

Name of Applicant City of Sioux Falls
Post Office Address 224 West 9th Street, Sioux Falls, SD 57102
Amount of Water Claimed 13.8 cfs / 10,000 AF Total Acres NA
Source of Water Supply Big Sioux River
Water to be used for municipal purposes County Minnehaha
About miles north of Sioux Falls

PROOF OF PUBLICATION: Received Not Received

APPLICATION: Approved Subject to

F.F.C.C.L. Adopted Not Approved Deferred

PRIORITY 6/6/77 Date Received June 9, 1989 Fee \$ 2275 Remarks Reserved

under Future Use #3981-3; received 1979 Legislative approval

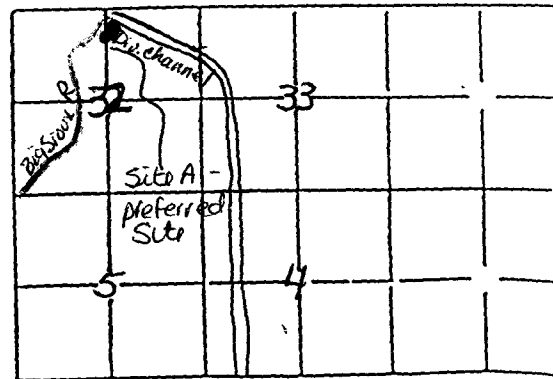
Corrected Application Received July 27, 1989 Period of Annual Use Jan 1 - Dec 31

WATER QUALITY APPROVAL RECEIVED NA APPROVED/CONDITIONAL (Circle one)

WI-1 Description same as Application YES NO REMARKS

Diversion Point N $\frac{1}{2}$ Section 32-T102N-R49W

Land to be Irrigated NA



Well Log: Driller NA Licensed YES NO

Depth of Well REMARKS

Type of Map topo PREPARED BY Gary L. Meyer Reviewed and the Number

assigned on June 12, 1989 By Susan Bowser

SOUTH DAKOTA
WATER PERMIT No. 5334-3

Date of first receipt of application June 9, 1989.

Date of return to applicant for corrections, amendments or changes July 7, 1989.

Date of receipt of corrected application July 27, 1989.

The Water Management Board approved Water Permit Application No. 5334-3 on September 28, 1989 for the City of Sioux Falls, 224 W Ninth Street, Sioux Falls SD 57102 authorizing the construction of the water use system and the placing of water to beneficial use subject to the following limitations, conditions and qualifications:

1. Water Permit No. 5334-3 authorizes construction of works and beneficial use of 13.8 cubic feet of water per second (10,000 acre-feet annually) from the Big Sioux River reserved by Future Use Permit No. 3981-3. The point of diversion is to be located within the W1/2 section 33; N1/2 section 32; all in T102N-R49W.
2. The water appropriated shall be used for the purpose of supplying the City of Sioux Falls and may not exceed the amount of water needed for beneficial use for municipal purposes.
3. The water is to be used during the following described annual period: January 1 - December 31.
4. The date from which applicant may claim right is June 6, 1977 (see No. 3981-3).
5. One-fifth of the construction is to be completed on or before March 28, 1992.
6. All construction is to be completed on or before September 28, 1994.
7. Water is to be put to beneficial use on or before September 28, 1998.
8. Water rights obtained in compliance with the laws of the State of South Dakota may not be unlawfully impaired by this appropriation.

QUALIFICATIONS

At least 20 cfs must be by-passed, when pumping, for downstream domestic use, including livestock watering, and prior water rights.

WATER MANAGEMENT BOARD

By: 
Chief Engineer, Water Rights Division
Department of Water and Natural Resources

NOV 20 1989
(date)

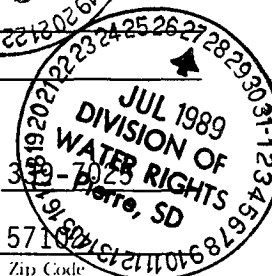
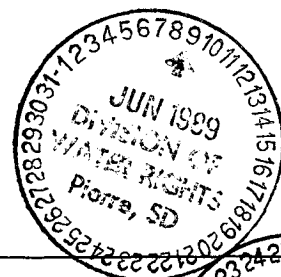
523 E. Capitol
Pierre, SD 57501
(605) 773-3352

No. 5334-3 Hydrologic Unit 10170203
 Map No. same Basin Big Sioux
 Newspaper Argus Leader Box 5034 57117
(daily)

Application For Permit To Appropriate Water Within The State Of South Dakota

Check use of water: Industrial ☐ Commercial ☐ Municipal ☒ Other Common Distribution System ☐
 Rural Water System ☐ Suburban Housing ☐ Geothermal Heat ☐ Institutional ☐ Recreational ☐
 Domestic ☐ (above 18gpm) Other ☐

Type of Application: Check one or more of the following

New ☐ Vested Right ☒ Future Use ☐ Change Use ☐☐ Amend Permit No. _____ with old priority date retainedChange diversion point(s) ☐ Add diversion point(s) ☐ Other ☐☐ Application to: Change diversion point(s) ☐ Add diversion point(s) ☐ on Permit No. _____☒ Construction to use water reserved by Future Use Permit No. 3981-3

- Name of Applicant City of Sioux Falls Phone No. 339-3025
 Post Office Address 224 West 9th Street Sioux Falls State SD Zip Code 57105
(Street, RR or Box) (City)
- Amount of water claimed (c.f.s) -41 cfs - 30,000 acre-feet per year 13.8 cfs - 10,000 ac ft/yr
- Source of water supply Big Sioux River
- Location of point of diversion At confluence of Big Sioux River and Diversion Channel
north of City; See Site Map for Site A in draft of enclosed predesign report.
W $\frac{1}{2}$ Section 33, N $\frac{1}{2}$ Section 32-T102N-R49W County Minnehaha
- Counties where water will be used Minnehaha and Lincoln
- Annual period during which water is to be used -All-year January 1 - December 31
- Give a brief description of proposed project. When available include any preliminary engineering report or other reports or information that will help explain the project. (Attach sheet if more space is needed)
Construction of a water intake and pumping station for a raw water supply for the City of Sioux Falls, South Dakota.
Attached is a draft copy of the predesign report.

Attachments: Attach Form 2A if diversion from a well or dugout, or if storage of water, is proposed. Attach map (see instruction)

STATE OF SOUTH DAKOTA)

County of Minnehaha, ss

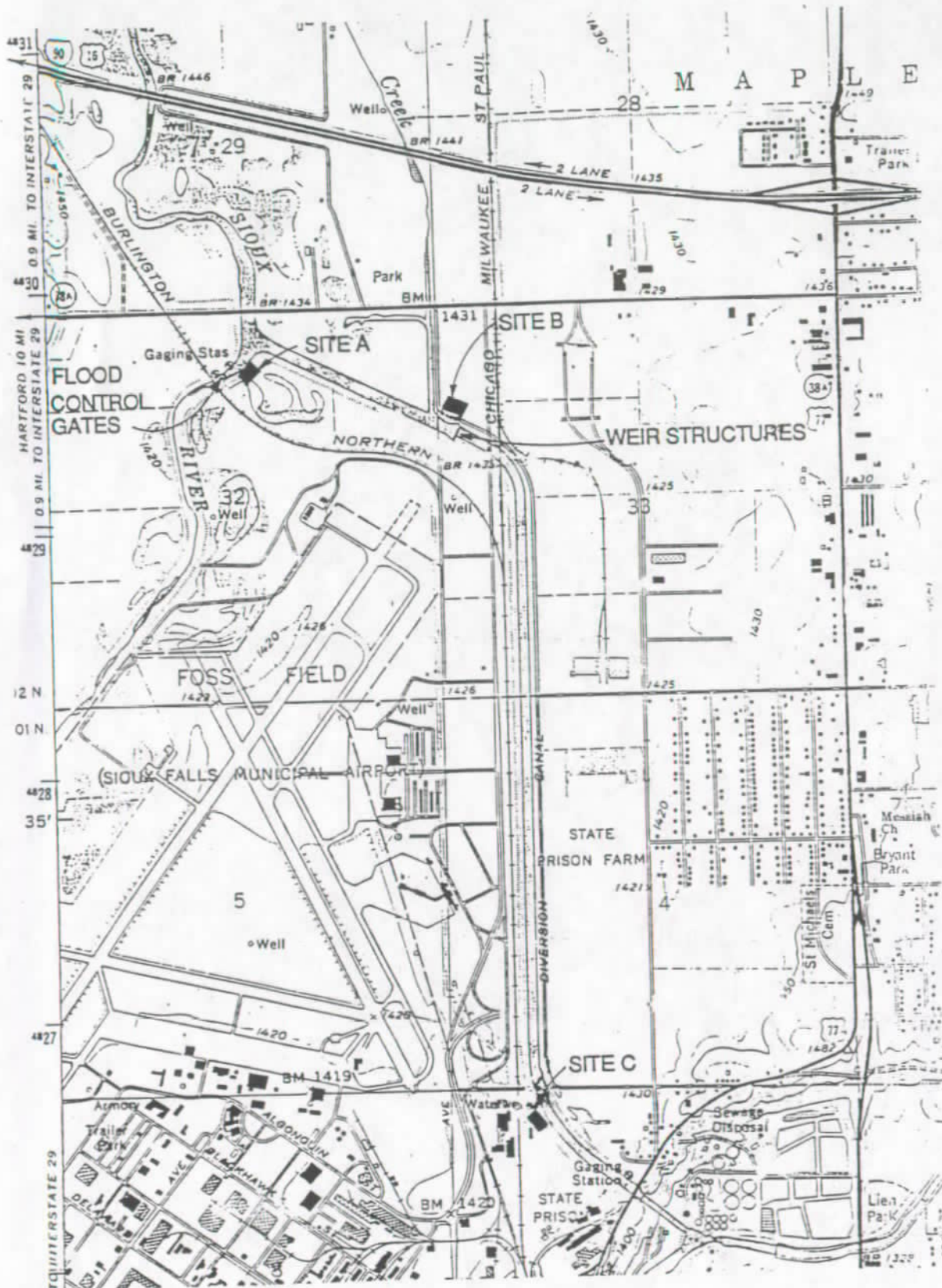
I, Jack White the applicant, certify that I have read this application, have examined the attached map and that the matters stated are true and that I intend, and am able to complete the necessary construction.

Signed

Jack White

MAYOR

Subscribed and sworn to before me this JUN 5 1989 day of _____ 19__Shaun WileyMy Commission Expires 4-20-97



Gary L. Meyer
Utility Eng'r.

Appl. No. 5334-3

SIOUX FALLS
RAW WATER PUMPING STATIC
SITE ALTERNATIVES

FIGURE 5.1

**Surface Water
Intake and
Pumping Station**

**Pre-Design
Report**



City of Sioux Falls

June 1989



H D R

HDR Engineering, Inc.
In Association with
Stockwell Engineers, Inc.

June 1989

Surface Water Intake
and
Pumping Station

City of Sioux Falls

HDR Engineering/Stockwell Engineers

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SECTION 1 - PROJECT SCOPE

1.1 Introduction

The Big Sioux River is a drainage area primarily in eastern South Dakota which encompasses over 5000 square miles above the City of Sioux Falls. The City's existing water supply are from shallow wells in the Big Sioux Aquifer located adjacent to the river, primarily north of the City. Growth and increasing demand for water by the City is stressing the available well capacity. The construction of additional wells is being pursued, however, the demand continues to exceed available supply from the aquifer. Also the cost per million gallons for development of a larger production well field is quite high.

An alternate to development of a larger well field is use of the water directly from the Big Sioux River. Flow in the river exists a majority of the time that the City's water demand is the highest. Thus, utilization of this surface water from the river is an alternative source worthy of consideration.

1.2 Purpose

Recent investigations by the City indicate that the development of a surface water source on the Big Sioux River can be accomplished at a lower and more reasonable cost per million gallons than the cost for increased well field development. Thus, the purpose of this project is to evaluate, design, and construct a surface water intake and pump station as a primary source of water to the City. At the present time up to 6 MGD of surface water from intakes along the diversion channel near the water treatment plant are being successfully treated when available providing a large

source of water which if not used would not be recoverable at a later date. In addition, the reduction of well field pumping caused by use of a river intake will allow complete recharge of the Big Sioux Aquifer which maximizes the possible yield for those periods that the river source is not available. An aquifer which is fully recharged ("rested") should be in a better position to meet the high demands during July and August if it has not been previously pumped during April, May and June when water from a river intake could be used. The philosophy of this approach to management of the water supply sources appears sound and would greatly improve the water source quantities, however; it must be noted that the possibility of extended low flows in the Big Sioux River still do exist. If a period such as this did occur it would reduce the amount of aquifer recharge and the maximum yield of the well field. So even with the construction of a river intake the well field may not be capable of supporting extended periods of maximum day demand during a low flow period in the river.

SECTION 2 - SURFACE WATER SUPPLY

2.1 Water Quantity Data

The Big Sioux River flows were reviewed to determine the amount of water available for a surface water supply. The records reviewed included information from the following stations and is summarized in Table 2.1.1.

1. Big Sioux River near Dell Rapids for the period from October 1975 to September 1984. This is approximately 15 miles upstream from the possible intake sites.
2. Big Sioux River near Akron, Iowa for the period from October 1984 to September 1987. This is substantially downstream from the possible intake sites.

TABLE 2.1.1

BIG SIOUX RIVER - STREAM FLOWS

<u>Year (1)</u>	<u>Average Flow</u>	<u>Minimum Flow</u>	<u>Approximate Days</u>	
			<u>Less than 100 cfs</u>	<u>Less than 50 cfs</u>
1987(2)	1240	400	---	---
1986(2)	1800	450	---	---
<u>1985(2)</u>	1300	290	---	---
1984(3)	780	66	45	---
1983(3)	770	53	70	---
1982(3)	230	8	200	180
1981(3)	40	17	365	260
1980(3)	120	40	180	60
1979(3)	490	10	150	140
1978(3)	270	18	210	75
1977(3)	140	0	320	290
1976(3)	100	0	285	270
1975(3)	80	5	300	270

- (1) From October of previous year to September of year identified
(2) Data from Akron, Iowa
(3) Data from Dell Rapids

In addition to the flow data and the amount of time each year the flows are below 100 or 50 cfs, it is critical to consider the duration of the low flows and the period of year during which they occur. A low river flow in January or February is not as detrimental as low river flows occurring during the summer months because the overall water demand is substantially reduced during the winter months. The aquifer will then generally be recharged during the spring runoff period.

Summary of the duration of the low flows were evaluated and the associated time of year during which they occurred. Also, the duration of low flows during the 120 day peak demand period which occurs from mid May to mid September was reviewed. These evaluations are presented in Tables 2.1.2 and Table 2.1.3.

TABLE 2.1.2
LOW FLOW DURATIONS AND PERIODS

<u>Period</u>	<u>Approx. Days of Flow Less than 50 cfs</u>	<u>Longest Duration</u>	<u>Occurred</u>
1986-1987	0	---	---
1985-1986	0	---	---
<u>1984-1985</u>	0	---	---
1983-1984	0	---	---
1982-1983	0	---	---
1981-1982	180	180	Aug. 81 to Jan. 82
1980-1981	260	150	Oct. 80 to March 81
1979-1980	60	60	Feb. 80 to March 80
1978-1979	140	140	Oct. 78 to Feb. 79
1977-1978	75	75	Jan. 78 to March 78
1976-1977	290	290	June 76 to March 77
1975-1976	270	225	July 75 to Feb. 76
1974-1975	270	195	Oct. 74 to April 75

TABLE 2.1.3
RIVER FLOWS DURING SUMMER PERIOD
(May 15 through September 15)

<u>Year</u>	<u>Average Flow (cfs)</u>	<u>Low Flow (cfs)</u>	<u>Duration (days) Less than 50 cfs</u>	<u>Approximate Dates Started</u>
1987	600	300	---	---
1986	2500	1000	---	---
<u>1985</u>	1500	600	---	---
1984	1500	1000	---	---
1983	700	60	---	---
1982	350	70	---	---
1981	45	18	30	Aug. 15
1980	140	53	---	---
1979	500	137	---	---
1978	270	57	---	---
1977	42	20	60	July 15
1976	23	0	105	June 1
1975	85	11	65	July 10

The information in Table 2.1.2 indicates that the majority of periods of low flow occur during the fall and winter months. Table 2.1.3 shows that during the high demand months of the summer flows less than 50 cfs have occurred for extended durations during some years. For most of the years however, the flows during this high demand period have stayed above 50 cfs.

2.2 Water Quantity Summary

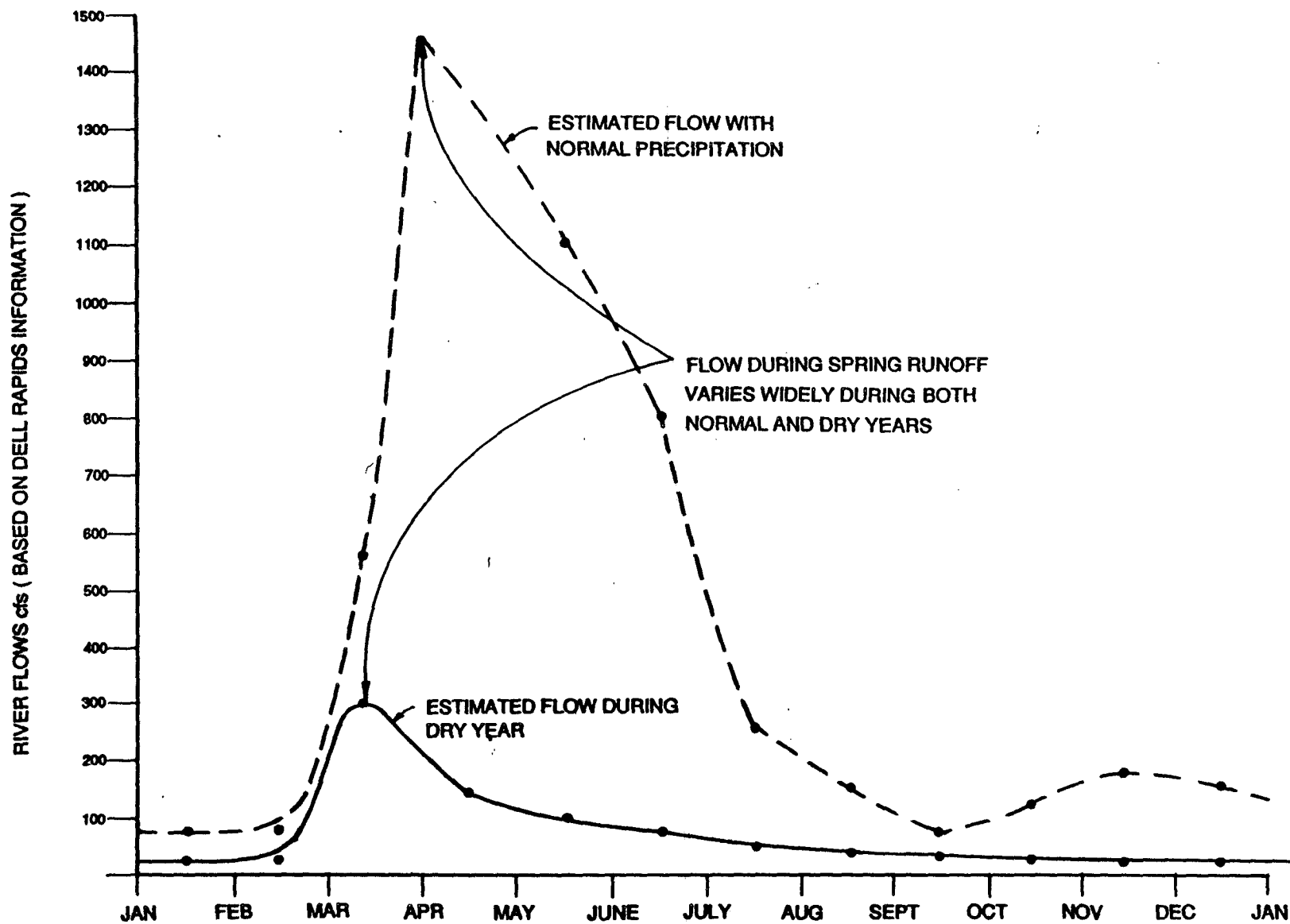
The data presented in Table 2.1.1 indicates that the average Big Sioux River flow is 560 cfs for the period of records reviewed and over 300 cfs for the period from 1975 to 1984 (data from Dell Rapids gaging station only). Either of these average flows is well in excess of the amount required for a water supply source. (Average demand is approximately 34 cfs as indicated in Section 3.) It should be noted that this period includes two droughts which occurred from 1974 to 1977 and also from 1980 to 1982. The records for 1988 are not yet available at this time, however, we know that river flows existed until July 1988.

The periods of longest low flow duration were July 1975 to February 1976 (225 days), June 1976 to March 1977 (290 days) and from August 1981 to January 1982 (180 days). These low flow periods all started in the mid or late summer months and extended into the winter months. The City's water demand is highest until September thus the majority of low flows occur when demand is at average or below average conditions. Figure 2.2.1 shows approximated monthly river flow conditions for typical normal and dry years based on the river flow data available. As can be seen from the figure the most likely month for low flow periods are during the winter months.

Based on a review of the river flow data presented, the following key points can be made regarding utilization of the river as a surface water supply:

1. Greater than 50 cfs of flow occurred for the entire year in 5 of 13 years or 38% of the time.
2. For the entire period reviewed greater than 50 cfs of flow was available approximately 3200 days out of a total of 4745 days or 67% of the time.
3. Greater than 50 cfs of flow occurred the entire summer (May 15 to September 15) in 10 of 13 years or 77% of the time.
4. Considering only the sustained maximum demand (SMD) period (May 15 to September 15), greater than 50 cfs of flow occurred 1300 days out of a total 1560 days or 83%. (Note that the September 15 date may be

BIG SIOUX RIVER FLOWS
RAW WATER PUMPING STATION
FIGURE 2.2.1



somewhat conservative for the late SMD date since the start of school/football practice, etc. decreases the availability of faucet turners and hose movers for watering lawns.)

5. Only in 1975, 1976, and 1977 (period identified as 100 year drought) was the river flow less than 50 cfs for greater than 60 days of the summer demand period.

2.3 Availability of Supply

As indicated from a comparison of all the key points in the previous section, it appears that a surface water supply of greater than 50 cfs would be available an average of 67% of the time. A more important observation is that the supply would be available 83% of the high demand period of the summer months. During the dry years such as those identified in Table 2.1.3 (1975, 1976, 1977, and 1981) the most probable dates the river flow could decrease below 50 cfs are around mid July. During these periods the City could rely on heavy pumpage from the aquifer for a period of 60-65 days. The aquifer would be fully "rested" or recovered at the start of this period due to use of the surface water so it should be more likely to meet these peak summer demands. It must be noted, however, that the SMD period would probably be followed by more normal demand on the aquifer until the spring runoff period and the source could then be switched back to surface water. Further discussion of this issue is presented in Section 3.7.

SECTION 3 - PUMP STATION CAPACITY

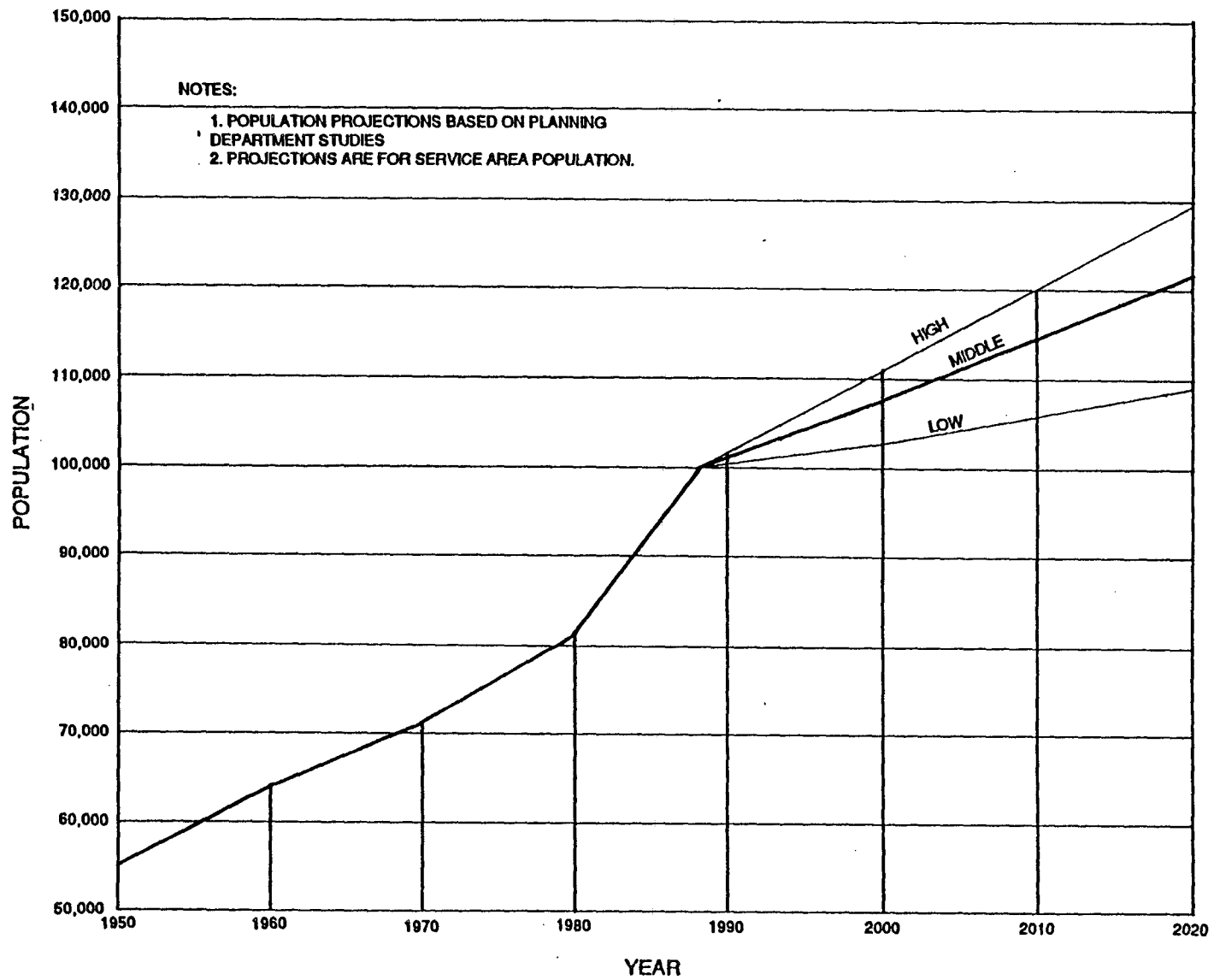
3.1 Population

The design demand for determining the size of the river intake pump station will be based on the population growth of the City. In projecting this growth and the probable service population for the 2010 design year of this project, past census data and city projections were reviewed. Historical population data for the City of Sioux Falls shows a continuous, moderate growth rate. However, significant surges in population have occurred in recent years due to the influence of significant economic growth, relocation to Sioux Falls of some large employers and annexation of areas adjacent to the City. This surge has resulted in growth rates of up to 3 percent per year through the 1980's. The City Planning Department is anticipating a more moderate growth rate of 1 to 1 1/2 per year for the foreseeable future. Table 3.1.1 and Figure 3.1.1 presents the population projections based on these assumptions. Based on this information we believe a reasonable population to use for design for the year 2010 would be 115,000.

TABLE 3.1.1

POPULATION PROJECTION

<u>Year</u>	<u>Middle</u>	<u>Low</u>	<u>High</u>
1980	81,300		
1985	93,700		
1990	101,000	100,000	102,000
2000	108,000	103,000	111,000
2010	113,000	105,000	119,000



SIoux FALLS
RAW WATER PUMPING STATION
POPULATION PROJECTIONS
FIGURE 3.1.1

3.2 Per Capita Water Usage

The average water consumption per person has been steadily increasing over the period detailed records have been kept. An extensive analysis of this parameter was completed in the 1985 Water Supply Program Report. The trend is verified with additional data in recent years and is shown in Table 3.2.1.

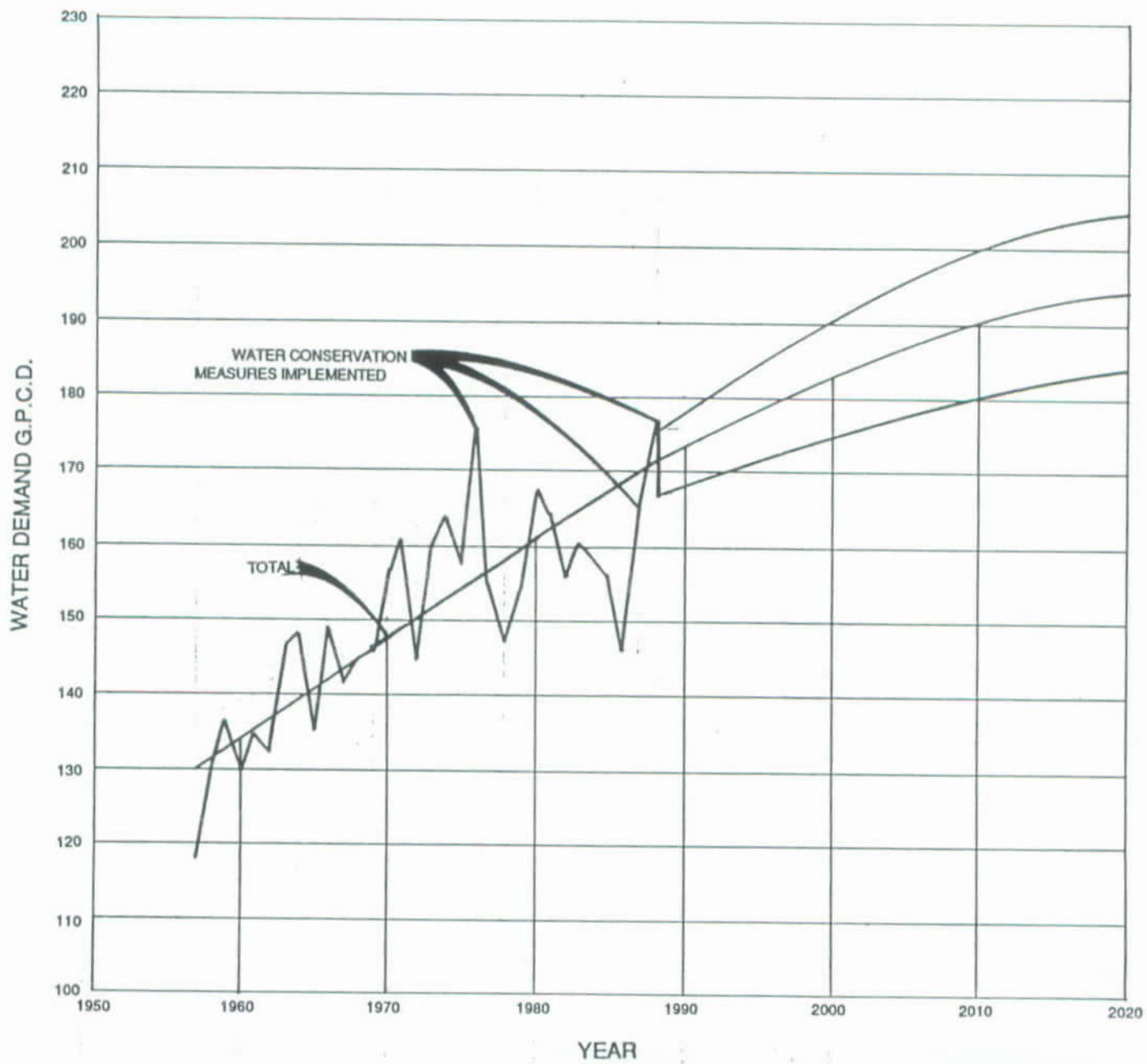
TABLE 3.2.1

PER CAPITA WATER USAGE

<u>Year</u>	<u>Usage (mgd)</u>	<u>Usage (gpcd)</u>	<u>Rainfall</u>	<u>Comments</u>
1988	17.3	175	19.14	Water Restrictions
1987	16.3	166	18.66	Water Restrictions
1986	14.4	152	30.49	
1985	13.5	145	27.16	
1984	13.8	153	29.64	
1983	13.7	161	26.95	
1982	12.7	153	33.26	
1981	13.5	164	18.11	
1980	13.6	167	13.75	
1979	12.3	153	32.24	
1978	11.7	148	23.17	
1977	12.1	155	31.62	
1976	13.4	176	11.42	Water Restrictions
1975	11.8	157	26.10	
1974	12.0	163	17.03	

Note: Additional data on water consumption and per capita usage is available, dating back to 1957. This additional listing is presented in the 1985 Water Supply Study and is shown on Figure 3.2.1.

The per capita water consumption data is impacted to a minor degree by the delivery of water to Lincoln County. The quantity of water delivered has increased from 0.13 MGD in 1983 to 0.27 MGD in 1988. Consequently this reduces the per capita demand by 2-3 gpcd. The City's contract with Lincoln County allows a maximum quantity of 116,800,000 gallons per year or an average of 0.32 MGD. This equates to approximately 1,800 population equivalent or an additional 2-3 gpcd. Lincoln County has in-system storage



SIoux FALLS
RAW WATER PUMPING STATION
PER CAPITA WATER DEMAND

FIGURE 3.2.1

which allows delivery to occur on an average basis or during "off peak" hours which helps reduce the peaking factor impact. This is already included in the City's peak day data thus use of the overall system per capita data is recommended since it provides the most accurate data.

The greatest impact on per capita demand is the amount of annual precipitation. During wet years lawn watering is less which reduces the per capita usage. Conversely dry years have significant increases in per capita usage.

Overall the rate of growth of per capita consumption is slowing, however, some continuation in the increase is highly probable. Also, the impact due to watering restrictions during 1987 and 1988 is difficult to predict. The per capita values for those years would have been higher if water was available. Using the historical data and considering the factors mentioned the most probable per capita usages have been projected as shown in Table 3.2.2.

TABLE 3.2.2

PROJECTED PER CAPITA USAGE

Gallons Per Capita Per Day

<u>Year</u>	<u>Low</u>	<u>Average</u>	<u>High</u>
1990	168	173	178
2000	175	183	190
2010	180	190	200

Based on the above, the recommended average annual consumption to be used for design is 190 gpcd for the year 2010.

3.3 Maximum Day Requirements

The demand for water is influenced by numerous factors including the time of year and precipitation. Since the demand varies due to these factors the determination of the peak day usage is required in sizing the pumping equipment. Table 3.3.1 presents the historical peak day pumping requirements compared with average day demands.

TABLE 3.3.1
PEAK DAY FLOWS

<u>Year</u>	<u>Average Day (MGD)</u>	<u>Peak Day (MGD)</u>	<u>Ratio</u>
1988	17.3	33.0 (Restrictions)	1.91
1987	16.3	32.7 (Restrictions)	2.01
1986	14.4	29.4	2.04
1985	13.5	28.1	2.08
1984	13.8	28.6	2.07
1983	13.7	27.9	2.04
1982	12.7	26.2	2.06
1981	13.5	25.5	1.89
1980	13.6	26.1	1.92
1979	12.3	23.8 (Restrictions)	1.94
1978	11.7	21.3	1.82
1977	12.0	23.8	1.97
1976	13.4	24.9	1.83
1975	11.8	27.7	2.35
1974	12.0	26.5	2.21
1973	11.6	23.2	2.00

As can be seen from the calculated ratios the peak day pumpage ratio normally varies from 1.9 to 2.1 of average flows. It did peak at 2.35 in 1975 and early data indicates a peak of 2.47 in 1960. Peaks of this greater magnitude can occur, however, as the size of the overall system increases the peak day ratio is less likely to reach those figures. Based on a review of the above it is interesting to note that the rough estimate of peak day for 1988 would be 38 to 40 MGD if the imposed water restrictions had not been in force. The recommended peak day ratio to be used for design is 2.05.

3.4 Summer/Drought Year Consumption

The summer demand, in particular during dry years, increases substantially. The City maintains water pumpage records for winter and summer seasons thus a review of six month summer demands for recent dry years is possible. Table 3.4.1 presents a comparison of the average annual demands compared to the six month summer demands.

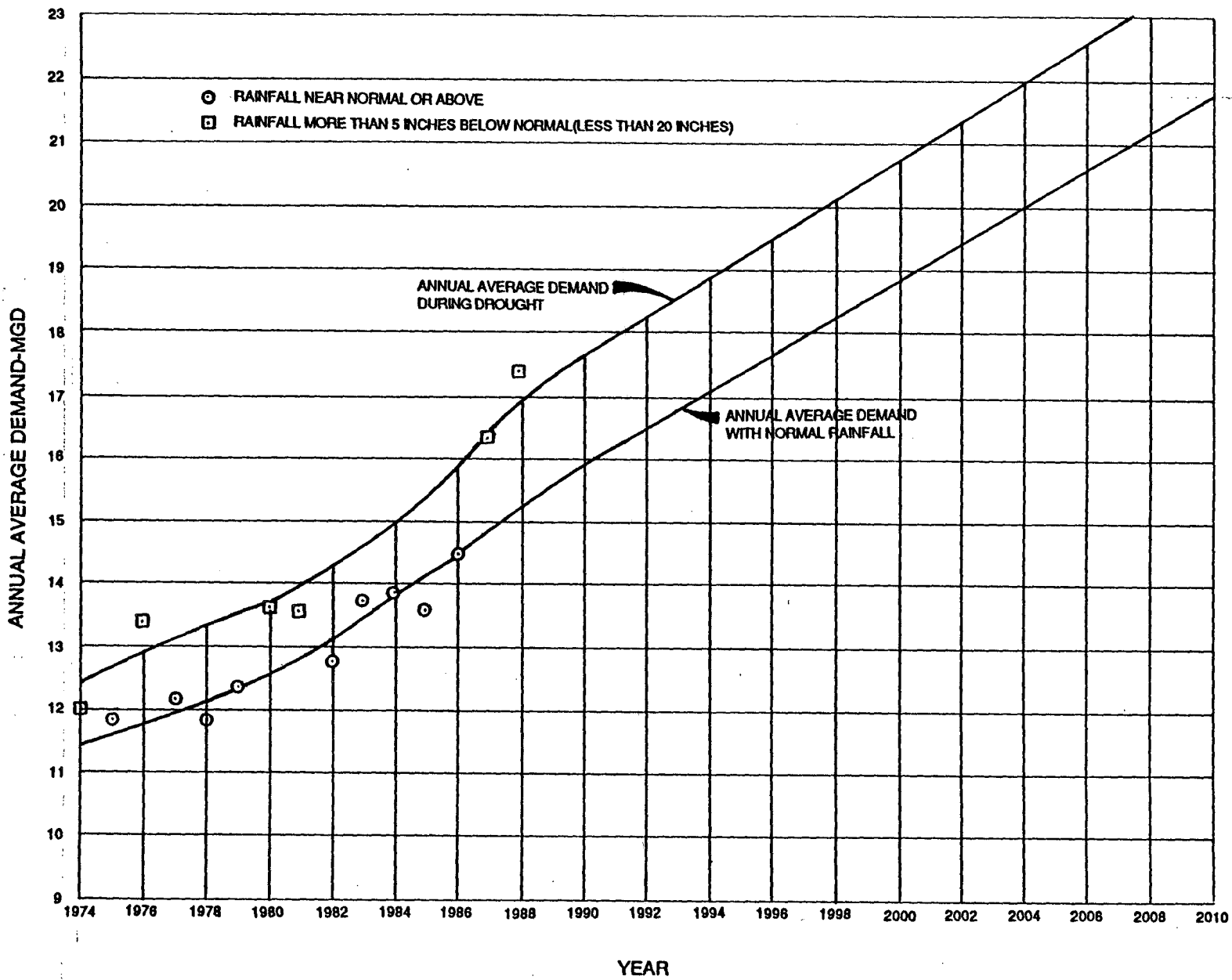
TABLE 3.4.1
SUMMER DEMAND (MGD)

<u>Year</u>	<u>Average Annual</u>	<u>Summer Demand (April-October)</u>	<u>Ratio to Average</u>	<u>Maximum Month</u>	<u>Ratio to Average</u>
1988	17.3	19.8	1.15	27.5	1.59
1987	16.3	17.5	1.07	22.7	1.39
1986	14.4	16.1	1.11	21.4	1.48
1985	13.5	14.9	1.10	20.74	1.53
1984	13.8	15.4	1.12	20.3	1.47

The average usage during maximum month typically increases at a ratio of 1.40 to 1.60 of annual average usage. For the full six month summer periods, average demands as shown in Table 3.4.1 are approximately 1.10 times larger than the annual demand. The impact during dry years such as those listed in the Table 3.4.1 in which precipitation is 5 inches or more below normal is shown in Figure 3.4.1. During these conditions a significant increase in the overall annual consumption is experienced over that which would normally be experienced. Typical increases could be expected to range from 1.10 to 1.15 times the average annual flows. This may not seem large, however on an annual basis this equals as much as 600,000,000 to 900,000,000 gallons of water.

SIOUX FALLS
 RAW WATER PUMPING STATION
 WATER DEMAND

FIGURE 3.4.1



The records were also reviewed for monthly plant pumpage over the last three years to further define seasonal demand. This information is presented in Table 3.4.2. Rainfall was above normal in 1986 and substantially below normal in 1987 and 1988.

TABLE 3.4.2
SEASONAL DEMAND
Average Usage (MGD)

<u>Month</u>	<u>1986</u>	<u>1987(1)</u>	<u>1988(1)</u>
January	11.6	12.3	13.6
February	11.6	12.0	13.7
March	11.8	12.5	13.6
April	12.7	16.6	14.8
May	13.4	17.3	20.0
June	17.8	22.7	27.6
July	21.4	21.2	24.1
August	18.5	20.5	19.2
September	14.5	18.0	17.3
October	14.1	15.7	15.7
November	12.0	13.5	13.7
December	12.1	12.8	13.4
Average Demand	14.3	16.2	17.3
SMD Demand During (May 15-Sept. 15)	17.9	20.5	22.4
Ratio to Average	1.25	1.25	1.30
SMD Demand During (June and July only)	19.6	22.0	25.85
Ratio to Average	1.37	1.35	1.49

(1) Water restrictions were imposed during peak summer demands of these years.

3.5 Recommended Pump Station Capacity

Based on the information presented in all the previous sections the recommended firm capacity for the design year 2010 for the pump station is shown in the following Table 3.5.1:

TABLE 3.5.1

PUMP STATION DESIGN PARAMETERS

Population	- 115,000
Per Capita Usage	- 190 gpcd
Peak Day Ratio	- 2.05 x Average

Average Annual Capacity = $115,000 \times 190 \text{ gpcd} = 21.9 \text{ MGD}$

Maximum Day Capacity = $115,000 \times 190 \text{ gpcd} \times 2.05 = 44.8 \text{ MGD (Firm)}$

Since water restriction did limit the peak to average day ratio in 1987 and 1988, it is recommended the station be designed with the space for a future pump to provide increased capacity to 60 MGD if required at a later date. The increased size of the building could be provided now at a nominal increase in cost.

3.6 Surface Withdrawal Permit Request

As shown in Table 3.5.1 the average annual consumption for the design year is 21.9 MGD. When considering the impact of drought year consumption increases, as discussed in Section 3.4 it is recommended that the permit request allow for 120% of average annual usage or 26.3 MGD or 9.6 billion gallons. This equates to approximately 29,500 acre feet, thus we recommend the request be made for 30,000 acre feet per year.

The City currently has future use permit (Permit No. 3981-3) in the amount of 50,000 acre feet per year. Thus the City request would exercise 60% of that future use permit. Based on the data regarding population growth and consumption this amount should be adequate through the year 2010.

The City's current future use permit contains a clause which limits withdrawals when river flow is less than 50 cfs. This would severely limit the use of the surface water source when flows would be large enough in the river to meet demand. The majority of the water which would be withdrawn from the river for a potable water supply would be returned to the river via the wastewater treatment facilities. Therefore, there is a small net loss in water from the river. The two significant wastewater discharges which exist in the City and are listed in Table 3.6.1.

TABLE 3.6.1

WASTEWATER DISCHARGES

<u>Discharge</u>	<u>Flow (MGD)</u>	<u>CFS</u>
City of Sioux Falls	12 - 15.0	18.5-23.2
Morrell's Facility	<u>2.5 - 3.0</u>	<u>3.9-4.7</u> ? More than diverted i.e. = 2.2 cfs
Total	14.5-18.0	22.5-27.9

Thus, approximately 50% of the minimum cfs requirement is provided by the wastewater discharges identified above. In addition, the drainage area increases dramatically from the point above the City where the river intake would be to the point below the City as indicated in Table 3.6.2.

TABLE 3.6.2

DRAINAGE AREAS

<u>Location</u>	<u>Drainage Area (sq.mi.)</u>
Big Sioux - Dell Rapids (above City)	5060
Big Sioux - North Cliff Ave.	5770
Big Sioux - Brandon (below City)	5810

As indicated by Table 3.6.2, the approximate increase in drainage area through Sioux Falls is 750 square miles. Skunk Creek drainage area and the entire City of Sioux Falls contribute significantly to the River downstream of the proposed diversion point. Also, numerous smaller drainage areas

such as Slip-up Creek, Silver Creek and others flow into the Big Sioux River downstream of the Dell Rapids location. In addition to the increase in drainage area a study of historical flows in the river verify the anticipated correlation between precipitation and river flows. Thus drainage area and nature have a far greater impact on downstream river flows than any withdrawals by the City.

Since the City simply uses and returns the majority of water withdrawal from the river it is recommended the City pursue the elimination of the clause in the permit which restricts withdrawals when river flows are below 50 cfs. As an alternate the location of measurement should be clarified to be downstream of the City to a location near Brandon. This 50 cfs limitation should be pursued as a separate request so that the permit for exercising the future use permit for quantity is not delayed for reasons involving this secondary criteria.

*losing stream from Sioux Falls to
Brandon, Mar to Oct period,
-1 to -123 cfs @ 50 percentile*

3.7 Future Aquifer Demand/Analysis

Section 2 reviews the past flow records and projects the availability of supply for future conditions. As indicated the normal dry weather low flow would occur approximately July 15th. The earliest recorded was June 1st. The duration can extend to approximately March 15th with the worst case being approximately April 15th. Thus the resultant stress on the aquifer for the design year is calculated based on a sustained maximum demand (1.35 x Average) occurring to September 15th with normal demand occurring on through the winter months (Table 3.7.1).

TABLE 3.7.1
POSSIBLE AQUIFER DEMAND

Year 2010

<u>Case</u>	<u>Sustained Maximum Demand</u>	<u>Period</u>	<u>Average Demand</u>	<u>Period</u>
Drought	29.5	60 days	21.8	180 days
Extreme	29.5	105 days	21.8	210 days

Past studies have indicated the aquifer is capable of yielding 24 MGD on an average annual basis, however it does not address the seasonal impact and variations in water demand. We recommend a simulation model be performed starting with a "rested aquifer" at 29.5 MGD for 105 days, followed by 21.8 MGD for 210 days. If the model shows that the aquifer can support this consumption, the SMD and average values should be raised based on the projected consumption beyond the year 2010. If the model indicates excessive drawdowns, the demand should be decreased in accordance with anticipated seasonal consumption, to determine the usage it can support when considering summer demands. This would be extremely beneficial and is critical for determining the approximate year in which a supplemental source of supply must be available.

SECTION 4 - WATER QUALITY

The utilization of a surface water source to supplement the existing well supply will require treatment of a raw water with different and varying characteristics as compared to the ground water source presently utilized. The surface water characteristics will play an important role in determining the treatment process requirement and capability of the existing water purification plant to adapt to the changing water source. The purpose of the analysis in this predesign report is to review and determine the short term chemicals required so that the pumping station design may proceed as rapidly as possible. A more detailed review in a separate report entitled "Long Range Treatment Plant Impact" will review the requirements and criteria for using surface water on a long range basis and the implications of the Safe Drinking Water Act amendments.

4.1 Raw Water Quality

Water quality in the Big Sioux River has been monitored regularly by the USGS for a significant period of time and information on the majority of key parameters is available. Table 4.1.1 summarizes several years of this data as well as comparing it to the average information on the raw water from the well supply for 1987.

TABLE 4.1.1

RAW WATER QUALITY SUMMARY

Parameter	1987 Well	Surface Water		
	Water	High	Median	Low
pH	7.2	8.8	8.0	7.1
Temperature (°C)	11-13	30	10	0
Turbidity (NTU)	12	65 (330)*	20	1
F. Coliform (Col/100 ml)	---	3000 (6000)*	300	60
Hardness (mg/l as CaCO ₃)	548	650 (940)	420	70
Non-Carbonate		380	210	40
Hardness (mg/l as CaCO ₃)				
Alkalinity (mg/l as CaCO ₃)	285	340	210	80
Sulfate (mg/l CO ₄)	245	330	210	100
Sodium (mg/l Na)	20	65	35	8
Dis. Fluoride (mg/l F)	0.3	0.5 (1.5)*	0.3	0.1
Nitrate (mg/l-N)	0.25	3.6 (7.5)*	0.8	0.0
Arsenic (ug/l as As)	---	9	4	0
Barium (ug/l as Ba)	---	120	95	72
Cadmium (ug/l as Cd)	---	2	1	0
Iron (ug/l as Fe)	3000	4500	600	60
Manganese (ug/l as Mn)	1900	700	350	90
Lead (ug/l as Pb)	---	140	10	1
Mercury (ug/l as Hg)	---	.3	0	0
Selenium (ug/l as Se)	---	7	2	0
Silver (ug/l as Ag)	---	21	0	0
Dissolved Solids (mg/l)		800	580	200
Suspend Solids (mg/l)	---	260 (1420)*	60	1
TOC (mg/l)	---	38	10	1.6
COD (mg/l)	---	91	33	0

*Indicate very limited extreme value

As indicated from Table 4.1.1 the surface water supply has some similar characteristics to the ground water. Typically the surface water has slightly higher medium values for turbidity, nitrates and sodium.

Coliforms, suspended solids and TOC as expected for a surface water are present in significant quantities. The median values for hardness, sulfate, iron, manganese are actually lower than the ground water source.

A surface water, inherently has large fluctuations in many parameters, particularly during periods of spring snow melt and rainfall events. These fluctuations must be evaluated to determine their impact on the water

treatment plant, both when blended with the existing ground water source and when treated separately. Figures 4.1.1 and 4.1.2 show the normal seasonal variation of some of the key water quality parameters.

The general characteristics of the proposed raw water appear to be within acceptable levels for a surface water supply. The following parameters are of particular importance in determining the treatment process modifications required.

Temperature: Impacts Chemical Dosages/effectiveness

Turbidity/Suspend Solids: Coagulants/Coagulant Aids

Taste/Odor/Color: Stripping or oxidation

Hardness: Lime Softening as required

Iron and Manganese: Lime Softening or Oxidation

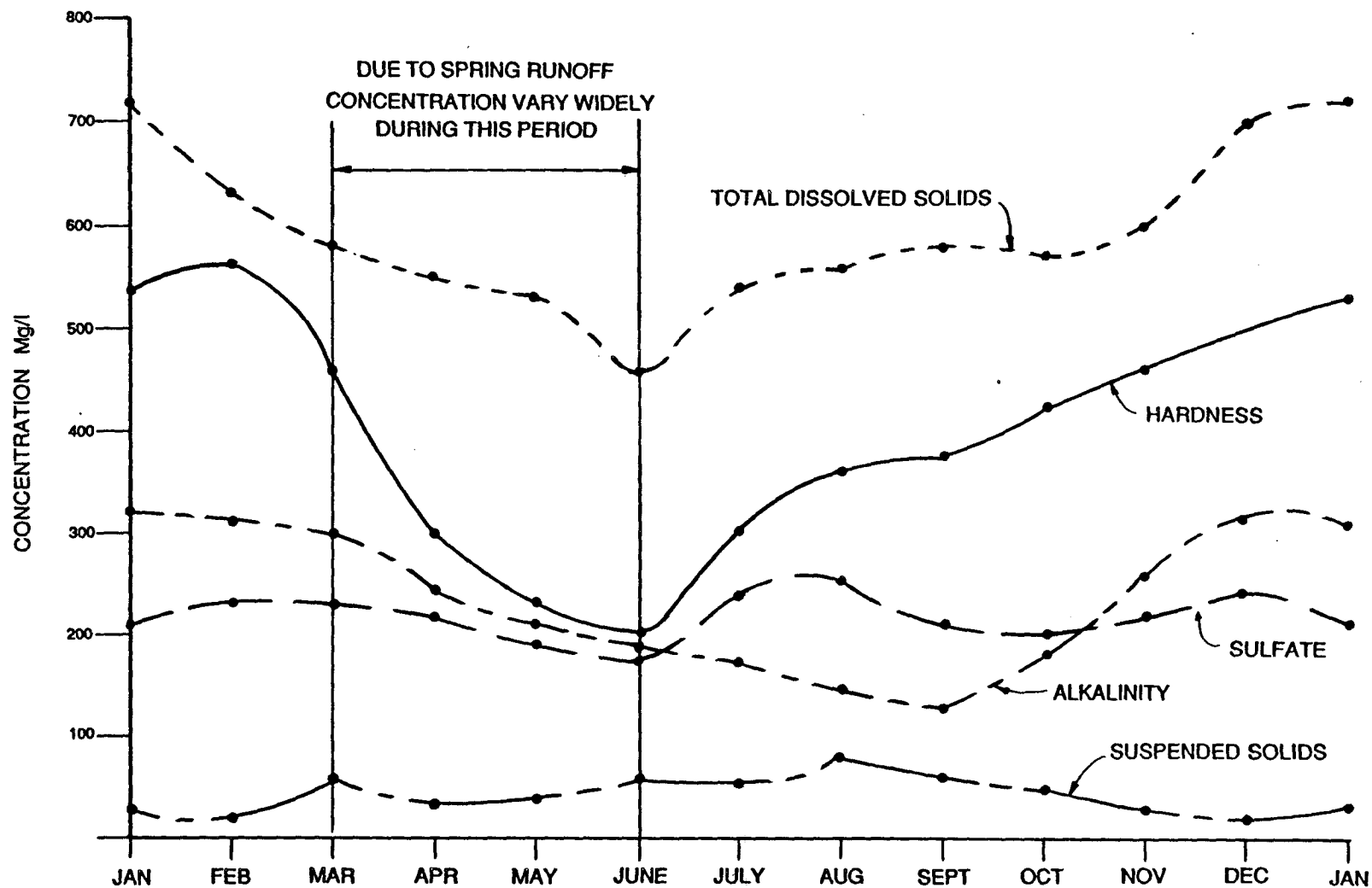
Organic Compounds: Coagulation/Oxidation

Fecal Coliforms: Disinfectants

4.2 Finished Water Quality

The treated water from the existing water purification plant has only trace quantities of iron and manganese, yet has a relative high hardness and sulfate content. The alkalinity is quite low and pH is above neutral. Table 4.2.1 shows the 1987 finished water quality characteristics. Treatment required for the surface water should meet or exceed many of these existing characteristics.

BIG SIOUX RIVER
SEASONAL WATER QUALITY
FIGURE 4.1.1



BIG SIOUX RIVER
SEASONAL WATER QUALITY
FIGURE 4.1.2

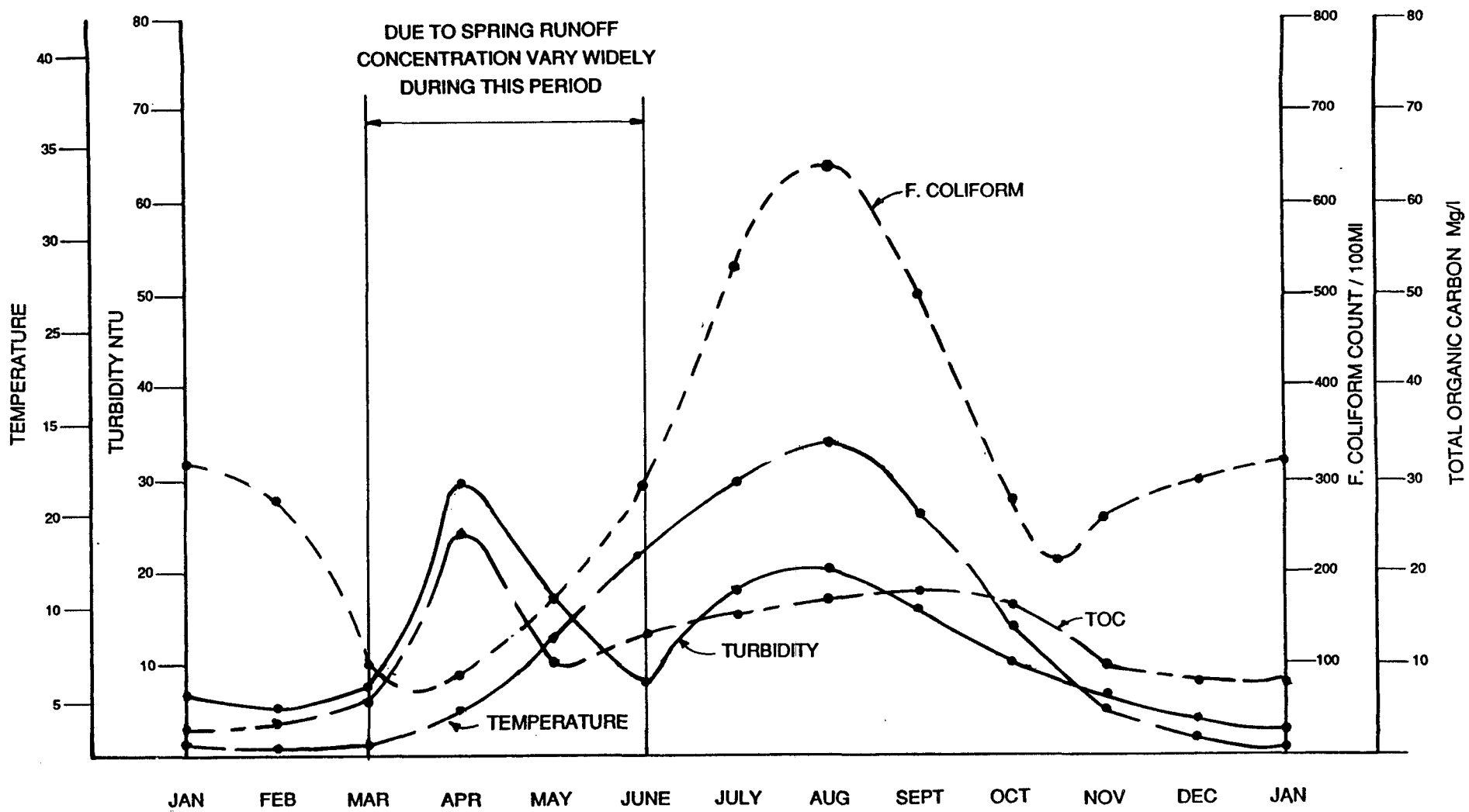


TABLE 4.2.1
EXISTING FINISHED WATER QUALITY (1987)

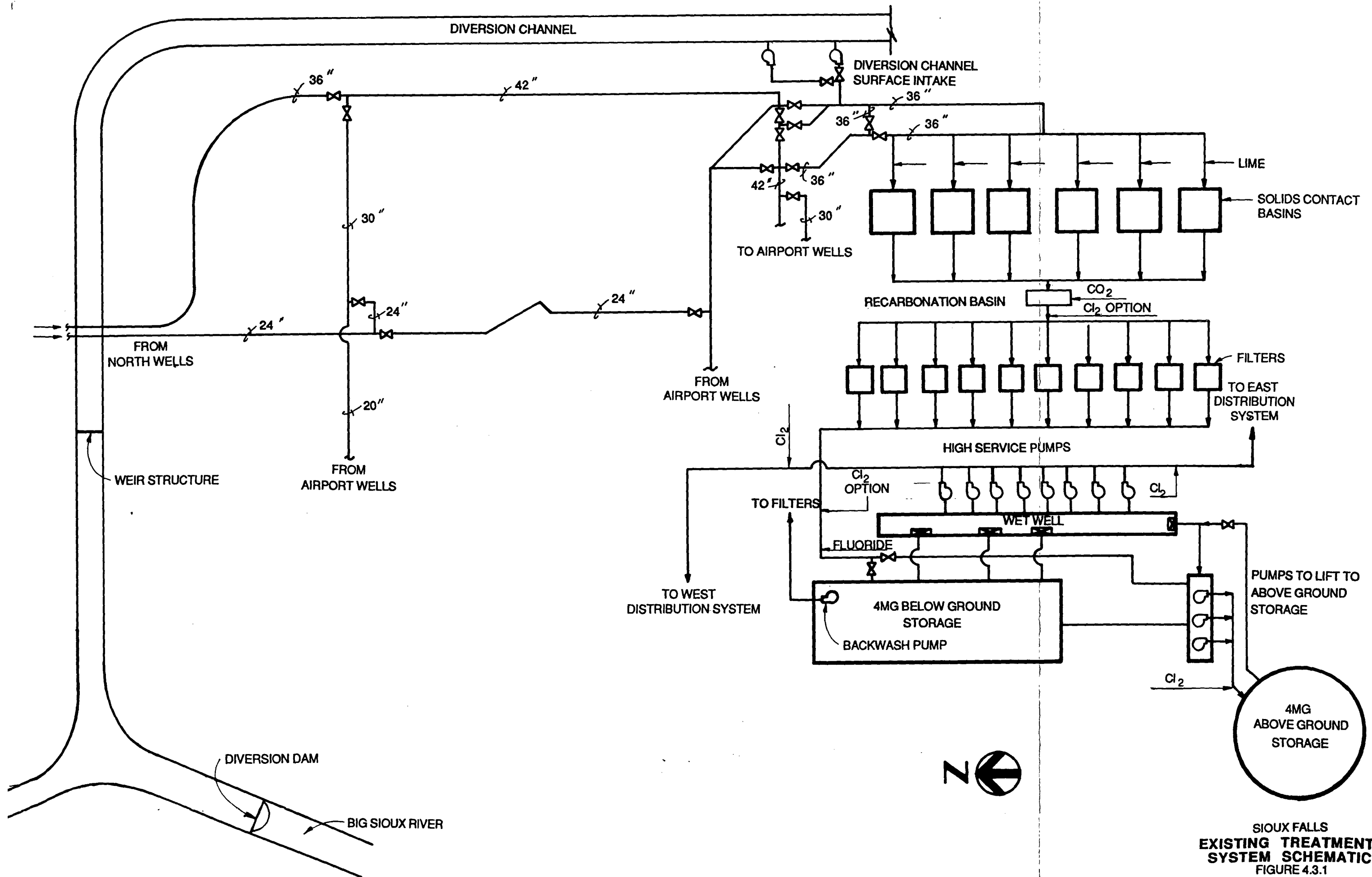
<u>Parameter</u>	<u>Characteristics</u>
Total Hardness as mg/L CaCO ₃	302
Total Hardness as gpg	18
Calcium as mg/L CaCO ₃	144
Calcium as gpg	8
Magnesium as mg/L CaCO ₃	158
Magnesium as gpg	10
Iron as mg/L Fe	0.05
Manganese as mg/L Mn	0.02
Alkalinity as mg/L CaCO ₃	39
pH	8.74
Nitrate as mg/L Nitrogen	0.25
Fluoride as mg/L F	1.22
Turbidity NTU	0.25
Sodium as mg/L Na	20
Sulfate as mg/L SO ₄	245

4.3 Treatment Impacts

The feeding of surface water into the Sioux Falls Water Purification Plant will have a significant impact on the treatment process which need to be used to provide adequate treatment. A schematic layout of the existing plant and chemicals used is shown in Figure 4.3.1. The use of surface water to supplement the groundwater supply will impact the plant's existing treatment process due to the the following changes in raw water characteristics:

- Introduction of organic constituents
- Increased solids loading
- Seasonal and climatic water quality changes
- Cold water temperatures
- Varying total hardness level

The presence of organics in the raw water supply poses potential color, taste and odor removal challenges for the treatment process. Increased



SIOUX FALLS
 EXISTING TREATMENT
 SYSTEM SCHEMATIC
 FIGURE 4.3.1

solids loadings at the plant will require improved sedimentation basin performance, as well as increasing the amount of waste sludges generated. Water quality changes caused by climatic events or seasonal variations will necessitate that plant operations be adjusted to adapt to the changes. Low water temperatures that occur during the winter months will inhibit treatment process chemical reactions, particularly those associated with the solids removal processes at the plant. Fluctuating hardness levels in the surface water source will also necessitate that the plant softening process be routinely adjusted to optimize treatment and maintain a consistent water quality.

4.3.1 Surface Water Pretreatment

Surface waters are generally pretreated with a strong oxidizing agent before entering the treatment plant. Introduction of an oxidizing agent can accomplish taste and odor control as well as disinfection. There are several chemicals which can be used for this pretreatment:

- Chlorine
- Potassium permanganate
- Activated carbon
- Chlorine dioxide
- Ozone

4.3.2 Chlorine

Chlorine has been used to control taste and odor problems by the oxidation of the taste and odor compounds. Low dosages of chlorine (0.2 mg/l) have been used to prevent the growth of

odor-causing microorganisms in the treatment plant and distribution system. In order to remove taste and odor compounds (T&O) such as geosmin and MIB, it is necessary to add chlorine at dosages of 20 to 50 mg/l. These high dosages require that dechlorination be implemented to remove the high chlorine residual. Certain compounds such as phenols have an intensified taste and odor when they are chlorinated. In addition, chlorine can form trihalomethanes (THM) if organics are not removed from the water prior to chlorination.

In a recent study of compounds which oxidize taste and odor substances, it was found that chlorine was not as effective as chlorine dioxide or ozone. Although it is not as effective as some oxidants, chlorine is much less expensive. However, the use of chlorine for taste and odor control is not recommended because of the potential to create THM's, and other chloroorganics which could exceed the EPA's allowable limits. Also chlorine will require high dosages, with subsequent dechlorination, and will have the potential to create chloro-derivatives which intensify tastes and odors.

4.3.3 Potassium Permanganate

Potassium permanganate is an oxidizing chemical which has been used to control taste and odor compounds in drinking water. The manganese in permanganate is reduced from an oxidation state of +7 to +4, which results in insoluble manganese dioxide and a color change from pink or purple to yellow or brown, depending on

relative concentrations. Potassium permanganate will treat taste and odor compounds by two methods: oxidation and adsorption. Adsorption of taste and odor compounds occurs on the insoluble manganese dioxide. Studies have shown that manganese dioxide precipitate is more effective at removing taste and odor compounds (by adsorption) than the oxidizing compound potassium permanganate. Potassium permanganate must first be reduced by oxidizing another compound before the precipitate of manganese dioxide is formed. A recent study concluded that both potassium permanganate and manganese dioxide were not as effective as ozone or chlorine dioxide for removing geosmin and MIB. However, potassium permanganate can be effective when used in conjunction with powdered activated carbon.

For the most effective use of potassium permanganate, it is important that it be fed as early as possible in the treatment system. If it is not possible to feed at the raw water intake, the potassium permanganate should be fed either ahead of or into the rapid mix. The pink color should not go very far past the rapid mix because of the possibility of colloidal manganese dioxide passing through the sedimentation basin and filter, resulting in a yellow color to the finish water. By limiting the pink color to the raw water intake any manganese dioxide will be coagulated and removed by sedimentation.

It is also important that potassium permanganate be fed ahead of any chlorine. The oxidation of organics by potassium

permanganate will reduce the amount of chlorine being used and will minimize the chances of forming chloro-derivatives, which may be more offensive than the original compounds. Carbon can also be fed after the potassium permanganate is consumed, because potassium permanganate consumption increases when fed together with carbon. Potassium permanganate dosages from 0.5 to 2.5 mg/l are usually sufficient to control most oxidizable taste and odor compounds.

4.3.4 Activated Carbon

Activated carbons are carbonaceous materials subjected to selective oxidation to produce a highly porous structure. This porous structure causes the carbon to have large surface areas in small volumes of carbon (in the range of 500 to 1500 m²/g). Carbon removes taste and odor compounds by absorbing them to the porous surfaces of the carbon. The majority of surface area lies within the small pores (less than 50 angstroms) and thus, external surface area of carbon is negligible in comparison. Therefore, the adsorption capacity of a given carbon is independent of the particle size. Various carbons have vastly different adsorption characteristics and comparative testing should be performed to determine which carbon has the best taste and odor removal properties. Powdered activated carbon (PAC) is typically used for taste and odor control applications. Granular activated carbon is also available but is generally used for more severe conditions of organics contamination and also requires carbon bed facilities.

The point of application of PAC is very important for effective taste and odor control. The point selected should ensure that: (a) adequate mixing is provided, and (b) adequate contact time is provided (5-15 minutes). Chlorine should be fed after carbon addition unless it has been determined that the chlorine does not effect the adsorption properties of the carbon. Application of PAC prior to and during the rapid mix appears to provide effective removals. Application of PAC during flocculation or sedimentation is not as effective, but is often applied at this location to avoid interference with potassium permanganate.

A typical PAC dosage for taste and odor control averages 3 mg/l. The spent carbon is collected in the sedimentation basin or is filtered out of the finish water and leaves no residue. There appears to be no toxicity associated with the use of PAC.

4.3.5 Chlorine Dioxide

Chlorine dioxide has an oxidative capacity of approximately 2.5 times that of chlorine. It is an unstable gas which must be produced on site, and is typically produced by the reaction of chlorine gas and sodium chlorite solution. Chlorine dioxide does not produce trihalomethanes as does chlorine. However, the EPA has indicated that chlorite ion (an end-product of chlorine dioxide application) may cause health problems related to the oxidation of hemoglobin (methemoglobinemia). Because of this concern, the EPA has suggested a combined residual limit of 1.0

mg/l. It has also been suggested that this dosage limit may be lowered in the future.

Chlorine dioxide is particularly effective at controlling phenols, chlorophenols, and other cyclic compounds (geosmin and MIB) which cause taste and odor problems. In a recent study of removing five earthy-musty taste and odor compounds ⁽⁴⁾, chlorine dioxide was shown to be slightly more effective than ozone, chlorine, and potassium permanganate.

Typical dosages of chlorine dioxide range from 0.2 to 1.0 mg/l, depending on the concentration of taste and odor compounds. Because the EPA is presently considering lowering the limit on chlorine dioxide in the finished water, the use of chlorine dioxide for taste and odor control could be limited to low taste and odor concentrations.

4.3.6 Ozone

Ozone is the strongest oxidizing agent used in water treatment. It is unstable and must be produced at the point of application. Ozone is produced by passing either air or oxygen between electrically charged surfaces. Since ozone is unstable, it cannot be stored and is therefore produced on an as needed basis.

Ozone will oxidize many organic compounds and may produce mutagenic compounds as end-products. The toxicity of ozone compounds has not been fully examined at this time, but it

appears there is little concern over this matter. Typical dosages of ozone range from 1.0 to 4.0 mg/l. Ozone facilities include a contactor with fine bubble diffusers to inject ozone into the raw water. The contactor is covered to prevent the release of off-gases and to contain unused ozone for subsequent thermal or catalytic destruction. Power requirements for ozone generation normally range from 3 to 10 KWh per pound of ozone generated. Due to the pending changes in the Safe Drinking Water Act requirements on THM, ozone should be considered as a future option. However, construction of an ozone system is not warranted at this time.

4.3.7 Pretreatment Recommendation

In order to meet the short-term treatment requirements of the plant, the use of potassium permanganate is recommended for pretreatment of the surface water supply. This chemical is currently being used for this purpose on the small amount of surface water which is being treated at the plant. As discussed earlier, it can be fed at any point ahead of the plant, but we recommend that it be fed at the pump station. This will allow for a long mixing and contact time in the pipelines.

Feed rates for potassium permanganate normally vary from 0.1 to 5.0 mg/L with higher rates sometimes required when abnormally high levels of organics are present. The City of Sioux Falls is currently conducting bench scale tests to determine the potassium permanganate demand of the surface water. Preliminary indications

point to a feed rate of 2.0 to 3.0 mg/l. The type and design parameters of the equipment used to feed the chemical will be discussed in Section 6.

4.3.8 Treatment Plant Impact

To deal with the high solids loads which will be encountered in the surface water, the existing softening process must be modified. Currently the small amount of surface water which is being treated utilizes conventional lime softening. As the ratio of surface to ground water is increased in the future, the ability of the existing lime softening process to remove turbidity from the raw water will be reduced. The use of a coagulant aid to assist raw water clarification during the lime softening process may be needed to avoid turbidity carryover in the solids contact basins. In addition, there will be times when softening of the surface water will not be required because the raw water hardness will already meet the finished water requirement. During these times which normally occur in April through May, effective coagulation will be needed.

The lime softening process could be converted to a conventional clarification process to treat surface waters during periods of low hardness. However, this would require a significant modification to the existing treatment process to permit it to operate successfully. The existing treatment process does not employ flocculation, a key component of the conventional clarification process. In addition, the lime softening sludge layer maintained

in the solids contact units is more stable than that for a clarification process due to the higher density of the lime softening sludge that is present.

The clarification process produces sludges that are normally composed of lighter density materials. The best application of solids contact units is for softening of well waters of a constant quality at a uniform rate. Solids contact units are normally rated with surface overflow rates 1.5 to 2.0 times higher for softening than for clarification processes. This concern, along with the lack of flocculation capability, greatly limits the applicability of the solids contact units for clarification of the surface water without the lime softening process.

Due to the potential concerns associated with utilizing the existing plant facilities for a clarification process during periods of low surface water hardness, strong consideration must be given in the short-term to utilizing the lime softening process under all conditions. Combined lime softening and clarification provides an effective means to treat the ranges in surface water quality anticipated. Potential problems with taste and odor control and floc formation greatly limit the potential use of only a clarification process. For the long-term, the potential use of presedimentation basins may make the clarification process more attractive.

The City of Sioux Falls is currently performing jar testing on three coagulant chemicals to determine which would be most effective. These three are aluminum sulfate, ferric chloride and ferric sulfate and are commonly used for water treatment. The results of Jar Testing for these coagulants will be included in a separate report "Long Range Treatment Plant Impacts."

The results of the Jar Testing will recommend use of one of the three coagulant chemicals and the best dosage to accomplish coagulation. Dosages for all three generally range from 5 mg/l to 50 mg/l. For the long term plant improvements, polymer should also be considered in conjunction with the coagulant to minimize the chemical costs and maximum treatment. In addition, some revisions to the sludge withdrawal and pumping system may be necessary to deal with the heavier surface water sludges. These items will also be discussed in the separate report "Long Range Treatment Plant Impacts".

SECTION 5 - INTAKE/PUMPING STATION LOCATION

The raw water intake and pumping station location must consider numerous factors such as the water availability, Corp of Engineer Studies on Diversion Channel, quality/sedimentation, impact on the Airport Authority, proximity to existing utilities (power and raw water transmission lines), capital cost and operational considerations and costs.

5.1 Alternative Sites

Three sites are considered as possible locations for the intake structure and pumping station. Figure 5.1.1 identifies the possible locations. They are as follows:

Site A: South side of Big Sioux River near flood control gates;
north portion of Airport property.

Site B: North side of Diversion Channel near the weir structure;
also located on Airport property.

Site C: East side of Diversion Channel behind Water Purification
Plant. Located on City property.

5.2 Site Considerations

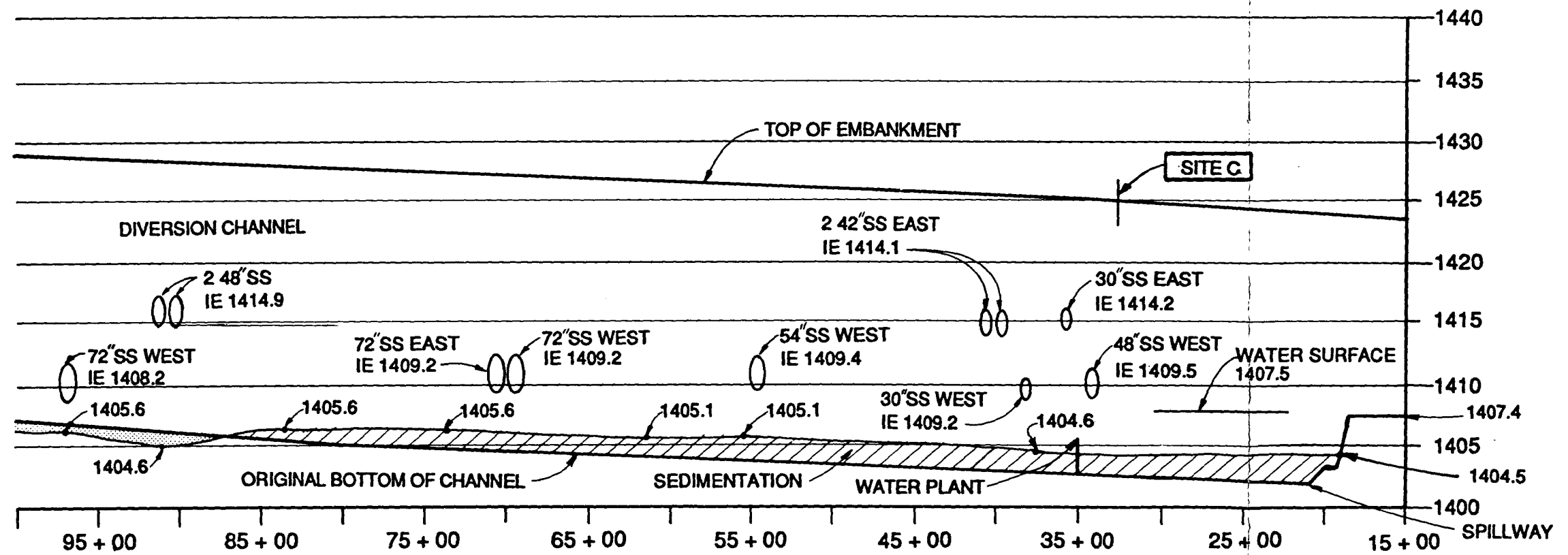
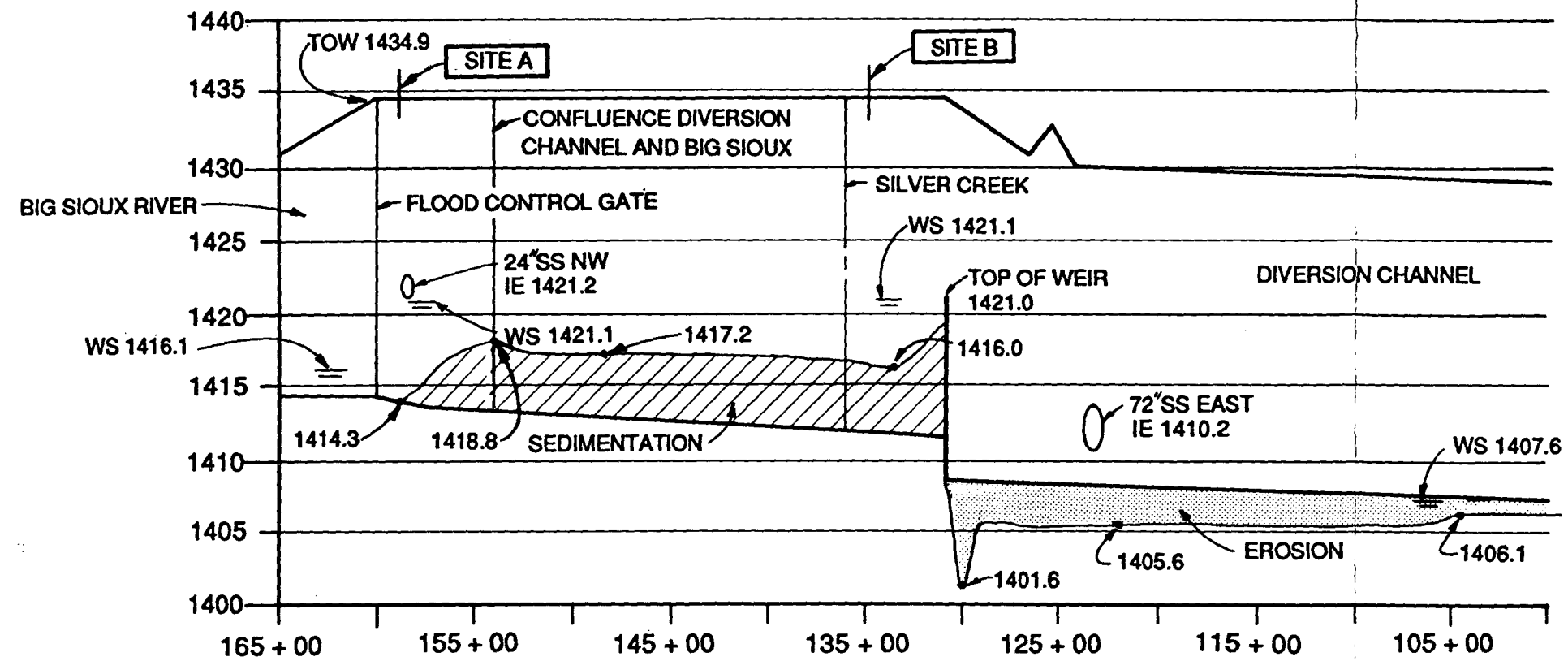
5.2.1 Water Storage/Quantity

Currently water in the Big Sioux River and diversion channel is controlled by flood control gates on the Big Sioux River (these gates control flow in the river through the City) and a weir structure on the diversion channel (creates a pool and allows all water not passing through the flood control gates to flow through

the diversion channel to the spillway). Approximately 35 million gallons of water is stored in this "pool". This is about 1.6 days of storage available at the design average flow of 22 MGD. A major consideration in the siting is the possible relocation of the weir to a point substantially downstream in the diversion channel near the spillway by the Corps of Engineers. Based on a similar height (approximately 6 ft) for the weir in this proposed location, the diversion channel could provide up to an additional 60 million gallons of storage. This would be about another 2.7 days of storage at the design average flow. Thus neither site provides a large volume of water in storage. Since a large storage volume does not exist at either location the river flow is the critical factor in supply availability.

This diversion channel study is being discussed by the Corps of Engineers and City Engineers office. Figure 5.2.1 shows a profile of the diversion channel from the spillway to the flood control gates on the Big Sioux River. As shown in that figure the possible downstream relocation of the weir would have a critical impact on the pump station location. The grade in the channel does slope from the confluence of the Big Sioux and Diversion channel down to elevation at the spillway. Thus the weir relocation could impact the static water elevation of the pool for sites A & B.

Contact was made with the Corps of Engineers regarding the purpose and status of the diversion channel study. The purpose



SIOUX FALLS
 RAW WATER PUMPING SYSTEM
DIVERSION CHANNEL PROFILE

FIGURE 5.2.1

of the study is to evaluate the capabilities of the diversion channel to pass the maximum probable flood flows. It is estimated the current embankment are suitable for a 40 to 50 year flood event and an additional 3 feet plus or minus on the embankments are required to increase the capacity of the diversion channel to handle a 100 year flood event. Also an increase in the spillway width may be required for the flows and for energy dissipation at the spillway discharge.

The study scope for the diversion channel study is being determined at this time with an approximate schedule as follows:

<u>Phase</u>	<u>Start</u>	<u>Duration</u>
Study	July 1989	18 months
Design	January-July 1991	12 months
Construction	1992-1993	1-2 years

The Corps is aware of the City's interest in development of a water supply source from the diversion channel, however they have indicated that a relocation of the weir structure substantially downstream is highly improbable due to the backwater elevation impact on the height of the embankments. The possibility of a shorter weir or an inflatable weir near the spillway to create a secondary pool in the diversion channel is a possibility. This would submerge several storm sewer discharges in the diversion channel from the airport which are at an approximate elevation of 1409. The proposed weir elevation would probably be somewhere in the range of 1413 to 1416 to create enough depth at the pump station site near the water purification plant. Maintaining this water elevation in the diversion channel above the storm sewer

discharges would probably cause sedimentation problems in the sewers and reduce their capacity. Substantial quantities of excavation could lower the elevation of the channel creating a deeper pool, however channel sedimentation would slowly reduce the pool depth and require significant effort and cost to dredge or excavate on a periodic basis.

Currently the static pool elevation created by the diversion weir is 1421 which provides approximately 6.5 feet of depth at the flood control gates. The Corps indicated the diversion weir will probably not be relocated and if modified would be increased in height. Since the weir will probably not be relocated the quantity of water is similar at all sites and would be greater at Sites A or B unless the airport storm sewers are operated in a substantially submerged condition. (Note: Many storm sewers do have flap gates, however pressure exerted in the channel would back discharges in the sewer to an elevation above the static water pool. This could impact stormwater discharges from the airport.) Sites A and B appear to be the preferred locations regarding water quantity because of the uncertainty and problems associated with Site C.

5.2.2 Water Quality/Sedimentation

The diversion channel and pool behind the weir structure were surveyed to determine the long range sedimentation occurring which would impact the pump station site location. As shown in Figure 5.2.1 the diversion channel has accumulated several feet

of sediment over the years in most areas and some erosion just downstream of the diversion weir. Also a major sediment removal program was completed in the diversion channel during the mid 1970's which removed large quantities of channel sediment.

Behind the weir structure, sedimentation has reduced the depth substantially at the weir (Site B), however has not significantly reduced the water depth at the flood control gate (Site A) due to the flushing effect of water through the gates. These gates are upward opening so that sediment in the channel near the gates is continually flushed from the bottom of the channel.

The depth of water and accumulation of sediment at the intake can greatly affect water quality. Optimum water quality can be obtained by providing flexibility in the location or depth for surface water withdrawals. Generally this is near the surface. Increased depth of water allows a greater profile from which to withdraw water which is beneficial since the sediment load and other contaminants are more concentrated along the stream bed. The accumulation of sediment caused by quiescent conditions (most likely to occur at Sites B and C shown in Figure 5.2.1) can result in eventual degradation of water quality. In addition Site C would be directly downstream of the storm sewer discharges from the airport area which could contain de-icer, fuel spills, etc. For these reasons, Alternate A is the best location for water quality/sedimentation considerations.

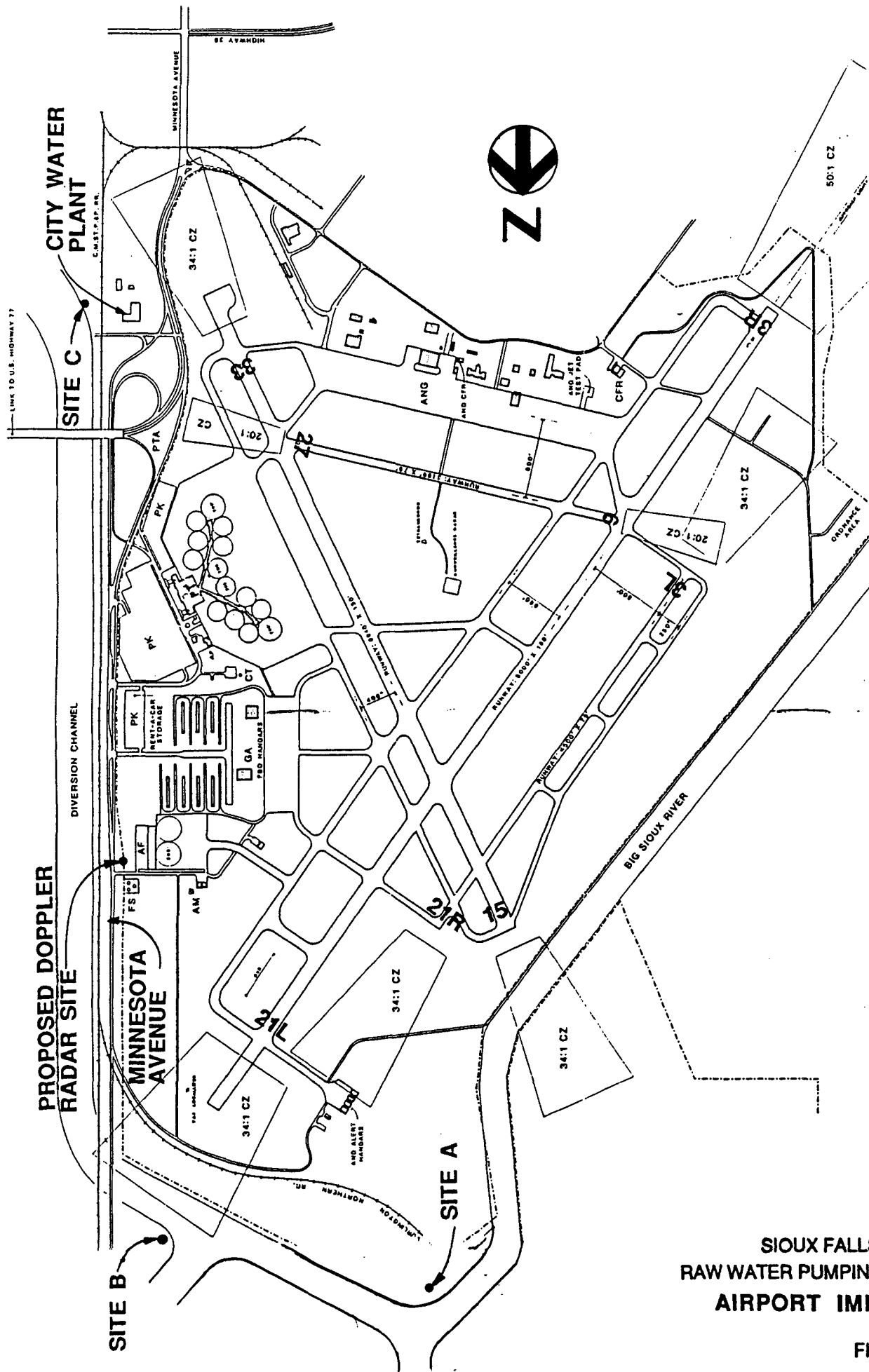
5.2.3 Airport Impact

Alternates A and B are on or near the airport property. Alternate C is on City owned property and would not impact the airport operations. All three sites relative to the airport layout plan are shown on Figure 5.2.2.

Alternate B is approximately 1900 feet from the end of runway 21 Left, the NE-SW 9000 feet runway for the airport. This runway is the instrument landing runway and has a 34:1 clear zone approach slope on the NE and a 50:1 approach slope on the SW. Runway 15, the NW-SE runway is 6658 feet long and has an approach zone of 34:1 on each end.

The estimated height of the pumping station is approximately 25 feet which would result in a roof elevation of about 1460. The NE end of the runway is 1427 thus at 1900 feet the maximum elevation could be 1482. Thus the Site B location does meet the criteria for approach, however the airport authority has conveyed that it is not a desirable location due to its alignment with the approach of runway 21 Left.

Site A is virtually straight north of the intersection of both runways and is approximately 3000 feet from the NE end and NW end of the two main runways. Therefore, it is in the best location to be out of the flight path of the two runways.



SIOUX FALLS
 RAW WATER PUMPING STATION
 AIRPORT IMPACT

FIGURE 5.2.2

Also, the impact of locating up to four 300 HP motors and associated equipment at the end of the instrument landing runway may radiate stray frequencies which could have a possible negative effect on the instrument landing systems. We have discussed this situation with the FAA and airport authority officials. It is believed that any problems the pump station could cause would be minor and the stray frequencies could be dampened by construction materials or minimized by careful equipment selection. This will be evaluated during detailed design and will be reviewed by the FAA with submittal of the required Notice of Proposed Construction or Alteration.

Site A, on the south side of the diversion channel would require permission from the airport authority for access during construction and for access to operate and maintain the station. This is similar to the requirements for water department personnel working on the existing airport wells. They have indicated that they would grant the City a lease for the amount of property required. In addition a penetration of the levee embankment would be required during construction. This is true for all pumping station locations and is discussed in greater detail under the Section 5.2.6.

In summary, from an airport impact standpoint Site C would not impact the airport, Site A impact is the least and Site B has the greatest impact. In addition, the airport authority has indicated a preference for Site A over Site B.

5.2.4 Raw Water Line and Power Availability

Site A is located approximately 2600 feet NW of the 24 and 36 inch raw water transmission lines which cross under the diversion channel just west of the weir location. These transmission mains are from the north well fields. Site B would be just east of the same transmission lines, just north of the channel, thus only minimal piping would be required to tie into the raw water lines. Site C is located approximately 1000 feet from the raw water lines on the east side of the water purification plant and would require boring or tunnelling under the railroad lines behind the plant. The connection line size for all sites would be 48 inches. This will meet the design flow of 45 MGD and a possible future flow of 60 MGD.

The electrical primary power feeds are available from the Light Department substation near the water plant (Site C) and near both Site A and B in the vicinity of the diversion weir. Primary power from the 13.8 KV lines would be available for the power service to all pumping station sites. Total connected load from the pump station will be approximately 1800 KVA.

In summary, Site B appears to have the least cost associated with construction of the raw water transmission line and connecting power line feeders.

5.2.5 Operational Considerations

The operational considerations include factors such as access/availability, winter operation/freezing, and sedimentation impact. Site C has the closest proximity to the water plant however is located across the railroad tracks. It could therefore be isolated by train traffic at certain times. Sites A and B are a greater distance from the plant and Site A would require coordination/permission from the airport authority for access. Site A would use the existing road at the top of the levee for access. Site B would involve constructing a short drive from the adjacent road. Site C would construct a short road from the water plant parking/access area.

Freezing water and associated winter operational problems are greatest as the depth of water and flow rates decrease. Site A would have the least problems because it would have the greatest water depth and the largest flow by it in the river (the river flow must pass through the confluence regardless of whether the flow routing is through the flood gates or diversion channel).

As discussed previously the channel sedimentation is a concern whenever quiescent conditions can exist. The flood gates allow readily available flushing means at Site A. Sites B and C could require extensive sediment removal at some point in the future either by dredging or direct excavation during dry periods. Also our experience with inflatable weirs which is suggested at the diversion chute for Site C, indicates that it would be prone to

punctures or damage over a period of time and thus a definite maintenance consideration.

Based on all the above considerations Alternative A appears to be preferred for ease of operation.

5.2.6 Section 10 Part 404 Permits

Regardless of location the basic intake and pump station layout would be similar. Two primary options are considered which include:

1. Construction of an intake structure in the channel with a large diameter pipe into the pump station well wet located behind the levee embankment.
2. Construction of a combined intake structure and pumping station located in the levee embankment.

Either alternative results in construction on the inside of the levee and penetration of the embankment, thus a Section 10 404 Permit is required. The Corps has indicated that the involvement or time to obtain the permit is dependent upon the magnitude and type of activities occurring in the channel and embankment.

Site C does have an additional consideration, in that to create a pool, a temporary/inflatable dam structure would probably be required in the channel. This would be located near or at the

spillway structure and could be a more lengthy process in the permit analysis.

5.2.7 Capital Cost

The basic pumping station and intake structure will be the same for all three sites thus this comparison will evaluate the differences in the alternatives. Following is a summary of items which differ for the Site alternatives.

Site A - Requires approximately 2600 feet of 48 inch transmission line to connect to the 24 and 36 inch lines.

Site B - Requires approximately 100 feet of 48 inch transmission line to connect to the same lines. It will also involve the dredging of about 4 ft. of material from the diversion channel from the Big Sioux River to the overflow river.

Site C - Requires approximately 1000 feet of 48 inch line to the water purification plant, tunneling under the railroad line and construction of an inflatable rubber dam in the diversion channel spillway structure to develop a pool.

A comparison of the capital costs which vary with site location are as follows:

TABLE 5.2.1

SITE COST COMPARISON

<u>Item</u>	<u>Site A</u>	<u>Site B</u>	<u>Site C</u>
48 inch Pipe	\$429,000	\$ 17,000	\$149,000
RR Crossing			35,000
Rubber Dam	<u> </u>	<u>300,000</u>	<u>415,000</u>
Totals	\$429,000	\$317,000	\$599,000

1. For 100' wide by 6' high dam for existing spillway. Price does not take into account increase for future widening of spillway by Corps of Engineers.

5.3 Site Analysis

The consideration of the composite effect of the above factors is accomplished by giving a priority rating to each of the above criteria from lowest to highest. Table 5.3.1 is a summary of that analysis.

TABLE 5.3.1

SITE ANALYSIS

<u>Parameter</u>	<u>Site A</u>	<u>Site B</u>	<u>Site C</u>
Water Availability	1	2	3
Water Quality	1	2	3
Airport Impact	2	3	1
Transmission Line/ Power Availability	2	1	2
Operational Considerations	1	3	2
Permit 404	1	1	2
Capital Cost	<u>2</u>	<u>1</u>	<u>3</u>
Total	10	13	14

The composite analysis indicates Site A appears to be the preferred location. It will be slightly more expensive, however airport considerations, sedimentation impact, and water quality are substantial advantages for this location.

5.4 Site Recommendation

Site A is the recommended location for the intake structural and pumping station. As discussed previously numerous advantages make this location the most attractive. In conjunction with development of the project at Site A we recommend the City maintain the direct diversion stations behind the water purification plant. The new pumping stations would provide the vast majority of surface water available. However, during dry years the diversion channel intakes will provide access to smaller quantities of water which "leak" from the aquifer into the diversion channel. It will not be adequate to meet demand but it may provide 2-6 MGD for a limited duration to supplement ground water sources. Also this water is already classified as ground water thus the City already has rights to its use.



SECTION 6 - PRELIMINARY DESIGN RECOMMENDATIONS

6.1 Site Plan

The recommended location for the pumping station and intake structure is Site A as discussed in Site Analysis and Recommendation in Section 5. Key considerations for the site plan include the following:

1. Approval of Airport Authority/FAA for construction at this site.
2. Accessibility/Parking for Operation and Maintenance personnel.
3. Ease of delivery and handling chemicals fed at the pumping station.
4. Incorporation of the raising the levees by 3 feet which is probable as a result of the Flood Control Study by the Corps of Engineers.

The preliminary site plan has been developed considering these items and is shown in the Appendix.

6.2 Transmission Line

6.2.1 Materials

Approximately 2600 feet of transmission line is required from the pumping station to the connection with the 24" and 36" well field transmission lines. The materials considered for the line include ductile iron (DI) and reinforced concrete cylinder pipe (RCCP). As mentioned previously, the line will be a 48 inch pipe. Based on this size the material cost for ductile iron would be higher than those for the RCCP (\$107 per foot versus \$88 per foot for RCCP).

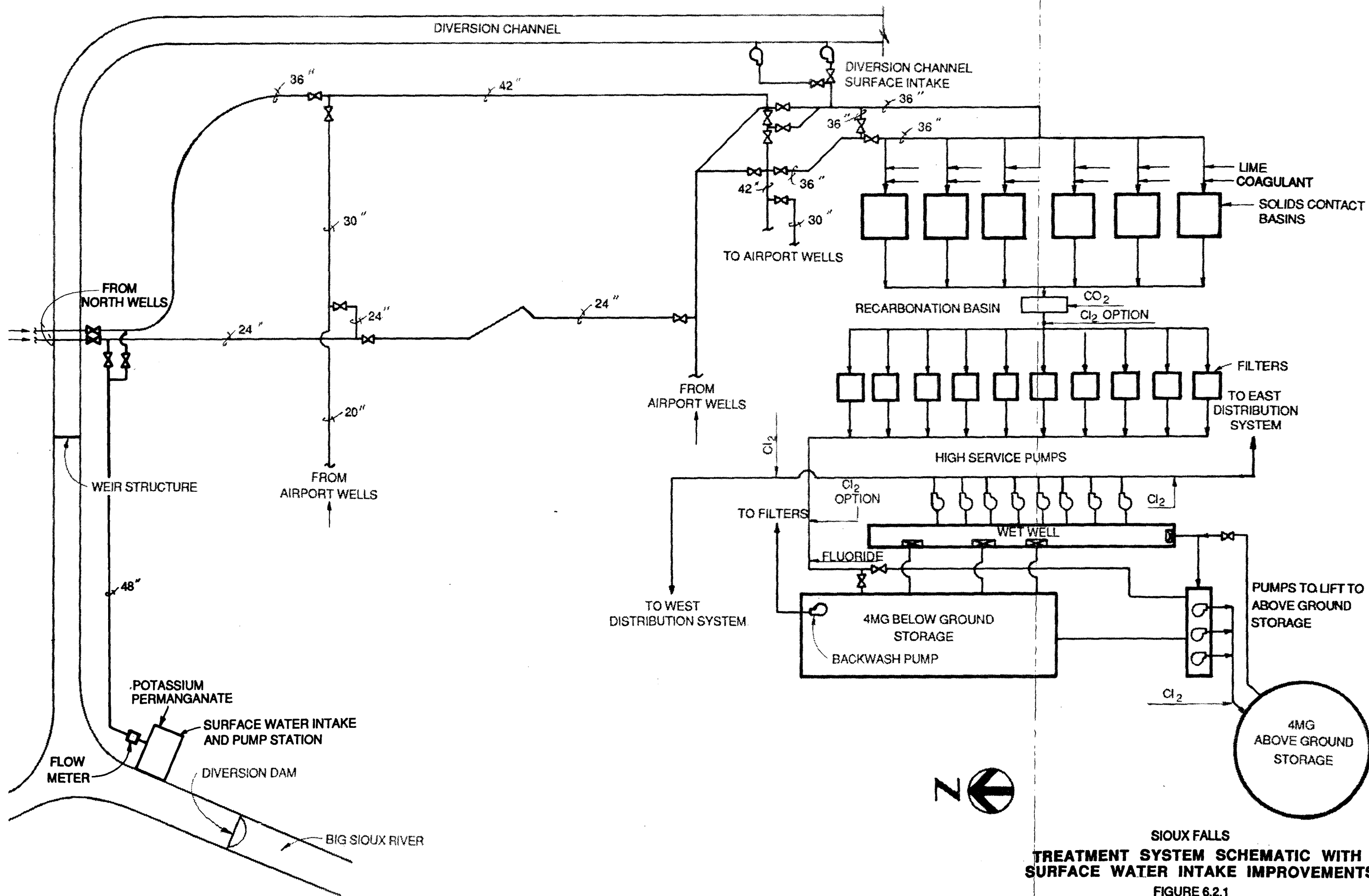
The transmission line, to the connection point with the well field lines, will be critical to the operation of the pumping station. Ductile iron has the advantage of an increased safety factor, service life and reliability. Based on the increased reliability, life and maintenance of ductile iron pipe we recommend the use of ductile iron for the transmission line.

6.2.2 Transmission Line Tie-In

At the point the 48 inch transmission line joins the 36 inch and 24 inch existing well field transmission lines, the line will split to allow connection to each line. Each connection will be independently valved. In addition, isolation valves will be added so that the well field lines to the north can be isolated when the pump station is in operation. This will minimize leakage in the delivery of water to the plant. A schematic of the connection and other improvements is shown in Figure 6.2.1.

The options for connection include tapping the existing lines with saddles (16" for 24" line and 20" for 36" line) or cutting into the existing lines and installing new full size wyes. A significant consideration is the headloss experienced with reduced connection size and sharp 90° bend. Following is the estimated headloss through the connection with both lines in operation.

<u>Flow</u>	<u>New Wyes</u>	<u>Saddles</u>
45 MGD	2.5 ft.	22 ft.
22 MGD	0.7 ft.	7.2 ft.



SIOUX FALLS
 TREATMENT SYSTEM SCHEMATIC WITH
 SURFACE WATER INTAKE IMPROVEMENTS
 FIGURE 6.2.1

As can be seen, the saddles present a significant restriction at peak flow. Because of this, we recommend installation of new wyes to substantially reduce headloss and the associated pumping costs. The construction of this connection will require coordination such that the installation of the new wyes into the existing 36 and 24 inch lines are made separately. The connections will also have to be made during a period when the demand is lower so that one of the two lines can be taken out of service. During this period the airport wells and the other transmission line can provide an adequate volume of wellfield raw water to the treatment plant.

6.3 Pumping Station Considerations

6.3.1 Intake Structure

The major components of intake structure include the following items and considerations:

1. Intake structure:

The intake and pump station could be designed two different ways.

- Separate the intake structure (connected by large diameter piping) in the channel from the pump station on other side of levee.
- Combine the intake structure with the pumping station and build both in the levee.

The combined structure has significant advantages from an operation and maintenance standpoint and is much better for accessibility. The separate structure would require a bridge from the levee to the structure and construction of the large diameter pipes (most likely 72 inch) to connect the pump station to the intake. Based on this it appears that the separate structure would be more expensive. Therefore we recommend the combined structure.

2. Intake Water Control Gates

The intake for the pump station will have two channels for entrance of water into one half of the wetwell with control gates to allow each half to be isolated and inspected while the other half remains in operation. Two options for use as control gates are:

- Downward opening slide or sluice gates.
- Stop logs (Specially fabricated structural beams, stacked on top of one another to the desired height).

The weir length required for the quantity of water would require a substantial number of large gates at various locations to provide flexibility of withdrawing the water at differing elevations. Stop logs which can be installed or removed to various heights provide superior flexibility, adequate weir length at much less capital cost. We recommend the use of stop logs in a structure divided in two sections to allow flow isolation for maintenance purposes as

shown the recommended station plan in the appendix. A monorail hoist will be provided for ease of removal and installation of the stop logs.

3. Screening

Two options for the screening of the raw surface water into the pump station were evaluated for this report.

- Coarse trash screen followed by fine mesh traveling water screen.
- Passive screens actually located in the channel (no coarse screen). These types of screen are similar to well screens and are mounted near the channel bottom. They consist of a cylindrical screen section plugged at each end with a pipe connection in the middle.

The possible fluctuation in water depths are not compatible with the fixed depth passive screens. The capability to withdraw near the surface with varying water depths is not possible. Freezing problems and cleaning of the dirty or clogged screens would also present substantial problems with the passive screens. In addition, with the design flow of the pump station the amount of screen surface area would be large.

The trash rack and fine screens are recommended over the passive screens due to water quality concerns and

operational superiority. The traveling water screens are automatically cleaned with a spray water system. The water from the spray nozzles for screen cleaning and the refuse (debris) removed will be returned to the channel downstream of the intake. The screens will be enclosed in a separate room to minimize freezing problems during the winter.

6.3.2 Pumping equipment

As discussed previously, the pump station has a rated capacity of 45 MGD firm capacity (one pump out of service).

We recommend a total three pumps to meet this flow with one additional pump provided as a backup. This would provide a total of 4 pumps each sized to deliver 15 MGD. Due to the growth rate of the City it is recommended the structure be designed to allow for the installation of a future pump without future major structural modifications. The life of the structure will be well in excess of 20 years thus the cost to provide space for another pump to increase capacity is warranted.

Design capacity of 15 MGD each of the four installed pumps is recommended. The head conditions for each of the 15 MGD pumps will vary depending upon the flow rate and existing transmission lines which are in use from the connection point of the proposed 48 inch line from the pump station. These transmission lines consist of a 24 inch line and a 36 inch line increasing to 42 inches. Depending on the sources used and operational philosophy

one or both can be used. These lines are shown on Figure 6.2.1. Following shows the total dynamic head (TDH) for both together and the 36 inch/42 inch line only for average flow and peak flow (based on C=110). The 24 inch line alone will be too small to use at the design flows conditions.

<u>Flow</u>	<u>TDH (ft)</u>	
	<u>24" & 36"/42"</u>	<u>36"/42" only</u>
25 MGD	35	43
45 MGD	64	88

These pumping heads assume the lowest possible flow in the river with an elevation of 1415. Normal pool will be at 1421 ± or about 6 feet higher. Since both transmission lines would be available the majority of the time and the actual "C" factor could be higher, we recommend a TDH of approximately 75 feet. Being overly conservative on the TDH allows the pump to "walk out" on its curve which can impact or increase motor and electrical equipment sizes as well as cause the pump to operate at a less efficient point on its curve. However, with use of variable speed units the speed of the units can be adjusted to match more closely the requirements of the actual operating conditions.

Therefore, we recommend sizing each unit at 15 MGD at 75 ft. TDH. The types of pumps considered include vertical turbine and vertical pump with non-clog impeller (VTSH). Axial split case or other dry well type pumps were not extensively evaluated due to the high structural costs associated with a wet well/dry well

type of pump station. Following are the characteristics of the vertical pumps.

<u>Characteristics</u>	<u>Vertical Turbine</u>	<u>VTSH (non-clog)</u>
Size	24"	24"
RPM	1170	705
Solids Passage	2.75"	6"
Shutoff Head	100 ft.	108 ft.
Design Condition	15 MGD @ 75 ft.	15 MGD @ 75 ft.
BHP	240	260
Efficiency	82%	78%
NPSH	30 ft.	20 ft.
Secondary Condition	17 MGD @ 55 ft.	23.5 MGD @ 55 ft.
BHP	220	280
Efficiency	77%	85%
NPSH	37 ft.	23 ft.

The vertical turbine pumps have better characteristics at the conditions anticipated. However, the VTSH pump is superior in its capability to "walk out" on its curve. It is capable of pumping up to 23.5 MGD at the reduced heads which may be experienced, while the turbine would require operation of a second pump at those conditions.

The impellers of the vertical turbine pumps would be more subject to wear and abrasion than the non-clog type impellers, however a very limited amount of sand or other material is anticipated. Existing withdrawals from the diversion channel show a negligible amount of abrasive material even when drawing from the bed of the

channel. With the use of stop logs as recommended the withdrawal will be made near the surface which should further minimize the entrance of abrasives. Also vertical turbines are less costly. Quotes for each pump with motors are as follows:

Vertical turbine	\$46,000
VTSH	\$88,000

As can be seen, the VTSH pumps are much more expensive. An additional consideration is the fact that numerous manufacturers provide quality vertical turbine pumps whereas competition for the VTSH would be limited. Therefore, we recommend use of vertical turbine pumps for this project.

6.3.3 Drives

The water demand varies substantially from day to day and due to seasonal fluctuation. The minimum day usage typically occurs in December and was 9.7 MGD in 1988 and 9.1 MGD in 1987. This lower flow can be met by different pump sizes such as 9 MGD, 15 MGD, 21 MGD (with additional 21 MGD as standby) with constant speed motors or with all pumps of the same size (15 MGD) utilizing variable speed drives (VSD). Variable speed drives provide numerous advantages such as maintenance (interchangeability of parts), better overall operating efficiency, soft start capability (limit inrush current). Most importantly with VSD's the capability to match any desired flow is accomplished which is very important for operation of the water purification plant.

VSD's replace the normal motor starting equipment and are more expensive than a normal MCC. However, VSD's do have the capability to control the lead pump to full speed then pick up the second pump and control the speed on that unit. Thus it is not necessary to provide a VSD for each pump. Also, in the event of VSD failure the units can continue to operate as a constant speed unit.

To provide the required flexibility and reliability we recommend incorporation of two VSD units for the four pumps. The units would be rated for 300 HP each.

6.3.4 Chemical Feed

Pump Station

The chemical injected at the pump station is potassium permanganate as indicated in Section 4.3. The dosage will vary with changes in the raw water quality, thus wide fluctuation in usage is possible. Following is a summary of various quantities required based on dosages and flow rates:

<u>Condition</u>	<u>Flow (MGD)</u>	<u>Dosage (mg/l)</u>	<u>Pounds/Day</u>
Average Winter	12.5	0.5	52
	12.5	3.0	300
Average Design	22.0	0.5	92
	22.0	3.0	550
Peak Day	45	0.5	190
	45	3.0	1125
Average Flow and Quality	22	2.0	370

Potassium Permanganate can be delivered in drums ranging in size from 50 lbs. to 330 lbs. or in bulk shipments up to 45,000 lbs. An eductor is used in lieu of a mix tank and chemical feed pump to dissolve the dry chemical prior to injection in the pump discharge header line. Two units are recommended to provide the desired reliability.

The handling requirements for the drums would be vary labor intensive. At average conditions more than one of the largest available drums would be used on a daily basis. Also, special handling and disposal is required for the used drums and the chemical is less expensive per pound on a bulk basis than the drums. Normal bulk storage requirements are based on 150% of the size of the shipment. Considering the usage rate of the chemical this guideline could be reduced to minimize capital cost associated with the storage tank. A reasonable storage size appears to be shipment size (45,000 lb.) plus 21 days of average usage. Thus, the recommended bulk storage is as follows.

$$\text{Bulk storage} = 45,000 + 370 (21) = 53,000 \text{ lbs.}$$

At average usage this would provide between 4 and 5 months of storage.

The dry chemical must be mixed in a solution prior to feeding into the raw water. KMNO_4 is quite soluble and thus aging time is not required. A volumetric feeder paced from the raw water flow signal with an eductor system is recommended for feeding the chemical.

Transportation and unloading considerations include adequate space around the station to negotiate the bulk transport truck. In addition, the truck will use the access road to the station, thus weights limits and access requirements must be verified and coordinated. The site plan around the pump station is included in the appendix.

6.3.5 Flow Metering

A flow meter on the pump station discharge is required for pump control as well as spacing the chemical feed equipment. The meter type could be sonic type, magnetic type, turbine type. The turbine type could experience maintenance problems with the small particles, etc. which could be in the flow stream. Magnetic and sonic type would both be suitable for this application with the critical parameters being velocity and liner material. The cost of a sonic meter is substantially less in the required size range thus we recommend sonic meter. A 42 inch meter will be used.

6.3.6 Instrumentation

The pump station will be capable of being monitored and controlled from the water purification plant. Following is a summary of signals and control features.

<u>Item</u>	<u>Number</u>	<u>Local/Panel</u>	<u>Water Plant</u>	<u>Method of Control</u>	<u>Status Lights/ Indication</u>
Water Pumps	4	HOR	HOA	Flow Rate	On/Off/ Standby/Fail
Flow Rate	1	0-50 MGD	0-50 MGD	N/A	Indication/ Control
Travelling Screen	2	HOR	HOA	Timer	On/Off/Fail
Water Water Valve	2	Open/Close	--	Interlock w/screen	Open/Close
Chemical Feeders	2	HOA	HOA	Interlock w/flow rate	On/Off
Eductor Water	2	HOA	--	Interlock w/feeder	Open/Close

6.4 Architectural Considerations

The structure will be designed in accordance with the 1988 Editions of the Uniform Building Code Standards, The Uniform Fire Code and The Uniform Fire Code Standards. The proposed facility will be designed using an occupancy classification of Group B-4 and of construction Type 11-N non-combustible such as concrete and masonry. Materials will be selected for appearance, durability, low maintenance and cost.

The building will consist of an intake structure below a single story pumping building with a Pump Room, Screen Room and a Chemical Feed Room. Total area will be approximately 2,370 sq. ft. of building area. Building construction will consist of exterior bearing walls using masonry back-up, 2 inch thick extended polystyrene cavity insulation and 4 inch masonry brick veneer; roofing will be a ballasted .045 inch thick black EPDM single-ply membrane roof over loose laid polystyrene insulation and vapor

retarder. Total insulation R value for roof will be minimum of R16. Gravel stops will be prefinished metal.

Skylights will be provided in the roof structure to provide natural light into the Pump Room, all exterior pedestrian doors will be anodized aluminum to reduce long term maintenance and the overhead door will be an aluminum ceiling door. Exterior guardrails and grating will also be aluminum.

All interior wall and roof structure surfaces will be painted using heavy duty industrial type polyamide epoxy painting systems except for the Chemical Feed Room which, due to the corrosive atmosphere, will have a vinyl ester coating on the floor and walls to a height of 48 inches. The exterior masonry surfaces will be treated with a liquid masonry water repellent.

Roof access will be accomplished via a roof scuttle with ladder access from the interior of the building.

6.5 Structural

The structural design will provide the necessary structural framing systems to support all proposed loadings and at the same time be compatible with the environmental and architectural schemes, as well as mechanical and electrical installations. This includes the design of all superstructure and substructure slabs, beams, columns, bearing walls, shear walls, foundation walls and foundations.

6.5.1 Design Loads

Structural design will be in accordance with the 1988 edition of the Uniform Building Code, Building Code Requirements for Reinforced Concrete ACI-318-83, and Concrete Sanitary Engineering Structures ACI-350R-83.

Design live loads to be as follows:

Roofs

Load

Snow
Equipment

30 psf
per equipment weight

Floors

Mechanical Equipment
Stairways, walkways and
corridors

As required for equipment but not
less than 300 psf.
100 psf

Foundation Walls

Water

62.4 pcf

Earth

As recommended by the Soils Report

Wind Pressure

Design wind speed to be 80 mph applied as per the 1988 Uniform Building Code with Exposure C and an Importance Factor of 1.0.

Seismic

As required by the 1988 Uniform Building Code, Seismic Zone 0.

6.5.2 Structural Framing

Roof to consist of precast prestressed concrete double tees supported by reinforced masonry bearing walls.

Ground level to be a reinforced concrete slab supported by concrete beams and walls over the Wetwell Area and a reinforced concrete slab on grade elsewhere.

Wind and seismic forces to be resisted by reinforced masonry exterior walls supported by horizontal diaphragms at roof and ground level which in turn will transmit those forces to the foundations by means of perimeter masonry shear walls.

Foundations located outside the Pit Area to consist of continuous reinforced concrete walls and footings. Bottom of footings to be located a minimum of 3'-6" below exterior finish grade to resist frost action.

The Wetwell Area to consist of reinforced concrete foundation walls supported by a concrete mat foundation.

Allowable bearing pressures for foundation design to be in accordance with the recommendations in the soils report.

To allow the Wetwell Area foundation to be placed on a dry firm subgrade, a dewatering system will be necessary in addition to the construction of a temporary cofferdam or earthen berm located between the river and area of foundation construction.

6.5.3 Structural materials

A.	Precast Concrete	5000 psi @ 28 days
B.	Cast-in-place Concrete	4000 psi @ 28 days
C.	Reinforcing Steel	ASTM A615 Grade 60
D.	Structural Steel	ASTM A36
E.	Structural Aluminum	Alloy 6061-T6

6.6 Mechanical (HVAC and Plumbing) Considerations

The mechanical systems in the proposed structure will be designed in accordance with the following standards.

Uniform Mechanical Code 1988

Uniform Plumbing Code 1988

American Society of Heating, Refrigerating and Air Conditioning
Engineers (ASHRAE)

The heating and ventilation systems will be designed utilizing the temperatures listed below:

Outdoor:	Winter	-15°F
	Summer	94°F db, 73° Fwb

Indoor:	Pump Room and Screen Room	
	Winter	72°F
	Summer	85°F

Ventilation for the pump room and screen room will be infiltration air only in the winter. For calculation purposes this is assumed to be about one half an air change per hour. In the summer the pump room will be ventilated and cooled with outside air. The air quantity will be such that a 5°F temperature difference will exist between the design outside temperature and the inside space.

Ventilation for the feed room will be separate from the pump room and screen room but designed using the same guidelines.

Wall louver and roof mounted exhaust fan will provide ventilation. Heating will be done with electric unit heaters.

The building plumbing system will include floor drains and roof drains. The feed room will have a separate floor drain system with the piping routed to a sump pit.

6.7 Electrical

The proposed electrical construction for the surface water pump station will be designed in accordance with the National Electrical Code (NEC) and applicable local codes.

6.7.1 Primary power distribution.

It is proposed that the City will extend primary power conductors to a location near the site and install a transformer dedicated to this facility. The transformer will step down the primary voltage to 480 Y/277 volts for service to the pump station. The neutral will be grounded at the transformer and a 480 volt delta system will feed the electrical equipment in the building.

6.7.2 Secondary power distribution.

Electrical equipment in the control room will consist of a Motor Control Center (MCC), necessary low voltage (480 V:208 Y/120V) step-down transformers, lighting and small power panelboards, and conversion equipment consisting of AC variable frequency drives (VFD's). All electrical equipment will be Underwriters Laboratories (UL) or Electrical Testing Laboratories (ETL) labeled or maximize the use of UL or ETL labeled or recognized hardware

where no UL or ETL test procedure has been established for the equipment.

The MCC incoming compartment will be Service Entrance Labeled to comply with NEC requirements to accept power directly from the power transformer secondary. MCC construction will be NEMA type 1B in a NEMA 12 enclosure.

Electrical distribution to constant speed motors will be full voltage combination magnetic starters located in the MCC. These starters will have provision for padlocking the starter disconnect in the Off position for the safety of maintenance personnel when they are required to work on the driven equipment. Each starter will consist of an instantaneous only Motor Circuit Protector (MCP) type of circuit breaker disconnect, a contactor with overload relay protection to apply electricity to the motor on demand, a 480:120 volt control power transformer, and control circuit. Other conversion equipment - including transformers and VFD's - will be fed through thermal magnetic circuit breakers in the MCC which will also be capable of being padlocked in the Off position.

Subject to space constraints it is proposed that the low voltage step down transformer and the lighting and small power panelboard be mounted in the MCC. This arrangement has the effect of containing all of the AC distribution equipment in one enclosure.

6.7.3 Low voltage power distribution.

Electrical power to lighting, receptacles, control panels, HVAC equipment as required and miscellaneous other equipment operating at 120 or 208 VAC will be distributed through the lighting and small panelboard. This panelboard will consist of thermal magnetic circuit breakers the majority of which will be rated 20 Amps, single pole, 120 VAC.

6.7.4 Utilization equipment.

Constant speed motors 3/4 HP and larger are usually fed at 480 VAC, 3 wire, 3 phase; those motors 1/4 HP and smaller are usually fed at 120 or 208 VAC, 2 wire, single phase; while motors rated 1/2 HP may be any of the above - 480 or 208 VAC, 3 phase, 3 wire; or 208 or 120 VAC, single phase, 2 wire. The utilization voltage determines the feed source for the equipment - MCC, panelboard or control panels. All 480 VAC motors remote from the area where the MCC is located will have a non-fused, 3 pole, HP rated safety switch - capable of being padlocked in the open position-mounted near the equipment. These are provided for the additional safety of maintenance personnel required to work on the equipment since it provides a line of site disconnect device to insure the equipment cannot be inadvertently energized while maintenance is being performed. These safety switches are not intended for starting and stopping the motor although they are rated to do so for a limited number of operations. Thus they may be used by an operator in an emergency to de-energize equipment experiencing mechanical problems. Good maintenance practice, when preparing

to work on rotating equipment equipped with safety switches, is to padlock the MCC starter disconnect in the Off position and to padlock the safety switch in the Off position. An exception to the preceding safety switch philosophy occurs when a control panel containing a combination magnetic starter, or a VFD with a disconnect device is mounted near the process equipment. In these instances the integral disconnect is considered in line of sight and a separate safety switch is not provided.

Equipment with utilization voltages other than 480 VAC will be provided with integral or remote disconnect devices generically known as manual motor starters. These devices consist of a toggle switch and thermal element in an enclosure and are mounted within or near the equipment. Certain HVAC equipment is required by code to have a fusible disconnect, in those instances this will serve as the local disconnect device.

6.7.5 Receptacles.

These will be strategically located at accessible locations within the facility. Generally, in process areas and stairwells, receptacles will be provided such that a 100 ft. extension cord will provide access to all areas in the room; in offices, receptacles will be provided in accordance with the NEC requirements for dwellings; in restrooms a ground fault circuit interrupter (GFCI) type receptacle will be provided; and outdoors GFCI receptacles will be installed near all personnel doors.

6.7.6 Lighting.

In an unmanned facility a combination of fluorescent and high pressure sodium (HPS) luminaries has proven effective for large process areas. This approach will be used in the pump room of this facility. Fluorescent luminaries provide long life, rapid start, and are less susceptible to loss of life due to frequent on-off cycling; HPS luminaries also provide long life but are slow starting (1 to 2 minutes to full lumen output) and more susceptible to loss of life due to frequent on-off cycles. However, the HPS luminaries offer the advantage of higher light level, evenly distributed, with fewer fixtures and reduced operating costs compared to fluorescent luminaries. Thus, fluorescent luminaries will be the main light source for scheduled visits to the facility with the light from these luminaries concentrated in control and electrical equipment areas and a reduced level of around other equipment. When maintenance, or a higher level of light is required the HPS luminaries will be used. Frequent cycling of these luminaries is thereby eliminated providing for optimum lamp life. Utilizing fluorescent fixtures only a foot candle (FC) level of 50-70 will be available in the location of electrical panels and other localized areas as required, while 5-10 FC will be provided on the pump room floor. When the HPS luminaries are included the lighting level on the pump room floor will increase to 30 FC.

Fluorescent luminaries will be the predominate light source in the screening and chemical feed rooms where the light level will

be 30 FC. If necessary to obtain a 30 FC level for maintenance HPS luminaries will be included, to operate the same as in the pump room.

Incandescent luminaries may be utilized in selected areas but the extremely short lamp life and uneven light distribution limit their effective application.

6.7.7 Power factor correction.

Capacitors to correct power factor are usually provided on constant speed motors 25 HP and above. These capacitors are mounted in the area of the MCC and electrically connected between the starter disconnect and contactor. The cost advantage of connecting the capacitor at the motor to allow a reduction in the overload relay heater element rating and in wire size to the motor is not evident in this application. Also proposed changes in the 1990 NEC will disallow reduction of the overload relay heater element. Power factor correction capacitors will not be utilized on motors associated with VFD's. However, the VFD's typically exhibit a power factor of 90 to 95 percent at full load, equivalent to that expected with power factor correction.

6.8 Utilities

Utilities to the site will consist of only electrical service. Heating systems will be all electric so natural gas will not be required. A potable water supply will be brought to the site or strained pump station raw water will be used for chemical feed systems, screen spray water and hose bibs. Since the pump station is an unmanned facility, no sanitary facilities will be provided. Since sanitary facilities will not be provided there will not be a connection to the sanitary sewer. A telephone will be brought to the site for instrumentation communication to the water plant.

SECTION 7.0 IMPLEMENTATION

7.1 Preliminary Cost Estimate

The preliminary cost estimate for the recommended Site A is shown in the following Table 7.1.1. The costs include the intake structure and pumping station as shown on the drawings in the appendix and the connecting 48 inch transmission main. Since the project is anticipated to begin in the fall of this year all costs are current and no allowance has been made for inflation.

7.2 Design and Construction Sequencing

This intake and pump station has the upmost priority of the City. Recent dry years have forced the city to place watering restrictions during the summer months. Therefore, the need to have the existing pump station on line is immediate. To expedite the construction of the pump station we are recommending that the following actions be implemented.

1. Begin engineering immediately for the improvements recommended in this report. Target date for completion of design would be August 1, 1989. Advertisement for bids would follow in mid August.
2. Arrange for meeting with state to review report and schematic drawings to expedite review and approval of final drawings. Submit a copy of this report to the State for their preliminary review and comments.
3. A copy of the permit request to withdraw water has been submitted. The City should monitor the progress of this permit application.

TABLE 7.1.1

PRELIMINARY COST ESTIMATE

Sioux Falls, South Dakota

PART I - Surface Water Intake and Pump Station

<u>Item</u>	<u>Estimated Cost</u>
Cast-in-place concrete	\$ 429,000
Masonry walls	137,000
Roof	39,000
Doors, windows and guardrail	15,000
Painting	8,000
Monorail systems	20,000
Stop logs, sluice gate and trash rack	105,000
Traveling water screens	115,000
Vertical turbine pumps, motors and VFD's	254,000
Discharge header piping and valves	73,000
Flow meter/structure/instrumentation	50,000
Chemical feed system	53,000
Motor control centers and misc. electrical	232,000
Mechanical HVAC	165,000
Sitework, cofferdam and dewatering	55,000
Mobilization/demobilization	<u>50,000</u>
Subtotal	\$1,800,000
Contractor Overhead and Profit (10%)	180,000
Contingencies (15%)	<u>270,000</u>
Total Construction Cost	\$2,250,000

PART II - Transmission Line

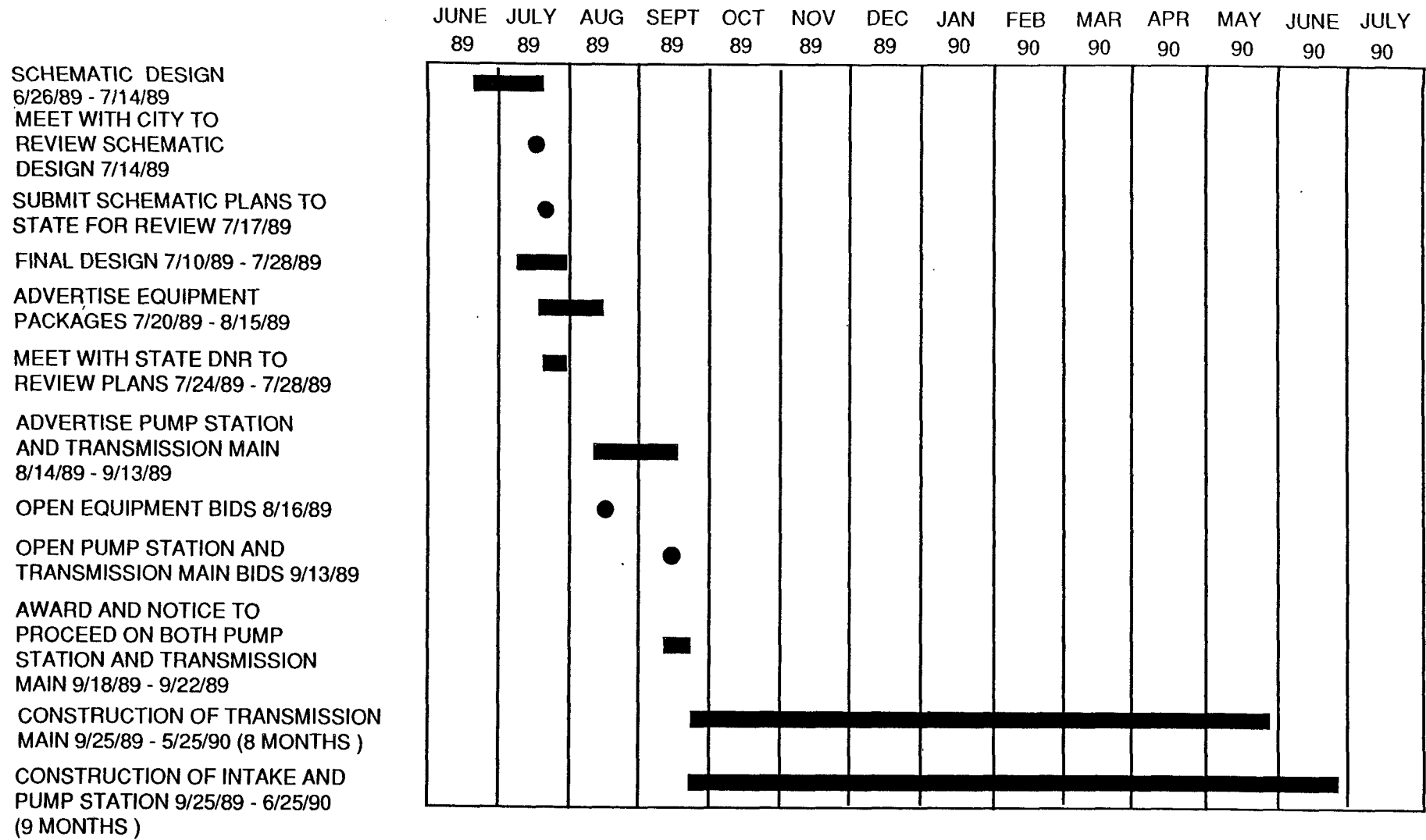
2600 LF of 48 inch Ductile Iron Pipe	\$ 429,000
Valves	24,000
Fittings	52,000
Dewatering	40,000
Mobilization/demobilization	<u>20,000</u>
Subtotal	\$570,000
Contractor Overhead and Profit (10%)	57,000
Contingencies (15%)	<u>85,000</u>
Total Construction Cost	712,000
Total Parts I and II	\$2,962,000

ENR Construction Cost Index: 4593 (June 1989)

4. Submit a copy of this report along with the Section 10/404 permit application to Corps of Engineers office in Pierre. Also an information copy should be sent to the Corps office in Omaha.
5. Submit application form and copy of the report to the FAA and Airport Authority for their review.
6. Schedule design review meetings with City Water Department personnel and building officials to allow comments concurrently with design.
7. Pre-bid the major equipment items. This would include the vertical turbine pumps and VFD's, water screens, chemical feed equipment including storage silo and water control gates. Equipment items selected would be incorporated into the intake and pump station bid package.
8. Separate the 48 inch transmission line into a separate bid package. This will probably encourage more pipeline contractors to bid and would allow for an earlier construction completion date. In addition, the pump station and intake construction could begin concurrently with the transmission line construction. Construction should begin around October 1, 1989 to allow for work to start during the fall before hard winter sets in.
9. Stipulate in contract documents that completion of all construction be complete by July 1, 1990. This would allow the facilities to be on line for the peak demand season next year.

7.3 Schedule

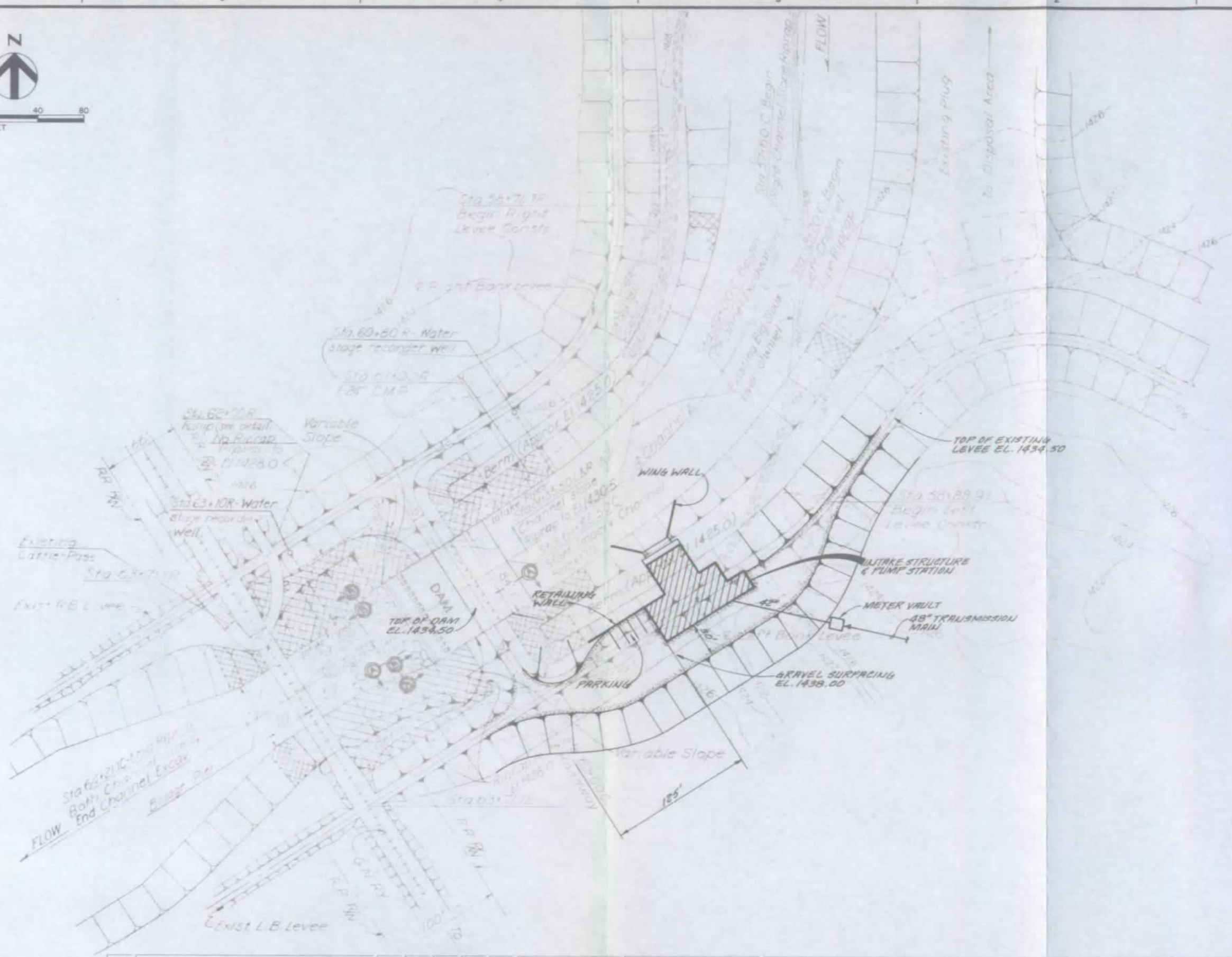
Incorporating the recommendations outlined in the previous section the following schedule is recommended as shown on Figure 7.3.1. With the schedule this pump station will be on line by July 1, 1990. This precedes the peak summer demand period.



**SURFACE WATER INTAKE AND PUMPING STATION
PROJECT SCHEDULE**

APPENDIX A

PRELIMINARY DRAWINGS

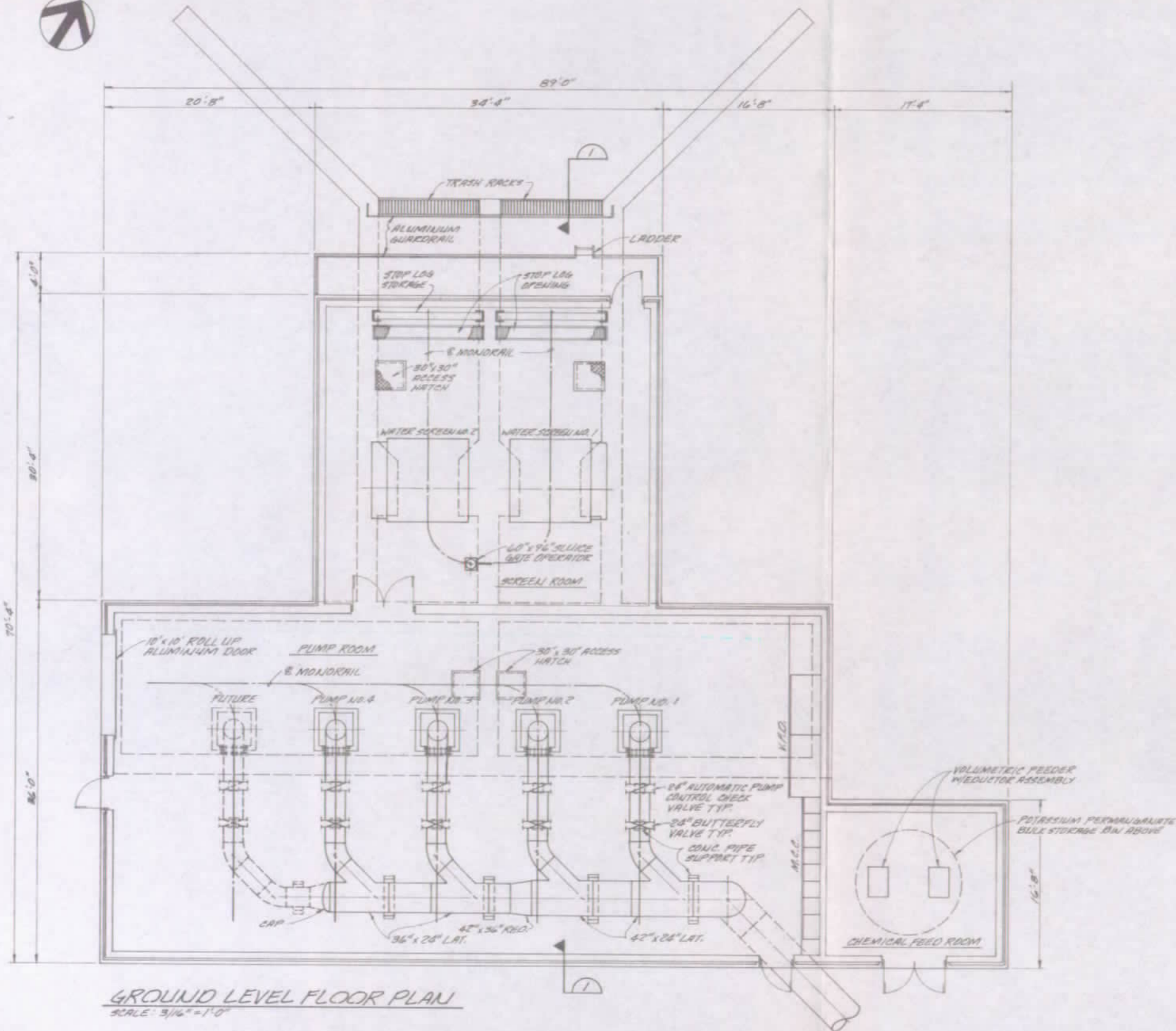
[illegible]

Project Manager	
Architect	S.C. Parsons
Civil	Westwood
Electrical	Westwood

Sioux Falls
Surface Water Intake
And
Pump Station

Site Plan

Date	Project No.	Drawing No.	Sheet
June 1989	01450-061-034		
Scale			



GROUND LEVEL FLOOR PLAN
SCALE: 3/16" = 1'-0"



HDR Engineering, Inc.

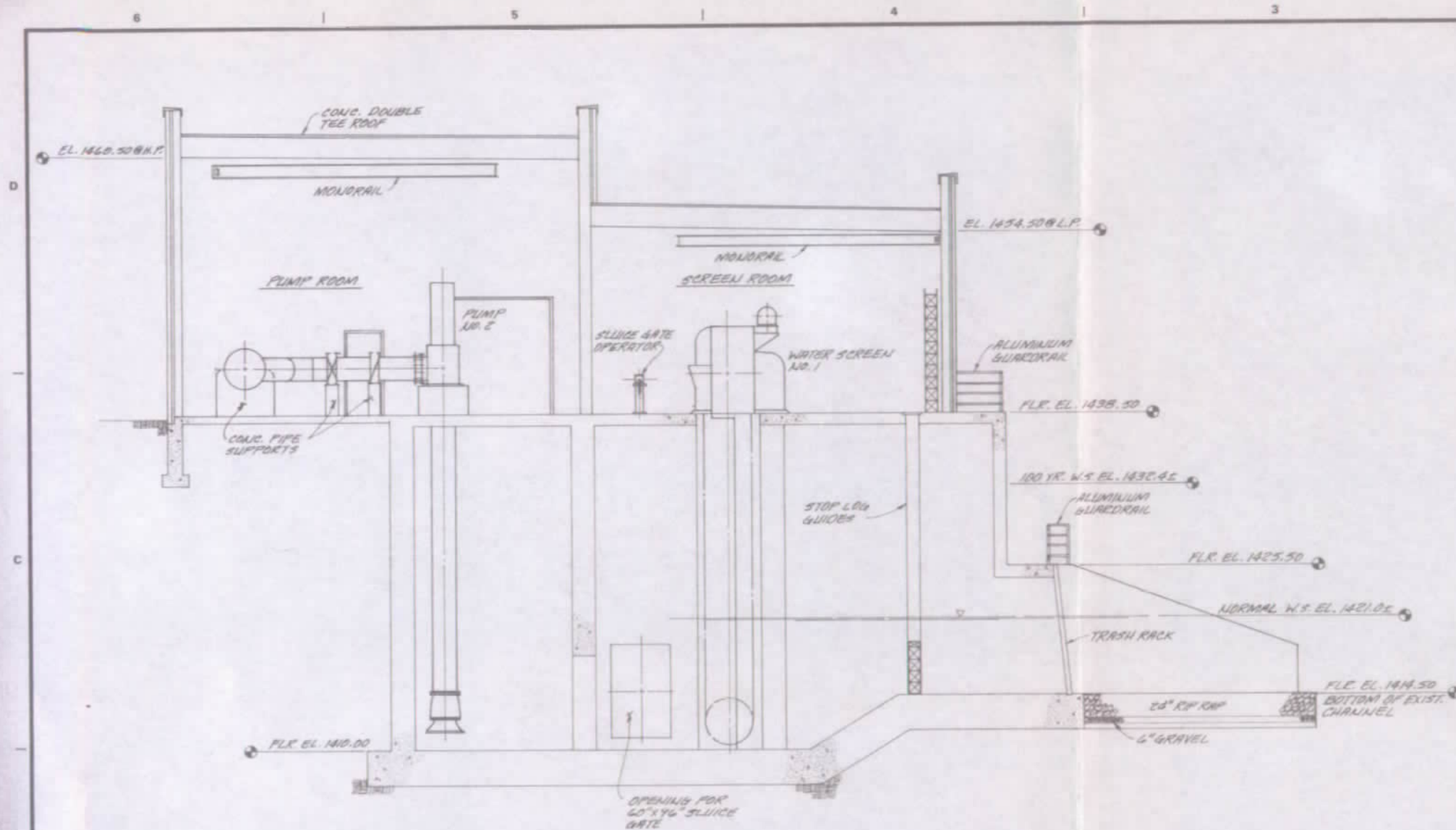
No.	Description	Date	By	Chk.	App.

Project Manager	
Architect	
Engineer	

Sioux Falls
Surface Water Intake
And
Pump Station

**Intake Structure
And
Pump Station**

Date June 1989	Project No. 01450-061-034	Drawing No.	
-------------------	------------------------------	-------------	--



SECTION ①
SCALE: 3/16" = 1'-0"



HDR Engineering, Inc.

Rev.	Description	Date	Drawn	Check	Rev.	Rev.

Project Manager	
Assistant	
Chief	
Engineer	

Sioux Falls
Surface Water Intake
And
Pump Station

Intake Structure
And
Pump Station

Date
June 1989

Project No.
01450-061-034

Drawing No.

Sheet

APPENDIX B

PERMITS

No. _____	Hydrologic Unit _____
Map No. _____	Basin _____
Newspaper _____	

Application For Permit To Appropriate Water Within The State Of South Dakota

Check use of water: Industrial ☐ Commercial ☐ Municipal ☒ Other Common Distribution System ☐
 Rural Water System ☐ Suburban Housing ☐ Geothermal Heat ☐ Institutional ☐ Recreational ☐
 Domestic ☐ (above 18gpm) Other ☐

Type of Application: Check one or more of the following

New ☐ Vested Right ☒ Future Use ☐ Change Use ☐☐ Amend Permit No. _____ with old priority date retainedChange diversion point(s) ☐ Add diversion point(s) ☐ Other ☐ _____☐ Application to: Change diversion point(s) ☐ Add diversion point(s) ☐ on Permit No. _____☒ Construction to use water reserved by Future Use Permit No. 3981-31. Name of Applicant City of Sioux Falls Phone No. 339-7025Post Office Address 224 West 9th Street Sioux Falls State SD 57102
(Street, RR or Box) (City) Zip Code2. Amount of water claimed (c.f.s) 41 cfs - 30,000 acre-feet per year3. Source of water supply Big Sioux River4. Location of point of diversion At confluence of Big Sioux River and Diversion Channel
north of City; See Site Map for Site A in draft of enclosed predesign report._____ County Minnehaha5. Counties where water will be used Minnehaha and Lincoln6. Annual period during which water is to be used All year

7. Give a brief description of proposed project. When available include any preliminary engineering report or other reports or information that will help explain the project. (Attach sheet if more space is needed)

Construction of a water intake and pumping station for a raw water supply for the City of Sioux Falls, South Dakota.

Attached is a draft copy of the predesign report.

Attachments: Attach Form 2A if diversion from a well or dugout, or if storage of water, is proposed. Attach map (see instruction)

STATE OF SOUTH DAKOTA)
County of _____)

I, _____ the applicant, certify that I have read this application, have examined the attached map and that the matters stated are true and that I intend, and am able to complete the necessary construction.

Signed _____

Subscribed and sworn to before me this _____ day of _____ 19____

APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT

(33 CFR 325)

OMB APPROVAL NO. 0702-0036
Expires 30 June 1989

The Department of the Army permit program is authorized by Section 10 of the River and Harbor Act of 1899, Section 404 of the Clean Water Act and Section 103 of the Marine, Protection, Research and Sanctuaries Act. These laws require permits authorizing activities in or affecting navigable waters of the United States, the discharge of dredged or fill material into waters of the United States, and the transportation of dredged material for the purpose of dumping it into ocean waters. Information provided on this form will be used in evaluating the application for a permit. Information in this application is made a matter of public record through issuance of a public notice. Disclosure of the information requested is voluntary; however, the data requested are necessary in order to communicate with the applicant and to evaluate the permit application. If necessary information is not provided, the permit application cannot be processed nor can a permit be issued.

One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

1. APPLICATION NUMBER (To be assigned by Corps)

3. NAME, ADDRESS, AND TITLE OF AUTHORIZED AGENT

Lyle Johnson, P.E.
Water Superintendent
224 West 9th Street
Sioux Falls, SD 57102
Telephone no. during business hours

2. NAME AND ADDRESS OF APPLICANT

City of Sioux Falls
224 West 9th Street
Sioux Falls, SD 57102

A/C () (Residence)

A/C (605) 339-7025 (Office)

Attn: Lyle Johnson, P.E.

Telephone no. during business hours

Statement of Authorization: I hereby designate and authorize _____
to act in my behalf as my
agent in the processing of this permit application and to furnish, upon request,
supplemental information in support of the application.

SIGNATURE OF APPLICANT

DATE

A/C () (Residence)

A/C (605) 339-7025 (Office)

4. DETAILED DESCRIPTION OF PROPOSED ACTIVITY

4a. ACTIVITY

Construction of intake structure and pumping station to provide raw water source to the City of Sioux Falls Water Purification Plant. This involves a structure constructed in the south levee of the Big Sioux River north of the airport in Sioux Falls South Dakota.

4b. PURPOSE

Provide a raw water source for a drinking water supply for the City of Sioux Falls, South Dakota.

4c. DISCHARGE OF DREDGED OR FILL MATERIAL

Fill material around the pump station will be used to provide the required site modifications as indicated on the site plan.

5. NAMES AND ADDRESSES OF ADJOINING PROPERTY OWNERS, LESSEES, ETC., WHOSE PROPERTY ALSO ADJOINS THE WATERWAY

Airport Authority
City of Sioux Falls
Sioux Falls, South Dakota

6. WATERBODY AND LOCATION ON WATERBODY WHERE ACTIVITY EXISTS OR IS PROPOSED

Big Sioux River at confluence of Big Sioux River and Diversion Channel

7. LOCATION ON LAND WHERE ACTIVITY EXISTS OR IS PROPOSED

ADDRESS: Near flood control gates north part of Sioux Falls at confluence of Big Sioux River and Diversion Channel.

STREET, ROAD, ROUTE OR OTHER DESCRIPTIVE LOCATION

Minnehaha SD 57102
COUNTY STATE ZIP CODE

City of Sioux Falls and Airport Authority
LOCAL GOVERNING BODY WITH JURISDICTION OVER SITE

8. Is any portion of the activity for which authorization is sought now complete? ☐ YES ☒ NO
If answer is "Yes" give reasons, month and year the activity was completed. Indicate the existing work on the drawings.

9. List all approvals or certifications and denials received from other federal, interstate, state or local agencies for any structures, construction, discharges or other activities described in this application.

ISSUING AGENCY	TYPE APPROVAL	IDENTIFICATION NO.	DATE OF APPLICATION	DATE OF APPROVAL	DATE OF DENIAL
----------------	---------------	--------------------	---------------------	------------------	----------------

10. Application is hereby made for a permit or permits to authorize the activities described herein. I certify that I am familiar with the information contained in this application, and that to the best of my knowledge and belief such information is true, complete, and accurate. I further certify that I possess the authority to undertake the proposed activities or I am acting as the duly authorized agent of the applicant.

SIGNATURE OF APPLICANT

DATE

SIGNATURE OF AGENT

DATE

The application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in Block 3 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of The United States knowingly and willfully falsifies, conceals, or covers up by any trick, scheme, or device a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false fictitious or fraudulent statement or entry, shall be fined not more than \$10,000 or imprisoned not more than five years, or both.

Do not send a permit processing fee with this application. The appropriate fee will be assessed when a permit is issued.



U.S. Department of Transportation
Federal Aviation Administration

NOTICE OF PROPOSED CONSTRUCTION OR ALTERATION

Aeronautical Study Number

1. Nature of Proposal

A. Type	B. Class	C. Work Schedule Dates
☒ New Construction	☒ Permanent	Beginning <u>10-89</u>
☐ Alteration	☐ Temporary (Duration _____ months)	End <u>8-90</u>

3A. Name and address of individual, company, corporation, etc. proposing the construction or alteration. (Number, Street, City, State and Zip Code)

(605) 339-7025
area code Telephone Number

City of Sioux Falls
224 West 9th Street
Sioux Falls, SD 57102
Lyle Johnson, P.E.

B. Name, address and telephone number of proponent's representative if different than 3 above.

2. Complete Description of Structure

- A. Include effective radiated power and assigned frequency of all existing, proposed or modified AM, FM, or TV broadcast stations utilizing this structure.
- B. Include size and configuration of power transmission lines and their supporting towers in the vicinity of FAA facilities and public airports.
- C. Include information showing site orientation, dimensions, and construction materials of the proposed structure.

- A. Structure includes 4-300 HP motors and variable speed drives. Telemetry via buried phone lines.
- B. Primary power will be buried 13.8 KV line.
- C. See site plan and relationship to airport in enclosed report for Site A.

(if more space is required, continue on a separate sheet.)

4. Location of Structure

A. Coordinates (To nearest second)	B. Nearest City or Town, and State	C. Name of nearest airport, heliport, flightpark, or seaplane base
<u>0</u> <u>1</u> <u>11</u>	<u>Sioux Falls</u>	<u>Sioux Falls Airport</u>
Latitude	(1) Distance to 4B <u>In City Limits</u> Miles	(1) Distance from structure to nearest point of nearest runway <u>Approx. 3,000ft</u>
Longitude	(2) Direction to 4B <u>Primarily South</u>	(2) Direction from structure to airport <u>South</u>

5. Height and Elevation (Complete to the nearest foot)

A. Elevation of site above mean sea level	<u>1435</u>
B. Height of Structure including all appurtenances and lighting (if any) above ground, or water if so situated	<u>29</u>
C. Overall height above mean sea level (A + B)	<u>1464</u>

D. Description of location of site with respect to highways, streets, airports, prominent terrain features, existing structures, etc. Attach a U.S. Geological Survey quadrangle map or equivalent showing the relationship of construction site to nearest airport(s). (if more space is required, continue on a separate sheet of paper and attach to this notice.)

In levee of Big Sioux River in north part of airport located approximately straight north of intersection of the two Sioux Falls runways. See location plan and site plan enclosed.

Notice is required by Part 77 of the Federal Aviation Regulations (14 C.F.R. Part 77) pursuant to Section 1101 of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1101). Persons who knowingly and willingly violate the Notice requirements of Part 77 are subject to a fine (criminal penalty) of not more than \$500 for the first offense and not more than \$2,000 for subsequent offenses, pursuant to Section 902(a) of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1472(a)).

I HEREBY CERTIFY that all of the above statements made by me are true, complete, and correct to the best of my knowledge. In addition, I agree to obstruction mark and/or light the structure in accordance with established marking & lighting standards if necessary.

Date _____ Typed Name/Title of Person Filing Notice _____ Signature _____

FOR FAA USE ONLY

FAA will either return this form or issue a separate acknowledgement.

The Proposal:

- ☐ Does not require a notice to FAA.
- ☐ Is not identified as an obstruction under any standard of FAR, Part 77, Subpart C, and would not be a hazard to air navigation.
- ☐ Is identified as an obstruction under the standards of FAR, Part 77, Subpart C, but would not be a hazard to air navigation.
- ☐ Should be obstruction ☐ marked, ☐ lighted per FAA Advisory Circular 70/7460-1, Chapter (s) _____
- ☐ Obstruction marking and lighting are not necessary.

Supplemental Notice of Construction: FAA Form 7460-2 is required any time the project is abandoned, or

- ☐ At least 48 hours before the start of construction
- ☐ Within five days after the construction reaches its greatest height.

This determination expires on _____ unless:

- (a) extended, revised or terminated by the issuing office;
- (b) the construction is subject to the licensing authority of the Federal Communications Commission and an application for a construction permit is made to the FCC on or before the above expiration date. In such case the determination expires on the date prescribed by the FCC for completion of construction, or on the date the FCC denies the application.

NOTE: Request for extension of the effective period of this determination must be postmarked or delivered to the issuing office at least 15 days prior to the expiration date.

If the structure is subject to the licensing authority of the FCC, a copy of this determination will be sent to that Agency.

Remarks:

Issued in

Signature

Date



Department of Water & Natural Resources

Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

July 7, 1989

Jack White, Mayor
City of Sioux Falls
224 West 9th Street
Sioux Falls, SD 57102

Dear Mr. White:

This letter is in response to the water permit application received from you on June 9, 1989.

The application that you have submitted requests 30,000 acre-feet of water annually. The water you have requested is reserved by Future Use Permit No. 3981-3, which was approved on January 30, 1980 and reserves for future use 50,000 acre-feet of water annually from the Big Sioux River. The location of the point of diversion specified on this permit is the W1/2 Section 33-T102N-R49W. The location of the point of diversion as requested in your application received June 9, 1989 is the N1/2 Section 32-T102N-R49W, which is outside of the location described on Future Use Permit No. 3981-3. For this reason, I am enclosing partially completed application forms to add a diversion point location area to that area authorized by Future Use Permit No. 3981-3. Please complete and return these forms along with the required \$50 application fee at your earliest convenience. We will use the map that you have already submitted for this application.

According to South Dakota Water Law, SDCL 46-5-20.1 and ARSD 74:02:01:15.01 through 74:02:01:15.05, any application for appropriation of water in excess of 10,000 acre-feet annually must receive Legislative approval. Your application must first be presented to the Water Management Board, who in turn will submit it to the Legislature, with or without recommendations. You do have the option of reducing the amount of water requested and resubmitting your water permit application.

Please return the application forms for changing the location of the point of diversion on Future Use Permit No. 3981-3 and let me know how you wish to proceed with the water permit application received from you on June 9, 1989.

Feel free to contact me if you have any questions.

Sincerely,

Susan A. Bowar
Natural Resources Engineer
Water Rights Division
(605) 773-3352
enclosures





Department of Water & Natural Resources

Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

100-1-10000

JUN 13 1989

0362

MEMO TO: John Haak

FROM: Susan A. Bowar, *Susan A. Bowar* Water Rights Division (phone # 3352)

SUBJECT: City of Sioux Falls' water permit application

DATE: June 12, 1989

I am enclosing a copy of a water permit application and map received from the City of Sioux Falls on June 9, 1989. This application requests appropriation of 30,000 acre-feet of water from the Big Sioux River. This water is reserved under Future Use Permit No. 3981-3. Future Use Permit No. 3981-3 received the required Legislative approval (SDCL 46-5-20.1) in 1979. I have also enclosed copies of pertinent items from this file.

I have two questions for you concerning this application:

- (1) Does this application to appropriate a portion of the water reserved by Future Use Permit No. 3981-3 require another Legislative approval ?
- (2) The future use water permit specifies a diversion location of the W 1/2 Section 33-T102N-R49W. The location of the diversion point as described on the water permit application received June 9, 1989 is not within the area specified on the future use permit (N 1/2 Section 32-T102N-R49W -- Site A on the enclosed map). Does adding a diversion point to Future Use Permit No. 3981-3 need Legislative approval (although this change involves no appropriation of water) ?

Please let me know your opinions on these two questions as soon as you can. Thank-you.



STATE OF SOUTH DAKOTA



OFFICE OF ATTORNEY GENERAL

STATE CAPITOL
Pierre, South Dakota 57501-5090
Phone (605) 773-3215



ROGER A. TELLINGHUISEN
ATTORNEY GENERAL

June 26, 1989

MEMORANDUM

TO: Susan A. Bowar, Water Rights Division
FROM: John E. Haak, Assistant Attorney General *JH*
RE: City of Sioux Falls' Water Permit Application

This memorandum is in response to your June 12 memorandum asking two specific questions. I am returning your memorandum along with its enclosures herewith for filing.

QUESTION NO. 1:

Does the City's application require another legislative approval?

ANSWER:

Yes. SDCL 46-5-20.1 requires legislative approval for "any application for appropriation of water" in excess of 10,000 acre feet annually. In my opinion, the above-quoted language requires legislative approval, not only for the original reservation, but also for a subsequent appropriation under the reservation such as the case at hand.

QUESTION NO. 2:

Does adding a diversion point to the future use permit need legislative approval?

ANSWER:

My research does not reveal any requirement for legislative approval of an amendment to a future use reservation which does not result in a detriment to the rights of others having rights to the use of the water. Of course no amendment, regardless of the size of the appropriation, can be granted that is detrimental to others having valid water

permits or rights to the use of the water. See SDCL §§ 46-5-24, 46-5-30.4, and 46-2A-12. If the proposed amendment adversely affects existing valid water rights, it cannot be granted. Since the proposed amendment moves the proposed point of diversion upstream, it may adversely impact existing valid water rights. If the proposed amendment does not adversely affect existing valid water rights, it is my opinion that the amendment can be granted without legislative approval subject to the procedures contained in Chapter 46-2A.

The opinions expressed herein are those of the writer and do not necessarily reflect the opinion of the Attorney General.

JEH:ss



HJR 1005

THURSDAY, MARCH 1, 1979-32nd L.D.

709

1 Also MR. SPEAKER:

2 The Committee on Agriculture and Natural Resources respectfully
3 reports that it has had under consideration House Joint Resolution No.
4 1005 and returns the same with the recommendation that said resolution
5 be amended as follows:

6 On page 1, line 6 of the printed resolution, delete "applica-
7 tions" and insert in lieu thereof "application".

8 On page 1, line 6, delete "3980-3 and".

9 On page 1, line 8, delete "each".

10 On page 1, line 9, delete "and Slip-up creek".

11 On page 1, line 12, delete "these" and insert in lieu thereof
12 "the".

13 On page 1, line 12, delete "applications" and insert in lieu
14 thereof "application".

15 On page 1, line 14, delete "these applications" and insert in
16 lieu thereof "application".

17 On page 1, line 14, delete "3980-3 and".

18 On page 1, line 18, delete "these applications" and insert in
19 lieu thereof "the application".

20 On page 2, line 1, delete "these applications" and insert in lieu
21 thereof "the application".

22 On page 2, line 2, delete "3980-3 and".

23 On page 2, line 8, delete "these" and insert in lieu thereof
24 "the".

25 On page 2, line 8, delete "applications have" and insert in lieu
26 thereof "application has".

27 On page 2, line 13, delete "appli-".

28 On page 2, line 14, delete "cations" and insert in lieu thereof
29 "application".

30 On page 2, line 14, delete "3980-3 and".

31 On page 2, line 14, after "3981-3" delete "are" and insert in
32 lieu thereof "is".

33 On page 2, line 14, after "approved and" delete "are" and insert
34 in lieu thereof "is".

35 On page 2, line 16, after "action" insert "provided that the
36 application is amended to delete any specific reference to a storage

1 reservoir on Slip-up creek without prejudice to the right of the city
2 of Sioux Falls to attempt to establish the propriety of that project
3 at a future date as allowed by law".

4 And that as so amended said resolution do pass.

5 Respectfully submitted,
6 G.F. MORTIMER, Chairman

7 Also MR. SPEAKER:

8 The Committee on Health and Welfare respectfully reports that it
9 has had under consideration SB No. 85 and returns the same with the
10 recommendation that said bill do pass.

11 Respectfully submitted,
12 DON HAM, Chairman

13 Also MR. SPEAKER:

14 The Committee on State Affairs respectfully reports that it has
15 had under consideration HB No. 1215 and returns the same with the
16 recommendation that said bill be amended as follows:

17 On page 1, line 10 of the printed bill, delete "all positions
18 that" and insert in lieu thereof "office supervisors who".

19 On page 1, line 12, delete everything after the comma.

20 On page 1, delete lines 13 and 14 and insert in lieu thereof "and
21 confidential assistants to exempt employees. The commissioner of per-
22 sonnel shall have the power to determine which positions are eligible
23 for exemption under the provisions of this Act and chapter 3-6A. Any
24 decision of the commissioner of personnel relating to exemptions from
25 the career service is final and".

26 On page 2, line 6, delete "to specify" and insert in lieu thereof
27 "which establish criteria to implement section 1 of this Act for".

28 And that as so amended said bill do pass.

29 Also MR. SPEAKER:

30 The Committee on State Affairs respectfully reports that it has
31 had under consideration HB No. 1271 and returns the same with the
32 recommendation that said bill do pass and be sent to the Committee on
33 Appropriations.

34 Respectfully submitted,
35 JOSEPH H. BARNETT, Chairman

State of South Dakota

FIFTY-FOURTH SESSION, LEGISLATIVE ASSEMBLY, 1979

3/3 Passed House; Y: 63- N: 3
3/12 Passed Senate; Y: 31- N: 2

79B728

HOUSE JOINT

RESOLUTION NO. 1005

Introduced by: Representatives Munson, Kull, Wick and Wofford

1 A JOINT RESOLUTION, Approving application number 3980-3 and 3981-3
2 for future water rights.

3 BE IT RESOLVED BY THE HOUSE OF REPRESENTATIVES OF THE STATE OF SOUTH
4 DAKOTA, THE SENATE CONCURRING THEREIN:

5 WHEREAS, pursuant to § 46-5-20.1, the city of Sioux Falls made
6 applications numbered ~~3980-3~~ and 3981-3 to the department of natural
7 resource development and the water rights commission for future water
8 rights, each in excess of ten thousand acre feet annually to be taken
9 from unappropriated flows of the Big Sioux river ~~and Slip up creek,~~
10 and

11 WHEREAS, the department of natural resource development after
12 studying these future use water right applications and, based solely
13 on the availability of unappropriated water, recommended that the
14 water rights commission submit these applications numbered ~~3980-3~~ and
15 3981-3 to the Legislature for its recommendation of approval, and

16 WHEREAS, the water rights commission at its regular meeting, held
17 in July 1978, in Sioux Falls, South Dakota recommended that the Legis-
18 lature not approve these applications, and

1 WHEREAS, the future use contemplated by these applications num-
2 bered ~~3980-3~~ and 3981-3 includes future municipal, commercial, indus-
3 trial, and recreational water uses, and

4 WHEREAS, in the event a future use permit is granted and feasi-
5 bility supports such uses, the applicants will be required to demon-
6 strate that the proposed use is beneficial and in the public interest,
7 and

8 WHEREAS, these water right applications have the support of the
9 east Dakota conservancy subdistrict, the South Dakota board of natural
10 resource development, and the city of Sioux Falls, and the staff of
11 the water rights division in the department of the natural resources
12 commission has recommended that unappropriated water is available,

13 NOW BE IT HEREBY RESOLVED that the future use water right appli-
14 cations numbered ~~3980-3~~ and 3981-3 are hereby approved and are hereby
15 transmitted back to the water rights commission or its successor for
16 final action.

A JOINT RESOLUTION, Approving application number 3981-3 for future water rights.

BE IT RESOLVED BY THE HOUSE OF REPRESENTATIVES OF THE STATE OF SOUTH DAKOTA, THE SENATE CONCURRING THEREIN:

WHEREAS, pursuant to § 46-5-20.1, the city of Sioux Falls made application numbered 3981-3 to the department of natural resource development and the water rights commission for future water rights, in excess of ten thousand acre feet annually to be taken from unappropriated flows of the Big Sioux river, and

WHEREAS, the department of natural resource development after studying the future use water right application and, based solely on the availability of unappropriated water, recommended that the water rights commission submit application numbered 3981-3 to the Legislature for its recommendation of approval, and

WHEREAS, the water rights commission at its regular meeting, held in July 1978, in Sioux Falls, South Dakota recommended that the Legislature not approve the application, and

WHEREAS, the future use contemplated by the application numbered 3981-3 includes future municipal, commercial, industrial, and recreational water uses, and

WHEREAS, in the event a future use permit is granted and feasibility supports such uses, the applicants will be required to demonstrate that the proposed use is beneficial and in the public interest, and

WHEREAS, the water right application has the support of the east Dakota conservancy subdistrict, the South Dakota board of natural resource development, and the city of Sioux Falls, and the staff of the water rights division in the department of the natural resources commission has recommended that unappropriated water is available,

NOW BE IT HEREBY RESOLVED that the future use water right appli-

House Joint Resolution #1005

cation number 3981-3 is hereby approved and is hereby transmitted back to the water rights commission or its successor for final action provided that the application is amended to delete any specific reference to a storage reservoir on Slip-up creek without prejudice to the right of the city of Sioux Falls to attempt to establish the propriety of that project at a future date as allowed by law.

STATE OF SOUTH DAKOTA
WATER MANAGEMENT BOARD

IN THE MATTER OF THE APPLICATION	)	
OF THE CITY OF SIOUX FALLS FOR	)	FINAL DECISION
PERMIT TO APPROPRIATE FOR FUTURE	)	
USE NO. 3981-3	)	

The reconsideration of the deferred application No. 3981-3, of the City of Sioux Falls for a Permit to appropriate for future use was held before the Water Management Board on November 27, 1979. The applicant, the City of Sioux Falls, appeared through Les Hash, manager of the City's Department of Water; Jeremiah D. Murphy; Vern Winegarden, City Commissioner; and Anthony Conteras. Mr. Edward H. Lacey appeared as an opponent to the application. The Department of Natural Resource Development appeared through Water Resources Engineer, James Winterton. Having served the proposed decision upon the parties and having provided each party with an opportunity to file proposed Findings of Fact and Conclusions of Law and present oral argument to the Board, and the Board having fully considered all such submissions, the Board hereby makes its final decision consisting of the following:

FINDINGS OF FACT

1. Application No. 3981-3, submitted by the City of Sioux Falls for a Permit to appropriate for future use, was received by the Water Rights Commission (Water Management Board) on June 6, 1977. The application proposes a withdrawal of 120 cfs to be stored in a reservoir and 50 cfs to be pumped to the Sioux Falls Purification Plant, up to a maximum withdrawal of 50,000 acre-feet-per-year, from the Big Sioux River. The proposed diversion point is in the west half of Section 33, Township 102 North, Range 49 west; the application is for future municipal use.

2. Notice of the July, 1977 hearing on Application No. 3981-3 was published for two consecutive weeks prior to the hearing. The application was deferred and was reconsidered in January, 1978 and July, 1978. Following the July, 1978 hearing, the Water Rights Commission directed that this Application be forwarded to the State Legislature for legislative consideration because the Application proposed to appropriate more than 10,000 acre-feet annually.

3. The 1979 Legislature approved Application No. 3981-3 to reserve 50,000 acre-feet annually from the Big Sioux River with instructions that the Water Rights Commission (Water Management Board) delete any reference to another Application by the City of Sioux Falls Application No. 3980-3 and to the Slip-Up Creek Project.

4. After Legislative approval, this application was reconsidered at the November, 1979 Water Management Board meeting.

5. Prior to the reconsideration hearing, Mr. John Hatch, Chief Engineer, notified each person of record by mail of the date and time that the application would be reconsidered.

6. The Department of Water and Natural Resources investigated the question of water availability, based on U.S. Geological Survey records, and determined that there is an eighty percent chance that, between the end of March and middle of June, the Big Sioux River would contain flows equalling or exceeding 100 cfs at Sioux Falls. Between Sioux Falls and Akron, Iowa there was a pick-up of flows from different tributaries of 175 cfs based on the same 80% chance of equalling or exceeding a given flow at the Akron, Iowa station.

WHEREFORE, the Board makes the following:

CONCLUSIONS OF LAW

1. All notices required by law have been duly given.
2. The parties to this contested case are the applicant, the City of Sioux Falls, South Dakota, Edward H. Lacey, and the Department of Water and Natural Resources.
3. SDCL 46-5-38 authorizes a municipality to apply for a future use permit.
4. ARSD 52:01:01:24 deems that the approval by the Water Management Board (Water Rights Commission) of an application by a public body to appropriate water for future use is a reservation of a definite amount of water with a specified priority date and does not grant any authority to construct works or put the water to beneficial use.

5. Legislation approval, required for all applications to appropriate more than 10,000 acre-feet per year, by SDCL 46-5-20.1, has been granted for this application, with the restriction that all references to Application No. 3980-3, also by the City of Sioux Falls, or Slip-Up Creek be deleted.

6. Therefore the Board has jurisdiction over the subject matter of this proceeding.

7. A 50 cfs low flow bypass is required to meet the appropriations of appropriators downstream from the proposed diversion point.

8. There is sufficient unappropriated water available from the Big Sioux River to allow the City of Sioux Falls to appropriate a maximum of 50,000 acre feet annually of water from the Sioux River at a diversion rate not to exceed 170 cfs for future municipal use.

9. The issuance of this future use permit to the City of Sioux Falls is in the public interest.

Therefore, the Board of Water Management hereby ORDERS:

1. that the City of Sioux Falls be granted a Permit to Appropriate for Future Use for a maximum withdrawal of 50,000 acre-feet per year at a diversion rate not to exceed 170 cfs;

2. that such permit is subject to the restriction that withdrawals may be made only when 50 cfs, or more, of water is flowing past the City's diversion point after diversions have been made;

3. that specific applications for all or any part of the water granted by this Permit must be submitted prior to the construction of any facilities;

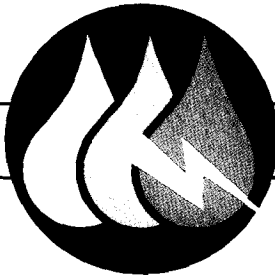
4. that the approval of this Permit is subject to review by the Water Management Board as to the accomplishments thereunder upon the expiration of seven years.

Dated and signed this 30th day of January, 1980.


Dennis Decker, Chairman
Water Management Board


Wendell H. Hanson, Secretary
Water Management Board

Sioux Falls UTILITIES



WATER • (605) 339-7031
WASTEWATER • (605) 339-7088

LIGHTS • (605) 339-7150
STORM DRAINAGE • (605) 339-7023

July 25, 1989

Ms. Susan A. Bower
Natural Resources Engineer
Joe Foss Building
523 East Capitol
Pierre, SD 57501-3181



Dear Ms. Bower:

Subject: Water Withdrawal Permit

The Sioux Falls City Commission has authorized Mayor Jack White to sign, on behalf of the City, a new application for water withdrawal from the Big Sioux River, substantially in the form sent to his attention July 7, 1989.

Please be advised that we are reducing the request at this time from 30,000 acre feet of water annually to 10,000 acre feet of water annually. We reserve the right to submit an additional application for the additional 20,000 acre feet annually, but wish to have that action separated from this request.

It is the City of Sioux Falls' intention to build a Big Sioux River pump station. We would like to put this pumping station into beneficial use as soon as possible. It makes no sense to commence Notice to Bidders on a project, unless we have a firm water right.

We have already forwarded, with our original application, the fee owing for the 30,000 acre foot application. As a result, instead of enclosing an additional filing fee at this time, we request that you take the filing fee from that and issue a refund for the overpayment.

If you have any questions, please feel free to contact me.

Sincerely,

Richard A. Willer
Utilities Support Services Manager

khs
cc Glenn Dostal
Lyle Johnson



Department of Water & Natural Resources

Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

July 31, 1989

Richard A. Willer
Utilities Support Services Manager
City of Sioux Falls
224 W. 9th Street
Sioux Falls, South Dakota 57102

Dear Mr. Willer:

This is in response to the revised water permit application received from you on July 27, 1989.

The original application, for 30,000 acre-feet of water annually from the Big Sioux River, had an application fee of \$6425. The fees for the applications have been adjusted as follows:

- 1) The fee for adding a diversion area to Future Use Permit No. 3981-2 is \$50.
- 2) The fee for appropriation of 10,000 acre-feet of water (reserved by Future Use Permit No. 3981-2) is \$2275.

These two application fees, which total \$2325, will be subtracted from the original fee submitted (\$6425) and the balance (\$4100) will be refunded. I am including your receipts for these transactions. The voucher has been submitted for your refund. Please allow 3 to 4 weeks for processing.

Feel free to contact me if you have any questions.

Sincerely,

Susan A. Bowar
Natural Resources Engineer
Water Rights Division
(605) 773-3352

enclosures



RECEIPT

Division of Water Rights

South Dakota Department of Water and Natural Resources

411791

Pierre, June 9, 1989

RECEIVED OF City of Sioux Falls, 224 W. 9th, Sioux Falls, SD 57102

the following amount in fees for services rendered as provided for by law:

Fee for Application for Permit No. _____ to Appropriate Water, to construct works and to put water to beneficial use _____	6425	00
Fee for Application for Permit No. _____ to Appropriate Water for Future Use _____		
Fee to retain Future Use Permit No. _____ after period of seven years.		
Fee for Inspecting Constructed Works, confirming beneficial use and issuing Water License No. _____		
Fee for Filing Transfer Form _____		
Fee for Filing Extension Request _____		
Fee for Certified Copy of _____		
Fee for Print Copy of Map _____		
Fee for Certifying _____		
Fee for _____		
(Any Other Work Provided by Law)	Total	6425 00

By John Hatch
Chief Engineer

COPYSTATE OF SOUTH DAKOTA
VOUCHER

Do not use this space.

☒ Direct(Z) ☐ Travel(N) ☐ Non-Cash(C) ☐ Cash Receipt(T) ☐ Cash Transfer(I) ☐ Investment(B) ☐ Appropriation-Budget Transfer(E) ☐ Expenditure Correction(R) ☐ Revenue Correction(P) ☐ Period Ending Adjustment(A) ☐ Other Adjustment**AGENCY USE ONLY****APPROVAL OFFICE ONLY**

Application Area 75		Vendor Number	Invoice ID	Voucher Number	Date
Date	Purchase Order ID	Document ID	Delivery Date	Payment Due Date	
S T A P L E	(Payee, Billed Agency)			(Department, Billing Agency)	
	TO: CITY OF SIOUX FALLS JACK WHITE, MAYOR 224 W 9TH SIOUX FALLS SD 57102			FROM: DWNR WATER RIGHTS DIVISION 523 E CAPITOL FOSS BLDG PIERRE SD 57501-3181	

FUNDING INFORMATION

S E Q	Company	Account		Center		Project Company Number	Debit/Credit Amount	Invoices		U C S O D E D R E
		Required	User	Required	User			Other	Dr.	
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
Total										

Description of Service, Product, or Transfer

City of Sioux Falls reduced their amount of water requested, fee amount reduced. original fee amount \$6,425.00 amount of refund	4100 00
Total	4100.00

I declare and affirm under the penalties of perjury that this claim is in all things, true and correct. I further agree to comply with the provisions of the Civil Rights Act of 1964 and regulations issued thereunder relating to nondiscrimination in federally assisted programs.

Claimant

Date

Authorization

Date

RECEIPT

Division of Water Rights

South Dakota Department of Water and Natural Resources

411059

Pierre, July 27, 1980

RECEIVED OF City of Sioux Falls, 224 W. 9th Sioux Falls, SD 57102

the following amount in fees for services rendered as provided for by law:

Fee for Application for Permit No. _____ to Appropriate Water, to construct works and to put water to beneficial use _____	22	00
Fee for Application for Permit No. _____ to Appropriate Water for Future Use _____		
Fee to retain Future Use Permit No. _____ after period of seven years.		
Fee for Inspecting Constructed Works, confirming beneficial use and issuing Water License No. _____		
Fee for Filing Transfer Form _____		
Fee for Filing Extension Request _____		
Fee for Certified Copy of _____		
Fee for Print Copy of Map _____		
Fee for Certifying _____		
Fee for _____		
(Any Other Work Provided by Law)	Total	22 00

By

John Hatch / s
Chief Engineer

South Dakota Department of Water and Natural Resources

RECEIVED OF City of Sioux Falls, 224 W. 9th, Sioux Falls, SD 57202

By John H. H. H. H.
Chief Engineer

Report on Application Nos. 3981A-3 and 5334-3
City of Sioux Falls
August 21, 1989

Application No. 3981A-3 proposes to amend Future Use Permit No. 3981-3 by adding a diversion area to the area authorized by Permit No. 3981-3 which reserves for future use 50,000 acre feet of water annually from the Big Sioux River. The diversion from the river was to be located within the W1/2 of Section 33, T102N-R49W. This application is to add the N1/2 of Section 32, T102N-R49W to the authorized diversion area. Approval of this application would not authorize any increase in the amount of water reserved for future use.

Application No. 5334-3 is to construct and place to beneficial use 13.8 cubic feet of water per second (cfs) - 10,000 acre feet annually - from the Sioux River reserved by Future Use Permit No. 3981-3. The point of diversion is to be located within the W1/2 of Section 33 and N1/2 of Section 32, all in T102N-R49W. The water is to be used by the City of Sioux Falls for municipal purposes.

DISCUSSION

The proposal to add diversion area as requested by Application No. 3981A-3 should have no adverse impacts to existing rights over that of the present authorized diversion area. Application No. 3981A-3 must be approved before Application No. 5334-3 can be considered for using a portion of Future Use Permit No. 3981-3.

With approval of the additional diversion area, the priority date for Application No. 5334-3 would be based on Future Use Permit No. 3981-3, June 6, 1977. Any water permit with a priority date later than June 6, 1977 could not require the City of Sioux Falls to bypass water to meet their water permit needs. However, a bypass requirement would be necessary for prior existing rights to the use of the Big Sioux River flows.

Future Use Permit No. 3981-3 required a 50 cfs bypass requirement to meet the needs of appropriations downstream. The requirement was partly based on the idea that storage facilities would be available in order to divert water during the higher flow periods in the spring of the year. The diversion rate not to exceed 170 cfs was approved on the future use permit. Application No. 5334-3 does not provide for storage facilities. This will be a direct diversion right. The 50 cfs was based on the downstream appropriation without consideration for stream flow accretions to the Sioux River which could satisfy the prior existing rights.

The flows of the Big Sioux River have been reviewed. During low flow conditions, the Big Sioux River below Sioux Falls will generally receive sufficient flows from tributary inflows to meet the needs of most of the downstream water permit holders. Tributary inflows occur from Skunk Creek, Split Rock Creek, Beaver Creek from the east, Rock River in Iowa, Beaver Creek from the west (Canton Area) and other tributaries primarily from the eastern drainage basins in Minnesota and Iowa. The greatest impacts would be on the water rights located downstream in Sioux Falls and Lincoln County. Below Lincoln County, the Water Rights should not be significantly affected because of tributary inflow.

The flow accretions on the Big Sioux River from North Cliff Avenue at Sioux Falls to the Akron, Iowa gage during low flows were computed to be 47 cfs in July, 25 cfs in August, and 19 cfs in September. The 80 percentile flow shows accretions between these two gaging stations of 105 cfs in July, 117 cfs in August, and 74 cfs in September. See attached graphs. The period of record used for the gaging stations for comparison purposes was limited to the 9 year period beginning October, 1971.

There are approximately 30 cfs of prior existing water rights in Minnehaha and Lincoln Counties downstream of the proposed diversion excluding water rights held by the City of Sioux Falls. Low flow periods do occur in the Big Sioux River which would require water to be bypassed to meet the needs of the existing rights. Based on the flow analysis during low flow periods, a 20 cfs bypass requirement should be sufficient to meet the needs of the existing rights and domestic uses downstream on the Big Sioux River. The NPDES Permit for discharge of effluent from the Sioux Falls wastewater treatment plant to the Big Sioux River is not based upon a requirement for dilution water in the river.

CONCLUSIONS AND RECOMMENDATION

Water is available in most years to meet the needs of Application No. 5334-3. Because of prior existing rights to the flows of the Big Sioux River, a bypass requirement would be necessary during low flow conditions. The additional diversion area proposed by Application No. 3981A-3 should cause no adverse impacts to existing rights.

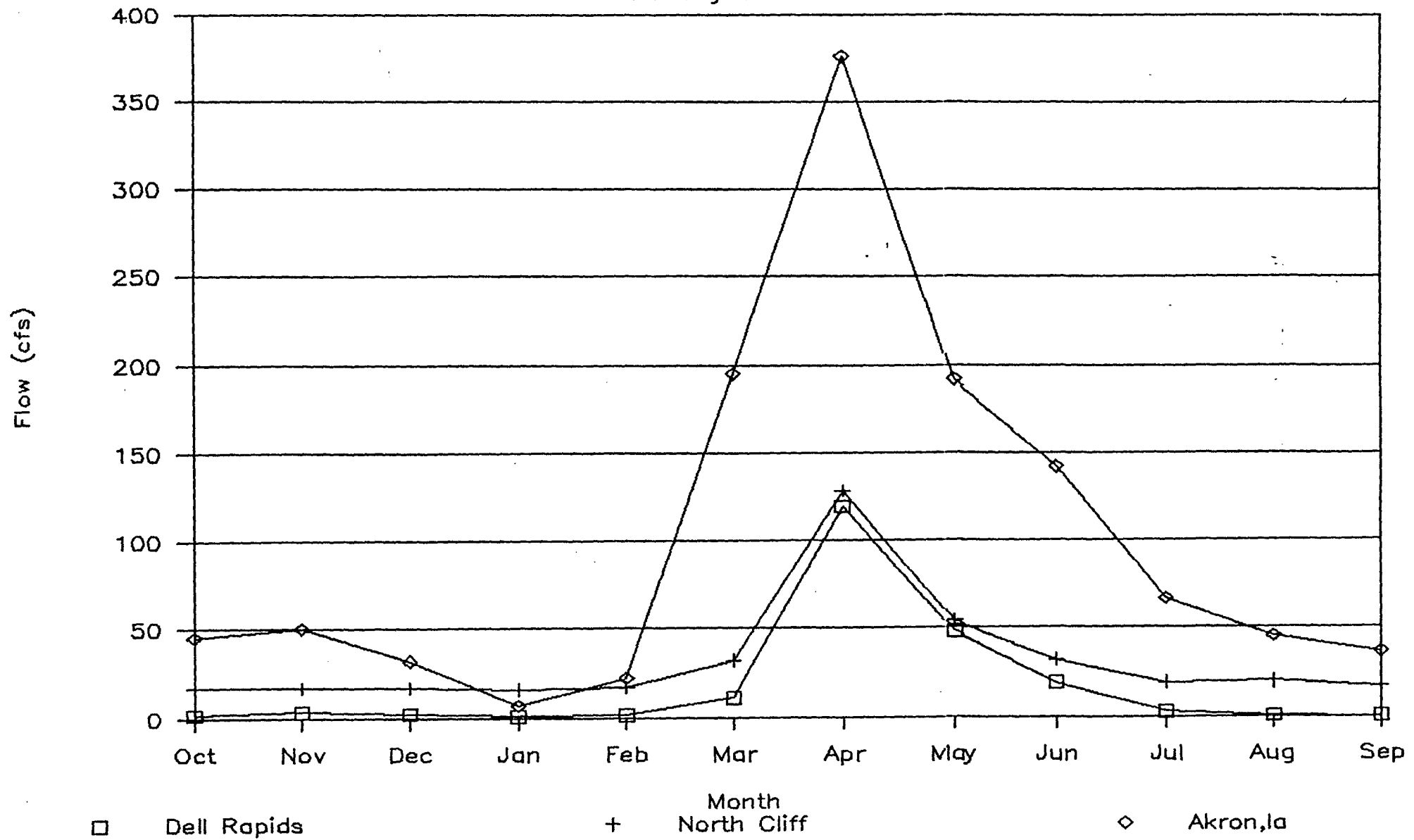
Application No. 3981A-3 should be approved to allow the additional diversion area. Then Application No. 5334-3 should be approved to allow the requested diversion rate of 13.8 cfs (10,000 acre feet annually) with a priority date of June 6, 1977 for municipal purposes subject to a low flow bypass requirement of 20 cfs.



James Winterton
Natural Resources Engineer

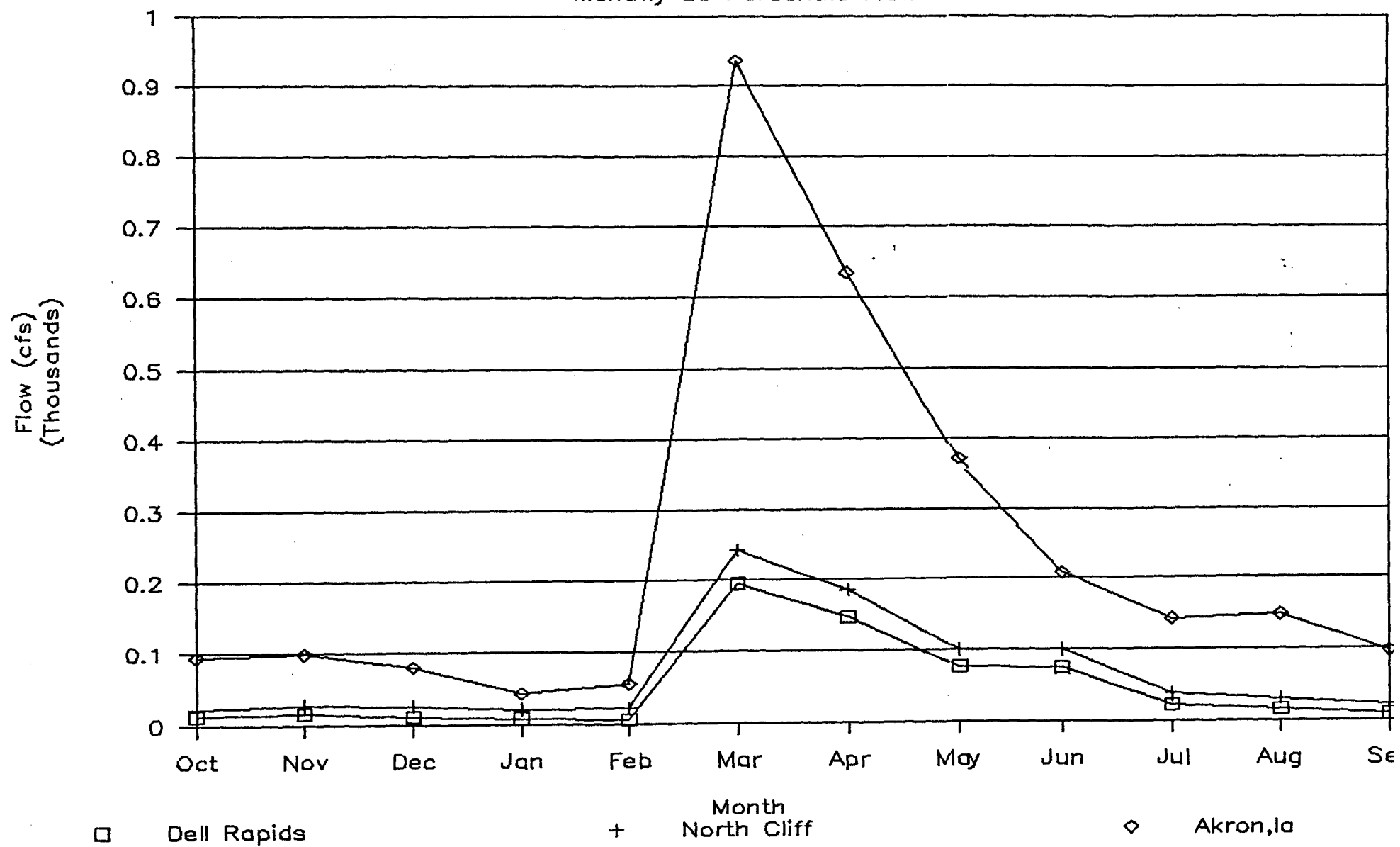
Big Sioux River

Monthly Low Flow



Big Sioux River

Monthly 80 Percentile Flow



PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 49-YEAR PERIOD BEGINNING OCTOBER 1929

STATION 06485500

BIG SIOUX R AT AKRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
5- 1	4820.00	2660.00	1980.00	1400.00	854.00	470.00	404.00	239.00	99.00
5- 2	4730.00	2570.00	2000.00	1230.00	794.00	456.00	387.00	236.00	101.00
5- 3	5080.00	2700.00	1860.00	1220.00	704.00	446.00	380.00	254.00	99.00
5- 4	6740.00	2840.00	2050.00	1290.00	690.00	455.00	376.00	238.00	97.00
5- 5	7580.00	2740.00	2000.00	1310.00	704.00	449.00	358.00	251.00	97.00
5- 6	6040.00	2930.00	2000.00	1280.00	773.00	440.00	349.00	268.00	91.00
5- 7	5060.00	2810.00	2110.00	1260.00	715.00	451.00	366.00	281.00	91.00
5- 8	4760.00	2560.00	1920.00	1230.00	689.00	448.00	382.00	246.00	85.00
5- 9	4280.00	2350.00	1810.00	1190.00	776.00	423.00	370.00	253.00	87.00
5-10	3880.00	2260.00	1900.00	1230.00	709.00	407.00	337.00	259.00	78.00
5-11	3760.00	2720.00	2120.00	1160.00	643.00	402.00	356.00	246.00	80.00
5-12	5380.00	3220.00	2340.00	1140.00	630.00	392.00	336.00	234.00	85.00
5-13	6040.00	2870.00	2330.00	1130.00	602.00	404.00	326.00	224.00	82.00
5-14	6220.00	2520.00	2100.00	1140.00	602.00	446.00	308.00	222.00	82.00
5-15	6150.00	2290.00	1920.00	1390.00	593.00	428.00	334.00	222.00	74.00
5-16	4820.00	2210.00	1850.00	1310.00	590.00	386.00	336.00	218.00	72.00
5-17	4590.00	2130.00	1750.00	1200.00	611.00	387.00	316.00	210.00	72.00
5-18	3930.00	2160.00	1630.00	1040.00	605.00	369.00	300.00	210.00	69.00
5-19	3090.00	2670.00	1520.00	1010.00	626.00	337.00	280.00	202.00	63.00
5-20	3280.00	2290.00	1560.00	1060.00	643.00	327.00	248.00	192.00	63.00
5-21	3000.00	2080.00	1640.00	1140.00	668.00	342.00	265.00	188.00	61.00
5-22	3030.00	2720.00	1650.00	1210.00	645.00	323.00	267.00	183.00	60.00
5-23	3280.00	2670.00	1680.00	1160.00	671.00	332.00	263.00	179.00	61.00
5-24	4640.00	2470.00	1710.00	1120.00	653.00	326.00	263.00	167.00	56.00
5-25	6090.00	2820.00	1820.00	1130.00	671.00	318.00	252.00	171.00	58.00
5-26	8000.00	3150.00	1920.00	1270.00	648.00	336.00	240.00	171.00	54.00
5-27	6440.00	3220.00	1920.00	1120.00	641.00	391.00	256.00	164.00	54.00
5-28	5780.00	3710.00	2260.00	1390.00	601.00	390.00	277.00	168.00	53.00
5-29	6930.00	3570.00	2060.00	1360.00	618.00	358.00	263.00	166.00	50.00
5-30	7190.00	3750.00	1580.00	1330.00	631.00	345.00	260.00	149.00	50.00
5-31	6970.00	3770.00	1930.00	1280.00	671.00	340.00	256.00	154.00	48.00
MEAN	3661.29	2336.12	2052.25	1547.74	836.71	478.45	369.61	235.48	73.29

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 49-YEAR PERIOD BEGINNING OCTOBER 1929

STATION 06485500
BIG SIOUX R AT AKRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
6- 1	5280.00	3190.00	1640.00	1330.00	684.00	353.00	258.00	142.00	46.00
6- 2	5620.00	2420.00	1640.00	1220.00	623.00	373.00	252.00	144.00	44.00
6- 3	12500.00	2610.00	1500.00	1190.00	590.00	364.00	240.00	136.00	41.00
6- 4	20000.00	2910.00	1800.00	1140.00	819.00	364.00	240.00	129.00	44.00
6- 5	15200.00	2800.00	1850.00	1150.00	764.00	348.00	248.00	125.00	48.00
6- 6	10500.00	3280.00	1770.00	1230.00	752.00	335.00	262.00	120.00	74.00
6- 7	8500.00	3350.00	1860.00	1230.00	715.00	428.00	274.00	183.00	78.00
6- 8	16100.00	4900.00	2150.00	1460.00	677.00	464.00	266.00	175.00	86.00
6- 9	13400.00	5260.00	1980.00	1370.00	622.00	416.00	284.00	163.00	80.00
6-10	13700.00	4150.00	1950.00	1230.00	577.00	454.00	276.00	155.00	74.00
6-11	9520.00	3800.00	2670.00	1140.00	588.00	422.00	304.00	177.00	73.00
6-12	9890.00	4430.00	2440.00	1050.00	580.00	433.00	275.00	153.00	69.00
6-13	10500.00	4050.00	2570.00	1080.00	667.00	482.00	275.00	153.00	69.00
6-14	5510.00	2930.00	2100.00	1080.00	660.00	486.00	257.00	138.00	66.00
6-15	9820.00	3950.00	1980.00	1030.00	625.00	428.00	254.00	132.00	65.00
6-16	9570.00	3450.00	1760.00	1180.00	618.00	420.00	254.00	125.00	67.00
6-17	9730.00	5720.00	1810.00	1220.00	684.00	388.00	262.00	120.00	94.00
6-18	11600.00	5170.00	2000.00	1580.00	715.00	355.00	254.00	120.00	90.00
6-19	9650.00	6750.00	2390.00	1560.00	807.00	328.00	247.00	113.00	83.00
6-20	12100.00	5170.00	3190.00	1640.00	839.00	313.00	227.00	126.00	78.00
6-21	18500.00	3820.00	2560.00	1500.00	807.00	318.00	237.00	159.00	74.00
6-22	20100.00	3330.00	2220.00	1520.00	903.00	317.00	240.00	172.00	76.00
6-23	14600.00	3010.00	1990.00	1450.00	803.00	334.00	256.00	140.00	74.00
6-24	9820.00	3000.00	1920.00	1610.00	772.00	356.00	241.00	149.00	69.00
6-25	7820.00	2640.00	1950.00	1480.00	826.00	372.00	248.00	165.00	69.00
6-26	4670.00	3960.00	2160.00	1550.00	821.00	419.00	255.00	187.00	62.00
6-27	6220.00	3010.00	2160.00	1390.00	692.00	416.00	316.00	177.00	60.00
6-28	6160.00	2530.00	2050.00	1390.00	650.00	351.00	288.00	168.00	56.00
6-29	6730.00	4490.00	1880.00	1470.00	653.00	351.00	252.00	158.00	56.00
6-30	7890.00	3160.00	1750.00	1600.00	784.00	366.00	246.00	149.00	54.00
MEAN	4750.00	3793.96	3255.66	1749.66	838.90	524.76	320.66	207.63	100.20

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 49-YEAR PERIOD BEGINNING OCTOBER 1929

STATION 06485500

BIG SIOUX R AT AKRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
7- 1	8220.00	4150.00	1920.00	1430.00	681.00	347.00	239.00	193.00	72.00
7- 2	11400.00	3510.00	1840.00	1420.00	587.00	319.00	248.00	187.00	74.00
7- 3	10800.00	3440.00	1720.00	1270.00	515.00	334.00	216.00	175.00	74.00
7- 4	10800.00	2610.00	1760.00	1200.00	527.00	284.00	209.00	150.00	82.00
7- 5	9330.00	2420.00	1940.00	1170.00	485.00	288.00	202.00	138.00	78.00
7- 6	6840.00	3050.00	2000.00	1190.00	434.00	269.00	212.00	140.00	72.00
7- 7	7040.00	3780.00	1820.00	1180.00	573.00	254.00	206.00	161.00	65.00
7- 8	3950.00	3330.00	1600.00	1170.00	586.00	225.00	178.00	158.00	65.00
7- 9	3670.00	2570.00	1500.00	1190.00	509.00	227.00	186.00	157.00	60.00
7-10	4180.00	2260.00	1740.00	1290.00	428.00	210.00	177.00	148.00	58.00
7-11	5210.00	2610.00	1630.00	1170.00	396.00	237.00	170.00	143.00	52.00
7-12	7180.00	1780.00	1390.00	1110.00	363.00	229.00	180.00	132.00	59.00
7-13	7400.00	1630.00	1270.00	968.00	392.00	218.00	166.00	133.00	52.00
7-14	8760.00	1440.00	1180.00	1010.00	469.00	187.00	165.00	125.00	52.00
7-15	9340.00	1360.00	1150.00	885.00	402.00	208.00	158.00	128.00	50.00
7-16	5700.00	2140.00	1050.00	808.00	389.00	188.00	140.00	125.00	46.00
7-17	3880.00	2110.00	1050.00	878.00	375.00	198.00	133.00	120.00	44.00
7-18	3210.00	1860.00	959.00	783.00	360.00	189.00	128.00	120.00	40.00
7-19	3030.00	1640.00	919.00	730.00	392.00	183.00	123.00	107.00	42.00
7-20	3040.00	1820.00	858.00	693.00	466.00	174.00	123.00	101.00	44.00
7-21	2900.00	2200.00	912.00	700.00	467.00	172.00	127.00	94.00	38.00
7-22	3220.00	2360.00	903.00	686.00	413.00	163.00	116.00	100.00	38.00
7-23	4580.00	2250.00	1230.00	659.00	400.00	184.00	126.00	97.00	35.00
7-24	5260.00	2470.00	1420.00	591.00	372.00	176.00	124.00	94.00	35.00
7-25	6210.00	2430.00	1150.00	598.00	321.00	160.00	134.00	93.00	33.00
7-26	3380.00	1690.00	1150.00	588.00	297.00	153.00	118.00	91.00	33.00
7-27	2470.00	1450.00	1120.00	538.00	299.00	152.00	113.00	95.00	33.00
7-28	2540.00	1870.00	1080.00	547.00	265.00	142.00	105.00	91.00	33.00
7-29	2400.00	1560.00	963.00	521.00	258.00	142.00	111.00	85.00	33.00
7-30	2190.00	1490.00	920.00	591.00	270.00	135.00	115.00	84.00	30.00
7-31	3560.00	1280.00	820.00	667.00	298.00	130.00	103.00	84.00	30.00
MEAN	3239.03	2237.96	1555.48	1200.74	406.87	219.58	185.35	127.58	50.74

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 49-YEAR PERIOD BEGINNING OCTOBER 1929

STATION 06485500
BIG SIOUX R AT AKRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
8- 1	8200.00	1180.00	912.00	672.00	293.00	126.00	103.00	90.00	30.00
8- 2	15400.00	1410.00	926.00	677.00	276.00	113.00	99.00	88.00	37.00
8- 3	10100.00	1700.00	1100.00	672.00	309.00	139.00	97.00	84.00	33.00
8- 4	6450.00	1600.00	1140.00	654.00	294.00	132.00	94.00	76.00	32.00
8- 5	4270.00	1580.00	1060.00	618.00	281.00	118.00	96.00	74.00	28.00
8- 6	4360.00	1480.00	993.00	472.00	280.00	118.00	99.00	75.00	28.00
8- 7	5070.00	1580.00	956.00	577.00	250.00	121.00	93.00	74.00	26.00
8- 8	4390.00	1560.00	760.00	483.00	237.00	106.00	88.00	70.00	33.00
8- 9	2700.00	1420.00	688.00	542.00	238.00	119.00	88.00	79.00	35.00
8-10	2220.00	1340.00	858.00	600.00	226.00	110.00	87.00	73.00	34.00
8-11	2210.00	1250.00	858.00	613.00	278.00	153.00	100.00	75.00	33.00
8-12	2220.00	1200.00	923.00	616.00	262.00	145.00	102.00	77.00	34.00
8-13	2550.00	1420.00	1110.00	615.00	269.00	142.00	93.00	74.00	34.00
8-14	3610.00	1310.00	1040.00	568.00	258.00	166.00	97.00	67.00	35.00
8-15	3220.00	1350.00	984.00	533.00	271.00	156.00	89.00	62.00	36.00
8-16	1860.00	1070.00	934.00	506.00	224.00	149.00	83.00	61.00	35.00
8-17	2460.00	1020.00	839.00	489.00	255.00	154.00	92.00	66.00	34.00
8-18	2210.00	1040.00	818.00	509.00	244.00	158.00	115.00	63.00	31.00
8-19	1600.00	1350.00	772.00	487.00	235.00	154.00	115.00	64.00	31.00
8-20	1520.00	974.00	718.00	448.00	222.00	152.00	111.00	63.00	31.00
8-21	1550.00	861.00	610.00	465.00	265.00	154.00	104.00	61.00	32.00
8-22	1390.00	840.00	547.00	398.00	245.00	161.00	102.00	59.00	34.00
8-23	1430.00	823.00	567.00	414.00	250.00	166.00	104.00	58.00	34.00
8-24	1540.00	920.00	555.00	441.00	234.00	151.00	112.00	54.00	32.00
8-25	2060.00	899.00	653.00	420.00	261.00	151.00	110.00	51.00	30.00
8-26	1860.00	870.00	613.00	414.00	243.00	154.00	122.00	49.00	28.00
8-27	1800.00	820.00	519.00	454.00	241.00	160.00	113.00	67.00	36.00
8-28	2600.00	1360.00	603.00	428.00	238.00	152.00	108.00	67.00	34.00
8-29	2110.00	1430.00	740.00	515.00	228.00	147.00	104.00	65.00	33.00
8-30	5540.00	1280.00	604.00	480.00	214.00	143.00	102.00	65.00	33.00
8-31	6860.00	1350.00	637.00	420.00	200.00	137.00	105.00	65.00	33.00
MEAN	2578.87	1211.25	763.58	569.25	290.32	200.45	147.29	79.32	45.19

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 49-YEAR PERIOD BEGINNING OCTOBER 1929

STATION 06485500

BIG SIOUX R AT AKRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
9- 1	4090.00	968.00	594.00	383.00	195.00	133.00	115.00	64.00	34.00
9- 2	3280.00	816.00	578.00	414.00	184.00	127.00	104.00	59.00	33.00
9- 3	4250.00	1020.00	631.00	428.00	197.00	122.00	94.00	60.00	33.00
9- 4	8500.00	1090.00	574.00	359.00	189.00	116.00	89.00	64.00	33.00
9- 5	10700.00	956.00	560.00	350.00	181.00	126.00	85.00	64.00	32.00
9- 6	8950.00	1050.00	515.00	309.00	175.00	126.00	86.00	60.00	32.00
9- 7	5880.00	1040.00	547.00	318.00	180.00	133.00	84.00	58.00	31.00
9- 8	2470.00	964.00	626.00	313.00	193.00	142.00	102.00	58.00	34.00
9- 9	2060.00	888.00	539.00	380.00	218.00	140.00	99.00	54.00	34.00
9-10	2400.00	1080.00	643.00	397.00	207.00	126.00	87.00	54.00	34.00
9-11	3340.00	1180.00	691.00	468.00	192.00	126.00	81.00	54.00	33.00
9-12	3620.00	994.00	657.00	462.00	222.00	125.00	74.00	50.00	31.00
9-13	3640.00	875.00	574.00	465.00	210.00	118.00	72.00	43.00	31.00
9-14	4540.00	878.00	513.00	455.00	208.00	112.00	74.00	43.00	38.00
9-15	4720.00	859.00	574.00	428.00	238.00	108.00	69.00	55.00	37.00
9-16	5730.00	907.00	560.00	389.00	222.00	105.00	77.00	53.00	35.00
9-17	9110.00	921.00	538.00	396.00	221.00	104.00	71.00	51.00	35.00
9-18	8230.00	836.00	454.00	362.00	179.00	100.00	72.00	51.00	34.00
9-19	4880.00	787.00	490.00	352.00	210.00	103.00	61.00	51.00	35.00
9-20	3210.00	688.00	492.00	338.00	218.00	110.00	85.00	47.00	34.00
9-21	3570.00	1060.00	470.00	354.00	204.00	117.00	84.00	44.00	33.00
9-22	2420.00	615.00	477.00	388.00	210.00	112.00	82.00	43.00	35.00
9-23	1860.00	839.00	466.00	394.00	197.00	110.00	72.00	46.00	33.00
9-24	1580.00	776.00	495.00	410.00	208.00	123.00	81.00	46.00	36.00
9-25	1420.00	820.00	448.00	412.00	199.00	126.00	81.00	43.00	33.00
9-26	1310.00	765.00	434.00	375.00	195.00	127.00	80.00	45.00	30.00
9-27	1230.00	694.00	421.00	329.00	187.00	132.00	79.00	49.00	32.00
9-28	1190.00	643.00	421.00	318.00	200.00	123.00	78.00	48.00	31.00
9-29	1230.00	597.00	385.00	322.00	194.00	115.00	79.00	45.00	32.00
9-30	1190.00	639.00	385.00	309.00	197.00	125.00	77.00	43.00	31.00
MEAN	2461.66	1295.53	530.66	403.03	237.50	128.53	95.53	58.60	36.36

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 49-YEAR PERIOD BEGINNING OCTOBER 1929

STATION 06485500

BIG SIOUX R AT AKRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
10- 1	1160.00	594.00	386.00	336.00	205.00	130.00	76.00	42.00	29.00
10- 2	1400.00	553.00	377.00	332.00	204.00	118.00	76.00	42.00	30.00
10- 3	1770.00	839.00	368.00	325.00	222.00	128.00	78.00	45.00	31.00
10- 4	2920.00	839.00	356.00	322.00	209.00	116.00	78.00	46.00	32.00
10- 5	2080.00	839.00	347.00	310.00	196.00	116.00	80.00	60.00	30.00
10- 6	1370.00	826.00	370.00	303.00	196.00	120.00	77.00	58.00	29.00
10- 7	1100.00	845.00	415.00	295.00	196.00	120.00	83.00	55.00	32.00
10- 8	1480.00	837.00	396.00	288.00	198.00	113.00	85.00	65.00	33.00
10- 9	1600.00	813.00	392.00	286.00	200.00	110.00	83.00	66.00	35.00
10-10	1480.00	778.00	368.00	284.00	200.00	116.00	83.00	59.00	38.00
10-11	1820.00	737.00	379.00	285.00	196.00	113.00	81.00	56.00	34.00
10-12	1670.00	730.00	391.00	290.00	185.00	111.00	79.00	55.00	32.00
10-13	1320.00	715.00	378.00	312.00	193.00	108.00	75.00	53.00	31.00
10-14	1280.00	686.00	377.00	322.00	196.00	114.00	83.00	49.00	31.00
10-15	1240.00	672.00	370.00	310.00	192.00	108.00	83.00	49.00	31.00
10-16	1170.00	607.00	370.00	299.00	198.00	105.00	85.00	51.00	35.00
10-17	1140.00	579.00	358.00	322.00	208.00	108.00	81.00	48.00	36.00
10-18	1070.00	629.00	358.00	324.00	221.00	107.00	76.00	53.00	33.00
10-19	1420.00	601.00	346.00	305.00	208.00	106.00	76.00	51.00	30.00
10-20	2400.00	574.00	350.00	294.00	207.00	109.00	78.00	49.00	30.00
10-21	2750.00	560.00	362.00	285.00	222.00	110.00	77.00	55.00	29.00
10-22	2280.00	537.00	343.00	269.00	199.00	109.00	77.00	55.00	30.00
10-23	1790.00	509.00	334.00	260.00	204.00	111.00	77.00	56.00	32.00
10-24	1520.00	476.00	322.00	258.00	202.00	112.00	76.00	56.00	31.00
10-25	1330.00	474.00	322.00	257.00	206.00	113.00	77.00	57.00	35.00
10-26	1170.00	466.00	311.00	261.00	210.00	117.00	80.00	55.00	34.00
10-27	1050.00	479.00	321.00	261.00	206.00	114.00	80.00	53.00	33.00
10-28	938.00	472.00	321.00	261.00	197.00	110.00	80.00	55.00	37.00
10-29	859.00	446.00	321.00	257.00	191.00	110.00	86.00	57.00	38.00
10-30	834.00	397.00	321.00	254.00	190.00	112.00	89.00	57.00	38.00
10-31	816.00	426.00	332.00	281.00	189.00	112.00	86.00	58.00	38.00
MEAN	922.09	681.93	362.87	295.64	203.35	114.83	82.77	54.96	32.93

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 49-YEAR PERIOD BEGINNING OCTOBER 1929

STATION 06485500

BIG SIOUX R AT AKRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
11- 1	816.00	446.00	338.00	295.00	217.00	106.00	94.00	55.00	39.00
11- 2	762.00	461.00	337.00	297.00	202.00	112.00	93.00	56.00	40.00
11- 3	672.00	524.00	345.00	298.00	202.00	105.00	88.00	60.00	39.00
11- 4	790.00	470.00	342.00	298.00	196.00	104.00	89.00	55.00	39.00
11- 5	808.00	495.00	422.00	300.00	192.00	113.00	88.00	56.00	42.00
11- 6	815.00	541.00	414.00	309.00	189.00	112.00	85.00	55.00	38.00
11- 7	780.00	500.00	414.00	306.00	187.00	112.00	88.00	57.00	39.00
11- 8	759.00	482.00	412.00	304.00	186.00	113.00	89.00	60.00	42.00
11- 9	760.00	508.00	370.00	292.00	195.00	114.00	88.00	61.00	45.00
11-10	807.00	551.00	338.00	284.00	195.00	114.00	86.00	62.00	41.00
11-11	807.00	576.00	379.00	276.00	186.00	114.00	86.00	62.00	43.00
11-12	807.00	542.00	351.00	281.00	186.00	112.00	86.00	63.00	45.00
11-13	807.00	646.00	334.00	282.00	183.00	111.00	86.00	65.00	46.00
11-14	1000.00	601.00	334.00	278.00	186.00	110.00	86.00	55.00	47.00
11-15	1180.00	588.00	320.00	287.00	184.00	108.00	80.00	51.00	45.00
11-16	1240.00	566.00	361.00	285.00	186.00	98.00	77.00	55.00	40.00
11-17	1400.00	570.00	325.00	287.00	184.00	114.00	82.00	60.00	40.00
11-18	1620.00	482.00	325.00	283.00	191.00	116.00	85.00	60.00	40.00
11-19	1680.00	448.00	380.00	280.00	176.00	114.00	94.00	59.00	45.00
11-20	1560.00	556.00	350.00	283.00	185.00	120.00	86.00	60.00	49.00
11-21	1350.00	588.00	330.00	290.00	186.00	110.00	86.00	67.00	48.00
11-22	1150.00	566.00	345.00	274.00	187.00	110.00	86.00	68.00	44.00
11-23	1000.00	532.00	351.00	259.00	184.00	110.00	85.00	58.00	44.00
11-24	900.00	454.00	340.00	275.00	182.00	110.00	86.00	60.00	45.00
11-25	940.00	469.00	322.00	262.00	176.00	112.00	89.00	64.00	44.00
11-26	980.00	530.00	307.00	260.00	175.00	106.00	85.00	73.00	42.00
11-27	1030.00	522.00	290.00	244.00	175.00	110.00	82.00	68.00	30.00
11-28	1100.00	480.00	299.00	250.00	175.00	105.00	82.00	50.00	30.00
11-29	1150.00	476.00	309.00	250.00	170.00	105.00	80.00	70.00	30.00
11-30	1200.00	440.00	286.00	254.00	159.00	100.00	85.00	62.00	33.00
MEAN	910.30	545.03	313.53	278.13	178.70	122.13	85.26	58.93	47.93

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 49-YEAR PERIOD BEGINNING OCTOBER 1929

STATION 06485500

BIG SIOUX R AT AKRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
12- 1	1130.00	425.00	270.00	230.00	150.00	100.00	78.00	53.00	30.00
12- 2	1080.00	410.00	260.00	230.00	145.00	100.00	78.00	55.00	30.00
12- 3	1010.00	410.00	275.00	210.00	150.00	95.00	80.00	51.00	32.00
12- 4	950.00	380.00	269.00	210.00	160.00	95.00	75.00	50.00	33.00
12- 5	880.00	410.00	260.00	220.00	160.00	95.00	78.00	46.00	34.00
12- 6	820.00	420.00	251.00	186.00	150.00	94.00	74.00	45.00	30.00
12- 7	780.00	360.00	230.00	200.00	145.00	86.00	74.00	47.00	30.00
12- 8	852.00	340.00	234.00	190.00	140.00	83.00	70.00	47.00	29.00
12- 9	852.00	350.00	234.00	179.00	130.00	84.00	70.00	47.00	25.00
12-10	816.00	400.00	255.00	185.00	140.00	90.00	68.00	47.00	25.00
12-11	580.00	420.00	210.00	185.00	130.00	90.00	68.00	47.00	26.00
12-12	600.00	340.00	205.00	180.00	130.00	90.00	68.00	45.00	25.00
12-13	650.00	330.00	200.00	175.00	130.00	86.00	70.00	40.00	25.00
12-14	690.00	300.00	200.00	170.00	130.00	86.00	65.00	45.00	25.00
12-15	710.00	253.00	210.00	175.00	130.00	84.00	68.00	42.00	26.00
12-16	720.00	280.00	205.00	175.00	128.00	83.00	68.00	42.00	30.00
12-17	740.00	300.00	210.00	175.00	115.00	80.00	65.00	42.00	30.00
12-18	750.00	310.00	220.00	175.00	120.00	80.00	65.00	42.00	30.00
12-19	730.00	320.00	230.00	173.00	115.00	76.00	60.00	42.00	29.00
12-20	720.00	325.00	230.00	175.00	115.00	75.00	58.00	42.00	25.00
12-21	700.00	301.00	230.00	180.00	107.00	70.00	56.00	41.00	25.00
12-22	680.00	300.00	210.00	170.00	100.00	70.00	55.00	41.00	30.00
12-23	670.00	290.00	220.00	180.00	104.00	70.00	60.00	41.00	30.00
12-24	660.00	260.00	210.00	175.00	113.00	70.00	60.00	45.00	31.00
12-25	650.00	250.00	205.00	170.00	110.00	75.00	64.00	45.00	32.00
12-26	630.00	241.00	200.00	172.00	105.00	70.00	65.00	41.00	31.00
12-27	615.00	235.00	200.00	170.00	105.00	71.00	65.00	40.00	34.00
12-28	600.00	280.00	190.00	160.00	105.00	70.00	65.00	45.00	34.00
12-29	580.00	289.00	195.00	170.00	105.00	65.00	65.00	41.00	28.00
12-30	875.00	289.00	193.00	165.00	100.00	70.00	60.00	41.00	22.00
12-31	1350.00	240.00	185.00	171.00	100.00	69.00	59.00	41.00	17.00
MEAN	720.80	344.35	212.93	180.48	137.90	85.03	68.06	48.13	32.13

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 49-YEAR PERIOD BEGINNING OCTOBER 1929

STATION 06485500

BIG SIOUX R AT AKRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
1- 1	1500.00	210.00	183.00	160.00	98.00	68.00	57.00	38.00	14.00
1- 2	1200.00	210.00	180.00	155.00	95.00	65.00	46.00	38.00	13.00
1- 3	675.00	215.00	168.00	150.00	95.00	60.00	48.00	37.00	12.00
1- 4	500.00	210.00	160.00	150.00	95.00	55.00	49.00	36.00	11.00
1- 5	430.00	200.00	160.00	140.00	100.00	61.00	47.00	36.00	10.00
1- 6	410.00	180.00	157.00	135.00	95.00	60.00	44.00	36.00	9.80
1- 7	390.00	170.00	155.00	130.00	100.00	59.00	42.00	35.00	9.20
1- 8	370.00	180.00	160.00	132.00	100.00	60.00	42.00	35.00	8.50
1- 9	350.00	200.00	157.00	125.00	100.00	60.00	42.00	35.00	7.90
1-10	335.00	190.00	154.00	125.00	90.00	50.00	43.00	31.00	7.20
1-11	400.00	190.00	141.00	130.00	90.00	60.00	40.00	30.00	6.60
1-12	1000.00	200.00	141.00	128.00	90.00	55.00	41.00	30.00	6.00
1-13	800.00	210.00	146.00	130.00	85.00	50.00	41.00	29.00	5.60
1-14	500.00	220.00	140.00	125.00	90.00	50.00	42.00	26.00	5.10
1-15	420.00	210.00	140.00	130.00	90.00	50.00	41.00	27.00	4.80
1-16	400.00	200.00	135.00	120.00	90.00	50.00	40.00	27.00	4.30
1-17	960.00	200.00	130.00	115.00	90.00	50.00	36.00	27.00	4.00
1-18	1400.00	190.00	130.00	110.00	85.00	50.00	38.00	28.00	4.10
1-19	1700.00	200.00	120.00	108.00	85.00	50.00	42.00	28.00	4.20
1-20	1750.00	210.00	120.00	110.00	80.00	50.00	42.00	29.00	4.50
1-21	1450.00	210.00	130.00	105.00	80.00	54.00	42.00	29.00	4.70
1-22	1200.00	205.00	130.00	110.00	80.00	60.00	44.00	25.00	4.90
1-23	950.00	200.00	130.00	105.00	75.00	67.00	45.00	25.00	5.10
1-24	700.00	195.00	130.00	100.00	75.00	65.00	45.00	29.00	5.40
1-25	630.00	190.00	120.00	95.00	75.00	65.00	45.00	25.00	5.10
1-26	615.00	187.00	125.00	105.00	75.00	60.00	45.00	25.00	4.80
1-27	590.00	220.00	125.00	105.00	70.00	58.00	44.00	25.00	4.50
1-28	570.00	220.00	128.00	100.00	70.00	60.00	43.00	25.00	4.80
1-29	580.00	210.00	130.00	100.00	71.00	55.00	40.00	25.00	5.00
1-30	590.00	200.00	124.00	100.00	72.00	58.00	40.00	25.00	5.30
1-31	960.00	195.00	125.00	95.00	73.00	58.00	40.00	21.00	5.60
MEAN	720.64	204.51	131.13	120.80	92.74	49.83	42.80	33.29	6.67

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 49-YEAR PERIOD BEGINNING OCTOBER 1929

STATION 06485500
BIG SIOUX R AT AKRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
2- 1	1240.00	185.00	120.00	100.00	74.00	60.00	43.00	25.00	5.80
2- 2	860.00	174.00	115.00	100.00	75.00	60.00	50.00	25.00	6.00
2- 3	800.00	200.00	120.00	105.00	85.00	60.00	52.00	25.00	5.90
2- 4	900.00	300.00	124.00	112.00	85.00	65.00	50.00	25.00	5.70
2- 5	800.00	300.00	150.00	115.00	91.00	65.00	54.00	25.00	5.50
2- 6	640.00	428.00	145.00	120.00	95.00	65.00	53.00	30.00	5.40
2- 7	800.00	510.00	150.00	130.00	90.00	65.00	52.00	30.00	7.50
2- 8	1200.00	550.00	174.00	135.00	90.00	65.00	50.00	30.00	10.00
2- 9	5400.00	560.00	200.00	140.00	90.00	65.00	50.00	30.00	12.00
2-10	7500.00	569.00	200.00	150.00	95.00	65.00	51.00	30.00	11.00
2-11	12000.00	507.00	200.00	150.00	95.00	69.00	60.00	25.00	11.00
2-12	16000.00	464.00	210.00	150.00	95.00	68.00	60.00	28.00	11.00
2-13	9400.00	600.00	240.00	160.00	90.00	65.00	60.00	30.00	11.00
2-14	3950.00	716.00	260.00	200.00	95.00	65.00	56.00	28.00	11.00
2-15	3850.00	800.00	400.00	200.00	100.00	70.00	55.00	26.00	11.00
2-16	3800.00	1300.00	400.00	290.00	100.00	70.00	55.00	30.00	11.00
2-17	3250.00	1150.00	500.00	300.00	115.00	70.00	56.00	30.00	11.00
2-18	2330.00	1300.00	625.00	305.00	120.00	70.00	56.00	30.00	11.00
2-19	4000.00	1500.00	748.00	344.00	115.00	75.00	60.00	30.00	11.00
2-20	4500.00	1270.00	800.00	350.00	100.00	75.00	60.00	44.00	11.00
2-21	5500.00	1300.00	1050.00	330.00	130.00	80.00	65.00	51.00	11.00
2-22	5900.00	1560.00	900.00	350.00	130.00	81.00	70.00	49.00	11.00
2-23	5610.00	2310.00	800.00	380.00	135.00	82.00	65.00	47.00	11.00
2-24	6810.00	1280.00	900.00	380.00	141.00	85.00	65.00	44.00	11.00
2-25	6870.00	1210.00	930.00	500.00	140.00	85.00	65.00	42.00	11.00
2-26	4920.00	2000.00	1000.00	520.00	150.00	82.00	70.00	45.00	7.00
2-27	10200.00	1800.00	1050.00	520.00	180.00	100.00	70.00	50.00	7.00
2-28	15400.00	2000.00	1200.00	885.00	260.00	105.00	70.00	53.00	7.00
MEAN	2399.17	1150.53	602.25	422.50	128.00	80.35	70.17	51.96	12.10

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 49-YEAR PERIOD BEGINNING OCTOBER 1929

STATION 06485500

BIG SIOUX R AT AKRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
3- 1	13300.00	2500.00	1190.00	700.00	320.00	125.00	70.00	55.00	11.00
3- 2	12300.00	3200.00	1250.00	845.00	300.00	123.00	76.00	70.00	18.00
3- 3	10400.00	3750.00	2100.00	1200.00	500.00	123.00	90.00	65.00	40.00
3- 4	8440.00	5340.00	2780.00	1400.00	570.00	147.00	116.00	70.00	41.00
3- 5	11100.00	6450.00	2900.00	1500.00	600.00	140.00	113.00	70.00	43.00
3- 6	12100.00	6850.00	3000.00	1520.00	650.00	140.00	110.00	75.00	45.00
3- 7	12000.00	6170.00	2750.00	1510.00	630.00	140.00	100.00	65.00	47.00
3- 8	10800.00	4350.00	2200.00	1500.00	600.00	140.00	100.00	65.00	50.00
3- 9	9640.00	3810.00	2470.00	1250.00	700.00	152.00	116.00	65.00	55.00
3-10	11600.00	4500.00	2680.00	1350.00	750.00	160.00	116.00	70.00	60.00
3-11	12900.00	3720.00	2060.00	1490.00	998.00	180.00	125.00	85.00	60.00
3-12	13300.00	4520.00	2520.00	1620.00	1000.00	160.00	130.00	100.00	55.00
3-13	12200.00	6100.00	2270.00	1920.00	1000.00	190.00	152.00	104.00	60.00
3-14	11400.00	7310.00	3100.00	1870.00	954.00	269.00	157.00	102.00	60.00
3-15	9680.00	7430.00	4000.00	2460.00	1030.00	320.00	140.00	110.00	60.00
3-16	9790.00	6260.00	4120.00	2500.00	1070.00	350.00	145.00	125.00	60.00
3-17	10200.00	6000.00	4590.00	2800.00	1070.00	359.00	170.00	120.00	60.00
3-18	10400.00	6340.00	4690.00	2960.00	1020.00	360.00	161.00	93.00	60.00
3-19	9500.00	6150.00	4120.00	2530.00	991.00	260.00	188.00	104.00	60.00
3-20	11600.00	6200.00	3940.00	2310.00	992.00	437.00	208.00	120.00	50.00
3-21	14200.00	7550.00	3710.00	2350.00	900.00	388.00	206.00	120.00	50.00
3-22	17600.00	6070.00	3360.00	2530.00	930.00	420.00	230.00	120.00	50.00
3-23	17500.00	5230.00	3020.00	2330.00	994.00	410.00	246.00	142.00	60.00
3-24	14300.00	4820.00	2950.00	2310.00	980.00	463.00	279.00	153.00	60.00
3-25	11600.00	4580.00	3160.00	2560.00	973.00	480.00	350.00	150.00	60.00
3-26	9530.00	4580.00	3090.00	2510.00	1320.00	654.00	440.00	220.00	60.00
3-27	8410.00	4570.00	3580.00	2440.00	1340.00	630.00	500.00	326.00	132.00
3-28	8080.00	5550.00	3110.00	2720.00	1500.00	684.00	500.00	311.00	130.00
3-29	17300.00	6470.00	3190.00	2370.00	1640.00	624.00	480.00	309.00	132.00
3-30	41200.00	7430.00	3520.00	2420.00	1560.00	700.00	564.00	350.00	132.00
3-31	50700.00	8760.00	3410.00	2410.00	1400.00	773.00	573.00	379.00	118.00
MEAN	5652.25	4627.73	3556.06	2841.93	1580.61	700.25	381.93	168.00	123.67

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 49-YEAR PERIOD BEGINNING OCTOBER 1929

STATION 06485500
BIG SIOUX R AT AKRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
4- 1	44000.00	8760.00	4000.00	2560.00	1410.00	874.00	530.00	330.00	142.00
4- 2	43900.00	9670.00	4430.00	2650.00	1310.00	854.00	558.00	280.00	142.00
4- 3	38100.00	11100.00	3880.00	2100.00	1320.00	848.00	604.00	356.00	147.00
4- 4	31600.00	13000.00	3670.00	2560.00	1360.00	867.00	604.00	365.00	149.00
4- 5	23200.00	13800.00	3810.00	2290.00	1280.00	784.00	601.00	351.00	152.00
4- 6	27600.00	15700.00	3910.00	1950.00	1210.00	748.00	598.00	356.00	152.00
4- 7	48600.00	15900.00	4890.00	1760.00	1210.00	762.00	573.00	357.00	149.00
4- 8	69700.00	14000.00	4490.00	1610.00	1180.00	752.00	526.00	356.00	149.00
4- 9	77500.00	13000.00	3710.00	1850.00	1150.00	735.00	484.00	318.00	147.00
4-10	67500.00	11300.00	2860.00	1730.00	1050.00	696.00	449.00	324.00	142.00
4-11	60500.00	9030.00	3390.00	1650.00	1020.00	680.00	449.00	318.00	137.00
4-12	52900.00	7500.00	3810.00	1590.00	976.00	670.00	428.00	313.00	130.00
4-13	39500.00	6750.00	3220.00	1430.00	934.00	674.00	416.00	315.00	128.00
4-14	28200.00	7890.00	2890.00	1380.00	890.00	665.00	410.00	317.00	123.00
4-15	20700.00	6800.00	2560.00	1440.00	892.00	648.00	402.00	303.00	142.00
4-16	16300.00	5520.00	2410.00	1410.00	878.00	635.00	396.00	292.00	130.00
4-17	13500.00	4540.00	2260.00	1480.00	861.00	626.00	388.00	268.00	125.00
4-18	11400.00	4150.00	2280.00	1410.00	847.00	603.00	379.00	258.00	128.00
4-19	9990.00	4010.00	2220.00	1370.00	885.00	597.00	367.00	247.00	140.00
4-20	8760.00	4550.00	2090.00	1400.00	880.00	594.00	380.00	229.00	142.00
4-21	7630.00	4440.00	1990.00	1730.00	868.00	577.00	421.00	232.00	140.00
4-22	6690.00	3930.00	2050.00	1690.00	847.00	596.00	460.00	230.00	140.00
4-23	5830.00	3550.00	2070.00	1590.00	858.00	577.00	454.00	254.00	140.00
4-24	5980.00	3080.00	1740.00	1390.00	779.00	578.00	428.00	246.00	137.00
4-25	6200.00	2690.00	1780.00	1440.00	769.00	594.00	454.00	244.00	132.00
4-26	5900.00	2510.00	1780.00	1410.00	770.00	564.00	436.00	236.00	127.00
4-27	5430.00	2960.00	1780.00	1360.00	758.00	535.00	422.00	226.00	116.00
4-28	5090.00	3060.00	1830.00	1310.00	776.00	502.00	405.00	223.00	104.00
4-29	4850.00	2960.00	1750.00	1290.00	751.00	477.00	399.00	213.00	99.00
4-30	4560.00	2710.00	1680.00	1450.00	846.00	492.00	427.00	247.00	101.00
MEAN	20688.66	9040.33	2689.96	1795.33	1122.36	683.26	576.50	375.56	139.16

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06461000

BIG SIOUX R NEAR DELL RAPIDS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
10- 1	169.00	169.00	109.00	64.00	45.00	13.00	6.20	0.00	0.00
10- 2	167.00	167.00	110.00	65.00	39.00	13.00	6.30	0.00	0.00
10- 3	161.00	161.00	106.00	65.00	33.00	13.00	7.40	0.00	0.00
10- 4	153.00	153.00	107.00	63.00	31.00	13.00	9.10	0.00	0.00
10- 5	154.00	154.00	106.00	60.00	31.00	12.00	9.60	0.00	0.00
10- 6	170.00	170.00	104.00	61.00	32.00	11.00	9.60	0.00	0.00
10- 7	170.00	170.00	102.00	69.00	31.00	11.00	10.00	0.00	0.00
10- 8	170.00	170.00	98.00	63.00	31.00	11.00	9.10	0.00	0.00
10- 9	182.00	182.00	96.00	66.00	54.00	11.00	8.60	0.00	0.00
10-10	188.00	188.00	98.00	94.00	53.00	10.00	8.60	0.00	0.00
10-11	186.00	186.00	95.00	81.00	51.00	9.90	9.20	0.00	0.00
10-12	184.00	184.00	95.00	91.00	51.00	13.00	9.80	0.00	0.00
10-13	183.00	183.00	100.00	95.00	49.00	14.00	9.80	0.00	0.00
10-14	179.00	179.00	98.00	98.00	50.00	14.00	9.10	0.00	0.00
10-15	178.00	178.00	97.00	96.00	49.00	15.00	8.50	0.00	0.00
10-16	170.00	170.00	94.00	93.00	49.00	15.00	9.30	0.00	0.00
10-17	165.00	165.00	94.00	82.00	49.00	15.00	10.00	0.00	0.00
10-18	165.00	165.00	98.00	81.00	47.00	15.00	10.00	0.15	0.15
10-19	165.00	165.00	109.00	77.00	44.00	15.00	11.00	2.80	2.80
10-20	166.00	166.00	107.00	78.00	41.00	15.00	13.00	2.80	2.80
10-21	167.00	167.00	100.00	71.00	39.00	16.00	12.00	2.60	2.60
10-22	163.00	163.00	97.00	67.00	41.00	15.00	11.00	2.60	2.60
10-23	163.00	163.00	104.00	67.00	41.00	15.00	11.00	2.80	2.80
10-24	164.00	164.00	110.00	66.00	41.00	14.00	12.00	3.40	3.40
10-25	165.00	165.00	117.00	66.00	41.00	13.00	13.00	3.90	3.90
10-26	167.00	167.00	121.00	64.00	37.00	16.00	13.00	4.40	4.40
10-27	160.00	160.00	113.00	62.00	37.00	16.00	14.00	4.60	4.60
10-28	158.00	158.00	115.00	61.00	44.00	16.00	14.00	5.10	5.10
10-29	158.00	158.00	118.00	63.00	47.00	16.00	14.00	5.10	5.10
10-30	160.00	160.00	128.00	68.00	48.00	18.00	15.00	4.80	4.80
10-31	279.00	279.00	170.00	71.00	47.00	19.00	15.00	4.60	4.60
MEAN	168.38	168.38	110.16	74.80	45.16	12.58	11.96	1.60	1.60

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06481000

BIG SIOUX R NEAR DELL RAPIDS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
11- 1	436.00	436.00	180.00	66.00	47.00	20.00	15.00	4.50	4.50
11- 2	419.00	419.00	212.00	71.00	46.00	20.00	14.00	4.40	4.40
11- 3	434.00	434.00	233.00	72.00	46.00	21.00	14.00	4.30	4.30
11- 4	407.00	407.00	280.00	78.00	47.00	22.00	14.00	4.20	4.20
11- 5	356.00	356.00	323.00	81.00	45.00	23.00	14.00	4.20	4.20
11- 6	330.00	330.00	318.00	86.00	46.00	23.00	14.00	4.00	4.00
11- 7	333.00	333.00	295.00	85.00	45.00	21.00	14.00	3.70	3.70
11- 8	322.00	322.00	274.00	93.00	45.00	21.00	15.00	3.40	3.40
11- 9	293.00	293.00	252.00	96.00	44.00	21.00	15.00	3.20	3.20
11-10	274.00	274.00	232.00	106.00	42.00	22.00	15.00	3.10	3.10
11-11	250.00	250.00	216.00	83.00	39.00	22.00	14.00	2.80	2.80
11-12	245.00	245.00	196.00	103.00	44.00	19.00	14.00	2.40	2.40
11-13	226.00	226.00	196.00	80.00	43.00	21.00	14.00	2.40	2.40
11-14	199.00	199.00	197.00	71.00	38.00	21.00	14.00	2.50	2.50
11-15	202.00	202.00	178.00	72.00	38.00	21.00	15.00	2.60	2.60
11-16	199.00	199.00	156.00	81.00	41.00	21.00	14.00	3.00	3.00
11-17	196.00	196.00	164.00	87.00	42.00	22.00	15.00	3.90	3.90
11-18	193.00	193.00	187.00	89.00	41.00	22.00	16.00	2.80	2.80
11-19	194.00	194.00	184.00	96.00	38.00	22.00	16.00	3.20	3.20
11-20	198.00	198.00	177.00	120.00	38.00	22.00	15.00	3.40	3.40
11-21	200.00	200.00	177.00	165.00	40.00	18.00	16.00	3.20	3.20
11-22	192.00	192.00	173.00	105.00	41.00	16.00	16.00	3.40	3.40
11-23	185.00	185.00	168.00	134.00	39.00	15.00	15.00	3.30	3.30
11-24	189.00	189.00	142.00	141.00	40.00	16.00	13.00	3.60	3.60
11-25	184.00	184.00	150.00	132.00	40.00	16.00	12.00	3.60	3.60
11-26	184.00	184.00	158.00	130.00	39.00	16.00	11.00	3.90	3.90
11-27	187.00	187.00	160.00	125.00	38.00	16.00	11.00	3.70	3.70
11-28	198.00	198.00	160.00	120.00	36.00	16.00	11.00	3.60	3.60
11-29	158.00	158.00	152.00	100.00	36.00	15.00	12.00	3.50	3.50
11-30	155.00	155.00	138.00	104.00	36.00	16.00	12.00	3.20	3.20
MEAN	225.00	225.00	219.53	105.63	40.40	18.56	14.96	3.43	3.43

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06481000

BIG SIOUX R NEAR DELL RAPIDS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
12- 1	148.00	148.00	135.00	122.00	35.00	16.00	12.00	3.10	3.10
12- 2	144.00	144.00	133.00	130.00	34.00	16.00	13.00	2.90	2.90
12- 3	149.00	149.00	137.00	95.00	34.00	15.00	13.00	2.80	2.80
12- 4	154.00	154.00	137.00	105.00	33.00	15.00	14.00	3.00	3.00
12- 5	155.00	155.00	130.00	115.00	32.00	15.00	14.00	3.70	3.70
12- 6	150.00	150.00	120.00	118.00	29.00	16.00	13.00	3.00	3.00
12- 7	153.00	153.00	122.00	111.00	27.00	15.00	11.00	2.50	2.50
12- 8	134.00	134.00	127.00	108.00	24.00	14.00	12.00	2.10	2.10
12- 9	146.00	146.00	132.00	109.00	22.00	13.00	12.00	1.90	1.90
12-10	165.00	165.00	127.00	105.00	20.00	13.00	13.00	1.90	1.90
12-11	150.00	150.00	122.00	100.00	20.00	14.00	13.00	2.00	2.00
12-12	125.00	125.00	117.00	94.00	20.00	14.00	13.00	2.00	2.00
12-13	139.00	139.00	110.00	88.00	20.00	14.00	12.00	2.20	2.20
12-14	144.00	144.00	105.00	81.00	19.00	13.00	11.00	2.40	2.40
12-15	137.00	137.00	100.00	77.00	19.00	12.00	9.50	2.50	2.50
12-16	118.00	118.00	97.00	75.00	19.00	12.00	8.50	2.70	2.70
12-17	120.00	120.00	102.00	93.00	18.00	11.00	7.50	2.90	2.90
12-18	125.00	125.00	114.00	88.00	18.00	10.00	7.00	3.00	3.00
12-19	115.00	115.00	114.00	85.00	16.00	9.00	7.50	2.70	2.70
12-20	117.00	117.00	111.00	80.00	17.00	8.50	7.60	2.40	2.40
12-21	119.00	119.00	109.00	80.00	17.00	8.10	7.80	2.20	2.20
12-22	114.00	114.00	109.00	78.00	17.00	8.00	7.90	2.00	2.00
12-23	111.00	111.00	109.00	77.00	16.00	8.30	7.70	1.80	1.80
12-24	111.00	111.00	109.00	75.00	15.00	8.60	7.50	1.60	1.60
12-25	111.00	111.00	105.00	75.00	13.00	8.80	7.90	1.50	1.50
12-26	109.00	109.00	94.00	80.00	13.00	9.00	8.80	1.70	1.70
12-27	109.00	109.00	84.00	83.00	14.00	10.00	9.30	1.90	1.90
12-28	107.00	107.00	87.00	80.00	15.00	12.00	9.60	2.10	2.10
12-29	107.00	107.00	90.00	73.00	15.00	12.00	9.80	1.80	1.80
12-30	107.00	107.00	35.00	69.00	14.00	12.00	10.00	1.60	1.60
12-31	107.00	107.00	80.00	69.00	13.00	12.00	10.00	1.30	1.30
MEAN	126.19	126.19	105.35	99.77	20.64	12.11	10.41	2.29	2.29

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06481000

BIG SIOUX R NEAR DELL RAPIDS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
1- 1	107.00	107.00	75.00	69.00	13.00	11.00	11.00	1.40	1.40
1- 2	107.00	107.00	70.00	68.00	12.00	12.00	11.00	1.40	1.40
1- 3	102.00	102.00	67.00	63.00	13.00	11.00	10.00	1.50	1.50
1- 4	100.00	100.00	63.00	59.00	13.00	11.00	10.00	1.70	1.70
1- 5	102.00	102.00	60.00	56.00	14.00	11.00	9.70	1.50	1.50
1- 6	96.00	96.00	59.00	55.00	14.00	11.00	9.20	1.70	1.70
1- 7	76.00	76.00	56.00	50.00	14.00	11.00	8.50	1.50	1.50
1- 8	75.00	75.00	53.00	45.00	14.00	11.00	8.00	1.70	1.70
1- 9	73.00	73.00	50.00	40.00	14.00	11.00	7.50	1.70	1.70
1-10	73.00	73.00	49.00	43.00	14.00	10.00	7.00	1.40	1.40
1-11	72.00	72.00	49.00	47.00	14.00	9.30	6.70	0.92	0.92
1-12	70.00	70.00	50.00	47.00	13.00	8.30	7.00	0.74	0.74
1-13	69.00	69.00	52.00	44.00	13.00	7.60	7.20	0.53	0.53
1-14	71.00	71.00	55.00	41.00	14.00	7.50	6.80	0.38	0.38
1-15	71.00	71.00	60.00	40.00	15.00	7.80	6.20	0.37	0.37
1-16	69.00	69.00	65.00	38.00	17.00	6.00	6.00	0.25	0.25
1-17	70.00	70.00	69.00	37.00	17.00	8.20	6.10	0.07	0.07
1-18	75.00	75.00	66.00	37.00	17.00	8.20	6.20	0.02	0.02
1-19	86.00	86.00	65.00	35.00	16.00	8.20	6.40	0.03	0.03
1-20	100.00	100.00	65.00	34.00	15.00	8.50	6.50	0.70	0.70
1-21	92.00	92.00	65.00	34.00	15.00	8.50	6.60	0.29	0.29
1-22	88.00	88.00	65.00	33.00	15.00	8.50	6.70	0.21	0.21
1-23	85.00	85.00	62.00	32.00	15.00	8.20	6.90	0.37	0.37
1-24	82.00	82.00	63.00	32.00	15.00	7.60	7.10	0.30	0.30
1-25	80.00	80.00	60.00	31.00	11.00	7.20	6.90	0.40	0.40
1-26	82.00	82.00	59.00	30.00	11.00	7.30	6.60	0.23	0.23
1-27	85.00	85.00	56.00	29.00	11.00	7.40	6.20	0.24	0.24
1-28	88.00	88.00	52.00	29.00	14.00	7.60	5.80	0.23	0.23
1-29	90.00	90.00	49.00	28.00	15.00	7.80	5.50	0.16	0.16
1-30	92.00	92.00	49.00	27.00	15.00	8.00	5.30	0.03	0.03
1-31	95.00	95.00	47.00	26.00	14.00	8.30	5.00	0.04	0.04
MEAN	71.77	71.77	70.54	42.42	15.19	8.24	8.05	0.71	0.71

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06481000

BIG SIOUX R NEAR DELL RAPIDS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
2- 1	98.00	98.00	47.00	25.00	14.00	8.50	5.30	0.10	0.10
2- 2	100.00	100.00	47.00	24.00	14.00	8.70	5.70	0.11	0.11
2- 3	103.00	103.00	46.00	24.00	13.00	8.60	6.00	0.23	0.23
2- 4	107.00	107.00	45.00	23.00	12.00	8.30	5.80	0.20	0.20
2- 5	110.00	110.00	44.00	22.00	12.00	8.00	5.60	0.04	0.04
2- 6	113.00	113.00	42.00	22.00	11.00	7.70	5.60	0.20	0.20
2- 7	116.00	116.00	40.00	22.00	10.00	7.30	5.20	2.70	2.70
2- 8	113.00	113.00	41.00	22.00	10.00	7.00	4.80	3.60	3.60
2- 9	110.00	110.00	40.00	21.00	10.00	7.30	4.50	2.30	2.30
2-10	105.00	105.00	40.00	20.00	10.00	8.00	4.20	1.80	1.80
2-11	95.00	95.00	40.00	20.00	10.00	9.00	4.40	2.20	2.20
2-12	85.00	85.00	40.00	20.00	11.00	9.50	4.50	1.90	1.90
2-13	80.00	80.00	38.00	20.00	11.00	9.50	4.70	0.94	0.94
2-14	75.00	75.00	38.00	20.00	12.00	10.00	4.90	0.78	0.78
2-15	70.00	70.00	39.00	20.00	13.00	10.00	5.20	0.34	0.34
2-16	65.00	65.00	40.00	19.00	15.00	11.00	5.40	0.18	0.18
2-17	70.00	70.00	40.00	25.00	17.00	11.00	5.60	0.35	0.35
2-18	75.00	75.00	50.00	39.00	18.00	10.00	5.80	0.20	0.20
2-19	80.00	80.00	50.00	39.00	20.00	10.00	5.40	0.00	0.00
2-20	88.00	88.00	75.00	40.00	19.00	11.00	5.10	0.00	0.00
2-21	150.00	150.00	95.00	41.00	19.00	12.00	5.20	0.00	0.00
2-22	125.00	125.00	103.00	43.00	19.00	13.00	5.40	0.10	0.10
2-23	120.00	120.00	110.00	44.00	19.00	13.00	5.70	2.40	2.40
2-24	200.00	200.00	110.00	44.00	19.00	12.00	6.00	3.50	3.50
2-25	350.00	350.00	100.00	43.00	19.00	12.00	6.20	4.60	4.60
2-26	450.00	450.00	90.00	43.00	18.00	11.00	6.40	3.50	3.50
2-27	400.00	400.00	75.00	60.00	18.00	12.00	6.60	2.20	2.20
2-28	350.00	350.00	100.00	75.00	18.00	12.00	6.90	1.80	1.80
MEAN	139.85	139.85	45.25	41.64	19.60	10.82	5.43	1.29	1.29

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06101000

BIG SIOUX R NEAR DELL RAPIDS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
3- 1	500.00	500.00	220.00	100.00	10.00	12.00	6.80	1.00	1.00
3- 2	800.00	800.00	150.00	100.00	18.00	13.00	6.70	1.40	1.40
3- 3	1200.00	1200.00	150.00	75.00	18.00	13.00	6.60	2.20	2.20
3- 4	1700.00	1700.00	300.00	60.00	17.00	13.00	6.40	2.20	2.20
3- 5	2100.00	2100.00	550.00	50.00	15.00	13.00	6.40	1.80	1.80
3- 6	2300.00	2300.00	500.00	54.00	16.00	13.00	6.70	1.00	1.00
3- 7	2800.00	2800.00	550.00	58.00	17.00	14.00	7.10	0.80	0.80
3- 8	3000.00	3000.00	900.00	62.00	19.00	14.00	7.40	0.50	0.50
3- 9	3600.00	3600.00	1370.00	65.00	21.00	14.00	7.60	1.50	1.50
3-10	3200.00	3200.00	875.00	80.00	44.00	18.00	13.00	7.30	7.30
3-11	2970.00	2970.00	550.00	498.00	47.00	20.00	13.00	7.80	7.80
3-12	3300.00	3300.00	1850.00	359.00	130.00	30.00	14.00	8.80	8.80
3-13	2320.00	2320.00	2150.00	600.00	140.00	46.00	16.00	8.00	8.00
3-14	2350.00	2350.00	2200.00	1100.00	160.00	54.00	18.00	8.50	8.50
3-15	2280.00	2280.00	2250.00	1400.00	260.00	87.00	20.00	8.90	8.90
3-16	2240.00	2240.00	2220.00	1750.00	280.00	130.00	27.00	9.30	9.30
3-17	2100.00	2100.00	1850.00	1630.00	310.00	190.00	40.00	9.60	9.60
3-18	2100.00	2100.00	1950.00	1350.00	370.00	260.00	60.00	10.00	10.00
3-19	2000.00	2000.00	1710.00	1300.00	400.00	182.00	80.00	11.00	11.00
3-20	1980.00	1980.00	1900.00	1480.00	630.00	228.00	150.00	12.00	12.00
3-21	2300.00	2300.00	1850.00	1290.00	442.00	215.00	200.00	13.00	13.00
3-22	2950.00	2950.00	1610.00	1140.00	500.00	270.00	185.00	14.00	14.00
3-23	5000.00	5000.00	1290.00	1140.00	600.00	326.00	144.00	13.00	13.00
3-24	4490.00	4490.00	1420.00	1030.00	900.00	281.00	120.00	12.00	12.00
3-25	4240.00	4240.00	1270.00	930.00	820.00	250.00	95.00	12.00	12.00
3-26	4280.00	4280.00	1170.00	926.00	780.00	219.00	102.00	13.00	13.00
3-27	4020.00	4020.00	1030.00	928.00	750.00	203.00	116.00	14.00	14.00
3-28	3430.00	3430.00	954.00	855.00	780.00	193.00	125.00	16.00	16.00
3-29	3050.00	3050.00	967.00	800.00	724.00	208.00	123.00	18.00	18.00
3-30	3610.00	3610.00	950.00	850.00	626.00	189.00	146.00	20.00	20.00
3-31	4730.00	4730.00	947.00	900.00	528.00	186.00	150.00	21.00	21.00
MEAN	1766.51	1766.51	1523.19	791.61	467.32	265.16	195.19	10.61	10.61

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06481020

BIG SIOUX R NEAR DELL RAPIDS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
4- 1	4880.00	4880.00	1000.00	916.00	442.00	197.00	125.00	20.00	20.00
4- 2	4600.00	4600.00	1050.00	882.00	383.00	188.00	141.00	20.00	20.00
4- 3	4380.00	4380.00	1250.00	844.00	336.00	185.00	146.00	20.00	20.00
4- 4	4380.00	4380.00	1350.00	796.00	311.00	172.00	137.00	20.00	20.00
4- 5	4420.00	4420.00	1600.00	752.00	281.00	152.00	144.00	21.00	21.00
4- 6	4250.00	4250.00	1450.00	718.00	260.00	152.00	137.00	23.00	23.00
4- 7	3630.00	3630.00	1350.00	677.00	240.00	140.00	137.00	35.00	35.00
4- 8	3020.00	3020.00	1350.00	650.00	225.00	137.00	133.00	90.00	90.00
4- 9	2550.00	2550.00	1400.00	621.00	390.00	212.00	137.00	130.00	130.00
4-10	2230.00	2230.00	1500.00	599.00	400.00	198.00	155.00	123.00	123.00
4-11	1980.00	1980.00	1700.00	573.00	380.00	180.00	158.00	115.00	115.00
4-12	2370.00	2370.00	1790.00	557.00	340.00	178.00	160.00	109.00	109.00
4-13	3280.00	3280.00	1590.00	544.00	400.00	172.00	162.00	107.00	107.00
4-14	3960.00	3960.00	1400.00	529.00	450.00	168.00	160.00	105.00	105.00
4-15	4040.00	4040.00	1270.00	534.00	480.00	188.00	153.00	106.00	106.00
4-16	4620.00	4620.00	1140.00	595.00	490.00	188.00	172.00	104.00	104.00
4-17	4750.00	4750.00	1070.00	746.00	536.00	162.00	155.00	99.00	99.00
4-18	4420.00	4420.00	1130.00	837.00	578.00	174.00	146.00	97.00	97.00
4-19	3980.00	3980.00	1170.00	816.00	532.00	175.00	155.00	91.00	91.00
4-20	3520.00	3520.00	1240.00	729.00	494.00	172.00	148.00	95.00	95.00
4-21	3260.00	3260.00	1340.00	683.00	532.00	156.00	139.00	107.00	107.00
4-22	3100.00	3100.00	1300.00	653.00	560.00	139.00	135.00	105.00	105.00
4-23	2870.00	2870.00	1260.00	714.00	536.00	140.00	127.00	94.00	94.00
4-24	2580.00	2580.00	1250.00	593.00	515.00	144.00	132.00	97.00	97.00
4-25	2310.00	2310.00	1240.00	690.00	508.00	147.00	120.00	107.00	107.00
4-26	2130.00	2130.00	1300.00	683.00	495.00	141.00	118.00	103.00	103.00
4-27	1990.00	1990.00	1360.00	683.00	472.00	142.00	111.00	97.00	97.00
4-28	1870.00	1870.00	1360.00	683.00	456.00	149.00	107.00	86.00	86.00
4-29	1790.00	1790.00	1310.00	671.00	435.00	144.00	91.00	86.00	86.00
4-30	1710.00	1710.00	1220.00	659.00	434.00	139.00	98.00	81.00	81.00
MEAN	2451.66	2451.66	2160.66	604.50	394.86	196.96	146.20	110.90	110.90

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06401000

BIG SIOUX R NEAR DELL RAPIDS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
5- 1	1680.00	1680.00	1110.00	945.00	445.00	132.00	94.00	76.00	76.00
5- 2	1670.00	1670.00	1590.00	1020.00	445.00	120.00	89.00	72.00	72.00
5- 3	1830.00	1830.00	1610.00	941.00	407.00	127.00	79.00	77.00	77.00
5- 4	2130.00	2130.00	1540.00	883.00	358.00	130.00	81.00	69.00	69.00
5- 5	2240.00	2240.00	1440.00	832.00	333.00	118.00	77.00	75.00	75.00
5- 6	2240.00	2240.00	1350.00	781.00	303.00	111.00	77.00	69.00	69.00
5- 7	2160.00	2160.00	1260.00	756.00	284.00	106.00	75.00	61.00	61.00
5- 8	1980.00	1980.00	1210.00	761.00	255.00	104.00	77.00	58.00	58.00
5- 9	1750.00	1750.00	1210.00	798.00	241.00	100.00	69.00	55.00	55.00
5-10	1560.00	1560.00	1520.00	926.00	235.00	92.00	77.00	51.00	51.00
5-11	1750.00	1750.00	1340.00	1040.00	226.00	88.00	87.00	49.00	49.00
5-12	1770.00	1770.00	1210.00	1050.00	225.00	98.00	83.00	47.00	47.00
5-13	1720.00	1720.00	1230.00	1060.00	222.00	105.00	79.00	44.00	44.00
5-14	1640.00	1640.00	1310.00	1030.00	207.00	96.00	75.00	43.00	43.00
5-15	1500.00	1500.00	1320.00	952.00	194.00	102.00	72.00	41.00	41.00
5-16	1350.00	1350.00	1340.00	861.00	182.00	109.00	66.00	40.00	40.00
5-17	1300.00	1300.00	1190.00	780.00	165.00	111.00	63.00	39.00	39.00
5-18	1250.00	1250.00	1080.00	714.00	153.00	120.00	63.00	39.00	39.00
5-19	1200.00	1200.00	997.00	658.00	200.00	116.00	59.00	40.00	40.00
5-20	1120.00	1120.00	921.00	605.00	135.00	116.00	58.00	43.00	43.00
5-21	1020.00	1020.00	859.00	560.00	220.00	111.00	55.00	39.00	39.00
5-22	959.00	959.00	817.00	515.00	230.00	109.00	52.00	46.00	46.00
5-23	1080.00	1080.00	770.00	474.00	220.00	102.00	53.00	39.00	39.00
5-24	1150.00	1150.00	735.00	447.00	214.00	98.00	48.00	37.00	37.00
5-25	1510.00	1510.00	705.00	433.00	211.00	87.00	48.00	35.00	35.00
5-26	1550.00	1550.00	673.00	425.00	192.00	100.00	50.00	34.00	34.00
5-27	1700.00	1700.00	637.00	417.00	168.00	100.00	45.00	33.00	33.00
5-28	1930.00	1930.00	604.00	411.00	155.00	94.00	40.00	32.00	32.00
5-29	2110.00	2110.00	567.00	425.00	162.00	81.00	38.00	31.00	31.00
5-30	2440.00	2440.00	551.00	453.00	132.00	69.00	37.00	30.00	30.00
5-31	3100.00	3100.00	557.00	540.00	123.00	73.00	36.00	28.00	28.00
MEAN	1598.83	1598.83	1158.61	731.80	205.03	120.58	75.71	47.87	47.87

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06481000

BIG SIOUX R NEAR DELL RAPIDS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
6- 1	3310.00	3310.00	635.00	552.00	123.00	62.00	36.00	27.00	27.00
6- 2	3330.00	3330.00	723.00	573.00	134.00	69.00	35.00	25.00	25.00
6- 3	3630.00	3630.00	840.00	582.00	137.00	71.00	32.00	25.00	25.00
6- 4	3510.00	3510.00	872.00	570.00	200.00	72.00	30.00	24.00	24.00
6- 5	2980.00	2980.00	840.00	542.00	235.00	66.00	28.00	24.00	24.00
6- 6	2470.00	2470.00	758.00	592.00	224.00	64.00	27.00	23.00	23.00
6- 7	2150.00	2150.00	667.00	501.00	219.00	63.00	26.00	24.00	24.00
6- 8	1920.00	1920.00	553.00	491.00	207.00	63.00	24.00	23.00	23.00
6- 9	1700.00	1700.00	549.00	477.00	195.00	70.00	24.00	23.00	23.00
6-10	1520.00	1520.00	658.00	435.00	186.00	67.00	23.00	22.00	22.00
6-11	1370.00	1370.00	805.00	388.00	172.00	67.00	24.00	22.00	22.00
6-12	1260.00	1260.00	889.00	351.00	173.00	69.00	23.00	22.00	22.00
6-13	1160.00	1160.00	910.00	345.00	165.00	70.00	23.00	22.00	22.00
6-14	1060.00	1060.00	798.00	336.00	167.00	77.00	22.00	20.00	20.00
6-15	982.00	982.00	623.00	315.00	160.00	82.00	24.00	17.00	17.00
6-16	928.00	928.00	484.00	342.00	145.00	76.00	24.00	16.00	16.00
6-17	888.00	888.00	513.00	414.00	141.00	76.00	28.00	18.00	18.00
6-18	858.00	858.00	545.00	356.00	149.00	80.00	75.00	15.00	16.00
6-19	827.00	827.00	467.00	459.00	248.00	82.00	73.00	15.00	16.00
6-20	827.00	827.00	583.00	530.00	234.00	88.00	62.00	15.00	15.00
6-21	962.00	962.00	721.00	592.00	227.00	85.00	59.00	14.00	14.00
6-22	1190.00	1190.00	764.00	641.00	222.00	86.00	59.00	12.00	12.00
6-23	1360.00	1360.00	866.00	646.00	210.00	83.00	54.00	11.00	11.00
6-24	1450.00	1450.00	926.00	540.00	200.00	82.00	49.00	9.90	9.90
6-25	1410.00	1410.00	889.00	407.00	170.00	82.00	44.00	10.00	10.00
6-26	1230.00	1230.00	826.00	330.00	175.00	79.00	42.00	10.00	10.00
6-27	1090.00	1090.00	1090.00	757.00	168.00	73.00	44.00	11.00	11.00
6-28	1770.00	1770.00	1010.00	672.00	163.00	71.00	35.00	11.00	11.00
6-29	2150.00	2150.00	875.00	580.00	160.00	67.00	35.00	11.00	11.00
6-30	2090.00	2090.00	796.00	496.00	155.00	62.00	33.00	11.00	11.00
MEAN	1602.10	1602.10	603.66	552.90	183.63	87.90	73.96	19.43	19.43

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06481000

BIG SIOUX R NEAR DELL RAPIDS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
7- 1	1850.00	1350.00	738.00	437.00	155.00	60.00	32.00	11.00	11.00
7- 2	1370.00	1370.00	586.00	392.00	140.00	55.00	29.00	11.00	11.00
7- 3	1050.00	1050.00	648.00	359.00	136.00	50.00	29.00	9.90	9.90
7- 4	886.00	886.00	508.00	333.00	125.00	48.00	30.00	9.50	9.50
7- 5	634.00	634.00	577.00	311.00	108.00	45.00	30.00	8.80	8.80
7- 6	570.00	570.00	518.00	293.00	99.00	43.00	31.00	7.90	7.90
7- 7	546.00	546.00	429.00	284.00	99.00	39.00	29.00	6.40	6.40
7- 8	529.00	529.00	426.00	270.00	85.00	37.00	28.00	4.50	4.50
7- 9	529.00	529.00	350.00	259.00	75.00	35.00	27.00	3.10	3.10
7-10	526.00	526.00	314.00	246.00	75.00	35.00	27.00	2.10	2.10
7-11	532.00	532.00	285.00	236.00	71.00	32.00	28.00	1.40	1.40
7-12	580.00	580.00	276.00	259.00	67.00	31.00	25.00	1.10	1.10
7-13	620.00	620.00	522.00	235.00	60.00	31.00	26.00	0.96	0.96
7-14	739.00	739.00	436.00	222.00	55.00	31.00	24.00	0.91	0.91
7-15	895.00	895.00	336.00	200.00	53.00	30.00	24.00	0.94	0.94
7-16	723.00	723.00	278.00	182.00	51.00	28.00	23.00	0.51	0.51
7-17	649.00	649.00	252.00	168.00	49.00	25.00	22.00	0.57	0.57
7-18	629.00	629.00	234.00	165.00	44.00	24.00	21.00	0.42	0.42
7-19	617.00	617.00	226.00	188.00	42.00	21.00	20.00	0.36	0.36
7-20	654.00	654.00	236.00	210.00	40.00	20.00	18.00	0.54	0.54
7-21	1170.00	1170.00	230.00	202.00	40.00	18.00	17.00	0.33	0.33
7-22	1330.00	1330.00	369.00	178.00	39.00	17.00	15.00	0.30	0.30
7-23	1090.00	1090.00	216.00	156.00	41.00	15.00	13.00	0.29	0.29
7-24	1020.00	1020.00	209.00	150.00	48.00	13.00	13.00	0.24	0.24
7-25	1010.00	1010.00	217.00	144.00	46.00	18.00	11.00	0.15	0.15
7-26	1050.00	1050.00	209.00	139.00	44.00	22.00	12.00	0.26	0.26
7-27	1090.00	1090.00	212.00	134.00	43.00	24.00	14.00	0.30	0.30
7-28	1110.00	1110.00	207.00	129.00	42.00	24.00	13.00	0.56	0.56
7-29	1070.00	1070.00	207.00	125.00	40.00	19.00	11.00	0.49	0.49
7-30	1050.00	1050.00	209.00	119.00	39.00	14.00	9.30	0.60	0.60
7-31	1050.00	1050.00	209.00	112.00	33.00	10.00	8.20	0.39	0.39
MEAN	794.67	794.67	366.00	280.96	60.61	29.22	21.53	2.76	2.76

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06481000

BIG SIOUX R NEAR DELL RAPIDS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
8- 1	1030.00	1030.00	231.00	210.00	31.00	13.00	7.00	0.32	0.32
8- 2	1020.00	1020.00	228.00	205.00	30.00	19.00	6.00	0.35	0.35
8- 3	965.00	965.00	196.00	107.00	30.00	19.00	5.60	0.30	0.30
8- 4	880.00	880.00	189.00	90.00	28.00	19.00	5.50	0.31	0.31
8- 5	849.00	849.00	180.00	86.00	30.00	18.00	5.70	0.31	0.31
8- 6	842.00	842.00	165.00	81.00	29.00	18.00	4.10	0.20	0.20
8- 7	751.00	751.00	152.00	74.00	31.00	18.00	2.90	0.12	0.12
8- 8	695.00	695.00	274.00	70.00	31.00	18.00	2.20	0.02	0.02
8- 9	688.00	688.00	645.00	75.00	30.00	16.00	5.50	0.02	0.02
8-10	744.00	744.00	614.00	71.00	29.00	14.00	13.00	0.03	0.03
8-11	589.00	589.00	434.00	72.00	31.00	18.00	12.00	0.10	0.10
8-12	563.00	563.00	321.00	74.00	29.00	18.00	12.00	0.11	0.11
8-13	531.00	531.00	283.00	103.00	27.00	18.00	13.00	0.10	0.10
8-14	504.00	504.00	295.00	123.00	27.00	18.00	14.00	0.04	0.04
8-15	435.00	435.00	311.00	127.00	39.00	26.00	12.00	0.05	0.05
8-16	432.00	432.00	310.00	120.00	30.00	25.00	9.30	0.20	0.20
8-17	418.00	418.00	289.00	116.00	27.00	23.00	7.60	0.44	0.44
8-18	398.00	398.00	268.00	123.00	20.00	22.00	12.00	0.53	0.58
8-19	380.00	380.00	279.00	139.00	27.00	22.00	11.00	0.47	0.47
8-20	376.00	376.00	365.00	141.00	26.00	22.00	9.40	0.38	0.38
8-21	582.00	582.00	348.00	127.00	24.00	21.00	7.70	0.31	0.31
8-22	669.00	669.00	342.00	125.00	24.00	20.00	9.00	0.27	0.27
8-23	522.00	522.00	339.00	121.00	23.00	18.00	11.00	0.11	0.11
8-24	452.00	452.00	365.00	111.00	25.00	20.00	13.00	0.02	0.02
8-25	403.00	403.00	393.00	99.00	23.00	20.00	14.00	0.00	0.00
8-26	377.00	377.00	375.00	95.00	23.00	20.00	17.00	0.00	0.00
8-27	371.00	371.00	359.00	93.00	23.00	20.00	19.00	0.00	0.00
8-28	362.00	362.00	335.00	89.00	23.00	18.00	17.00	0.00	0.00
8-29	348.00	348.00	314.00	87.00	23.00	16.00	15.00	0.00	0.00
8-30	333.00	333.00	288.00	79.00	24.00	16.00	13.00	0.00	0.00
8-31	311.00	311.00	278.00	78.00	24.00	16.00	12.00	0.00	0.00
MEAN	541.61	541.61	346.64	94.77	25.16	16.86	14.93	0.16	0.16

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06481000

BIG SIOUX R NEAR DELL RAPIDS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
9- 1	303.00	303.00	271.00	80.00	27.00	16.00	11.00	0.00	0.00
9- 2	294.00	294.00	247.00	31.00	32.00	16.00	11.00	0.00	0.00
9- 3	284.00	284.00	238.00	118.00	33.00	14.00	11.00	0.00	0.00
9- 4	273.00	273.00	226.00	132.00	35.00	12.00	11.00	0.20	0.00
9- 5	271.00	271.00	212.00	124.00	40.00	12.00	10.00	0.00	0.00
9- 6	265.00	265.00	198.00	108.00	41.00	11.00	9.50	3.00	0.00
9- 7	252.00	252.00	190.00	94.00	39.00	11.00	9.10	0.00	0.00
9- 8	371.00	371.00	245.00	83.00	39.00	9.60	9.10	0.00	0.00
9- 9	311.00	311.00	242.00	73.00	34.00	9.80	8.90	0.00	0.00
9-10	240.00	240.00	226.00	65.00	34.00	9.90	7.60	0.00	0.00
9-11	228.00	228.00	215.00	64.00	33.00	9.90	8.60	0.00	0.00
9-12	283.00	283.00	222.00	68.00	35.00	10.00	9.70	0.00	0.00
9-13	386.00	386.00	230.00	65.00	33.00	11.00	9.00	0.00	0.00
9-14	305.00	305.00	240.00	65.00	32.00	12.00	9.90	0.00	0.00
9-15	261.00	261.00	250.00	65.00	33.00	11.00	9.30	0.00	0.00
9-16	255.00	255.00	238.00	61.00	32.00	11.00	9.20	0.00	0.00
9-17	248.00	248.00	215.00	59.00	32.00	11.00	9.00	0.00	0.00
9-18	232.00	232.00	203.00	71.00	32.00	12.00	8.50	0.00	0.00
9-19	222.00	222.00	195.00	67.00	30.00	13.00	7.90	0.00	0.00
9-20	215.00	215.00	175.00	62.00	32.00	14.00	7.00	0.00	0.00
9-21	208.00	208.00	166.00	59.00	32.00	14.00	6.10	0.00	0.00
9-22	205.00	205.00	160.00	51.00	32.00	14.00	6.00	0.00	0.00
9-23	195.00	195.00	151.00	61.00	37.00	14.00	6.00	0.00	0.00
9-24	188.00	188.00	142.00	59.00	43.00	14.00	6.50	0.00	0.00
9-25	190.00	190.00	140.00	58.00	31.00	15.00	7.60	0.00	0.00
9-26	195.00	195.00	135.00	58.00	34.00	15.00	7.70	0.00	0.00
9-27	190.00	190.00	130.00	57.00	35.00	16.00	7.10	0.00	0.00
9-28	180.00	180.00	120.00	60.00	35.00	15.00	5.70	0.00	0.00
9-29	170.00	170.00	119.00	61.00	41.00	16.00	6.20	0.00	0.00
9-30	169.00	169.00	117.00	59.00	48.00	14.00	6.30	0.00	0.00
MEAN	230.55	230.55	211.60	72.60	35.10	12.79	8.62	0.00	0.00

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 5-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06485500

BIG SIOUX R AT AKRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.90	.95	LOW
10- 1	849.00	849.00	386.00	383.00	224.00	133.00	75.00	41.00	41.00
10- 2	806.00	806.00	442.00	374.00	239.00	133.00	75.00	40.00	40.00
10- 3	1770.00	1770.00	770.00	385.00	237.00	131.00	70.00	30.00	30.00
10- 4	2920.00	2920.00	755.00	356.00	226.00	130.00	80.00	45.00	45.00
10- 5	2020.00	2020.00	721.00	347.00	227.00	120.00	82.00	40.00	40.00
10- 6	1370.00	1370.00	600.00	353.00	226.00	121.00	85.00	39.00	39.00
10- 7	1090.00	1090.00	556.00	350.00	225.00	116.00	83.00	40.00	40.00
10- 8	952.00	952.00	550.00	351.00	223.00	113.00	85.00	40.00	40.00
10- 9	902.00	902.00	526.00	374.00	220.00	110.00	87.00	40.00	40.00
10-10	1220.00	1220.00	607.00	358.00	213.00	108.00	86.00	39.00	39.00
10-11	1320.00	1320.00	600.00	371.00	211.00	103.00	85.00	41.00	41.00
10-12	1570.00	1570.00	1550.00	589.00	210.00	111.00	85.00	42.00	42.00
10-13	1300.00	1300.00	1000.00	570.00	211.00	100.00	87.00	40.00	40.00
10-14	1120.00	1120.00	904.00	563.00	207.00	108.00	90.00	41.00	41.00
10-15	1010.00	1010.00	729.00	552.00	205.00	106.00	87.00	41.00	41.00
10-16	911.00	911.00	607.00	544.00	197.00	105.00	104.00	40.00	40.00
10-17	825.00	825.00	537.00	536.00	185.00	115.00	103.00	40.00	40.00
10-18	751.00	751.00	542.00	485.00	183.00	113.00	125.00	41.00	41.00
10-19	683.00	683.00	563.00	445.00	182.00	110.00	105.00	46.00	46.00
10-20	631.00	631.00	513.00	485.00	165.00	110.00	105.00	47.00	47.00
10-21	712.00	712.00	586.00	370.00	186.00	110.00	98.00	46.00	46.00
10-22	744.00	744.00	537.00	362.00	105.00	113.00	99.00	47.00	47.00
10-23	723.00	723.00	500.00	360.00	179.00	111.00	99.00	49.00	49.00
10-24	688.00	688.00	475.00	362.00	179.00	112.00	96.00	52.00	52.00
10-25	672.00	672.00	449.00	362.00	184.00	112.00	94.00	52.00	52.00
10-26	656.00	656.00	430.00	356.00	175.00	117.00	94.00	55.00	55.00
10-27	649.00	649.00	419.00	359.00	176.00	120.00	94.00	53.00	53.00
10-28	634.00	634.00	403.00	359.00	177.00	122.00	94.00	55.00	55.00
10-29	629.00	629.00	352.00	353.00	162.00	119.00	95.00	57.00	57.00
10-30	697.00	697.00	378.00	356.00	220.00	112.00	103.00	57.00	57.00
10-31	1070.00	1070.00	384.00	377.00	230.00	112.00	112.00	55.00	55.00
MEAN	922.09	922.09	667.77	442.67	201.25	114.83	92.93	45.19	45.19

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06405500

BIG SIOUX R AT AKRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
11- 1	2670.00	2670.00	403.00	339.00	219.00	112.00	106.00	55.00	55.00
11- 2	4770.00	4770.00	461.00	437.00	238.00	112.00	104.00	55.00	55.00
11- 3	6020.00	6020.00	605.00	524.00	230.00	113.00	105.00	60.00	60.00
11- 4	8330.00	8330.00	790.00	557.00	212.00	112.00	103.00	55.00	55.00
11- 5	7810.00	7810.00	802.00	572.00	224.00	113.00	103.00	54.00	54.00
11- 6	5550.00	5550.00	815.00	512.00	210.00	112.00	101.00	55.00	55.00
11- 7	4420.00	4420.00	720.00	476.00	194.00	112.00	90.00	55.00	55.00
11- 8	3910.00	3910.00	739.00	452.00	181.00	113.00	90.00	53.00	53.00
11- 9	3420.00	3420.00	755.00	539.00	217.00	124.00	100.00	55.00	55.00
11-10	3040.00	3040.00	734.00	551.00	197.00	135.00	104.00	59.00	59.00
11-11	2710.00	2710.00	705.00	576.00	194.00	140.00	102.00	55.00	55.00
11-12	2420.00	2420.00	680.00	533.00	191.00	151.00	101.00	53.00	53.00
11-13	2250.00	2250.00	682.00	546.00	192.00	141.00	94.00	52.00	52.00
11-14	2140.00	2140.00	1020.00	550.00	197.00	141.00	85.00	51.00	51.00
11-15	2070.00	2070.00	1100.00	501.00	193.00	130.00	74.00	50.00	50.00
11-16	2020.00	2020.00	1240.00	556.00	193.00	115.00	93.00	51.00	51.00
11-17	1980.00	1980.00	1400.00	570.00	215.00	155.00	101.00	52.00	52.00
11-18	1950.00	1950.00	1520.00	587.00	241.00	139.00	105.00	53.00	53.00
11-19	1920.00	1920.00	1680.00	573.00	234.00	130.00	111.00	54.00	54.00
11-20	1880.00	1880.00	1550.00	555.00	244.00	120.00	112.00	51.00	51.00
11-21	1870.00	1870.00	1350.00	552.00	276.00	112.00	103.00	48.00	48.00
11-22	2020.00	2020.00	1150.00	565.00	285.00	111.00	105.00	46.00	46.00
11-23	2190.00	2190.00	1000.00	562.00	280.00	114.00	100.00	44.00	44.00
11-24	2150.00	2150.00	900.00	566.00	255.00	110.00	109.00	45.00	45.00
11-25	2020.00	2020.00	940.00	565.00	255.00	112.00	92.00	44.00	44.00
11-26	1970.00	1970.00	960.00	542.00	277.00	115.00	91.00	42.00	42.00
11-27	2040.00	2040.00	1030.00	545.00	288.00	118.00	86.00	39.00	39.00
11-28	2030.00	2030.00	1100.00	524.00	281.00	120.00	84.00	37.00	37.00
11-29	1760.00	1760.00	1150.00	476.00	274.00	125.00	60.00	34.00	34.00
11-30	1220.00	1220.00	1190.00	434.00	256.00	120.00	75.00	33.00	33.00
MEAN	3022.33	3022.33	910.30	613.93	234.36	122.13	93.55	49.70	49.70

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06405520

BIG SIOUX R AT ALEXA IA

DATE	HIGH	.10	.20	.30	.50	.70	.90	.98	LOW
12- 1	1150.00	1150.00	1130.00	425.00	222.00	115.00	72.00	32.00	32.00
12- 2	1180.00	1180.00	1080.00	400.00	200.00	112.00	59.00	30.00	30.00
12- 3	1270.00	1270.00	1010.00	370.00	197.00	120.00	60.00	32.00	32.00
12- 4	1480.00	1480.00	950.00	350.00	153.00	125.00	74.00	23.00	32.00
12- 5	1590.00	1590.00	880.00	350.00	190.00	130.00	80.00	24.00	34.00
12- 6	1040.00	1040.00	820.00	345.00	186.00	125.00	90.00	33.00	33.00
12- 7	1020.00	1020.00	760.00	340.00	183.00	120.00	85.00	32.00	32.00
12- 8	1950.00	1950.00	700.00	325.00	180.00	115.00	83.00	29.00	29.00
12- 9	1660.00	1660.00	640.00	320.00	175.00	112.00	84.00	27.00	27.00
12-10	1510.00	1510.00	500.00	322.00	172.00	102.00	85.00	25.00	25.00
12-11	1770.00	1770.00	580.00	310.00	160.00	105.00	90.00	26.00	26.00
12-12	1710.00	1710.00	600.00	250.00	150.00	135.00	93.00	20.00	20.00
12-13	1290.00	1290.00	650.00	270.00	159.00	100.00	85.00	30.00	30.00
12-14	1240.00	1240.00	650.00	250.00	157.00	110.00	85.00	32.00	32.00
12-15	1220.00	1220.00	710.00	235.00	157.00	110.00	84.00	34.00	34.00
12-16	1140.00	1140.00	720.00	220.00	157.00	100.00	82.00	35.00	35.00
12-17	920.00	920.00	740.00	225.00	150.00	95.00	71.00	39.00	39.00
12-18	1000.00	1000.00	750.00	225.00	154.00	90.00	77.00	41.00	41.00
12-19	1100.00	1100.00	730.00	230.00	160.00	92.00	75.00	42.00	42.00
12-20	1140.00	1140.00	720.00	230.00	160.00	93.00	77.00	40.00	40.00
12-21	1160.00	1160.00	700.00	235.00	165.00	95.00	79.00	38.00	38.00
12-22	1160.00	1160.00	680.00	235.00	170.00	95.00	80.00	35.00	36.00
12-23	1030.00	1030.00	670.00	240.00	180.00	97.00	79.00	34.00	34.00
12-24	1050.00	1050.00	660.00	250.00	175.00	100.00	78.00	31.00	31.00
12-25	1050.00	1050.00	630.00	235.00	170.00	90.00	75.00	32.00	32.00
12-26	1020.00	1020.00	630.00	220.00	160.00	95.00	75.00	33.00	33.00
12-27	1020.00	1020.00	615.00	270.00	155.00	91.00	74.00	36.00	36.00
12-28	970.00	970.00	600.00	280.00	145.00	100.00	73.00	34.00	34.00
12-29	960.00	960.00	580.00	350.00	140.00	90.00	71.00	28.00	28.00
12-30	940.00	940.00	675.00	560.00	135.00	95.00	70.00	22.00	22.00
12-31	1350.00	1350.00	920.00	540.00	120.00	92.00	69.00	17.00	17.00
MEAN	1274.51	1274.51	720.83	344.35	175.32	110.29	78.54	32.13	32.13

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 3-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 05425500
BIG SIXX R AT AKRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.90	.95	LOW
1- 1	1500.00	1500.00	520.00	520.00	125.00	67.00	60.00	14.00	14.00
1- 2	1200.00	1200.00	850.00	500.00	120.00	63.00	55.00	13.00	13.00
1- 3	850.00	850.00	675.00	470.00	115.00	70.00	54.00	12.00	12.00
1- 4	850.00	860.00	500.00	450.00	110.00	75.00	63.00	11.00	11.00
1- 5	850.00	850.00	430.00	425.00	105.00	73.00	61.00	10.00	10.00
1- 6	830.00	830.00	410.00	400.00	100.00	72.00	60.00	9.00	9.00
1- 7	780.00	780.00	390.00	380.00	90.00	75.00	59.00	9.00	9.00
1- 8	730.00	730.00	370.00	350.00	85.00	70.00	57.00	8.50	8.50
1- 9	690.00	690.00	350.00	325.00	93.00	65.00	53.00	7.90	7.90
1-10	660.00	660.00	335.00	300.00	90.00	65.00	47.00	7.20	7.20
1-11	670.00	670.00	320.00	310.00	85.00	67.00	37.00	6.60	6.60
1-12	590.00	590.00	315.00	310.00	80.00	57.00	22.00	5.00	5.00
1-13	730.00	730.00	320.00	290.00	85.00	69.00	20.00	5.00	5.00
1-14	740.00	740.00	325.00	280.00	90.00	65.00	26.00	5.10	5.10
1-15	760.00	760.00	330.00	270.00	93.00	62.00	27.00	4.00	4.00
1-16	760.00	760.00	400.00	260.00	97.00	64.00	27.00	4.00	4.00
1-17	950.00	950.00	750.00	250.00	100.00	66.00	27.00	4.00	4.00
1-18	1400.00	1400.00	740.00	240.00	103.00	68.00	28.00	4.10	4.10
1-19	1700.00	1700.00	720.00	230.00	107.00	70.00	20.00	4.20	4.20
1-20	1750.00	1750.00	710.00	220.00	109.00	70.00	29.00	4.50	4.50
1-21	1450.00	1450.00	700.00	210.00	110.00	68.00	30.00	4.70	4.70
1-22	1200.00	1200.00	590.00	205.00	110.00	65.00	31.00	4.90	4.90
1-23	950.00	950.00	670.00	200.00	107.00	65.00	32.00	5.10	5.10
1-24	700.00	700.00	660.00	195.00	95.00	62.00	36.00	5.40	5.40
1-25	650.00	650.00	630.00	190.00	93.00	64.00	45.00	5.10	5.10
1-26	530.00	530.00	615.00	167.00	89.00	65.00	45.00	4.80	4.80
1-27	600.00	600.00	590.00	183.00	84.00	66.00	44.00	4.50	4.50
1-28	560.00	560.00	570.00	182.00	79.00	65.00	43.00	4.80	4.80
1-29	580.00	580.00	570.00	180.00	70.00	64.00	41.00	5.00	5.00
1-30	590.00	590.00	540.00	170.00	83.00	63.00	40.00	5.30	5.30
1-31	600.00	600.00	540.00	177.00	93.00	62.00	38.00	5.60	5.60
MEAN	720.64	720.64	713.22	289.74	109.36	70.48	42.32	5.57	5.57

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06485500
BIG SIOUX R AT AXRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
2- 1	610.00	610.00	530.00	176.00	89.00	62.00	43.00	5.00	5.00
2- 2	620.00	620.00	530.00	174.00	65.00	61.00	50.00	5.00	5.00
2- 3	630.00	630.00	530.00	172.00	80.00	60.00	55.00	5.00	5.00
2- 4	630.00	630.00	520.00	170.00	75.00	60.00	55.00	5.70	5.70
2- 5	600.00	600.00	515.00	170.00	72.00	59.00	54.00	5.50	5.50
2- 6	570.00	570.00	505.00	165.00	71.00	59.00	53.00	5.40	5.40
2- 7	520.00	550.00	500.00	160.00	71.00	59.00	52.00	7.50	7.50
2- 8	530.00	530.00	520.00	167.00	71.00	59.00	50.00	10.00	10.00
2- 9	515.00	515.00	495.00	165.00	70.00	58.00	50.00	15.00	15.00
2-10	500.00	500.00	450.00	164.00	70.00	60.00	51.00	20.00	20.00
2-11	450.00	490.00	480.00	180.00	80.00	62.00	52.00	25.00	25.00
2-12	450.00	450.00	450.00	210.00	100.00	54.00	54.00	25.00	23.00
2-13	485.00	485.00	420.00	240.00	150.00	65.00	55.00	30.00	30.00
2-14	485.00	485.00	420.00	250.00	150.00	67.00	55.00	28.00	28.00
2-15	800.00	800.00	485.00	370.00	154.00	65.00	57.00	25.00	25.00
2-16	1300.00	1300.00	485.00	240.00	132.00	60.00	55.00	25.00	25.00
2-17	1350.00	1850.00	480.00	210.00	150.00	66.00	55.00	23.00	23.00
2-18	2000.00	2000.00	480.00	225.00	150.00	68.00	55.00	24.00	24.00
2-19	1500.00	1500.00	475.00	340.00	140.00	71.00	53.00	26.00	26.00
2-20	1200.00	1200.00	465.00	350.00	147.00	74.00	50.00	27.00	27.00
2-21	1050.00	1050.00	515.00	250.00	145.00	77.00	52.00	23.00	20.00
2-22	900.00	900.00	700.00	370.00	145.00	70.00	55.00	30.00	30.00
2-23	1200.00	1200.00	000.00	475.00	143.00	79.00	57.00	31.00	31.00
2-24	1250.00	1250.00	1120.00	750.00	141.00	77.00	56.00	32.00	32.00
2-25	1150.00	1150.00	950.00	800.00	140.00	73.00	60.00	32.00	32.00
2-26	1200.00	1200.00	520.00	900.00	138.00	70.00	62.00	33.00	33.00
2-27	1250.00	1250.00	520.00	870.00	134.00	74.00	63.00	34.00	34.00
2-28	1300.00	1300.00	940.00	950.00	122.00	77.00	64.00	36.00	35.00
MEAN	614.20	614.20	602.25	590.00	155.35	67.00	54.64	21.60	21.60

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 5-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 26485500
BIG SIOUX R AT AKRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
3- 1	1920.00	1920.00	1920.00	770.00	170.00	70.00	62.00	37.00	37.00
3- 2	2700.00	2700.00	600.00	700.00	150.00	75.00	55.00	38.00	35.00
3- 3	3750.00	3750.00	750.00	700.00	151.00	30.00	59.00	40.00	40.00
3- 4	5700.00	5700.00	950.00	550.00	147.00	82.00	60.00	41.00	41.00
3- 5	11100.00	11100.00	1120.00	620.00	152.00	00.00	51.00	43.00	42.00
3- 6	12100.00	12100.00	1520.00	650.00	162.00	84.00	53.00	45.00	45.00
3- 7	12000.00	12000.00	1790.00	700.00	203.00	90.00	64.00	47.00	47.00
3- 8	9810.00	9810.00	1580.00	800.00	235.00	100.00	55.00	52.00	50.00
3- 9	7980.00	7980.00	1370.00	950.00	231.00	110.00	55.00	55.00	55.00
3-10	6620.00	6620.00	1350.00	1020.00	230.00	120.00	57.00	56.00	60.00
3-11	5630.00	5630.00	1490.00	1420.00	770.00	123.00	70.00	65.00	65.00
3-12	6290.00	6290.00	4200.00	1460.00	600.00	130.00	60.00	65.00	65.00
3-13	7790.00	7790.00	5420.00	2000.00	1000.00	190.00	125.00	65.00	65.00
3-14	8520.00	8520.00	7310.00	3800.00	1120.00	350.00	140.00	63.00	63.00
3-15	8550.00	8550.00	8530.00	4940.00	1040.00	920.00	150.00	62.00	60.00
3-16	9530.00	9530.00	8230.00	4120.00	2520.00	981.00	200.00	63.00	63.00
3-17	10100.00	10100.00	7610.00	4000.00	3050.00	924.00	270.00	67.00	67.00
3-18	8250.00	8250.00	6070.00	5900.00	2950.00	375.00	800.00	75.00	75.00
3-19	7500.00	7500.00	5020.00	4980.00	2330.00	1700.00	825.00	90.00	90.00
3-20	11600.00	11600.00	4250.00	3850.00	2350.00	2100.00	825.00	120.00	120.00
3-21	14200.00	14200.00	4200.00	3770.00	2350.00	1000.00	781.00	160.00	160.00
3-22	17600.00	17600.00	5800.00	3350.00	2530.00	1400.00	750.00	250.00	250.00
3-23	17500.00	17500.00	13220.00	3060.00	2250.00	1150.00	719.00	350.00	350.00
3-24	24000.00	24000.00	14300.00	2950.00	2310.00	900.00	520.00	400.00	400.00
3-25	29720.00	29720.00	11500.00	2900.00	2150.00	600.00	650.00	425.00	425.00
3-26	18500.00	18500.00	5530.00	3000.00	2110.00	700.00	770.00	530.00	530.00
3-27	13300.00	13300.00	6410.00	3050.00	1840.00	705.00	630.00	520.00	500.00
3-28	11000.00	11000.00	7350.00	2960.00	1710.00	643.00	629.00	390.00	350.00
3-29	9750.00	9750.00	6570.00	2830.00	1540.00	610.00	604.00	230.00	330.00
3-30	10500.00	10500.00	6050.00	2750.00	1550.00	584.00	584.00	350.00	350.00
3-31	12200.00	12200.00	5530.00	2660.00	1470.00	502.00	593.00	390.00	350.00
MEAN	5552.25	5552.25	5152.93	4936.45	1021.93	1150.32	935.64	194.51	194.51

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06405501

BIG SIOUX R AT AXRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.90	.95	LOW
4- 1	12900.00	12900.00	4950.00	2620.00	1460.00	601.00	574.00	230.00	330.00
4- 2	11500.00	11500.00	4800.00	2550.00	1530.00	591.00	549.00	280.00	290.00
4- 3	9130.00	9120.00	5100.00	2470.00	1440.00	523.00	525.00	330.00	320.00
4- 4	7710.00	7710.00	5510.00	2360.00	1290.00	545.00	523.00	400.00	400.00
4- 5	6710.00	6710.00	5160.00	2030.00	1190.00	645.00	521.00	420.00	420.00
4- 6	5340.00	5340.00	6230.00	3910.00	1100.00	559.00	535.00	470.00	470.00
4- 7	6070.00	6070.00	5980.00	2740.00	1050.00	657.00	657.00	460.00	450.00
4- 8	6400.00	5400.00	5400.00	2290.00	1150.00	991.00	559.00	440.00	440.00
4- 9	6770.00	6770.00	5120.00	2090.00	1050.00	933.00	657.00	417.00	417.00
4-10	6010.00	6010.00	5320.00	2510.00	1730.00	385.00	572.00	360.00	360.00
4-11	5230.00	5230.00	5170.00	2430.00	1650.00	246.00	630.00	356.00	356.00
4-12	5140.00	5140.00	4390.00	2310.00	1350.00	220.00	570.00	337.00	337.00
4-13	5780.00	5780.00	4111.00	2340.00	1570.00	762.00	676.00	342.00	342.00
4-14	7650.00	7650.00	3600.00	2410.00	1450.00	733.00	710.00	345.00	346.00
4-15	11200.00	11200.00	3180.00	2350.00	1460.00	750.00	710.00	350.00	350.00
4-16	12100.00	12100.00	2020.00	2220.00	1320.00	913.00	727.00	348.00	340.00
4-17	9510.00	9510.00	2620.00	2260.00	1320.00	617.00	710.00	337.00	337.00
4-18	7910.00	7910.00	2600.00	2280.00	1280.00	781.00	707.00	320.00	320.00
4-19	7420.00	7430.00	2270.00	2220.00	1257.00	734.00	636.00	337.00	337.00
4-20	7330.00	7330.00	4540.00	2090.00	1260.00	665.00	655.00	323.00	323.00
4-21	7110.00	7110.00	5180.00	1530.00	1270.00	551.00	635.00	315.00	315.00
4-22	6550.00	6550.00	4280.00	1720.00	1270.00	615.00	611.00	317.00	317.00
4-23	6050.00	6050.00	3550.00	1120.00	1200.00	605.00	577.00	255.00	355.00
4-24	5300.00	5500.00	3320.00	1590.00	1390.00	599.00	537.00	337.00	337.00
4-25	5130.00	5130.00	3250.00	1700.00	1280.00	607.00	521.00	320.00	320.00
4-26	4930.00	4920.00	3500.00	1760.00	1300.00	545.00	503.00	305.00	305.00
4-27	4550.00	4550.00	3400.00	1760.00	1270.00	683.00	408.00	265.00	265.00
4-28	4210.00	4210.00	3180.00	1050.00	1260.00	636.00	474.00	274.00	274.00
4-29	3890.00	3890.00	3000.00	2050.00	1260.00	607.00	453.00	260.00	260.00
4-30	3570.00	3570.00	2650.00	2510.00	1210.00	589.00	433.00	247.00	247.00
MEAN	6895.56	6895.66	4250.00	1755.32	1591.65	659.53	633.53	375.56	375.56

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 05435502

BIG BEND R AT ARDEN LA

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
5- 1	3550.00	3550.00	2740.00	2650.00	1150.00	604.00	405.00	230.00	230.00
5- 2	3570.00	3570.00	3450.00	2570.00	1230.00	589.00	394.00	224.00	224.00
5- 3	5200.00	5000.00	3560.00	2400.00	1300.00	546.00	370.00	225.00	225.00
5- 4	5740.00	5740.00	3490.00	2230.00	1300.00	516.00	357.00	227.00	227.00
5- 5	7580.00	7580.00	3330.00	2000.00	1310.00	503.00	347.00	251.00	251.00
5- 6	6040.00	6040.00	3130.00	1950.00	1220.00	477.00	335.00	260.00	260.00
5- 7	5050.00	5050.00	2930.00	1880.00	1230.00	453.00	320.00	277.00	277.00
5- 8	4760.00	4760.00	2770.00	1800.00	1210.00	441.00	323.00	245.00	245.00
5- 9	4200.00	4200.00	2600.00	1810.00	1130.00	423.00	325.00	217.00	217.00
5-10	3300.00	3030.00	3190.00	1500.00	1050.00	407.00	337.00	190.00	190.00
5-11	4700.00	4700.00	3510.00	1950.00	1010.00	386.00	354.00	187.00	187.00
5-12	5910.00	5910.00	3180.00	1900.00	955.00	354.00	375.00	177.00	177.00
5-13	6120.00	6120.00	3050.00	1900.00	974.00	420.00	360.00	150.00	160.00
5-14	7370.00	7370.00	3220.00	1970.00	937.00	453.00	350.00	159.00	159.00
5-15	5520.00	5520.00	3210.00	1930.00	902.00	440.00	351.00	151.00	151.00
5-16	4930.00	4930.00	3220.00	1850.00	874.00	450.00	335.00	145.00	145.00
5-17	4220.00	4220.00	3000.00	1750.00	843.00	440.00	316.00	135.00	135.00
5-18	3760.00	3760.00	2640.00	1530.00	804.00	455.00	280.00	120.00	120.00
5-19	3450.00	3450.00	2670.00	1520.00	752.00	400.00	255.00	125.00	125.00
5-20	3190.00	3190.00	2450.00	1420.00	759.00	457.00	279.00	137.00	137.00
5-21	2960.00	2960.00	2320.00	1220.00	721.00	497.00	265.00	131.00	131.00
5-22	2720.00	2720.00	2200.00	1230.00	710.00	532.00	257.00	145.00	145.00
5-23	2500.00	2500.00	2210.00	1160.00	605.00	600.00	205.00	147.00	147.00
5-24	2470.00	2470.00	2320.00	1120.00	575.00	573.00	325.00	167.00	167.00
5-25	2020.00	2020.00	2100.00	1000.00	521.00	555.00	341.00	192.00	192.00
5-26	3550.00	3550.00	2670.00	1050.00	654.00	542.00	330.00	169.00	169.00
5-27	3710.00	3710.00	2000.00	1020.00	641.00	518.00	309.00	256.00	256.00
5-28	3540.00	3540.00	1930.00	1010.00	631.00	499.00	299.00	237.00	237.00
5-29	3630.00	3630.00	1830.00	1120.00	816.00	404.00	279.00	190.00	190.00
5-30	3630.00	3630.00	3430.00	1700.00	620.00	458.00	254.00	179.00	179.00
5-31	3770.00	3770.00	2370.00	1710.00	555.00	437.00	254.00	170.00	170.00
YEAR	3651.29	3651.29	3498.71	1723.37	559.42	469.35	370.38	192.38	192.38

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06483500

BIG SIOUX R AT AXRON IA

DATE	MEAN	.10	.20	.30	.50	.70	.80	.90	LOW
5- 1	3350.00	3330.00	2290.00	2030.00	941.10	415.00	244.00	109.00	109.00
5- 2	4230.00	4220.00	2120.00	2120.00	303.00	358.00	232.00	151.00	151.00
5- 3	4500.00	4500.00	2100.00	1650.00	850.00	358.00	221.00	126.00	126.00
5- 4	4510.00	4510.00	1590.00	1540.00	339.00	252.00	211.00	120.00	120.00
5- 5	4450.00	4490.00	1650.00	1540.00	1030.00	375.00	208.00	110.00	116.00
5- 6	4420.00	4420.00	2390.00	1770.00	1410.00	384.00	193.00	103.00	103.00
5- 7	5500.00	5500.00	4680.00	1670.00	1030.00	353.00	103.00	93.00	93.00
5- 8	9320.00	9320.00	5340.00	1530.00	752.00	302.00	175.00	86.00	86.00
5- 9	6030.00	6030.00	3030.00	1330.00	622.00	415.00	163.00	80.00	80.00
5-10	4770.00	4770.00	2740.00	1430.00	543.00	457.00	155.00	74.00	74.00
5-11	3600.00	3600.00	2340.00	1430.00	608.00	470.00	145.00	73.00	73.00
5-12	3190.00	3190.00	2110.00	1470.00	522.00	454.00	153.00	59.00	59.00
5-13	2830.00	2830.00	1980.00	1440.00	577.00	491.00	153.00	65.00	65.00
5-14	2550.00	2550.00	1950.00	1410.00	640.00	485.00	153.00	55.00	55.00
5-15	2220.00	2220.00	1920.00	1310.00	632.00	464.00	132.00	65.00	65.00
5-16	2130.00	2130.00	1800.00	1290.00	549.00	425.00	125.00	67.00	67.00
5-17	1900.00	1900.00	1650.00	1200.00	705.00	374.00	120.00	104.00	104.00
5-18	1900.00	1900.00	1520.00	1450.00	837.00	372.00	120.00	117.00	117.00
5-19	2270.00	2270.00	2070.00	1070.00	570.00	352.00	115.00	113.00	113.00
5-20	2120.00	2120.00	1390.00	1520.00	1050.00	335.00	135.00	107.00	107.00
5-21	2130.00	2130.00	1910.00	1110.00	1000.00	315.00	159.00	101.00	101.00
5-22	2430.00	2430.00	1330.00	1750.00	1250.00	639.00	194.00	97.00	97.00
5-23	2710.00	2710.00	1700.00	1450.00	1230.00	734.00	200.00	93.00	93.00
5-24	2710.00	2710.00	1750.00	1610.00	901.00	651.00	420.00	97.00	97.00
5-25	2500.00	2500.00	1040.00	1420.00	345.00	520.00	455.00	90.00	93.00
5-26	2320.00	2320.00	1910.00	1430.00	600.00	527.00	415.00	93.00	95.00
5-27	2200.00	2200.00	1530.00	1340.00	700.00	553.00	362.00	100.00	100.00
5-28	2140.00	2140.00	1870.00	1120.00	753.00	527.00	329.00	89.00	89.00
5-29	2010.00	2010.00	1700.00	1040.00	721.00	476.00	293.00	92.00	92.00
5-30	1040.00	1040.00	1650.00	1260.00	670.00	443.00	275.00	56.00	58.00
MEAN	3255.65	3253.66	1822.10	1775.66	651.60	493.85	207.63	142.00	142.00

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06405500

BIG BIGUX R AT KAREN IA

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
7- 1	1750.00	1750.00	1690.00	1650.00	593.00	375.00	250.00	50.00	50.00
7- 2	2050.00	2050.00	1970.00	1920.00	597.00	397.00	235.00	35.00	60.00
7- 3	2350.00	2350.00	1950.00	1890.00	515.00	275.00	216.00	05.00	05.00
7- 4	2030.00	2000.00	1350.00	1320.00	558.00	237.00	209.00	82.00	32.00
7- 5	2150.00	2150.00	1260.00	1250.00	552.00	215.00	202.00	70.00	70.00
7- 6	2050.00	2050.00	1750.00	1290.00	540.00	212.00	190.00	75.00	75.00
7- 7	1550.00	1550.00	1180.00	1140.00	573.00	200.00	162.00	75.00	75.00
7- 8	1220.00	1220.00	1170.00	1150.00	520.00	178.00	150.00	71.00	71.00
7- 9	1500.00	1500.00	1110.00	1050.00	601.00	103.00	160.00	57.00	57.00
7-10	1910.00	1910.00	1030.00	1020.00	523.00	180.00	152.00	63.00	63.00
7-11	1070.00	1070.00	1630.00	975.00	391.00	176.00	159.00	63.00	63.00
7-12	1430.00	1430.00	1330.00	940.00	639.00	180.00	155.00	59.00	59.00
7-13	1030.00	1030.00	1150.00	980.00	542.00	165.00	154.00	57.00	57.00
7-14	1180.00	1180.00	1010.00	884.00	473.00	179.00	149.00	50.00	50.00
7-15	1210.00	1210.00	902.00	862.00	422.00	164.00	143.00	62.00	62.00
7-16	1470.00	1470.00	1050.00	770.00	339.00	144.00	135.00	55.00	55.00
7-17	1690.00	1690.00	1020.00	699.00	355.00	134.00	120.00	54.00	64.00
7-18	1800.00	1800.00	595.00	632.00	330.00	130.00	120.00	51.00	51.00
7-19	1640.00	1640.00	530.00	576.00	312.00	123.00	114.00	51.00	51.00
7-20	2010.00	2010.00	695.00	533.00	303.00	113.00	109.00	62.00	62.00
7-21	2040.00	2040.00	510.00	345.00	293.00	120.00	104.00	63.00	63.00
7-22	2550.00	2550.00	2400.00	895.00	200.00	116.00	100.00	50.00	60.00
7-23	3040.00	3040.00	3520.00	1190.00	273.00	102.00	97.00	57.00	57.00
7-24	2920.00	2920.00	2710.00	1500.00	270.00	121.00	94.00	54.00	54.00
7-25	2920.00	2920.00	2420.00	1720.00	253.00	100.00	92.00	53.00	53.00
7-26	2340.00	2340.00	2150.00	1450.00	203.00	161.00	93.00	63.00	63.00
7-27	2330.00	2030.00	2020.00	1220.00	203.00	149.00	95.00	59.00	59.00
7-28	1930.00	1930.00	1740.00	1030.00	253.00	112.00	103.00	55.00	59.00
7-29	1880.00	1880.00	1560.00	997.00	250.00	134.00	92.00	57.00	57.00
7-30	1820.00	1820.00	1340.00	1100.00	352.00	135.00	65.00	57.00	67.00
7-31	1700.00	1700.00	1150.00	1110.00	330.00	131.00	65.00	70.00	70.00
MEAN	1675.80	1675.80	1399.00	1145.61	453.80	128.35	141.90	65.42	65.42

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 6-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 02405500
BIG SIOUX R AT AXRON IA

DATE	HIGH	.10	.25	.50	.75	.90	.95	LOW
8- 1	1700.00	1700.00	1290.00	1270.00	328.00	138.00	122.00	59.00
8- 2	1570.00	1570.00	1410.00	1150.00	265.00	235.00	92.00	55.00
8- 3	1640.00	1542.00	1100.00	1040.00	250.00	162.00	35.00	52.00
8- 4	1590.00	1590.00	1210.00	1050.00	315.00	132.00	51.00	49.00
8- 5	1550.00	1550.00	1220.00	985.00	320.00	114.00	70.00	50.00
8- 6								
8- 7	1480.00	1480.00	993.00	861.00	234.00	103.00	75.00	52.00
8- 8	1530.00	1530.00	635.00	765.00	205.00	93.00	75.00	47.00
8- 9	1550.00	1550.00	744.00	703.00	211.00	85.00	73.00	45.00
8- 9	1420.00	1420.00	652.00	685.00	230.00	92.00	64.00	45.00
8-10	1550.00	1550.00	1320.00	522.00	215.00	110.00	87.00	44.00
8-11								
8-12	2430.00	2430.00	1242.00	573.00	202.00	151.00	59.00	45.00
8-13	4290.00	4290.00	1170.00	527.00	167.00	145.00	79.00	45.00
8-14	3750.00	3750.00	1110.00	480.00	185.00	142.00	74.00	45.00
8-14	2450.00	2450.00	1040.00	451.00	172.00	133.00	57.00	45.00
8-15	2020.00	2020.00	904.00	505.00	155.00	128.00	52.00	44.00
8-16								
8-16	1750.00	1750.00	534.00	505.00	159.00	131.00	51.00	54.00
8-17	1620.00	1600.00	802.00	512.00	427.00	144.00	124.00	57.00
8-18	1000.00	1000.00	1700.00	831.00	500.00	145.00	115.00	53.00
8-19	2510.00	2510.00	1602.00	701.00	461.00	142.00	115.00	50.00
8-20	2300.00	2300.00	574.00	739.00	445.00	127.00	115.00	47.00
8-21								
8-21	2770.00	2770.00	700.00	621.00	425.00	154.00	131.00	45.00
8-22	3540.00	3540.00	760.00	533.00	390.00	194.00	120.00	45.00
8-23	4130.00	4130.00	685.00	565.00	300.00	220.00	155.00	44.00
8-24	4300.00	4300.00	1540.00	671.00	520.00	300.00	234.00	41.00
8-25	5470.00	5470.00	2000.00	653.00	455.00	205.00	240.00	32.00
8-26								
8-26	4550.00	4550.00	1220.00	539.00	414.00	247.00	210.00	37.00
8-27	3250.00	3250.00	772.00	629.00	510.00	212.00	107.00	35.00
8-28	3530.00	3530.00	526.00	587.00	497.00	190.00	165.00	34.00
8-29	4140.00	4140.00	777.00	515.00	467.00	174.00	153.00	32.00
8-30	4590.00	4590.00	604.00	490.00	420.00	164.00	142.00	33.00
8-31	3530.00	3530.00	607.00	420.00	400.00	153.00	127.00	33.00
MEAN	2594.54	2594.54	1044.25	534.95	395.45	214.93	147.29	45.19

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06405522
BIG SIOUX R AT AKRON IA

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
9- 1	2730.00	2730.00	304.00	232.00	329.00	151.00	168.00	24.00	34.00
9- 2	2330.00	2330.00	570.00	251.00	219.00	150.00	123.00	23.00	33.00
9- 3	2140.00	2140.00	557.00	279.00	291.00	150.00	110.00	33.00	33.00
9- 4	2050.00	2050.00	540.00	391.00	254.00	143.00	110.00	33.00	33.00
9- 5	1990.00	1990.00	523.00	394.00	283.00	133.00	105.00	32.00	32.00
9- 6	1920.00	1920.00	512.00	358.00	271.00	128.00	102.00	32.00	32.00
9- 7	1640.00	1640.00	505.00	404.00	240.00	131.00	102.00	31.00	31.00
9- 8	1720.00	1720.00	515.00	415.00	227.00	135.00	102.00	34.00	34.00
9- 9	1790.00	1790.00	497.00	414.00	210.00	172.00	100.00	34.00	34.00
9-10	1750.00	1750.00	479.00	373.00	227.00	140.00	94.00	34.00	34.00
9-11	1620.00	1620.00	455.00	320.00	192.00	125.00	84.00	33.00	33.00
9-12	1540.00	1540.00	422.00	444.00	204.00	132.00	100.00	31.00	31.00
9-13	1780.00	1780.00	465.00	310.00	193.00	153.00	100.00	27.00	37.00
9-14	2520.00	2520.00	435.00	333.00	153.00	140.00	100.00	33.00	30.00
9-15	2200.00	2200.00	455.00	259.00	176.00	154.00	103.00	37.00	37.00
9-16	2220.00	2220.00	445.00	401.00	190.00	153.00	95.00	35.00	35.00
9-17	2620.00	2620.00	430.00	351.00	240.00	157.00	95.00	35.00	35.00
9-18	2170.00	2170.00	430.00	362.00	172.00	155.00	92.00	34.00	34.00
9-19	1900.00	1900.00	425.00	252.00	174.00	141.00	87.00	35.00	35.00
9-20	1710.00	1710.00	452.00	335.00	160.00	125.00	85.00	30.00	29.00
9-21	1530.00	1530.00	437.00	340.00	160.00	125.00	81.00	28.00	33.00
9-22	1390.00	1390.00	420.00	335.00	155.00	124.00	82.00	38.00	36.00
9-23	1270.00	1270.00	425.00	322.00	150.00	122.00	81.00	37.00	37.00
9-24	1100.00	1100.00	410.00	235.00	151.00	123.00	81.00	45.00	45.00
9-25	1110.00	1110.00	412.00	295.00	130.00	126.00	81.00	43.00	43.00
9-26	1050.00	1050.00	425.00	201.00	157.00	127.00	80.00	41.00	41.00
9-27	1000.00	1000.00	424.00	275.00	150.00	140.00	75.00	41.00	41.00
9-28	954.00	954.00	435.00	264.00	191.00	138.00	76.00	41.00	41.00
9-29	920.00	920.00	412.00	266.00	197.00	129.00	79.00	41.00	41.00
9-30	870.00	870.00	397.00	282.00	191.00	135.00	77.00	41.00	41.00
MEAN	1790.05	1790.05	450.90	310.33	198.30	163.55	95.53	35.35	35.35

FLOTTING POINTS FOR DURATION HYDROGRAPH FOR 5-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 05482020

BIG SIOUX R AT NORTH CLIFF AVE AT SIOUX FALLS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
10- 1	193.00	193.00	182.00	163.00	64.00	27.00	22.00	17.00	17.00
10- 2	200.00	200.00	171.00	101.00	62.00	27.00	22.00	15.00	15.00
10- 3	195.00	195.00	165.00	81.00	64.00	26.00	23.00	13.00	13.00
10- 4	188.00	188.00	160.00	81.00	61.00	24.00	23.00	18.00	18.00
10- 5	190.00	190.00	160.00	81.00	52.00	23.00	21.00	17.00	17.00
10- 6	213.00	213.00	154.00	78.00	42.00	25.00	19.00	16.00	16.00
10- 7	237.00	227.00	202.00	151.00	42.00	25.00	23.00	17.00	17.00
10- 8	200.00	200.00	153.00	151.00	48.00	23.00	23.00	17.00	17.00
10- 9	202.00	202.00	207.00	146.00	81.00	22.00	21.00	15.00	15.00
10-10	489.00	489.00	207.00	146.00	79.00	21.00	21.00	13.00	13.00
10-11	245.00	245.00	220.00	146.00	77.00	24.00	18.00	18.00	18.00
10-12	221.00	221.00	154.00	144.00	75.00	21.00	19.00	17.00	17.00
10-13	216.00	216.00	141.00	140.00	65.00	22.00	18.00	18.00	18.00
10-14	214.00	214.00	139.00	122.00	59.00	23.00	21.00	19.00	19.00
10-15	203.00	203.00	145.00	116.00	68.00	22.00	21.00	11.00	18.00
10-16	213.00	213.00	144.00	114.00	67.00	23.00	21.00	15.00	15.00
10-17	162.00	162.00	141.00	105.00	70.00	27.00	22.00	12.00	12.00
10-18	154.00	154.00	102.00	100.00	70.00	23.00	22.00	17.00	17.00
10-19	143.00	143.00	120.00	96.00	70.00	23.00	15.00	18.00	18.00
10-20	215.00	215.00	135.00	95.00	70.00	22.00	20.00	19.00	19.00
10-21	216.00	216.00	139.00	96.00	68.00	25.00	22.00	18.00	18.00
10-22	218.00	218.00	146.00	88.00	68.00	23.00	22.00	19.00	19.00
10-23	217.00	217.00	146.00	93.00	67.00	25.00	22.00	17.00	17.00
10-24	151.00	151.00	150.00	92.00	69.00	29.00	23.00	15.00	15.00
10-25	225.00	226.00	154.00	93.00	70.00	24.00	23.00	16.00	16.00
10-26	225.00	225.00	158.00	92.00	64.00	24.00	20.00	17.00	17.00
10-27	229.00	229.00	159.00	146.00	65.00	23.00	21.00	18.00	18.00
10-28	223.00	223.00	154.00	132.00	66.00	25.00	22.00	19.00	19.00
10-29	163.00	163.00	152.00	87.00	65.00	27.00	25.00	15.00	19.00
10-30	285.00	285.00	242.00	168.00	67.00	29.00	24.00	18.00	18.00
10-31	546.00	546.00	251.00	115.00	67.00	31.00	26.00	14.00	14.00
MEAN	201.03	201.03	168.32	105.25	71.71	23.64	22.32	15.80	16.80

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 05482020

BIG SIOUX R AT NORTH CLIFF AVE AT SIOUX FALLS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
11- 1	559.00	559.00	268.00	96.00	68.00	30.00	25.00	19.00	19.00
11- 2	616.00	616.00	331.00	53.00	65.00	28.00	24.00	20.00	20.00
11- 3	605.00	605.00	295.00	91.00	65.00	32.00	20.00	19.00	19.00
11- 4	585.00	585.00	235.00	88.00	61.00	34.00	23.00	19.00	19.00
11- 5	550.00	550.00	347.00	94.00	60.00	34.00	25.00	18.00	18.00
11- 6	472.00	472.00	371.00	90.00	62.00	35.00	25.00	15.00	15.00
11- 7	433.00	433.00	369.00	88.00	59.00	34.00	24.00	13.00	13.00
11- 8	404.00	404.00	234.00	85.00	53.00	33.00	25.00	17.00	17.00
11- 9	379.00	379.00	347.00	85.00	60.00	37.00	25.00	17.00	17.00
11-10	324.00	324.00	311.00	84.00	61.00	39.00	23.00	17.00	17.00
11-11	305.00	305.00	305.00	94.00	57.00	36.00	27.00	17.00	17.00
11-12	304.00	304.00	300.00	90.00	61.00	39.00	27.00	15.00	15.00
11-13	294.00	294.00	290.00	110.00	67.00	34.00	27.00	16.00	16.00
11-14	292.00	292.00	275.00	135.00	60.00	32.00	25.00	15.00	15.00
11-15	298.00	298.00	260.00	160.00	60.00	30.00	25.00	18.00	18.00
11-16	298.00	298.00	240.00	162.00	65.00	27.00	26.00	18.00	19.00
11-17	301.00	301.00	230.00	158.00	70.00	30.00	27.00	19.00	19.00
11-18	293.00	293.00	240.00	151.00	65.00	31.00	30.00	20.00	20.00
11-19	288.00	288.00	250.00	177.00	63.00	31.00	29.00	20.00	20.00
11-20	274.00	274.00	250.00	174.00	62.00	30.00	20.00	17.00	17.00
11-21	328.00	328.00	260.00	116.00	74.00	31.00	27.00	14.00	14.00
11-22	296.00	296.00	265.00	159.00	60.00	31.00	30.00	19.00	19.00
11-23	281.00	281.00	260.00	174.00	60.00	31.00	26.00	20.00	20.00
11-24	250.00	250.00	218.00	156.00	61.00	28.00	25.00	20.00	20.00
11-25	240.00	240.00	219.00	160.00	60.00	29.00	23.00	15.00	15.00
11-26	272.00	272.00	235.00	176.00	64.00	33.00	27.00	19.00	19.00
11-27	240.00	240.00	235.00	188.00	61.00	33.00	26.00	15.00	15.00
11-28	250.00	250.00	196.00	178.00	60.00	30.00	27.00	13.00	13.00
11-29	250.00	250.00	199.00	168.00	62.00	31.00	28.00	17.00	17.00
11-30	245.00	245.00	200.00	197.00	61.00	31.00	24.00	17.00	17.00
MEAN	342.53	342.53	275.10	131.86	60.73	30.76	27.33	17.36	17.36

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 0648202C

BIG SIOUX R AT NORTH CLIFF AVE AT SIOUX FALLS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
12- 1	220.00	220.00	208.00	194.00	58.00	30.00	26.00	17.00	17.00
12- 2	208.00	208.00	187.00	180.00	54.00	32.00	26.00	17.00	17.00
12- 3	221.00	221.00	175.00	150.00	50.00	32.00	26.00	18.00	10.00
12- 4	229.00	229.00	172.00	120.00	42.00	32.00	27.00	15.00	15.00
12- 5	233.00	233.00	159.00	125.00	40.00	30.00	29.00	14.00	14.00
12- 6	224.00	224.00	143.00	130.00	46.00	26.00	17.00	7.20	7.20
12- 7	224.00	224.00	135.00	134.00	47.00	29.00	25.00	19.00	19.00
12- 8	190.00	190.00	150.00	133.00	50.00	27.00	23.00	18.00	18.00
12- 9	216.00	216.00	146.00	139.00	44.00	28.00	25.00	19.00	19.00
12-10	239.00	239.00	158.00	115.00	43.00	28.00	27.00	18.00	18.00
12-11	209.00	209.00	148.00	108.00	48.00	29.00	28.00	17.00	17.00
12-12	185.00	185.00	138.00	113.00	47.00	29.00	28.00	15.00	15.00
12-13	193.00	193.00	134.00	109.00	46.00	29.00	27.00	19.00	19.00
12-14	204.00	204.00	132.00	105.00	44.00	27.00	25.00	20.00	20.00
12-15	198.00	198.00	128.00	107.00	47.00	27.00	23.00	19.00	15.00
12-16	148.00	148.00	121.00	108.00	45.00	27.00	25.00	15.00	15.00
12-17	164.00	164.00	150.00	120.00	44.00	27.00	25.00	20.00	20.00
12-18	159.00	159.00	155.00	120.00	44.00	26.00	24.00	17.00	17.00
12-19	163.00	163.00	144.00	118.00	45.00	27.00	25.00	15.00	15.00
12-20	164.00	164.00	128.00	118.00	45.00	27.00	24.00	18.00	18.00
12-21	167.00	167.00	127.00	118.00	44.00	26.00	23.00	18.00	18.00
12-22	165.00	165.00	129.00	120.00	45.00	25.00	24.00	18.00	18.00
12-23	162.00	162.00	124.00	118.00	43.00	26.00	25.00	18.00	18.00
12-24	163.00	163.00	120.00	110.00	41.00	25.00	25.00	17.00	17.00
12-25	159.00	159.00	112.00	105.00	37.00	21.00	21.00	13.00	12.00
12-26	164.00	164.00	116.00	103.00	40.00	25.00	24.00	13.00	13.00
12-27	164.00	164.00	117.00	98.00	41.00	25.00	24.00	19.00	19.00
12-28	164.00	164.00	113.00	97.00	41.00	22.00	22.00	20.00	20.00
12-29	163.00	163.00	135.00	93.00	39.00	25.00	21.00	19.00	19.00
12-30	160.00	160.00	145.00	87.00	36.00	26.00	25.00	18.00	18.00
12-31	163.00	163.00	121.00	84.00	35.00	25.00	24.00	17.00	17.00
MEAN	185.80	185.80	133.16	127.74	44.19	26.77	25.45	17.45	17.45

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 5-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06402020

BIG SIOUX R AT NORTH CLIFF AVE AT SIOUX FALLS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
1- 1	160.00	162.00	112.00	69.00	32.00	23.00	20.00	14.00	14.00
1- 2	159.00	159.00	110.00	73.00	34.00	24.00	23.00	13.00	13.00
1- 3	148.00	148.00	112.00	76.00	34.00	23.00	22.00	19.00	19.00
1- 4	153.00	153.00	100.00	77.00	31.00	21.00	21.00	18.00	18.00
1- 5	155.00	155.00	90.00	75.00	31.00	22.00	19.00	18.00	16.00
1- 6	146.00	146.00	88.00	75.00	29.00	24.00	22.00	17.00	17.00
1- 7	99.00	99.00	84.00	73.00	31.00	22.00	22.00	17.00	17.00
1- 8	124.00	124.00	81.00	68.00	31.00	23.00	23.00	14.00	14.00
1- 9	114.00	114.00	81.00	60.00	29.00	24.00	21.00	14.00	14.00
1-10	124.00	124.00	76.00	58.00	30.00	25.00	20.00	17.00	17.00
1-11	117.00	117.00	72.00	58.00	29.00	20.00	20.00	18.00	18.00
1-12	103.00	103.00	59.00	59.00	29.00	22.00	18.00	17.00	17.00
1-13	109.00	109.00	67.00	58.00	25.00	21.00	18.00	18.00	18.00
1-14	110.00	110.00	72.00	57.00	24.00	22.00	18.00	2.10	2.10
1-15	115.00	115.00	76.00	53.00	25.00	23.00	16.00	2.80	2.80
1-16	119.00	119.00	85.00	51.00	28.00	24.00	22.00	15.00	15.00
1-17	118.00	118.00	89.00	52.00	35.00	23.00	22.00	15.00	15.00
1-18	124.00	124.00	117.00	51.00	35.00	22.00	21.00	17.00	17.00
1-19	161.00	161.00	114.00	50.00	35.00	22.00	19.00	17.00	17.00
1-20	160.00	160.00	113.00	49.00	34.00	24.00	23.00	18.00	18.00
1-21	136.00	135.00	116.00	47.00	28.00	22.00	22.00	17.00	17.00
1-22	115.00	116.00	116.00	45.00	32.00	25.00	20.00	17.00	17.00
1-23	116.00	116.00	107.00	48.00	31.00	25.00	21.00	14.00	14.00
1-24	124.00	124.00	110.00	48.00	25.00	23.00	22.00	18.00	18.00
1-25	122.00	122.00	105.00	46.00	25.00	21.00	18.00	3.60	3.60
1-26	110.00	110.00	102.00	44.00	25.00	19.00	17.00	3.10	3.10
1-27	111.00	111.00	103.00	41.00	26.00	22.00	17.00	9.60	9.60
1-28	103.00	103.00	95.00	40.00	25.00	21.00	18.00	11.00	11.00
1-29	112.00	112.00	87.00	40.00	28.00	22.00	16.00	15.00	15.00
1-30	120.00	120.00	85.00	43.00	28.00	22.00	15.00	11.00	11.00
1-31	117.00	117.00	85.00	41.00	28.00	25.00	22.00	16.00	16.00
MEAN	118.54	118.54	101.95	55.13	30.23	23.93	21.45	16.38	16.38

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06482020

BIG SIOUX R AT NORTH CLIFF AVE AT SIOUX FALLS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
2- 1	117.00	117.00	77.00	40.00	27.00	25.00	19.00	16.00	16.00
2- 2	118.00	118.00	75.00	39.00	27.00	23.00	20.00	15.00	15.00
2- 3	119.00	119.00	73.00	40.00	29.00	23.00	16.00	12.00	12.00
2- 4	115.00	115.00	79.00	39.00	25.00	22.00	16.00	14.00	14.00
2- 5	132.00	132.00	81.00	39.00	26.00	21.00	17.00	14.00	14.00
2- 6	141.00	141.00	79.00	39.00	26.00	21.00	16.00	11.00	11.00
2- 7	147.00	147.00	78.00	40.00	24.00	22.00	15.00	15.00	15.00
2- 8	150.00	150.00	78.00	40.00	24.00	21.00	19.00	16.00	16.00
2- 9	140.00	140.00	74.00	40.00	30.00	19.00	17.00	14.00	14.00
2-10	132.00	132.00	73.00	40.00	31.00	22.00	17.00	17.00	17.00
2-11	128.00	128.00	72.00	42.00	31.00	20.00	13.00	18.00	18.00
2-12	130.00	130.00	72.00	48.00	34.00	22.00	20.00	15.00	16.00
2-13	134.00	134.00	70.00	48.00	34.00	22.00	19.00	12.00	12.00
2-14	122.00	122.00	66.00	51.00	33.00	25.00	21.00	16.00	16.00
2-15	115.00	115.00	64.00	62.00	38.00	24.00	20.00	16.00	16.00
2-16	111.00	111.00	60.00	57.00	38.00	23.00	19.00	16.00	16.00
2-17	110.00	110.00	62.00	62.00	37.00	23.00	21.00	18.00	16.00
2-18	111.00	111.00	109.00	65.00	35.00	22.00	20.00	17.00	17.00
2-19	193.00	193.00	117.00	66.00	33.00	22.00	22.00	15.00	15.00
2-20	194.00	194.00	124.00	69.00	34.00	24.00	22.00	13.00	13.00
2-21	212.00	212.00	128.00	82.00	35.00	25.00	23.00	15.00	15.00
2-22	217.00	217.00	135.00	100.00	36.00	25.00	21.00	18.00	18.00
2-23	236.00	236.00	149.00	94.00	37.00	26.00	25.00	20.00	20.00
2-24	264.00	264.00	183.00	85.00	39.00	23.00	22.00	22.00	22.00
2-25	550.00	550.00	178.00	75.00	35.00	23.00	22.00	20.00	20.00
2-26	700.00	700.00	154.00	95.00	34.00	25.00	23.00	17.00	17.00
2-27	850.00	850.00	193.00	137.00	37.00	25.00	23.00	15.00	15.00
2-28	700.00	700.00	215.00	129.00	38.00	27.00	24.00	19.00	15.00
MEAN	213.82	213.82	96.25	75.67	37.46	22.03	21.50	16.64	16.64

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06482020

BIG SIOUX R AT NORTH CLIFF AVE AT SIOUX FALLS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
3- 1	950.00	950.00	235.00	129.00	36.00	27.00	21.00	19.00	12.00
3- 2	1600.00	1600.00	235.00	158.00	37.00	22.00	20.00	19.00	19.00
3- 3	2000.00	2000.00	225.00	166.00	35.00	27.00	22.00	20.00	20.00
3- 4	2300.00	2300.00	393.00	134.00	31.00	23.00	21.00	18.00	18.00
3- 5	2600.00	2600.00	656.00	102.00	30.00	24.00	19.00	17.00	17.00
3- 6	2820.00	2820.00	665.00	132.00	41.00	31.00	24.00	20.00	20.00
3- 7	2000.00	2800.00	546.00	132.00	41.00	32.00	25.00	25.00	25.00
3- 8	2810.00	2810.00	708.00	124.00	34.00	30.00	30.00	24.00	24.00
3- 9	2770.00	2770.00	961.00	120.00	41.00	32.00	30.00	23.00	23.00
3-10	2760.00	2760.00	846.00	112.00	62.00	38.00	26.00	26.00	26.00
3-11	2760.00	2760.00	601.00	486.00	122.00	39.00	30.00	27.00	27.00
3-12	3010.00	3010.00	986.00	951.00	160.00	56.00	37.00	27.00	27.00
3-13	3950.00	3950.00	1560.00	1360.00	182.00	85.00	39.00	27.00	27.00
3-14	2500.00	3500.00	1920.00	1430.00	205.00	93.00	35.00	28.00	28.00
3-15	3200.00	3200.00	2210.00	1620.00	245.00	120.00	35.00	29.00	29.00
3-16	2600.00	2600.00	2090.00	1520.00	273.00	224.00	41.00	32.00	32.00
3-17	2400.00	2400.00	1780.00	1040.00	267.00	254.00	61.00	36.00	36.00
3-18	2150.00	2150.00	1450.00	1010.00	351.00	255.00	165.00	36.00	35.00
3-19	2000.00	2000.00	1790.00	1500.00	1100.00	368.00	239.00	37.00	37.00
3-20	2500.00	2500.00	1920.00	1820.00	822.00	457.00	226.00	41.00	41.00
3-21	3890.00	3890.00	1750.00	1440.00	621.00	428.00	214.00	40.00	40.00
3-22	5030.00	5000.00	3010.00	1520.00	937.00	465.00	209.00	38.00	38.00
3-23	5070.00	5070.00	4520.00	1500.00	554.00	390.00	150.00	42.00	42.00
3-24	5550.00	5550.00	1990.00	1400.00	972.00	320.00	134.00	39.00	35.00
3-25	5110.00	5110.00	1720.00	1390.00	959.00	310.00	186.00	35.00	35.00
3-26	4770.00	4770.00	1700.00	1290.00	945.00	290.00	183.00	35.00	36.00
3-27	4590.00	4590.00	1280.00	1230.00	945.00	260.00	177.00	42.00	42.00
3-28	4050.00	4090.00	1300.00	1270.00	919.00	250.00	185.00	42.00	42.00
3-29	3440.00	3440.00	1990.00	1320.00	788.00	240.00	186.00	41.00	41.00
3-30	3300.00	3300.00	1940.00	1320.00	555.00	230.00	186.00	38.00	39.00
3-31	4070.00	4070.00	1730.00	1290.00	605.00	220.00	125.00	39.00	39.00
MEAN	2137.74	2137.74	1793.00	847.45	593.00	341.09	242.13	31.74	31.74

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06482020

BIG SIOUX R AT NORTH CLIFF AVE AT SIOUX FALLS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
4- 1	4820.00	4820.00	1690.00	1240.00	500.00	220.00	151.00	37.00	37.00
4- 2	5140.00	5140.00	1510.00	1100.00	443.00	210.00	192.00	35.00	36.00
4- 3	4970.00	4970.00	1520.00	1130.00	397.00	212.00	210.00	37.00	37.00
4- 4	4570.00	4570.00	1530.00	1090.00	350.00	200.00	195.00	41.00	41.00
4- 5	4540.00	4540.00	1660.00	1050.00	355.00	190.00	185.00	46.00	46.00
4- 6	4530.00	4530.00	1640.00	1020.00	325.00	191.00	182.00	50.00	50.00
4- 7	4080.00	4080.00	1710.00	962.00	312.00	198.00	159.00	55.00	55.00
4- 8	3350.00	3350.00	1020.00	902.00	323.00	191.00	121.00	78.00	78.00
4- 9	2830.00	2830.00	1720.00	892.00	332.00	184.00	122.00	91.00	91.00
4-10	2450.00	2450.00	1740.00	864.00	342.00	243.00	161.00	112.00	112.00
4-11	2170.00	2170.00	1950.00	780.00	330.00	225.00	193.00	110.00	110.00
4-12	2910.00	2910.00	1970.00	690.00	311.00	215.00	201.00	120.00	120.00
4-13	3490.00	3490.00	1750.00	741.00	377.00	209.00	201.00	111.00	111.00
4-14	3550.00	3550.00	1550.00	730.00	434.00	214.00	210.00	103.00	103.00
4-15	3710.00	3710.00	1410.00	738.00	553.00	215.00	212.00	87.00	87.00
4-16	3910.00	3910.00	1270.00	705.00	571.00	224.00	213.00	132.00	132.00
4-17	4320.00	4320.00	1360.00	714.00	564.00	214.00	105.00	102.00	102.00
4-18	4450.00	4450.00	1690.00	768.00	525.00	222.00	173.00	58.00	55.00
4-19	4040.00	4040.00	1800.00	832.00	615.00	208.00	177.00	89.00	89.00
4-20	3500.00	3500.00	1580.00	801.00	545.00	193.00	185.00	153.00	153.00
4-21	3190.00	3190.00	1540.00	752.00	551.00	185.00	148.00	115.00	115.00
4-22	2990.00	2990.00	1510.00	692.00	617.00	178.00	165.00	105.00	105.00
4-23	2020.00	2020.00	1470.00	710.00	648.00	182.00	171.00	115.00	115.00
4-24	2520.00	2520.00	1450.00	746.00	629.00	214.00	152.00	122.00	102.00
4-25	2430.00	2430.00	1440.00	684.00	613.00	192.00	157.00	105.00	105.00
4-26	2220.00	2220.00	1430.00	585.00	595.00	183.00	145.00	101.00	101.00
4-27	2070.00	2070.00	1470.00	680.00	568.00	184.00	140.00	96.00	96.00
4-28	1940.00	1940.00	1470.00	603.00	550.00	208.00	133.00	07.00	87.00
4-29	1870.00	1870.00	1440.00	663.00	523.00	202.00	128.00	05.00	85.00
4-30	1770.00	1770.00	1350.00	640.00	542.00	190.00	111.00	67.00	87.00
MEAN	2549.66	2549.66	2414.66	736.23	401.33	245.16	184.30	127.63	127.63

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 05462020

BIG SIOUX R AT NORTH CLIFF AVE AT SIOUX FALLS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
5- 1	1740.00	1740.00	1270.00	1260.00	527.00	172.00	111.00	01.00	01.00
5- 2	2450.00	2450.00	1720.00	1160.00	512.00	163.00	111.00	73.00	73.00
5- 3	2110.00	2110.00	1670.00	1000.00	455.00	155.00	135.00	105.00	105.00
5- 4	2130.00	2130.00	1510.00	1000.00	414.00	151.00	102.00	85.00	85.00
5- 5	2520.00	2520.00	1530.00	941.00	301.00	149.00	58.00	77.00	77.00
5- 6	2370.00	2370.00	1440.00	875.00	354.00	139.00	98.00	72.00	72.00
5- 7	2050.00	2050.00	1250.00	915.00	328.00	135.00	99.00	65.00	65.00
5- 8	2310.00	2310.00	1310.00	920.00	299.00	123.00	99.00	51.00	51.00
5- 9	2070.00	2070.00	1550.00	954.00	235.00	114.00	98.00	62.00	62.00
5-10	2150.00	2150.00	1790.00	1010.00	270.00	131.00	117.00	58.00	58.00
5-11	2320.00	2320.00	1600.00	1120.00	274.00	125.00	100.00	51.00	51.00
5-12	2110.00	2110.00	1400.00	1170.00	263.00	110.00	109.00	47.00	47.00
5-13	2000.00	2000.00	1560.00	1160.00	255.00	138.00	105.00	43.00	43.00
5-14	1970.00	1970.00	1690.00	1120.00	252.00	134.00	100.00	42.00	42.00
5-15	1730.00	1730.00	1490.00	1050.00	235.00	131.00	50.00	39.00	39.00
5-16	1580.00	1580.00	1530.00	968.00	217.00	130.00	86.00	37.00	37.00
5-17	1520.00	1520.00	1420.00	878.00	197.00	143.00	87.00	34.00	34.00
5-18	1450.00	1450.00	1300.00	802.00	185.00	136.00	50.00	32.00	32.00
5-19	1380.00	1380.00	1200.00	754.00	178.00	134.00	57.00	31.00	31.00
5-20	1310.00	1310.00	1100.00	666.00	221.00	122.00	59.00	41.00	41.00
5-21	1230.00	1230.00	1020.00	641.00	252.00	124.00	77.00	68.00	68.00
5-22	1170.00	1170.00	963.00	507.00	235.00	118.00	94.00	71.00	71.00
5-23	1570.00	1570.00	895.00	570.00	245.00	113.00	85.00	54.00	54.00
5-24	2100.00	2100.00	851.00	533.00	241.00	105.00	77.00	37.00	37.00
5-25	2170.00	2170.00	815.00	529.00	230.00	93.00	75.00	42.00	42.00
5-26	2120.00	2120.00	797.00	502.00	211.00	114.00	71.00	41.00	41.00
5-27	2000.00	2000.00	734.00	549.00	211.00	112.00	68.00	51.00	51.00
5-28	2250.00	2250.00	693.00	534.00	193.00	110.00	66.00	46.00	46.00
5-29	2600.00	2600.00	675.00	557.00	238.00	108.00	58.00	39.00	39.00
5-30	2850.00	2850.00	726.00	505.00	225.00	90.00	54.00	35.00	35.00
5-31	3230.00	3230.00	735.00	642.00	170.00	86.00	53.00	35.00	35.00
MEAN	1931.93	1931.93	1340.03	845.45	239.45	151.67	99.51	54.38	54.38

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06482020

BIG SIOUX R AT NORTH CLIFF AVE AT SIOUX FALLS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
6- 1	3510.00	3610.00	769.00	631.00	162.00	65.00	53.00	30.00	30.00
6- 2	3660.00	3590.00	768.00	537.00	155.00	85.00	58.00	29.00	29.00
6- 3	3730.00	3730.00	855.00	729.00	164.00	93.00	54.00	30.00	30.00
6- 4	3910.00	3910.00	920.00	579.00	158.00	120.00	52.00	27.00	27.00
6- 5	3760.00	3760.00	005.00	634.00	295.00	91.00	49.00	24.00	24.00
6- 6	3220.00	3220.00	652.00	797.00	204.00	04.00	44.00	27.00	27.00
6- 7	2820.00	2820.00	858.00	696.00	280.00	80.00	45.00	27.00	27.00
6- 8	2400.00	2400.00	708.00	605.00	275.00	80.00	44.00	27.00	27.00
6- 9	2110.00	2110.00	644.00	542.00	254.00	119.00	37.00	25.00	25.00
6-10	1870.00	1870.00	655.00	529.00	244.00	92.00	34.00	29.00	25.00
6-11	1680.00	1680.00	755.00	488.00	231.00	98.00	33.00	25.00	25.00
6-12	1560.00	1560.00	871.00	459.00	228.00	111.00	33.00	23.00	23.00
6-13	1450.00	1450.00	925.00	447.00	216.00	101.00	29.00	26.00	26.00
6-14	1350.00	1350.00	880.00	435.00	205.00	127.00	28.00	28.00	28.00
6-15	1260.00	1260.00	741.00	423.00	200.00	123.00	35.00	27.00	27.00
6-16	1150.00	1150.00	590.00	575.00	194.00	118.00	34.00	26.00	26.00
6-17	1180.00	1180.00	590.00	491.00	176.00	115.00	41.00	25.00	25.00
6-18	1080.00	1080.00	734.00	422.00	208.00	102.00	02.00	24.00	24.00
6-19	1040.00	1040.00	721.00	376.00	179.00	113.00	91.00	23.00	23.00
6-20	1010.00	1010.00	608.00	320.00	222.00	127.00	107.00	22.00	22.00
6-21	1010.00	1010.00	995.00	601.00	283.00	125.00	105.00	21.00	21.00
6-22	1150.00	1150.00	1070.00	704.00	262.00	129.00	123.00	19.00	15.00
6-23	1330.00	1330.00	1100.00	801.00	243.00	92.00	85.00	18.00	18.00
6-24	1430.00	1430.00	1150.00	774.00	229.00	92.00	75.00	31.00	31.00
6-25	1470.00	1470.00	1120.00	616.00	232.00	91.00	91.00	23.00	23.00
6-26	1420.00	1420.00	1040.00	476.00	229.00	94.00	65.00	17.00	17.00
6-27	1280.00	1280.00	995.00	638.00	204.00	99.00	72.00	14.00	14.00
6-28	1290.00	1290.00	1190.00	659.00	248.00	79.00	64.00	18.00	18.00
6-29	1040.00	1040.00	1070.00	753.00	229.00	72.00	40.00	18.00	18.00
6-30	2040.00	2040.00	965.00	690.00	210.00	69.00	43.00	19.00	19.00
MEAN	1073.16	1073.16	720.00	617.10	210.05	130.93	100.10	31.60	31.60

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06482020

BIG SIOUX R AT NORTH CLIFF AVE AT SIOUX FALLS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
7- 1	1930.00	1930.00	897.00	554.00	167.00	67.00	51.00	19.00	19.00
7- 2	1650.00	1650.00	844.00	529.00	180.00	60.00	55.00	20.00	20.00
7- 3	1240.00	1240.00	750.00	483.00	153.00	53.00	52.00	18.00	18.00
7- 4	1120.00	1120.00	752.00	433.00	123.00	48.00	49.00	17.00	17.00
7- 5	818.00	818.00	725.00	461.00	105.00	52.00	46.00	17.00	17.00
7- 6	729.00	729.00	641.00	375.00	152.00	49.00	44.00	21.00	21.00
7- 7	696.00	696.00	555.00	355.00	112.00	47.00	43.00	22.00	22.00
7- 8	674.00	674.00	505.00	342.00	92.00	49.00	44.00	23.00	23.00
7- 9	653.00	653.00	447.00	332.00	140.00	40.00	43.00	23.00	23.00
7-10	649.00	649.00	390.00	316.00	102.00	45.00	42.00	24.00	24.00
7-11	638.00	638.00	354.00	301.00	141.00	45.00	39.00	23.00	23.00
7-12	548.00	548.00	319.00	294.00	64.00	45.00	34.00	23.00	23.00
7-13	579.00	579.00	420.00	285.00	83.00	39.00	34.00	22.00	22.00
7-14	700.00	700.00	524.00	308.00	79.00	37.00	32.00	22.00	22.00
7-15	901.00	901.00	414.00	253.00	74.00	35.00	32.00	25.00	25.00
7-16	944.00	944.00	347.00	233.00	75.00	34.00	30.00	24.00	24.00
7-17	059.00	059.00	313.00	216.00	70.00	34.00	31.00	22.00	22.00
7-18	897.00	897.00	267.00	215.00	70.00	34.00	30.00	20.00	20.00
7-19	002.00	002.00	254.00	213.00	69.00	31.00	30.00	19.00	19.00
7-20	803.00	803.00	273.00	226.00	65.00	29.00	27.00	18.00	18.00
7-21	1040.00	1040.00	322.00	277.00	60.00	32.00	28.00	17.00	17.00
7-22	1430.00	1430.00	526.00	484.00	65.00	33.00	32.00	15.00	15.00
7-23	1290.00	1290.00	425.00	350.00	69.00	33.00	32.00	15.00	15.00
7-24	1160.00	1160.00	385.00	319.00	95.00	33.00	33.00	15.00	15.00
7-25	1140.00	1140.00	387.00	280.00	69.00	32.00	30.00	14.00	14.00
7-26	1170.00	1170.00	362.00	287.00	64.00	30.00	27.00	18.00	18.00
7-27	1190.00	1190.00	345.00	243.00	63.00	29.00	26.00	18.00	18.00
7-28	1220.00	1220.00	323.00	220.00	69.00	33.00	23.00	18.00	18.00
7-29	1070.00	1070.00	514.00	205.00	65.00	34.00	24.00	15.00	15.00
7-30	1140.00	1140.00	418.00	218.00	57.00	34.00	25.00	17.00	17.00
7-31	1180.00	1180.00	355.00	208.00	54.00	31.00	24.00	15.00	15.00
MEAN	916.05	916.05	446.25	385.95	83.67	36.35	35.83	19.38	19.35

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 05482020

BIG SIOUX R AT NORTH CLIFF AVE AT SIOUX FALLS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
8- 1	1220.00	1220.00	432.00	319.00	122.00	34.00	23.00	13.00	13.00
8- 2	1170.00	1170.00	413.00	399.00	111.00	33.00	24.00	15.00	15.00
8- 3	1140.00	1140.00	310.00	305.00	38.00	26.00	22.00	17.00	17.00
8- 4	1050.00	1050.00	293.00	197.00	99.00	25.00	19.00	17.00	17.00
8- 5	1040.00	1040.00	274.00	166.00	85.00	23.00	22.00	18.00	18.00
8- 6	1050.00	1050.00	269.00	157.00	61.00	23.00	20.00	18.00	18.00
8- 7	930.00	930.00	267.00	151.00	59.00	23.00	19.00	16.00	16.00
8- 8	850.00	850.00	411.00	146.00	40.00	27.00	23.00	17.00	17.00
8- 9	805.00	805.00	651.00	134.00	45.00	42.00	28.00	19.00	19.00
8-10	1100.00	1100.00	763.00	131.00	51.00	38.00	24.00	21.00	21.00
8-11	940.00	940.00	753.00	128.00	42.00	33.00	25.00	23.00	23.00
8-12	780.00	780.00	695.00	122.00	40.00	30.00	23.00	22.00	22.00
8-13	700.00	700.00	649.00	144.00	42.00	33.00	23.00	21.00	21.00
8-14	640.00	640.00	517.00	130.00	41.00	32.00	22.00	18.00	18.00
8-15	600.00	600.00	581.00	493.00	137.00	34.00	30.00	18.00	18.00
8-16	570.00	570.00	545.00	214.00	130.00	32.00	30.00	30.00	30.00
8-17	540.00	540.00	494.00	131.00	73.00	49.00	35.00	26.00	26.00
8-18	500.00	500.00	471.00	131.00	55.00	28.00	32.00	26.00	26.00
8-19	720.00	720.00	465.00	140.00	42.00	33.00	32.00	25.00	25.00
8-20	860.00	860.00	444.00	145.00	39.00	32.00	31.00	24.00	24.00
8-21	750.00	750.00	445.00	132.00	80.00	40.00	29.00	21.00	21.00
8-22	680.00	680.00	432.00	400.00	107.00	33.00	33.00	19.00	19.00
8-23	600.00	600.00	420.00	136.00	98.00	36.00	30.00	22.00	22.00
8-24	550.00	550.00	414.00	122.00	66.00	35.00	27.00	22.00	22.00
8-25	600.00	600.00	437.00	125.00	57.00	34.00	24.00	22.00	22.00
8-26	650.00	650.00	439.00	126.00	53.00	32.00	28.00	20.00	20.00
8-27	565.00	565.00	415.00	116.00	47.00	33.00	30.00	20.00	20.00
8-28	535.00	535.00	408.00	107.00	45.00	28.00	25.00	17.00	17.00
8-29	469.00	469.00	395.00	102.00	46.00	31.00	25.00	15.00	15.00
8-30	427.00	427.00	389.00	99.00	41.00	30.00	25.00	18.00	18.00
8-31	396.00	396.00	377.00	119.00	38.00	30.00	22.00	18.00	18.00
MEAN	655.45	655.45	562.09	145.16	79.36	39.55	30.03	20.25	20.25

PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BEGINNING OCTOBER 1971

STATION 06482623

BIG SIOUX R AT NORTH CLIFF AVE AT SIOUX FALLS SD

DATE	HIGH	.10	.20	.30	.50	.70	.80	.90	LOW
9- 1	379.00	379.00	358.00	105.00	38.00	30.00	20.00	16.00	16.00
9- 2	350.00	350.00	345.00	100.00	42.00	30.00	20.00	15.00	15.00
9- 3	540.00	540.00	333.00	116.00	50.00	30.00	23.00	14.00	14.00
9- 4	520.00	520.00	326.00	133.00	39.00	37.00	25.00	13.00	13.00
9- 5	372.00	372.00	327.00	119.00	40.00	35.00	24.00	12.00	12.00
9- 6	355.00	355.00	337.00	129.00	41.00	34.00	24.00	12.00	12.00
9- 7	310.00	310.00	308.00	123.00	37.00	33.00	24.00	17.00	17.00
9- 8	335.00	335.00	287.00	122.00	46.00	33.00	22.00	17.00	17.00
9- 9	471.00	471.00	200.00	106.00	40.00	31.00	24.00	17.00	17.00
9-10	351.00	351.00	275.00	99.00	35.00	33.00	24.00	18.00	18.00
9-11	335.00	335.00	275.00	119.00	37.00	32.00	25.00	17.00	17.00
9-12	511.00	511.00	299.00	155.00	50.00	33.00	26.00	14.00	14.00
9-13	563.00	563.00	274.00	155.00	48.00	31.00	24.00	18.00	18.00
9-14	526.00	526.00	260.00	126.00	42.00	29.00	22.00	15.00	15.00
9-15	451.00	451.00	277.00	130.00	38.00	32.00	20.00	19.00	19.00
9-16	387.00	337.00	200.00	107.00	37.00	32.00	22.00	19.00	19.00
9-17	346.00	346.00	271.00	108.00	37.00	31.00	22.00	15.00	19.00
9-18	314.00	314.00	268.00	130.00	37.00	31.00	23.00	18.00	18.00
9-19	292.00	292.00	258.00	121.00	35.00	31.00	23.00	15.00	15.00
9-20	275.00	275.00	268.00	115.00	35.00	28.00	22.00	15.00	18.00
9-21	255.00	255.00	242.00	100.00	38.00	25.00	20.00	10.00	18.00
9-22	238.00	238.00	229.00	105.00	35.00	29.00	18.00	18.00	18.00
9-23	228.00	223.00	220.00	101.00	44.00	29.00	22.00	17.00	17.00
9-24	221.00	221.00	215.00	98.00	41.00	28.00	22.00	18.00	16.00
9-25	265.00	265.00	210.00	95.00	42.00	27.00	22.00	16.00	16.00
9-26	227.00	227.00	201.00	105.00	62.00	28.00	22.00	14.00	14.00
9-27	215.00	215.00	194.00	101.00	45.00	28.00	23.00	16.00	18.00
9-28	205.00	205.00	190.00	90.00	38.00	28.00	21.00	16.00	18.00
9-29	201.00	201.00	105.00	142.00	41.00	25.00	19.00	13.00	18.00
9-30	734.00	734.00	195.00	176.00	70.00	30.00	21.00	16.00	18.00
MEAN	335.70	335.70	271.03	112.46	62.00	32.30	22.30	16.65	15.55

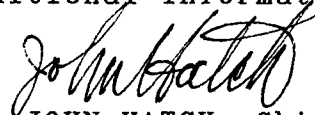
RECOMMENDATION OF CHIEF ENGINEER FOR WATER PERMIT
APPLICATION NO. 5334-3, City of Sioux Falls

Pursuant to SDCL 46-2A-2, the following is the recommendation of the Chief Engineer, Water Rights Division, Department of Water and Natural Resources concerning Water Permit Application No. 5334-3, City of Sioux Falls, 224 West 9th Street, Sioux Falls SD.

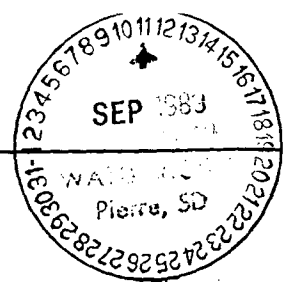
The Chief Engineer is recommending APPROVAL of Application No. 5334-3 because 1) the proposed diversion can be developed without unlawful impairment of existing rights, 2) the proposed use is a beneficial use and 3) in the public interest with the following qualification:

At least 20 cfs must be by-passed, when pumping, for downstream domestic use, including livestock watering, and prior water rights.

See the attached report for additional information.

A handwritten signature in cursive script, appearing to read "John Hatch".

JOHN HATCH, Chief Engineer
August 22, 1989

**PROOF OF PUBLICATION**

STATE OF SOUTH DAKOTA)
) ss.
 County _____)

I, Sonja Oakland
 certify that the attached printed Notice was taken
 from the Sioux Valley News

A newspaper which during the whole time of publication of
 said notice herein after stated, has been and is printed and
 published in the _____

City _____ of _____ Canton _____
 County of Lincoln and State of South Dakota;
 that the said notice was published in said newspaper on the
 following two dates:

August 31, 1989

September 7, 1989

Sonja Oakland
 (Signature)

Bookkeeper
 (Title)

September 7, 1989
 (Date Signed)

Cost of Printing: \$46.48

**NOTICE OF HEARING ON
 APPLICATION NO. 39-81A-3 &
 5334-4 TO APPROPRIATE WATER**

Notice is given that the City of
 Sioux Falls, 224 W. 9th Street,
 Sioux Falls, SD 57102 has filed
 two applications for water
 permits. Application No. 3981A-3
 is to amend Future Use Permit No.
 3981-3 by adding diversion area to
 that area authorized by Future
 Use Permit No. 3981-3 which
 reserves for Future Use 50,000
 acre-feet of water annually from
 the Big Sioux River. Diversion
 from the river was to be located
 within the W½ Section 33-T102N-
 R49W. This application is to add
 the N½ Section 32-T102N-R49W
 to the authorized diversion area.
 This application, if approved, does
 not authorize any increase in the
 amount of water reserved for
 future use.

Application No. 5334-3 is to
 construct works and place to
 beneficial use 13.8 cubic feet of
 water per second (10,000 acre-feet
 annually) from the Big Sioux River
 reserved by Future Use Permit No.
 3981-3. The point of diversion is to
 be located within the W½ Section
 33, N½ Section 32; all in T102N-
 R49W. Water is to be used by the
 City of Sioux Falls for municipal
 purposes.

Pursuant to SDCL 46-2A-2, the
 Chief Engineer of the Water
 Rights Division recommends
 APPROVAL of Application No.
 3981-A-3 to amend Future Use
 Permit No. 3981-3 because 1) the
 addition of diversion area will not
 impair existing rights and 2) is in
 the public interest and No. 5334-3
 because 1) the proposed diversion
 can be developed without
 unlawful impairment of existing
 rights, 2) the proposed use is a
 beneficial use and 3) in the public
 interest. These applications will
 be considered by the Water
 Management Board in Room 216
 of the Joe Foss Building at 523 E.
 Capitol, Pierre, SD on September
 27, 1989 at 10:00 a.m. The Chief
 Engineer's recommendation is not
 final or binding upon the Board.
 The Board is authorized to 1)

approve, 2) approve with
 qualifications 3) defer or 4) deny
 these applications based on the
 facts presented at the public
 hearing.

Any interested person that
 intends to participate in the
 hearing before the Board by
 presenting evidence or cross-
 examining witnesses according to
 SDCL 1-26, must file a written
 petition with BOTH the applicant
 and Chief Engineer by September
 15, 1989. The Chief Engineer's
 address is "Water Rights Division,
 Foss Building, 523 E. Capitol,
 Pierre, SD 57501. (605 773-3352)".
 The petition may be informal, but
 must include a statement
 describing the petitioner's
 interest in the applications, the
 petitioner's reasons for opposing
 or supporting the applications
 and the signature and mailing
 address of the petitioner or legal
 counsel if legal counsel is
 obtained. The applicant need not
 file a petition. Contact the Water
 Rights Division to request
 information on these applications
 or to assure access to the hearing
 by the handicapped.

This hearing is an adversary
 proceeding. Any person filing a
 petition and/or the applicant have
 the right to be represented by a
 lawyer. These and other due
 process rights will be forfeited if
 not exercised. Decisions of the
 Board may be appealed to the
 Circuit Court and State Supreme
 Court as provided by law. The time
 of the hearing will also be
 automatically delayed for at least
 twenty days upon written request
 to the Chief Engineer from the
 applicant or a petitioner. The
 request for a delay must be
 received by September 15, 1989.
 These applications are made
 pursuant to SDCL 46-1-1 thru 46-1-
 9, 46-1-12 thru 46-1-15; 46-2-3.1, 46-
 2-9, 46-2-11, 46-2-13, 46-2-17; 46-2A-
 1 thru 46-2A-10, 46-2A-12, 46-2A-14
 46-2A-15; 46-5-1 thru 46-5-11, 46-5-
 13 thru 46-5-15, 46-5-24, 46-5-25, 46-
 5-30.2, 46-5-30.4, 46-5-31; 46-5-36
 thru 46-5-40; and Board Rules
 ARSD 74:02:01:01 thru 74:02:01:15;
 74:02:01:24 thru 74:02:01:25.

VERNON R. THORSON
 My commission expires
 January 20, 1995.

PROOF OF PUBLICATION

STATE OF SOUTH DAKOTA)
) ss.
 County Minnehaha)

I, Mary J. Devish

certify that the attached printed Notice was taken
 from the Argus Leader

A newspaper which during the whole time of publication of
 said notice herein after stated, has been and is printed and
 published in the Argus Leader

City of Sioux Falls

County of Minnehaha and State of South Dakota;
 that the said notice was published in said newspaper on the
 following two dates:

Wednesday, August 30, 1989

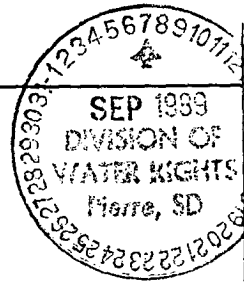
Wednesday, September 6, 1989

Mary J. Devish
 (Signature)

Controller
 (Title)

9/6/89
 (Date Signed)

Cost of Printing: \$93.00



NOTICE OF HEARING
 on Application No. 3981A-3
 5334-3 to Appropriate Water
 Notice is given that the City of
 Sioux Falls, 224 W. 9th Street,
 Sioux Falls, SD 57102, has filed
 applications for water permits.
 Application No. 3981A-3 is to
 amend Future Use Permit No.
 3981-3 by adding diversion area to
 that area authorized by Future Use
 Permit No. 3981-3 which reserves
 for Future Use 50,000 acre-feet of
 water annually from the Big Sioux
 River. Diversion from the river was
 to be located within the W1/2
 Section 33-T102N-R49W. This ap-
 plication is to add the N1/2 Section
 32-T102N-R49W to the authorized
 diversion area. This application, if
 approved, does not authorize any
 increase in the amount of water
 reserved for future use.

Application No. 5334-3 is to con-
 struct works and place to beneficial
 use 13.8 cubic feet of water per
 second (10,000 acre-feet annually)
 from the Big Sioux River reserved
 by Future Use Permit No. 3981-3.
 The point of diversion is to be
 located within the W1/2 Section 33,
 N1/2 Section 32; all in T102N-
 R49W. Water is to be used by the
 City of Sioux Falls for municipal
 purposes.

Pursuant to SDCL 46-2A-2, the
 Chief Engineer of the Water Rights
 Division recommends APPROVAL
 of Application No. 3981A-3 to
 amend Future Use Permit No.
 3981-3 because 1) the addition of
 diversion area will not impair ex-
 isting rights and 2) is in the public
 interest and No. 5334-3 because 1)
 the proposed diversion can be
 developed without unlawful impair-
 ment of existing rights, 2) the
 proposed use is a beneficial use
 and 3) in the public interest. These
 applications will be considered by
 the Water Management Board in
 Room 216 of the Joe Foss Building
 at 523 E. Capitol, Pierre, SD on
 September 27, 1989 at 10:00 am.
 The Chief Engineer's recommenda-
 tion is not final or binding upon the
 Board. The Board is authorized to
 1) approve, 2) approve with qualifi-
 cations, 3) defer or 4) deny these
 applications based on the facts
 presented at the public hearing.

Any interested person that in-
 tends to participate in the hearing
 before the Board by presenting
 evidence or cross-examining wit-
 nesses according to SDCL 1-26,
 must file a written petition with
 BOTH the applicant and Chief
 Engineer by September 15, 1989.
 The Chief Engineer's address is
 "Water Rights Division, Foss
 Building, 523 E. Capitol, Pierre, SD
 57501 (605 773-3352)". The peti-
 tion may be informal, but must
 include a statement describing the
 petitioner's interest in the applica-
 tions, the petitioner's reasons for
 opposing or supporting the applica-
 tions and the signature and mailing
 address of the petitioner or legal
 counsel if legal counsel is obtained.
 The applicant need not file a
 petition. Contact the Water Rights
 Division to request information on
 these applications or to assure
 access to the hearing by the
 handicapped.

This hearing is an adversary
 proceeding. Any person filing a
 petition and/or the applicant have
 the right to be represented by a
 lawyer. These and other due pro-
 cess rights will be forfeited if not
 exercised. Decisions of the Board
 may be appealed to the Circuit
 Court and State Supreme Court as
 provided by law. The time of the
 hearing will also be automatically
 delayed for at least twenty days
 upon written request to the Chief
 Engineer from the applicant or a
 petitioner. The request for a delay
 must be received by September 15,
 1989.

These applications are made pur-
 suant to SDCL 46-1-1 thru 46-1-9,
 46-1-12 thru 46-1-15; 46-2-3.1,
 46-2-9, 46-2-11, 46-2-13, 46-2-17;
 46-2A-1 thru 46-2A-10, 46-2A-12,
 46-2A-14, 46-2A-15; 46-5-1 thru
 46-5-11, 46-5-13 thru 46-5-15,
 46-5-24, 46-5-25, 46-5-30.2, 46-5-
 30.4, 46-5-31; 46-5-38 thru 46-5-40;
 and Board Rules ARSD 74:02:01:01
 thru 74:02:01:15; 74:02:01:24 thru
 74:02:01:25.



**US Army Corps
of Engineers**
Omaha District

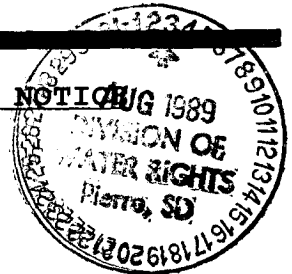
Public Notice

Reply to:
Regulatory Branch
Federal Building, Room 260
Pierre, South Dakota 57501

Application No: SD 2SB OXT 2 013794
Date: August 2, 1989
Expiration Date: August 23, 1989

CEMRO-OP-R
City of Sioux Falls
Fill/Intake Structure
Big Sioux River, Mile 172.95

21 DAY NOTICE AUG 1989



NOTICE OF PERMIT PENDING

The application of the City of Sioux Falls, 224 West Ninth Street, Sioux Falls, South Dakota 57102, for approval of plans and issuance of a permit under authority of the Secretary of the Army is being considered by the District Engineer, U.S. Army Engineer District, Omaha, Nebraska.

The applicant requests authorization to place fill material in the Big Sioux River (mile 172.95) in conjunction with the construction of a water intake structure. The project is located in Section 32, Township 102 North, Range 49 West, Minnehaha County, South Dakota.

The project will consist of constructing an intake structure and pumping station to provide a raw water source to the City of Sioux Falls' water purification plant. The intake and pump station will be constructed in the south levee of the Big Sioux River north of the Sioux Falls airport (see attached drawings for location and details).

Approximately eight hundred fifty (850) cubic yards of earth will be used to construct a temporary cofferdam for the purpose of keeping the work area dry (see sheet 2 of 3). It is anticipated that the contractor will dewater the area behind the cofferdam then excavate into the levee to prepare the site for the construction of the intake and pump station. The foundation and walls will be poured to elevation 1425 ±. The walls will then be backfilled, the cofferdam removed in its entirety, and the structures constructed up to the required elevations and specifications.

A trash rack with two (2) inch clear openings will be installed on the exterior of the intake structure. Traveling screens having a clear opening size of three-eighths (3/8) inch will be installed behind the trash rack. The approach channel will have a velocity at peak pumping rate (45 MGD) of one-half (1/2) foot per second. The ordinary high water elevation is considered to be 1421 ±.

In addition to the construction of the pumping station and intake, approximately two thousand (2000) cubic yards of river bottom sediments will be removed from the vicinity of the intake to the original desired channel elevation of 1414.5. This sediment removal action does not require U.S. Department of the Army authorization; however, it is associated with the over all project purpose.

The purpose of the project is to provide a raw water source for a drinking water supply for the City of Sioux Falls. At the present time up to 6 MGD of surface water, from intakes along the Big Sioux diversion channel, is being drawn for use by the city. The remaining city water supply is being obtained from shallow wells in the Big Sioux Aquifer located adjacent to the river, primarily north of the city. City growth and an increasing water demand is stressing the available well capacity.

Certification that the proposed project will not violate applicable water quality standards has been requested from the Regional Administrator, U.S. Environmental Protection Agency, Region VIII, One Denver Place, Suite 1300, 999 - 18th Street, Denver, Colorado.

In compliance with the National Environmental Policy Act of 1969 and Section 106 of the National Historic Preservation Act of 1966, as amended, the National Register of Historic Places and current supplements have been consulted. There are no sites included or which have been determined eligible for inclusion therein which will be affected by the proposed project. The project area has been previously disturbed due to the construction of the existing levee. The probability of finding undisturbed cultural resources is minimal.

In compliance with the Endangered Species Act, our review indicates that the proposed activity will not affect species designated as threatened or endangered pursuant to the Endangered Species Act or their critical habitat.

The decision whether to issue a permit will be based on an evaluation of the probable impacts including cumulative impacts of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefit which reasonably may be expected to accrue from the proposals must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the activity will be considered including the cumulative effects thereof; among those are conservation, economics, aesthetics, general environmental concerns, wetlands, cultural values, fish and wildlife values, flood hazards, flood plain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food production, and, in general, the needs and welfare of the people. In addition, the evaluation of the impacts of the project on public interest will include application of the guidelines promulgated by the Administrator, Environmental Protection Agency, under authority of Section 404(b) of the Clean Water Act (40 CFR § 230).

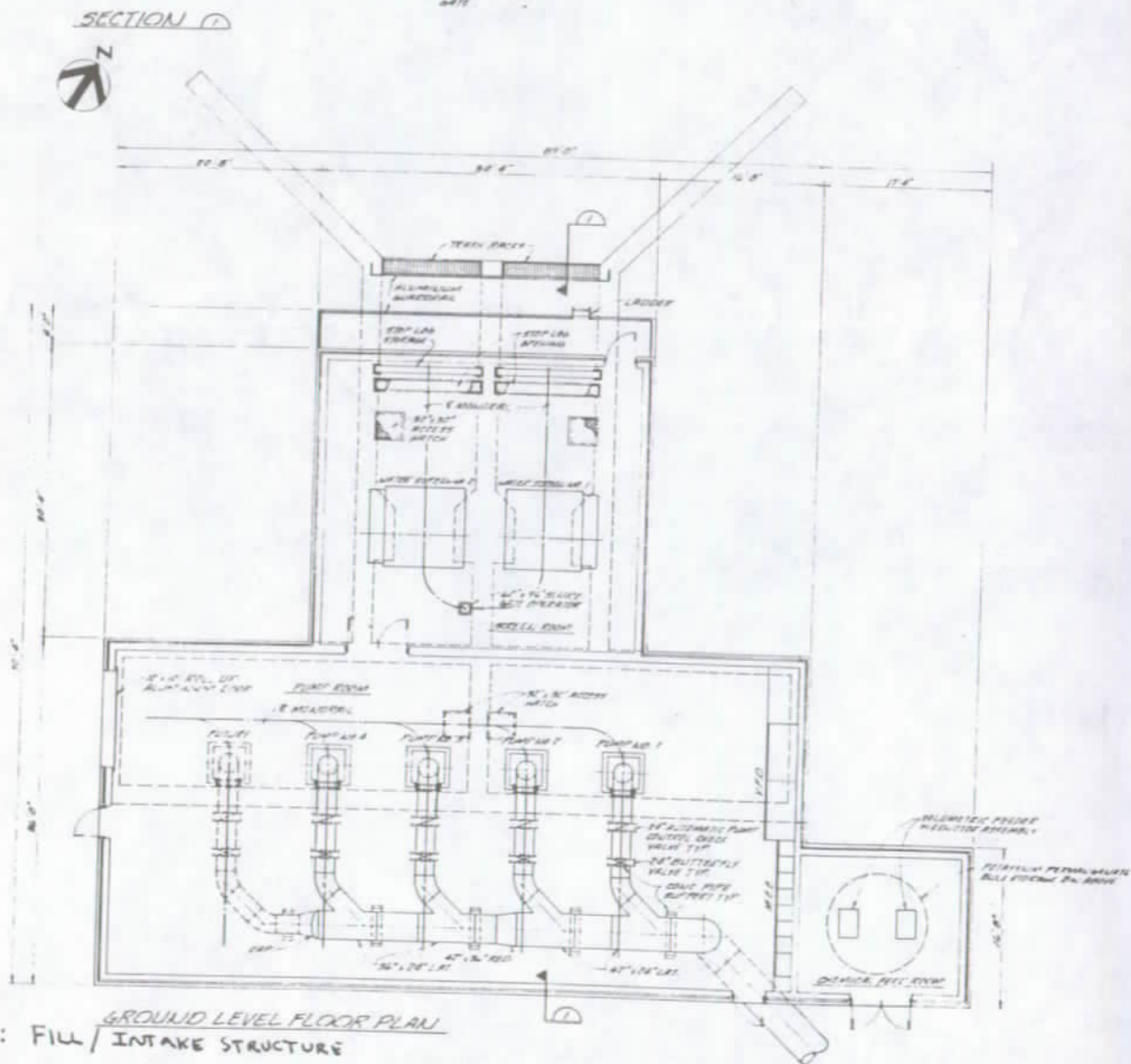
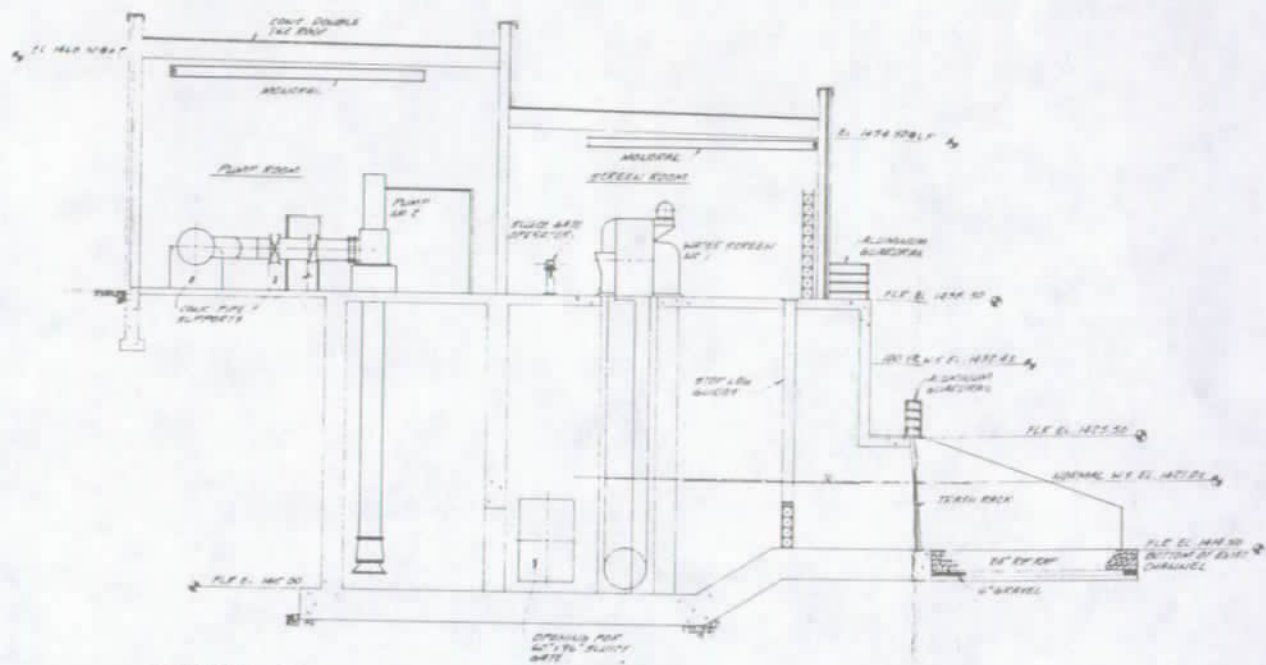
Any person may request, in writing, within the comment period specified in this notice, that a public hearing be held to consider this application. Requests for public hearings shall state, with particularity, the reason for holding a public hearing. The request must be submitted to the U.S. Army Corps of Engineers, Pierre Regulatory Branch, Federal Building, Room 260, Pierre, South Dakota 57501.

Any interested party (particularly officials of any town, city, county, state, Federal agency, or local association whose interests may be affected by the proposed work) is invited to submit to this office, written facts, arguments, or objections on or before August 23, 1989. Any agency or individual having an objection to the proposed work should specifically identify it as an objection with clear and specific reasons. Comments, both favorable and unfavorable, will be accepted, made a part of the record and will receive full consideration in subsequent actions on this permit application. All replies to the public notice should be addressed to the address listed in the previous paragraph. Mr. Steve Naylor, telephone number (605) 224-8531, may be contacted for additional information.

Comments received after the close of the business day on the expiration date of this public notice will not be considered.

This project, if authorized, will be under the provisions of Section 404 of the Clean Water Act.

A drawing showing the location and extent of the work is attached to this notice.



PURPOSE: FILL / GROUND LEVEL FLOOR PLAN
INTAKE STRUCTURE

DATUM

ADJACENT PROPERTY OWNERS:

1 CITY AIRPORT

2

SD 2SB OXT 2 013794

IN BIG SIOUX RIVER
AT MILE 172.95

COUNTY OF MINNEHABA

STATE SD

APPLICATION BY CITY OF SIOUX FALLS STATE

SHEET OF DATE JULY 1989

170 FORM

**US Army Corps
of Engineers
Regulatory Branch
Federal Building, Room 260
Pierre, South Dakota 57501**

John Hatch
SD Dept of Water & Nat. Resources
Division of Water Rights
523 East Capitol Avenue
Pierre, SD 57501



Department of Water & Natural Resources

Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

NOV 20 1989

Jack White, Mayor
City of Sioux Falls
224 W 9th St
Sioux Falls SD 57102

Dear Mayor White:

Enclosed is Water Permit No. 5334-3 as approved by the Water Management Board authorizing you to construct your water diversion system and put the water to beneficial use, not exceeding the limits as specified in the Water Permit.

Also enclosed is Form 10, Notice of Completion of Works and Application of Water to Beneficial Use, which you are to complete and submit to the Chief Engineer when you have completed the system and/or have put the water to beneficial use. An inspection can then be scheduled so that the Water License may be issued, thus completing your acquisition of a Water Right.

Very truly yours,

A handwritten signature in dark ink, appearing to read "John Hatch". The signature is written in a cursive, flowing style.

JOHN HATCH, Chief Engineer
Water Rights Division
605 773-3352

enclosures

PLEASE NOTE: Certain changes can be made in your permit within the five year construction period, usually without affecting the priority date provided an application to amend your permit is made within the five year period - i.e. changes in location or number of diversion points (wells) or location of land to be irrigated. Well locations for wells into the same aquifer can be moved up to 660 feet without application.

Applications to amend a permit after the five year construction period will be assigned a new priority date. Applications to change water sources, to add lands or increase original diversion rates, if approved will usually receive the date of the new application as a priority date regardless of the five year construction period.



DEPARTMENT OF WATER & NATURAL RESOURCES

Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

February 7, 1991

Lyle D Johnson, Water/Wastewater Manager
Utilities Department
224 W 9th Street
Sioux Falls SD 57102

Dear Mr. Johnson:

This letter is in response to my inspection of the City's water permits/rights completed on January 16, 1991.

Several of the city's permits can be licensed after receipt of the following information:

- 1) Permit Nos. 5127-3 and 5127A-3 (Well Nos. 53 thru 58).
Permit No. 5115-3 (Well Nos. 48 thru 52).
Permit No. 5235-3 (Well Nos. 60 thru 65).

- Sustained pump rate for each well under optimal operating conditions,
- Type and horsepower of the submersible units in each of the wells, and
- Brief description of the distribution system.

I have located a well completion report (copy enclosed) for a well that appears to be north of well No. 58. A copy of the well completion report for well No. 58 is also enclosed. No well was noted north of No. 58 during my inspection. Please explain if the well exists as described on the enclosed report and if the well is being used by the city.

- 2) Permit No. 5202-3 for water impounded in Silver Creek by the Big Sioux diversion dam. Two units are used with a capacity of 700 gpm each.

- Type and model no. of the motor and pump with the horsepower.

- 3) Permit No. 5334-3 for the Big Sioux River pump facility.

- Brief description of the operation of the facility at peak operating capacity.

An application (forms enclosed) needs to be approved to increase the permitted pumping rate to 46.4 cfs and to increase the annual volume of water if you plan to exceed the current 10,000 acre-feet. If approved, No. 5334-3 and the new permit would be issued one water license.

(continued)

February 7, 1991
Lyle D Johnson
Page 2 of 3

The following changes are needed to correct errors on the current licenses:

- 1) The following licenses need to have R50W deleted and be reissued for R49W:

254-3, 255-3, 256-3, 257-3, ~~258-3~~^{cancel RO 5/13/91}, 259-3, 260-3, 261-3, 262-3, 264-3, 266-3, 267-3, 269-3, 270-3, 272-3, 273-3, 275-3, 276-3, and 274-3 needs the same range correction plus should be T102N instead of T103N.

License No. 300-3 needs to have section 32 deleted and be reissued for section 33. The original notice of hearing and application are correct.

License No. 4101-3 needs to have T101N deleted and be reissued for T102N and 2,030 feet east rather than 2,030 feet west. The original notice of hearing is correct.

License Nos. 4098-3, 4099-3, 4100-3, and 4812-3 also need to be reissued to identify the correct location of the wells. The original notices of hearing are correct for each license.

- 2) The notice of hearing for 1306-3 needs to be readvertised to correct a diversion point error (should be NW1/4 NW1/4 instead of NE1/4 NE1/4).

The notice of hearing for 4811-3 needs to be readvertised to correct a diversion point error (should be T102N instead of T101N).

Each of these changes (Nos. 1 & 2) will be initiated by the Division of Water Rights. Item No. 2 will require publication of a notice of hearing. The city will be notified of the completion of the corrections.

Well Nos. 30, 31, 32, and 33 have been rehabilitated in the last two years. Revisions may also be needed to some of the water rights held by the city to reflect changes in the pumping capacity of the wells. If the sustained pump rate of these wells under optimal operating conditions is less than the permitted pump rate, then the licenses should be reissued for the reduced pump rate. If the sustained pump rate exceeds the permitted amount, then a new permit is needed for the increase in the pump rate. Please indicate what the sustained pump rates are for well Nos. 30, 31, 32, 33, and other wells as rehabilitation efforts and aquifer conditions allow.

^{258-3 RO 5/13/91}
Water Right Nos. 254-3, 255-3, ²⁵⁸⁻³265-3, 268-3, 271-3, and 1579-3 will be scheduled for a hearing to allow the Water Management Board to consider cancellation of the water rights due to abandonment and/or forfeiture. Notice will be given of the time and place of hearing. If the Parks and Recreation Department is using of the well authorized by No. 1579-3, please inform me.

February 7, 1991
Lyle D Johnson
Page 3 of 3

In response to your questions during our meeting on January 17, 1991, the city can plug abandoned wells if the work is completed according to the Well Construction Standards. A copy of the standards and some plugging report forms are enclosed for the city's use.

Water Permit No. 1790-3 held by the Lincoln County Rural Water System is for supplying the rural water system from the city's well field. Enclosed is a copy of Permit No. 1790-3, including the affected city permits and a resolution signed by the mayor of Sioux Falls.

Thank you and your staff for the assistance we received concerning these inspections. I appreciate Mr. Holden taking the time to show us around. If you have any questions regarding any of this information, please contact me.

Sincerely,



Ron Duvall
Natural Resources Engineer
605 773-3352

enc.

cc: Glenn Dostal, HDR Engineering, Inc.



5334-3

**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE SOUTH DAKOTA 57501-3181

January 13, 1994

Lyle D. Johnson
City of Sioux Falls
224 W 9TH Street
Sioux Falls, SD 57102

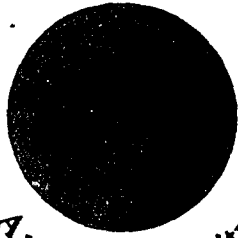
Dear Mr. Johnson:

Pursuant to qualifications on Water Permit/Right No. 5726-3 (Big Sioux:Middle Skunk Creek Aquifer) & 5710-3 (Big Sioux:Sioux Falls Aquifer), and an annual water use limit from the Big Sioux River on Nos. 5334-3 and 5431-3, I am requesting that the City of Sioux Falls report the total amount of water diverted from each of these water sources during 1993. Please respond by January 31, 1994.

If you have any questions concerning this or other water rights questions, please contact Barry McLaury, Natural Resources Analyst, (605) 773-3352.

Sincerely,

RON DUVALL, Natural Resources Engineer
for JOHN HATCH, Chief Engineer
Water Rights Division



America's #1 City

UTILITIES DEPARTMENT

Hearing Impaired (605) 339-7039



January 27, 1994

Ron Duvall, Natural Resources Engineer
DENR - Water Rights Division
Joe Foss Building
523 East Capitol
Pierre, SD 57501-3181

Dear Mr. Duvall:

This letter is in response to your request regarding the City of Sioux Falls' total 1993 pumpages from our existing water supply sources.

Please review the attached Sioux Falls water supply summary. We have listed the total diverted water amounts from the Big Sioux Aquifer, Split Rock Creek Aquifer, Southern Skunk Creek Aquifer, and the Big Sioux River.

Please note that we have not, as of this time, diverted any water for our use from the Middle Skunk Creek Aquifer.

If you have any questions concerning this information, please contact Lyle Johnson at 339-7088 or contact me at 339-7040.

Sincerely,

Randy Janssen, Water Superintendent

gl
attachments
cc: Lyle Johnson, Water/Wastewater Manager

Utility Office
224 West Ninth Street
Sioux Falls, SD 57102
(605) 339-7031
FAX (605) 338-8490

Water Purification
2100 N. Minnesota Ave.
Sioux Falls, SD 57104
(605) 339-7025
FAX (605) 338-7801

Water Reclamation
4500 N. Sycamore Ave.
Sioux Falls, SD 57104
(605) 339-7088
FAX (605) 338-8484

Lights
2000 N. Minnesota Ave.
Sioux Falls, SD 57104
(605) 339-7150
FAX (605) 339-7006

Maint./Svc. Division
668 Algonquin Avenue
Sioux Falls, SD 57104
(605) 339-7020
FAX (605) 338-7883



SIoux FALLS WATER SUPPLY SUMMARY

BIG SIOUX AQUIFER

Well No.	Permit No.	Total 1993 Pumpage Acre-Ft.	Million Gals(MG)
3	256-3	19	6.19
4	257-3	30	9.78
10	259-3	18	5.87
11	260-3	27	8.80
12	261-3	28	9.13
13	262-3	91	29.66
14	263-3	8	2.61
15	264-3	241	78.54
17	266-3	17	5.54
18	267-3	93	30.31
20	269-3	277	90.27
21	270-3	482	158.06
23	272-3	57	18.58
24	273-3	53	17.27
25	274-3	329	107.22
26	275-3	265	86.36
27	276-3	286	93.21
28	298-3	491	160.01
29	299-3	758	247.03
30	300-3	133	43.34
31	395-3	380	123.84
32	396-3	639	208.24
33	397-3	187	60.94
34	1305-3	125	40.74
36	2018-3	412	134.27
37	2019-3	349	113.74
38	2747-3	388	126.45
39	2886-3	97	31.61
42	4098-3	322	104.94
43	4099-3	242	78.87
44	4100-3	370	120.58
46	4812-3	638	207.92
47	4811-3	389	126.77
48-53	5115-3	632	205.96
54-58	5127A-3	757	246.70
60-65	5235-3	326	106.24
Total		9956	3245.59



Split Rock Creek Aquifer

Well	Permit	Acre-Ft.	MG
67	5213-3	261	85.05
NSP	5213-3	265	86.36
Total		526	171.41

Southern Skunk Creek Aquifer

Well	Permit	Acre-Ft.	MG
66	5214-3	<u>58</u>	<u>18.90</u>
Total		58	18.90

Big Sioux River

Well	Permit	Acre-Ft.	MG
Intake			
Sioux River			
Pump Station	5431-3	<u>6287</u>	<u>2049</u>
Total		6287	2049





**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3181

November 6, 1996

Randy Janssen, Water Plant Superintendent
Water Purification Plant
2100 N Minnesota Ave
Sioux Falls SD 57104

Dear Mr. Janssen:

I am writing in response to our November 5, 1996, phone conversation concerning the city's surface water supply from the Big Sioux River.

Currently, the city holds Water Permit No. 5334-3 which appropriates 13.8 cubic feet of water per second from the Big Sioux River with an annual volume limit of 10,000 acre-feet (3.25 billion gallons per year.) A copy of the permit is enclosed. I am also enclosing a copy of a letter dated February 7, 1991, which was based on an inspection of the city's permits, including No. 5334-3 (see Item No. 3.)

The city has in reserve 40,000 acre-feet from the Big Sioux River as specified in Future Use Permit Nos. 3981-3 and 3981A-3. Your application to increase the diversion rate and annual volume will need to specify that the water to be placed to beneficial use is from your future use permits.

If you have any questions about completing the enclosed application forms or related matters, please give me a call at (605) 773-3352. I will try to assist you in any way possible.

Sincerely,

Ron Duvall
Natural Resources Engineer
Water Rights Program

enclosures

Gronlund, Eric

To: Janssen, Randy
Subject: RE: Water Permit 5334-3

Randy

Garland Erbele, Mark Rath and I finally had an opportunity to sit down and discuss the station to use for the 20 cfs by-pass requirement on Water Permit No. 5334-3. The City of Sioux Falls has requested to use the Cliff Avenue gaging station as the point used in determining the 20 cfs by-pass requirement.

The Water Rights Program is agreeable to a working understanding with the city that the Cliff Avenue gaging station be used in determining the 20 cfs by-pass. In doing so, the city is receiving the benefit and/or credit for Skunk Creek tributary inflows, John Morrell discharges and the flows through the diversion (flood) channel. However, you also have to be aware that there are existing water rights on the Big Sioux River between the city's pump station and the Cliff Avenue gage. The city may in some circumstances find itself having to by-pass more water at its pump station to meet the 20 cfs by-pass requirement at the Cliff Avenue gaging station than a straight 20 cfs by-pass at the pump site to account for these diversions.

As part of this working understanding, the city of Sioux Falls may not at any time divert all the Big Sioux River flow at their pump station. This could adversely impact the reach between the pump station and the confluence of Skunk Creek with the Big Sioux River. It is not in the best interest of the city or state to cause this stream segment to become dry or stagnate.

Please be aware that at some point in the future someone could challenge our mutual understanding to use the Cliff Avenue gaging station. If that were to occur it would ultimately need to be resolved by a hearing before the Water Management Board.

If you have any questions or we need to discuss this further, please do not hesitate to contact me.

Eric Gronlund
Water Rights Program
605 773-3352

-----Original Message-----

From: Janssen, Randy [mailto:rjanssen@SIOUX-FALLS.org]
Sent: Monday, October 02, 2000 2:36 PM
To: 'Eric Gronlundn @ DENR Water Rights'
Subject: Water Permit 5334-3
Importance: High

Eric, did you have a chance to review the permit no. 5334-3 to determine what station is to be used for determining the cfs bypass limit. I looked and it doesn't indicate on our permit copy, just that 20 cfs must be allowed to flow downstream. Let me know what you find out. Thanks.

Randy Janssen
Water Superintendent
Water Purification Plant
2100 N MN Ave
Sioux Falls, SD 57104
Phone: (605)367-7040
fax: (605)367-8475
email: rjanssen@sioux-falls.org



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

JUN 20 2003

Randy Jenssen
Sioux Falls Water Superintendent
2100 N Minnesota Ave
Sioux Falls SD 57104

Dear Mr. Jenssen:

Enclosed are Water License Nos. 5213-3, 5214-3, 5431-3, 5611-3, 5612-3, 5614-3, 5615-3, 5726-3, 6210-3, 6214-3 and 6215-3 for the City of Sioux Falls. A map prepared by Lynn Beck is also included for each permit as well as receipts for payment of the license fees.

These are the final water right documents completing the city's process of obtaining Water Rights.

As long as the city uses the water beneficially, as stated in the Water Licenses, State Water Laws provide a continuing right to use the water.

Sincerely,

Garland Erbele, Chief Engineer
Water Rights Program
(605) 773-3352

NOTE: The applicable portions of No. 5334-3 are incorporated into Water License No. 6210-3.
The applicable portions of Nos. 2923-3 and 5613-3 are incorporated into Water License No. 5726-3.

enclosures