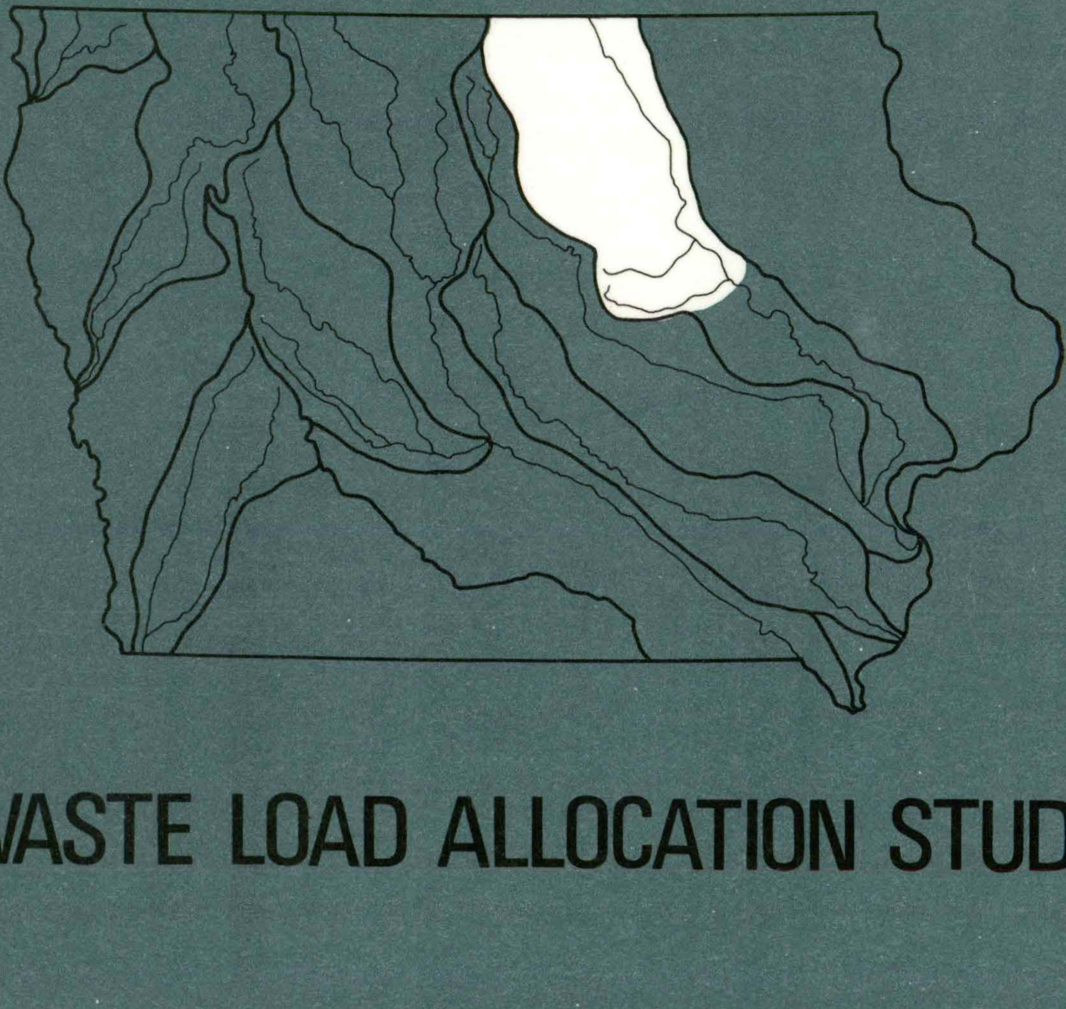
iowa department
of
environmental quality
Water Quality Management Division

CEDAR RIVER BASIN



WASTE LOAD ALLOCATION STUDY

STANLEY CONSULTANTS
INTERNATIONAL CONSULTANTS IN ENGINEERING, ARCHITECTURE, PLANNING, AND MANAGEMENT

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January 22, 1975

Iowa Department of Environmental
Quality
3920 Delaware Avenue
P.O. Box 3326
Des Moines, Iowa 50316

Gentlemen:

We are pleased to submit our report entitled "Cedar River Basin - Waste Load Allocation Study." This report has been prepared in accordance with our contract dated November 12, 1973, and Amendment No. 1 dated April 18, 1974, with the Iowa Department of Environmental Quality for a series of waste load allocation studies.

Respectfully submitted,

STANLEY CONSULTANTS, INC.

R. J. Gear

Ronald J. Gear
Vice President

INTERNATIONAL CONSULTANTS IN ENGINEERING, ARCHITECTURE, PLANNING, AND MANAGEMENT

CEDAR RIVER

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SYNOPSIS

The Cedar River Basin encompasses an area of approximately 5,230 square miles in the north central to northeast section of Iowa. Topography varies from flat glacial drift to rolling and the drainage pattern of the basin is tree-shaped (dendritic). Stream flows per square mile on the major stream in the Cedar River Basin are generally greater than those of the state of Iowa as a whole, especially the 7-day, 1-in-10 year low flow.

Most of the main streams in the basin have a Class B (warm water fisheries) water quality criteria classification. There is a lack of comprehensive water quality data on existing conditions within the basin. The limited data available show, under winter conditions and low flows, lowered water quality within the streams. Under these conditions, the water quality within the Cedar River falls below the applicable water quality criteria. This decrease in water quality is directly related to the impact of treated wastewater discharges upon the stream.

Within the basin, 79 communities are incorporated. Of these, 45 have wastewater treatment facilities. Also, there are 42 industrial and 2 semi-public wastewater dischargers. Thirty-one municipalities maintain wastewater treatment facilities which will not be required to adopt a controlled discharge mode of operation under the National Pollutant Discharge Elimination System (NPDES).

To determine allowable waste load allocations for these 31 dischargers, a computer model based upon a modified Streeter-Phelps equation was utilized. Input data to the model included such physical characteriztics as length of reach, water temperature, channel slope, river width, roughness coefficient, deoxygenation rate constants, wastewater discharge characteristics, and flow and characteristics of groundwater and tributaries. The model approximates the impact of dischargers on stream quality for the specified winter and summer low flow conditions. Wherever stream quality criteria were not met by secondary treatment, reductions were made in the allowable wastewater discharges until satisfactory conditions prevailed.

Under summer low flow conditions, Ackley, Allied Mills (Mason City), Aplington, Clear Lake Sanitary District, Conrad, Forest City, Grundy Center, Hampton, Jesup, Lake Mills, Mason City, and Reinbeck must all provide better than secondary treatment to meet stream quality standards. However, under winter conditions, the above as well as Chamberlain Mfg. Co. (Waterloo), Hudson, La Porte City, Pepsi Cola Bottling (Waterloo), Traer, and Waterloo must also provide better than secondary treatment to meet stream quality criteria.

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PART I
INTRODUCTION

Purpose

The Iowa Department of Environmental Quality (IDEQ) is charged with the responsibility of protecting and maintaining surface and underground water quality throughout the state. This report on the study area of the Cedar River Basin has been prepared for IDEQ to provide waste load allocations.

This report provides basic inventory information relative to comprehensive river basin planning and meets some of the objectives specified for Section 303 (e) plans. Waste load allocations are necessary to facilitate issuance of permits under the National Pollutant Discharge Elimination System (NPDES). All material presented herein is relevant to Section 303 (e) plans, but it is anticipated that additional effort is required to develop a complete river basin plan as now defined. In addition, as with any planning tool, periodic revisions are necessary to assure that the data base and subsequent extrapolations are current and valid. Each expansion of a planning report should build upon previous efforts in order to meet current planning objectives.

The specific purposes of the study and resulting report, as specified by IDEQ, are:

1. To inventory point source wastewater discharges.
2. To define stream low flow characteristics for the study area.
3. To determine waste load allocations for all uncontrolled wastewater discharges to streams within the basin boundary.

Scope

The scope of the completed investigation is summarized below. Topics described relate to major parts of the report.

1. Background Data. Significant physical features in the study area are identified for future reference. These include such factors as geology, soil type, and stream and groundwater characteristics.

2. Water Quality. Water quality data pertinent to the study have been tabulated and evaluated to present the most accurate possible picture of water quality throughout the basin.
3. Point Source Wastewater Discharges. Available records have been reviewed to determine the location and characteristics of point source wastewater discharges. This information forms the basis for waste load allocation investigations.
4. Waste Load Allocation Investigations. Water quality modeling techniques have been utilized to evaluate the impact of wastewater discharges upon stream quality characteristics under both summer and winter critical low flow conditions. Reductions in allowable waste load discharges from various point sources have been identified, as required to maintain water quality within the streams at a level consistent with adopted stream standards.

Water Quality Management Deadlines

As indicated, this report will provide the waste load allocations for utilization in water quality management programs. The 1972 Federal Water Pollution Control Act Amendment and Iowa Pollution Abatement Schedule specifies several deadlines that must be met in the implementation of a management program. Following are several key dates which have been established:

Date	Action
December 31, 1974	NPDES permits issued.
June 30, 1975	Section 303 (e) basin plans completed.
July 1, 1977	Secondary treatment required for all publicly-owned treatment works.
July 1, 1977	Best practical waste treatment technology for all industrial discharges.
January 1, 1978	Ammonia removal to meet IDEQ water quality standards.
July 1, 1983	Best practical waste treatment technology for all publicly-owned treatment works.
July 1, 1983	Best available technology for all industrial discharges.
July 1, 1985	Zero pollutant discharge.

PART II

BACKGROUND DATA

General

The Cedar River Basin area, for purposes of this study, is comprised of the drainage basin within the state of Iowa from the Iowa-Minnesota border to the point where the Cedar River crosses the Black Hawk-Benton County line. Within the study area, the Cedar River flows approximately south while major tributaries join it from the northwest and west. Area of the drainage basin within the study area is approximately 4,858 square miles (3.110 million acres). The Cedar River Basin study area encompasses portions of the following counties and are represented as a percent of the total county in the following tabulation.

Benton	11%	Chicksaw	13%	Marshall	2%
Black Hawk	86%	Floyd	98%	Mitchell	83%
Bremer	44%	Franklin	80%	Tama	33%
Buchanan	3%	Grundy	88%	Winnebago	46%
Butler	100%	Hancock	9%	Worth	100%
Cerro Gordo	97%	Hardin	8%		

The rivers tributary to the Cedar River within the study area are West Fork Cedar River, Shell Rock River, Winnebago River (Lime Creek), and Little Cedar River. Major tributaries to these streams are: Beaver Creek (mouth in Black Hawk County), Beaverdam Creek, Black Hawk Creek, and Wolf Creek. The Cedar River and its tributaries, approximate stream lengths, and drainage areas for the study area are tabulated on the following page.

Average annual precipitation within the basin is approximately 31.3 inches; of this total, 22.7 inches fall during the April through September growing season.

Stream	Stream Length	Drainage Area	
		(1,000 acres)*	(sq mi)*
Cedar River	137	771	1,205
West Fork Cedar River	44	455	711
Little Cedar River	51	175	272
Shell Rock River	84	535	836
Winnebago River (Lime Creek)	73	401	626
Beaver Creek	48	250	391
Beaverdam Creek	27	93	145
Black Hawk Creek	32	220	344
Wolf Creek	56	210	328

*Does not include drainage area in Minnesota.

Political Subdivisions

Within the study area are 79 incorporated communities with a total population of 228,246 according to the "1970 Census of Population." Of these, 30 communities have populations greater than 1,000, comprising about 92 percent of the population. Seven municipalities have a population greater than 5,000 and account for 72 percent of the population; three municipalities have a population greater than 10,000, for 60 percent of the population; and one municipality has a population greater than 50,000, for 33 percent of the population. Populations are summarized for each county and city in Table 1.

Population projections for 1990, Table 1, had been made by the Iowa State Department of Health (Provisional Projections of the Population of of Iowa Counties and Cities: 1975 to 1990, by James R. Taylor, June, 1972). These projections were utilized in determining future waste loads.

Physiography

The topography of the basin varies from flat glacial drift areas with saucer-like depressions in the northwest portion of the basin to a gently rolling topography in the central and southern portions. In the northwest, low ridges with occasional knob-like hills wind across the landscape. Principal streams are deep but have only a few tributaries. The Cedar River valley is 70 to 175 feet below upland areas and cuts through limesone in some sections. The flood plain averages about one-half mile in

TABLE 1

EXISTING AND PROJECTED POPULATIONS
FOR WASTE LOAD ALLOCATIONS

	1970	1990
BLACK HAWK COUNTY	132,916	181,232
Cedar Falls	29,597	52,623
Elk Run Heights	1,175	1,602
Evansdale	5,038	5,473
Gilbertville	655	799
Hudson	1,535	1,873
La Porte City	2,256	2,753
Raymond	582	710
Waterloo	75,533	95,381
BREMER COUNTY	22,737	30,738
Denver	1,169	1,533
Janesville	741	972
Plainfield	446	585
Waverly	7,205	10,374
BUCHANAN COUNTY	21,762	25,963
Jesup	1,662	1,920
BUTLER COUNTY	16,963	19,887
Allison	1,071	1,256
Aplington	936	1,098
Aredale	126	148
Bristow	230	270
Clarksville	1,360	1,595
Dumont	724	849
Greene	1,363	1,600
New Hartford	690	809
Parkersburg	1,631	1,913
Shell Rock	1,159	1,360
CERRO GORDO COUNTY	49,223	58,899
Clear Lake	6,430	8,160
Dougherty	133	152
Mason City	30,379	36,542
Meservey	354	405
Plymouth	461	527
Rock Falls	150	172
Rockwell	923	1,056
Swaledale	222	254
Thornton	410	469
Ventura	543	621
CHICKASAW COUNTY	14,969	18,181
Bassett	152	152
Nashua	1,712	1,712
FLOYD COUNTY	19,860	22,282
Charles City	9,268	10,231
Colwell	100	114
Floyd	380	432
Marble Rock	461	525
Rockford	902	1,026
Rudd	429	488

	1970	1990
FRANKLIN COUNTY	13,255	13,064
Alexander	249	249
Coulter	262	262
Geneva	201	201
Hampton	4,376	5,066
Hansell	124	124
Latimer	395	395
Sheffield	1,070	1,070
GRUNDY COUNTY	14,119	17,238
Beaman	222	263
Conrad	932	1,104
Dike	794	940
Grundy Center	2,712	3,728
Holland	258	306
Morrison	136	161
Reinbeck	1,711	2,026
Stout	196	232
Wellsburg	754	893
HARDIN COUNTY	22,248	26,637
Ackley	1,794	1,902
MITCHELL COUNTY	13,108	14,552
Carpenter	122	130
Orchard	115	122
Osage	3,815	4,670
St. Ansgar	994	1,057
Stacyville	598	636
TAMA COUNTY	20,147	22,572
Gladbrook	961	1,079
Lincoln	184	207
Traer	1,682	1,888
WINNEBAGO COUNTY	12,990	15,677
Forest City	3,841	6,280
Lake Mills	2,124	2,182
Leland	220	226
Scarville	81	83
Thompson	600	616
WORTH COUNTY	8,984	9,145
Fertile	394	401
Grafton	254	259
Hanlontown	182	185
Joice	201	204
Kensett	361	367
Manly	1,294	1,317
Northwood	1,950	1,985

width. Other streams have narrow bottoms with some terraces. The general incline of the basin is to the south and east.

The surface drainage pattern in the basin is dendritic. Natural surface drainage in the northwest part of the basin is inadequate because the drainage pattern is not well developed. Over the remainder of the basin, surface drainage is generally adequate. Intermittent drainageways extend into the uplands to provide good surface water removal. Bottomlands are poorly drained and subject to flooding. Surface drainage ditches and drain tile improve drainage where natural drainage is inadequate.

Upland soils in the basin have been formed from glacial drift and loess. Drift soils occur throughout the basin but are most extensive in the north part. Loess soils occupy about the southern two-thirds of the basin. Loess thickness varies from a few inches in the north to 30 feet in the south. Most soils have moderate permeability. Pockets of stratified sand and gravel occur in the underlying drift. A few of the heavy-textured soils with impervious subsoils have poor drainage. Clarion soils represent drift soils while Tama soils are representative of loess soils.

Terrace soils in the basin are not very extensive. Drainage on terrace soils ranges from poorly to excessively drained. Bremer soils are representative of terrace soils.

Bottomland soils are formed from alluvium. These soils have slow permeability, a high water table, and are subject to flooding. Wabash soils are representative of bottomland soils.

The surficial aquifer that overlies the bedrock aquifers is formed by alluvium and glacial drift. Although surficial aquifers of glacial drift do not generally produce large enough quantities of water for public or industrial water needs, they do produce water in sufficient quantities for farmsteads and rural residences.

Soil conditions on the upland areas are variable. Potential pollution problems exist for unsealed sewage lagoons because some soils have moderate permeability and the underlying material contains pockets of sand and gravel. On flat and depressional areas, slow permeability and a seasonally high water table create a potential pollution hazard for both unsealed sewage lagoons and septic tank filter fields.

Alluvial aquifers in river bottoms, especially those along major river valleys and on terraces, produce large quantities of water. These aquifers are recharged by local precipitation. Water quality is variable even in local areas, but generally fair to good.

Potential contamination of groundwater in alluvial aquifers is great. Pollutants flowing over terraces that are highly permeable can infiltrate the soil. Since these aquifers are located adjacent to streams, contaminated groundwater can transmit to streams any pollutants which are present. These areas have severe limitations for wastewater disposal because of high permeability on some terraces and because bottomlands have a high water table, slow permeability, and subject to flooding.

All sites where wastewater disposal is proposed should be carefully evaluated on an individual basis.

Streams

Water contains oxygen required by microorganisms for degradation of organic material. The quantity of oxygen available for waste assimilation is a direct function of the flow volume. In addition, physical characteristics of the channel establish velocity and turbulence, and determine the reoxygenation capability of a stream. Therefore, physical conditions in a stream influence the available oxygen supply, and the biological degradation of organic matter and ammonia which occurs naturally.

Water quality criteria of the state of Iowa must be met at all times when the flow of the stream equals or exceeds the statistical seven-day, one-in-ten year (7-day, 1-in-10 year) low flow. Based upon this flow information and the physical characteristics of the stream, the assimilative capacity may be analyzed and allowable discharges determined.

Low Flow Characteristics - The United States Geological Survey (USGS) maintains an extensive nationwide network of stream gaging stations. Stream flow and certain water quality parameters are monitored continuously at some stations and periodically at others. By extrapolation of data from this established network and review of partial-record stations, additional flow information may be determined for streams where continuous-record stations are not provided.

Low flow in the study portion of the Cedar River Basin varies with size of stream when results are reduced to a common basis of discharge per square mile. The magnitude of the variation ranges from double the state average to half of it. The following tabulation is a comparison of flows at gaging stations on the lower reaches of study area streams to the average of 84 continuous-record stations with the state of Iowa.

	Percentage of Time Flow Equaled or Exceeded[1]				
	50	90	95	98	99
State of Iowa Average (cfs/sq mi)	0.150	0.033	0.024	0.018	0.015
Cedar River near Waterloo (cfs/sq mi)	0.253	0.091	0.074	0.056	0.049
Little Cedar River near Ionia (cfs/sq mi)	0.144	0.049	0.033	0.020	0.013
West Fork Cedar River near Finchford (cfs/sq mi)	0.174	0.040	0.026	0.015	0.011
Winnebago River at Mason City (cfs/sq mi)	0.148	0.032	0.023	0.016	0.012
Shell Rock River at Shell Rock (cfs/sq mi)	0.186	0.066	0.052	0.040	0.034
Black Hawk Creek near Hudson (cfs/sq mi)	0.168	0.036	0.025	0.013	0.009

[1] Iowa Natural Resources Council, Low-Flow Characteristics of Iowa Streams Through 1966, Bulletin No. 10, 1970.

The above table refers to daily average discharges recorded at each gaging station regardless of chronological sequence. The period of record for the study area gaging stations ranges from 21 to 42 years. Considerable variation of flow values exists with the major streams generally near or above the average values for the state and with the smaller streams exhibiting less than average flows.

As with the daily flow data presented, the average 7-day, 1-in-10 year low flow for the above gages varies considerably when reduced to the common basis of discharge per square mile. Average 7-day, 1-in-10 year low flow for the state of Iowa is 0.020 cfs/sq mi while 7-day, 1-in-10 year low flows within the basin range from 0.047 cfs/sq mi on the Cedar River to 0.0099 cfs/sq mi on Black Hawk Creek. The Little Cedar River averages 0.011 cfs/sq mi; West Fork Cedar River, 0.011 cfs/sq mi; Winnebago River, 0.013 cfs/sq mi; and Shell Rock River, 0.033 cfs/sq mi.

Specific USGS gaging station locations are identified on Figure 1. Both partial-record and continuous-record stations have been identified on this presentation. Table 2 identifies the specific station number, tributary drainage areas above the station, and the 7-day, 1-in-10 year low flow (where available) for each station.

As indicated in Table 2, insufficient data are available for identification of low flow at each gaging station. In order to conduct a waste load allocation analysis, determination of 7-day, 1-in-10 year low flow was conducted for specific gaging stations. This was necessary primarily at partial-record stations. Because of a lack of data at these stations, various methods were used to estimate the 7-day, 1-in-10 year low flow. Verification of these values, as additional flow information becomes available, is required.

The frequency of extreme flows is cyclic within the basin. Due to the climatological and geological characteristics of the basin, low flows can occur either during August and September or during Janaury and February of any given year. In addition, long-term climatological cycles have an influence upon stream flow. Based upon this information, analyses of critical conditions for defining waste load allocation must be conducted for both warm and cold water temperatures.

Stream Hydrodynamics - The term hydrodynamics refers to the characteristics of motion associated with a body of water. As is discussed in further detail in PART V - WASTE LOAD ALLOCATION METHODOLOGY, stream velocity and slope are of major interest. The relationship between these two characteristics allow definition of reaeration rate constants within particular reaches of streams based upon cross section and slope information. The two physical characteristics which are required to define the reaeration rate constants are the slope of the water surface and time of travel for each reach.

U.S.G.S. GAGING STATIONS

FIG. 1

TABLE 2

USGS GAGING STATION INFORMATION

Station No.	Stream[1]	Location	Drainage Area	7-Day, 1-in-10 Year Low Flow	
			(sq mi)	(cfs)	(mgd)
4573	Otter Creek	Near Otranto	60.3	---	---
4573.5	Cedar River	Otranto	656	---	---
4574	Deer Creek	Near Meltonville	67.5	<0.1	<0.065
4574.4[2]	Deer Creek	Near Carpenter	91.6	---	---
4574.5	Ceer Creek	St. Ansgar	97.5	---	---
4576	Rock Creek	Near Floyd	69.7	---	---
4577[2]	Cedar River	Charles City	1,064	---	---
4578	Little Cedar River	Near Staceyville	77.3	---	---
4580	Little Cedar River	Near Ionia	306	3.5	2.3
4584	Quarter Section Run	Near Denver	83.5	0	0
4585	Cedar River	Janesville	1,661	62	40
4585.5	Beaverdam Creek	Near Rockwell	72.4	---	---
4585.6[2]	Beaverdam Creek	Near Sheffield	12.3	---	---
4586	Bailey Creek	Near Sheffield	75.2	---	---
4587.5	Otter Creek	Near Hansell	92.0	---	---
4587.7	Squaw Creek	Near Hansell	24.2	---	---
4587.8	Hartgrave Creek	Near Hansell	161	---	---
4587.9	Boylan Creek	Near Bristow	55.7	0	0
4588	Maynes Creek	Near Hampton	71.0	---	---
4588.5	Maynes Creek	Near Dumont	121	---	---
4589	W. Fork Cedar River	Finchford	846	9.6	6.2
4590	Shell Rock River	Near Northwood	300	8.2	5.3
4590.1[2]	Elk Creek	Kensett	58.1	---	---
4590.5	Lime Creek	Near Scarville	113	---	---
4592	Winnebago River	Near Forest City	205	---	---
4593	Winnebago River	Near Fertile	303	---	---
4594	Beaver Creek	Near Fertile	54.9	<0.1	<0.065
4594.9[2]	Spring Creek	Near Mason City	29.3	---	---
4595	Winnebago River	Mason City	526	6.8	4.4
4600	Clear Lake	Clear Lake	22.6	---	---

TABLE 2 (Cont.)

USGS GAGING STATION INFORMATION

Station No.	Stream[1]	Location	Drainage Area	7-Day, 1-in-10 Year Low Flow	
			(sq mi)	(cfs)	(mgd)
4601[2]	Willow Creek	Near Mason City	78.6	---	---
4602	Willow Creek	Mason City	86.0	---	---
4605	Shell Rock River	Marble Rock	25	---	---
4611	Cold Water Creek	Near Greene	56.8	0	0
4613	Flood Creek	Near Rockford	59.3	0	0
4614	Flood Creek	Near Packard	145	0	0
4620	Shell Rock River	Shell Rock	1,746	57	37
4627	Beaver Creek	Near Ackley	55.5	---	---
4627.5[2]	Beaver Creek	Near Arlington	11.6	---	---
4628	South Beaver Creek	Near Parkersburg	114	---	---
4630	Beaver Creek	New Hartford	347	3.9	2.5
4630.9[2]	Black Hawk Creek	Grundy Center	56.9	---	---
4631	Black Hawk Creek	Near Grundy Center	71.0	---	---
4632	Mosquito Creek	Reinbeck	24.0	<0.1	<0.0065
4633	Black Hawk Creek	Reinbeck	135	---	---
4634	N. Black Hawk Creek	Dike	76.3	<0.1	<0.065
4635	Blackhawk Creek	Hudson	303	3.0	1.9
4640	Cedar River	Waterloo	5,164	240	155
4641	Wolf Creek	Near Beaman	63.2	---	---
4641.3	Four Mile Creek	Near Lincoln	13.78	---	---
4641.33	Half Mile Creek	Near Gladbrook	1.33	---	---
4641.45[2]	Twelve Mile Creek	Near Traer	43.8	---	---
4641.5	Twelve Mile Creek	Near Buckingham	76.8	<0.1	<0.0065
4642	Wolf Creek	Near Buckingham	287	---	---
4642.5	Wolf Creek	La Porte City	327	---	---
4643	Spring Creek	Near La Porte City	57.5	---	---

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[1] Iowa Natural Resources Council, Low-Flow Characteristics of Iowa Streams Through 1966, Bulletin No. 10, 1970

[2] Water Resource Data for Iowa, USGS, 1972

Information on the actual slope of the water surface is not available for this river basin. Surface water slope varies with the amount of flow in the stream and at 7-day, 1-in-10 year low flows, the assumption is made that the slope of the water surface is essentially the same as the slope of the stream bottom. Stream bed slopes have been obtained from the information on USGS topographic maps. Channel slopes in the streams to be modeled range from approximately 0.8 ft/mi to approximately 16.7 ft/mi. Channel slopes of the Cedar River, Black Hawk Creek, and Wolf Creek fall within the bottom third of this range. The Shell Rock River, Winnebago River (Lime Creek), and West Fork Cedar River slopes cover the entire range.

Determination of time of travel is dependent only upon distance traveled and stream velocity. Distance is measured from USGS topographic maps. Determination of stream velocity is described in detail in PART V. The two physical characteristics required to calculate stream velocity are the width of stream and value of the Manning coefficient ("n"). Values of both the width and "n" are dependent upon the stream flow, and so these values must be determined at the 7-day, 1-in-10 year low flow. Values for these two characteristics can be obtained at USGS gagting stations, but data available at the stations do not usually include measurements at the 7-day, 1-in-10 year low flows. Available data must be extrapolated to obtain an approximate value for these characteristics under low flow conditions. Since there are few USGS gaging stations at which these characteristics may be obtained, the values of "n" and stream width for other reaches of the stream must be estimated from the approximations available at the gaging stations and from field observations. Field observations of stream widths at low flows (not 7-day, 1-in-10 year low flows) also aid in estimating stream widths under the low flow condition. The approximate "n" values at the gaging stations, visual examination of the stream, and use of the method for estimating "n" presented in Open Channel Hydraulics (by V. T. Chow) are all aids in estimated "n" values for stream reaches which do not have a USGS gaging station.

PART III

WATER QUALITY

General

The main objective of determining allowable waste loads is protection and enhancement of water resources to ensure acceptable conditions for designated uses. Identification of realistic waste load allocations is aided by knowledge of the existing water quality within the Cedar River Basin.

Iowa Water Quality Standards establish a baseline for evaluating adequate stream quality under existing and projected discharge conditions. The National Water Quality Criteria, as proposed by the Federal Environmental Protection Agency (EPA), provide an additional measure of the adequacy of existing water quality.

Existing water quality for Winnebago River (Lime Creek), Shell Rock River, Black Hawk Creek, and Cedar River has been identified based upon analyses of available data obtained from various sources. The data indicate some areas with degraded water quality and provide limited information on overall water quality within the basin. Review of existing data shows major deficiencies in the extent of water quality monitoring in the study area.

Water Quality Criteria

Water quality criteria define the constituent levels which will protect the utility of the water resource for multiple uses. Concentrations of water quality parameters in a "pristine" state are impossible to locate or estimate because of the activities of man within the basin. Existing criteria are the standard against which water quality parameters are compared to determine the quality of a stream. Differences between existing quality and criteria establish a basis for defining waste load allocations.

Iowa Department of Environmental Quality Regulations - Regulations promulgated by the Iowa Water Quality Commission specify water quality for all surface waters within Iowa. Powers and authorities of IDEQ are defined in the Code of Iowa, 1973, Sections 455B.32(2) and 455B.35. Specific regulations are given in the "Iowa Departmental Regulations - Department of Environmental Quality" (IDR-DEQ).

The most important regulations applicable to the study area are identified in Chapter 16, Sections 1 and 2, "Water Quality Standards" of the IDR-DEQ. This document specifies the stream quality requirements for the following use classifications:

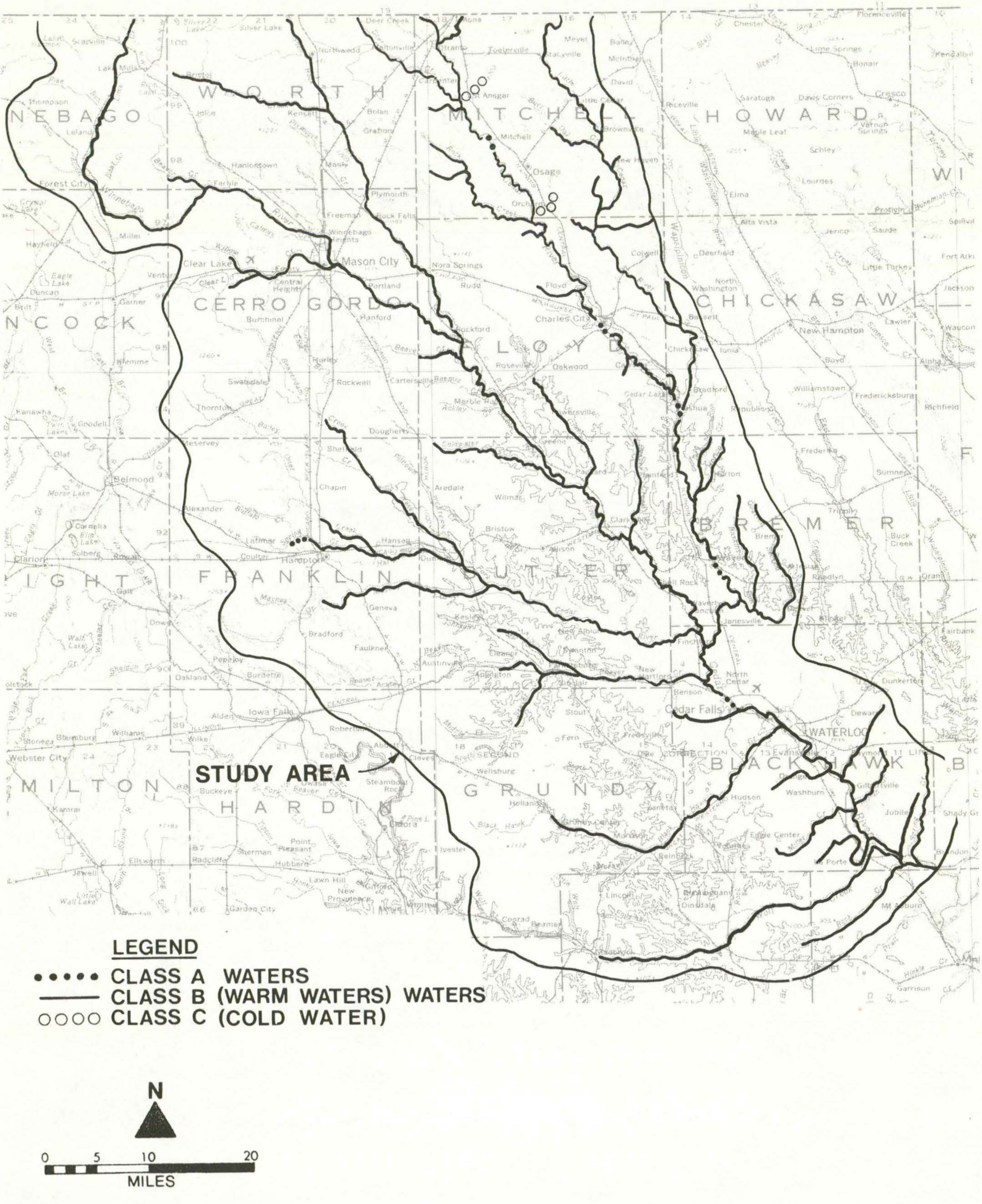
Class A - Body Contact Recreation
Class B - Wildlife, Non-body Contact Recreation and Aquatic Life
Class C - Potable Water Supply

In accordance with use classifications, certain streams within the basin must satisfy the water quality standards for Class B and certain designated areas must satisfy the Class A requirements. Figure 2 indicates which streams within the study area must satisfy Class A and Class B requirements. Other streams have not been classified and must satisfy General Water Quality Criteria. Tables 3 and 4 summarize the applicable standards for the classifications.

Class B uses apply to waters which will support both cold and warm water fisheries, and different sets of criteria are enumerated for each use. Within the basin study area, some streams are classified for warm water fisheries, while others are classified for cold water fisheries. Therefore, Table 3 contains stream standards applicable for both cold and warm water fisheries.

Federal EPA Regulations - In conformance with 1972 Federal Water Pollution Control Act Amendments [Section 304(a)(1) and (2), Public Law 92-500], EPA has published "Proposed Criteria for Water Quality." Under existing legislation, major programs which will be affected by the criteria are:

Water Quality Standards
Toxic and Pretreatment Standards
Water Quality Inventory (monitoring)
Toxic and Pretreatment Effluent Standards
National Pollutant Discharge Elimination System
Ocean Discharge Criteria



SURFACE WATER CLASSIFICATION

FIG. 2

TABLE 3

WATER QUALITY STANDARDS

Water Quality Parameter	Class A	Class B (Warm Water)	Class B (Cold Water)
Dissolved Oxygen		At least 5.0 mg/l during at least 16 hours of any 24-hour period. At all times equal to or greater than 4.0 mg/l.	At least 5.0 mg/l during at least 16 hours of any 24-hour period. At all times equal to or greater than 4.0 mg/l.
pH	Not less than 6.5, nor greater than 9.0. Maximum change permitted as a result of a waste discharge shall not exceed 0.5 pH units.	Not less than 6.5, nor greater than 9.0. Maximum change permitted as a result of a waste discharge shall not exceed 0.5 pH units.	Not less than 6.5, nor greater than 9.0. Maximum change permitted as a result of a waste discharge shall not exceed 0.5 pH units.
Turbidity	Shall not be increased by more than 25 Jackson turbidity units by any point source discharge.	Shall not be increased by more than 25 Jackson turbidity units by any point source discharge.	Shall not be increased by more than 25 Jackson turbidity units by any point source discharge.
Fecal Coliforms	Maximum allowable count of 200 per 100 ml when the count is attributable to waste discharges which may contain human pathogens or parasites.	Shall not exceed 2,000 per 100 ml, except when waters are materially affected by surface runoff.	Shall not exceed 2,000 per 100 ml, except when waters are materially affected by surface runoff.
Temperature		Maximum increase of 5° F. The rate of temperature change shall not exceed 2° F per hour. Maximum allowable stream temperature is 90° F. Maximum increase for lakes and reservoir is 3° F. The rate of temperature change shall not exceed 2° F per hour. Maximum allowable temperature is 90° F.	Maximum increase of 3° F. The rate of temperature change shall not exceed 2° F per hour. Maximum allowable stream tempera- is 68° F.
Chemical Constituents		The concentrations given in Table 5 shall not be exceeded at any time the flow equals or exceeds the 7-day, 1-in-10 year low flow unless it is known that the material is from uncontrollable non-point sources. All substances toxic or detrimental to aquatic life shall be limited to non-toxic or non-detrimental concentrations in the surface water.	The concentrations given in Table 5 shall not be exceeded at any time the flow equals or exceeds the 7-day, 1-in-10 year low flow unless it is known that the material is from uncontrollable non-point sources. All substances toxic or detrimental to aquatic life shall be limited to non-toxic or non-detrimental concentrations in the surface water.

TABLE 4

WATER QUALITY STANDARDS
GENERAL WATER QUALITY CRITERIA

Such waters shall be free from substances attributable to municipal, industrial or other discharges, or agricultural practices that will settle to form objectionable sludge deposits.

Such waters shall be free from floating debris, oil, grease, scum, and other floating materials attributable to municipal, industrial or other discharges, or agricultural practices in amounts sufficient to be unsightly or deleterious.

Such waters shall be free from materials attributable to municipal, industrial or other discharges, or agricultural practices producing color, odor, or other conditions in such degree as to create a nuisance.

Such waters shall be free from substances attributable to municipal, industrial or other discharges, or agricultural practices in concentrations or combinations which are toxic or harmful to human, animal, plant, or aquatic life.

The turbidity of the receiving water shall not be increased by more than 25 Jackson turbidity units by any point source discharge.

The major objectives of the EPA water quality criteria are to provide protection of all waters and improve natural water quality. The means by which this will be accomplished is best described by the following:

> "EPA Water Quality Criteria will be incorporated into revised State water quality standards under the direction of EPA Regions by means of policy guidelines developed by the EPA Office of Water Planning and Standards. Those guidelines have provisions for waters to be exempted from specific criteria on a case-by-case basis for specified periods when naturally occurring conditions exceed limits of the EPA criteria or other extenuating conditions prevail to warrant such exemptions."[1]

These criteria are to provide the protection necessary to sustain recreational uses in/on the water, and for the preservation and propagation of desirable aquatic biota. This level of protection ensures the suitability of all waters for other uses. Based upon the latest scientific information, these criteria define the water quality necessary to satisfy 1983 interim goals [Section 101(a)(2), Public Law 92-500].

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[1] "Proposed Criteria for Water Quality," Volume 1, U.S. Environmental Protection Agency, Washington, D.C., October, 1973, p. 17.

TABLE 5

WATER QUALITY STANDARDS
CHEMICAL CONSTITUENTS

Chemical Constituent	Allowable Concentration** Class B (mg/l)
Ammonia Nitrogen-N	2.0
Phenols (other than natural sources)	0.001
Total Dissolved Solids	750.
Arsenic	1.0
*Barium	1.0
*Cadmium	0.05
*Chromium (hexavalent)	0.05
*Chromium (trivalent)	1.0
*Copper	0.02
Cyanide	0.025
*Lead	0.10
*Mercury	0.005
*Selenium	1.0
*Zinc	1.0

*The sum of the entire heavy metal group shall not exceed 1.5 mg/l.

**Not to be exceeded when flow is equal to or greater than the 7-day, 1-in-10 year low flow unless from uncontrollable non-point sources.

The "Proposed Criteria for Water Quality" are not used in evaluating water quality for this study. However, a comparison between proposed EPA criteria and IDEQ water quality standards for Class B streams (warm water fisheries) is presented in Table 6 for reference.

Water Quality Criteria Summary - Examination of Table 6 indicates both differences and similarities between proposed EPA criteria and Iowa water quality standards. Many parameters not limited by Iowa criteria are to be regulated by EPA. Since proposed EPA criteria must be incorporated into Iowa criteria through resolution of differences with the state of Iowa, evaluation of existing stream quality using EPA criteria would not provide meaningful results. Thus, for purposes of this study, IDEQ standards will be utilized.

Iowa standards are either more stringent or comparable to proposed EPA criteria for all parameters except trivalent chromium, lead, mercury, and dissolved oxygen (DO). Differences may exist between the two agencies for other toxic materials; however, since EPA values are based upon bioassay determinations of toxic concentrations, a direct comparison is not possible.

Initial review of ammonia levels suggests EPA criteria are much more stringent than Iowa standards. However, EPA criteria refer to the concentration of un-ionized ammonia while Iowa standards specify total ammonia concentration. The differences between the Iowa 2.0 mg/l total ammonia standard and EPA criteria depend on stream pH as evidenced below:

pH	(NH_4^+) (mg/l-N)	(NH_3) (mg/l-N)	Total Ammonia (mg/l-N)
6	39.98	0.02	40.00
7	3.62	0.02	3.64
8	0.36	0.02	0.38

Note: Values based upon the dissociation constant at 25° C.

Existing Water Quality

Data Sources - The study area is the drainage basin of the Cedar River from the Iowa-Minnesota border to the Black Hawk-Benton county line. The

TABLE 6

COMPARISON OF WATER QUALITY CRITERIA

Water Quality Parameter	IDEQ Class B Water Quality Standards	EPA Proposed Criteria for Water Quality
pH	6.5 - 9.0	6.0 - 9.0
Alkalinity	--	30 - 130 mg/l
Acidity	--	Addition of acids unacceptable
Ammonia	2.0 mg/l-N (ammonia plus ammonium ion)	0.02 mg/l-N maximum (ammonia only) or 0.05 of the 96-hour LC_{50}[1]
Cadmium	0.05 mg/l	0.03 mg/l - hard water[2] 0.004 mg/l - soft water
Chlorine (free)	--	0.003 mg/l - chronic exposure 0.05 mg/l - 30 minute exposure
Chromium (hexavalent)	0.05 mg/l	0.03 mg/l
Chromium (trivalent)	1.0 mg/l	0.03 mg/l
Copper	0.02 mg/l	0.10 of the 96-hour LC_{50}[1]
Cyanide	0.025 mg/l	0.05 of the 96-hour LC_{50}[1]
Lead	0.10 mg/l	0.03 mg/l
Mercury	5.0 ug/l	0.2 ug/l - single occurrance 0.5 ug/l - average concentration
Nickel	--	0.02 of the 96-hour LC_{50}[1]
Phosphorus	--	25 ug/l-P lakes and reservoirs[3] 100 ug/l-P - streams[3]
Zinc	1.0 mg/l	0.003 of the 96-hour LC_{50}[1]
Fecal Coliforms	200 per 100 ml - Class A waters 2,000 per 100 ml - Class B waters	2,000 per 100 ml average - non-recreational waters 200 per 100 ml average - recreational waters.
Dissolved Solids	750 mg/l	Bio-assay to be used to determine limits of tolerance of aquatic ecosystem.
Temperature	4	5
Pesticides	--	0.01 of the 96-hour LC_{50}[1] for those pesticides not listed in Reference [7]
Turbidity	Less than 25 Jackson Turbidity Unit increase from any point source.	Compensation point may not be changed by more than 10 percent.
Radioactivity	--	8
Dissolved Oxygen	5.0 mg/l for at least 16 hours of any 24-hour period. Never less than 4.0 mg/l at any time.	6.8 mg/l at 1.5° C 6.8 mg/l at 7.7° C 6.5 mg/l at 16.0° C 6.2 mg/l at 21.0° C 5.8 mg/l at 27.5° C 5.8 mg/l at 36.0° C Never less than 4.0 mg/l for a 24-hour or less period when water temperatures exceed 31.0° C.
Sulfides	--	0.002 mg/l
Detergents (as LAS)	--	0.2 mg/l - maximum or 0.05 of the 96-hour LC_{50}[1]
Oils	--	No visible oil 0.05 of the 96-hour LC_{50}[1]
Phthalate Esters	--	0.3 ug/l
Polychlorinated Biphenyls	--	0.002 ug/l
Tainting Substances	--	6

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[1] LC_{50} identifies the concentration at which 50 percent of the test organisms die within the stated time period.

[2] Hard water is defined as having a total hardness of 100 mg/l as $CaCO_3$ or more.

[3] Concentrations required to prevent nuisance aquatic plant growths where phosphorus is the limiting constituent.

[4] Refer to Table 3.

[5] Refer to "Proposed Criteria for Water Quality," EPA, p. 144-170.

[6] Refer to "Proposed Criteria for Water Quality," EPA, p. 141-143.

[7] Refer to "Proposed Criteria for Water Quality," EPA, p. 125.

[8] "Water Quality and Treatment," American Waterworks Association, Inc., 1971, p. 27-32.

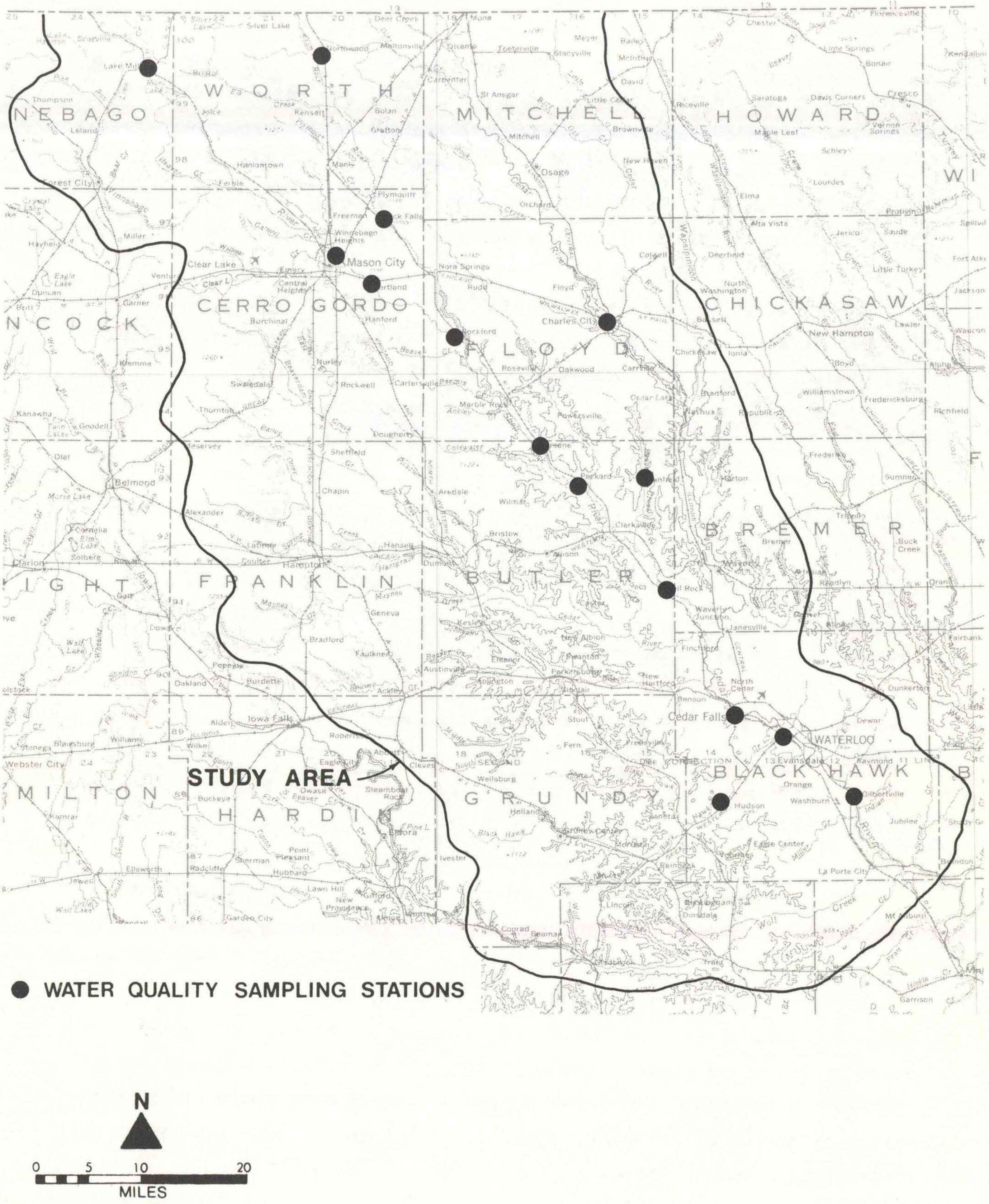
evaluation of water quality data herein is based upon data collected by the State Hygienic Laboratory. Some data are available from other Federal, State, and local agencies; but these data are scattered, both in time and over the basin, and are not useful in evaluating water quality. No additional sampling, gaging, or quality analyses were initiated specifically for this program.

The locations of all sampling stations collecting data utilized for this report are shown on Figure 3. All of the water quality data used in this evaluation have been obtained since 1970.

Winnebago River (Lime Creek) - This stream rises in Minnesota and terminates with its confluence with the Shell Rock River. Definitive data for the Winnebago River comes from Report No. 70-29, "Water Quality Survey of the Winnebago River, from Mason City to the Shell Rock River," done in February, 1970, and Report No. 74-21, "Iowa Internal Stream Quality Survey," containing data taken from August through December, 1973.

Purpose of Report No. 70-29 was to investigate the effect of various wastewater discharges on stream quality. Data from this report do not reflect current conditions as a major wastewater discharger (American Crystal Sugar) no longer discharges wastewater to the stream. Stream samples were taken on both February 3 and 10. On both dates, the river upstream of Mason City was 100 percent ice covered. On February 3, partial ice cover was in evidence through the Mason City area. On February 10, the stream had practically no ice cover through and below Mason City.

A large number of sampling staitons were utilized and dissolved oxygen concentration profiles for both February 3 and 10 are shown on Figure 4. The combined industrial and municipal wastewater discharges from the Mason City area cause a dissolved oxygen sag which falls below the stream standard of 5.0 mg/l. Little difference is noted in the two curves due to the differences in ice cover. Ammonia nitrogen concentrations downstream of the Mason City area, as shown on Figure 5, are also in violation of the stream standards of 2.0 mg/l. Water quality data for both February 3 and 10 are summarized in Table 7.



WATER QUALITY SAMPLING STATIONS

STANLEY CONSULTANTS

FIG. 3

FIGURE 4
DISSOLVED OXYGEN CONCENTRATIONS
WINNEBAGO RIVER-1970

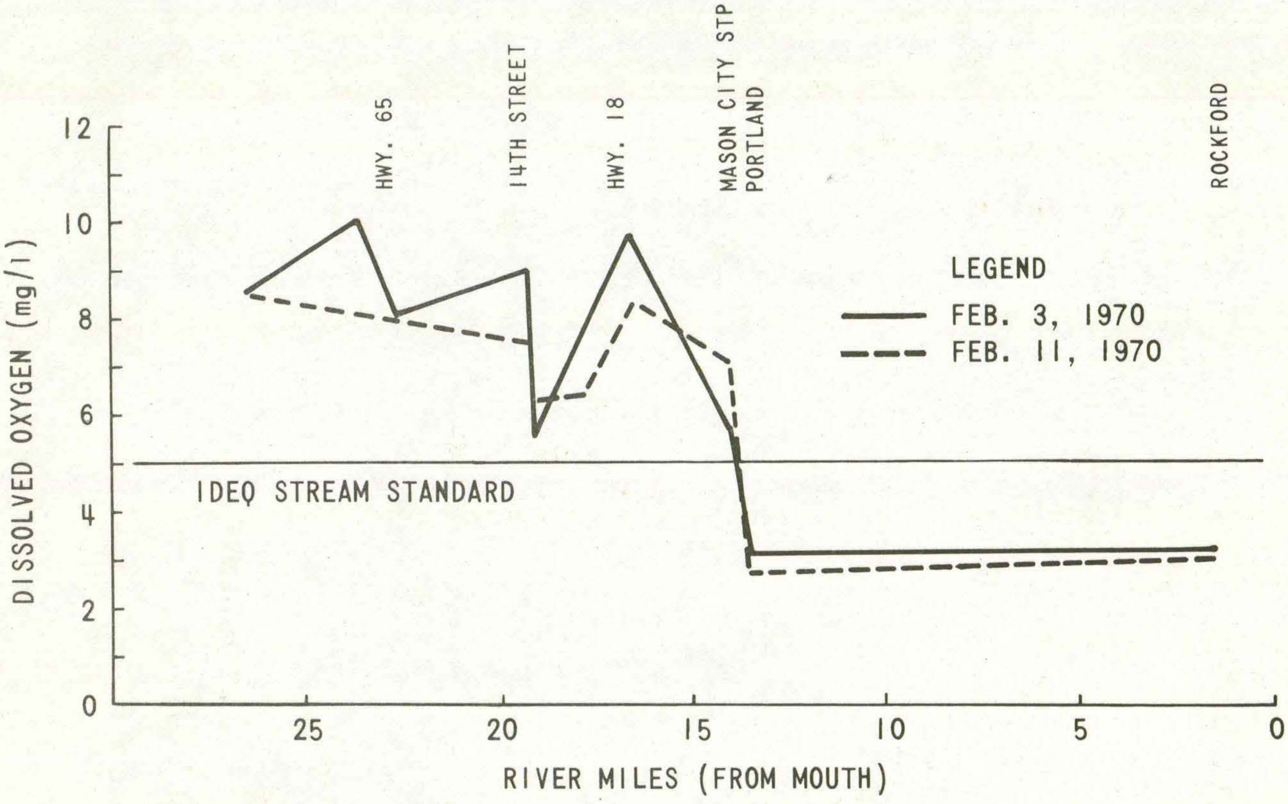


FIGURE 5
AMMONIA NITROGEN CONCENTRATIONS
WINNEBAGO RIVER-1970

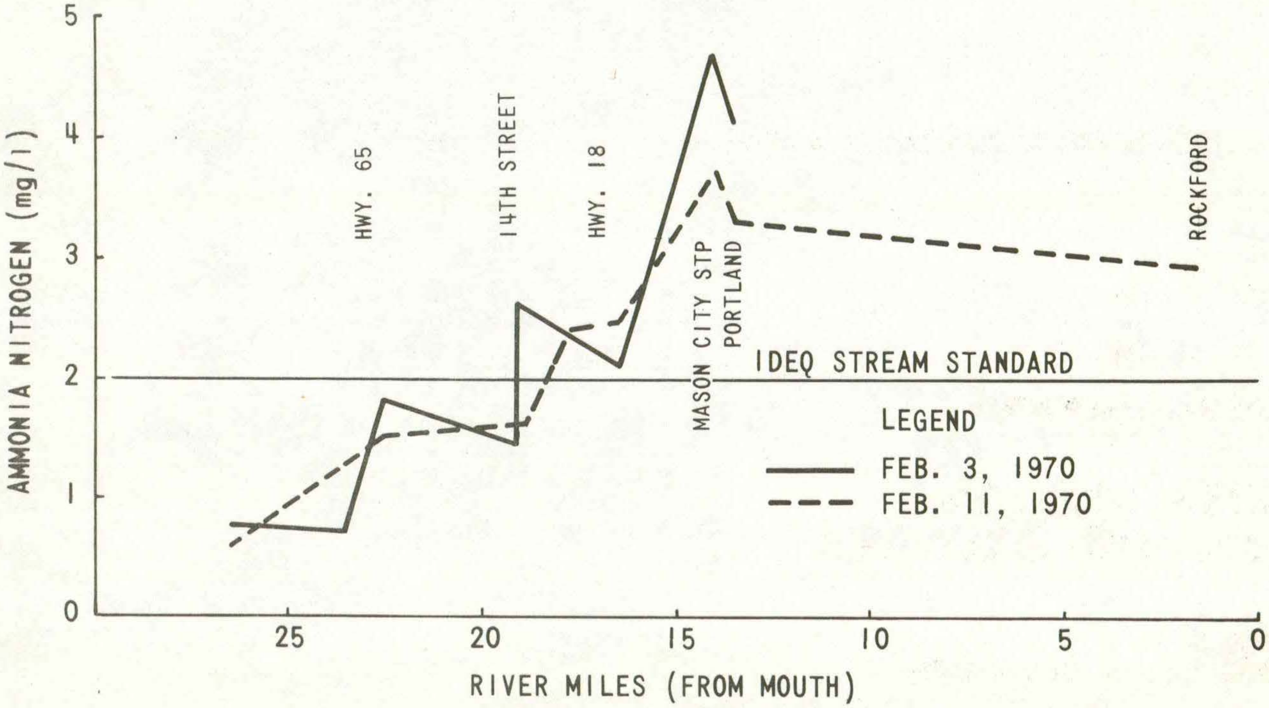


TABLE 7

WATER QUALITY DATA
WINNEBAGO RIVER - 1970

Parameter	Location and Dates											
	County Road Bridge Near Mason City		One Mile West U.S. 65 Bridge		U.S. 65 Bridge		Approx. One Mile Upstream From Armour Packing		Between Calmus Creek & Armour Outfall		14th Street Northeast Bridge	
	Feb. 3	Feb. 11	Feb. 3	Feb. 11	Feb. 3	Feb. 11	Feb. 3	Feb. 11	Feb. 3	Feb. 11	Feb. 3	Feb. 11
Temperature (° C)	0	0	---	---	4	---	---	---	0	---	---	7
Dissolved Oxygen (mg/l)	8.5	8.6	10.2	---	8.2	7.9	8.9	---	9.1	7.5	5.6	6.4
Fecal Coliforms (MPN/100 ml)	450.	320.	260.	---	380.	1,900.	220.	---	320.	130.	1,790,000.	26,000.
pH (SU)	7.45	7.3	7.5	---	7.6	7.45	7.65	---	7.75	7.55	7.5	7.6
Organic Nitrogen (mg/l)	0.48	0.51	0.37	---	0.80	0.6	1.3	---	0.84	0.88	3.8	2.0
Ammonia Nitrogen (mg/l)	0.73	0.65	0.67	---	1.8	1.5	1.5	---	1.4	1.9	2.6	2.2
Nitrate Nitrogen (mg/l)	2.3	2.6	2.3	---	2.2	2.2	2.2	---	2.3	1.6	1.8	1.5
Total Solids (mg/l)	526.	477.	---	---	---	---	---	---	577.	---	---	---
Total Volatile Solids (mg/l)	177.	150.	---	---	---	---	---	---	217.	---	---	---
Total Suspended Solids (mg/l)	55.	14.	---	---	---	---	---	---	31.	---	---	---
Volatile Suspended Solids (mg/l)	3.	3.	---	---	---	---	---	---	7.	---	---	---
Phosphate (Filtrable) (mg/l)	0.5	0.5	0.5	---	0.2	0.4	0.1	---	0.1	0.2	1.5	1.3
Total Phosphate (mg/l)	1.7	0.6	1.6	---	0.5	0.7	0.4	---	0.5	0.5	3.4	1.7
BOD_5 (mg/l)	1.	1.	2.	---	9.	10.	12.	---	11.	17.	130.	18.
COD (mg/l)	12.6	10.3	8.4	---	16.7	16.5	20.9	---	16.7	18.6	301.	43.3

TABLE 7 (Cont.)

WATER QUALITY DATA
WINNEBAGO RIVER - 1970

Parameter	Location and Dates									
	North Carolina Street Bridge		Hwy. 18 Bridge East of Mason City		Portland Bridge		County Road S-70 Southeast of Portland		Rockford	
	Feb. 3	Feb. 11	Feb. 3	Feb. 11	Feb. 3	Feb. 11	Feb. 3	Feb. 11	Feb. 3	Feb. 11
Temperature (° C)	---	0	0	0	3.	---	0	0	0	0
Dissolved Oxygen (mg/l)	7.9	6.5	9.9	8.4	5.9	7.1	2.6	2.7	3.2	3.0
Fecal Coliforms (MPN/100 ml)	153,000.	9,000.	183,000.	3,800.	17,000.	5,600.	19,000.	800.	---	100.
pH (SU)	7.65	7.5	7.65	7.6	7.55	7.55	7.6	7.4	---	7.45
Organic Nitrogen (mg/l)	1.1	1.3	1.1	1.3	2.6	1.4	1.1	0.93	---	0.80
Ammonia Nitrogen (mg/l)	2.4	2.4	2.1	2.5	4.7	3.7	4.1	3.3	---	2.9
Nitrate Nitrogen (mg/l)	1.6	1.3	2.3	1.5	1.9	1.3	2.0	1.6	---	1.6
Total Solids (mg/l)	---	---	---	---	757.	---	618.	---	---	491.
Total Volatile Solids (mg/l)	---	---	---	---	235.	---	190.	---	---	165.
Total Suspended Solids (mg/l)	---	---	---	---	48.	---	38.	---	---	14.
Volatile Suspended Solids (mg/l)	---	---	---	---	15.	---	6.	---	---	4.
Phosphate (filtrable) (mg/l)	1.1	1.1	1.4	1.8	3.4	3.1	2.7	2.7	---	2.5
Total Phosphate (mg/l)	1.4	1.5	1.6	2.0	4.7	3.7	3.4	3.7	---	2.9
BOD_5 (mg/l)	18.	20.	9.	9.0	30.	10.	10.	4.	---	3.
COD (mg/l)	37.7	45.4	23.0	37.1	48.1	37.1	23.0	22.7		20.6

Data from Report No. 74-21 are given in Table 8. These data represent four samples taken at a single point near Lake Mills in 1973. None of the data violates stream quality standards. Dissolved oxygen concentrations are lower than would be expected and ammonia nitrogen concentrations slightly higher than would be expected. This could indicate some stream pollution due to either point or non-point sources.

Available data indicate stream quality upstream of the Mason City area is good, while below Mason City stream water quality criteria are not met. Stream flow in the Winnebago River at Mason City was 37 cfs on February 3 and 43 cfs on February 10. The 7-day, 1-in-10 year low flow at Mason City is 6.8 cfs. Even with reduced industrial wastewater discharges in the area, lowered water quality is to be expected during low flows. No water quality data are available on the impact of wastewater discharges from Forest City.

Shell Rock River - This river rises in Minnesota and ends with its confluence with the West Fork Cedar River. Comprehensive water quality data for this stream is obtained from Report No. 70-35, "Water Quality Survey of the Shell Rock River," conducted in February, 1970, Report No. 74-21, "Iowa Internal Stream Quality Survey," containing data acquired from August through December, 1973, and an unpublished report done in September, 1972.

Data from Report No. 70-35 are presented in Table 9. During this study, the stream had heavy ice cover over its entire length. As stated in the report, water quality in the Shell Rock River entering Iowa was very poor. Stream flows were substantially higher than the 7-day, 1-in-10 year low flow with 28 cfs at Northwood as compared to a low flow of 8.2 cfs, and 234 cfs at Shell Rock, as compared to a low flow of 57 cfs. The report also states that reaeration of the stream was being accomplished at at least two dam locations. Because of the relatively high flow and other factors, no pollution impact was evident from wastewater discharges within the state of Iowa. However, poor water quality existed over a long reach of the stream due to the pollution load carried by the stream upon entering Iowa.

TABLE 8

1973 WATER QUALITY DATA
WINNEBAGO RIVER - LAKE MILLS

Parameter	Aug. 28, 1973	Sept. 25, 1973	Oct. 23, 1973	Nov. 27, 1973
Temperature (° C)	30.	19.	13.	4.
Dissolved Oxygen (mg/l)	8.9	---	7.8	10.7
Fecal Coliform (MPN/100 ml)	700.	700.	690.	50.
Total Kjeldahl Nitrogen (mg/l)	0.76	0.68	1.2	1.3
Ammonia Nitrogen (mg/l)	0.36	0.25	0.48	0.40
Nitrate Nitrogen (mg/l)	3.4	0.3	3.3	<0.1
Total Suspended Solids (mg/l)	---	88.	---	6.
Phosphate (filtrable) (mg/l)	---	0.05	---	0.02
BOD_5 (mg/l)	5.	2.	4.	3.
Total Chromium (mg/l)	<0.01	<0.01	<0.01*	<0.01
Hexavalent Chromium (mg/l)	<0.01	<0.01	<0.01*	<0.01
Arsenic (mg/l)	---	<0.01	---	<0.01
Barium (mg/l)	---	0.2	0.1	0.1
Cadmium (mg/l)	---	<0.01	<0.01	<0.01
Copper (mg/l)	---	<0.01	<0.01	<0.01
Lead (mg/l)	---	<0.01	<0.01	<0.01
Mercury (mg/l)	---	2.6 µg/l*	<1. µg/l	<1. µg/l
Zinc (mg/l)	---	0.14	<0.01	<0.01

*Being resampled because of mercury level.

TABLE 9

1970 WATER QUALITY DATA
SHELL ROCK RIVER - FEBRUARY 10-11, 1970

Parameter	Highway 105, W. of Northwood	Highway 65, S. of Northwood	Rock Falls	Above Dam, Rockford	Co. Rd. 3 Mi. S.E. of Rockford	Highway 14 Greene	Packard	Shellrock
Temperature (° C)	---	---	---	0	0	---	---	---
Dissolved Oxygen (mg/l)	0.2	1.4	4.0	7.9	8.6	10.1	10.9	11.6
Fecal Coliforms (MPN/100 ml)	710.	6,500.	180.	3,500.	130.	140.	1,200.	50.
pH (SU)	7.55	7.4	7.45	7.4	7.55	7.6	7.6	7.6
Organic Nitrogen (mg/l)	1.5	1.2	0.85	0.92	0.88	0.71	0.64	0.59
Ammonia Nitrogen (mg/l)	4.7	3.7	2.4	2.0	2.2	1.8	1.8	1.2
Nitrate Nitrogen (mg/l)	0.1	0.6	1.2	0.074	0.08	1.6	2.1	2.3
Total Solids (mg/l)	546.	---	---	2.0	1.6	---	---	---
Total Volatile Solids (mg/l)	158.	---	---	---	---	---	---	---
Total Suspended Solids (mg/l)	9.	---	---	---	---	---	---	---
Volatile Suspended Solids (mg/l)	3.	---	---	---	---	---	---	---
Phosphate (filtrable) (mg/l)	5.1	4.0	2.6	2.1	2.3	2.0	1.9	1.4
Total Phosphate (mg/l)	5.3	4.4	2.7	2.3	2.6	2.2	2.1	1.5
BOD_5 (mg/l)	4.	2.	1.	2.	3.	3.	3.	3.
COD (mg/l)	41.2	33.0	24.7	20.6	20.6	16.5	22.7	16.5

Dissolved oxygen and ammonia nitrogen concentrations for the Shell Rock River for February 10, 1970, are shown on Figures 6 and 7, respectively. Good water quality was restored by the time the stream merged with the West Fork Cedar River.

Summer water quality data are available from the unpublished report done in September, 1972. During the survey, streamflow near Northwood was 75 cfs and at Shell Rock 546 cfs. Data from this survey are summarized in Table 10. There were no violations of dissolved oxygen or ammonia nitrogen stream quality criteria, and only one violation of the criteria for fecal coliforms. Profiles for dissolved oxygen and ammonia nitrogen concentrations are shown on Figures 6 and 7, respectively. Lack of water quality violations does not properly indicate the level of stream pollution. Under summer conditions, ammonia nitrogen concentrations are always low due to bio-oxidation. While dissolved oxygen concentrations are high, this is undoubtedly due to the presence of heavy algal growths mentioned in the report. Diurnal fluctuations of dissolved oxygen may bring levels below the applicable criteria during the night. This is probable since stream BOD is two to three times larger than normal for Iowa streams. The report again identifies pollution sources in Minnesota as being responsible for this pollution load.

Water quality data from Report No. 74-21 are summarized in Table 11. These data were all obtained at a single sampling station near Waverly. None of the samples shows violation of any of the stream quality criteria. This may be partially due to extremely high streamflows during the sampling period.

There is evidence of stream pollution in the Shell Rock River, which begins in Minnesota. Under 7-day, 1-in-10 year low flow conditions, the severity of pollution should be much greater. Whether or not wastewater discharges in Iowa will contribute to stream degradation is unknown since during past sampling periods streamflows have provided sufficient dilution to mask pollutional effects.

FIGURE 6
DISSOLVED OXYGEN CONCENTRATIONS
SHELL ROCK RIVER-1970

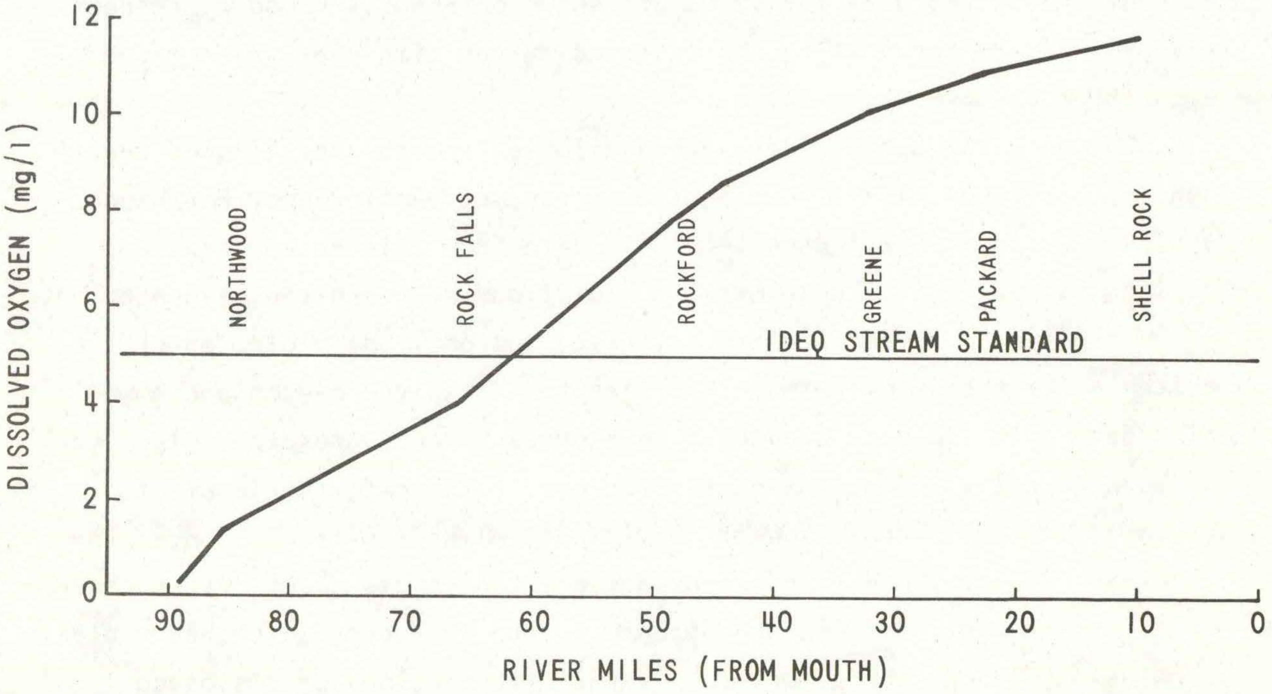


FIGURE 7
AMMONIA NITROGEN CONCENTRATIONS
SHELL ROCK RIVER-1970

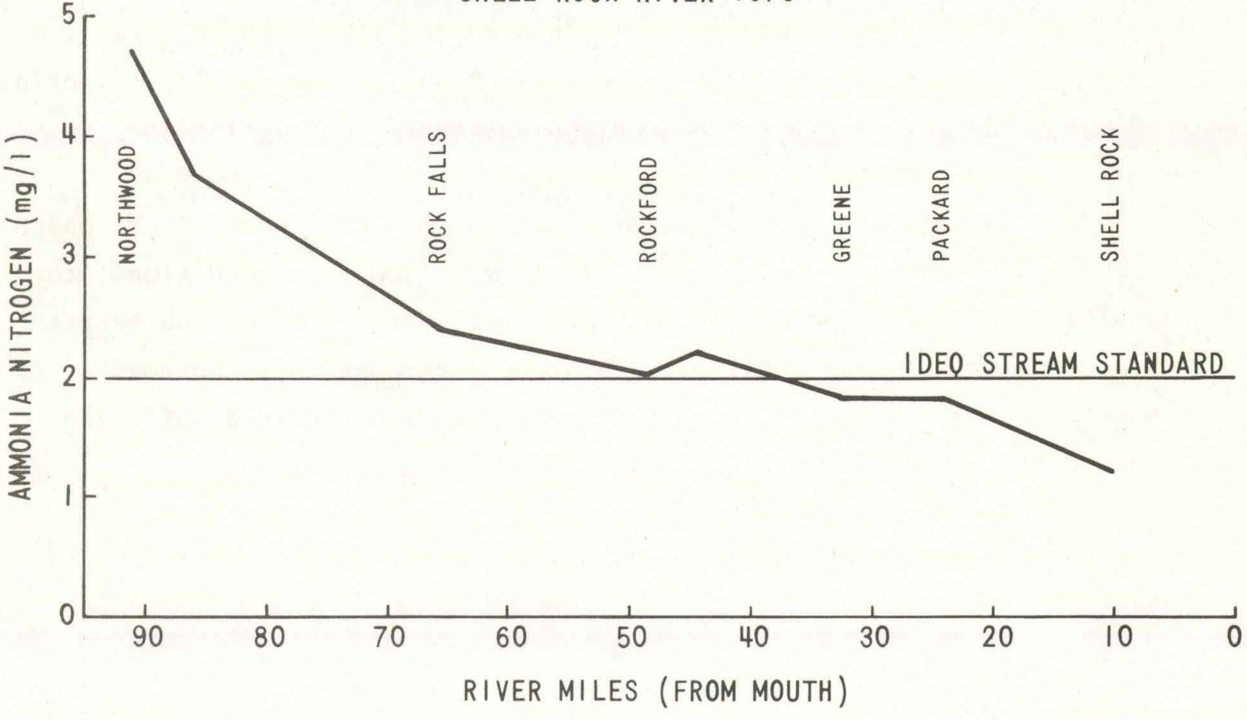


TABLE 10

WATER QUALITY DATA
SHELL ROCK RIVER - SEPTEMBER 19, 1972

Parameter	Co. Rd. 2 Mi. N.W. of Northwood	Highway 105 W. of Northwood	Highway 65 S. of Northwood	Rock Falls	Rockford	Co. Rd. 3 Mi. S.E. of Rockford	Highway 14 Greene	Packard	Shell Rock
Temperature (° C)	19.0	19.0	19.0	19.5	19.5	20.0	20.0	20.0	20.0
Dissolved Oxygen (mg/l)	11.3	11.6	12.7	11.5	13.9	10.8	11.3	13.5	14.1
Fecal Coliforms (MPN/100 ml)	1,100.	1,100.	4,700.	670.	530.	1,850.	160.	110.	120.
Conductance (micromhos)	640.	600.	600.	610.	580.	730.	670.	630.	630.
pH (SU)	8.3	8.4	8.05	8.2	8.4	8.2	8.2	8.3	8.3
Organic Nitrogen (mg/l)	5.1	4.5	4.3	3.5	3.4	2.1	2.0	2.3	2.3
Ammonia Nitrogen (mg/l)	0.005	0.04	0.07	0.07	0.07	0.01	0.03	0.01	0.01
Nitrate Nitrogen (mg/l)	0.2	0.4	0.4	2.0	2.5	4.8	4.5	4.4	3.7
Total Solids (mg/l)	454.	440.	477.	406.	375.	484.	439.	420.	423.
Total Volatile Solids (mg/l)	145.	155.	166.	137.	143.	124.	141.	108.	124.
Total Suspended Solids (mg/l)	96.	93.	141.	66.	57.	44.	59.	36.	71.
Volatile Suspended Solids (mg/l)	38.	41.	50.	11.	35.	0	38.	2.	28.
Phosphate (filtrable) (mg/l)	0.14	0.12	0.12	0.06	0.04	0.29	0.17	0.14	0.11
Total Phosphate (mg/l)	0.40	0.37	0.37	0.25	0.22	0.42	0.28	0.29	0.29
BOD_5 (mg/l)	18.	15.	15.	12.	11.	7.	6.	8.	8.
COD (mg/l)	89.	85.	81.	69.	60.	60.	44.	44.	48.

TABLE 11

WATER QUALITY DATA
SHELL ROCK RIVER - NEAR WAVERLY

Parameter	Aug. 28, 1973	Sept. 25, 1973	Oct. 22, 1973	Nov. 27, 1973
Temperature (° C)	27.	19.	15.	5.
Dissolved Oxygen (mg/l)	14.8	12.5	12.7	11.4
Fecal Coliform (MPN/100 ml)	<100.	300.	300.	620.
Total Kjeldahl Nitrogen (mg/l)	0.60	0.56	0.64	1.6
Ammonia Nitrogen (mg/l)	0.18	0.20	0.22	0.24
Nitrate Nitrogen (mg/l)	1.1	1.6	7.8	6.2
Total Suspended Solids (mg/l)	---	51.	---	43.
Phosphate (filtrable) (mg/l)	---	0.01	---	0.09
BOD_5 (mg/l)	9.	8.	7.	4.
Total Chromium (mg/l)	<0.01	<0.01	<0.01	<0.01
Hexavalent Chromium (mg/l)	<0.01	<0.01	<0.01	<0.01
Arsenic (mg/l)	---	<0.01	---	<0.01
Barium (mg/l)	---	0.4	---	0.1
Cadmium (mg/l)	---	<0.01	---	<0.01
Copper (mg/l)	---	<0.01	---	<0.01
Lead (mg/l)	---	<0.01	---	<0.01
Mercury (µg/l)	---	<1.	---	<1.
Zinc (mg/l)	---	0.33	---	<0.01

Black Hawk Creek - This stream rises in Grundy County and confluences with the Cedar River at Waterloo. Water quality data on this stream are available from Report No. 74-21, "Iowa Internal Stream Quality Study," containing data taken from August through December, 1973, at two sampling stations.

Data from both sampling stations are given in Table 12, which allows a comparison of water quality changes through the Waterloo area. Examination of the data shows that there is no violation of stream quality criteria except for fecal coliform values. High fecal coliform counts are obtained both upstream and downstream of the metropolitan area. None of the other parameters indicates stream pollution at either of the sampling stations. Flows in the stream during sampling times are all at least 20 times larger than the 7-day, 1-in-10 year low flow of 3.0 cfs.

Cedar River - Water quality data on the Cedar River within the study area consist of Report No. 71-22, "Cedar River Water Quality Survey, Cedar Falls-Waterloo Area," with sampling conducted during March, June, and October, 1970; Report No. 74-1, "Iowa Internal Stream Quality Study," with data taken from August through December, 1973; and from the quarterly stream monitoring survey.

The most comprehensive data available are that in Report No. 71-22. This report covers only a small section of the study portion of the Cedar River. Data from this report are given in Table 13. The 7-day, 1-in-10 year low flow for the USGS gaging station at Waterloo is 240 cfs. Flows during the sampling periods were 2,260 cfs in March, 2,280 cfs in June, and 920 cfs in October. Dilution provided by these high flows results in no violations of stream quality criteria other than fecal coliform counts. Another indication of stream pollution is the relatively high values of BOD_5. During periods of low stream flow, it is likely that the portion of the Cedar River surveyed would show a marked effect of wastewater discharges upon stream quality parameters and possibly even violations of stream quality criteria.

TABLE 12

WATER QUALITY DATA
BLACK HAWK CREEK

	Aug. 28, 1973		Oct. 2, 1973		Oct. 22, 1973		Nov. 27, 1973	
Parameter	Waterloo	Hudson	Waterloo	Hudson	Waterloo	Hudson	Waterloo	Hudson
Temperature (° C)	27.	27.	17.	17.	16.	16.	9.	7.
Dissolved Oxygen (mg/l)	7.3	7.8	8.7	8.6	9.2	9.2	10.7	10.6
Fecal Coliform (MPN/100 ml)	620.	750.	6,000.	9,000.	2,200.	1,600.	4,200.	2,900.
Total Kjeldahl Nitrogen (mg/l)	0.78	1.0	0.52	0.46	0.34	0.30	1.3	0.44
Ammonia Nitrogen (mg/l)	0.42	0.28	0.28	0.22	0.10	0.12	0.32	0.14
Nitrate Nitrogen (mg/l)	3.0	0.9	6.6	7.1	6.0	6.4	<0.1	<0.1
Total Suspended Solids (mg/l)	---	---	332.	269.	---	---	81.	75.
Phosphate (filtrable) (mg/l)	---	---	0.15	0.14	---	---	0.09	0.09
BOD_5 (mg/l)	1.	1.	2.	2.	2.	<1.	2.	2.
Total Chromium (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Hexavalent Chromium (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic (mg/l)	---	---	<0.01	<0.01	---	---	<0.01	<0.01
Barium (mg/l)	---	---	0.4	0.3	---	---	0.1	0.2
Cadmium (mg/l)	---	---	<0.01	<0.01	---	---	<0.01	<0.01
Copper (mg/l)	---	---	<0.01	<0.01	---	---	<0.01	<0.01
Lead (mg/l)	---	---	<0.01	<0.01	---	---	<0.01	<0.01
Mercury (µg/l)	---	---	<1.	<1.	---	---	<1.	<1.
Zing (mg/l)	---	---	0.20	0.17	---	---	<0.01	<0.01

Note: Waterloo location at Ridgeway Street bridge.
Hudson location at County Road D-35 bridge one mile southwest of Hudson.

TABLE 13

WATER QUALITY DATA
CEDAR RIVER

Parameter	Co. Rd. C-57	Near Highway 218 Bridge				~1/2 Mi. Below Cedar Falls STP	3 Mi. Below Cedar Falls STP
			(West Bank)	(East Bank)	(East Bank)		
	Oct. 6, 1970	Mar. 18, 1970	June 23, 1970	June 23, 1970	Oct. 6, 1970	Oct. 6, 1970	Oct. 6, 1970
Temperature (° C)	16.4	3.	---	---	17.0	17.0	17.5
Dissolved Oxygen (mg/l)	9.4	12.4	10.5	10.6	9.3	10.2	11.0
Fecal Coliforms (MPN/100 ml)	40.	50.	370.	720.	60.	3,000.	900.
pH (SU)	8.8	7.85	7.9	8.05	7.75	7.8	7.9
Organic Nitrogen (mg/l)	1.8	0.56	1.7	1.7	1.9	2.0	1.9
Ammonia Nitrogen (mg/l)	0.04	0.35	0.07	0.07	0.07	0.04	<0.01
Nitrate Nitrogen (mg/l)	0.6	3.3	2.6	2.5	0.6	1.3	0.8
Total Solids (mg/l)	288.	359.	435.	440.	---	330.	---
Total Volatile Solids (mg/l)	119.	109.	158.	165.	---	135.	---
Total Suspended Solids (mg/l)	60.	7.	99.	104.	---	60.	---
Volatile Suspended Solids (mg/l)	28.	5.	19.	45.	---	34.	---
Phosphate (filtrable) (mg/l)	<0.1	0.6	0.1	0.1	<0.1	1.6	<0.1
Total Phosphate (mg/l)	0.4	0.7	0.4	0.5	0.4	3.0	0.6
BOD_5 (mg/l)	11.	3.	6.	7.	11.	10.	9.
COD (mg/l)	36.9	14.5	34.9	34.9	41.0	41.0	36.9

TABLE 13 (Cont.)

WATER QUALITY DATA
CEDAR RIVER

	1/2 Mi. Below Waterloo STP			1 1/2 Mile Below Waterloo STP	WCF&N Railroad Bridge	Gilbertville	
Parameter	(West Bank) June 23, 1970	(East Bank) June 23, 1970	(West Bank) Oct. 6, 1970	Oct. 6, 1970	Oct. 6, 1970	Mar. 18, 1970	Oct. 6, 1970
Temperature (° C)	---	---	19.	18.	18.	3.	18.
Dissolved Oxygen (mg/l)	11.1	12.4	15.3	16.3	16.5	12.6	15.3
Fecal Coliforms (MPN/100 ml)	12,100.	800.	9,000.	12,000.	1,600.	220.	1,000.
pH (SU)	8.3	8.4	8.2	8.2	8.35	8.05	8.4
Organic Nitrogen (mg/l)	1.9	1.8	2.6	2.6	2.5	0.64	2.3
Ammonia Nitrogen (mg/l)	0.15	0.03	0.75	0.79	0.03	0.41	0.01
Nitrate Nitrogen (mg/l)	2.6	5.2	1.0	1.2	0.8	3.4	0.8
Total Solids (mg/l)	437.	428.	338.	---	---	---	---
Total Volatile Solids (mg/l)	163.	151.	132.	---	---	---	---
Total Suspended Solids (mg/l)	88.	101.	63.	---	---	---	---
Volatile Suspended Solids (mg/l)	33.	8.	37.	---	---	---	---
Phosphate (filtrable) (mg/l)	1.2	0.2	0.7	1.2	<0.1	1.1	<0.1
Total Phosphate (mg/l)	1.7	0.6	1.9	2.6	0.9	1.2	0.9
BOD_5 (mg/l)	8.	8.	13.	14.	13.	4.	13.
COD (mg/l)	37.0	34.9	53.3	55.3	57.4	12.4	53.3

TABLE 13 (Cont.)

WATER QUALITY DATA
CEDAR RIVER

	Above Black Hawk Creek			Highway 63 Bridge		11th St. Bridge	18th St. Bridge	1/2 Mi. Above Waterloo STP
	(East Bank)	(West Bank)	(Mid-River)					
Parameter	June 23, 1970	June 23, 1970	Oct. 6, 1970	Mar. 18, 1970	June 23, 1970	Oct. 6, 1970	Oct. 6, 1970	Oct. 6, 1970
Temperature (° C)	---	---	---	3.	---	18.	18.	18.
Dissolved Oxygen (mg/l)	11.4	12.9	13.2	12.3	10.0	12.4	13.0	17.7
Fecal Coliforms (MPN/100 ml)	1,700.	480.	170.	300.	400.	330.	160.	600.
pH (SU)	8.1	8.2	8.2	7.8	8.15	8.3	8.3	8.45
Organic Nitrogen (mg/l)	1.6	1.7	2.1	0.65	1.5	1.9	1.9	2.2
Ammonia Nitrogen (mg/l)	0.07	0.07	0.04	0.41	0.08	0.02	0.01	0.03
Nitrate Nitrogen (mg/l)	2.2	2.3	0.6	3.3	2.4	0.8	0.8	0.6
Total Solids (mg/l)	---	---	---	---	---	318.	318.	---
Total Volatile Solids (mg/l)	---	---	---	---	---	130.	129.	---
Total Suspended Solids (mg/l)	---	---	---	---	---	65.	63.	---
Volatile Suspended Solids (mg/l)	---	---	---	---	---	28.	51.	---
Phosphate (filtrable) (mg/l)	0.3	0.2	<0.1	0.6	0.8	<0.1	<0.1	<0.1
Total Phosphate (mg/l)	0.7	0.5	0.4	0.7	1.1	0.5	0.5	0.5
BOD_5 (mg/l)	11.	9.	9.	3.	9.	10.	10.	13.
COD (mg/l)	37.0	30.8	41.0	12.4	43.1	43.0	30.7	36.9

Water quality data from a single sampling station near Plainfield are presented in Report No. 74-21. Again, water quality samples were taken during periods of high flow. The four water quality samples taken at the station from August through December, 1973, are summarized in Table 14. There are no violations of stream quality criteria and no indications of stream pollution.

The quarterly stream monitoring survey sampling station is at Charles City, upstream of the wastewater treatment plant discharge. Data from this sampling station are given in Table 15. Again, there are no violations of stream quality criteria and no indication of stream pollution. Expected seasonal variations in dissolved oxygen and ammonia nitrogen concentrations are present. Although stream flows are much higher than 7-day, 1-in-10 year low flows, lowered water quality during low flow periods is not expected because of the location of the sampling station.

Summary

Available water quality data for the Cedar River Basin study area are incomplete. No data are available for some water quality classified streams with wastewater dischargers. Identification of existing water quality has also been difficult because the best available data have generally been taken at times of relatively high stream flows. Additional water quality sampling under varying conditions will be necessary to assess the effectiveness of the waste load allocations in maintaining the stream quality standards.

TABLE 14

WATER QUALITY DATA
CEDAR RIVER - NEAR PLAINFIELD

Parameter	Aug. 28, 1973	Sept. 25, 1973	Oct. 22, 1973	Nov. 27, 1973
Temperature (° C)	28.	20.	16.	5.
Dissolved Oxygen (mg/l)	12.2	8.3	9.2	11.8
Fecal Coliform (MPN/100 ml)	200.	710.	540.	1,000.
Total Kjeldahl Nitrogen (mg/l)	0.78	0.62	0.78	1.0
Ammonia Nitrogen (mg/l)	0.22	0.23	0.42	0.38
Nitrate Nitrogen (mg/l)	2.0	2.5	4.4	6.4
Total Suspended Solids (mg/l)	---	62.	---	26.
Phosphate (filtrable) (mg/l)	---	0.10	---	0.14
BOD_5 (mg/l)	6.	6.	3.	2.
Total Chromium (mg/l)	<0.01	<0.01	<0.01	<0.01
Hexavalent Chromium (mg/l)	<0.01	<0.01	<0.01	<0.01
Arsenic (mg/l)	---	<0.01	---	<0.01
Barium (mg/l)	---	0.2	---	0.1
Cadmium (mg/l)	---	<0.01	---	<0.01
Copper (mg/l)	---	<0.01	---	<0.01
Lead (mg/l)	---	<0.01	---	<0.01
Mercury (µg/l)	---	1.	---	<1.
Zinc (mg/l)	---	0.11	---	<0.01

TABLE 15

WATER QUALITY DATA
CEDAR RIVER - NEAR CHARLES CITY

Parameter	Nov. 28, 1972	Feb. 28, 1973	June 5, 1973	Aug. 28, 1973	Nov. 27, 1973
Temperature (° C)	1.	1.	---	27.	5.
Dissolved Oxygen (mg/l)	13.5	12.7	10.4	7.3	11.2
Fecal Coliforms (MPN/100 ml)	30.	150.	120.	3,800.	90.
Conductance (micromhos)	---	590.	660.	420.	610.
pH (SU)	---	8.0	8.1	8.0	8.05
Organic Nitrogen (mg/l)	0.53	0.57	1.0	1.0	0.84
Ammonia Nitrogen (mg/l)	0.04	0.48	0.03	0.03	0.07
Nitrate Nitrogen (mg/l)	6.1	3.4	5.0	2.1	<0.1
Total Solids (mg/l)	397.	325.	393.	300.	420.
Total Volatile Solids (mg/l)	109.	58.	130.	126.	168.
Total Suspended Solids (mg/l)	14.	11.	37.	42.	20.
Volatile Suspended Solids (mg/l)	4.	0.	1.	0.	0.
Phosphate (filtrable) (mg/l)	0.14	0.36	<0.01	0.21	0.17
Total Phosphate (mg/l)	0.15	0.37	0.13	0.27	0.17
BOD_5 (mg/l)	2.	1.	4.	7.	2.
COD (mg/l)	8.	15.	16.	21.	18.

PART IV

POINT SOURCE WASTEWATER DISCHARGES

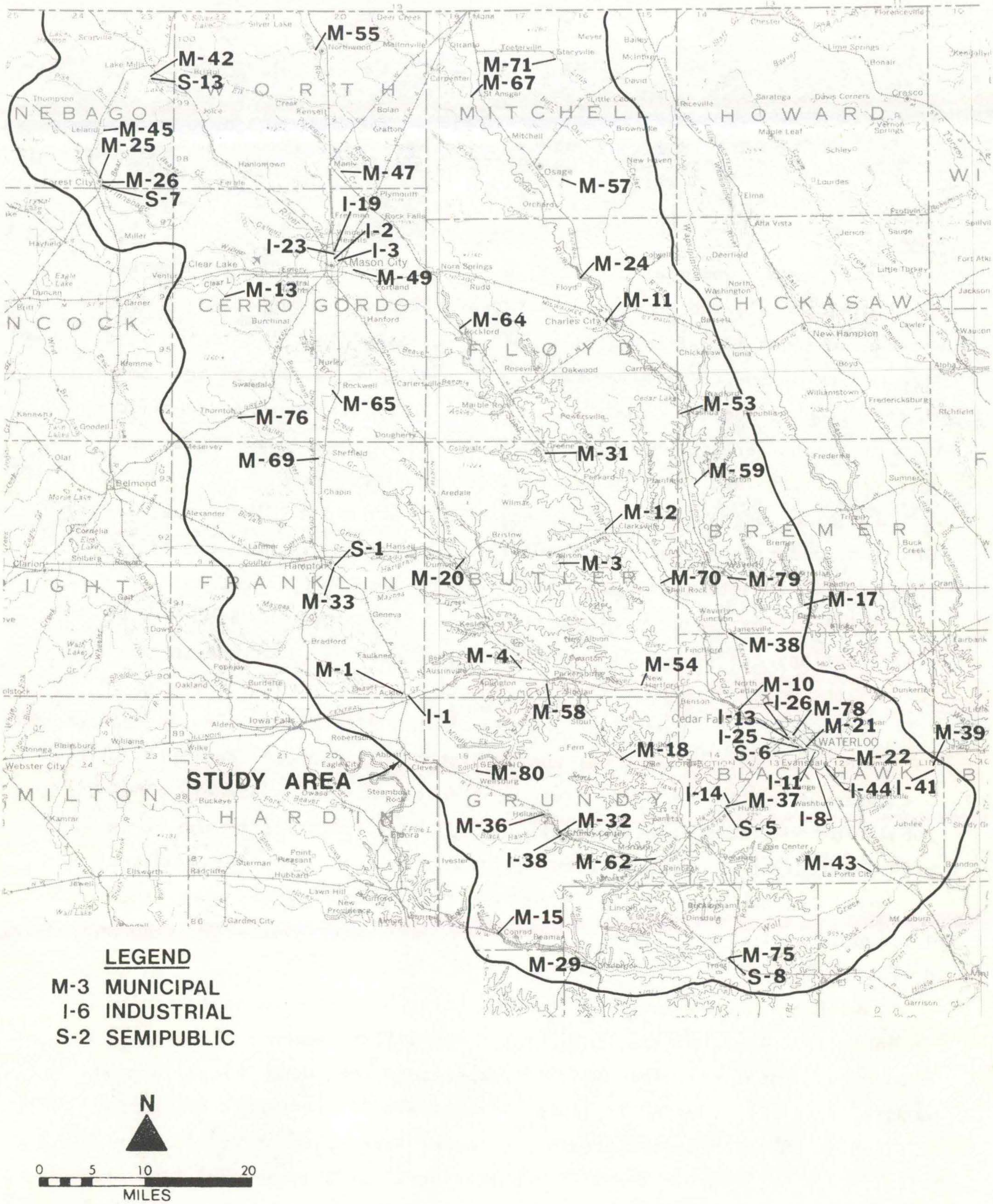
General

Point source wastewater discharges consist of effluents from municipal, industrial, and semipublic wastewater treatment facilities. Wastewater discharges identified in the IDEQ files as discharging to the surface waters of the Cedar River Basin have been inventoried and are compiled in the attached tables. The tabulations include location and identification of dischargers, quantity and quality of wastewater discharged, and operational data and descriptions of treatment facilities.

Table 16, at the end of this PART, lists individual discharges, location, and river miles. An identification system has been established with municipal wastewater discharge reference numbers preceded by "M," industrial discharges by "I," and semipublic discharges by "S." River mile locations are identified for each discharge with reference to mile zero at the mouth of each major stream.

Table 17, which appears at the end of this PART, identifies characteristics of each point source wastewater discharge, in order, beginning with the upstream end of the Cedar River at the Iowa-Minnesota border. The tabulation continues downstream picking up the tributaries to the Black Hawk County line. For each tributary, the point source farthest upstream is identified and the tabulation continues downstream to the confluence. The location of each existing point source wastewater discharge is shown on Figure 8.

Available wastewater quality and quantity information is tabulated in Table 17. Average flow, BOD_5, suspended solids, ammonia nitrogen, phosphorus, total dissolved solids, temperature, and other miscellaneous constituents are reported in Table 17. Where sufficient data are available, BOD_5, ammonia nitrogen and temperature values have been indicated for both summer and winter conditions. Discharge quantities are tabulated in both milligrams per liter (mg/l) and pounds per day (lb/day) unless otherwise stated.



POINT SOURCE WASTEWATER DISCHARGES

STANLEY CONSULTANTS

FIG. 8

Municipal

Sewage flow and quality data for 45 municipalities were extracted from IDEQ records and files. Average sewage flow values contained in reports submitted by treatment plant operators have been extracted by IDEQ and published in "Wastewater Treatment Plant Flow Data - 1970, 1971, and 1972." Flow values shown in Table 17 are the averages obtained for the last full year of record; in most instances 1972.

Most quality data were collected from "Effluent Quality Analysis Program" (EQAP) by IDEQ. These data were supplemented by review of treatment facility reports supplied by the operators. Data reported through EQAP are results of tests conducted by the Iowa State Hygenic Laboratory on wastewater samples supplied by the individual dischargers. In most instances, the number of BOD_5, ammonia notrigen, and total phosphorus values reported each year was minimal. Because of large seasonal variations in BOD_5, ammonia nitrogen, and temperature, both summer and winter values have been tabulated where available.

BOD_5 analysis results from the Iowa State Hygienic Laboratory (reported in EQAP) are reported between 25 mg/l and 150 mg/l. For some communities, a large percentage of the values reported are 25 or "25-" mg/l. Values designated "25-" are less than 25 mg/l, thus lower summer BOD_5 average values would result. The adequacy of this reporting procedure is being reviewed since some dischargers are, or soon will be, required to provide BOD_5 removals of less than 25 mg/l. In some instances, due to the scarcity and scatter of data, engineering judgment was applied to arrive at representative values rather than taking straight averages of available data.

Industrial

Information for 42 industries discharging wastewater to streams within the study area was obtained. The best sources of available discharge information utilized were U.S. Army Corps of Engineers discharge permit applications (Discharge Permit Program, River and Harbors Act of 1899), IDEQ industrial files, and the National Pollutant Discharge Elimination Systems (NPDES).

Although these sources provide the best available discharge information, caution must be exercised in data interpretation. Information tabulated in Table 17 has been submitted by the individual industries with very little verification. Also, some U.S. Corps of Engineers permit applications are not administratively complete.

Semipublic

Information identifying only 2 of 13 semipublic treatment facilities was obtained from IDEQ files. Description of semipublic facility discharges is difficult due to the minimal surveillance provided. Quantity and quality relationships are practically nonexistent and, in most cases, design information is all that is available.

Existing Wastewater Treatment Facilities

Inventory information for existing wastewater treatment facilities has been compiled in Table 18 at the end of this PART. The order of presentation in Table 18 is identical to that utilized in Table 17 beginning with the facilities at the upstream reaches and continuing downstream to the Black Hawk County line.

Table 18 contains existing design average day capacity, present average day flow, both influent and effluent concentrations for BOD_5 and suspended solids, type of treatment processes, and comments about the facility or process. Influent values are only available for the larger treatment facilities. Specific processes identify primary treatment, secondary treatment, and solids handling operations. The treatment abbreviations are those presently used by IDEQ and are listed at the end of the table. The "Comments" column includes information obtained by IDEQ personnel on existing operations, age of existing facilities, specific IDEQ permit requirements, IDEQ orders for additional treatment, and delineation of proposed facilities.

A total of 50 municipal, 53 industrial, and 13 semipublic entities having treatment facilities or wastewater discharges has been identified in the study area. In addition, 23 incorporated communities presently without municipal collection or treatment systems are also included in

Table 18. Some of these are in various stages of municipal treatment facility development.

Summary

Distribution of hydraulic and organic loads (after existing treatment) upon the streams in the Cedar River Basin from the three point source wastewater discharge classifications is summarized in Table 19.

TABLE 19

REPORTED POINT SOURCE

WASTEWATER DISCHARGE SUMMARY

	Total	Municipal	Industrial	Semipublic
Flow, mgd	231.77	32.26	199.44	0.07
Percent		14	85	1
BOD_5, lb/day	18,210	10,236	7,974	N.A.
Percent		56	44	
Ammonia-N, lb/day	5,448	4,421	1,027	N.A.
Percent		81	19	
Phosphorus-P, lb/day	11,388	4,163	7,225	N.A.
Percent		37	63	

The relatively low percentage of BOD_5 discharged by industries compared to flow is due to the following:

1. Several quarries discharge large volumes of water, but add little BOD_5 to the stream.
2. Several industrial discharges consist of only cooling water; therefore, negligible amounts of BOD_5 are discharged.

Table 20 summarizes the classifications of municipal treatment facilities and populations served. The smaller communities are typically served by waste stabilization pond systems, while most larger cities utilize trickling filter plants. Only one community with a population of greater than 1,000 maintains a waste stabilization pond. Five communities having populations less than 1,000 are served by trickling filters.

TABLE 20

WASTEWATER TREATMENT FACILITIES

PROCESS SUMMARY

Type of Plant	Communities Served	Population Served
Trickling Filter	17	154,245
Waste Stabilization Pond	15	13,289
Imhoff Tank	7	6,910
Extended Aeration	3	37,191

None of the communities in the study area presently operates advanced waste treatment facilities.

TABLE 16

POINT SOURCE WASTEWATER DISCHARGES

Discharger	Reference Number	County	River* Mile	Discharge To	Page Reference	
					Quantity	Treatment
Municipal						
Ackley	M-1	Hardin		Beaver Creek	62	71
Alexander	M-2	Franklin			NEMTF	
Allison	M-3	Butler		Feddeke Creek	60	67
Aplington	M-4	Butler		Beaver Creek	62	71
Aredale	M-5	Butler			NEMTF	
Bassett	M-6	Chickasaw			NEMTF	
Beaman	M-7	Grundy			NEMTF	
Bristow	M-8	Butler			NEMTF	
Carpenter	M-9	Mitchell			NEMTF	
Cedar Falls	M-10	Black Hawk	163.6	Cedar River	62	72
Charles City	M-11	Floyd	220.6	Cedar River	59	65
Clarksville	M-12	Butler		Shell Rock River	62	71
Clear Lake Sanitary District	M-13	Cerro Gordo		Drainage Ditch to Beaverdam Creek	59	66
Colwell	M-14	Floyd			NEMTF	
Conrad	M-15	Grundy		Wolf Creek	64	74
Coulter	M-16	Franklin			NEMTF	
Denver	M-17	Bremer		Quarter Section Run	59	66
Dike	M-18	Grundy		North Fork Black Hawk Creek	62	72
Dougherty	M-19	Cerro Gordo			NEMTF	
Dumont	M-20	Butler	29.2	West Fork Cedar River	60	66
Elk Run Heights	M-21	Black Hawk		Cedar River	64	74
Evansdale	M-22	Black Hawk	150.3	Cedar River	64	74
Fertile	M-23	Worth			NEMTF	
Floyd	M-24	Floyd	227.4	Cedar River	59	65
Forest City (E)	M-25	Winnebago	52.0	Winnebago River	60	68
Forest City (SW)	M-26	Winnebago	52.0	Winnebago River	60	68

* River mile of discharge or tributary confluence with the main stream.

NEMTF: No Existing Municipal Treatment Facility.

TABLE 16 (Cont.)

POINT SOURCE WASTEWATER DISCHARGES

Discharger	Reference Number	County	River* Mile	Discharge To	Page Reference	
					Quantity	Treatment
Municipal (cont.)						
Geneva	M-27	Franklin			NEMTF	
Gilbertville	M-28	Black Hawk			NEMTF	
Gladbrook	M-29	Tama		Wolf Creek	64	74
Grafton	M-30	Worth			NEMTF	
Greene	M-31	Butler	32.6	Shell Rock River	61	70
Grundy Center	M-32	Grundy		Black Hawk Creek	62	72
Hampton	M-33	Franklin		Squaw Creek	60	67
Hanlontown	M-34	Worth			NEMTF	
Hansell	M-35	Franklin			NEMTF	
Holland	M-36	Grundy		Holland Creek	-	72
Hudson	M-37	Black Hawk		Black Hawk Creek	62	73
Janesville	M-38	Bremer	179.0	Cedar River	59	66
Jesup	M-39	Buchanan		Spring Creek	64	75
Joice	M-40	Worth			NEMTF	
Kensett	M-41	Worth			NEMTF	
Lake Mills	M-42	Winnebago		Beaver Creek	60	68
La Porte City	M-43	Black Hawk		Wolf Creek	64	75
Latimer	M-44	Franklin			NEMTF	
Leland	M-45	Winnebago		Winnebago River	60	68
Lincoln	M-46	Tama			NEMTF	
Manley	M-47	Worth		Rose Creek	60	68
Marble Rock	M-48	Floyd	39.0	Shell Rock River	-	70
Mason City	M-49	Cerro Gordo	17.5	Winnebago River	61	70
Meservey	M-50	Cerro Gordo			NEMTF	
Mitchell	M-51	Mitchell			NEMTF	
Morrison	M-52	Grundy			NEMTF	
Nashua	M-53	Chickasaw	210.0	Cedar River	59	65
New Hartford	M-54	Butler		Beaver Creek	62	71
Northwood	M-55	Worth		Shell Rock River	60	67

* River mile of discharge or tributary confluence with the main stream.

NEMTF: No Existing Municipal Treatment Facility.

NORA SPRINGS

TABLE 16 (Cont.)

POINT SOURCE WASTEWATER DISCHARGES

Discharger	Reference Number	County	River* Mile	Discharge To	Page Reference Quantity	Page Reference Treatment
Municipal (cont.)						
Orchard	M-56	Mitchell		Spring Creek	NEMTF	
Osage	M-57	Mitchell		Sugar Creek	59	65
Parkersburg	M-58	Butler		Beaver Creek	62	71
Plainfield	M-59	Bremer	200.0	Cedar River	59	65
Plymouth	M-60	Cerro Gordo			NEMTF	
Raymond	M-61	Black Hawk			NEMTF	
Reinbeck	M-62	Grundy		Black Hawk Creek	62	72
Rock Falls	M-63	Cerro Gordo			NEMTF	
Rockford	M-64	Floyd		Shell Rock River	-	68
Rockwell	M-65	Cerro Gordo		County Park Recreation Pond	59	66
Rudd	M-66	Floyd		Flood Creek	-	71
St. Ansgar	M-67	Mitchell	252.6	Cedar River	59	65
Scarville	M-68	Winnebago			NEMTF	
Sheffield	M-69	Franklin		Bailey Creek	60	66
Shell Rock	M-70	Butler	10.7	Shell Rock River	62	71
Staceyville	M-71	Mitchell		Little Cedar River	59	65
Stout	M-72	Grundy			NEMTF	
Swaledale	M-73	Cerro Gordo			NEMTF	
Thompson	M-74	Winnebago			NEMTF	
Traer	M-75	Tama		Wolf Creek	64	74
Thornton	M-76	Cerro Cordo		Bailey Creek	60	66
Ventura	M-77	Cerro Gordo		To Clear Lake Sanitary District	NEMTF	
Waterloo	M-78	Black Hawk		Cedar River	64	73
Waverly	M-79	Bremer	185.5	Cedar River	59	66
Wellsburg	M-80	Grundy		Unnamed Creek	62	71

* River mile of discharge or tributary confluence with the main stream.

NEMTF: No Existing Municipal Treatment Facility.

TABLE 16 (Cont.)

POINT SOURCE WASTEWATER DISCHARGES

Discharger	Reference Number	County	River* Mile	Discharge To	Page Reference Quantity	Page Reference Treatment
Industrial						
Ackley Food Processors, Inc.	I-1	Hardin		Beaver Creek	-	71
Allied Mills	I-2	Cerro Gordo	17.5	Winnebago River	61	70
Armour & Co.	I-3	Cerro Gordo	17.5	Winnebago River	61	69
B. L. Anderson Co. - Ballheim Quarry	I-4	Black Hawk		Wolf Creek	-	-
B. L. Anderson Co. - Jabens Quarry	I-5	Benton		Rock Creek	-	75
Carnation Co.	I-6	Bremer		Cedar Creek	59	65
Cedar Falls Utilities	I-7	Black Hawk		Cedar River	62	72
Chamberlain Manufacturing Co.	I-8	Black Hawk		Cedar River	64	74
Charles City Water Treatment Plant	I-9	Floyd		Cedar River	59	65
Chicago, Milwaukee, St. Paul and Pacific R.R.	I-10	Cerro Gordo	17.5	Winnebago River	61	70
Construction Machinery Co.	I-11	Black Hawk	152.8	Cedar River	64	74
Clay Equipment Corp.	I-12	Black Hawk	163.6	Cedar River	-	72
C. W. Shirey Co.	I-13	Black Hawk	152.8	Cedar River	64	73
Deere and Co.	I-14	Black Hawk		Black Hawk Creek	62	73
Engineered Equipment Co.	I-15	Black Hawk		Cedar River	62	73
Farmers Co-op Creamery	I-16	Butler	31.7	Shell Rock River	61	70
Greene Limestone Co.-Burns Quarry	I-17	Butler		Unnamed Creek	60	67
Greene Limestone Co.-Lubben Quarry	I-18	Butler		Palmer Creek	61	71

* River mile of discharge or tributary confluence with the main stream.

NEMTF: No Existing Municipal Treatment Facility.

TABLE 16 (Cont.)

POINT SOURCE WASTEWATER DISCHARGES

Discharger	Reference Number	County	River* Mile	Discharge To	Page Reference	
					Quantity	Treatment
Industrial (cont.)						
Greene Limestone Co. - Portland Quarry	I-19	Cerro Gordo	12.0	Winnebago River	61	70
Greene Rendering Company	I-20	Butler	32.6	Shell Rock River	-	70
Grundy Center Water Treatment Plant	I-21	Grundy		Black Hawk Creek	62	72
Hallett Constr.	I-22	Franklin		Maynes Creek	60	67
Hebel Fertilizer and Chemical Co.	I-23	Cerro Gordo	17.5	Winnebago River	61	69
Interstate Power Company	I-24	Cerro Gordo		Willow Creek	61	70
Iowa Public Service Company	I-25	Black Hawk	152.8	Cedar River	63 & 64	73
John Deere & Co.	I-26	Black Hawk	152.8	Cedar River	62	73
Kark Rendering Company	I-27	Mitchell		Sugar Creek	59	65
La Porte City Water Treatment Plant	I-28	Black Hawk		Wolf Creek	-	75
Lehigh Portland Cement Company	I-29	Cerro Cordo		Calmus Creek	61	69
Libby Owens Ford	I-30	Cerro Gordo	17.5	Winnebago River	61	70
Martin Marietta Corp. - Boever Pit	I-31	Chickasaw		Little Cedar River	59	65
Martin Marietta Corp. - Boice Quarry	I-32	Chickasaw		Little Cedar River	59	65
Martin Marietta Corp. - Concrete Materials Div.	I-33	Black Hawk		Elk Run	64	74

* River mile of discharge or tributary confluence with the main stream.

NEMTF: No Existing Municipal Treatment Facility.

TABLE 16 (Cont.)

POINT SOURCE WASTEWATER DISCHARGES

Discharger	Reference Number	County	River* Mile	Discharge To	Page Reference Quantity	Page Reference Treatment
Industrial (cont.)						
Martin Marietta Corp. - Ernivine Quarry	I-34	Chickasaw	208.7	Cedar River	59	65
Martin Marietta Corp. - Portland Quarry	I-35	Cerro Gordo	14.5	Winnebago River	61	70
Martin Marietta Corp. - Randall Quarry	I-36	Worth		Drainage Ditch #5	60	67
Martin Marietta Corp. - Smith Quarry	I-37	Benton		Wolf Creek	64	74
Mid Equipment Company	I-38	Grundy		Black Hawk Creek	-	72
Northwestern States Portland Cement Company	I-39	Cerro Gordo		Winnebago River	61	69
Ogden-Waterloo 26" Main Line Loop	I-40	Grundy		Black Hawk Creek	62	73
Paul Niemann Construction Co. Bloom Quarry	I-41	Buchanan		Spring Creek	-	75
Pepsi Cola Bottling Co., Inc.	I-42	Black Hawk	152.8	Cedar River	63	73
P & M Stone Co., Inc.	I-43	Cerro Gordo	28.6	Winnebago River	61	69
Rath Packing Co.	I-44	Black Hawk	152.8	Cedar River	63	73
Viking Pump Co.	I-45	Black Hawk	163.6	Cedar River	-	72
Walker Manufacturing Co.	I-46	Winnebago		Drainage Ditch #92	60	68
Waterloo Industries	I-47	Black Hawk	152.8	Cedar River	63	73

* River mile of discharge or tributary confluence with the main stream.

NEMTF: No Existing Municipal Treatment Facility.

TABLE 16 (Cont.)

POINT SOURCE WASTEWATER DISCHARGES

Discharger	Reference Number	County	River* Mile	Discharge To	Page Reference	
					Quantity	Treatment
Industries (cont.)						
Weaver Construction Co - Hibness Quarry	I-48	Franklin		Maynes Creek	60	67
Weaver Construction Plant	I-49	Cerro Gordo		Winnebago River	61	69
Welp and McCarten, Inc. - Kuemen Quarry	I-50	Worth	77.6	Shell Rock River	60	67
Welp and McCarten, Inc. - Strickler Quarry	I-51	Cerro Gordo		Winnebago River	61	69
Welp and McCarten, Inc. - Swaledale Quarry	I-52	Cerro Gordo	28.6	Beaverdam Creek	59	66
Winnebago Industries, Inc.	I-53	Winnebago	52.0	Winnebago River	-	68
Semipublic						
Beeds Lake State Park	S-1	Franklin		Squaw Creek	60	67
Cedar Knoll Park	S-2	Black Hawk	152.8	Cedar River	-	74
Cono Center Presbyterian Church	S-3	Buchanan			-	-
Country Side Court	S-4				-	-
Dietrick Mobile Home Park	S-5	Grundy		Black Hawk Creek	-	73
Elk Run School	S-6	Black Hawk	152.8	Cedar River	64	74
Greenfield Estates Mobile Home Park	S-7	Winnebago	52.0	Winnebago River	-	68
Hickory Hills Homes of Tama County, Inc.	S-8	Tama		Wolf Creek	-	74

* River mile of discharge or tributary confluence with the main stream.

NEMTF: No Existing Municipal Treatment Facility.

TABLE 16 (Cont.)

POINT SOURCE WASTEWATER DISCHARGES

	Reference		River*		Page Reference	
Discharger	Number	County	Mile	Discharge To	Quantity	Treatment
Semipublic (cont.)						
Highway No. 3 Mobile Home Park	S-9				-	-
Oak Grove Mobile Home Park	S-10	Black Hawk		Millers Creek	-	74
Terrace Hill Sanitary District	S-11	Franklin		Squaw Creek	-	67
West Hills Housing Development	S-12	Black Hawk			-	71
Winnebago County Home	S-13	Winnebago		Beaver Creek	-	68

* River mile of discharge or tributary confluence with the main stream.

NEMTF: No Existing Municipal Treatment Facility.

TABLE 17

POINT SOURCE
WASTEWATER DISCHARGE QUANTITIES

Ref. No.	Average Flow (mgd)	BOD_5				Suspended Solids		Ammonia Nitrogen (N)				Phosphorus (Total P)		Total Dissolved Solids		Temperature		Other
		Summer		Winter				Summer		Winter						Summer	Winter	
		(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(F)	(F)	(mg/l unless noted otherwise)
Cedar River																		
M-67	0.097	30	24	40	32			4	3	18	15	13	11					
Sugar Creek																		
M-57	0.267	40	92	110	254			6	14	22	51	43	99					
I-27	0.150	1238	83															
Cedar River																		
M-24		25		25														
M-11	1.631	40	550	75	1032	48	661	25	344	80	1101	12	165					
I-9	0.030													237	59	50	49	Na = 3.7 K = 1.5 Mg = 14.8 Mn = 0.05 Fe = 1.06 Ca = 60.5 F = 0.75 Cl = 0.5 pH = 10.1
Little Cedar River																		
M-71	0.026	30	7	80	17			7	2	18	4	24	5					
I-32	1.00																	
I-31	0.050																	
Cedar River																		
M-53	0.135	35	39	70	79			14	16	26	29	30	34					
I-34	0.050																	
M-59	0.010	70		150				4		16		28						
I-6	0.050	0	0	0	0			0	0	0	0					90	80	TDS = 288 pH = 7.5
	0.004	0	0	0	0			0	0	0	0					130	110	TDS = 288
	0.150					0	0							288		70	110	NO_3 = 0.5
M-79	0.500	25	105	35	147			11	46	20	84	36	152					
Quarter Section Run																		
M-17	0.129	25	26	35	36			2	2	4	4	9	9					
Cedar River																		
M-38	0.030	100	26	150	39									683	177			Org-N = 15 NO_3-N = 0.12 Ortho-P = 15 pH = 7.2
West Fork Cedar River																		
Beaverdam Creek																		
M-13	1.696																	
I-52						15	313	22	459	35	730	52	1084	348	7256			pH = 8.1 Turb. = 10 J.U.
East Branch Drainage Ditch #92																		
M-65	0.085	50	35	150	106			18	13	22	16	36	26					

TABLE 17 (Cont.)

POINT SOURCE
WASTEWATER DISCHARGE QUANTITIES

Ref. No.	Average Flow (mgd)	BOD$_5$				Suspended Solids		Ammonia Nitrogen (N)				Phosphorus (Total P)		Total Dissolved Solids		Temperature		Other
		Summer		Winter				Summer		Winter						Summer (F)	Winter (F)	(mg/l unless noted otherwise)
		(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)			
Bailey Creek																		
M-76	0.036																	
M-69	0.093	25	19	50	39			6	5	26	20	15	12					
West Fork Cedar River																		
M-20	0.304	25	63	25	63			1	3	3	8	4	10					
Hartgrave Creek																		
Squaw Creek																		
M=33	0.350	25	77	40	122			7	21	28	86	28	86					Zn = 0.007 Cv - 0.03 Cr = 0.01
S-1	0.063															61	31	
Maynes Creek																		
I-22	1.5																	
I-48	2.4													402	8046			
Unnamed Creek																		
I-17	0.75 (max.)					16	100							436	2727			pH = 7.8 units Alk as $CaCO_3$ = 164 Turb. = 12 J.U.
Feddeke Creek																		
M-3	0.100	30	25	50	42			1	1	5	4	3	3					
Shell Rock River																		
M-55	0.181	25	38	40	60			17	26	16	24	16	24					
I-50	1.5															72	46	Turb. = 4 J.U. Alk = 163 pH = 8.3
Drainage Ditch #5																		
I-36	0.480															60	32	Hardness = 272 Turb. = 5 J.U. Alk = 294 pH = 8.0
Rose Creek																		
M-47		40		100				25		30		30						
Winnebago River																		
Drainage Ditch #57																		
Drainage Ditch #92																		
I-46	0.023																	
Winnebago River																		
M-45	0.290																	
M-25	0.290	25	62	30	75			12	30	22	55	21	52					
M-26	0.129	25	27	25	27			1	1	2	2	1	1					
Beaver Creek																		
M-42	0.153	25	32	35	45			4	5	20	26	14	18					

TABLE 17 (Cont.)

POINT SOURCE
WASTEWATER DISCHARGE QUANTITIES

Ref. No.	Average Flow	BOD$_5$				Suspended Solids		Ammonia Nitrogen (N)				Phosphorus (Total P)		Total Dissolved Solids		Temperature		Other
		Summer		Winter				Summer		Winter						Summer	Winter	
	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(F)	(F)	(mg/l unless noted otherwise)
	Winnebago River																	
I-43	1.08																	
I-51	6.0					215	10,759											
I-39	5.38																	
	Calmus Creek																	
I-29	15.4					80	10,275	0.1	13			0.0	0.0	430	55,227	100	66	
	0.97					60	485	0.06	0			1.4	11	428	3,462	60	40	
	0.97					106	858	0.06	0			0.03	0	416	3,365	60	40	
	0.97					3	24	0.06	0			0.0	0	387	3,131	60	40	
	0.14					340	397	0.70	1			0.03	0	4,426	5,168	70	32	
	2.16					56	1,009	0.10	2			0.0	0	544	9,800	60	32	
	0.144					30	36	0.2	0			0.0	0	506	608	60	32	
	0.072					30	18	0.2	0			0.0	0	506	304	60	32	
	Winnebago River																	
I-49	0.70															52	48	
I-3	0.640					30	160	21	112			16	85	2,670	14,251			
	0.250	2	4			32	67	1	2	1	2	1	2	1,124	2,344			
I-23																		
	Willow Creek																	
I-24		7		7														
	Winnebago River																	
M-49	4.586	25	956	25	956			10	382	20	765	18	688					
I-2	0.002																	
	0.0036																	
I-30	0.058	0		0	0	0	0	0	0	0	0	0.96	0.5					Ortho-P = 0.2
I-10	0.0006					20	0.1									700	4	pH = 7.0 units
I-35	0.711															60	33	
I-19	0.90	9	68											484	3,633			
	Shell Rock River																	
M-31	0.100	35		70				22		40		30						
I-16	0.0022																	
	Coldwater Creek																	
	Palmer Creek																	
I-18	0.90	11	83	0	0													pH = 7.8 Turb. = 4 J.U.

TABLE 17 (Cont.)

POINT SOURCE
WASTEWATER DISCHARGE QUANTITIES

Ref. No.	Average Flow (mgd)	BOD$_5$				Suspended Solids		Ammonia Nitrogen (N)				Phosphorus (Total P)		Total Dissolved Solids		Temperature		Other
		Summer		Winter				Summer		Winter						Summer	Winter	
		(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(F)	(F)	(mg/l unless noted otherwise)
Shell Rock River																		
M-12	0.079	50	33	150	99			13	9	28	18	42	28					
M-70		30		40				18		28		31						
Beaver Creek																		
M-1	0.189	25		25				2		4		5						
M-4	0.053	30	13	50	22			13	6	21	9	21	9					
South Beaver Creek																		
Unnamed Creek																		
M-80	0.038	30	10	60	19													
Beaver Creek																		
M-58	0.105	30		70				6		25		17						
M-54	0.039	30	8	65	16			1	0.3	20	5	17	4					
Cedar River																		
M-10	3.60	25	720	25	720			4	144	11	317							
I-7	5.4																	
Black Hawk Creek																		
I-21	0.012															54	52	
M-32	0.346	25	72	35	101			8	23	30	87	17	49					
M-62	0.249	30	63	60	126			12	25	28	59	24	50					
North Fork Black Hawk Creek																		
M-18		25		70														
Black Hawk Creek																		
I-40	7.05																	
M-37	0.234	150	293	150	293			34	66	49	96	37	72					
I-14								165										Org-N = 1170
Cedar River																		
I-26	7.776	10	649													72	44	
	23.911															94	29	
	2.46	6	123			99	2,031	1	21							72	44	
	1.683	3	42			6	84	0.4	6							74	54	
	1.65															65	65	
I-15	0.0045																	

TABLE 17 (Cont.)

POINT SOURCE
WASTEWATER DISCHARGE QUANTITIES

Ref. No.	Average Flow (mgd)	BOD_5 Summer (mg/l)	BOD_5 Summer (lb/day)	BOD_5 Winter (mg/l)	BOD_5 Winter (lb/day)	Suspended Solids (mg/l)	Suspended Solids (lb/day)	Ammonia Nitrogen (N) Summer (mg/l)	Ammonia Nitrogen (N) Summer (lb/day)	Ammonia Nitrogen (N) Winter (mg/l)	Ammonia Nitrogen (N) Winter (lb/day)	Phosphorus (Total P) (mg/l)	Phosphorus (Total P) (lb/day)	Total Dissolved Solids (mg/l)	Total Dissolved Solids (lb/day)	Temperature Summer (F)	Temperature Winter (F)	Other (mg/l unless noted otherwise)
Cedar River (cont.)																		
1-47	0.080															55	53	SO_4 = 7.7 LI = 7.0 pH = 7.0 units Cr = 0.6 ug/l Zn = 3.6 ug/l
1-44	2.6	1	22					0.2	4							80	79	
	1.65															85	83	
1-42	0.027	167	38									35	8					COD = 200
1-25	88.16	4	2,941			127	93,377	0	0	0	0	8.1	5,956	329	241,899	82	55	Org-N = 1.12 NO_3-N = 2.97 TVS = 47 COD = 37 pH = 8.0
	0.43	4	14			127	455	0	0	0	0	8.1	29	329	1,180	89	57	Org-N = 1.12 NO_3-N = 2.97 TVS = 43 COD = 37 pH = 8.0
	0.40	4	13			127	424	0	0	0	0	8.1	27	329	1,098	86	56	Org-N = 1.12 NO_3-N = 2.97 TVS = 47 COD = 37 pH = 8.0
	0.033	3.5	1			13	4	0	0	0	0	4	1	325	89			Org-N = 2.24 NO_3-N = 3.04 SO_4 = 18 TVS = 14 COD = 35
	0.030	12	3			43	11	0	0	0	0	4.3	1	306	77			Org-N = 1.68 NO_3-N = 2.96 SO_4 = 29 TVS = 70 COD = 0
	0.049	2	1			18	7	0	0	0	0	5.3	2	592	242			Org-N = 1.26 NO_3-N = 3.94 SO_4 = 29 TVS = 41 COD = 8.0 pH = 6.7

TABLE 17 (Cont.)

POINT SOURCE
WASTEWATER DISCHARGE QUANTITIES

Ref. No.	Average Flow	BOD_5				Suspended Solids		Ammonia Nitrogen (N)				Phosphorus (Total P)		Total Dissolved Solids		Temperature		Other
		Summer		Winter				Summer		Winter						Summer	Winter	
	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(F)	(F)	(mg/l unless noted otherwise)
Cedar River (cont.)																		
I-25 (cont.)	0.200	4	7			3	5	0.59	1			0.07	0.1	361	602	--	50	Org-N = 0.69 NO_3-N = 1.75 SO_4 = 64 TVS = 13 COD = 34 pH = 8.5
I-13	0.01					96	8											COD = 10 TS = 2,436 pH = 12.1 SO_4 = 540
	0.007					25	1											COD = 5 TS = 383 SO_4 = 33
M-78	15.254	30	4,282	50	7,136			7	999	25	3,568	17	2,426					
I-11	0.0046	1	0	1	0			0.2	0	0.2	0							
I-8	7.3	25	1,522	35	2,131	183	11,141	0.15	9			.3	18	242	14,733			Org-N = 2.94 NO_3-N = 7
M-21	0.050	25	10					14	6			56	23					
S-6																		
Elk Run																		
M-22	0.516	25	108	25	108			6	26	17	73	15	65					
I-33	1.13					1	9							332	3,129			
Wolf Creek																		
M-15	0.050	30		40						14		16						
M-29	0.117	25	24	25	24			2	2	12	11	12	11					
M-75	0.141																	
I-37	0.68					14	79							304	1,724	62	32	pH = 8.5 Turb = 15 J.U. Hardness = 228 Alk = 140
M-43		25		25				7		24		10						
Spring Creek																		
M-39	0.300	25	59	40	94			30	71	30	71	33	78					

TABLE 18

WASTEWATER TREATMENT FACILITIES

Discharge (Ref. No.)	Existing Design Average Day Capacity (mgd)	Present Average Day Flow (mgd)	BOD_5		Suspended Solids		Type of Treatment			Comments
			Influent Conc. (mg/l)	Effluent Conc. (mg/l)	Influent Conc. (mg/l)	Effluent Conc. (mg/l)	Primary	Secondary	Solids Treatment	
Cedar River										
Deer Creek										
Carpenter (M-9)										No existing municipal treatment facility.
Cedar River										
St. Ansgar (M-67)	0.120	0.097		30			Lo	Lo		Plant has problems during spring melt. Seems to carry over for several months.
Mitchell (M-51)										No existing municipal treatment facility.
Sugar Creek										
Osage (M-57)	0.336	0.267		53			Gh Sh Cm Cp	Ftr Cm	Dcm Hc Xl	Present plant is being upgraded to activated sludge and polishing pond. New plant design flow will be 1.36 mgd.
Kark Rendering (I-27)		0.150		1,235						To cease discharge by January 1, 1975.
Cedar River										
Floyd (M-24)							La	La		
Charles City (M-11)	2.440	1.631	220	49	250	48	Sh Gmw Cm	Ftrc Cm	Dfht Xl Do	Very frequent flooding resulting in discharge of raw sewage to the river.
Charles City - Water Treatment Plant (I-9)		0.030								
Little Cedar River										
Stacyville (M-71)	0.030	0.026		43			Sh Ci	Ftrc	Bo	
Colwell (M-14)										No existing municipal treatment facility.
Bassett (M-6)										No existing municipal treatment facility. A waste stabilization lagoon has been proposed.
Martin Marietta Corp. Boice Quarry (I-32)		1.00								Discharge is rockwash and quarry dewatering water.
Martin Marietta Corp. Boevers Pit (I-31)		0.050								
Cedar River										
Nashua (M-53)	0.079	0.135		47			Ci	Ftrc Cp	Bo Xl	
Martin Marietta Corp. Ernivine Quarry (I-34)		0.050								Seasonal discharge April through November.
Plainfield (M-59)		0.010		120			Sh Cs	Lo		A waste stabilization lagoon has been proposed.
Carnation Co. (I-6)		0.050		0						Discharge is cooling water.
		0.004		0						Dishcarge is boiler blowdown water.
		0.150			0	0				

TABLE 18 (Cont.)

WASTEWATER TREATMENT FACILITIES

Discharge (Ref. No.)	Existing Design Average Day Capacity (mgd)	Present Average Day Flow (mgd)	BOD_5		Suspended Solids		Type of Treatment			Comments
			Influent Conc. (mg/1)	Effluent Conc. (mg/1)	Influent Conc. (mg/1)	Effluent Conc. (mg/1)	Primary	Secondary	Solids Treatment	
Cedar River (cont.)										
Waverly (M-79)	1.085	0.500		26			Sc (GmKa) Cm	Ftrc Cm	Dfhm Hc Xl	Plant is periodically overloaded and is discharging raw sewage to the Cedar River.
Quarter Section Run										
Denver (M-17)	0,150	0.129		30			Lo	Lo		Total surface area equals 10 acres. Plant constructed in 1962.
Cedar River										
Janesville (M-38)	0.030	0.030	180	140	140	152	Ci	Ftnc Cp	Bo	Preliminary report was submitted to IDEQ May 30, 1974. Present plant is overloaded.
West Fork Cedar River										
Beaverdam Creek										
Clear Lake Sanitary District (M-13)	2.352	1.696					Cm Smg Cm	Ftr Cm	Dfht Bo Xl	
Drainage Ditch #92										
Swaledale (M-73)										A waste stabilization lagoon has been proposed.
Beaverdam Creek										
Welp & McCarten, Inc. Swaledale Quarry (I-52)	2.5									
East Branch Beaverdam Creek										
Rockwell (M-65)	0.073	0.085		79			Cm	Frnc Cp	Dcp Bo	
Bailey Creek										
Meservey (M-50)										A waste stabilization lagoon has been proposed.
Thornton (M-76)	0.060	0.036					Lo	Lo		
Sheffield (M-69)	0.143	0.093		40			Lo	Lo		
West Fork Cedar River										
Dumont (M-20)	0.250	0.304		25			Lo	Lo		Total surface area equals 10.7 acres.
Hartgrave Creek										
Spring Creek										
Alexander (M-2)										No existing municipal treatment facility.
Latimer (M-44)										No existing municipal treatment facility.

TABLE 18 (Cont.)

WASTEWATER TREATMENT FACILITIES

Discharge (Ref. No.)	Existing Design Average Day Capacity (mgd)	Present Average Day Flow (mgd)	BOD_5 Influent Conc. (mg/l)	BOD_5 Effluent Conc. (mg/l)	Suspended Solids Influent Conc. (mg/l)	Suspended Solids Effluent Conc. (mg/l)	Type of Treatment Primary	Type of Treatment Secondary	Type of Treatment Solids Treatment	Comments
Cedar River (cont.)										
West Fork Cedar River (cont.)										
Hartgrave Creek (cont.)										
Otter Creek										
Hansell (M-35)										No existing municipal treatment facility.
Squaw Creek										
Hampton (M-33)	0.620	0.350		30			Sch (GwKm)	Ftr Cm	Dfh Bo	
Beeds Lake State Park (S-1)		0.063					Lo			
Terrace Hill Sanitary District (S-11)										Plant constructed in 1971.
Boylan Creek										
Aredale (M-5)										No existing municipal treatment facility.
Bristow (M-8)										No existing municipal treatment facility.
Maynes Creek										
Coulter (M-16)										No existing treatment facility. A waste stabilization lagoon was proposed in 1970.
Geneva (M-27)										No existing municipal treatment facility.
Hallett Construction (I-22)		1.5								
Weaver Construction Co. Hibness Quarry (I-48)		2.4				31				
Unnamed Creek										
Greene Limestone Co. Burns Quarry (I-17)		0.75 (max.)				16				Pumping periods for 3 months per year. No winter operation.
Feddeke Creek										
Allison (M-3)	0.200	0.100		33			Lo	Lo		
Shell Rock River										
Northwood (M-55)	0.180	0.181		42			Sh (CmDm)	Frnc Cm	BoXl	
Kensett (M-41)										No existing municipal treatment facility.
Welp & McCarten, Inc. Kuemen Quarry (I-50)		1.5								
Drainage Ditch #5										
Martin Marietta Corp. Randall Quarry (I-36)		0.480				1				

TABLE 18 (Cont.)
WASTEWATER TREATMENT FACILITIES

Discharge (Ref. No.)	Existing Design Average Day Capacity (mgd)	Present Average Day Flow (mgd)	BOD_5		Suspended Solids		Type of Treatment			Comments
			Influent Conc. (mg/l)	Effluent Conc. (mg/l)	Influent Conc. (mg/l)	Effluent Conc. (mg/l)	Primary	Secondary	Solids Treatment	
Cedar River (cont.)										
West Fork Cedar River (cont.)										
Shell Rock River (cont.)										
Drainage Ditch #53										
Grafton (M-30)										No existing municipal treatment facility. A waste stabilization lagoon has been proposed.
Rose Creek										
Manley (M-47)	0.075			72			Lo	Lo		A new waste stabilization lagoon is being designed.
Shell Rock River										
Rockford (M-64)							Lo	Lo		
Winnebago River										
Drainage Ditch #18										
Scarville (M-68)										No existing municipal treatment facility.
Drainage Ditch #57										
Drainage Ditch #92										
Walker Manufacturing Co. (I-46)		0.023								Sanitary wastes are discharged to the municipal sanitary sewer system.
Pike Run										
Thompson (M-74)										No existing municipal treatment facility.
Winnebago River										
Leland (M-45)	0.033	0.290					Lo	Lo		
Forest City E (M-25)	0.600	0.290		28			Sh Gmw Cm	Ftn Ftrc Cm	D(cg)h Dop Bo Xl	
Forest City SW (M-26)	0.276	0.129		25			Lo	Lo		135-day storage capacity.
Winnebago Industries (I-53)										June, 1971, had preliminary plans to treat anodizing waste.
Greenfield Estates Mobile Home Park (S-7)							Lo			Have temporary waste stabilization lagoon.
Beaver Creek										
Lake Mills (M-42)	0.187	0.153		27			Cm	Fth Cm Lo	Dch Bo Xl	
Winnebago County Home (S-13)							Cs			
Winnebago River										
Fertile (M-23)										No existing municipal treatment facility. A waste stabilization lagoon was planned in 1971.

TABLE 18 (Cont.)

WASTEWATER TREATMENT FACILITIES

Discharge (Ref. No.)	Existing Design Average Day Capacity (mgd)	Present Average Day Flow (mgd)	BOD_5 Influent Conc. (mg/l)	BOD_5 Effluent Conc. (mg/l)	Suspended Solids Influent Conc. (mg/l)	Suspended Solids Effluent Conc. (mg/l)	Type of Treatment Primary	Type of Treatment Secondary	Type of Treatment Solids Treatment	Comments
Cedar River (cont.)										
West Fork Cedar River (cont.)										
Shell Rock River (cont.)										
Winnebago River (cont.)										
Winans Creek										
Hanlontown (M-34)										No existing municipal treatment facility.
Winnebago River										
P & M Stone Co., Inc. (I-43)		1.08								Discharge is quarry dewatering water.
Welp & McCarten, Inc. Strickler Quarry (I-51)		6.0				215				Discharge is quarry dewatering water and possibly some washing water.
Northwestern States Portland Cement Co. (I-39)		5.38								Discharge is from a quarry, probably dewatering and rock washing.
Calmus Creek										
Lehigh Portland Cement Co. (I-29)		15.4		2		80				
		0.97		4		60				
		0.97		3		106				
		0.97		2		3				
		0.14		3		340				
		2.16		2		56				
		0.144		2		30				
		0.072		2		30				
Winnebago River										
Weaver Construction Co. and Mason City Sand Plant (I-49)		0.70								
Armour & Co. (I-3)		0.640		90		30	CCL	Ft Ft Cm Cm		Presently designing system to discharge wastes to the municipal sanitary sewer system.
		0.250		2.1		32				Discharge is cooling water.
Hebel Fertilizer and Chemical Co. (I-23)							L	L		Boiler blowdown as well as sanitary wastes are discharged to the municipal treatment facility.

TABLE 18 (Cont.)

WASTEWATER TREATMENT FACILITIES

Discharge (Ref. No.)	Existing Design Average Day Capacity (mgd)	Present Average Day Flow (mgd)	BOD_5		Suspended Solids		Type of Treatment			Comments
			Influent Conc. (mg/l)	Effluent Conc. (mg/l)	Influent Conc. (mg/l)	Effluent Conc. (mg/l)	Primary	Secondary	Solids Treatment	
Cedar River (cont.)										
West Fork Cedar River (cont.)										
Shell Rock River (cont.)										
Winnebago River (cont.)										
Willow Creek										
Interstate Power Co. (I-24)	8.47			7						
Winnebago River										
Mason City (M-49)	4.150	4.586		25			Sm Gmw Ka Cm	Ftr Cm Aa Cm Ka Ecgk	D(cg)hm Dfh Bo Xl	Existing sewers have a large quantity of infiltration during periods of wet weather. Plant modification is presently being carried out with nitrification being added.
Allied Mills (I-2)		0.022						Fr		Sanitary wastes.
		0.0036								Process wastes.
Libby Owens Ford (I-30)		0.058	0	0	0	0				No existing treatment facility. Sanitary wastes are discharged to the municipal sanitary sewer.
Chicago, Milwaukee, St. Paul and Pacific R.R. (I-10)		0.0006				22				Oil separator should be in use.
Martin Marietta Corp. Portland Quarry (I-35)		0.711								Discharge is quarry dewatering water.
Greene Limestone Co. Portland Quarry (I-19)		0.90		9			L			
Shell Rock River										
Marble Rock (M-48)										Two-cell, 5-acre stabilization lagoon under construction.
Greene (M-31)	0.171	0.100		50			Ci	Fth Cm	XL	Plant has had flooding problems in the spring.
Greene Rendering (I-20)										Waste stabilization lagoon was proposed May 8, 1974.
Farmers Co-op Creamery (I-16)		0.0022		31		31				Discharge is cooling water and wash water.

TABLE 18 (Cont.)

WASTEWATER TREATMENT FACILITIES

Discharge (Ref. No.)	Existing Design Average Day Capacity (mgd)	Present Average Day Flow (mgd)	BOD5 Influent Conc. (mg/l)	BOD5 Effluent Conc. (mg/l)	Suspended Solids Influent Conc. (mg/l)	Suspended Solids Effluent Conc. (mg/l)	Type of Treatment Primary	Type of Treatment Secondary	Type of Treatment Solids Treatment	Comments
Cedar River (cont.)										
West Fork Cedar River (cont.)										
Shell Rock River (cont.)										
Coldwater Creek										
Palmer Creek										
Greene Limestone Co Lubben Quarry (I-18)		0.90		11						Not in operation during winter months. Discharge is surface water and seepage.
Coldwater Creek										
Dougherty (M-19)										No existing municipal treatment facility.
Flood Creek										
Rudd (M-66)										Present waste stabilization lagoon in process of being modified to meet EPA standards.
Shell Rock River										
Clarksville (M-12)	0.060	0.079		90			Gh Cs		Bo	Presently considering a waste stabilization lagoon and/or package plant.
Shell Rock (M-70)				33			Sh (CpDo)	Fth Cp	Bo Xl	
Beaver Creek										
Ackley (M-1)	0.200	0.189		25			Gh Sc Cm	Ftrc Cm	Dcp Bo Xl	
Ackley Food Processors, Inc. (I-1)							Cs			Apparently the only discharge to the creek is boiler feed water and the effluent from a three compartment septic tank.
Aplington (M-4)	0.153	0.053		41			Sh Cm	Ftn Cp	Do Bo	
South Beaver Creek										
Unnamed Creek										
Wellsburg (M-80)	0.094	0.038		48			Sh Ci	Ftr Cp	Bo	
Beaver Creek										
Parkersburg (M-58)	0.060	0.105		48			Lo	Lo		New waste stabilization lagoons are presently being constructed. New design flow will be 0.201 mgd.
New Hartford (M-54)	0.099	0.039		41			Lo	Lo		Plant has been experiencing some seepage problems.
West Hills Housing Development (S-12)	0.024									Proposed activated sludge package plant followed by a polishing pond.

TABLE 18 (Cont.)

WASTEWATER TREATMENT FACILITIES

Discharge (Ref. No.)	Existing Design Average Day Capacity (mgd)	Present Average Day Flow (mgd)	BOD_5		Suspended Solids		Type of Treatment			Comments
			Influent Conc. (mg/1)	Effluent Conc. (mg/1)	Influent Conc. (mg/1)	Effluent Conc. (mg/1)	Primary	Secondary	Solids Treatment	
Cedar River										
Cedar Falls (M-10)	4.230	3.460		25			Scm Gw Cm	Fth Cm Ftr Cm	Dfh Dfp Ho Bo	
Viking Pump Co. (I-45)										
Cedar Falls Utilities (I-7)		5.4		10						No existing treatment facility. Sanitary wastes are discharged to the municipal sanitary sewers. Discharge to Cedar River is condensing water with some boiler blowdown.
Clay Equipment Corp. (I-12)										No data in files on flow or treatment other than cyanide destruction.
Black Hawk Creek										
Holland Creek										
Holland (M-36)							Lo	Lo Lp		As of 1973, waste stabilization lagoons were under construction.
Black Hawk Creek										
Grundy Center Water Treatment Plant (I-21)	0.0	0.012								Discharges backwash water from iron filter once every 10 days.
Grundy Center (M-32)	0.180	0.346		28			Sch Cm	Ftr Cm	Dfh Bo	
Mid-Equipment Co. (I-38)							Lo	Lo		A permit was issued by IDEQ April 8, 1974, to build a two-cell waste stabilization lagoon. Total surface tree equals 60,000 sq.ft.
Morrison (M-52)										No existing municipal treatment facility.
Mosquito Creek										
Unnamed Creek										
Lincoln (M-46)										
Black Hawk Creek										
Reinbeck (M-62)	0.100	0.249		30			Sh Ci	Ftr Cp	Bo Xl	No existing municipal treatment facility. Plans for four waste stabilization lagoons were submitted to IDEQ in 1973.
North Fork Black Hawk Creek										
Stout (M-72)										No existing municipal treatment facility.
Dike (M-18)				43			(CpDo)	Ftr Cp	Bo	Plant constructed in 1964.

TABLE 18 (Cont.)

WASTEWATER TREATMENT FACILITIES

Discharge (Ref. No.)	Existing Design Average Day Capacity (mgd)	Present Average Day Flow (mgd)	BOD_5 Influent Conc. (mg/1)	BOD_5 Effluent Conc. (mg/1)	Suspended Solids Influent Conc. (mg/1)	Suspended Solids Effluent Conc. (mg/1)	Type of Treatment Primary	Type of Treatment Secondary	Type of Treatment Solids Treatment	Comments
Cedar River (cont.)										
Black Hawk Creek										
Ogden-Waterloo 26" Main Line Loop (I-40)		7.05								Discharges only from September to November.
Hudson (M-37)	0.100	0.234		150			Cm	Fth Cp	Bo	
Dietrick Mobile Home Park (S-5)							Lo			90 units.
Deere & Co. (I-14)								Ae O		Settling pond overflow contains a heavy concentration of sulfur bacteria.
Cedar River										
John Deere & Co. (I-26)		7.776		10						
		23.911								
		2.46		6		99				
		1.683		3		6				
		1.65								
Engineered Equipment Co. (I-15)		0.0045								
Waterloo Industries (I-47)		0.080								Discharge is cooling and rinse water.
Rath Packing Co. (I-44)		2.6								
		1.65								Both discharges are cooling water.
Pepsi Cola Bottling Co. (I-42)		0.027		127						No existing treatment facility.
Iowa Public Service Co. (I-25)		88.16		4		127				All water except 0.13 mgd is surface water.
		0.43		4		127				
		0.40		4		127				
		0.033		3.5		13				
		0.030		12		43				
		0.049		2		18				
		0.200		4		3				
C. W. Shirey Co. (I-13)		0.01				96				Not operating during summer months.
Waterloo (M-78)	18.270	15.254		45			(GaOaCmFo Cm) Sm Gm Oa Ka Cm	Fth Cm Eh	Dfh Vv Xl	Present plant is overloaded. Preliminary study has been submitted to IDEQ.

TABLE 18 (Cont.)

WASTEWATER TREATMENT FACILITIES

Discharge (Ref. No.)	Existing Design Average Day Capacity (mgd)	Present Average Day Flow (mgd)	BOD_5		Suspended Solids		Type of Treatment			Comments
			Influent Conc. (mg/l)	Effluent Conc. (mg/l)	Influent Conc. (mg/l)	Effluent Conc. (mg/l)	Primary	Secondary	Solids Treatment	
Cedar River (cont.)										
Construction Machinery Company (I-11)		0.0046	1	1						Discharge is cooling water.
Chamberlain Mfg. Co. (I-8)		7.3	10	25	79	183				Separate systems for sanitary, storm, and cooling water.
Cedar Knoll Park (S-2)										213 unit mobile home park.
Elk Run Heights (M-21)	0.174	0.050		25			Sch Ae	Ae Lp		
Elk Run School (S-6)	0.005						Cs	Fr		
Elk Run										
Evansdale (M-22)	0.680	0.516		25			Sc Gm Cm	Am Cm Lp	Ad Ls Xl	Existing sewers have a large quantity of infiltration during periods of wet weather. Some work has been started to correct this problem.
Martin Marietta Corp. Concrete Materials Division (I-33)		1.13			1	1				Discharge is quarry dewatering water.
Cedar River										
Gilbertville (M-28)										No existing municipal treatment facility. Construction permit no. 74-12-3 was issued January 18, 1974, by IDEQ for a sewage collection system. Lift station and extended aeration/contact stabilization plant with a design flow of 0.20 mgd.
Millers Creek										
Oak Grove Mobile Home Park (S-10)										Construction permit issued by IDEQ September 22, 1970, for a waste stabilization lagoon. 54 unit mobile home park.
Wolf Creek										
Conrad (M-15)	0.090	0.050		37			Sh Gh (CmDm)	Fthc Cp	Bo Xl	Plans and specifications were received by IDEQ March 15, 1974, for a waste stabilization lagoon.
Gladbrook (M-29)	0.106	0.117		25			Lo	Lo		
Traer (M-75)	0.173	0.141					Gh Sc Km Gm	Ftr Cp	Dch Bo	
Martin Marietta Corp. Smith Quarry (I-37)		0.68			14	14				
Hickory Hills Park (S-8)	0.052						Lo			

TABLE 18 (Cont.)

WASTEWATER TREATMENT FACILITIES

Discharge (Ref. No.)	Existing Design Average Day Capacity (mgd)	Present Average Day Flow (mgd)	BOD$_5$		Suspended Solids		Type of Treatment			Comments
			Influent Conc. (mg/1)	Effluent Conc. (mg/1)	Influent Conc. (mg/1)	Effluent Conc. (mg/1)	Primary	Secondary	Solids Treatment	
Cedar River (cont.)										
Wolf Creek (cont.)										
La Porte City Water Treatment Plant (I-28)		0.016								Discharge is backwash water.
La Porte City (M-43)	0.140			25			Sc Gh Cm	Ftr Cm	Dch Bo	Plant constructed in 1939.
Cedar River										
Rock Creek										
B. L. Anderson, Inc. Jabins Quarry (I-5)										
Spring Creek										
Jesup (M-39)	0.439	0.300		35			Sh Gmw (Afctr)	Ac Cm	Ad Xl	Existing sewer has a large quantity of infiltration during periods of wet weather. Creamery discharge causes some shock loads.
Paul Niemann Construction Bloom Quarry (I-41)							Lo			Three settling ponds.

ABBREVIATIONS

WASTEWATER TREATMENT FACILITIES

A ----Aeration (in tanks or basins)
Aa----Activated sludge, diffused air aeration
Ac----Contact stabilization
Ad----Aerobic digestion
Ae----Extended aeration
Af----Air flotation
Am----Activated sludge, mechanical aeration
Ao----Oxidation ditch
Ap----Aeration, plain, without sludge return

B ----Sludge beds
Bo----Open
Bc----Glass covered

C ----Settling tanks
Ci----Two-story (Imhoff)
Cm----Mechanically equipped
Cp----Plain, hopper bottom, or intermittently drained for cleaning
Cs----Septic tank
Ct----Multiple tray, mechanically equipped
CmDm--Two-story "Clarigester"
CpDo--Two-story "Spiragester"

D ----Digesters, separate sludge
Dc----With cover (fixed if not otherwise specified)
D(cg)-Gasometer in fixed cover
De----Gas used in engines (heat usually recovered)
Df----With floating cover
Dg----With gasometer cover
Dh----Gas used in heating
Dm----Mixing
Do----Open top
Dp----Unheated
Dr----Heated
Ds----Gas storage in separate holder
Dt----Stage digestion

E ----Chlorination
Ec----With contact tank
Eg----By chlorine gas
Eh----By hypochlorite

F ----Filters
Fc----Covered filter
Fo----Roughing filter
Fr----Rapid sand or other sand straining
Fs----Intermittent sand
Ft----Trickling (no further details)
Fth---High capacity
Ft2H--High capacity, two-stage
Ftn---Fixed nozzle, standard capacity
Ftr---Rotary distributor, standard capacity
Ftt---Traveling distributor, standard capacity

G ----Grit chambers
Ga----Aerated grit removal
Gh----Without continuous removal mechanism
Gm----With continuous removal mechanism
Gp----Grit pocket at screen chamber
Gw----Separate grit washing device

H ----Sludge storage tanks (not second-stage digestion units)
Ha----Aerated
Hc----Covered
Hm----With stirring or concentrating mechanism
Ho----Open

I ----Sewage application to land
If----Ridge and furrow irrigation
Is----Subsurface application
Iu----Land underdrained
Iy----Spray irrigation

ABBREVIATIONS

WASTEWATER TREATMENT FACILITIES

K ----Chemical treatment-flocculation. Chemical treatment-type units or equipment not necessarily complete or operated as chemical treatment.
Ka----Flocculation tank, air agitation
Kc----Chemicals used
Km----Flocculation tank, mechanical agitation
Kx----No chemicals used

L ----Lagoons
La----Aerated lagoon
Le----Evaporation lagoon
Ln----Anaerobic lagoon
Lo----Waste stabilization lagoon
Lp----Polishing lagoon
Ls----Sludge lagoon - not for treatment of sewage

O ----Grease removal or skimming tanks - not incidental to settling tanks
Oa----Aerated tank (diffused air)
Om----Mechanically equipped tank
Ov----Vacuum type

S ----Screens
Sc----Comminutor (screenings ground in sewage stream)
Sf----Fine screen (less than 1/8" opening)
Sg----Screenings ground in separate grinder and returned to sewage flow
Sh----Bar rack, hand cleaned 1/2" to 2" openings
Si----Intermediate screen 1/8" to 1/2" openings
Sm----Bar rack mechanically cleaned 1/2" to 2" openings
Sr----Coarse rack (openings over 2")
St----Garbage ground at plant and returned to sewage flow

T ----Sludge thickener
Tc----Covered
Tm----Stirring mechanism
Tp----Open top

V ----Mechanical sludge dewatering
Vc----Sludge centrifuge
Vp----Pressure filter
Vv----Rotary vacuum filter
Vo----Other

X ----Sludge drying or incineration
Xd----Used for fertilizer
Xf----Sludge burned for fuel
Xl----Disposal to land
Xn----Incinerated
Xp----Used for fill

Z ----Sludge conditioning
Za----Chemicals used, alum
Zc----Chemical used (unidentified)
Zi----Chemicals used, iron salts
Zl----Chemicals used, lime
Zp----Polyelectrolytes used
Zx----No chemicals used
Zy----Elutriation

PART V

WASTE LOAD ALLOCATION METHODOLOGY

The most important consideration in determining the capacity of a stream to assimilate wastewater discharges is the ability to maintain an acceptable dissolved oxygen (DO) concentration. Microbial oxidation of organics and certain inorganics present in wastewater creates an oxygen demand. Oxygen is supplied to a stream principally by reaeration from the atmosphere. If the rate of deoxygenation exceeds the rate of reoxygenation, DO concentrations may decrease below minimum allowable standards.

To assess the variations in DO and ammonia nitrogen concentrations in the Cedar River Basin, a computer-based mathematical model was utilized. Model input data was developed from available information. In most cases data were lacking and more extensive data would improve the validity of the model. However, it is felt that the developed methodology is an equitable method for establishing waste load allocations.

It is recommended that the computer-based mathematical modeling techniques should be dated and improved as more information is obtained for the Nishnabotna River Basin to more accurately predict water quality.

Theory and Methodology

General - Dissolved oxygen concentrations in streams are controlled by atmospheric reaeration, biochemical oxygen demands (carbonaceous and nitrogenous), algal photosynthesis and respiration, benthal demands, temperature, and the physical characteristics of the stream. Many of these factors are difficult, if not impossible, to accurately define.

Photosynthesis can produce large quantities of oxygen during the day if algae are present in the stream. Conversely, at night algal respiration creates an oxygen demand. Research efforts have attempted to fit harmonic functions to this phenomenon, but with limited success. Therefore, allowance for diurnal fluctuations in oxygen levels is not included in the computer model.

Benthal demands result from anaerobic decomposition of settled organic material at the bottom of the stream. These reactions release carbonaceous and nitrogenous organic materials which create biochemical oxygen demands.

The inclusion of benthal demands in the model requires extensive field surveys to determine the areal extent of sludge deposits within a stream and coefficients that describe the release into the water. Since the impact is minor in most instances and no data are available describing sludge deposition areas, no benthal oxygen demands are included in the model formulation.

Model Equation - A complete mathematical model to describe DO concentrations within the stream would include all significant factors. Natural systems cannot presently be expressed mathematically with absolute certainty, but reasonably accurate predictions can be made through realistic assumptions of the reaeration phenomenon and deoxygenation caused by carbonaceous and nitrogenous biochemcial oxygen demands.

The nitrogenous biochemical oxygen demand is due to the oxidation of ammonia to nitrates by certain species of bacteria. This oxidation process is called nitrification. Nitrification is a two-step process whereby a specific bacterial species oxidizes ammonia to nitrite and a different bacterium oxidizes the nitrite to nitrate. Approximately 4.5 mg/l of oxygen are required to oxidize 1 mg/l of ammonia (expressed as nitrogen) to nitrate, although this value may vary between 3.8 and 4.5 mg/l. Since secondary wastewater effluents quite commonly contain ammonia nitrogen levels of 10 mg/l, the equivalent nitrogenous biochemical oxygen demand (should all the ammonia be converted to nitrates) is approximately 45 mg/l. This is equivalent to the carbonaceous biochemical oxygen demand of most secondary wastewater effluents.

For the modeling program, a modified version of the Streeter-Phelps equation for DO deficit within the stream was utilized. This approach recognizes both carbonaceous and nitrogenous biochemical oxygen demands, and atmospheric reaeration. Effects of photosynthesis and benthal demands are not considered. The rate of deoxygenation is as follows:

$$\frac{dD}{dt} = K_1L + K_nN - K_2D$$

Integrated this equation becomes the modified Streeter-Phelps equation as follows:

$$D(t) = \frac{K_1 L_o}{K_2 - K_1} \left(e^{-K_1 t} - e^{-K_2 t}\right) + \frac{K_n N_o}{K_2 - K_n} \left(e^{-K_n t} - e^{-K_2 t}\right) + D_o e^{-K_2 t}$$

Where:

$D(t)$ = DO deficit at time t.
D_o = Initial DO deficit.
L_o = Initial ultimate carbonaceous BOD.
N_o = Initial nitrogenous BOD.
K_1 = Carbonaceous deoxygenation rate constant.
K_n = Nitrogenous deoxygenation rate constant.
K_2 = Reaeration rate constant.

In this equation, the rates of oxygen utilization due to both carbonaceous and nitrogenous biochemical oxygen demands are expressed as first order reactions.

Ultimate BOD and ammonia nitrogen concentrations are calculated as follows:

$$L(t) = L_o e^{-K_1 t}$$

$$N(t) = N_o e^{-K_n t}$$

Where:

$L(t)$ = Ultimate carbonaceous BOD at time t.
$N(t)$ = Nitrogenous BOD at time t.

and nitrogenous oxygen demand (N) equals 4.5 times the ammonia nitrogen concentration.

Since nitrification is a two-step process, many researchers have proposed that it is a second order reaction, although no practical DO prediction equation has been developed in this form. Since nitrogenous biochemical oxygen demands are too great to ignore, most developed models assume that it is a first order reaction. The present investigation has also utilized this assumption.

Nitrifying bacteria are generally present in relatively small numbers in untreated wastewaters. The growth rate at 20° C (68° F) is such that the organisms do not exert an appreciable oxygen demand until about 8 to

10 days have elapsed. This lag period may be reduced or practically eliminated in a stream receiving large amounts of secondary effluent containing seed organisms. In biological treatment systems, substantial nitrification can take place with a resultant buildup of nitrifying organisms. These nitrifying bacteria can immediately begin to oxidize the ammonia nitrogen present and exert a significant oxygen demand in a stream.

In addition to dispersed bacteria, there can be considerable nitrification by nitrifying organisms that are attached to sediments, rocks, weeds, etc., along the stream bottom. These organisms oxidize the ammonia nitrogen in the stream as it passes by them. Such attached growths can build up below treatment plant discharges where the stream is enriched with ammonia nitrogen.

It is known that the nitrification biological process is generally more sensitive to environmental conditions than carbonaceous decomposition. The optimal temperature range for growth and reproduction of nitrifying bacteria is 26° to 30° C (79° to 86° F). It is generally concluded that the nitrogenous BOD will assume greatest importance in small streams which receive relatively large volumes of secondary wastewater effluents, and during the low flow, warm weather periods of the year (August and September). These conditions were utilized for the low flow determination of allowable effluent characteristics during summer periods. During winter low flow periods (January and February), nitrification will probably have limited influence upon the oxygen demand due to the intolerance of the nitrifying bacteria to low temperatures; thus, for winter conditions, it was assumed nitrification did not occur.

To assume that nitrification, during summer conditions, proceeds immediately following a wastewater discharge, and simultaneously with carbonaceous oxidation, is to generally assume the worst possible conditions in regards to downstream dissolved oxygen concentrations. Therefore, waste load allocations identified in this manner will generally be on the conservative side.

In addition, to assume no nitrification occurs during winter flow conditions is to treat ammonia nitrogen as a conservative (nondegrading) pollutant.

In many streams during winter conditions, the water quality criteria of 2 mg/l of ammonia nitrogen becomes the determining factor in waste load allocations. During summer conditions, the critical water quality factor is generally dissolved oxygen.

Rate Constant Determination - The carbonaceous deoxygenation rate constant (K_1) for most streams will vary from 0.1 to 0.5 per day. Early work by Streeter and Phelps determined an average value for the Ohio River of 0.23/day (0.1/day, base 10). This value has been accepted and commonly used for years with reasonable results.

Deoxygenation rates higher than 0.23/day have been reported for various streams in the United States. No measurements of deoxygenation rates for the streams under investigation are available. For this study a carbonaceous deoxygenation rate of 0.2/day (base e) was used. Field measurements of typical deoxygenation rates for streams in Iowa are needed to verify this value and would greatly improve the predictability of the modeling.

Information on nitrogenous deoxygenation rates is extremely limited. Available information indicates that nitrification rates (when active nitrification does occur) are somewhat greater than carbonaceous oxidation rates. Therefore a nitrogenous deoxygenation rate (K_n) of 0.3/day (base e) was selected for the study. Again, field measurements of typical nitrogenous deoxygenation rates in Iowa streams would greatly enhance the accuracy of the modeling effort.

Many predictive formulations have been used for stream reaeration. For this study, reaeration rate constants were predicted by a method developed by Tsivoglou ("Characterization of Stream Reaeration Capacity," Tsivoglou and Wallace, EPA-R3-72-012, October, 1972). Tsivoglou's method is based on the premise that the reaeration capacity of nontidal fresh water streams is directly related to the energy expended by the flowing water, which in turn is directly related to the change in water surface elevation.

The change in water surface elevation divided by the time of flow is the average rate of energy expenditure. This relationship is expressed by:

$$K_2 = 0.048\ (\frac{h}{t})\ @\ 20°\ C$$

Where:

K_2 = Reaeration rate constant (base e) per day.

h = Water surface elevation change in feet.

t = Time of flow in days.

Tsivoglou's method was derived from actual measurement of stream reaeration rates by a new field tracer procedure in which a radioactive form of the noble gas krypton serves as a tracer for oxygen.

The reaeration rate predictive model has been verified for streams ranging in flow from 5 to 3,000 cfs. It can also be used to quite accurately predict reaeration effects of dams and waterfalls.

In development of Tsivoglou's procedure, other reaeration rate predictive formulas were compared with results obtained from the field tracer technique, but none appeared to predict stream reaeration rates as accurately as the Tsivoglou model.

Under winter ice conditions, the reaeration rate constant is reduced in direct proportion to the percentage of ice cover up to 95 percent. For instance, if it is estimated that there is 90 percent ice cover, then the reaeration rate constant is reduced by 90 percent. With 100 percent ice cover, the reaeration rate is reduced only by 95 percent, for it is estimated that there will always be a small amount of reaeration taking place.

Temperature corrections for the carbonaceous and nitrogenous deoxygenation rate constants and also the reaeration rate constants are subroutines within the computer model. The following formulations define the specific temperature corrections utilized in the program:

$$K_{1(T)} = K_{1(20)} \times 1.047^{T-20}$$

$$K_{2(T)} = K_{2(20)} \times 1.0241^{T-20}$$

$$K_{n(T)} = K_{n(20)} \times (0.058T - 0.16) \qquad T > 3°\ C$$

Where T = water temperature, ° C.

Temperature corrections for K_1 and K_2 are generally accepted formulations. Information on the effects of temperature on K_n is lacking. The formula given was derived from information on temperature effects on nitrification rates in biological treatment systems. The formula predicts nitrification rates of zero at approximately 3° C (37° F). The rate constant is set to zero at all temperatures below 3° C (37° F).

The principal factor affecting the solubility of oxygen is the water temperature. Dissolved oxygen saturation values at various temperatures are calculated as follows:

$$C_s = 24.89 - 0.426t + 0.00373t^2 - 0.0000133t^3$$

Where:

t = Water temperature, ° F.

C_s = Saturation value for oxygen at temperature, t (° F), at standard pressure.

Stream Velocity Calculations - Stream velocities are important in determining reaeration rates and the downstream dispersion of pollutants. The computer model utilized calculates velocity based on a variation of the Manning formula for open channel flow. The Manning formula for open channel flow is:

$$v = \frac{1.5R^{2/3}S^{1/2}}{n}$$

Where:

v = Velocity, fps.

R = Hydraulic radius, ft = wetted perimeter/cross sectional area which approximately equals the mean depth for rivers.

S = Channel slope, ft/ft.

n = Roughness coefficient.

By multiplying both sides of the equation by the cross sectional area, which is equal to the mean depth times the water surface width, and solving for the mean depth, the following relationship is obtained:

$$d = \left(\frac{Qn}{1.5WS^{1/2}}\right)^{3/5}$$

Where:

d = Mean river depth, ft.

Q = Discharge, cfs.

W = Water surface width, ft.

S = Slope, ft/ft.

n = Roughness coefficient.

Once mean depths were calculated, velocities were determined from the relationship:

$$v = Q/A = Q/W \cdot d$$

River slopes were obtained from existing profiles when available, but usually were taken from USGS topographic maps. Slopes obtained from USGS maps are rather generalized, and more accurate river profiles would greatly improve the accuracy of velocity determinations.

River widths and roughness coefficients were estimated from information obtained from field observations, and flow and cross section data at each USGS gaging station.

Computer Input and Output Data - In order to calculate water quality at various points in the river, the river length to be modeled was divided into reaches. River characteristics such as mean velocities and depths, river widths, deoxygenation and reaeration rate constants, and water temperature were considered constant for each reach. The location of the reaches was set by one or more of the following:

1. A tributary.
2. A wastewater discharge.
3. A change in river characteristics such as river width or slope.
4. A dam.

In order to calculate water quality characteristics at various points within each reach, the reaches were divided into segments called sections.

Mixing and dispersion assumptions inherent in the model are:

1. Complete and instantaneous mixing of wastewater and tributary flows with the main river flow.
2. Uniform lateral and logitudinal dispersion (plug flow) of the stream constituents as they move downstream.

Flows that could not be allocated to tributary inflows or wastewater discharges were distributed uniformly along the main river stem and are called groundwater contributions.

Actual data input into the computer program are as follows:

1. Initial river conditions such as flow and concentrations of ultimate carbonaceous BOD, ammonia nitrogen, and DO.
2. Uniform groundwater contributions for each reach and concentrations of ultimate carbonaceous BOD, ammonia nitrogen, and DO.
3. The number of reaches and the following for each reach:
    a. Length.
    b. Number of sections.
    c. Water temperature.
    d. Channel slope.
    e. River width.
    f. Deoxygenation rate constants.
    g. Roughness coefficient.
4. Wastewater or tributary inflows consisting of inflow rates, ultimate carbonaceous BOD, ammonia nitrogen, and DO concentrations.

After calculations, computer output data consists of the following for each reach:

1. Mean river velocities.
2. Mean river depths.
3. Reaeration rate constants.
4. Temperature corrected reaeration and deoxygenation rate constants.
5. Saturation DO concentrations for the given temperature.

and the following at the beginning of every section within a reach:

1. Summation of the river miles evaluated.
2. Cumulative discharge.
3. Cumulative travel time in days.
4. Ammonia nitrogen concentrations.
5. Ultimate carbonaceous BOD concentrations.
6. DO concentrations.
7. DO deficits.

PART VI

WASTE LOAD ALLOCATIONS

Utilizing the previously defined computer methodology, waste load allocations required for dischargers to meet state water quality standards within the Cedar River study area were determined. The evaluation procedure considered the situation with 1990 wastewater discharges under both summer and winter low flow conditions. The following sections describe specific results for these evaluations and a tabulation of the waste load allocation for each discharger is presented for both summer and winter conditions. Analyses were conducted for all streams with a water quality classification and a wastewater discharger.

Evaluation Assumptions

In order to define waste load allocations for dischargers within the Cedar River Basin, specific assumptions are required. Identification of the major items required to evaluate and determine waste load allocations are identified in the following list.

1. The major objective of the present investigation is to satisfy Iowa Water Quality Standards with future effluent discharges. Determination of allowable effluent concentrations was based upon varying the effluent quality from point source discharges until the model maintained dissolved oxygen concentrations above 5.0 mg/l and ammonia nitrogen concentrations below 2.0 mg/l in all water quality classified sections of the streams. Because NPDES permits are requiring dischargers with stabilization ponds to utilize controlled discharge of the effluent, no discharge from stabilization pond treatment facilities to the stream was assumed for the low flow conditions.
2. Definition of 7-day, 1-in-10 year low flow was required for each stream modeled. For all streams within the study area, the low flow exceeded the total present average daily wastewater discharges from all entities within their respective basins. The difference between the 7-day, 1-in-10 year low flow and the wastewater

discharges was assumed to be the result of groundwater inflow to the stream. This amount of groundwater inflow was assumed to remain constant over the planning period. Since most wastewater discharges will increase during this time period, the 7-day, 1-in-10 year low flow in 1990 is greater by the amount of this increase. Groundwater contribution to the stream flow was distributed throughout the drainage basin in relationship to the area contributing to the stream along the length of the channel. Values of 4.0 mg/l BOD$_5$, 0.0 mg/l ammonia nitrogen, and 2.0 mg/l dissolved oxygen concentrations were assumed as the water quality of the groundwater contribution.

3. Ultimate carbonaceous BOD was assumed to be 1.5 times the BOD$_5$.
4. Since no data are available describing effluent dissolved oxygen concentrations or temperatures, the following values were assumed for each class of wastewater discharge.

	Summer Condition			Winter Condition		
Discharger	Dissolved Oxygen	Temperature		Dissolved Oxygen	Temperature	
	(mg/l)	(°C)	(°F)	(mg/l)	(°C)	(°F)
Trickling Filter	3.0	20	68	4.0	9	48
Activated Sludge	3.0	20	68	4.0	9	48
Industrial	Each Discharger Handled Individually					

5. In order to assess the reaeration rate constants under wintertime conditions, the amount of ice cover on the stream was estimated. Then the winter reaeration rate constant for each reach of the stream was determined by multiplying the predicted constant by the percentage of open water in the reach. Ice cover estimates were based upon general climatological conditions for the basin and upon personal observations of persons familiar with the area. Complete ice cover was assumed to be non-coincidental with the 7-day, 1-in-10 year low flow.
6. Deoxygenation rate coefficients were assumed to be 0.2/day for carbonaceous demand and 0.3/day for nitrogenous demand.

7. Best practicable waste treatment technology (BPWTT) effluent limitations described by EPA guidelines were utilized for industrial discharges when available. Otherwise, the actual allowable waste load which could be discharged into the stream was determined and identified as the waste load allocation for that discharger.
8. Tributaries (without wastewater sources) discharging to the streams being modeled were assumed to have saturated dissolved oxygen concentrations, an ultimate BOD of 6.0 mg/l and ammonia nitrogen concentrations of 0.0 mg/l in the summer and 0.5 mg/l in the winter.
9. There are a number of impoundments on the Cedar River and its tributaries. Computer modeling through some of the impoundments is possible. In general, impoundments deep enough for thermal stratification to occur were not included in the model. Whenever an impoundment is not included in the model, the model ends at the upper end of the impoundment and resumes just downstream of the dam. Specific assumptions for each situation are:
   a. When the model is interrupted by a thermally stratified impoundment, summer conditions assume water quality below the dam to have saturated dissolved oxygen concentrations, 0.0 mg/l ammonia nitrogen, and an ultimate BOD of 10 mg/l. The higher BOD concentration is considered to be the result of an increase of algal cells within the stream. Under winter conditions, dissolved oxygen is assumed to be at 80 percent of saturation, while ammonia nitrogen and BOD concentrations remain the same as those in the stream entering the upper end of the impoundment. Due to low temperatures, no reduction in ammonia nitrogen or BOD through the impoundment is assumed under winter conditions.
   b. Modeling through an impoundment requires an estimate of the water surface profile along the stream reach of the impoundment. Width upstream is also increased through the impoundment

reach. The dam is assumed to take up a reach of stream equal to 0.001 miles with a change in head equal to the height of the dam. This results in a high reaeration rate constant for the stream flow over the dam.

Discussion of Results

The waste load allocations are based upon a computer model that utilizes the best available information for the Cedar River Basin study area. Some of the input data provided are approximations and model predictability could be considerably improved with more accurate field information. Based on the available data, the model computes stream quality for the assigned wastewater discharges. For the initial run, all discharges were assumed to meet either secondary treatment (municipalities) or best practicable treatment (BPT) (industries). Where the model indicated violation of IDEQ stream quality criteria, more stringent effluent requirements were imposed until satisfactory levels were obtained. Whenever more than one entity was required to meet more stringent effluent limitations in a particular stream reach to maintain quality, approximately the same requirements were established for all the entities regardless of size or whether they were municipal or industrial dischargers. Other possible combinations of effluent limitations on BOD, ammonia nitrogen, and dissolved oxygen could result in meeting stream quality criteria.

Waste load allocations for the Cedar River, Black Hawk Creek, and Wolf Creek are required. To properly assess the effect of tributary water quality upon the water quality of the Cedar River, it was necessary to also analyze other major tributaries to the Cedar River. The additional streams which have been modeled are West Fork Cedar River, Shell Rock River, Winnebago River (Lime Creek), Little Cedar River, and Beaver Creek.

Summer Conditions - The upper limit for wastewater discharges is secondary treatment for municipal dischargers and BPT for industrial dischargers. IDEQ has set the allowable ammonia nitrogen level for secondary treatment as 10 mg/l in summer.

Winnebago River (Lime Creek) - Waste load allocations for each discharger for summer conditions are given in Table 21. The computer modeling began with Forest City, the furthest upstream discharger in Iowa, and continued to the confluence of the Winnebago River with the Shell Rock River. The community of Emmons, Minnesota discharges treated wastewater to a stream which is tributary to the Winnebago River (Lime Creek) just north of the Iowa-Minnesota border. The effect of this wastewater discharge upon the stream water quality just above Forest City has been incorporated into the model. It is assumed that the wastewater discharge from Emmons will be given a waste load allocation that meets stream water quality standards.

Dissolved oxygen concentration profiles for Beaver Creek and Winnebago River (Lime Creek) for 1990 discharges are shown on Figure 9. Profiles are shown for both secondary treatment conditions and waste load allocations. Violations of the 5.0 mg/l dissolved oxygen criteria occur under secondary treatment discharge conditions.

Summer ammonia nitrogen concentrations for both streams are shown on Figure 10. Better than secondary level removals of ammonia nitrogen are required to meet the stream quality criteria of 2.0 mg/l for all classified sections of the streams.

To meet water quality criteria under summer low flow conditions the communities of Forest City, Lake Mills, and Mason City must provide better than secondary treatment with nitrification. Because of the extremely stringent waste load allocations necessary for Forest City, further study of water quality in the Winnebago River below Forest City under low flow conditions is recommended.

Shell Rock River - The entire length of the Shell Rock River within the state of Iowa is water quality classified. The 7-day, 1-in-10 year low flow in the stream is much greater than any of the wastewater discharges and secondary treatment easily meets stream quality criteria. Waste load allocations for 1990 flows are given in Table 21. Water quality of the Shell Rock River entering Iowa has been assumed to be the same as in Item 8,

TABLE 21

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 SUMMER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Cedar River							
Deer Creek							
Carpenter (M-9)		---	No Existing Municipal Facility				
Cedar River							
St. Ansgar (M-67)		0	Controlled Discharge				
Mitchell (M-51)		---	No Existing Municipal Facility				
Sugar Creek							
Osage (M-57)	18.46	0.340	45[3]	128	10[3]	28	3.0
Cedar River							
Floyd (M-24)		0	Controlled Discharge				
Charles City (M-11)	24.44	1.823	45[3]	684	10[3]	152	3.0
Charles City Water Treatment Plant (I-9)		0	No Discharge				
Little Cedar River							
Stacyville (M-71)	0.78	0.027	45[3]	10	10[3]	2	3.0
Colwell (M-14)		---	No Existing Municipal Facility				
Bassett (M-6)		0	Controlled Discharge				

TABLE 21 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 SUMMER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Little Cedar River (cont.)							
Martin Marietta Corp. Boice Quarry (I-32)				No Discharge Limitations Necessary[4]			
Martin Marietta Corp. Boevers Pit (I-31)				No Discharge Limitations Necessary[4]			
Cedar River							
Nashua (M-53)	27.56	0.135	45[3]	51	10[3]	11	3.0
Martin Marietta Corp. Ernivine Quarry (I-34)				No Discharge Limitations Necessary[4]			
Plainfield (M-59)		0		Controlled Discharge			
Carnation Co. (I-6)				No Discharge Limitations Necessary[4]			
Waverly (M-79)	30.32	0.665	45[3]	250	10[3]	55	3.0
Quarter Section Run							
Denver (M-17)		0		Controlled Discharge			
Cedar River							
Janesville (M-38)	32.62	0.039	45[3]	15	10[3]	3	3.0

TABLE 21 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 SUMMER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
West Fork Cedar River							
Beaverdam Creek							
Clear Lake Sanitary District (M-13)	0.00	2.153	20	259	5	90	3.0
Drainage Ditch #92							
Swaledale (M-73)		0	Controlled Discharge				
Beaverdam Creek							
Welp & McCarten, Inc. Swaledale Quarry (I-52)			No Discharge Limitations Necessary[4]				
East Branch Beaverdam Creek							
Rockwell (M-65)	2.62	0.097	45	36	10	8	3.0
Bailey Creek							
Meservey (M-50)		0	Controlled Discharge				
Thornton (M-76)		0	Controlled Discharge				
Sheffield (M-69)		0	Controlled Discharge				
West Fork Cedar River							
Dumont (M-20)		0	Controlled Discharge				

TABLE 21 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 SUMMER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Hartgrave Creek							
Spring Creek							
Alexander (M-2)		---		No Existing Municipal Facility			
Latimer (M-44)		---		No Existing Municipal Facility			
Otter Creek							
Hansell (M-35)		---		No Existing Municipal Facility			
Squaw Creek							
Hampton (M-33)	0.933	0.425	45[3]	160	9	32	3.0
Beeds Lake State Park (S-1)		0		Controlled Discharge			
Terrace Hill Sanitary District (S-11)				No Discharge Data Available			
Boylan Creek							
Aredale (M-5)		---		No Existing Municipal Facility			
Bristow (M-8)		---		No Existing Municipal Facility			
Maynes Creek							
Coulter (M-16)		---		No Existing Municipal Facility			
Geneva (M-27)		---		No Existing Municipal Facility			
Hallett Construction (I-22)				No Discharge Limitations Necessary[4]			
Weaver Construction Co. Hibness Quarry (I-48)				No Discharge Limitations Necessary[4]			

TABLE 21 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 SUMMER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Unnamed Creek							
Greene Limestone Co. Burns Quarry (I-17)			No Discharge Limitations Necessary[4]				
Feddeke Creek							
Allison (M-3)		0	Controlled Discharge				
Shell Rock River							
Northwood (M-55)	5.11	0.181	45[3]	68	10[3]	15	3.0
Kensett (M-41)		---	No Existing Municipal Facility				
Welp & McCarten, Inc. Kuemen Quarry (I-50)			No Discharge Limitations Necessary[4]				
Drainage Ditch #5							
Martin Marietta Corp. Randall Quarry (I-36)			No Discharge Limitations Necessary[4]				
Drainage Ditch #53							
Grafton (M-30)		0	Controlled Discharge				
Rose Creek							
Manley (M-47)		0	Controlled Discharge				
Shell Rock River							
Rockford (M-64)		0	Controlled Discharge				

TABLE 21 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 SUMMER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/1)	(1b/day)	(mg/1)	(1b/day)	(mg/1)
Winnebago River							
Drainage Ditch #18							
Scarville (M-68)		---		No Existing Municipal Facility			
Drainage Ditch #57							
Drainage Ditch #92							
Walker Manufacturing Co. (I-46)				No Discharge Limitations Necessary[4]			
Pike Run							
Thompson (M-74)		---		No Existing Municipal Facility			
Winnebago River							
Leland (M-45)		0		Controlled Discharge			
Forest City (M-25 & 26)	0.15	0.700	3	18	1	6	6.0
Winnebago Industries (I-53)				No Discharge Data Available			
Greenfield Estates Mobile Home Park (S-7)		---		To Municipal Treatment Facility			
Beaver Creek							
Lake Mills (M-42)	0.00	0.158	15	20	6	8	3.0
Winnebago County Home (S-13)				No Discharge Data Available			

TABLE 21 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 SUMMER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Winnebago River							
Fertile (M-23)		0	Controlled Discharge				
Winans Creek							
Hanlontown (M-34)		---	No Existing Municipal Facility				
Winnebago River							
P & M Stone Co., Inc. (I-43)			No Discharge Limitations Necessary[4]				
Welp & McCarten, Inc. Strickler Quarry (I-51)			No Discharge Limitations Necessary[4]				
Northwestern States Portland Cement Co. (I-39)			No Discharge Limitations Necessary[4]				
Calmus Creek							
Lehigh Portland Cement Co. (I-29)			No Discharge Limitations Necessary[4]				
Winnebago River							
Weaver Construction Co. & Mason City Sand Plant (I-49)			No Discharge Limitations Necessary[4]				
Armour & Co. (I-3)			To Municipal Treatment Facility				
Hebel Fertilizer & Chemical Co. (I-23)			To Municipal Treatment Facility				

TABLE 21 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 SUMMER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Willow Creek							
Interstate Power Co. (I-24)				No Discharge Limitations Necessary[4]			
Winnebago River							
Mason City (M-49)	3.48	6.510	7.5	271.3=BOD5 407	3.0	163	3.0
Allied Mills (I-2)	9.99	0.026	7.5	2	3.0	1	3.0
Libby Owens Ford (I-30)				To Municipal Treatment Facility			
Chicago, Milwaukee, St. Paul & Pacific R.R. (I-10)				No Discharge Limitations Necessary[4]			
Martin Marietta Corp. Portland Quarry (I-35)				No Discharge Limitations Necessary[4]			
Greene Limestone Co. Portland Quarry (I-19)				No Discharge Limitations Necessary[4]			
Shell Rock River							
Marble Rock (M-48)		0			Controlled Discharge		
Greene (M-31)	17.61	0.116	45[3]	44	10[3]	10	3.0
Greene Rendering (I-20)		0			Controlled Discharge		
Farmers Co-op Creamery (I-16)	17.61	0.002	45[3]	1	10[3]	0.2	3.0

TABLE 21 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 SUMMER CONDITION

Discharger (Ref. No.)	Stream Flow^1	1990 Discharge	Ultimate BOD^2		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Coldwater Creek							
Palmer Creek							
Greene Limestone Co. Lubben Quarry (I-18)			No Discharge Limitations Necessary^4				
Coldwater Creek							
Dougherty (M-19)		---	No Existing Municipal Facility				
Flood Creek							
Rudd (M-66)		0	Controlled Discharge				
Shell Rock River							
Clarksville (M-12)		0	Controlled Discharge				
Shell Rock (M-70)	36.43	0.097	45^3	36	10^3	8	3.0
Cedar River							
Beaver Creek							
Ackley (M-1)	0.18	0.212	15	27	6	11	3.0
Ackley Food Processors, Inc. (I-1)			No Discharge Data Available				
Aplington (M-4)	0.87	0.062	15	8	6	3	3.0
South Beaver Creek							
Unnamed Creek							
Wellsburg (M-80)	0.31	0.045	45^3	17	10^3	4	3.0

TABLE 21 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 SUMMER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Beaver Creek							
Parkersburg (M-58)		0		Controlled Discharge			
New Hartford (M-54)		0		Controlled Discharge			
West Hills Housing Development (S-12)				No Discharge Data Available			
Cedar River							
Cedar Falls (M-10)	115.68	5.365	45[3]	2,013	10[3]	447	3.0
Viking Pump Co. (I-45)				No Discharge Data Available			
Cedar Falls Utilities (I-7)				To Municipal Treatment Facility			
Clay Equipment Corp. (I-12)				No Discharge Data Available			
Black Hawk Creek							
Holland Creek							
Holland (M-36)		0		Controlled Discharge			
Black Hawk Creek							
Grundy Center Water Treatment Plant (I-21)		---		No Discharge			
Grundy Center (M-32)	0.31	0.472	3	12	2	8	3.0
Mid-Equipment Co. (I-38)		0		Controlled Discharge			
Morrison (M-52)		---		No Existing Municipal Facility			

TABLE 21 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 SUMMER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Mosquito Creek							
Unnamed Creek							
Lincoln (M-46)		0		Controlled Discharge			
Black Hawk Creek							
Reinbeck (M-62)	1.00	0.300	3	8	2	5	3.0
North Fork Black Hawk Creek							
Stout (M-72)		---	No Existing Municipal Facility				
Dike (M-18)	1.38	0.094	45[3]	35	10[3]	8	3.0
Black Hawk Creek							
Ogden-Waterloo 26" Main Line Loop (I-40)			No Discharge Limitations Necessary[4]				
Hudson (M-37)	1.99	0.286	45	107	10	24	3.0
Dietrick Mobile Home Park (S-5)			No Discharge Data Available				
Deere & Co. (I-14)			No Discharge Data Available				
Cedar River							
John Deere & Co. (I-26)			Only BPT Required				
Engineered Equipment Co. (I-15)			No Discharge Limitations Necessary[4]				
Waterloo Industries (I-47)			No Discharge Data Available				

TABLE 21 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 SUMMER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Cedar River (cont.)							
Rath Packing Co. (I-44)			No Discharge Limitations Necessary[4]				
Pepsi Cola Bottling Co. (I-42)	152.84	0.017	45[3]	6	10[3]	1	3.0
Iowa Public Service Co. (I-25)			No Discharge Limitations Necessary[4]				
C. W. Shirey Co. (I-13)			No Discharge Data Available				
Waterloo (M-78)	152.89	21.720	45[3]	8,152	10[3]	1,811	3.0
Construction Machinery Company (I-11)			No Discharge Limitations Necessary[4]				
Chamberlain Mfg. Co. (I-8)	174.61	4.72	45[3]	212	10[3]	47	3.0
Cedar Knoll Park (S-2)			No Discharge Data Available				
Elk Run Heights (M-21)	180.04	0.150	45[3]	56	10[3]	13	3.0
Elk Run School (S-6)	180.04	0.005	45[3]	2	10[3]	1	3.0
Elk Run							
Evansdale (M-22)	180.05	0.562	45[3]	211	10[3]	47	3.0
Martin Marietta Corp. Concrete Materials Division (I-33)			No Discharge Limitations Necessary[4]				

TABLE 21 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 SUMMER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Cedar River							
Gilbertville (M-28)	181.20	0.056	45[3]	21	10[3]	5	3.0
Millers Creek							
Oak Grove Mobile Home Park (S-10)		0	Controlled Discharge				
Wolf Creek							
Conrad (M-15)	0.16	0.058	6	3	5	2	3.0
Gladbrook (M-29)		0	Controlled Discharge				
Traer (M-75)	0.89	0.155	45[3]	58	10[3]	13	3.0
Martin Marietta Corp. Smith Quarry (I-37)			No Discharge Limitations Necessary[4]				
Hickory Hills Park (S-8)		0	Controlled Discharge				
La Porte City Water Treatment Plant (I-28)		---	No Discharge				
La Porte City (M-43)	1.86	0.271	45[3]	102	10[3]	23	3.0
Cedar River							
Rock Creek							
B. L. Anderson, Inc. Jabens Quarry (I-5)			No Discharge Limitations Necessary[4]				

TABLE 21 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 SUMMER CONDITION

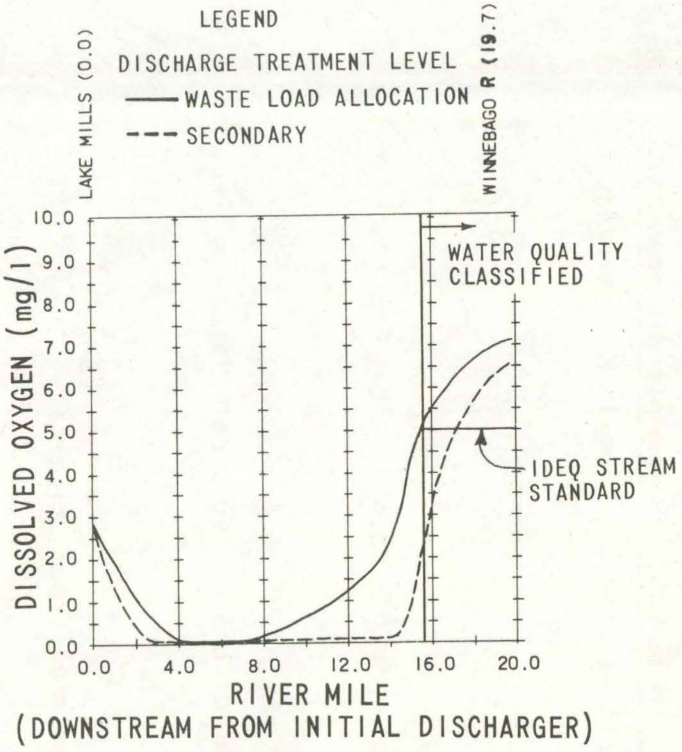
Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Spring Creek							
Jesup (M-39)	0.00	0.327	9	25	4.5	12	3.0
Paul Nieman Const. Bloom Quarry (I-41)			No Discharge Limitations Necessary[4]				

[1] Seven-day, 1-in-10 year low flow in stream just above point of discharge, if stream is classified, or flow of classified stream at confluence with tributary.

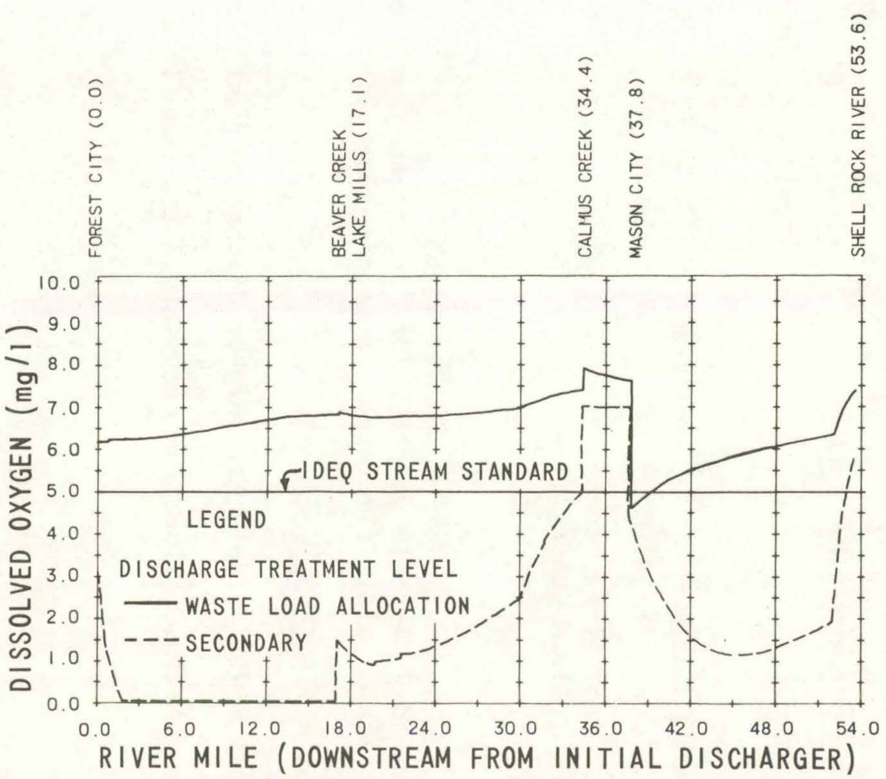
[2] UBOD = 1.5 (BOD_5).

[3] Meets BPWTT guidelines. Higher discharge quantities could satisfy stream criteria.

[4] No waste load allocation necessary. Low quantities of BOD and ammonia nitrogen in effluent.

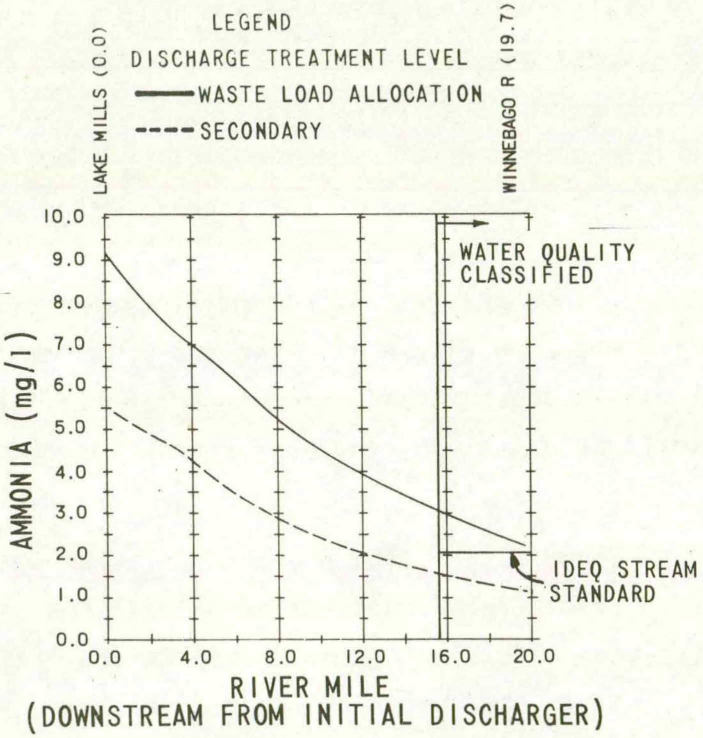


BEAVER CREEK

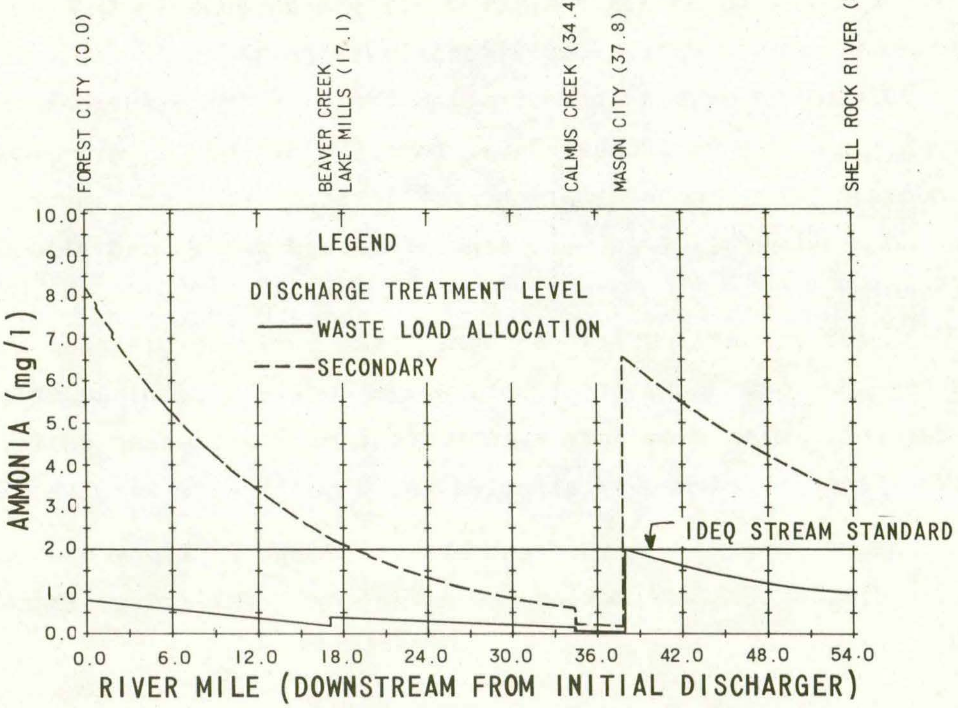


WINNEBAGO RIVER

FIGURE 9
DISSOLVED OXYGEN
CONCENTRATIONS
SUMMER CONDITIONS



BEAVER CREEK



WINNEBAGO RIVER

FIGURE 10
AMMONIA NITROGEN
CONCENTRATIONS
SUMMER CONDITIONS

page 89. In the past this has not always been the case, as is indicated in PART III - WATER QUALITY. Because of the large streamflow to wastewater discharge ratio on the Shell Rock River, the wastewater discharges will have little impact upon stream water quality. Under secondary treatment conditions, the Winnebago River (Lime Creek) has an adverse effect upon water quality in the Shell Rock River.

Dissolved oxygen and ammonia nitrogen concentration profiles for 1990 discharges are shown on Figure 11. Secondary wastewater treatment is sufficient for all wastewater discharges to the Shell Rock River. Impact of wastewater discharges upon the Marble Rock impoundment has not been analyzed.

West Fork Cedar River - There are a number of water quality classified tributaries to this stream. Waste load allocations necessary to maintain water quality standards within the tributaries have little impact upon water quality within the West Fork Cedar River.

The major wastewater dischargers are Hampton, discharging to Squaw Creek and then Hartgrave Creek, and Clear Lake Sanitary District, to Beaverdam Creek which becomes the West Fork Cedar River upon its confluence with Bailey Creek. Waste load allocations for both of the above dischargers are necessary to maintain water quality standards in the classified portions of the streams. Waste load allocations are given in Table 21.

Dissolved oxygen concentration profiles for Beaverdam Creek, Hartgrave Creek, and West Fork Cedar River for 1990 discharges are shown on Figure 12. Ammonia nitrogen concentration profiles are shown on Figure 13. Profiles for both secondary treatment conditions and waste load allocations are presented.

Under summer conditions, Clear Lake Sanitary District and Hampton require better than secondary treatment, while Rockwell requires only secondary treatment. With secondary treatment conditions, water quality in West Fork Cedar River is adversely affected until confluence with the Shell Rock River.

Beaver Creek - This stream has its mouth in Black Hawk County. Wastewater dischargers are Ackley and Aplington. Wellsburg discharges to a

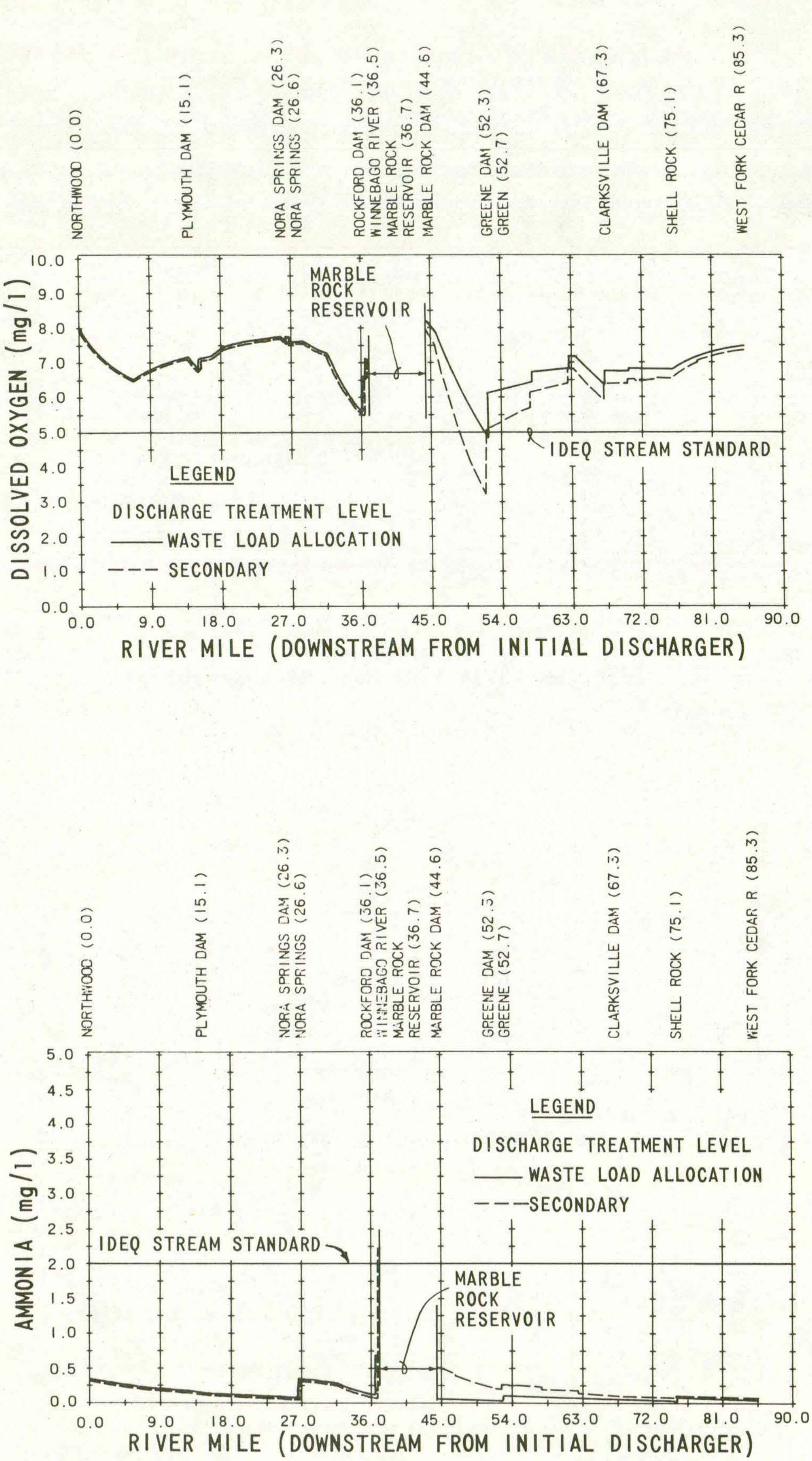
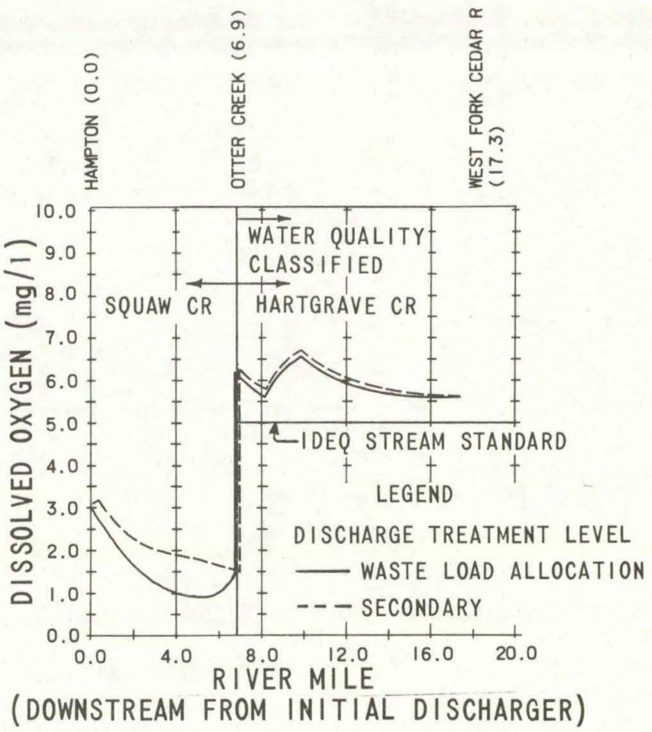
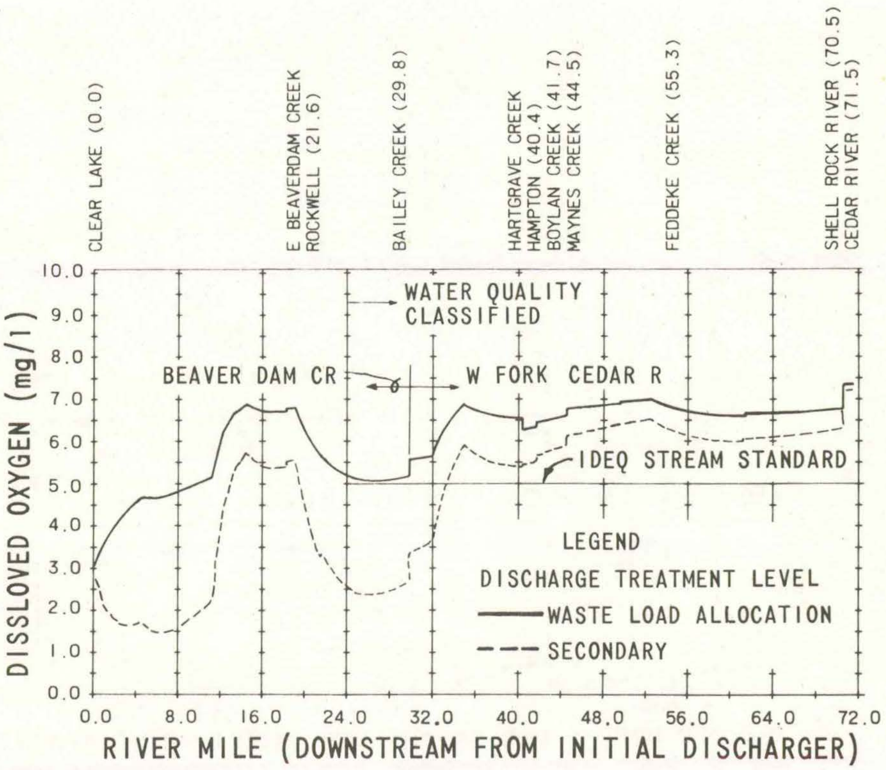


FIGURE 11
SHELL ROCK RIVER
SUMMER CONDITIONS

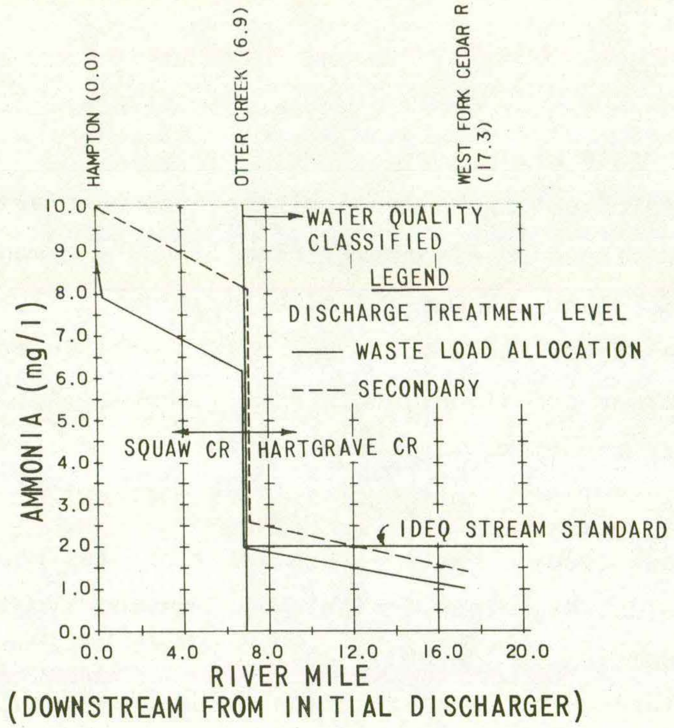


HARTGRAVE CREEK

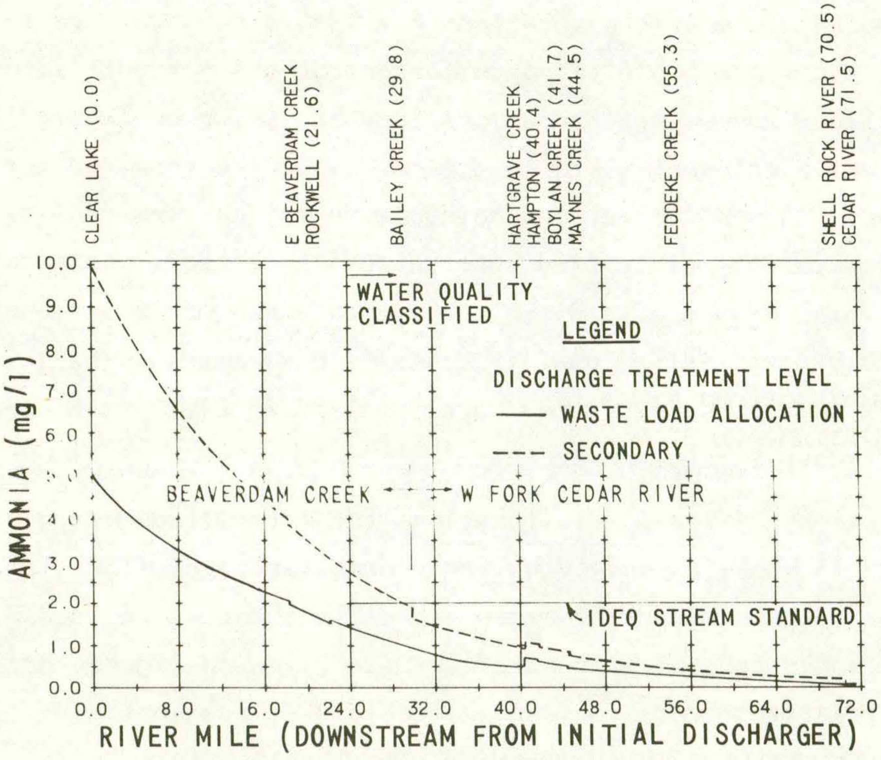


WEST FORK CEDAR RIVER

FIGURE 12
DISSOLVED OXYGEN
CONCENTRATIONS
SUMMER CONDITIONS



HARTGRAVE CREEK



WEST FORK CEDAR RIVER

FIGURE 13
AMMONIA NITROGEN
CONCENTRATIONS
SUMMER CONDITIONS

tributary, South Beaver Creek. Waste load allocations for these communities are given in Table 21.

Dissolved oxygen and ammonia nitrogen concentration profiles for 1990 discharges are shown on Figure 14. Profiles are given for both secondary treatment conditions and waste load allocations. Significant violations of stream quality criteria occur under secondary treatment conditions.

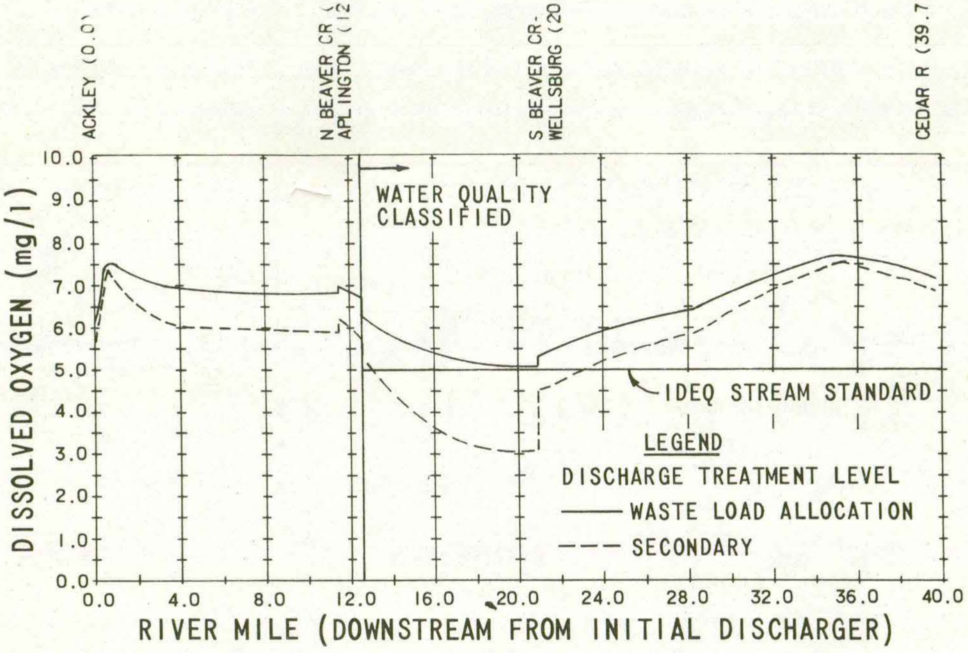
Under summer conditions, both Ackley and Aplington must provide better than secondary treatment level removals of BOD and ammonia nitrogen to meet stream quality criteria in the classified sections of the streams.

Black Hawk Creek - Waste load allocations for each discharger under summer conditions are given in Table 21. Seven-day, 1-in-10 year low flow for this stream is considerably smaller than for most other streams in the study area, taking into consideration size of drainage basins. The lower reaches of this stream pass through the Waterloo metropolitan area. While it is likely that the stream is being affected by urban nonpoint source discharges, no consideration of these discharges was made in the modeling procedure.

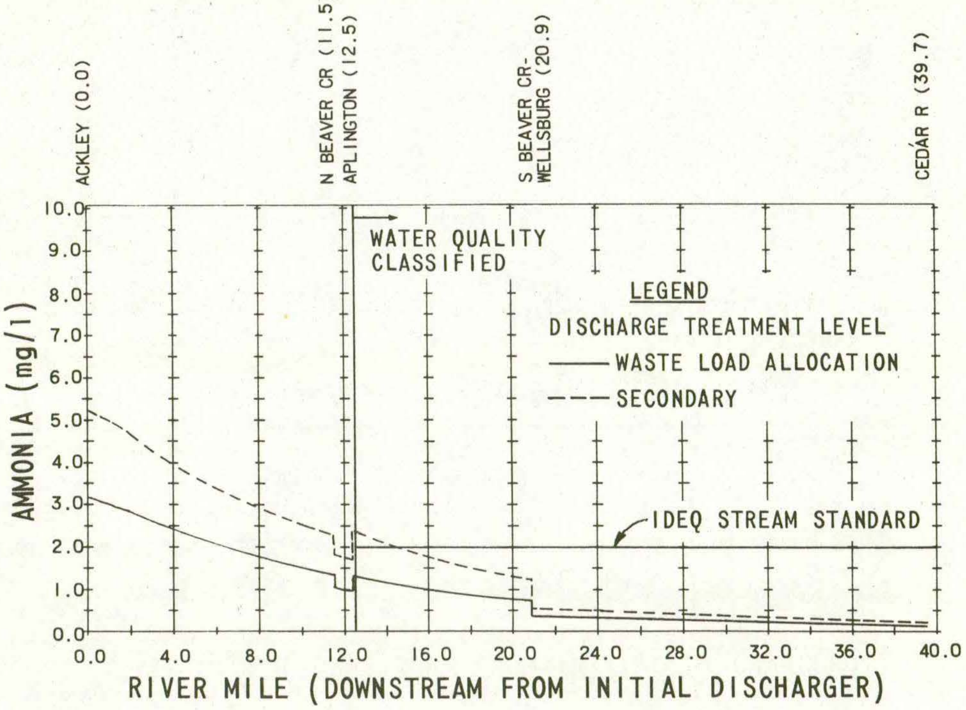
Dissolved oxygen concentration profiles for both secondary treatment conditions and waste load allocations for 1990 discharges are shown on Figure 15. Summer ammonia nitrogen concentrations for both secondary treatment conditions and waste load allocations are shown on Figure 16.

Extremely stringent waste load allocations are required for the communities of Grundy Center and Reinbeck to meet stream quality standards in all water quality classified sections of the stream. Secondary treatment wastewater discharges cause dissolved oxygen and ammonia nitrogen concentrations to violate stream quality criteria over most of the length of the stream. Further study of summer water quality in Black Hawk Creek under low flow conditions is recommended.

Wolf Creek - Waste load allocations for this stream are given in Table 21. Figure 15 shows dissolved oxygen concentration profiles for 1990 discharges for both secondary treatment conditions and waste load allocations. Ammonia nitrogen concentration profiles are given on Figure 16 for both secondary treatment conditions and waste load allocations.

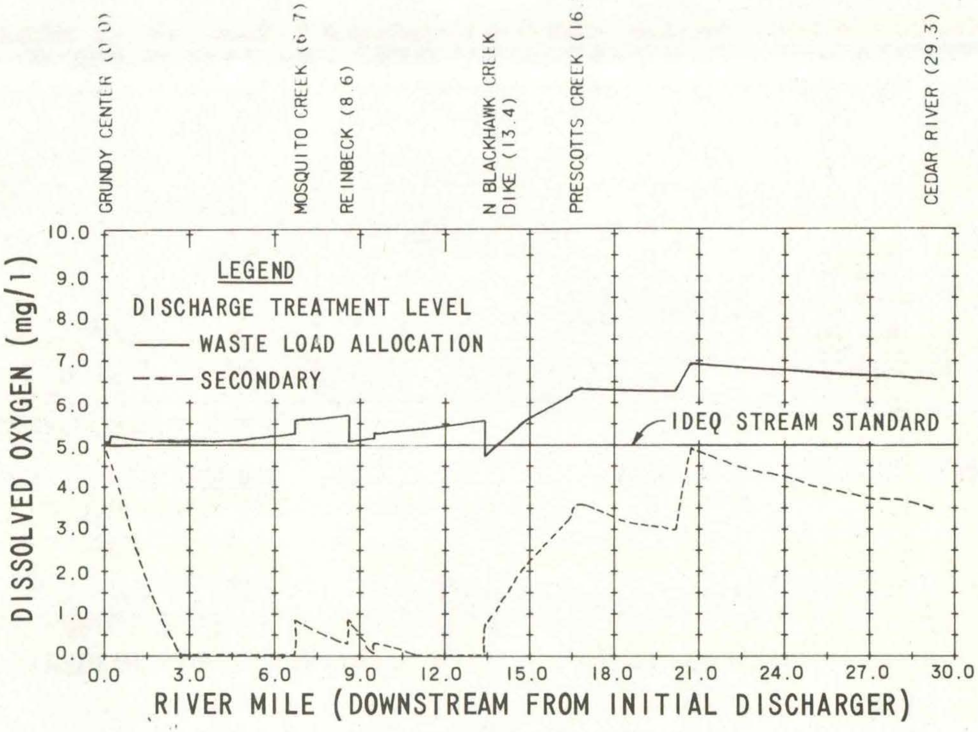


DISSOLVED OXYGEN CONCENTRATIONS

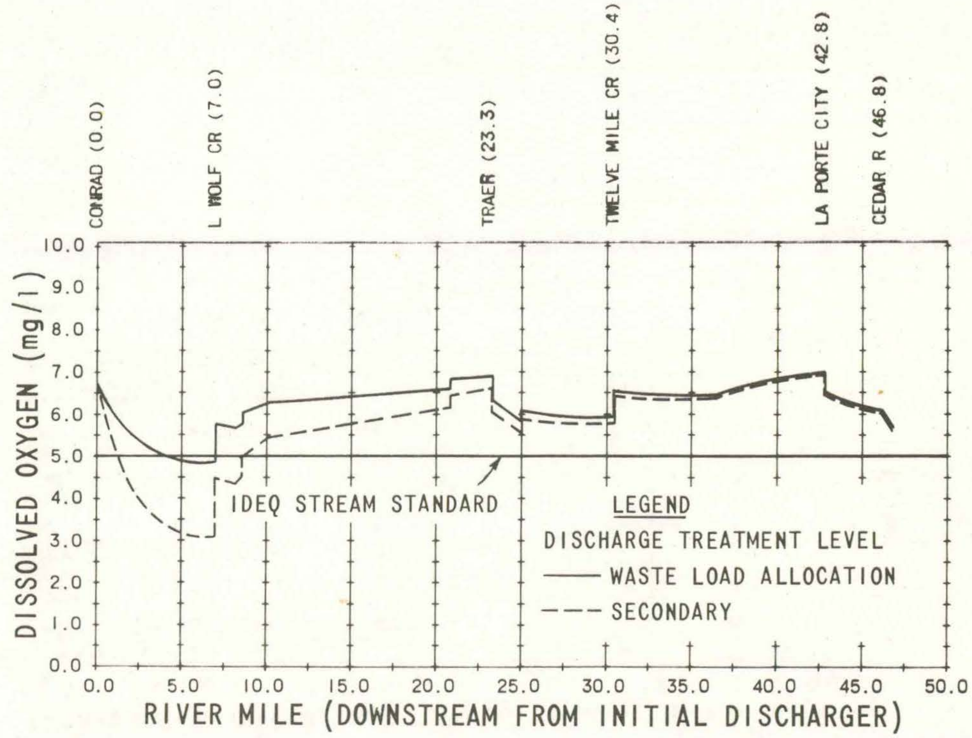


AMMONIA NITROGEN CONCENTRATIONS

FIGURE 14
BEAVER CREEK
SUMMER CONDITIONS

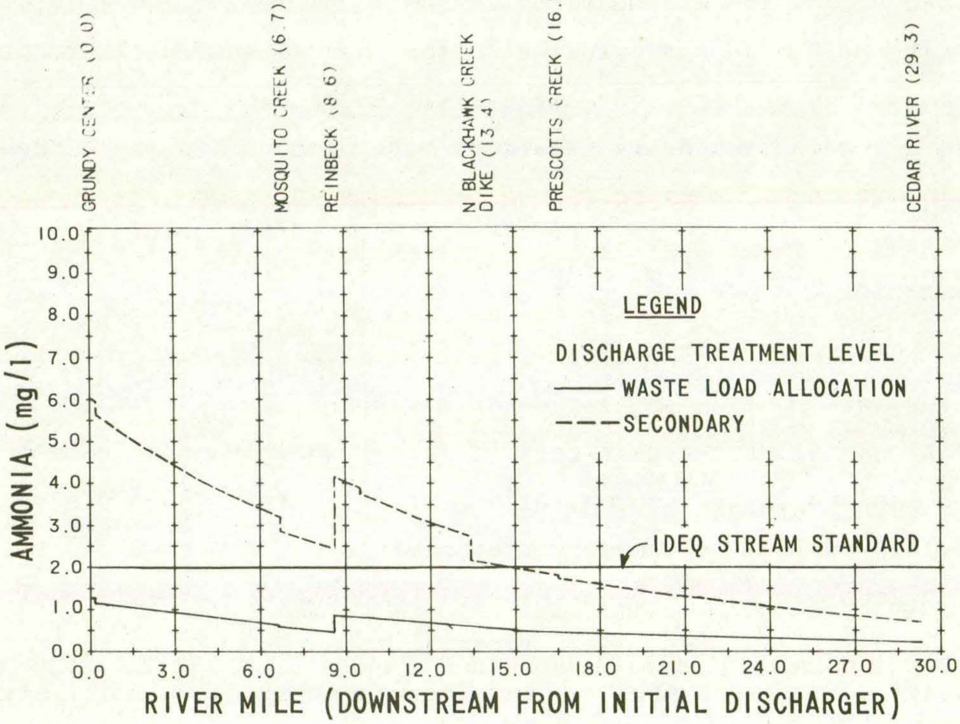


BLACK HAWK CREEK

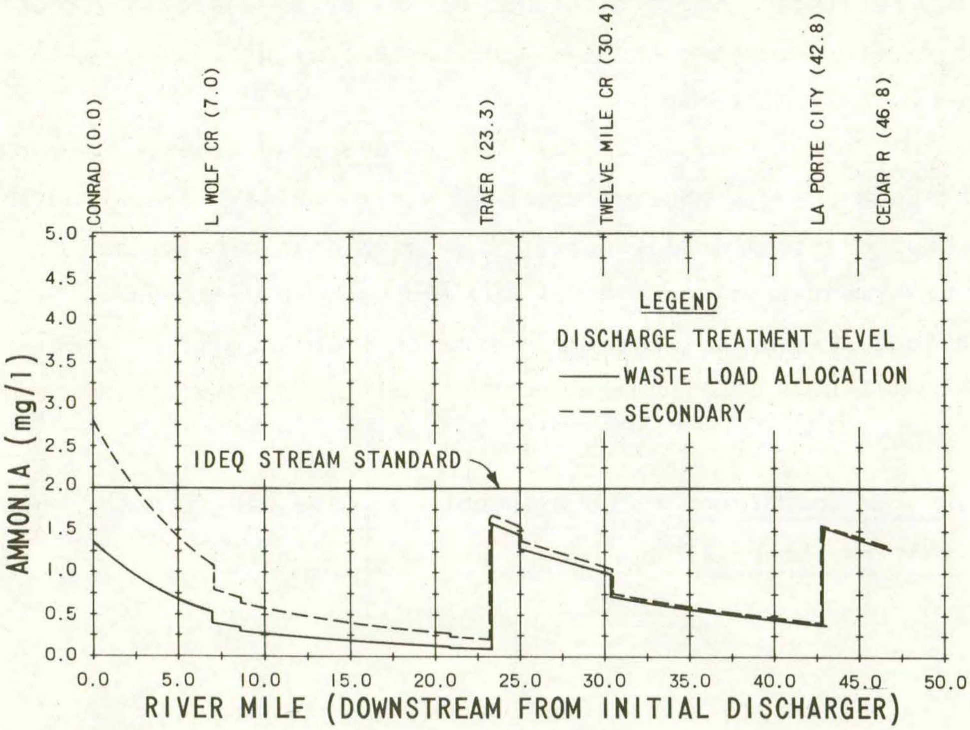


WOLF CREEK

FIGURE 15
DISSOLVED OXYGEN
CONCENTRATIONS
SUMMER CONDITIONS



BLACK HAWK CREEK



WOLF CREEK

FIGURE 16
AMMONIA NITROGEN
CONCENTRATIONS
SUMMER CONDITIONS

Because of low stream flows in the upper reaches of Wolf Creek, the community of Conrad must provide better than secondary treatment to meet stream quality criteria for all classified sections of the stream. Removal levels exceeding secondary treatment must be obtained for both BOD and ammonia nitrogen. Because the waste load allocations are stringent, further study of water quality in this stream under low flow conditions is recommended.

Cedar River - This stream is characterized by extremely large 7-day, 1-in-10 year low flow to wastewater discharge flow ratios. Waste load allocations for dischargers to this stream are given in Table 21.

Dissolved oxygen concentrations profiles for 1990 discharges are shown on Figure 17. Secondary treatment levels are required for wastewater discharges to the Cedar River. Secondary treatment level water quality for tributaries has an impact upon water quality in the Cedar River. The profile is interrupted for two impoundments which are likely to exhibit thermal stratification. The impact of the wastewater discharges upon water quality and eutrophication in any of the impoundments has not been assessed.

Summer ammonia nitrogen concentrations are shown on Figure 18. Secondary treatment level removals of ammonia nitrogen meet stream quality criteria. For those communities and industries discharging directly to the Cedar River, secondary treatment of wastewater discharges will easily meet stream quality criteria.

The community of Jesup discharges to Spring Creek, a minor tributary of the Cedar River. Spring Creek is water quality classified and, in order to meet the stream quality criteria, Jesup must provide better than secondary treatment level removal of BOD and ammonia nitrogen. The stringent waste load allocations required to meet stream quality criteria on Spring Creek warrant further study of water quality in this stream under low flow conditions.

Winter Conditions - The allowable ammonia nitrogen for secondary treatment has been set as 15 mg/l by IDEQ.

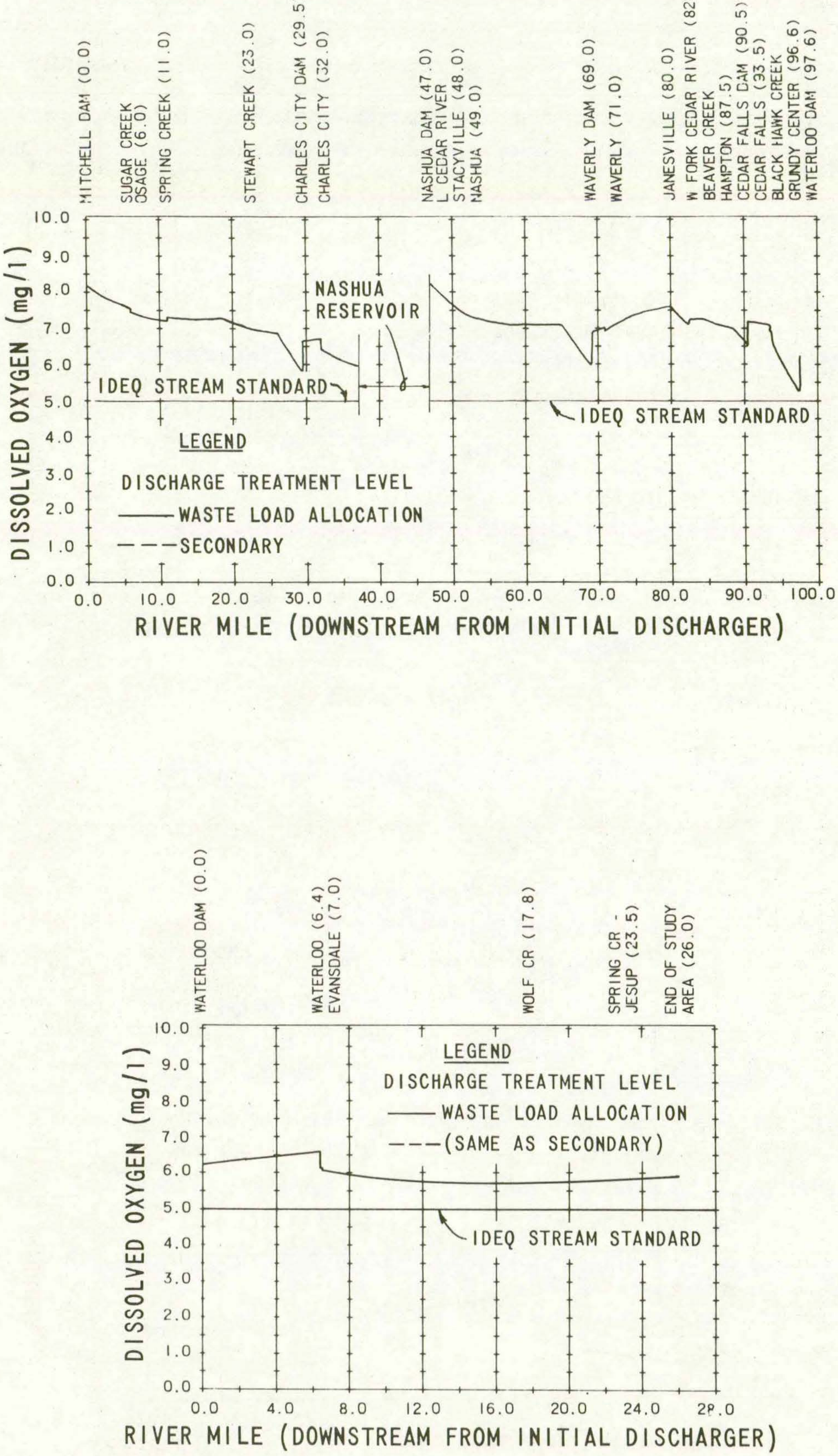


FIGURE 17
DISSOLVED OXYGEN
CONCENTRATIONS
CEDAR RIVER
SUMMER CONDITIONS

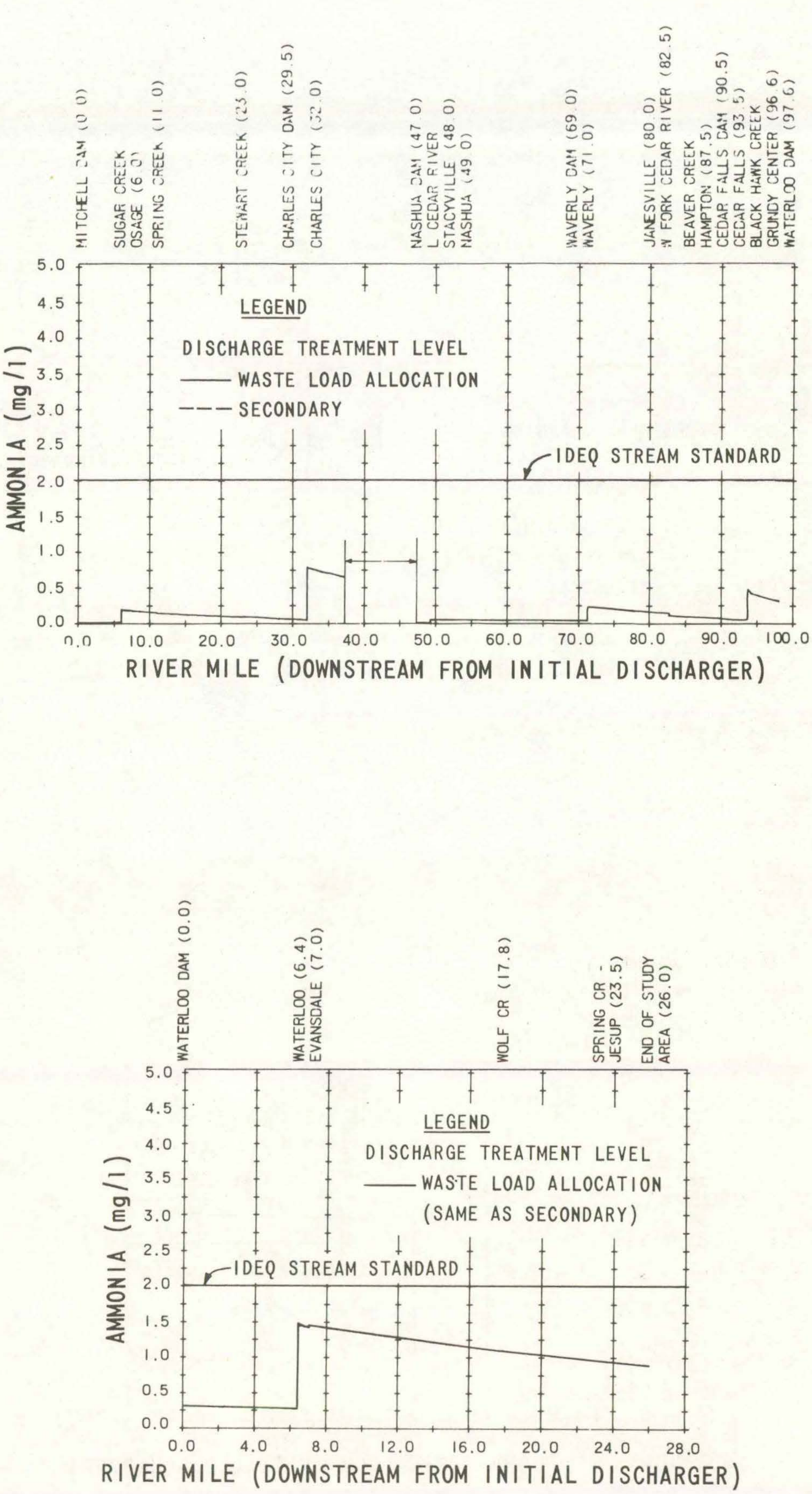


FIGURE 18
AMMONIA NITROGEN
CONCENTRATIONS
CEDAR RIVER
SUMMER CONDITIONS

Winnebago River (Lime Creek) - Waste load allocations for each discharger within the drainage basin study area of this stream for winter conditions are given in Table 22. The effect of Emmons, Minnesota, wastewater discharge has been taken into account as under summer conditions.

Winter dissolved oxygen concentration proviles for Beaver Creek and Winnebago River for 1990 discharges are shown on Figure 19 for secondary treatment conditions and waste load allocations. Ammonia nitrogen concentrations for both secondary treatment levels and waste load allocations are shown on Figure 20. Waste load allocations maintain stream criteria of 5.0 mg/l dissolved oxygen and less than 2.0 mg/l ammonia nitrogen, while secondary treatment conditions result in major violations of these criteria.

The communities of Forest City, Lake Mills, and Mason City have been assigned waste load allocations more stringet that secondary treatment. Lake Mills discharges to Beaver Creek, which is water quality classified for only a short distance from the mouth, but lowered winter reaeration rates and lack of ammonia nitorgen bio-oxidation require the waste load allocation to meet stream standards.

Shell Rock River - As under summer conditions, the large flow ratio of stream flow to wastewater discharges results in secondary treatment levels being sufficient to meet stream quality standards in all water quality classified sections of the stream. Upstream water quality assumptions are given under summer conditions. Waste load allocations for the Shell Rock River are given in Table 22.

Winter dissolved oxygen and ammonia nitrogen concentrations profiles for 1990 discharges are shown on Figure 21. Over most of the stream, profiles for secondary treatment and the waste load allocations are identical. At the point at which the Winnebago River (Lime Creek) meets the Shell Rock River, the effect of only secondary treatment within the Winnebago River (Lime Creek) basin upon the water quality of the Shell Rock River is clearly evident.

TABLE 22

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 WINTER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Cedar River							
Deer Creek							
Carpenter (M-9)		---	No Existing Municipal Facility				
Cedar River							
St. Ansgar (M-67)		0	Controlled Discharge				
Mitchell (M-51)		---	No Existing Municipal Facility				
Sugar Creek							
Osage (M-57)	18.46	0.340	45[3]	128	15[3]	43	4.0
Cedar River							
Floyd (M-24)		0	Controlled Discharge				
Charles City (M-11)	24.44	1.823	45[3]	684	15[3]	228	4.0
Charles City Water Treatment Plant (I-9)		0	No Discharge				
Little Cedar River							
Stacyville (M-71)	0.78	0.027	45[3]	10	15[3]	4	4.0
Colwell (M-14)		---	No Existing Municipal Facility				
Bassett (M-6)		0	Controlled Discharge				

TABLE 22 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 WINTER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Little Cedar River (cont.)							
Martin Marietta Corp. Boice Quarry (I-32)				No Discharge Limitations Necessary[4]			
Martin Marietta Corp. Boevers Pit (I-31)				No Discharge Limitations Necessary[4]			
Cedar River							
Nashua (M-53)	27.56	0.135	45[3]	51	15[3]	17	4.0
Martin Marietta Corp. Ernivine Quarry (I-34)				No Discharge Limitations Necessary[4]			
Plainfield (M-59)		0			Controlled Discharge		
Carnation Co. (I-6)				No Discharge Limitations Necessary[4]			
Waverly (M-79)	30.32	0.665	45[3]	250	15[3]	83	4.0
Quarter Section Run							
Denver (M-17)		0			Controlled Discharge		
Cedar River							
Janesville (M-38)	32.62	0.039	45[3]	15	15[3]	5	4.0

TABLE 22 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 WINTER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
West Fork Cedar River							
Beaverdam Creek							
Clear Lake Sanitary District (M-13)	0.00	2.153	3	54	2	36	4.0
Drainage Ditch #92							
Swaledale (M-73)		0		Controlled Discharge			
Beaverdam Creek							
Welp & McCarten, Inc. Swaledale Quarry (I-52)				No Discharge Limitations Necessary[4]			
East Branch Beaverdam Creek							
Rockwell (M-65)	2.62	0.097	45	36	15	12	4.0
Bailey Creek							
Meservey (M-50)		0		Controlled Discharge			
Thornton (M-76)		0		Controlled Discharge			
Sheffield (M-69)		0		Controlled Discharge			
West Fork Cedar River							
Dumont (M-20)		0		Controlled Discharge			

TABLE 22 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 WINTER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Hartgrave Creek							
Spring Creek							
Alexander (M-2)		---		No Existing Municipal Facility			
Latimer (M-44)		---		No Existing Municipal Facility			
Otter Creek							
Hansell (M-35)		---		No Existing Municipal Facility			
Squaw Creek							
Hampton (M-33)	0.993	0.425	45[3]	160	5	18	4.0
Beeds Lake State Park (S-1)		0		Controlled Discharge			
Terrace Hill Sanitary District (S-11)				No Discharge Data Available			
Boylan Creek							
Aredale (M-5)		---		No Existing Municipal Facility			
Bristow (M-8)		---		No Existing Municipal Facility			
Maynes Creek							
Coulter (M-16)		---		No Existing Municipal Facility			
Geneva (M-27)		---		No Existing Municipal Facility			
Hallett Construction (I-22)				No Discharge Limitations Necessary[4]			
Weaver Construction Co. Hibness Quarry (I-48)				No Discharge Limitations Necessary[4]			

TABLE 22 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 WINTER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
<u>Unnamed Creek</u>							
Greene Limestone Co. Burns Quarry (I-17)				No Discharge Limitations Necessary[4]			
<u>Feddeke Creek</u>							
Allison (M-3)		0		Controlled Discharge			
<u>Shell Rock River</u>							
Northwood (M-55)	5.11	0.181	45[3]	68	15[3]	23	4.0
Kensett (M-41)		---		No Existing Municipal Facility			
Welp & McCarten, Inc. Kuemen Quarry (I-50)				No Discharge Limitations Necessary[4]			
<u>Drainage Ditch #5</u>							
Martin Marietta Corp. Randall Quarry (I-36)				No Discharge Limitations Necessary[4]			
<u>Drainage Ditch #53</u>							
Grafton (M-30)		0		Controlled Discharge			
<u>Rose Creek</u>							
Manley (M-47)		0		Controlled Discharge			
<u>Shell Rock River</u>							
Rockford (M-64)		0		Controlled Discharge			

TABLE 22 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 WINTER CONDITION

Discharger (Ref. No.)	Stream Flow^1	1990 Discharge	Ultimate BOD^2		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Winnebago River							
Drainage Ditch #18							
Scarville (M-68)		---		No Existing Municipal Facility			
Drainage Ditch #57							
Drainage Ditch #92							
Walker Manufacturing Co. (I-46)				No Discharge Limitations Necessary^4			
Pike Run							
Thompson (M-74)		---		No Existing Municipal Facility			
Winnebago River							
Leland (M-45)		0			Controlled Discharge		
Forest City (M-25 & 26)	0.15	0.700	3	18	2	12	6.0
Winnebago Industries (I-53)				No Discharge Data Available			
Greenfield Estates Mobile Home Park (S-7)		---		To Municipal Treatment Facility			
Beaver Creek							
Lake Mills (M-42)	0.00	0.158	18	24	2.5	3	4.0
Winnebago County Home (S-13)				No Discharge Data Available			

TABLE 22 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 WINTER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Winnebago River							
Fertile (M-23)		0	Controlled Discharge				
Winans Creek							
Hanlontown (M-34)		---	No Existing Municipal Facility				
Winnebago River							
P & M Stone Co., Inc. (I-43)			No Discharge Limitations Necessary[4]				
Welp & McCarten, Inc. Strickler Quarry (I-51)			No Discharge Limitations Necessary[4]				
Northwestern States Portland Cement Co. (I-39)			No Discharge Limitations Necessary[4]				
Calmus Creek							
Lehigh Portland Cement Co. (I-29)			No Discharge Limitations Necessary[4]				
Winnebago River							
Weaver Construction Co. & Mason City Sand Plant (I-49)			No Discharge Limitations Necessary[4]				
Armour & Co. (I-3)			To Municipal Treatment Facility				
Hebel Fertilizer & Chemical Co. (I-23)			To Municipal Treatment Facility				

TABLE 22 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 WINTER CONDITION

Discharger (Ref. No.)	Stream Flow[1] (mgd)	1990 Discharge (mgd)	Ultimate BOD[2] (mg/l)	Ultimate BOD[2] (lb/day)	Ammonia Nitrogen (N) (mg/l)	Ammonia Nitrogen (N) (lb/day)	Effluent Dissolved Oxygen (mg/l)
Willow Creek							
Interstate Power Co. (I-24)			No Discharge Limitations Necessary[4]				
Winnebago River							
Mason City (M-49)	3.48	6.510	15	524.7 BOD_5 814	2.5	136	4.0
Allied Mills (I-2)	9.99	0.026	15	4	2.5	1	4.0
Libby Owens Ford (I-30)			To Municipal Treatment Facility				
Chicago, Milwaukee, St. Paul & Pacific R.R. (I-10)			No Discharge Limitations Necessary[4]				
Martin Marietta Corp. Portland Quarry (I-35)			No Discharge Limitations Necessary[4]				
Greene Limestone Co. Portland Quarry (I-19)			No Discharge Limitations Necessary[4]				
Shell Rock River							
Marble Rock (M-48)		0	Controlled Discharge				
Greene (M-31)	17.61	0.116	45[3]	44	15[3]	15	4.0
Greene Rendering (I-20)		0	Controlled Discharge				
Farmers Co-op Creamery (I-16)	17.61	0.002	45[3]	1	15[3]	0.3	4.0

TABLE 22 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 WINTER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Coldwater Creek							
Palmer Creek							
Greene Limestone Co. Lubben Quarry (I-18)				No Discharge Limitations Necessary[4]			
Coldwater Creek							
Dougherty (M-19)		---		No Existing Municipal Facility			
Flood Creek							
Rudd (M-66)		0		Controlled Discharge			
Shell Rock River							
Clarksville (M-12)		0		Controlled Discharge			
Shell Rock (M-70)	36.43	0.097	45[3]	36	15[3]	12	4.0
Cedar River							
Beaver Creek							
Ackley (M-1)	0.18	0.212	45[3]	80	6	11	4.0
Ackley Food Processors, Inc. (I-1)				No Discharge Data Available			
Aplington (M-4)	0.87	0.062	45[3]	23	6	3	4.0
South Beaver Creek							
Unnamed Creek							
Wellsburg (M-80)	0.31	0.045	45[3]	17	15[3]	6	4.0

TABLE 22 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 WINTER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Beaver Creek							
Parkersburg (M-58)		0	Controlled Discharge				
New Hartford (M-54)		0	Controlled Discharge				
West Hills Housing Development (S-12)			No Discharge Data Available				
Cedar River							
Cedar Falls (M-10)	115.68	5.365	45[3]	2,013	15	671	4.0
Viking Pump Co. (I-45)			No Discharge Data Available				
Cedar Falls Utilities (I-7)			To Municipal Treatment Facility				
Clay Equipment Corp. (I-12)			No Discharge Data Available				
Black Hawk Creek							
Holland Creek							
Holland (M-36)		0	Controlled Discharge				
Black Hawk Creek							
Grundy Center Water Treatment Plant (I-21)		---	No Discharge				
Grundy Center (M-32)	0.31	0.472	3	12	3	12	4.0
Mid-Equipment Co. (I-38)		0	Controlled Discharge				
Morrison (M-52)		---	No Existing Municipal Facility				

TABLE 22 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 WINTER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Mosquito Creek							
Unnamed Creek							
Lincoln (M-46)		0	Controlled Discharge				
Black Hawk Creek							
Reinbeck (M-62)	1.00	0.300	3	8	3.5	9	4.0
North Fork Black Hawk Creek							
Stout (M-72)		---	No Existing Municipal Facility				
Dike (M-18)	1.38	0.094	45[3]	35	15[3]	12	4.0
Black Hawk Creek							
Ogden-Waterloo 26" Main Line Loop (I-40)			No Discharge Limitations Necessary[4]				
Hudson (M-37)	1.99	0.286	45[3]	107	5	12	4.0
Dietrick Mobile Home Park (S-5)			No Discharge Data Available				
Deere & Co. (I-14)			No Discharge Data Available				
Cedar River							
John Deere & Co. (I-26)			Only BPT Required				
Engineered Equipment Co. (I-15)			No Discharge Limitations Necessary[4]				
Waterloo Industries (I-47)			No Discharge Data Available				

TABLE 22 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 WINTER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Cedar River (cont.)							
Rath Packing Co. (I-44)		.025 ?		No Discharge Limitations Necessary[4]			
Pepsi Cola Bottling Co. (I-42)	152.84	0.017	45[3]	6	?,10 → 7 ← 3 ?	1	4.0
Iowa Public Service Co. (I-25)				No Discharge Limitations Necessary[4]			
C. W. Shirey Co. (I-13)				No Discharge Data Available			
Waterloo (M-78)	152.89	21.720	45[3]	8,152	7	1,268	4.0
Construction Machinery Company (I-11)				No Discharge Limitations Necessary[4]			
Chamberlain Mfg. Co. (I-8)	174.61	4.72	45[3]	212	5	197	4.0
Cedar Knoll Park (S-2)				No Discharge Data Available			
Elk Run Heights (M-21)	180.04	0.150	45[3]	56	15	19	4.0
Elk Run School (S-6)	180.04	0.005	45[3]	2	15	1	4.0
Elk Run							
Evansdale (M-22)	180.05	0.562	45[3]	211	15	70	4.0
Martin Marietta Corp. Concrete Materials Division (I-33)				No Discharge Limitations Necessary[4]			

TABLE 22 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 WINTER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Cedar River							
Gilbertville (M-28)	181.20	0.056	45[3]	21	15	7	4.0
Millers Creek							
Oak Grove Mobile Home Park (S-10)		0	Controlled Discharge				
Wolf Creek							
Conrad (M-15)	0.16	0.058	45[3]	22	5	2	4.0
Gladbrook (M-29)		0	Controlled Discharge				
Traer (M-75)	0.89	0.155	45[3]	58	9	12	4.0
Martin Marietta Corp. Smith Quarry (I-37)			No Discharge Limitations Necessary[4]				
Hickory Hills Park (S-8)		0	Controlled Discharge				
La Porte City Water Treatment Plant (I-28)		---	No Discharge				
La Porte City (M-43)	1.86	0.271	45[3]	102	9	20	4.0
Cedar River							
Rock Creek							
B. L. Anderson, Inc. Jabens Quarry (I-5)			No Discharge Limitations Necessary[4]				

TABLE 22 (Cont.)

WASTE LOAD ALLOCATION

7-DAY, 1-IN-10 YEAR LOW FLOW

1990 WINTER CONDITION

Discharger (Ref. No.)	Stream Flow[1]	1990 Discharge	Ultimate BOD[2]		Ammonia Nitrogen (N)		Effluent Dissolved Oxygen
	(mgd)	(mgd)	(mg/l)	(lb/day)	(mg/l)	(lb/day)	(mg/l)
Spring Creek							
Jesup (M-39)	0.00	0.327	1	3	1	3	4.0
Paul Nieman Const. Bloom Quarry (I-41)				No Discharge Limitations Necessary[4]			

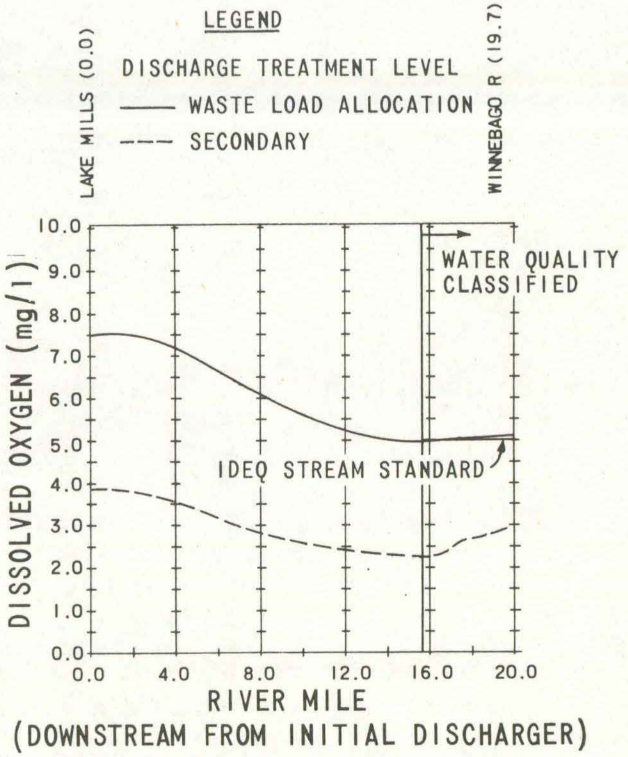
---

[1] Seven-day, 1-in-10 year low flow in stream just above point of discharge, if stream is classified, or flow of classified stream at confluence with tributary.

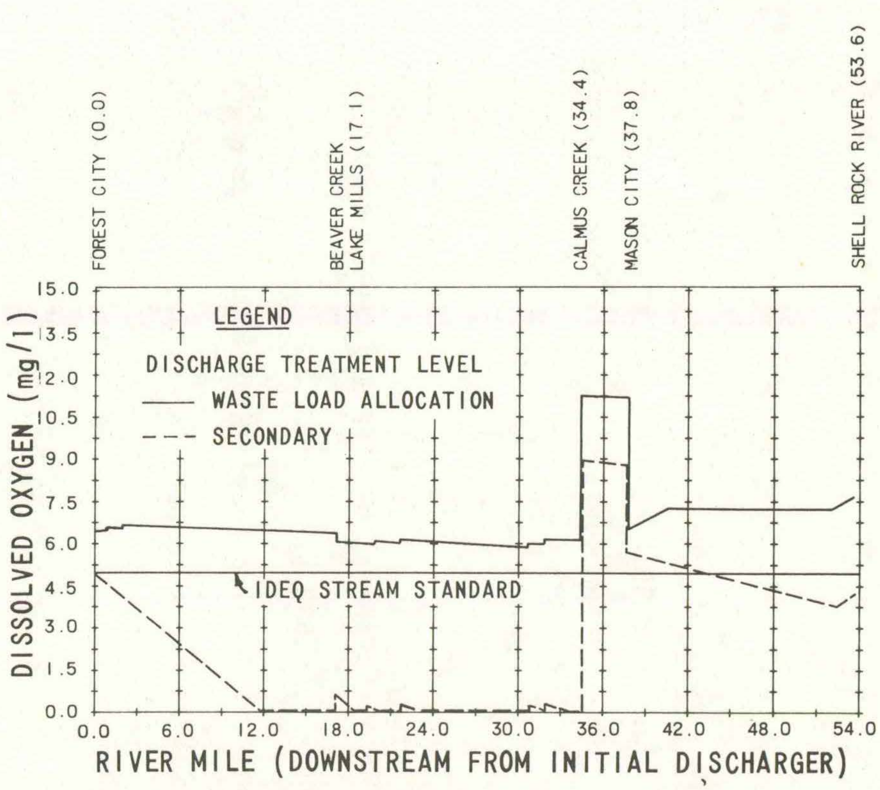
[2] UBOD = 1.5 (BOD_5).

[3] Meets BPWTT guidelines. Higher discharge quantities could satisfy stream criteria.

[4] No waste load allocation necessary. Low quantities of BOD and ammonia nitrogen in effluent.

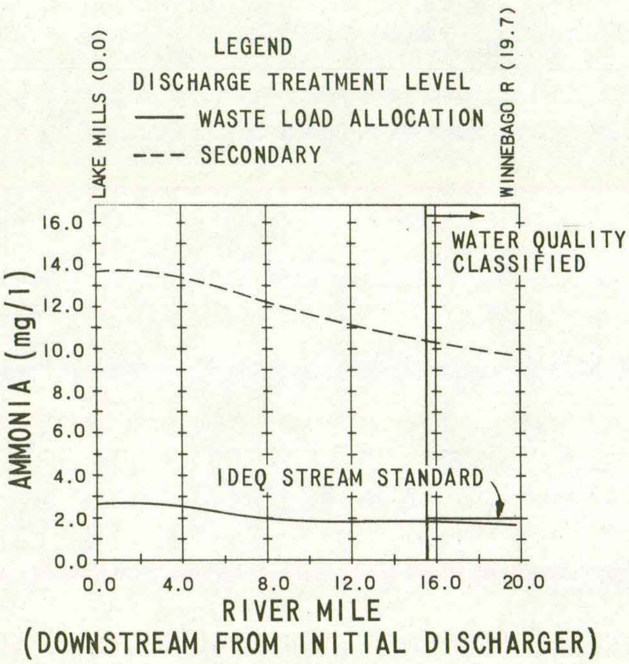


BEAVER CREEK

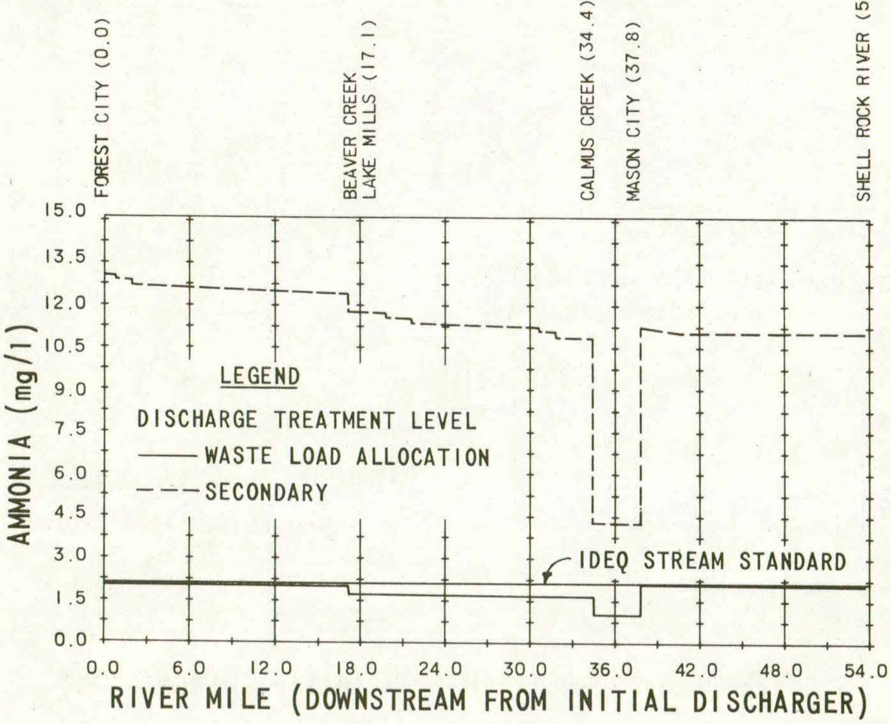


WINNEBAGO RIVER

FIGURE 19
DISSOLVED OXYGEN
CONCENTRATIONS
WINTER CONDITIONS

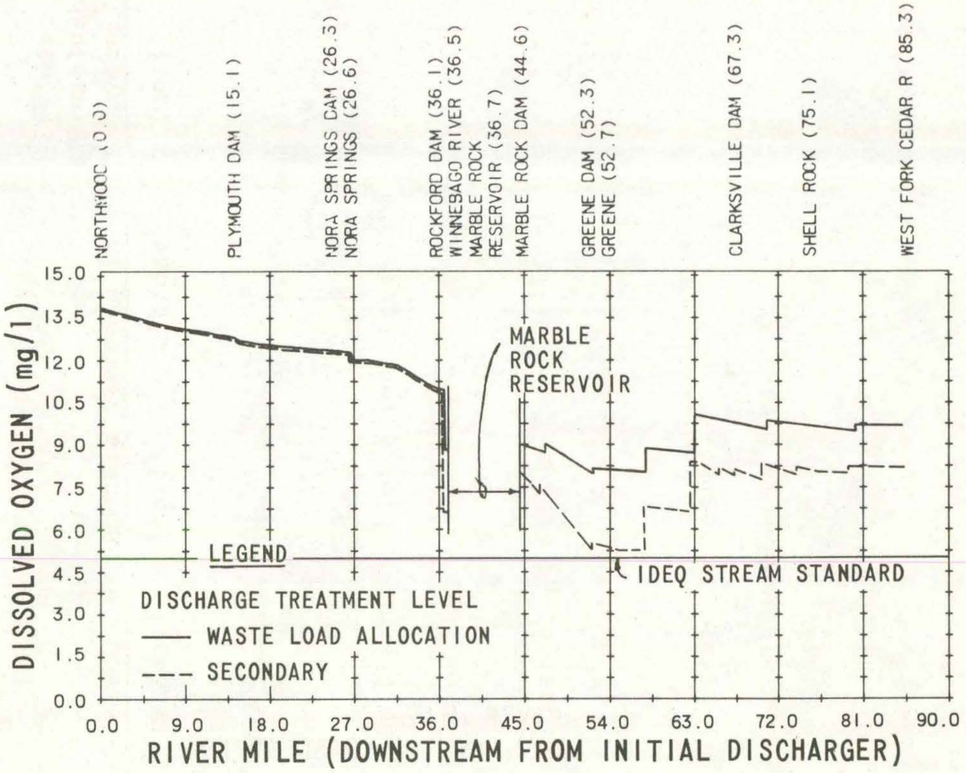


BEAVER CREEK

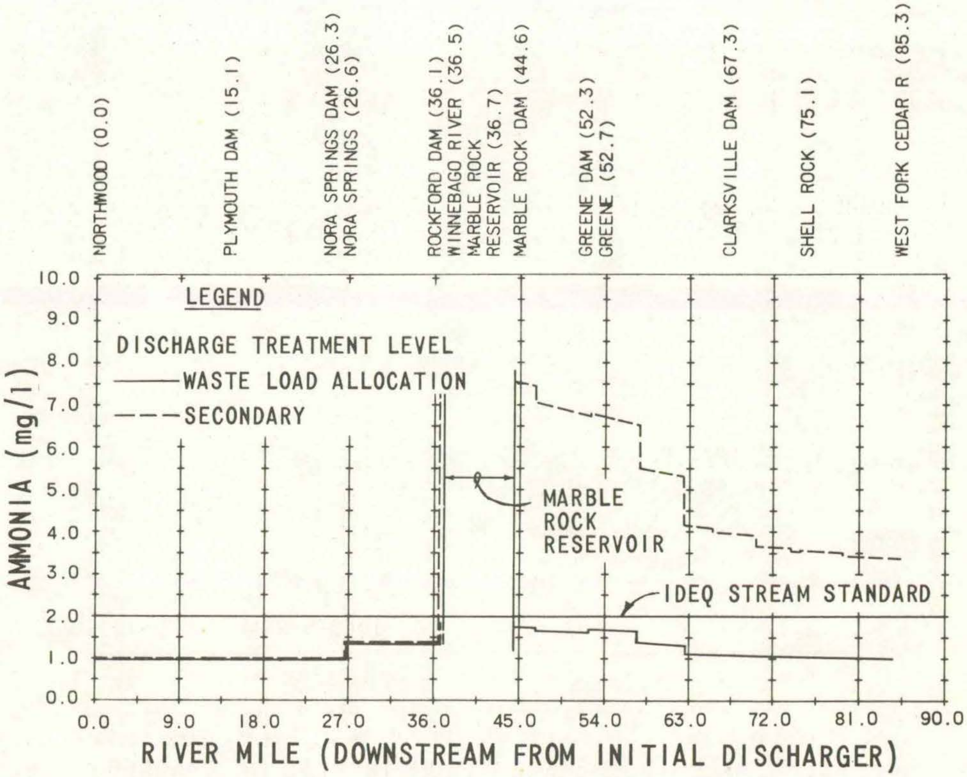


WINNEBAGO RIVER

FIGURE 20
AMMONIA NITROGEN
CONCENTRATIONS
WINTER CONDITIONS



DISSOLVED OXYGEN CONCENTRATIONS



AMMONIA NITROGEN CONCENTRATIONS

FIGURE 21
SHELL ROCK RIVER
WINTER CONDITIONS

West Fork Cedar River - Waste load allocations for this stream and its tributaries are given in Table 22. Waste load allocations necessary to maintain water quality standards within the tributaries have little impact upon water quality within the West Fork Cedar River.

The profiles shown on Figures 22 and 23 include the West Fork Cedar River and its extension, Beaverdam Creek, to the Clear Lake discharge and Hartgrave Creek. Winter dissolved oxygen concentration profiles for secondary treatment and waste load allocations for 1990 discharges are shown on Figure 22, while Figure 23 shows the profiles for ammonia nitrogen concentrations.

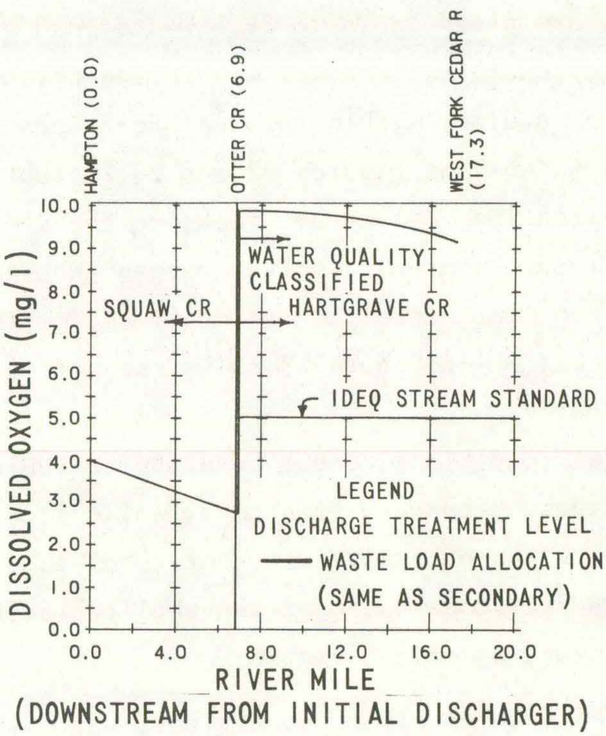
Under winter conditions, Clear Lake Sanitary District and Hampton require better thatn secondary treatment, while Rockwell needs only secondary treatment. With secondary treatment conditions, water quality in West Fork Cedar River does not meet the applicable stream stnadards for dissolved oxygen and ammonia nitrogen.

Beaver Creek - Under winter conditions, waste load allocations for discharges in this drainage basin are given in Table 22. Winter dissolved oxygen and ammonia nitrogen concentration profiles are shown on Figure 24 for 1990 discharges for both secondary treatment conditions and waste load allocations.

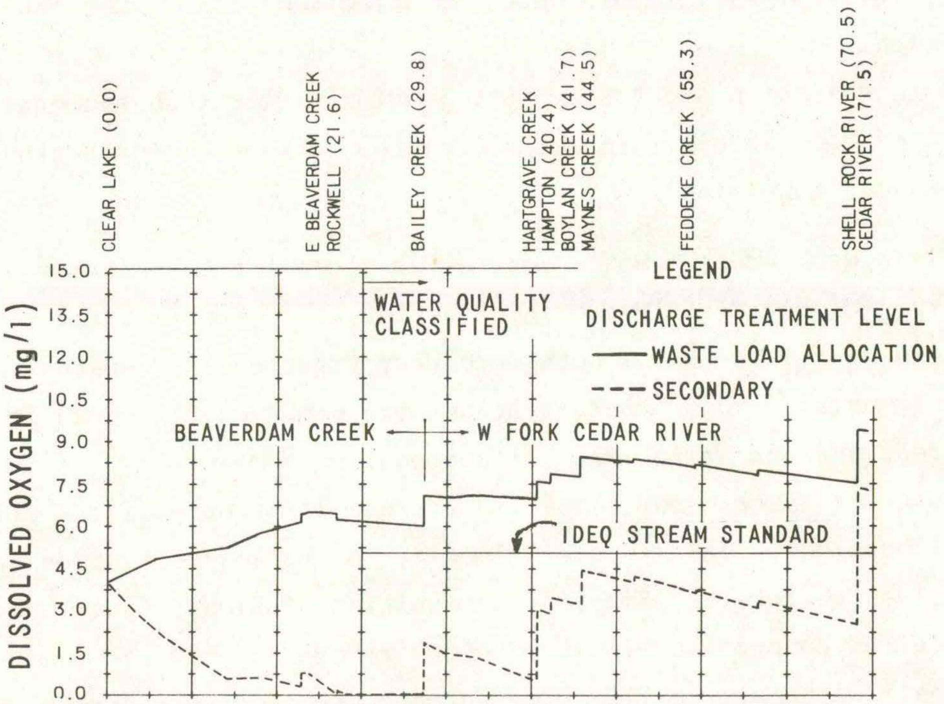
Both Aplington and Ackley must provide better than secondary treatment removal of ammonia nitrogen because of the lack of bio-oxidation of ammonia under winter conditions.

Black Hawk Creek - Waste load allocations for this stream are given in Table 22. Winter dissolved oxygen concentration profiles for 1990 discharges are shown on Figure 25 for both secondary treatment and waste load allocations. Winter ammonia nitrogen concentrations are shown on Figure 26 for both secondary treatment and waste load allocations.

As under summer conditions, low stream flows necessitate stringent waste load allocations. This is due primarily to the low reaeration rate caused by partial ice cover. Both the communities of Grundy Center and Reinbeck are required to provide almost complete removal of BOD and ammonia nitrogen from their wastewater effluents. Further study of this stream under low flow conditions is recommended.

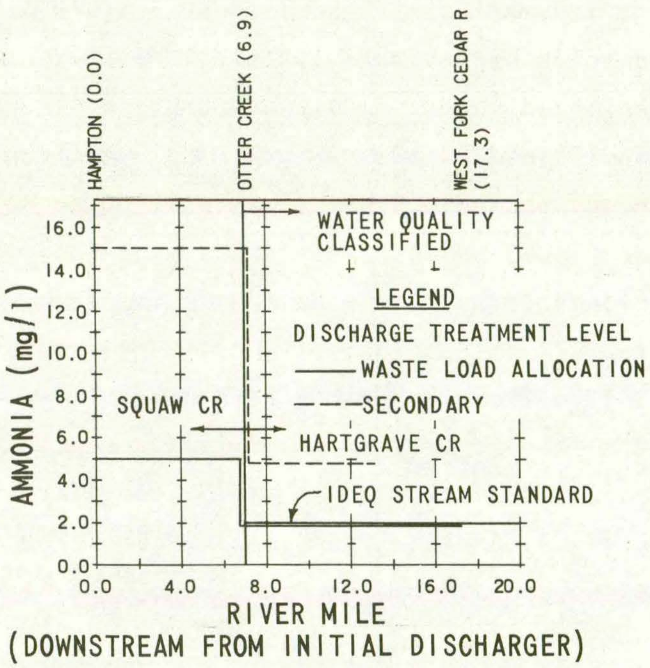


HARTGRAVE CREEK

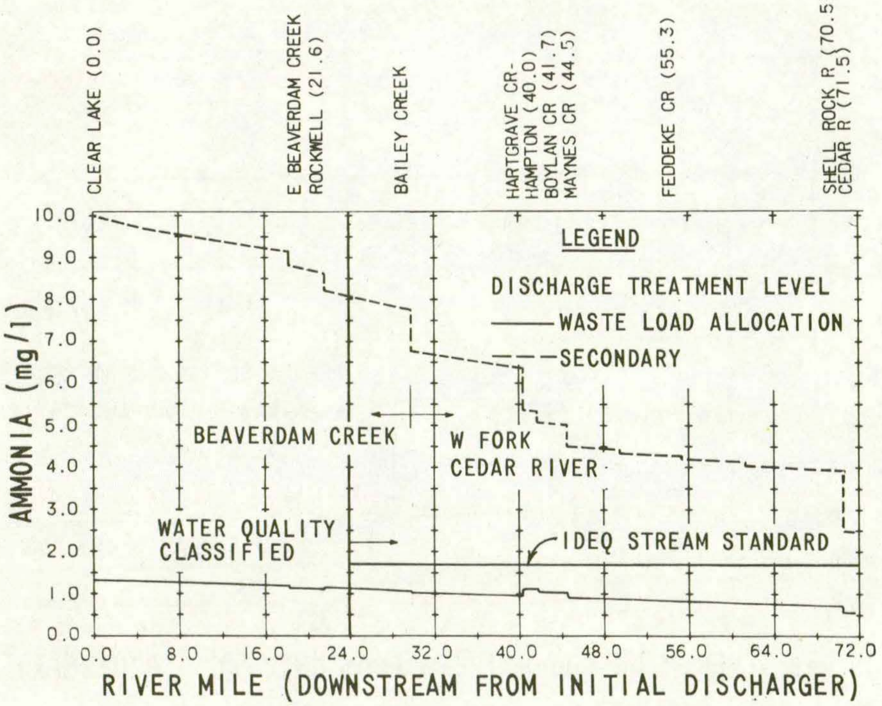


WEST FORK CEDAR RIVER

FIGURE 22
DISSOLVED OXYGEN
CONCENTRATIONS
WINTER CONDITIONS

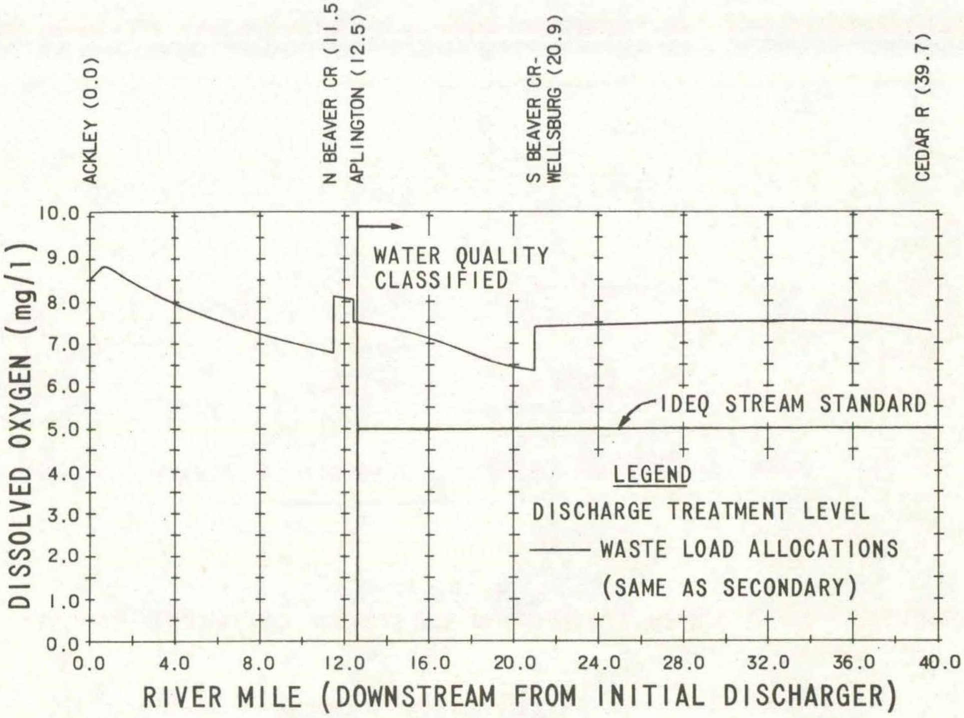


HARTGRAVE CREEK

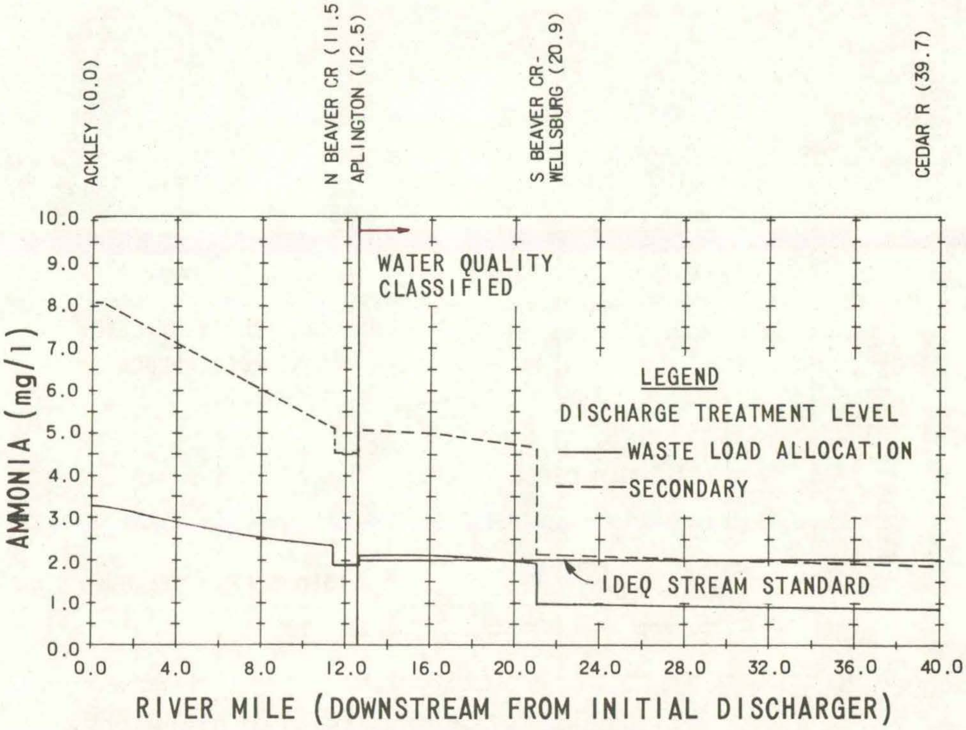


WEST FORK CEDAR RIVER

FIGURE 23
AMMONIA NITROGEN
CONCENTRATIONS
WINTER CONDITIONS

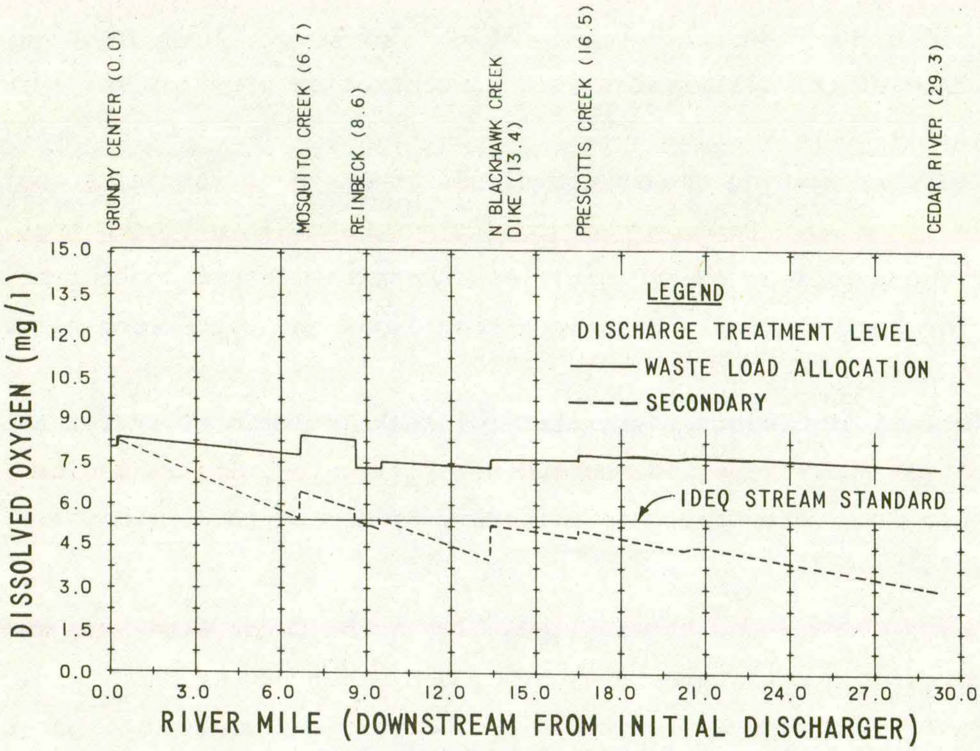


DISSOLVED OXYGEN CONCENTRATIONS

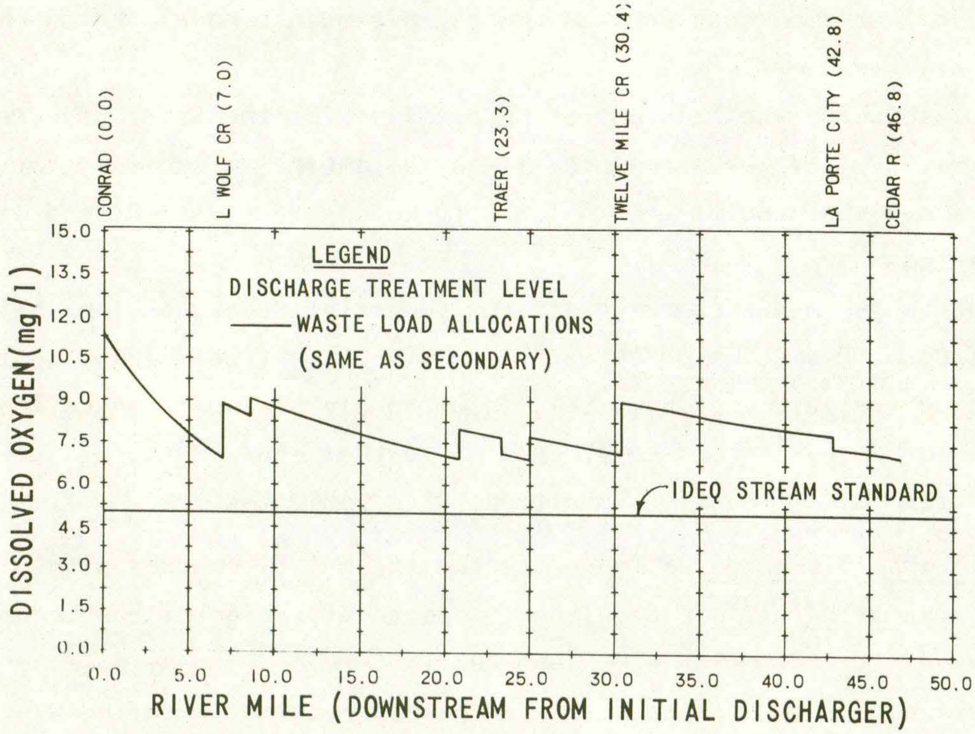


AMMONIA NITROGEN CONCENTRATIONS

FIGURE 24
BEAVER CREEK
WINTER CONDITIONS



BLACK HAWK CREEK



WOLF CREEK

FIGURE 25
DISSOLVED OXYGEN
CONCENTRATIONS
WINTER CONDITIONS

Wolf Creek - Waste load allocations for this stream are given in Table 22. Winter dissolved oxygen concentration profiles for 1990 discharges are shown on Figure 25. Secondary treatment level removals of BOD result in meeting the stream dissolved oxygen criteria, so only one profile is shown. Under winter conditions, ammonia nitrogen does not affect the dissolved oxygen profile. Ammonia nitrogen concentration profiles for both secondary treatment conditions and waste load allocations are shown on Figure 26.

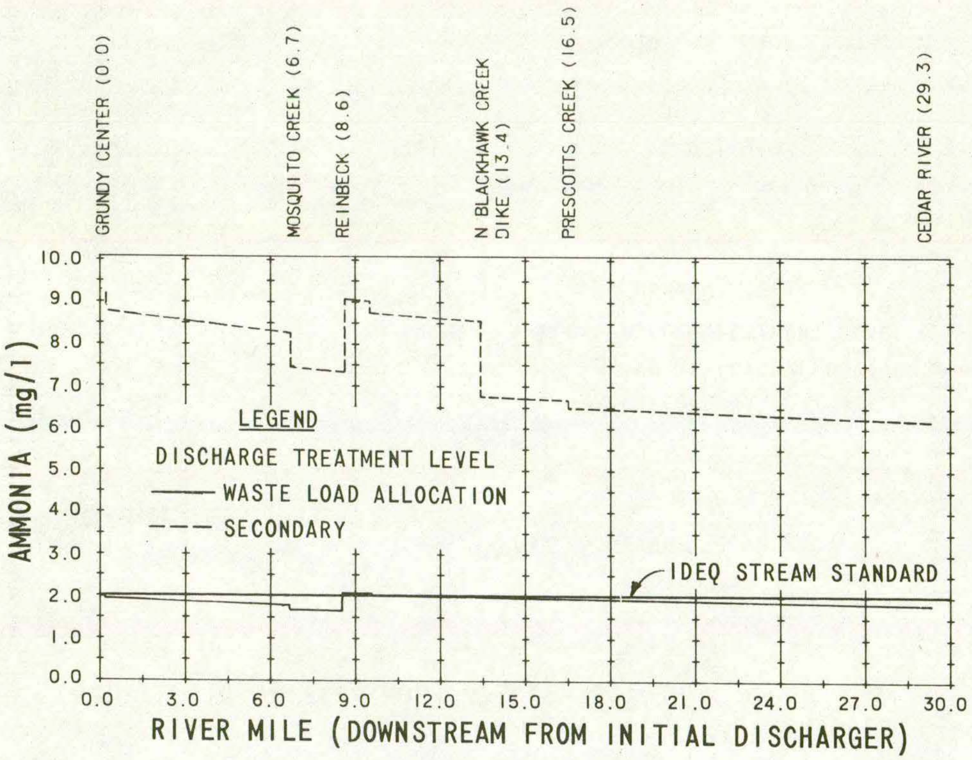
To meet stream quality criteria for all water quality classified sections of the stream, the communities of Conrad, Traer, and La Porte City must provide better than secondary treatment level removal of ammonia nitrogen.

Cedar River - Low stream flows within the Cedar River are much greater than any single wastewater dishcarge, and under winter conditions secondary treatment level removals of BOD meet the stream dissolved oxygen criteria of 5.0 mg/l without difficulty. Under winter conditions, ammonia nitrogen is not removed from the stream by bio-oxidation and higher levels of ammonia nitrogen within the stream are common. To maintain the ammonia nitrogen criteria of less than 2.0 mg/l within the Cedar River, the community of Waterloo must provide ammonia nitrogen removals below those of secondary treatment.

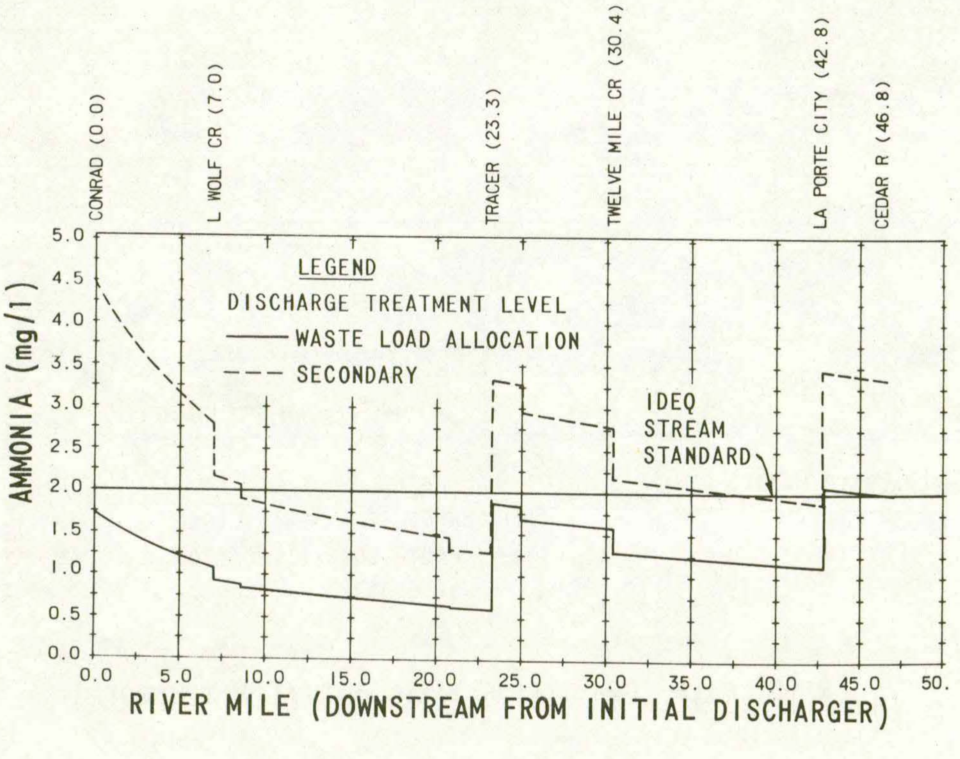
Dissolved oxygen concentration profiles for the Cedar River are shown on Figure 27. Winter ammonia nitrogen concentration profiles for 1990 discharges are shown on Figure 28 for both secondary treatment and waste load allocations.

Jesup has a wastewater discharge to Spring Creek, a minor tributary of the Cedar River, which is water quality classified. To maintain stream quality criteria on Spring Creek, an extremely stringent waste load allocation for Jesup is necessary. Again, further study of water quality in this stream under low flow conditions is recommended.

Thermal Discharges - There are two thermal discharges within the study area of sufficient magnitude to cause violation of the temperature stream quality criteria. The Iowa Public Service Company power generation plant in Waterloo violates stream temperature criteria during winter



BLACK HAWK CREEK



WOLF CREEK

FIGURE 26
AMMONIA NITROGEN
CONCENTRATIONS
WINTER CONDITIONS

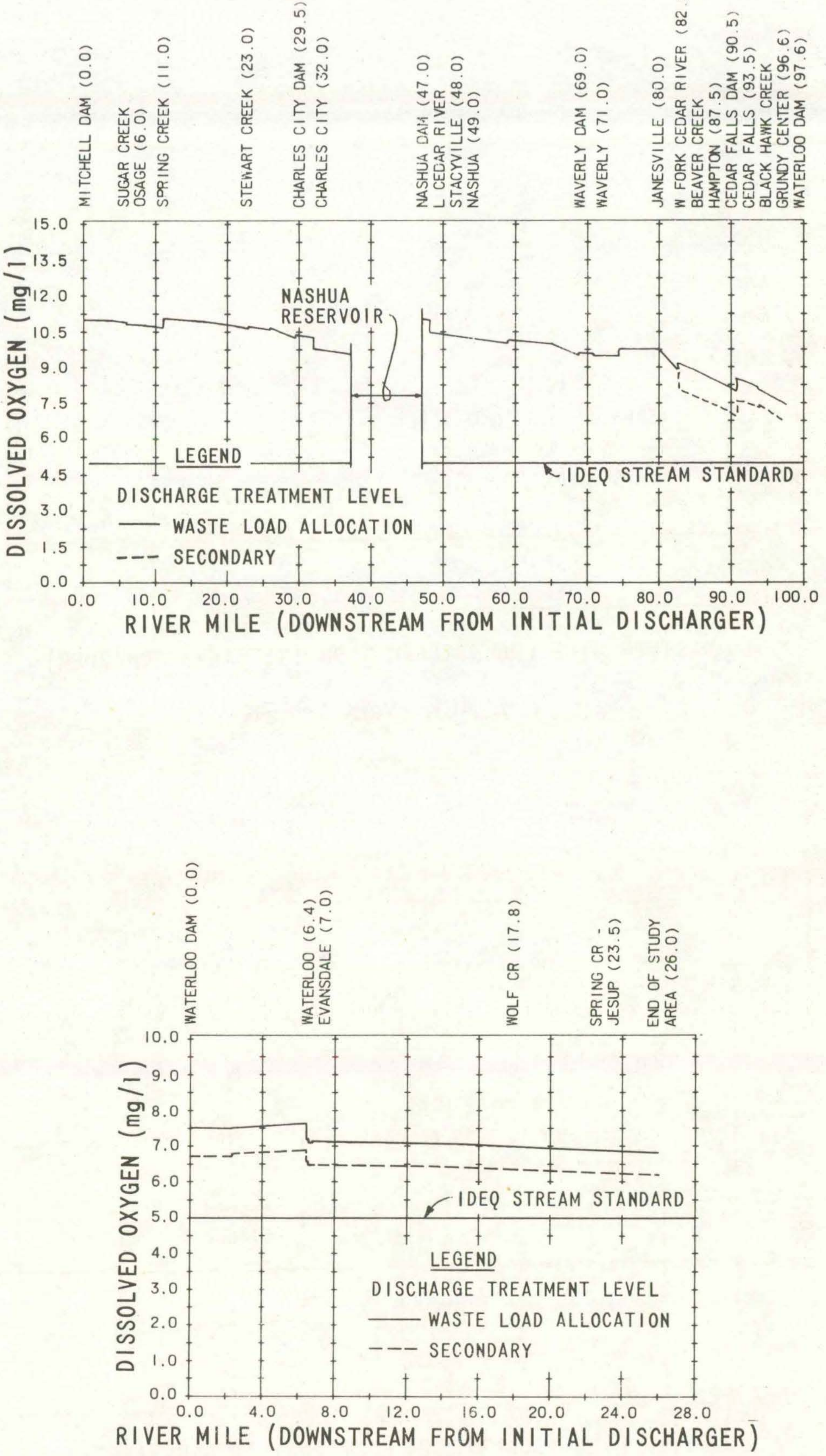


FIGURE 27
DISSOLVED OXYGEN
CONCENTRATIONS
CEDAR RIVER
WINTER CONDITIONS

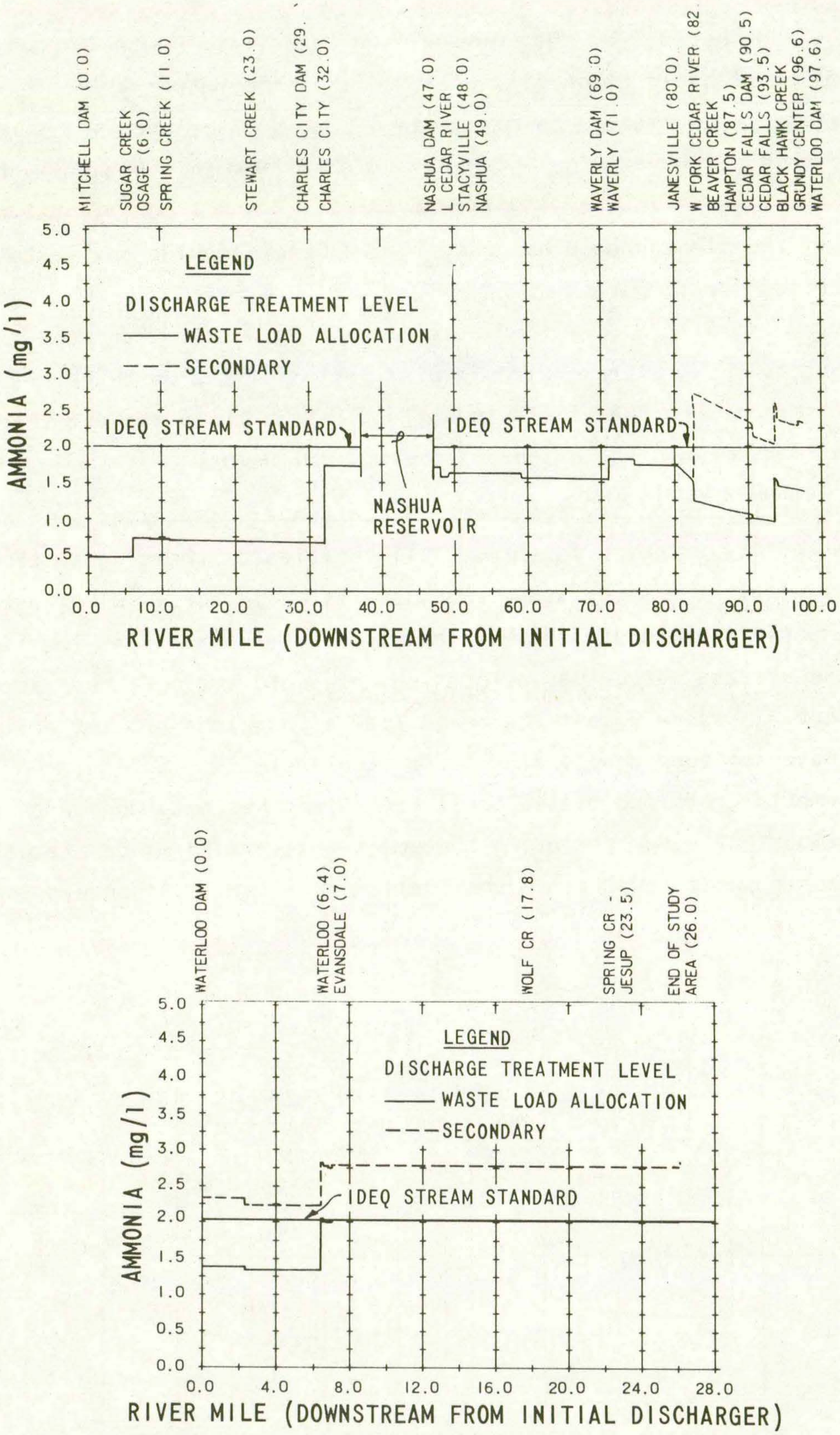


FIGURE 28
AMMONIA NITROGEN
CONCENTRATIONS
CEDAR RIVER
WINTER CONDITIONS

periods, but not during the summer. The Interstate Power Company power generating plant in Mason City will violate temperature criteria whenever the effluent temperature is more than 6.5° F greater than the stream temperature. However, cooling water volumes from this plant may be decreased during periods of low stream flow, and exact operational procedures of the plant should be investigated before making any waste load allocations for temperature.

Modeling of the termal effects of cooling water discharges from these two sources shown extremely rapid dissipation of the waste heat discharge to the stream. Further field investigations at these two sites are recommended to ascertain the extent of thermal pollution.

Summary - Secondary treatment of wastewater dishcarges will meet stream quality criteria for almost all entities discharging to the major streams within the study area. Many smaller tributaries with wastewater dischargers in the study are have a low 7-day, 1-in-10 year low flow and on these streams waste load allocations are more stringet than secondary treatment. In some cases, the waste load allocations are set at levels which have not been demostrated to be attainable.

Computer modeling of the Shell Rock River has been done with the assumption that water pollution abatement programs in Minnesota will restore high water quality in the Shell Rock River as it enters Iowa.

Respectfully submitted,

STANLEY CONSULTANTS, INC.

By Douglas A. Wallace
Douglas A. Wallace

By R John Tagg
R. John Tagg

Approved by Robert L. Thoem
Robert L. Thoem

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of Iowa.

Robert L. Thoem
Robert L. Thoem

January 22, 1975 Reg. No. 5802

BIBLIOGRAPHY

Chow, V. T., Open-Channel Hydraulics, 1959.

Fenton, T. E., Highland, J. D., and Phillips, J. A., Highway Guide of Iowa, Soil Association Room 389, Iowa State University, Cooperative Extension Service, Ames, Iowa, July, 1967.

Iowa Natural Resources Council, Low-Flow Characteristics of Iowa Streams Through 1966, Bulletin No. 10, 1970.

Larimer, O. J., Drainage Areas of Iowa Streams, 1957.

Tsivoglou, E. C. and Wallace, J. R., Characterization of Stream Reaeration Capacity, 1972.

U. S. Department of Agriculture, Soil Survey Report for Brenner County, also the same source for Butler, Cerro Gordo, Floyd, Franklin, Mitchell, Winnebago, and Worth Counties.

U. S. Department of Interior, Water Resources Data for Iowa, annual volumes for years 1961 through 1973.

U. S. Environmental Protection Agency, Proposed Criteria for Water Quality, Volumes I - III, 1973.