DAEC

CEDAR RIVER WATER QUALITY STUDY

Quarterly Report

Summer 1971

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INTRODUCTION

This report presents the results of studies of the limnology and fishery of the Cedar River in the vicinity of the Duane Arnold Energy Center near Palo, Iowa, conducted during the period June 18-July 21, 1971. In accordance with the Duane Arnold Energy Center Environmental Report, April 1971, intensive studies of the chemistry and biology of the Cedar River will be conducted quarterly, in addition to the twice monthly studies which are routinely conducted.

HYDROLOGICAL CHARACTERISTICS OF THE CEDAR RIVER

The Cedar River, in the vicinity of the plant site, has a drainage area of about 6250 square miles. Average yearly flow of the Cedar River at Cedar Rapids (15 miles below the site) is 3065 c.f.s. Provisional U.S.G.S. data indicates that, during the months of June and July, 1971, flows at Cedar Rapids were somewhat above the medians for those months. Average flow for June, 1971 was 5890 c.f.s. (154% of the median June flow of 3822 c.f.s.). A high flow of 9200 c.f.s. occurred on June 2, and flows generally declined for the rest of the month.

Average flow for July, 1971, was 3360 c.f.s. (134% of the median July flow of 2508 c.f.s.). In general, flows remained fairly constant throughout the month, although slight increases occurred on July 10 and 11. By the end of the month, flows had declined to about 2000 c.f.s. at Cedar Rapids.

PHYSICAL, CHEMICAL AND BIOLOGICAL CHARACTERISTICS

Physical and Chemical Studies

Water samples for physical and chemical analysis were collected on July 8, 1971, and are summarized in Tables I and II. At the time of sampling, relatively high turbidity and phosphate values were observed; but in general, the results obtained are typical of this section of the Cedar River. It is likely that the major source of phosphates and nitrogen compounds is agricultural land, rather than discharges of domestic or industrial wastes; and there was no evidence of any significant water quality problems. In general, there appeared to be no difference in the quality of the water at the four stations sampled.

Diurnal Variations

Diurnal variations in dissolved oxygen, carbon dioxide, alkalinity, pH, and air and water temperatures are summarized in Table V.

As might be expected, lowest dissolved oxygen values occurred just before, or shortly after, sunrise. Maximum concentrations occurred in the late afternoon. There appeared to be little difference between the four stations. A maximum diurnal variation of 3.1 mg./l. occurred at the Lewis Access Station (Station 1). Maximum oxygen concentration observed was 9.9 mg./l. (120% of saturation). These data indicate moderate algal activity and little evidence of organic pollution. This conclusion is supported by the phenophthalein alkalinity and pH values observed.

Plankton Studies

The analysis of plankton samples collected on July 8 are given in Tables III and IV. Plankton concentrations observed at this time were relatively low. This may be due to the elevated turbidity present in the river at that time (140-230 J.T.U.).

In general, the composition of the plankton is fairly typical of the Cedar River. The large blue-green algal populations observed, chiefly Oscillatoria and Aphanizomenon, frequently occur in the Cedar and Iowa Rivers during July and August when water temperatures are high. These forms, as well as others observed at the time, are fairly indicative of a river containing high concentrations of available nitrogen and phosphorous.

Bacteriological Studies

The results of bacterial determinations are given in Table III. Although a good deal of variation is present between the various stations, this was not felt to be significant. High bacterial concentrations are typical of the Cedar River during periods of high turbidity due to the introduction of organisms from the drainage basin. Substantially larger total coliform, fecal coliform and fecal streptococci concentrations were observed during June when greater runoff and higher river flows were present. This would tend to indicate that the principal source of these organisms in this section of the Cedar River is runoff from agricultural land, rather than domestic sewage effulents upstream.

Bottom Fauna

Bottom organisms were collected from a number of sites in the vicinity of the plant by means of a Ponar dredge. In most areas, the benthic population was sparce, but this appears to be due to the nature of the bottom sediment and the scouring action of the river, rather than the quality of the water.

Most bottom samples taken from the river channel consisted of shifting sand and silt or silt and gravel. Samples taken in quiet water areas near shore consited primarily of silt and mud. The only organisms found in those samples were immature tubificid worms and a few chironomid larvae of the family chironomidae.

Although the bottom fauna obtained from the river channel were sparce in number and generally not indicative of high water quality, the presence of relatively large numbers of mayfly nymphs of the genus Stenonema on submerged rocks in areas not subjected to silting or scouring is indicative of fair to good water quality, as these forms are not generally associated with polluted waters. There appeared to be no significant difference between the benthic population of the river above and below the plant site.

Fishery Studies

Fisheries studies were conducted by the Iowa State Conservation Commission in cooperation with personnel from the University of Iowa Department of Environmental Engineering. Samples were taken above and below the plant site by means of two cheese baited nets (1½" and 1¾" mesh), one unbaited hoop net (1½" mesh) and electroshocking.

The results of the shocking and net sampling are summarized in Table VI.

The present study and other studies indicate that the Cedar River supports a relatively homogenous fishery from Vinton, Iowa, to the Interstate 80 bridge. Little difference was observed in the fishery above and below the plant site. This section of the river is noted for good to excellent channel cat fishing and also supports a fairly good flathead catfish fishery. Carp are also frequently taken by fishermen.

Walleye, sauger, and other game fish are not common in the area and, with the exception of one White Crappie, were not taken by net or shocking during the course of the study.

Preliminary analysis of stomach samples indicates that the aufwuch community (organisms growing attached to submerged rocks, trees, etc.) may provide a significant amount of food for a number of fish species. The Iowa Conservation Commission collected a number of scale samples for age and growth studies, which will be analyzed during the winter.

Fish Pesticide Residues

Pesticide residues found in a variety of fish collected in the vicinity of the plant are summarized in Table VII. Relatively high pesticide concentrtions were observed in several of the fish analyzed. This condition is typically observed in mid-western streams, such as the Cedar River, which receives extensive runoff from agricultural land to which pesticides have been applied. Dieldrin and the breakdown products of DDT were found in the greatest concentrations. As might be expected, those species of fish which are bottom feeders contained the largest residues. This is probably due to the adsorption of pesticides onto clay particles, which are subsequently washed into the stream by runoff. Lowest residues were observed in the Crappie.

Table I
DUANE ARNOLD ENERGY CENTER PROJECT
Chemical Analysis
July 8, 1971

Station	Dissolved oxygen-mg./l.	Carbon Dioxide as $CaCO_3$ mg./l.	pH	Alkalinity as $CaCO_3$ mg./l.		Hardness as $CaCO_3$ mg./l.		Nitrogen mg./l. as:			Phosphates mg./l.		Lignins & Tanins-mg./l.
				Phenolphthalein	Total	Calcium	Total	NH_3	NO_2	NO_3	Ortho	Total	
1. Lewis Access	8.4	0	8.6	12	218	180	272	0.19	0.02	0.66	0.68	1.97	0.25
2. DAEC Plant	8.1	0	8.6	10	226	180	252	0.25	0.02	0.44	0.74	2.20	0.40
3. Comp Farm	8.1	0	8.6	10	218	176	256	0.28	0.02	0.46	0.76	1.81	0.40
4. Mohawk Park	8.8	0	8.7	18	218	188	280	0.20	0.02	0.90	0.46	1.57	0.25

Table I, Cont.
DUANE ARNOLD ENERGY CENTER PROJECT
Chemical Analysis
July 8, 1971

Station	Cl- mg./l.	$SO_4^=$ mg./l.	Fe mg./l.	Mn mg./l.	Zn mg./l.	Cu mg./l.	Cr^{+6} mg./l.	Pb mg./l.	Hg mg./l.	C.O.D. mg./l.
1. Lewis Access	16.3	40	0.09	< 0.05	.08	.14	Neg.			25
2. DAEC Plant	17.1	38	0.11	<0.05	.03	.11	Neg.			22
3. Comp Farm	17.4	38	0.11	<0.05	.07	.10	Neg.			28
4. Mohawk Park	17.6	35	0.06	<0.05	.04	.11	Neg.			19

Table II
DUANE ARNOLD ENRGY CENTER PROJECT
Physical Analysis
July 8, 1971

Station	Temperature °C.	Turbidity J.T.U.	Color	SOLIDS mg./l.			Threshold Odor Number
				Total	Suspended	Dissolved	
Lewis Access	25.5	200	15	581	168	313	5.6
DAEC Plant	25.5	230	15	486	118	368	7.5
Comp Farm	25.5	200	15	484	120	364	13.0
Mohawk Park	26.0	140	15	498	128	370	13.0

Table III
DUANE ARNOLD ENERGY CENTER PROJECT
Bioglogical Analysis
July 8, 1971

Station	20° C. Biochemical Oxygen Demand mg./l.	Total Bacteria org./100 ml.	Total Coliform org./100 ml.	Fecal Coliform org./100 ml.	Fecal Strep org./100,ml.	Total Plankton org./ml.
1. Lewis Access	3.9	960,000	58,000	160	20	8,400
2. DAEC Plant	2.2	73,000	48,000	600	20	4.775
3. Comp Farm	2.5	237,000	39,000	270	10	3,870
4. Mohawk Park	3.5	38,000	2,900	50	0	8,990

Table IV
DUANE ARNOLD ENERGY CENTER PROJECT
Plankton Count
(Per Milliliter)
July 8, 1971

	Lewis Access	DAEC Plant	Comp Farm	Mohawk Park
Blue-Green Algae				
1. Anabaena	51	13	64	96
2. Anacystis		38		
3. Aphanizomenon	172		190	324
4. Oscillatoria	1,679	1,524	1,372	1,499
Diatoms				
1. Cyclotella	1,376	416	896	2,048
2. Diatoma	128			
3. Melosira	640	1,216	96	1,824
4. Meridion			160	
5. Navicula	960	96		96
6. Nitzschia	224	192	32	
7. Pinnularia				320
8. Stephanodiscus	736			388
9. Synedra	1,050	96		160
Green Algae				
1. Actinastrum	448	32		416
2. Ankistrodesmus		128		
3. Chlorella-like	576	672	1,024	1,504
4. Pediastrum	352	32		160
5. Scenedesmus				96
Flagellates				
1. Euglena		192		160
2. Phacus			32	
Miscellaneous				
1. Ciliate	many	many	many	many
TOTALS	8,398+	4,775+	3,866+	8,991+

Table V
DUANE ARNOLD ENERGY CENTER PROJECT
Twenty-four Hour Chemical Analysis
July 20-21

Station	Time	D.O. mg./l.	CO_2 mg./l.	Alkalinity as $CaCO_3$		pH	Water Temp °F.	Air Temp °F.
				Phth.	Total			
1. Lewis Access	06:45	6.8	0	14	190	8.4	73	66
	10:45	7.2	0	12	180	8.4	74	84
	15:10	9.1	0	12	200	8.4	74	90
	18:55	9.9	0	10	204	8.3	79	78
	22:30	9.2	0	18	210	8.5	76	62
	02:30	7.8	0	12	200	8.4	76	62
2. DAEC Plant	07:15	6.8	0	14	192	8.2	73	66
	11:45	7.8	0	14	194	8.4	74	90
	16:05	8.3	0	16	176	8.4	75	90
	19:30	9.2	0	10	204	8.4	76	63
	23:15	8.5	0	16	210	8.4	76	63
	03:15	7.4	0	16	206	8.5	76	62
3. Comp Farm	08:15	6.8	0	14	190	8.4	73	78
	12:35	7.8	0	16	192	8.5	74	90
	16:35	8.3	0	14	190	8.4	75	90
	20:00	9.0	0	10	208	8.4	79	82
	23:45	8.3	0	14	202	8.4	76	62
	05:00	7.0	0	8	202	8.3	75	61
4. Mohawk Park	09:55	7.3	0	18	194	8.5	74	84
	14:15	8.7	0	18	220	8.5	74	90
	17:05	9.8	0	18	208	8.5	78	88
	20:45	9.0	0	14	208	8.4	77	78
	00:45	7.8	0	14	202	8.4	76	62

Table VI
DUANE ARNOLD ENERGY CENTER PROJECT
Fisheries Studies - Shocking and Bait Nets
June 18 - 22, 1971
Above Site

Species	Nets (10 Net days)		Shocking (15 minutes)	
	Number	Weight (lbs.)	Number	Weight (lbs.)
Channel Catfish	210	262	0	0
Flathead Catfish	8	28	0	0
Carpsucker	1	1	8	11.0
Carp	11	32	2	5.0
White Crappie	0	0	1	0.1
Northern Redhourse	0	0	1	0.3
Gizzard Shad	0	0	3	0.3

Table VI (Cont.)
Below Site

Species	Nets (9 net days)		Shocking (20 minutes)	
	Number	Weight (lbs.)	Number	Weight (lbs.)
Channel Catfish	232	52	4	1.0
Flathead Catfish	5	47	1	0.6
Carpsucker	2	2	30	23.0
Carp	9	30	17	28.0
Bigmouth Buffalo	7	24	0	0
Black Crappie	0	0	1	0.4
Northern Redhouse	0	0	7	11.0
Gizzard Shad	0	0	1	0.1

Table VII
DUANE ARNOLD ENERGY CENTER PROJECT
Pesticide Residues in Fish
July 1971

Species	Location (above/ below site)	Length	Weight	Pesticide Residue in ppb						
				Heptachlor	Aldrin	Hept. Epoxide	p,p'-DDE	Dieldrin	o,p'-DDT	p,p'-DDD
Channel cat	below	7.5	57.3	10.8	17.2	22.8	26.4	96.0	-	48.0
Crappie	above	8.0	120.7	10.2	14.3	41.8	84.0	27.9	trace	92.8
Channel cat	below	8.5	69.4	12.0	63.0	40.5	82.5	132.6	-	93.0
Mooneye	below	6.0	36.0	7.5	9.0	14.4	195.0	72.0	-	174.0
Quillback	below	10.0	136.8	-	7.1	-	13.8	20.5	-	-
Sucker	below	14.5	473.6	12.8	28.2	26.5	216.0	227.5	-	259.2
Carpsucker	below	11.0	284.2	31.0	18.4	57.0	68.1	64.7	trace	42.3