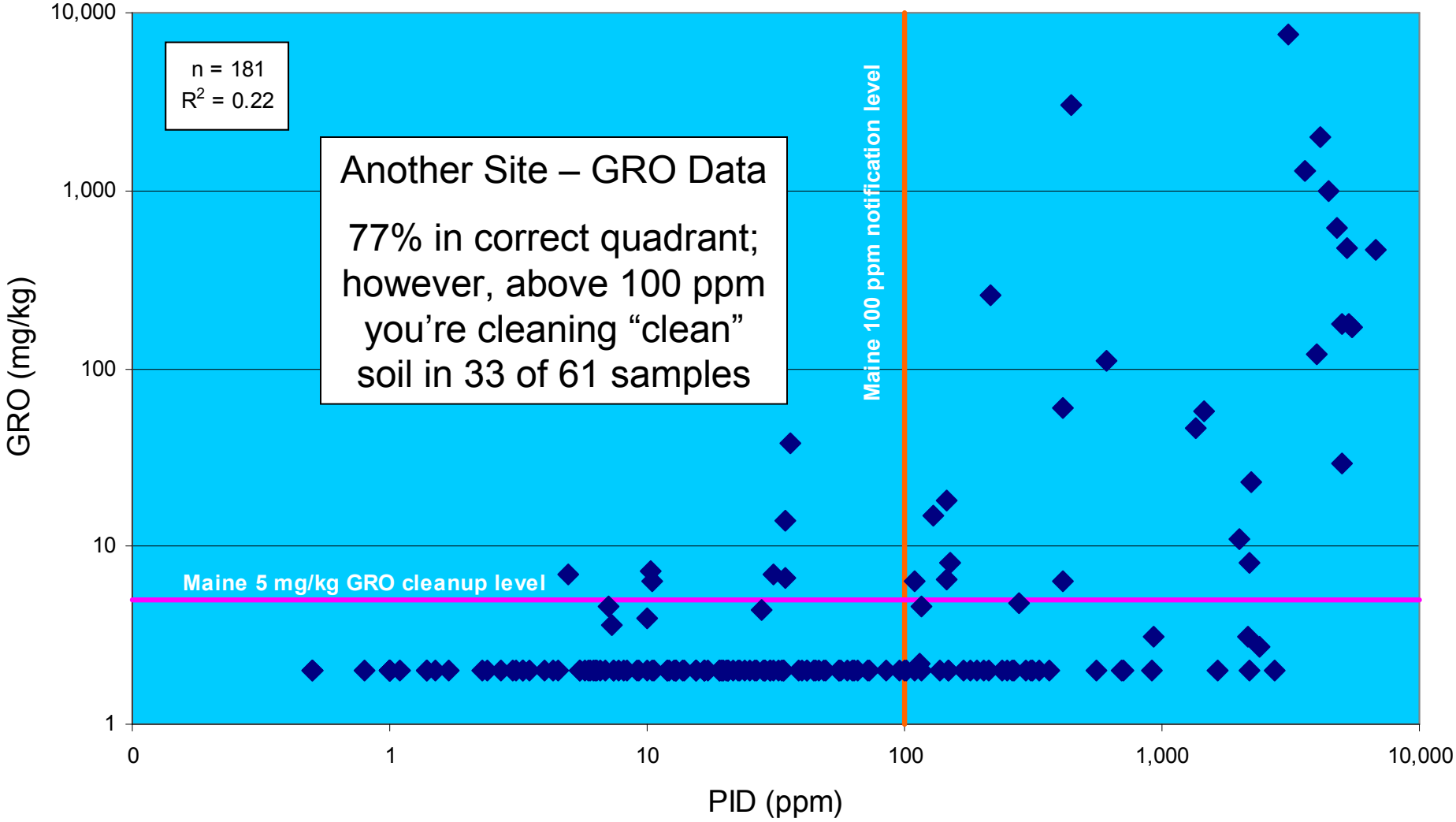
Field PID vs Lab GRO in Soils at Tibbetts Bulk Plant



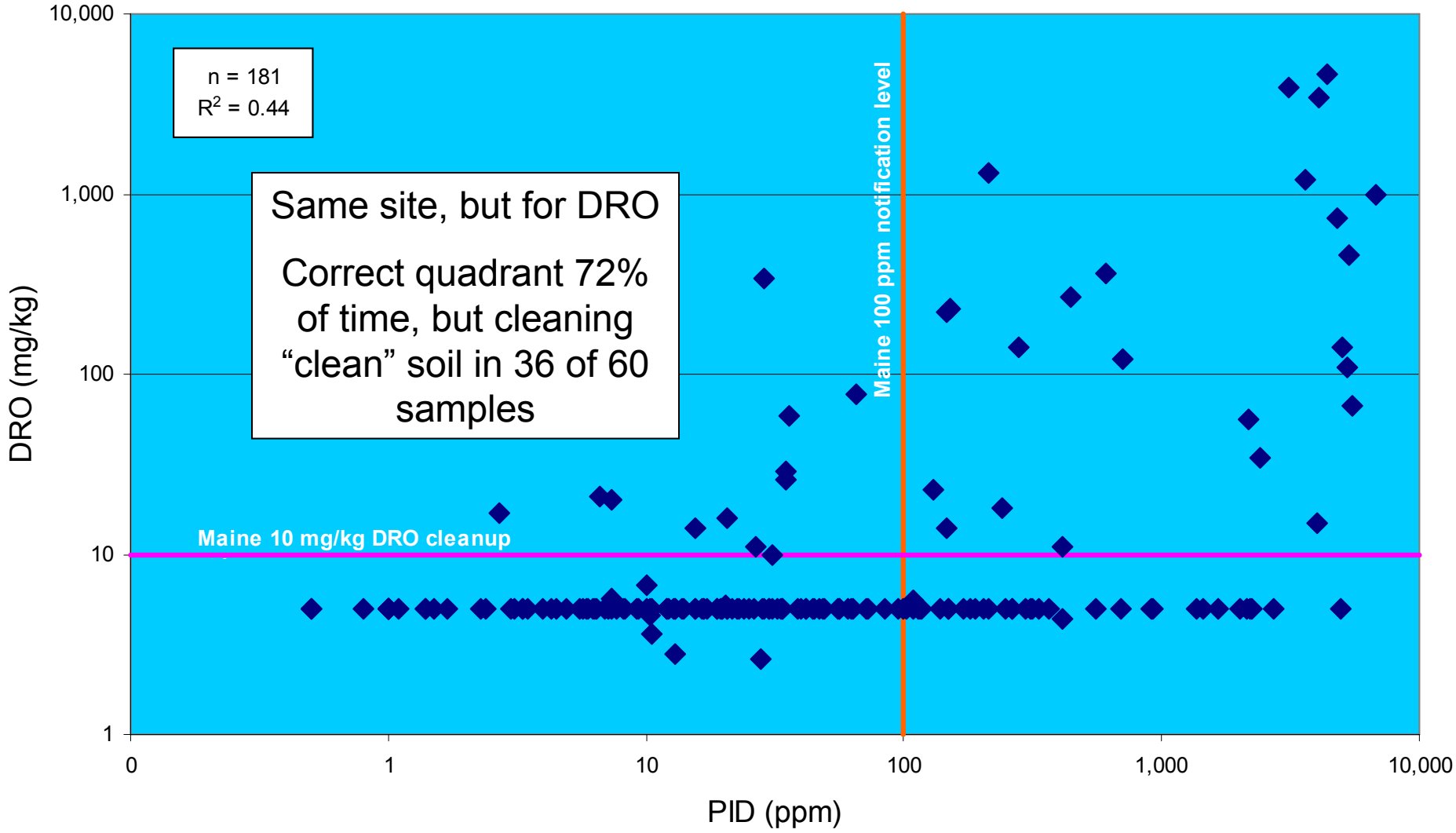
Field PID vs Lab DRO in Soils at Tibbetts Bulk Plant



Field PID vs Lab GRO in Soils at Houlton Sites



Field PID vs Lab DRO in Soils at Houlton Sites



Potential Impact of Relying on PID

Site Name	Parsons Street	Tibbetts Bulk Plant		Houlton Sites Combined		Parsons Street
Maine Classification	Stringent	Intermediate		Intermediate		Baseline Hypothetical
Soil Removed (Tons)	4688	6563		9360		4688
Number of co-located Samples	78	41		181		78
Contaminant	GRO	GRO	DRO	GRO	DRO	GRO
Percentage of Samples that exceed 100 PPM PID Headspace, but are below Cleanup Level (Scenario A)	49%	35%	28%	54%	60%	47%
Based on percentage, potential extra tonnage of clean soil that would be removed if relying on PID (Scenario A)	2297	2297	1838	5054	5616	2203
At $50 per ton T&D, Potential Additional Cost	**$114,856**	**$114,853**	**$91,882**	**$252,720**	**$280,800**	**$110,168**

Potential Impact: four sites, 19,305 tons @ $50/ton = $965K

Recommendations

- Don’t just set a PID/Headspace standard and walk away: need to understand how the results will be used;
- Consider using a field lab for sites with estimates remediation costs >$50,000;
- Try multiple headspace readings taken 5 to 10 minutes apart to distinguish contaminated soil from soil vapor or venting the bag and re-sealing;

Recommendations (cont'd)

- Plot headspace and lab data:
  - During investigations to identify vapor sites;
  - During excavations, to identify problem early;
- Recognize the limitations of your instrument and live within those limitations.

A Parting Thought ….

- There is more to data than just correlation: the data needs to be useful;
- Even data with poor correlation can provide a useful line of evidence

Future Steps For Maine Program

- Transitioning from GRO/DRO to risk-based standards using MA Method fractions and indicator parameters;
- Investigating feasibility of “wet chemistry” methods (e.g., PetroFLAG, RemediAID) in a response setting;
- Longer-term goal to incorporate eco-risk in cleanup standards

- Your comments and experiences welcomed!

- PID Performance on Petroleum Hydrocarbons
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