

Introduction

Landfarming is generally a practice that uses land application and/or treatment as a remediation technique for soils that have become contaminated by petroleum contaminants via leaking storage tanks. In Arkansas, the term landfarm has also come to encompass those facilities that accept water-based fluids or muds from companies that drill wells for the extraction of natural gas or oil. The Environmental Preservation group was tasked with attempting to assess the impacts of landfarms in the state. Currently, that includes 11 operational facilities. Four are in Sebastian County, two each in Franklin and White Counties, and one each in Conway, Johnson, Lonoke and Yell Counties.

The landfarms all have some combination of the following elements: storage ponds, storage tanks, and application fields, monitoring wells, and natural water bodies. Samples were taken where possible in each of these available elements following the “Drilling Fluid Disposal Site Sampling” protocol below. All laboratory analyses were conducted at the ADEQ laboratory.

During site visits, the Environmental Preservation group was always accompanied by the ADEQ inspector in charge of the facility. These inspectors gave insight as to their experiences with each site, and provided introductions to each of the sites’ owners/operators.

Drilling Fluid Disposal Site Sampling Plan

ADEQ was assigned to evaluate drilling fluid disposal sites by sampling each site and its nearby areas. The sampling involved Water and Environmental Preservation and Technical Services Divisions in the Department. A significant amount of personnel and laboratory resources was expended. The questions that were to be answered are below.

1. Is the application of drilling fluids to these sites a “beneficial” addition to the site?
2. Is the adsorption capacity of the site soils sufficient to contain the waste?
3. Are there adverse effects in adjoining ecosystems?
4. Is the groundwater either onsite or offsite showing negative impacts?

ADEQ sampled all media, both affected and potentially affected, for the following parameters.

1. Field parameters of conductivity, pH, and temperature (water).
2. Dissolved and suspended solids (water).
3. Anions—chlorides, fluorides, bromides, sulfates, etc.--(water and soils).
4. Total metals and dissolved metals (water and soils).
5. Total hydrocarbons if a sheen or other indications of oil were present in the fluid reservoir (water and soils).

The sampling plan had to be altered to fit each site, but included, where applicable, monitoring wells, nearby streams, soil from application area low points, and background soil and water. The number of samples of each type and the testing parameters were determined after a thorough inspection of each site.

In order to generate sufficient quality data to answer the questions above, the following data quality objectives (DQOs) were required.

1. Precision and accuracy followed the acceptance criteria from the ADEQ lab. Acceptable criteria for field duplicates, matrix spikes and spike duplicates, and laboratory control samples was noted.
2. Field and lab blanks were screened for contaminants above the reporting limit for any parameter.
3. All other normal lab QA procedures were documented.
4. Calibration of field equipment was documented daily.
5. All samples will be documented through GPS location and chain of custody transfer to the lab.

If any sample set failed to meet these DQO's, a complete documentation of the corrective actions and any limitations on the data, such as flags, was included in the final report.

QA samples were collected on a daily basis. A full field QA sample set included a field duplicate. Cross contamination between samples was minimized by using disposable sampling gear.

A comprehensive report of monitoring results was compiled after data validation. The report evaluated the overall condition of the site and any specific environmental problems. Any suspected violations of permits or water quality standards were noted.

Summary of Findings

While the goal of this project was to assess the impacts on the environment by the landfarm, the assessment has proven to be problematic. We encountered a number of problems that prevented this from being a true assessment of the impact from landfarms. These problems included: unable to ascertain, with certainty, the date of the last application and amount of fluid applied; fluids applied to areas that were not permitted; fluids applied by methods not approved by the permit; unable to ascertain chloride concentrations of fluids applied; and a variety of other factors that could influence our findings. We did complete an evaluation of the impacts of the facilities and our findings are summarized below.

Eleven facilities with an authorization for a no-discharge permit were evaluated between November 25, 2008 and January 20, 2009. These permits are for storage and land application of drilling fluids generated by activities within the Fayetteville Shale Play.

When conditions allowed, streams were sampled above and below the landfarms. Conductivity, measured in the field, and samples analyzed in the lab (chlorides, total dissolved solids, etc.) indicate fluids are discharged to waters of the state by all eleven facilities. Downstream sample concentrations of these constituents are increased by at least an order of magnitude, and clearly exceeded Regulation No. 2 stream values. Attached photos also illustrate these facilities cannot be considered no-discharge.

Possible explanations may include but not be limited to:

- Over application or misapplication of drilling fluids,
- Inadequate soil permeability (applied to shale, coal mine spoil, etc.),
- Inadequate vegetative cover,
- Improper site location,
- Abnormal rainfall events and so on.

Only fluids with chloride concentrations less than 3,000 mg/L shall be land applied, as required by permit. This evaluation found holding pond concentrations from 61 to 12,200 mg/L. Four facilities had pond chlorides greater than 3,000 mg/L and the ponds were full. It is unknown how this condition is corrected and remain in compliance with the permit.

Permits require soil chloride concentrations remain less than 1,000 mg/Kg in areas intended to be used as land application units. These concentrations ranged from 26 to 45,400 mg/Kg. Eight out of eleven facilities had soil concentrations greater than 1,000 mg/Kg on at least one application area. Most were several times higher than 1,000 mg/Kg and had standing water (ponding) in the low lying areas. Off-site soil chlorides ranged from 2 to 64 mg/Kg.

In addition to the chloride concentrations in soil, the sodium adsorption ratio (SAR) is also an important consideration. According to soil scientist, Dr. Kristofor Brye, the SAR in soil should be less than 12 to 15. SAR values above this range are considered undesirable conditions for plant growth. High sodium content disperses the soil and causes to crust. Sodium also negatively impacts the ability of water to infiltrate the soil. Soils above this range are also not easily reconditioned. Our study found that the SAR on soils in which waste had been applied ranged from 0.3 – 51.4. Five of the eleven sites sampled had one or more SAR values above twelve. Two landfarms had three samples with an SAR above twelve. Again, these levels are above that at which soil can be remediated or reconditioned. In comparison, SAR values in offsite dirt samples ranged from 0 – 1.5 with most of these less than 0.3.

Another area of concern is the concentration of total petroleum hydrocarbons (TPH) in the soils. Oil-based drilling fluids are specifically prohibited by the permit. Nine out of eleven facilities had TPH concentrations that seemed to indicate application of these types of fluids had taken place. Samples from separate land application units had TPH concentrations from 159 to 42,500 mg/Kg. TPH was not detected in 10 off-site samples. One sample, with a concentration of 172 mg/Kg, may have been due to poor site selection.

In response to the questions that this study was designed to address:

1. Application of drilling fluids to these sites does not appear to be “beneficial”
2. The sorption capacity of site soils is not sufficient to contain the waste
3. Adverse effects in adjoining ecosystems have occurred
4. Groundwater effects will require further evaluation. A determination of proper well placement should also be considered.
5. The sodium adsorption ratio indicates that some farms will need to cease application on some fields and some fields may have been irreversibly damaged.
6. The usefulness of lysimeters in monitoring around these facilities is questionable.

Big Mac Tank Farm

Permit #: 4904-WR-1

Date Sampled: 12/01/2008

Site Description:

Big Mac Tank Farm is located in White County 2.5 miles south of Griffithville off McDoniel Rd. This facility receives drilling fluids from tanker trucks and has frac tank storage. Big Mac has two holding ponds and one application field.

On-Site observations:

- Applying fluids with irrigation pipe.
- Berm at end of field appeared to have directed fluids from application area into drainage ditch going off site. Nearest stream is a tributary of Dogwood Creek.
- Monitoring wells were locked and Envirotech has keys.
- Dormant vegetation over all of application field.
- Holding ponds lined with plastic.

Sample descriptions

Ditch off property-drainage ditch running along side of application field

Pond 1 Sample-Holding pond (west)

Pond 2 Sample-Holding pond (east)

Dirt sample 1-northwest corner of application field

Dirt sample 2-mid field near irrigation pipe

Off site dirt sample-field off site

Big Mac Land Farm Water Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/L)	Conductance (µMHOS)	TDS (mg/L)
2008-3371	Big Mac Tank Farm - Ditch off property	12/1/2008	124	632	325
2008-3372	Big Mac Tank Farm - Pond #1	12/1/2008	1,150	6,030	3,340
2008-3373	Big Mac Tank Farm - Pond #2	12/1/2008	887	4,350	2,290

Big Mac Land Farm Soil Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/Kg)	TPH (mg/Kg)	Sodium Adsorption Ratio
2008-3374	Big Mac Tank Farm - Dirt #1	12/1/2008	263	<61.1	2.7
2008-3375	Big Mac Tank Farm - Dirt #2	12/1/2008	4,260	<62.2	11.0
2008-3376	Big Mac Tank Farm - Offsite dirt sample	12/1/2008	40	<60.5	1.5

Pictures of Big Mac Tank Farm



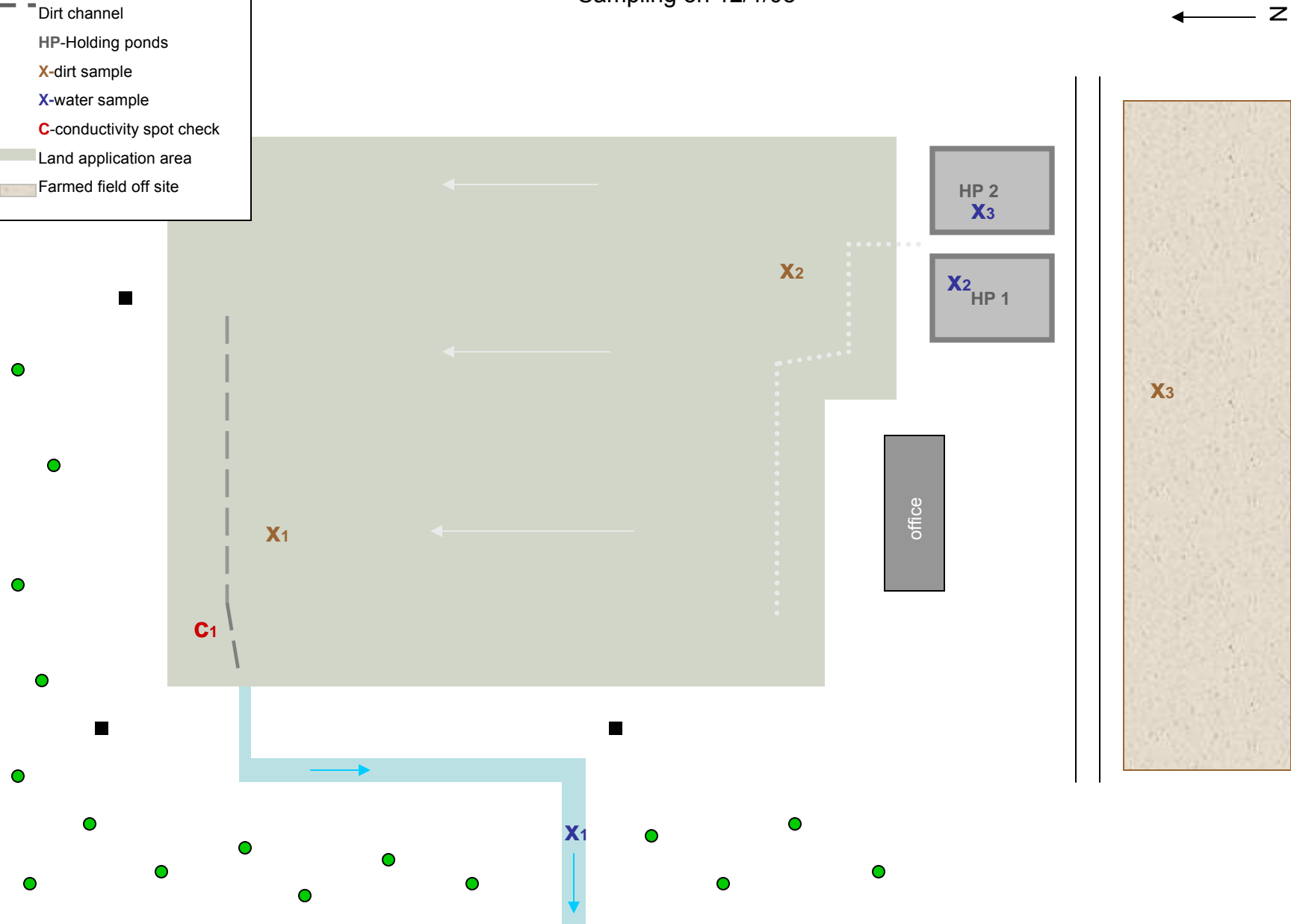
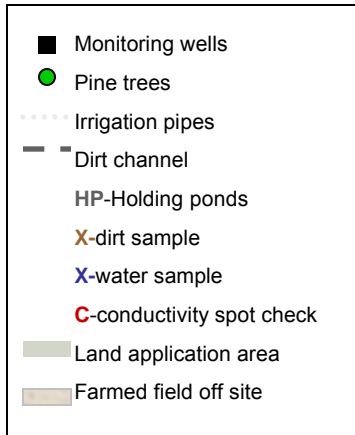


1. Holding pond
2. East end of application area
3. Holding pond with hoses to irrigation system
4. Application field (soybean stalks were present)
5. Frac tanks that were to be removed (according to inspector)
6. East end of application area showing “furrow”
7. Furrow as it goes off to watercourse
8. Furrow as it continues off field into watercourse

Big Mac Tank Trucks LLC

White County, AR

Sampling on 12/1/08



Big Mac Tank Farm

Sample description for diagram
12/1/08

X₁- Ditch off property

Conductivity: 632 $\mu\text{S}/\text{cm}$
Lab #: 2008-3371

X₂- Pond water sample #1

Conductivity: 6,030 $\mu\text{S}/\text{cm}$
Lab #: 2008-3372

X₃- Pond water sample #2

Conductivity: 4,350 $\mu\text{S}/\text{cm}$
Lab #: 2008-3373

X₁-Dirt sample #1

Lab #: 2008-3374

X₂-Dirt sample #2

Lab #: 2008-3375

X₃-Offsite dirt sample

Lab #: 2008-3376

C₁-Northeast corner land application area

Furthest distance from irrigation pipe
Conductivity: 1184 $\mu\text{S}/\text{cm}$



Capstone Oilfield Disposal Service of Arkansas, Inc.

Permit #: 2919-WR-2

Date Sampled: 1/20/2009

Site Description:

Capstone Oilfield Disposal is located in Johnson County, 2.5 miles northeast of Hartman, AR off County Road 2201. This facility has currently been recommended by ADEQ for consideration by the Attorney General's Office. They receive drilling fluids from tanker trucks. Facility consists of 5 active holding ponds and 2 application fields. Capstone has been told to cease accepting drilling mud and fluid since between May and July 2008. Found in October 2008 to have recently taken mud despite this being prohibited at the time.

On-Site observations:

- Holding ponds are clay lined and those that aren't historically had plastic liners which have since deteriorated.
- Both application fields are covered with dormant vegetation.
- A drainage creek that runs through field 1 flows directly off site (eastern border) onto adjoining property.
- Not sure of application method.
- Site has 2 monitoring wells, both of which appear to be up-gradient of application areas.

Sample descriptions

Water Sample 1-East field water flowing off site

Water Sample 2-Holding pond 4

Water Sample 3-Holding pond 5

Water Sample 4-Holding pond 6

Water Sample 5-Holding pond 1

Water Sample 6-Holding pond 2

Dirt sample 1-Northeast field (field 1)

Dirt sample 2-East end of property, off site

Dirt sample 3-South side of field 1

Dirt sample 4-Field 2, southwest corner

Dirt sample 5-Off site dirt sample

Capstone Land Farm Water Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/L)	Conductance (µMHOS)	TDS (mg/L)
2009-0224	East field water flowing off site	1/20/2009	1,590	5,600	2,930
2009-0225	Holding pond 4	1/20/2009	3,730	11,900	6,810
2009-0226	Holding pond 5	1/20/2009	5,060	15,500	9,000
2009-0227	Holding pond 6	1/20/2009	4,420	13,900	7,790
2009-0228	Holding pond 1	1/20/2009	4,210	13,700	7,790
2009-0229	Holding pond 2	1/20/2009	9,040	25,300	16,300

Capstone Land Farm Soil Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/Kg)	TPH (mg/Kg)	Sodium Adsorption Ratio
2009-0230	Northeast field - Field 1	1/20/2009	804	3,690	6.1
2009-0231	East end of property, off site	1/20/2009	16	<59.9	0.4
2009-0232	South side of field 1	1/20/2009	220	<99.9	1.9
2009-0233	Field 2 southwest corner	1/20/2009	193	5,490	2.5
2009-0234	Off site dirt sample	1/20/2009	14	<59.5	-

Pictures of Capstone Oilfield Disposal





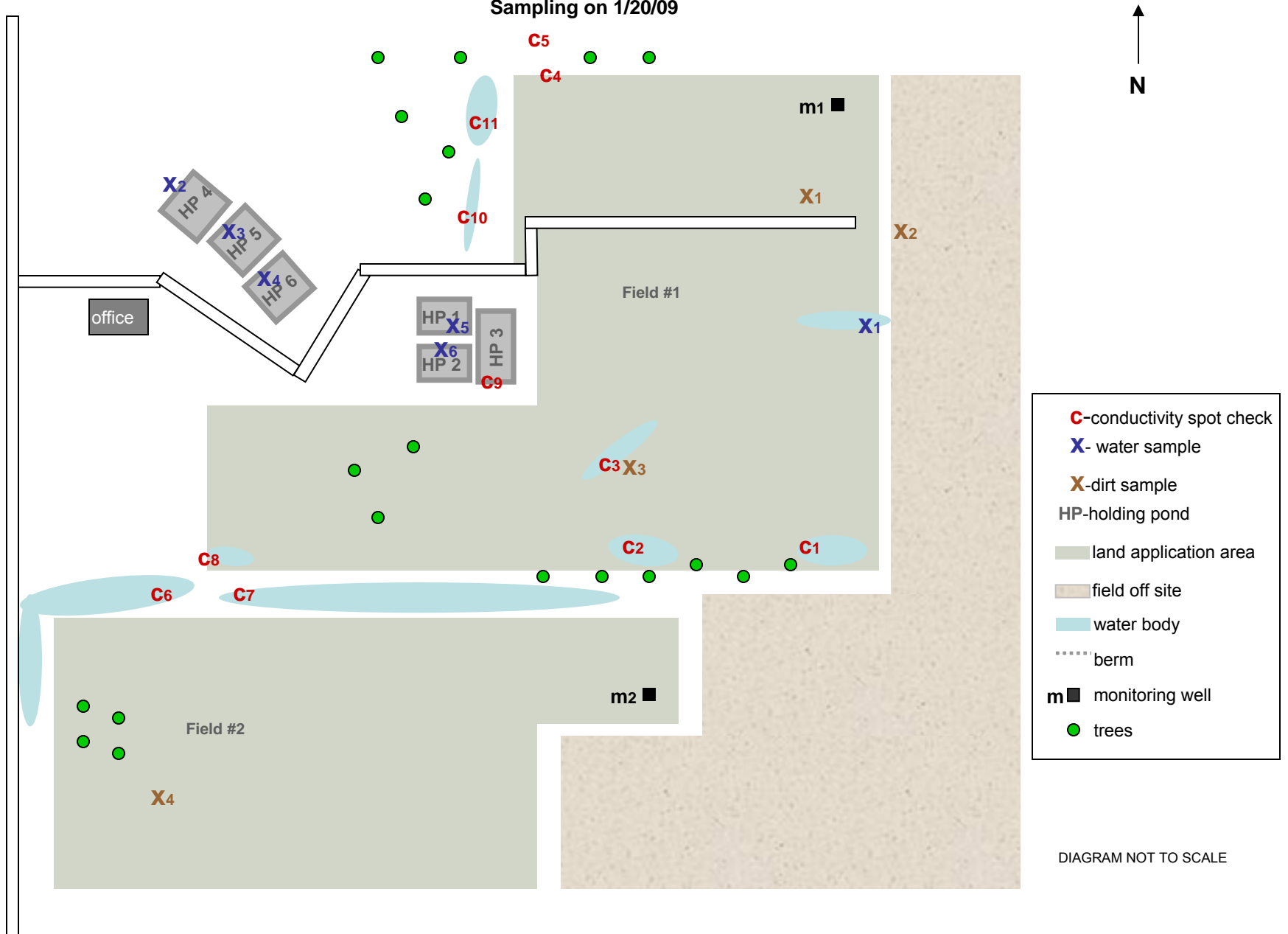


1. Application field
2. Application field salt deposits and debris
3. Application field
4. Application field salt deposits
5. Monitoring well sampling
6. Drainage channel flowing off property
7. Close up of drainage channel flowing off property
8. Low area pooling in application field
9. Low area pooling in application field
10. Drainage channel flowing off property
11. Overlook of application area
12. Application area
13. Holding pond
14. Holding pond
15. Holding pond
16. Holding pond
17. Holding pond
18. Deteriorated plastic liner for holding ponds
19. Part of application field

Capstone Oilfield Disposal of AR, Inc.

Hartman, AR

Sampling on 1/20/09



Capstone Oilfield Disposal of AR

Sample description for diagram

1/20/09

X₁- Water sample #1

Conductivity: 5,600 $\mu\text{S/cm}$

Lab #: 2009-0224

X₂- Water sample #2

Conductivity: 11,930 $\mu\text{S/cm}$

Lab #: 2009-0225

X₃- Water sample #3

Conductivity: 15,500 $\mu\text{S/cm}$

Lab #: 2009-0226

X₄- Water sample #4

Conductivity: 13,920 $\mu\text{S/cm}$

Lab #: 2009-0227

X₅- Water sample #5

Conductivity: 13,690 $\mu\text{S/cm}$

Lab #: 2009-0228

X₆- Water sample #6

Conductivity: 25,300 $\mu\text{S/cm}$

Lab #: 2009-0229

X₁-Dirt sample 1

Lab #: 2009-0230

X₂-Dirt sample 2

Lab #: 2009-0231

X₃-Dirt sample 3

Lab #: 2009-0232

X₄-Dirt sample 4

Lab #: 2009-0233

X₅-Dirt sample 5

Lab #: 2009-0234

m₁-Monitoring well #1

pH: 4.93 Temp: 13.0°C

Conductivity: 36 $\mu\text{S/cm}$

m₂-Monitoring well #2

pH: 5.18 Temp: 12.3°C

Conductivity: 180 $\mu\text{S/cm}$

C₁-Pond at edge of property SE corner

Conductivity: 47 $\mu\text{S/cm}$

C₂-Pooling at southside of field 1

Conductivity: 230 $\mu\text{S/cm}$

C₃-Low area behind ponds south field 1

Conductivity: 1,300 $\mu\text{S/cm}$

C₄-Northside of field 1, along property line

Conductivity: 150 $\mu\text{S/cm}$

C₅-Northside of field 1, other side of berm

Conductivity: 24 $\mu\text{S/cm}$

C₆-strip pit ponds, west pit

Conductivity: 296 $\mu\text{S/cm}$

C₇-strip pit ponds, east pit

Conductivity: 250 $\mu\text{S/cm}$

C₈-Pond at south side of field #1

Conductivity: 203 $\mu\text{S/cm}$

C₉-Pond 3, overflow from ponds 1&2

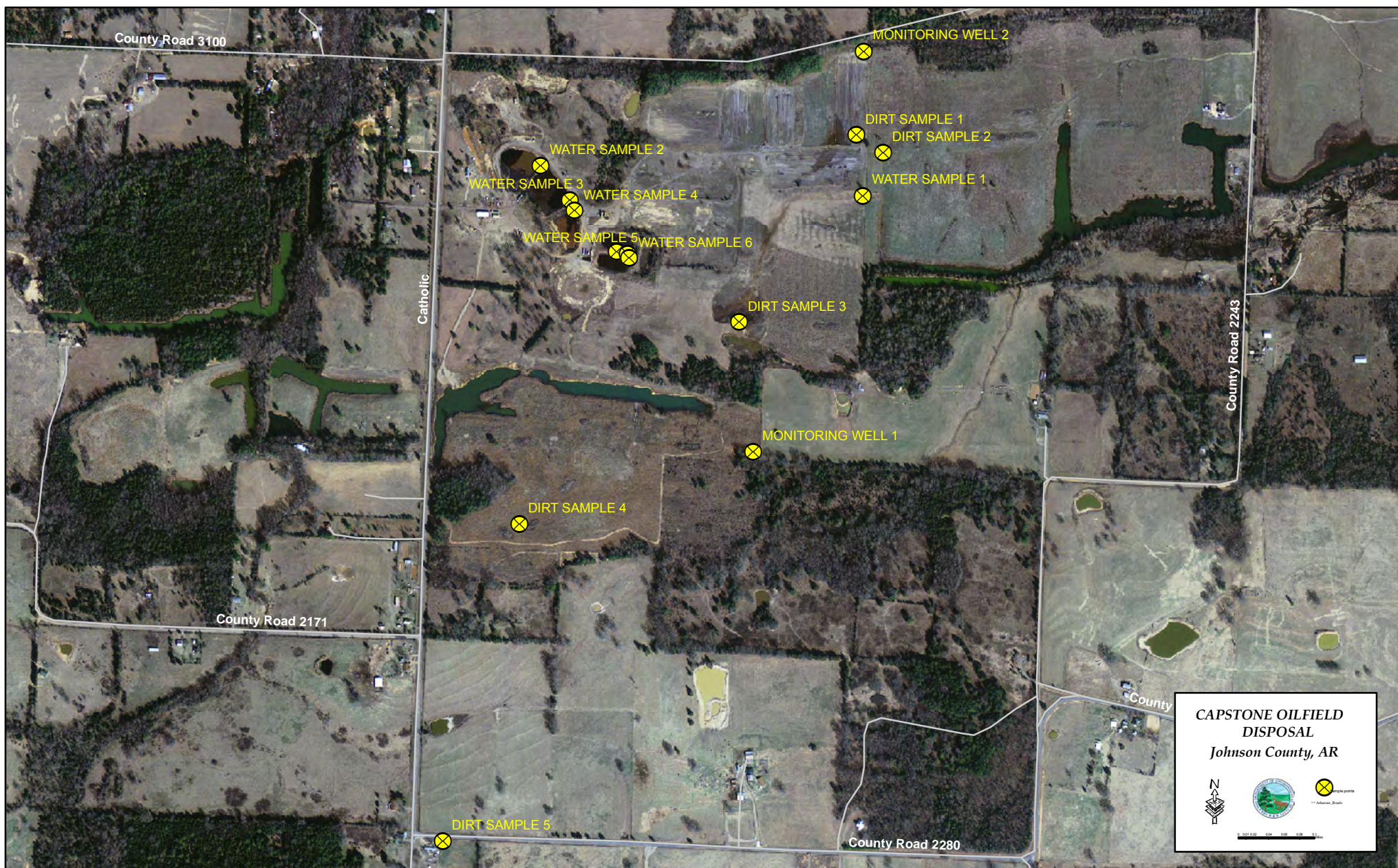
Conductivity: 94 $\mu\text{S/cm}$

C₁₀-freshwater pond north of ponds 1&2

Conductivity: 30 $\mu\text{S/cm}$

C₁₁-drainage ditch north of ponds 1&2

Conductivity: 473 $\mu\text{S/cm}$



Central Arkansas Disposal, LLC

Permit #: 4929-WR-1

Date Sampled: 12/2/2008

Site Description:

Central Arkansas Disposal (Waste Recovery) is located in White County 2.5 miles northeast of Griffithville off of Jack Stewart Rd. The facility is also a currently functioning soybean farm. They receive drilling fluids from tanker trucks. There is a conductivity meter on site to check trucks as they receive fluids. Facility consists of 2 holding ponds and 4 application fields. Facility was recently found to have a pipe going to unpermitted pond east of actual site.

On-Site observations:

- Very busy the day of sampling. Approximately 100+ trucks in the 4 hours we were on site.
- Application areas have dormant vegetation or soybeans. One field was green.
- Fluids are applied using a center pivot irrigation system.
- Ditch off site directly beyond (west) application field berm had low conductivity.
- Berm on application field north of ponds cut to allow drainage to roadside ditch.
- Holding ponds were lined with plastic.

Sample descriptions

Standing water near rice well 1-southwestern most field

Ditch off western border of property-ditch off property beyond application field berm.

Field west of ponds-Field sample 2 west of office, pooled water

Below irrigation equipment-Center pivot pool

Holding Pond #1-north receiving pond

Holding Pond #2-south receiving pond

Standing water behind office-pooled water in application field behind office

Dirt sample #1-near rice well 1

Dirt sample #2-field sample 2 west of office and holding pond area

Dirt sample #3-Below irrigation equipment at pump (field north of holding pond area)

Field near office-dirt sample from field near office

Greenfield- dirt sample from green field, application area south of holding ponds

Off Site dirt sample- farmed field off site

Central Arkansas Waste Land Farm Water Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/L)	Conductance (µMHOS)	TDS (mg/L)
2008-3392	Standing water near rice well, SW field	12/2/2008	346	2,120	1,280
2008-3393	Ditch off western border of property	12/2/2008	21	138	77
2008-3394	Field west of ponds	12/2/2008	447	2,120	1,020
2008-3395	Below irrigation equipment	12/2/2008	3,340	12,000	6,810
2008-3396	Holding Pond #1	12/2/2008	3,460	13,800	7,850
2008-3397	Holding Pond #2	12/2/2008	2,910	12,800	7,130
2008-3398	Standing water behind office	12/2/2008	1,040	4,570	2,410

Central Arkansas Waste Land Farm Soil Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/Kg)	TPH (mg/Kg)	Sodium Adsorption Ratio
2008-3399	Field sample near rice well	12/2/2008	723	1,790	3.4
2008-3400	Field sample west of office	12/2/2008	215	<65.6	2.3
2008-3401	Field sample below irrigation equipment	12/2/2008	6	<60.0	0.3
2008-3402	Field sample near office	12/2/2008	193	<61.6	1.6
2008-3403	Greenfield dirt sample	12/2/2008	6	<57.7	0.6
2008-3404	Off site dirt sample	12/2/2008	9	<60.9	0.2

Pictures of Central Arkansas Waste Recovery





1. Holding ponds showing liner
2. Rice field that is included in permitted application area
3. Application area
4. Application area showing pooled water near center pivot irrigation system
5. Holding pond with trucks offloading product

Central Arkansas Waste Disposal

White County, AR
Sampling on 12/2/08

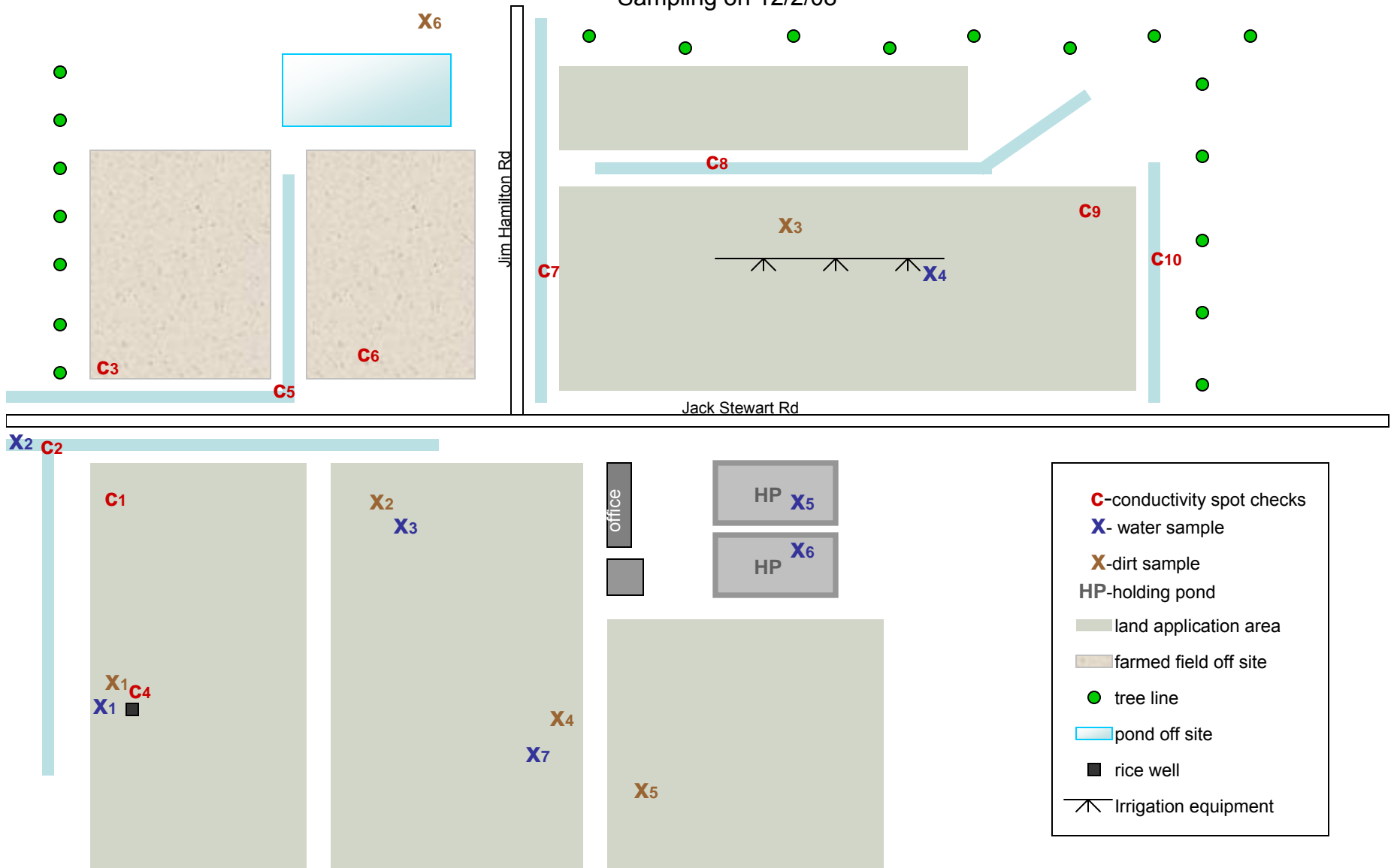


DIAGRAM NOT TO SCALE

Central Arkansas Waste Recovery

Sample description for diagram

12/2/08

X1- Standing water near rice well

Conductivity: 2,120 $\mu\text{S}/\text{cm}$

Lab #: 2008-3392

X2- Ditch off western border of property

Conductivity: 138 $\mu\text{S}/\text{cm}$

Lab #: 2008-3393

X3- Field west of ponds

Conductivity: 2,120 $\mu\text{S}/\text{cm}$

Lab #: 2008-3394

X4- Below irrigation equipment

Conductivity: 12,000 $\mu\text{S}/\text{cm}$

Lab #: 2008-3395

X5- Holding pond #1

Conductivity: 13,840 $\mu\text{S}/\text{cm}$

Lab #: 2008-3396

X6- Holding pond #2

Conductivity: 12,700 $\mu\text{S}/\text{cm}$

Lab #: 2008-3397

X7- Standing water behind office

Conductivity: 4,570 $\mu\text{S}/\text{cm}$

Lab #: 2008-3398

C1-Corner of property (west)

Conductivity: 1,782 $\mu\text{S}/\text{cm}$

C2-Ditch off previous site (west)

Conductivity: 225 $\mu\text{S}/\text{cm}$

C3-Standing water across road

Conductivity: 318 $\mu\text{S}/\text{cm}$

C4-Rice well (unbaled)

Conductivity: 600 $\mu\text{S}/\text{cm}$

C5-Cross ditch coming from big pond

NW of property

Conductivity: 161 $\mu\text{S}/\text{cm}$

X1-Dirt sample #1

Lab #: 2008-3399

X2-Dirt sample #2

Lab #: 2008-3400

X3-Dirt sample #3

Lab #: 2008-3401

X4-Field near office

Lab #: 2008-3402

X5-Green field

Lab #: 2008-3403

X6-Off site dirt sample

Lab #: 2008-3404

C6-Standing water below pond

Conductivity: 350 $\mu\text{S}/\text{cm}$

C7-Ditch along road beside N field

Conductivity: 470 $\mu\text{S}/\text{cm}$

C8-Ditch between treeline & N field

Conductivity: 336 $\mu\text{S}/\text{cm}$

C9-Standing water in N field

Conductivity: 336 $\mu\text{S}/\text{cm}$

C10-Ditch east of N field

Conductivity: 336 $\mu\text{S}/\text{cm}$



Eastern Tank Services, Inc.-Branch

Permit #: 4493-WR-2

Date Sampled: 1/13/2009

Site Description:

Eastern Tank Services is located in Franklin County 2 miles northeast of Branch, AR off County Road 27. This facility has been recommended for consideration by the Attorney General's office. They receive drilling fluids from tanker trucks. Facility consists of 3 holding ponds and 4 application fields.

On-Site observations:

- Holding ponds are clay lined.
- On-site conductivity checks seem to indicate that pond 3 is leaking. A puddle directly down gradient of pond 3 had a conductivity reading of 16,000 $\mu\text{S}/\text{cm}$.
- Application field 3 appeared to have high oil content.
- Fluids are applied using a spray gun system.
- Spray gun set up to spray into swamp area behind application field 3. Facility had a pipe going from ponds 1 and 2, which was flowing by gravity down to a low-lying wetland area. This discharge had a conductivity of 40,000 $\mu\text{S}/\text{cm}$, which is the highest value we have ever documented.
- Partial grass on fields 1 and 2. Fields 3 and 4 solid dirt and/or rocks, no vegetation.
- Direct discharge to waters of the state.
- Mangled channel with undersized culvert under new road.

Sample descriptions

Water Sample 1-Holding pond 1

Water Sample 2-Holding pond 2

Water Sample 3-Holding pond 3

Water Sample 4-Pond in southeast corner of field 3

Water Sample 5-Out of pipe south of field 3, discharging into wetland area

Water Sample 6-Far east property line water leaving site

Water Sample 7-Pooled stream western property line, off site (upstream of water sample 6)

Dirt sample 1-Field below office

Dirt sample 2-Field 1

Dirt sample 3-Field 2, south end

Dirt sample 4-Mid west side of field 3

Dirt sample 5-Field 4 (SW) near off site citizen complaint pond

Dirt sample 6-Field 4 east side (old pipe discharge?)

Dirt sample 7-Off site

Eastern Tank Services at Branch Land Farm Water Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/L)	Conductance (µMHOS)	TDS (mg/L)
2009-0144	Holding pond 1	1/13/2009	12,200	35,500	22,300
2009-0145	Holding pond 2	1/13/2009	2,320	7,870	4,360
2009-0146	Holding pond 3	1/13/2009	7,470	22,300	13,300
2009-0147	Pond in SE corner of field 3	1/13/2009	847	3,050	1,640
2009-0148	Pipe south of field 3	1/13/2009	12,900	37,800	24,300
2009-0149	Eastern Tank Branch - Water sample 6	1/13/2009	790	2,600	1,390
2009-0150	Eastern Tank Branch - Water sample 7	1/13/2009	15	161	104

Eastern Tank Services at Branch Land Farm Soil Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/Kg)	TPH (mg/Kg)	Sodium Adsorption Ratio
2009-0151	Field below office	1/13/2009	45,400	772	51.4
2009-0152	Field 1	1/13/2009	4,750	419	14.3
2009-0153	Field 2, south end	1/13/2009	2,400	712	8.6
2009-0154	Midwest side of field 3	1/13/2009	4,880	1430	12.5
2009-0155	Field 4 near offsite citizen complaint pond	1/13/2009	194	<52.1	3.5
2009-0156	Field 4 east side	1/13/2009	1,320	276	6.4
2009-0157	Off site dirt sample	1/13/2009	55	<68.2	0.8

Pictures of Eastern Tank-Branch





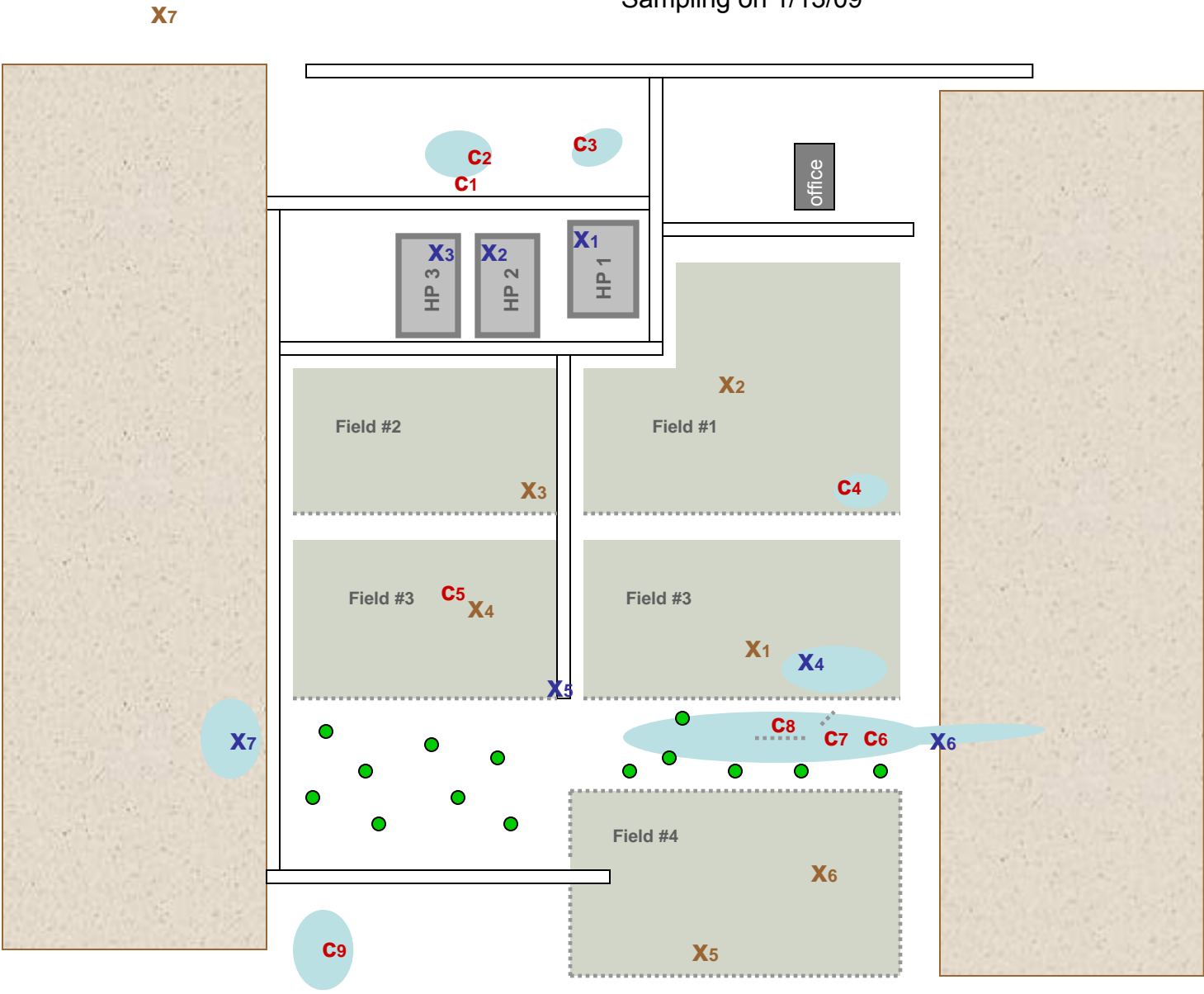


1. Levee of holding pond
 2. Application area
 3. Holding pond
 4. Holding pond
 5. Holding pond
 6. Application pipe and hose run through wetland area in which creek flows through property
 7. Wetland area in which creek flows through property
 8. Application field
 9. Application field
 10. Applicator in middle of wetland area through which creek flows
 11. Road that has been constructed along border of property with culvert insufficient to handle flow of creek
 12. Water dammed up by construction of road
 13. Application area number 4
- Application area number 4

Eastern Tank Services

Branch, AR

Sampling on 1/13/09



- C**-conductivity spot checks
- X**- water sample
- X**-dirt sample
- HP**-holding pond
- land application area
- farmed field off site
- tree line
- water body
- berm

DIAGRAM NOT TO SCALE

Eastern Tank Services-Branch

Sample description for diagram

1/13/09

X1-Water sample 1

Conductivity: 35,500 $\mu\text{S/cm}$

Lab #: 2009-0144

X2-Water sample 2

Conductivity: 7,870 $\mu\text{S/cm}$

Lab #: 2009-0145

X3-Water sample 3

Conductivity: 22,300 $\mu\text{S/cm}$

Lab #: 2009-0146

X4-Water sample 4

Conductivity: 3,050 $\mu\text{S/cm}$

Lab #: 2009-0147

X5-Water sample 5

Conductivity: 37,800 $\mu\text{S/cm}$

Lab #: 2009-0148

X6-Water sample 6

Conductivity: 2,600 $\mu\text{S/cm}$

Lab #: 2009-0149

X6-Water sample 7

Conductivity: 161 $\mu\text{S/cm}$

Lab #: 2009-0150

X1-Dirt sample #1

Lab #: 2009-0151

X2-Dirt sample #2

Lab #: 2009-0152

X3-Dirt sample #3

Lab #: 2009-0153

X4-Dirt sample #4

Lab #: 2009-0154

X5-Dirt sample #5

Lab #: 2009-0155

X6-Dirt sample #6

Lab #: 2009-0156

X7-Dirt sample #7

Lab #: 2009-0157

C1-Puddle btw Pond 3 & north pond

Conductivity: 16,000 $\mu\text{S/cm}$

C2-Pond north of Pond 3

Conductivity: 2,350 $\mu\text{S/cm}$

C3-Pond by entrance

Conductivity: 1,150 $\mu\text{S/cm}$

C4-Puddle in field 1

Conductivity: 300 $\mu\text{S/cm}$

C5-Puddle in field 3 west

Conductivity: 31,000 $\mu\text{S/cm}$

C6-Swamp below field 3

Conductivity: 3,000 $\mu\text{S/cm}$

C7-Swamp below field 3

Conductivity: 6,800 $\mu\text{S/cm}$

C8-Swamp below field 3

Conductivity: 9,000 $\mu\text{S/cm}$

C7-Strip pit west of field 4

Conductivity: 5,830 $\mu\text{S/cm}$



Eastern Tank Services, Inc.-Hartford

Permit #: 4927-W

Date Sampled: 1/14/2009

Site Description:

Eastern Tank Services is located in Sebastian County 1.5 miles west of Hartford, AR off Hwy 96 and Gap Rd. They receive drilling fluids from tanker trucks. Facility consists of 2 holding ponds and 4 application fields.

On-Site observations:

- Holding ponds are clay lined.
- Appeared they were using an unpermitted field. Manager admitted to this. See lab results below for Dirt Sample 4A and Ice sample.
- Fluids are applied using a spray gun system and piping.
- Spray gun set up to spray into woods in application field 4. Dead trees in the area.
- Appears some fluids are getting into nearby Sugarloaf creek. Lab results confirm this.
- Partial grass on fields 1, 2, and 4. Field 3 has a little grass growing.
- Four monitoring wells on site.
- Tanker unloading to Pond 2 – both ponds exceed freeboard requirement.

Sample descriptions

Water Sample 1A-Holding pond 1

Water Sample 2A-Pooling at southwest end of field 1

Water Sample 3A-Pooling at southwest end of field 2

Water Sample 4A-Sugarloaf creek beside field 2 upstream of Hwy 96 bridge

Water Sample 5A-Pooling at southeast end of field 4

Water Sample 6A-Upstream sample of Sugarloaf Creek at road crossing

Water Sample 7A-Ponding on southwest end of field 3

Water Sample 8A-Holding pond 2

Dirt sample 1A-Dirt near pooling at southwest corner of field 1

Dirt sample 2A-Middle of field 1

Dirt sample 3A-Middle of field 2

Dirt sample 4A-Unnamed field west of Sugarloaf Creek

Dirt sample 5A-South middle of field 4

Dirt sample 6A-Middle of field 4

Dirt sample 7A-Field 3

Ice sample-from unnamed field west of Sugarloaf Creek, pipe trail

Eastern Tank Services Hartford Land Farm Water Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/L)	Conductance (µMHOS)	TDS (mg/L)
2009-0158	Holding pond 1	1/14/2009	2,630	8,810	4,790
2009-0159	Pooling at SW end of field 1	1/14/2009	3,220	10,500	5,750
2009-0160	Pooling at SW end of field 2	1/14/2009	4,710	15,200	8,770
2009-0161	Sugarloaf Creek downstream sample near field 2	1/14/2009	770	2,680	1,350
2009-0162	Pooling at SE end of field 4	1/14/2009	4,050	12,700	
2009-0163	Sugarloaf Creek upstream sample at road	1/14/2009	19	113	104
2009-0164	Pooling at SW end of field 3	1/14/2009	4,930	17,500	9,010
2009-0165	Holding pond 2	1/14/2009	2,630	9,200	5,100
2009-0173	Ice sample from unnamed field W of field 2	1/14/2009	606		

Eastern Tank Services Hartford Land Farm Soil Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/Kg)	TPH (mg/Kg)	Sodium Adsorption Ratio
2009-0166	Near pooling at SW end of field 1	1/14/2009	1,840	<70.9	9.0
2009-0167	Middle of field 1	1/14/2009	1,670	<65.9	9.3
2009-0168	Middle of field 2	1/14/2009	1,350	178	8.7
2009-0169	Unnamed field W of Sugarloaf Creek	1/14/2009	31	<61.8	0.3
2009-0170	South middle of field 4	1/14/2009	3,240	<90.8	15.1
2009-0171	Middle of field 4	1/14/2009	2,690	<71.4	15.5
2009-0172	Field 3	1/14/2009	4,620	159	14.5

Pictures of Eastern Tank-Hartford





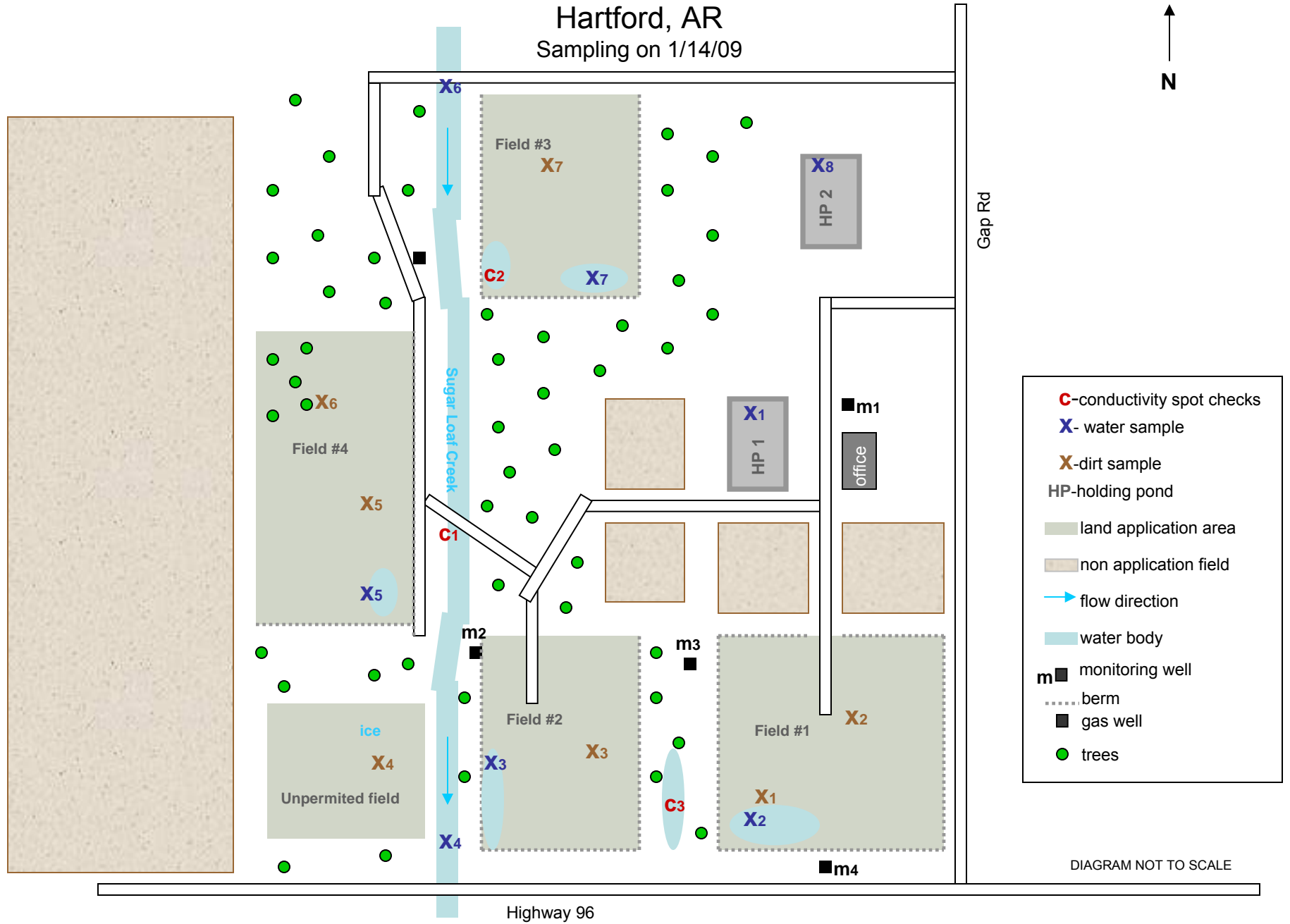


1. Application area with standing water
2. Application area where standing water is being pumped off
3. Creek crossing
4. Standing water in application area with sheen
5. Sampling crew sampling stream between application areas
6. Application area where evergreens haven't been removed prior to application. Evergreens showing signs of distress due to application of fluids on foliage.
7. Sampling from holding pond
8. Holding pond showing oil residue
9. Pipe running thru application area. Trees showing signs of stress due to application of fluids on foliage.
10. Frac tank with berm
11. Applicator (was located to shoot into an area with woody vegetation...According to inspector, they were to have removed the vegetation prior to application.
12. Dirt sample being collected
13. Applicator in middle of application area
14. Application area
15. Application area
16. Application area with applicator

Eastern Tank Services

Hartford, AR

Sampling on 1/14/09



Eastern Tank-Hartford
Sample description for diagram
1/14/09

X1- Water Sample 1A

Conductivity: 8,810 $\mu\text{S/cm}$
Lab #: 2009-0158

X2- Water Sample 2A

Conductivity: 10,500 $\mu\text{S/cm}$
Lab #: 2009-0159

X3- Water Sample 3A

Conductivity: 15,200 $\mu\text{S/cm}$
Lab #: 2009-0160

X4- Water Sample 4A

Conductivity: 2,680 $\mu\text{S/cm}$
Lab #: 2009-0161

X5- Water Sample 5A

Conductivity: 12,700 $\mu\text{S/cm}$
Lab #: 2009-0162

X6- Water Sample 6A

Conductivity: 113 $\mu\text{S/cm}$
Lab #: 2009-0163

X7- Water Sample 7A

Conductivity: 17,500 $\mu\text{S/cm}$
Lab #: 2009-0164

X8- Water Sample 8A

Conductivity: 9,200 $\mu\text{S/cm}$
Lab #: 2009-0165

C1-Stream crossing btw shop & field 4

Conductivity: 1,610 $\mu\text{S/cm}$

C2-Ponding on SE end of field 3

Conductivity: 16,200 $\mu\text{S/cm}$

C3-Pooling between fields 1 & 2

Conductivity: 5,700 $\mu\text{S/cm}$

X1-Dirt sample 1A

Lab #: 2009-0166

X2-Dirt sample 2A

Lab #: 2009-0167

X3-Dirt sample 3A

Lab #: 2009-0168

X4-Dirt sample 4A

Lab #: 2009-0169

X5-Dirt sample 5A

Lab #: 2009-0170

X6-Dirt sample 6A

Lab #: 2009-0171

X7-Dirt sample 7A

Lab #: 2009-0172

ice-Ice sample

Lab #: 2009-0173

m1-Montoring well #1

Conductivity: 600 $\mu\text{S/cm}$

m2-Montoring well #2

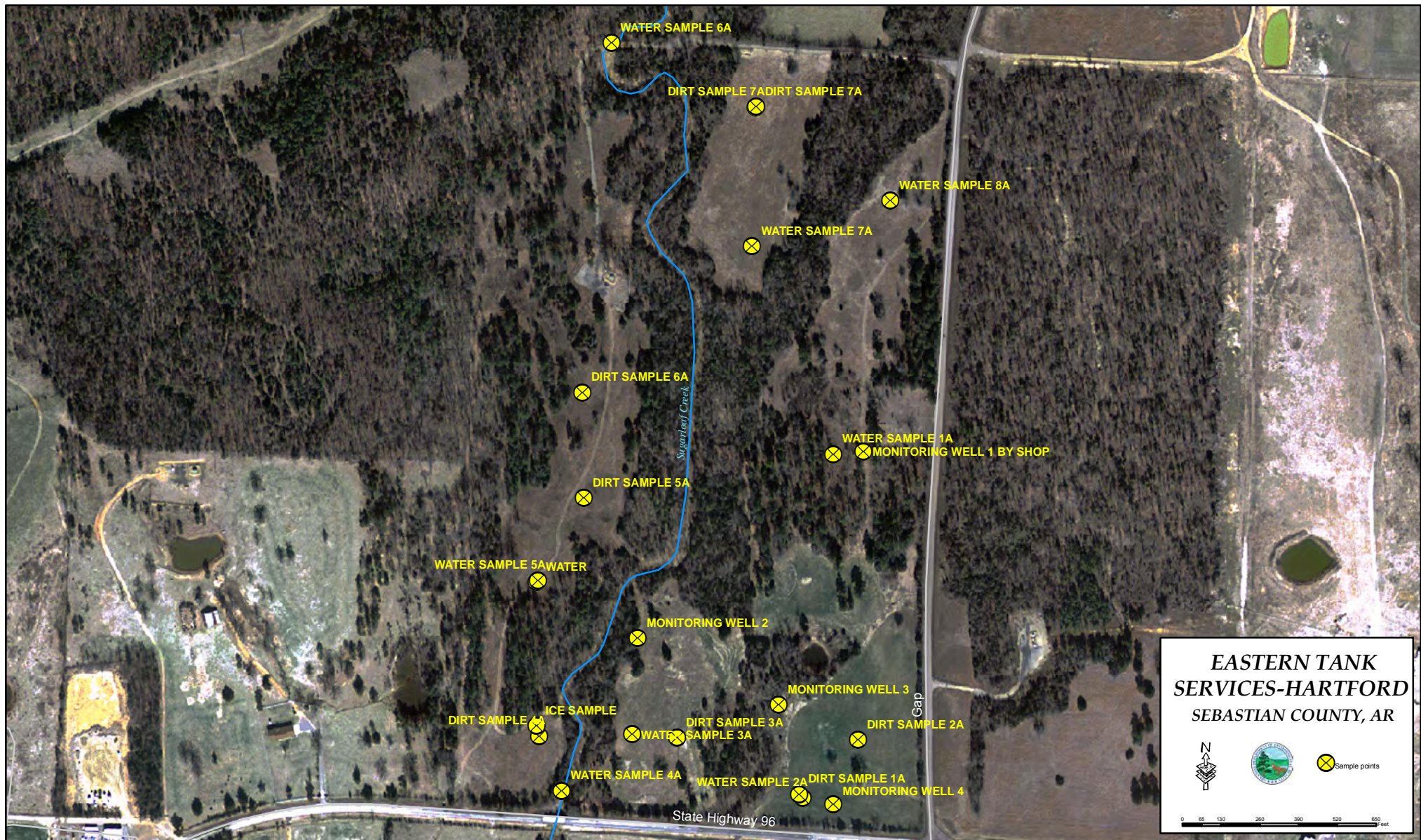
Conductivity: 835 $\mu\text{S/cm}$

m3-Montoring well #3

Conductivity: 692 $\mu\text{S/cm}$

m4-Montoring well #4

Conductivity: 695 $\mu\text{S/cm}$



Enviro Disposal

Permit #:4944-W

Date Sampled: 1/14/2009

Site Description:

Enviro Disposal is located in Sebastian County, 1 mile north of Hartford, AR off Sugarloaf Mountain Rd. This facility receives drilling fluids from tanker trucks. Facility consists of 3 holding ponds and 2 application fields. Site has not received fluids since September 2008. Currently, they have been suggested by ADEQ for consideration by the Attorney General's office.

On-Site observations:

- Application area A has dormant grass with shale soil. Application area B is all shale. Fluids have only been applied once to field B. Both fields are surrounded by a berm.
- Fluids in holding ponds are low in conductivity according to on-site readings.
- Slope of site is without question too high.
- Soil is shale, which does not absorb fluids well.
- There is a creek running directly through the site.
- Creek looked dammed up by berm created for application field 1.
- Appears to be a seep out of holding pond 3.
- Liner in holding pond 3 is bubbled.
- Lysimeters are used instead of monitoring wells.
- Holding ponds lined with plastic.

Sample descriptions

Water Sample 1C-Holding pond 1

Water Sample 2C-Holding pond 2

Water Sample 3C-Holding pond 3

Water Sample 4C-Pooling at south end of field A

Water Sample 5C-Stream beside field A

Dirt sample 1C-field north of ponds, application area B

Dirt sample 2C-middle of field A

Dirt sample 3C-Off site dirt sample

Enviro Disposal Land Farm Water Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/L)	Conductance (µMHOS)	TDS (mg/L)
2009-0174	Holding pond 1	1/14/2009	168	1,100	3,430
2009-0175	Holding pond 2	1/14/2009	109	913	2,640
2009-0176	Holding pond 3	1/14/2009	61	669	1,700
2009-0177	Pooling at south end of field A	1/14/2009	142	776	707
2009-0178	Stream beside field A	1/14/2009	33	426	238

Enviro Disposal Land Farm Soil Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/Kg)	TPH (mg/Kg)	Sodium Adsorption Ratio
2009-0179	Field N of ponds application area A	1/14/2009	69	<53.9	0.7
2009-0180	Middle of Field A	1/14/2009	193	243	2.8
2009-0181	Off site dirt sample	1/14/2009	48	172	0.5

Pictures of Enviro Disposal

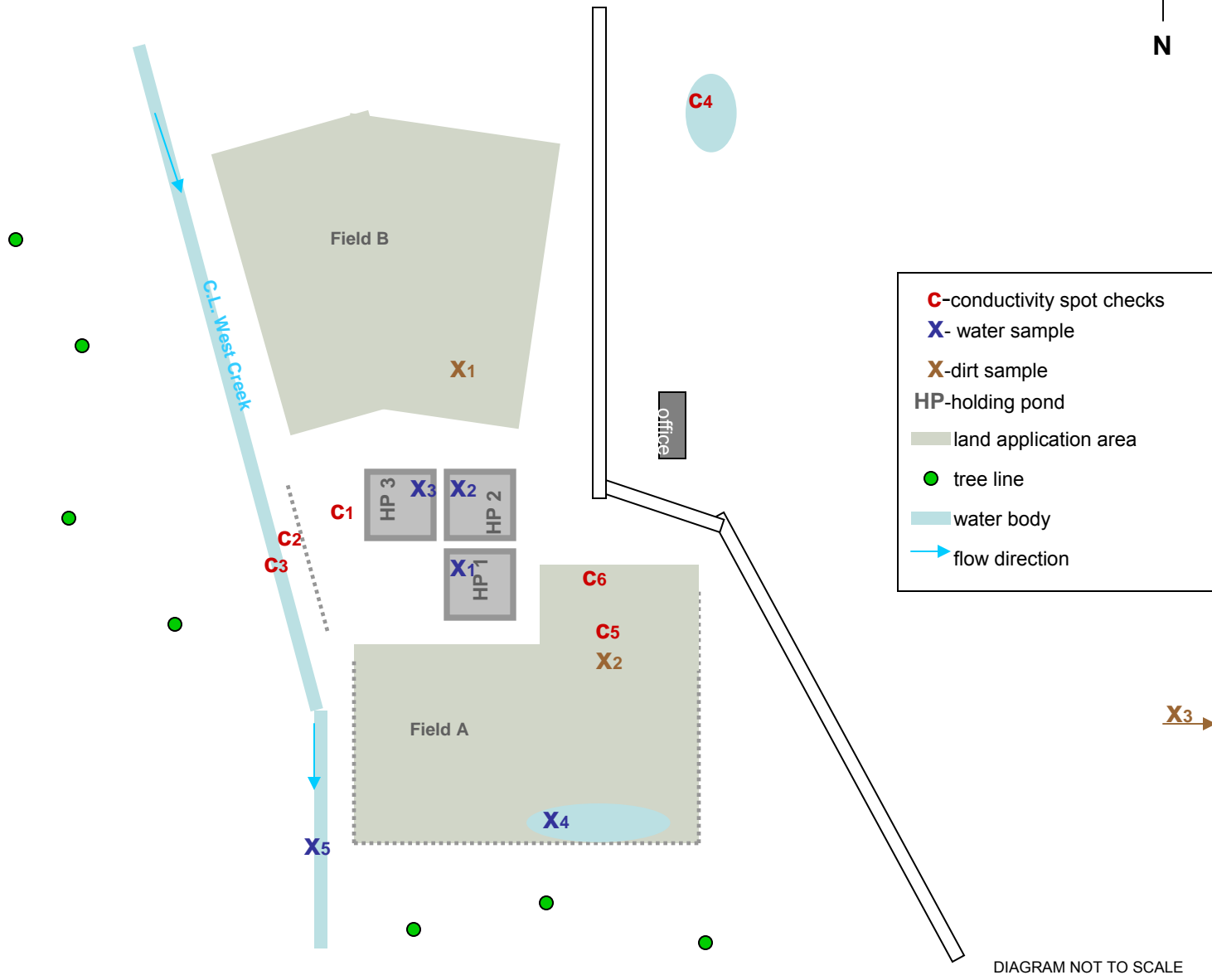
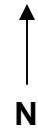




1. One of the holding ponds
2. Holding pond with pump and pipe to applicator
3. Holding pond
4. Water being retained by berm at end of application area
5. Application area
6. Application area that was being used
7. Creek that flows through property (berm behind individual is constructed near (in) creek and retains water that flows off property)
8. Creek that flows on below site
9. Lysimeter from which we were unable to obtain enough water to sample

Enviro Disposal

Hartford, AR
Sampling on 1/14/09



Enviro Disposal

Sample description for map: see engineer map of facility
1/14/09

X₁-Water sample 1C

Conductivity: 1,100 $\mu\text{S/cm}$
Lab #: 2009-0174

X₂-Water sample 2C

Conductivity: 913 $\mu\text{S/cm}$
Lab #: 2009-0175

X₃-Water sample 3C

Conductivity: 669 $\mu\text{S/cm}$
Lab #: 2009-0176

X₄-Water sample 4C

Conductivity: 776 $\mu\text{S/cm}$
Lab #: 2009-0177

X₅-Water sample 5C

Conductivity: 426 $\mu\text{S/cm}$
Lab #: 2009-0178

X₁-Dirt sample 1C

Lab #: 2009-0179

X₂-Dirt sample 2C

Lab #: 2009-0180

X₃-Dirt sample 3C

Lab #: 2009-0181

C₁-Wet weather spring west of Pond 3

Conductivity: 815 $\mu\text{S/cm}$

**C₂-Beyond levy before stream west
Of Pond 3**

Conductivity: 895 $\mu\text{S/cm}$

C₃-Stream west of Pond 3

Conductivity: 220 $\mu\text{S/cm}$

**C₄-Fresh water pond north of holding
ponds**

Conductivity: 105 $\mu\text{S/cm}$

C₅-Seepage in field A

Conductivity: 1,400 $\mu\text{S/cm}$

C₆-Seepage in field A near road

Conductivity: 400 $\mu\text{S/cm}$



Environmental Solutions and Services

Permit #: 4919-WR-1

Date Sampled: 12/10/2008

Site Description:

Environmental Solutions and Services is located in Conway County 4 miles southeast of Morrilton off Sandy Rd. The Arkansas River runs along the western border of the property. They receive drilling fluids from tanker trucks. Facility consists of 2 holding ponds and what appears to be 4 application fields.

On-Site observations:

- Fluids are applied using a center-pivot irrigation system.
- Application areas have dormant vegetation.
- There are multiple outlets through the berm.
- Evidence of irrigation system spraying over berm with direct drainage to Arkansas River backwater.
- Holding ponds lined with plastic
- Rained the day before sampling

Sample descriptions

Grab sample 1-Pond in southeast corner of field

Grab sample 2-Southwest field ditch beside dirt road

Grab sample 3-West field

Grab sample 4-Northwest field

Grab sample 5-Northeast field, puddle below irrigation equipment

Grab sample 6-Low area going into river straight west of holding pond area

Grab sample 7-East holding pond

Grab sample 8-West holding pond

Dirt sample 1-Near pond in southeast corner of field

Dirt sample 2-Southwest field ditch beside dirt road

Dirt sample 3-West field near dirt road

Dirt sample 4-West field outside of berm; next to river

Dirt sample 5-Northwest field

Dirt sample 6-Northeast field, near puddle below irrigation equipment

Dirt sample 7-Low area going into river straight west of holding pond area

Dirt sample 8-Off site dirt sample

Environmental Solutions Land Farm Water Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/L)	Conductance (µMHOS)	TDS (mg/L)
2008-3551	Pond in SE corner of field	12/10/2008	808	3,000	1,980
2008-3552	SW field ditch beside dirt road	12/10/2008	845	3,500	2,060
2008-3553	West field	12/10/2008	865	4,200	2,330
2008-3554	Northwest field	12/10/2008	1,320	6,850	3,480
2008-3555	Northwest field, puddle below irrigation equipment	12/10/2008	603	2,480	1,750
2008-3556	Low area going to river; west of holding ponds	12/10/2008	948	4,250	2,340
2008-3557	East holding pond	12/10/2008	2,690	6,300	3,810
2008-3558	West holding pond	12/10/2008	2,620	10,600	6,470

Environmental Solutions Land Farm Soil Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/Kg)	TPH (mg/Kg)	Sodium Adsorption Ratio
2008-3562	Near pond in SE corner of field	12/10/2008	350	<59.4	4.3
2008-3563	SW field, ditch beside road	12/10/2008	560	<59.4	6.8
2008-3564	West field near dirt road	12/10/2008	79	<116	12.4
2008-3565	West field outside of berm; next to river	12/10/2008	87	<72.1	2.2
2008-3566	NW field	12/10/2008	5,550	<63.7	19.8
2008-3567	NE field, puddle near irrigation equipment	12/10/2008	946	<61.7	3.1
2008-3568	Low area going into river; just west of ponds	12/10/2008	372	<62.2	6.8
2008-3569	Off site dirt sample	12/10/2008	4	<79.9	0.2

Picture Key of Environmental Solutions and Services

1. Holding pond and trucks emptying into it
2. Application area with center pivot irrigation system
3. Berm around land application area
4. Application area with standing water that we offsite out of picture
5. Standing water near a berm
6. Ditch leading to Arkansas River

Pictures of Environmental Solutions and Services



Environmental Solutions

Morrilton, AR
Sampling on 12/10/08

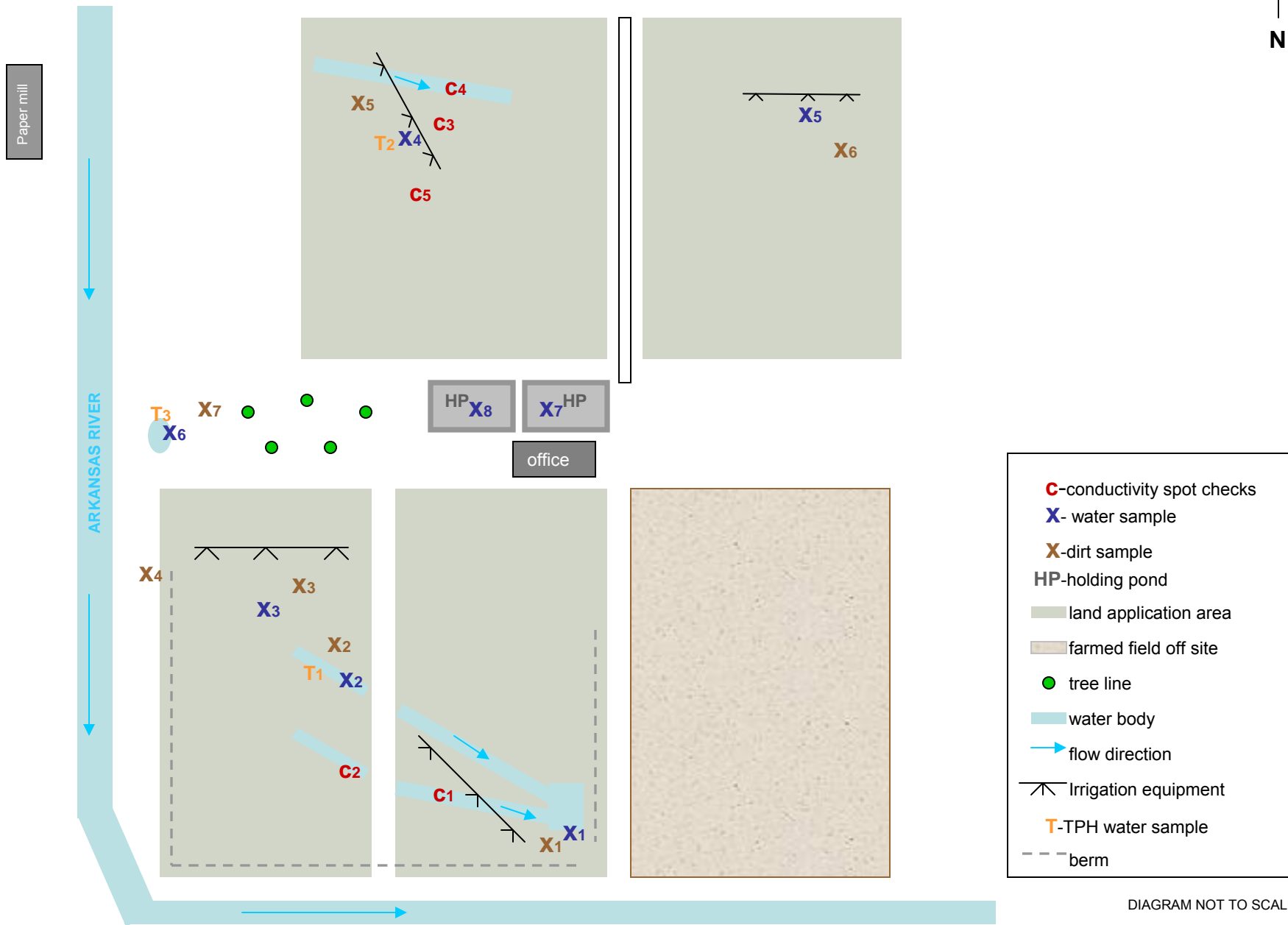


DIAGRAM NOT TO SCALE

Environmental Solutions

Sample description for diagram

12/10/08

X1- Grab sample 1

Conductivity: 3,000 $\mu\text{S}/\text{cm}$

Lab #: 2008-3551

X2- Grab sample 2

Conductivity: 3,500 $\mu\text{S}/\text{cm}$

Lab #: 2008-3552

X3- Grab sample 3

Conductivity: 4,200 $\mu\text{S}/\text{cm}$

Lab #: 2008-3553

X4- Grab sample 4

Conductivity: 6,850 $\mu\text{S}/\text{cm}$

Lab #: 2008-3554

X5- Grab sample 5

Conductivity: 2,480 $\mu\text{S}/\text{cm}$

Lab #: 2008-3555

X6- Grab sample 6

Conductivity: 4,250 $\mu\text{S}/\text{cm}$

Lab #: 2008-3556

X7- Grab sample 7

Conductivity: 6,300 $\mu\text{S}/\text{cm}$

Lab #: 2008-3557

X8- Grab sample 8

Conductivity: 10,560 $\mu\text{S}/\text{cm}$

Lab #: 2008-3558

X1-Dirt sample #1

Lab #: 2008-3562

X2-Dirt sample #2

Lab #: 2008-3563

X3-Dirt sample #3

Lab #: 2008-3564

X4-Dirt sample #4

Lab #: 2008-3565

X5-Dirt sample #5

Lab #: 2008-3566

X6-Dirt sample #6

Lab #: 2008-3567

X7-Dirt sample #7

Lab #: 2008-3568

X8-Dirt sample #8

Lab #: 2008-3569

C1-Low spot/ditch going to SE pond

Conductivity: 2,600 $\mu\text{S}/\text{cm}$

C2-SW ditch beside dirt road

Conductivity: 2,600 $\mu\text{S}/\text{cm}$

C3-Irrigation track in NW field

Conductivity: 3,500 $\mu\text{S}/\text{cm}$

C4-Ditch through NW field

Conductivity: 4,200 $\mu\text{S}/\text{cm}$

C5-Puddle in NW field beside mid road

Conductivity: 5,700 $\mu\text{S}/\text{cm}$

Arkansas River back waters

DIRT SAMPLE 8

DIRT SAMPLE 5
GRAB SAMPLE 4

GRAB SAMPLE 5 DIRT SAMPLE 6

DIRT SAMPLE 7
GRAB SAMPLE 6

HOLDING PONDS/GRAB SAMPLE 7,8

DIRT SAMPLE 4

DIRT SAMPLE 3
GRAB SAMPLE 3

DIRT AND WATER SAMPLE 2

DIRT SAMPLE 1 GRAB SAMPLE 1

ENVIRONMENTAL
SOLUTIONS & SERVICES
Conway County, AR



? Sample points

0 0.0125 0.025 0.05 0.075 0.1 0.125 Miles

Fayetteville Shale Land Farm

Permit #: 4891-WR-1

Date Sampled: 11/25/2008

Site Description:

Fayetteville Shale Land Farm is located in Lonoke County off of State Highway 381. This facility has been converted from a minnow farm to a land farm. They receive drilling fluids from tanker trucks. There is a conductivity meter on site to check trucks as they receive fluids.

On-Site observations:

- They appear to apply fluids with high oil content directly onto application fields.
- Application areas are not vegetated.
- Fluids have the ability to get into Shumaker Branch. Nearby berm is less than 100ft from stream. Also, ditch between application fields runs into Shumaker Branch.
- Holding pond lined with plastic and has thick layer of oil.
- Evidence of uneven application. Farm seems to apply drilling fluids using a hose.

Sample descriptions

Stream above site-creek above land farm (Shumaker Branch).

Pond water sample 1-southwest field below holding pond

Pond water sample 2-southwest field

Ditch between ponds-ditch running between application fields into Shumaker Branch.

Stream below site-stream below land farm

Pond water sample 3-corner of southeast pond near Dirt Sample 2

Pond water sample 4-northeast field

Pond water sample 5-northwest field

Holding pond sample-receiving pond

Dirt sample 1-southwest field

Dirt sample 2-corner of southeast field

Dirt sample 3-northeast field

Dirt sample 4-field off site

Dirt sample 5-northwest field

Dirt sample 6-southwest field (note: labeled Dirt sample 5 in map/GPS point)

*Dirt Sample 3 and 5 do not have a GPS point and therefore are not on the map.

Fayetteville Shale Land Farm Water Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/L)	Conductance (µMHOS)	TDS (mg/L)
2008-3356	Shumaker Branch above site	11/25/2008	12	170	167
2008-3357	SW field below holding ponds	11/25/2008	988	3,290	2,100
2008-3358	SW field	11/25/2008	236	2,330	816
2008-3359	Ditch between ponds	11/25/2008	204	1,000	662
2008-3360	Shumaker Branch below site	11/25/2008	124	617	367
2008-3361	Corner of SE pond	11/25/2008	6,460	23,300	13,700
2008-3362	NE field	11/25/2008	281	1,250	672
2008-3363	NW field	11/25/2008	456	1,970	1,040
2008-3364	Holding pond sample	11/25/2008	Oil Sample	Oil Sample	Oil Sample

Fayetteville Shale Land Farm Soil Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/Kg)	TPH (mg/Kg)	Sodium Adsorption Ratio
2008-3365	SW field	11/25/2008	550	5,560	2.6
2008-3366	Corner of SE field	11/25/2008	6,440	42500	14.2
2008-3367	NE field	11/25/2008	2,500	<67	9.3
2008-3368	Off site dirt sample	11/25/2008	13	<65.6	0.4
2008-3369	NW field	11/25/2008	190	169	2.7
2008-3370	SW field	11/25/2008	450	3,790	18.7

Pictures of Fayetteville Shale Land Farm

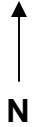


1. Pooled water at end of application area
2. Application area where fluids were being applied
3. Holding pond (oil skimmer seen at far end of pond)
4. Application area where fluids were just being piped into area

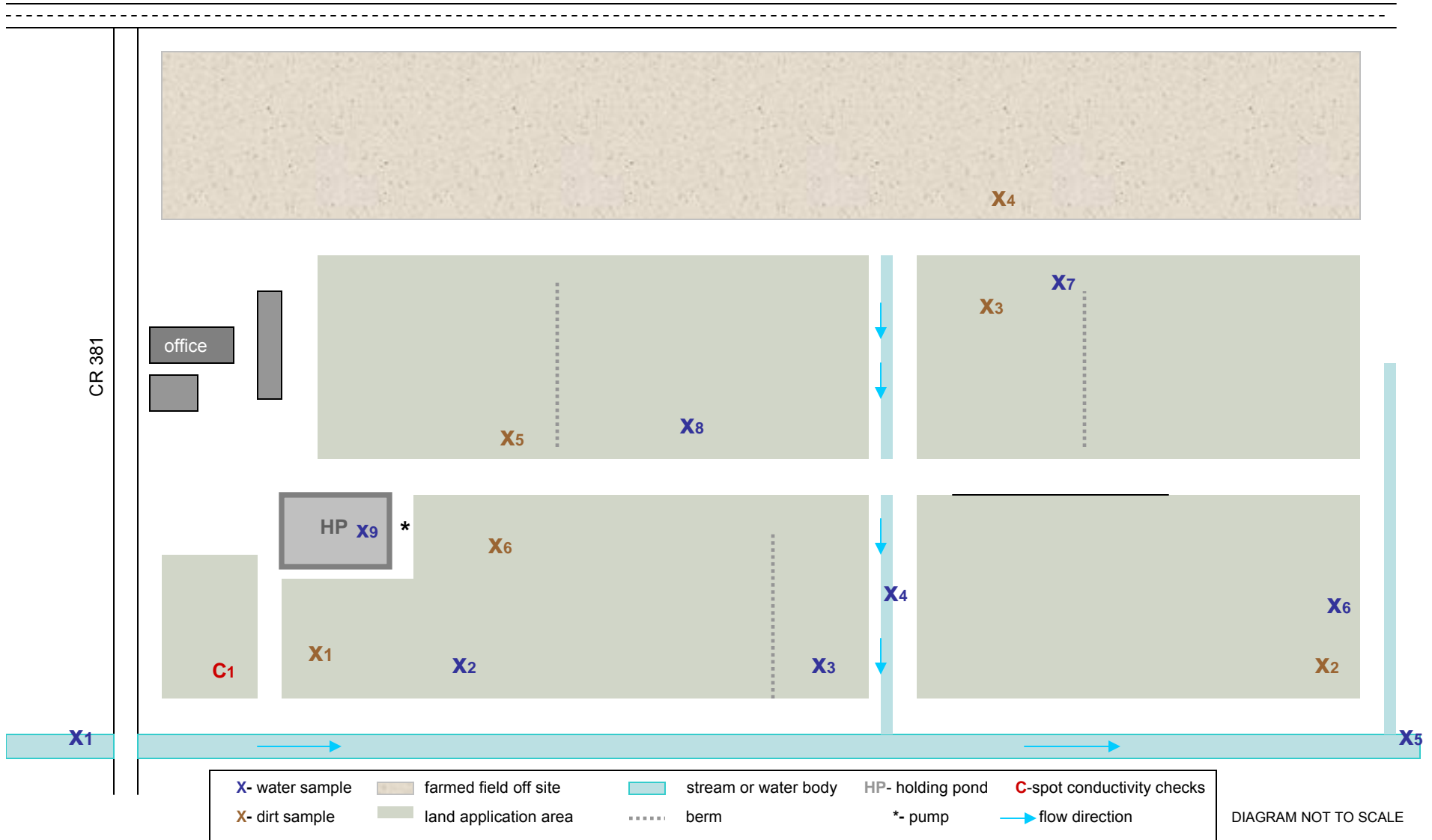
Fayetteville Shale Land Farm

Lonoke County, AR

Sampling on 11/25/08



Highway 70



Fayetteville Shale Land Farm

Sample description for diagram

11/25/08

X₁- Creek above landfarm

Conductivity: 170 $\mu\text{S}/\text{cm}$

Lab #: 2008-3356

X₂- Pond water sample #1

Conductivity: 3,290 $\mu\text{S}/\text{cm}$

Lab #: 2008-3357

X₃- Pond water sample #2

Conductivity: 2,330 $\mu\text{S}/\text{cm}$

Lab #: 2008-3358

X₄- Ditch between ponds

Conductivity: 1,000 $\mu\text{S}/\text{cm}$

Lab #: 2008-3359

X₅- Stream below landfarm

Conductivity: 617 $\mu\text{S}/\text{cm}$

Lab #: 2008-3360

X₆- Pond water sample #3

Conductivity: 23,300 $\mu\text{S}/\text{cm}$

Lab #: 2008-3361

X₇- Pond water sample #4

Conductivity: 1,250 $\mu\text{S}/\text{cm}$

Lab #: 2008-3362

X₈- Pond water sample #5

Conductivity: 1,970 $\mu\text{S}/\text{cm}$

Lab #: 2008-3363

X₉- Holding pond sample

No Conductivity on site due to nasty conditions for meter

Lab #: 2008-3364

X₁-Dirt sample #1

Lab #: 2008-3365

X₂-Dirt sample #2

Lab #: 2008-3366

X₃-Dirt sample #3

Lab #: 2008-3367

X₄-Dirt sample #4

Off site sample

Lab #: 2008-3368

X₅-Dirt sample #5

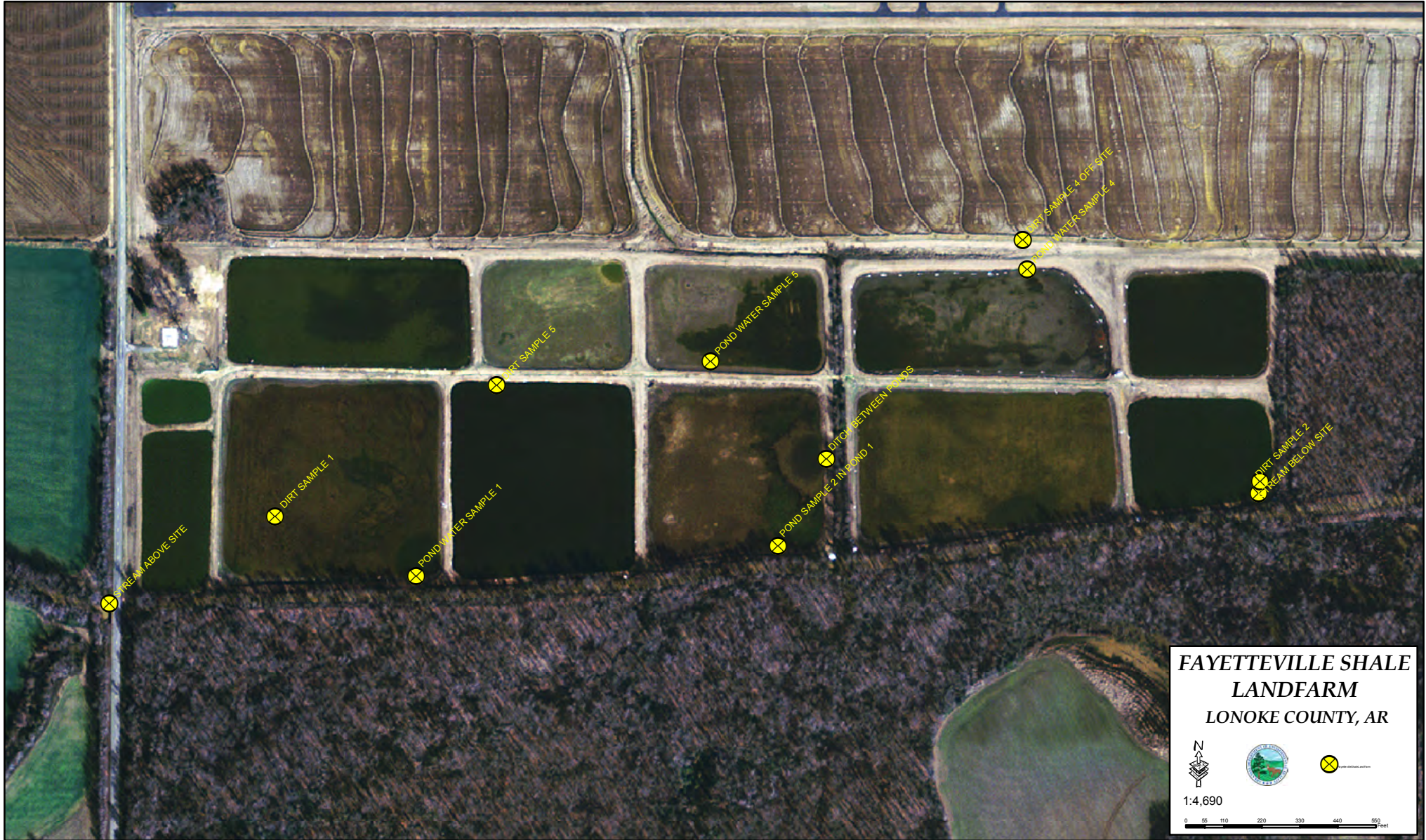
Lab #: 2008-3369

X₆-Dirt sample #6

Lab #: 2008-3370

C₁-dry western field on property

Conductivity: 336 $\mu\text{S}/\text{cm}$



**FAYETTEVILLE SHALE
LANDFARM
LONOKE COUNTY, AR**



1:4,690

0 55 110 220 330 440 550 Feet

Fugo Services

Permit #: 4500-W

Date Sampled: 1/08/2009

Site Description:

Fugo Services is located in Franklin/Logan County, 2.5 miles northwest of Roseville, AR off State Highway 309. This facility receives frac tanks only. They apply fluids from some tanks and store/transfer other tanks. Facility consists of one application field, and no holding ponds. The Arkansas River runs along the eastern border of the property.

On-Site observations:

- Application area has dormant vegetation.
- Permit states application be spreader bar on tankers.
- Berm around most frac tanks (11). Manager says frac tanks (3) outside berm are empty. Did not sample.
- Rained 2 days prior to sampling.
- Evidence of uneven application.

Sample descriptions

Water Sample 1A-pooled water at back of property

Water Sample 2A-Ditch at beginning of property

Dirt sample 1-Field behind frac tanks

Dirt sample 2-Field west of drive

Dirt sample 3-South east of field

Dirt sample 4-Rise in south field

Dirt sample 5-Pooled water at back of property

Dirt sample 6-East field near well

Dirt sample 7-Off-site in nearby cow pasture

Fugo Services Land Farm Water Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/L)	Conductance (µMHOS)	TDS (mg/L)
2009-0065	Pooled water near back of property	1/8/2009	443	1,800	2,040
2009-0066	Ditch at front of property	1/8/2009	141	722	688

Fugo Services Land Farm Soil Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/Kg)	TPH (mg/Kg)	Sodium Adsorption Ratio
2009-0067	Field behind frac tanks	1/8/2009	3,190	879	15.0
2009-0068	Field west of drive	1/8/2009	522	2880	3.5
2009-0069	SE of field	1/8/2009	7	327	11.9
2009-0070	Rise in south of field	1/8/2009	576	1060	3.8
2009-0071	Near pooled water at back of property	1/8/2009	1,030	2730	7.6
2009-0072	East field near well	1/8/2009	5,520	5740	36.7
2009-0073	Off site in nearby pasture	1/8/2009	18	<75.2	0.3

Pictures of Fugo Services





1. Picture showing frac tanks and application area
2. Picture of frac tanks showing containment
3. Rear view of frac tanks showing containment
4. Application area
5. Application area with hose
6. Area near frac tanks with standing water (probably from rainfall event)
7. Application area near back of property with standing water that continued off property
8. Swale where water collects across from application area (accessible to livestock)
9. Pooled water in application area
10. Pond at "entrance" to facility.

Fugo Services Ozark, AR Sampling on 1/8/09

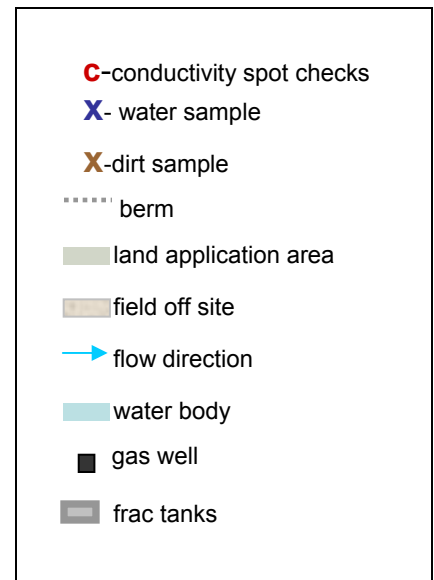
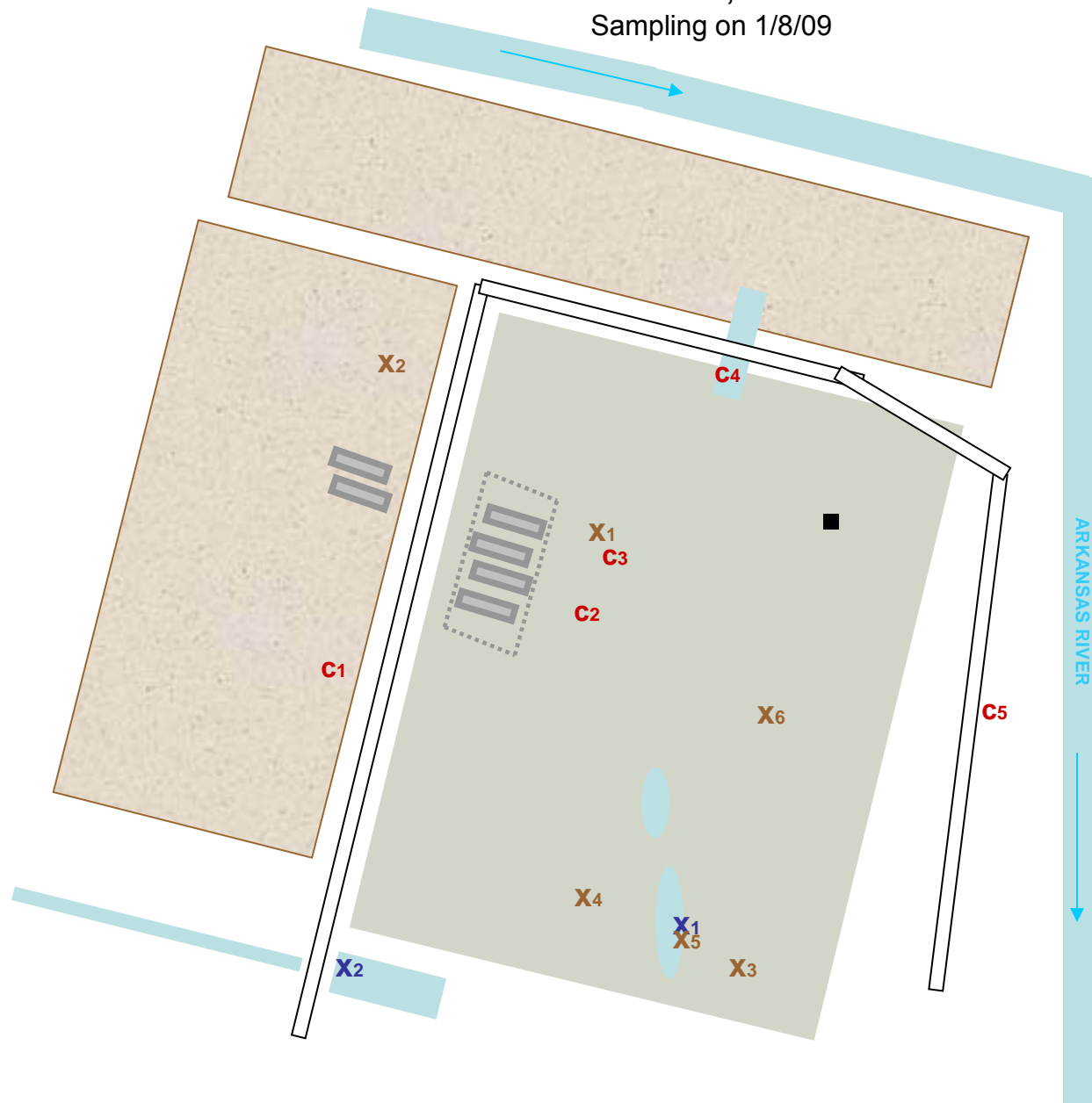
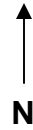


DIAGRAM NOT TO SCALE

Fugo Services
Sample description for diagram
1/8/09

X₁- Water sample #1A- pooled water at back of property (south)

Conductivity: 1800 $\mu\text{S}/\text{cm}$

Lab #: 2009-0065

X₂- Water sample #2A- ditch at beginning of property

Conductivity: 722 $\mu\text{S}/\text{cm}$

Lab #: 2009-0066

X₁-Dirt sample 1A

Lab #: 2009-0067

X₂-Dirt sample 2A

Lab #: 2009-0068

X₃-Dirt sample 3A

Lab #: 2009-0069

X₄-Dirt sample 4A

Lab #: 2009-0070

X₅-Dirt sample 5A

Lab #: 2009-0071

X₆-Dirt sample 6A

Lab #: 2009-0072

X₇-Dirt sample 7A- off site sample

Lab #: 2009-0073

C₁-small puddle beside drive

Conductivity: 1800 $\mu\text{S}/\text{cm}$

C₂-puddle behind tanks

Conductivity: 2380 $\mu\text{S}/\text{cm}$

C₃-puddle in tracks behind tanks

Conductivity: 5000 $\mu\text{S}/\text{cm}$

C₄-pooled water by drive due north

Conductivity: 1125 $\mu\text{S}/\text{cm}$

C₅-pooled water near river (east)

Conductivity: 150 $\mu\text{S}/\text{cm}$

FUGO SERVICES
Franklin County, AR



0 0.005 0.01 0.02 0.03 0.04 0.05 Miles



Green Grow Disposal

Permit #: 3968-WR-1

Date Sampled: 12/11/2008

Site Description:

Green Grow is located in Sebastian County, 1 mile south of Greenwood, AR off Stewart Lane. Vache Grasse Creek runs along the western border of the property. They receive drilling fluids and mud from tanker trucks. Facility consists of one holding pond and 3 application fields.

On-Site observations:

- Holding pond is clay lined.
- Application areas have dormant vegetation except for field 3 (some green grass).
- Vache Grasse Creek does not appear affected based on conductivity readings performed on site.
- Spray gun application of drilling fluids.
- According to manager drilling mud is brought on site on a regular basis and difficult to deal with. Facility had a pond designated specifically for drilling mud on site.
- Rained two days prior to site visit.
- Appears fluid from field 3 seeps onto adjoining property.
- Monitoring well locations may not be appropriate. One well has water level at about the same level as the pond. High conductivity measured on site.

Sample descriptions

Water Sample 1A-Northeast corner of property, Vache Grasse Creek downstream sample

Water Sample 2A-North field (field #3) past berm and across fence on neighbor's property

Water Sample 6A-Middle field (field #2) mud pond

Water Sample 8A-Holding pond

Water Sample 9A-Vache Grasse Creek upstream sample

Dirt sample 2A-North field (field #3) past berm and across fence on neighbor's property

Dirt sample 3A-North field (field #3) pooling west corner

Dirt sample 4A-North field (field #3) southwest side

Dirt sample 5A-North end of middle field (field #2)

Dirt sample 6A-Middle field (field #2) mud pool

Dirt sample 7A-South field (field #1) near spray gun

Dirt sample 10A-Off site dirt sample

Green Grow Disposal Land Farm Water Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/L)	Conductance (µMHOS)	TDS (mg/L)
2008-3570	Vache Grasse Creek below downstream of property	12/11/2008	75	93	68
2008-3571	North field; past berm on neighbor's property	12/11/2008	493	1,190	1,340
2008-3572	Middle field mud pond	12/11/2008	887	3,340	4,680
2008-3573	Holding pond	12/11/2008	428	2,650	970
2008-3574	Vache Grasse Creek above property	12/11/2008	4	80	47

Green Grow Disposal Land Farm Soil Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/Kg)	TPH (mg/Kg)	Sodium Adsorption Ratio
2008-3575	North field; past berm on neighbor's property	12/11/2008	103	<75.3	0.2
2008-3576	North field; pooling in west corner	12/11/2008	327	235	1.2
2008-3577	North field, SW side	12/11/2008	599	1810	2.6
2008-3578	North end of middle field	12/11/2008	522	2440	3.2
2008-3579	Middle field mud pool	12/11/2008	1,220	2200	3.0
2008-3580	South field near spray gun	12/11/2008	116	1100	5.5
2008-3581	Off site dirt sample	12/11/2008	64	<82.5	2.6

Pictures of Green Grow Disposal





1. Sample from pond where drilling mud has been deposited.
2. Swale where crosses into neighboring property
3. Application Field
4. Application Field
5. Application Field
6. Application Field
7. Baler from well sampled near holding pond
8. Crew sampling well

Highway 10

Green Grow Disposal

Greenwood, AR
Sampling on 12/11/08

N
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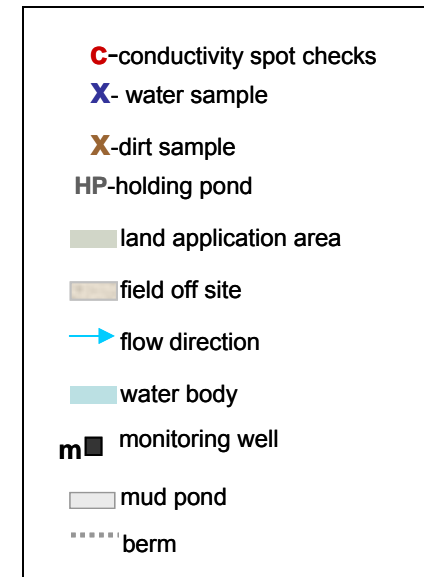
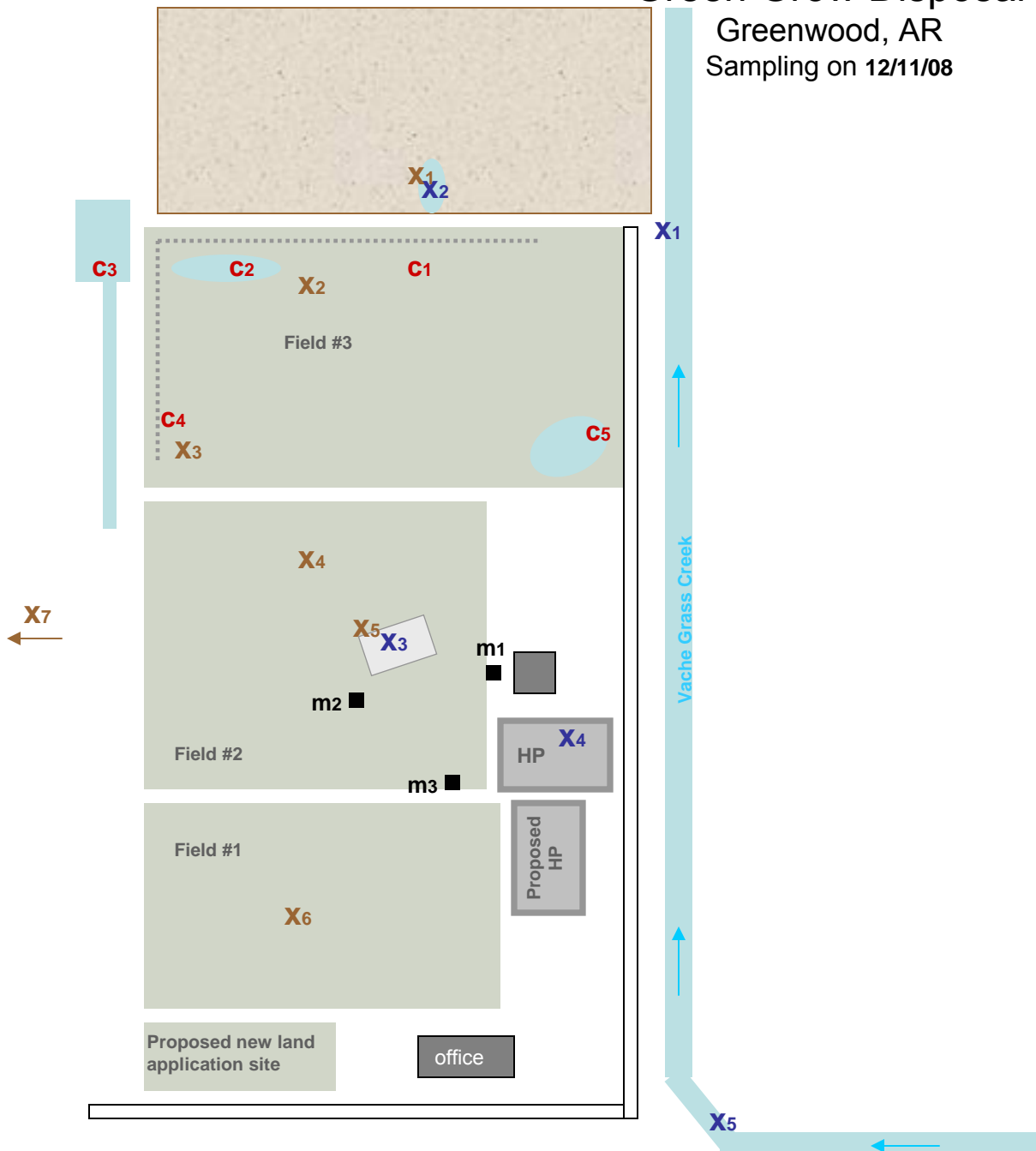


DIAGRAM NOT TO SCALE

Green Grow Land Farm
Sample description for diagram
12/11/08

X1- Grab Sample 1A

Conductivity: 93 $\mu\text{S/cm}$
Lab #: 2008-3570

X2- Grab Sample 2A

Conductivity: 1190 $\mu\text{S/cm}$
Lab #: 2008-3571

X3- Grab Sample 6A

Conductivity: 3340 $\mu\text{S/cm}$
Lab #: 2008-3572

X4- Grab Sample 8A

Conductivity: 2650 $\mu\text{S/cm}$
Lab #: 2008-3573

X5- Grab Sample 9A

Conductivity: 80 $\mu\text{S/cm}$
Lab #: 2008-3574

X1-Dirt sample 2A

Lab #: 2008-3575

X2-Dirt sample 3A

Lab #: 2008-3576

X3-Dirt sample 4A

Lab #: 2008-3577

X4-Dirt sample 5A

Lab #: 2008-3578

X5-Dirt sample 6A

Lab #: 2008-3579

X6-Dirt sample 7A

Lab #: 2008-3580

X7-Dirt sample 10A

Lab #: 2008-3581

C1-North field (#3) pooling

Conductivity: 2,000 $\mu\text{S/cm}$

C2-North field (#3) pooling, west corner

Conductivity: 1,800 $\mu\text{S/cm}$

**C3-Pond at NW side of field #3
Between properties (?)**

Conductivity: 734 $\mu\text{S/cm}$

C4-Pooling at NW field side on site

Conductivity: 1769 $\mu\text{S/cm}$

C5-East side of field #3, pool area

Conductivity: 1,300 $\mu\text{S/cm}$

m1-Monitoring well #1

pH: 7.4 Temp: 15.1°C
Conductivity: 666 $\mu\text{S/cm}$

m2-Monitoring well #2

pH: 5.18 Temp: 15.2°C
Conductivity: 374 $\mu\text{S/cm}$

m3-Monitoring well #3

pH: 7.19 Temp: 12.6°C
Conductivity: 2300 $\mu\text{S/cm}$



Comer Mining Corporation

Permit #:4693-WR-2

Date Sampled: 1/07/2009

Site Description:

Comer Mining is located in Sebastian County 2.5 miles north of Midland AR off Hwy 253. They receive drilling fluids and mud from tanker trucks. Facility consists of 3 active holding ponds and 4 application fields.

On-Site observations:

9. Holding ponds are clay lined.
10. Application area 3 has moderate grass coverage. Application area 2 has dormant grass. Application area 6 is mostly tilled dirt with grass sprigs. Application area 1 is all drilling mud partially mixed with topsoil. Application area 4 is forested.
11. Uses reel and gun to apply fluids.
12. Old mining site, shale and coal most common.
13. Drilling mud a problem, shut down pond 1
14. Rained 2 days prior to sampling
15. Many places where water flows underground. (as per Mr. Henry Comer)
16. Installed monitoring wells week of 1/12/2009. Went back to sample.
17. Pit pond overflowing into stream that runs along property which is a trib to MacKenay Creek. Also, natural drainage through property.
18. Ponding on SW corner (application field 3?)

Sample descriptions

Water Sample 1-Property line pooled water border of field 4 (woods)

Water Sample 2-Holding pond #2

Water Sample 3-Holding pond #4

Water Sample 4-Holding pond #1

Water Sample 5-Holding pond #5

Water Sample 6-Tributary from Comer property to MacKenay Creek

Dirt sample 1-Application field #3

Dirt sample 2-Application field #3 corner pooled area near new berm

Dirt sample 3-Application field #5

Dirt sample 4-Application field #4

Dirt sample 5-Application field #2

Dirt sample 6-Application field #6

Dirt sample 7-Application field #1

Dirt sample 8-Off-site, near bridge on Mockingbird Hill Rd.

Henry Comer Land Farm Water Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/L)	Conductance (µMHOS)	TDS (mg/L)
2009-0051	Property line; pooled water west of field 4	1/7/2009	364	1,600	853
2009-0052	Holding pond 2	1/7/2009	253	1,620	2,740
2009-0053	Holding pond 4	1/7/2009	533	2,500	1,740
2009-0054	Holding pond 1	1/7/2009	614	2,880	1,680
2009-0055	Holding pond 5	1/7/2009	188	900	585
2009-0056	Tributary from Comer property to MacKenay Creek	1/7/2009	10	99	65

Henry Comer Land Farm Soil Sample Critical Results

Lab #	Sample Description	Collection Date	Chloride (mg/Kg)	TPH (mg/Kg)	Sodium Adsorption Ratio
2009-0057	Application field 3	1/7/2009	3,150	3,830	10.2
2009-0058	Application field 3, corner area near new berm	1/7/2009	635	4240	5.4
2009-0059	Application field 5	1/7/2009	875	<68.6	2.6
2009-0060	Application field 4	1/7/2009	182	<67.5	3.1
2009-0061	Application field 2	1/7/2009	26	<75.9	1.2
2009-0062	Application field 6	1/7/2009	609	678	3.6
2009-0063	Application field 1	1/7/2009	1,600	2,900	6.0
2009-0064	Off site dirt sample	1/7/2009	2	<59.5	0.3

Pictures of Henry Comer Disposal

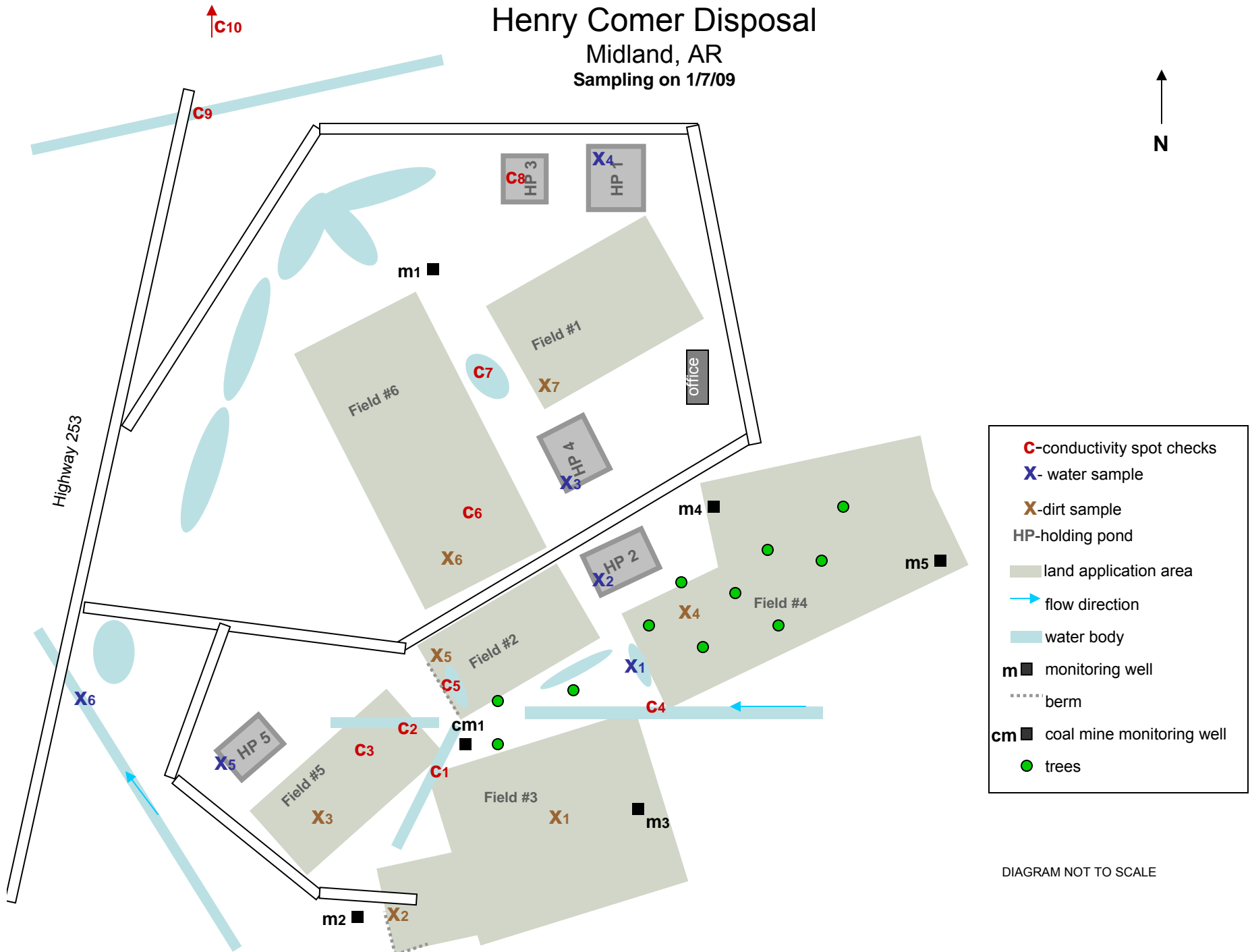




1. Application area with standing water
2. Nat sampling near application area number 4
3. Applicator with application area number 4
4. Application area number 4 with water distribution system
5. Application field
6. MacKenay Creek and discharge from pond on Comer property
7. Holding pond number 2
8. Pooled water in application area
9. Holding pond
10. Mine pit
11. Unknown

Henry Comer Disposal

Midland, AR
Sampling on 1/7/09



Henry Comer
Sample description for map
1/07/09

X1-Water sample 1

Conductivity: 1,600 $\mu\text{S/cm}$
Lab #: 2009-0051

X2-Water sample 2

Conductivity: 1,620 $\mu\text{S/cm}$
Lab #: 2009-0052

X3-Water sample 3

Conductivity: 2,500 $\mu\text{S/cm}$
Lab #: 2009-0053

X4-Water sample 4

Conductivity: 2,880 $\mu\text{S/cm}$
Lab #: 2009-0054

X5-Water sample 5

Conductivity: 900 $\mu\text{S/cm}$
Lab #: 2009-0055

X6-Water sample 6

Conductivity: 99 $\mu\text{S/cm}$
Lab #: 2009-0056

X1-Dirt sample #1

Lab #: 2009-0057

X2-Dirt sample #2

Lab #: 2009-0058

X3-Dirt sample #3

Lab #: 2009-0059

X4-Dirt sample #4

Lab #: 2009-0060

X5-Dirt sample #5

Lab #: 2009-0061

X6-Dirt sample #6

Lab #: 2009-0062

X7-Dirt sample #7

Lab #: 2009-0063

X8-Dirt sample #8

Lab #: 2009-0064

C1-Stream beside (east) field #5

Conductivity: 419 $\mu\text{S/cm}$

C2-Stream beside (north) field #5

Conductivity: 800 $\mu\text{S/cm}$

C3-Pooled water in field #5

Conductivity: 350 $\mu\text{S/cm}$

**C4-Trib coming from off property
bordering field #4**

Conductivity: 240 $\mu\text{S/cm}$

C5-Field #2 pooled area

Conductivity: 230 $\mu\text{S/cm}$

C6-Field #6 bottom end by road

Conductivity: 1456 $\mu\text{S/cm}$

C7-Pooled area (Field 6?) next to Pond 4

Conductivity: 20 $\mu\text{S/cm}$

C8- Holding pond #3

Conductivity: 87 $\mu\text{S/cm}$

C9-MacKenay Creek at Hwy 253

Conductivity: 245 $\mu\text{S/cm}$

C10-MacKenay Creek at Mockingbird Hill Rd

Conductivity: 150 $\mu\text{S/cm}$

Henry Comer

Sample description for map
1/15/09 revisit after wells drilled

**Overflowing pond at end of property by Hwy
253**

Conductivity: 707 $\mu\text{S/cm}$

Trickle from pond going to creek

Conductivity: 707 $\mu\text{S/cm}$

**Creek running along Comer property-trib to
MacKenay Creek**

Conductivity: 165 $\mu\text{S/cm}$

m1-Montoring well #1

not enough water

m2-Montoring well #2

Conductivity: 228 $\mu\text{S/cm}$

m3-Montoring well #3

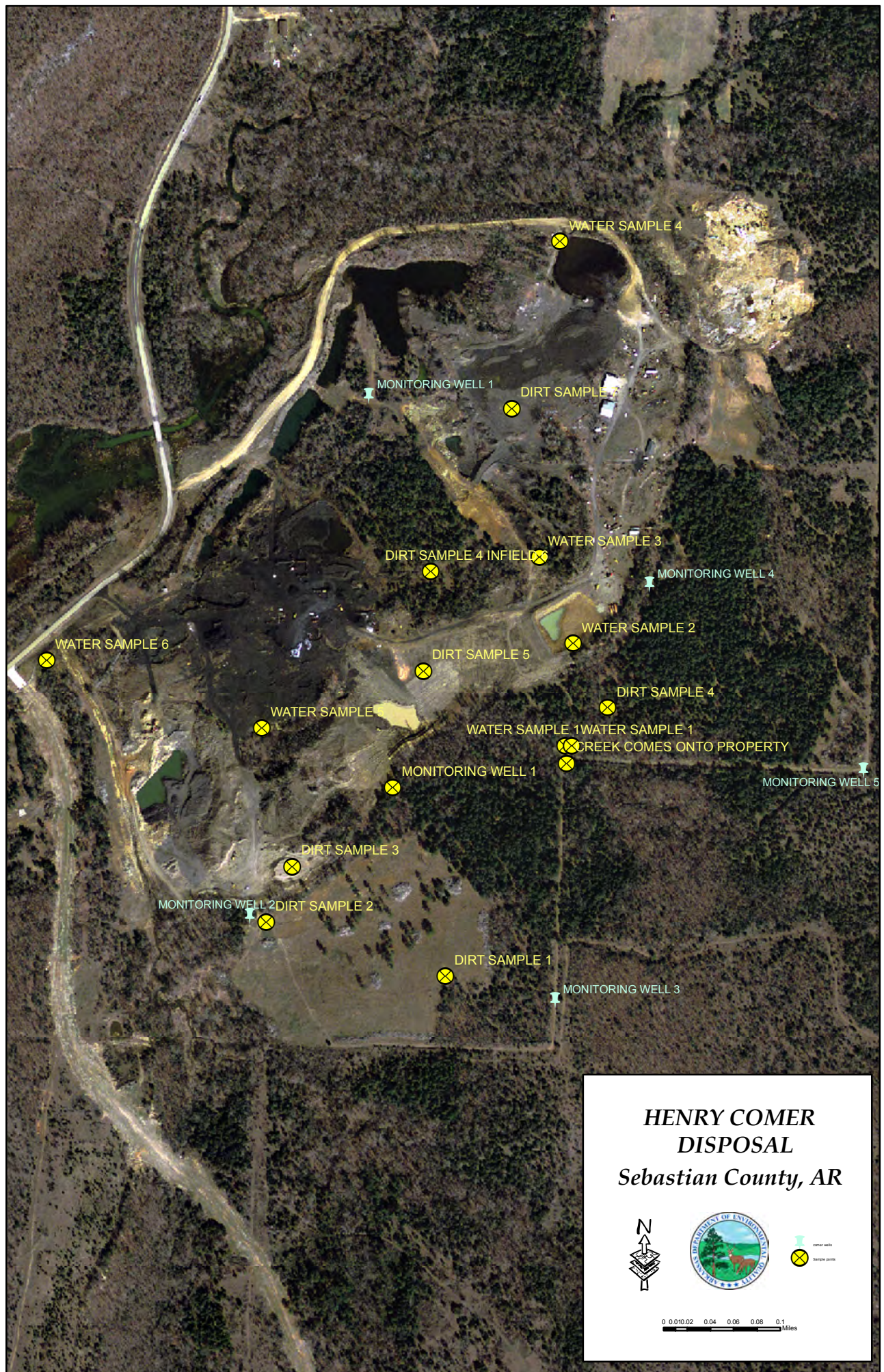
Conductivity: 234 $\mu\text{S/cm}$

m4-Montoring well #4

Conductivity: 355 $\mu\text{S/cm}$

m5-Montoring well #5

no water



**HENRY COMER
DISPOSAL**
Sebastian County, AR

