1099568 - R8 SDMS

Field Notes of Steven D. Acree

March 2001

June 2002

Sep 2002

Aug 2003

May 2005

July 2005

Sep 2005

Oct 2005

June 2006

Sep 2006

Oct 2006

Jan 2007

July 2007

Oct 2007

Mar 2008

Apr 2008

June 2008

July 2008

Sep 2008

3/29/01

Asarco - East Helena
Bob Pols, Rick Wilkin
As wall discussions - USEPA, MT offic

Concerns:
High K ∴ creation of flow barrier, residence tim
High V ∴ residence time
Hetero - pref pathways
Depth to ash/tuff unit @ DH-17 ∴ wall depth
Cobbles ∴ char ~~$~~

Need:

① P + slug test data from closest wells

② Four most recent site wide gw elev + all historical for nearest wells

③ Geol logs from nearest wells - cores ~~$~~ SS

④ Well inst methods + costs

⑤ GW flow model developed for site.

⑥ "Tracer" tests, other measures of flow velocity

⑦ Br, I, Cl + other

Plant closing 3/01.
- Changes that may result in lower i? (1

n wall ≈ 50%, n or n_e?
~5% loss/yr

P. Test
DH-16 24hr test - multiwell test

Hydrometrics - v_s ~ 10ft/d from p.tests
monitoring "conservative" tracers (eg SO_4^{2-})
Constits move ~ 3000+ ft in 1yr

Matrix = boulders, cobbles in tight, compacted matrix (2

(3

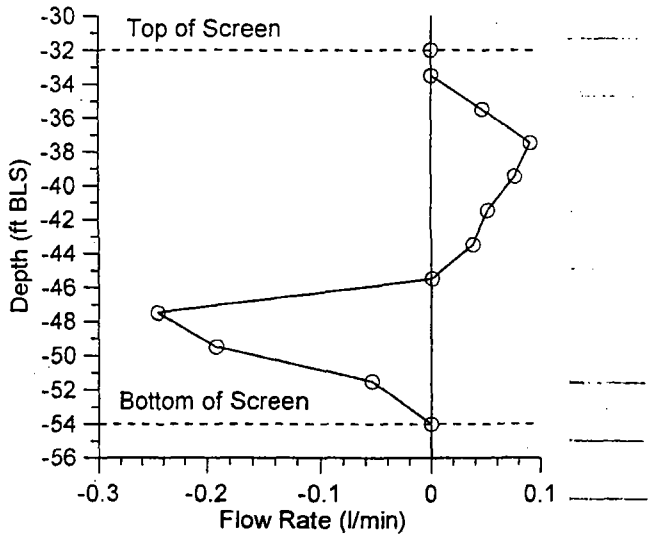
(4

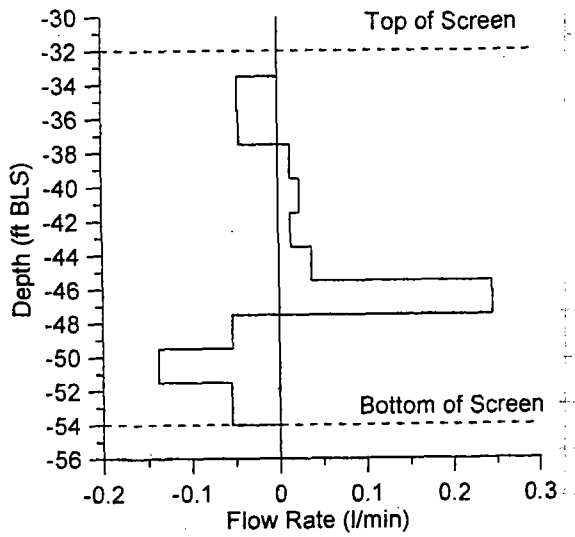
Project ASARCO, E. Helena, MT Notebook No.

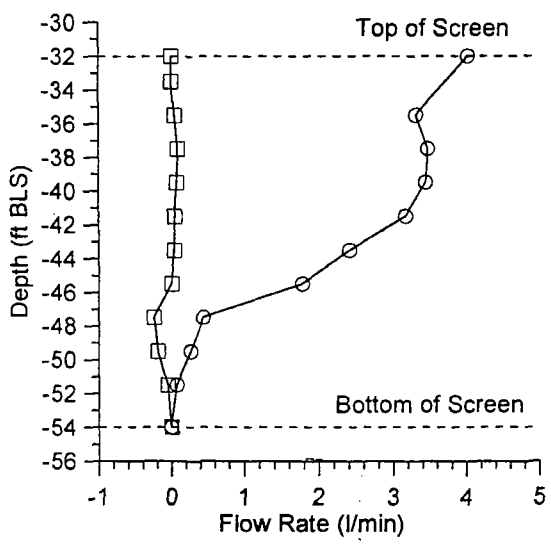
Continued from Page

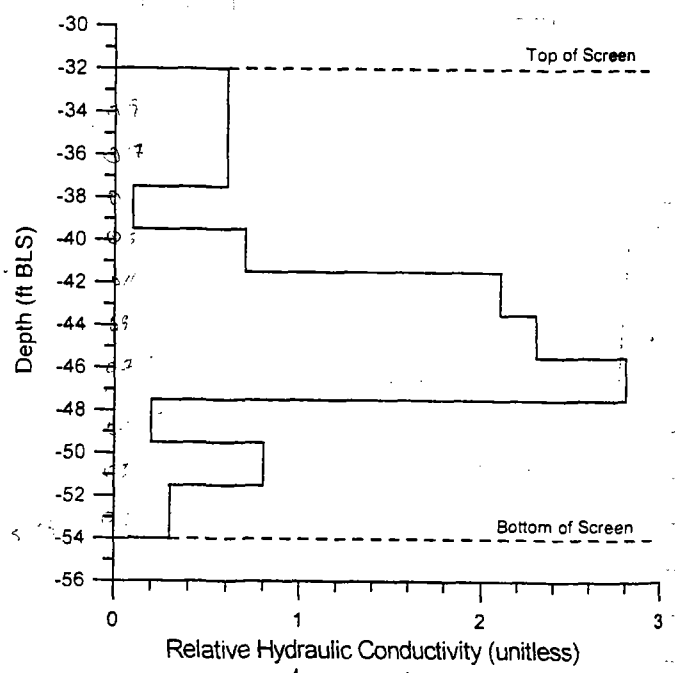
Field work plan:
Wells for data loggers

DH-6, DH8, DH-16, DH-24, DH-49, DH-50, DH-51, DH-52, DH-55, DH-56, DH-58, DH-61, DH-62, DH-63, DH-64, DH-65









	TOC Elevation (Ft AMSL)	Ground Surface (Ft AMSL)
PBTW1	3904.27	3901.88
PBTW2	3903.42	3900.96

Continued on Page

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Conf. Call 6/17/02
Dan Powell, Dave Borden, Rick Ehrhart etc., SA
Richard Wiseman (TetraTech) *Robert —

* Planning docs – Dan Powell

Re:use standards?
Screening tables in Corr. Action Stds
(website – App D)

July 3 – conf call (ODEQ, R6, TTO, Ada)
Tech questions to ~~support~~ develop
dynamic work plan

Susan Zazzali

John Nichols 227-7191

Darryl Shaw 227-7173

6/19/02 Asarco · East Helena

PBTW-1 Minitroll
WL = 33.45' BTOC 5:15 pm

Continued on Page

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Well	Depth to water	Screen (BLS)	Logger Depth (ft BTOC)
DH-~~16~~17	30.52' BTOPVC 32.36' BTOstickup 1.85' TOC PVC - TOC stickup TOC stickup - 0.97' BLS	31'-41'	40'
PBTW-1		31'-45' (33.5'-47.5' BTOC)	40
PBTW-2			40
DH-17	30.13'		

Continued on Page

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Project Asarco Notebook No.

Continued from Page

Well	Depth to water (ft BTOC)	Time	Screen (ft BLS)	(ft BTOC) Logger Depth
DH-17	30.13	12:50	31-41	40
DH-51	31.38	13:16	24-34* bgs	35
DH-50	32.79	13:27	24-34 bgs	35 ~~[illegible]~~
DH-24	28.15	13:47		~~33.5~~ 34
DH-49	33.52	13:53	24-34	35
DH-63	35.62	14:03	24-39	40
DH-56	~~76.69~~ 76.68	14:27	70-85	85
DH-56	76.68 ~~76.68~~ ~~76.77~~	14:57		
DH-36	27.74	15:33	21-31	30
DH-52	3.63	15:49	7-17	15

(maybe labeled DH-15 on XD)

miniTrolls

PBTW-1	33.29	17:07	
STW-1	32.90	17:10	

Continued on Page

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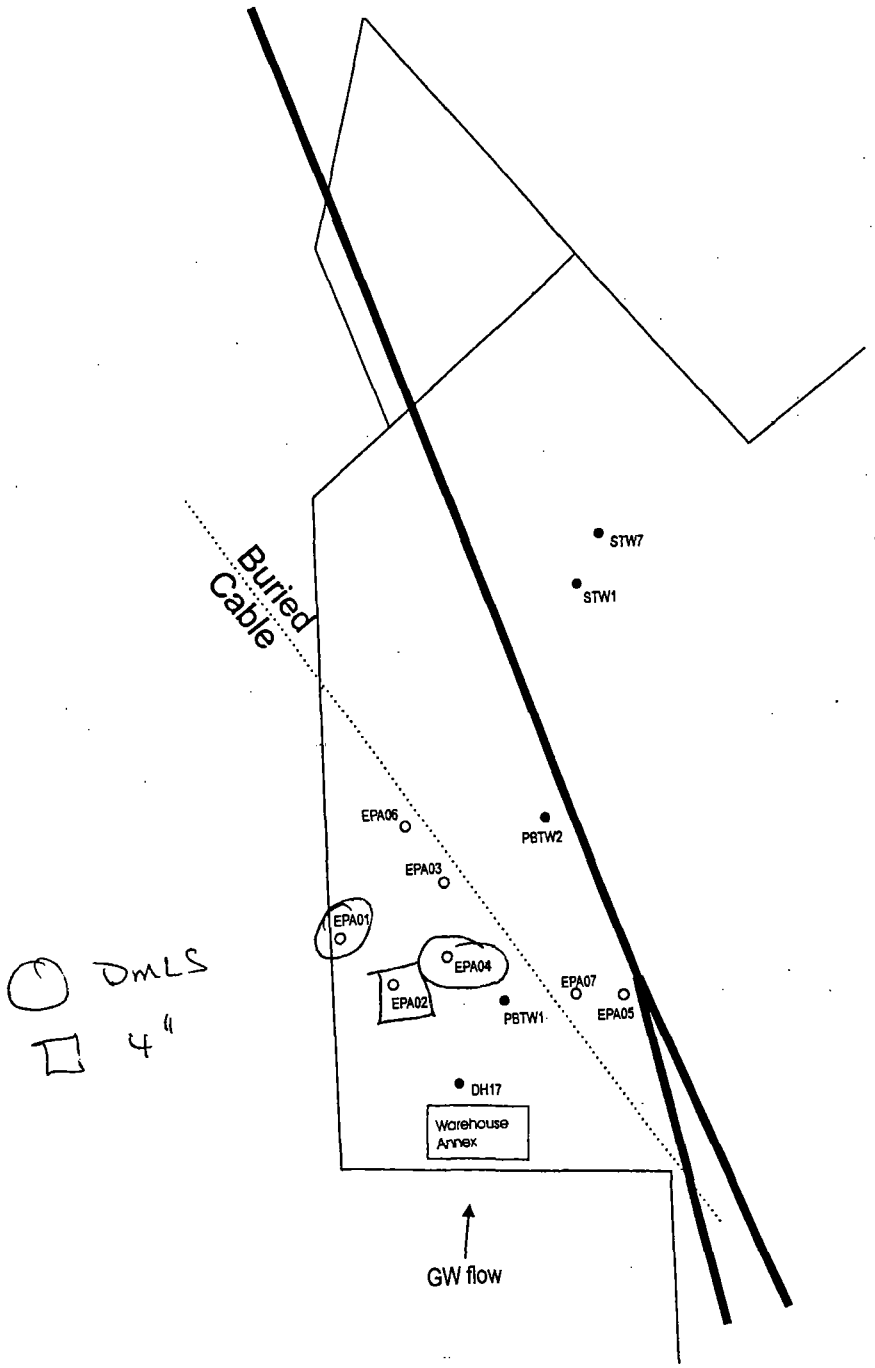
Continued from Page

New EPA wells installed 8/02!



Site Map

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Project Asarco - E. Helena, MT Notebook No. _____

Continued from Page _____

Flowmeter survey

Calibration: 1" probe, 4" ID sch 40 PVC cell w/steel collar
Calibration factor = 4.43556

Wells EPA01 and EPA04 each have 15 ft of DLMS in place (each well with 3 five ft sections). Each well is loaded with 36 cells.

To remove these units:

1) record date/time
2) pull up the EPA01 unit, as the cells emerge, remove them from the DMLS rod, dry the cells, number in duplicate (1 = top, 36 = bottom), cap both ends of the cell. Place the capped cells in a large zip-lock baggie and store in the refrigerator. Label the bag as EPA01. Repeat the process for well EPA04.
3) dismantle the rods as they come up and store them in the lab.
4) ship the samples to me (overnight) on blue ice in a well-taped icechest.

Piece of cake. The most difficult part will be snapping the caps in place - they do not fit well.
Supplies (general DLMS removal stuff (use that green bar), baggies, markers, caps, tape, ice chest) will be found in the mobile lab. I'll get you some blue ice that can be placed in the freezer the first day you arrive for overnight freezing. I will be in the office if any issues arise.

Equipment Needs

Pelican for Redi Flo 2 controller + pump
6" packers for 2" well
EnviroKey
4" J plugs

Continued on Page

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Project Asarco Notebook No.
Continued from Page

Field Work Plan

ASARCO-East Helena
Sept 23-27

Sept 23
Well development (EPA-4, 2-3 other new wells on west side of parking lot)
Pumping test
Diffusion tracer test in PBTW-2 with packers

Sept 24
FM in EPA-4
Diffusion tracer test in PBTW-2 with packers
Pneu Slug tests in new 2-in SCH 40 PVC wells with packer? (Scr across WT)

Sept 25
Pneu Slug test in EPA-4 (4-in Sch 40 PVC)
Diffusion tracer test in PBTW-2 with packers
Download data loggers

Sept 26
Diffusion tracer test in PBTW-2 with packers
Download data loggers
FM - ambient in DH-24?

Sept 27- a.m.
Pack & ship equip

Continued on Page

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Project Asarco Notebook No.

Continued from Page

ASARCO - East Helena

Onsite @ ~9:30 a.m., 9/23/02

Well EPA 02 (4" sch40 PVC construction)

Depth to gw: 29.79 @ 10:12 a.m.
TD: 48.48 ft BTOC (+0.35 = 48.83) (soft bottom, lots of resistance)
TOC ~0.45 ft BLS

FED EX lost box w/ pwr cords, purge pumps, fittings, assorted small parts. Replaced critical parts from hardware store + WalMart.

Attempted to develop EPA 04 using Waterra foot valve equipped with surge block. Fine sand clogged foot valve rendering inertial pump useless.

Continued on Page

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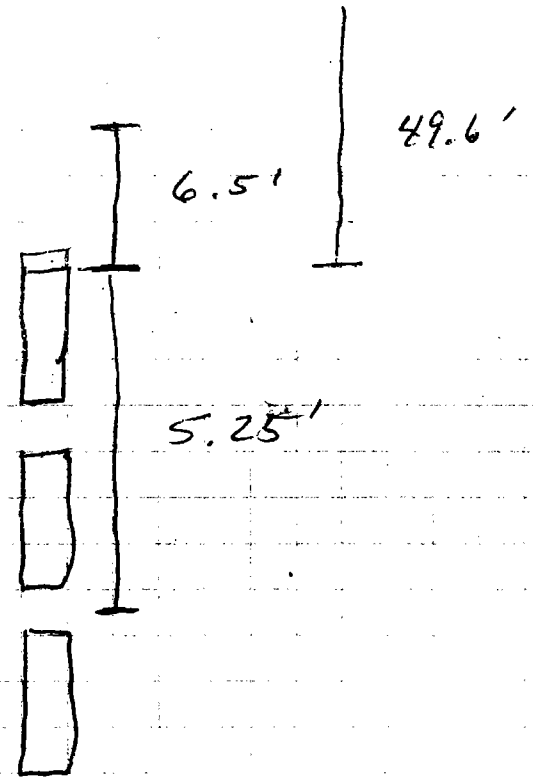
PBTW-2

Depth to gw = 31.24 ft BTOC @ 9:40 am, 9/24/02
Removed minitroll in prep for diffusion tracer test.
Downloaded data to laptop: Filename = 2002-06-21_155612 pbtw1.6in
Stopped test. Saved file to disks. Deleted data from Troll.
Changed file name to SN07922_2002-06-21_155612_pbtw2.6in



49.6
6.5
43.10'
5.25
48.35'

~~49.0~~ ft BLS
~~2.4~~ ft BLS to TOC
~~51.4~~ ft BTOC

49.0 ft BLS 3903.42
2.5 ft BLS to TOC 3900.96
51.5 ft BTOC 2.46

50.0 ft BLS
2.5 ft BLS to TOC
52.5 ft BTOC

Installed DMLS cell w/ 500 mg/l Br^- solution:
Depth = 52.5 ft BTOC
Time = 14:08
Packers + cell removed at 17:18

Installed DMLS (3 sections) at ~~5~~ 17:30.

Continued on Page

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Project Asarco Notebook No.

Continued from Page

BRØ1 – Sample of natural Bromide Solution

PBTW2-DS1 (DMLS cell placed @ 52.5 ft BTOC between packers)

Removed DMLS string from PBTW-2 : 8:11

Installed DMLS cell between 2 packers at 8:30
Sample # PBTW 2-DS 2
Depth : 48.5 ft BTOC

Continued on Page

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Flowmeter Survey

Well EPA-02
Meter on: 10:24, Equipment: 125' cable, 1.0" probe, A/D converter
WL = 29.82' BTOC @ 11:01
Ambient Flow Profile
Electronics settings: MF = 239, TC = 20, Probe = 1.0 inch

Depth	Time	FM Response (volts)	STD
cylinder	~~10:~~ 11:00	-0.004	0.005
31.5	11:15	+0.001	0.006
48.5-TD	11:22	0.000	0.000
48.0	11:28	-0.005	0.008
46.0	11:35	-0.140	0.614
46.0	11:41	-0.009	0.016
46.0	11:44	-0.006	0.014
44.0	11:48	-0.019	0.007
42.0	11:~~54~~57	-0.019	0.007
40.0	12:03	-0.001	0.008
40.0	12:05	-0.002	0.011
38.0	12:10	+0.004	0.009
36.0	12:15	+0.005	0.014
34.0	12:21	+0.006	0.010
32.0	12:27	+0.000	0.004
32.0	12:30	+0.000	0.002
44.0	12:~~39~~41	-0.032	0.025
44.0	12:43	-0.034	0.027

Continued on Page

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9/25/02 — Date
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Project Asarco Notebook No.

Continued from Page

Induced Flow Profile

Depth	TIME	FM Response (volts)	STD
48.5	~~13:58~~ 14:01	-0.002	0.006
Start pump @ 14:14			
Start pump @ 14:38			
48.0	15:~~22~~ 25	+0.017	0.094
48.0	15:28	+0.019	0.067
46.0	15:~~34~~ 36	+0.326	+0.167
46.0	15:42	+0.324	0.098
44.0	~~15:47~~ 15:51	0.380	0.226
44.0	15:53	0.385	0.280
42.0	16:03	0.326	0.307
42.0	16:05	0.349	0.401
40.0	16:15	0.503	0.170
40.0	16:~~17~~ 22	0.533	0.314
40.0	16:24	0.538	0.019
38.0	16:33	0.540	0.152
38.0	16:~~35~~ 38	0.573	0.074
36.0	16:46	0.678	0.083
36.0	16:48	0.668	0.069
34.0	16:55	0.661	0.306
~~34.0~~	~~16:58~~		
~~33.4~~	~~17:03~~		
38.0	~~17:17~~ 17:19	~~0.723~~ 0.713	~~0.280~~ 0.085
36.0	17:24	0.755	0.414
34.0	~~17:32~~ ~~17:35~~ 17:38	~~0.7~~ 0.749	0.115
40.0	17:45	0.643	0.562
40.0	17:48	0.561	0.189
~~3~~ 42.0	17:52	0.497	0.063
44.0	17:59	0.171	1.856
44.0	18:02	0.399	3.332
46.0	18:07	0.457	2.056
46.0	18:10	0.435	2.100
46.0	18:13	0.399	0.328
32.0	18:25	-0.002	0.006

Continued on Page

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Project Asarco Notebook No.

Continued from Page

Flowrate

TIME	Flow volume (l)	Elapsed TIME (s)	Flowrate (l/min)
14:40	2.300	61.04	2.26
14:50	2.800	59.30	2.83
14:55	3.100	57.79	3.22
15:00	3.050	58.31	3.14
15:05	3.350	59.67	3.37
15:10	3.430	57.77	3.56
15:21	3.250	58.34	3.34
15:32 FM Test Started	3.490	59.16	3.54
15:47	3.400	58.61	3.48
15:59	3.400	58.21	3.50
16:16	3.500	59.00	3.56
16:30	3.550	59.20	3.60
16:43	3.450	59.80	3.46
16:58	3.550	60.38	3.53
17:10	3.460	59.27	3.50
17:34	3.530	59.38	3.57
18:02	3.600	61.02	3.54
18:15 FM Test Ended	3.550	59.65	3.57

Stop Pump 18:16

Average Q during Flowmeter test = 3.53 l/min

Continued on Page

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9/25/02 — Date

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Date

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Continued from Page

Download data loggers

Well	Depth to gw (ft BTOC)	Date	TIME	Depth to Geo	TIME	Logger Start
✓ DH-17	28.12	9/26	15:28	28.12	15:50	16:00
✓ PBTW-1	31.34	9/26	16:10			16:35
✓ DH-8	39.04	9/27	10:08 9/27			Old test cont.
✓ DH-36	26.74	9/27	10:22 9/27			
✓ DH-63	33.40	9/27	10:31			
✓ DH-56	>75	9/27	—			
✓ DH-52	5.63	9/27	10:57			
✓ DH-51	29.50	9/27	11:11			
✓ DH-50	30.80	9/27	11:16			
✓ DH-49	31.32	9/27	11:21			

Conditions on 9/26: Clear + sunny → partly cloudy, cool
Conditions on 9/27: 40's + rain

Water was accumulating at berm separating Asarco from Chemetric plant on NE portion of site near wells DH-50, DH-51, and DH-24.

DH-24 logger removed by Asarco.

Logger serial # 32558 in PBTW-1.

Continued on Page

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S. A 9/26/02

Signed Date Signed Date

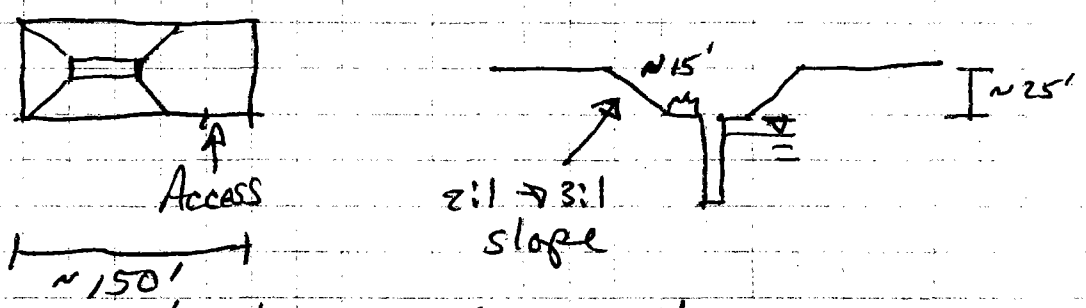
Down load data loggers

Well	Depth to gw (ft BTOC)	Time		Date
DH-24	See previous page			
DH-36				
DH-49				
DH-50				
DH-51				
DH-52				
DH-56				
DH-63				
PBTW-2	31.34	11:40	MiniTroll	9/27
STW-1	30.83	8:26	Logger SN 32557	9/27

Test started at 8:45

Met w/ Bob Miller, John Nichol, Conrad Parrish (Shaw) + Kirk Brower (Shaw) for ~ 1 hr to discuss Shaw ideas for wall + hear their capabilities, etc.

1st proposal: Excavation w/ setback.



John's concerned w/ utility line that runs across site. Questioned whether stud could be moved upgradient into other parking lot. (Addl char would be required + should have been discussed before last series of wells installed.) Concerned w/ RCRA status of excavated soil + disposal (He + Bob will discuss w/ Susan.)
Caisson installation also mentioned but not discussed in detail. Pros + cons (con = not continuous)

Continued on Page

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Project Asarco Notebook No.

Continued from Page

Ambient Profile (raw data from Flowmeter)

ELECTROMAGNETIC BOREHOLE FLOWMETER SURVEY

File Name = epa02.txt
Well Number = EPA-02
Time = Wed Sep 25 10:45:52 2002

Flowmeter Zero = +0.000
Flowmeter Cal = +4.436

Samples for Avg = 120

Measuring Units: Flow = LPM; Scale = Feet

Time	Depth	Volts	Flow	STD
10:58	+0.000	-0.004	-0.016	00.005
11:13	+0.000	+0.001	+0.003	00.006
11:20	+48.500	+0.000	+0.000	00.000
11:26	+48.000	-0.005	-0.023	00.008
11:32	+46.000	-0.140	-0.621	00.614
11:39	+46.000	-0.009	-0.038	00.016
11:42	+46.000	-0.006	-0.026	00.014
11:46	+44.000	-0.019	-0.082	00.007
11:55	+42.000	-0.019	-0.084	00.007
12:01	+40.000	-0.001	-0.004	00.008
12:04	+40.000	-0.002	-0.010	00.011
12:08	+38.000	+0.004	+0.019	00.009
12:13	+36.000	+0.005	+0.020	00.014
12:19	+34.000	+0.006	+0.027	00.010
12:25	+32.000	+0.000	+0.001	00.004
12:28	+32.000	+0.000	+0.000	00.002
12:39	+44.000	-0.032	-0.141	00.025
12:41	+44.000	-0.034	-0.150	00.027

ELECTROMAGNETIC BOREHOLE FLOWMETER SURVEY

Flowmeter response @ zero flow obtained between ambient and induced flow tests.

File Name = epa02in.txt
Well Number = epa02
Time = Wed Sep 25 13:59:48 2002

Flowmeter Zero = +0.000
Flowmeter Cal = +4.436

Samples for Avg = 120

Measuring Units: Flow = LPM Scale = Feet

Time	Depth	Volts	Flow	STD
13:59	+48.500	-0.002	-0.008	00.006

Continued on Page

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Signed	Date	Signed	Date
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Project HSGCD Notebook No.

Continued from Page

Induced Flow Profile (raw flowmeter data)

ELECTROMAGNETIC BOREHOLE FLOWMETER SURVEY

File Name = epa02in2.txt
Well Number = epa02
Time = Wed Sep 25 15:17:01 2002

Flowmeter Zero = +0.000
Flowmeter Cal = +4.436

Samples for Avg = 120

Measuring Units: Flow = LPM Scale = Feet

Time	Depth	Volts	Flow	STD
15:23	+48.000	+0.017	+0.075	00.094
15:25	+1.000	+0.019	+0.083	00.067
15:34	+46.000	+0.326	+1.445	00.167
15:40	+46.000	+0.324	+1.439	00.098
15:49	+44.000	+0.380	+1.687	00.226
15:51	+44.000	+0.385	+1.709	00.280
16:01	+42.000	+0.326	+1.446	00.307
16:03	+42.000	+0.349	+1.549	00.401
16:13	+40.000	+0.503	+2.229	00.170
16:20	+40.000	+0.533	+2.363	00.314
16:22	+40.000	+0.538	+2.388	00.019
16:31	+38.000	+0.540	+2.397	00.152
16:36	+38.000	+0.573	+2.541	00.074
16:44	+36.000	+0.678	+3.008	00.083
16:46	+36.000	+0.668	+2.963	00.069
16:53	+34.000	+0.661	+2.932	00.306
17:17	+38.000	+0.713	+3.161	00.085
17:26	+36.000	+0.755	+3.347	00.414
17:36	+34.000	+0.749	+3.323	00.115
17:43	+40.000	+0.643	+2.850	00.562
17:46	+40.000	+0.561	+2.490	00.189
17:51	+42.000	+0.497	+2.206	00.063
17:57	+44.000	+0.171	+0.759	01.856
18:00	+44.000	+0.397	+1.762	03.332
18:05	+46.000	+0.457	+2.026	02.056
18:08	+46.000	+0.435	+1.928	02.100
18:11	+46.000	+0.399	+1.771	00.328
18:23	+32.000	-0.002	-0.009	00.006

Continued on Page

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Project Asarco Notebook No.

Continued from Page

Ambient Profile

Depth (ft BTOC)	Flow (l/min)	Del Amb
48.5	0	
48	-0.023	-0.023
46	-0.032	-0.009
44	-0.082	-0.05
42	-0.084	-0.002
40	-0.007	0.077
38	0.019	0.026
36	0.02	0.001
34	0.027	0.007
32	0	-0.027

Del Amb = difference in ambient flow rates between each measurement

Reoccupy

44	-0.141	-6.1856
44	-0.15	

Reoccupied depths

Repeat

46	-0.038	37.5
46	-0.026	
40	-0.004	-85.714
40	-0.01	

Repeated measurements without moving probe

Induced Profile

Depth (ft BTOC)	Flowrate (l/min)	Zero	Flowrate - zero (l/min)
48.5	-0.008	-0.008	0
48	0.075	-0.008	0.083
48	0.083	-0.008	0.091
46	1.445	-0.008	1.453
46	1.439	-0.008	1.447
44	1.687	-0.008	1.695
44	1.709	-0.008	1.717
42	1.446	-0.008	1.454
42	1.549	-0.008	1.557
40	2.388	-0.009	2.397
38	2.541	-0.009	2.55
36	3.008	-0.009	3.017
36	2.963	-0.009	2.972
34	2.932	-0.009	2.941
38	3.161	-0.009	3.17
36	3.347	-0.009	3.356
34	3.323	-0.009	3.332
40	2.49	-0.009	2.499
42	2.206	-0.009	2.215
46	1.771	-0.009	1.78
32	-0.009	-0.009	0

Continued on Page

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Signed	Date	Signed	Date
SA	8/6/03		

Project Asarco Notebook No.

Continued from Page

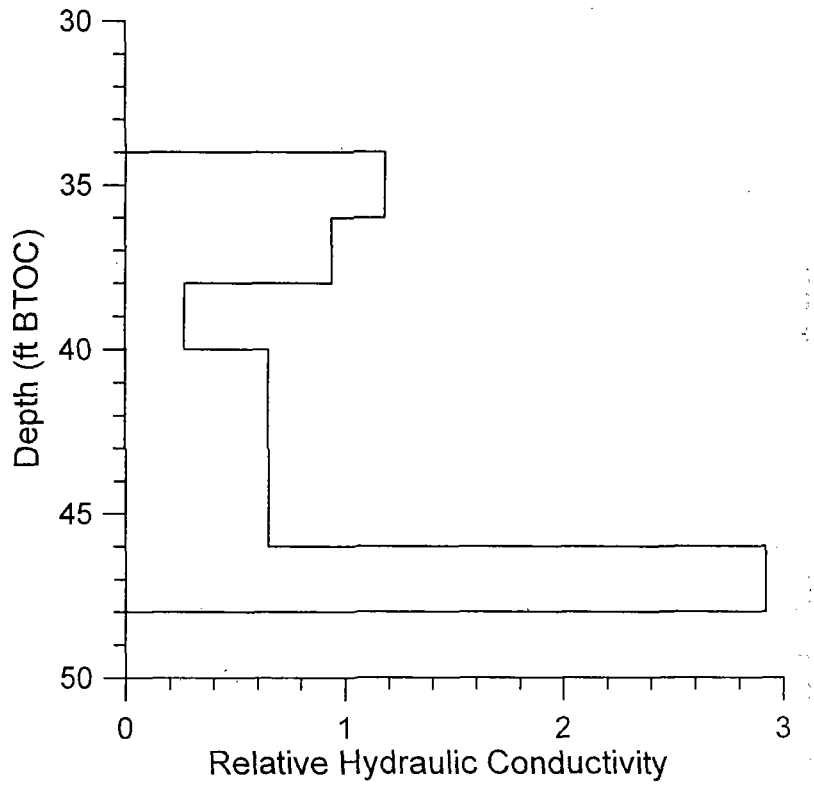
Depth (ft BTOC)	Flow	Amb	Net Flow (l/min)	Del Net (l/min)	Zi (ft)	Rel K	Abs K (ft/d)
48.5	0	0	0				
48	0.087	-0.023	0.11	0.11			
46	1.45	-0.032	1.482	1.372	2	2.92	59.2
44	1.706	-0.082	1.788	0.306	2	0.65	13.2
42	1.506	-0.084	1.59				
40	2.397	-0.007	2.404	0.616	4	0.65	13.3
38	2.55	0.019	2.531	0.127	2	0.27	5.5
36	2.995	0.02	2.975	0.444	2	0.94	19.1
34	3.53		3.53	0.555	2	1.18	23.9

Repeats

Depth (ft BTOC)	Flowrate (l/min)	
46	1.453	0.41379
46	1.447	
44	1.695	-1.2896
44	1.717	
42	1.454	-6.8416
42	1.557	
36	3.017	1.50276
36	2.972	

Reoccupy

38	2.55	-21.678
38	3.17	
36	2.995	-11.368
36	3.356	
34	2.941	-12.466
34	3.332	
40	2.397	-4.1667
40	2.499	
42	1.506	-38.108
42	2.215	
46	1.45	-20.433
46	1.78	



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Read and Understood By

Signed: S Ann Date: 8/6/03

Signed: Date:

Project Asarco Notebook No.

Continued from Page

Hydraulic conductivity estimates provided by R. Ross:

Well	Hydraulic Conductivity (ft/day)
EPA-01	49.8
EPA-02	10.7 - 20.3*
EPA-03	9.4
EPA-04	33.9
EPA-05	7
EPA-07	3.9

Note: *K value obtained after aggressive well development and flowmeter study.

Well construction information:

ASARCO EAST HELENA
PERMEABLE BARRIER WALL MONITORING WELL
DRILLING SUMMARY
AUGUST 19 THROUGH 26, 2002

WELL ID	WELL CASING DIAMETER (inches)	SAMPLED BOREHOLE DEPTH (ft) (bgs)	CASED WELL DEPTH (ft)(bgs)	DEPTH TO TOP OF ASH (ft)(bgs)	SCREENED INTERVAL (ft)(bgs)	Water Level (ft)(btoc)
EPA 01	2	47.4	46.2	47.0	26.2 - 46.2	30.40
EPA 02	4	49.7	49.1	49.4	34.1 - 49.1	29.67
EPA 03	2	48.4	48.3	48.4	28.3 - 48.3	29.12
EPA 04	2	48.6	48.0	48.3	28.0 - 48.0	29.19
EPA 05	2	50.0	50.0	49.2	29.8 - 49.8	27.48
EPA 06	2	50.1	51.0	50.1	31.0 - 51.0	29.65
EPA 07	2	48.5	48.6	47.3	28.6 - 48.6	27.60

NOTE: Assume +0.4 feet from top of casing (toc) to ground surface (gs).
All wells completed as flush-mounts.

Calibration Factor For Flowmeter 1" probe w/ mechanical collar = 4.2624

Physical slug's

	Volume (ft^3)	WL Rise in 2" Sch 40 pipe
5.25 in long X 1.5 in OD	5.3689E-3	0.23 ft
10.75 in long X 1.5 in OD	0.01099	0.47 ft
21.375 in long X 1.5 in OD	0.02185	0.93 ft

Continued on Page

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Signed 8/6/03 Date Signed Date

Work Plan

Monday

Pick up equipment from FedEx
Rent generator
Develop EPA02, 03, 04
Ptest EPA02, Monitor EPA04
Ptest EPA04, Monitor EPA02
Ptest EPA03, Monitor EPA06

Pneumatic slug PBTW1 and PBTW2 (rising & falling head)

Tuesday

FM in EPA02
Slug test (physical slugs) EPA03 & EPA04
Download Leveloggers and remove from DH-52, DH-56, DH-36, DH-49.

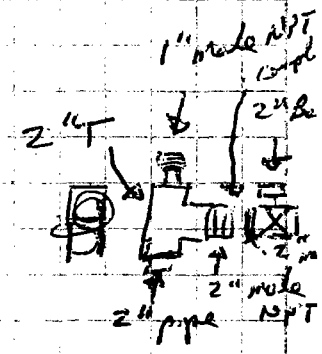
Wednesday

Pneumatic slug EPA02
Multi-level slug EPA02

Return generator

Thursday

Finish downloading & redeploying Leveloggers
Clean, pack, & ship equipment



Need: Plastic sheeting
~~Engine starter~~ ~~1" PVC pipe + fitting (ML slug)~~
20 gal distilled water 12 keyed locks 25' power cords
2 small (12 pack) ice chests ✓ paper towels ✓
2-3 Action Packers trash bags ✓ cubitainer
Chunmang Su (cell phone) 580-421-7280. sun canopy channel locks

230 V Redi Flo 2, whale pump, belt clip for iPAQ, Rubbermaid shipping box

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Signed	Date	Signed	Date
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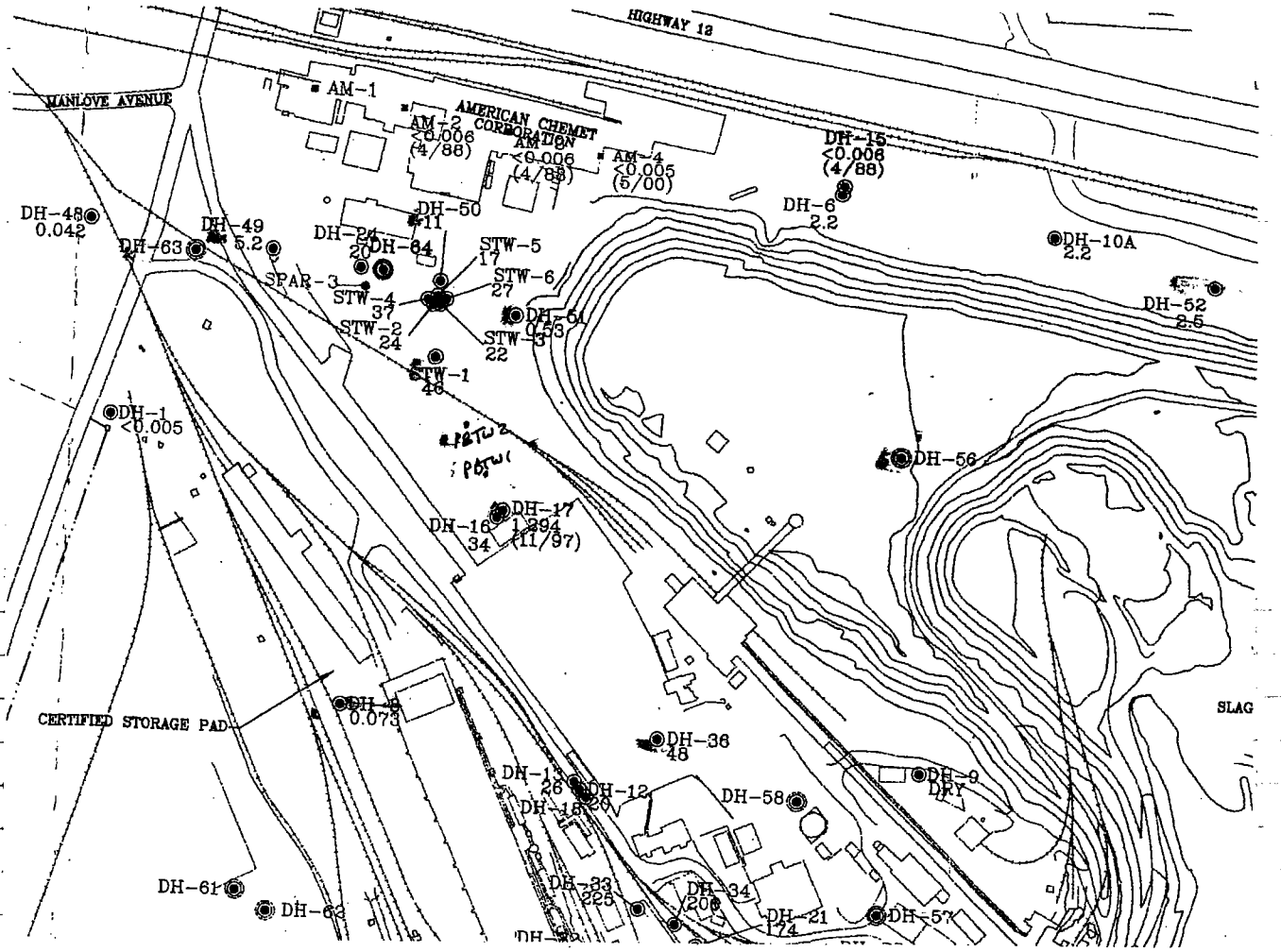
Project Asarco Notebook No.

Continued from Page

Wells with Leveloggers:



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Read and Understood By

S Aa	8/6/03		
Signed	Date	Signed	Date

[illegible] Site ~~8:00am~~ 9:00. 8/11/03

Tested generators at ~~MAGIN~~ Godwin Pumps (Honda 3500 EB, + Honda 5500 watt) RediFlo2 was under voltage w/ both. Voltages were 121 V for 3500 and 122 V for 5500.

Still tested EPA04 using solid slugs. R. Ross used CSI ~~pneumatic~~ data logger + XD.

8/12/03

Developed EPA04 using Waterra w/ surgeblock and Whale 12V pump. Surged and pumped for 3 hr. Pumped @ ~1 gpm. Pumped total of ~100 gal water. Finished development @ 11:30 am. Water initially murky but clear within 5 gal of removal.

3:00 p.m. Started developing EPA02 using 4" surge block with Waterra valve and Whale pump.

WL PBTW1
4:47 32.03 ft BTOC
Remove Levelogger

5:06 WL PBTW2 31.79 ft BTOC
Remove mini Troll, Battery's dead, Data were lost.

8/13/03
10:00 am. Develop EPA03 using waterra surgeblock + Whale Pumped total of 80 gal.

TIME	DH17 WL (ft BTOC)
14:53	28.89

Continued on Page

Read and Understood By

S. [illegible] 8/11/03

Signed Date Signed Date

8/14/03

Well	TIME	Depth to GW (ft BTOC)	
STW 1	8:11	31.39	
DH-56	8:30	78.14	
DH-50	12:21	31.15	Restarted
* DH-57	12:38	30.12	Cap askew, left in place for 1hr
DH-49	12:47	31.67	, Restarted immediately
DH-8	13:13	39.95	Restarted immediately
DH-63	13:45	33.59	Restarted immediately
DH-52	14:01	6.07	Removed Levelogger
DH-51	14:25	30.10	
DH-36	~~12~~ 14:39	27.84	Removed Levelogger
PBTW-2	15:06		Installed Levelogger
PBTW-1	15:25		Installed Levelogger
DH-17	15:35		Installed Levelogger
Barologger	15:47		Downloaded data
Barologger			Restarted in EPA02

~~left in~~

DH-17	16:09	28.90	
PBTW-1	16:19	32.07	
PBTW-1	16:25	31.83	
STW-1	16:28	31.32	
DH-64	16:36	30.68	
STW-7	16:38	31.48	
STW-9	16:42	30.22	
DH-50	17:02	31.11	Reset logger @ 16:58

8/15/03

DH-51	8:01		Installed logger
DH-51	9:14	30.15	

Continued on Page

Read and Understood By

S. [illegible] 8/14/03

Signed Date Signed Date

CONTENTS

Asarco - E. Helena Site

PAGE	REFERENCE	DATE
2	Field Work 5/31 - 6/3/05	
10	Field Work 7/18-20/05	
17	Field Work 10/3-6/05	
28	Field Work 6/6-8/06	
38	Field Work 9/18-21/06	
45	Flow meter Calibration	
48	Levelogger Evaluation	
49	Field Work 1/22-25/07	
54	Field Work 7/17-20/07	
72	Field Work 10/1-3/07	
78	Field Work 3/30-4/3/08	
87	Field Work 6/22-26/08	
102	Field Work 7/9/08	
103	Field Work 7/21-24/08	
115	Field Work 9/8-18/08	

"Rite in the Rain"®
ALL-WEATHER WRITING PAPER

ALL-WEATHER
FIELD BOOK

Name Steve Acree
U.S. EPA

Address 919 Kerr Research Dr
Ada, OK 74820

Phone 580-436-8609

Project Asarco PRB - E. Helena, MT

R. Wilkin = P.I.

This book is printed on "Rite in the Rain" All-Weather Writing Paper - A unique paper created to shed water and enhance the written image. It is widely used throughout the world for recording critical field data in all kinds of weather. For best results, use a pencil or an all-weather pen.

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Columnar	1/4" Grid	Item No 350N	Item No. 350NF

Asarco - East Helena 5/31/05

Dataloggers

	well	TOC	Depth to gw 8/14/03	5/31/05	
•	DH-17	3901.35 ~~3902.27~~	28.90	3:05P 30.77	3870.58
•	PBTW-1	3904.27		3:47 34.00	3870.27
	DH-8	3913.39	39.95	6-2 3:25 41.94	3871.45
Removed Loss'y	DH-36	3904.68	27.84	6-2 ~~[illegible]~~ 9:32 ~~77.69~~ 28.58	SA
	DH-63	3901.92	33.59	6-2 3:33 36.82	
	DH-56		78.14	6-2 9:27 77.69	
Removed 8/14/03	DH-52	3885.43	6.07		
•	DH-51	3900.96	30.15	3:40 32.11	3868.85
•	DH-50	3901.37	31.15	3:30 33.40	3867.97
•	DH-49	3900.63	31.67	3:23 34.41	3866.22
•	~~DH~~ STW-1	3902.21	31.39	3:14 33.49	3868.72
•	PBTW-2	3903.42		3:54 33.88	3869.54
•	STW-7		31.48	6-2 9:43 33.63	
•	STW-9		30.22		
	EPA02			6-2 4:33 32.40	

Asarco 5/31/05

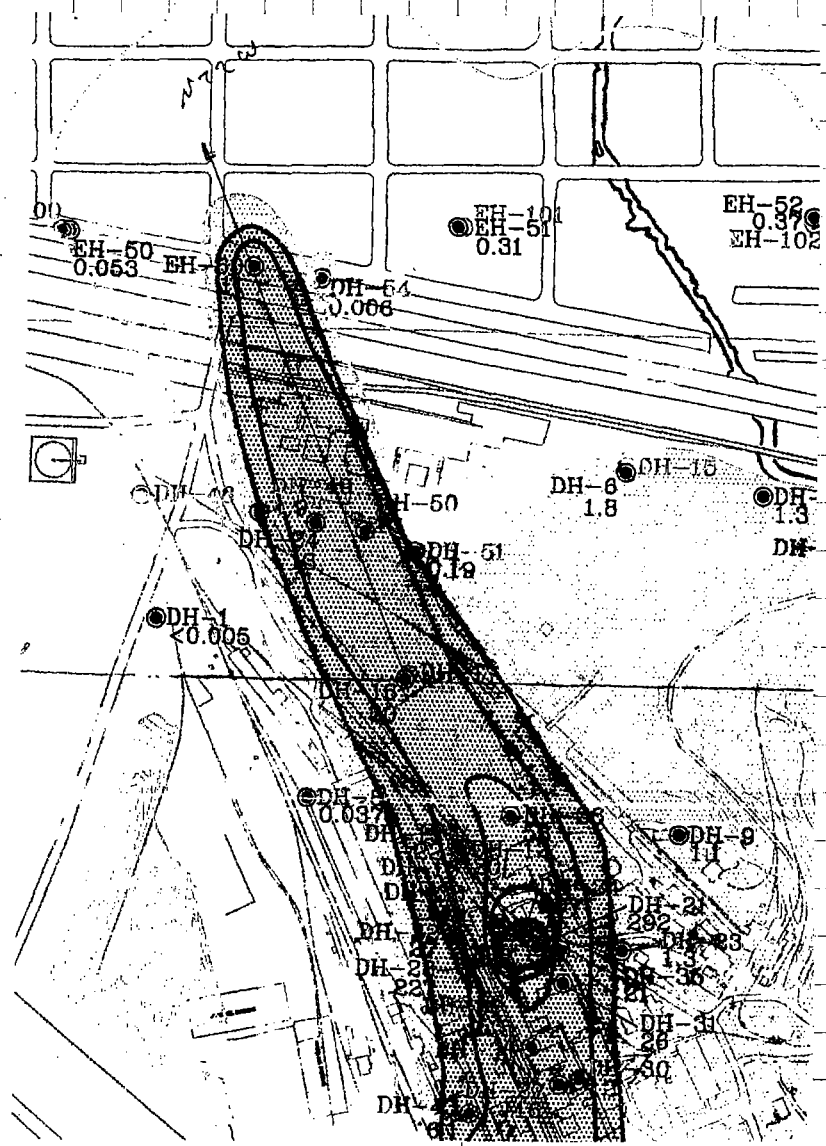
Asarco 5/31/05

Water table maxi

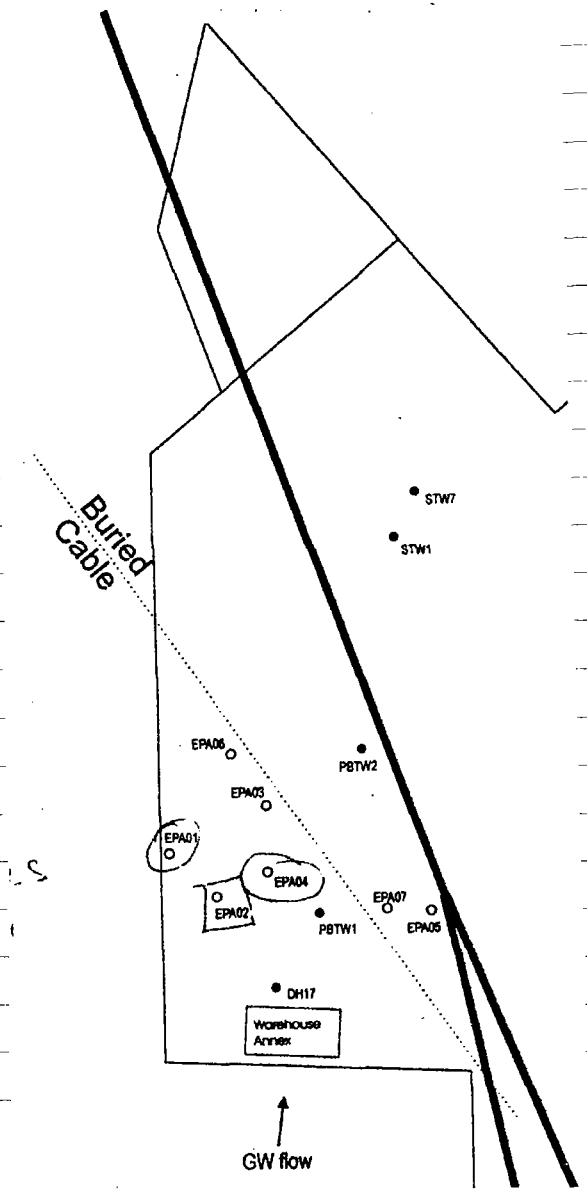
Date	Direction	Mag	
1997	N22W	0.008	(RI)
8/29/01	N30W	0.006	

Asarco 5/31/05

Plume Axis - IM Air Sparging Report



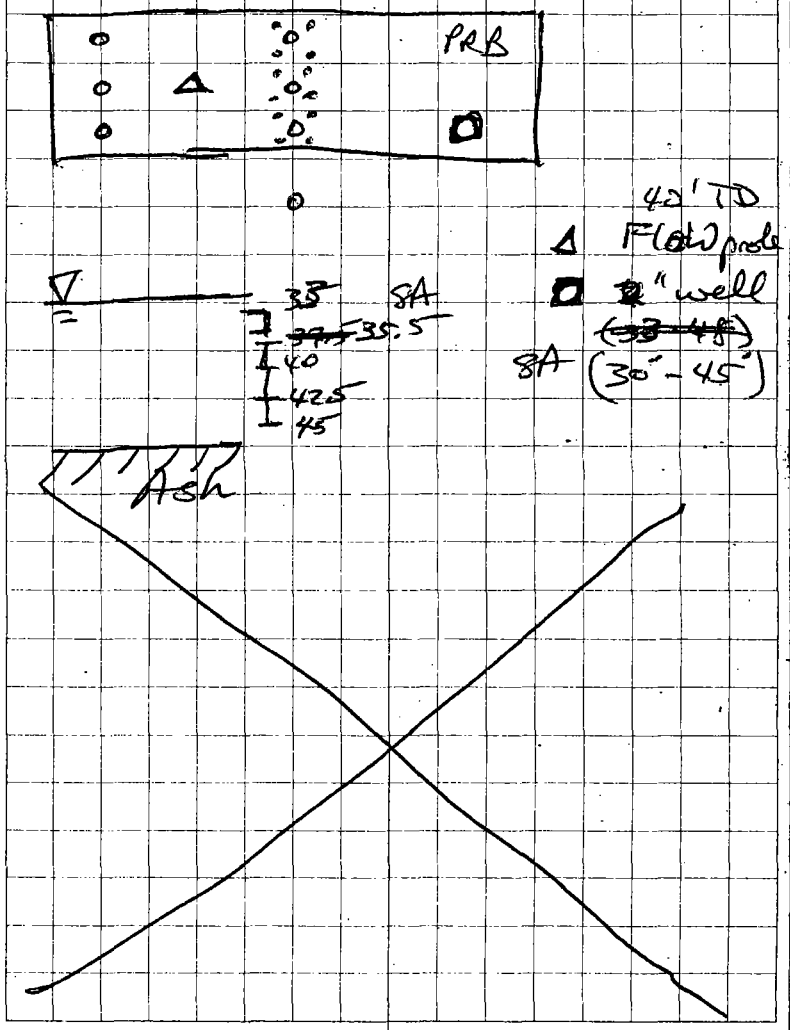
Asarco Pilot Study Area 5/31/05



Asarco 5/31/05

Don Jones - H+S plan

Preliminary PRB monitoring design:



27000 14000 10,000 (100x100)

8

Asarco Notes: 5/31/05

SF Travel ~~A~~

Spoils

1. Spread thin + cover w/ topsoil
2. Spread smaller fraction + rocks → MineSite
3. Send to mine waste site
4. Daily cover @ landfill (Great Falls)

~~Lafrell~~ SA

Conf call Reg 8 Helena office
- ~~Scott~~ Brown
- Chuck Figure/Suzanne Bonar/Linda T.
- Rick, Randall, SA

SA

9

6/3	Depth to GW	Asarco
9:01	33.82	PBTW1
9:12	33.69	PBTW2
10:05	33.82	STW1
10:11	31.92	DH51

Water level measurements

SA

Asarco - East Helena, MT
ARB well installations - workplan

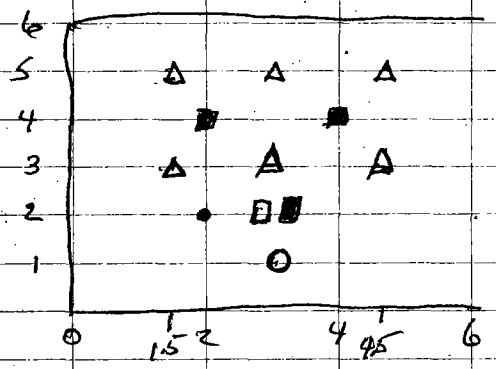
Fed Ex #s

79233195 1665

79297438 4453

79297438 5840

Well Network - West End



- Existing 2"
- ○ 2" scr 32.5' - 45' bgs
- □ 1" scr 32.5' - 35'
- ■ 1" scr 37.5' - 40'

SA

Asarco 7/18/05

Flow probe installation

6" temporary casing
Stickup = 1 ft above grd surf.
TD = 39.95 + 0.5 = 40.45 BTOC
− 1
39.5 ft bgs

∇ 26.22 ft btoc

Pulled 6" casing ~ 1 ft
Knocked off bottom plug
New TD 40.5 BTOC
New stickup = 1.7 ft above grd surface
New TD 38.8 ft bgs

Put probe in hole.
New TD = 39.85 ft BTOC
− 1.7 (stickup)
38.15 ft bgs
TD = 45.1' below top of Geoprobe
Pull casing ~ 1 ft. Probe moved up + was pushed down
TD = 43.4' below top of Geoprobe

SA

Asarco 7/18/05

Pull 2½ ft of casing
TD = 40.9' below top of Geoprobe
Pour more Fe.
TD = 40.1' below top of Geoprobe
Pull ~5' pipe.
TD = 34.9' below top of Geoprobe
Pull ~2.5' pipe
TD = 32.2 below top of Geoprobe
Pull pipe
~~TD = below~~ SA

Probe construction:
Probe length = 3.5 ft
2 ft 0.010 screen on top of probe. Riser to surface.

SA

Asarco 7/19/05

To do:
Mark spots for 2" outside wells
Download + set out Levelloggers

Install Solinst CMT.
Channel 1 = 32.7' - 34.7' bgs (2 ft)
Channel 2 = 37.7' - 39.7' bgs (2 ft)
Channel 3 = 42.7' - 43.7' bgs (1 ft)
Holes punched every 3" using Solinst guide.
Installed thru 2 1/8" rods.
Screen = 500 micron mesh nylon.
Length of Noodle 1 = 44' tendage
loc = u.g. east

Noodle 2 (Length = 46')
Channel 1 = 32.86' - 34.86' bgs
Channel 2 37.86' - 39.86' bgs
Channel 3 42.86' - 44.86' bgs
Holes cut every 1.5".
Screen = 500 um mesh nylon.
loc = u.g. center
Noodle 2 zero line = 0.14 ft above grd surf.

Noodle 1 zero line: 0.3 ft above grd surf

SA

Asarco 7/19/05

Noodle 3 Loc = u.g. west
TD = 46'
Noodle length = 46' + end cap
Zero line = 0.35' above gd surf.
Holes cut every 1.5".
Channel 1 = 32.65' – 34.65' bgs
Channel 2 = 37.65' – 39.65' bgs
Channel 3 = 42.65' – 44.65' bgs

Noodle 4 Loc = d.g. center
TD = 46'
Noodle length = 46' + endcap (2")
Zero line = 0.25' above gd surf
Holes cut every 3".
Channel 1 = 32.75' – 34.75' bgs
Channel 2 = 37.75' – 39.75' bgs
Channel 3 = 42.75' – 44.75' bgs

Noodle 5 Loc = d.g. west
Botched installation. Rods lost.

Noodle 6 Loc = d.g. east 7/20/05
TD = 46'
Noodle length = 46' + end cap. (2")
Zero line = 1" above grd surf.
Holes cut every 3".

S Ar

Asarco 7/19/05

Noodle ~~3~~ 6
Channel 1 = 32.9' – 34.9' bgs
Channel 2 = 37.9' – 39.9' bgs
Channel 3 = 42.9' – 44.9' bgs

Installed 1" wells to replace Noodle 5. Screened @ 32.5 ~~40~~ 35 and 37.5 – 40 ft bgs.

Set up HydroTechnics probe.
Power Supply setting: 11:00 am
48.6 volts 1.18 amp.
watts = 57.3 (V X A).

48.7 v	1.18 amp	13:23
48.7 V	1.17 amp	16:09
48.7 v	1.17 amp	15:29 7/21

Power glitch shut down power supply for < 10 sec @ 16:08.
48.7 v 1.18 amp @ 7:56 7/22

S Ar

Asarco 7/20/05

Download levelloggers

1. DH17 SN 28016 Comm error
Replaced w/ SN Start @ 16:00 (4hr)
2. PBTW-1 Depth to gw = 30.41' @ 15:54
3. PBTW-2 Depth to gw = 30.33' @ 15:56
4. DH-51 Depth to gw = 28.76' @ 16:03
5. STW-1 Depth to gw = 30.03' @ 15:59
6. EPA02 Depth to gw = 28.83' @ 15:59

DH17 Depth to gw = 27.13 @ 16:07

7/21/05

7. WT 1' well - mid wall east side
TD = 40.64' BTOC
Depth to gw = 30.08' btoc @ 11:00
8. EPA06 Depth to gw =
+ Barologger
9. DH-36 Depth to gw = 25.20' BTOC @ 12:04

All loggers set to acquire data every 4 hours starting @ 12:00 pm.

9/30/05

Asarco

Work Plan
Survey wells
Flow probe
Download loggers
Add loggers to:
(DH30, 31, 35, 46 + 47)
WL response to trains (DH-17) TDH-36
Slug tests - 2" x hole
Tracer - LTCs + Levelloggers

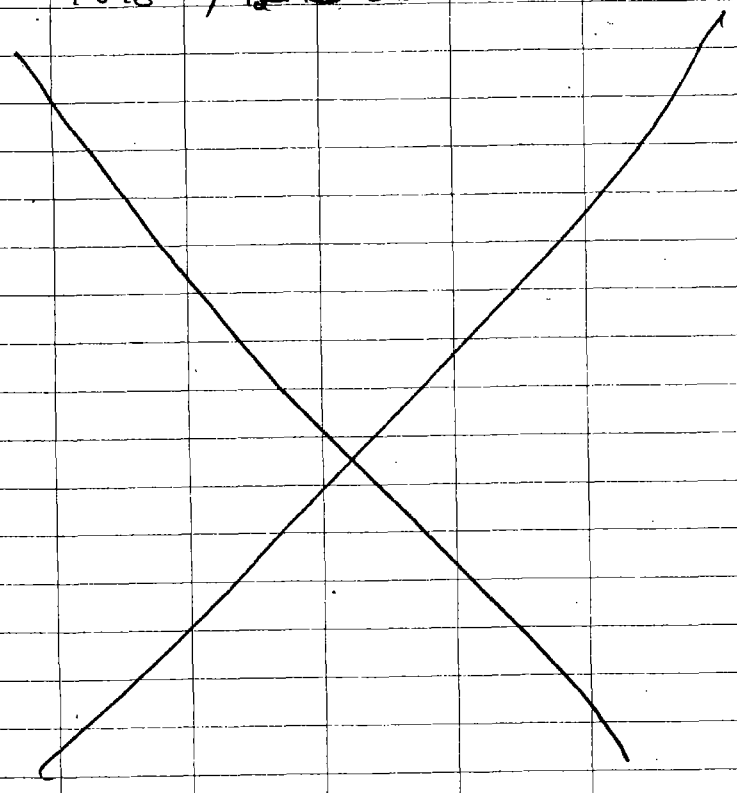
1:51pm | 6:11pm | Delta Air Lines 4233* / 3879* | R. Wilkin

OKC / HLN CR7/CRJ D 5:20 hrs. dsc. 10/29/05

790662694745 – 43 packer?
790662695557 – 51 R³ rig - bl. pelican
790662704198 – 13 tripod
790663255662 – 9#5 prism (red ice chest)
791222042684 – 47 packer
791222376246 – 42# Black pelican
791743305315 – 33 Orange pelican
~~791743914261 – 7~~
792398534146 – 43 R³ data logger
~~792398981727 – 9#5~~ 9A
792541108247 – 6 survey rod
792541551395 – 33 Topcon blue ice chest

Asarco 10/3/05

Arrive site: 2:30p
Set up CR10X w/ Flow probe
Data logger on ~ 4:15p
Heater on: ~ 4:20 p
Voltage: 48.7v Current: 1.20a Watts: 58.44
Miss wired CR10X, shut down ~ 4:45p
Rewired, reset, restarted heater 5:50p
48.8v, 1.20 a



SA

Asarco 10/4/05

Water levels

Well	(Ft BTOC) Depth to gw	TIME
~~29.14~~ T3-C	29.14	8:36
T3B	29.13	8:38
T3A	29.11	8:40
MT Probe	30.06	8:40
S5	29.29	8:40
S6	29.36	8:41
S8	29.39	8:41
S7	29.29	8:43
T2C	29.29	8:44
T2B	29.20	8:44
T2A	29.30	8:45
S4	29.38	8:45
S3	29.36	8:46
S2	29.42	8:46
S1	29.45	8:47
TR11-2	30.55	8:47
TR11-3	30.42	8:48
TR11-1	30.56	8:50
TR-10	30.38	8:53
TR9	30.43	8:53

SA

Asarco 10/4/05

Water Levels (cont)

Well	Depth to Gw	TIME
TR12-1	30.65	8:54
TR12-2	30.55	8:55
TR12-3	30.40	8:57
TR8	30.30	8:58
TR7	30.27	8:59
TR5-1	30.50	9:00
TR5-3	30.52	9:00
TR5-2	30.52	9:02
TR6-1	30.56	9:03
TR6-2	30.55	9:03
TR6-~~2~~ 3 SA	30.60	9:04
TR4-1	30.43	9:05
TR4-2	30.16	9:06
TR4-3	30.46	9:08
TR2 SA	~~3~~ 29.28	9:09
TR3	29.29	9:09
TR1	30.43	9:10
EPA01	29.87	9:19
T1C	29.79	9:20
T1B	29.78	9:21
T1A	30.95	9:24 Fuzzy
EPA02	29.18	9:25
EPA04	28.75	9:30
EPA03	28.71	9:31
EPA06	29.16	9:33

SA

Asarco 10/4/05

Marsh Funnel Viscometer

Water from T2A - clear

32 oz measured using Fann beaker

1. Time: 33.16 seconds
2. TIME: 31.75 seconds
3. Time: 31.69 seconds

Water from S3 - grey then brown w/ Fn sand 4.5 gal

1. TIME: 32.44 S
2. TIME: 32.70 S

T2B - clear

1. TIME: 32.70 S

TR10 - gray

1. TIME - 32.01 S

S1 - gray then brown w/ Fn sand 4 gal

1. TIME - 32.01 S
2. TIME - 32.15 S

TR3 gray 3 gal

32.59 SA

SA

Asreo SA 10/4/05

~~T2B~~ TR9 - Grey w/sheen

① TIME: 31.82 s
② TIME: 32.02 s 52.2°F

T2B Grey w/ sheen

① TIME: 31.09 s 52.7°F
TIME: 31.02 s

~~T2A~~

Time 31.57 sec 52.9°F
Time 31.83 sec

~~T~~ S2 - gray + cloudy

① TIME: 32.29 s 54.3°F
② TIME: 31.96 s

TR2 - Black + cloudy

① TIME: 32.19 s 54.9°F
② TIME: 32.38 s

TR8 - brown + cloudy

① TIME: 31.75 s 54.5°F
② TIME 31.71

SA

Asreo 10/4/05

S4 - gray + cloudy

① TIME: 32.26 s 53.6°F
② TIME: 32.53 s

T3A

① TIME: 31.57 s 51.4°F
② TIME: 31.63 s

S6 gray + sheeny + cloudy

① TIME: 31.96 s 53.4°F
② TIME: 31.59 s

S5 gray + cloudy

① TIME: 32.27 s 53.8°F
② TIME: 32.08 s

DI water

① TIME: 31.72 s 51.8°F
② TIME: 32.01 s 51.4°F

Flow probe heater: 49.0V, 1.19A
10/4 - 4:27pm

SA

Asarco 10/4/05

Loveloggers Set to log every 4hr. Start 12:00

Serial #	Well	TIME
✓ 63106	DH-~~60~~30	SA
✓ 63134	DH ~~31~~ 31	SA
✓ 63136	DH35 ~~31~~ 59	SA
✓ 63478	DH46 ~~DH46~~ ~~APS10~~ ~~WE9~~	SA
✓ 63118	DH47	
63099	DH20	

SA

Asarco 10/5/05

Pneumatic Slug Testing

Well ~~S7~~ TR7 SA — File

① Pres = +7.70	SA	~~S7~~ TR7a
② Pres = +4.35	SA	~~S7b~~ TR7b
③ Pres = +7.75	SA	~~S7c~~ TR7c
④ Vac = -5.57	SA	~~S7d~~ TR7d

Well TR4-1 — Channels 2+3 plugged

① Pres = +7.40	TR4-1a
② Pres = +4.44	TR4-1b
③ Pres = +7.76	TR4-1c
④ Vac = -5.50	TR4-1f
⑤ Vac = -2.49	TR4-1g
⑥ Vac = -5.60	TR4-1h

Well TR4-2 — Channels 1+3 plugged

① Pres = +7.40	TR4-2a
② Pres = +4.56	TR4-2b
③ Pres = +7.55	TR4-2c
④ Vac = -3.08	TR4-2e

TR4-3 — Channel 1 plugged

① Pres = +7.60	TR4-3a
② Pres = +4.62	TR4-3b
③ Pres = +7.82	TR4-3c
④ Vac ≈ -3.6	TR4-3f

SA

Asarco 10/6/05

Deploy leveloggers

Well	Depth to gw (ft BTOC)	TIME	Logger Depth
PBTW-1 27982	30.86	9:45	36
PBTW-2 27977	30.60	9:58	35
STW1 32538	30.09	10:16	36
DH-51 27299	28.90 Scr 24-34 BGS	10:26	35
DH-17 62802	27.61	10:57	36
EPA02 28017	29.16	11:09	
EPA02 Baro 36834		11:14	
EPA06 63121	29.10	~~10~~ 11:22	37
EPA06 Baro 27799			
TR-8 62775	30.31	11:35	
HT Flow probe	30.07	12:15	
DH 47	6.89	13:30	
DH 46	5.83	13:38	
DH20	15.08	13:45	
DH 30	16.91	14:00	
DH 31	27.89	14:11	
DH42	24.36	15:25	
(Logger calls it DH59)			
DH36	26.53	15:39	

SA

Asarco 10/6/05

Water levels - No loggers

Well	Depth to gw (ft BTOC)	TIME
DH-50	30.11	10:41
DH-49	30.41	10:48
DH-63	32.34 Scr 24-39 BGS	10:48
EPA03	28.59	15:58
EPA01	29.79	16:02
EPA04	28.66	16:04
EPA07	27.14	16:08
EPA05	26.87	16:09

10/7/05

Download HT probe data.
Heater settings: 48.8 v, 1.18 a
File: HTFinal.DAT

SA

Asarco 6/2/06

Work Plan

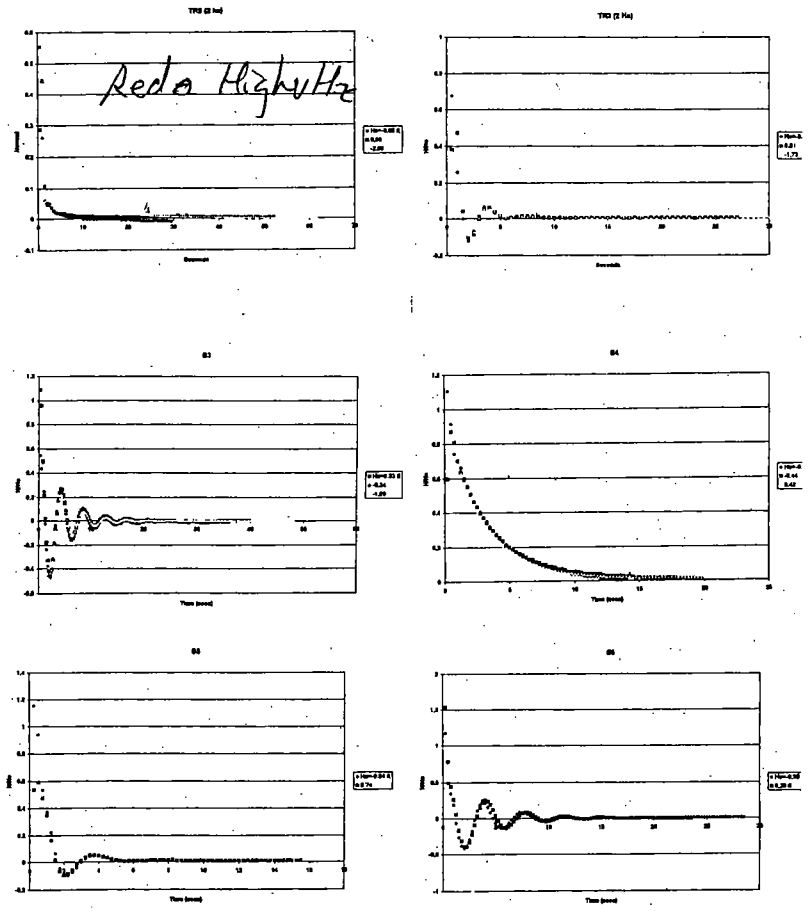
1. Install HF probe through secured piping
2. Water levels - Wed
3. Test HF probe directions - Thurs.
4. Install new leveloggers + micro Ts - Wed
5. Isotope sampling - Wed
6. Pneumatic slug tests

Supplies

8 - D cell batts, shirt, hair, ear buds
3/16" cable for micro Ts + stakes + wts
cable clamps or Rope

S A

Pneumatic slug tests - 10/05 6/2/06



S A

Asarco - East Helena 6/6/06

Water levels

Well	DTW (FT BTOC)	Time	Stickup (Ft)
T3A	31.59	9:10	-0.3
T3B	31.59		-0.25
T3C	31.63		-0.25
S5	31.80	9:17	-0.25
S6	31.86		-0.15
S8	31.88		-0.20
S7	31.78		-0.30
T2C	31.77	9:22	-0.25
T2B	31.66		-0.25
T2A	31.80		-0.20
New US well	32.03	9:25	-0.15
New ds well	32.05		-0.15
S3	31.85		-0.15
S4	31.87		-0.05
S2	31.92		0.00
S1	31.93		+0.05
TR3	31.79	9:31	-0.20
TR2	31.78		-0.15
TR1	32.93		+0.85
TR7	32.76		+0.75
TR8	32.77		+0.75
TR9	32.99		+0.75

SA

Asarco 6/6/06

Well	DTW	Time	Stickup	
TR10	32.92	9:41	+0.78	
T1A	32.32		-0.10	Casing cut @ 5"
T1B	32.22		-0.18	"
T1C	32.32	9:46	-0.15	"
EPA01	32.38		-0.20	
EPA06	31.63		-0.35	
EPA03	31.14	9:52	-0.35	
EPA04	31.19		-0.35	
EPA02	31.63	9:56	-0.35	
EPA07	29.54		-0.35	
EPA05	29.75		-0.35	
DH17	29.58			155 ft W of DH16
PBTW1	33.24	10:11		
PBTW2	33.03			
STW1	32.58	10:16		
DH51	31.25			
DH50	32.43			
STW5	31.37			
STW4	31.49			
STW2	31.75			
STW9	31.53			
STW6	31.62			
STW3	32.19	10:33		

SA

Asarco 6/6/06

Well	DTW	TIME	
STW 8	30.43		No survey mark
STW 7	32.77		
DH 64	37.10	10:40	

Download data loggers + Install new ones

well	TIME	File	Comments	Logger time
TR-8	11:02	TR8.CSV	Black precip on logger	11:25
PBTW2	11:14	PBTW2.CSV		11:25
PBTW1	11:20	PBTW1CSV		11:34
TR-8	Logger depth = 37.25' BTOC			
STW1	11:32	STW1		11:47
DH51	11:40	DH51		11:52
DH17	11:47	DH17		12:03
EPA02	12:00	EPA2		12:16
	EPA2 logger depth = 35.2' BTOC			
EPA02 BARO		EPA02BARO 12:07		12:27
	BARO logger depth = 10.35' BTOC			
	Logger defective SN 36834			

Install Baro logger SN 110572 in EPA02.

~~Asar~~ SA
~~Steve~~ A

Asarco 6/6/06

Cart Stickups

TR12	1.2 H
TR11	1.3
TR4	1.15
TR5	1.25
TR6	1.3

Setup CSI Logger

Port 7

Problem establishing comm:
Removed top of batt case, plugged w/ batts, redid 12V connections
Downloaded old data
(Cannot erase data using 7H, *A 28, *, 0)
CSI returns E09_1 when entering
SA ~~terminal mode~~ ~~to~~ terminal mode after getting * prompt)
Datalogger has problem maintaining connection.
Mylf of thermistors = 0.
Removed SE 9/10 coupler. Red stripe on 10

6/7/06

9:45 am Start probe heater
Voltage = 49.5 Amps = 1.21
watts = 59.9 SA

Asarco 6/7/06

Shut down heater 10:00. All thermistors now logging after setting data collection to 1/hr interval. Reset to 1/min interval and restarted heater @ 10:14.
49.5V 1.21A

6/8/06

Install Iwelloggers Every 4hr start @ 12:00
well DH45, DTW = 8.79' BTOC
Logger @ 15' BTOC SN 53115 @ 10:30a

DH19R - Flush mt in low area
No logger deployed.

DH41 DTW = 16.83' BTOC @ 11:10a
Logger @ 21 Ft BTOC SN 53113

DH47 6.24' BTOC @ 11:30 Logger @ 15'
DH46 5.14 BTOC Logger @ 15'

DH20 14.36' BTOC @ 11:51
Logger depth 24' BTOC

SA

Asarco 6/8/06

Deploy iButtons Dist to shore

- (1) Upper Lake SW side @ Fence
  SN 3E000000 16123A 21 ~20 ft
- (2) SN 1A 000000 162A221 ~20 ft
  Upper Lake @ APSD-9
- (3) SN DA000000 15EFB21 ~10 ft
  Upper Lake south central along concrete embankment (stake @ base of embankment)

(4) SN 1C000000 1620B021
Lower Lake

(5) SN 8A000000 160D0721
Lower Lake - up grad of DH47, shoreline @ western most extent of welded wire Fence

~~Location of #4 iButton~~ 8A
Location of #5 (SN 8A....) 8A
Lower Lake - North shore, 3/4 distance betw Loc #5 and water intake, ~1 Ft north of shoreline upgrad of water Faucet, @ break in Fence

SA

Asaro 6/8/06

Levelogger 14:15

DH 31 23.09' BTOC Logger @ 28'

DH37 27.11' BTOC 14:36

Logger @ 31' BTOC

DH33 30.44' BTOC – No Logger

DH34 26.52' BTOC

Logger @ 30' BTOC.

DH23 11.64' BTOC, 15:20

Logger @ 15'

DH13 29.73' BTOC @ 15:41

Logger @ ~~36' BTOC~~ TD (~38' BTOC)

DH36 28.04' BTOC Logger @ 29' BTOC

Download HT Probe. File = JUN06.DAT

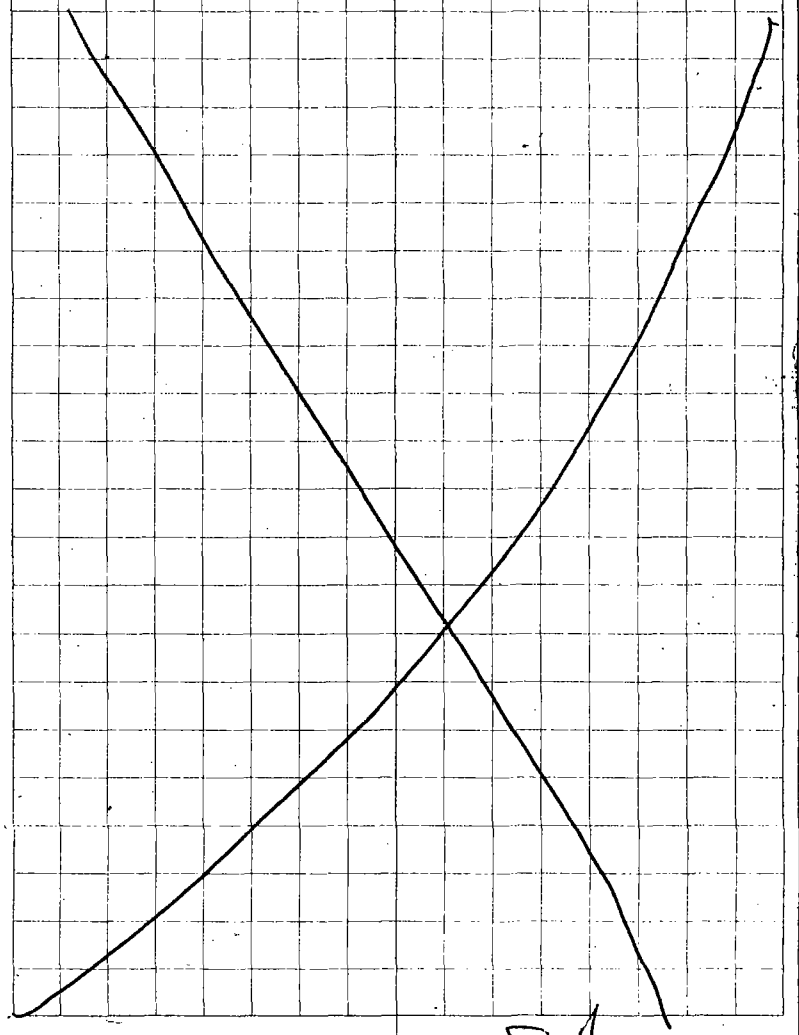
Reset program to 1 hr data collection. Download data again @ 8:03p. Program change successful

Power Supply Settings: 49.2V, 1.19A

Asaro 6/8/06

Download Levelogger @ EPA06

DTW = 31.53 ft BTOC 8:24pm



Asarco 9/18/06

1. Download HT Probe 14:25
Protek 49.1 V, 1.18 A
Datalogger batteries dead. Installed transformer system.

2. Download loggers Reset to start @ 20:00

Well	DTW	Time	Logger Time
PBTW1	30.60	15:58	16:16 MDT
DH17	27.37	16:07	16:31 MDT
PBTW2	30.35	16:19	16:35 MDT several failures
DH51	28.68	16:28	16:41 MDT
DH50	29.70	16:47	No Logger
STW1	Abandoned?		X 2 9 6 E
DH49	30.15	16:55	No logger
DH63	32.08	16:58	"
STW2	29.01	17:03	No logger
EPA05	26.70	17:26	"
Asarco Well SE of EPA05	28.33	17:28	" meas on N. side of casing
EPA07	26.96	17:30	"
EPA04	28.47	17:32	

SA

Asarco 9/18/06 39

Well	DTW	Time	Logger Time
EPA03	28.41	17:35	No Logger
EPA01	29.61	17:36	"
EPA06	28.87	17:38	18:09
EPA02	28.92	17:48	18:10
T2C	29.08	17:56	No Logger

9/19/06

Well	DTW	Time	
PRB-UG	29.31	8:46	(EPA08)
PRB-DG	29.26	8:48	(EPA09)
✓ T2A	29.08	8:51	
~~T2B~~			
T2C	29.07	8:52	
✓ T3B	28.92	8:53	
T3A	28.90	8:54	
TR8	30.04	11:55	

Flowmeter PRB-UG EPA08
Ambient Flow
0.5" Probe # 01985001 2, MF = 235
TC = 1.0
Readings unstable. Switched to 1" probe
1.0" Probe # 0198 1000 1, MF = 239
TC = 1.0
Zero = 0 CAL = 4.0

SA

Asarco 9/19/06

Top of probe hit screen joint @ 30 ft measurement.

Set up induced flow test.
Pump intake @ ~31.5 BTOC
XD @ 30.5 ft BTOC.
Using MegaTyphoon w/ Booster I - Cur Running

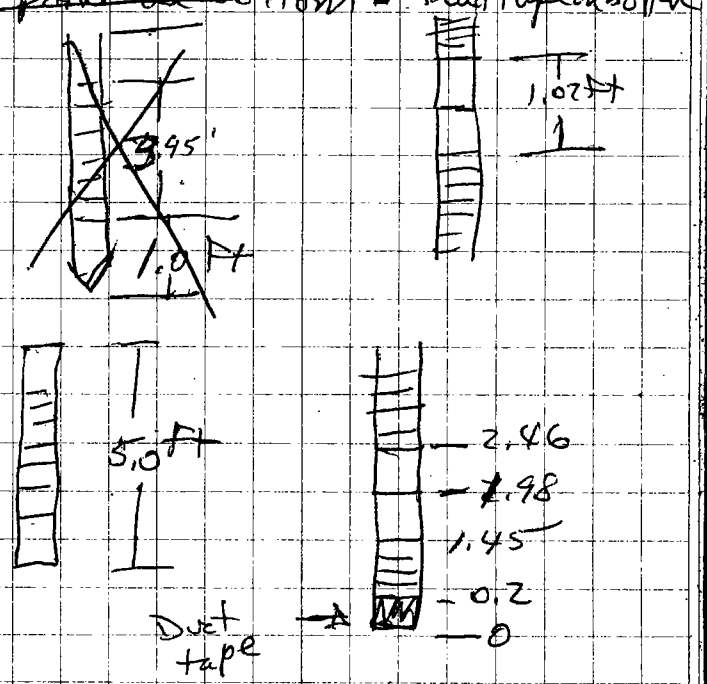
Time	Vol Pumped	ET SA	Rate SA
14:28	1985 ml	~~20.17~~ s	~~4.732~~ lpm
		17.25	6.904
14:35	2040 ml	17.99	6.804
14:45	1915	17.32	6.634
14:55	1920	17.28	6.667
15:35	1940	17.43	6.678
16:05	1930	17.59	6.583
16:23	1920	17.35	6.640
16:27	2030	18.41	6.46

Pump off ~16:30

SA

Asarco 9/20/06

Flowmeter Survey 1.5" probe - DG well EPA 89
Depth to gw = 29.31 ft @ 9:30
Ambient profile 9:45 - 11:30.
Geoprobe arrives.
Install well in Lab. EPA 10
2" Sch 40 PVC
SA ~~point on bottom~~ Duct tape on bottom



Well TD = 47' BGS
Screen = 30' - 47' BGS

SA

Asarco 9/20/06

Start induced flow test @ 14:07.

Pumping rate

Time	Vol(ml)	ET(s)	Rate (lpm)
14:08	1895	15.81	7.192
14:18	1905	17.43	6.558
14:24	1910	17.36	6.601
14:38	1935	18.00	6.450
15:10	1940	18.38	6.333
15:35	1910	17.68	6.482
15:42	1960	18.39	6.395

Stopped pump ~15:50.

Purged T3C (NE of HT Probe) @ 16:20.

Q = 1920 ml / 19.05 s = 6.0 lpm

Reset Q @ 16:22 = 1730 ml / 24.62 s = 4.2 lpm

SA

Asarco 9/21/06

Download loggers

Well	DTW	Time
~~STW1~~		
STW1	29.93	9:21

Download i Buttons

- i Button location ① changed to 10 ft from shore
- i Button loc ② found out of water. Relocated ~12 ft south + 5' from shore

Deployed new i Button 11000000160221

- located South end of Upper Lake attached to north gate post along dam - 3 ft from shore

Note: Upper Lake is discharging to Prickly Pear? through pipes

Locations in Lower Lake not Found.

Redeploy @ ~~water intake~~ SN# F000000157D8121 adj. to well DH5A, attached to base of T post @ shoreline. No EPA stake. Used SS wire. ~5 ft from shore

SA

Asarco 9/21/06

Button Location

- Tied to Northern L beam @ intake on ~~west~~ east side of lake w/SS wire. No EPA stake.

Button # 24000000161E5121

Download Loggers

	Well	DTW	Time	
	DH47	6.70	12:00	
Baro	EPA02		15:18	
	DH46	5.64	15:34	
	DH45	9.33	15:40	Changed logger to SN 74342
	DH20	14.98	15:50	
	DH23	11.75	16:07	
	DH31	22.42	16:20	
	DH37	25.45	16:26	
	DH36	26.50	16:39	
BARO	EPA06		17:00	

Download HT Robo 17:20.

Protek settings 49.3V 1.19A

S A

Flowmeter Calibration 10/2/06

Equipment: 1" probe, new electronics, 75' cable A/D converter, probe #01981001 1

Meter settings: MF = 239, TC = 10

Meter on: 9:55

Number	Time	FM Reading	Flow Vol (ml)	ET (s)	Rate (lpm)
0	10:20	+0.001			0
0	10:22	+0.001			0
1		+0.014	75.0	60.15	0.0794
1		+0.015	75.0	60.75	0.0741
2	10:37	+0.012	65.0	60.49	0.0645
3	10:40	+0.037	97.0	29.36	.1982
4	10:42	+0.083	242.0	32.25	.4502
5	10:51	+0.155	853.0	61.00	.8440
6	10:54	+0.339	980	32.28	1.822
7	10:58	+0.581	959	18.53	3.165
8	11:04	+0.758	3.875	57.36	4.053
8	11:05	+0.706	3.490	67.10	3.372
SA ~~8~~ 9	11:10	+0.796	3.525	49.85	4.243
10	11:12	+1.412	3.710	27.08	10.852
11	11:16	+1.907	3.875	23.10	10.065
12	11:19	+1.190	3.875	37.02	6.280
13	11:26	+0.909	3.850	48.31	4.782
14	11:29	+1.338	3.915	33.26	7.063
14	11:31	+1.340	3.845	32.45	7.109
0	11:35	+0.001			0
0	11:37	+0.001			0

S A

Asarco
Flowmeter Calibration 10/2/06

1006cal.txt

ELECTROMAGNETIC BOREHOLE FLOWMETER SURVEY

File Name = 1006cal
Well Number = 2
Time = Mon Oct 02 10:19:00 2006

Flowmeter Zero = +0.000
Flowmeter Cal = +4.000

Samples for Avg = 60

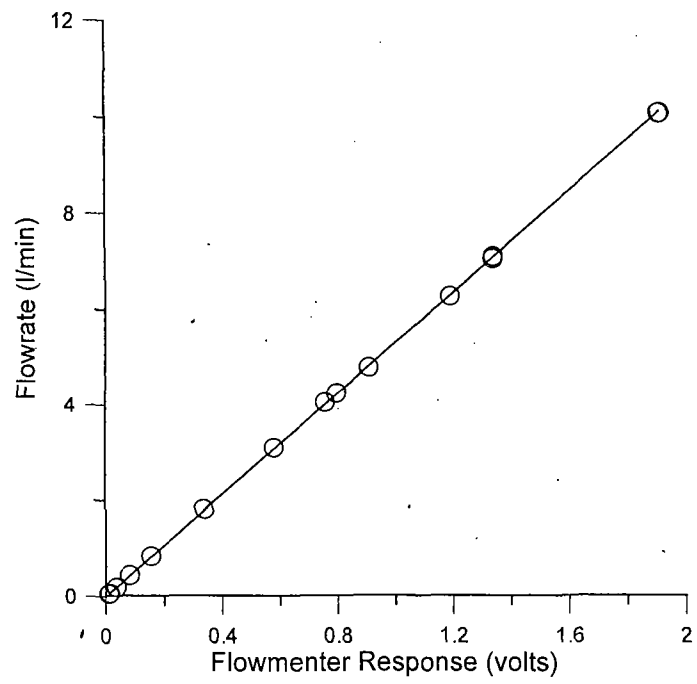
Measuring Units:
Flow = LPM
Scale = Feet

File Heading Not Available

Time	Depth	Volts	Flow	STD
10:19	+0.000	+0.002	+0.008	00.008
10:20	+0.000	+0.001	+0.003	00.004
10:25	+1.000	+0.014	+0.057	00.007
10:27	+1.000	+0.015	+0.058	00.007
10:35	+2.000	+0.012	+0.049	00.007
10:39	+3.000	+0.037	+0.148	00.007
10:41	+4.000	+0.083	+0.330	00.007
10:50	+5.000	+0.155	+0.622	00.007
10:53	+6.000	+0.339	+1.357	00.010
10:56	+7.000	+0.581	+2.323	00.013
11:02	+8.000	+0.758	+3.031	00.014
11:04	+8.000	+0.706	+2.822	00.325
11:08	+9.000	+0.796	+3.186	00.029
11:12	+10.000	+1.912	+7.648	00.078
11:15	+11.000	+1.907	+7.629	00.083
11:18	+12.000	+1.190	+4.760	00.034
11:24	+13.000	+0.909	+3.636	00.041
11:28	+14.000	+1.338	+5.354	00.067
11:30	+14.000	+1.340	+5.360	00.026
11:34	+0.000	+0.001	+0.004	00.005
11:36	+0.000	+0.001	+0.003	00.004

Flowmeter Readings

Asarco
Flowmeter Calibration 10/2/06



Fit 1: Through origin
Equation Y = 5.289167617 * X
Number of data points used = 16
Average X = 0.710938
Average Y = 3.76915
Residual sum of squares = 0.00932377
Coef of determination, R-squared = 0.999977
Residual mean square, sigma-hat-sq'd = 0.000621585

~~11/16/~~ SA Asarco 11/16/06

Leveloggers in STW1 and PBTW2 are periodically failing, Need to replace.

Need to add logger to new Asarco well west of PRB.

SA

Asarco 1/22/07

Arrive on site 2:00 pm
Download HT Probe
Protek: 49.2V, 1.19 amp
PC TIME: 1/22/07 14:37 MST
Logger Time: 1/22/07 15:39 MDT
Logger left on MDT.

Setup Leveloggers
Time synch for MST.
Well TR10 = SN 64186
TR9 = SN 32564
TR8 = SN 71790
TR7 = SN 410 15572 Gold

Note: Order new mega Typhoon pump

SA

Ascreo 1/23/07

Set up temperature tracer test
Start inj of ~35 gal hot water into TR1 w/ Mega Typhoon pump intake @ 33' BTOC (TD ~34' BTOC) and discharge ~10 ft BTOC
Injected using Typhoon pump. Start ~11:29
Injection finished @ 11:37 MST.
Circulation stopped @ 11:41 MST.
Note: CR 23 x clock is 59 min ahead of my watch.

S A

Ascreo 1/24/07

Water Levels @ PRB

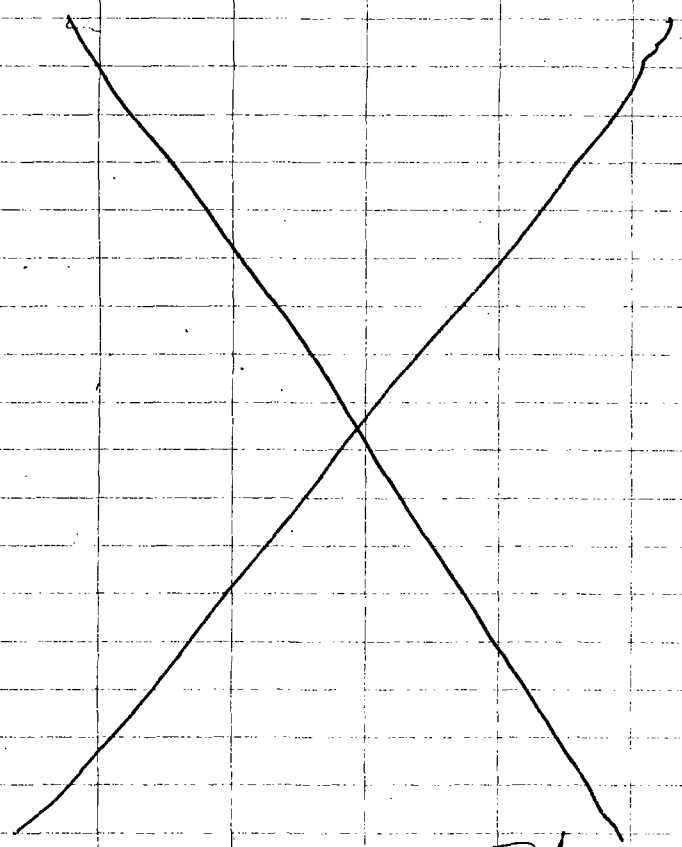
Well	DTW (ft BTOC)	Time
T1B	32.32	15:42
EPA01	32.43	
TR1	33.03	
EPA08	32.09	
T2A	31.87	
T2B	31.75	
T2C	31.81	
EPA10	33.11	
EPA09	32.14	
T3B	31.68	
EPA02	31.73	
DH 17	30.11	
BOBEAST	31.01	
EPA05	29.41	
EPA07	29.69	
PBTW1	33.43	
EPA04	31.26	
EPA03	31.23	
EPA06	31.73	16:02
PBTW2	33.15	
DH 51	31.42	
STW-1	32.70	

S A

Asarco 1/24/07

DH50	32.60	16:16
DH49	33.43	
DH36	28.83	16:25

Water levels (cont)



SAm

Asarco 1/25/07

Levellogger in PBTW2 currently set @ 35.25' BTOC (32.75' BGS)

Well screen = 32.0'-54.0' BGS

Set additional Levellogers @ 43' BGS (~~45.5'~~ 45 BTOC) and @ 53 ft BGS (~~55.5~~ 55 ft BTOC)

SN 71790 (F65) set @ 55 ft

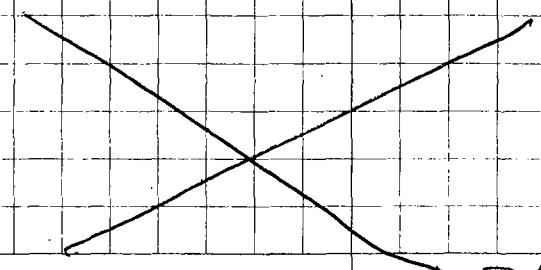
SN 32564 (F15) set @ 45 ft

SN 27977 (F15) set @ 35.25 ft BTOC

Loggers in @ 15:44.

Depth to gw

well	DTG (ft BTOC)	TIME
S1	32.01	16:50
S2	32.02	
S3	31.92	
S4	31.94	
TR8	32.83	16:55



SAm

Asarco - East Helena 7/12/07

Work Plan

Mon – Pick up equip, Home Depot, build sampler, download iButtons & loggers
Tues – FM EPA10
Wed – FM amb EPA8, EPA9, EPA6, others , slug EPA 10, 8, 9
Thurs – Download HT probe, download loggers & iButtons
Fri – Ship equip

Jon Nichol:
Get loggers removed from abandoned wells (DH-41, 45, 46)
Get WL data for DH-17, 36, 49, 50, 51, STW1 (1/02-present)

HD list:
50 ft 0.75" PVC
PVC cement
End cap
Slip/slip
Slip/male (20)
Galvanized female/female (10)
Teflon tape
water - 2gal

Fed Ex

790289872432

791341250333

791341253207

792519869842

798716309013

SA

Asarco 7/17/07

Flowmeter EPA10
Depth to gw = 30.73' BTOC
Stickup: 1.08' AGS
Meter on: 7:30a
Bottom of probe @ 31.2' BTOC
SA ~~Note: 1R7~~

Ambient Flow profile; Time Cost = 10

Depth (ft BTOC)	Notes	SD		Meter Factor: 239
SA ~~32.1~~ 31.2				Probe = 1" ID
SA ~~32.1~~ 31.2		0.000	+0.001	Probe SN:
~~47.75~~ → (Sqft)				01981001
47				
46				
45		-0.010		
44		-0.018	+0.022	
43		-0.036	+0.017	Unstable
42		-0.001	0.005	
42	Repeat	-0.001	0.013	
41		-0.000	0.003	
40		+0.002	0.006	
39		+0.003	0.006	
38		+0.003	0.004	
37		+0.002	0.004	
36		+0.002	0.006	

SA

Asarco 7/17/07

Depth (ft BTOC)	Volts	SD
35	+0.002	0.004
34	+0.002	0.004
33	+0.001	0.003
32	+0.001	0.004
31.2	0.000	0.001
31.2	0.000	0.001
42	0.000	0.008
46	+0.001	0.03)

Depth to gw in T2A = 29.44' BTOC @ 11:38a

Install Level Troll SN 112705 11.5 psi in T2A.

Distance from T2A → EPA10 = 1.95'.

Install pump intake (Typhoon pump) @ 32.75

Setup data logger in T2A for 1s interval. File = T2A 0615

Start data logger.

SA

Asarco SA 7/17/07

START Pump @ ~~1:28p~~ 1:38:00 (laptop clock)

Data logger sych to same clock.

Pumping Rate

TIME (computer clock)	Vol (l)	ET (s)	Q l/min
13:36	1.990	20.80	5.740
13:45	1.940	21.46	5.424
14:01	1.980	22.58	5.261
14:12	1.920	20.72	5.697
14:23	1.970	21.48	5.503
14:32	1.970	21.81	5.420
14:43	2.040	22.37	5.472
		Ave:	5.502

Pump off

No check valve used. ∴ Recovery data skewed.

SA

Asarco 7/17/07

SA Flowmeter - Induced Flow profile

~~Time~~	Depth	Volts	SD	TIME
SA	~~47~~	~~0.000~~	~~0.000~~	~~13:42~~
Logger not connected	~~46~~			
	47 +	0.029	0.018	13:55
	46	0.063	0.005	13:59
	45	0.205	0.008	14:02
	44	0.379	0.023	14:06
	44	0.385	0.016	14:08
	43	0.554	0.014	14:10
	42	0.714	0.010	14:14
	41	0.749	0.010	14:17
	40	0.814	0.050	14:20
	40	0.814	0.023	14:21
	39	0.854	0.032	14:25
	38	0.906	0.058	14:28 Too Noisey
	38	0.884	0.022	14:29
	37	0.911	0.064	14:35
	37	0.914	0.086	14:37
	36	0.919	0.045	14:40
	35	0.941	0.142	Pump bumped up 1 ft
	46	0.075	0.013	
	Stopped test			
	31.2	-0.000	0.006	15:21
	31.2	-0.000	0.005	15:22

SA

Asarco 7/18/07

Depth to gw (Historic)

Well	DTW	TIME	Logger	Logger Time vs Clock
DH-36	26.91	8:08	63130	+26 min
DH-31	23.12	9:10	63134	+22 min
DH23	11.82	9:22	53117	+25 min
DH37	26.70	9:40	No Logger	
DH38	20.65	9:43	No Logger	
DH30	17.75	9:50	63106	+45 min
DH32	31.64	10:03	No Logger	
DH34	26.00	10:00	74337	+11 min
DH33	29.70		No Logger	
DH45	Logger removed by Asarco.		74342	+29 min
DH41	"		53113	+16 min
DH46	"		71245	+11 min
DH37	"		42630	+24 min
DH8	39.00		No Logger	
DH47	6.80	12:57	63118	+20 min
DH20	14.96	13:10	63099	+24 min
DH42	~~Under geotextile~~ SA. New Stickup.			
	No Logger.			
	30.15	15:01		
DH13	28.38	15:18	53124	+41 min
PBTW2	30.64	~~15:42~~ 16:09 SA		

SA Shallow Middle Deep

Logger failed. 27977 +12 min
MST 32564 +9 min
MST 71790 +5 min

Agoreo 7/18/07

Download iButtons

Upper Lake

Loc 3. String cut. Device lost.

Loc 2. Device ~ 1 Ft from shore.
SN AA0000001622A221
Redeploy, starting @ 4 pm.
Device clock was 5 min fast wrt laptop.
Stake ~~north~~ south of well near cat tails.

Loc 4. Device ~ 2 Ft from shore
SN 1100000016060221
Device clock 2 min fast wrt PC.
Redeploy @ 4:00 p.
Device attached to north gate post @ dam (~~east~~ east side of lake)

Loc 1. At new power pole McFarland-Cascade 7-2005. Stake @ base of concrete. Fence good. Device ~ 5 ft from shore.
SN D7000000 15ED FB21
Device clock 5 min fast wrt PC.

SA

Agoreo 7/18/07

Lower Lake

Loc A. Northern T post @ well DH5A.
~ 5 Ft from shore.
SN FD000000 15F0B121
Device clock 3 min fast wrt PC.

Loc B: North side of intake tagged under rocks.

Redeploy levelogger s:
PBTW2 MID (SN ~~32564~~ 53037) SA
PBTW2 SHALLOW (SN 53113)

Well	DTW (FT BTOC)	Time	Logger	Logger Time vs PC
DH51	28.90	16:17	27299	+15
DH50	29.83	16:20	No Logger	
STW1	30.08	16:30	32558	Logger Dead
Deploy SN 32564 @ STW1				
PBTW1	31.02	16:45	27982	+16
Line kinked ~ 6". Unkinked dur. re-reset.				
DH63	31.67	16:49	No Logger	
DH49	30.07	17:34	No Logger	
TR8	Logger removed by R. Ross		62775	+19
(R. Ross)	30.66	10:50	@ 7/13/07	

SA

Ascreo 7/19/07

Waterlevels

Well	DTW (Ft BTOC)	Time
T3A	29.25	7:18a
T3B	29.23	
T3C	29.27	
S5	29.43	
S6	29.50	
S7	29.42	
S8	29.51	
T2C	29.41	
EPA08	29.67	
EPA09	29.67	
EPA10	30.66	
T2A	29.82	
T2B	29.29	
S1	29.57	
S2	29.55	
S3	29.49	
S4	29.53	
TR1	30.58	
TR2	29.39	
TR3	29.41	
TR8	30.41	
TR7	30.40	7:44

SA

Ascreo 7/19/07

Well	DTW	Time	Well	DTW	Time
TR9	30.58		EPA03	28.76	8:48
TR10	30.53		EPA04	28.83	#
T1A	30.55		EPA05	29.31	16:40
T1B	29.92		EPA06	29.20	10:47
T1C	29.94		EPA07	27.27	16:36
EPA01	29.99		~~EPA~~ HT Probe Too Heavy		
EPA02	29.29	8:15			

Well EPA08 – Ambient Flowmeter Profile

Meter on: 7:55, MF = 239 TC = 10

Probe = 1.0 " S/N 0198100 11

Depth (Ft BTOC)	Volts	SD
30.0 - Zero	+0.007	0.008
31	0.000	0.002
32	+0.001	0.004
33	0.000	0.005
34	0.002	0.006
36	0.006	0.005
38	0.010	0.005
38	0.008	0.005
40	0.013	0.007
42	0.049	0.007
41	0.021	0.003
39	0.009	0.006

SA

Ascreo 7/19/07

EPA09 Ambient Flowmeter profile (cont)

Depth (ft btoc)	volts	SD	
43	0.092	0.012	
44	0.098	0.007	
45	0.100	0.008	
46	0.085	0.006	
46	0.085	0.006	
47	0.041	0.012	
47.5 - TD	-0.004	0.006	Power lost.
43	+0.029	0.024	Sonicable.
33	0.000	0.026	File epa09am2
30	-0.037	0.069	
30	-0.054	0.009	
33	-0.001	0.006	
43	+0.081	0.020	
30	-0.003	0.004	
30	-0.003	0.004	

Ascreo 7/19/07

Download Level loggers

Well EPA02 DTW 29.29 @ 8:15

EPA02 Baro Logger clock 2 min fast

SN 1015724

EPA02 SN 28017 Logger = RH 17 min

Logger dead.

Replaced by SN 71245.

Well EPA06

DTW = 29.20' btoc @ 10:47

EPA06 Baro SN 27799 +23 min

EPA06 SN 63121 +22 min

well HT SN 63139 +5 1/min

Depth to gw 16:25

PRB1 34.08' btoc (westwell)

PBTW2 30.62

PBTW1 30.98

PRB2 28.62 (eastwell)

DH17 27.76 16:54

Download DH17 logger SN 62802

DTW @ 1654 = 27.76' btoc clock +17 min

7/19/07

A Sacco 7/19/07.

Well EPA06 Amb Flowmeter Profile

1" Probe 01981001 1 MF = 239, TC = 10

Depth (ft BTOC)	volts	SD
30 – Zero	-0.005	0.004
30	-0.005	0.005
32	+0.001	0.006
34	+0.004	0.008
36	+0.005	0.003
38	+0.006	0.004
40	+0.007	0.005
42	+0.006	0.004
SA ~~42~~ 44	+0.002	0.010
44	+0.003	0.006
44	+0.003	0.006
46	-0.003	0.012
48	-0.004	0.010
50 – TD (80ft)	No measurement made.	
40	+0.003	0.004
30	-0.003	0.005

~~Acree~~ SA A Sacco 7/19/07

Pneumatic slug tests

well EPA10

Test 1: epa10-1 vacuum
Shut in pressure: -6.50 in HOH
Laptop locked up.

Test: EPA103 vac shut in pres: -3.68 in HOH
Laptop locked up.

Test: EPA104 vac shut in pres: -5.99 in HOH
~~Zero @ 2 ft HOH~~ SA
XD @ 1 ft below WL.
Laptop locked up.

Test: EPA105 vac shut in pres: -5.93 in HOH
Shut in press prior to loading program. Zero set @ shut in.

Test: EPA106 vac shut in pres: -7.75 in HOH
Zeroed after shut in.
Test not saved.

Test EPA107 vac shut in pres: -8.50 in HOH
Zeroed after shut in.
Laptop locked.

Asarco 7/19/07

Test EPA108 vac shut in : -8.50 in HOH
Test EPA109 vac shut in : -3.00 in HOH
Lockedup (No device)
Test EPA1010 vac shut in : -2.99 in HOH
No device.
Test EPA1011 vac shut in : -2.98 in HOH
Test EPA1012 vac shut in : -5.76 in HOH
No device.
Test EPA1013 vac shut in : -5.72 in HOH

Pressure test : EPA1014 shut in : +888 in HOH
No device.

EPA1015 : +8.88 in HOH
EPA1016 : +2.90 in HOH
EPA1017 : +5.15 in HOH
EPA1018 : +8.85 in HOH

Well TR11 Well leaks. Pump kept running.

Test	~~Shut in~~ pres (+) or vac (-)
TR11	+ 4.80 in HOH
TR12	+ 6.80
TR13	+ 2.43
TR14	- 2.82
TR15	- 5.95

SA

Asarco 7/19/07

Well TR1 (cont)

Test	Pres (+) or Vac (-)	
TR16	- 8.82	
TR17	+ 8.60	No Device
TR18	+ 8.07	
TR19	+ 4.63	

XD ~2 ft below WL.

Download HT Probe
Voltage : 49.3 Current : 1.18 Amp
PC Time : 17:12:24 Logger : 17:12:18
File : Jul07.dat (Area 1)
Jul07-2.dat (Area 2)

SA

Asarco 7/19/07

Trailer Inventory of Hydro Equip

sm. vice grips
Mega Typhoon + Booster I
Typhoon
4 hose clamps, (2) 0.5" hose fittings
peristaltic tubing for pump connections
5 iButtons + Cases
treble hooks + wts (No line)
teflon tape
PVC cement
hand cream, deodorant, shaving gel
tarp
~6 cable ties (9")
sm roll duct tape
R^3 gloves
½ gal water Thermos
3 socket GFI
rope

SA

Asarco 7/20/07

Downloaded HT probe. Several channels not giving good data. File: JUL152.Dat. Shut down heater probe @ 9:30a. Restarted probe @ 9:35a.
voltage: 49.2 V
Current: 1.18 amp

SA

Asarco - East Helena 9/28/07

Work Plan

Mon - Buy CPVC pipe + cement, 30 gal container, 20 gal water, Baggies

Meas WL, Make packers, install pumps, sample, label bottles, mix tracer + sample, install pump in TR1

Tues Start tracer, sample @ T0 + every 4 hr

Wed Sample, Levelloggers, TD TR1, stickups

Thurs FM, Survey, HT probe, +

Jon - X, Y, Z of new wells

Buy - screws + 1" → 1.25" bushing

790347506040

790839106272

791399273156

791399279761

792428178758

792571369534

798274417756

798274419472

799195284120

799195285366

Fed Ex

799724839286

790838088869

799724017669

Asarco 10/1/07

Measure DTW

well	DTW (ft BTOC)	MDT TIME	(ft AGS) Stickup	(ft BTOC) TD
EPA05	28.13	10:52	-0.35	49.2
EPA07	28.41	10:54	-0.40	46.4
EPA04	29.94	10:57	-0.40	47.1
EPA03	29.88	11:05	-0.40	48.2
EPA06	30.34	11:09	-0.45	50.1
EPA02	30.38	11:11	-0.40	48.3
EPA08	30.76	11:15	-0.20	47.6
EPA09	30.78	11:18	-0.20	47.25
EPA10	31.76	11:20	+1.05	47.6
EPA01	31.10	11:23	-0.30	45.7
PBTW1	32.12	11:32		
PBTW2	31.79	11:36		
Bob E (PRB-2)	29.76	11:38	+2.0	56.1
DH17	28.86	11:44		
TR8	31.52	13:44		

Asarco 10/1/07

Mix tracer solution

KBr (certified ACS): 25.37g
Mix in 3 l water (distilled)
Total solution: 20 gal distilled H2O
Mix solution in 120 l icechest
using mega-Typhoon pump.
Start mixing @ 1:40 p.m.

Download levelogger @ TR8 1:50 pm.
SN ~~57987~~ 62725 SA Logger time 14:17
Computer time 13:52
Stop logger and put in tracer tank.
Log temperature @ ~~40~~ 30 min interval.
Move pump to different position
every 30 min.

Sample wells. 15:48 start
Well TR11-1 doesn't yield sufficient
water.

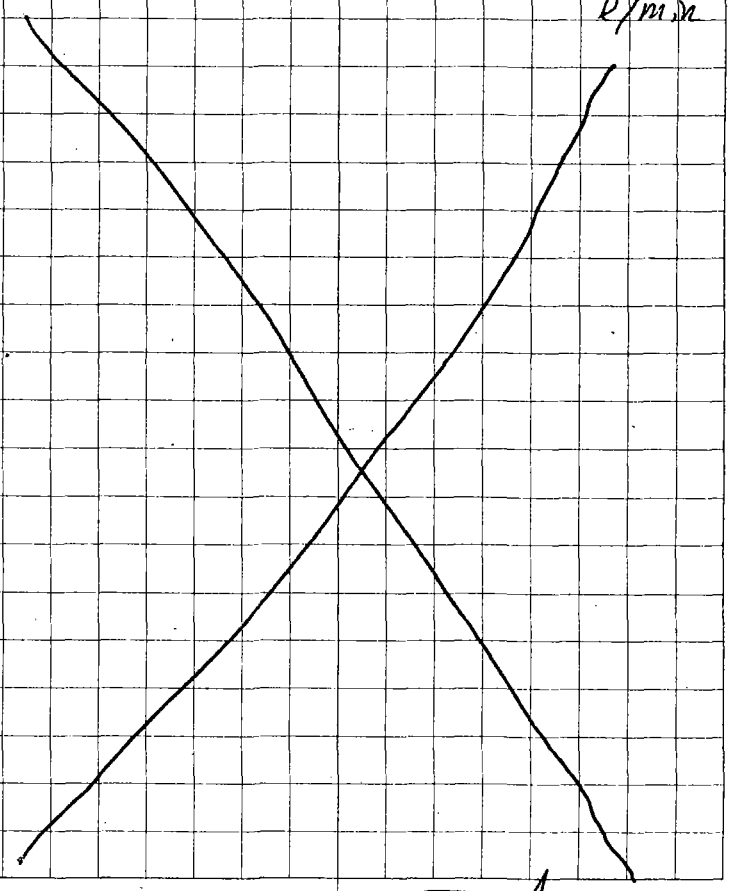
Well TR1 TD = 43.55 ft BTOC
Stickup = 0.87 ft AGS

SA

Asarco 10/1/07

Sample TR1. Purge 3 well
volumes: 5.6 gallons using Mega
Typhoon set @ 37' BTOC.

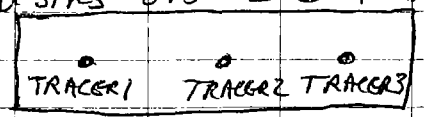
Flowrate: 1915 ml / 31.21 s = 3.68
l/min



SA

Asarco 10/2/07

Sample tracer tank (120 quart ice chest)
Divide into 1/3 s. Obtain one sample from ~~mid point (horiz + vert)~~ vertical profile in each 1/3. Vertical profile obtained using 0.5" ID tube. Similar to Calawassi tube.



Start recirculation pump set @ 42 Ft BTOC @ 8:10.

Start tracer injection @ 8:15.
Injection finished 8:20. Volume ≈ 20 gal
Stop recirculation 8:20.
Start sampling Round 1 @ 8:20.
Finished sampling Round 1 @ 10:20.
Purged each 1" well 950 ml.
Purged each CMT well by pulling tube, draining water to waste, and purging 150 ml.
Sample Round 2 Start 12:00.
Sample Round 3 Start 14:30.

SA

Asarco 10/3/07

Sample Round 4. Start 7:00.
Survey: DH17, EPA08, EPA10, EPA09, EPA01, EPA02

Survey name: 10-3-2007
First point defaults: START, 1000X, 1000Y, 1000E
Backsight on RR sign center.
BS Azimuth (arbitrary): 123.5810

Pts
1. DH17
2. EPA08
3. EPA10
4. EPA09
5. S4
6. EPA02
7. ~~DH17~~ EPA05 SA
8. DH18 (Reshot of DH17)

Sample EPA08 for bi.
Purge 3 well vols (8 gal) using Mega Typhoon set @ 40 Ft BTOC.

SA

Asarco 8/27/08

Preparation For Fieldwork:

Calibrate Solinst LTC loggers using LTC Levelogger user's guide.

1. Loggers recording at 1 min interval for 24 hr prior to calibration in tg1404.
2. Calibrate using Levelogger software in 5000 µS/cm reference soln. Lot G169, exp 10/2009, New bottle.
   Temperature read by logger 23.57 °C
   Temperature read by Precision Thermometer = 24.10 °C.
   Logger SN 60141.

Calibrate SN 60277 using levelogger software in 5000 µS/cm reference solution.
Temperature read by logger = 23.84 °C.

Calibrate Solinst TLC meter using instruction manual + 1413 µS/cm + 80,000 µS/cm solutions.
Readings: 1431 µS/cm + 80.0 mS/cm, respectively.

SA

Asarco 3/27/08

Check Calibration AquaTroll 200 conductivity sensor using manufacturer's instructions and 5000 µS/cm solution. Reading: 4840 µS/cm.

Work Plan:

Mon: - start hot water tracer test using CSI thermocouples and data logger #CR23X
- Measure water levels prior to test
- Instrument LTC loggers (3)
- Instrument iButtons (10)

Tues: Geol photos - RR tracks
Wed: Remove Upper + Lower Lake iButtons
Thurs a.m: Remove Loggers from u.g. wells

Thurs pm: Ship equip. Travel to Bozeman.

Destination	Tracking number
3171 Bozeman Ave Helena MT 59601 US	790479804503
701 N WASHINGTON ST HELENA MT 596013259 US	790971235873
3171 Bozeman Ave Helena MT 59601 US	791031913740
701 N WASHINGTON ST HELENA MT 596013259 US	792029923450
701 N WASHINGTON ST HELENA MT 596013259 US	792672973392
3171 Bozeman Ave Helena MT 59601 US	799297673200

SA

Asarco 3/30/08

Arrive on site 3:15 p.m. MDT
Set up CSI logger and monitoring network.

TR-8 Depth tape @ 3:46p = 35.75'
Download logger. PC clock 16:00.
Logger clock 16:08.
EC = 874 uS/cm T = 13.6°C
using Solinst LTC meter.

iButton placed 6" from bottom @ TR3	8DG86 SN
TR8	8DCC8
EPA08	8E145
~~TR7~~	8DCB7
TR10	8DF5A

3/31

iButtons on injection pipe:	iButton SN
loc 0.5' below bottom packer ring	8G405
mid injection zone	89ED3
0.5 ft above top packer	8DE98

SA

Asarco 3/31/08

loc	iButton
0.5' above packer	8A1FB

Screen interval = 3' section of 3/4" PVC drilled w/ 1/4" holes every 3".

Top of screen = 37' BLS (38' BTOC)
Bottom of screen = 40' BLS (41' BTOC)
Injection well = TR1

Button 8A13D in TR2. Set @ 34 ft BLS

Insulated logger box using foam sealant ~~and~~ ensolite and radiant barrier bubble wrap.

Water injection - 25 gal tap water-hot
Start: 17:01
End: 17:07
Injected using mega Typhoon

SA

Asarco 4/1/08

Water Levels

Well	DTW	TIME	Time	SC µS/cm	Temp °C
EPA08	35.02	PBTW1 9:24	10:52	~~1181~~ 1168	~~12.7~~ 13.7
EPA10	36.02	9:26	10:51	911	14.2
EPA09	35.05	9:27	10:48	1206	12.9
EPA02	34.625	9:32	11:27	1362	12.6
EPA01	35.37	9:54	10:54	1048	12.9
EPA06	34.62	9:56	11:54	~~1444~~ 1267	12.2
EPA03	34.14		10:56	1608	12.7
EPA04	34.18		10:46	1559	13.0
EPA07	32.56	10:02	10:43	1262	13.0
EPA05	32.28		10:41	1181	12.7
PBTW1	36.29		10:59	1776	13.1
DH17	32.98	10:07	11:16	1601	12.7
PBTW2	36.05	10:10	12:08	1388	12.9
STW1	35.57		12:13	1247	12.7
DH51	34.25	10:15	12:19	13~~30~~ 43	11.4
DH50	35.41	10:17			
DH49	36.07	10:20			
DH63	38.46	10:23			
DH48	DRY	10:24	35.63 - 2.5		
PRB2 (East)	33.89	10:35		1169	11.6 33.91
DH36	31.62	12:34		1159	11.2
PRB1	39.52	12:50		1065	11.2
PRB3	41.79	12:52	TD 251	1075	11.9
DH66	42.90	12:58		2727	11.49

Asarco 4/1/08

Leveloggers Downloaded

PBTW1 11:05 (11:32 logger time)
SN 27982
DH17 11:10 SN 62802 (11:40 logger time)
EPA02 11:~~19~~ 23 SN 71245 (11:32 logger time)
Baro 11:14 SN 615724 (11:23 logger time)
EPA06 11:51 SN 63121 (12:30 logger time)
Baro 11:46 SN 27799 (12:26 logger time)
Restarted baro logger. (MDT)
PBTW2 Shallow SN 53113 12:00 (12:11 logger)
Middle 53037 12:02 (12:10 logger)
Deep 71790 12:05 (12:13 logger)
STW1 32564 12:14 (12:43 logger)
DH51 27299 12:23 (12:49 logger)
DH36 63160 12:33 (13:22 logger)
Restarted logger (MDT)

Ascarco 4/2/08

Download HT Probe

Power Supply settings: 48.8V, 1.18 A

PC Clock 4/2/08 11:40

Logger Clock 4/2/08 11:42

Pushed out logging program for 1 min interval, which worked on all channels.

Pushed out program for 60 min interval.

Cleared data memory.

SA

Ascarco 4/2/08

Trailer Inventory

Pumps: Typhoon, mega Typhoon (No controller)

Solinst MVP bubble controller

Compressor

Morrison well caps ~10

Solinst SS line ~300 ft

Pipe cutters

Channel locks

Well Key in yellow box lid

4/3/08

* Holiday Inn tap water: ~~6.4~~ 7.9 SA

Sp Cond: ~~178~~ 169 uS/cm, T: ~~16.4~~ °C

TR3 LTC: 0.46 mS/cm, 10.00 °C

TR8 LTC Helena HI tap water recorded as last 3 points on file

Sp Cond: 0.133 mS/cm @ T = 10.80 °C

Download HT probe.

Measure TD + stickup of new wells

SA

Asarco 4/3/08

Well	TD	Stickup
EPA08	47.85 ~~FT BTOC 0.27 FT AGS~~	
EPA09	47.45 soft	-0.2
EPA10	47.80 soft	1.08

Download MT Robe Leveloggr
Logger appeared to be dry.
Logger time 13:29 PC Time 12:20

5/19/08
Helena Tap Water from Holiday Inn
Specific conductance measured
using Oakton Con10 meter
calibrated using 447 uS/cm solution
= 118.4 uS/cm @ 23.2°C.

Asarco 6/19/08

Fed Ex to Hotel (Ross/Acree):
7919 1846 9633
1847 1714
Fed Ex to Fed Ex (Wilkin/Acree):
7984 6451 5603
7993 4158 9229
Fed Ex to Fed Ex (Ross/Acree):
7919 1845 8945
7920 7381 5375
7920 7381 6901
7900 3739 4176
7989 6446 4782

Plan:
Sunday
Install leveloggers in 1" wells, thermocouples, & sampling lines
Insulate logger
Sample for bkgrd
Mix Br stock soln
Install inj pipe

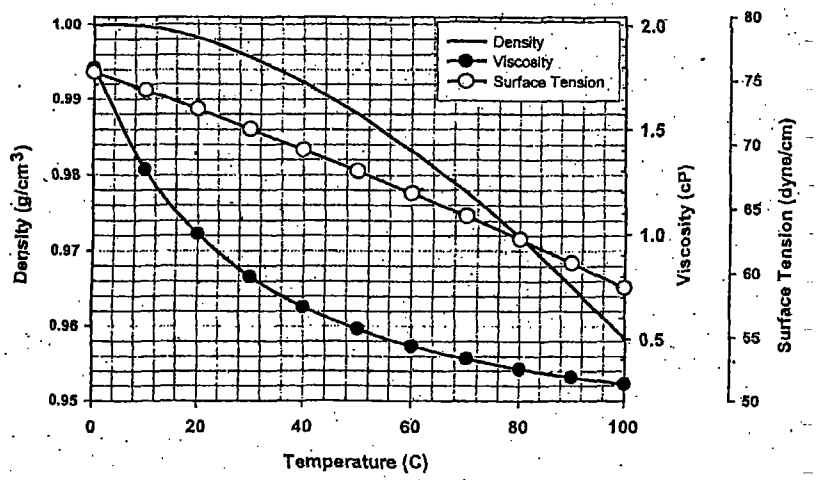
Monday
Mix hot Br tracer
Measure WLs
Inject
Start monitoring

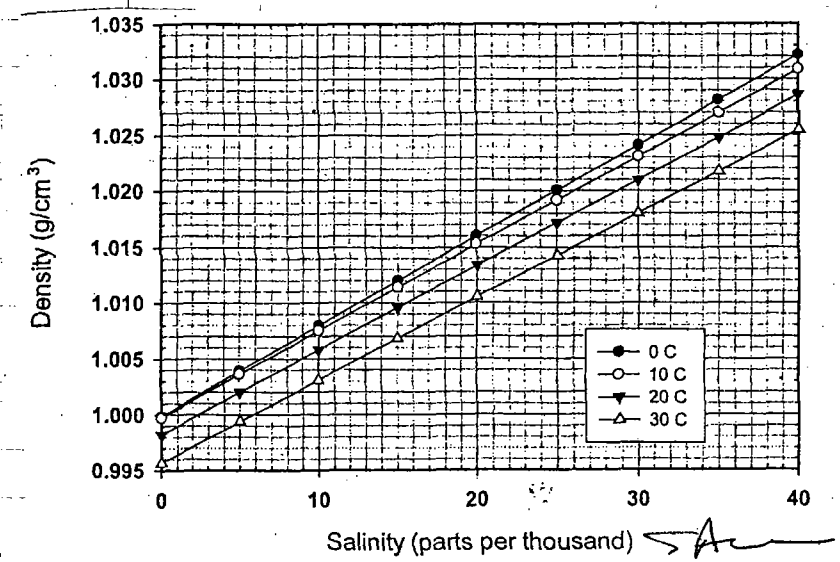
Download nearby leveloggers
Pull outer Leveloggers

Purchase:
Insulation
½" hose clamps for pumps/tubing
Distilled water - 10

Asarco 6/19/08

Useful info:





SA

Asarco 6/22/08

Arrive in Helena ~ 4:30p.
Towels for insulation.
Site @ 5:30p.
Install thermocouples & sample wells.

Samples:

Well	Time
TR3	19:22
TR4-2	19:35
TR5-2	19:47
TR6-2	19:59
TR7	20:05
TR8	20:09
TR10	20:39
TR11-2	20:15
TR12-2	20:32

Refrigerate samples in mobile lab.

Install injection pipe in well TR1 w bottom of screen @ 41 ft BTOC.
Screen = 3 ft. ∴ TOS = 38 ft BTOC

TR2 DTW = Meter not working

SA

Asarco 6/23/08

Mix 61.7g NaBr in 1 liter water.

EPA 10 DTW = 33.84' BTOC @ 9:10

10:38 add 25 gal hot tap water from Holiday Inn to tank and start pump (~ 4-5 gpm)

Sample tank + start injection: 11:00

Finish injection: 11:07

Sample wells: (Round 1)

Well	Time	
TR3	11:09	
TR4-2	11:27	
TR5-2	11:49	
TR6-2	11:36	
TR7	11:15	
TR8	11:11	
TR10	11:12	
TR11-2	11:56	
TR12-2	12:14	Purged dry. Purged 100 ml.

Tank Samples:

Top-West Side 11:00

East Side - Bottom 11:00

Center - Middle 11:00

SA

ASARCO 6/23/08

Sample wells (Round 2):

Well	Time	
TR3	13:06	
TR4-2	13:29	
TR5-2	13:42	
TR6-2	13:29	
TR7	13:09	
TR8	13:13	
TR10	13:16	
TR11-2	14:00	
TR12-2	13:53	Purged dry. Purged 90 ml

Sample Round 3:

Well	Time	
TR3	16:18	
TR4-2	16:40	
TR5-2	16:51	
TR6-2	~~16:22~~ 16:40	SA
TR7	16:25	
TR8	16:22	
TR10	16:28	
TR11-2	16:51	
TR12-2	17:04	

SA

Asarco 6/23/08

Sample Round 4:

Well	Time
TR3	19:55
TR4-2	20:18
TR5-2	20:24
TR6-2	20:11
TR7	19:58
TR8	20:00
TR10	20:02
TR11-2	20:35
TR12-2	No Sample, Cont purge.

Asarco 6/24/08

Sample Round 5:

Well	Time
TR3	05:18
TR4-2	05:48
TR5-2	05:55
TR6-2	05:42
TR7	05:22
TR8	05:26
TR10	05:56
TR11-2	05:31
TR12-2	06:04 Purged to dryness (45ml)

ASARCO 6/24/08

6/24/08 Asarco Water Level

	ASTOC	
DH-17	~~30.42~~ 30.62	08:15
PBTW1	33.91	08:19
EPA-07	30.17	8:20
EPA-05	29.87	8:21
PRB2	31.42	8:22
PBTW2	33.74	8:24
STW-1	33.34	8:27
DH-51	31.93	8:28
DH-50	33.19	8:31
DH-49	34.19	8:33
DH-63	36.61	8:37
EPA-06	32.39	8:42
EPA-03	31.87	8:44
EPA-04	31.91	8:46
EPA-09	32.80	8:48
EPA-10	33.77	8:50
EPA-08	32.77	8:51
EPA-01	33.13	8:54
EPA-02	32.35	8:56
DH-36	28.32	9:00
SDMW-1	32.58	9:03
PRB-3	39.67	9:12

SA

ASARCO 6/24/08

PRB 1	37.33	9:15
DH-42	30.10	9:24 New Stickup

Sample Round 6!

Well	TIME
TR3	11:52
TR4-2	12:18
TR5-2	12:44
TR6-2	12:48
TR7	11:55
TR8	11:57
TR10	12:00
TR11-2	13:04
TR12-2	No sample.

Water levels Continued

DH60	Destroyed.	
DH20	14.12	14:43
APSD4	8.88	14:53
APSD10	5.92	14:56

Upper, Lake 1 ~~so~~ pore sample acquired adjacent to APSD4 at 14:59 -> UL

SA

ASARCO 6/24/08

Recovered upper Lake iButton adjacent to APSD-9

APSD9	6.27	15:06
APSD7	6.79	15:48
DH5A	13.65	15:50
DH5	12.83	15:52

2 upper lake Isotope sample taken adjacent to DH5

DH47	6.01	15:55
DH24	8.25	16:00
DH4	9.23	16:02

Recovered upper lake iButton adjacent to gate post @ dam

SA

ASARCO 6/24/08

SAMPLE ROUND 7

	Time	Bc mV
TR3	17:30	34.3
TR4-2	18:04	56.1
TR5-2	18:23	80.0
TR6-2	18:13	112.1
TR7	17:41	128.6
TR8	17:46	121.3
TR10	17:38	72.0
TR11-2	18:27	80.5
TR12-2	18:30	132.2

Sample Round 8

TR3	21:39
TR4-2	22:15
TR5-2	22:08
TR6-2	21:56
TR7	21:41
TR8	21:44
TR10	21:46
TR11-2	21:52
TR12-2	

SA

ASARCO 6/25/08

SAMPLE ROUND 9!

well	TIME	
TR3	7:25	
TR4-2	8:04	
TR5-2	7:58	
TR6-2	7:50	
TR7	7:28	
TR8	7:31	
TR10	7:34	
TR11-2	7:42	
TR12-2	8:10	Purged to dryness (30 ml)

Survey TOC Elevations @ PR6

APSD11	7.45'	BTOC DTW @ 13:28
U2 Grating 2	2.15'	DTW @ 13:33
DH30	14.49'	DTW @ 14:02
DH69	32.66'	BTOC @ 14:57
DH22	DRY	BTOC @ 15:35

Upper lake elevation control points - grating over biggest pipe East-West

UL1. 10th rib from NE corner - outside edge of rib

UL2. Rock @ water's edge along dam

UL3. 11th rib from NE corner of grating. GO West to next N/S rib. (East-West)

ASARCO 6/25/08

SAMPLE ROUND 10!

Well	Time
TR3	16:06
TR4-2	16:34
TR5-2	16:20
TR6-2	16:14
TR7	15:56
TR8	16:03
TR10	15:59
TR11-2	16:15
TR12-2	No sample. Dry.

ROUND 11.

TR3	20:56
TR4-2	21:33
TR5-2	21:18
TR6-2	21:23
TR7	20:57
TR8	21:03
TR10	21:00
TR11-2	21:22
TR12-2	No sample

ASARCO 6/26/08

SAMPLE ROUND 12:

TR3 08:31
TR4-2 08:55
TR5-2 08:56
TR6-2 08:58
TR7 08:36
TR8 08:45
TR10-2 08:38
TR11-2 ~~09:00~~ 08:46 SA
TR12-2 09:00 Purged 80 ml

Survey @ land between lakes:

APSD-12 4.78' PTW BTOC @ 10:38
APSD-11 7.46' BTOC @ 10:42
APSD-8 6.28' " " 10:46
APSD-7 6.88' " " 10:50
Prickly Pear Dam 4.86 BMP @ 10:55
DH14 8.31 ft BTOC @ 11:01
DH 4 9.31 " " " 11:02
DH-5A 13.66 " " " 11:10
DH-5 12:84 " " " 11:11
Lower Lake Flood gate 1.51 ft BMP @ 11:15
DH47 6.04 " BTOC @ 11:19

SA

Asarco 6/26/08

DH20 14.15' BTOC @ 11:26
APSD4 8.40' " @ 11:32
APSD10 5.96 " " 11:36
APSD9 6.30 " " 11:39
UL3 (East pt) 2.16' BMP @ 11:45
UL4 (West pt) 2.04' BMP @ 11:46

Download i Buttons:
Upper Lake @ APSD9 (A A000000162 2A2)
Lower Lake @ Flood gate (24000000161E51)
Redeploy Lower Lake on MWT.

SAMPLE ROUND 13:

Well	Time
TR3	1302
TR4-2	12:51
TR5-2	
TR6-2	
TR7	12:55
TR8	12:57
TR10	12:59
TR11-2	12:41
TR12-2	12:58 Purged 76 ml

SA

ASARCO 6/26/08

well	DTW ft BTOC	TIME	Logger time
DH17	30.44	14:27	15:10
PBTW 1	33.75	14:45	15:19
STOPPED PBTW 1			
Added ~5 ft of line and new logger. Set on MDT. Logger SN 1021483.			
EPA06	32.22	15:22	16:09
EPA06 BARO	- Logger dead - ~~ft~~		* 15:34
Problem w/ data read.			
EPA02 BARO	32.19	15:39	15:45
EPA02			15:55
PBTW2 Deep	33.57	15:50	16:05
PBTW2 Shallow			16:13
PBTW2 MID			

Added 3 ft to shallow PBTW2. SA
~~Subtracted 2 ft from mid PBTW2.~~
Changed PBTW2 MID to F65 logger
SN ~~410155508~~ SA 10155508

7/9/08

Sampled tracer wells - Round 21.

TR3	16:10	TR6-2	17:01	TR10	17:25
TR4-2	16:24	TR7	17:14	TR11-2	17:37
TR5-2	16:33	TR8	17:20	TR12-2	17:53

SA

ASARCO 7/17/08

Work plan:

Mon	Travel, pick up Fed Ex in HLN (Garden)
Tues	Sample wells incl shallow. Slug tests in S wells, TR wells (Toi) 406 443 6656 Slug tests in outer wells. Loggers in EPA01, EPA05 EPA10. Replace other
Wed	loggers w/gold. Lower EPA02 by 3 ft. (Blackfoot nite)
Thurs	Water levels. Borehole dilution tests. Townsend. Ship equip. (Spin salad)
Fri	Travel.

Check TR8 TD.

Fed Ex:

Tracking Number
790546086042
790546091567
799883317717

7/21/08

Arrived on site ~5:00 pm.
Sampled tracer study wells.
Sample Round 22:

well	Time
TR2	18:22
TR3	18:15
TR4-2	17:59
TR5-2	18:04
TR6-2	18:11
TR7	17:45
TR8	17:49
TR10	17:39
TR11-2	17:36
TR12-2	17:29
TR9	18:30

SA

Asarco 7/22/08

TR9 DTW 32.75' BTOC @ 8:20

Setup pneumatic slug test @ TR9

Test	Pressure/Vacuum (in H2O)	Pretest Head (ft)
TR905p	4.98	2.372
TR905V	-8.52 (shut in)	2.401
TR902V	-3.31 (shut in)	2.414
TR907V	-8.31 (shut in)	2.433

TR10 DTW = 32.73' BTOC @ 9:59

Test	Pressure/Vacuum (in H2O)	Pretest Pressure
TR1007V	-8.40 (shut in)	-0.63
TR1002V	-3.17 (shut in)	-0.63
TR1006p	+7.65 (shut in)	-0.65
TR1007V2	-8.39 (shut in)	-0.13

SA

Asarco 7/22/08

TR7 DTW = 32.57' BTOC @ 10:20

Test	Pres/Vac (in H2O)	Pretest Pres (ft)
TR707V	-8.35 (shut in)	1.56
TR702V	-3.04 (shut in)	1.56
TR705p	+5.50	1.56
TR707V2	-8.38 (shut in)	1.56

TR8 DTW = 32.58' BTOC @ 10:55

Test	Pres/Vac (in H2O)	Pretest Pres (ft)
TR807V	-8.40 (shut in)	-1.48
TR802V	-3.18 (shut in)	-1.48
TR805p	+5.70 (shut in)	-1.48
TR807V2	-8.38 (shut in)	-1.5

Too much sunscreen.

SA

Asarco 7/22/08

TR3 DTW = 31.58' BTOC @ 11:12

Test	Pres/Voc (in H2O)		Pretest pres (ft)
TR307V	-8.37	(Shutin)	1.3
TR302V	-3.19	(Shutin)	1.3
TR305V	-5.63	(Shutin)	1.3
TR305p	+4.73	(bubbling)	1.3
TR305p	= bad test - valve not shut		
TR305p2	+5.90		
TR307V2	-8.45	(Shutin)	1.3

TR2 DTW = 31.57' BTOC @ 13:15

Test	Pres/Voc (in H2O)		Pretest Pres (ft)
TR207V	~~-8.77~~ -8.50	(Shutin)	1.3
TR202V	-3.15	(Shutin)	1.3
TR205p	+6.12	(Shutin)	1.3
TR207V2	-8.31	(Shutin)	1.3

S1 DTW = 31.74' BTOC @ 1312

S2 DTW = 31.72' BTOC @ 1314

S1 Test	Pres/Voc (in H2O)		Pre Test Res (ft)
S107V	-8.33	(Shutin)	1.13
S102V	-3.57	(Shutin)	1.13
S105p	+5.75	(Shutin)	1.13
S107V2	-8.37	(Shutin)	1.13

SA

Asarco 7/22/08

S2

Test	Pres/Voc (in H2O)		Pretest Pres (ft)
S207V	-8.36	(Shutin)	1.13
S202V	-3.30	(Shutin)	1.13
S205p	+6.34	(Shutin)	1.13
S207V2	-8.38	(Shutin)	1.13

S4 DTW = 31.66' Pretest Pres

Test	Pres/Voc	
~~S407V~~		
S407V	-8.19	1.15
S402V	-3.07	
S405p	+6.30	
S407V2	-8.24	

S3 DTW 31.64' BTOC @ 14:26

Test	Pres/Voc (in H2O)	Pre Test (ft)
S307V	-8.18	1.12
S302V	-3.37	
S305p	~~+6.0~~ +5.97	
S307V2	-8.40	

SA

ASARCO 7/22/08

S5 DTW 31.59' BTOC @ 1455
S6 DTW 31.66' BTOC @ 1456

S5

Test	Pres/Voc (in H2O)	Pretest Pres (ft)
S507V	-8.31 (shutin)	
S502V	-3.20 (shutin)	
S505P	+5.50 (shutin)	
S507V2	-8.15 (shutin)	

S6

	Pres/Voc (in H2O)	Pre Test Pres (ft)
S607V	~~-8.~~ -7.98	
S602V	-3.16	0.98
S605P	+6.35	
S607V2	-8.20	

S7 DTW = 31.56 'BTOC @ ~~15~~ 15:33
S8 DTW = 31.67 'BTOC @ 15:34

S7

Test	Pres/Voc (in H2O)	Pretest Pres (ft)
S707V	-8.27 (shutin)	1.15
S702V	-3.28 (shutin)	
S705P	+6.20 (shutin)	
S707V2	-8.27 (shutin)	

SA

ASARCO 7/22/08

Well EPA08
- Massive vacuum leak, probably casing joints, Can't test.

Well EPA09
- DNLS in hole. Inaccessible.

Well EPA01
- Massive vacuum leak, prob casing.

Asarco 7/23/08

Slugtest S8

Test	Pres/Voc (in H2O)	Pretest Pres (ft)
S807V	-8.24 (shutin)	1.65
S802V	-3.17 (shutin)	
S805P	+6.12 (shutin)	
S807V2	-8.15 (shutin)	

Waterlevels

Well	TIME	DTW (ft BTOC)
PRB2	13:56	30.60
EPA05	13:57	29.02
EPA07	13:58	29.31
PBTW1	14:00	33.04

SA

ASARCO 7/23/08

Water levels (cont):

well	TIME	DTW (ft BTOC)	
unk well 20-25' east of DH16	14:03	30.26	TD = 40.9
DH16		Dry	
DH17	14:11	29.72	
EPA02	14:14	31.40	
EPA08	14:16	31.81	
EPA10	14:18	32.81	
EPA01	14:19	32.16	
EPA04	14:20	30.97	
EPA03	14:23	30.92	
EPA06	14:25	31.41	
~~PB~~ TW2	14:27	32.82	
STW1	14:29	32.40	
DH51	14:31	31.10	

Calibrate LTC loggers:
Loggers running at 1 min interval in potable water for 5 hr.
Calibrated in 1413 uS/cm and 5000 uS/cm ~~set~~ standards using Levelogger calibration wizard software, per owners manual.

SA

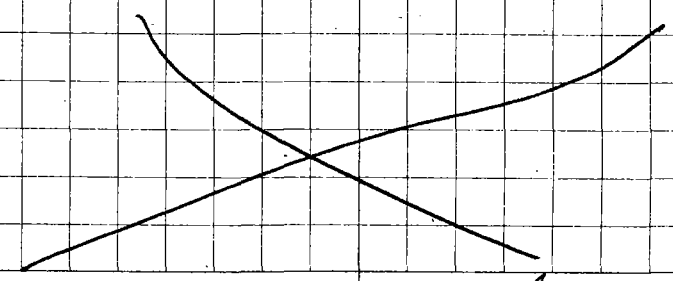
ASARCO 7/23/08

TR8 TD = 40.7' BTOC
LTC tip set 1.5' above TD.

TR10 TD = 40.7' BTOC
LTC Tip set 1.5' above TD.

TR8
Add 1 gal distilled water with logger @ TD. Move logger up/down w/in screen for 1 min following inj. Reset logger tip 1.5 ft above TD.
START INJ: 17:22:00
FINISH INJ: 17:22:40

Use same procedure @ TR10.
START INJ: 17:28:00
FINISH INJ: 17:28:36



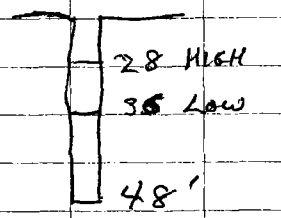
SA

ASARCO 7/24/08

Install Levelogger (4hr freq):

EPA01 SN 1021450 Set MMDT

T. of logger @ 40' BTOC.



EPA ~~07~~ 05 SN 1032745, Logger @ ~~35~~ 37 BTOC

EPA04 SN 1032758, Logger @ 40' BTOC

EPA10 SN ~~1032757~~ 1032802, Logger @ 40' BTOC

DTW @ ~~29~~ DH17 29.75 @ 9:41.

Download DH17 Logger time = 10:21, PC time = 9:45

Replace logger @ DH17 w/ SN 1032757.

Download EPA02 BARO,

Logger time: 10:14, PC time: 10:10

EPA02 DTW: 31.40' BTOC @ 10:15

Note: Ice chest w/ CSI power transformer had ~ 1/8" water in bottom.

SA

Asarco 7/24/08

Replace thermocouples.

Old location	New location
TR4-2	TR4-1
TR5-2	TR5-1
TR6-2	TR6-1
TR3	TR2
TR11-2	TR11-1
TR12-2	TR12-1
TR8	TR9

Others remained same:

TR7	TR7
S3	S3
TR1	TR1

Water levels

Well	DTW ('BTOC)	Time
EPA01	32.14	12:18
EPA05	29.02	12:23
EPA04	30.95	12:26
EPA02	31.39	12:29
EPA10	32.79	12:31
DH17	29.7~~3~~4	12:3[illegible]

SA

SA

ASARCO 7/24/08

Pulled borehole dilution loggers @ ~5pm.

Left:
2 short sleeve shirts, 1 long sleeve, 1 sweat, a pair of pants, sox, + tee shirt

Next TSD:
- physical slugs in 2" wells + EAA02 (4")
- borehole dilution tests (Need 1413 + 5000 uS/cm stds)
- Goose Bay Blown Glass
- Fix roof (drill

Asarco 9/3/08

Work plan:

Monday
Install thermocouples & sampling lines
Measure WL
Sample for bkgrd
Mix Br/Cl stock soln
Install inj pipe

Tuesday
Mix hot Br/Cl tracer
Measure WLs
Inject
Start monitoring

Download nearby leveloggers
Pull outer Leveloggers

Wednesday
Est sw mon pts
Measure gw/sw levels

Purchase:
USB A/B
Roof sealant, re-bar

Fed Ex:

111 Pencader Drive Newark DE 19701 US	796078461782
3171 Bozeman Ave Helena MT 59601 US	797077663839
3171 Bozeman Ave Helena MT 59601 US	797077665268

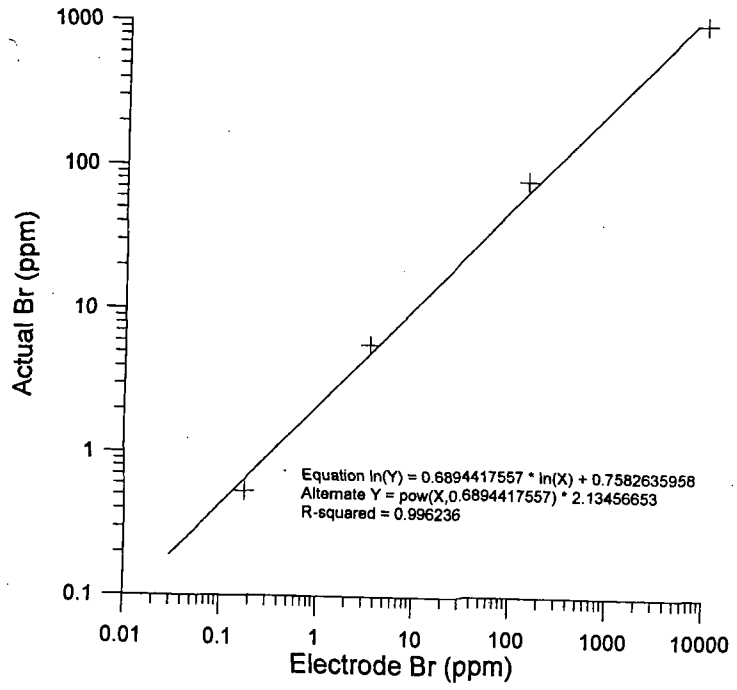
Calibrate Nexsens Br^- sensor:

Cal Standard	Sensor Reading
0 ppm Br^- (RO water)	0.03 ppm
0.534 ppm Br^-	0.175 ppm
5.77 ppm Br^-	3.4 ppm
80.1 ppm Br^-	145 ppm
1000 ppm Br^-	9437 ppm*

Sensor stirring slowly while reading.
* - Average of 20 readings.

Asarco 9/3/08

Nexsens Br Electrode Calibration



Asarco 9/8/08

DTW well TR2 = 29.83' BTOC @ 15:14

Single wells for Br^- & Cl^- background:

Round ~~0~~ 1

well	Time	Purge vol (ml)
TR2	16:20	1200
TR3	16:23	1200
TR4-1	16:32	180
TR4-2	16:37	320
TR5-1	16:43	100
TR6-1	16:50	100
TR7	16:54	1200
TR9	16:31	1200
TR10	17:04	1200
TR11-1	17:01	180
TR12-1	17:09	100
TR12-3	17:12	540

Install injection pipe ~~with~~ SA ~~SA~~ in TR1 with bottom of screen @ 36 ft BTOC. Screen = 3 ft in length.

Purge volumes for all rounds same as above.

Asarco 9/9/08

Mix tracer for 10 min using pump.
Inject tracer (Br^-, Cl^-) soln - 20 gal at 9:00 am.
Finish injection at 9:05 am.
Sample tracer solution: East, Center, West

Sample round 2: (well, time)

TR2	9:12
TR3	9:16
TR4-1	9:16
TR4-2	9:37
TR5-1	9:21
TR6-1	9:20
TR7	9:27
TR9	9:27
TR10	9:31
TR11-1	9:55
TR12-1	9:47
TR12-2	9:55

Sample Round 3: (well, time)

TR2	10:38	TR5-1	10:39	TR10	NS
TR3	NS	TR6-1	10:42	TR11-1	10:53
TR4-1	10:45	TR7	NS	TR12-1	10:57
TR4-2	NS	TR9	10:45	TR12-3	10:50

NS - No Sample

Asarco 9/9/08

Sample Round 4: (well, time)

TR2	12:11	TR6-1	12:19	TR12-1	12:21
TR4-1	12:11	TR9	12:16	TR12-3	12:25
TR5-1	12:15	TR11-1	12:23		

Round 5: (well, time)

TR2	15:00	TR6-1	15:07	TR12-1	15:11
TR4-1	15:03	TR9	15:05	TR12-3	15:16
TR5-1	15:05	TR11-1	15:18		

Nexsens Br^- Electrode

Check calibration:

Cal Standard (ppm Br^-)	Sensor Reading
0 (distilled water)	0.00 (ppm)
0.534	0.17
5.77	3.099
80.1	123.48
1000	~~7596.82~~ SA 7581.72

$\ln y = 0.7015667 * \ln x + 0.80492949$

Asarco 9/~~8~~ 9 SA/08

Measure Br^- using Nexsens electrode:

Sample Round 2

Well	Electrode Reading (ppm)	Calc Br^- (ppm)
TR2	85	
TR3	~~9~~ 8 SA 8.5	
TR4-1	2.4	
TR4-2	5.9	
TR5-1	1.05	
TR6-1	1.5	
TR7	7.25	
TR9	0.47	
TR10	5.0	
TR11-1	0.16	
TR12-1	0.23	
TR12-3	5.1	

All Br^- measurements are performed w/Nexsens.

Round 1	Br^- Electrode		Br^- Electrode
TR2	1.04 ppm	TR11-1	0.12 ppm
TR3	6.4	TR12-1	0.18
TR4-1	2.2	TR12-3	4.5
TR4-2	7.8		
TR5-1	1.6		
TR6-1	1.10		
TR7	7.5		
TR9	0.25		
TR10	4.9		

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Round 3	Br^- Electrode Reading (ppm)		
TR2	60	TR11-1	0.12
TR4-1	2.1	TR12-1	0.15
TR5-1	1.45	TR12-3	3.9
TR6-1	1.4		
TR9	0.3		

Round 4	Br^- Electrode Reading (ppm)		
TR2	72	TR11-1	0.10
TR4-1	2.4	TR12-1	0.18
TR5-1	2.1	TR12-3	4.6
TR6-1	1.4		
TR9	0.34		

Round 5	Br^- Electrode Reading (ppm)		
TR2	60	TR9	0.53
TR4-1	3.1	TR11-1	0.15
TR5-1	3.0	TR12-1	0.22
TR6-1	1.6	TR12-3	4.5

Br^- Electrode Readings

Tracer Tank Samples		Standards	Electrode Reading
East	900 ppm	0 ppm	0.01 ppm
Center	870	80.1	132
West	860		

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~~A~~ SA Sample wells

Round 6 (well, time)

TR2 19:00
TR4-1 19:05
TR5-1 19:07
TR6-1 19:10
TR9 19:05
TR11-1 19:17
TR12-1 19:13
TR12-3 19:08

9/10/08

Sample wells Round 7 (well, time)

TR2 7:48
TR3 7:50
TR4-1 7:48
TR4-2 8:07
TR5-1 7:52
TR6-1 7:55
TR7 ~~7:50~~ 7:56
TR9 8:01
TR10 8:06
TR11-1 8:16
TR12-1 8:12
TR12-3 8:17

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Calibrate Br^- electrode (Nexsens)

Std (ppm)	Electrode (ppm)
0	0.02
0.534	0.22
5.77	5.1
80.1	180
1000	1037.8 (10 pt average)

$\ln y = \overset{0.702184296}{\cancel{0.7015667426}}^{SA} \times \ln X + \overset{0.548922 75}{\cancel{0.8047244}}^{SA}$

Sample Round 6

Well	Br^- Electrode
TR2	~~165~~ ppm 110 SA
TR4-1	7.5
TR5-1	6.5
TR6-1	3.6
TR9	1.40
TR11-1	0.45
TR12-1	0.60
TR12-3	14

Sample Round 7 (well, Br^- electrode)

TR2	175	TR9	7.4
TR4-1	20	TR11-1	0.96
TR5-1	12.3	TR12-1	0.87
TR6-1	4.4	TR12-3	21.8
TR3	30	TR10	35
TR7	28	TR4-2	32

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Calibration stds for Br⁻ Nonsense!

Std	Electrode
0 ppm	0.10 ppm
80.1	235

Sample Round 8		Br Electrode	After Cal (ppm)
TR2	15:55	140 ppm	38.1
TR4-1	16:01	5	2.1
TR5-1	16:03	6.5	2.7
TR6-1	16:05	4.7	2.0
TR9	15:56	2.55	1.2
TR11-1	16:10	1.25	0.6
TR12-1	15:58	1.3	0.7
TR12-3	15:59	9.35	3.7

9/11/08

Sample Round 9		Br Elec	After Cal (ppm)
TR2	7:36	115 ppm	32.1
TR4-1	7:47	4.9	2.1
TR5-1	7:52	8.5	3.4
TR6-1	8:00	4.3	1.9
TR9	7:40	3.4	1.5
TR11-1	8:06	0.9	0.5
TR12-1	8:15	1.4	0.7
TR12-3	8:20	8.3	3.3

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Sample Round 10		Br Electrode	After Cal (ppm)
TR2	7:08	88 ppm	25.5
TR3	7:11	10	3.9
TR4-1	7:46	4.4	1.9
TR5-1	7:54	~~9.~~ SA 14.5	5.4
TR6-1	7:57	3.5	1.6
TR7	7:17	9.7	3.8
TR9	7:18	3.4	1.5
TR11-1	SA 10 7:22	9	3.6
TR11-1	8:00	0.9	0.5
TR12-1	8:03	1.35	0.7
TR12-3	7:25	7.7	3.1
TR4-2	7:48	9.5 3.7	

9/13/08

Sample Round 11		Br Electrode	After Cal (ppm)
TR2	14:30	60	18.3
TR4-1	14:50	5.6	2.4
TR5-1	14:51	23	8.0
TR6-1	14:55	2.9	1.3
TR9	14:35	2.9	1.3
TR11-1	15:06	0.85	0.5
TR12-1	15:12	1.2	0.6
TR12-3	14:39	13	4.9

~~Std~~	~~Br Electrode~~
~~0 ppm~~	SA
80.1	

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Nexsens Br⁻ Electrode Calibration !

Std	Electrode 15:20
0 ppm	0.745 ppm
0.539	1.568
5.77	11.059
80.1	222.245
1000	8375.447

$\ln Y = 0.864537 * \ln X - 0.6328522$

Check Calibration 17:22

0 ppm	0.37 ppm
80.1	140

Asarco 9/14/08

Cl⁻ Electrode Calibration
(Cole Parmer electrode used throughout)

Std	Electrode Reading ~~217 mV~~ ~~ppm~~ 8A 8A 265.5
0 ppm	257.2
1	
10	217.2
100	171.4
1000	122.0

$\ln Y = -9.27602 * \ln X + 51.81693$

Sample Round 8 (Cl Electrode Reading)

Well	Electrode (mV)	Calibrated Conc
TR2	132.0	681 ppm
TR4-1	169.6	67
TR5-1	173.2	55
TR6-1	172.1	58
TR9	181.8	35
TR11-1	204.5	12
TR12-1	195.2	18
TR12-3	163.2	95

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Cl⁻ Electrode Readings

Round 9

TR2	129 mV
TR4-1	173.2
TR5-1	173.4
TR6-1	178.4
TR9	182.2
TR11	207.1
TR12-1	197.3
TR12-3	166.9

Round 10

TR2	131.1 mV
TR3	174.5
TR4-1	175.3
TR4-2	175.7
TR5-1	164.3
TR6-1	183.1
TR7	175.3
TR9	181.7
TR10	173.5
TR11-1	207.1
TR12-1	196.8
TR12-3	171.4

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Round 11 Cl⁻ electrode Readings

TR4-2 SA	128.2 mV
TR8 4-1 SA	174.2
TR5-1	154.9
TR6-1	182.3
TR9	182.7
TR11-1	204.1
TR12-1	193.8
TR12-3	167.7

Cl⁻ Electrode Standards

Std	Electrode Reading
0 ppm	262.9 ~~258.2~~ mV
100 ppm	167.7 SA mV

Sample Round 12 (well, time)

TR2 SA	~~14:28~~ 14:22
TR4-1	15:01
TR5-1	15:05
TR6-1	15:04
TR9	14:26
TR11-1	14:40
TR12-1	14:37
TR12-3	14:28

Asarco 9/15/08

Sample Round 13 (well, time)

TR2	15:05
TR3	15:10
TR4-1	16:03
TR4-2	16:07
TR5-1	16:10
TR6-1	16:14
TR7	15:15
TR9	15:20
TR10	15:25
TR11-1	16:00
TR12-1	15:56
TR12-3	15:30

Sample Round 14

TR2	11:36
TR4-1	12:11
TR5-1	12:08
TR6-1	12:07
TR9	11:40
TR11-1	11:50
TR12-1	11:57
TR12-3	11:45

9/16/08

Nexsens Br Electrode Calibration

Std	Reading
0 ppm	0.03 ppm
0.534	0.245
5.77	3.26
80.1	115.85

$\ln y = 0.80888 \ln x + 0.61546$

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Asarco 9/16/08

Nexsens Br- Electrode Readings

Well	Electrode	Calibrated
Sample Round 12		
TR2	95 ppm	74 ppm
TR4-1	1.8	3.0
TR5-1	18.5	19.6
TR6-1	1.1	2.0
TR9	1.6	2.7
TR11-1	0.3	0.7
TR12-1	0.6	1.2
TR12-3	3	4.5
Sample Round 13		
TR2	6.6	5.5
TR3	4.5	6.3
TR4-1	2.3	3.6
~~TR5-1~~ 4-2 SA	5.5	7.4
TR5-1	31	30
TR6-1	0.9	1.7
TR7	5	6.8
TR9	2.1	3.4
TR10	4.2	5.9
TR11-1	0.45	1.0
TR12-1	0.6	1.2
TR12-3	3.4	5.0

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Nexsens Br^- Electrode Readings

Sample Round 14

Well	Electrode (ppm)	Calibrated (ppm)
TR2	78 ppm	63
TR4-1	4	5.7
TR5-1	58	44
TR6-1	1.4	2.4
TR9	1.9	3.1
TR11-1	0.43	0.9
TR12-1	0.8	1.5
TR12-3	8.3	10

Br^- Calibration Stds

Std	Reading
0 ppm	0.02 ppm
80.1	85

	DTW (ft BTOC)	Time
EPA09	30.17	16:09
EPA01	30.49	16:12
EPA04	29.32	16:14
EPA03	29.26	16:17
EPA06	29.70	16:19
PBTW2	31.15	16:22

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well	DTW (ft BTOC)	TIME
PBTW2SA	31.53	16:25
EPA07	27.80	16:28
EPA05	27.52	16:31
EPA02	29.79	16:36
DH17	28.28	16:39

9/17/08

Sample Round 15

Well	TIME	Nexsens Br^-	Calibrated
TR2	11:02	65 ppm	68 ppm
TR4-1	11:38	4	4
TR5-1	11:40	42	44
TR6-1	11:44	1.8	1.7
TR9	11:06	2.8	2.7
TR11-1	11:21	1.1	1.1
TR12-1	11:18	2.1	2.0
TR12-3	11:12	9.5	9.5

Nexsens Br^- Electrode Calibration

Std	Electrode Reading
0 ppm	0.093 ppm
0.534	0.584
5.77	5.46
80.1	78.5

$\ln y = 1.02125 \ln x - 0.043823$

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Sample Round 16

well	Time
TR2	13:55
TR3	13:58
TR4-1	14:42
TR4-2	~~14:46~~ SA 14:46
TR5-1	14:50
TR5-2	~~14:06~~ SA 15:06
TR6-1	14:53
TR7	14:05
TR9	14:10
TR10	14:12
TR11-1	14:35
TR11-2	14:58
TR12-1	14:30
TR12-3	14:19

Stored in bottom center cabinet (south):

12 volt pumps left in trailer:
Typhoon - old style
Mega Typhoon - old style
Mega Typhoon - quick connect
Monsoon - old style
Power Booster II for Monsoon
Power Booster I / Low Flow w/ quick connect

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Remove thermocouples in numerical order starting w/

TR1 @ 11:26
TR2 @ 11:29
TR3 @ 11:31
TR4-1 @ 11:32
TR5-1 @ 11:34
TR6-1 @ 11:38
TR7 @ 11:42
TR9 @ 11:44
TR10 @ 11:46
TR11-1 @ 11:48
TR12-1 @ 11:51
TR12-3 @ 11:33

Downloaded HT probe into Apr0408.DAT.

SA