

Order: 1

WATER PERMIT NO. 5145-3

MAP No. Same

Applicant Paul M. Juel

Office Address RR3, Box 21, Canton SD 57013

Amount of Water Claimed 58.9 acre - feet Total Acres NA

Source of Water Supply un-named creek

Water to be used for REC & FWP County Lincoln

About 3 miles N of Canton

PROOF OF PUBLICATION: Received _____ Not Received _____

APPLICATION: Approved _____ Subject to _____

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

PRIORITY _____ Date Received July 27, 1987 Fee 150⁰⁰/₁₀₀ Remarks _____

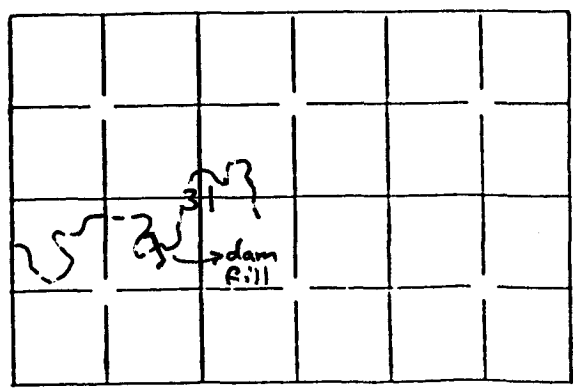
Corrected Application Received _____ Period of Annual Use _____

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

WI-1 Description same as Application YES _____ NO _____ REMARKS _____

Diversion Point dam: N 1/2 SW 1/4 section 31 -
T99N-R48W

Land to be Irrigated NA



Well Log: Driller NA Licensed YES _____ NO _____

Depth of Well _____ REMARKS _____

Type of Map aerial photo PREPARED BY Robert Lehman, SCS Reviewed and the Number assigned on July 27, 1987 By Ron Durrell

NR, Foss Bldg.
Pierre, SD 57501
(505) 773-3352

*2 copies
file
MCM*

11A-M

South Dakota

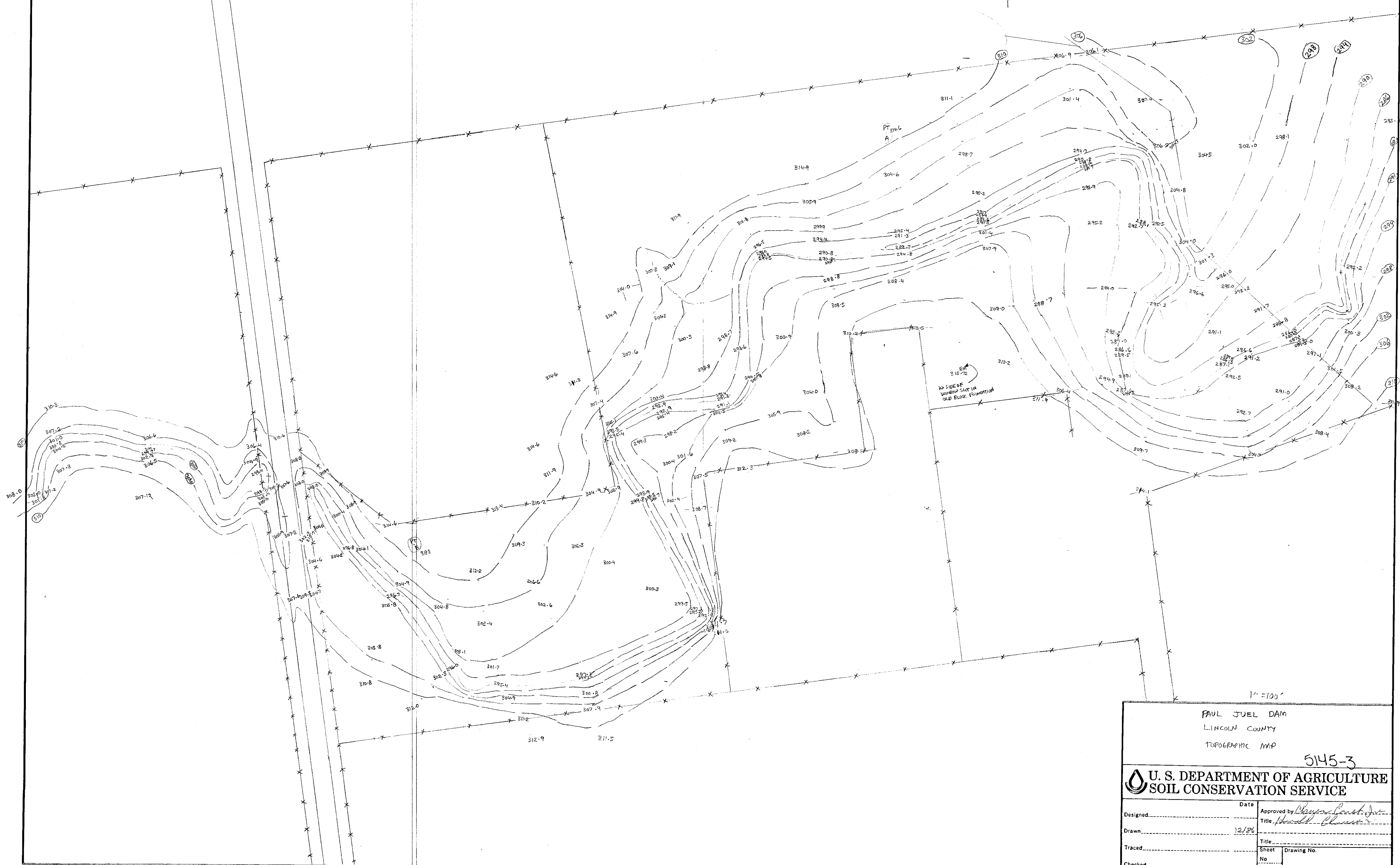
JUL 1987

**DIVISION OF
WATER RIGHTS**

Pierre, SD

23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

Notary Public (or other qualified officer)



1" = 100'

PAUL JUEL DAM
LINCOLN COUNTY
TOPOGRAPHIC MAP

5145-3

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed.....	Date.....	Approved by.....
Drawn.....	12/86	Title.....
Traced.....		Sheet.....
Checked.....		No.....
		of.....

Drawing No.

WATER PERMIT

The Water Management Board hereby approves Water Permit Application No. _____

(Applicant)

(Post Office Address)

(State)

(Zip Code)

With the following qualifications.

Date of first receipt of application _____, 19____.

Date of return to applicant for correction, amendments or changes required _____, 19____.

Date of receipt of corrected application _____, 19____. Approved _____, 19____.

The Water Management Board hereby approves this Water Permit No. _____ authorizing the construction of the water use system and the placing of water to beneficial use as stated in the Application and as qualified in the Water Permit approval, subject, however, to the following limitations and conditions:

1. The date from which applicant may claim right is _____, 19____.
2. One-fifth of the work is to be completed on or before _____, 19____.
3. The whole of said work is to be completed on or before _____, 19____.
4. The time limit for proof of beneficial use of water is _____, 19____.
5. The water appropriated shall be used for the purpose of _____.
6. The prior right of all persons who, by compliance with the laws of the State of South Dakota, have acquired a right to the use of water must not be unlawfully impaired by this appropriation.
7. The amount of the appropriation herein granted shall not exceed _____ cubic feet per second; neither shall it exceed the capacity of the above described water supply system nor shall it exceed the amount of water needed for beneficial uses served. For irrigation purposes said appropriation must be limited to not more than 2 acre feet per acre per year and be limited to not more than one-seventieth ($1/70$) of one cubic foot of water per second of time for each acre of land to which water is actually and beneficially applied for irrigation on or before _____, 19____; said water to be used during the following described annual period: _____.

WATER MANAGEMENT BOARD

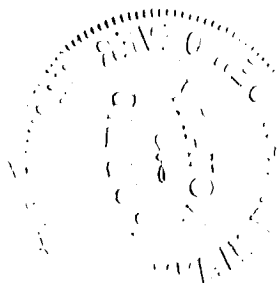
By: _____

Chief Engineer

Division of Water Rights

Dept. of Water and Natural Resources

_____, 19____



**SOUTH DAKOTA
WATER PERMIT**

Date of first receipt of application July 27, 1987

Date of return to applicant for correction, amendments or changes required _____

Date of receipt of corrected application _____

The Water Management Board approved Water Permit Application No. 5145-3

on September 9, 1987 for Paul M. Juel
(Applicant)

RR 3, Box 21 Canton South Dakota 57013
(Street, RR or Box) (City) (State) (Zip Code)

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. 5145-3 authorizes storage of 58.9 acre-feet of water annually in a dam located in the N $\frac{1}{2}$ SW $\frac{1}{4}$ Section 31-T99N-R48W
2. The water appropriated shall be used for the purpose of erosion control, recreational uses and providing habitat for fish and wildlife production
and may not exceed the amount of water needed for beneficial use for recreational and fish & wildlife production uses.
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 the right is July 27, 1987
5. One-fifth of the construction is ~~to be completed on or before~~
6. All construction is ~~to be completed on or before~~
7. Water is ~~to be~~ put to beneficial ^{use} ~~use on or before~~
8. Water rights obtained in compliance with the laws of the State of South Dakota may not be unlawfully impaired by this appropriation.

QUALIFICATIONS

1. Approval of this permit is subject to submission of plans and specifications to the chief engineer pursuant to Board Rules Chapter 74:02:08, Safety of Dams for review and approval.
2. Low flows as needed for downstream domestic use, including livestock water and prior water rights must be by-passed.
3. Approval of this Permit authorizes storage of up to 58.9 acre feet of water annually.

WATER MANAGEMENT BOARD

By: John Hatch
Chief Engineer

FEB 14 1989

Division of Water Rights
Dept. of Water and Natural Resources

Supplemental Information.

(type or print in ink)

1. Well Information - Proposed construction

- a) Drill Hole Diameter _____ Depth _____
- b) Casing Type _____ Diameter _____ Thickness _____
- c) Screen Type _____ Diameter _____ Thickness _____
- d) Gravel Pack Thickness _____ Length of Gravel Pack _____
- e) Depth to Top of Water Bearing Material _____
- f) Depth of Water (ground surface to water level) _____
- g) Distance to nearest existing domestic well:
- On applicants property _____ On property owned by others _____

2. Dugout Information Estimates

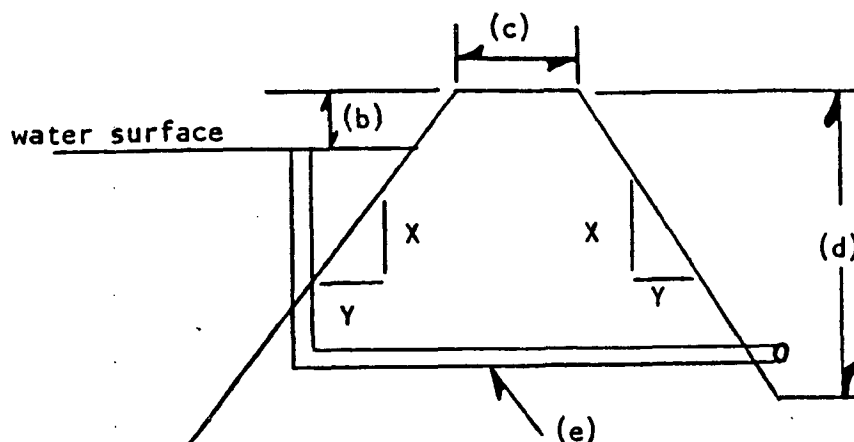
- a) Surface Dimensions _____ Depth _____
- b) Depth to water (ground surface to water level) _____

3. Water Storage Dams

If the proposed water use system contains one or more storage dams, please furnish the information requested below. The locations of each dam should be shown on the map submitted with the application.

- a) If a private engineering firm or government agency was involved in the design of this dam please give their name and address

USDA - SOIL CONSERVATION SERVICE
Box 211, Canton, S.D. 57013



- b) Freeboard 8.5'
- c) Crest Width 12'
 Crest Length 408'
- d) Height 24'
- e) Outlet Dimensions:
 Pipe diameter 66"
 Spillway width 102'
- f) X & Y Slope
 Upstream 3:1
 Downstream 2:1
- Surface Area of Impoundment 11.2
- Storage 58.9 acre feet
- Drainage area above dam 5380 Ac.

Paul M. Juel
 Signature of Applicant

Flood Estimates

$$Q_{25} = 83.4 (A)^{.60} (S)^{.44} (S_i)^{-.72}$$

A = contributing drainage area = 8.4 mi^2

S = main channel slope = 20.2 ft/mile

S_i = soil-infiltration index = 3.33

$$\underline{Q_{25} = 472 \text{ cfs.}}$$

$$Q_{50} = 106 (A)^{.63} (S)^{.45} (S_i)^{-.69}$$

$$\underline{Q_{50} = 683 \text{ cfs}}$$

$$Q_{100} = 132 (A)^{.65} (S)^{(.46)} (S_i)^{-.67}$$

$$\underline{Q_{100} = 937 \text{ cfs}}$$

Techniques for Estimating Flood Peaks, Volumes,
and Hydrographs on Small Streams in South
Dakota.

U.S. Geological Survey

DAM INSPECTION HYDROLOGIC ANALYSIS - SUMMARY TABLE

JUEL DAM
DAM
SAFETY
ANALYSIS
UNIT GRAPH

SYNDERS 0.500 HOUR UNIT HYDROGRAPH DATA AND PARAMETERS

DURATION	Q ₁	L	LCA	CP	CT	QP	TP	M50	M75	UNIT VOL
HOURS	SEC-MI	MILES	MILES			C.F.S	HOURS	HOURS	HOURS	AC-FT
0.500	8.40	5.00	3.20	0.800	1.000	1778.0	0.10	1.74	1.05	449.00

PROBABLE MAXIMUM STORM PRECIPITATION AND RUNOFF CHARACTERISTICS

RMP	RAIN	DISTRIBUTION IN PERCENT OF RMP				INT-LOS	INF-RATE	VOLUME IN INCHES		
INDEX	FACTOR	6-HR	12-HR	18-HR	24-HR	INCHES	INCH/HR	RAIN	LOSS	EXCESS
22.00	0.800	100.00	120.00	126.00	132.00	0.0	0.50	23.23	0.11	15.12

LAKE INFLOW HYDROGRAPH ORDINATES

PROBABLE MAXIMUM FLOOD HYDROGRAPH ORDINATES IN CFS AT 0.500 HOUR INTERVALS BEGINNING AT ZERO TIME											
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	10.5	31.7	62.4	117.0	191.4	292.1	292.2	338.3	359.6	346.9	410.4
439.0	524.5	736.7	1109.6	1677.5	4202.2	6991.3	9852.7	13963.3	17501.2	16457.7	14051.0
12743.1	11654.4	10553.7	9352.6	7951.5	6374.3	4943.1	3595.4	2521.1	1482.5	900.2	534.0
492.3	228.9	112.0	35.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

LAKE AND DAM INFORMATION

BEGINNING	OUTLET	BOTTOM	SPILLWAY	SPILLWAY	TOP OF DAM	TOP OF DAM	HEIGHT	DOWNSTREAM	N-VALVE	COEF OF
POOL ELEV	INVERT	OF LAKE	CREST	CREST WIDTH	ELEVATION	LENGTH	OF DAM	SLOPE	ON DS	FLOW
FT, MSL	FT, MSL	FT, MSL	FT, MSL	FEET	FT, MSL	FEET	FEET	OF DAM	SLOPE	OVER DAM
100.00	0.0	75.00	100.00	40.0	106.00	330.0	21.0	1V ON	3.00H	0.020

SUMMARY OF FLOOD ROUTINGS OF INFLOW HYDROGRAPH THROUGH THE LAKE

ROUTING	PERCENT	TOTAL	MAXIMUM	DEPTH OF	ESTIMATED	INITIAL	TOTAL	VOLUME	MAXIMUM
NUMBER	CEGGO	INFLOW	LAKE	LAKE OVER	VELOCITIES	TIME TO	TIME	SPILLED	DISCHARGE
	INFLOW	VOLUME	ELEVATION	TOP OF DAM	CREST	TOE	OVER TOP	OVER DAM	FROM DAM
	HYDROGRAPH	AC-FT	FT, MSL	FEET	FPS	FPS	HOUR	AC-FT	CFS
1	100.0	5774.	107.07	1.07	4.79	11.72	15.22	555.5	17480.7
2	90.0	5095.	106.73	0.73	3.95	9.30	16.68	236.4	15717.7
3	80.0	5419.	105.37	0.37	2.83	6.23	15.71	97.5	13971.3
4	70.0	4742.	105.01	0.01	0.55	0.50	17.01	0.10	12199.0
5	60.0	4064.	105.52	-0.48	0.0	0.0	0.0	0.0	10449.3
6	50.0	3397.	105.01	-0.99	0.0	0.0	0.0	0.0	8597.5
7	40.0	2709.	104.41	-1.59	0.0	0.0	0.0	0.0	5957.1
8	30.0	2032.	103.75	-2.25	0.0	0.0	0.0	0.0	5212.7
9	20.0	1355.	103.00	-3.00	0.0	0.0	0.0	0.0	2455.7
10	10.0	677.	101.55	-4.04	0.0	0.0	0.0	0.0	1724.0

 DAM INSPECTION HYDROLOGIC ANALYSIS - LAKE ELEVATIONS, STORAGES AND DISCHARGE RATING TABLES

JUEL DAM

LAKE ELEVATION FT, MSL	LAKE STORAGE AC-FT	STORAGE PLUS HOLF DISCHARGE AC-FT	OUTLET DISCHARGE C. F. S.	SPILLWAY DISCHARGE C. F. S.	OVER TOP OF DAM C. F. S.	TOTAL DISCHARGE C. F. S.
108.000	107.669	662.040	0.0	20876.000	2460.720	23335.727
107.000	157.493	526.211	0.0	16225.599	879.000	17075.595
106.000	155.000	405.541	0.0	12126.070	0.000	12126.000
105.000	144.333	222.153	0.0	3555.000	0.0	3555.000
104.000	134.312	253.776	0.0	5782.000	0.0	5782.000
103.000	124.095	156.404	0.0	3461.000	0.0	3461.000
102.000	116.058	152.712	0.0	1774.000	0.0	1774.000
101.000	107.770	121.221	0.0	651.000	0.0	651.000
100.000	100.000	100.000	0.0	0.000	0.0	0.000
99.000	97.711	87.711	0.0	0.0	0.0	0.0
98.000	76.839	76.839	0.0	0.0	0.0	0.0
97.000	67.208	67.208	0.0	0.0	0.0	0.0
96.000	58.709	58.709	0.0	0.0	0.0	0.0
95.000	51.212	51.212	0.0	0.0	0.0	0.0
94.000	44.608	44.608	0.0	0.0	0.0	0.0
93.000	38.799	38.799	0.0	0.0	0.0	0.0
92.000	33.594	33.594	0.0	0.0	0.0	0.0
91.000	28.217	28.217	0.0	0.0	0.0	0.0
90.000	25.295	25.295	0.0	0.0	0.0	0.0
89.000	21.854	21.854	0.0	0.0	0.0	0.0
88.000	18.867	18.867	0.0	0.0	0.0	0.0
87.000	16.254	16.254	0.0	0.0	0.0	0.0
86.000	13.978	13.978	0.0	0.0	0.0	0.0
85.000	12.000	12.000	0.0	0.0	0.0	0.0
84.000	6.130	6.130	0.0	0.0	0.0	0.0
83.000	3.115	3.115	0.0	0.0	0.0	0.0
82.000	1.568	1.568	0.0	0.0	0.0	0.0
81.000	0.782	0.782	0.0	0.0	0.0	0.0
80.000	0.387	0.387	0.0	0.0	0.0	0.0
79.000	0.190	0.190	0.0	0.0	0.0	0.0
78.000	0.092	0.092	0.0	0.0	0.0	0.0
77.000	0.044	0.044	0.0	0.0	0.0	0.0
76.000	0.021	0.021	0.0	0.0	0.0	0.0
75.000	0.0	0.0	0.0	0.0	0.0	0.0

DOM INSPECTION HYDROLOGIC ANALYSIS - COMPUTED PROBABLE MAXIMUM FLOOD HYDROGRAPH (LOVE INFLON HYDROGRAPH)

JUEL DAM
DAM
SAFETY
ANALYSIS
UNIT GRAPH

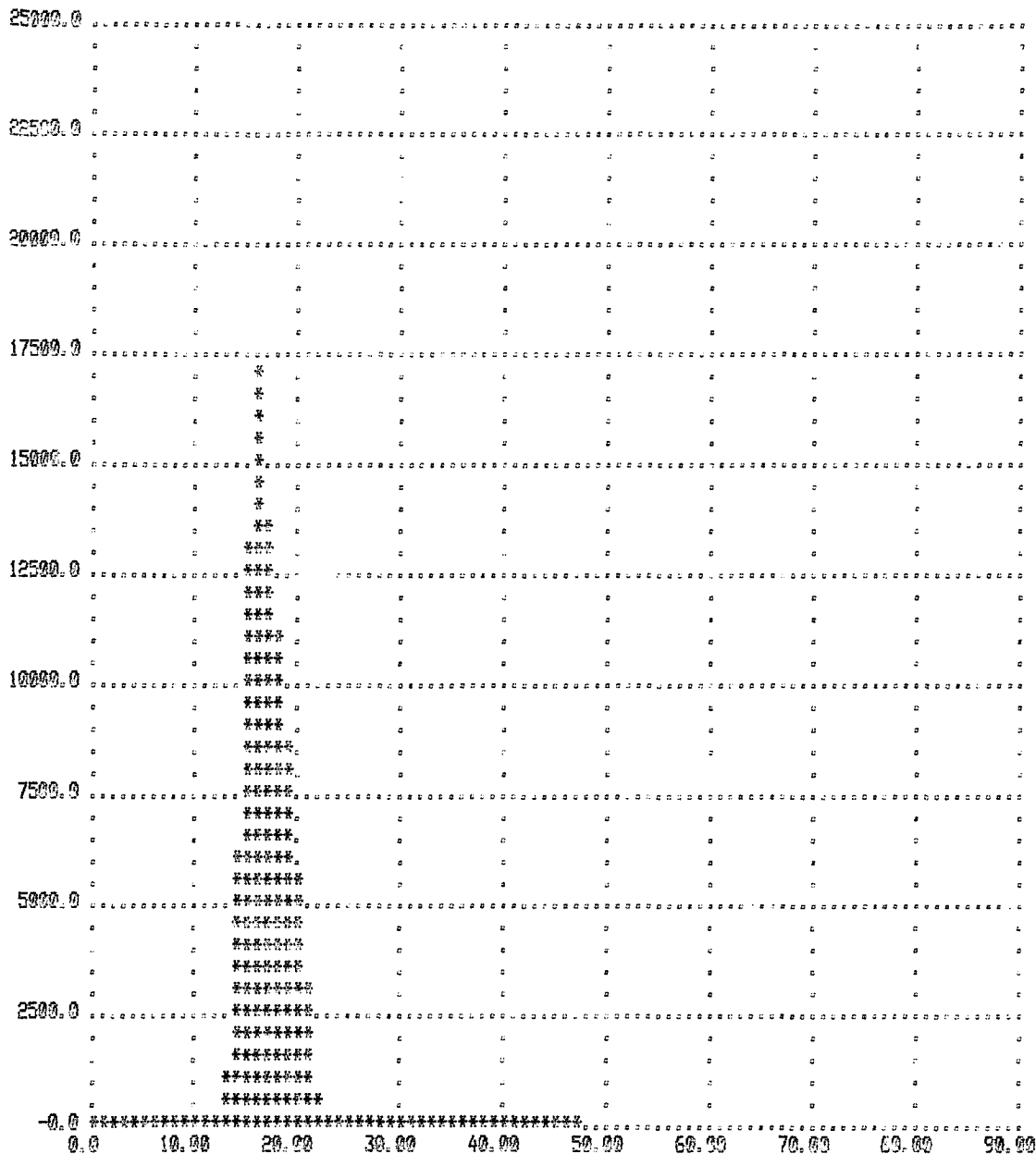
LAKE INFLOW HYDROGRAPH ORDINATES IN CFS AT 0.500 HOUR INTERVALS BEGINNING AT ZERO TIME

2000-2001 FISCAL YEAR					2001-2002 FISCAL YEAR					2002-2003 FISCAL YEAR				
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0.0	10.6	31.7	63.4	117.0	191.4	252.1	293.2	323.3	359.5	336.9	410.4			
430.0	524.5	735.7	1109.5	1877.5	4302.2	6991.3	9352.7	13563.3	17521.8	16457.7	14051.9			
12743.1	11654.4	10553.7	9352.6	7951.5	5374.3	4943.1	3696.4	2531.1	1482.5	980.2	634.8			
492.3	228.9	112.0	35.5	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			

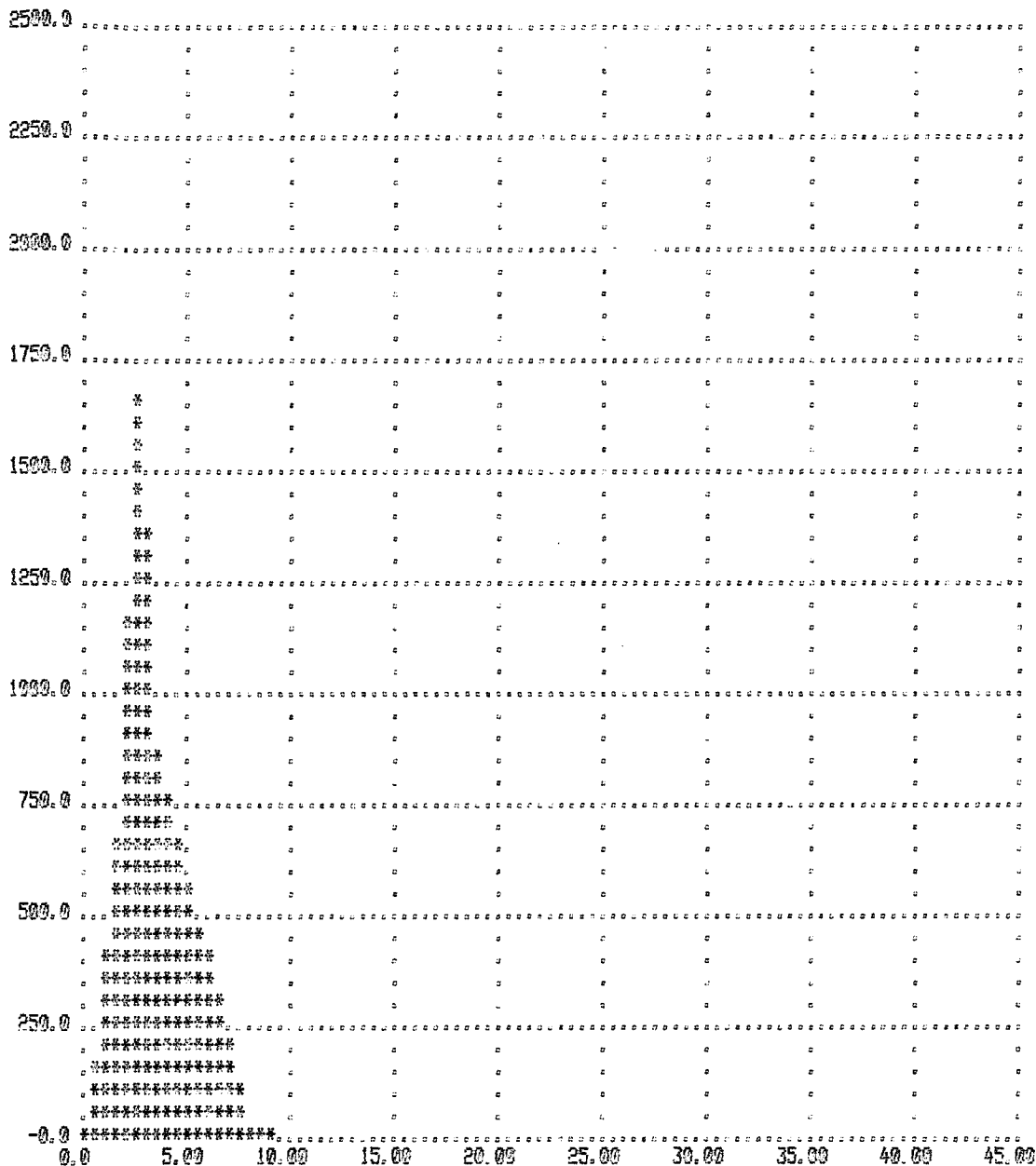
.....

SNYDERS 0.500 HOUR UNIT HYDROGRAPH ORDINATES IN CFS AT 0.500 HOUR INTERVALS BEGINNING AT ZERO TIME											
0.0	244.0	487.9	731.9	1236.0	1736.4	1400.5	949.2	810.6	721.0	631.5	541.9
452.3	362.8	273.2	183.6	94.1	4.5	0.0					

[illegible]



DAM INSPECTION HYDROLOGIC ANALYSIS - COMPUTED PROBABLE MAXIMUM FLOOD HYDROGRAPH (LAKE INFLOW HYDROGRAPH)
JUEL DAM



DAM INSPECTION HYDROLOGIC ANALYSIS - COMPUTED SNYDERS 0.500 HOUR UNIT HYDROGRAPH
JUL 83

***** LISTING OF CARD INPUT DATA ***** PAGE 1

JUEL DAM

DAM

SAFETY

ANALYSIS

UNIT GRAPH

0.5 0.4 100. 30. 10. 10.

UNIT HYDROGRAPH DATA

5.8 3.2 0.8 8.4 1.0 47. 20.5

PMP STORM PMP HYDROGRAPH

100. 120. 132. 22. 0.5

ELEVATION CAPACITY CURVE

4. 5. 75. 0. 05. 12. 100. 100. 105. 155. 110. 210.

TYPE 2 SPILLWAY RATINGS

2. 8. 100. 40. 170. 0. 101. 651. 102. 1774. 103. 3461. 104. 5702.

105. 8655. 106. 12126. 108. 20876.

TYPE 3 TOP OF DAM RATINGS

3. 106. 300. 3. 2.9

TYPE 3 OUTLET RATINGS NO OUTLET

0.

FINISHED

RUN

508 PMF 10/26/81
0.050 Mannings ^

SIMPLIFIED DAMBREAK MODEL
BASIC LANGUAGE INTERACTIVE VERSION
WRITTEN BY JONATHAN N. WETMORE HRL MAY, 1983

INPUT 'SHORT' FOR SHORTENED VERSION, 'LONG' FOR FULL MODEL
? long

INPUT NAME OF DAM
? Paul Juel

INPUT RIVER NAME
? unnamed trib.

INPUT DAM CREST ELEVATION (FT. MSL)
? 1308.5

INPUT FINAL BREACH BOTTOM ELEVATION (FT. MSL)
? 1287.5

INPUT VOLUME OF RESERVOIR (AC-FT) AT MAX POOL ELEV
IF N/A ENTER 0. AND VOL WILL BE EST. FROM SURF. AREA
? 58.9 28.7

INPUT RESERVOIR SURFACE AREA (ACRES) AT MAX POOL ELEV
IF N/A ENTER 0. AND S.A. WILL BE EST. FROM VOLUME.
? 11.2 30

INPUT FINAL BREACH WIDTH (FT)
IF N/A ENTER 0. DEFAULT USED = 3 * BREACH DEPTH
? 63

INPUT TIME (MINUTES) REQUIRED FOR BREACH FORMATION
IF N/A, ENTER 0.
? 7

INPUT TURBINE/SPILLWAY/OVERTOPPING FLOW (CFS).
IF N/A, ENTER 0.0. DEFAULT = 0.0
? 8700

INPUT NUMBER OF X-SECTIONS (STARTING AT DAM) USED TO
DESCRIBE ROUTING REACH. (MIN=1, MAX=8)
? 5

INPUT NUMBER OF PAIRS OF ELEV-TOPWIDTHS USED TO
DESCRIBE EACH X-SECTION (MIN=2, MAX=8)
? 4

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 1
(ELEVATION OF BASE OF DAM (FT. MSL))
? 1286

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 1
? 1290, 50

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 1
? 1300, 267

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 1
? 1310, 535

INPUT MANNING N AT X-S # 1 (DEFAULT = 0.050)

? .05

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 1
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 1
IF N/A ENTER 0.
?

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 2
? .62

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 2
? 1269

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 2
? 1273,67

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 2
? 1280,284

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 2
? 1290,384

INPUT MANNING N AT X-S # 2 (DEFAULT = 0.050)
? .05

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 2
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 2
IF N/A ENTER 0.
? 28

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 3
? .85

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 3
? 1264

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 3
? 1267,67

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 3
? 1270,301

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 3
? 1280,802

INPUT MANNING N AT X-S # 3 (DEFAULT = 0.050)
? .05

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 3
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 3
IF N/A ENTER 0.
? 16

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 4

? 1.37

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 4
? 1253

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 4
? 1257,67

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 4
? 1260,201

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 4
? 1270,401

INPUT MANNING N AT X-S # 4 (DEFAULT = 0.050)
? .05

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 4
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 4
IF N/A ENTER 0.
?

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 5
? 1.79

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 5
? 1244

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 5
? 1248,67

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 5
? 1250,201

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 5
? 1260,368

INPUT MANNING N AT X-S # 5 (DEFAULT = 0.050)
? .05

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 5
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 5
IF N/A ENTER 0.
? 14

PROFILE OF CRESTS AND TIMES FOR Paul Jue 1 DAM
ON unnamed trib. RIVER

| DISTANCE
DOWNSTREAM
(MILES) | PEAK
FLOW
CFS | PEAK
DEPTH
FEET | FLOOD
STAGE
FEET | TIME
FLOOD
HR | TIME
PEAK
HR | TIME
DEFLOOD
HR |
|-----------------------------------|---------------------|-----------------------|------------------------|---------------------|--------------------|-----------------------|
| 0 | 14451.13 | 15.44 | 0 | -999 | .12 | -999 |
| .62 | 8769.356 | 11.59 | 28 | -999 | .24 | -999 |
| .85 | 7459.306 | 9.350001 | 16 | -999 | .3 | -999 |
| 1.37 | 5530.583 | 9.97 | 0 | -999 | .45 | -999 |
| 1.79 | 4795.374 | 9.140001 | 14 | -999 | .56 | -999 |

RUN

50% of PMT

0.035 manning's n

10/26/87
JLB

SIMPLIFIED DAMBREAK MODEL
BASIC LANGUAGE INTERACTIVE VERSION
WRITTEN BY JONATHAN N. WETMORE HRL MAY, 1983

INPUT 'SHORT' FOR SHORTENED VERSION, 'LONG' FOR FULL MODEL
? long

INPUT NAME OF DAM
? Paul Juel

INPUT RIVER NAME
? unnamed trib.

INPUT DAM CREST ELEVATION (FT. MSL)
? 1308.5

INPUT FINAL BREACH BOTTOM ELEVATION (FT. MSL)
? 1287.5

INPUT VOLUME OF RESERVOIR (AC-FT) AT MAX POOL ELEV
IF N/A ENTER 0. AND VOL WILL BE EST. FROM SURF. AREA
? 58.9

INPUT RESERVOIR SURFACE AREA (ACRES) AT MAX POOL ELEV
IF N/A ENTER 0. AND S.A. WILL BE EST. FROM VOLUME.
? 11.2

INPUT FINAL BREACH WIDTH (FT)
IF N/A ENTER 0. DEFAULT USED = 3 * BREACH DEPTH
? 63

INPUT TIME (MINUTES) REQUIRED FOR BREACH FORMATION
IF N/A, ENTER 0.
? 7

INPUT TURBINE/SPILLWAY/OVERTOPPING FLOW (CFS).
IF N/A, ENTER 0.0. DEFAULT = 0.0
? 8700

INPUT NUMBER OF X-SECTIONS (STARTING AT DAM) USED TO
DESCRIBE ROUTING REACH. (MIN=1, MAX=8)
? 5

INPUT NUMBER OF PAIRS OF ELEV-TOPWIDTHS USED TO
DESCRIBE EACH X-SECTION (MIN=2, MAX=8)
? 4

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 1
(ELEVATION OF BASE OF DAM (FT. MSL))
? 1286

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 1
? 1290, 50

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 1
? 1300, 267

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 1
? 1310, 535

INPUT MANNING N AT X-S # 1 (DEFAULT = 0.050)

? .035

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 1
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 1
IF N/A ENTER 0.
?

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 2
? .62

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 2
? 1269

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 2
? 1273, 67

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 2
? 1280, 284

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 2
? 1290, 384

INPUT MANNING N AT X-S # 2 (DEFAULT = 0.050)
? .035

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 2
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 2
IF N/A ENTER 0.
? 28

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 3
? .85

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 3
? 1264

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 3
? 1267, 67

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 3
? 1270, 301

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 3
? 1280, 8052

INPUT MANNING N AT X-S # 3 (DEFAULT = 0.050)
? .035

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 3
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 3
IF N/A ENTER 0.
? 16

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 4

? 1.37

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 4
? 1253

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 4
? 1257,67

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 4
? 1260,201

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 4
? 1270,401

INPUT MANNING N AT X-S # 4 (DEFAULT = 0.050)
? .035

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 4
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 4
IF N/A ENTER 0.
?

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 5
? 1.79

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 5
? 1244

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 5
? 1248,67

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 5
? 1250,201

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 5
? 1260,368

INPUT MANNING N AT X-S # 5 (DEFAULT = 0.050)
? .035

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 5
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 5
IF N/A ENTER 0.
? 14

PROFILE OF CRESTS AND TIMES FOR Paul Juel DAM
ON unnamed trib. RIVER

| DISTANCE
DOWNSTREAM
(MILES) | PEAK
FLOW
CFS | PEAK
DEPTH
FEET | FLOOD
STAGE
FEET | TIME
FLOOD
HR | TIME
PEAK
HR | TIME
DEFLOOD
HR |
|-----------------------------------|---------------------|-----------------------|------------------------|---------------------|--------------------|-----------------------|
| 0 | 18158.91 | 14.74 | 0 | -999 | .12 | -999 |
| .62 | 11810.76 | 11.34 | 28 | -999 | .2 | -999 |
| .85 | 10455.81 | 9.29 | 16 | -999 | .24 | -999 |
| 1.37 | 8169.91 | 10.09 | 0 | -999 | .35 | -999 |
| 1.79 | 7234.426 | 9.32 | 14 | -999 | .42 | -999 |

RUN

SIMPLIFIED DAMBREAK MODEL
BASIC LANGUAGE INTERACTIVE VERSION
WRITTEN BY JONATHAN N. WETMORE HRL MAY, 1983

10/24/87

100 year Flood

0.035 Mannings n

INPUT 'SHORT' FOR SHORTENED VERSION, 'LONG' FOR FULL MODEL
? long

INPUT NAME OF DAM
? Paul Juel

INPUT RIVER NAME
? unnamed trib.

INPUT DAM CREST ELEVATION (FT. MSL)
? 1308.5

INPUT FINAL BREACH BOTTOM ELEVATION (FT. MSL)
? 1287.5

INPUT VOLUME OF RESERVOIR (AC-FT) AT MAX POOL ELEV
IF N/A ENTER 0. AND VOL WILL BE EST. FROM SURF. AREA
? 58.9

INPUT RESERVOIR SURFACE AREA (ACRES) AT MAX POOL ELEV
IF N/A ENTER 0. AND S.A. WILL BE EST. FROM VOLUME.
? 11.2

INPUT FINAL BREACH WIDTH (FT)
IF N/A ENTER 0. DEFAULT USED = 3 * BREACH DEPTH
? 63

INPUT TIME (MINUTES) REQUIRED FOR BREACH FORMATION
IF N/A , ENTER 0.
? 7

INPUT TURBINE/SPILLWAY/OVERTOPPING FLOW (CFS).
IF N/A, ENTER 0.0. DEFAULT = 0.0
? 940

INPUT NUMBER OF X-SECTIONS (STARTING AT DAM) USED TO
DESCRIBE ROUTING REACH. (MIN=1, MAX=8)
? 5

INPUT NUMBER OF PAIRS OF ELEV-TOPWIDTHS USED TO
DESCRIBE EACH X-SECTION (MIN=2, MAX=8)
? 4

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 1
(ELEVATION OF BASE OF DAM (FT. MSL))
? 1286

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 1
? 1290, 1350

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 1
? 1300, 267

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 1
? 1310, 535

INPUT MANNING N AT X-S # 1 (DEFAULT = 0.050)

? .035

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 1
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 1
IF N/A ENTER 0.
?

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 2
? .62

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 2
? 1269

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 2
? 1273,67

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 2
? 1280,284

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 2
? 1290,384

INPUT MANNING N AT X-S # 2 (DEFAULT = 0.050)
? .035

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 2
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 2
IF N/A ENTER 0.
? 28

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 3
? .85

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 3
? 126544

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 3
? 1267,67

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 3
? 1270,301

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 3
? 1280,802

INPUT MANNING N AT X-S # 3 (DEFAULT = 0.050)
? .035

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 3
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 3
IF N/A ENTER 0.
? 16

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 4

? 1.37

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 4
? 12353

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 4
? 1257,67

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 4
? 1260,201

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 4
? 1270,401

INPUT MANNING N AT X-S # 4 (DEFAULT = 0.050)
? .035

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 4
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 4
IF N/A ENTER 0.
?

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 5
? 1.79

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 5
? 1244

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 5
? 1248,67

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 5
? 1250,201

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 5
? 1260,368

INPUT MANNING N AT X-S # 5 (DEFAULT = 0.050)
? .035

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 5
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 5
IF N/A ENTER 0.
? 14

PROFILE OF CRESTS AND TIMES FOR Paul Juel DAM
ON unnamed trib. RIVER

| DISTANCE
DOWNSTREAM
(MILES) | PEAK
FLOW
CFS | PEAK
DEPTH
FEET | FLOOD
STAGE
FEET | TIME
FLOOD
HR | TIME
PEAK
HR | TIME
DEFLOOD
HR |
|-----------------------------------|---------------------|-----------------------|------------------------|---------------------|--------------------|-----------------------|
| 0 | 13994.15 | 13.35 | 0 | -999 | .12 | -999 |
| .62 | 9497.512 | 10.48 | 28 | -999 | .21 | -999 |
| .85 | 8573.399 | 8.72 | 16 | -999 | .25 | -999 |
| 1.37 | 6817.591 | 9.47 | 0 | -999 | .36 | -999 |
| 1.79 | 6054.426 | 8.75 | 14 | -999 | .44 | -999 |

RUN

10/26/87
100 year flood
0.050 Manning n

SIMPLIFIED DAMBREAK MODEL
BASIC LANGUAGE INTERACTIVE VERSION
WRITTEN BY JONATHAN N. WETMORE HRL MAY, 1983

INPUT 'SHORT' FOR SHORTENED VERSION, 'LONG' FOR FULL MODEL
? long

INPUT NAME OF DAM
? Paul Juel

INPUT RIVER NAME
? unnamed trib.

INPUT DAM CREST ELEVATION (FT. MSL)
? 1308.5

INPUT FINAL BREACH BOTTOM ELEVATION (FT. MSL)
? 1287.5

INPUT VOLUME OF RESERVOIR (AC-FT) AT MAX POOL ELEV
IF N/A ENTER 0. AND VOL WILL BE EST. FROM SURF. AREA
? 58.9

INPUT RESERVOIR SURFACE AREA (ACRES) AT MAX POOL ELEV
IF N/A ENTER 0. AND S.A. WILL BE EST. FROM VOLUME.
? 11.2

INPUT FINAL BREACH WIDTH (FT)
IF N/A ENTER 0. DEFAULT USED = 3 * BREACH DEPTH
? 63

INPUT TIME (MINUTES) REQUIRED FOR BREACH FORMATION
IF N/A, ENTER 0.
? 7

INPUT TURBINE/SPILLWAY/OVERTOPPING FLOW (CFS).
IF N/A, ENTER 0.0. DEFAULT = 0.0
? 940

INPUT NUMBER OF X-SECTIONS (STARTING AT DAM) USED TO
DESCRIBE ROUTING REACH. (MIN=1, MAX=8)
? 5

INPUT NUMBER OF PAIRS OF ELEV-TOPWIDTHS USED TO
DESCRIBE EACH X-SECTION (MIN=2, MAX=8)
? 4

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 1
(ELEVATION OF BASE OF DAM (FT. MSL))
? 1286

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 1
? 1290, 50

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 1
? 1300, 267

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 1
? 1310, 535

INPUT MANNING N AT X-S # 1 (DEFAULT = 0.050)

? .05

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 1

IF N/A INPUT 0.

?

INPUT FLOOD DEPTH AT X-S # 1

IF N/A ENTER 0.

?

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 2

? .62

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 2

? 1269

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 2

? 1273, 67

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 2

? 1280, 284

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 2

? 1290, 384

INPUT MANNING N AT X-S # 2 (DEFAULT = 0.050)

? .05

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 2

IF N/A INPUT 0.

?

INPUT FLOOD DEPTH AT X-S # 2

IF N/A ENTER 0.

? 28

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 3

? .85

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 3

? 1264

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 3

? 1267, 67

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 3

? 1270, 301

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 3

? 1280, 802

INPUT MANNING N AT X-S # 3 (DEFAULT = 0.050)

? .05

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 3

IF N/A INPUT 0.

?

INPUT FLOOD DEPTH AT X-S # 3

IF N/A ENTER 0.

? 16

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 4

? 1.37

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 4
? 1253

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 4
? 1257,67

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 4
? 1260,201

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 4
? 1270,401

INPUT MANNING N AT X-S # 4 (DEFAULT = 0.050)
? .05

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 4
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 4
IF N/A ENTER 0.
?

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 5
? 1.79

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 5
? 1244

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 5
? 1248,67

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 5
? 1250,201

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 5
? 1260,368

INPUT MANNING N AT X-S # 5 (DEFAULT = 0.050)
? .05

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 5
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 5
IF N/A ENTER 0.
? 14

PROFILE OF CRESTS AND TIMES FOR Paul Juel DAM
ON unnamed trib. RIVER

| DISTANCE
DOWNSTREAM
(MILES) | PEAK
FLOW
CFS | PEAK
DEPTH
FEET | FLOOD
STAGE
FEET | TIME
FLOOD
HR | TIME
PEAK
HR | TIME
DEFLOOD
HR |
|-----------------------------------|---------------------|-----------------------|------------------------|---------------------|--------------------|-----------------------|
| 0 | 13340.59 | 15.04 | 0 | -999 | .12 | -999 |
| .62 | 8088.956 | 11.25 | 28 | -999 | .24 | -999 |
| .85 | 6971.669 | 9.149999 | 16 | -999 | .3 | -999 |
| 1.37 | 5207.648 | 9.770001 | 0 | -999 | .45 | -999 |
| 1.79 | 4519.026 | 8.95 | 14 | -999 | .56 | -999 |

1/29/88
DLB

RUN

SIMPLIFIED DAMBREAK MODEL
BASIC LANGUAGE INTERACTIVE VERSION
WRITTEN BY JONATHAN N. WETMORE HRL MAY, 1983

INPUT 'SHORT' FOR SHORTENED VERSION, 'LONG' FOR FULL MODEL
? long

INPUT NAME OF DAM
? paul juel

INPUT RIVER NAME
? unnamed trib.

INPUT DAM CREST ELEVATION (FT. MSL)
? 1310

INPUT FINAL BREACH BOTTOM ELEVATION (FT. MSL)
? 1285

INPUT VOLUME OF RESERVOIR (AC-FT) AT MAX POOL ELEV
IF N/A ENTER 0. AND VOL WILL BE EST. FROM SURF. AREA
? 255.7

INPUT RESERVOIR SURFACE AREA (ACRES) AT MAX POOL ELEV
IF N/A ENTER 0. AND S.A. WILL BE EST. FROM VOLUME.
? 30

INPUT FINAL BREACH WIDTH (FT)
IF N/A ENTER 0. DEFAULT USED = 3 * BREACH DEPTH
?

INPUT TIME (MINUTES) REQUIRED FOR BREACH FORMATION
IF N/A , ENTER 0.
? 8

INPUT TURBINE/SPILLWAY/OVERTOPPING FLOW (CFS).
IF N/A, ENTER 0.0. DEFAULT = 0.0
? 742

INPUT NUMBER OF X-SECTIONS (STARTING AT DAM) USED TO
DESCRIBE ROUTING REACH. (MIN=1, MAX=8)
? 5

INPUT NUMBER OF PAIRS OF ELEV-TOPWIDTHS USED TO
DESCRIBE EACH X-SECTION (MIN=2, MAX=8)
? 4

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 1
(ELEVATION OF BASE OF DAM (FT. MSL))
? 1286

INPUT ELEV.(FT. MSL)# 2 AND ASSOC. TOPWIDTH FOR X-S # 1
? 1290,50

INPUT ELEV.(FT. MSL)# 3 AND ASSOC. TOPWIDTH FOR X-S # 1
? 1300,267

INPUT ELEV.(FT. MSL)# 4 AND ASSOC. TOPWIDTH FOR X-S # 1
? 1310,535

INPUT MANNING N AT X-S # 1 (DEFAULT = 0.050)
? .04

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 1
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 1
IF N/A ENTER 0.
?

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 2
? .62

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 2
? 1269

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 2
? 1273,67

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 2
? 1280,m284

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 2
? 1290,384

INPUT MANNING N AT X-S # 2 (DEFAULT = 0.050)
? .04

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 2
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 2
IF N/A ENTER 0.
? 28

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 3
? .85

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 3
? 1264

INPUT ELEV. (FT. MSL) # 2 AND ASSOC. TOPWIDTH FOR X-S # 3
? 1267,67

INPUT ELEV. (FT. MSL) # 3 AND ASSOC. TOPWIDTH FOR X-S # 3
? 1270,301

INPUT ELEV. (FT. MSL) # 4 AND ASSOC. TOPWIDTH FOR X-S # 3
? 1280,802

INPUT MANNING N AT X-S # 3 (DEFAULT = 0.050)
? .04

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 3
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 3
IF N/A ENTER 0.
? 16

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 4
? 1.37

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 4
? 1253

INPUT ELEV.(FT. MSL)# 2 AND ASSOC. TOPWIDTH FOR X-S # 4
? 1257,67

INPUT ELEV.(FT. MSL)# 3 AND ASSOC. TOPWIDTH FOR X-S # 4
? 1260,201

INPUT ELEV.(FT. MSL)# 4 AND ASSOC. TOPWIDTH FOR X-S # 4
? 1270,401

INPUT MANNING N AT X-S # 4 (DEFAULT = 0.050)
? .04

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 4
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 4
IF N/A ENTER 0.
?

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 5
? 1.79

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 5
? 1244

INPUT ELEV.(FT. MSL)# 2 AND ASSOC. TOPWIDTH FOR X-S # 5
? 1248,67

INPUT ELEV.(FT. MSL)# 3 AND ASSOC. TOPWIDTH FOR X-S # 5
? 1250,201

INPUT ELEV.(FT. MSL)# 4 AND ASSOC. TOPWIDTH FOR X-S # 5
? 1260,368

INPUT MANNING N AT X-S # 5 (DEFAULT = 0.050)
? .04

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 5
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 5
IF N/A ENTER 0.
? 14

PROFILE OF CRESTS AND TIMES FOR paul juel DAM
ON unnamed trib. RIVER

| DISTANCE
DOWNSTREAM
(MILES) | PEAK
FLOW
CFS | PEAK
DEPTH
FEET | FLOOD
STAGE
FEET | TIME
FLOOD
HR | TIME
PEAK
HR | TIME
DEFLOOD
HR |
|-----------------------------------|---------------------|-----------------------|------------------------|---------------------|--------------------|-----------------------|
| 0 | 23305.23 | 16.8 | 0 | -999 | .13 | -999 |
| .62 | 17969.73 | 13.86 | 28 | -999 | .22 | -999 |
| .85 | 17681.87 | 11.48 | 16 | -999 | .26 | -999 |
| 1.37 | 15460.19 | 13.21 | 0 | -999 | .36 | -999 |
| 1.79 | 14376.01 | 12.52 | 14 | -999 | .43 | -999 |

Break in 4570

RUN

1/29/88
D.L.B.

SIMPLIFIED DAMBREAK MODEL
BASIC LANGUAGE INTERACTIVE VERSION
WRITTEN BY JONATHAN N. WETMORE HRL MAY, 1983

INPUT 'SHORT' FOR SHORTENED VERSION, 'LONG' FOR FULL MODEL
? long

INPUT NAME OF DAM
? paul juel

INPUT RIVER NAME
? unnamed tirib.

INPUT DAM CREST ELEVATION (FT. MSL)
? 1310

INPUT FINAL BREACH BOTTOM ELEVATION (FT. MSL)
? 1285

INPUT VOLUME OF RESERVOIR (AC-FT) AT MAX POOL ELEV
IF N/A ENTER 0. AND VOL WILL BE EST. FROM SURF. AREA
? 255.7

INPUT RESERVOIR SURFACE AREA (ACRES) AT MAX POOL ELEV
IF N/A ENTER 0. AND S.A. WILL BE EST. FROM VOLUME.
? 30

INPUT FINAL BREACH WIDTH (FT)
IF N/A ENTER 0. DEFAULT USED = 3 * BREACH DEPTH
?

INPUT TIME (MINUTES) REQUIRED FOR BREACH FORMATION
IF N/A , ENTER 0.
? 8

INPUT TURBINE/SPILLWAY/OVERTOPPING FLOW (CFS).
IF N/A, ENTER 0.0. DEFAULT = 0.0
? 470 $\leq$ 25 year flood flow

INPUT NUMBER OF X-SECTIONS (STARTING AT DAM) USED TO
DESCRIBE ROUTING REACH. (MIN=1, MAX=8)
? 5

INPUT NUMBER OF PAIRS OF ELEV-TOPWIDTHS USED TO
DESCRIBE EACH X-SECTION (MIN=2, MAX=8)
? 4

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 1
(ELEVATION OF BASE OF DAM (FT. MSL))
? 1286

INPUT ELEV.(FT. MSL)# 2 AND ASSOC. TOPWIDTH FOR X-S # 1
? 1290,50

INPUT ELEV.(FT. MSL)# 3 AND ASSOC. TOPWIDTH FOR X-S # 1
? 1300,267

INPUT ELEV.(FT. MSL)# 4 AND ASSOC. TOPWIDTH FOR X-S # 1
? 1310,535

INPUT MANNING N AT X-S # 1 (DEFAULT = 0.050)
? .04

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 1
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 1
IF N/A ENTER 0.
?

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 2
? .62

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 2
? 1269

INPUT ELEV.(FT. MSL)# 2 AND ASSOC. TOPWIDTH FOR X-S # 2
? 1273,67

INPUT ELEV.(FT. MSL)# 3 AND ASSOC. TOPWIDTH FOR X-S # 2
? 1280,284

INPUT ELEV.(FT. MSL)# 4 AND ASSOC. TOPWIDTH FOR X-S # 2
? 1290,384

INPUT MANNING N AT X-S # 2 (DEFAULT = 0.050)
? .04

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 2
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 2
IF N/A ENTER 0.
? 28

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 3
? .85

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 3
? 1264

INPUT ELEV.(FT. MSL)# 2 AND ASSOC. TOPWIDTH FOR X-S # 3
? 1267,67

INPUT ELEV.(FT. MSL)# 3 AND ASSOC. TOPWIDTH FOR X-S # 3
? 1270,301

INPUT ELEV.(FT. MSL)# 4 AND ASSOC. TOPWIDTH FOR X-S # 3
? 1280,802

INPUT MANNING N AT X-S # 3 (DEFAULT = 0.050)
? .04

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 3
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 3
IF N/A ENTER 0.
? 16

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 4
? 1.37

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 4
? 1253

INPUT ELEV.(FT. MSL)# 2 AND ASSOC. TOPWIDTH FOR X-S # 4
? 1257,67

INPUT ELEV.(FT. MSL)# 3 AND ASSOC. TOPWIDTH FOR X-S # 4
? 1260,201

INPUT ELEV.(FT. MSL)# 4 AND ASSOC. TOPWIDTH FOR X-S # 4
? 1270,401

INPUT MANNING N AT X-S # 4 (DEFAULT = 0.050)
? .04

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 4
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 4
IF N/A ENTER 0.
?

INPUT DISTANCE DOWNSTREAM FROM DAM (MILES) TO X-SECTION # 5
? 1.79

INPUT LOWEST CHANNEL ELEV. (FT. MSL) AT X-SECTION # 5
? 1244

INPUT ELEV.(FT. MSL)# 2 AND ASSOC. TOPWIDTH FOR X-S # 5
? 1248,67

INPUT ELEV.(FT. MSL)# 3 AND ASSOC. TOPWIDTH FOR X-S # 5
? 1250,201

INPUT ELEV.(FT. MSL)# 4 AND ASSOC. TOPWIDTH FOR X-S # 5
? 1260,368

INPUT MANNING N AT X-S # 5 (DEFAULT = 0.050)
? .04

INPUT VALLEY WALL HEIGHT ABOVE CHANNEL BOTTOM AT X-S # 5
IF N/A INPUT 0.
?

INPUT FLOOD DEPTH AT X-S # 5
IF N/A ENTER 0.
? 14

PROFILE OF CRESTS AND TIMES FOR paul juel DAM
ON unnamed trib. RIVER

| DISTANCE
DOWNSTREAM
(MILES) | PEAK
FLOW
CFS | PEAK
DEPTH
FEET | FLOOD
STAGE
FEET | TIME
FLOOD
HR | TIME
PEAK
HR | TIME
DEFLOOD
HR |
|-----------------------------------|---------------------|-----------------------|------------------------|---------------------|--------------------|-----------------------|
| 0 | 23106.83 | 16.74 | 0 | -999 | .13 | -999 |
| .62 | 17815.3 | 13.82 | 28 | -999 | .22 | -999 |
| .85 | 17529.9 | 11.45 | 16 | -999 | .26 | -999 |
| 1.37 | 15348.11 | 13.18 | 0 | -999 | .36 | -999 |
| 1.79 | 14273.08 | 12.49 | 14 | -999 | .43 | -999 |

Break in 4570

List of things don't have

Breach Analysis - Contacted Brunner on Oct. 27, 1987 - \$8,500

Discharge Rating Curve - Drop Inlet & Emergency spillway

Signed set of Plans - SCS design used in building dam,

- Consulting firm present during construction
- Schmitz, Kalda Associates out of Sioux Falls

- Contractor was Conky Claussen out of Clark

List of things do have

Easement between Tuel & Dayton township - road

- Don't have one for Curtis Tangen, Jackson Michigan

- supposedly doesn't care

- Karl Longren in Sioux Falls lives - farms adjacent land

6 Bore hole information

- Centerline of Dam

Stage storage computations

- 1285 bottom of Dam, 1310 Top of Dam

F.S. for River

Hydrologic Data - 2, 5, 10, 25, 50, 100, 200, 500, 1000 years

Topomap

Designed for 20 years



DEWILD GRANT RECKERT & ASSOCIATES CO.
CONSULTING ENGINEERS

1113 East 14th Street
Sioux Falls, SD 57104
(605) 339-4157

Letter of Transmittal

Oct. 19 1988

Project: Paul Guel Dam
Canton, SD

File No. 3870

To: John Hatch
Water Rights Div. - SDOUWR
Pierre, SD



Gentlemen: We are sending the following:

ACTION
TAKEN

| | | | |
|------------------------------------|-------------|-------------------------------|--------------------------|
| <u>1</u> Copies of Sheet No. _____ | From: _____ | Re: <u>Field Survey &</u> | ☐ |
| _____ Copies of Sheet No. _____ | From: _____ | Re: <u>Rating Curves</u> | ☐ |
| _____ Copies of Sheet No. _____ | From: _____ | Re: _____ | ☐ |
| _____ Copies of Sheet No. _____ | From: _____ | Re: _____ | ☐ |
| _____ Copies of Sheet No. _____ | From: _____ | Re: _____ | ☐ |
| _____ Copies of Sheet No. _____ | From: _____ | Re: _____ | ☐ |
| _____ Copies of Sheet No. _____ | From: _____ | Re: _____ | ☐ |
| _____ Copies of Sheet No. _____ | From: _____ | Re: _____ | ☐ |

| | | | |
|--------------|--|---|--|
| ACTION TAKEN | ☐ 1 NO EXCEPTIONS | ☐ 2 MAKE CORRECTIONS NOTED | ☐ 3 REVISE AND RESUBMIT |
| | ☐ 4 REJECTED | ☐ 5 SUBMIT SPECIFIED ITEM | ☐ 6 _____ |

REMARKS: I have affixed my seal to these
documents, in accordance with your request.

Please send us _____ prints of the above drawings for our ☐ files, ☐ correction.

DEWILD GRANT RECKERT & ASSOCIATES CO.

By Donald C. Neugebauer

TABLE VI QUANTITIES

[illegible]

LOCATION

The diagram illustrates a cross-section of a dam with the following features:

- Principal spillway:** Located on the left, with a crest elevation of El. 1308.5 and a downstream slope of 3:1.
- Emergency spillway:** Located on the right, with a crest elevation of El. 1305.9 and a downstream slope of 2.5:1.
- Allowance for settlement:** Indicated by a dashed line and an arrow pointing to the emergency spillway crest.
- Strip sod and brush from dam foundation to minimum depth 6':** A layer shown along the base of the dam.
- Cutoff trench, (approx depths shown on Profile Along E of Dam):** A trench shown at the base of the dam, with a depth of 10 feet indicated.
- Slopes:** The upstream slope of the principal spillway is 1:1, and the downstream slope of the emergency spillway is 1:1.
- Dimensions:** A vertical dimension of 12 is shown for the principal spillway crest, and a horizontal dimension of 10 is shown for the cutoff trench.

TYPICAL CROSS SECTION OF DAM

S.D. CONSTRUCTION AND MATERIAL SPECIFICATIONS:

EARTH DAM

OPERATOR: Paul Juec

CONSERVATION DISTRICT:

**U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE**

SKETCH PLAN OF DAM AND RESERVOIR AREA

Approximate scale 1" =

REFERENCE: GUIDE PLAN NO. 1.0

JOB PLAN NO. 1.0

H30A-3C3-LINCOLN. NEW. 1979

(Rev. 4-73) 5, N-29, 073.1a(1)

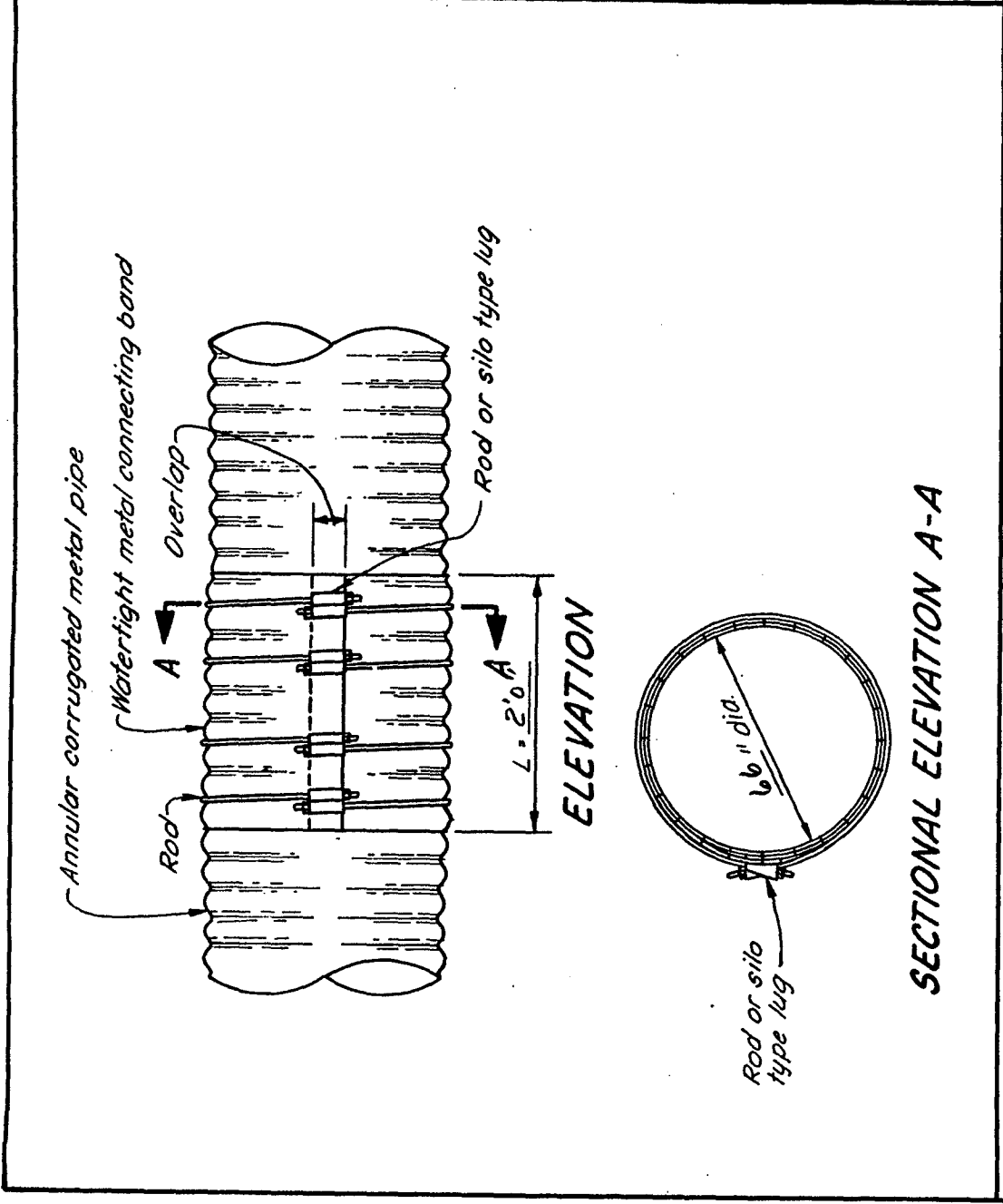
CROSS SECTION AT CREST OF EMERGENCY SPILLWAY AND PROFILE ALONG E OF DAM

PROFILE ALONG E OF EMERGENCY SPILLWAY

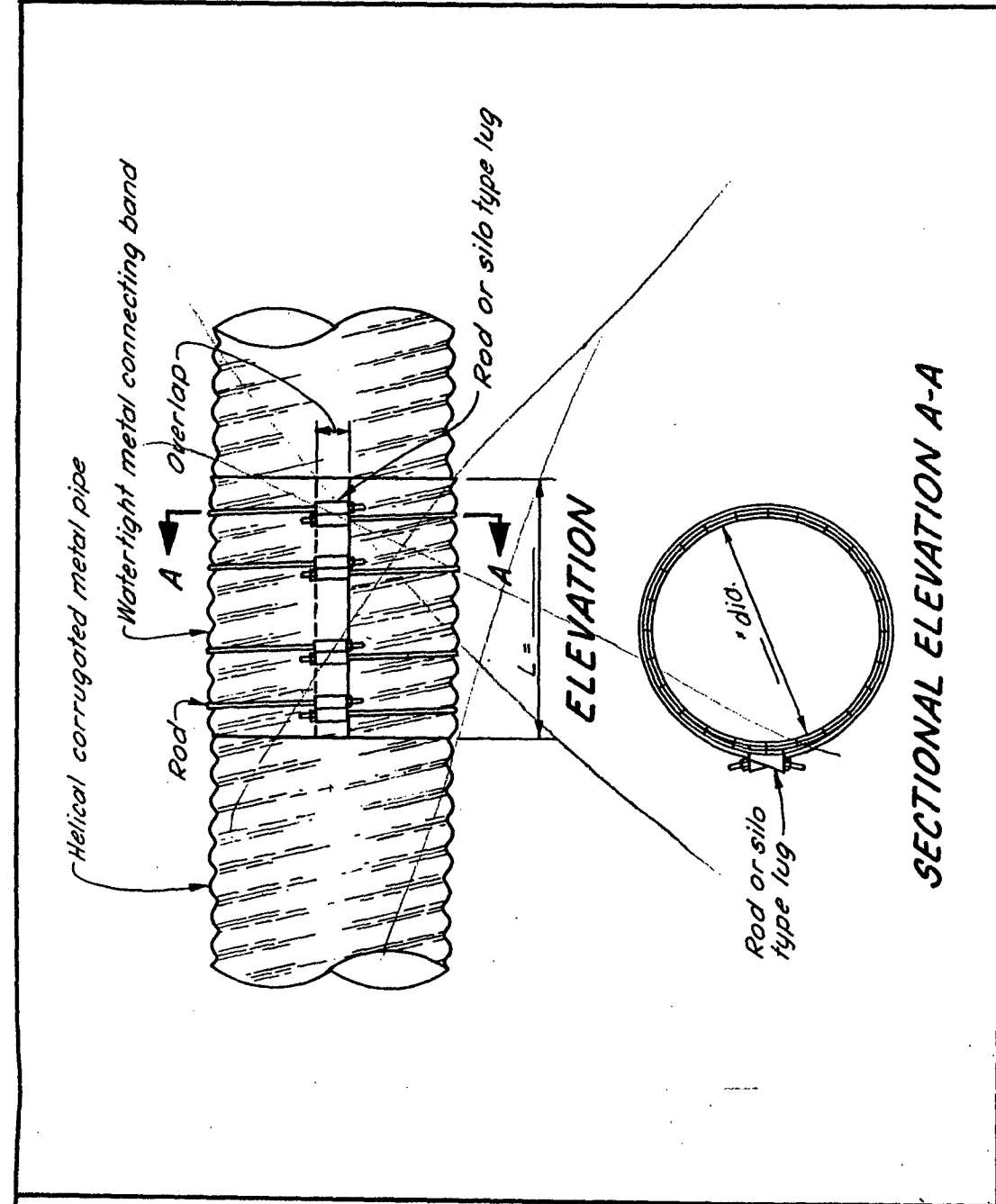
SEDIMENT YIELD

| ERODIBILITY
AREA
ACRES | GROSS
RATE
A.F./AC./YR. | DRAINAGE
AREA
ACRES | DELIVERY
RATE
% | DESIGN
PERIOD
YEARS | REQ'D. SEDIMENT
VOLUME
AC.FT. |
|------------------------------|-------------------------------|---------------------------|-----------------------|---------------------------|-------------------------------------|
| C | .0037 | 5380 | 10 | 20 | 39.8 |

MAXIMUM CROSS SECTION OF DAM



SECTIONAL ELEVATION A-A



SECTIONAL ELEVATION A-A

DIMENSIONS AND QUANTITIES

| PIPE DIA.
INCHES | MINIMUM "L"
INCHES | APPROX.
OVERLAP
INCHES | NUMBER OF
RODS & LUGS | MINIMUM
ROD DIA.
IN. | NEOPRENE
GASKET WIDTH
INCHES | ASPHALT
MASTIC
GAL. |
|---------------------|-----------------------|------------------------------|--------------------------|----------------------------|------------------------------------|---------------------------|
| 6-18 | 12 | 2 | 2 | 1/2 | 12 | 1 1/2 |
| 21-30 | 24 | 3 | 4 | 1/2 | 12 | 1 1/2 |
| 36-48 | 24 | 6 | 4 | 1/2 | 12 | 2 |

NOTES:

1. WATERTIGHTNESS WILL BE OBTAINED BY USE OF (1) 3/8" THICK NEOPRENE GASKET (WIDTH AS SHOWN) OR (2) ASPHALT MASTIC SEALING MATERIAL TO COVER FULL WIDTH OF BAND.
2. CROSS OUT BAND AND QUANTITIES NOT APPLICABLE.

WATERTIGHT CONNECTING BAND
FOR ANNULAR AND HELICAL
CORRUGATED METAL PIPE

OPERATOR: Paul Juel

CONSERVATION DISTRICT: _____

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

| | | |
|----------------|-------------|-------------------|
| Designed _____ | Date _____ | Approved by _____ |
| Drawn _____ | Title _____ | Title _____ |
| Traced _____ | Sheet _____ | Drawing No. _____ |
| Checked _____ | No. _____ | |



| ITEM | LENGTH FOR 46" DIA.
C.M. PIPE | UNIT | QUANTITY |
|-----------------------------------|----------------------------------|------|----------|
| PRESSURE TREATED POLE 12" DIA. | 12'-0" | EACH | 2 |
| 2" X 12" PRESSURE TREATED LUMBER | 8'-0" | EACH | 2 |
| 2" X 6" PRESSURE TREATED LUMBER | 8'-0" | EACH | 2 |
| 2" X 12" PRESSURE TREATED LUMBER | 2'-0" | EACH | 6 |
| 2" X 6" PRESSURE TREATED LUMBER | 2'-0" | EACH | 2 |
| 1/2" DIA. MACHINE BOLTS WITH NUTS | 1'-4" | EACH | 4 |
| 1/2" DIA. WASHERS | | EACH | 8 |

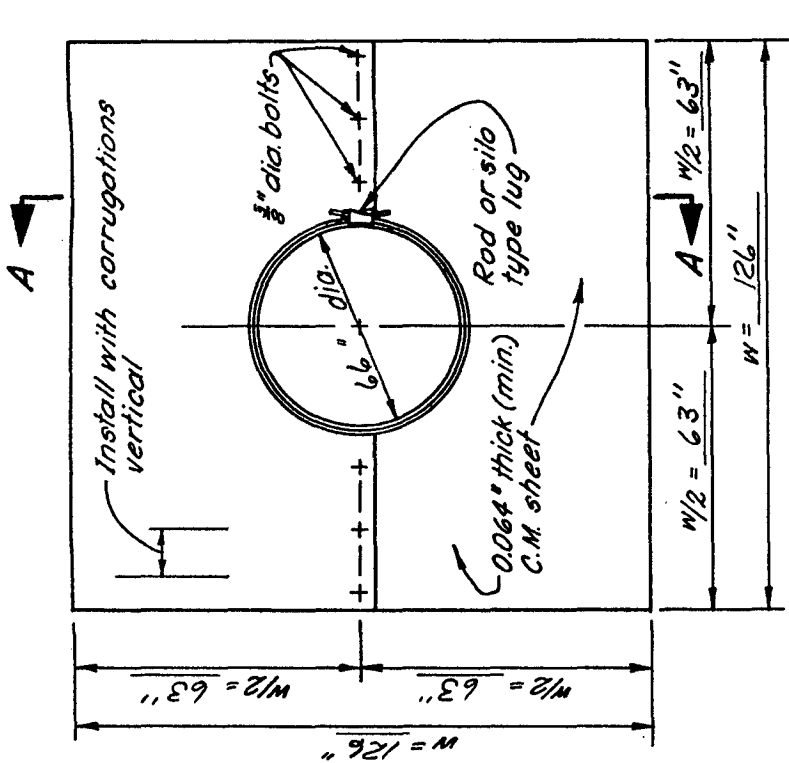
1. HAND OR MACHINE TAMP BACKFILL THOROUGHLY
AROUND FOOTINGS AND COLUMNS.

OPERATOR: PAUL JUEL

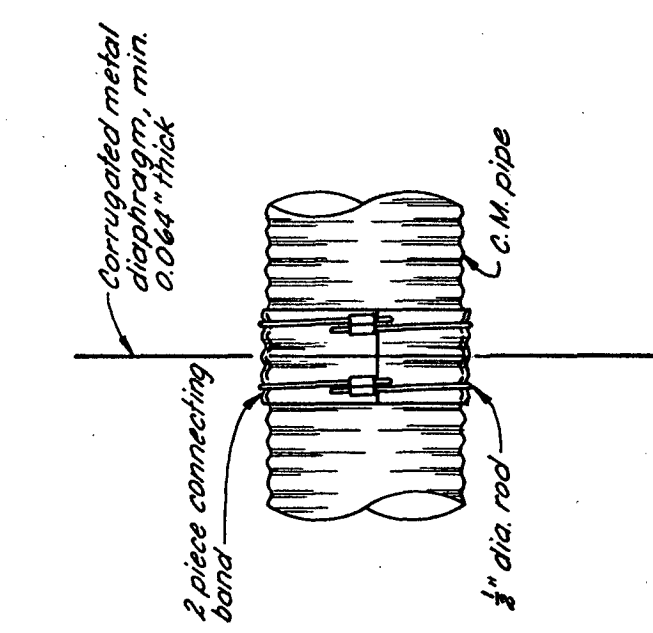
CONSERVATION DISTRICT: _____

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

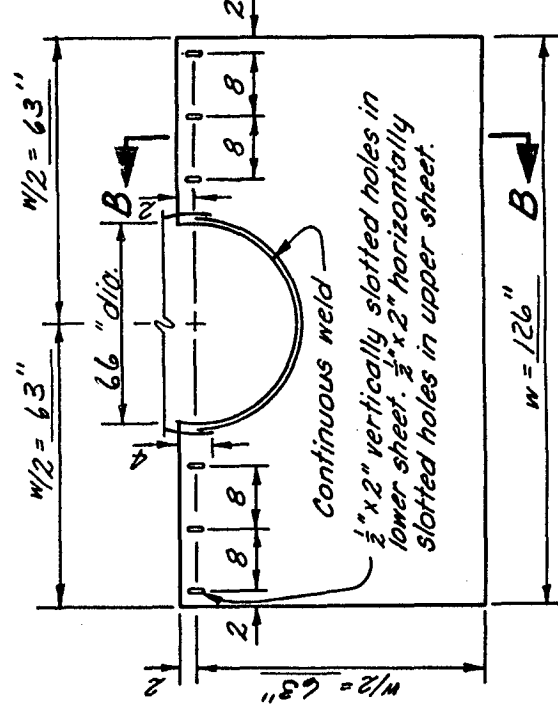
| | | |
|----------------|------------|--------------------|
| Designed _____ | Date _____ | Approved by: _____ |
| Drawn _____ | | Title _____ |
| Traced _____ | | Title _____ |
| Checked _____ | | Sheet _____ |
| | | Drawing No. _____ |
| | | No. _____ |
| | | of _____ |



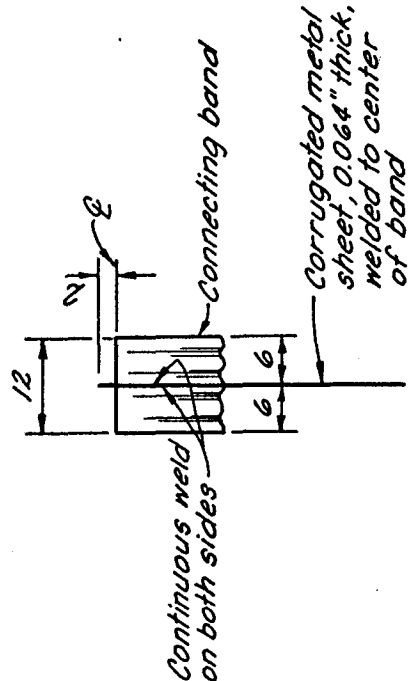
ELEVATION



SECTION A-A



HALF ELEVATION



SECTION B-B

NOTES:

1. WATERTIGHTNESS WILL BE OBTAINED BY USE OF (1) $3/8''$ THICK NEOPRENE GASKET (WIDTH AS SHOWN) OR (2) ASPHALT MASTIC SEALING MATERIAL TO COVER FULL WIDTH OF BAND. CROSS OUT TYPE NOT USED ON DIMENSIONS AND QUANTITIES.
2. WELD BAND TO LOWER SHEET WITH CONTINUOUS WELD AROUND TO $2''$ BELOW CENTERLINE. WELD BAND TO UPPER SHEET WITH CONTINUOUS WELD AROUND TO CENTERLINE.
3. ALL DAMAGED GALVANIZING AND UNGALVANIZED METAL SHALL BE CLEANED AND PAINTED WITH TWO COATS OF ZINC DUST, ZINC OXIDE PRIMER (FED. SPEC. TT-P-641 TYPE III).

TWO PIECE C.M. DIAPHRAGM
(ROD TYPE)

OPERATOR: Paul Juel

CONSERVATION DISTRICT: _____

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

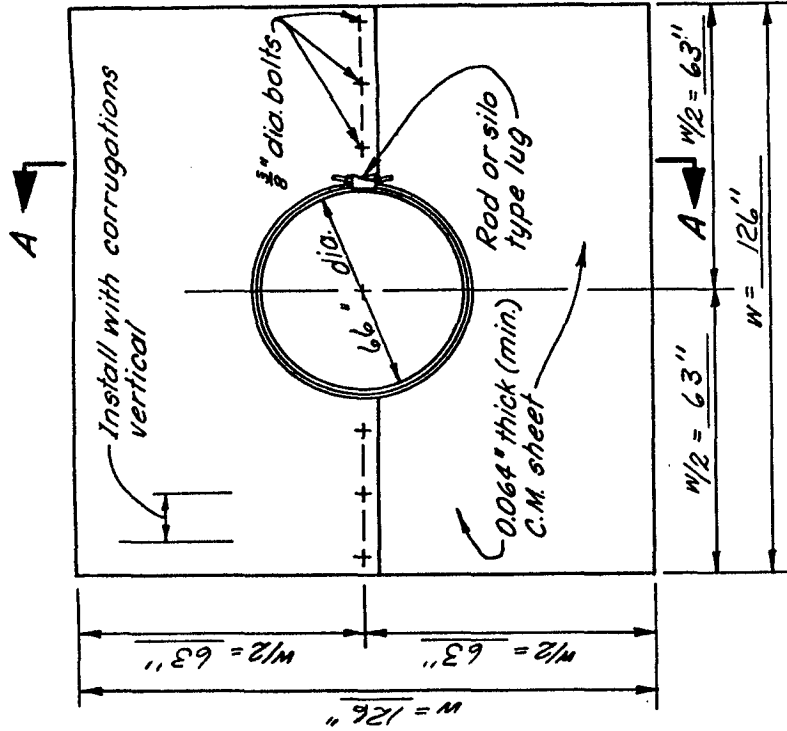
Designed: _____ Date: _____ Approved by: _____

Drawn: _____ Title: _____

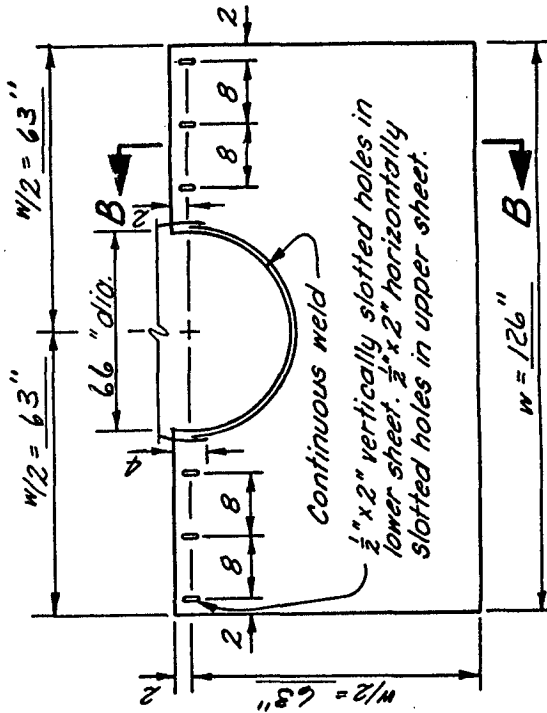
Traced: _____ Sheet: _____ Drawing No. _____

DIMENSIONS AND QUANTITIES

| PIPE DIAMETER IN INCHES | 12 | 15 | 18 | 21 | 24 | 30 | 36 | 42 | 48 |
|---------------------------------|-----|-----|-----|----|----|----|-------|-------|-------|
| "W" IN INCHES | 60 | 63 | 66 | 69 | 72 | 90 | 96 | 102 | 108 |
| NO. OF RODS AND LUGS | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| NEOPRENE GASKET WIDTH IN INCHES | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| QUANTITY SUBJECT TO CHANGE | 1/2 | 1/2 | 1/2 | 1 | 1 | 1 | 1 1/2 | 1 1/2 | 1 1/2 |



ELEVATION



HALF ELEVATION

OPERATOR: Paul Juel
CONSERVATION DISTRICT: _____

**U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE**

| | | |
|----------|------|-------------------|
| Designed | Date | Approved by |
| Drawn | | Title |
| Traced | | Title |
| | | Sheet Drawing No. |

DIMENSIONS AND QUANTITIES

[illegible]

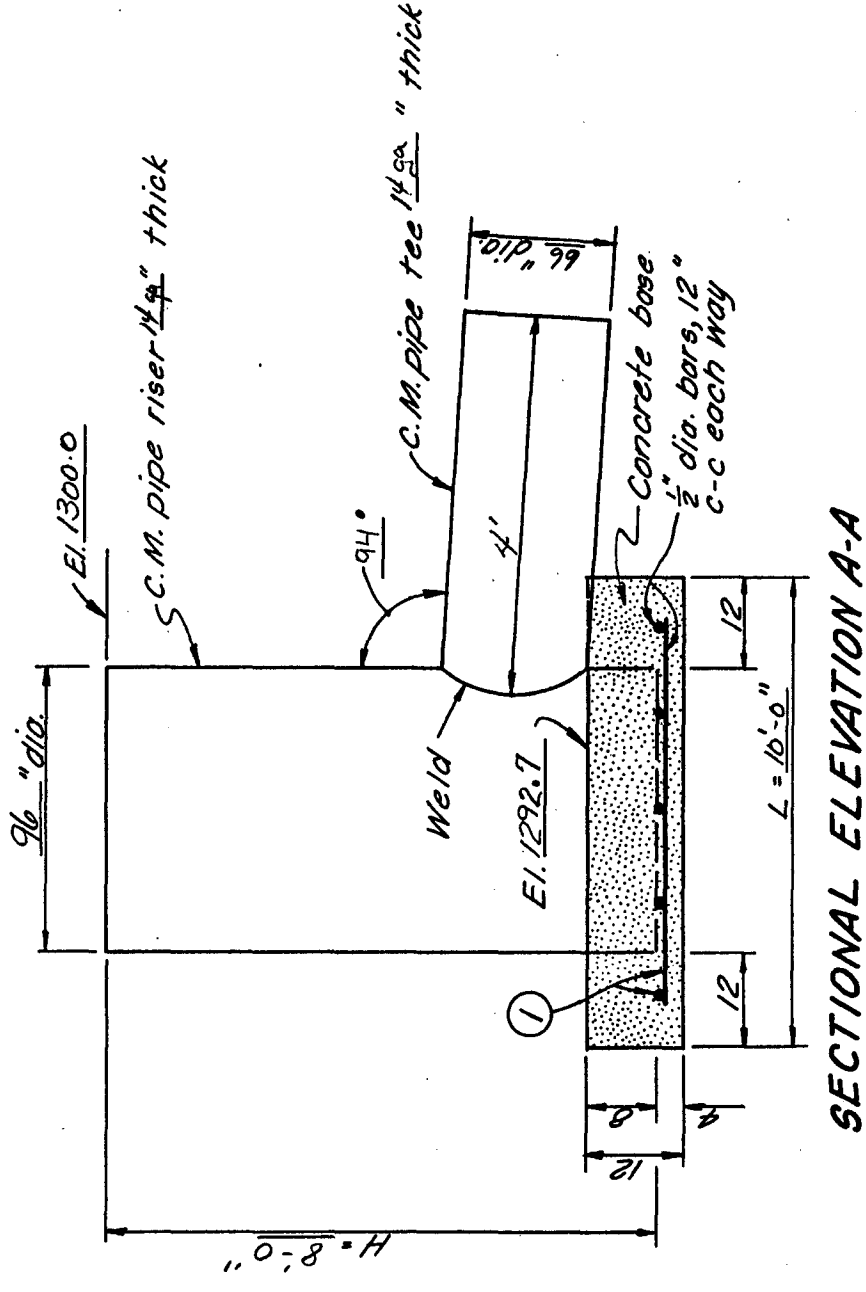
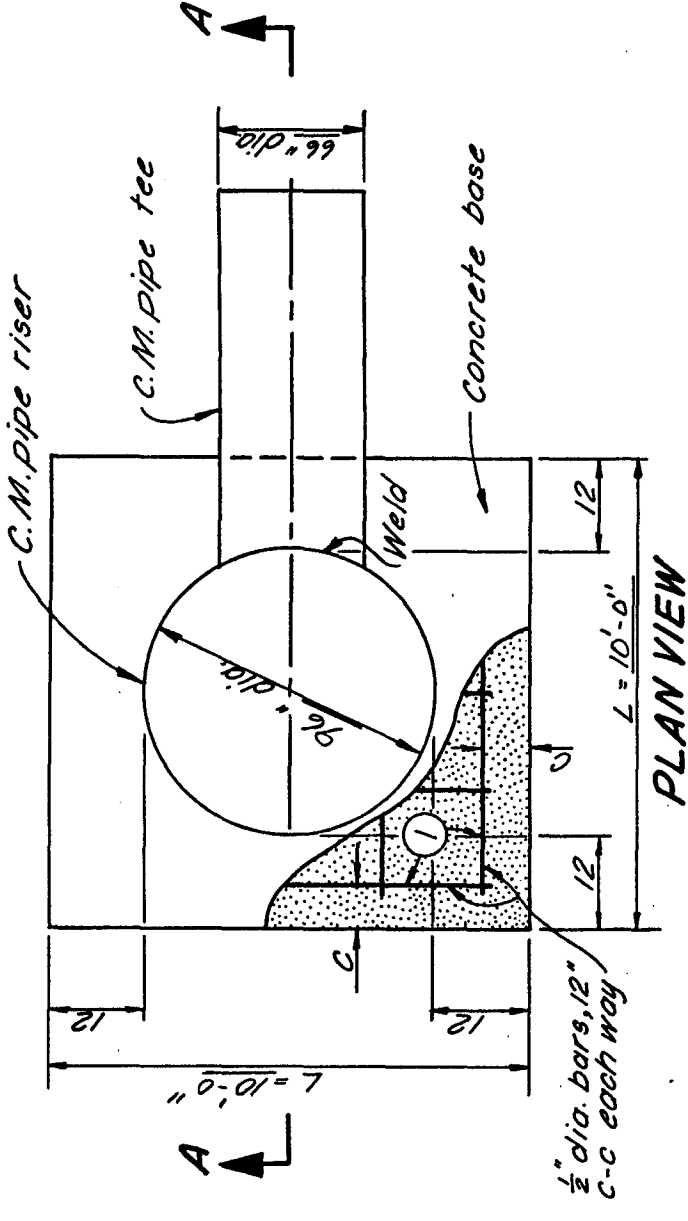
STEEL SCHEDULE

| RISER
DIA.
IN. | BAR
SIZE | MARK | TYPE | NO.
REQ'D. | LENGTH
FT.-IN. | TOTAL
LENGTH
FT.-IN. | TOTAL
WT. LB. | C
IN. | L
FT.-IN. |
|----------------------|-------------|------|------|---------------|-------------------|----------------------------|--------------------|----------|--------------|
| 96" | 4 | 1 | STR. | 20 | 9'-0" | 180'-0" | 121 ^{###} | 6" | 10'-0" |

TABLE OF QUANTITIES

| ITEM | UNIT | QUANTITY |
|-------------------|---------|----------|
| CONCRETE | CU. YD. | 3.7 |
| REINFORCING STEEL | LB. | 121 |

NOTE:



**C.M. PIPE RISER WITH
FABRICATED TEE**

OPERATOR:

CONSERVATION DISTRICT:

**U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE**

Approved by:

Table 1

1

S-001 Drawing No.

i

Trash rack and baffle plate not shown. See job plan no. _____

12'

Top of dam after settlement El. 1308.5

Note: Allowance for settlement 5%

Berm, if required 3:1
slope normal to £ of
dam

**OUTLET DETAIL WITHOUT
PIPE SUPPORT**

(Not to scale)

Prefabricated
elbow 2

Pipe support, see job
plan no. 4-D

OUTLET DETAIL WITH PIPE SUPPORT

Sec. 31, T. 99, R. 48
Linn County
LOCATION

CORRUGATED METAL PIPE DROP INLET PRINCIPAL SPILLWAY

| | | | |
|--|------------|--|---|
| OPERATOR <u>PAUL JUEL</u>
CONSERVATION DISTRICT _____ | | U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE | |
| Designed _____
Drawn _____
Traced _____
Checked _____ | Date _____ | Approved by _____
Title _____ | Title _____
Sheet _____
Drawing No. _____ |
| | | No. _____
of _____ | No. _____
of _____ |
| | | No. _____
of _____ | No. _____
of _____ |

APPLICABLE STANDARD S.C.S. SPECIFICATIONS

Rev. 8/80
JOB PLAN NO. 2.0

REFERENCE: GUIDE PLAN NO. 2.0

SPECIFICATION NOTES

1. ELBOW, IF REQUIRED, MAY BE FABRICATED BY CONTINUOUS WELDING SEPERATE PIPE SECTIONS OR BY FABRICATING A CONTINUOUS WELDED JOINT ON THE UPSTREAM END OF LAST SECTION OF PIPE.

2. PIPE WALL THICKNESS SHALL BE 14 GAGE OR 0.79 INCHES.

[illegible]

TABLE OF QUANTITIES

| Designated | Date | Approved by | | Sheet | Drawing No. |
|------------|------|-------------|----------|-------|-------------|
| | | Title | Initials | | |
| Drawn | | | | | |
| Traced | | | | | |

1. LOCATE ANODES IN NATURAL SOIL WITHIN 200' OF TEST STATION AS DIRECTED BY THE ENGINEER.
2. PIPE WELD CONNECTION AREAS SHALL BE ROUGHENED AND CLEANED TO EXPOSE THE BASE METAL TO PROVIDE GOOD CONDUCTIVITY.
3. TERMINAL WELDS ON BANDS SHALL BE PLACED OUTSIDE OF BAND LAP AREA TO AVOID INTERFERENCE WITH LAP.
4. AFTER WELDING, ALL EXPOSED METAL SHALL BE COATED AS SPECIFIED FOR PATCHING DAMAGED PIPE COATING.
5. THE POWDER WELDING CARTRIDGE SHALL BE EQUAL TO OR BETTER THAN COWLED CARTRIDGE CA 15 +.
6. WHEN TWO PIECE ANTI-SLEEP COLLARS ARE USED, WELD A LENGTH OF BRIDGING CABLE TO UPPER AND LOWER PIECES AND FROM PIPE TO COLLAR.
7. BACKFILL AROUND ANODE WITH WELL TAMPED, MOIST CL MATERIAL.
8. MINIMUM TRENCH WIDTH FOR ANODES SHALL BE 2'.
9. ANODE MAY BE LOCATED EITHER DOWNSTREAM OR UPSTREAM OR BOTH LOCATIONS
10. CROSS OUT VIEWS NOT APPLICABLE.

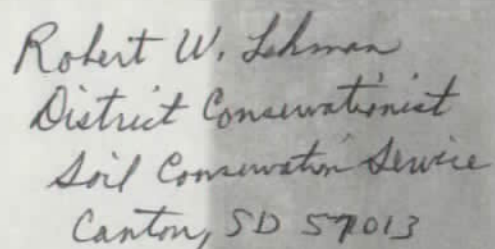
CANTON
SOUTH
7.5 MINUTE SI

6670 1 NE
R. 49 W. R. 48 W. (KLONDIKE)

KLONDIKE 1.5 MI.
3 010 000 FEET (S. DAK.)



99-48



Appl. No. 5145-3

RECEIPT

Division of Water Rights

South Dakota Department of Water and Natural Resources

410945

Pierre, July 27, 19 87

RECEIVED OF Paul M. Juel, RR 3, Box 21, Canton, SD 57013

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

| | | |
|--|-------|--------|
| Fee for Application for Permit No. <u>5145-3</u> to Appropriate Water, to construct works and to put water to beneficial use _____ | 150 | 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 | 150 00 |

By

John Hatch

Chief Engineer

JOHN HATCH

MS

REPORT ON APPLICATION NO. 5145-3

Paul M. Juel
July 28, 1987

Water Permit Application No. 5145-3 is for construction of a dam to store 58.9 acre feet of water annually. The dam will be located in the N1/2 of the SW1/4 of Section 31 - T99N - R48W, Lincoln County. The water is to be used for recreational purposes, provide habitat for fish and wildlife, and for erosion control.

DISCUSSION

The dam is to be built on an unnamed tributary of the Big Sioux River. Currently there are no water rights on this tributary. There are four water permits in Lincoln County which divert water from the Big Sioux River which are downstream from this project. The total diversion rate for these four permits is 10.36 cfs. Due to the limited drainage area for this dam and its small storage capacity, these water rights should not be adversely affected.

Plans and specifications for the proposed dam have not been submitted with this application. If Water Permit No. 5145-3 is approved by the Water Management Board, plans and specifications must be submitted to the Division of Water Rights for review and approval by staff before the dam can be constructed. Along with these plans, a breach analysis and downstream flood routing report must be completed and submitted to determine the hazard classification for the dam.

Depending upon the size and classification of this dam, minimum spillway design flood requirements must be met to satisfy the Water Management Board Rules Chapter 74:02:08 Safety of Dams. The following is a listing of minimum spillway capacities for the dam when it is classified by staff in a certain hazard category and size.

| HAZARD
CATEGORY | SIZE | SPILLWAY CAPACITY |
|--------------------|-----------------------------------|--|
| 3 | effective height x storage < 3000 | 25 year flood - 470 cfs |
| 3 | small | 50 year flood - 680 cfs |
| 2 | small | 100 year flood - 940 cfs |
| 1 | small | 0.5 PMF - 8700 cfs
(Probable Maximum Flood) |

The effective height of the dam is the difference in elevation between the lowest point in the cross section taken along the centerline of the dam and the crest of the emergency spillway. The spillway capacities for the 25, 50, and 100 year floods listed above were estimated using "Techniques for Estimating

Flood Peaks, Volumes, and Hydrographs on Small Streams in South Dakota" prepared by the U.S. Geological Survey. The PMF was estimated using 'Hydrologic Analysis of Dams' computer program.

CONCLUSIONS

1. If this application is approved by the Water Management Board, plans and specifications for the dam must be submitted for review and approval by staff before the dam can be constructed.
2. A breach analysis and downstream flood routing report must be completed and submitted to determine hazard classification for the dam.
3. Due to the small drainage area of the dam, existing water rights on the Big Sioux River should not be adversely affected by approval of Water Permit Application No. 5145-3.
4. It is recommended Application No. 5145-3 be approved with the qualification that low flows as needed for downstream domestic use including livestock water and prior downstream water rights must be by-passed.

A handwritten signature in cursive script, reading "Tim Tollefsrud".

Tim Tollefsrud
Natural Resources Engineer

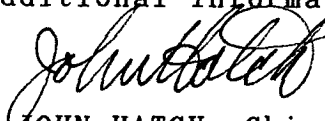
RECOMMENDATION OF CHIEF ENGINEER FOR WATER PERMIT
APPLICATION NO. 5145-3

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. 5145-3, Paul M Juel, RR 3, Box 21, Canton SD.

The Chief Engineer is recommending APPROVAL of Application No. 5145-3 because 1) there is reasonable probability that there is unappropriated water available for the applicant's proposed use, 2) the proposed diversion can be developed without unlawful impairment of existing rights, 3) the proposed use is a beneficial use and 4) in the public interest with the following qualifications:

1. Approval of this permit is subject to submission of plans and specifications to the chief engineer pursuant to Board Rules Chapter 74:02:08, Safety of Dams prior to construction of the dam for review and approval. A breach analysis and downstream flood routing report shall be completed prior to determining the hazard classification for the dam.
2. Low flows as needed for downstream domestic use, including livestock water and prior water rights must be by-passed.
3. Approval of this Permit authorizes storage of up to 58.9 acre feet of water annually.

See the attached report for additional information.



JOHN HATCH, Chief Engineer
August 3, 1987



Department of Water & Natural Resources

Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501

Water Rights Division
605 773-3352

Paul M. Juel
RR 3, Box 21
Canton, South Dakota 57013

Dear Mr. Juel :

Enclosed herewith is your Water Permit No. 5145-3 as approved by the Water Management Board authorizing you to construct your water diversion system and the water to beneficial use, not exceeding the limits as specified in said Water Permit No. 5145-3 .

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 your Water License may be issued to you, thus completing your acquisition of a Water Right.

Very truly yours,

JOHN HATCH, Chief Engineer
Water Rights Division

JH:ms

enclosure

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.

Instruction to Newspaper - Publish first publication of the following Notice on or before **August 13, 1987** with 2nd publication 1 week later. The applicant is responsible for payment.

NOTICE OF HEARING on Application No. 5145-3 to Appropriate Water
~~and/or to Amend Water Permit or Water Right No. _____~~

Notice is hereby given that Paul M. Juel whose mailing address is RR 3, Box 21, Canton, South Dakota has made an application for a permit to store 58.9 acre-feet of water annually in a dam to be located in the N¹/₄SW¹/₄ Section 31-T99N-R48W. The water is to be used for recreational purposes, provide habitat for fish and wildlife production and for erosion control purposes.

Pursuant to SDCL 46-2A-2 the Chief Engineer of the Water Rights Division recommends **APPROVAL** of Application No. 4145-3 because 1) unappropriated water is available, 2) will be no unlawful impairment of existing rights, 3) is beneficial use of water and 4) is in the public interest.

This application will be considered by the Water Management Board at room 216, Joe Foss Building, 523 E. Capitol, Pierre, SD, September 9 1987 at 10:00 am.

The recommendation of the Chief Engineer is not final or binding upon the Board and the Board is authorized to 1) approve, 2) approve with qualifications, 3) defer, or 4) deny this application after it reaches a conclusion based upon facts presented at the public hearing. Any interested person who may be affected by a Board decision and who intends to participate in the hearing before the Board and present evidence or cross-examine witnesses according to SDCL 1-26, must file a written petition with BOTH the applicant and the Chief Engineer by August 28, 1987. The petition may be informal, but it must include a statement describing the petitioners interest in the application, the reasons for the petitioner's opposition to or support of the application, and the signature and mailing address of the petitioner or his legal counsel if legal counsel is obtained. The applicant need not file a petition.

This application is made pursuant to the provisions of 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; ~~(ground) 46-6-3, 46-6-3.1, 46-6-6.1, 46-6-10, 46-6-13, 46-6-14; (future use) 46-5-38 thru 46-5-40; (transfer lands) 46-5-30.4, 46-5-33 thru 46-5-35; (10,000 AFA) 46-5-20.1, 46-5-8.1; and Board Rules ARSD 74:02:01:01 thru 74:02:01:15, (future use) 74:02:01:24 thru 74:02:01:25; (10,000 AFA) 74:02:01:15:02 thru 74:02:01:15:05~~

This hearing is an adversary proceeding. The applicant or any person, after filing a petition, has the right to be present or to be represented by a lawyer. These and other due process rights will be forfeited if they are not exercised. Decisions of the Board may be appealed to the Circuit Court and the State Supreme Court as provided by law.

Any person wishing a copy of the Chief Engineer's recommendation, further information on this application or to assure access to the hearing by the handicapped can contact the Water Rights Division, DWNr, Joe Foss Bldg, Pierre SD (605 773-3352) for assistance prior to the hearing date. The time of the hearing will be automatically extended for at least twenty days upon written request of the applicant or any person who has filed a petition to oppose or support the application. The request for extension must be filed with the Chief Engineer by August 28, 1987.

This hearing is an adversary proceeding. The applicant or any person, after filing a petition, has

Notice is hereby given that Paul the right to be present or to be
M. Juel whose mailing address is represented by a lawyer. These
RR 3, Box 21, Canton, South Dakota other due process rights will
Dakota has made an applicationbe forfeited if they are not
for a permit to store 58.9 acre-feetexercised. Decisions of the Board
of water annually in a dam to bemay be appealed to the Circuit
located in the N½SW¼ SectionCourt and the State Supreme
31-T99N-R48W. The water is to beCourt as provided by law.

used for recreational purposes; Any person wishing a copy of the report may obtain it from the Chief Engineer's Office, Department of Fish and Wildlife Production and for erosion recommendation, control purposes. Information on this application or

Pursuant to SDCL 46-2A-2 the Chief Engineer of the Water Rights Division recommends APPROVAL of Application No. _____

APPROVAL of Application No. 5145-3 because 1) inappropriate water is available, 2) will be no unlawful impairment of existing rights, 3) is beneficial use of water and 4) is in the public interest.

This application will be considered by the Water Management Board at Room 216, Joe Foss Building, 523 E. Capitol, Pierre, SD, September 9, 1987 at 10:00 a.m.

The recommendation of the Chief Engineer is not final or binding upon the Board and the Board is authorized to 1) approve, 2) approve with qualifications, 3) defer, or 4) deny this application after it reaches a conclusion based upon facts presented at the public hearing. Any interested person who may be affected by a Board decision and who intends to participate in the hearing before the Board and present evidence or cross-examine witnesses according to SDCL 1-26, must file a written petition with BOTH the applicant and the Chief Engineer by August 28, 1987. The petition may be informal, but it must include a statement describing the petitioners interest in the application, the reasons for the petitioner's opposition to or support of the application, and the signature and mailing address of the petitioner or his legal counsel if legal counsel is obtained. The applicant need not file a petition.

This application is made pursuant to the provisions of 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; and Board Rules ARSD 74:02:01:01 thru 74:02:01:15.

(8-13, 20)

(8-13, 20)

(Signature)

Bookkeeper

(Title)

August 20, 1987

(Date Signed)

Cost of Printing: \$39.06



Conversation or File Documentation

NAME OF PERSON OR FILE: Paul M. TuelADDRESS: RR 3 Box 21 COUNTY LincolnDATE: 9/28/87 TELEPHONE _____RE: Plans & Specs

COMMENTS:

I talked to Bob Lahman from the SCS office in Canton. He said they did not have the final plans completed yet. I told him what additional information we needed and told him I would send him a copy of our Safety of Dams Rules. He said he would talk to Mr. Tuel about not starting construction until the plans are approved.

File in Permit or other file as necessary. Use to document conversations and what the other party was told; why action or decision was made.

NAME: Toni Schaefer

9/25/87

Paul Fuel Dam

Height - 24'
Eff. Height - 21'
Storage - 58.9 Ac.-Ft.

Top of Dam 1308.5
Primary 1300
2nd 1305.5

74:02:08:08 Breach Analysis

- 74:02:08:09
1. Topo Map - OK? Flood Easements
 2. test pits & borings - NA
 3. X-Section of Dam - OK
 - * 4. Area Capacity Curve - NO
 5. Drawings of Outlet - OK
 - * 6. Spillway Rating Curve - NO
 7. Plans of Spillway Structure - OK
 8. Supervision during Construction - ?

Primary Spillway 66" CMP 102' long with 8'-96" Riser
From SCS Engineering Field Manual

$$Q = A \sqrt{\frac{2.48H}{1 + K_m + K_p L}}$$

$$A = \pi r^2 = \pi (2.75)^2 = 23.75$$

$$H = 24'$$

$$L = 102'$$

$$K_m = 1.0$$

$$K_p = 0.0089 (n = 0.021)$$

$$Q = 23.75 \sqrt{\frac{2(32.2)(24)}{1 + 1 + (0.0089)(102)}}$$

$$Q = \underline{\underline{548 \text{ cfs}}}$$

WATER RIGHTS DIVISION
(605) 773-3352

September 30, 1987

Soil Conservation Service
Box 211
Canton, South Dakota 57013

ATTENTION: Bob Lahman:

Dear Mr. Lahman:

Enclosed is a draft copy of our Safety of Dams Rules. Additions to these rules were approved at the September 9, 1987 Water Management Board Meeting so we do not have a final copy yet. Approval of plans and specifications must meet the requirements of Sections 74:02:08:08 and 74:02:08:09. The information we received for the Paul Juel dam does not have any breach analysis information, or reservoir area capacity and spillway discharge capacity rating curves.

Sincerely,

Timothy G. Schaal,
Water Resources Engineer

TGS:ms



Department of Water & Natural Resources

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

October 5, 1987

Paul M Juel
RR 3, Box 21
Canton SD 57013

Dear Mr. Juel:

Enclosed is a draft copy of our Safety of Dams Rules. Additions to these rules were approved at the September 9, 1987 Water Management Board meeting so we do not have a final copy yet. Approval of plans and specifications must meet the requirements of Sections 74:02:08:08 and 74:02:08:09.

If you have any questions, please contact us.

Sincerely,

A handwritten signature in black ink that reads "Timothy G. Schaal". The signature is written in a cursive style with a large, stylized "S" at the end.

TIMOTHY G SCHAAL
Natural Resources Engineer
605 773-3352

enclosures



Department of Water & Natural Resources

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

October 27, 1987

Paul M. Juel
RR 3, Box 21
Canton, SD 57013

Dear Mr. Juel:

This letter is in regard to your Water Permit No. 5145-3 for construction of a dam for recreational use, to provide habitat for fish and wildlife production and for erosion control. The dam is to be located in the N1/2 N1/2 SW1/4 of Section 31, T99N, R48W.

Water Permit No. 5145-3 was approved September 9, 1987 by the Water Management Board subject to submission of plans and specifications to the Chief Engineer pursuant to Water Management Board Rules Chapter 74:02:08, Safety of Dams, prior to construction of the dam for review and approval. A breach analysis and downstream flood routing report was also to be completed prior to determining the hazard classification for the dam.

We would like to make an inspection of the proposed dam site. If it is convenient for you, we would like to make an inspection of the proposed dam site on Wednesday, November 4, 1987 at 4:00 PM. If Wednesday is not a convenient time for you, please contact me at 773-3352. We are willing to schedule the inspection whenever you are available to show us the proposed dam site.

Sincerely,

David S. Brown /ks

David S. Brown
Natural Resources Engineer

SOUTH Dakota Department of
Water & Natural Resources

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

November 3, 1987

Judy Juel
RR 3, Box 21
Canton, SD 57013

Dear Mrs. Juel:

This letter is in regard to our telephone conversation on November 2, 1987. In our telephone conversation, you requested that the November 4 inspection of the proposed dam site under Water Permit No. 5145-3 be rescheduled. This letter is to confirm that the inspection of the proposed dam site is rescheduled for 4:00 pm on Thursday, December 3, 1987. If December 3 is not a convenient time for you, please contact me at 773-3352.

Sincerely,



David S. Brown
Natural Resources Engineer
Water Rights Division

SOUTH Dakota Department of
Water & Natural Resources

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

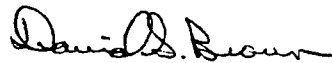
November 30, 1987

Paul Juel
RR 3, Box 21
Canton, SD 57013

Dear Mr. Juel:

This letter is in regard to our telephone conversation on November 30, 1987. In our telephone conversation, you requested that the December 3 inspection of the proposed dam site under Water Permit No. 5145-3 be rescheduled due to your unforeseen trip to Chicago. This letter is to confirm that the inspection of the proposed dam site is rescheduled for 4:00 pm on Tuesday, December 8, 1987.

Sincerely,



David S. Brown
Natural Resources Engineer
Water Rights Division
605 773-3352



Department of Water & Natural Resources

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

December 10, 1987

Paul Juel
RR 3, Box 21
Canton, SD 57013

Dear Mr. Juel:

On December 8, 1987, I visited with you in your home concerning the construction the dam applied for under Water Permit #5145-3. At that time, you gave me several documents that the Division of Water Rights did not previously have. One of those documents was an easement between you and the Dayton Township. I have made a Xerox copy of the original easement and returning the original easement as you requested.

Sincerely,

A handwritten signature in cursive script that reads "David S. Brown".

David S. Brown
Natural Resources Engineer
Water Rights Division
605 773-3352

SIOUX FALLS KENWORTH, INC. J&R GMC TRUCKS



TRUCKS • PARTS • SERVICE

PAUL M. JUEL
SALES ENGINEER

4500 NORTH CLIFF AVENUE BUS: (605) 332-711
SIOUX FALLS, SD 57104 HOME: (605) 987-587

12/10/87

These Documents obtained
from Mr. Juel on
December 8, 1987 when
I talked with him at
his home.

David
Brown

EASEMENT

The undersigned, being the duly governing body of Dayton Township, Lincoln County, South Dakota, maintain and govern a certain township road, which road passes between real estate presently owned by Curtis Tangen, legally described as:

Southeast Quarter (SE $\frac{1}{4}$) and the East One-Half (E $\frac{1}{2}$) of the Southwest Quarter (SW $\frac{1}{4}$) of the Southwest Quarter (SW $\frac{1}{4}$) of Section Thirty-Six (36), Township Ninety-Nine (99) Range 40 West of the 5th P.M., Lincoln County, South Dakota.

and real esate currently owned by Paul Juel, legally described as:

North One-Half ($\frac{1}{2}$) of Lots One (1) and Two (2) of the Southwest Quarter (SW $\frac{1}{4}$) of Section Thirty-One (31), Township Ninety-Nine (99) North, Range 48 West of the 5th P.M., Lincoln County, South Dakota, except the South Three Hndred Thirty Feet (S 330') of the North Six Hundred Sixty-six Feet (N 660') of the West Six Hundred Sixty-six Feet (W 666') thereof.

The undersigned hereby consents to the construction and erection of a dam across a stream, which dam will be constructed on the property of Paul Juel as above described, and cause a back flow of water and formation of a lake, which water and lake will flow over the township road dividing the two above described properties.

For One Dollar (\$1.00) and other good and valuable consideration, the undersigned hereby grants to Paul Juel, his successors, heirs and assigns, a perpetual right and easement to back water over or under, and the right of water flowage caused by such dam over the township road dividing the two above properties.

The undersigned hereby releases Paul Juel, his heirs, successors, and assigns from any and all claims for damages caused to said roadway because of the water flowage and erection of such dam.

This easement shall run with the land and shall be in perpetuity and shall inure to the benefit of the owners of the above described real estate, their successors, heirs and assigns.

Dated this _____ day of June, 1987.

DAYTON TOWNSHIP

BY:

T.M. Eisland township Sup.
Graig Hitzelberger

Subscribed and sworn to before me
this 17th day of ^{July}~~June~~, 1987.

Darwin L. Van Der Auwer
Notary Public, South Dakota
My commission expires 6/25/89.

(SEAL)



SIoux FALLS KENWORTH INC.

4500 NORTH CLIFF AVENUE • SIOUX FALLS, SD 57104
TELEPHONE (605) 332-7112

Tim:

Attached you will find some additional information from ASCS files. Please add these to the file you already have and review for approval of the permit.

When we submitted the original application back in the summer, we were told that after approval by the board the approval of the plans was basically a "rubber stamp of aproval." I would appreciate this being finalized as soon as possible. We have already invested a great deal of time and over \$20,000.

Your cooperation will be appreciated.

Sincerely,

Paul M. Juel

SD-ENG-45
4/70

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG SHEET FOR EARTH BORINGS

Cooperator PAUL JUEL Practice DAM

CD LINCOLN County

Farm, I.D. No. Technician Date 2-23-87

Sec. T R Hole No. 1 Hole Elevation 1306.4

Drilling Location S. END OF DAM ON E (STA 6+87)

Unified Soil
Class Symbol

Description of Material

| | | |
|----|-------|--|
| 0 | ML | BLACK TOP SOIL |
| 2 | CL/CH | BROWNISH GRAY + LT YELLOWISH BROWN MOTTLED
CALCAREOUS GLACIAL TILL |
| 4 | | LT BROWNISH GRAY + LT GRAY MOTTLED
CALCAREOUS
EARLY MISCELLANEOUS GLACIAL TILL |
| 6 | CH | |
| 8 | | |
| 10 | | |
| 12 | | |
| 14 | | |

LEGEND

ied Soil
sification
em Symbol

Description

| | |
|----|--|
| GW | Well graded gravels with less than 5% fines |
| GP | Poorly graded gravels with less than 5% fines |
| GM | Gravels with 12 to 50% non-plastic to slightly plastic fines |
| GC | Gravels with 12 to 50% moderately to very plastic fines |
| SW | Well graded sands with less than 5% fines |
| SP | Poorly graded sands with less than 5% fines |
| SM | Sands with 12 to 50% non-plastic to slightly plastic fines |
| SC | Sands with 12 to 50% moderately plastic to very plastic fines |
| ML | Non-plastic to slightly plastic fines with low liquid limit |
| CL | Slightly to moderately plastic fines with low liquid limit |
| MH | None to slightly plastic fines with high liquid limit |
| CH | Highly plastic to very highly plastic fines with high liquid limit |

| Total Depth - TD | Hole No. | Location |
|-------------------------|----------|--------------------|
| Water Table - WT or | 1-99 | Centerline of dam |
| Disturbed Sample - DS | 100-199 | Borrow |
| Undisturbed Sample - US | 200-299 | Emergency Spillway |
| Slit Spoon Sample - SpT | 300-399 | Principal Spillway |
| | 400-499 | Creek Channel |
| | 500-599 | Relief Wells |
| | 600-699 | Other Exploration |

Conditions:

SD-ENG-45
4/70

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG SHEET FOR EARTH BORINGS

Cooperator PAUL JUEL Practice DAM

CD LINCOLN County

Farm, I.D. No. Technician Date 2-23-87

Sec. T R R Hole No. 2 Hole Elevation 1288.9

Drilling Location DAM & S. OF DRAW (STA 5+05)

Unified Soil
Class Symbol

Description of Material

| | | |
|----|-------|---|
| 0 | | |
| | ML/CL | BLACK-YAD SOIL
CALCAREOUS |
| 2 | | |
| | ML | WATER, DK GRAY + DK GRAYISH BROWN STRATIFIED ALLUVIUM
AT 3' FEW STRATA OF SM
CALCAREOUS |
| 4 | | |
| | SM | DK GRAY STRATIFIED ALLUVIUM
DOMINANTLY SM
CALCAREOUS |
| 6 | | |
| | CH | OLIVE + LT GRAY MOTTLED
CALCAREOUS
GLACIAL TILL |
| 8 | | |
| | CH | LT GRAY + LT OLIVE MOTTLED
CALCAREOUS
EARLY WISCONSIN GLACIAL TILL |
| 10 | | |
| | | |
| 12 | | |

SD-ENG-45
4/70

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG SHEET FOR EARTH BORINGS

Cooperator PAUL JUEL Practice DAM
CD LINCOLN County
Farm, I.D. No. Technician Date 2-23-87
Sec. T R R Hole No. 3 Hole Elevation 1391.4
Drilling Location DAM & N. OF DRAW (STA 4+05)
Unified Soil Class Symbol Description of Material

| | | |
|----|----|--|
| 0 | ML | BLACK TOP SOIL |
| 2 | CL | BROWNISH GRAY + LT GRAYISH BROWN MOTTLED
CALCAREOUS ALLUVIUM |
| 4 | | STRATIFIED ALLUVIUM
MASTLY SM, SP, + ML
DOMINATELY BROWN & LT GRAY |
| 6 | | WATER TABLE AT 6' |
| 8 | CH | GRAY + LT BROWNISH GRAY
CALCAREOUS
EARLY WISCONSIN GLACIAL TILL |
| 10 | | TO |
| 12 | | |
| 14 | | |
| 16 | | |

SD-ENG-45
4/70

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG SHEET FOR EARTH BORINGS

Cooperator PAUL JUEL Practice DAM

CD LINCOLN County

Farm, I.D. No. Technician Date 2-23-87

Sec. T R R Hole No. 4 Hole Elevation 1296.0

Drilling Location DAM & BETWEEN DRAW AND ES (STA 3+00)

Unified Soil
Class Symbol

Description of Material

| | | |
|----|----|--|
| 0 | | |
| | ML | BLACK TOP SOIL |
| 2 | | |
| | ML | DARK BROWN ALLUVIUM |
| 4 | | |
| | CL | DK GRAYISH BROWN
CALCAREOUS, ALLUVIUM |
| 6 | | |
| | CL | LT GRAY
LT YELLOWISH BROWN MOTTLED
CALCAREOUS, ALLUVIUM |
| 8 | | |
| | CH | LT BROWNISH GRAY
LT YELLOWISH BROWN
MOTTLED, CALCAREOUS GLACIAL TILL
EARLY MISISSIPPIAN |
| 12 | | |
| | | GRAY CALCAREOUS GLACIAL TILL |
| | | T.D. |
| 14 | | |
| 16 | | |

SD-ENG-45
4/70

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG SHEET FOR EARTH BORINGS

Cooperator PAUL JUEL Practice DAM
CD LINCOLN County
Farm, I.D. No. Technician Date 2-23-87
Sec. T R R Hole No. 5 Hole Elevation 1306.9
Drilling Location ES LOCATION (APPROX & STA 0-30)
Unified Soil Class Symbol Description of Material

| | | |
|----|---------|---|
| 0 | ML | BLACK, TOP SOIL |
| 1 | ML | BROWN |
| 2 | GM & SM | STRATIFIED BROWN, GLACIAL OUTWASH, CALCAREOUS |
| 3 | | |
| 4 | | LIGHT BROWN |
| 5 | | LIGHT YELLOWISH BROWN MOTTLED |
| 6 | CL | CALCAREOUS GLACIAL TILL |
| 7 | | |
| 8 | | |
| 9 | | LT BROWNISH GRAY |
| 10 | CL | STRONG BROWN MOTTLED
CALCAREOUS GLACIAL TILL |
| 11 | | |
| 12 | | T.O. |
| 13 | | |
| 14 | | |
| 15 | | |
| 16 | | |

SD-ENG-45
4/70

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG SHEET FOR EARTH BORINGS

Cooperator PAUL JUEL Practice DAM

CD LINCOLN County

Farm, I.D. No. _____ Technician _____ Date 2-23-87

Sec. T R Hole No. 6 Hole Elevation 1300.7

Drilling Location BORROW AREA (200' NE OF BM)

| Unified Soil
Class Symbol | Description of Material |
|------------------------------|-------------------------|
| | |

A hand-drawn stratigraphic column with a vertical axis on the left marked from 0 to 12 in increments of 2. The column is divided into sections by horizontal lines. The descriptions for each section are as follows:

| Depth (ft) | Soil Type | Description |
|-------------|-----------|---|
| 0 - 1.5 | ML | BLACK |
| 1.5 - 4.0 | ML | DARK BROWN |
| 4.0 - 7.0 | ML | BROWN |
| 7.0 - 8.5 | | LIGHT GRAY |
| 8.5 - 11.0 | CH | LIGHT YELLOWISH BROWN MOTTLED
EARLY WISCONSIN SURFICIAL TILL |
| 11.0 - 12.0 | T.D. | NO H ₂ O |

SD-WS-13
(Rev. 2/72)

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service

STAGE STORAGE COMPUTATIONS

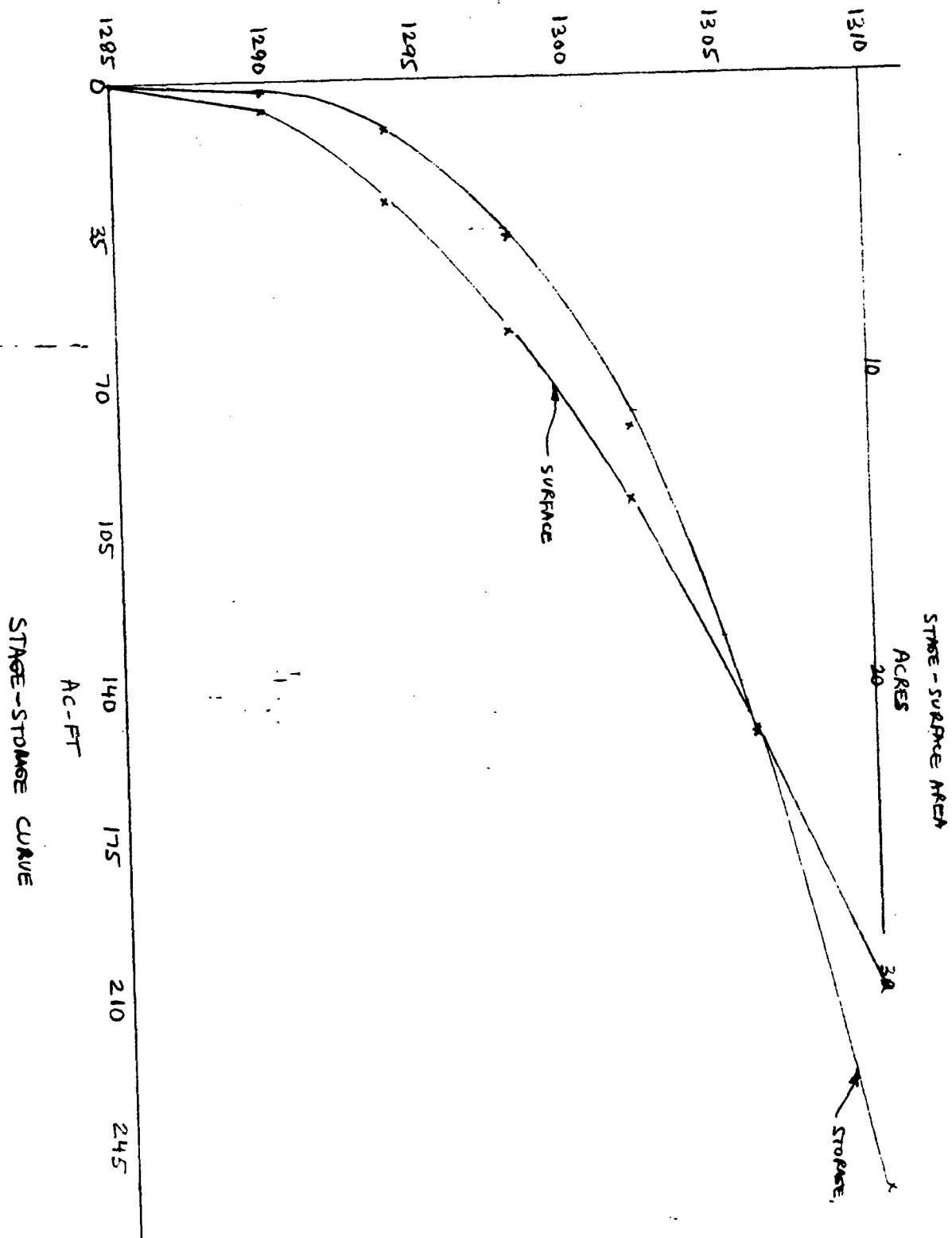
[illegible]

S. DAKOTA

12-86

STAGE-STORAGE

PAUL JUEL D.M.



OVER DAM

2-26-87

F.S. OF RISER AGAINST FLOTATION

2

2

TRY 12.5' X 12.5' X 1' PAD

WEIGHT OF RISER = 1,000 # (IGNORING CORRECTIONS FOR STUB)

$$\text{SUBMERGED WEIGHT OF CONCRETE PAD} = (12.5 \times 12.5 \times 1) \times (145 - 62.4) = 12,906 \#$$

SUBMERGED WEIGHT OF FILL ABOVE PAD, RISER, STUB (SATURATED FILL)

$$\text{AREA} = 12.5 \times 12.5 - \pi \frac{8^2}{4} = 105.925 \text{ FT}^2$$

$$\text{VOLUME} = 7.33' \times 105.925 = 776.87 \text{ FT}^3$$

$$\text{VOLUME TAKEN OUT BY STUB ABOVE PAD} = 2.25 \times \pi \frac{5.5^2}{4} = 53.46 \text{ FT}^3$$

$$\begin{aligned} \text{VOLUME ABOVE STUB} & \text{ BEYOND PAD (TO RISER CREST ELEV)} \\ & = (4 - 2.25) \times 5.5 \times (7.33 - \frac{5.5}{2}) = 44.08 \text{ FT}^3 \end{aligned}$$

$$\begin{aligned} \text{VOLUME TAKEN OUT BY STUB (ABOVE \text{OF STUB})} \\ & = (4 - 2.25) \times \pi \frac{5.5^2}{4} / 2 = 20.79 \text{ FT}^3 \end{aligned}$$

$$\text{NET VOLUME} = 776.87 - 53.46 + 44.08 - 20.79 = 746.70 \text{ FT}^3$$

$$\text{WEIGHT} = 746.70 \times (120 - 62.4) = 43,010 \#$$

WEIGHT ^(NOT SUBMERGED) OF FILL OVER STUB BEYOND PAD AND ABOVE CREST ELEV (DRY FILL)

$$\text{AREA} = (4 - 2.25) \times 5.5 = 9.625 \text{ FT}^2$$

$$\text{FILL HT ABOVE CREST ELEV AT EDGE OF PAD} = 0.417' = 1.25/3$$

$$\text{" " " " " " END OF STUB} = 1.000'$$

$$\text{AVE FILL HT} = (0.417 + 1.000) / 2 = 0.71'$$

$$\text{VOLUME} = 9.625 \times 0.71 = 6.82 \text{ FT}^3$$

$$\text{WEIGHT} = 100 \times 6.82 = 682 \#$$

$$\text{TOTAL WT} = 1,000 + 12,906 + 43,010 + 682 = 57,598 \#$$

UPLIFTING FORCE

$$\text{VOLUME OF PAD} = 12.5 \times 12.5 \times 1 = 156.25$$

$$\text{VOLUME OF WATER DISPLACED} = 459.6 + 156.25 = 615.85 \text{ FT}^3$$

$$\text{WT OF WATER DISPLACED} = 615.85 \times 62.4 = 38,429 \#$$

$$\text{SO SAFETY FACTOR} = \frac{57,598}{38,429} = 1.5 \quad \underline{\text{OK}}$$

IGNORING MINOR EFFECT OF PAD EXTENDING PAST LEVEL ELEV

RECEIVED

EST 2 / 190.

BANNER ASSOC., INC.

JUEL DAM

SS

2-26-87

F.S. OF RISER AGAINST FLOTATION

1 2

ASSUME WATER TO TOP OF RISER (EL 1300.0) BUT NOT IN RISER

WEIGHT OF RISER (IGNORING STUB)

USE 125#/FT FOR 96" DIA PIPE

$$\text{WEIGHT} = 8 \times 125 = 1000 \#$$

SUBMERGED WEIGHT OF CONCRETE PAD (IGNORING STEEL REINFORCEMENT)

USE 145#/FT³ FOR CONCRETE WEIGHT

$$\text{WEIGHT} = (10 \times 10 \times 1) \times (145 - 62.4) = 8,260 \#$$

SUBMERGED WEIGHT OF FILL ABOVE CONCRETE PAD (ASSUME SATURATED FILL)

USE 120#/FT³ FOR FILL WEIGHT

$$\text{AREA} = 10 \times 10 - \pi \frac{8^2}{4} = 49.735 \text{ FT}^2$$

$$\text{VOLUME} = 7.33' \times 49.735 \text{ FT}^2 = 364.6 \text{ FT}^3$$

$$\text{WEIGHT} = 364.6 \times (120 - 62.4) = 20,998 \#$$

* IGNORING ADJUSTMENTS FOR STUB

$$\text{TOTAL WT} = 1,000 + 8,260 + 20,998 = 30,258 \#$$

UPLIFTING FORCE IS WATER DISPLACED BY RISER AND PAD

$$\text{VOLUME OF RISER} = 364.6 + 4 \times \pi \frac{5.5^2}{4} = 459.6 \text{ FT}^3$$

(INCLUDING STUB,

$$\text{VOLUME OF PAD} = 100 \text{ FT}^3$$

$$\text{VOLUME OF WATER DISPLACED} = 459.6 + 100 = 559.6 \text{ FT}^3$$

$$\text{WEIGHT OF WATER DISPLACED} = 559.6 \times 62.4 = 34,919 \#$$

SO UPLIFTING FORCE IS GREATER THAN DOWNWARD FORCE

NEED TO MAKE PAD LARGER

S. DAKOTA

PAUL JUEL DAM

12-86

HYDROLOGIC DATA

1

2

WATERSHED AREA

SECTION 31 of T99 R48

SECTIONS 10, 11, 14, 15, 16, 21, 22, 23, 25, 26, 27, 28, 34, 35, 36 OF T99 R49

CANTON - 2345 ACRES

KLONDIKE - 2020 ACRES

HARRISBURG - 210 ACRES

CANTON SW - 205 ACRES

5380 ACRES

SOIL HYDROLOGY GROUP:

A_{CA} - AICESTER

- B

C_a - CHANCELLOR - TETONKA

- C

- 550 ACRES

C_d - CHANCELLOR - VIBORG

- 35% C, 65% B : $.35 \times 660 = 230$ ACRES

C_h - CHANCELLOR - WAKONDA - TETONKA

- C

- 285 ACRES

E_{aB} - EGAN

- B

E_{sB} - EGAN - SHINDLER

- B

E_{sC} - EGAN - SHINDLER

- B

L_a - LAMO

- C

- 20 ACRES

S_{AD2} - SHINDLER - EGAN

- B

T₂ - TETONKA

- C

- 65 ACRES

W_{HA} - WENTWORTH - CHANCELLOR

- 25% C, 75% B : $1720 \times .25 = 430$ ACRES

W_{2A} - WENTWORTH

- B

W_s - WORTHING

- D

- 125 ACRES

1580 ACRES OF E, 125 ACRES OF D

LENGTH OF WATERSHED = 39,000 FT

WATERSHED SLOPE

USE SECTION LINES FOR GRID

| <u>GRID LINE</u> | <u>LENGTH</u> |
|------------------|---------------|
| A (N) | 3.68 |
| B | 7.15 |
| C | 6.78 |
| D (S) | 6.22 |
| 1 (W) | 0.20 |
| 2 | 6.10 |
| 3 | 9.19 |

S. DAKOTA

PAUL JUEL

12-86

2

2

GRID CROSSINGS:

| GRID | CROSSINGS |
|------|-------------------|
| A | 6 |
| B | 6 |
| C | 14 |
| D | 8 |
| 1 | 0 |
| 2 | 6 |
| 3 | 11 |
| 4 | 11 |
| 5 | 6 |
| | <u>TOTAL = 68</u> |

$$S = \frac{1.571(10)(68)}{89,940} = 0.012 = 1.2\%$$

PEAK FLOWS

(FIG 15-2 NEW 4)

AVE VELOCITY = 0.38 FT/SEC 7500' @ 0.6%, MIN. TILL FIELDS
 → 5.48 HRS LAG (UPLAND SECTION)

90' DROP IN 31,500 FT = 0.3% IN DEFINED CREEK
 FIG 15-2 → 1.5 FT/SEC → 5.83 HRS LAG

$$TOTAL LAG = 5.48 + 5.83 = 11.31 HRS$$

$$T_c = L/0.6 = 18.85 HRS$$

$$DA = 5280 \div 640 = 8.41 MI^2$$

$$q_p = \frac{484 AQ}{\frac{0.133 T_c}{2} + L} = \frac{484 AQ}{\frac{0.133 \times 18.85}{2} + 11.31} = 38.52 AQ$$

$$q_2 = 38.52 \times 8.41 \times 0.81 = 262 CFS$$

$$q_5 = 38.52 \times 8.41 \times 1.36 = 441 CFS$$

$$q_{10} = 38.52 \times 8.41 \times 1.81 = 586 CFS$$

$$q_{25} = 38.52 \times 8.41 \times 2.29 = 742 CFS$$

HYDROLOGIC DATA SHEET

Operator: PAUL JUEL Farm No.:

Structure or Practice: DAM

Location: 31-99-48 County: LINCOLN

Computations by: Date: 12/86

PEAK RATE AND VOLUME OF RUNOFF
(See Chapt. 2, Eng. Field Manual)

| Soil Group | Land Use and Condition | Curve Number | Acres | (CN) (Acres) |
|------------|--------------------------------|--------------|-------|-----------------|
| D | WETLAND - MEADOW | 78 | 125 | 9,750 |
| B | ROW CROP - GOOD COND - CONTOUR | 75 | 3,315 | 3,675 } 248,625 |
| B | GRASS - NATURAL - GOOD/FAIR | 65 | 360 | |
| C | ROW CROP - GOOD COND - CONTOUR | 82 | 1,430 | 1,580 } 117,260 |
| C | GRASS - NATURAL - GOOD/FAIR | 76 | 150 | |

TOTAL 5380 410,435

Weighted CN = 76.29 (USE 76)

Average Watershed Slope 1.2 % Slope Factor

| Weighted CN | Design Storm | P Inches Rainfall | Q Inches Runoff | q (ft ³ /s) Peak Flow | Storm Volume Ac.-In. Ac.-Ft. |
|-------------|--------------|-------------------|-----------------|----------------------------------|------------------------------|
| 76 | 2 | 2.7 | 0.81 | 262 | 363 |
| 76 | 5 | 3.5 | 1.36 | 441 | 610 |
| 76 | 10 | 4.1 | 1.81 | 586 | 811 |
| 76 | 25 | 4.7 | 2.29 | 742 | 1,027 |
| 76 | 50 | 5.4 | 2.87 | 930 | 1,287 |

ANNUAL YIELD

| % Chance | Freq. | Isogram No. | Area Acres | Inches | Ac.-In. | Ac.-Ft. |
|----------|----------|-------------|------------|--------|---------|---------|
| 20 | 5 YR | 4 | 5380 | 2.25 | 12,105 | 1009 |
| 50 | 2 YR | 4 | 5380 | 0.84 | 4,519 | 377 |
| 80 | 1 1/4 YR | 4 | 5380 | 0.32 | 1,775 | 148 |

SEDIMENT YIELD

| Erodibility Area | Gross Rate
(Ac.Ft./Ac./Yr.) | Drainage Area
Acres | Delivery Rate
(%) | Design Period
Years | Req'd. Sediment Volume
(Ac.Ft.) |
|------------------|--------------------------------|------------------------|----------------------|------------------------|------------------------------------|
| C | .0037 | 5280 | 10 | 20 | 39.81 |

HYDRAULIC DATA

SPILLWAYS - EARTH OR VEGETATED

| Crest Elev. | Crest Length | Permissible Velocity | Hp (ft) | qx (ft ³ /s/ft) | Width (ft) | Velocity at Control Section | Q (ft ³ /s) |
|-------------|--------------|----------------------|---------|----------------------------|------------|-----------------------------|------------------------|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

CHANNELS (DITCHES, DIVERSIONS, WATERWAYS, ETC.)

[illegible]

PRINCIPAL SPILLWAYS

[illegible]

CULVERTS

| CULVERTS | | | | | | | |
|----------|--------------|----------------|---------------|----------------------|----------------|----------------------|---------------------------|
| Type | Dia.
(in) | Length
(ft) | Inlet Control | | Outlet Control | | Q
(ft ³ /s) |
| | | | Head-ft | Q-ft ³ /s | Head-ft | Q-ft ³ /s | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

WATERWAYS-DIVERSIONS (FROM TABLES)

[illegible]



Department of Water & Natural Resources

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

February 1, 1988

NOTICE

TO: Paul M. Juel, RR 3, Box 21, Canton SD 57013

FROM: John Hatch, Chief Engineer
Water Rights Division 605 773-3352 *John Hatch*

SUBJECT: Notice of Hearing Regarding Violation of Qualification
to Water Permit Application No. 5145-3

The Water Management Board will conduct a public hearing to consider action to be taken regarding violation of the following qualification to approval of Water Permit Application No. 5145-3.

Approval of this permit is subject to submission of plans and specifications to the chief engineer pursuant to Board Rules Chapter 74:02:08, Safety of Dams prior to construction of the dam for review and approval. A breach analysis and downstream flood routing report shall be completed prior to determining the hazard classification for the dam.

The hearing will be held at 2:45 pm, March 2 1988, in Room 216, Joe Foss Building, 523 E. Capitol, Pierre SD. The agenda time is an estimate. The actual time of hearing may be later than 2:45 pm due to prior agenda items. The Board has legal authority and jurisdiction to consider this matter pursuant to SDCL 46-2-9, 46-2-11 and 46-2-17.

David Brown, Division Engineer, completed an inspection on December 8, 1987 of the proposed site in the N1/2 SW1/4 section 31-T99N-R48W specified on Water Permit Application No. 5145-3. The Water Management Board approved Application No. 5145-3 on September 9, 1987 with the qualifications specified on the Chief Engineer's recommendation dated August 3, 1987.

The on-site inspection found that the dam had been constructed in violation of the above qualification to approval of No. 5145-3. The Board will consider the violation of No. 5145-3 pursuant to SDCL 46-1-12, 46-1-14, 46-1-15, 46-5-9 through 46-5-11 and Board Rule 74:02:01:14. Notice that the above qualification would be considered by the Board was sent to you on August 3, 1987 in the Chief Engineer's recommendation. Confirmation that the Board approved Application No. 5145-3 with the above qualification was given via phone conversation with Ron Duvall, Division Engineer, on October 1, 1987 and via letter from Tim Schaal, Division Engineer, dated October 5, 1987.

February 1, 1988

Notice

Page 2

After all evidence is taken at the hearing, the Board may issue a decision to: 1. Order removal of the dam, 2. Amend the permit, 3. Suspend the permit, 4. Take no action or some combination of Nos. 1 through 3. The hearing will be held pursuant to the contested case procedures required by SDCL Chapter 1-26. The hearing is an adversary proceeding and you have the right to be present at the hearing and to be represented by a lawyer. These and other due process rights will be forfeited, if not exercised at the hearing. Any decision rendered by the Board may be appealed to the Circuit Court and to the State Supreme Court as provided by law.

CERTIFICATION

I hereby certify that on February 1, 1988 I have personally deposited with the U.S. Mail, a postage prepaid envelope containing Notice of Hearing Regarding Violation of Qualification to Water Permit Application No. 5145-3 addressed as follows: Paul M Juel, RR 3, Box 21, Canton SD 57013

Karen Schlaak

KAREN SCHLAAK
Senior Secretary

STATE OF SOUTH DAKOTA)
) SS
COUNTY OF HUGHES)

Sworn to, before me, this 3rd day of February, 1988.

John Hatich
Notary Public



**Report on Violation of Qualification
to Water Permit Application No. 5145-3**

February 22, 1988

July 27, 1987, Water Permit Application No. 5145-3 was received by the Division of Water Rights. The permit application was for storage of 58.9 acre-feet of water annually in a dam to be located in the N1/2 SW1/4 Section 31, T99N, R48W, Lincoln County. The water was to be used for recreational purposes, provide habitat for fish and wildlife production and for erosion control purposes.

Water Permit No. 5145-3 was approved by the Water Management Board on September 9, 1987 with the following qualification:

Approval of this permit is subject to submission of plans and specifications to the Chief Engineer pursuant to Board Rules Chapter 74:02:08, Safety of Dams prior to construction of the dam for review and approval. A breach analysis and downstream flood routing report shall be completed prior to determining the hazard classification for the dam.

October 27, 1987, the Division made a written request to Paul Juel to make an inspection of the proposed dam site November 4, 1987. November 2, 1987, Mrs. Paul Juel requested by telephone that the inspection be rescheduled for December 3, 1987. On November 30, 1987, Mr. Juel requested by telephone that the December 3 inspection be rescheduled for December 8, 1987.

On December 8, 1987, an inspection was conducted by David Brown, Division Engineer. The inspection determined that the dam had been constructed during the end of October, 1987. Construction of the dam prior to review and approval of plans and specifications, and receipt of a breach analysis and flood routing report is in violation of qualification to Water Permit No. 5145-3.

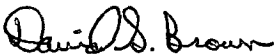
Notice that the above qualification would be considered by the board was sent to Mr. Juel on August 3, 1987 in the Chief Engineer's recommendation. Confirmation that the Board approved Water Permit Application No. 5145-3 with the above qualification was given via telephone conversation with Ron Duvall, Division Engineer on October 1, 1987 and via letter from Tim Schaal, Division Engineer on October 5, 1987 (see attached letter).

CONCLUSIONS

1. Mr. Juel is in violation of the permit qualification.
2. The Water Management Board has the authority to consider the violation of the qualification for Water Permit No. 5145-3 pursuant to SDCL 46-1-12, 46-1-14, 46-1-15, 46-5-9 through 46-5-11 and Board Rule 74:02:01:14.

OPTIONS AVAILABLE TO THE BOARD

The Board may issue a decision to: take no action, amend the permit, suspend the permit, order removal of the dam, or some combination of these options.



David S. Brown
Natural Resources Engineer



Department of Water & Natural Resources

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

February 25, 1988

Paul Juel
RR 3, Box 21
Canton SD 57013

Dear Mr. Juel:

Enclosed is a copy of the Report on Violation of Qualification to Water Permit Application No. 5145-3 which will be considered at the March 2, 1988 Water Management Board meeting.

Very truly yours,

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

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

enclosure



Department of Water & Natural Resources

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

March 8, 1988

NOTICE

TO: Paul M. Juel, RR 3, Box 21, Canton SD 57013

FROM: John Hatch, Chief Engineer
Water Rights Division
605 773-3352 *John Hatch*

SUBJECT: Amendment of Qualification on Water Permit Application
No. 5145-3 and Notice of Hearing

The Water Management Board amended qualification No. 1 on Application No. 5145-3 at the March 2 and 3, 1988 Board meeting to read as follows:

Approval of this permit is subject to submission of plans and specifications to the chief engineer pursuant to Board Rules Chapter 74:02:08, Safety of Dams for review and approval. A breach analysis and downstream flood routing report shall be completed to determine the hazard classification for the dam. This qualification shall be completed by the May 11 and 12, 1988 Board meeting.

The following information needs to be submitted for review and approval to comply with the above amended qualification:

- 1) A complete set of plans and specifications including a spillway rating curve pursuant to requirements in Chapter 74:02:08 (copy enclosed). The plans and specifications need to be signed by a registered professional engineer.
- 2) A breach analysis with a downstream flood routing report completed by a registered professional engineer.

The information needs to be received by the Water Rights Division by May 11, 1988. If the information has not been received, a hearing will be held at 11:30 am on May 11, 1988 before the Board to consider the violation of the above amended qualification. The agenda time is an estimate. The actual time of hearing may be later than 11:30 am due to prior agenda items. Applicable provisions of the original Notice of hearing dated February 1, 1988 will still apply at this hearing.

cc: Harold Deering, Assistant Attorney General
John Guhin, Assistant Attorney General

CERTIFICATION

I hereby certify that on March 8, 1988 I have personally deposited with the U.S. Mail, a postage prepaid envelope containing Notice of Amendment of Qualification on Water Permit Application No. 5145-3 and Notice of Hearing addressed as stated on the notice.

Karen Schlaak

KAREN SCHLAAK
Senior Secretary

STATE OF SOUTH DAKOTA)
) SS
COUNTY OF HUGHES)

Sworn to, before me, this 9th day of March, 1988.



John H. Hatch
Notary Public

March 23, 1988



Mr. John Hatch
Water Right Dept.
Pierre, SD

Dear Mr. Hatch:

I received your letter regarding the completion of approval for my permit. As I remember the hearing, the motion was made, seconded, and passed by vote, that I was to provide a Breach Analysis for approval of my permit. I verified this with the council members at the time. In your letter you are requesting signed plans, a spillway rating curve, and the Breach Analysis. It was my understanding that the breach analysis was the only requirement made by the board.

I am in the process of contacting engineers to do the breach analysis required. This will be provided prior to the Spring meeting in May as requested.

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

Sincerely,

A handwritten signature in cursive script that reads "Paul M. Juel".

Paul M. Juel
RR 3, Box 21
Canton, SD 57013
(605) 987-5872



Department of Water & Natural Resources

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

March 30, 1988

Paul M. Juel
RR 3, Box 21
Canton, SD 57013

Dear Mr. Juel:

I am writing in response to your letter dated March 21, 1988 concerning the qualifications the Water Management Board placed on your Water Permit Application No. 5145-3.

The Water Management Board amended qualification No.1 on Application 5145-3 at the March 2 and 3, 1988 Board meeting to read as follows:

Approval of this permit is subject to submission of plans and specifications to the chief engineer pursuant to Board Rules Chapter 74:02:08, Safety of Dams for review and approval. A breach analysis and downstream flood routing report shall be completed to determine the hazard classification for the dam. This qualification shall be completed by the May 11 and 12, 1988 Board meeting.

The following information needs to be submitted for review and approval to comply with the above amended qualification:

- 1) A complete set of plans and specifications including a spillway rating curve pursuant to requirements of Chapter 74:02:08. The plans and specifications need to be signed by a registered professional engineer.
- 2) A breach analysis with a downstream flood routing report completed by a registered professional engineer.

If you will remember there was some discussion at the Board Meeting on liability and the situation we would be in if a signed set of plans were not submitted. It was also mentioned that there might be a possibility your contractor could sign off on the SCS plans that were used.

If you have any questions concerning this matter, please contact us.

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



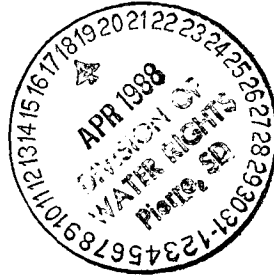
United States
Department of
Agriculture

Soil
Conservation
Service

107 22nd avenue
Brookings SD 57006

Copy

April 7, 1988



Paul M. Juel
Rte. 3, Box 21
Canton, SD 57013

Dear Paul,

Due to the workload and time restraints that have been caused by the Food Security Act, we have to deny your request for assistance with the Breach Analysis of your dam.

Neither our field personnel nor our state and area office specialists have the time available to complete the extensive surveys and computations needed to complete this type of analysis. I would suggest that you contact a consultant engineer in your area to complete this work.

If you have any additional questions please contact Mike Kuck at the Brookings Area Office.

Sincerely,

Gary J. Coplan

Gary J. Coplan
Area Conservationist

cc: Mike Kuck, AE, Brookings, SD
Keith Nelson, SCE, Huron, SD
Bob Lehman, DC, Canton, SD



The Soil Conservation Service
is an agency of the



April 12, 1988



Mr. John Hatch
Chief Engineer
South Dakota Department of
Water and Natural Resources
Water Rights Division
523 East Capitol
Pierre, SD 57501-3181

Dear Mr. Hatch:

Enclosed please find the plans for our dam signed by an engineer per the boards request.

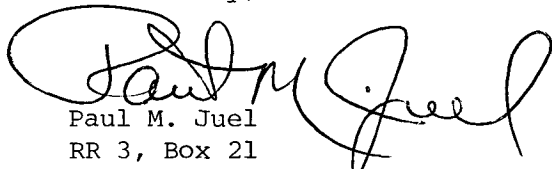
We contacted the Soil Conservation Service with regards to the Breach Analysis and other requirement recently and learned that at this time, they do not have the time to complete the extensive surveys and computations needed to compute the necessary information.

It is our desire to allow the SCS to furnish this information, since we have been working with them on this project for over ten (10) years. After sending the letter to them in March, we placed several calls and finally got in touch with Mike Kuck, AE. We received a letter from the SCS office today explaining that at this time they are too busy to live with the deadline of May 11. Mike Kuck indicated that if we would be able to get an extension, they could complete the required analysis, etc., at a later date when they had more time.

I will continue to be in contact with Mike at the SCS in an effort to pin him down as to how soon they may be able to prepare the Breach Analysis and Spillway Curve.

Perhaps you could let me know when the Board will meet again after the May 11th meeting, if an extension can be granted. Thank you,

Yours truly,


Paul M. Juel
RR 3, Box 21
Canton, SD 57013

 **Department of
Water & Natural Resources**
Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

April 25, 1988

Paul M. Juel
RR 3, Box 21
Canton, SD 57013

Dear Mr. Juel:

I am writing in response to your letter dated April 12, 1988 concerning the submittal of signed plans for your dam and your request for an extension beyond the May 11 and 12, 1988 Water Management Board meeting to submit your Breach Analysis.

The Water Management Board amended qualification No.1 on Application 5145-3 at the March 2 and 3, 1988 Board meeting to read as follows:

Approval of this permit is subject to submission of plans and specifications to the chief engineer pursuant to Board Rules Chapter 74:02:08, Safety of Dams for review and approval. A breach analysis and downstream flood routing report shall be completed to determine the hazard classification for the dam. This qualification shall be completed by the May 11 and 12, 1988 Board meeting.

The following information needs to be submitted for review and approval to comply with the above amended qualification:

- 1) A complete set of plans and specifications including a spillway rating curve pursuant to requirements of Chapter 74:02:08. The plans and specifications need to be signed by a registered professional engineer.
- 2) A breach analysis with a downstream flood routing report completed by a registered professional engineer.

The information you submitted as signed plans cannot be approved. The amended qualification calls for a complete set of plans and specifications signed by a registered professional engineer pursuant to Board Rules Chapter 74:02:08, Safety of Dams. The information you submitted only contains a topographic map of the area and does not appear to have been signed by a registered professional engineer. Also, we cannot issue you an extension of time to submit your breach analysis. The Water Management Board would need to do so.

April 25, 1988

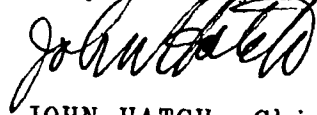
Paul M Juel

Page 2

As stated in the March 8, 1988 NOTICE, if the above information is not received by May 11, 1988; a hearing will be held at 11:30 am on May 11, 1988 before the Board to consider the violation of the above amended qualification.

If you have any questions concerning this matter, please contact us.

Very truly yours,

A handwritten signature in cursive script, appearing to read "John Hatch", written over the typed name.

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



Department of Water & Natural Resources

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

April 29, 1988

Paul M. Juel
RR 3, Box 21
Canton, SD 57013

Dear Mr. Juel:

I am writing in response to your telephone conversation with Tim Schaal April 28, 1988 concerning the difficulty you are having getting signed plans and a breach analysis for your dam before the May 11 and 12, 1988 Water Management Board meeting.

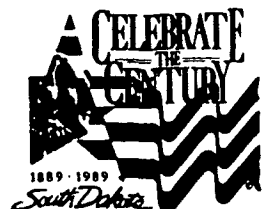
As was discussed, you could request the Board to amend Qualification No. 1 on your application removing the portion pertaining to the submittal of a breach analysis. This request would be based on the fact that we have already completed a breach analysis on your dam and have determined that it will be a Category 3 dam. If the Board would recognize your request and make such an amendment, then you would still need to provide a complete set of plans and specifications including a spillway rating curve signed by a registered professional engineer pursuant to Board Rules Chapter 74:02:08, Safety of Dams.

We are suggesting that you submit a letter to the Water Management Board making your request along with an explanation of your difficulties. Also you should state a specific date when you would be able to submit a signed set of plans and breach analysis if the Board does not amend your permit. You should plan to be present at the Water Management Board meeting to explain your situation to the Board and answer any questions they may have.

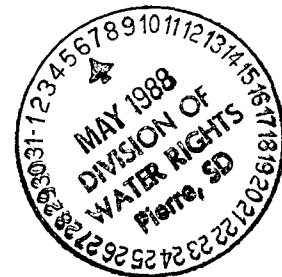
If you have any questions concerning this matter, please contact us.

Very truly yours,

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



May 4, 1988



Water Management Board
Water Rights Division
Joe Foss Building
523 East Capitol
Pierre, SD 57501-3181

Dear Board Members:

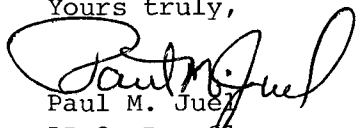
I am writting this letter to make a formal request to the Board to consider amending Qualification No. 1 on my application removing the portion pertaining to the breach analysis. This request is based on the fact that the Water Rights Division has completed a Breach Analysis of their own.

We are making this request because we have contacted many engineering firms regarding the Board's requests and have had no success in getting any definite committment from any of them. We did find one engineering firm with the capabilities to perform a breach analysis but they could only guess that they would be able to get to it sometime in late July.

We have exhausted all possibilities of finding an engineer who would be able to have the information completed by May 11 or 12. We are working on getting the plans signed, and have a committment for a spillway rating curve within the next two to three weeks. However, the breach analysis (as explained to me requires a great deal of time) and could not be provided until late July.

Please, would you give this request your consideration.

Yours truly,


Paul M. Jue
RR 3, Box 21
Canton, SD 57013

SCHMITZ, KALDA & ASSOCIATES

ENGINEERS & LAND SURVEYORS

MUNICIPAL & CIVIL ENGINEERING

WATER SUPPLY - SEWAGE WORKS - INDUSTRIAL WASTES - LAND PLANNING - STREETS - AIRPORTS

260 BOYCE-GREELEY BUILDING - TELEPHONE 332-8241 - SIOUX FALLS, SOUTH DAKOTA 57102

May 11, 1988

Mr. Paul Juel
RR 3, Box 21
Canton, SD 57013

Dear Paul:

This is to certify that we staked your Dam in accordance
with the SCS plans you supplied us with the exception
that the downstream slope was changed from 2.5:1 to 3:1.

Sincerely yours,

SCHMITZ, KALDA & ASSOCIATES, INC.



Kim J. Buell, PE LS
Reg. No. 4190

kkh

 **Department of
Water & Natural Resources**

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

May 13, 1988

NOTICE

TO: Paul Juel, RR 3, Box 21, Canton SD 57013

FROM: John Hatch, Chief Engineer
Water Rights Division
605 773-3352 

SUBJECT: Amendment of Qualification on Water Permit No. 5145-3

The Water Management Board amended qualification No. 1 on Permit No. 5145-3 at the May 11 and 12, 1988 Board meeting to read as follows:

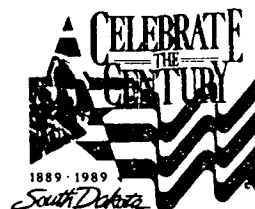
Approval of this permit is subject to submission of plans and specifications to the Chief Engineer pursuant to Board Rules Chapter 74:02:08, Safety of Dams for review and approval. This qualification shall be completed by the October 5, 1988.

The following information needs to be submitted for review and approval to comply with the above amended qualification:

- 1) A complete set of plans and specifications including a spillway rating curve pursuant to requirements in Chapter 74:02:08. The plans and specifications need to be signed by a South Dakota registered professional engineer (SDRPE) or by someone under the supervision of a SDRPE that designs or inspects dams as part of his or her employment.

The Board directed in the amendment that the qualification be completed by October 5, 1988. However, if no indication is given that the qualification will be complied with, then Notice of a hearing time and place will be given approximately two weeks prior to the October 5, 1988 Board meeting.

cc: Harold Deering, Assistant Attorney General
John Guhin, Assistant Attorney General



CERTIFICATION

I hereby certify that on May 13, 1988 I have personally deposited with the U.S. Mail, a postage prepaid envelope containing Notice addressed to:

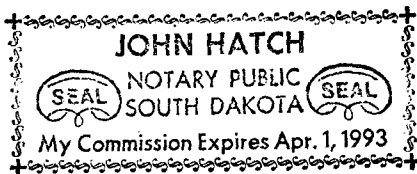
Paul Juel, RR 3, Box 21, Canton SD 57013

Haren Schlaak

KAREN SCHLAAK
Senior Secretary

STATE OF SOUTH DAKOTA)
) SS
COUNTY OF HUGHES)

Sworn to, before me, this 16th day of May, 1988.

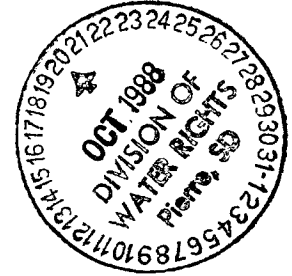


John Hated
Notary Public

DeWild Grant Reckert & Associates Co.

Architecture Engineering and Planning

1113 East 14th Street
Sioux Falls, South Dakota 57104
(605) 339-4157



August 12, 1988

Mr. and Mrs. Paul Juel
RR 3
Canton, SD 57013

RE: Field Survey and Rating Curves for Juel Dam
DGR File 3870

Dear Paul and Judy:

This letter presents the results of our field survey and office calculations for the dam on your farm located about 3 miles northeast of Canton, SD. The dam is located in the southwest quarter of Section 31, T99N, R48W.

Our field work consisted of determining elevations of the crest of the spill tube as well as the bottom of the upstream and downstream ends of the 66" CMP culvert through the dam. We also surveyed a profile of the elevations of the top of the dam as well as an elevation profile of the emergency spillway located at the north end of the dam. We also surveyed four cross sections through the emergency spillway for use in computing a rating curve for the emergency spillway. We also ran a level circuit to the west where the creek feeding the lake crosses the gravel road. We determined the elevations of the bottoms of the twin 62"x102" RCAP culverts as well as the lowest elevation on the top of the gravel road at this location.

The attached drawings show a plan and profile of the dam and a cross section through the emergency spillway. The profile also includes a drawing of the elevation profile along the centerline of the emergency spillway.

We have computed a rating curve for the emergency spillway with the results of our calculations and a graph of the results enclosed with this letter. We have also developed a rating curve for the spill tube.

Our survey shows that the elevations of the bottoms of the twin culverts at the gravel road at the west line of Section 31 are 1298.8 on the downstream side and 1299.3 on the upstream side. The elevation of the low point of the gravel road near the twin culverts is 1308.7. In comparison, the crest of the spill tube is at elevation 1300.0, the top of dam elevation varies from 1307.8 to 1309.2, and the emergency spillway is about 1306.0.

August 12, 1988
Mr. and Mrs. Paul Juel
Page 2

During our field work, we observed that the 66" CMP culvert through the dam has deflected substantially under the weight of the earthfill dam. At the center of the dam we measured the inside of the pipe to be 4.8' vertically and 6.2' horizontally (the undeflected pipe at each end is round with an inside diameter of 5.5'). It is not normal for this much deflection to occur in a properly designed and constructed CMP culvert. It is possible that the life expectancy of the CMP culvert may be in jeopardy with this much deflection. We suggest that you further investigate this situation with the Contractor, pipe supplier, and/or Soil Conservation Service to determine whether corrective action is needed and/or who would be responsible for replacing the CMP culvert should it structurally fail sometime in the future.

As shown by the profile of the top of dam, the top of dam has a low point over the culvert. This depression may have resulted from the deformation which has occurred in the CMP culvert below. After any corrective action which may be done to the culvert is completed, we recommend that this low area in the dam be filled so that it is level with the rest of the top of dam (about elevation 1308.5).

During the field work, we also noted that there is some erosion occurring on the face of the dam. We understand that you have attempted to get grass growing on the face of the dam but have been unsuccessful due to the drought conditions which have occurred this spring and summer. We would recommend that you continue your efforts this fall or next spring to get grass growing on the face of the dam to control erosion on the face. Also, we would recommend that no trees be planted on the dam itself and that any trees which may start growing naturally on the face or top of the dam be removed.

As indicated by the drawings, our field survey has revealed that the dam was constructed within reasonable tolerances of the planned dimensions and elevations shown on the copy of the construction drawings which you provided us. We understand that you are interested in the possibility of raising the elevation of the crest of the spill tube, in order to increase the normal elevation of the lake surface. We can understand your interest since at the present time the lake is about 2.3' below the crest of the spill tube as a result of the drought conditions that have occurred this spring and summer. It appears to us that it is indeed possible to accomplish this by simply welding some additional pipe onto the existing 96" CMP spill tube so that the lake surface must reach a higher elevation before it overflows and drains into the creek below. We suggest that you request permission for such raising from the SD Department of Natural Resources in Pierre. With the information that we have developed during

August 12, 1988
Mr. and Mrs. Paul Juel
Page 3

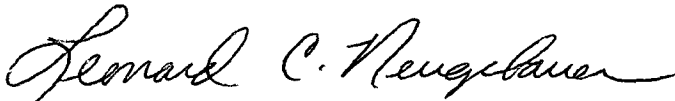
our field survey and with the rating curves provided with this letter, they will be able to evaluate the technical feasibility of such raising and advise you whether they can grant you a permit to make this alteration.

Before raising the crest of the spill tube, we suggest that you should also consider the impact of such raising of the lake level on the evergreen trees which you have planted on the high area upstream of the north end of the dam. These trees may die if inundated for a significant period of time by a higher lake surface.

We thank you for the opportunity to assist you in this matter. If you have any further questions or comments, please let us know.

Sincerely yours,

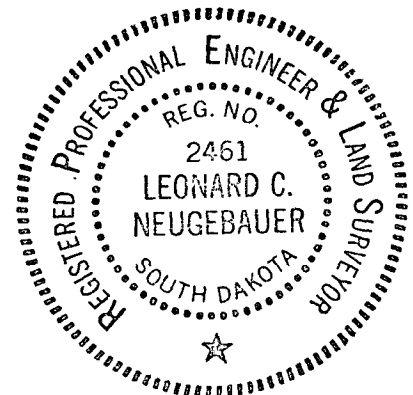
DEWILD GRANT RECKERT
& ASSOCIATES COMPANY



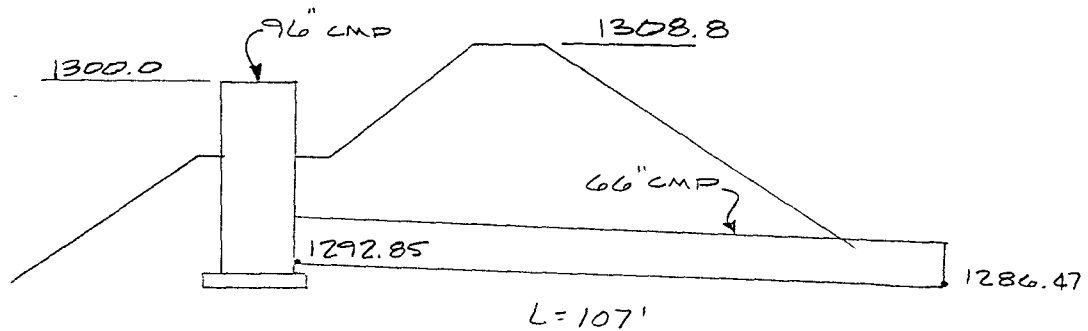
Leonard C. Neugebauer, PE/LS
Project Manager

Enclosures

LCN:cg



PIPE CAPACITY - 66" CMP



$$S = \frac{1292.85 - 1286.47}{107} \times 100 = 5.96\% = S$$

$$n = .025$$

$$HW = 1300'$$

DAM OVERTOPS.

$$\frac{HW}{d} \text{ USE } .25, .50, .75, 1.0, 1.3, 2.0, 2.43, 2.9$$

↑ SPILLWAY OVERTOPS.

WEIR FLOW OVER 96" CMP PIPE -

$$Q = CLH^{3/2} \quad C = 3.0 \quad L = \pi \left(\frac{96}{12} \right) = 25.1327$$

| HEADWATER | H FT | Q CFS |
|-----------|------|-------|
| 1301 | 1 | 75.4 |
| 1302 | 2 | 214 |
| 1303 | 3 | 392 |
| 1304 | 4 | 603 |
| 1305 | 5 | 843 |
| 1306 | 6 | 1108 |
| 1306.2 | 6.2 | 1164 |
| 1308 | 8 | 1706 |
| 1308.8 | 8.8 | 1968 |
| 1310 | 10 | 2384 |

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

Culvert Diameter (feet) 5.5
 FHWA Chart Number (1,2 or 3) 2
 Scale Number on Chart (Type of Culvert Entrance) 1
 Manning's Roughness Coefficient (n-value) .025
 Entrance Loss Coefficient of Culvert Opening 0.5
 Culvert Length (feet) 107
 Culvert Slope (feet per foot) .0596

*** RESULTS ***

| Flow Rate
(cfs) | Tailwater
Depth(ft) | ..Headwater (ft)..
In.Ctrl. Out.Ctrl. | Normal
Depth(ft) | Critical
Depth(ft) | Depth at
Outlet(ft) | Outlet
Vel.(fps) |
|--------------------|------------------------|--|---------------------|-----------------------|------------------------|---------------------|
| 50.00 | 2.00 | 2.66/295.51-2.47 | 1.27 | 1.93 | 1.27 | 12.01 |
| 100.00 | 2.50 | 3.98/296.83-1.48 | 1.81 | 2.76 | 1.81 | 14.67 |
| 150.00 | 3.00 | 5.17/298.02-0.21 | 2.25 | 3.42 | 2.25 | 16.39 |
| 200.00 | 3.50 | 6.47/299.32-1.40 | 2.65 | 3.96 | 2.65 | 17.66 |
| 250.00 | 4.50 | 7.98/300.83-3.34 | 3.03 | 4.41 | 3.03 | 18.65 |
| 300.00 | 5.50 | 9.83/302.65-5.98 | 3.40 | 4.77 | 3.40 | 19.43 |
| 350.00 | 5.50 | 12.01/304.86-8.45 | 3.80 | 5.02 | 3.80 | 20.00 |
| 400.00 | 5.50 | 14.53/307.38-11.31 | 4.22 | 5.19 | 4.22 | 20.44 |
| 450.00 | 5.50 | 17.38/310.23-14.54 | 4.83 | 5.30 | 4.83 | 20.34 |
| 500.00 | 5.50 | 20.57/313.42-18.16 | 5.50 | 5.37 | 5.50 | 21.05 |

Enter Flow Rate and Tailwater, or Press the <Esc> Key to End

5. Bend Loss

Energy loss due to bends in a sewer system is in addition to the normal wall friction loss in conduit flow.

$$h_b = K_b \left[\frac{V^2}{2g} \right]$$

$$\text{where } K_b = 0.25 \sqrt{\frac{\phi}{90}}$$

ϕ = central angle of bend (degrees)

Hence, for a given diameter, the greater the helix angle, the less the friction factor. For a given helix, the greater the diameter, the less the friction factor.

The values in Table 4b are based on standard helical pipe manufactured from a 24-in. net-width strip of steel. However, the pipes tested were of a smaller diameter for a given helix angle. Further research may show even lower values when larger diameters of standard helical pipe for a given helix angle are taken into account.

MANNING'S "n"

Accepted values for Manning's "n" for CSP and structural plate as verified through research and model testing are given in Tables 4a and 4b.

Coefficients of Friction for Structural Plate

Early model studies by the U.S. Corps of Engineers, and analyses of the same, had been the basis for friction factors of structural plate for several years.

In 1968, full-scale measurements, the first of their kind, were made on a 1500-ft. long 14-ft. diameter structural plate pipe line in Lake Michigan. These measurements indicated a lower friction factor than those derived from model studies. As a result, the recommended values of Manning's "n" for structural plate pipe of 10-ft. diameter and larger have been modified as shown in Table 4a. The values for the smaller diameters remain as they were.

Coefficients of Friction for Helical CSP

Tests by the St. Anthony Falls Hydraulic Laboratory of the University of Minnesota, in 1969, have determined that the "n" value for spiral pipe varies directly with the diameter of the pipe. The reason for this is that on small diameter pipes the spiral corrugations form a smaller angle with the axis of the pipe than they do on the larger diameters. This small angle produces a spiral flow which reduces the friction factor.

Table 4a

Coefficients of Friction (n) for Structural Plate
(Manning's Formula)

| Corrugations
6" x 2" | Diameters | | | |
|-------------------------|-----------|-------|--------|--------|
| | 5 ft. | 7 ft. | 10 ft. | 15 ft. |
| Plain — unpaved | .033 | .032 | .030 | .028 |
| 25% Paved | .028 | .027 | .026 | .024 |

Table 4b

Coefficients of Friction (n) for Corrugated Steel Pipe (CSP)
(Manning's Formula)

| Corrugations | Riveted
2 2/3" x 1/2" | Helical | | | | | | | | | |
|--------------|--------------------------|---------------|------|---------------|------|------|------|------|------|------|----------|
| | | 1 1/2" x 1/4" | | 2 2/3" x 1/2" | | | | | | | |
| | All Diam. | 8" | 10" | 12" | 15" | 18" | 21" | 24" | 36" | 48" | 60"-120" |
| Unpaved | .024 | .012 | .014 | .012 | .013 | .014 | .015 | .016 | .018 | .020 | .024 |
| 25% Paved | .021 | | | | | | | .015 | .017 | .020 | .021 |
| Fully Paved | .012 | | | | | | | .012 | .012 | .012 | .012 |

| Corrugations | Riveted
3" x 1" | Helical — 3" x 1" | | | | | | | |
|--------------|--------------------|-------------------|------|------|------|------|------|-----|------|
| | | All Diam. | | | | | | | |
| | All Diam. | 36" | 48" | 54" | 60" | 66" | 72" | 78" | 144" |
| Unpaved | .027 | .021 | .023 | .023 | .024 | .025 | .026 | | .027 |
| 25% Paved | .023 | .019 | .020 | .020 | .021 | .022 | .022 | | .023 |
| Fully Paved | .012 | .012 | .012 | .012 | .012 | .012 | .012 | | .012 |

PAUL JUEL DAM
OUTLET RATING CURVE

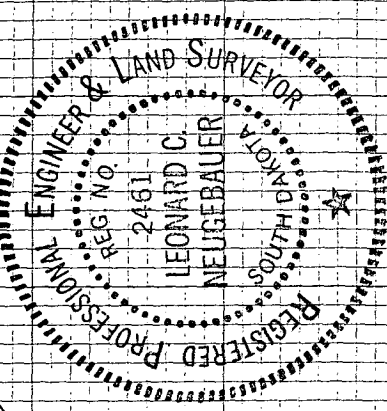
TOP OF DAM 1308.8

CREST OF SPILLWAY 1306.2

WEIR CONTROLS

60" CMP
CONTROLS

Leonard C. Neugebauer



2500

2000

1500

1000

500

0

DISCHARGE CFS

THIS RUN EXECUTED 08-10-88

 HEC2 RELEASE DATED NOV 76 UPDATED MAY 1984
 ERROR CORR - 01.02.03.04.05.06
 MODIFICATION - 50.51.52.53.54.55.56
 IBM-PC-XT VERSION AUGUST 1985

TILINCOLN COUNTY DAM STUDY FOR PAUL JUEL
 T28Y DEWILD GRANT RECKERT AND ASSOCIATES CO., SIOUX FALLS, SD JOB 3870
 T3JUUEL DAM

| J1 | ICHECK | INQ | NINQ | IDIR | STRT | METRIC | HVINS | Q | WSEL | FQ |
|----|--------|-----|------|-----------|------|--------|-------|----------|------|----|
| 40 | 2. | 0. | 0. | -1.000000 | .00 | .0 | 0. | 1308.000 | .000 | |

| J2 | NPROF | IPLOT | PRFVS | XSECV | XSECH | FN | ALLDC | IBW | CHNIM | ITRACE |
|----|-------|-------|--------|-------|-------|------|-------|------|-------|--------|
| 1 | 1.000 | .000 | -1.000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |

J3 VARIABLE CODES FOR SUMMARY PRINTOUT

| | | | | | | | | | |
|--------|-------|--------|-------|--------|--------|--------|-------|--------|--------|
| 38.000 | 1.000 | 42.000 | 8.000 | 50.000 | 53.000 | 54.000 | 4.000 | 25.000 | 43.000 |
|--------|-------|--------|-------|--------|--------|--------|-------|--------|--------|

| | | | | | | | | | |
|--------|--------|--------|------|--------|-------|--------|-------|-------|-------|
| 35.000 | 60.000 | 59.000 | .000 | 38.000 | 1.000 | 10.000 | 3.000 | 5.000 | 2.000 |
|--------|--------|--------|------|--------|-------|--------|-------|-------|-------|

| | | | | | | | | | |
|--------|--------|--------|--------|--------|--------|--------|---------|---------|------|
| 11.000 | 12.000 | 34.000 | 43.000 | 55.000 | 26.000 | 56.000 | 100.000 | 201.000 | .000 |
|--------|--------|--------|--------|--------|--------|--------|---------|---------|------|

*****REQUESTED SECTION NUMBERS*****

J5 LPRINT NUMSEC

| | | | | | | | | | |
|----|----------|---------|----------|---------|----------|----------|----------|--------|----------|
| NC | .035 | .035 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| QT | 6.000 | 250.000 | 500.000 | 750.000 | 1000.000 | 1500.000 | 2000.000 | .000 | .000 |
| X1 | 50.000 | 6.000 | .000 | 113.000 | .000 | .000 | .000 | .000 | .000 |
| GR | 1304.700 | .000 | 1305.000 | 25.000 | 1305.100 | 50.000 | 1305.000 | 75.000 | 1304.400 |
| GR | 1305.300 | 113.000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |

| | | | | | | | | | |
|----|----------|---------|----------|---------|----------|--------|----------|--------|----------|
| X1 | 110.000 | 6.000 | .000 | 108.000 | 60.000 | 60.000 | 60.000 | .000 | .000 |
| GR | 1306.100 | .000 | 1305.800 | 25.000 | 1305.700 | 50.000 | 1305.400 | 75.000 | 1305.500 |
| GR | 1307.400 | 108.000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |

| | | | | | | | | | |
|----|----------|---------|----------|---------|----------|---------|----------|---------|----------|
| X1 | 180.000 | 9.000 | 700.000 | 853.000 | 70.000 | 70.000 | 70.000 | .000 | .000 |
| GR | 1309.200 | 700.000 | 1306.800 | 730.000 | 1305.800 | 750.000 | 1305.800 | 775.000 | 1306.100 |
| GR | 1306.200 | 825.000 | 1306.200 | 831.000 | 1308.800 | 844.000 | 1308.800 | 853.000 | .000 |

| | | | | | | | | | |
|----|----------|---------|----------|---------|----------|---------|----------|--------|----------|
| X1 | 280.000 | 7.000 | .000 | 133.000 | 100.000 | 100.000 | 100.000 | .000 | .000 |
| GR | 1306.100 | .000 | 1305.700 | 25.000 | 1305.900 | 50.000 | 1306.300 | 75.000 | 1306.300 |
| GR | 1306.600 | 115.000 | 1309.000 | 133.000 | .000 | .000 | .000 | .000 | .000 |

1 08-10-88 09:54:42

PAGE 2

| | | | | | | | | | |
|----|----------|---------|----------|---------|----------|---------|----------|---------|----------|
| X1 | 550.000 | 11.000 | .000 | 315.000 | 270.000 | 270.000 | 270.000 | .000 | .000 |
| GR | 1307.000 | .000 | 1302.000 | 25.000 | 1298.000 | 40.000 | 1294.000 | 52.000 | 1290.000 |
| GR | 1290.000 | 84.000 | 1294.000 | 110.000 | 1298.000 | 180.000 | 1302.000 | 230.000 | 1306.000 |
| GR | 1310.000 | 315.000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| EJ | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |

THIS RUN EXECUTED 08-10-88

 HEC2 RELEASE DATED NOV 76 UPDATED MAY 1984
 ERROR CORR - 01.02.03.04.05.06
 MODIFICATION - 50.51.52.53.54.55.56
 IBM-PC-XI VERSION AUGUST 1985

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

AM

SUMMARY PRINTOUT

| SECNO | CWSEL | ELMIN | DEPTH | DIFWSP | SSTA | ENDST | TOPWID | AREA | Q | QLOBP | QCHP | QROBP |
|-----------|---------|---------|-------|--------|--------|--------|--------|---------|---------|-------|--------|-------|
| * 50.000 | 1305.43 | 1304.40 | 1.03 | .00 | .00 | 113.00 | 113.00 | 59.52 | 250.00 | .00 | 100.00 | .00 |
| * 50.000 | 1305.74 | 1304.40 | 1.34 | .31 | .00 | 113.00 | 113.00 | 94.79 | 500.00 | .00 | 100.00 | .00 |
| * 50.000 | 1306.01 | 1304.40 | 1.61 | .26 | .00 | 113.00 | 113.00 | 124.49 | 750.00 | .00 | 100.00 | .00 |
| * 50.000 | 1306.24 | 1304.40 | 1.84 | .23 | .00 | 113.00 | 113.00 | 150.96 | 1000.00 | .00 | 100.00 | .00 |
| * 50.000 | 1306.66 | 1304.40 | 2.26 | .41 | .00 | 113.00 | 113.00 | 197.79 | 1500.00 | .00 | 100.00 | .00 |
| * 50.000 | 1307.03 | 1304.40 | 2.63 | .37 | .00 | 113.00 | 113.00 | 239.83 | 2000.00 | .00 | 100.00 | .00 |
| 110.000 | 1306.42 | 1305.40 | 1.02 | .00 | .00 | 101.36 | 101.36 | 73.51 | 250.00 | .00 | 100.00 | .00 |
| 110.000 | 1306.76 | 1305.40 | 1.36 | .34 | .00 | 103.62 | 103.62 | 107.34 | 500.00 | .00 | 100.00 | .00 |
| 110.000 | 1307.01 | 1305.40 | 1.61 | .25 | .00 | 105.36 | 105.36 | 133.93 | 750.00 | .00 | 100.00 | .00 |
| 110.000 | 1307.22 | 1305.40 | 1.82 | .21 | .00 | 106.78 | 106.78 | 155.90 | 1000.00 | .00 | 100.00 | .00 |
| * 110.000 | 1307.59 | 1305.40 | 2.19 | .37 | .00 | 108.00 | 108.00 | 195.93 | 1500.00 | .00 | 100.00 | .00 |
| * 110.000 | 1307.97 | 1305.40 | 2.57 | .38 | .00 | 108.00 | 108.00 | 237.08 | 2000.00 | .00 | 100.00 | .00 |
| 180.000 | 1306.97 | 1305.80 | 1.17 | .00 | 727.85 | 834.86 | 107.01 | 95.16 | 250.00 | .00 | 100.00 | .00 |
| 180.000 | 1307.45 | 1305.80 | 1.65 | .48 | 721.87 | 837.25 | 115.38 | 148.35 | 500.00 | .00 | 100.00 | .00 |
| 180.000 | 1307.84 | 1305.80 | 2.04 | .39 | 717.03 | 839.19 | 122.16 | 194.32 | 750.00 | .00 | 100.00 | .00 |
| 180.000 | 1308.19 | 1305.80 | 2.39 | .35 | 712.59 | 840.96 | 128.38 | 238.85 | 1000.00 | .00 | 100.00 | .00 |
| 180.000 | 1308.85 | 1305.80 | 3.05 | .65 | 704.42 | 853.00 | 148.58 | 326.83 | 1500.00 | .00 | 100.00 | .00 |
| 180.000 | 1309.38 | 1305.80 | 3.58 | .53 | 700.00 | 853.00 | 153.00 | 407.03 | 2000.00 | .00 | 100.00 | .00 |
| 280.000 | 1307.28 | 1305.70 | 1.58 | .00 | .00 | 120.10 | 120.10 | 139.73 | 250.00 | .00 | 100.00 | .00 |
| 280.000 | 1307.82 | 1305.70 | 2.12 | .54 | .00 | 124.12 | 124.12 | 205.14 | 500.00 | .00 | 100.00 | .00 |
| 280.000 | 1308.25 | 1305.70 | 2.55 | .42 | .00 | 127.32 | 127.32 | 258.73 | 750.00 | .00 | 100.00 | .00 |
| 280.000 | 1308.61 | 1305.70 | 2.91 | .36 | .00 | 130.07 | 130.07 | 305.94 | 1000.00 | .00 | 100.00 | .00 |
| 280.000 | 1309.25 | 1305.70 | 3.55 | .64 | .00 | 133.00 | 133.00 | 391.22 | 1500.00 | .00 | 100.00 | .00 |
| 280.000 | 1309.75 | 1305.70 | 4.05 | .50 | .00 | 133.00 | 133.00 | 458.06 | 2000.00 | .00 | 100.00 | .00 |
| 550.000 | 1307.34 | 1290.00 | 17.34 | .00 | .00 | 285.13 | 285.13 | 2556.71 | 250.00 | .00 | 100.00 | .00 |
| 550.000 | 1307.94 | 1290.00 | 17.94 | .60 | .00 | 291.86 | 291.86 | 2729.34 | 500.00 | .00 | 100.00 | .00 |
| 550.000 | 1308.42 | 1290.00 | 18.42 | .47 | .00 | 297.17 | 297.17 | 2868.44 | 750.00 | .00 | 100.00 | .00 |
| 550.000 | 1308.82 | 1290.00 | 18.82 | .41 | .00 | 301.78 | 301.78 | 2991.13 | 1000.00 | .00 | 100.00 | .00 |
| 550.000 | 1309.55 | 1290.00 | 19.55 | .72 | .00 | 309.94 | 309.94 | 3212.87 | 1500.00 | .00 | 100.00 | .00 |
| 550.000 | 1310.14 | 1290.00 | 20.14 | .59 | .00 | 315.00 | 315.00 | 3396.99 | 2000.00 | .00 | 100.00 | .00 |

Spillout
 Riser
 Curb

AM

SUMMARY PRINTOUT

6 OF 8

08-10-88 09:54:42

AM

SUMMARY PRINTOUT

| SECNO | CWSEL | HV | EG | 10K*5 | CRWS | HL | OLSS | .OLK | Q | VLOB | VCH | VR08 |
|-----------|---------|------|---------|--------|---------|-----|------|---------|---------|------|------|------|
| * 50.000 | 1305.43 | .27 | 1305.71 | 232.58 | 1305.43 | .00 | .00 | 16.39 | 250.00 | .00 | 4.20 | .00 |
| * 50.000 | 1305.74 | .43 | 1305.74 | 198.65 | 1305.74 | .00 | .00 | 35.48 | 500.00 | .00 | 5.27 | .00 |
| * 50.000 | 1306.01 | .56 | 1306.57 | 181.28 | 1306.01 | .00 | .00 | 55.70 | 750.00 | .00 | 6.02 | .00 |
| * 50.000 | 1306.24 | .88 | 1306.92 | 170.40 | 1306.24 | .00 | .00 | 76.61 | 1000.00 | .00 | 6.62 | .00 |
| * 50.000 | 1306.66 | .89 | 1307.55 | 157.26 | 1306.66 | .00 | .00 | 119.61 | 1500.00 | .00 | 7.58 | .00 |
| * 50.000 | 1307.03 | 1.08 | 1308.11 | 148.31 | 1307.03 | .00 | .00 | 164.23 | 2000.00 | .00 | 8.34 | .00 |
| 110.000 | 1306.42 | .18 | 1306.60 | 98.97 | .00 | .87 | .03 | 25.13 | 250.00 | .00 | 3.40 | .00 |
| 110.000 | 1306.76 | .34 | 1307.10 | 115.94 | .00 | .89 | .03 | 46.44 | 500.00 | .00 | 4.66 | .00 |
| 110.000 | 1307.01 | .49 | 1307.50 | 127.99 | .00 | .91 | .02 | 66.29 | 750.00 | .00 | 5.60 | .00 |
| * 110.000 | 1307.22 | .64 | 1307.86 | 139.96 | .00 | .92 | .01 | 84.53 | 1000.00 | .00 | 6.41 | .00 |
| * 110.000 | 1307.59 | .91 | 1308.50 | 150.27 | 1307.59 | .92 | .01 | 122.37 | 1500.00 | .00 | 7.66 | .00 |
| * 110.000 | 1307.97 | 1.11 | 1309.08 | 142.82 | 1307.97 | .87 | .01 | 167.35 | 2000.00 | .00 | 8.44 | .00 |
| 180.000 | 1306.97 | .11 | 1307.07 | 44.83 | .00 | .45 | .02 | 37.34 | 250.00 | .00 | 2.63 | .00 |
| 180.000 | 1307.45 | .18 | 1307.63 | 45.17 | .00 | .48 | .05 | 74.40 | 500.00 | .00 | 3.37 | .00 |
| 180.000 | 1307.84 | .23 | 1308.07 | 44.61 | .00 | .49 | .08 | 112.29 | 750.00 | .00 | 3.86 | .00 |
| 180.000 | 1308.19 | .27 | 1308.47 | 42.62 | .00 | .50 | .11 | 153.18 | 1000.00 | .00 | 4.19 | .00 |
| 180.000 | 1308.85 | .33 | 1309.17 | 40.99 | .00 | .50 | .17 | 234.28 | 1500.00 | .00 | 4.59 | .00 |
| 180.000 | 1309.38 | .37 | 1309.75 | 36.69 | .00 | .45 | .22 | 330.18 | 2000.00 | .00 | 4.91 | .00 |
| 280.000 | 1307.28 | .05 | 1307.33 | 14.71 | .00 | .24 | .02 | 65.18 | 250.00 | .00 | 1.79 | .00 |
| 280.000 | 1307.82 | .09 | 1307.91 | 17.19 | .00 | .26 | .03 | 120.58 | 500.00 | .00 | 2.44 | .00 |
| 280.000 | 1308.25 | .13 | 1308.38 | 18.54 | .00 | .27 | .03 | 174.19 | 750.00 | .00 | 2.90 | .00 |
| 280.000 | 1308.61 | .17 | 1308.77 | 19.46 | .00 | .28 | .03 | 226.67 | 1000.00 | .00 | 3.27 | .00 |
| 280.000 | 1309.25 | .23 | 1309.48 | 20.05 | .00 | .28 | .03 | 335.02 | 1500.00 | .00 | 3.83 | .00 |
| 280.000 | 1309.75 | .30 | 1310.05 | 21.27 | .00 | .27 | .02 | 433.63 | 2000.00 | .00 | 4.37 | .00 |
| 550.000 | 1307.34 | .00 | 1307.34 | .00 | .00 | .00 | .01 | 4646.28 | 250.00 | .00 | .10 | .00 |
| 550.000 | 1307.94 | .00 | 1307.94 | .01 | .00 | .00 | .03 | 5094.66 | 500.00 | .00 | .18 | .00 |
| 550.000 | 1308.42 | .00 | 1308.42 | .02 | .00 | .00 | .04 | 5463.52 | 750.00 | .00 | .26 | .00 |
| 550.000 | 1308.82 | .00 | 1308.83 | .03 | .00 | .00 | .05 | 5794.25 | 1000.00 | .00 | .33 | .00 |
| 550.000 | 1309.55 | .00 | 1309.55 | .05 | .00 | .01 | .07 | 6404.33 | 1500.00 | .00 | .47 | .00 |
| 550.000 | 1310.14 | .01 | 1310.14 | .08 | .00 | .01 | .09 | 6942.78 | 2000.00 | .00 | .59 | .00 |

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SUMMARY PRINTOUT TABLE 100

| SECNO | EGLWC | ELLC | EGPRS | ELTRD | QPR | QMEIR | CLASS | H3 | DEPTH | CWSEL | VCH | EG |
|-------|-------|------|-------|-------|-----|-------|-------|----|-------|-------|-----|----|
|-------|-------|------|-------|-------|-----|-------|-------|----|-------|-------|-----|----|

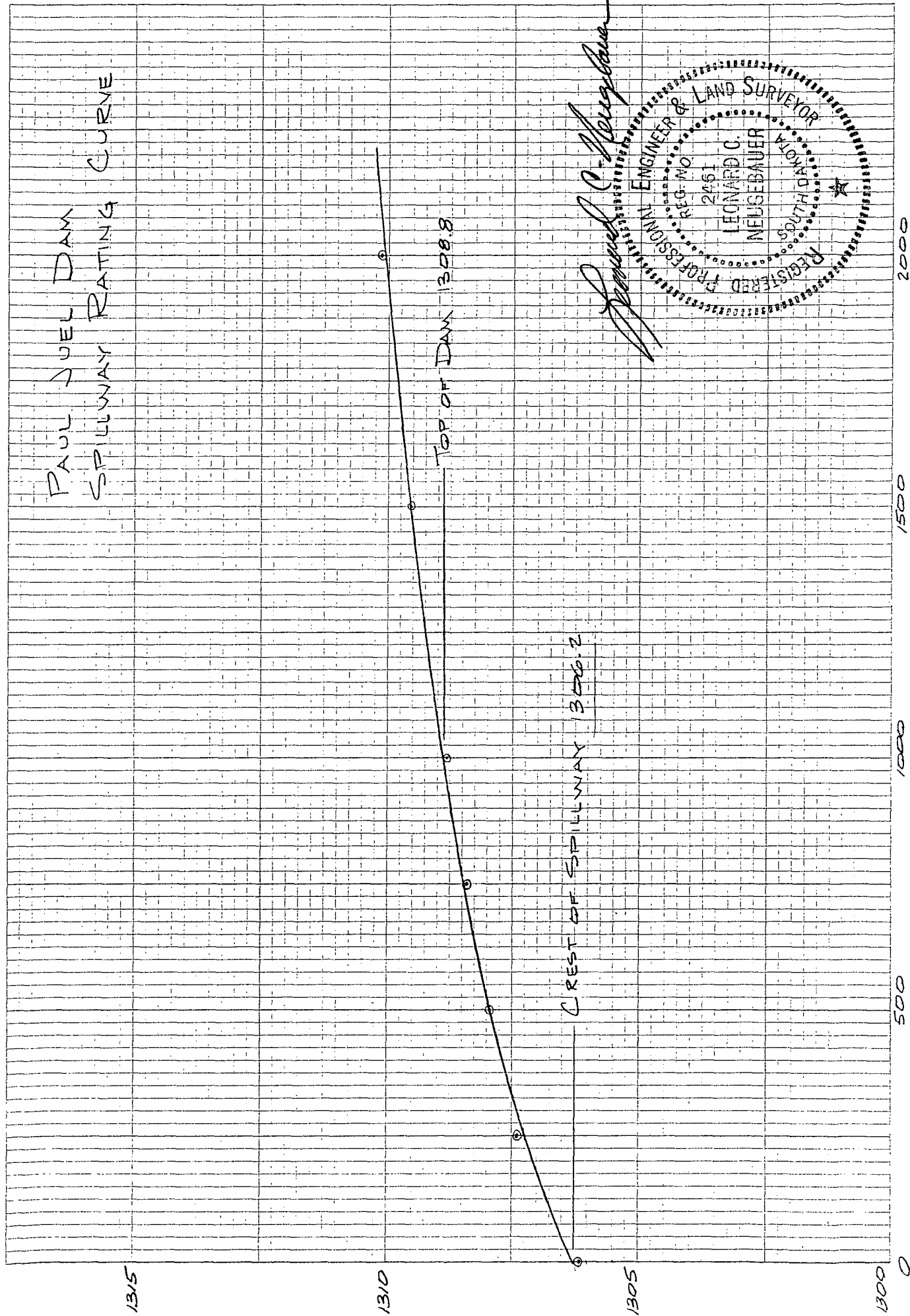
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PAGE 11

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO= 50.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 50.000 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 50.000 PROFILE= 3 CRITICAL DEPTH ASSUMED

PAUL JUEL DAM SPILLWAY RATING CURVE



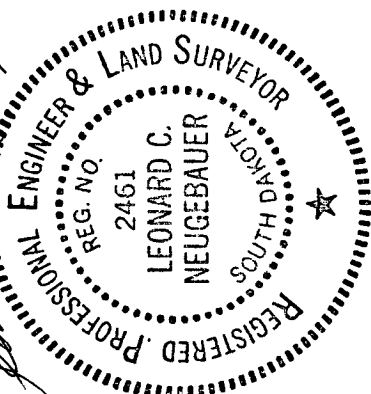
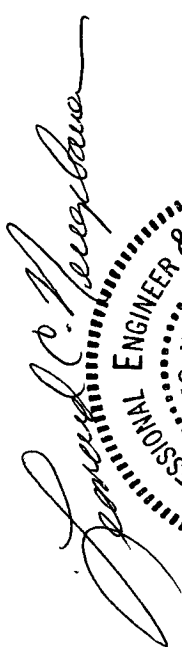


Rock Rapids, Iowa
Sioux City, Iowa
Sioux Falls, South Dakota



Project Number
3870
Sheet

JUEL DAM
SW 1/4 SEC 31
T99N-R48W
LINCOLN CO. SD.





Department of Water & Natural Resources

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

September 22, 1988

NOTICE

TO: Paul M Juel, RR 3, Box 21 Canton SD 57013

FROM: John Hatch, Chief Engineer
Water Rights Division
605 773-3352
John Hatch
by James Hunter

SUBJECT: Noncompliance with Amendment of Qualification on Water
Permit No. 5145-3

The Water Management Board amended qualification No. 1 on Permit No. 5145-3 at the May 11 and 12, 1988 Board meeting to read as follows:

Approval of this permit is subject to submission of plans and specifications to the Chief Engineer pursuant to Board Rules Chapter 74:02:08, Safety of Dams for review and approval. This qualification shall be completed by the October 5, 1988 Board meeting.

The following information needs to be submitted for review and approval to comply with the above amended qualification:

A complete set of plans and specifications including a spillway rating curve pursuant to requirements in Chapter 74:02:08. The plans and specifications need to be signed by a South Dakota registered professional engineer (SDRPE) or by someone under the supervision of a SDRPE that designs or inspects dams as part of his or her employment.

The Water Rights Division received the spillway rating curve, a cross-section diagram and spillway flow calculations for the dam on August 30, 1988. Additional information is needed to complete the plans and specifications as outlined in Chapter 74:02:08. The portions of the plans and specifications received on August 30, 1988 are not complete without the signature of a SDRPE or by someone under the supervision of a SDRPE as described above.

The Water Management Board will consider the noncompliance with the amended qualification at a hearing to be held at 9:45 am on October 6, 1988 in Room 216, Joe Foss Building, 523 E Capitol, Pierre SD. The agenda time is an estimate. The actual time of hearing may be later than 9:45 am due to prior agenda items. Applicable provisions of the original Notice of hearing dated February 1, 1988 will still apply at this hearing. The hearing to be held October 6, 1988 will be cancelled subject to receipt, review and approval of a complete set of plans and specifications. The plans and specifications will need to be received by October 3, 1988 to allow adequate time to review the plans and specifications.

CERTIFICATION

I hereby certify that on September 22, 1988 I have personally deposited with the U.S. Mail, a postage prepaid envelope containing a Notice on Noncompliance with Amendment of Qualification on Water Permit No. 5145-3 addressed as follows:

Paul M Juel, RR 3, Box 21, Canton SD 57013

Karen Schlaak
KAREN SCHLAACK
Senior Secretary

STATE OF SOUTH DAKOTA)
) SS
COUNTY OF HUGHES)

Sworn to, before me, this 23rd day of September 1988.



John Walsh
Notary Public



Department of Water & Natural Resources

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

September 22, 1988

NOTICE

TO: Paul M Juel, RR 3, Box 21 Canton SD 57013

FROM: John Hatch, Chief Engineer
Water Rights Division
605 773-3352

SUBJECT: Noncompliance with Amendment of Qualification on Water
Permit No. 5145-3

John Hatch
by James Venturini

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The following information needs to be submitted for review and approval to comply with the above amended qualification:

A complete set of plans and specifications including a spillway rating curve pursuant to requirements in Chapter 74:02:08. The plans and specifications need to be signed by a South Dakota registered professional engineer (SDRPE) or by someone under the supervision of a SDRPE that designs or inspects dams as part of his or her employment.

The Water Rights Division received the spillway rating curve, a cross-section diagram and spillway flow calculations for the dam on August 30, 1988. Additional information is needed to complete the plans and specifications as outlined in Chapter 74:02:08. The portions of the plans and specifications received on August 30, 1988 are not complete without the signature of a SDRPE or by someone under the supervision of a SDRPE as described above.

The Water Management Board will consider the noncompliance with the amended qualification at a hearing to be held at 9:45 am on October 6, 1988 in Room 216, Joe Foss Building, 523 E Capitol, Pierre SD. The agenda time is an estimate. The actual time of hearing may be later than 9:45 am due to prior agenda items. Applicable provisions of the original Notice of hearing dated February 1, 1988 will still apply at this hearing. The hearing to be held October 6, 1988 will be cancelled subject to receipt, review and approval of a complete set of plans and specifications. The plans and specifications will need to be received by October 3, 1988 to allow adequate time to review the plans and specifications.

**Department of
Water & Natural Resources**

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

October 18, 1988

Leonard C. Neugebauer, PE/LS
Project Manager
DeWild, Grant, Reckert & Associates Co.
1113 East 14th Street
Sioux Falls, SD 57104

Dear Mr. Neugebauer:

I am writing in reference to the Field Survey and Rating Curves you prepared for the dam Paul Juel constructed near Canton.

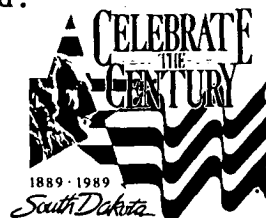
Water Permit No. 5145-3 was approved on September 9, 1987 authorizing the construction of the dam with the following qualification.

Approval of this permit is subject to submission of plans and specifications to the chief engineer pursuant to Board Rules Chapter 74:02:08, Safety of Dams for review and approval. A breach analysis and downstream flood routing report shall be completed to determine the hazard classification for the dam.

The plans and specifications need to be signed by a South Dakota registered professional engineer (SDRPE) pursuant to SDCL 36-18, or a person under the supervision of a SDRPE who designs and inspects dams as part of his or her employment.

At the May 11 and 12, 1988 Water Management Board meeting the Board amended the qualification to remove the breach analysis requirement. This was based on the fact that the staff had already performed a breach analysis and determined that the classification of Juel Dam would be a Low Hazard, Category 3 dam.

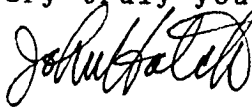
At the October 5 and 6, 1988 Water Management Board meeting the Board recognized Mr. Juel's difficulties in obtaining a complete set of plans and specifications. The Board made a motion to accept your field survey and rating curves as a final as built inspection if we could obtain your signature and professional registration seal on them. The Board would then consider the above qualification satisfied with your final inspection along with the preliminary design information we have received.



October 18, 1988
Leonard C. Neugebauer
Page 2

Enclosed is your Field Survey and Rating Curves, please attach your professional registration seal to them and return them to our office. If you have any questions, please contact our office or Mr. Juel.

Very truly yours,

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

John Hatch, Chief Engineer
Water Rights Division
605 773-3352

cc: Paul Juel

DeWild Grant Reckert & Associates Co.
Architecture Engineering and Planning

1113 East 14th Street
Sioux Falls, South Dakota 57104
(605) 339-4157

August 12, 1988

Mr. and Mrs. Paul Juel
RR 3
Canton, SD 57013

RE: Field Survey and Rating Curves for Juel Dam
DGR File 3870

Dear Paul and Judy:

This letter presents the results of our field survey and office calculations for the dam on your farm located about 3 miles northeast of Canton, SD. The dam is located in the southwest quarter of Section 31, T99N, R48W.

Our field work consisted of determining elevations of the crest of the spill tube as well as the bottom of the upstream and downstream ends of the 66" CMP culvert through the dam. We also surveyed a profile of the elevations of the top of the dam as well as an elevation profile of the emergency spillway located at the north end of the dam. We also surveyed four cross sections through the emergency spillway for use in computing a rating curve for the emergency spillway. We also ran a level circuit to the west where the creek feeding the lake crosses the gravel road. We determined the elevations of the bottoms of the twin 62"x102" RCAP culverts as well as the lowest elevation on the top of the gravel road at this location.

The attached drawings show a plan and profile of the dam and a cross section through the emergency spillway. The profile also includes a drawing of the elevation profile along the centerline of the emergency spillway.

We have computed a rating curve for the emergency spillway with the results of our calculations and a graph of the results enclosed with this letter. We have also developed a rating curve for the spill tube.

Our survey shows that the elevations of the bottoms of the twin culverts at the gravel road at the west line of Section 31 are 1298.8 on the downstream side and 1299.3 on the upstream side. The elevation of the low point of the gravel road near the twin culverts is 1308.7. In comparison, the crest of the spill tube is at elevation 1300.0, the top of dam elevation varies from 1307.8 to 1309.2, and the emergency spillway is about 1306.0.

August 12, 1988
Mr. and Mrs. Paul Juel
Page 2

During our field work, we observed that the 66" CMP culvert through the dam has deflected substantially under the weight of the earthfill dam. At the center of the dam we measured the inside of the pipe to be 4.8' vertically and 6.2' horizontally (the undeflected pipe at each end is round with an inside diameter of 5.5'). It is not normal for this much deflection to occur in a properly designed and constructed CMP culvert. It is possible that the life expectancy of the CMP culvert may be in jeopardy with this much deflection. We suggest that you further investigate this situation with the Contractor, pipe supplier, and/or Soil Conservation Service to determine whether corrective action is needed and/or who would be responsible for replacing the CMP culvert should it structurally fail sometime in the future.

As shown by the profile of the top of dam, the top of dam has a low point over the culvert. This depression may have resulted from the deformation which has occurred in the CMP culvert below. After any corrective action which may be done to the culvert is completed, we recommend that this low area in the dam be filled so that it is level with the rest of the top of dam (about elevation 1308.5).

During the field work, we also noted that there is some erosion occurring on the face of the dam. We understand that you have attempted to get grass growing on the face of the dam but have been unsuccessful due to the drought conditions which have occurred this spring and summer. We would recommend that you continue your efforts this fall or next spring to get grass growing on the face of the dam to control erosion on the face. Also, we would recommend that no trees be planted on the dam itself and that any trees which may start growing naturally on the face or top of the dam be removed.

As indicated by the drawings, our field survey has revealed that the dam was constructed within reasonable tolerances of the planned dimensions and elevations shown on the copy of the construction drawings which you provided us. We understand that you are interested in the possibility of raising the elevation of the crest of the spill tube, in order to increase the normal elevation of the lake surface. We can understand your interest since at the present time the lake is about 2.3' below the crest of the spill tube as a result of the drought conditions that have occurred this spring and summer. It appears to us that it is indeed possible to accomplish this by simply welding some additional pipe onto the existing 96" CMP spill tube so that the lake surface must reach a higher elevation before it overflows and drains into the creek below. We suggest that you request permission for such raising from the SD Department of Natural Resources in Pierre. With the information that we have developed during

August 12, 1988
Mr. and Mrs. Paul Juel
Page 3

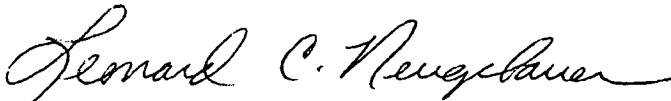
our field survey and with the rating curves provided with this letter, they will be able to evaluate the technical feasibility of such raising and advise you whether they can grant you a permit to make this alteration.

Before raising the crest of the spill tube, we suggest that you should also consider the impact of such raising of the lake level on the evergreen trees which you have planted on the high area upstream of the north end of the dam. These trees may die if inundated for a significant period of time by a higher lake surface.

We thank you for the opportunity to assist you in this matter. If you have any further questions or comments, please let us know.

Sincerely yours,

DEWILD GRANT RECKERT
& ASSOCIATES COMPANY

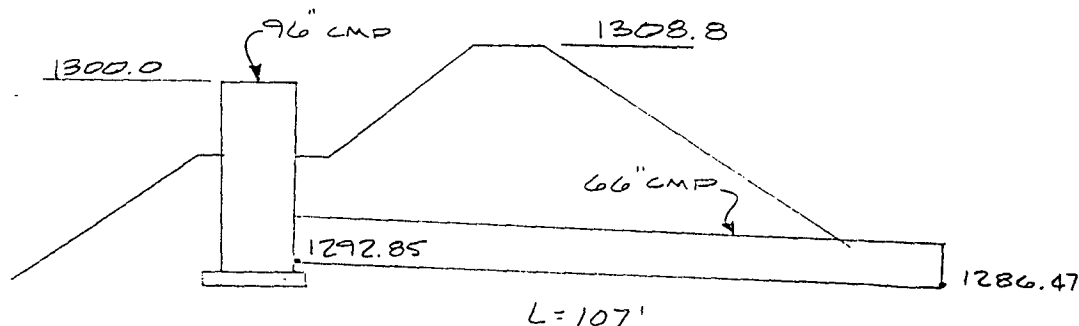
A handwritten signature in cursive script, reading "Leonard C. Neugebauer".

Leonard C. Neugebauer, PE/LS
Project Manager

Enclosures

LCN:cg

PIPE CAPACITY - 66" CMP



$$S = \frac{1292.85 - 1286.47}{107} \times 100 = 5.96\% = S$$

$$n = .025$$

$$H_w = 1300'$$

DAM OVERTOPS.

$\frac{H_w}{d}$

USE .25, .50, .75, 1.0, 1.3, 2.0, 2.43, 2.9

↑ SPILLWAY OVERTOPS.

WEIR FLOW OVER 96" CMP PIPE -

$$Q = CLH^{3/2} \quad C = 3.0 \quad L = \pi \left(\frac{96}{12} \right) = 25.1327$$

| <u>HEADWATER</u> | <u>H FT</u> | <u>Q CFS</u> |
|------------------|-------------|--------------|
| 1301 | 1 | 75.4 |
| 1302 | 2 | 214 |
| 1303 | 3 | 392 |
| 1304 | 4 | 603 |
| 1305 | 5 | 843 |
| 1306 | 6 | 1108 |
| 1306.2 | 6.2 | 1164 |
| 1308 | 8 | 1706 |
| 1308.8 | 8.8 | 1968 |
| 1310 | 10 | 2384 |

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

| | |
|--|-------|
| Culvert Diameter (feet) | 5.5 |
| FHWA Chart Number (1,2 or 3) | 2 |
| Scale Number on Chart (Type of Culvert Entrance) | 1 |
| Manning's Roughness Coefficient (n-value) | .025 |
| Entrance Loss Coefficient of Culvert Opening | 0.5 |
| Culvert Length (feet) | 107 |
| Culvert Slope (feet per foot) | .0596 |

*** RESULTS ***

| Flow Rate
(cfs) | Tailwater
Depth(ft) | ..Headwater (ft)..
In.Ctrl. Out.Ctrl. | Normal
Depth(ft) | Critical
Depth(ft) | Depth at
Outlet(ft) | Outlet
Vel.(fps) |
|--------------------|------------------------|--|---------------------|-----------------------|------------------------|---------------------|
| 50.00 | 2.00 | 2.66/275.51-2.47 | 1.27 | 1.93 | 1.27 | 12.01 |
| 100.00 | 2.50 | 3.98/296.83-1.48 | 1.81 | 2.76 | 1.81 | 14.67 |
| 150.00 | 3.00 | 5.17/298.02-0.21 | 2.25 | 3.42 | 2.25 | 16.39 |
| 200.00 | 3.50 | 6.47/299.32-1.40 | 2.65 | 3.96 | 2.65 | 17.66 |
| 250.00 | 4.50 | 7.98/300.83-3.34 | 3.03 | 4.41 | 3.03 | 18.65 |
| 300.00 | 5.50 | 9.83/302.62-5.98 | 3.40 | 4.77 | 3.40 | 19.43 |
| 350.00 | 5.50 | 12.01/304.26-8.45 | 3.80 | 5.02 | 3.80 | 20.00 |
| 400.00 | 5.50 | 14.53/307.32-11.31 | 4.22 | 5.19 | 4.22 | 20.44 |
| 450.00 | 5.50 | 17.38/310.23-14.54 | 4.83 | 5.30 | 4.83 | 20.34 |
| 500.00 | 5.50 | 20.57/313.42-18.16 | 5.50 | 5.37 | 5.50 | 21.05 |

Enter Flow Rate and Tailwater, or Press the <Esc> Key to End

5. Bend Loss

Energy loss due to bends in a sewer system is in addition to the normal wall friction loss in conduit flow.

$$h_b = K_b \left[\frac{V^2}{2g} \right]$$

$$\text{where } K_b = 0.25 \sqrt{\frac{\phi}{90}}$$

ϕ = central angle of bend (degrees)

Hence, for a given diameter, the greater the helix angle, the less the friction factor. For a given helix, the greater the diameter, the less the friction factor.

The values in Table 4b are based on standard helical pipe manufactured from a 24-in. net-width strip of steel. However, the pipes tested were of a smaller diameter for a given helix angle. Further research may show even lower values when larger diameters of standard helical pipe for a given helix angle are taken into account.

MANNING'S "n"

Accepted values for Manning's "n" for CSP and structural plate as verified through research and model testing are given in Tables 4a and 4b.

Coefficients of Friction for Structural Plate

Early model studies by the U.S. Corps of Engineers, and analyses of the same, had been the basis for friction factors of structural plate for several years.

In 1968, full-scale measurements, the first of their kind, were made on a 1500-ft. long 14-ft. diameter structural plate pipe line in Lake Michigan. These measurements indicated a lower friction factor than those derived from model studies. As a result, the recommended values of Manning's "n" for structural plate pipe of 10-ft. diameter and larger have been modified as shown in Table 4a. The values for the smaller diameters remain as they were.

Coefficients of Friction for Helical CSP

Tests by the St. Anthony Falls Hydraulic Laboratory of the University of Minnesota, in 1969, have determined that the "n" value for spiral pipe varies directly with the diameter of the pipe. The reason for this is that on small diameter pipes the spiral corrugations form a smaller angle with the axis of the pipe than they do on the larger diameters. This small angle produces a spiral flow which reduces the friction factor.

Table 4a

Coefficients of Friction (n) for Structural Plate
(Manning's Formula)

| Corrugations
6" x 2" | Diameters | | | |
|-------------------------|-----------|-------|--------|--------|
| | 5 ft. | 7 ft. | 10 ft. | 15 ft. |
| Plain — unpaved | .033 | .032 | .030 | .028 |
| 25% Paved | .028 | .027 | .026 | .024 |

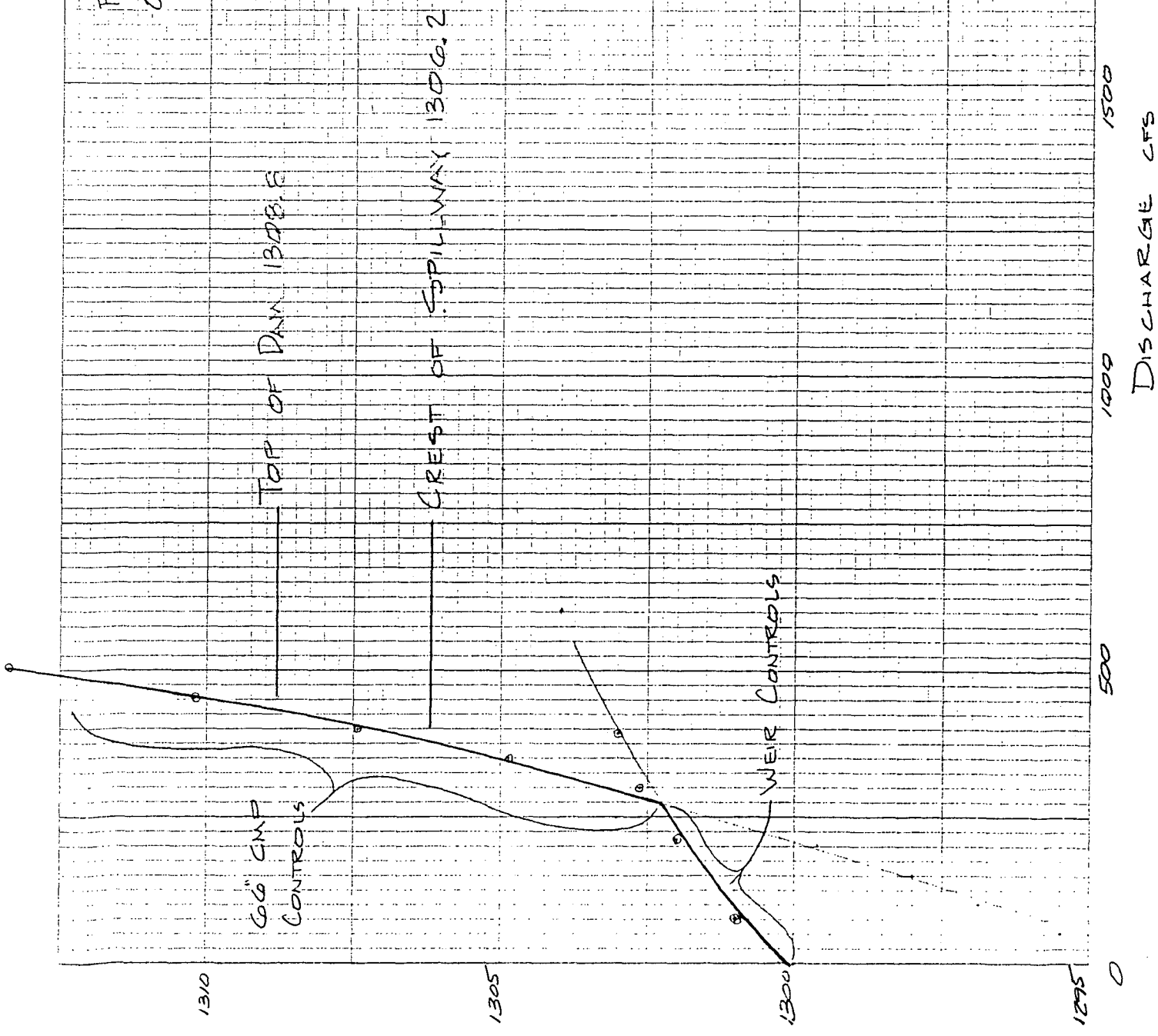
Table 4b

Coefficients of Friction (n) for Corrugated Steel Pipe (CSP)
(Manning's Formula)

| Corrugations | Riveted
2 2/3" x 1/2" | Helical | | | | | | | | | |
|--------------|--------------------------|---------------|------|---------------|------|------|------|------|------|------|----------|
| | | 1 1/2" x 1/4" | | 2 2/3" x 1/2" | | | | | | | |
| | All Diam. | 8" | 10" | 12" | 15" | 18" | 21" | 24" | 36" | 48" | 60"-120" |
| Unpaved | .024 | .012 | .014 | .012 | .013 | .014 | .015 | .016 | .018 | .020 | .024 |
| 25% Paved | .021 | | | | | | | .015 | .017 | .020 | .021 |
| Fully Paved | .012 | | | | | | | .012 | .012 | .012 | .012 |

| Corrugations | Riveted
3" x 1" | Helical — 3" x 1" | | | | | | |
|--------------|--------------------|-------------------|------|------|------|------|------|----------|
| | | 36" | 48" | 54" | 60" | 66" | 72" | 78"-144" |
| Unpaved | .027 | .021 | .023 | .023 | .024 | .025 | .026 | .027 |
| 25% Paved | .023 | .019 | .020 | .020 | .021 | .022 | .022 | .023 |
| Fully Paved | .012 | .012 | .012 | .012 | .012 | .012 | .012 | .012 |

PAUL JUEL DAM OUTLET RATING CURVE



THIS RUN EXECUTED 08-10-88

```
*****  
HEC2 RELEASE DATED NOV 76 UPDATED MAY 1984  
ERROR CORR - 01.02.03.04.05.06  
MODIFICATION - 50.51.52.53.54.55.56  
IBM-PC-XT VERSION AUGUST 1985  
*****
```

T1LINCOLN COUNTY DAM STUDY FOR PAUL JUEL
T2BY DEWILD GRANT RECKERT AND ASSOCIATES CO., SIOUX FALLS, SD
T3JUEL DAM
JOB 3870

| J1 | ICHECK | INO | NINV | IDIR | STAT | METRIC | HVINS | Q | WSEL | FQ |
|----|--------|-------|--------|-------|-----------|--------|-------|--------|-------|--------|
| J2 | NPROF | IPLOT | PRFVS | XSECV | XSECH | FN | ALLDC | IBW | CHNIM | ITRACE |
| | 1.000 | .000 | -1.000 | .000 | .000 | .00 | .0 | 0.1309 | .000 | .000 |
| | 40 | 2. | 0. | 0. | -1.000000 | .00 | .0 | 0.1309 | .000 | .000 |

J3 VARIABLE CODES FOR SUMMARY PRINTOUT.

| | | | | | | | | | |
|--------|--------|--------|---------|----------|--------|----------|---------|----------|--------|
| 38.000 | 1.000 | 42.000 | 8.000 ✓ | 50.000 ✓ | 53.000 | 54.000 | 4.000 | 25.000 ✓ | 43.000 |
| 35.000 | 60.000 | 59.000 | 0.000 | 38.000 | 1.000 | 10.000 | 3.000 | 5.000 ✓ | 2.000 |
| 11.000 | 12.000 | 34.000 | 43.000 | 55.000 | 26.000 | 56.000 ✓ | 100.000 | 201.000 | 0.000 |

```

JS  LPRNT      NUMSEC *****REQUESTED SECTION NUMBERS*****

```

| | -10..000 | -10..000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
|----|-----------|-----------|-----------|-----------|-----------|-----------|----------|-----------|----------|
| NC | .035 | .035 | .300 | .500 | .000 | .000 | .000 | .000 | .000 |
| QT | 6..000 | 500..000 | 750..000 | 1000..000 | 1500..000 | 2000..000 | .000 | .000 | .000 |
| X1 | 50..000 | 6..000 | 113..000 | .000 | .000 | .000 | .000 | .000 | .000 |
| GR | 1304..700 | 1305..000 | 25..000 | 1305..100 | 50..000 | 1305..000 | 75..000 | 1304..400 | 100..000 |
| GR | 1305..300 | 113..000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| X1 | 110..000 | 6..000 | 108..000 | 60..000 | 60..000 | 60..000 | .000 | .000 | .000 |
| GR | 1306..100 | 1305..800 | 25..000 | 1305..700 | 50..000 | 1305..400 | 75..000 | 1305..500 | 95..000 |
| GR | 1307..400 | 108..000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| X1 | 180..000 | 9..000 | 853..000 | 70..000 | 70..000 | 70..000 | .000 | .000 | .000 |
| GR | 1309..200 | 700..000 | 730..000 | 1305..800 | 750..000 | 1305..800 | 775..000 | 1306..100 | 800..000 |
| GR | 1306..200 | 825..000 | 831..000 | 1308..800 | 844..000 | 1308..800 | 853..000 | .000 | .000 |
| X1 | 280..000 | 7..000 | 133..000 | 100..000 | 100..000 | 100..000 | .000 | .000 | .000 |
| GR | 1306..100 | .000 | 1305..700 | 1305..900 | 50..000 | 1306..300 | 75..000 | 1306..300 | 100..000 |
| GR | 1306..600 | 115..000 | 1309..000 | 133..000 | .000 | .000 | .000 | .000 | .000 |

[illegible]

08-10-88 09:54:42

THIS RUN EXECUTED 08-10-88

 HEC2 RELEASE DATED NOV 76 UPDATED MAY 1984
 ERROR CORR - 01,02,03,04,05,06
 MODIFICATION - 50,51,52,53,54,55,56
 IBM-PC-XT VERSION AUGUST 1985

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

AM

SUMMARY PRINTOUT

| SECCNO | CWSEL | ELMIN | DEPTH | DIFWSP | SSTA | ENOST | TOPWID | AREA | Q | QL08P | QCHP | QRQBP |
|-----------|---------|---------|-------|--------|--------|--------|--------|---------|---------|-------|--------|-------|
| * 50.000 | 1305.43 | 1304.40 | 1.03 | .00 | .00 | 113.00 | 113.00 | 59.52 | 250.00 | .00 | 100.00 | .00 |
| * 50.000 | 1305.74 | 1304.40 | 1.34 | .31 | .00 | 113.00 | 113.00 | 94.79 | 500.00 | .00 | 100.00 | .00 |
| * 50.000 | 1306.01 | 1304.40 | 1.61 | .26 | .00 | 113.00 | 113.00 | 124.49 | 750.00 | .00 | 100.00 | .00 |
| * 50.000 | 1306.24 | 1304.40 | 1.84 | .23 | .00 | 113.00 | 113.00 | 150.96 | 1000.00 | .00 | 100.00 | .00 |
| * 50.000 | 1306.66 | 1304.40 | 2.26 | .41 | .00 | 113.00 | 113.00 | 197.79 | 1500.00 | .00 | 100.00 | .00 |
| * 50.000 | 1307.03 | 1304.40 | 2.63 | .37 | .00 | 113.00 | 113.00 | 239.83 | 2000.00 | .00 | 100.00 | .00 |
| 110.000 | 1306.42 | 1305.40 | 1.02 | .00 | .00 | 101.36 | 101.36 | 73.51 | 250.00 | .00 | 100.00 | .00 |
| 110.000 | 1306.76 | 1305.40 | 1.36 | .34 | .00 | 103.62 | 103.62 | 107.34 | 500.00 | .00 | 100.00 | .00 |
| 110.000 | 1307.01 | 1305.40 | 1.61 | .25 | .00 | 105.36 | 105.36 | 133.93 | 750.00 | .00 | 100.00 | .00 |
| 110.000 | 1307.22 | 1305.40 | 1.82 | .21 | .00 | 106.78 | 106.78 | 155.90 | 1000.00 | .00 | 100.00 | .00 |
| * 110.000 | 1307.59 | 1305.40 | 2.19 | .37 | .00 | 108.00 | 108.00 | 195.93 | 1500.00 | .00 | 100.00 | .00 |
| * 110.000 | 1307.97 | 1305.40 | 2.57 | .38 | .00 | 108.00 | 108.00 | 237.08 | 2000.00 | .00 | 100.00 | .00 |
| 180.000 | 1306.97 | 1305.80 | 1.17 | .00 | 727.85 | 834.86 | 107.01 | 95.16 | 250.00 | .00 | 100.00 | .00 |
| 180.000 | 1307.45 | 1305.80 | 1.65 | .48 | 721.87 | 837.25 | 115.38 | 148.35 | 500.00 | .00 | 100.00 | .00 |
| 180.000 | 1307.84 | 1305.80 | 2.04 | .39 | 717.03 | 839.19 | 122.16 | 194.32 | 750.00 | .00 | 100.00 | .00 |
| 180.000 | 1308.19 | 1305.80 | 2.39 | .35 | 712.59 | 840.96 | 128.38 | 238.85 | 1000.00 | .00 | 100.00 | .00 |
| 180.000 | 1308.85 | 1305.80 | 3.05 | .65 | 704.42 | 853.00 | 148.58 | 326.83 | 1500.00 | .00 | 100.00 | .00 |
| 180.000 | 1309.38 | 1305.80 | 3.58 | .53 | 700.00 | 853.00 | 153.00 | 407.03 | 2000.00 | .00 | 100.00 | .00 |
| 280.000 | 1307.28 | 1305.70 | 1.58 | .00 | .00 | 120.10 | 120.10 | 139.73 | 250.00 | .00 | 100.00 | .00 |
| 280.000 | 1307.82 | 1305.70 | 2.12 | .54 | .00 | 124.12 | 124.12 | 205.14 | 500.00 | .00 | 100.00 | .00 |
| 280.000 | 1308.25 | 1305.70 | 2.55 | .42 | .00 | 127.32 | 127.32 | 258.73 | 750.00 | .00 | 100.00 | .00 |
| 280.000 | 1308.61 | 1305.70 | 2.91 | .36 | .00 | 130.07 | 130.07 | 305.94 | 1000.00 | .00 | 100.00 | .00 |
| 280.000 | 1309.25 | 1305.70 | 3.55 | .64 | .00 | 133.00 | 133.00 | 391.22 | 1500.00 | .00 | 100.00 | .00 |
| 290.000 | 1309.75 | 1305.70 | 4.05 | .50 | .00 | 133.00 | 133.00 | 458.06 | 2000.00 | .00 | 100.00 | .00 |
| 550.000 | 1307.34 | 1290.00 | 17.34 | .00 | .00 | 285.13 | 285.13 | 2556.71 | 250.00 | .00 | 100.00 | .00 |
| 550.000 | 1307.94 | 1290.00 | 17.94 | .60 | .00 | 291.86 | 291.86 | 2729.34 | 500.00 | .00 | 100.00 | .00 |
| 550.000 | 1308.42 | 1290.00 | 18.42 | .47 | .00 | 297.17 | 297.17 | 2868.44 | 750.00 | .00 | 100.00 | .00 |
| 550.000 | 1308.82 | 1290.00 | 18.82 | .41 | .00 | 301.78 | 301.78 | 2991.13 | 1000.00 | .00 | 100.00 | .00 |
| 550.000 | 1309.55 | 1290.00 | 19.55 | .72 | .00 | 309.94 | 309.94 | 3212.87 | 1500.00 | .00 | 100.00 | .00 |
| 550.000 | 1310.14 | 1290.00 | 20.14 | .59 | .00 | 315.00 | 315.00 | 3396.99 | 2000.00 | .00 | 100.00 | .00 |

08-10-88 09:54:42

AM

SUMMARY PRINTOUT

08-10-83 09:54:42

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AM

SUMMARY PRINTOUT

| SECTNO | CWSEL | HV | EG | 10K*S | CRIWS | HL | OLOSS | .01K | Q | VLOB | VCH | VR0B |
|-----------|---------|------|---------|--------|---------|-----|-------|---------|---------|------|------|------|
| * 50.000 | 1305.43 | .27 | 1305.71 | 232.58 | 1305.43 | .00 | .00 | 16.39 | 250.00 | .00 | 4.20 | .00 |
| * 50.000 | 1305.74 | .43 | 1306.18 | 198.65 | 1305.74 | .00 | .00 | 35.48 | 500.00 | .00 | 5.27 | .00 |
| * 50.000 | 1306.01 | .56 | 1306.57 | 181.28 | 1306.01 | .00 | .00 | 55.70 | 750.00 | .00 | 6.02 | .00 |
| * 50.000 | 1306.24 | .68 | 1306.92 | 170.40 | 1306.24 | .00 | .00 | 76.61 | 1000.00 | .00 | 6.62 | .00 |
| * 50.000 | 1306.66 | .89 | 1307.55 | 157.26 | 1306.66 | .00 | .00 | 119.61 | 1500.00 | .00 | 7.58 | .00 |
| * 50.000 | 1307.03 | 1.08 | 1308.11 | 148.31 | 1307.03 | .00 | .00 | 164.23 | 2000.00 | .00 | 8.34 | .00 |
| 110.000 | 1306.42 | .18 | 1306.60 | 98.97 | .00 | .87 | .03 | 25.13 | 250.00 | .00 | 3.40 | .00 |
| 110.000 | 1306.76 | .34 | 1307.10 | 115.94 | .00 | .89 | .03 | 46.44 | 500.00 | .00 | 4.66 | .00 |
| 110.000 | 1307.01 | .49 | 1307.50 | 127.99 | .00 | .91 | .02 | 66.29 | 750.00 | .00 | 5.60 | .00 |
| 110.000 | 1307.22 | .64 | 1307.86 | 139.96 | .00 | .92 | .01 | 84.53 | 1000.00 | .00 | 6.41 | .00 |
| * 110.000 | 1307.59 | .91 | 1308.50 | 150.27 | 1307.59 | .92 | .01 | 122.37 | 1500.00 | .00 | 7.66 | .00 |
| * 110.000 | 1307.97 | 1.11 | 1309.08 | 142.82 | 1307.97 | .87 | .01 | 167.35 | 2000.00 | .00 | 8.44 | .00 |
| 180.000 | 1306.97 | .11 | 1307.07 | 44.83 | .00 | .45 | .02 | 37.34 | 250.00 | .00 | 2.63 | .00 |
| 180.000 | 1307.45 | .18 | 1307.63 | 45.17 | .00 | .48 | .05 | 74.40 | 500.00 | .00 | 3.37 | .00 |
| 180.000 | 1307.84 | .23 | 1308.07 | 44.61 | .00 | .49 | .08 | 112.29 | 750.00 | .00 | 3.86 | .00 |
| 180.000 | 1308.19 | .27 | 1308.47 | 42.62 | .00 | .50 | .11 | 153.18 | 1000.00 | .00 | 4.19 | .00 |
| 180.000 | 1308.85 | .33 | 1309.17 | 40.99 | .00 | .50 | .17 | 234.28 | 1500.00 | .00 | 4.59 | .00 |
| 180.000 | 1309.38 | .37 | 1309.75 | 36.69 | .00 | .45 | .22 | 330.18 | 2000.00 | .00 | 4.91 | .00 |
| 280.000 | 1307.28 | .05 | 1307.33 | 14.71 | .00 | .24 | .02 | 65.18 | 250.00 | .00 | 1.79 | .00 |
| 280.000 | 1307.82 | .09 | 1307.91 | 17.19 | .00 | .26 | .03 | 120.58 | 500.00 | .00 | 2.44 | .00 |
| 280.000 | 1308.25 | .13 | 1308.38 | 18.54 | .00 | .27 | .03 | 174.19 | 750.00 | .00 | 2.90 | .00 |
| 280.000 | 1308.61 | .17 | 1308.77 | 19.46 | .00 | .28 | .03 | 226.67 | 1000.00 | .00 | 3.27 | .00 |
| 280.000 | 1309.25 | .23 | 1309.48 | 20.05 | .00 | .28 | .03 | 335.02 | 1500.00 | .00 | 3.83 | .00 |
| 280.000 | 1309.75 | .30 | 1310.05 | 21.27 | .00 | .27 | .02 | 433.63 | 2000.00 | .00 | 4.37 | .00 |
| 550.000 | 1307.34 | .00 | 1307.34 | .00 | .00 | .00 | .01 | 4646.28 | 250.00 | .00 | .10 | .00 |
| 550.000 | 1307.94 | .00 | 1307.94 | .01 | .00 | .00 | .03 | 5094.66 | 500.00 | .00 | .18 | .00 |
| 550.000 | 1308.42 | .00 | 1308.42 | .02 | .00 | .00 | .04 | 5463.52 | 750.00 | .00 | .26 | .00 |
| 550.000 | 1308.82 | .00 | 1308.83 | .03 | .00 | .00 | .05 | 5794.25 | 1000.00 | .00 | .33 | .00 |
| 550.000 | 1309.55 | .00 | 1309.55 | .05 | .00 | .01 | .07 | 6404.33 | 1500.00 | .00 | .47 | .00 |
| 550.000 | 1310.14 | .01 | 1310.14 | .08 | .00 | .01 | .09 | 6942.78 | 2000.00 | .00 | .59 | .00 |

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SUMMARY PRINTOUT TABLE 100

| SECTNO | EGLWC | ELLC | EGPRS | ELTRD | QPR | QWEIR | CLASS | H3 | DEPTH | CWSEL | VCH | EG |
|--------|-------|------|-------|-------|-----|-------|-------|----|-------|-------|-----|----|
|--------|-------|------|-------|-------|-----|-------|-------|----|-------|-------|-----|----|

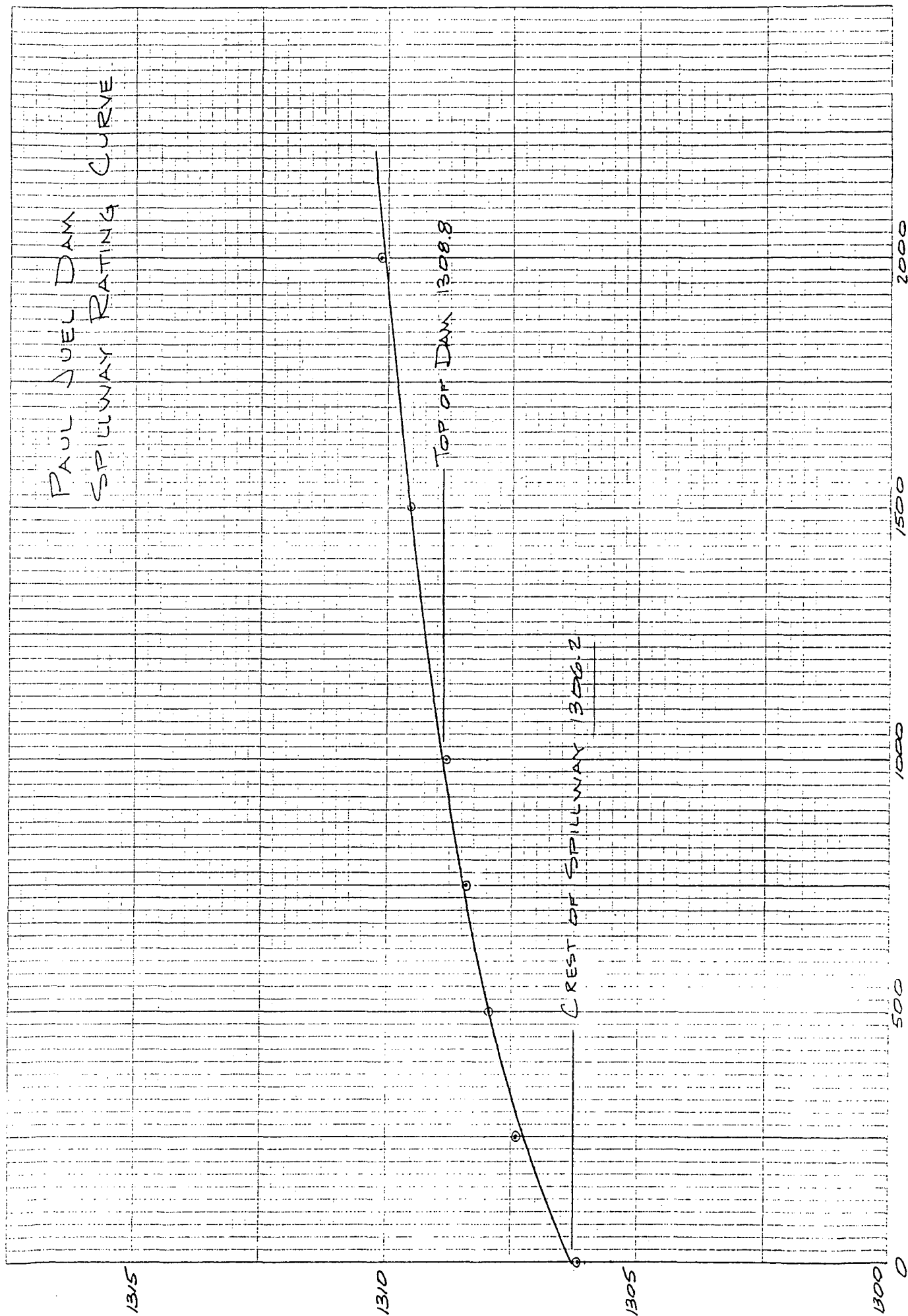
08-10-83 09:54:42

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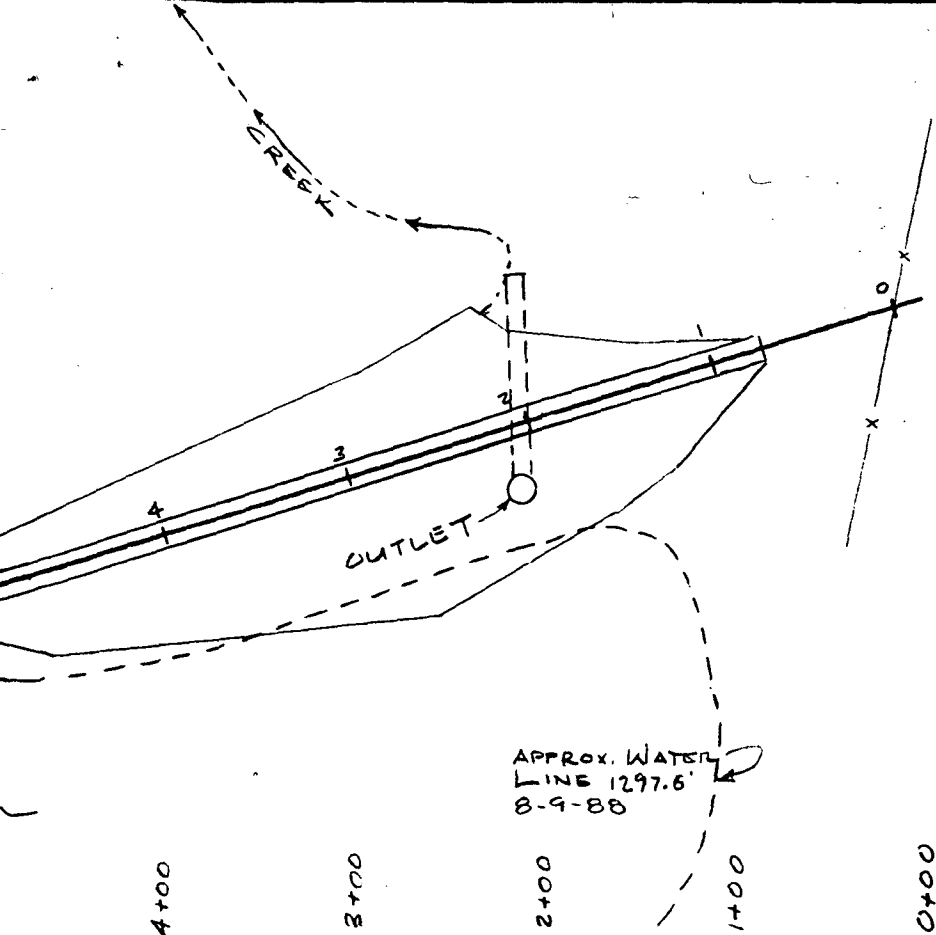
SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECTNO= 50.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECTNO= 50.000 PROFILE= 2 CRITICAL DEPTH ASSUMED

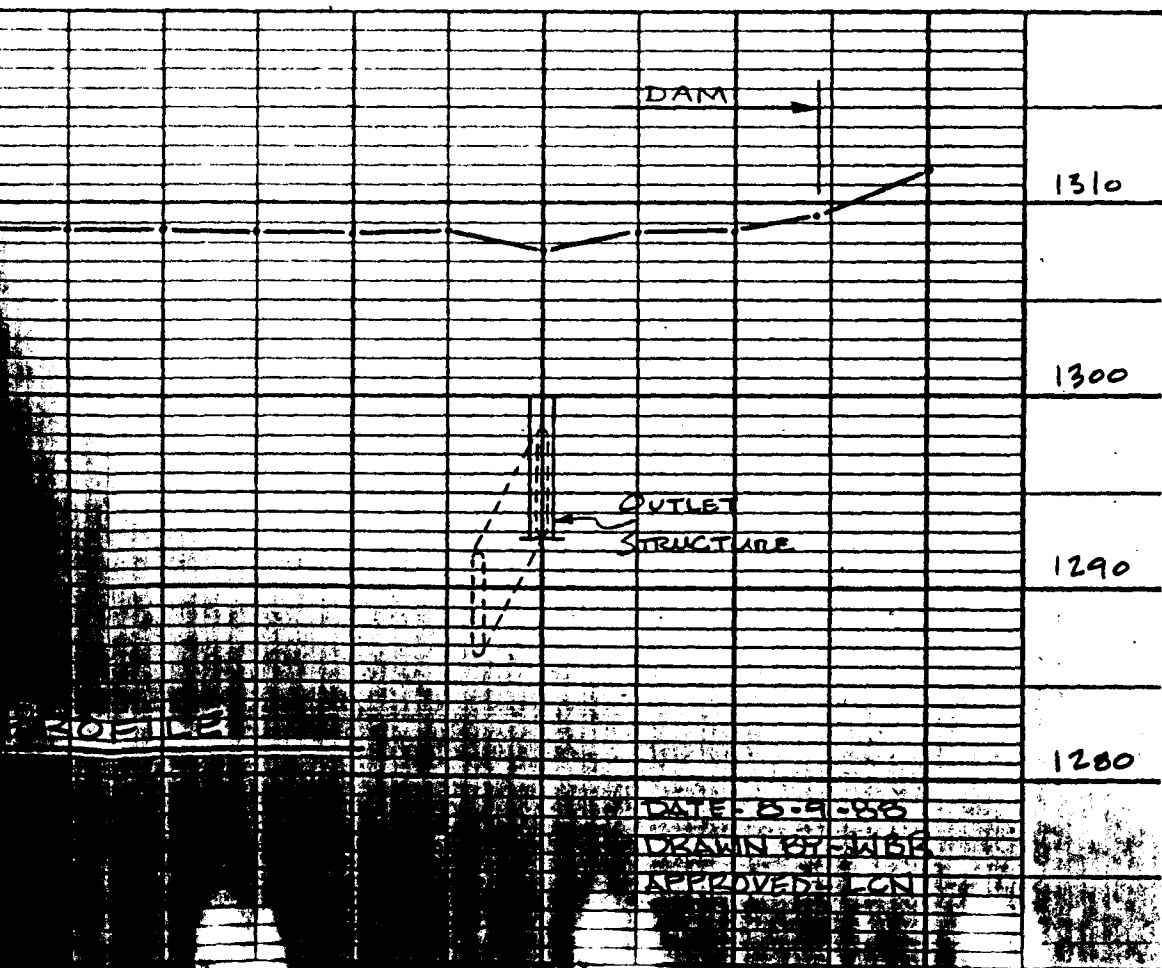
PAUL DUKE DAM
SPILLWAY RATING CURVE



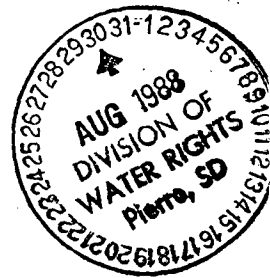
DISCHARGE (CFS)



APPROX. WATER
LINE 1297.6'
8-9-88



DeWild Grant Reckert & Associates Co.
Architecture Engineering Planning



Rock Rapids, Iowa
Sioux City, Iowa
Sioux Falls, South Dakota

Project Number
3870
Sheet

JUEL DAM
SW 1/4 SEC 31
T99N-R48W
LINCOLN CO. S.D.

4+00

3+00

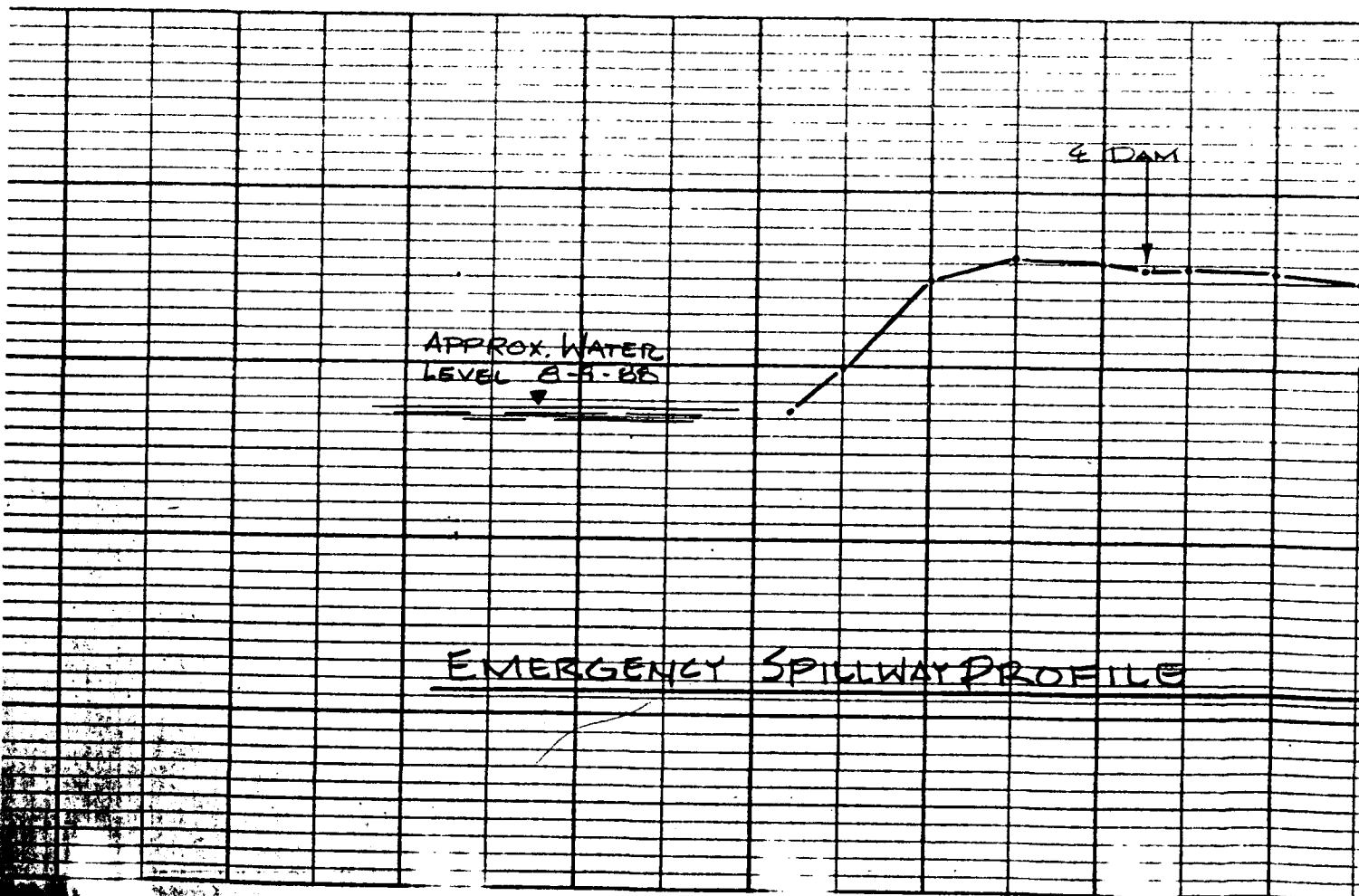
2+00

1+00

4 DAM

APPROX. WATER
LEVEL 8-3-88

EMERGENCY SPILLWAY PROFILE





Department of Water & Natural Resources

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

October 28, 1988

Paul Juel
RR 3, Box 21
Canton, SD 57013

Dear Mr. Juel:

I am writing in regard to your Water Permit No. 5145-3. With the receipt of the stamped Field Survey and Rating Curves from DeWild, Grant, Reckert & Associates Co. on October 20, 1988, qualifications on Water Permit No. 5145-3 has been complied with. Thank you for your cooperation.

If you have any questions, please contact us.

Very truly yours,

John Hatch, Chief Engineer
Water Rights Division
605 773-3352



**Department of
Water & Natural Resources**

Cross Building
East Capitol
Pierre, South Dakota 57501-3181

FEB 14 1989

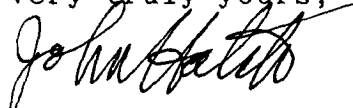
Paul M. Juel
Rural Route 3, Box 21
Canton, South Dakota 57013

Dear Mr. Juel:

Enclosed is your Water Permit No. 5145-3 as approved by the Water Management Board authorizing construction of the water system and the application of water to beneficial use, not exceeding the limits as specified in the Water Permit.

We will schedule an inspection so that the Water License may be issued to you, thus completing your acquisition of a Water Right.

Very truly yours,



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

JH:ms

enclosure

Permit No. 5145-3 Paul M. JuelSafety of Dams ID number 02211
Vermillion River Water District**Report Of Examination Of Works And/Or Application Of Water To Beneficial Use**

TO: Chief Engineer, Division of Water Rights, DWRN, Foss Bldg., Pierre, SD 57501

I have this day made a thorough examination of the water use system constructed by Paul M. Juel
_____ of RR 3, Box 21, Canton, South Dakota 57013 holder ofPermit No. 5145-3, bearing the priority of July 27, 1987 19____ authorizing
the diversion of 58.9 acre-feet, annually of the waters of surface water (unnamed creek)
erosion control, recreational uses and providing habitat for fish and
for wildlife production purposes, in Lincoln County.

I have to report on the conditions of the same as follows:

A. Works used to divert the water: Dam

22 feet tall, approximately 675 feet long, 100 foot wide emergency spillway, 58.9 acre-feet
normal storage, 217 (approximately) acre-feet maximum storage, 8.0 foot diameter CMP riser,
5.4 foot diameter CMP conduit (note: CMP is primary spillway)

B. Works used to transport water to place of use: In place use

C. Works used to apply water to beneficial use: In place use

The system is in the following condition adequate (exceptions noted in PHASE 1 INSPECTION CHECKLIST)The point of diversion is located 700 feet south and 800 feet west of the center of section 31,
T99N R48WThe works are capable of diverting and conveying to the place of use 58.9 acre-feet
erosion control, recreational uses and providing
~~diverting~~ of water which is to be used for habitat for fish and wildlife productionWater has been put to beneficial use to the maximum extent as follows: in place use

_____~~comprising a total of~~ //////// acres of land and the license should be issued for 58.9 acre-feet.Applicable permit qualifications have been complied with X Yes NoExceptions to compliance are: _____ Date September 13, 1989
(signature)

LICENSE FOR PERMIT NUMBER 5145-3 Paul Juel

1. Legal location of wells: NA

dams & structures: SW1/4 of Section 31, T99N R48W (north 1/2)

2. Well Information: Well Drilling Firm NA

Completion Report Yes No No. of Wells Depth

Casing a) diameter Screen a) type

b) length b) length

c) type Static Water Level

Pump a) make Motor a) make

b) model b) model No.

c) size c) horsepower rating

d) capacity gpm

e) turbine pump - no. of stages

f) operating PSI

3. Distribution lines or canals NA

a) size

b) type

c) length

4. Dam Information:

a) height to crest 22 feet m) Outlet tubes: Primary Spillway

b) height to primary spillway 13.1' above toe 1) diameter 8.0' (riser), 5.4' (conduit)

c) height to secondary spillway 19.2' above toe 2) type CMP

d) crest width 13' 3) valved (Y/N) No

e) crest length 675' approximately 4) valve type none

f) spillway length 250' + 5) location on structure

g) spillway width 100' South End of Dam (station 140)

h) approx. storage 58.9 acre feet n) Category of Dam 3

i) approx. storage to crest 217 acre feet

j) date constructed October of 1987

k) inspection sheet completed (Y/N) yes

l) Name of Contractor Corky Claussen (Clark, South Dakota)

Note: Toe of dam measured at downstream invert of 5.4' diameter CMP

5. System Type a) sideroll:

- 1) length _____ feet
- 2) diameter of pipe _____
- 3) make, model & number of
sprinklers _____
- 4) spacing of sprinklers _____
- 5) nozzle size _____

c) gun

- 1) make _____
- 2) nozzle size _____
- 3) capacity (GPM) _____
- 4) hose size _____
- 5) hose length _____

e) gated pipe

- 1) length _____
- 2) diameter _____
- 3) spacing of gates _____

f) portable boom

- 1) make _____
- 2) nozzle size _____
- 3) capacity (GPM) _____

b) towline:

- 1) length _____ feet
- 2) make, model & number of
sprinklers _____
- 3) spacing of sprinklers _____
- 4) nozzle size _____

d) center pivot

- 1) make _____
- 2) number of towers _____
- 3) distance between towers _____
- 4) overall length _____
- 5) end gun (Y/N) _____
- 6) high or low pressure _____
- 7) make & size of nozzles _____
- 8) capacity (GPM) _____

g) siphons

- 1) size _____
- 2) number _____

NOTE: For Permits with additional wells or changes in well locations, record the following for each well: pumping capacity, date constructed, well driller and if a well log is available.

Indicate any other permit(s) which are associated with project None

| Yes | No | Check Items |
|-----------|----------|---|
| <u>X</u> | --- | 1. Soil and water permit lands agree with lands being irrigated and lands listed on permit? |
| <u>X</u> | --- | 2. Special qualifications to permit being abided by? |
| --- | <u>X</u> | 3. All structures, wells and lands on map? All structures are located as described in the Water Permit application |
| <u>NA</u> | --- | 4. Irrigation Questionnaires checked to determine if permit owner started irrigation by end of construction period? |
| <u>NA</u> | --- | 5. Is chemigation used? |
| <u>NA</u> | --- | 6. If yes, does equipment comply with chemigation rules? |

REMARKS:

 **Department of
Water & Natural Resources**

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

January 16, 1990

5145-3

Paul M Juel
RR 3, Box 21
Canton SD 57013

Dear Mr. Juel:

The inspection of your water use system and the inspection of the extent of the application of water to beneficial use, as developed under your Water Permit No. 5145-3 has been completed. Your final water right document, the Water License, can now be issued.

Statutes require that we charge a \$50.00 fee for the inspection and issuance of the Water License. Upon receipt of the \$50.00 fee from you, we will begin processing your Water License.

South Dakota Water Law 46-5-30.1 requires that a permit holder may not divert water until this \$50.00 license fee has been paid. Please contact us if you have any questions.

Sincerely,



GENNY MCMATH
Natural Resources Analyst
(605) 773-3352

NOTE: On check or money order, please specify your permit number. This will insure proper handling of the fee.





Department of Water & Natural Resources

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

January 16, 1990

Paul M. Juel
RR 3, Box 21
Canton, SD 57013

Dear Mr. Juel:

I am writing in regard to the condition of your dam constructed under Water Permit No. 5145-3. On September 13, 1989, David Brown, Water Rights Division Engineer, made a final inspection of Water Permit No. 5145-3 for licensing purposes. The final inspection found dam safety concerns that you should be aware of. I am not requiring you to remediate the safety concerns but I am recommending that you initiate actions to alleviate them.

Enclosed is a completed inspection checklist for your dam. The upstream and downstream slopes do not have an adequate grass cover as evidenced by the rilling occurring on the slopes. Minor seepage is present along the downstream toe of the dam and should be monitored to detect any change in seepage quantity and clarity. At the present time, the seepage is not considered to be a safety concern.

The dam crest has experienced 1.0 - 1.4 feet of visual settlement over the old creek bed which coincides with the location of the corrugated metal pipe (CMP) discharge tube. Settlement over the old creek bed has caused the CMP to become bowed and elliptical in shape (CMP should be circular in shape). Loss of joint material and displacement of the CMP joints has also occurred due to settlement problems. The crest does not have an adequate grass cover.

The 8.0 foot diameter CMP riser on the upstream slope of the dam is a safety hazard because it is not fenced off to prevent people or animals from falling into the riser and being seriously hurt.

If we may be of further assistance to you in this matter, please contact David Brown (605) 773-3352).

Very truly yours,

JOHN HATCH, Chief Engineer
Water Rights Division

enclosure



PHASE I

INSPECTION CHECKLIST

NAME OF DAM: Paul Juel Dam
 STATE: South Dakota
 COUNTY: Lincoln County
 INVENTORY NO.: 02211
 HAZARD CATEGORY: 3
 TYPE OF DAM: Rolled Earth

OWNER: Paul Juel (Water Permit No. 5145-3)
 DATE INSPECTED: September 13, 1989
 WEATHER: clear and sunny
 TEMPERATURE: unknown
 POOL ELEVATION: trickling over cmp inlet
 TAILWATER ELEVATION: unknown

DIRECTIONS: Mark an "X" in the YES or NO column.

If an item does not apply, write "NA" in the REMARKS column.

| ITEM | YES | NO | REMARKS |
|----------------------------------|-----|----|---|
| 1. CREST. | | | |
| a. Any visual settlements? | X | | 1.0 - 1.4 feet over old river bed |
| b. Misalignment? | | X | |
| c. Cracking? | | X | |
| 2. UPSTREAM SLOPE. | | | |
| a. Adequate grass cover? | | X | Grass cover not established yet, weeds |
| b. Any erosion? | X | | Rilling occurring due to surface runoff |
| c. Are trees growing on slope? | | X | |
| d. Longitudinal cracks? | | X | |
| e. Transverse cracks? | | X | |
| f. Adequate riprap protection? | | | No riprap present, No scarps formed yet |
| g. Any stone deterioration? | | | NA |
| h. Visual depressions or bulges? | | X | |
| i. Visual settlements? | | X | |
| 3. DOWNSTREAM SLOPE. | | | |
| a. Adequate grass cover? | | X | Grass cover not well established yet |
| b. Any erosion? | X | | Rilling occurring due to surface runoff |
| c. Are trees growing on slope? | | X | |
| d. Longitudinal cracks? | | X | |
| e. Transverse cracks? | | X | |
| f. Visual depressions or bulges? | | X | |
| g. Visual settlements? | | X | |
| h. Is the toe drain dry? | | | No toe drain present |
| i. Are the relief wells flowing? | | | No relief wells present |
| j. Are boils present at the toe? | | X | |
| k. Is seepage present? | X | | Minor seepage between stations 200 to 300 |
| 4. ABUTMENT CONTACTS. | | | -cattails and lush vegetation present |
| a. Any erosion? | | X | |
| b. Visual differential movement? | X | | Settlement has not been as pronounced in this |
| c. Any cracks noted? | | X | area as over old stream bed |
| d. Is seepage present? | | X | |
| 5. INTAKE STRUCTURE. none | | | |
| a. Do concrete surfaces show: | | | |
| (1) Spalling? | | | |
| (2) Cracking? | | | |
| (3) Erosion? | | | |
| (4) Scaling? | | | |
| (5) Exposed reinforcement? | | | |
| (6) Other? | | | |
| b. Do the joints show: | | | |
| (1) Displacement or offset? | | | |
| (2) Loss of joint material? | | | |
| (3) Leakage? | | | |

| ITEM | YES | NO | REMARKS |
|--------------------------------------|-----|----|---|
| c. Metal appurtenances? | | | |
| (1) Corrosion present? | | | |
| (2) Breakage present? | | | |
| (3) Anchor system secure? | | | |
| 6. CONDUIT. | | | 8.0' riser and 5.4' conduit |
| a. Is the conduit concrete? | | X | CMP |
| b. Do concrete surfaces show: | | | NA |
| (1) Spalling? | | | |
| (2) Cracking? | | | |
| (3) Erosion? | | | |
| (4) Scaling? | | | |
| (5) Exposed reinforcement? | | | |
| (6) Other? | | | |
| c. Do the joints show: | | | NA |
| (1) Displacement or offset? | | | |
| (2) Loss of joint material? | | | |
| (3) Leakage? | | | |
| d. Is the conduit metal? | X | | |
| (1) Corrosion present? | | X | |
| (2) Protective coatings adequate? | | X | Loss of joint materials, Joints are offset |
| (3) Is the conduit misaligned? | X | | Conduit is bowed due to differential settlement |
| 7. STILLING BASIN. | | | None |
| a. Do concrete surfaces show: | | | |
| (1) Spalling? | | | |
| (2) Cracking? | | | |
| (3) Erosion? | | | |
| (4) Scaling? | | | |
| (5) Other? | | | |
| (6) Exposed reinforcement? | | | |
| b. Do the joints show: | | | |
| (1) Displacement or offset? | | | |
| (2) Loss of joint material? | | | |
| (3) Leakage? | | | |
| c. Do the energy dissipators show: | | | |
| (1) Signs of deterioration? | | | |
| (2) Are they covered with debris? | | | |
| (3) Other? | | | |
| d. Is the channel: Discharge channel | | | |
| (1) Eroding or backcutting? | | X | |
| (2) Sloughing? | | X | |
| (3) Obstructed? | | X | |
| e. Is released water: | | | |
| (1) Undercutting the outlet? | | X | |
| (2) Eroding the embankment? | | X | |
| 8. SPILLWAY. Emergency Spillway | | | |
| a. Does spillway concrete show: | | | NA |
| (1) Spalling? | | | |
| (2) Cracking? | | | |
| (3) Erosion? | | | |
| (4) Scaling? | | | |
| (5) Other? | | | |
| (6) Exposed reinforcement? | | | |
| b. Do the joints show: | | | NA |
| (1) Displacement or offset? | | | |
| (2) Loss of joint material? | | | |
| (3) Leakage? | | | |

| ITEM | YES | NO | REMARKS |
|---------------------------------------|-----|----|---------------------------------|
| c. Do the energy dissipators show: | | | NA |
| (1) Signs of deterioration? | | | |
| (2) Are they covered with debris? | | | |
| (3) Other? | | | |
| d. Is the spillway earth cut? | X | | |
| (1) Are slopes eroding? | | X | |
| (2) Are slopes sloughing? | | X | |
| (3) Other? | | | |
| e. Is the channel: | | | |
| (1) Eroding or backcutting? | | X | |
| (2) Obstructed? | | X | |
| f. Has released water: | | | |
| (1) Eroded the embankment? | | X | |
| (2) Undercut the outlet? | | X | |
| (3) Other? | | | |
| g. Is weir in good condition? | X | | Weir is 8.0' diameter CMP riser |
| h. Is control at the weir? | X | | |
| 9. GATES. | | | NA |
| a. Are the flood gates: | | | |
| (1) Broken or bent? | | | |
| (2) Corroded or rusted? | | | |
| (3) Periodically maintained? | | | |
| (4) Operational? | | | |
| (5) Date last operated. | | | |
| b. Is there a low level gate? | | | |
| c. Is the low-level gate operational? | | | |
| 10. RESERVOIR CONTROL. | | | |
| a. Recent upstream development? | | | |
| b. Slides in reservoir area? | | | |
| c. Change in reservoir operation? | | X | |
| d. Large impoundment upstream? | | | |
| 11. INSTRUMENTATION. | | | NA |
| a. List type(s) of instrumentation. | | | |
| b. In good condition? | | | |
| c. Read periodically? | | | |
| d. Is data available? | | | |

Other comments:

Road on crest prohibits grass cover from establishing itself. CMP riser is a safety hazard because it is not fenced to keep out people. People could fall into the riser and be seriously hurt. Small trees have been planted in the vicinity of the dam but at this time due not pose a safety hazard to the dam, nor are they expected to in the future.

A good grass cover has not been established on the dam. Subsidence and deflection of the CMP conduit over the old river bed are the most serious deficiencies noted during the field inspection.

This dam was inspected by:

David Brown, DWNr, Water Rights Division, Pierre, SD
Jody Kazmierczak, DWNr, Water Rights Divison, Pierre, SD.

RECEIPT

Division of Water Rights

South Dakota Department of Water and Natural Resources

412058

Pierre, January 26, 19 90

RECEIVED OF Paul Seal RR #3 Box 21, Stanton, SD 57013

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 _____ | | |
| 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. <u>Water Permit No. 5145-3</u> | 50 | 00 |
| 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 | 50 00 |

By

John Hatch / mro
Chief Engineer



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

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

AUG 13 1997

5145-3

Paul M. Juel
5210 N. Tigua Dr.
Tucson, AZ 85704-3740

Dear Mr. Juel:

Enclosed is Water License No. 5145-3 and Receipt No. 412058 for \$50.00 which was assessed for an investigation and issuance of the license. Water License No. 5145-3 is the final document which completes the process of obtaining a water right.

As long as you use the water beneficially, as stated in the Water License, State Water Laws provide that you have a continuing right to use the water.

Very truly yours,

A handwritten signature in black ink, appearing to read "John Hatch". The signature is fluid and cursive, with a large, stylized "J" and "H".

JOHN HATCH, Chief Engineer
Water Rights Program
(605) 773-3352

ks
enclosures

STATE OF SOUTH DAKOTA

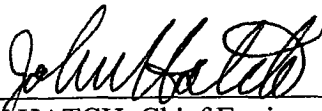
WATER LICENSE NO. 5145-3

(1) Paul M Juel, 5210 N Tigua Dr, Tucson AZ 85704-3740 made Application No. 5145-3, July 27, 1987 for a water permit to authorize storage of 58.9 acre-feet of water annually from an unnamed creek, Lincoln County, South Dakota for recreational use, erosion control and fish & wildlife production purposes. Permit No. 5145-3, with a priority date of July 27, 1987 was approved September 9, 1987 and issued to the applicant for diversion of water with construction of the described water supply system completed and the application to beneficial use of said water completed.

(2) It is certified that the applicant has complied with the provisions of South Dakota State Law relating to completion of the construction of the water supply system and is entitled to store 58.9 acre-feet of water annually for beneficial use. The location of the storage dam (spillway) is 700 feet south and 800 feet west of the center of Section 31-T99N-R48W.

(3) The applicant has complied with the provisions of South Dakota State Law relating to the application of water to beneficial use.

(4) Pursuant to South Dakota Water Law 46-5-30.1 Paul M Juel, 5210 N Tigua Dr, Tucson AZ 85704-3740 the holder and/or owner of Water Permit No. 5145-3 is issued a license to store 58.9 acre-feet of water annually from an unnamed creek with a priority date of July 27, 1987 from the location specified in (2) of this license for the purpose of recreational use, erosion control and fish & wildlife production. This license is subject to any limitations or qualifications listed in Water Permit No. 5145-3 and subject to South Dakota State Law.



JOHN HATCH, Chief Engineer
Water Rights Program
Department of Environment and Natural Resources

AUG 13 1997

date





**DEPARTMENT OF ENVIRONMENT
and NATURAL RESOURCES**

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
denr.sd.gov



September 30, 2014

John Christensen
48230 279th Street
Canton, SD 57013

Dear Mr. Christensen:

We have reviewed the plans and specifications for your dam repair project located in the SW ¼ of Section 31-T99N-R48W, in Lincoln County. This project is for the repair of the dam formally known as the Juel Dam (SD ID No. SD02211) and authorized by Water Right No. 5145-3. The plans and specifications for the construction of the dam are approved.

Our review was to determine compliance with the requirements of the Water Management Board Safety of Dams Rules, Chapter 74:02:08. Approval of these plans and specifications does not release you, as owner of the dam, from the responsibility for operating and maintaining the dam in good repair to ensure the safety of the dam.

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

Sincerely,

Timothy G. Schaal, P.E.
Engineer IV
for Jeanne Goodman, Chief Engineer
Water Rights Program
(605) 773-3352

c: Leonard Neugebauer, DGR Engineering, Sioux Falls

John Christensen Dam
(Paul Tuel Dam)
WR # 5145-3

Existing Dam (Tuel Dam)
Breachd June 16-17, 2014

Cat. 3 Low Hazard Dam
ID No SD 02211

Proposed Repaired Dam

Top of Dam Elev. - 1312 (Existing) - 1314 (Repaired Breach Section)
2nd Spillway Elev. - 1307
P. Spillway Elev. - 1304

DGR's plan for repair includes replacing the 66 in. CMP and lowering the 2nd Spillway 3 ft to Elev 1307. The dam grade will remain @ about Elev 1312 and the repaired Breach Section will be @ Elev 1314.

They route a Q₅₀ peak of 1606 cfs thru the dam with a peak Elev. of 1310.1 and a Q₁₀₀ peak of 1894 cfs with a peak Elev. of 1310.5 - leaving 1.5 ft freeboard to the minimum top of dam elevation of 1312.

From USGS WRE 98-4055 "Tech for Est. Peak Flows ... in SD"

Region B $DA = 5848 \text{ ac} = 9.14 \text{ mi}^2$
 $P_{II} = 1.2$

$$\begin{aligned} Q_{50} &= 206 CA^{.606} P_{II}^{.728} \\ &= 206 (9.14)^{.606} (1.2)^{.728} \\ &= 206 (3.8224) (1.1419) \\ &= \underline{900 \text{ cfs}} \end{aligned}$$

$$\begin{aligned} Q_{100} &= 275 CA^{.625} P_{II}^{.742} \\ &= 275 (9.14)^{.625} (1.2)^{.742} \\ &= 275 (3.9865) (1.1449) \\ &= \underline{1255 \text{ cfs}} \end{aligned}$$

207

11/3/18

October 1918

Went to the bank
(with Mr. Jones)
to get money

Went to the bank
to get money

Went to the bank
to get money

Went to the bank
to get money

Went to the bank
to get money

Went to the bank
to get money

Went to the bank
to get money

Went to the bank
to get money

Went to the bank
to get money

Went to the bank
to get money

RECEIVED

SEP 29 2014

WATER RIGHTS
PROGRAM



September 26, 2014

Mr. Tim Schaal, P.E.
Engineer IV, Water Rights
SD Department of Environment and Natural Resources
Joe Foss Building
523 E Capitol Avenue
Pierre, SD 57501

**RE: Christensen Dam Repair, Canton, SD
DGR Project No. 664630**

Dear Mr. Schaal:

We are transmitting two documents with this letter for your review and approval. The first document is a letter with attachments to John Christensen, who together with his wife Linda, own the property which includes the dam being referred to as the Christensen Dam. The second document is the Plans for the Proposed Christensen Dam Repair.

As you know, John and Linda Christensen are interested in repairing this dam which was breached by the severe storm which occurred June 16-17, 2014. We trust that the information transmitted herewith will be sufficient for your needs to review and approve their request to proceed with making the proposed repairs to this breached dam.

Since John and Linda are interested in proceeding with repairing the dam yet this fall, your prompt review will be sincerely appreciated. If you have any questions or comments during your review, please feel free to contact me at my email lnuegebauer@midco.net or you may phone me at either 605-331-2532 or my cell phone 605-215-8146.

Thank you in advance for your help on this project and for providing a prompt review of the enclosed documents.

Sincerely,

DGR ENGINEERING

A handwritten signature in cursive script, reading "Leonard C. Neugebauer".

Leonard C. Neugebauer, PE/LS

Enclosure: Letter to John Christensen with attachments
Plans for Proposed Christensen Dam Repair

cc: John Christensen, 48230 279th Street, Canton, SD 57013

September 26, 2014



Mr. John Christensen
48230 279th Street
Canton, SD 57013

RE: Christensen Dam Repair, Canton, SD
DGR Project No. 664630

Dear Mr. Christensen:

This letter with attachments summarizes the analysis of the Christensen Dam located on your property near Canton, SD. This analysis is based on the topographic survey performed by DGR, as well as the plans for the Christensen Dam Repair which accompany this letter.

Our analysis and design are also based on information contained within the original plans for the construction of this dam which were prepared by the Soil Conservation Service, as well as information which you furnished to us during our meetings with you. We understand that you have owned your property which includes this dam for approximately ten years. During this time, you have observed two prior storm events during which the water level rose to near the top of the dam. The June 16-17, 2014 storm which resulted in the breach of this dam was a very severe magnitude storm. Attached to this letter is a copy of an email which addresses information from the City of Canton and the National Weather Service. This information would indicate that the storm consisted of about 8.5 inches of rain. Information from the City of Canton would indicate that this rain occurred in about a 9-hour period, more or less. A storm of this magnitude is far greater than the 100-year (1% chance) storm event, and probably is in the order of magnitude of a 1000-year (0.1% chance) storm event.

We have prepared a map of the watershed which drains through this dam and have found this watershed to consist of approximately 5848 acres, which is about 9% greater than the SCS estimate of 5380 acres shown on their plans. We then used this watershed to develop the hydrologic data for stormwater runoff from this watershed which must pass through this dam.

We have also computed outflow capacity of the dam. Under conditions which existed just prior to the breach, this outflow capacity includes flow through the outflow pipe for water elevations about the crest of the primary outflow structure (1304.0) plus the flow across the bypass spillway for water elevations above the spillway crest (1310.0). From these capacity calculations, we determined that the flow through the outflow pipe increases to about 286 cfs at elevation 1307 and then only increases to 349 cfs at elevation 1310. We also observed water must rise to elevation 1310 before flow can start to occur through the bypass spillway, which is only 2 feet below the top of the dam. These observations caused us to realize that more flow is needed through the bypass spillway and that this flow should begin at a lower elevation of about 1307.

Based on the above described analysis and observations, we have prepared a design for repairing this existing dam which will include excavating a bypass channel through the existing bypass spillway, which will allow stormwater to bypass the dam at a lower elevation and at a larger outflow capacity. This bypass channel is proposed to be about 300 feet long and have an 80-foot bottom width with 4:1 side slopes. It is anticipated that earth excavated from the bypass channel can be used as fill in repairing the breach in the dam. The repair will also include replacing the old 66-inch outlet pipe with a new 66-inch outlet pipe installed similar to the installation of the original outlet pipe.

The following tables present data from our hydrologic and hydraulic analysis of the dam as it existed prior to the breach as well as the dam as it is proposed to be repaired, including the addition of the bypass channel.

Elevation - Storage - Outflow Capacity Data

| Christensen Dam Repair With New Bypass Channel | | | | | Existing | |
|--|---------------------|--------------------|----------------------|---------------------|---------------------|---------------------------|
| Water Elev. (ft) | Storage Volume (AF) | Pipe Outflow (cfs) | Bypass Channel (cfs) | Total Outflow (cfs) | Total Outflow (cfs) | Increase Outflow Capacity |
| 1304 | 27.0 | 0 | 0 | 0 | 0 | 0% |
| 1305 | 34.4 | 75 | 0 | 75 | 75 | 0% |
| 1306 | 43.0 | 212 | 0 | 212 | 212 | 0% |
| 1307 | 53.1 | 286 | 0 | 286 | 286 | 0% |
| 1308 | 64.7 | 314 | 220 | 534 | 314 | 70% |
| 1309 | 78.1 | 332 | 630 | 962 | 332 | 190% |
| 1310 | 93.2 | 349 | 1200 | 1549 | 349 | 344% |
| 1311 | 110.2 | 366 | 1900 | 2266 | 546 | 315% |
| 1312 | 129.3 | 382 | 2800 | 3182 | 1062 | 200% |

Reservoir Flood Routing Analysis Data

| Christensen Dam Repair With New Bypass Channel | | | | | Existing | |
|--|-------------------|--------------------|-------------------|----------------------|----------------------|--------------------------|
| Storm Frequency | Peak Inflow (cfs) | Peak Outflow (cfs) | Peak Storage (AF) | Peak Water Elev (ft) | Peak Water Elev (ft) | Decrease Water Elev (ft) |
| 2-yr | 414 | 405 | 59 | 1307.5 | 1309.2 | 1.7 |
| 5-yr | 723 | 718 | 70 | 1308.4 | 1311.3 | 2.9 |
| 10-yr | 962 | 954 | 78 | 1309.0 | 1311.8 | 2.8 |
| 25-yr | 1287 | 1274 | 86 | 1309.5 | 1312.2 OT | 2.7 |
| 50-yr | 1606 | 1595 | 94 | 1310.1 | 1312.4 OT | 2.3 |
| 100-yr | 1894 | 1872 | 101 | 1310.5 | 1312.6 OT | 2.1 |

As can be seen in the above tables, the dam as it existed prior to the breach had limited outflow capacity, and was subject to overtopping by storm events greater than 10-year frequency. Excavating the bypass channel through the bypass spillway area increases the outflow capacity by an average of 224% and allows the 100-year storm runoff to flow through the dam at a peak water elevation of 1310.5, which still allows 1.5 feet of freeboard to the minimum top of dam elevation of 1312. Therefore, this repair and addition of the bypass channel will better safeguard the dam from future overtopping and should be a substantial improvement to the function of this dam.

Mr. John Christensen
September 26, 2014
Page Three

A copy of the hydrologic and hydraulic data is attached for your information and records, as well as for review by the SD Department of Environment and Natural Resources. We trust that this letter with attachments along with the enclosed set of plans entitled Christensen Dam Repair, Canton, SD will be sufficient for you to obtain approvals and necessary permits and allow you to proceed with the repair of your dam.

By my signature below, I hereby certify that this letter report with attachments was prepared by me or under my direct personal supervision and that I am a licensed Professional Engineer and Land Surveyor in the State of South Dakota.

Sincerely,

DGR ENGINEERING



Leonard C. Neugebauer, PE/LS



Attachments: Email concerning June 16-17, 2014 storm
Hydrologic and Hydraulic Data

Enclosure: Plans for Proposed Christensen Dam Repair

cc: Tim Schaal, SD Department of Environment and Natural Resources

Len Neugebauer

From: Len <lneugebauer@midco.net>
Sent: Thursday, September 25, 2014 10:32 AM
To: Len Neugebauer
Subject: FW: Canton rainfall - storm frequency

From: Myron Adam [mailto:mkadam.jsa@midconetwork.com]
Sent: Thursday, September 25, 2014 8:20 AM
To: 'Len '
Subject: FW: Canton rainfall - storm frequency

fyi

Myron Adam
JSA

From: Michael Gillispie - NOAA Federal [mailto:michael.gillispie@noaa.gov]
Sent: Tuesday, July 08, 2014 8:12 AM
To: Myron Adam
Subject: Re: Canton rainfall - storm frequency

Myron,

I apologize for not getting back to you sooner. Here is what I've been able to find regarding your questions.

1) the "official" report from our cooperative observer in Canton from 7am on June 16 to 7am on June 17 was 8.43". Other big reports in the general area from that day were 8.70" 7 mile NE of Centerville, and 7.52" 2 miles west of Worthing.

2) 10 inches in 12 hrs would be less than a 0.1% chance (1000-year). The 12 hr. value for Canton for a 0.1% chance (1000 year) is 8.06". We do not have precipitation frequency estimates for a 9-hr period. The 0.1% (1000-yr) amount for a 6-hour period is 7.25".

3) if we use the observed values of ~8.70, this would relate to a 0.1% (1000 year) frequency for a 24-hour event.

I hope this helps answer your questions, and again I apologize for the slow response!

Mike

On Thu, Jul 3, 2014 at 7:34 AM, Myron Adam <mkadam.jsa@midconetwork.com> wrote:

I hope things have quieted down for you a little. We are meeting with City of Canton officials on Monday concerning the rainfall events on and around Monday, June 16. If you could shed some light on the highlighted items below that would be great.

Myron Adam, PE/LS

JSA

From: Michael Gillispie - NOAA Federal [mailto:michael.gillispie@noaa.gov]
Sent: Wednesday, June 18, 2014 1:33 PM
To: Myron Adam
Subject: Re: Canton rainfall - storm frequency

I am about to head out to man the EOC at Dakota Dunes, so I won't be able to look up what you are asking for for a couple of days, but I should be able to get it without too much trouble once I get a little extra time.

Thanks!

Mike Gillispie

On Wed, Jun 18, 2014 at 10:49 AM, Myron Adam <mkadam.jsa@midconetwork.com> wrote:

Mike – sorry to bother you on what must be some busy times for you. We (JSA Engineers/Land Surveyors) are the designated City engineers for the City of Canton. We are attempting to hydraulically model the recent storm event that moved thru Canton on Monday.

We have local reports of rainfall from Canton public works staff ranging between 10 and 11 inches of rainfall over a 9 hour timeframe (between 3pm and 12 midnight).

Not sure if you can shed some light on the following questions:

1. Do you have reported rainfall amounts and durations for the Canton area for Monday, June 16 into Tuesday morning?
2. What would be the return frequency of a 10" rain event over 9 hours as reported by public works staff? That is above our 1% chance event but not sure where it falls in relation to a 0.2% event or?
3. What would be the return frequency for your reported rainfall amount/duration for the same storm?

The frequency curves I am using for SE South Dakota range up to the 1% chance event (about 5.95 inches over 24 hours) but I do not have info on any larger storm events. Thanks for any info you can provide.

Myron Adam, PE/LS

JSA Engineers/Land Surveyors

6810 S. Lyncrest Avenue, Suite 101

Sioux Falls SD 57108-2515

605.367.1036 office

605.359.2796 mobile

No virus found in this message.

Checked by AVG - www.avg.com

Version: 2014.0.4765 / Virus Database: 4025/8268 - Release Date: 09/24/14

Hydrograph Return Period Recap

Hydraflow Hydrographs by Intellisolve v9.02

| Hyd. No. | Hydrograph type (origin) | Inflow Hyd(s) | Peak Outflow (cfs) | | | | | | | | Hydrograph description |
|---|--------------------------|---------------|--------------------|--------|-------|--------|--------|---------|---------|---------|------------------------|
| | | | 1-Yr | 2-Yr | 3-Yr | 5-Yr | 10-Yr | 25-Yr | 50-Yr | 100-Yr | |
| 1 | SCS Runoff | ----- | 250.79 | 413.62 | ----- | 723.34 | 961.89 | 1287.15 | 1605.55 | 1884.38 | Full Watershed |
| 2 | Reservoir | 1 | 245.25 | 406.57 | ----- | 718.17 | 954.23 | 1278.91 | 1595.01 | 1871.88 | Route improved dam |
| <div> <div>Proj. file: Christiansen-imp.gpw</div> <div>Wednesday, Sep 17, 2014</div> </div> | | | | | | | | | | | |

IMPROVED
BYPASS CHANNEL

Hydrograph Report

2

Hydraflow Hydrographs by Intelisolve v9.02

Wednesday, Sep 17, 2014

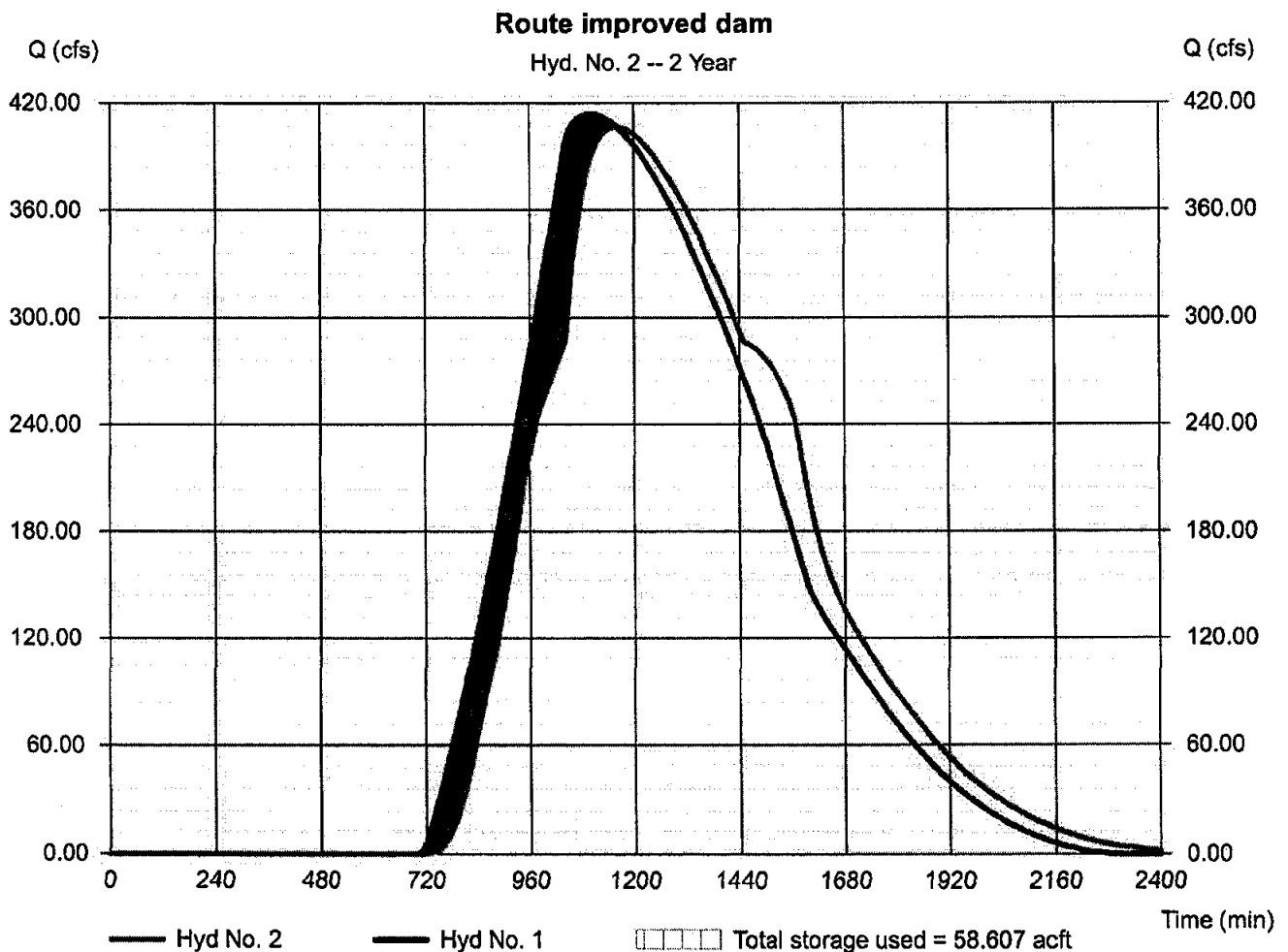
Hyd. No. 2

Route improved dam

Hydrograph type = Reservoir
Storm frequency = 2 yrs
Time interval = 2 min
Inflow hyd. No. = 1 - Full Watershed
Reservoir name = Christiansen Lake

Peak discharge = 406.57 cfs
Time to peak = 1160 min
Hyd. volume = 375.719 acft
Max. Elevation = 1307.47 ft
Max. Storage = 58.607 acft

Storage Indication method used. Wet pond routing start elevation = 1304.00 ft.



Hydrograph Report

3

Hydraflow Hydrographs by Intellisolve v9.02

Wednesday, Sep 17, 2014

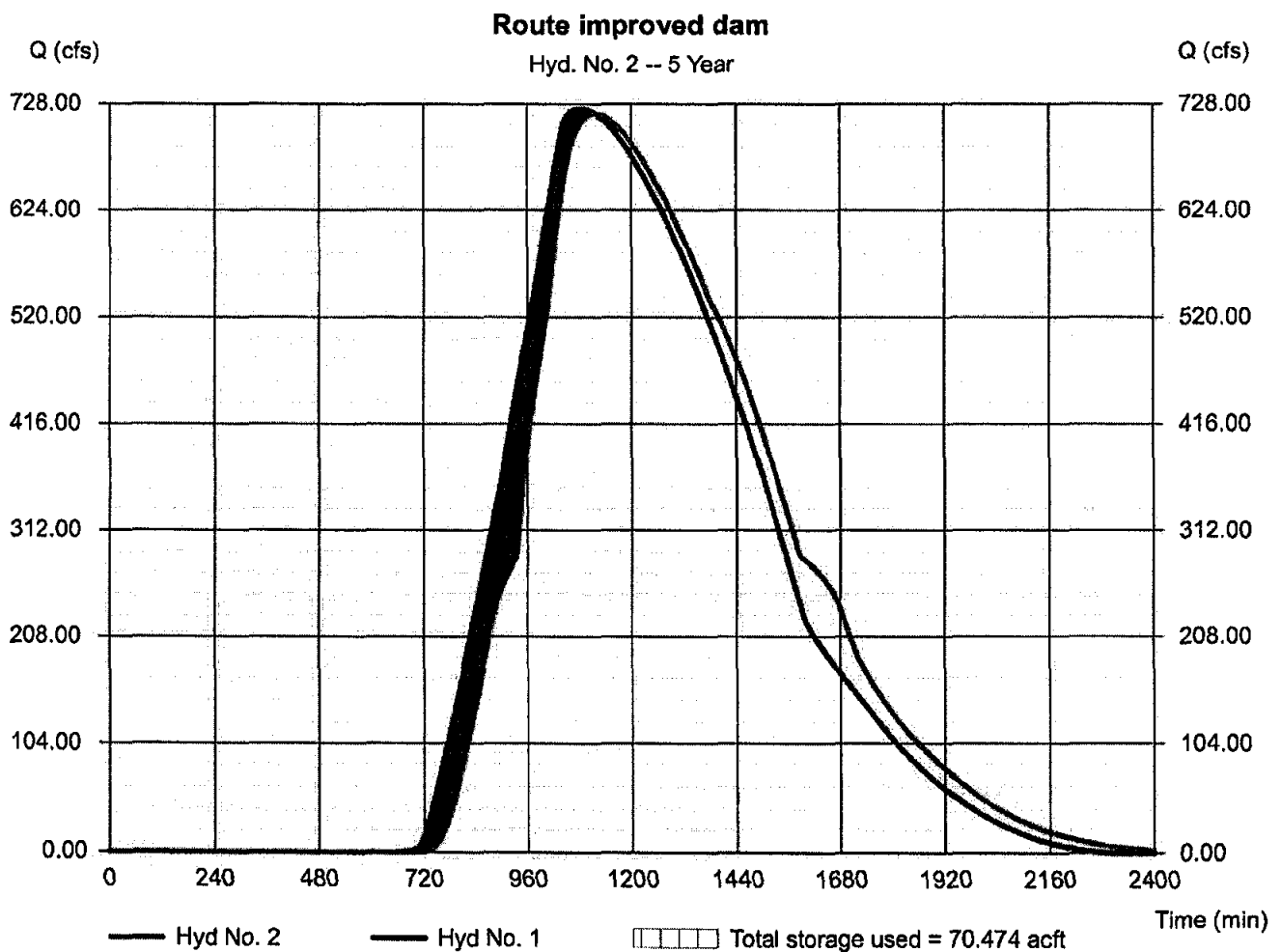
Hyd. No. 2

Route improved dam

Hydrograph type = Reservoir
Storm frequency = 5 yrs
Time interval = 2 min
Inflow hyd. No. = 1 - Full Watershed
Reservoir name = Christiansen Lake

Peak discharge = 718.17 cfs
Time to peak = 1116 min
Hyd. volume = 634.889 acft
Max. Elevation = 1308.43 ft
Max. Storage = 70.474 acft

Storage Indication method used. Wet pond routing start elevation = 1304.00 ft.



Hydrograph Report

4

Hydraflow Hydrographs by Intelisolve v9.02

Wednesday, Sep 17, 2014

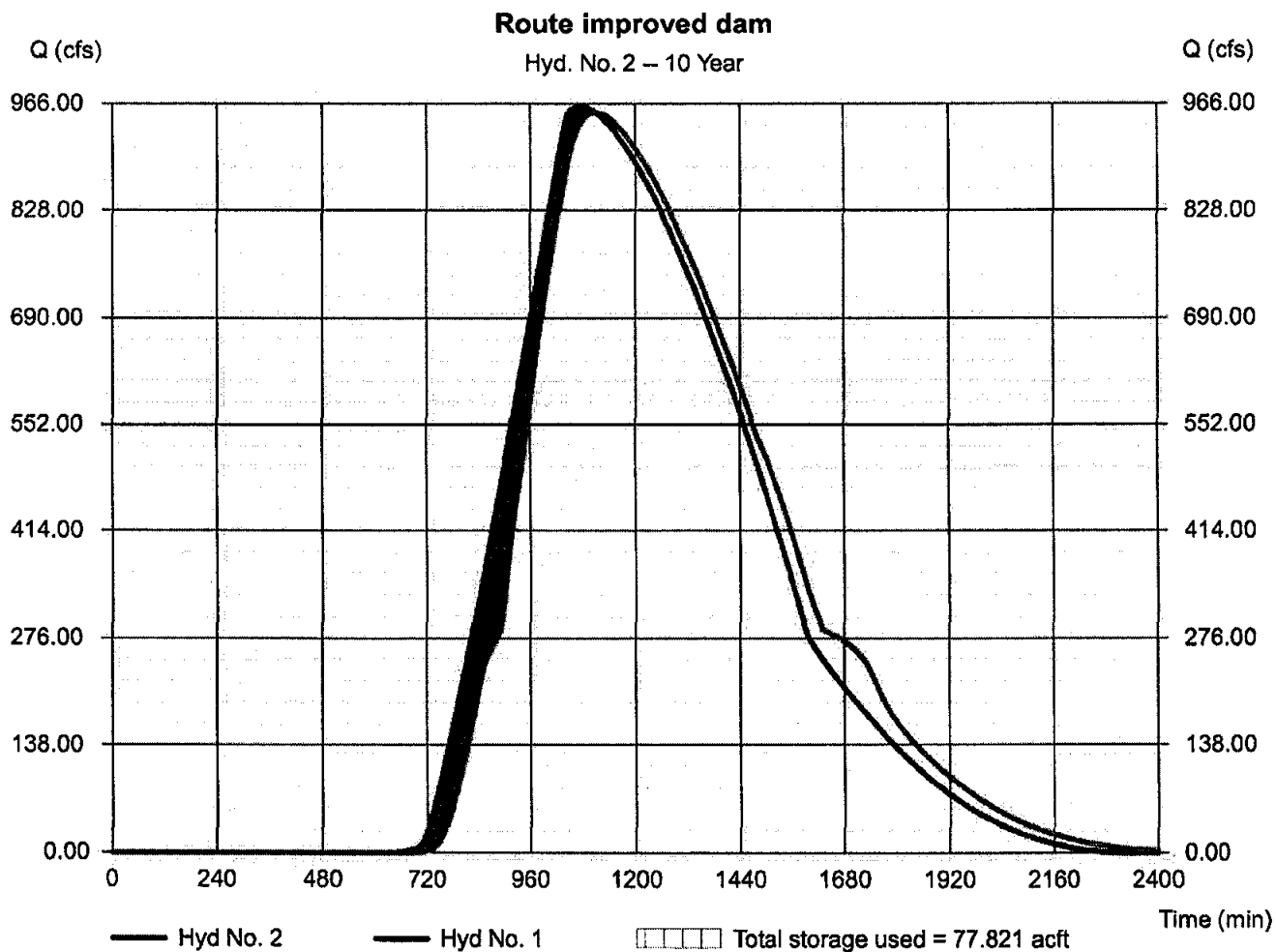
Hyd. No. 2

Route improved dam

Hydrograph type = Reservoir
Storm frequency = 10 yrs
Time interval = 2 min
Inflow hyd. No. = 1 - Full Watershed
Reservoir name = Christiansen Lake

Peak discharge = 954.23 cfs
Time to peak = 1108 min
Hyd. volume = 831.166 acft
Max. Elevation = 1308.98 ft
Max. Storage = 77.821 acft

Storage indication method used. Wet pond routing start elevation = 1304.00 ft.



Hydrograph Report

5

Hydraflow Hydrographs by Intelisolve v9.02

Wednesday, Sep 17, 2014

Hyd. No. 2

Route improved dam

Hydrograph type = Reservoir

Storm frequency = 25 yrs

Time interval = 2 min

Inflow hyd. No. = 1 - Full Watershed

Reservoir name = Christiansen Lake

Peak discharge = 1278.91 cfs

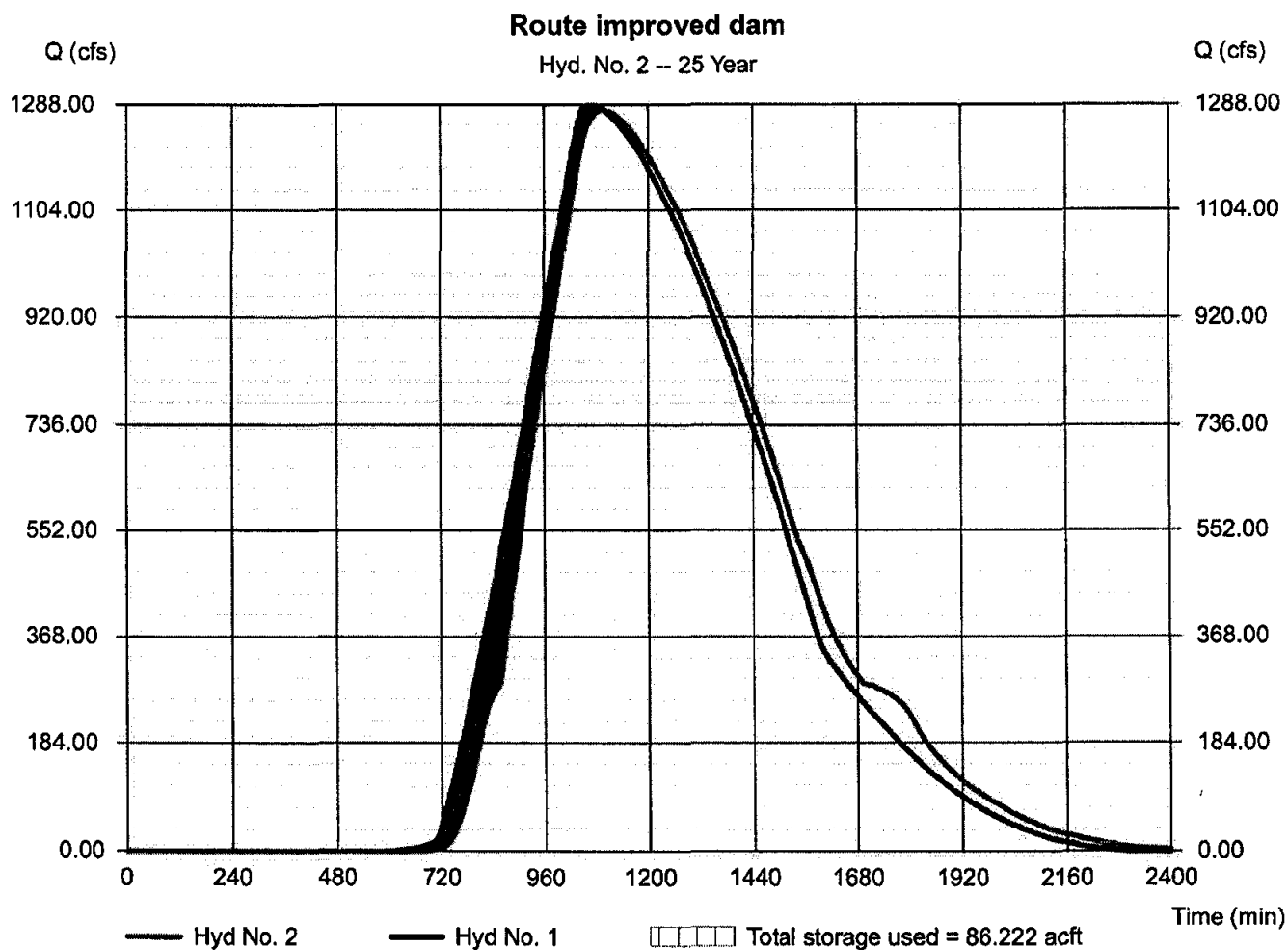
Time to peak = 1096 min

Hyd. volume = 1096.410 acft

Max. Elevation = 1309.54 ft

Max. Storage = 86.222 acft

Storage Indication method used. Wet pond routing start elevation = 1304.00 ft.



Hydrograph Report

6

Hydraflow Hydrographs by Intelisolve v9.02

Wednesday, Sep 17, 2014

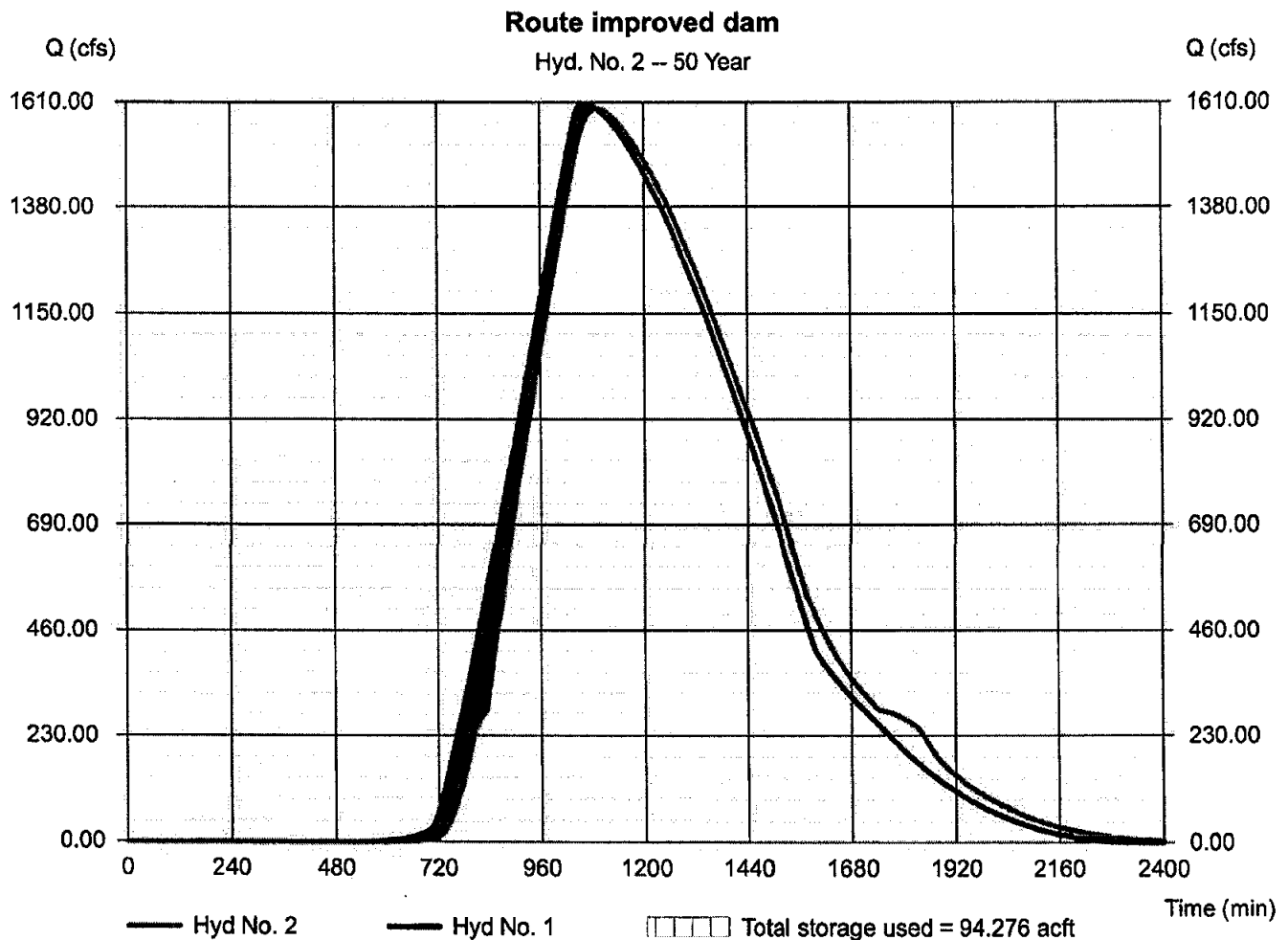
Hyd. No. 2

Route improved dam

Hydrograph type = Reservoir
Storm frequency = 50 yrs
Time interval = 2 min
Inflow hyd. No. = 1 - Full Watershed
Reservoir name = Christiansen Lake

Peak discharge = 1595.01 cfs
Time to peak = 1092 min
Hyd. volume = 1354.543 acft
Max. Elevation = 1310.06 ft
Max. Storage = 94.276 acft

Storage Indication method used. Wet pond routing start elevation = 1304.00 ft.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.02

Wednesday, Sep 17, 2014

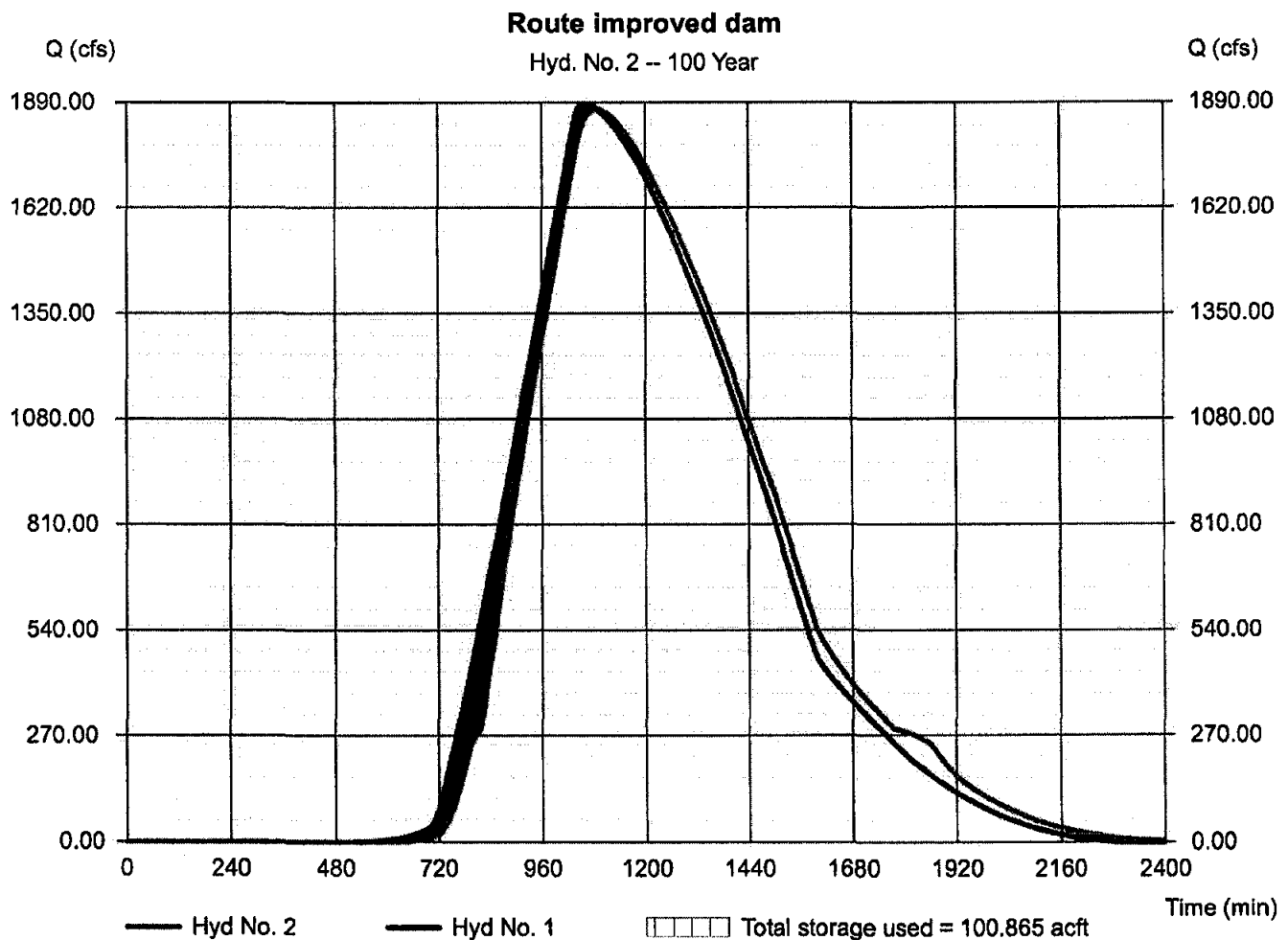
Hyd. No. 2

Route improved dam

Hydrograph type = Reservoir
 Storm frequency = 100 yrs
 Time interval = 2 min
 Inflow hyd. No. = 1 - Full Watershed
 Reservoir name = Christiansen Lake

Peak discharge = 1871.88 cfs
 Time to peak = 1088 min
 Hyd. volume = 1579.897 acft
 Max. Elevation = 1310.45 ft
 Max. Storage = 100.865 acft

Storage Indication method used. Wet pond routing start elevation = 1304.00 ft.



INDEX OF SHEETS

| | |
|------------------------|---|
| SHEET NO. 1 | TITLE SHEET |
| SHEET NO. 2 | WATERSHED MAP |
| SHEET NO. 3 | AERIAL PHOTO & TOPOGRAPHIC SURVEY |
| SHEET NO. 4 | GENERAL NOTES |
| SHEET NO. 5 | SITE PLAN & CENTERLINE PROFILE |
| SHEET NO. 6 | PLAN/PROFILE - BYPASS CHANNEL |
| SHEET NO. 7 | CROSS SECTIONS - BYPASS CHANNEL |
| SHEET NO. 8 | OUTLET PIPE REPLACEMENT & BREACH REPAIR |
| SHEET NO. 1/7 THRU 7/7 | ORIGINAL DAM DRAWINGS |

Plans For Proposed

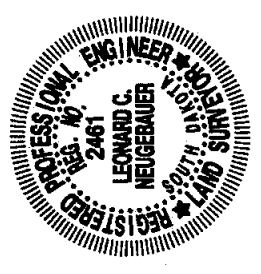
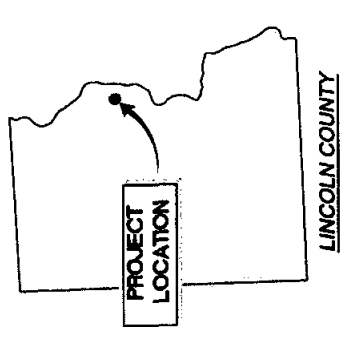
CHRISTENSEN DAM REPAIR

48230 279th STREET

CANTON, SD

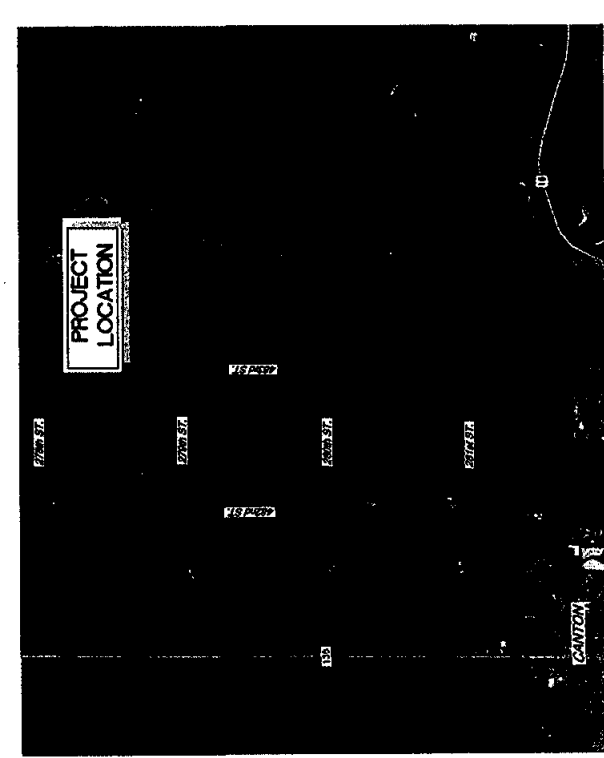
LINCOLN COUNTY

DGR No. 664630



I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF SOUTH DAKOTA.

Leonard C. Neugebauer DATE 9/26/14
 LEONARD C. NEUGEBAUER, P.E./L.S.
 REG. NO. 2461

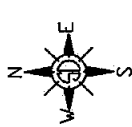


VICINITY MAP

NOTE: FOR SOUTH DAKOTA ONE CALL, THE PROJECT IS LOCATED IN THE SOUTHWEST QUARTER OF SECTION 31-193N-48W.

DRAWING INDICATES GENERAL UTILITY LOCATIONS OF EXISTING AND PROPOSED UTILITIES. THE COMPLETENESS OF LOCATIONS ARE GUARANTEED. CONTACT SOUTH DAKOTA ONE CALL PRIOR TO EXCAVATIONS. (1-800-781-7474)

INFORMATION ON SECTION-TOWNSHIP-RANGE SHOWN ON LOCATION MAP ON THIS SHEET.



- ## LEGEND
- EXISTING 5 FOOT CONTOUR
 - EXISTING 1 FOOT CONTOUR
 - PROPOSED 5 FOOT CONTOUR
 - PROPOSED 1 FOOT CONTOUR
 - EXISTING STORM SEWER/CULVERT
 - EXISTING FENCE
 - TRAVERSE POINT
 - FOUND PIN, PROPERTY LINE
 - CONIFEROUS TREE, DECIDUOUS TREE, BUSH
 - PROPOSED STORM SEWER/CULVERT

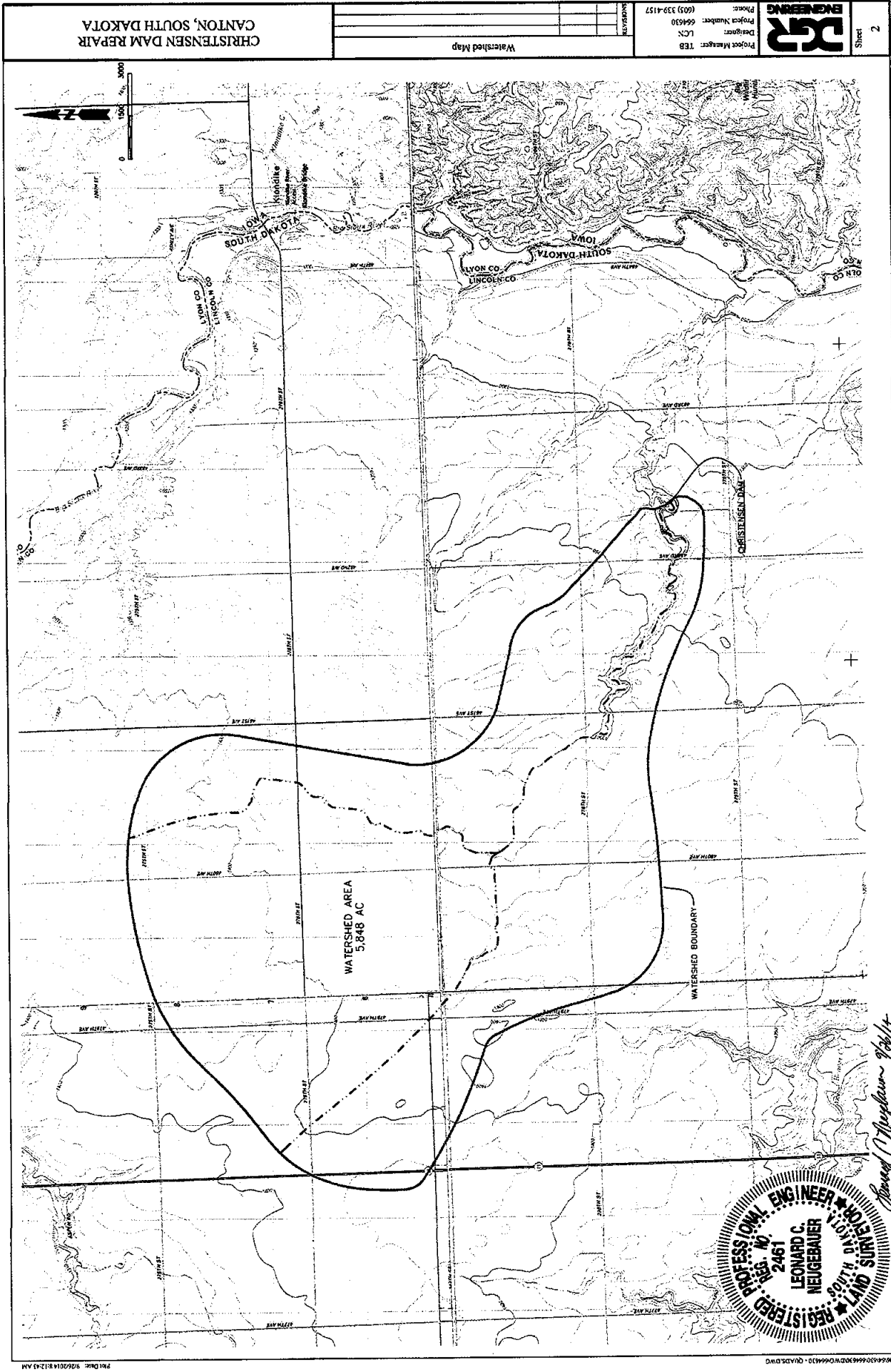


DGR ENGINEERING
 2909 E. 57TH STREET, SUITE 101
 SIOUX FALLS, SD 57108
 (605) 339-4157 office
 (605) 339-4175 fax
 www.dgr.com

RECEIVED

SEP 29 2014

WATER RIGHTS PROGRAM



CHRISTENSEN DAM REPAIR
CANTON, SOUTH DAKOTA

Watershed Map

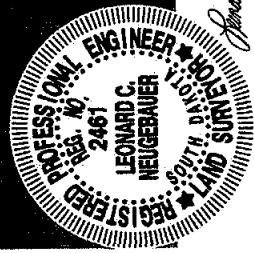
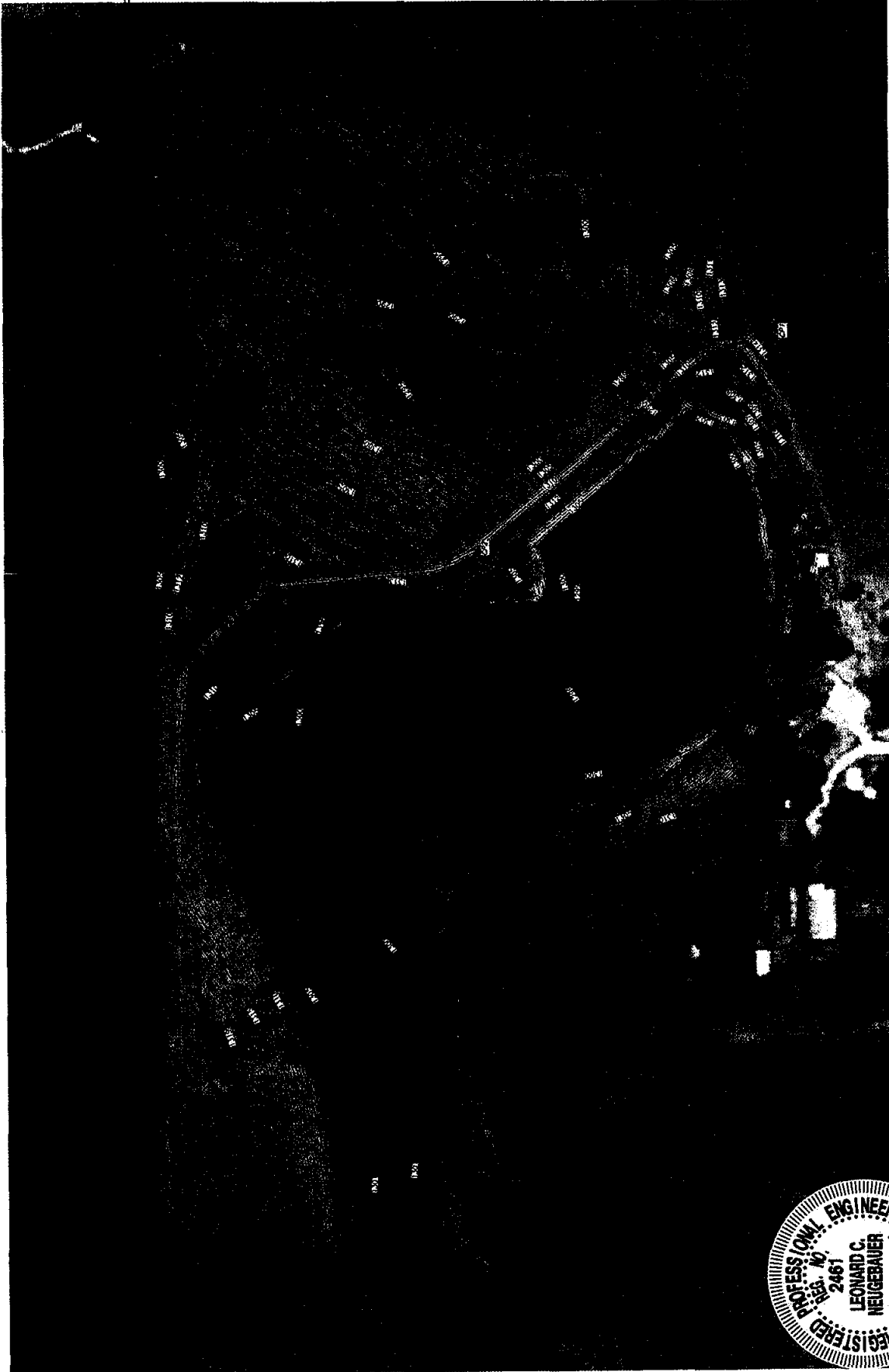
Project Manager: TEB
Designer: LCN
Project Number: 664630
Phone: (605) 339-4157



Sheet
2



James C. Neugebauer 9/24/14



David C. Neugebauer 9/26/14

PROJECT SCOPE

This project consists of excavating a new bypass channel through the existing bypass spillway area of this existing dam. After stripping topsoil, excavated material from the bypass channel which is suitable for fill will be used for filling in the breach in the existing dam. The project also includes replacement of the 66-inch outlet pipe, complete filling of the breach in the dam, topsoiling of the excavated and filled areas, and revegetation of the disturbed areas.

PROJECT DESIGN DATA

Watershed Area = 8948 acres
SCS Curve Number (CN) = 75
Hydraulic Length = 3000 feet
Average watershed slope = 1.0%
SCS 24-hour, Type II distribution rainfall

Elevation, Storage, Outflow Capacity Data

| Water Elev. (ft) | Storage Volume (cfs) | Pipe Outflow (cfs) | Bypass Channel (cfs) | Total Outflow (cfs) |
|------------------|----------------------|--------------------|----------------------|---------------------|
| 1304 | 27.0 | 0 | 0 | 0 |
| 1305 | 34.4 | 75 | 0 | 75 |
| 1306 | 43.0 | 212 | 0 | 212 |
| 1307 | 53.1 | 266 | 0 | 266 |
| 1308 | 64.7 | 314 | 220 | 534 |
| 1309 | 78.1 | 332 | 630 | 962 |
| 1310 | 93.2 | 349 | 1200 | 1549 |
| 1311 | 110.2 | 369 | 1900 | 2268 |
| 1312 | 128.3 | 392 | 2500 | 3192 |

Reservoir Flood Routing Analysis Data

| Storm Frequency | Peak Inflow (cfs) | Peak Outflow (cfs) | Peak Storage (AF) | Peak Water Elev. (ft) |
|-----------------|-------------------|--------------------|-------------------|-----------------------|
| 2-yr | 414 | 405 | 59 | 1307.5 |
| 5-yr | 723 | 718 | 70 | 1308.4 |
| 10-yr | 962 | 954 | 78 | 1309.0 |
| 15-yr | 1287 | 1274 | 86 | 1309.5 |
| 50-yr | 1606 | 1595 | 94 | 1310.1 |
| 100-yr | 1894 | 1872 | 101 | 1310.5 |

STORM WATER DISCHARGE
Because the total area to be disturbed is less than 1 acre, a Notice of Intent (NOI) for coverage under the General Permit for Storm Water Discharges Associated with Construction Activities is not required.



P:\06641630\641630.dwg, general notes.docx 9/26/2014 8:30:56 AM

UNCLASSIFIED EXCAVATION AND TOPSOIL MANAGEMENT

Prior to excavating the bypass channel, approximately 6 inches of topsoil shall be stripped from the area to be excavated and then stockpiled for later use on the project. Earthwork shall be performed as shown on plans and cross sections. The bypass channel shall be over-excavated by approximately 6 inches depth to allow replacement with 6 inches of topsoil to the finished grade shown on the plans. Estimated in-place volume of topsoil stripping from the bypass channel area is approximately 600 CY. Estimated excavation from the bypass spillway is 2300 CY in-place volume.

Prior to placing fill in the dam breach, any areas of standing water shall be pumped out. Where possible, the surface soils of the dam breach shall be left in place to allow integration of the fill soil with the surface soils of the dam. Topsoil shall be placed in lifts of approximately 6 inches and compacted to a minimum thickness of 6 inches. The compacted fill shall be surfaced with top soil to a minimum thickness of 6 inches. The finished in-place volume of fill to replace the dam breach to the grades as shown on the plans is approximately 3200 CY, which in-place volume includes approximately 200 CY of topsoil at 6-inch thickness.

Water for compaction and/or drying of subgrade, embankments, and trench material shall be performed by the Contractor to maintain soil at or near optimum moisture content to obtain required density. Compaction of subgrade and embankments shall be governed by the specified density method. Compaction of embankment shall be no less than 95% of Standard Proctor Density. Placement of the 6-inch thick surface topsoil shall be graded to a uniform surface without being compacted.

OUTLET PIPE REPLACEMENT

The outlet pipe shall be replaced with a 66-inch outlet pipe similar to that which was installed during the original dam construction, as shown on the attached copy of the original plans for the dam. The replacement pipe shall be bedded on a foundation prepared with cohesive soil. Three anti-sweep collars shall be installed where shown on the plans. The replacement pipe shall be anchored to and made water tight to the existing outlet structure by forming and placing a concrete collar around the pipe, which concrete collar is encased in the existing concrete using 3/4-inch diameter steel anchors or similar anchors placed approximately 12" on centers. The replacement pipe shall be embedded in concrete soil fill placed on both sides of the pipe uniformly in 6 lifts and compacted with a pneumatic compaction device over the suitable compacted, up to a height of fill where there is at least 12" of compacted soil over the replacement pipe. Care shall be taken to place and tamp cohesive fill under the haunches of the pipe during the placement of the first few lifts of fill.

RIPRAP AND FABRIC

The downstream end of the replacement outlet pipe shall be supported on a riprap foundation under and around the outlet pipe as shown on the plans. The riprap protection shall be extended downstream of the outlet pipe as shown on the plans, to protect against erosion from stormwater discharging from the pipe.

Riprap shall be Class A as shown in the plans, and shall conform to Section 700 of the SDDOT Standard Specifications. It is estimated that approximately 100 tons of riprap will be required for riprapping as shown on the plans.

Fabric shall be placed on the soil surface prior to placing the riprap. The fabric for rip rap shall conform to Section 831-1, Type B of the SDDOT Standard Specifications. It is estimated that approximately 100 SY of fabric will be required under the riprapping as shown on the plans.

SEEDING, FERTILIZING, MULCHING AND EROSION CONTROL BLANKET

Prior to seeding and fertilizing the areas to be revegetated, the topsoil shall be loosened with a tiller or similar device. The seed and fertilizer shall then be incorporated into the topsoil by a suitable planting method. Seedbeds for sloped areas of the dam breach fill, which has been crimped into the topsoil, shall be prepared for sloped areas of the dam breach fill, which shall be protected with erosion control blanket.

Seeding and fertilizing shall generally comply with sections 730 and 731 of the SDDOT Standard Specifications for Roads and Bridges. Seed shall be as described below or shall be a similar rural grass seed mixture as approved by the Owner.

| Special Permanent Seed Mixture 1 | |
|----------------------------------|------------|
| | Lbs / Acre |
| Western Wheat Grass | 13 |
| Sideoats Grama | 10 |
| Little Bluestem | 8 |
| TOTALS | 31 |

These rates shall be doubled if seed is broadcast and shall be increased by 50 percent if the seeding is applied through hydraulic seeding. Hydraulic seeding may be substituted for drilling only where slopes are steeper than 3:1. All seed shall be drilled in with an approved drill and incorporated to the top 1/2" +/- of topsoil. Small areas not accessible with a drill may be broadcast and dragged or raked in.

Starter fertilizer shall be placed into the seedbed. The all-natural fertilizer shall have a minimum guaranteed analysis of 4-6-4 and be USDA Certified BioBased. It should provide a minimum of 4% (N) nitrogen with a minimum water insoluble nitrogen (WIN) fraction of 3.2%, a minimum of 6% (P2O5) available phosphate, a minimum of 4% (K2O) soluble potash, and a maximum carbon to nitrogen ratio (C:N ratio) of 5:1. The all-natural fertilizer shall be free of weed-seed and pathogens accomplished through thermophilic composting, and not mechanical or chemical sterilization, to assure presence of beneficial soil microbiology. The fertilizer shall have a near neutral pH, a low salt index, a low biological oxygen demand, contain organic humic and fulvic acids, and have high aerobic organism counts. The fertilizer shall also be stable, free of bad odors, and be unattractive as a food source for animals. It should also be in a granular form that is easily spread. Application rate should be 400 lbs/acre.

For the bypass channel, the seeded topsoil shall be protected with straw mulch which shall be spread on the surface of the seeded area and the SDDOT straw mulch shall be applied at a rate of 200 lbs/acre. The straw mulch shall be applied in a manner that it will be blown on and building into the newly seeded area. Coverage shall be at the rate of 4,000 pounds (2 tons) per acre. Type straw shall not be used.

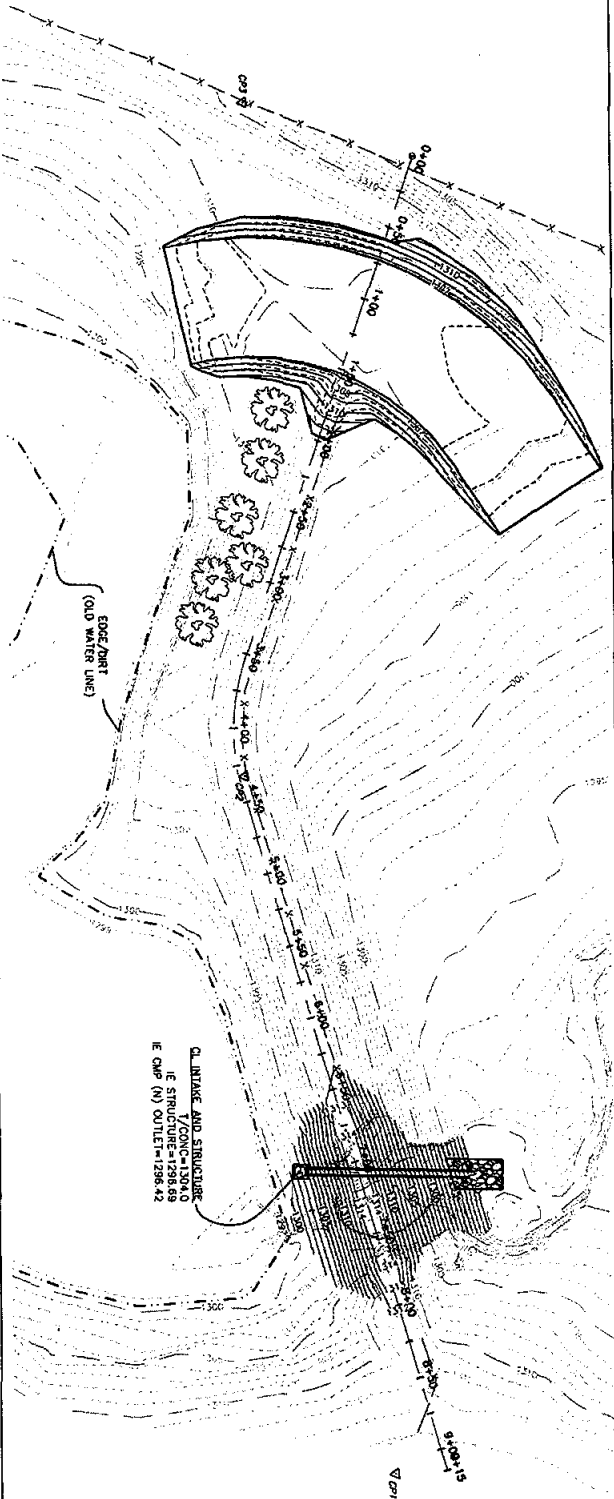
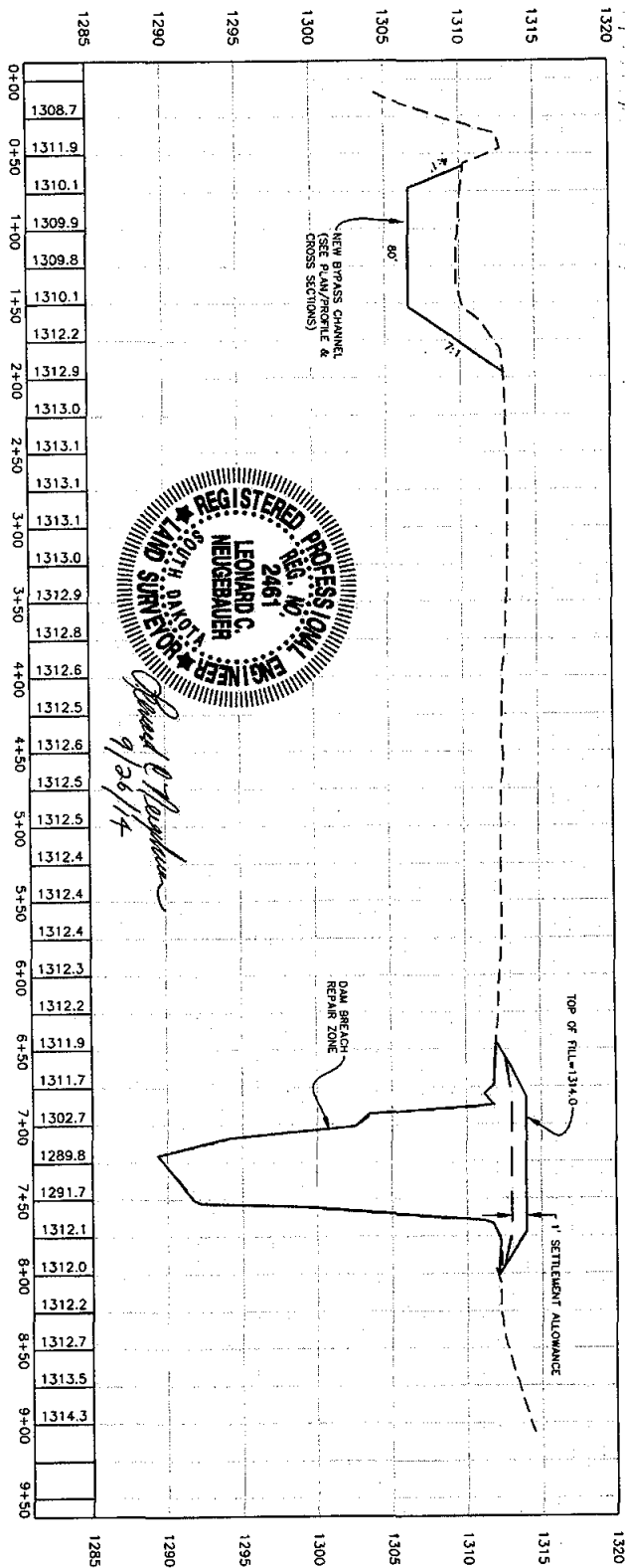
For the fill area of the dam breach, the seeded slopes of the dam shall be protected with erosion control blanket. Erosion control blanket shall be Type 3. The Contractor shall install erosion control blanket according to the manufacturer's installation instructions. The erosion control blanket shall be from the SDDOT approved product list, which may be viewed at the following internet site: <http://apps.sd.gov/applications/CS44approvedProducts/main.asp>. It is estimated that about 1200 SY of erosion control blanket will be required.

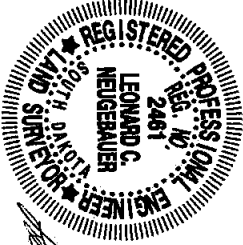
CHRISTENSEN DAM REPAIR
CANTON, SOUTH DAKOTA

General Notes

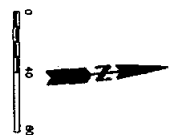
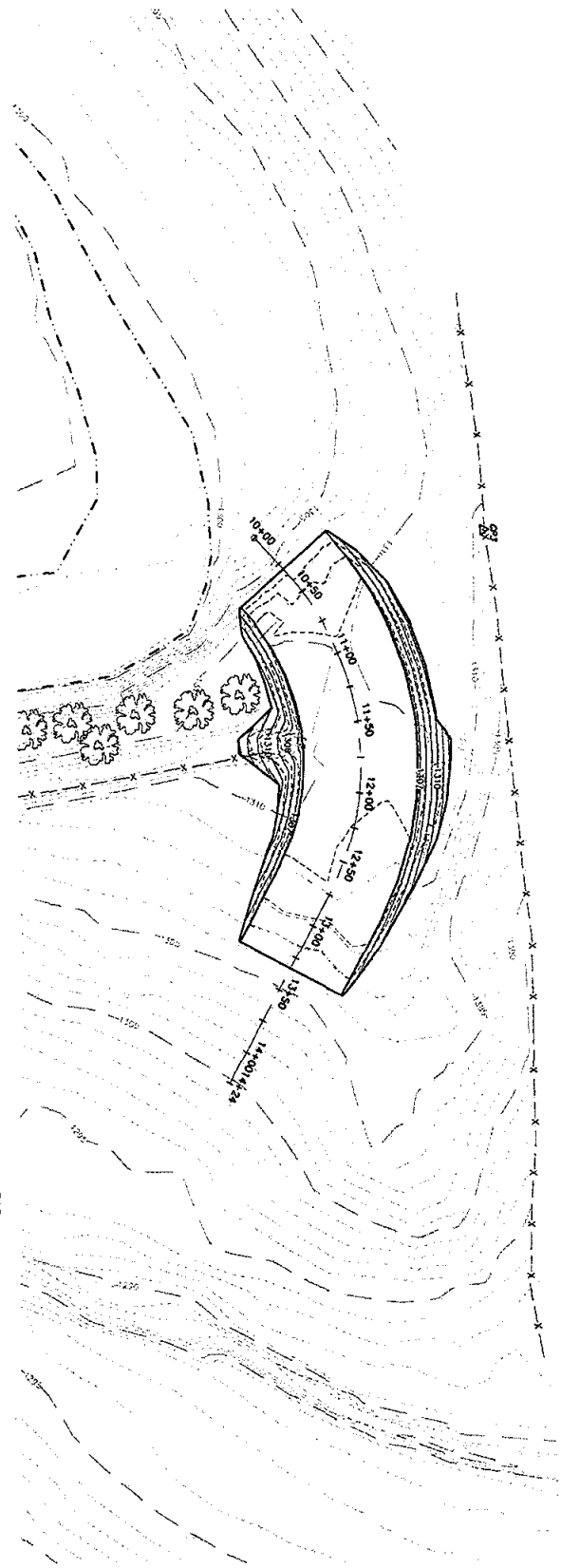
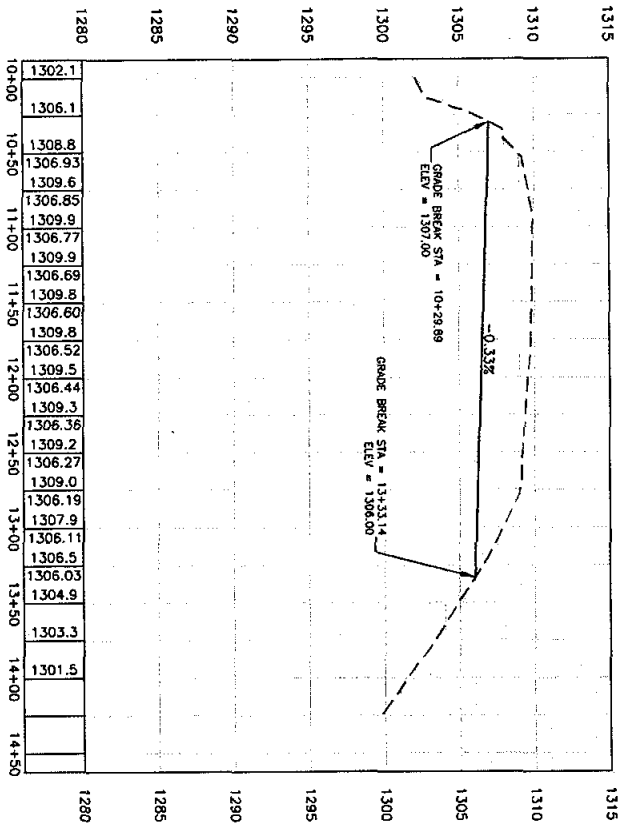
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|------------------|----------------|
| Project Manager: | TEB |
| Designer: | LCN |
| Project Number: | 664630 |
| Phone: | (605) 339-4157 |

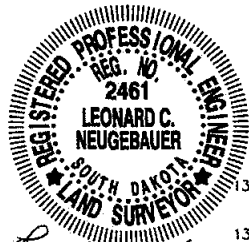




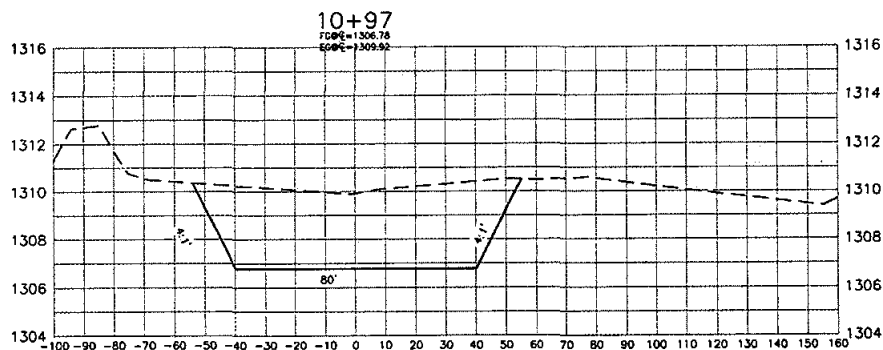
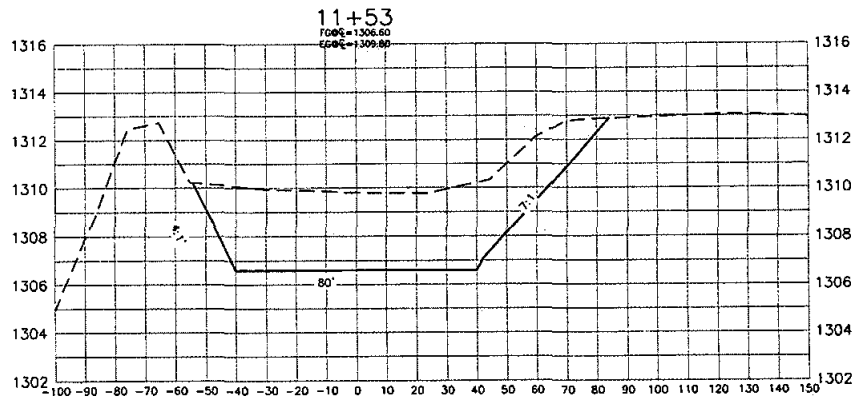
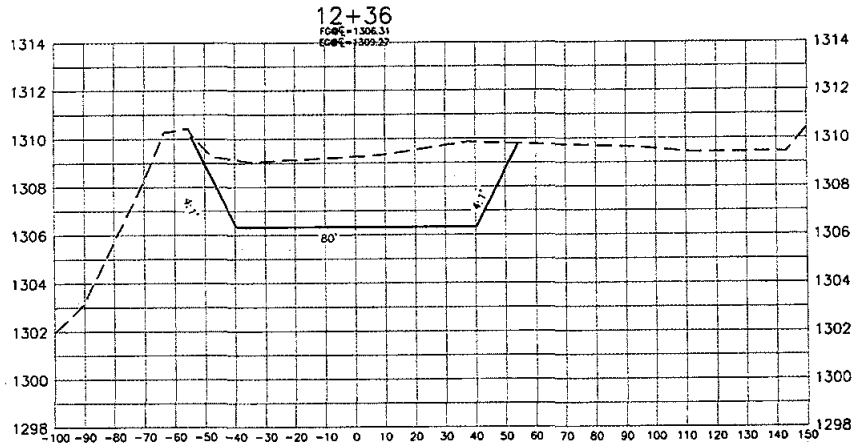
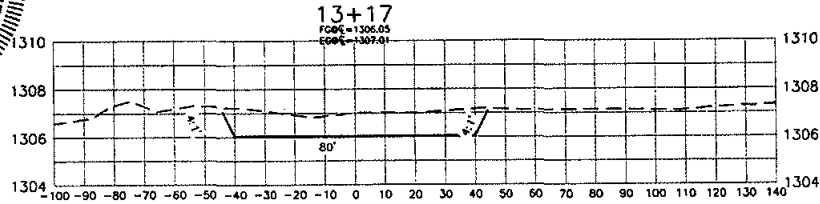


Leonard C. Neugebauer
9/26/14

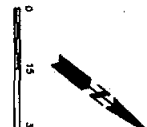




Leonard C. Neugebauer
9/26/14



SCALE:
1"=5' VERT
1"=40' HOR



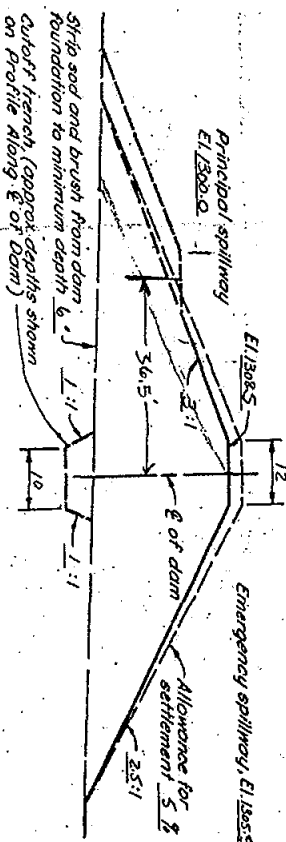
| SE880 | 377 | 742 | — | 15.0 | 11.2 | 39.8 | 58.9 |
|---------------|--------------------|-------------|------------------------|-------------|--------------|------------------|---------------|
| ACRES | AC.FT. | 25-YR. | C.F.S. | FEET | ACRES | AC.FT. | AC.FT. |
| DRAINAGE AREA | ANNUAL YIELD (50%) | PEAK RINOFF | EMERG. SPLWM. CAPACITY | WATER DEPTH | SURFACE AREA | SEDIMENT STORAGE | TOTAL STORAGE |

| SE880 | 377 | 742 | — | 15.0 | 11.2 | 39.8 | 58.9 |
|---------------|--------------------|-------------|------------------------|-------------|--------------|------------------|---------------|
| DRAINAGE AREA | ANNUAL YIELD (50%) | PEAK RINOFF | EMERG. SPLWM. CAPACITY | WATER DEPTH | SURFACE AREA | SEDIMENT STORAGE | TOTAL STORAGE |
| ACRES | AC.FT. | 25-YR. | C.F.S. | FEET | ACRES | AC.FT. | AC.FT. |

Sec. 7 R. 1
County Franklin
LOCATION

[illegible]

TYPICAL CROSS SECTION OF DAM



S.D. CONSTRUCTION AND MATERIAL SPECIFICATIONS:

EARTH DAM

OPERATOR: Tracy J. JUEL

CONSERVATION DISTRICT:

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

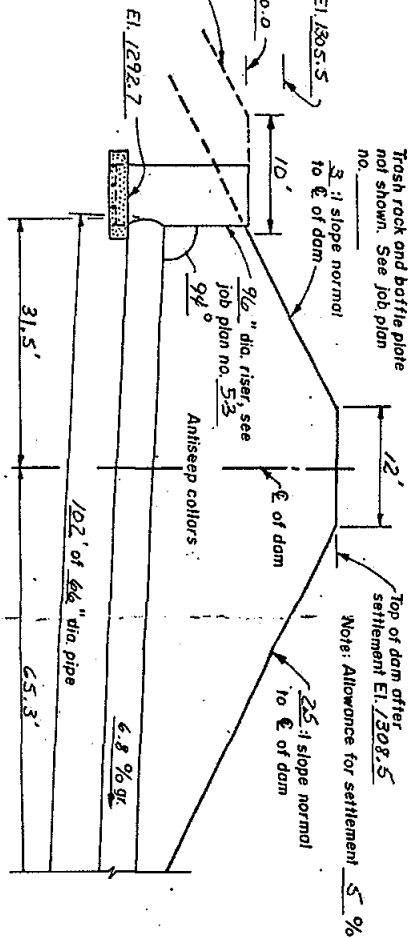
SKETCH PLAN OF DAM AND RESERVOIR AREA

Approximate scale 1" = _____

REFERENCE: GUIDE PLAN NO. 1.0

JOB PLAN NO. 1.0

(Rev. 4-73). 5, N-29, 073.10(1)



CROSS SECTION OF DAM ALONG ϕ OF PRINCIPAL SPILLWAY
(Not to scale)

(Not to scale)

SPECIFICATION NOTES

1. ELBOW, IF REQUIRED, MAY BE FABRICATED BY CONTINUOUS WELDING SEPARATE PIPE SECTIONS OR BY FABRICATING A CONTINUOUS WELDED JOINT ON THE UPSTREAM END OF LAST SECTION OF PIPE.
2. PIPE WALL THICKNESS SHALL BE 1/4 GAGE OR $\phi 7 \frac{1}{2}$ INCHES.

TABLE OF QUANTITIES:

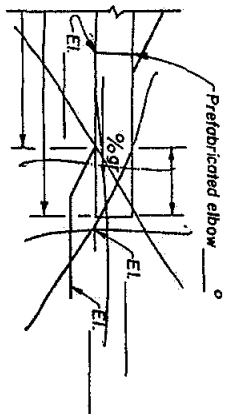
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APPLICABLE STANDARD S.C.S. SPECIFICATIONS

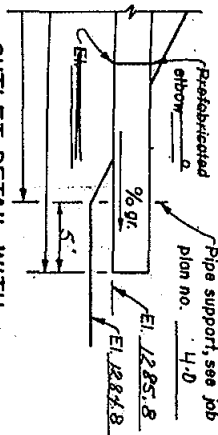
REFERENCE: GUIDE PLAN NO. 2.0

Rev. 8/80
JOB PLAN NO. 2.0

OUTLET DETAIL WITHOUT
PIPE SUPPORT



OUTLET DETAIL WITH
PIPE SUPPORT



Sac. 31, T. 99, R. 48
Lincoln County
LOCATION

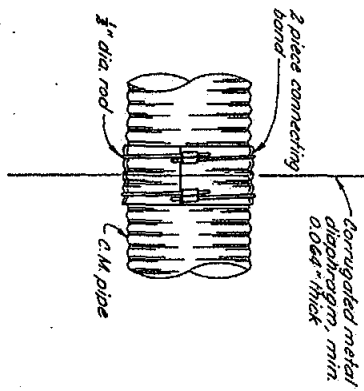
**CORRUGATED METAL PIPE
DROP INLET PRINCIPAL SPILLWAY**

OPERATOR Paul Tunc

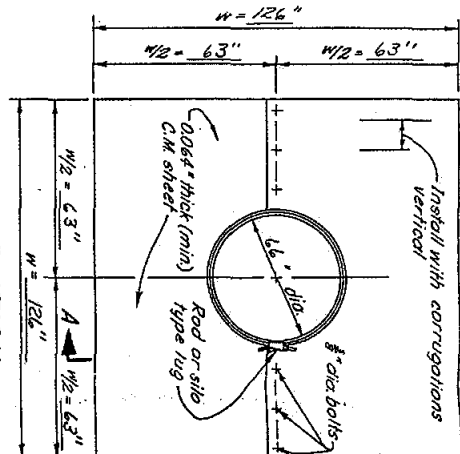
CONSERVATION DISTRICT

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

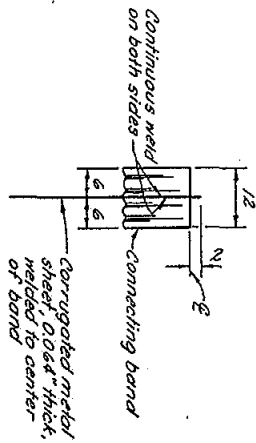
| | | |
|---------------|------------------|----------|
| Date | Assigned by..... | |
| Designed..... | Title | |
| Dated..... | Type | |
| Tracked..... | Control | |
| Checked..... | Growing No. | No. |



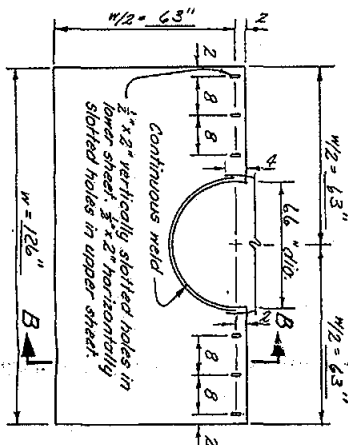
SECTION A-A



ELEVATION



SECTION B-B



HALF ELEVATION

DIMENSIONS AND QUANTITIES

| PIPE DIAMETER IN INCHES | 12 | 15 | 18 | 21 | 24 | 30 | 36 | 42 | 48 |
|---------------------------------|-------|-------|-------|----|----|----|-------|-------|-------|
| "W" IN INCHES | 60 | 63 | 66 | 69 | 72 | 90 | 96 | 102 | 108 |
| NO. OF RODS AND LUGS | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| NEOPRENE GASKET WIDTH IN INCHES | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| ASPHALT MASTIC IN GALS. | 1 1/2 | 1 1/2 | 1 1/2 | 1 | 1 | 1 | 1 1/2 | 1 1/2 | 1 1/2 |

NOTES:

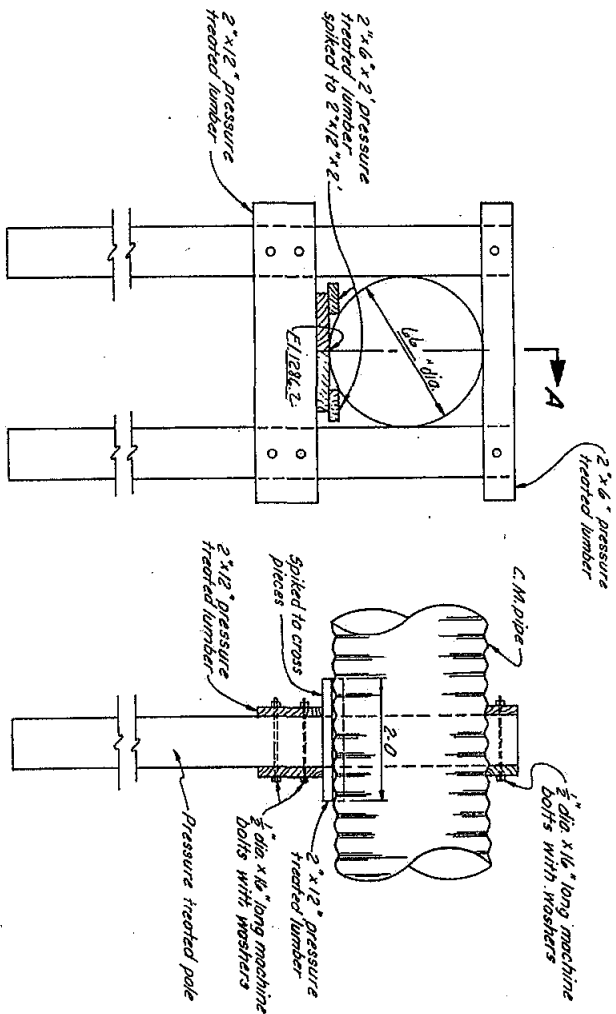
1. WATER-TIGHTNESS WILL BE OBTAINED BY USE OF (1) 3/8" THICK NEOPRENE GASKET (WIDTH AS SHOWN) OR (2) ASPHALT MASTIC SEALING MATERIAL TO COVER FULL WIDTH OF BAND. CROSS OUT TYPE NOT USED ON DIMENSIONS AND QUANTITIES.
2. WELD BAND TO LOWER SHEET WITH CONTINUOUS WELD AROUND TO 2" BELOW CENTERLINE. WELD BAND TO UPPER SHEET WITH CONTINUOUS WELD AROUND TO CENTERLINE.
3. ALL DAMAGED GALVANIZING AND UNGALVANIZED METAL SHALL BE CLEANED AND PAINTED WITH TWO COATS OF ZINC DUST, ZINC OXIDE PRIMER (FED. SPEC. TT-P-64) TYPE III).

TWO PIECE C.M. DIAPHRAGM (ROD TYPE)

OPERATOR: Paul Juel
CONSERVATION DISTRICT: _____

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

| | |
|-------------------|------------------|
| Designed by _____ | Checked by _____ |
| Drawn by _____ | Typed by _____ |
| Field _____ | Station _____ |
| Date _____ | Time _____ |



ELEVATION

SECTIONAL ELEVATION A-A

TABLE OF QUANTITIES

| ITEM | LENGTH FOR 66" DIA. C.M. PIPE | UNIT | QUANTITY |
|-----------------------------------|-------------------------------|------|----------|
| PRESSURE TREATED POLE 1/2" DIA. | 12'-0" | EACH | 2 |
| 2" X 12" PRESSURE TREATED LUMBER | 8'-0" | EACH | 2 |
| 2" X 6" PRESSURE TREATED LUMBER | 8'-0" | EACH | 2 |
| 2" X 12" PRESSURE TREATED LUMBER | 2'-0" | EACH | 6 |
| 2" X 6" PRESSURE TREATED LUMBER | 2'-0" | EACH | 2 |
| 1/2" DIA. MACHINE BOLTS WITH NUTS | 1'-4" | EACH | 4 |
| 1/2" DIA. WASHERS | | EACH | 8 |

NOTES:

- HAND OR MACHINE TAMP BACKFILL THOROUGHLY AROUND FOOTINGS AND COLUMNS.

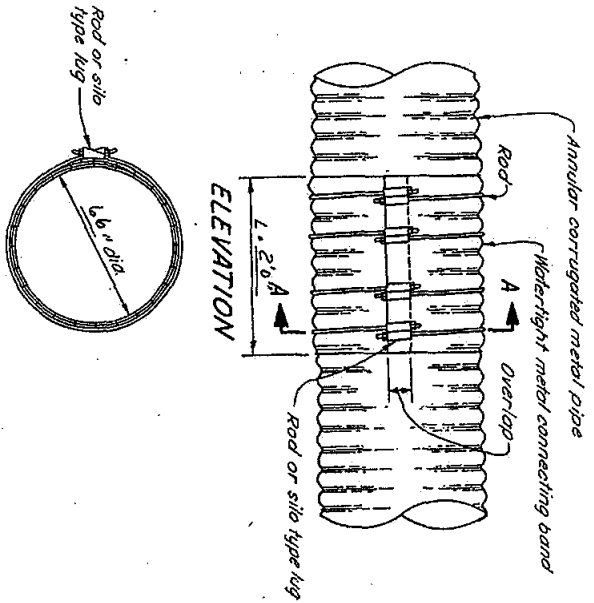
TIMBER PIPE SUPPORT

OPERATOR: Paul J. Lee

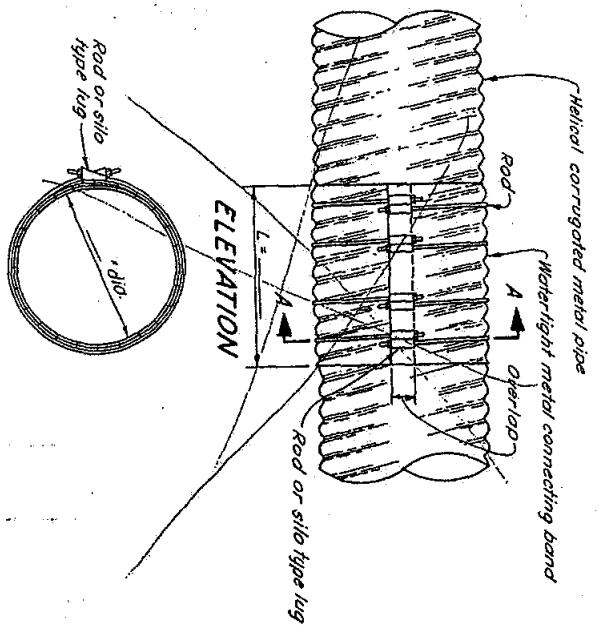
CONSERVATION DISTRICT: _____

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

| | |
|-------------------|-------------------|
| Designed by _____ | Checked by _____ |
| Drawn by _____ | Reviewed by _____ |
| Date _____ | Scale _____ |
| Sheet _____ | Project _____ |



SECTIONAL ELEVATION A-A



SECTIONAL ELEVATION A-A

DIMENSIONS AND QUANTITIES

| PIPE DIA.
INCHES | MINIMUM "L"
INCHES | APPROX.
OVERLAP
INCHES | NUMBER OF
RODS & LUGS | MINIMUM
ROD DIA.
IN. | NEOPRENE
GASKET WIDTH
INCHES | ASPHALT
MASTIC
GAL. |
|---------------------|-----------------------|------------------------------|--------------------------|----------------------------|------------------------------------|---------------------------|
| 6-18 | 12 | 2 | 2 | 1/2 | 12 | 1 1/2 |
| 21-30 | 24 | 3 | 4 | 1/2 | 12 | 1 1/2 |
| 36-48 | 24 | 6 | 4 | 1/2 | 12 | 2 |

NOTES:

1. WATERTIGHTNESS WILL BE OBTAINED BY USE OF (1) 3/8" THICK NEOPRENE GASKET (WIDTH AS SHOWN) OR (2) ASPHALT MASTIC SEALING MATERIAL TO COVER FULL WIDTH OF BAND.
2. CROSS OUT BAND AND QUANTITIES NOT APPLICABLE.

WATERTIGHT CONNECTING BAND FOR ANNULAR AND HELICAL CORRUGATED METAL PIPE

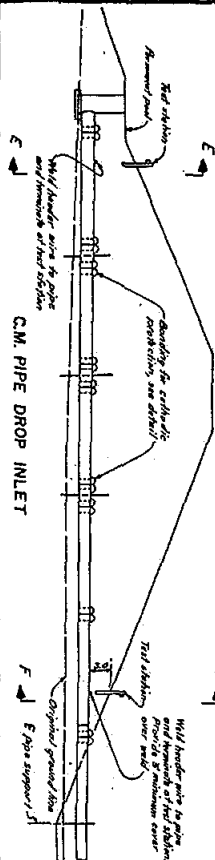
OPERATOR: Paul Tuel
CONSERVATION DISTRICT: _____

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

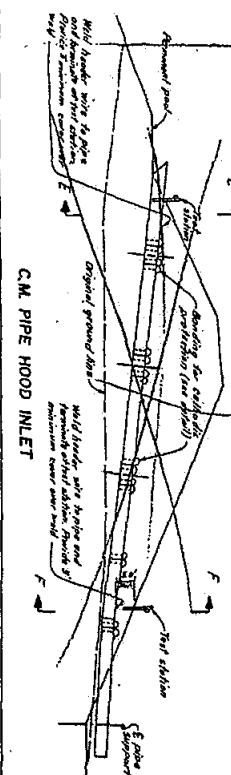
| | |
|-------------------|----------------------|
| Designed by _____ | Approved by _____ |
| Drawn by _____ | Checked by _____ |
| Titled _____ | Scale _____ |
| Created _____ | Sheet _____ of _____ |

JOB PLAN NO. 3.0

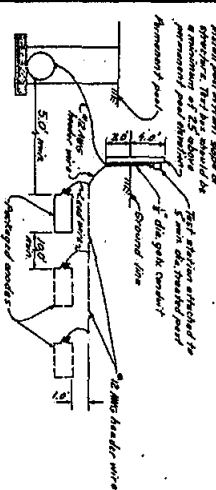
Note: 1 piece anti-slip collars are showing, see note 6.



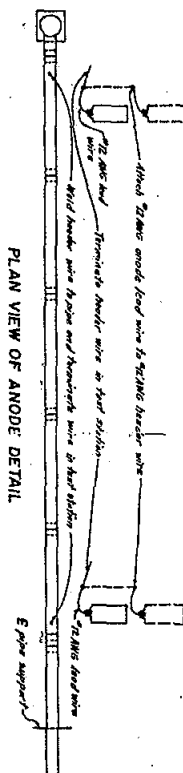
C.M. PIPE DROP INLET



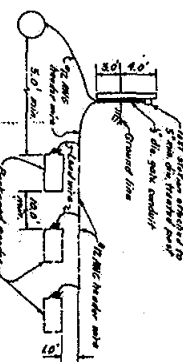
C.M. PIPE HOOD INLET



PACKAGED MAGNESIUM ANODES REQUIRED



PLAN VIEW OF ANODE DETAIL



PACKAGED MAGNESIUM ANODES REQUIRED

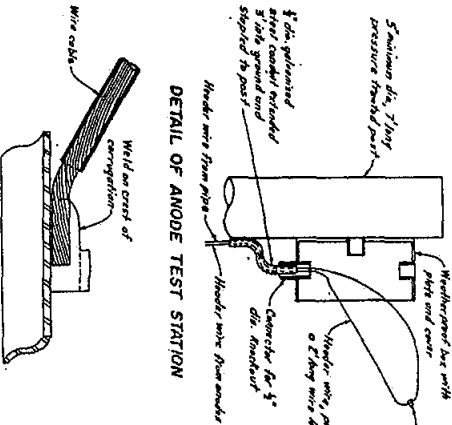
| SECTION | SIZE | NO. REQ'D |
|---------|------|-----------|
| E-1 | 1/2" | 1 |
| E-2 | 1/2" | 1 |
| E-3 | 1/2" | 1 |
| E-4 | 1/2" | 1 |
| E-5 | 1/2" | 1 |
| E-6 | 1/2" | 1 |
| E-7 | 1/2" | 1 |
| E-8 | 1/2" | 1 |
| E-9 | 1/2" | 1 |
| E-10 | 1/2" | 1 |
| E-11 | 1/2" | 1 |
| E-12 | 1/2" | 1 |
| E-13 | 1/2" | 1 |
| E-14 | 1/2" | 1 |
| E-15 | 1/2" | 1 |
| E-16 | 1/2" | 1 |
| E-17 | 1/2" | 1 |
| E-18 | 1/2" | 1 |
| E-19 | 1/2" | 1 |
| E-20 | 1/2" | 1 |
| E-21 | 1/2" | 1 |
| E-22 | 1/2" | 1 |
| E-23 | 1/2" | 1 |
| E-24 | 1/2" | 1 |
| E-25 | 1/2" | 1 |
| E-26 | 1/2" | 1 |
| E-27 | 1/2" | 1 |
| E-28 | 1/2" | 1 |
| E-29 | 1/2" | 1 |
| E-30 | 1/2" | 1 |
| E-31 | 1/2" | 1 |
| E-32 | 1/2" | 1 |
| E-33 | 1/2" | 1 |
| E-34 | 1/2" | 1 |
| E-35 | 1/2" | 1 |
| E-36 | 1/2" | 1 |
| E-37 | 1/2" | 1 |
| E-38 | 1/2" | 1 |
| E-39 | 1/2" | 1 |
| E-40 | 1/2" | 1 |
| E-41 | 1/2" | 1 |
| E-42 | 1/2" | 1 |
| E-43 | 1/2" | 1 |
| E-44 | 1/2" | 1 |
| E-45 | 1/2" | 1 |
| E-46 | 1/2" | 1 |
| E-47 | 1/2" | 1 |
| E-48 | 1/2" | 1 |
| E-49 | 1/2" | 1 |
| E-50 | 1/2" | 1 |
| E-51 | 1/2" | 1 |
| E-52 | 1/2" | 1 |
| E-53 | 1/2" | 1 |
| E-54 | 1/2" | 1 |
| E-55 | 1/2" | 1 |
| E-56 | 1/2" | 1 |
| E-57 | 1/2" | 1 |
| E-58 | 1/2" | 1 |
| E-59 | 1/2" | 1 |
| E-60 | 1/2" | 1 |
| E-61 | 1/2" | 1 |
| E-62 | 1/2" | 1 |
| E-63 | 1/2" | 1 |
| E-64 | 1/2" | 1 |
| E-65 | 1/2" | 1 |
| E-66 | 1/2" | 1 |
| E-67 | 1/2" | 1 |
| E-68 | 1/2" | 1 |
| E-69 | 1/2" | 1 |
| E-70 | 1/2" | 1 |
| E-71 | 1/2" | 1 |
| E-72 | 1/2" | 1 |
| E-73 | 1/2" | 1 |
| E-74 | 1/2" | 1 |
| E-75 | 1/2" | 1 |
| E-76 | 1/2" | 1 |
| E-77 | 1/2" | 1 |
| E-78 | 1/2" | 1 |
| E-79 | 1/2" | 1 |
| E-80 | 1/2" | 1 |
| E-81 | 1/2" | 1 |
| E-82 | 1/2" | 1 |
| E-83 | 1/2" | 1 |
| E-84 | 1/2" | 1 |
| E-85 | 1/2" | 1 |
| E-86 | 1/2" | 1 |
| E-87 | 1/2" | 1 |
| E-88 | 1/2" | 1 |
| E-89 | 1/2" | 1 |
| E-90 | 1/2" | 1 |
| E-91 | 1/2" | 1 |
| E-92 | 1/2" | 1 |
| E-93 | 1/2" | 1 |
| E-94 | 1/2" | 1 |
| E-95 | 1/2" | 1 |
| E-96 | 1/2" | 1 |
| E-97 | 1/2" | 1 |
| E-98 | 1/2" | 1 |
| E-99 | 1/2" | 1 |
| E-100 | 1/2" | 1 |

| ITEM | UNIT | QUANTITY |
|--|----------|----------|
| 5 GAL. F.L. LONG PRESSURE TREATED POST | EACH | 1 |
| 1/2 DIA. 6' LONG GALV STEEL CONDUIT | EACH | 1 |
| WEATHERPROOF BOX | EACH | 1 |
| PACKAGED MASONRY ANCHORS | EACH | 1 |
| 6' LONG NUT BENDING CABLE | LIN. FT. | 20 |
| 12 AWG. 10' LEADER WIRE | LIN. FT. | 100 |

SIZE 3216 NO. ADD. 5

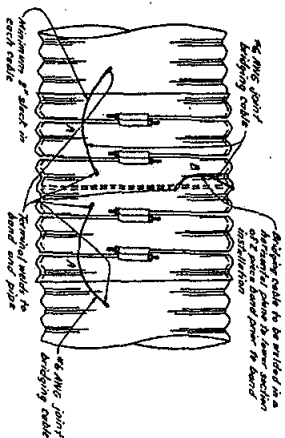
1. LOCATE ANODES IN NATURAL SOIL WITHIN 20' OF THE SHIELD.
2. FIND SHIELD AS DIRECTED BY THE INVENTOR. INSTEAD OF THE SHIELD, THE ANODES MAY BE USED TO EXPOSE THE BARE METAL TO PROVIDE GOOD CONDUCTIVITY.
3. TERMINAL WELDING ANODES SHALL BE PLACED CAREFULLY TO AVOID SHORTING TO THE SHIELD.
4. BURN FUEL AREA TO AVOID SHORTING TO THE SHIELD.
5. COATED AS SPECIFIED FOR MATCHING DAMAGED PIPE COATING.
6. THE POWER WELDING ANODES SHALL BE EQUAL TO OR BETTER THAN THE DAMAGED PIPE. THEY SHALL BE WELDED TO THE SHIELD. THE ANODES ARE USED TO WEAR DOWN THE SHIELD. THE ANODES ARE USED TO WEAR DOWN THE SHIELD. THE ANODES ARE USED TO WEAR DOWN THE SHIELD.
7. LOCATE ANODES WITH WELD TAPPED. MOST ANODES ARE USED TO WEAR DOWN THE SHIELD.
8. ANODES WITHIN 20' OF THE SHIELD SHALL BE USED TO WEAR DOWN THE SHIELD.
9. ANODES MAY BE LOCATED EITHER DOWNSTREAM OR UPSTREAM ON BOTH LOCATIONS.
10. CROSS OUT VIEWS NOT APPLICABLE.

DETAIL OF ANODE TEST STATION



DETAIL OF CABLE WELD CONNECTION

PLAN VIEW
CABLE FOR C.M. PIPE AND COUPLING BAND



CATHODIC PROTECTION SYSTEM

OPERATOR: PAUL JUEL
CONSERVATION DISTRICT: _____
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

| PIPE | A | | | B* | | |
|------|----------|--------|----------|--------|----------|--------|
| | DIAMETER | LENGTH | QUANTITY | LENGTH | QUANTITY | LENGTH |
| 12 | 2'-0" | 2 | 1'-0" | 1 | 1'-0" | 1 |
| 15 | 2'-0" | 2 | 1'-5" | 1 | 1'-5" | 1 |
| 18 | 2'-0" | 2 | 1'-8" | 1 | 1'-8" | 1 |
| 21 | 2'-0" | 2 | 1'-5" | 1 | 1'-5" | 1 |
| 24 | 2'-0" | 2 | 2'-8" | 1 | 2'-8" | 1 |
| 30 | 2'-0" | 2 | 2'-8" | 1 | 2'-8" | 1 |
| 36 | 2'-0" | 2 | 3'-4" | 1 | 3'-4" | 1 |
| 48 | 2'-0" | 2 | 4'-0" | 1 | 4'-0" | 1 |
| 60 | 2'-0" | 2 | 4'-8" | 1 | 4'-8" | 1 |
| 72 | 2'-0" | 2 | 5'-5" | 1 | 5'-5" | 1 |

CROSS SECTION AT CREST OF EMERGENCY SPILLWAY AND PROFILE ALONG E OF DAM

MAXIMUM CROSS SECTION OF DAM ARE

PROFILE ALONG E OF EMERGENCY SPILLWAY

SEDIMENT YIELD

| ERODIBILITY
AREA
ACRES | GROSS
RATE
A.F./AC./YR. | DRAINAGE
AREA
ACRES | DELIVERY
RATE
% | DESIGN
PERIOD
YEARS | REQ'D. SEDIMENT
VOLUME
AC.FT. |
|------------------------------|-------------------------------|---------------------------|-----------------------|---------------------------|-------------------------------------|
| C | 0037 | 5380 | 10 | 20 | 39.8 |

(Rev 4-73) 5-N-29, 073.10 (2)

NOTICE OF TRANSFER OF OWNERSHIP

For assistance call (605) 773-3352

RECEIVED

OCT 06 2014

WATER RIGHTS
PROGRAM

Mail to: PMB 2020
DENR - Water Rights Program
523 E Capitol Ave
Pierre, SD 57501-3182

Water Right/Permit No. 5145-3Date: October 1, 2014

I/We request that Water Right/Permit No. 5145-3 formerly owned by:
Juel Dam be transferred to:

New Owner Name: John and Linda ChristensenAddress: 48230 279th StCity, State, Zip Canton SD 57013 Telephone No. 605 9874162

Title to the following described land(s)/property has been transferred as described above:

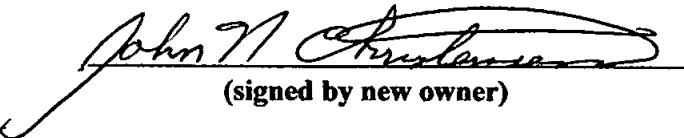
SW 1/4 of Section 31-T99N-R48W, In Lincoln County

☒ I understand that the validity of Water Right/Permit No. 5145-3 has not been determined by this transfer action. If I have any questions on validity, I understand that only the Water Management Board has the authority to determine if a water right/permit is valid (see note below.)

You are requested to file this "Notice of Transfer" in the appropriate file with the Water Rights Program, as evidence of the change of ownership.

A fee of Fifty Dollars (\$50.00) is included to cover the filing fee as required by SDCL 46-2-13.

I, John N Christensen, the new owner, certify that the above information is true and correct.


(signed by new owner)

NOTE: Water permits may be cancelled for nonconstruction after the five year construction period has expired. Once a water permit is developed and the water used, the permit becomes a right. A water right may be lost for three reasons:

1. Abandonment - no intent to use water and use is abandoned.
2. Forfeiture - no use of water for three year period without legal excuse.
3. For a third violation of a condition of a water permit/right.

RECEIPT

WATER RIGHTS PROGRAM

South Dakota Department of Environment and Natural Resources

Date 10/6, 20 14

RECEIVED OF Christensen Bros 48230 279th St Canton SD 57013

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

| | | |
|--|-------|-------|
| Fee for Application for Permit No. _____ to Appropriate Water, to construct and to put water to beneficial use | 50 | 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 <u>5145-3</u> | | |
| Fee for _____ | | |
| Fee for Issuing New Well Driller's License No. _____ for C.Y. _____ | | |
| Fee for Renewal of Well Driller's License No. _____ for C.Y. _____ | | |
| Fee for Issuing Well Pump Installer's License No. _____ for C.Y. _____ | | |
| Fee for Renewal of Well Pump Installer's License No. _____ for C.Y. _____ | | |
| (Any Other Work Provided by Law) | TOTAL | 50 00 |

No. 06962

By

Jaune Goodman
Chief Engineer



DEPARTMENT OF ENVIRONMENT
and NATURAL RESOURCES

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
denr.sd.gov



October 6, 2014

5145-3

John & Linda Christensen
48230 279th St
Canton SD 57013

Dear Mr. & Mrs. Christensen:

I am writing to acknowledge receipt of the transfer form and filing fee you submitted for changing ownership on Water Right No. 5145-3.

The ownership change has been completed. Water Right No. 5145-3 formerly held by Paul M Juel is now listed in your names.

Enclosed for your records is Receipt No. 06962 in the amount of \$50 which you paid for filing the ownership change. Also included is a copy of the water right in the event you do not have one.

If you have any questions, please contact me.

Sincerely,

Genny McMath
Water Rights Program
(605) 773-3352
email: genny.mcmath@state.sd.us

enclosures



October 27, 2014

Tim Schaal
South Dakota DENR
523 East Capitol Avenue
Pierre, SD 57501

RECEIVED

OCT 31 2014

WATER RIGHTS
PROGRAM

**RE: Christensen Dam Repair
Canton, South Dakota
DGR Project No. 664630**

Dear Tim:

Jerke and Sons recently completed the repair work on the Christensen Dam Project, northeast of Canton SD, to address the damage caused by the June 2014 floods. The construction work was in substantial compliance with the project plans that were issued to your office on September 26, 2014. Approximately 120 linear feet of poly coated CMP pipe was installed with seep collars placed at 25', 50' and 75', as measured from the outlet structure. The invert elevation of the pipe was approximately 1' higher than plan elevation. While no topographic survey of the dam repairs was performed upon completion of the dam repair work, visual observation indicates the dam and emergency spillway will function as designed.

We trust this information is adequate for your acceptance of repair work performed on the dam in compliance with SDDENR standards. Should you have any questions or need further information, please feel free to contact us.

Sincerely,

DGR Engineering

A handwritten signature in black ink, appearing to read "Trent Bruce".

Trent Bruce, PE

TEB/mlb

cc: John and Linda Christensen

DGR Engineering — 2909 East 57th Street — Suite 101 — Sioux Falls, SD 57108
phone: 605.339.4157 — fax: 605.339.4175 — dgr.com