ABR: Types, Volumes, Geographical Distribution and Disposal

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Arsenic-Bearing Water Treatment Residuals
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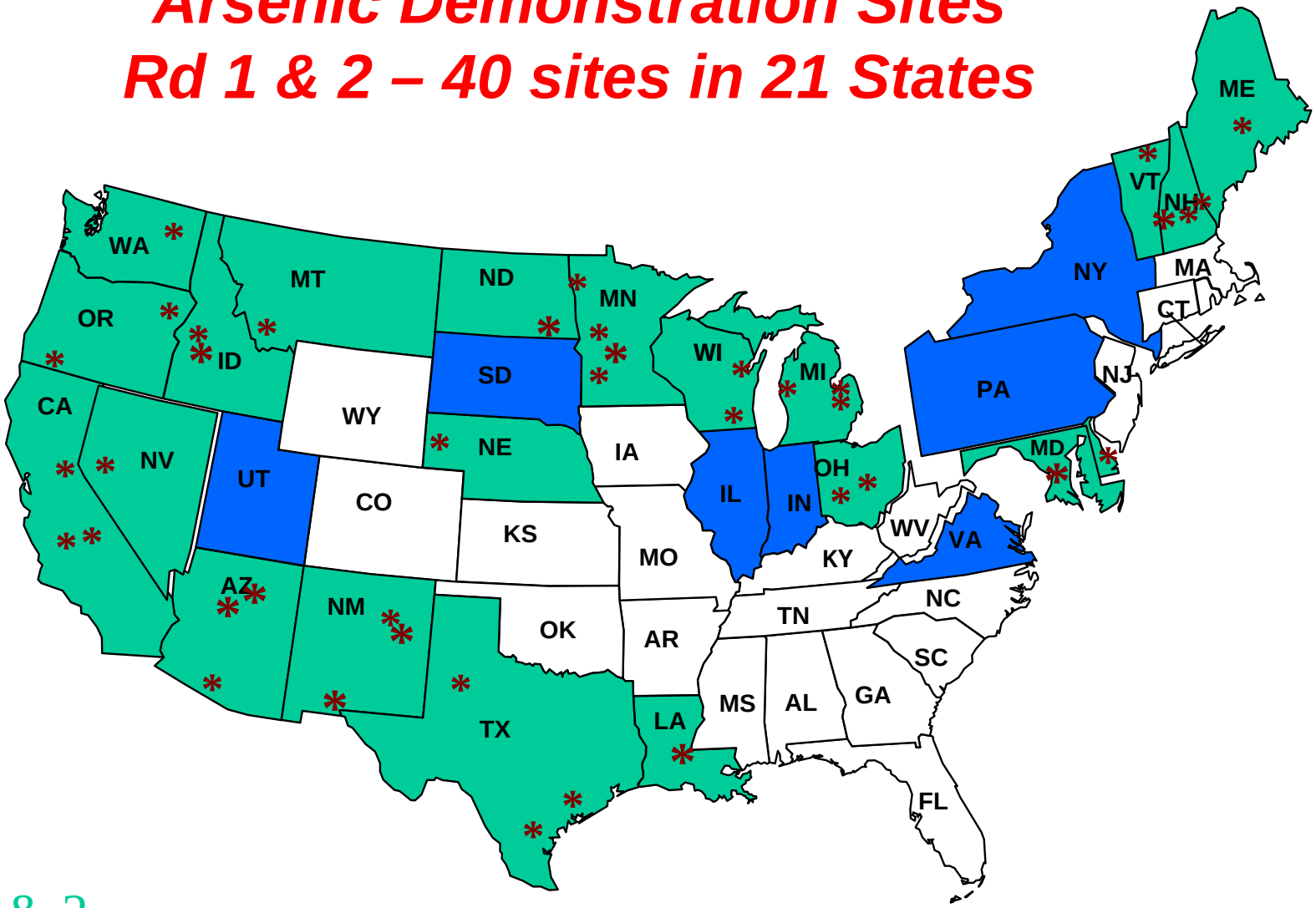
Arsenic Demonstration Sites
Rd 1 & 2 – 40 sites in 21 States



Sites

Rd 1 & 2

Rd 3

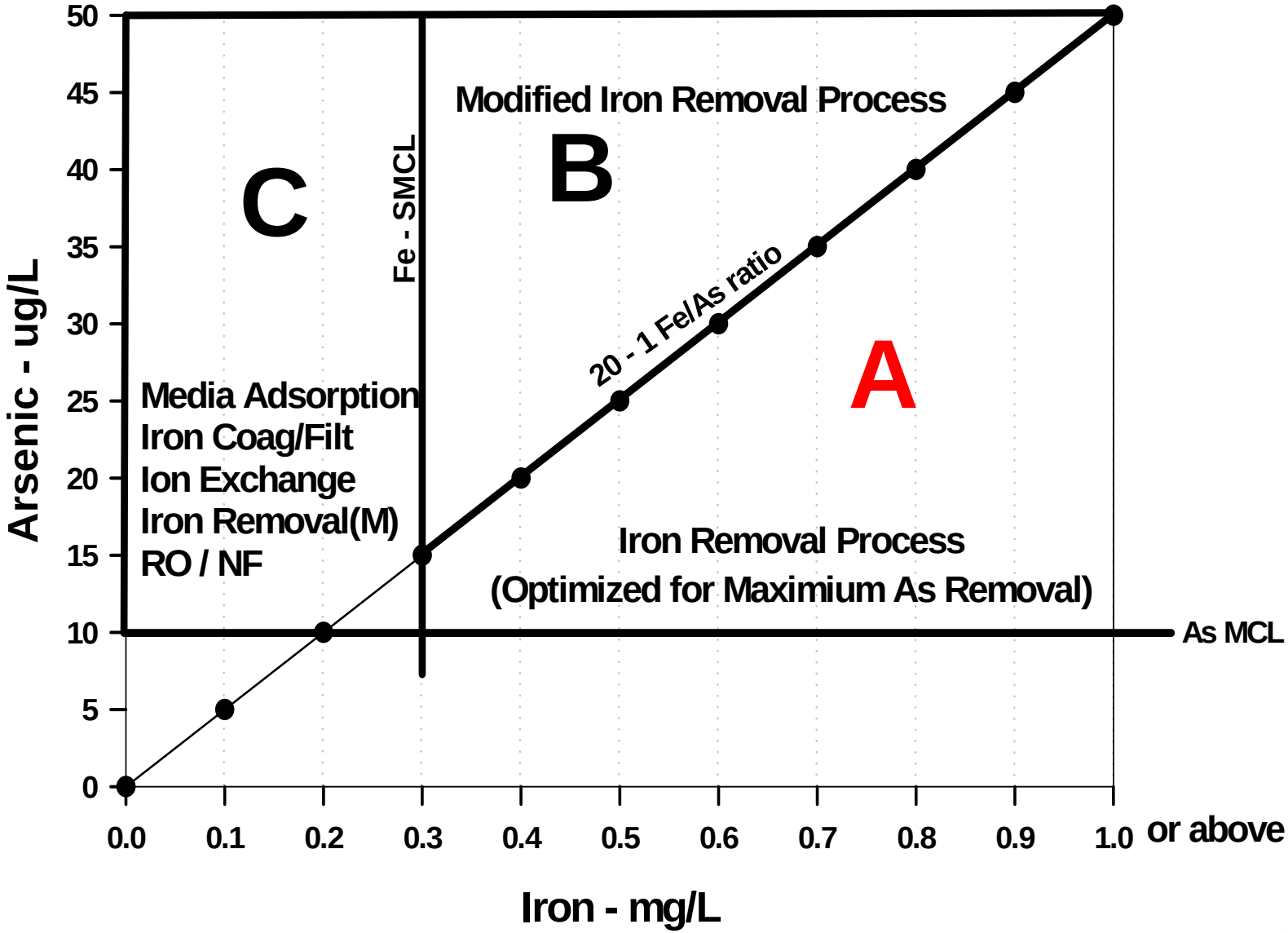
Arsenic Demonstration Sites
Rd 1 & 2 – 40 sites in 21 States

- Adsorptive media [25]
  - Nine types of media
- Iron removal and coagulation & filtration [12]
  - Macrolite®, Electromedia I, and Aeralater®
- Anion exchange [2]
- Reverse osmosis (POU)[1]

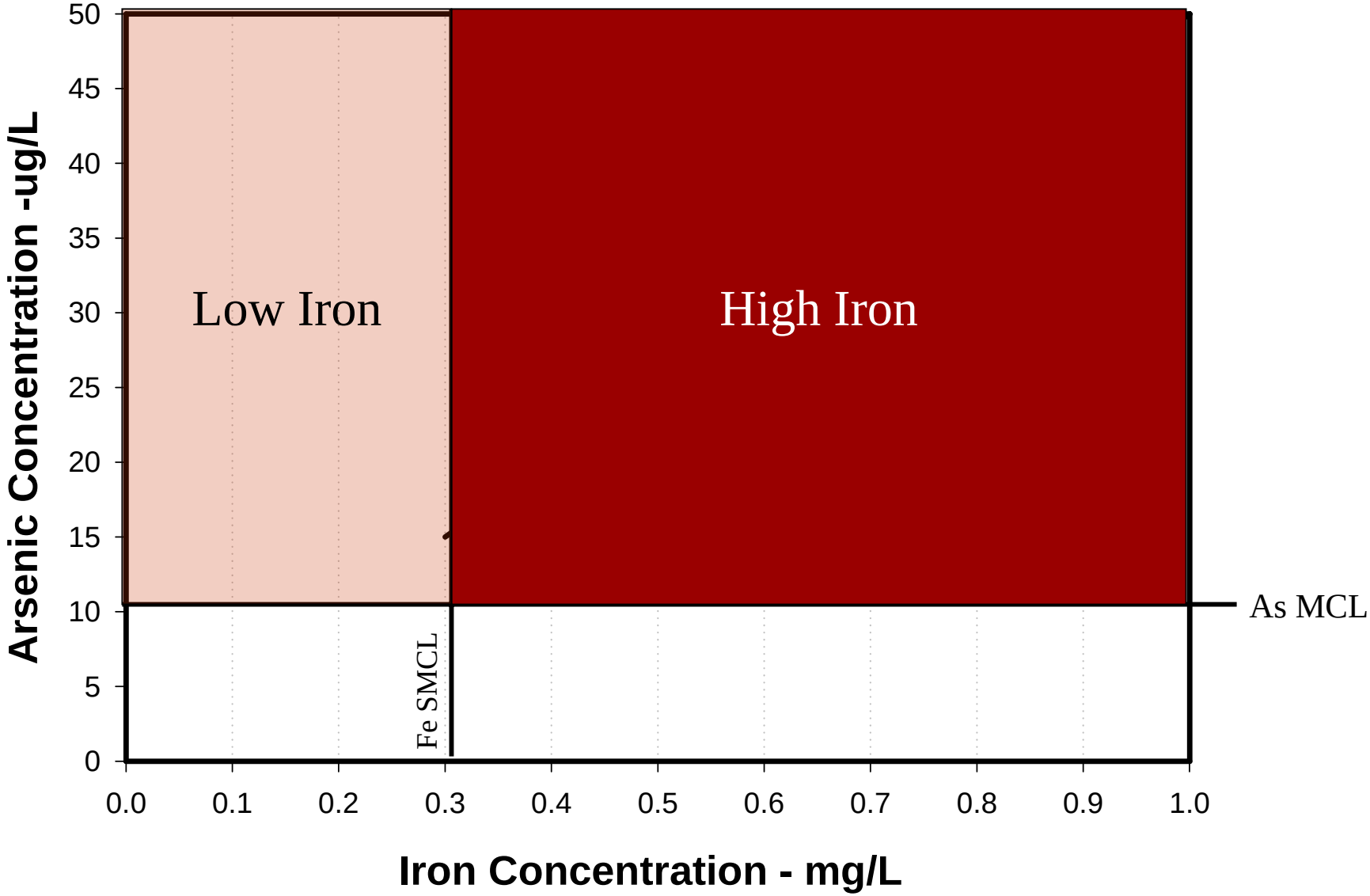
Arsenic Removal Technologies Rd 1 & Rd 2

Technologies	No. of Sites Rd 1	No. of Sites Rd 2	Total
Adsorption media	**9 (8)**	**16 (11)**	**25**
E 33 ***(2 /pretreatment)***	6 (5)	8 (4)	14
GHF	1 (1)		1
ATS Complex 2000		3 (3)	3
MEI Zirconium		1 (1)	1
ArseneX^{np}		1 (1)	1
ARM 200		2 (1)	2
AAFS 50	1 (1)		1
G2	1 (1)		1
Absorbsia (Dow)		1 (1)	1
Coagulation/filtration	**1 (1)**	**4 (2)**	**5**
Iron Removal		**6 (2)**	**6**
Ion Exchange	**1 (1)**	**1 (0)**	**2**
POU - RO		**1 (1)**	**1**
System Modification (C/F)	**1 (1)**		**1**

Arsenic Treatment – Simple Process Selection Guide



Application – Where?



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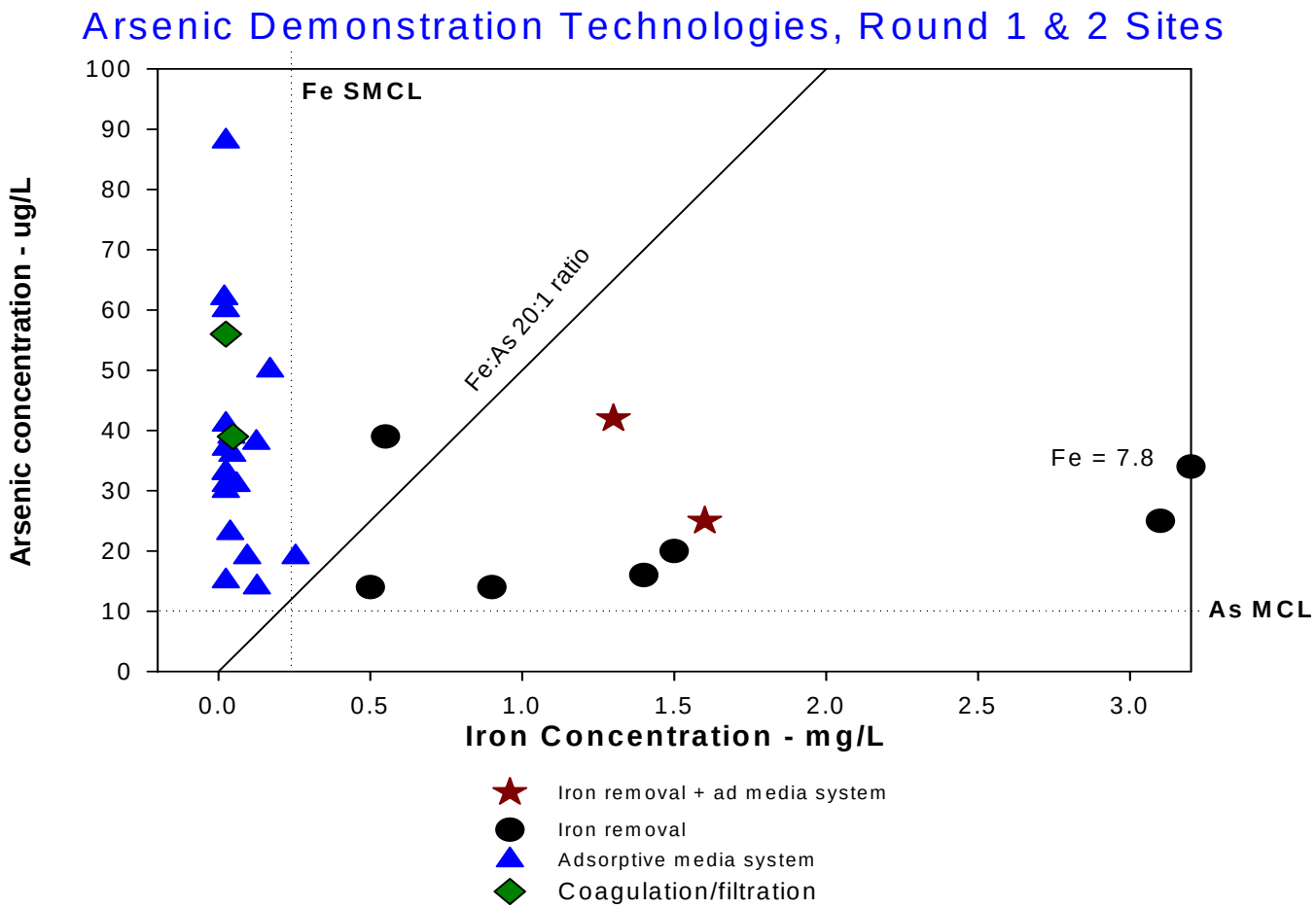
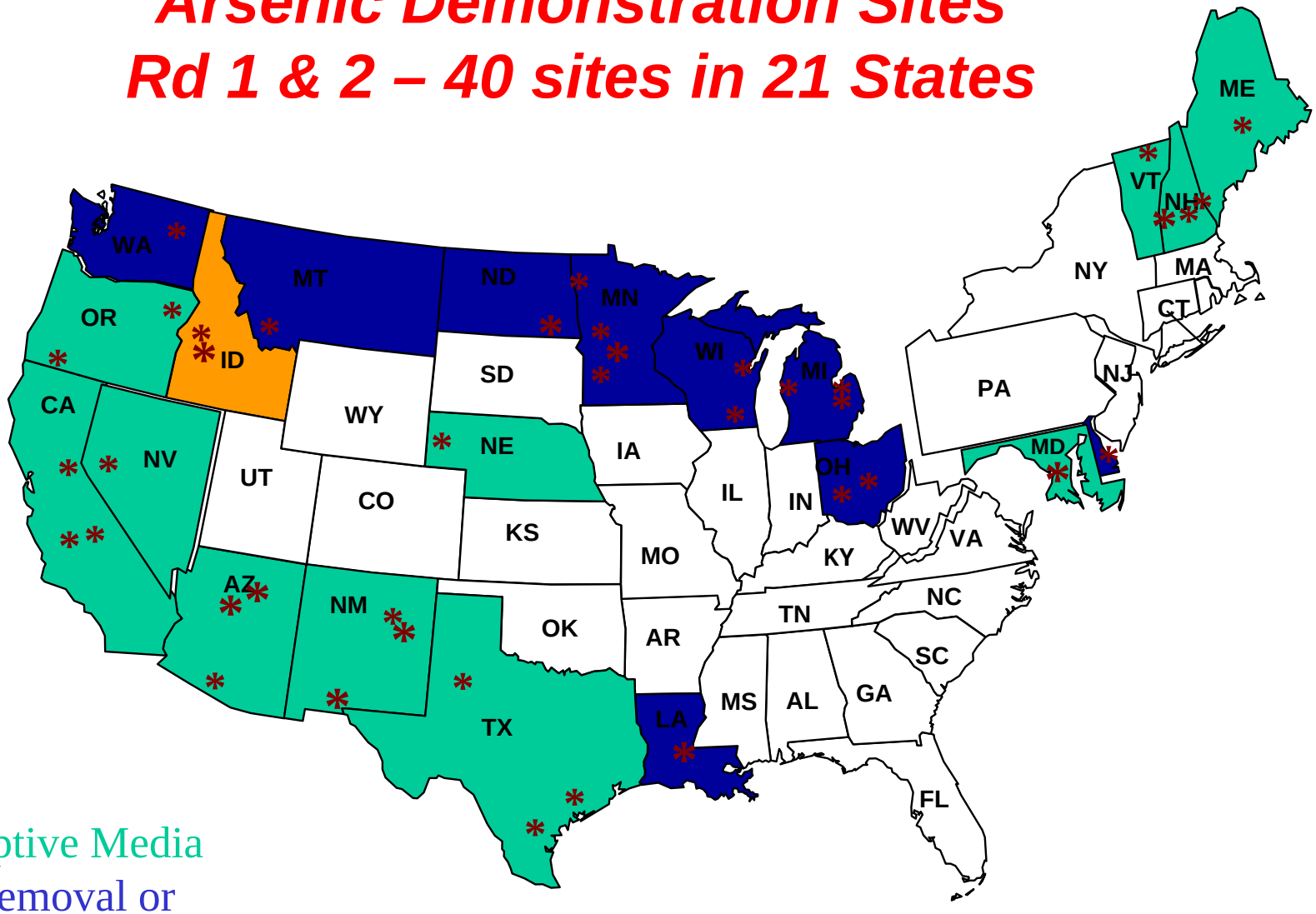


Arsenic Demonstration Sites
Rd 1 & 2 – 40 sites in 21 States



Sites

Adsorptive Media

Iron Removal or Coagulation/Filtration

IX & RO

Adsorptive Media Rd 1 & Rd 2

Media Type	Media Manufacturer	System Vendor	No. of Sites
E33 (Fe-based)	Bayer	STS AdEdge	5 9
GFH (Fe-based)	USFilter	USFilter	1
ARM200 (Fe-based)	Englehard	Kinetico	2
AAFS 50 (Al-based)	Alcan	Kinetico	1
A/I C2000 (Al-based)	ATS	ATS	3
Adsorbsia (Ti-based)	Dow	Kinetico	1
Isolux-302M (Zr-based)	MEI	MEI	1
G2 (Si-based)	ADI	ADI	1
As:X^{np} (resin-based)	Purolite	VEETech	1

Performance Evaluation Studies – Round 1 Adsorptive Media

Site	As (ug/L)	System	Design Flow rate	Months Operating*
Desert Sands, NM	23	AM – E33	320	24
Rollinsford, NH	36	AM – E33	100	19
Queens Ann's County, MD	19	AM – E33	300	19
Brown City, MI	14	AM – E33	640	20
Rimrock, AZ	50	AM – E33	45	19
Valley Vista, AZ	41	AM – AAFS 50	37	19
Bow, NH	39	AM – G2	35	14
South Truckee Meadows, Reno, NV	39	AM - GFH	350	3
Nambe Pueblo, NM	33	AM – E33	145	0

* As of Dec. 31, 2005

Treatment Residuals

- Adsorptive media
  - Spent media (Solids)
  - Backwash water (Liquid w/solids)
- Iron removal and coagulation & filtration
  - Backwash water (liquid w/solids)
- Anion exchange
  - Brine (Liquid)
- Reverse osmosis
  - Reject wastewater (Liquid)

Adsorption Media – Residual Disposal Options

- Media
  - Disposal to landfill [24]
  - Regeneration and reuse [1]

- Backwash Water
  - Sanitary sewer or septic system
  - Surface discharge [8]
  - Reclaim [2]
  - Not yet specified [5]


adedge
adedge


04/15/2005

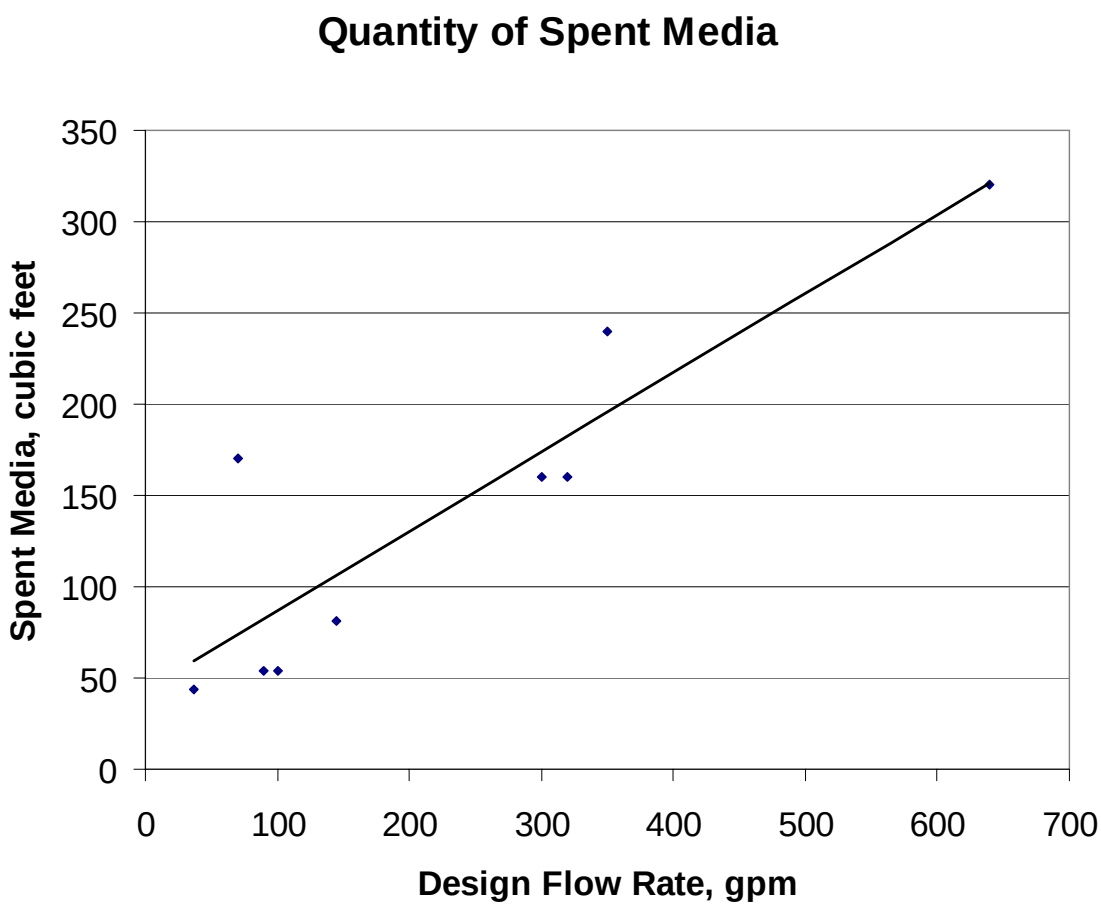

WELL-X-TROL


WELL-X-TROL

Quantity of Spent Adsorption Media

Most adsorption systems designed with 5 to 10 minutes of contact time
Amount of media required proportional to flow rate

Round 1 Range
- 54 ft^3 @100 GPM
- 320 ft^3 @ 640 GPM



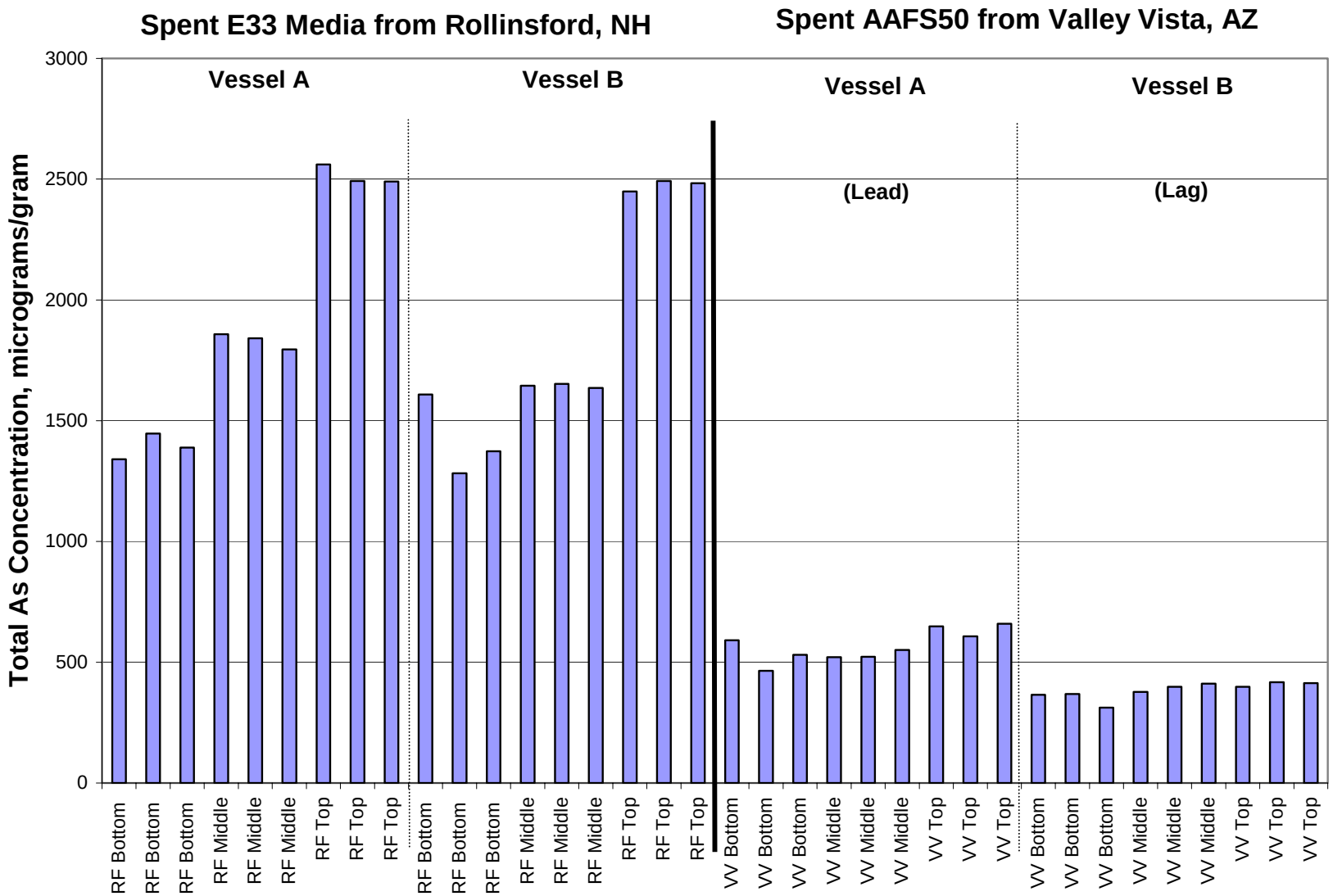
Characteristics of Spent Adsorption Media

Parameter	Units	Rollinsford, NH	Valley Vista, AZ
Media Type	NA	E33	AAFS50
Media Bed Life	BV	15,000 BV	16,860 BV(a)
Quantity	ft^3	54	16.7
TCLP As	mg/L	<0.05	<0.05
TCLP Ba	mg/L	0.95 to 0.96	1.4 to 1.6
TCLP Cd	mg/L	<0.05	<0.05
TCLP Cr	mg/L	<0.05	<0.05
TCLP Pb	mg/L	<0.1	<0.1
TCLP Hg	mg/L	<0.003	<0.003
TCLP Se	mg/L	<0.3	<0.3
TCLP Si	mg/L	<0.05	<0.05

Notes:

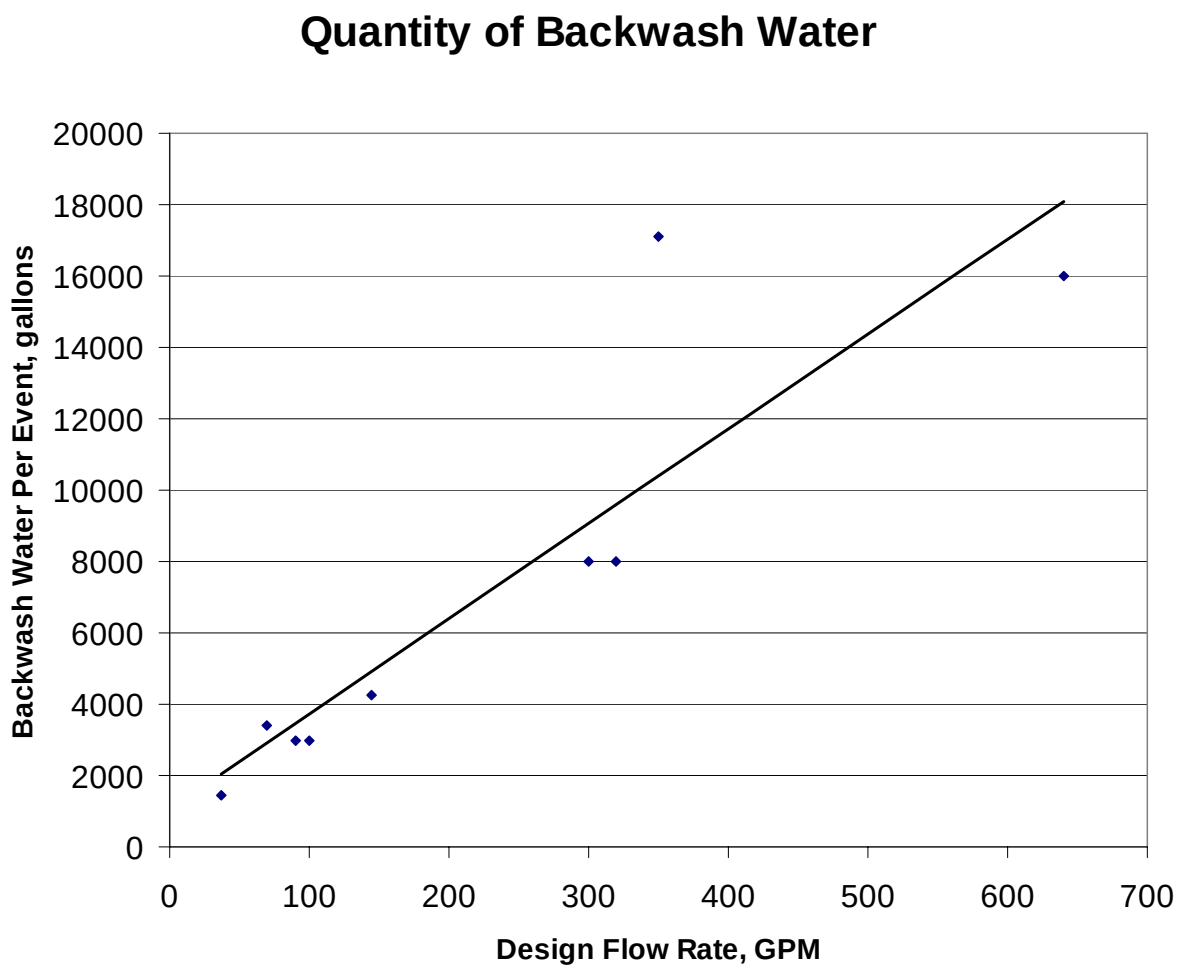
(a) Before pH Adjustment was implemented

Characteristics of Spent Adsorption Media



Adsorption – Quantity of Backwash Water

- Typical frequency of backwashing is weekly to monthly
- Range of backwash loading rates
  - 4 to 12 gpm/ft2
- Some media loss may be experienced at high backwash rates



Adsorption – Characteristics of Backwash Water

Parameter	Units	AN	BC	RF	RR	SV
Influent As	µg/L	22.7	14.2	36.2	50	18.8
Media Type	NA	E33	E33	E33	E33	E33
pH	S.U.	7.5 - 8.1	7.4 – 8.1	7.2 – 8.8	7.0 – 7.4	7.2 - 7.9
Turbidity	NTU	40 - 330	0.8 - 210	110 -1400	7.3 - 52	12 - 600
TDS	mg/L	706 - 886	392 -1030	278 - 734	306 - 564	100 - 430
As Soluble	µg/L	6.4 - 25.7	4.9 - 20	9.5 – 70.9	1.6 – 55.4	0.2 - 12.4
Fe Soluble	µg/L	<25 - 176	<25 - 280	<25 - 113	<25	<25
Mn Soluble	µg/L	2.1 - 13	9.5 – 19.5	3.7 - 118	<0.1 – 0.6	0.1 – 5.7

Notes:
Site 1 AN = Desert Sands MDWCA Anthony, NM
Site 2 BC = Brown City, MI
Site 3 RF = Rollinsford, NH
Site 4 RR = Rimrock, AZ
Site 5 SV = Queen Anne's County Stevensville, MD

Adsorption – Characteristics of Backwash Water (Continued)

Parameter	Units	BO	VV
Influent As	µg/L	39.2	41
Media Type	NA	G2	AAFS50
pH	S.U.	6.2 - 6.9	6.8 - 7.7
Turbidity	NTU	34 - 390	2.6 - 890
TDS	mg/L	38 - 244	118 - 822
As Soluble	µg/L	11.4 - 42.8	0.3 - 40.5
Fe Soluble	µg/L	<25 - 66	<25
Mn Soluble	µg/L	0.3 - 0.6	<0.1 - 1.0
Al Soluble	µg/L	NA	<10 - 32.6

Notes:
Site 6 BO = Bow, NH
Site 7 VV = Valley Vista, AZ

C/F and Iron Removal Technologies

- CF/IR – Macrolite® [9]
- CF/IR – Electromedia [1]
- CF/IR – Aeralater® [2*]
- CF/IR – MnO2-coated anthrasand [1]
- IR - Manganese Greensand [1**]

Notes:

*Includes Aeralater™ plus E33 treatment system for polishing step

**From USEPA Licking Valley High School Study

Climax, MN Iron Removal System

Treatment Residuals

- Adsorptive media
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  - Brine (Liquid)
- Reverse osmosis
  - Reject wastewater (Liquid)

CF/IR – Characteristics of Backwash Water

Parameter	Units	CM	LW	LVHS
pH	S.U.	7.3 - 7.5	7.2 - 7.6	7.9 - 8.0
Turbidity	NTU	13.7 - 140	110 - 200	2.5 - 70
TDS	mg/L	646 - 940	928 - 1540	NA
As Soluble	µg/L	6.4 - 10.7	7.5 - 11.9	15 - 18
Fe Soluble	µg/L	25.7 - 148	<25	117 - 142
Mn Soluble	µg/L	68.1 - 86.7	0.8 - 46.6	108 - 421

Notes:
Site 1 CM = Climax, MN
Site 2 LW = Lidgerwood, ND
Site 3 LVHS = Licking Valley High School, OH

IR – Characteristics of Backwash Solids at LVHS

Tank ID	Tank C	Tank B	Tank C
Arsenic, TCLP (mg/L)	<0.5	<0.5	<0.5
Barium, TCLP (mg/L)	0.55	0.751	0.46
Cadium, TCLP (mg/L)	<0.05	<0.05	<0.05
Chrome, Total, TCLP (mg/L)	<0.05	<0.05	<0.05
Lead, TCLP (mg/L)	<0.1	<0.1	<0.1
Mercury, TCLP (mg/L)	<0.002	<0.002	<0.002
Selenium, TCLP (mg/L)	<0.1	<0.1	<0.1
Silver, TCLP (mg/L)	<0.05	<0.5	<0.05

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Ion Exchange – Fruitland, ID

- Kinetico IX-248-AS/N arsenic and nitrate removal system
  - Resin Type: Purolite A-520E strong base anion
  - Resin Volume: 50 ft3 in each of two vessels
  - Flow rate: 250 GPM
  - Brine discharged to sanitary sewer
- Influent Arsenic: 35 to 49 µg/L
  - Most of the arsenic present as As(V)
- Influent Nitrate: 9.4 to 11.2 mg/L
- Influent Sulfate: 52 to 75 mg/L

Conclusions

- Adsorption Systems
  - Spent media TCLP samples were non-hazardous
  - Both sanitary sewer and surface water discharge options used for BW water
  - Backwash frequency is typically weekly to monthly
  - Raw water often used for backwash with subsequent As removal observed during this step
- IR/CF Systems
  - Most discharges are to sanitary sewer due to volume/frequency of discharge
  - Similar volume per event compared to adsorption, but more frequent backwash at >3 times per week
- IX Systems
  - Quantity of wastewater can be reduced through reclaim and tracking of elution curve

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