	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1						**CALCULATIONS OF ARKANSAS WATER QUALITY-BASED EFFLUENT LIMITATIONS**									
2	The spreadsheet logic will function correctly when ALL yellow cells with "?" have data entered.							**For an Arkansas River/Stream**								
3	Do not enter data in yellow cells marked "Reserved". White cells marked "Reserved" have comp							*(Reserved)*								
4	**STEP 1:**	INPUT TWO LETTER CODE FOR ECOREGION (Use Code at Right)						GC								
5																
6																
7	FACILITY										**Codes & TSS for Ecoregions and Large Rivers**					
8										Ouachita Mts. Eco (OM) =	2.0 mg/l	Arkansas (Ft. Smith to Dardanelle Dam				12.0 mg/l
9	Permittee							EDCC		Ozark Highlands Eco (OH) =	2.5 mg/l	Arkansas (Dardanelle Dam to Terry L&I				10.5 mg/l
10	NPDES Permit No.							AR0000752		Boston Mts. Eco (BM) =	1.3 mg/l	Arkansas (Terry L&D to L&D No. 5)				8.3 mg/l
11	Outfall No.(s)							103ST		Ark River Valley Eco (AV) =	3.0 mg/l	Arkansas (L&D No. 5 to Mouth)				9.0 mg/l
12	Plant Effluent Flow (MGD)							0.65		Gulf Coastal Eco (GC) =	5.5 mg/l	White (Above Beaver Lake)				2.5 mg/l
13	Plant Effluent Flow (cfs)							1.00		Delta Ecoregion (DL) =	8.0 mg/l	White (Below Bull Shoals to Black Riv)				3.3 mg/l
14												White (From Black River to Mouth)				18.5 mg/l
15	RECEIVING STREAM											St. Francis River				18.0 mg/l
16												Ouachita (Above Caddo River)				2.0 mg/l
17	Is this a **Large River from the list at right?** (enter "1" if yes, "0" if no; make entry as a number)							0				Ouachita (Below Caddo River)				5.5 mg/l
18	Name of Receiving Stream:							unnamed tributary				Red River				33.0 mg/l
19																
20	Is this a lake or reservoir? (enter '1' if yes, ' 0 ' = no; make entry as a number)							0			**Total Hardness for:**					
21	(Reserved)							0			Arkansas River = 125 mg/l			Red River = 211 mg/l		
22	(Reserved)	DO NOT INPUT DATA INTO CELL H22, H23 & H24....LEAVE BLANK→						?			Ouachita River = 28 mg/l			St. Francis River = 103 mg/l		
23	(Reserved)										White River = 116 mg/l					
24		(Reserved)		(Reserved)				(Reserved)								
25				(Reserved)				(Reserved)			Gulf Coastal = 31 mg/l			Ouachita Mount = 31 mg/l		
26				(Reserved)				(Reserved)			Ozark Highlands = 148 mg/l			Ark River Valley = 25 mg/l		
27				(Reserved)				(Reserved)			Boston Mount = 25 mg/l			Delta = 81 mg/l		
28																
29	Ecoregion TSS (mg/l) (For Large River, See List to Right)							5.50			**Large Rivers**					
30	Ecoregion Hardness (mg/l)	(Reserved)						31.00			Mississippi River, Arkansas River, Red River					
31	Enter 7Q10 (cfs) as the Critical Flow		(Reserved)					11.56	(Reserved		White (Below confluence with Black River)					
32	Long Term Ave / Harmonic Mean Flow (cfs)							1.00	(Reserved	(Reserved)	Ouachita (Below confluence with Little Miss. River)					
33	Using Diffusers (Yes/No)							no								
34	pH (Avg)							7.00			For industrial and federal facility, use the highest monthly average flow					
35	Percent (%) of Critical Flow for Chronic Criteria							0.67			for the past 24 months. For POTWs, use the design flow.					
36	Percent (%) of Critical Flow for Acute Criteria							0.33								
37	Water Effect Ratio (WER)							1.00	These cells		#VALUE! => No violation or Not Applicable					
38	Ave Monthly Limit LTA Multiplier (Ref: page 103 TSD for WQ-Based Toxics Control)							1.55	must be		9999999.00 => No EPA/ADEQ Guideline					
39	Max Daily Limit LTA Multiplier (Ref: " " " ")							3.11	unlocked							
40	Max Daily Limit LTA Multiplier for Human Health (Ref: 2009 CPP; Section 5.27.2)							1.64	to change.							

STEP 2: INPUT AMBIENT AND EFFLUENT DATA

CALCULATE IN-STREAM WASTE CONCENTRATIONS

DATA INPUT

For less than 20 data points enter geometric mean concentration as micro-gram per liter (ug/l or ppb).

For 20 or more data points in set enter highest concentration as micro-gram per liter (ug/l or ppb).

Effluent value reported as "< detection level" (DL) but the DL is greater than MQL, the 1/2 DL is used.

Effluent value reported as "< detection level" (DL) and the DL is smaller than MQL, "0" is used.

If a firm value is reported, even less than MQL, the reported value is used.

The following formulae is used to calculate the Instream Waste Concentration (IWC)

(Please refer to CPP for detail)

IWC = [(F*Qa*Cb) + (Qe*2.13*Ce)] / (F*Qa + Qe)

Where:

IWC = Instream Waste Concentration

F = Fraction of stream allowed for mixing

Ce = Reported concentration in effluent

Cb = Ambient stream concentration upstream of discharge

Qe = Plant effluent flow

Qb = Critical low flow of stream at discharge point expressed as the 7Q10 or harmonic mean flow for human health criteria

Upstream Flow (Qb)= (% of 7Q10) X 7Q10 for Chronic and Acute

The following formulae convert metals reported in total form to dissolved form if criteria are in dissolved form

Kp = Kpo * (TSS**a)

Kp = Linear partition coefficient; Kpo and a can be found in table below

C/Ct = 1/ (1 + Kp*TSS* 10^-6)

TSS = Total suspended solids concentration found in receiving stream (or in effluent for intermittent stream)

Total Metal Criteria (Ct) = Cr / (C/Ct)

C/Ct = Fraction of metal dissolved; and Cr = Dissolved criteria value

	*Stream Linear Partition Coefficient (Insert "Dissolved" Conc in Column B to convert to "Total")						Lake Linear Partition Coefficient				
Total Metals	Dissolved Value in Stream	Kpo	alpha (a)	Kp	C/Ct	Total Value	Kpo	alpha (a)	Kp	C/Ct	Total Value
Cadmium		4000000	-1.13	582706.889	0.237818469	0.00	3520000.00	-0.92	733514.98	0.1986361	0
Chromium(3)		3360000	-0.93	688338.365	0.208948818	0.00	2170000.00	-0.27	1369499.28	0.1172024	0
Copper		1040000	-0.74	294554.016	0.381672529	0.00	2850000.00	-0.9	614495.12	0.2283249	0
Lead		2800000	-0.8	715925.58	0.202527926	0.00	2040000.00	-0.53	826490.64	0.1803199	0
Mercury		2900000	-1.14	415321.613	0.30448177	0.00	1970000.00	-1.17	268066.09	0.4041443	0
Nickel		490000	-0.57	185433.992	0.495077211	0.00	2210000.00	-0.76	604946.03	0.2310962	0
Zinc		1250000	-0.7	379014.766	0.324193117	0.00	3340000.00	-0.68	1047851.74	0.1478593	0
Silver		2400000	-1.03	414607.994	0.30484608	0.00	2400000.00	-1.03	414607.99	0.3048461	0

Note: Use this section to convert lab concentrations shown as "dissolved" to "total"

Dissolved Total

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
83	**The following formulas are used to calculate water quality criteria based on Regulation No. 2 (Act 472 of Ark 1949)**										WQC (ug/l)	WQC(ug/l)				
84	Cadmium			Acute			WER X CF1 X e(1.128[ln(hardness)]-3.828)				1.04		CF1 = 1.136672 - [0.041838*ln(hardness)]			
85				Chronic			WER X CF2 X e(0.7852[ln(hardness)]-3.490)				0.43		CF2 = 1.101672 - [0.041838*ln(hardness)]			
86																
87	Chromium Tri			Acute			WER X 0.316 X e(0.819[ln(hardness)]+3.688				210.28					
88				Chronic			WER X 0.86 X e(0.819[ln(hardness)]+1.561				68.21					
89																
90	Chromium Hex			Acute			WER X 0.982 X 16				15.71					
91				Chronic			WER X 11 X 0.962				10.58					
92																
93	Copper			Acute			WER X 0.96 X e(0.9422[ln(hardness)]-1.464)				5.64					
94				Chronic			WER X 0.96 X e(0.8545[ln(hardness)]-1.465)				4.17					
95																
96	Lead			Acute			WER X e(1.273[ln(hardness)]-1.460)*CF3				17.68		CF3 = 1.46203 - [0.145712*ln(hardness)]			
97				Chronic			WER X e(1.273[ln(hardness)]-4.705)*CF3				0.69					
98																
99	Mercury			Acute			WER X 0.85 X 2.4				2.04					
100				Chronic			WER X 0.012				0.01					
101																
102	Nickel			Acute			WER X 0.998 X e(0.8460[ln(hardness)]+3.3612)				525.50					
103				Chronic			WER X 0.997 X e(0.8460[ln(hardness)]+1.1645)				58.36					
104																
105	Zinc			Acute			WER X 0.978 X e(0.8473[ln(hardness)]+0.8604)				42.43					
106				Chronic			WER X 0.986 X e(0.8473[ln(hardness)]+0.7614)				38.74					
107																
108	Silver			Acute			WER X 0.85 X e(1.72[ln(hardness)]-6.52)				0.46					
109																
110	Cyanide			Acute			WER X 22.36				22.36					
111				Chronic			WER X 5.2				5.20					
118																
119	Selenium			Acute			WER X 20				20.00					
120				Chronic			WER X 5				5.00					
121																
122	The following formulas are applicable to the Jet Stream Model for lakes for calculating the Dilution Factor (DF):															
123			DF = ((2.8 * D * 3.1416^0.5) / X)			where DF is % of effluent at distance X, D is the diameter of the outfall pipe										
124				and X is aquatic life criteria--25 feet for ZID; 100 feet for mixing zone; human health criteria 200 feet for mixing zone.												
125			DF =	#VALUE!	Acute	#VALUE!	Chronic	#VALUE!	Bioacc.							
126																

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
127	The following formulas are used to calculate the instream waste concentration (IWC) for each pollutant:															
128																
129			IWC = [(Frac X Critical Flow X Cb) + (2.13 X Ce X Qd)] / [Frac X Critical Flow + Qd] where the critical flow is the 7Q10 except for lakes with the Jet Stream Model.													
130			Use EPA Statistical Factor of 2.13 for less than 20 Ce data points with the Geometric Mean of the Ce's; use 1 for more than 20 data points with the maximum Ce.													
131			IWC = (DF X Ce) + Cb for lakes with Jet Stream Model.													
132	POLLUTANTS		Number of Data points	MQL	EPA Statistical	Background Conc. Cb	Effluent Conc. Ce	Domestic Supply IWC	Acute Aquatic IWC	Chronic Aquatic IWC	Bioacc. IWC	[Reserved]	Arkansas Acute Aquatic	Arkansas Chronic Aquatic	Arkansas Bioacc.	EPA Bioacc.
133				ug/l	Factor	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l		ug/l	ug/l	ug/l	ug/l
137	**METALS AND CYANIDE**															
138	8. Copper Total		18	0.5	2.13	0	8.25	1.40	3.64	2.01	8.78	9999999	14.79	10.93	9999999	13,000
139	9. Lead Total		53	0.5	1	0	9.9	0.79	2.05	1.13	4.95	9999999	87.29	3.40	9999999	50
140	16. Zinc Total		18	20	2.13	0	101.29	17.15	44.74	24.63	107.77	9999999	130.87	119.50	9999999	260,000
141														*Primary Drinking Water MCL		

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
142	STEP 3:	APPLICABLE WATER QUALITY-BASED LIMITS														
143																
144																
145								ADEQ HUMAN HEALTH CRITERIA								
146	POLLUTANTS		Permit Daily Maximum	Permit Monthly Average	Permit Daily Maximum	Permit Monthly Average		Permit Daily Maximum	Permit Monthly Average	Permit Daily Maximum	Permit Monthly Average					
147			ug/l	ug/l	lb/day	lb/day		ug/l	ug/l	lb/day	lb/day					
148	Copper Total		NO	NO	NO	NO										
149	Lead Total		NO	NO	NO	NO										
150	Zinc Total		NO	NO	NO	NO										