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PINE BLUFF ARSENAL
10020 KABRICH CIRCLE
PINE BLUFF AR 71602-9500

May 26, 2016

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SUBJECT: Arkansas River Study Plan

Ms. Tammie Hynum, Chief
Hazardous Waste Division
Arkansas Department of Environmental Quality
5301 Northshore Drive
North Little Rock, Arkansas 72118-5317

Dear Ms. Hynum,

In response to your comments on the study plan titled "Assessment of DDT Compounds and Mercury in Ecological and Human Health Receptors in the Arkansas River Adjacent to the Pine Bluff Arsenal, Pine Bluff, Arkansas," Pine Bluff Arsenal (PBA) has made all the requested changes to the attached revised study plan. Regarding Item 2 in your letter, Figure 1, the two locations US1 and DS1 were removed from the map as they were residual from a previous map and not relevant for this study. Thank you for your careful review and recommendations to the study plan.

If you have any questions, please don't hesitate to contact Mr. Kevin Dorman, Restoration Manager at 870-540-2806 or via e-mail to kevin.d.dorman2.civ@mail.mil.

Sincerely,

A handwritten signature in blue ink that reads "Doug McKim".

Doug McKim,
Chief Environmental Compliance Division
Risk Management and Regulatory Affairs

Study Plan

Assessment of DDT Compounds and Mercury in Ecological and Human Health Receptors in the Arkansas River Adjacent to the Pine Bluff Arsenal, Pine Bluff, Arkansas

Pine Bluff Arsenal
Pine Bluff, Arkansas



May 2016

Introduction

The work described in this Study Plan is designed to assess DDT compounds and mercury in ecological and human health receptors in the Arkansas River adjacent to Pine Bluff Arsenal. The original draft Study Plan was prepared during March 2016; this revised Study Plan incorporates Arkansas Department of Environmental Quality comments dated April 28, 2016 (ADEQ, 2016).

The two chemicals of interest, DDT compounds and mercury, are both bioaccumulative compounds that have elevated concentrations in Phillips Creek, a stream that enters the Arkansas River adjacent to the Arsenal. Pine Bluff Arsenal (PBA) is planning to conduct the field work for this study July through September of 2016.

DDT Compounds

The inclusion of DDT compounds (DDT, DDE and DDD) in this study is in response to comments submitted by the ADEQ (2015) to PBA regarding ADEQ's review of the Five-Year Groundwater Assessment and Ecological Trend Monitoring Report, Reporting Years: 2009-2013 (GLEC, 2014). Specifically, this Study Plan addresses Item #2 in ADEQ's (2015) letter to PBA which requests that PBA perform an updated evaluation of the impact of DDT compounds in Phillips Creek on the Arkansas River. A previous evaluation of the Arkansas River was conducted by PBA in 1993 in which tissue and/or sediment samples were collected and analyzed for DDT compounds from three stations upstream of Phillips Creek and four stations downstream of Phillips Creek. A summary of the 1993 Arkansas River assessment is as follows (GLEC, 1994):

- DDT compounds in Arkansas River sediment occurred at low levels upstream and downstream of Phillips Creek. In backwater areas of the Arkansas River where sediment characteristics are conducive for holding organic contaminants (e.g., greater concentrations of organic carbon and smaller sediment particles), the concentrations of DDT compounds were higher but typical for low background concentrations for these contaminants.
- Fish collected in the Arkansas River approximately 2 kilometers (km) below Phillips Creek did not contain concentrations of DDT compounds that were different than fish collected approximately 2 km above Phillips Creek.
- Caged Asian clams (*Corbicula sp.*) exposed to the Arkansas River approximately 0.5 km downstream of Phillips Creek accumulated DDT compounds greater than caged Asian clams deployed at a station upstream of Phillips Creek.

The 1993 survey findings indicated that the elevated levels of DDT compounds in Phillips Creek do get transported into the Arkansas River and sessile organisms that inhabit the stretch of stream immediately downstream of Phillips Creek can accumulate these residues (GLEC, 1994).

The amount of DDT compounds that are transported to the Arkansas River, however, do not significantly impact the concentration of these residues in the local fish community nor do they become sequestered in the sediment located adjacent to the Arsenal. PBA proposes to conduct a repeat of the 1993 Arkansas River survey in 2016 with the inclusion of mercury as a target analyte.

Background of DDT Contamination in Phillips Creek

Site 11, the Former Chemical Manufacturing Area, encompasses a 50-acre site located in the north central part of PBA and within the Phillips Creek watershed. From 1948 to 1957, the facility was leased to Niagara Chemical Company for the production of pesticides such as DDT, and its intermediates including chlorobenzene (GLEC, 2016a). During this time, malathion, parathion, and chlorobenzenes were brought onsite to be blended with pesticide products, but were not manufactured onsite. Nearly all of the 168 buildings included in the Site 11 complex became contaminated with DDT during both production activities and due to disposal of off-specification DDT at several locations within Site 11.

During the mid-1970's through 1983, remedial activities included the removal of 18,000 CY of contaminated sediment (disposed of in SWMU 23), removal of the most highly contaminated DDT materials in the Site 11 buildings (disposed of in SWMU 24), and the construction of the Run-off Control Impoundment (RCI). The RCI was constructed to capture contaminated runoff followed by the demolition of buildings, industrial sewer lines, and the disposal of contaminated soils within Site 11. The RCI discharges to an intermittent stream which flows into Phillips Creek. The point of RCI's discharge to the intermittent stream is subject to a National Pollutant Discharge Elimination System (NPDES) permit. The RCI is also subject to the requirements of hazardous waste Permit 1H-RN2 .

PBA has monitored Phillips Creek to determine the effectiveness of this large and extensive remediation effort. One of these monitoring tasks consisted of placing clams (*Corbicula sp.*) at a location in Phillips Creek approximately 500 m downstream from the confluence of the intermittent stream containing the discharge from the RCI, station PC4, to determine if Phillips Creek was continuing to receive DDT from the remediated area.

During the late 1990's, a review of the monitoring data of DDT compounds in clam, fish and sediment samples collected along Phillips Creek indicated there was considerable DDT contamination upstream of the point where the RCI enters Phillips Creek. This observation suggested there was a DDT source outside the area constructed to constrain Sites 7 and 11 surface water runoff to the RCI. A study was undertaken by PBA in 1999 to identify the source of this contamination in Phillips Creek. Initially, semipermeable membrane devices (SPMDs, a surrogate for fish tissue) were placed at ten locations along Phillips Creek, and were measured for DDT after a 4 week exposure. The results of this initial task confirmed the observation that the majority of the DDT contamination in Phillips Creek was not originating from the RCI, but rather from an unknown source outside the remediated drainage area and suggested a point to

which it entered the stream. A follow-up study used C18 disks placed *in situ* in the soil across a grid suspected to contain the source. Elevated DDT in several of the C18 disks indicated the location of the source of the contamination. In 2004, PBA removed the contaminated soil located at SWMU 75 (Site 11) and contained the contaminated soil in SWMU 23 within the retention drainage area (GLEC, 2016a). The site found to be contaminated outside the remediated area was capped and is being maintained and monitored (SWMU 75). As a follow up to the remedial activity associated with SWMU 75 and as part of the Ecological Monitoring Plan, PBA is monitoring DDT compounds in fish and sediment samples from five stations in Phillips Creek. Tables 1 and 2 provide a summary of the findings from the annual ecological monitoring as well as historical data collected from previous PBA monitoring activities (GLEC, 2016a).

Table 1. 4,4-DDT, 4,4-DDD, and 4,4-DDE ($\mu\text{g}/\text{kg}$) concentrations in fish and Asian clam samples collected from Phillips Creek

Site	Sample Year	Sample Month	Species	DDT	DDD	DDE	Total DDT
PC1	2005	July	Green sunfish	14.5	12.6	39.8	67
PC1	2006	Sept	Green sunfish	4.3	4.3	4.5	13
PC1	2007	Oct	Green sunfish	2,824	2,794	1,908	7,526
PC1	2009	Aug	Green sunfish	<140	<140	<140	<140
PC1	2009	Aug	Green sunfish	<140	<140	<140	<140
PC1-Rep1	2010	Oct	Green sunfish	<200	<200	<200	<200
PC1-Rep2	2010	Oct	Green sunfish	<200	<200	<200	<200
PC1-Rep1	2011	Oct	Green sunfish	<200	<200	<200	<200
PC1-Rep2	2011	Oct	Green sunfish	<200	<200	<200	<200
PC1-Rep1	2012	Oct	Green sunfish	<20	<20	<20	<20
PC1-Rep2	2012	Oct	Green sunfish	<20	<20	<20	<20
PC1-Rep1	2013	Dec	Warmouth	<20	<20	27	27
PC1-Rep2	2013	Dec	Green sunfish	<20	<20	42	42
EB	1995	Nov	Sunfish	169	48	307	524
PC2	2005	July	1 yellow bullhead, 1 longear sunfish, 2 blackspotted topminnows, 2 red shiners	1,695	5,424	3,975	11,094
PC2	2006	Sept	Blackspotted topminnows	332	2,106	2,246	4,684
PC2	2007	Oct	2 green sunfish, 1 golden shiner, 1 blackspotted topminnow, 2 yellow bullhead	14,019	26,926	12,695	53,640
PC2	2009	Aug	Green sunfish	<140	<140	41,000	41,000
PC2	2011	Oct	18 Red Shiners, 12 Black Stripe Top Minnows	2,400	10,000	21,000	33,400
PC2	2012	Oct	2 Green Sunfish, 2 Red Shiners, 1 Golden Shiner, 10 Blackstripe Topminnows	<20	<20	810	810
PC2	2013	Dec	Green sunfish	3,800	9,600	6,600	20,000
PC3	2005	July	Sunfish - rep 1	3,636	8,910	14,044	26,590
PC3	2005	July	Sunfish - rep 2	1,733	2,654	3,780	8,167

Site	Sample Year	Sample Month	Species	DDT	DDD	DDE	Total DDT
PC3	2006	Sept	3 green sunfish, 3 bluegill sunfish	23,457	47,434	9,244	80,135
PC3	2007	Oct	Green sunfish	54,089	113,783	53,266	221,138
PC3	2009	Aug	Green sunfish	7,000	11,000	7,500	25,500
PC3	2009	Aug	Green sunfish	6,800	9,800	8,000	24,600
PC3	2010	Oct	Bluegill	3,500	13,000	10,000	26,500
PC3	2011	Oct	Bluegill	1,700	4,500	5,800	12,000
PC3-Rep1	2012	Oct	Yellow Bullhead	980	3,400	4,500	8,880
PC3-Rep2	2012	Oct	Green sunfish	270	120	890	1,280
PC3	2013	Dec	Green sunfish	1,900	9,600	5,300	16,800
PC4	1991	Sept	<i>Corbicula</i> 49-day <i>in situ</i> exposure	5,490	6,780	1,680	13,950
PC4	1992	Mar	<i>Corbicula</i> 41-day <i>in situ</i> exposure	9,600	20,390	2,580	32,570
PC4	1992	Nov	<i>Corbicula</i> 63-day <i>in situ</i> exposure	970	4,570	820	6,360
PC4	1993	Mar	<i>Corbicula</i> 42-day <i>in situ</i> exposure	370	1,320	250	1,940
PC4	1993	Dec	<i>Corbicula</i> 56-day <i>in situ</i> exposure	184	831	0.5	1,016
PC4	1994	Oct	<i>Corbicula</i> 60-day <i>in situ</i> exposure	2,158	4,914	1,358	8,430
PC4	1995	Nov	Green sunfish	9,353	40,332	21,430	71,115
PC4	2005	July	Green sunfish	367	44.8	1,003	1,415
PC4	2006	Sept	5 green sunfish, 1 longear sunfish	785	5,940	1,506	8,231
PC4	2007	Oct	2 yellow bullhead, 2 warmouth, 2 bluegill sunfish	23,415	59,546	16,467	99,428
PC4	2009	Aug	Green sunfish	5,600	10,000	6,800	22,400
PC4	2010	Oct	Bluegill	200	10,000	6,700	16,900
PC4	2010	Oct	Bluegill	1,700	9,300	4,900	15,900
PC4-Rep1	2011	Oct	Green sunfish	1,800	13,000	7,800	22,600
PC4-Rep2	2011	Oct	Green sunfish	1,200	7,700	4,200	13,100

Site	Sample Year	Sample Month	Species	DDT	DDD	DDE	Total DDT
PC4-Rep1	2012	Oct	Green sunfish	29	<20	1,300	1,329
PC4-Rep2	2012	Oct	Green sunfish	74	35	1,400	1,509
PC4-Rep3	2012	Oct	Longear sunfish	170	<20	1,300	1,470
PC4-Rep1	2013	Dec	Green sunfish	2,200	9,300	6,100	17,600
PC4-Rep2	2013	Dec	Green sunfish	1,100	5,300	3,100	9,500
PC5	2009	Aug	Green sunfish	5,000	9,400	6,000	20,400
PC5	2010	Oct	Bluegill	1,600	7,600	3,300	12,500
PC5-Rep1	2011	Oct	Bluegill	1,200	6,000	2,700	9,900
PC5-Rep2	2011	Oct	Bluegill	880	4,700	2,100	7,680
PC5	2013	Dec	Bluegill	1,800	4,900	3,800	10,500

Table 2. 4,4-DDT, 4,4-DDD, and 4,4-DDE ($\mu\text{g}/\text{kg}$) and total organic carbon (TOC) (mg/kg) concentrations in sediment samples collected from Phillips Creek

Site	Sample Year	Sample Month	DDT	DDD	DDE	TOC
PC1	1991	Sept	1	2	4	not meas.
PC1	1992	Aug	3	0.5	6	not meas.
PC1	1993	Sept	1	1	2	not meas.
PC1	1994	June	15	9	8	not meas.
PC1	1996	Jan	1	1	0.5	not meas.
PC1	2003	July	2	0.2	2.2	not meas.
PC1 - rep 1	2005	July	4.27	4.22	9.23	not meas.
PC1 - rep 2	2005	July	<4.08	<4.08	4.62	not meas.
PC1 - rep 3	2005	July	<4.62	<4.62	<4.62	not meas.
PC1 - rep 3 Dup	2005	July	<6.45	<6.45	<6.45	not meas.
PC1 - rep 4	2005	July	0.23	<0.22	0.85	not meas.
PC1	2006	Sept	<1.9	<1.9	<1.9	not meas.
PC1 - rep 1	2007	Oct	<0.90	<0.90	0.91	not meas.
PC1 - rep 2	2007	Oct	<0.75	<0.75	0.75	not meas.
PC1 - rep 3	2007	Oct	0.55	0.45	1.08	not meas.
PC1 - rep 4	2007	Oct	0.51	0.24	0.81	not meas.

Site	Sample Year	Sample Month	DDT	DDD	DDE	TOC
PC1 - rep 1	2009	Aug	32	<6.7	<6.7	not meas.
PC1 - rep 2	2009	Aug	240	<27	<27	not meas.
PC1 - rep 3	2009	Aug	32	<6.7	<6.7	not meas.
PC1 - rep 4	2009	Aug	130	<14	<14	not meas.
PC1 - rep 1	2010	Oct	<1.4	<1.4	<1.4	0.38
PC1 - rep 2	2010	Oct	<1.4	<1.4	<1.4	
PC1 - rep 3	2010	Oct	<1.4	<1.4	<1.4	
PC1 - rep 4	2010	Oct	<1.4	<1.4	<1.4	
PC1 - rep 1	2011	Oct	<1.4	<1.4	1.9	0.39
PC1 - rep 2	2011	Oct	<1.4	<1.4	2.4	
PC1 - rep 3	2011	Oct	<1.4	<1.4	2.4	
PC1 - rep 4	2011	Oct	<1.4	<1.4	2.7	
PC1 - rep 1	2012	Oct	<1.4	<1.4	<1.4	0.37
PC1 - rep 2	2012	Oct	<1.4	<1.4	<1.4	
PC1 - rep 3	2012	Oct	<1.4	<1.4	<1.4	
PC1 - rep 4	2012	Oct	<1.4	<1.4	<1.4	
PC1 - rep 1	2013	Dec	<20	<20	<20	0.87
PC1 - rep 2	2013	Dec	<20	<20	<20	
PC1 - rep 3	2013	Dec	<20	<20	<20	
PC1 - rep 4	2013	Dec	<20	<20	<20	
PC2	1995	Nov	59,717	2,011	598	not meas.
PC2	2003	July	1,638	298	39	not meas.
PC2 - rep 1	2005	July	902	419	24.9	not meas.
PC2 - rep 2	2005	July	14,843	5,837	168	not meas.
PC2 - rep 1	2006	Sept	1,799	91.2	32.3	not meas.
PC2 - rep 2	2006	Sept	130	384	202	not meas.
PC2 - rep 1	2007	Oct	1,037	70	18	not meas.
PC2 - rep 2	2007	Oct	1,541	87	20	not meas.
PC2 - rep 1	2009	Aug	500	80	<67	not meas.
PC2 - rep 2	2009	Aug	5,800	440	<270	not meas.
PC2	2010	Oct	430	74	<27	0.12
PC2	2011	Oct	1,000	340	260	0.22
PC2	2012	Oct	960	68	16	<0.1
PC2	2013	Dec	1,100	190	45	<0.1

Site	Sample Year	Sample Month	DDT	DDD	DDE	TOC
PC3	1995	Nov	729	102	30	not meas.
PC3	2003	July	7,161	4,118	46	not meas.
PC3	2005	July	9,871	2,591	496	not meas.
PC3	2006	Sept	1,123	610	406	not meas.
PC3	2007	Oct	2,921	59.1	11.8	not meas.
PC3	2009	Aug	46,000	2,600	510	not meas.
PC3 - rep 1	2010	Oct	170	130	28	0.14
PC3 - rep 2	2010	Oct	150	150	26	0.16
PC3 - rep 1	2011	Oct	4,500	730	1,500	0.21
PC3 - rep 2	2011	Oct	<66	<66	990	0.29
PC3 - rep 1	2012	Oct	43,000	2,500	300	0.15
PC3 - rep 2	2012	Oct	2,100	950	330	<0.1
PC3 - rep 1	2013	Dec	7,300	120	39	<0.1
PC3 - rep 2	2013	Dec	65,000	1,300	4,000	<0.1
PC4	1991	Sept	4,602	178	1,694	not meas.
PC4	1992	Aug	9,389	2,170	939	not meas.
PC4	1993	Sept	6,649	2,095	0.5	not meas.
PC4	1994	June	9,778	1,803	238	not meas.
PC4	1995	Nov	4,535	1,543	125	not meas.
PC4	2003	July	26	0.6	0.3	not meas.
PC4	2005	July	3,257	4,284	385	not meas.
PC4	2006	Sept	162	95.1	46.0	not meas.
PC4	2007	Oct	12,620	692	136	not meas.
PC4	2009	Aug	4,300	440	<140	not meas.
PC4	2010	Oct	4,200	180	<67	0.12
PC4	2011	Oct	180	38	290	0.19
PC4	2012	Oct	1,100	1,300	200	0.43
PC4	2013	Dec	1,600	53	53	0.35
PC5	2009	Aug	860	860	170	not meas.
PC5	2010	Oct	2,400	280	<140	0.35
PC5	2011	Oct	1,100	<270	4,500	0.46
PC5	2012	Oct	3,800	750	140	0.38
PC5	2013	Dec	100	29	<20	0.91

Mercury

PBA submitted a “Plan to Achieve Compliance with the Mercury Limit at Outfall 01C, Pine Bluff Arsenal, Permit AR0001678” to the Arkansas Department of Environmental Quality (ADEQ) on February 1, 2016 (GLEC, 2016b). The Plan describes the non-compliance of mercury with its permit limit at NPDES Outfall 01C, a historical perspective of mercury on the Arsenal, the presence of mercury in Phillips Creek, and an evaluation of several engineering and non-engineering options for achieving compliance.

After a review and evaluation of the engineering and non-engineering options for achieving compliance with the mercury limit at Outfall 01C, the approach recommended in the Plan was to add a subcategory to the designated use for Phillips Creek that restricts its environmental protection to aquatic life (GLEC, 2016b). The merits for selection of this option were discussed in the Plan. ADEQ reviewed the Plan and expressed concern that if the designated use in Phillips Creek is modified by restricting its protection to aquatic life, would the State’s water quality standard for mercury be attained in the downstream waters, that is, the Arkansas River downstream of Phillips Creek.

To address ADEQ’s concern over protection of the downstream use, PBA has modified the previously submitted Study Plan dated March 2016 to include mercury. Mercury in water, sediment and fish tissue will be measured in samples collected from the Arkansas River above and below Phillips Creek. The results of the study will be used to determine if the water quality standard for mercury is being attained in the Arkansas River and if not is the discharge of mercury from Phillips Creek causing the impairment.

2016 Arkansas River Sampling Stations, Sample Media and Analyses

A general framework for the sampling effort proposed for the Arkansas River study is provided in this section. Once the framework is finalized with ADEQ, a more detailed description of the Study Plan can be developed.

Seven stations in the Arkansas River will be assessed for mercury and DDT compounds in sediment, fish and Asian clam samples. Mercury will also be measured in water at these same seven stations. Three of these stations will be located upstream of Phillips Creek to assess background conditions of mercury and DDT compounds in the Arkansas River and four stations will be located downstream of Phillips Creek to assess the potential impact of mercury and DDT compounds discharged from Phillips Creek to the Arkansas River. A list of these stations and their location description along with the media to be sampled and the analytes to be measured are given in Table 3; a map of their locations is given in Figure 1. Note the station numbers are the same as those used in the 1993 survey for consistency. Stations AR3 and AR6 are not included because in 1993 those stations were for macroinvertebrate community assessment only. The focus of this survey is to assess the impact of mercury and DDT compounds being released from

Phillips Creek on ecological receptors in the Arkansas River. Community assessment is considered a less sensitive indicator for mercury and DDT compounds compared to residue measurement in tissues and sediment (and also water for mercury).

Table 3. Proposed Sampling Stations in the Arkansas River, their Location and Sampling Characteristics

Station ID	General Description	Media	Measurements*
AR1	Approximately 4.6 km upstream of Phillips Cr.	Fish, water (Hg only)	Mercury, DDT compounds, species, length, weight, % lipid
AR2	Approximately 3 km upstream of Phillips Cr.	Sediment, Asian clam, water (Hg only)	Mercury, DDT compounds, TOC, Asian clam % lipid
AR4	Approximately 0.5 km upstream of Phillips Cr.	Sediment, water (Hg only)	Mercury, DDT compounds, TOC
AR5	Approximately 0.5 km downstream of Phillips Cr.	Sediment, Asian clam, water (Hg only)	Mercury, DDT compounds, TOC, Asian clam % lipid
AR7	Approximately 3 km downstream of Phillips Cr.	Sediment, water (Hg only)	Mercury, DDT compounds, TOC
AR8	Approximately 4.3 km downstream of Phillips Cr.	Fish, water (Hg only)	Mercury, DDT compounds, species, length, weight, % lipid
AR9	Approximately 5.7 km downstream of Phillips Cr.	Sediment, water (Hg only)	Mercury, DDT compounds, TOC

*EPA Method 1631 will be used for all water samples with mercury.

In addition to the stations in the Arkansas River, five stations in Phillips Creek will be sampled as part of the annual ecological monitoring plan during the same time the Arkansas River samples will be collected. These stations include PC1 through PC5 (see Table 4, Figure 2). Fish tissue and sediment samples will be collected and analyzed at each of these five stations for mercury and DDT compounds. Total mercury will be measured in water samples at each of these five stations.

Table 4. Proposed Sampling Stations in Phillips Creek, their Location and Sampling Characteristics

Station ID	General Description	Media	Measurements*
PC1	Upstream of Site 11 and associated with SWMU 75 and will serve as a control station.	Fish, sediment, water (Hg only)	Mercury, DDT compounds, species, length, weight, % lipid, TOC
PC2	Located approximately 0.5 mile downgradient from SMWU 75, this site will monitor near field effects of remedial activities.	Fish, sediment, water (Hg only)	Mercury, DDT compounds, species, length, weight, % lipid, TOC
PC3	Located approximately 1 river mile downstream from PC2, this site will monitor persistence and recovery of the remedial activities associated with SWMU 75.	Fish, sediment, water (Hg only)	Mercury, DDT compounds, species, length, weight, % lipid, TOC
PC4	Located approximately 2 river miles downstream from PC3 and downstream from the discharge from the Runoff Control Impoundment (RCI), this site will monitor persistence and recovery of the remedial activities relative to the discharge of the RCI.	Fish, sediment, water (Hg only)	Mercury, DDT compounds, species, length, weight, % lipid, TOC
PC5	Located near the confluence with the Arkansas River, this site will monitor the level of DDT contamination that potentially enters the Arkansas River.	Fish, sediment, water (Hg only)	Mercury, DDT compounds, species, length, weight, % lipid, TOC

*EPA Method 1631 will be used for all water samples with mercury.

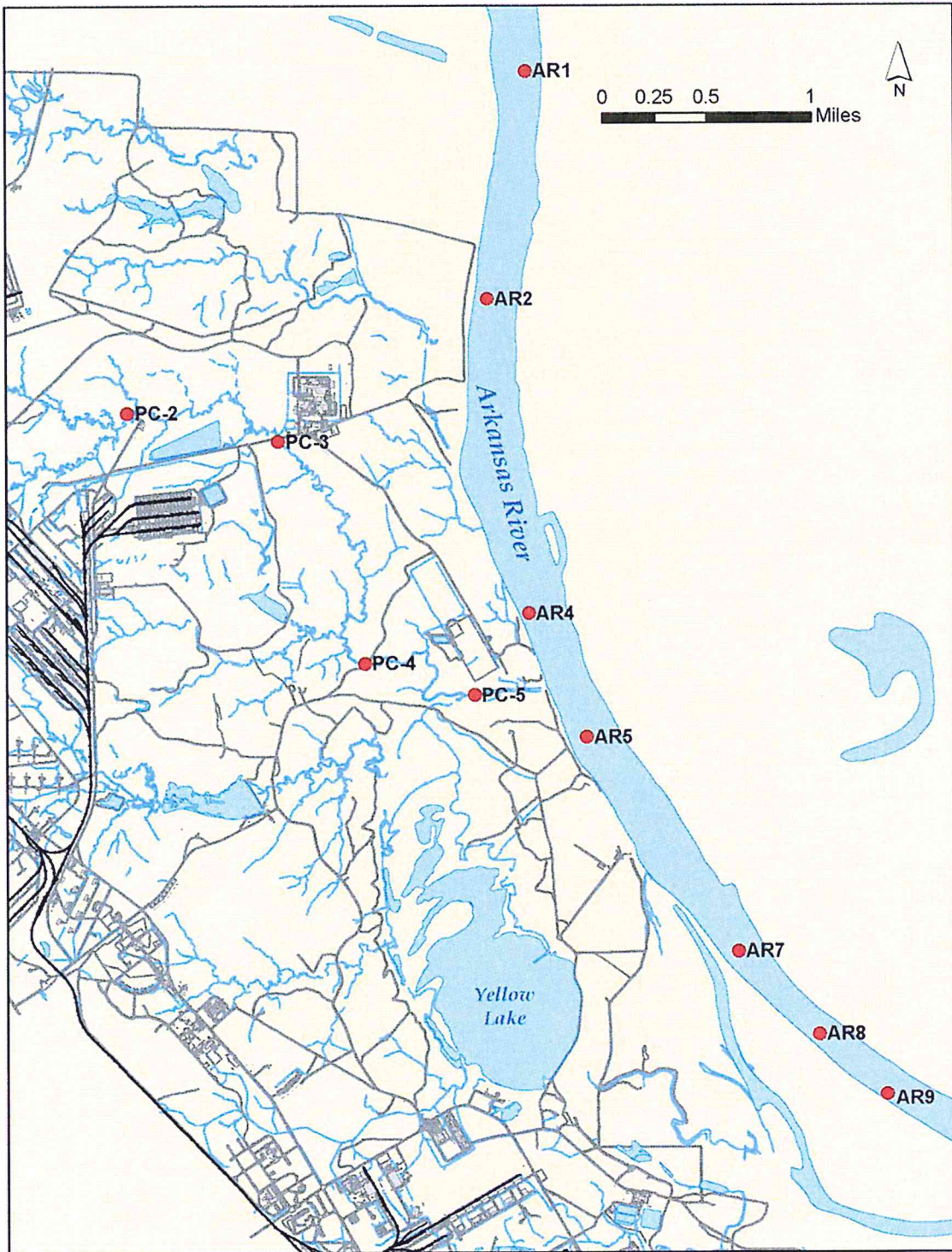


Figure 1. Proposed Sampling Locations for the Arkansas River Study.

Sediment Sampling

Sediment samples will be collected from two stations upstream of Phillips Creek and three stations downstream (Table 3, Figure 1). At each station, ten sediment samples will be collected using a Ponar dredge across a transect of the river. An effort will be made to space the samples equally across the transect. Each dredge sample will be emptied into a stainless steel bucket and mixed. A subsample of each dredge sample will be placed into clean sample jars for analysis.

As part of PBA's annual ecological monitoring, sediment samples will also be collected from each of the five Phillips Creek sites. The Phillips Creek stations will be sampled for sediment during the same time period as the Arkansas River sampling effort. All sediment measurements will be compared to sediment screening levels listed in the 2009 Remedial Action Decision Document (RADD; ADEQ, 2009). The sediment screening levels for DDT, DDD, and DDE are 0.001, 0.002, and 0.00142 mg/kg, respectively. The sediment screening level for mercury is 0.13 mg/kg.

Fish Sampling

A boat electrofishing unit will be used to collect fish in the Arkansas River. Target fish species will be largemouth bass/spotted bass and channel catfish; with a secondary species selected if neither of the target species are available at the time of collection. A target of eight individual fish per species will be collected. Fish will be filleted (skin-off) and then frozen for shipment to the analytical laboratory for analysis. Prior to filleting, each will be measured for length and weight. All measurements will be made on an individual fish basis to capture variability based on species, size and lipid content. Statistical comparisons of the mercury and DDT compounds will be made between the fish collected upstream of Phillips Creek (AR1) to those collected downstream (AR8). Total DDT (sum of DDT, DDD and DDE) in fish samples will also be compared to the tissue screening level listed in the RADD of 0.006 mg/kg ww (ADEQ, 2009).

A backpack electrofishing unit will be used to collect fish in Phillips Creek. Sunfish (green and bluegill) are the target fish species. Fish are typically small in Phillips Creek so whole body individual fish are composited into one or two samples to obtain sufficient mass for analysis. If sunfish are not available, secondary species include shiners and topminnows.

Caged Asian Clams

Asian clams (*Corbicula sp.*) will be exposed at two sites in the Arkansas River, one site upstream and one site downstream of Phillips Creek. Three replicate stainless steel cages containing the clams will be deployed at each site for eight weeks. The Asian clams will be obtained from a commercial source or collected locally. Prior to deployment, a sample of the clams will be obtained and analyzed to determine if mercury and DDT compound levels are sufficiently low. After collection of the clams at the end of eight week exposure, the clams will

be placed in a clean water flow-through system overnight to purge their intestines of non-bioaccumulated residues.

Water Sampling

Total mercury will be measured in water samples collected mid-channel at each of the seven Arkansas River sites and at each of the five Phillips Creek sites. Mercury measurements in water will be compared to the surface water screening level listed in the RADD of $0.77 \mu\text{g/L}$ as well as the State of Arkansas' water quality criterion of $0.012 \mu\text{g/L}$.

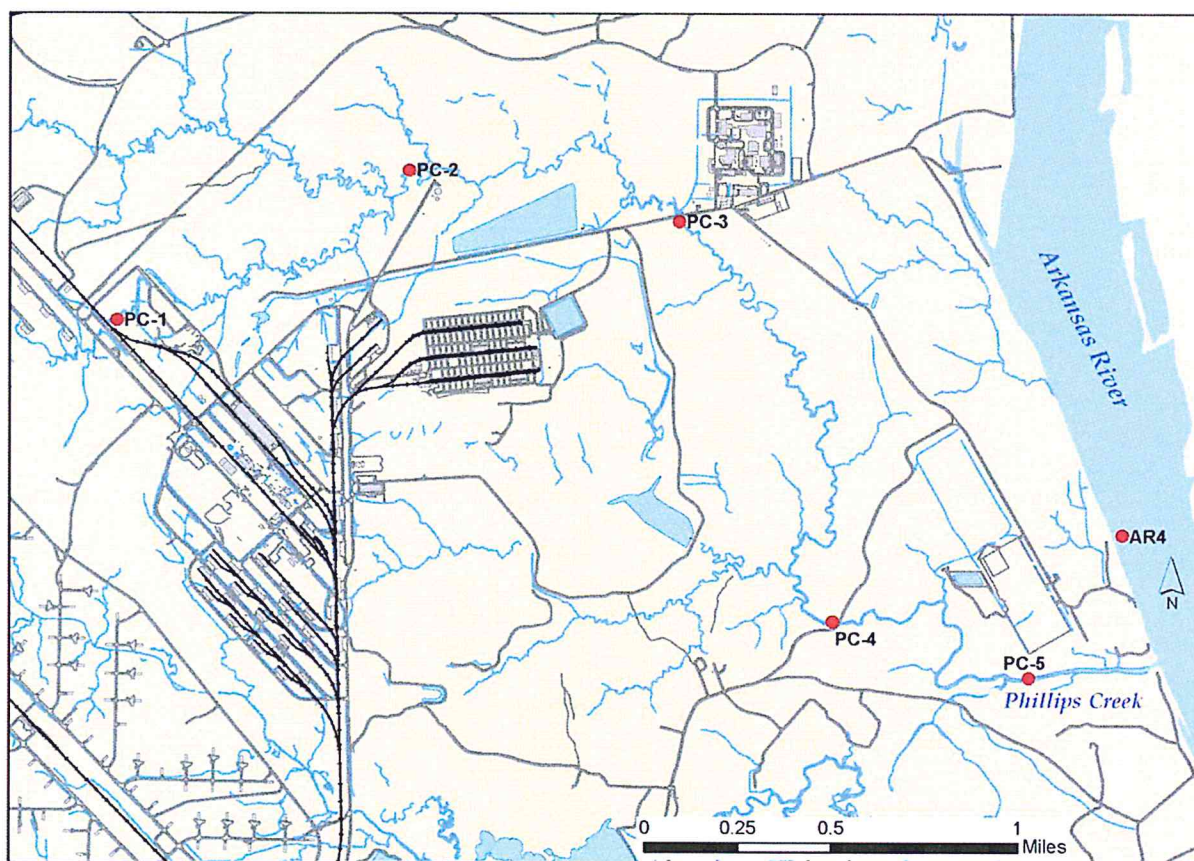


Figure 2. Current Sampling Locations for Phillips Creek Ecological Monitoring program.

References

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