

**Concentrations of Polycyclic Aromatic Hydrocarbons (PAHs) in
Sediment, Metals in Sediment, and Biological Conditions in
Days Creek, Texarkana, TX.**

A Summary for the Sulphur River Steering Committee

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Days Creek, Segment 0304, located in Bowie County, TX, originates in the mid-to-southern half of the City of Texarkana. Days Creek flows south from the city, crossing the state line into Arkansas before joining the Sulphur River. The watershed is approximately 250 km² with the upper third receiving the majority of residential and industrial storm water drainage from the City of Texarkana. Following rain events, the stream is subject to rapid increases in flow from urban runoff. Upper Days Creek is composed of four tributaries: Cowhorn Creek; Waggoner Creek; Swampoodle Creek; and Nix Creek (Figures 1 and 2). Both Days Creek and Waggoner Creek are designated as having and/or maintaining an *Intermediate* Aquatic Life Use and a Contact Recreation Use under the Texas Surface Water Quality Standards, 30 T.A.C. Chapter 307 (TCEQ, 2000).

Days Creek and Waggoner Creek have received attention in the past due to the proximity of former wood treating facilities. Creosote or coal tar pitch was the primary preservative used at the wood treating facilities in Texarkana. Creosote, a mixture of chemicals, is primarily composed of organic compounds called polycyclic (or polynuclear) aromatic hydrocarbons, or PAHs. PAHs may also be found in substances such as road tar/asphalt and roofing tar. Because PAHs are generally more dense than water, movement from soil to groundwater is possible resulting in groundwater contamination. Once contaminated, PAHs in groundwater can persist several years.

PAHs are considered dense non-aqueous phase liquids or DNAPLs and will migrate vertically through the soil until they are confined by the local geology. Movement is then lateral. PAHs adsorb to soil particles and settle to the bottoms of rivers, streams, or lakes (ATSDR, 1995). Once in the sediments, the PAHs then remain until naturally broken down or the stream sediments are disturbed.

Several PAHs have been identified as possibly carcinogenic to humans. Conclusions were drawn from studies in which laboratory mammals were exposed (inhalation or skin contact) or fed PAHs for long periods of time. PAHs are readily metabolized and are not stored long term inside the body (ATSDR, 1995). Data from other sites and laboratory bioassays have shown that PAHs can induce lethal and sub-lethal effects in benthic macroinvertebrates and fish (Beller, 1988).

Two facilities exist on Days Creek: Texarkana Wood Preserving Co. (TWP)¹, and Kerr-McGee Chemical Corporation (Figures 1 or 2). One facility, Koppers Co. (KOP)¹ exists on Waggoner Creek. Contamination of sediment and groundwater at the sites has been documented (Weston Consultants, 1989; Keystone Environmental, 1992). Wood treating-related contamination of sediment in Days Creek and Waggoner Creek has been documented by consultants for Kerr-McGee, 1989, and Inmon, *et. al.*, 1993.

Creek contamination was also noted by Crowe, 1995, for the Texas Natural Resource Conservation Commission. In the study, PAHs were found in sediment in Waggoner Creek downstream of KOP and Days Creek downstream of Kerr-McGee Chemical Corporation. No PAHs were noted in sediment from Days Creek adjacent to TWP. Biological evaluations of the fish communities at study sites showed that both streams were meeting their designated uses. Macroinvertebrate evaluations showed some impairment when compared to a reference stream

¹ TWP and KOP are Federal Superfund Program sites. Information regarding history and current status of these sites can be obtained from the following website:

<http://www.tnrcc.state.tx.us/permitting/remed/superfund/> 1

The objective of this study was to determine relative concentrations of PAHs in the sediments of Days Creek and Waggoner Creek adjacent to and downstream of all three facilities and to compare these values to current screening levels and those levels documented by the TNRCC in 1994 (Crowe, 1995).

The second objective of the study was to assure that Days Creek was meeting its designated Aquatic Life Use. To accomplish this objective, biological communities were assessed using current TCEQ protocols for evaluating the aquatic habitat, fish, and macroinvertebrate assemblages.

The last and lesser objective was to determine levels of metals in sediment at each site and compare findings to TCEQ screening levels.

No direct measurements of stream sediment toxicity were performed.

Figure 1. Sampling Locations, Days Creek and Waggoner Creek.

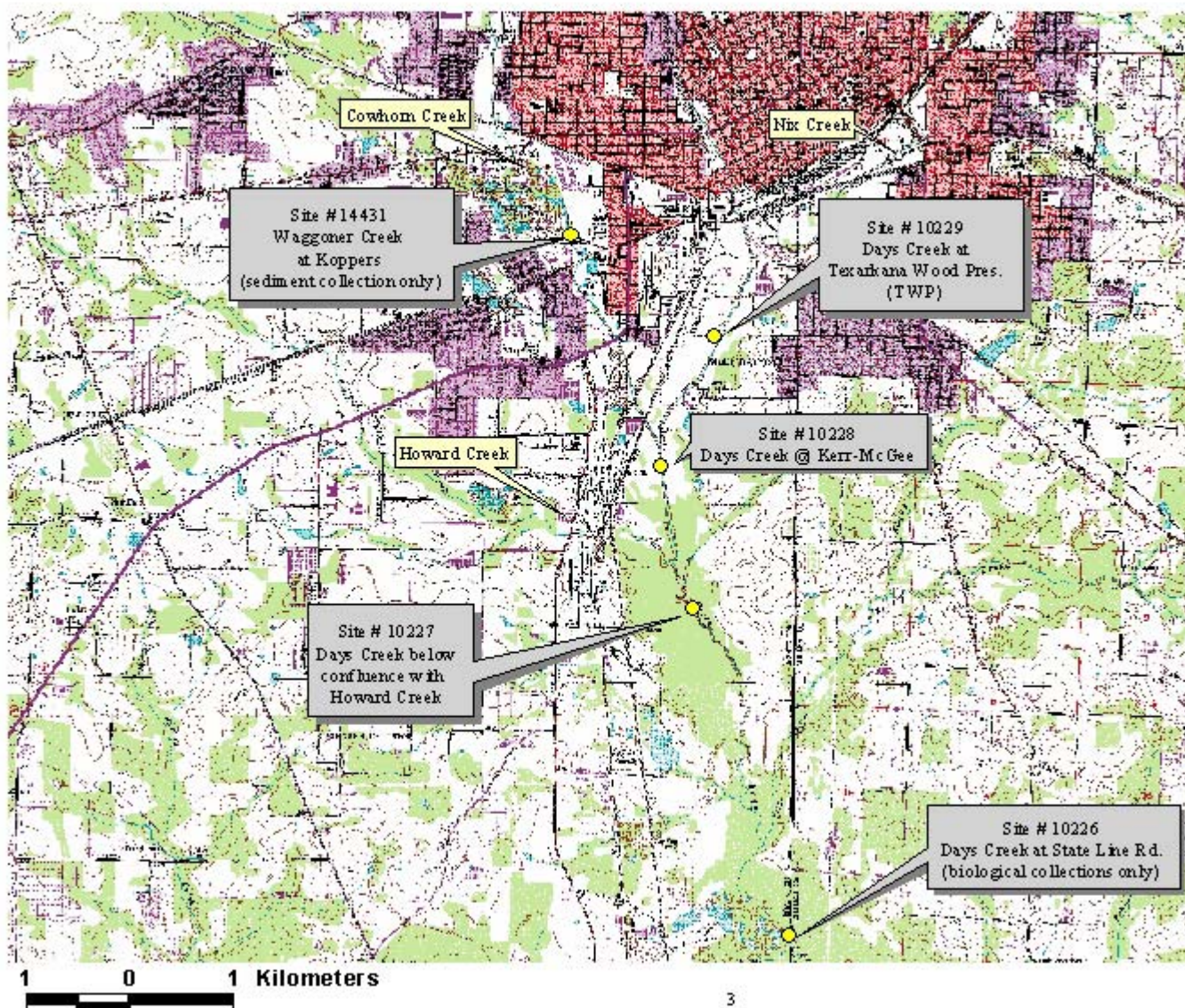
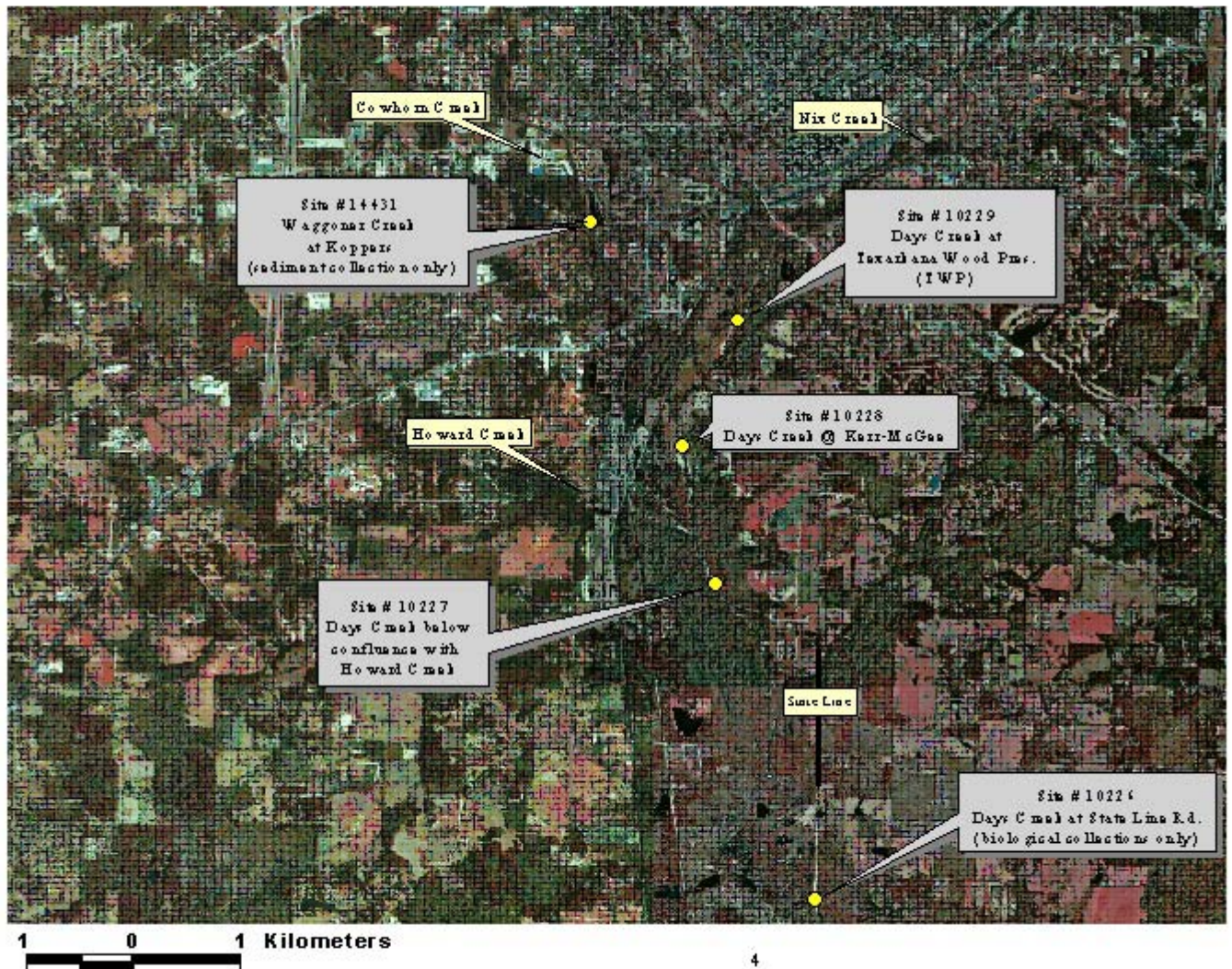


Figure 2. Sampling Locations, Days Creek and Waggoner Creek (Aerial Photographs).



The TCEQ collected sediment samples on 02 June 2004 at sites adjacent to TWP, KOP and Kerr-

McGee Chemical Corporation. Sediment was also collected from a fourth site located on Days Creek downstream of all facilities (Figures 1 and 2). Sites were as follows:

- !Waggoner Creek at KOP (TCEQ station I.D.14431)
- !Days Creek at TWP (TCEQ station I.D.10229)
- !Days Creek at Kerr-McGee Chemical Corp. (TCEQ station I.D. 10228)
- !Days Creek below Howard Creek confluence (TCEQ station I.D. 10227)

Sediment was collected consistent with TCEQ protocols (TCEQ, 2003). Due to the localized nature of PAH sediment contamination, three composited samples were collected at each site for a total of 12 sediment samples (4 sites x 3 composited samples per site). Samples at each site were collected within 50 m of one another.

The creek was walked in an attempt to find depositional areas in which fine sediments accumulate and where noticeable sheens were present. In some cases, sheens were only present after walking in the creek. After depositional sediments and sheens were located, 3-5 scoops of undisturbed sediment were collected using a Teflon scoop. The top 5 cm (\pm 2 cm) of sediment was placed into a pre-labeled glass jar with a Teflon lid. Jars were wrapped in a nylon sleeve to prohibit breakage and placed in a cooler on ice. Samples were shipped to the Lower Colorado River Authority (LCRA) Environmental Laboratory Services for analysis of semivolatiles.

The following screening values were used in assessing sediment data: TCEQ screening levels based on 85th percentiles and Probable Effects Levels (PELs). TCEQ screening levels based on the 85th percentile are calculated by pooling state-wide sediment monitoring data in the TCEQ TRACS database (TCEQ, 2003b). Values exceeding the 85th percentile of the pooled data are considered above the screening level and warrant a concern. These values are published in the Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data, 2004 (TCEQ, 2003b). The TCEQ currently adopts PELs set by the National Oceanic and Atmospheric Administration, or NOAA (NOAA, 1999). Probable Effects Levels (PELs) are based on macroinvertebrate community metrics and toxicity tests. The PEL is the level above which adverse biological effects are frequently expected. To enhance the evaluation of data in this study and because some compounds had no TCEQ/NOAA PEL, PELs from the Canadian Council of Ministers of the Environment (CCME) were utilized (CCME, 2001).

Note: The TCEQ is in the process of revising the screening levels used in evaluating sediment quality. These levels will be published in a new version of the *Guidance for Screening and Assessing Texas Surface and Finished Drinking Water Quality Data* (TCEQ document). At the time of this report the 2004 publication of the above document was used to obtain sediment screening levels (PELs and 85th percentiles). With the new publication, screening levels will change and 85th percentiles will be omitted. While similar, the new screening levels are likely to be less conservative than the PELs used in this report.

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Sediments for metals analysis were collected as outlined above. One composited sample was collected at each site and analyzed for the following metals of concern: arsenic; barium; cadmium; chromium; copper; lead; mercury; nickel; silver; zinc. Results were compared to current TCEQ screening levels (85th percentiles and PELs).

Under contract for the Clean Rivers Program, aquatic habitat, fish and macroinvertebrate evaluations were conducted by Texarkana College for the Sulphur River Basin Authority. Evaluations were made on two separate occasions at each site following TCEQ protocols (TCEQ, 1999). Data were evaluated using current TCEQ scoring matrices (TCEQ 1999). Fish communities were further evaluated using regionalized criteria which factor in natural geographic differences in geology, vegetation, and climate (Linam *et al.*, 2002). Habitat assessments were made during the first visit to each site at the time of fish and macroinvertebrate collections. Collections were made during and following stable flow conditions.

Collections were made in the following locations:

- !Days Creek at TWP (TCEQ station I.D.10229)
- !Days Creek at Kerr-McGee Chemical Corp. (TCEQ station I.D. 10228)
- !Days Creek below Howard Creek confluence (TCEQ station I.D. 10227)
- !Days Creek at Stateline Rd. (TCEQ station I.D.10226)

Fish were collected using a backpack electrofisher for approximately 15 minutes (time of actual current applied to water). Additionally, a seine was pulled a minimum of six times at each site to collect smaller species less susceptible to the electrofisher. Every effort was made to sample all available habitats. Fish identification was conducted in the field and voucher specimens or unknown fish were preserved and later identified in the laboratory.

Benthic macroinvertebrates were collected with a D-frame kicknet for approximately five minutes. Collections were made in riffle areas when present and from stable snags when riffles were not available. Macroinvertebrates were processed in the field, preserved, and taken to the laboratory for identification.

To gauge the quality and suitability of the aquatic habitat for fish and macroinvertebrates, habitat evaluations were also performed. Six transects at each site were evaluated for parameters including substrate stability, flow, riparian characteristics, and instream cover. Habitat was evaluated during the first visit at the time of fish and macroinvertebrate collections. Habitat was not evaluated during the second visit because habitat parameters were unchanged from previous visit.

Hourly measurements of in-stream physico-chemical conditions were taken at the biological collection sites over a 24-hr period. Parameters monitored included: Dissolved oxygen (D.O.); pH; conductivity; and temperature. Stream flow was also recorded at each site using an electronic flow meter.

Analytical results for sediment analyses are given in Appendix A (PAHs) and Appendix B (metals).

Some types of PAHs were detected at all sites. Levels were variable between samples within the same site and between sites (Results for values greater than detection limit are summarized in Tables 1-4). Data for compounds with published PELs are compared graphically between sites in Figures 3-15. In general, PAH levels were highest at the Kerr-McGee site (Table 3). The second highest concentrations were found downstream of Kerr-McGee below the Howard Creek confluence (Table 4). PAH levels in sediment adjacent to TWP were lowest and below detection limits for several compounds (Table 2). For most cases in which PAHs were detected, the levels were greater than the PELs at which adverse biological effects are expected.

Barring one result, levels of metals in sediment were below current TCEQ screening levels and PELs. The exception, arsenic, found in the sediment taken adjacent to Kerr-McGee, was slightly greater than the 85th percentile screening level (result = 7.90 mg/kg, screening level = 7.00 mg/kg). However, this level was lower than the PEL (17.0 mg/kg).

Results for biological and habitat evaluations are found in Tables 5-8. Criteria used to evaluate habitat, fish, and macroinvertebrates are given in Appendix C. All data collected from biological sampling are given in Appendix D.

Fish assemblages evaluated using statewide criteria showed Intermediate Aquatic Life Use. Results using regionalized criteria were similar. No large discrepancies in scoring between the two criteria were noted. Results for individual matrices were generally similar between sites. Species considered tolerant of adverse conditions were well represented at all sites. Only one intolerant species was collected, a darter, at the State Line Road site. Trophic levels were generally balanced at each site and high rates of fish disease/anomalies were not observed.

Aquatic Life Use designations based upon macroinvertebrate evaluations were mixed (Limited and Intermediate) at the two uppermost sites and Intermediate at the lower sites. Results between sampling events and sites were variable. Taxa richness was generally greater at the two lower sites. However, Ephemeroptera - Plecoptera - Trichoptera (EPT) taxa, considered more intolerant or sensitive, did not differ greatly among sites.

Habitat Quality was High at all sites except the site at State Line Road (Intermediate). The difference in quality at State Line Road is chiefly due to two factors: A moderately unstable substrate; and absence of riffles. Bank stability at each site was poor, partly due to the rapid and severe flow changes in the stream following significant rain events.

Physico-chemical parameters were similar at each site (Table 9). Dissolved oxygen levels were above levels established to sustain an Intermediate Aquatic Life Use (4.0 mg/L).

compound	sample 1	sample 2	sample 3 TCEQ 85 th perc.	PEL TCEQ ₁	PEL CME ₂
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acenaphthene	8040	7800	310 750.0 nd 750.0 87		88.9 128
acenaphthylene anthracene	260 j	580	j 767.0 350 750.0 305		245 385
benzo(a)anthracene	4340	8360	750.0 537 750.0 140 j		782 862
benzo(a)pyrene	4020	7970	750.0 230 j 750.0 417		2355 144
benzo(b)flouranthene	2120	4180	750.0 1300 767.0 230		201 515
benzo(g,h,i)perylene	2900	6960	750.0 190 j 120 j 1490		875 391
benzo(k)flouranthene	541	1090	767.0 1170 750.0 633		
chrysene flouranthene	1270	2330	nd 670.0 120 j 750.0	385.0	
flourene 2-	3540	6160		782.0	
methylnaphthalene	13200	32100		862.0	
dibenzofuran	8640	11400		2355.0	
phenanthrene pyrene	1500	3200		515.0	
carbazole napthalene	4280	6980		875.0	
indeno(1,2,3-cd) pyrene	30800	49300			
	9410 nd	19500			
	nd nd	2240			
		2690			
		1070			

nd = non detect j = analyte detected below quantitation limits 1 = Probable Effects Level, Texas Commission on Environmental Quality 2 = Probable Effects Level, Canadian Council of Ministers of the Environment

Table 2. PAH sediment concentrations ($\mu\text{g}/\text{Kg}$ -dry weight) from Days Creek adjacent to TWP, site # 10229, 02 June 2004.

compound	sample 1	sample 2	sample 3 TCEQ 85 th perc.	PEL TCEQ ₁	PEL CME ₂
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acenaphthene	nd nd	nd nd	nd 750.0 nd 750.0 32 j		88.9 128
acenaphthylene anthracene	24 j 64	44 j 150	767.0 130 j 750.0 170		245 385
benzo(a)anthracene	j 87 j	j 210 j	j 750.0 277 750.0 120		782 862
benzo(a)pyrene	150 j 98	349 180	j 750.0 97 j 750.0 190		2355 144
benzo(b)flouranthene	j nd 93	j 120 j	j 750.0 319 767.0 nd		201 515
benzo(g,h,i)perylene	j 34 j	240 j	750.0 nd nd 190 j		875 391
benzo(k)flouranthene	nd nd	412 nd	767.0 394 750.0 nd nd		135
chrysene flouranthene	nd 64 j	nd nd	670.0 99 j 750.0 nd		
flourene 2-	190 j nd	230 j	750.0 568 900.0		
methylnaphthalene	nd 75 j	437 nd		385.0	
dibenzofuran phenanthrene	nd 326	nd 130 j		782.0	
pyrene carbazole naphthalene		nd 672		862.0	
indeno(1,2,3-cd) pyrene				2355.0	
dibenz(a, h) anthracene				515.0	
bis(2-ethylhexyl)phthalate				875.0	

nd = non detect j = analyte detected below quantitation limits 1 = Probable Effects Level, Texas Commission on Environmental Quality 2 = Probable Effects Level, Canadian Council of Ministers of the Environment

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compound	sample 1	sample 2	sample 3 TCEQ 85 th perc.	PEL TCEQ ₁	PEL CME ₂
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acenaphthene	71800	41100	41500 750.0 1730		88.9 128
acenaphthylene anthracene	2410	1240	750.0 17400 767.0		245 385
benzo(a)anthracene	33200	18500	15500 750.0 7160		782 862
benzo(a)pyrene	25800	16900	750.0 9640 750.0 1580		2355 144
benzo(b)flouranthene	9940	6340	750.0 3860 750.0		201 515
benzo(g,h,i)perylene	16600	10700	13300 750.0 79000		875 391
benzo(k)flouranthene	2680	1600	767.0 47500 750.0		135
chrysene flouranthene	5480	3670	22500 34400 124000		
flourene 2-	23200	14500	767.0 56700 750.0	385.0	
methylnaphthalene	134000	84300	17700 15100 670.0	782.0	
dibenzofuran	88900	50100	1640 750.0 631 750.0	862.0	
phenanthrene pyrene	43100	15600		2355.0	
carbazole naphthalene	66800	32900		515.0	
indeno(1,2,3-cd) pyrene	201000	122000		875.0	
dibenz(a, h) anthracene	90800	60100			
	22800	12800			
	37500	7390			
	2680	1620			
	1000	626			

1 = Probable Effects Level, Texas Commission on Environmental Quality
2 = Probable Effects Level, Canadian Council of Ministers of the Environment

Table 4. PAH sediment concentrations ($\mu\text{g}/\text{Kg}$ -dry weight) from Days Creek below Howard Creek confluence, site # 10227, 02 June 2004.

compound	sample 1	sample 2	sample 3 TCEQ 85 th perc.	PEL TCEQ ₁	PEL CME ₂
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acenaphthene	3900	9660	33100 750.0 1140		88.9 128
acenaphthylene anthracene	241	607	750.0 13300 767.0		245 385
benzo(a)anthracene	3360	7680	13100 750.0 5660		782 862
benzo(a)pyrene	4100	6940	750.0 9130 750.0 1490		2355 144
benzo(b)flouranthene	1830	3210	750.0 3360 750.0		201 515
benzo(g,h,i)perylene	3030	5300	11000 750.0 65800		875 391
benzo(k)flouranthene	512 971	921	767.0 37300 750.0		135
chrysene flouranthene	3450	1740	9370 26200 106000		
flourene 2-	19100	6080	767.0 51000 750.0		
methylnaphthalene	5270	33000	7460 4980 670.0 1470	385.0	
dibenzofuran	354	16900	750.0 nd 750.0 718	782.0	
phenanthrene pyrene	3460	2610	900.0	862.0	
carbazole napthalene	18600	11500		2355.0	
indeno(1,2,3-cd) pyrene	15200	50100		515.0	
dibenz(a, h) anthracene	1240	25500		875.0	
bis(2ethylhexyl)phthalate	603 519 nd 180 j	3540 1110 936 nd 447			

nd = non detect j = analyte detected below quantitation limits 1 = Probable Effects Level, Texas Commission on Environmental Quality 2 = Probable Effects Level, Canadian Council of Ministers of the Environment

Site	Date	Habitat Quality	Index of Biotic Integrity (Fish) statewide criteria	Index of Biotic Integrity (Fish) regionalized criteria	Rapid Bioassessment Macroinvertebrates
Days Creek at TWP	05/24-25/04	high	intermediate	intermediate	limited
Days Creek at TWP	07/19-20/04	high*	intermediate	intermediate	intermediate
Days Creek at Kerr-McGee Chemical Corp	05/25-26/04	high	intermediate	intermediate	limited
Days Creek at Kerr-McGee Chemical Corp	07/20-21/04	high*	intermediate	intermediate	intermediate

Metric	Days Cr @ TWP		Days Cr @ Kerr-McGee		Days Cr below Howard Cr confl		Days Cr at State Line Road	
	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2
# Species	9	8	10	8	11	8	10	9
# Native Cyprinid species	1	1	2	1	1	1	1	1
# Benthic Invertivore spec	0	0	0	0	0	0	1	0
# Sunfish species	6	3	4	2	5	2	4	4
# Intolerant species	0	0	0	0	0	0	1	0
% Tolerant species *	34.7	50.3	58.1	23.1	44.1	32.8	32.2	21.7
% Omnivores	9.7	2.1	2.9	0.3	5.5	2.9	2.5	2.8
% Insectivores	71.8	88.0	94.8	97.9	92.1	96.7	91.7	93.4
% Piscivores	18.6	9.9	2.3	1.8	2.4	0.4	5.8	3.8
# Ind. in sample								
a. # ind./seine haul	6.8	27	17.1	33.7	14.5	31.2	0.9	4.4
b. # ind/min. electrofish	5.5	8.7	4.6	8.7	2.7	5.8	7.7	5.0
% Ind. non-native species	0	0	0	0	0	0	0	0
% Diseased /anomalies	0	0.68	0	0	0.8	0	2.48	0
<i>total score</i>	39	37	36	38	37	34	39	40
<i>aq. life use designation</i>	intermed	intermed	intermed	intermed	intermed	limited	intermed	intermed

*excluding Western Mosquitofish

Metric	Days Cr @ TWP		Days Cr @ Kerr-McGee		Days Cr below Howard Cr confl		Days Cr at State Line Road	
	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2
Taxa richness	10	12	9	10	16	12	13	17
EPT taxa abundance	3	4	3	2	3	4	3	4
Biotic Index, HBI	6.4	5.2	5.9	4.9	5.2	5.3	4.8	5.1
% Chironomidae	18.0	29.6	79.7	23.9	34.9	52.4	18.9	30.1
% Dominant taxon	54.1	43.6	79.7	52.2	34.9	52.4	48.8	30.1

% Dominant FFG	38.4	53.7	37.4	38.5	39.7	36.7	34.2	36.6
% Predators	15.5	19.6	26.6	12.4	16.5	18.1	7.9	19.8
Intolerant : Tolerant	0.2	1.8	0.10	1.8	1.1	0.8	3.6	1.4
% Hydropsychidae	0	100	0	100	100	100	100	100
# Non-insect taxa	3	2	3	2	2	2	2	2
% Collector-gatherers	38.4	18.1	37.4	38.5	39.7	36.7	31.9	25.4
Percent Elmidae	0	0	5.8	5.3	1.5	1.2	0.8	0.7
<i>total score</i>	19	23	21	25	25	23	24	25
<i>aq. life use designation</i>	limited	intermed	limited	intermed	intermed	intermed	intermed	intermed

Table 9. Habitat metric scores by site.

Metric	Days Cr @ TWP		Days Cr @ Kerr-McGee		Days Cr below Howard Cr confl		Days Cr at State Line Road	
	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2
available instream cover	common	same	common	same	rare	same	rare	same
bottom substrate stability	stable	same	stable	same	stable	same	mod sta	same
number of riffles	rare	same	common	same	common	same	absent	same
dimensions largest pool	moderat	same	large	same	large	same	glide	same
channel flow status	moderat	same	moderat	same	moderat	same	moderat	same
bank stability	mod un	same	mod un	same	mod un	same	mod un	same
channel sinuosity	low	same	low	same	moderat	same	low	same
riparian buffer vegetation	extensiv	same	wide	same	extensiv	same	extensiv	same
aesthetics of reach	comm	same	comm	same	natural	same	comm	same
<i>total score</i>	20	same	21	same	23	same	18	same
<i>hab. quality designation</i>	high	same	high	same	high	same	intermed	same

mod sta=moderately stable mod un=moderately unstable
comm=common setting

Table 10. 24-hr averages of physico-chemical parameters in Days Creek.

Physico-chemical parameter	Days Cr @ TWP		Days Cr @ Kerr-McGee		Days Cr below Howard Cr confl		Days Cr at State Line Road	
	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2
Diss. Oxygen (D.O.) mg/L	5.9	5.7	7.1	8.1	7.5	8.3	6.3	6.7
Temperature (C°)	25.0	28.7	24.2	27.3	25.3	27.1	24.6	28.1
Conductivity (µhom/cm)	264	291	337	361	333	354	503	444
pH (s.u.) Max	7.2	7.3	7.2	7.9	8.3	7.9	7.1	7.4
pH (s.u.) Min	7.1	7.0	7.0	7.0	7.1	7.0	6.8	6.8
Flow (cfs)	1.4	1.0	5.0	5.1	6.4	7.3	10.4	9.5

Acenaphthene concentrations in sediment (3 samples per site)

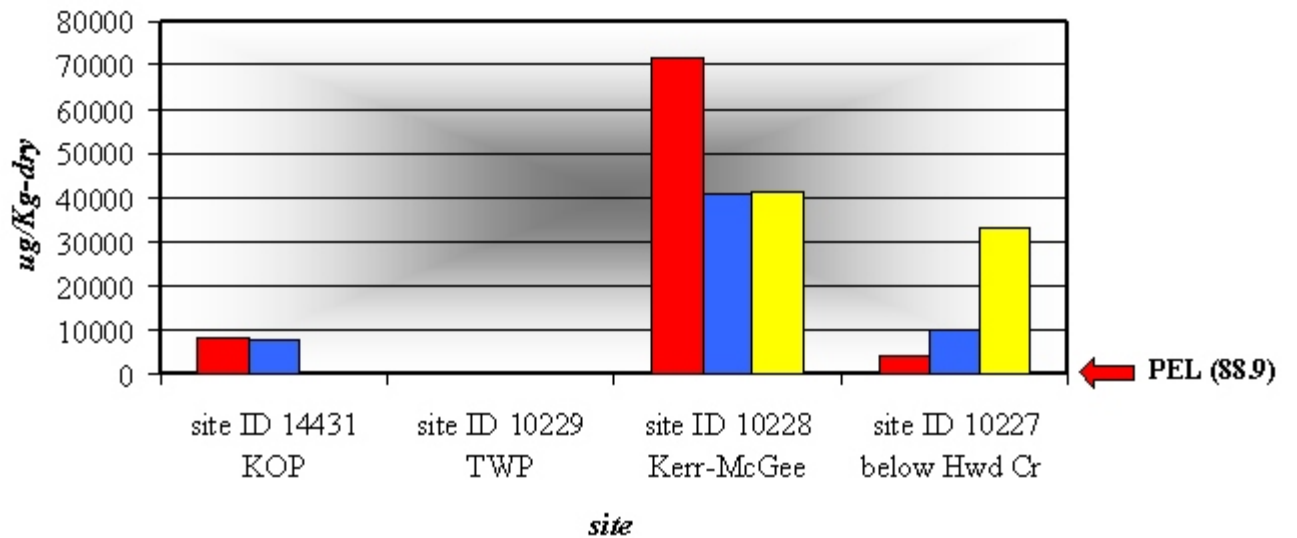
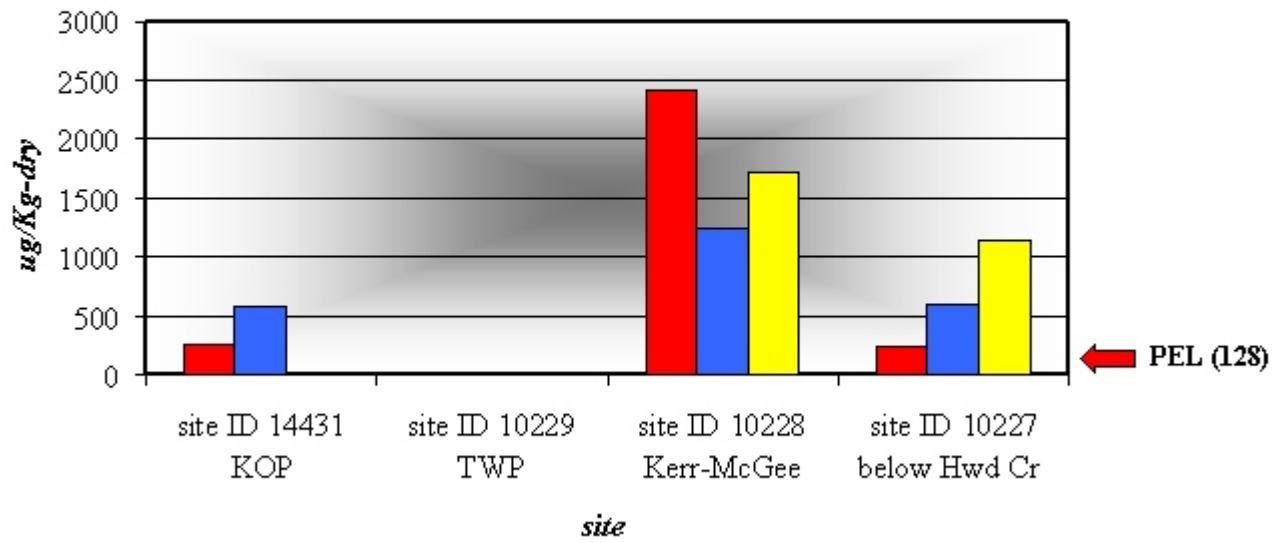
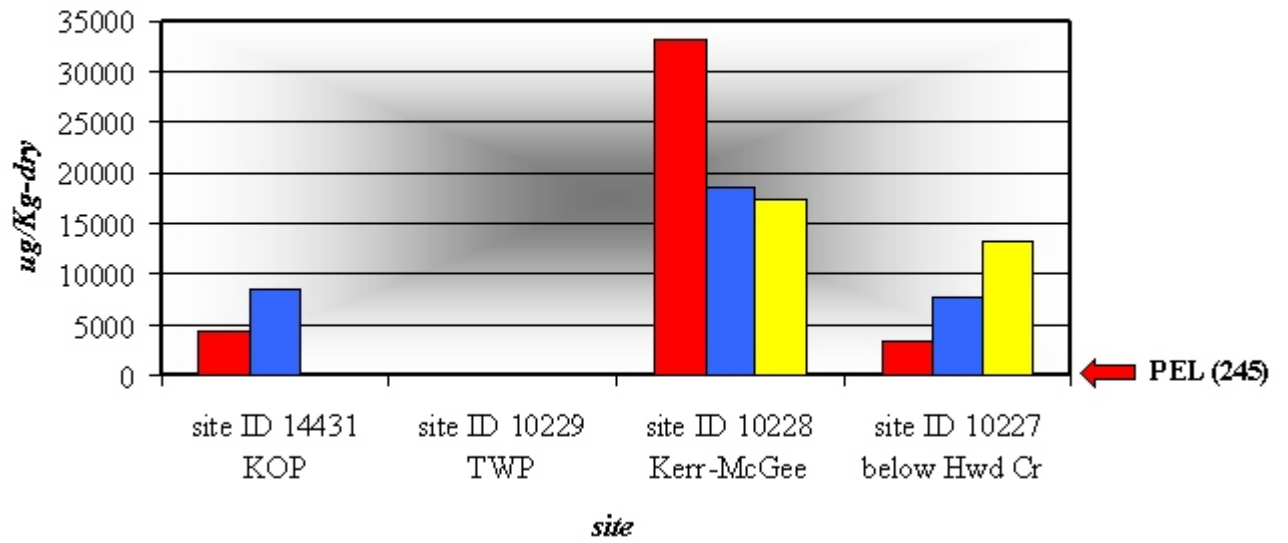


Figure 4. Figure 6. Figure 8. Figure 10. Figure 12. Figure 14.

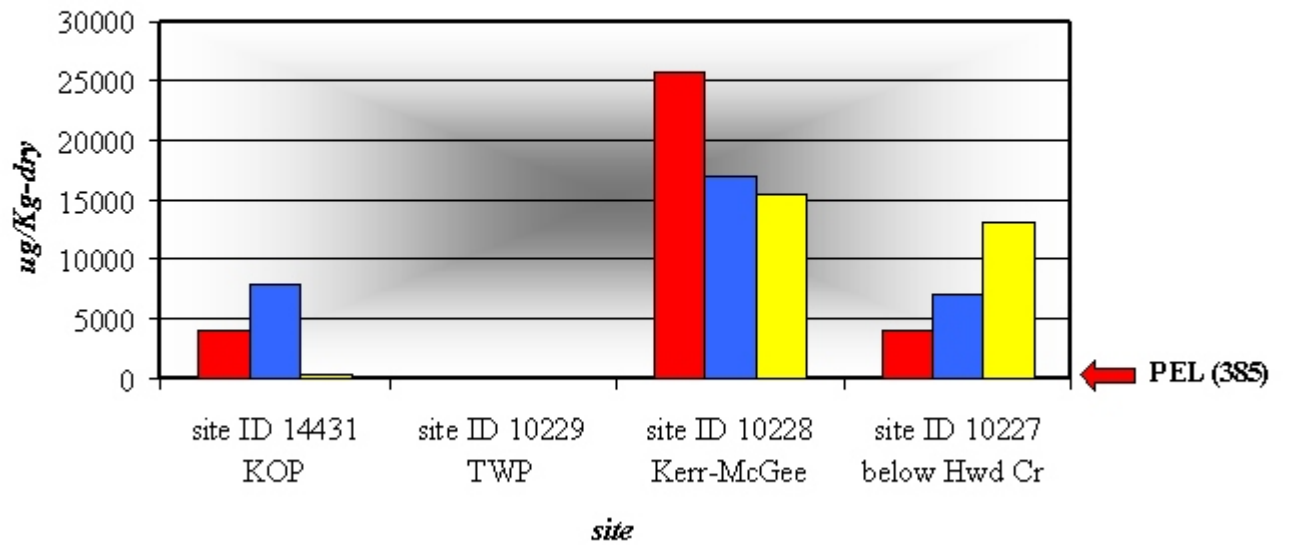
Acenaphthylene concentrations in sediment
(3 samples per site)



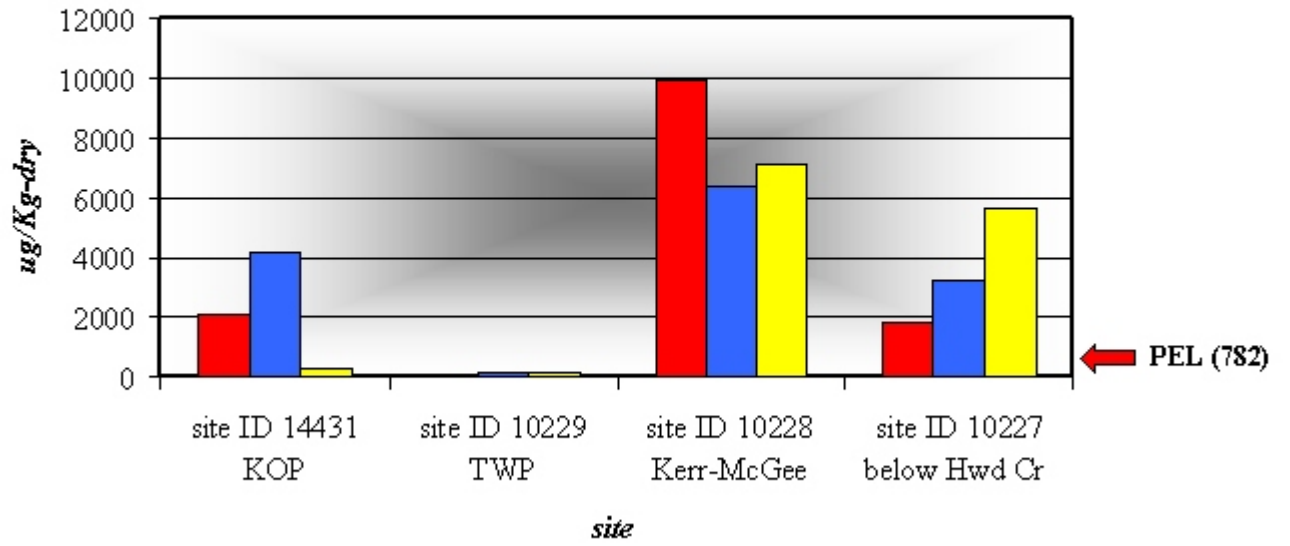
**Anthracene concentrations in sediment
(3 samples per site)**



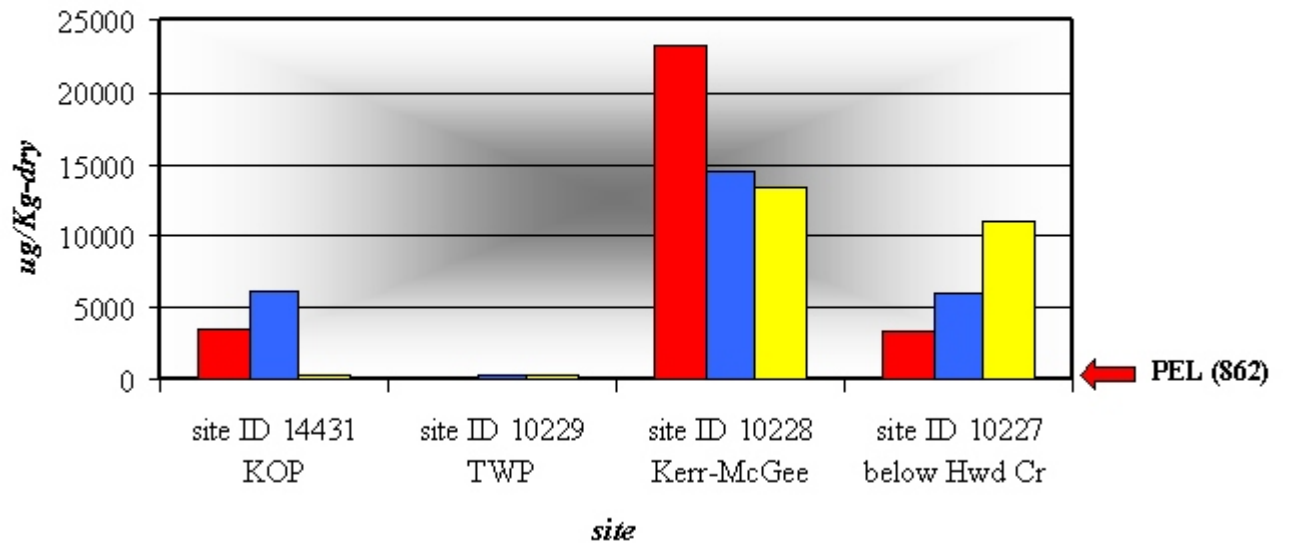
**Benzo(a)anthracene concentrations in sediment
(3 samples per site)**



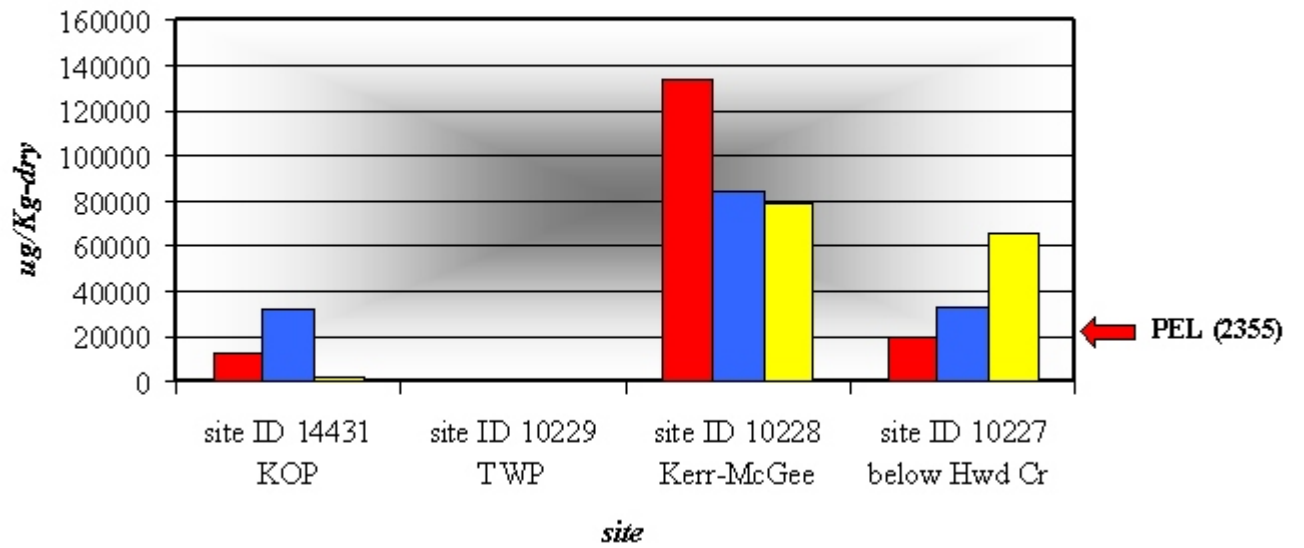
**Benzo(a)pyrene concentrations in sediment
(3 samples per site)**



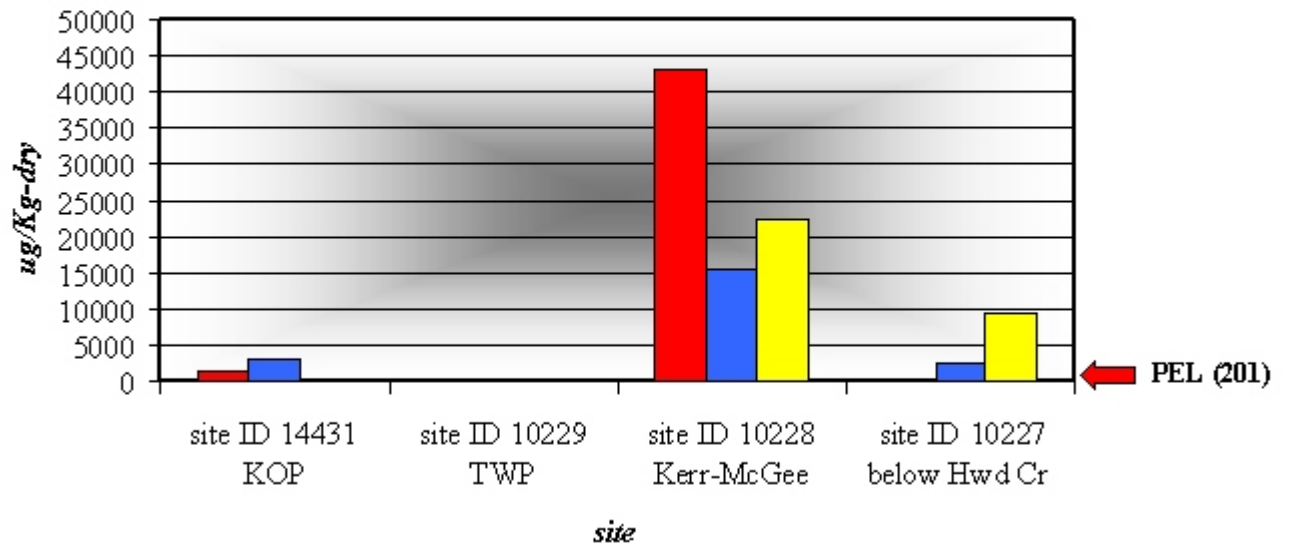
**Chrysene concentrations in sediment
(3 samples per site)**



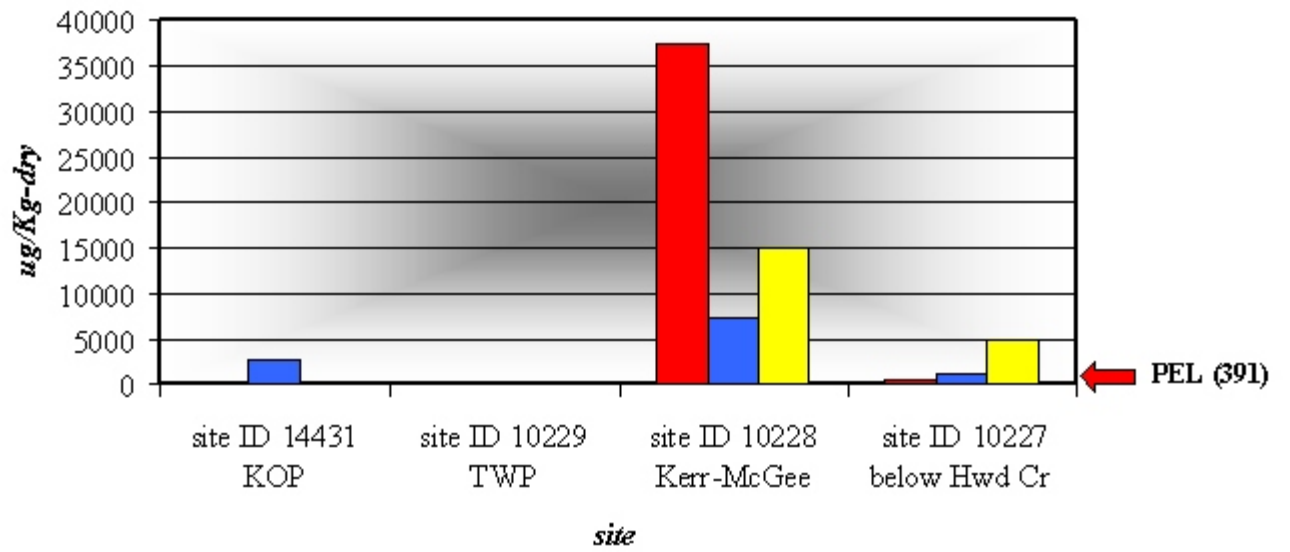
**Flouranthene concentrations in sediment
(3 samples per site)**



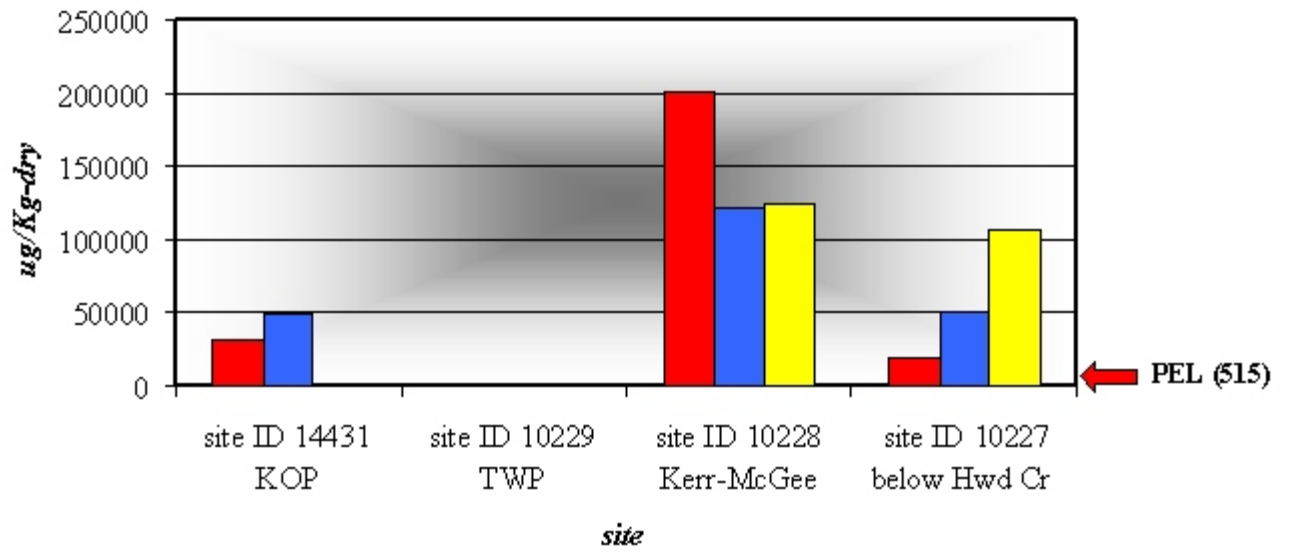
**2-methyl naphthalene concentrations in sediment
(3 samples per site)**



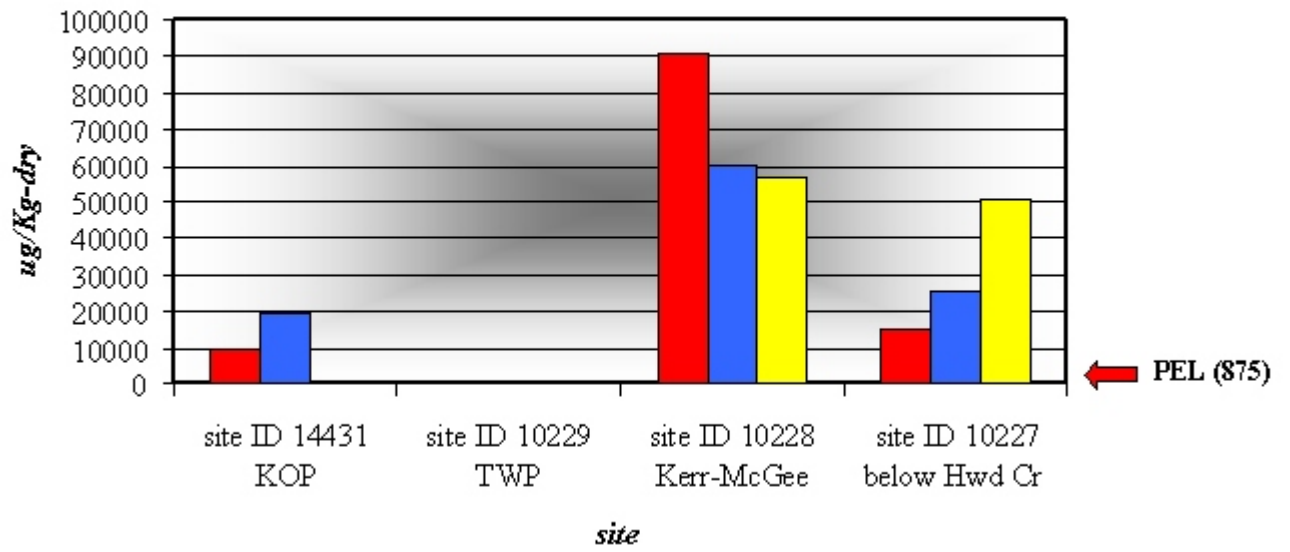
**Naphthalene concentrations in sediment
(3 samples per site)**



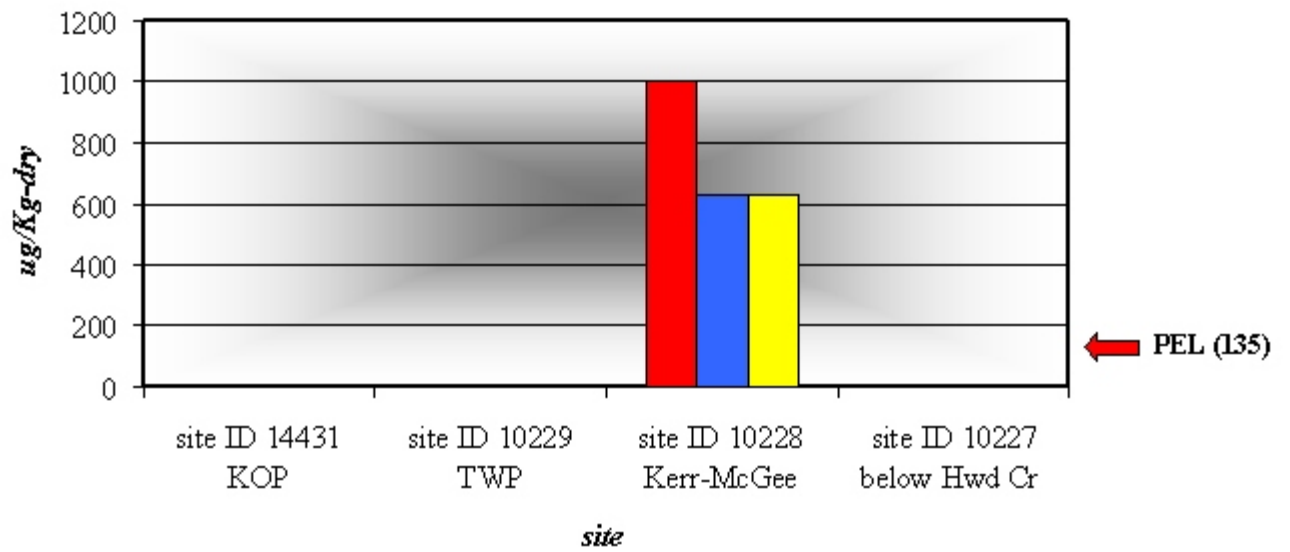
**Phenanthrene concentrations in sediment
(3 samples per site)**



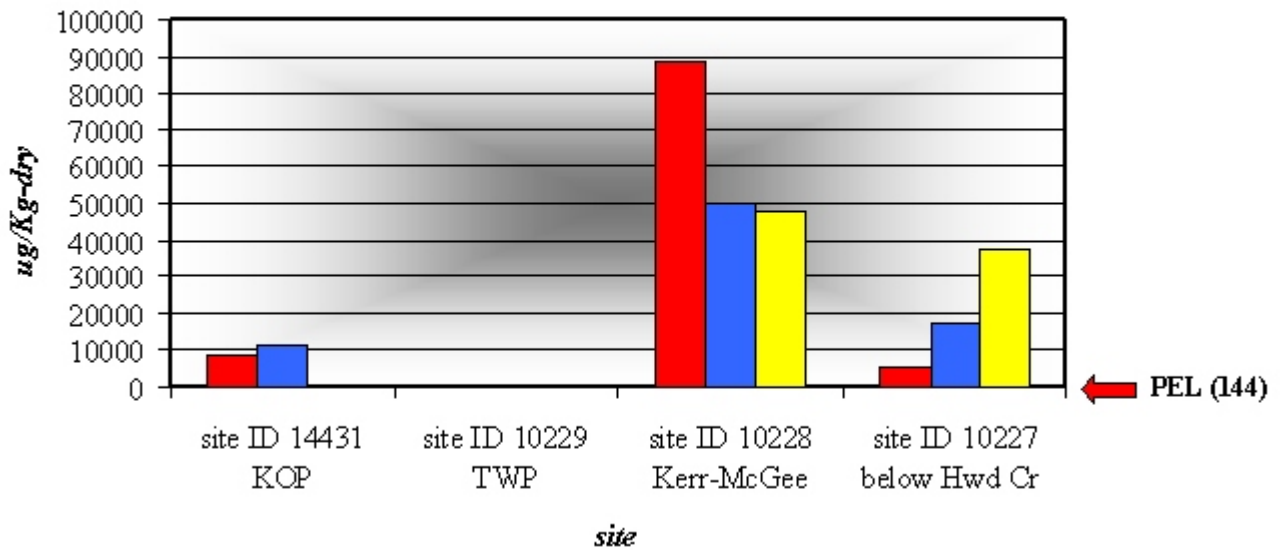
**Pyrene concentrations in sediment
(3 samples per site)**



**Dibenzo(a,h)anthracene concentrations in sediment
(3 samples per site)**



**Flourene concentrations in sediment
(3 samples per site)**



PAH levels presented in this study do not reflect conditions indicative of Days Creek and Waggoner Creek as a whole. Sediment sampling was restricted to depositional areas where noticeable sheens were present and therefore represent only those portions of the streams.

Consistent with samples collected by Crowe for the TNRCC in 1994, levels of PAHs at each site were highly variable. However, more types of PAHs and concentrations in sediment were higher and detected more frequently in this study. Levels were generally higher at and downstream of the Kerr-McGee facility. It is possible that the levels of PAHs in sediments adjacent to Kerr-McGee and below are exacerbated by sediment moving downstream from KOP and TWP. The findings of this survey however, suggest inputs of PAHs from the Kerr-McGee property.

The higher levels of PAHs noted in this study as compared to the 1994 TNRCC study could reflect more extensive groundwater contamination than originally thought, inefficient containment/capturing procedures, the short time that actual remediation has been operational, minor sampling differences, or a combination of the above. According to information contained on the US EPA Superfund website, removal of PAHs from sediment and groundwater at the two Superfund sites has only occurred over the last few years. Kerr-McGee currently operates

recovery trenches along Days Creek. At TWP in November of 2000, a field pilot study to evaluate the effectiveness of trenches in the collection and removal of non-aqueous phased liquids (NAPL) was completed. The test indicated that trenches were not the most effective method in collection of non-aqueous phased liquids (NAPL) at the TWP site (TCEQ, 2005). Recently at Kerr-McGee, new remediation technology using methods to stimulate the bacterial breakdown of contamination in groundwater have been explored (AquAeTer, 2004). Results of these methods are pending pilot studies. It is suggested that the study sites be re-visited in 5-10 years to re-evaluate sediment PAH concentrations.

According to results of fish sampling, Days Creek is meeting the designated Intermediate Aquatic Life Use (ALU). Results were similar to results observed in 1994 (TNRCC, 1995). No patterns connecting fish results to sediment contaminant levels were noted. However, certain indicators of general impairment are evident (low taxa richness, high proportion of tolerant species, no intolerant species). Whether these impairments are linked to certain habitat attributes, the urban nature of the Days Creek watershed, or sediment PAH concentrations is unclear.

Macroinvertebrate results were mixed but with the majority achieving an Intermediate status. With closer ties to the sediment, macroinvertebrates should be a better indicator of sediment contamination than fish. A higher degree of impairment was visible in the macroinvertebrate communities at TWP and Kerr-McGee. Macroinvertebrate collections downstream from Kerr-McGee, where the second highest levels of PAHs were noted, did not show the same limited scores as the uppermost sites. Therefore, no clear patterns were visible that correspond with the observed contaminant levels in sediment. This might be due to the inability of the macroinvertebrate metrics to register subtle effects between sites. For purposes of strictly assessing sediment contamination impacts, and not just Aquatic Life Use, a more comprehensive and sensitive macroinvertebrate survey is needed. Other macroinvertebrate sampling techniques may be better suited (Hester Dendy, Surber Sampler) with more detailed taxonomic identification efforts. Upstream sites should be considered as controls or reference.

It must also be noted that although PAHs are well-represented in the sediments, they may be relatively unavailable to the biota. Burton and Scott (1992) noted that the percentage of chemical that may be bioavailable may range from 0 to 100% and that chemical concentrations are not always accurate predictors of biological effects. Future studies should include toxicity tests of sediment.

Habitat quality at the sites was generally high and thus theoretically capable of supporting a higher ALU. Given the urban watershed and potentials for non-point source pollution, it is unclear if the stream could obtain a higher ALU in absence of the PAH-contaminated sediments.

Neither metals in sediment nor adverse water quality parameters (D.O., pH, temperature, conductivity) appear to be negatively affecting the fish or macroinvertebrate populations. Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Public Health Statement for Polycyclic Aromatic Hydrocarbons (PAHs). U.S. Department of Health and Human Services. Atlanta, GA.

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