CONSULTING ENGINEERING • GEOLOGICAL INVESTIGATION • ENGINEERING INSPECTION

HEMPHILL CORPORATION
4834 SOUTH 83RD EAST AVENUE
OFFICE-(918) 622-5133 TULSA, OKLAHOMA 74145 AFTER HOURS 587-5822

September 1978

CLIENT:
Mr. James A. Pierret
Project Manager
Fansteel Metals, Inc.
Ten Tantalum Place
Muskogee, Oklahoma 74401

REPORT OF
RETENTION POND STUDY
PART II
FANSTEEL, INC.
MUSKOGEE, OKLAHOMA

TABLE OF CONTENTS:

10003

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AP

ITEM 1. Detailed Topographic Map of Site Area

The topographic map with the location of the retention pond as presented to NRC during Fansteel's visit to NRC on August 4, 1978, is given in drawing No. 6413-2A1-R, revised on 8-21-78.

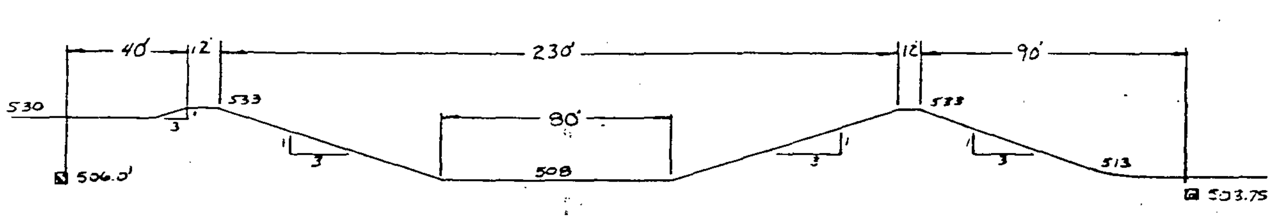
ITEM 2 Provide Map of Site Boundaries

Site boundaries are indicated on the map mentioned in Item 1.

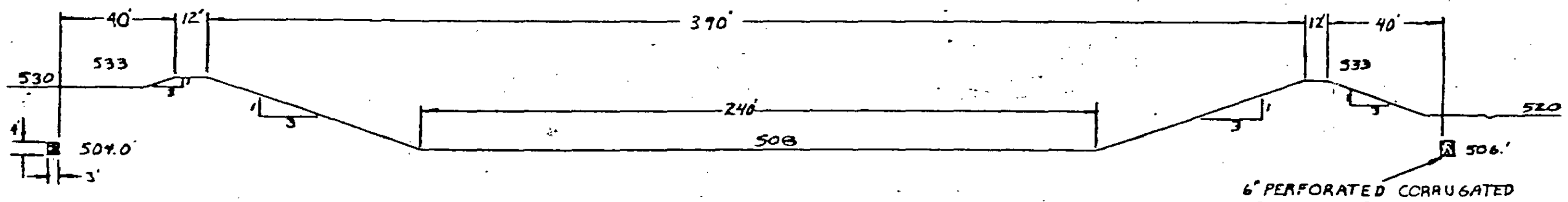
ITEM 3 Provide a Detailed Ground Water Contour Map of the Site Area. The Map Should Have Contour Intervals of Not More Than Five Feet and Should Indicate Expected Flow Paths From the Waste Retention Ponds to the Site Boundary or Nearest Downgradient Water Users.

The map is presented on the next page. The contour interval is two feet. Ground water flow is from the south and west to the east and the Arkansas River, and to the north to the flat plain.

The proposed pond is impervious with a liner. The pond will make no contribution to ground water.



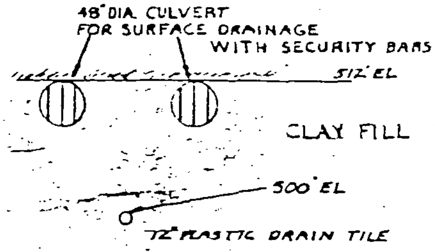
SECTION B-B



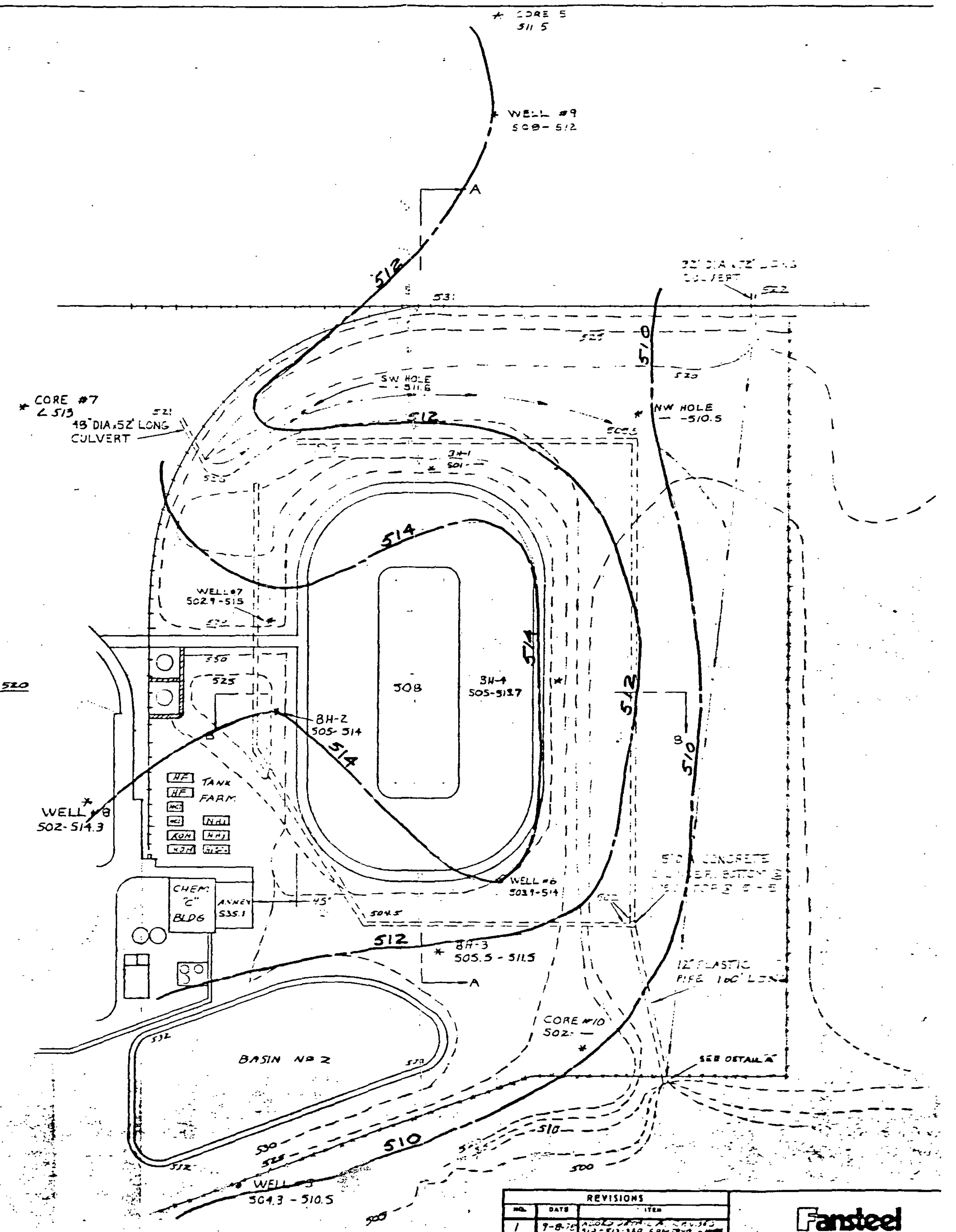
SECTION A-A

6" PERFORATED CORRUGATED GALVANIZED METAL PIPE, COVERED WITH STONE, AND FELT COVERING

SCALE; 1"=30'



DETAIL "A"



GROUND WATER CONTOUR MAP
CONTOUR INTERVAL = 2 FEET

REVISIONS		
NO.	DATE	ITEM
1	9-8-78	ADDED DETAIL A, REVISED 510-512-520 CONTOUR LINES
2	9-11-78	ADD POND SECTIONS & CORE DEPTHS

Fansteel Metals

POND Nº 3
CONTOUR MAP

DC-1-132

ITEM 4 Specify the Exact Drainage Area of Waste Retention Pond. If Streams Drain into the Pond, Provide Information Regarding Stream Lengths, Slopes, Drainage Areas, Basin Vegetative Cover, and Basin Characteristics.

The proposed pond is constructed with adequate freeboard so that no surface runoff from adjacent areas will enter the pond. The only surface water is that water that will fall directly on the basin as precipitation.

ITEM 5 Provide Area Capacity Curves For The Waste Retention Ponds

There is only one pond being proposed for development at this time. The bottom of this pond is at elevation 505. The free surface, when the pond reaches design capacity, will be at elevation 530. When the basin is full, its volume will be 1,132,000 cubic feet.

The area - capacity curve for the pond is presented on the following page of this response.

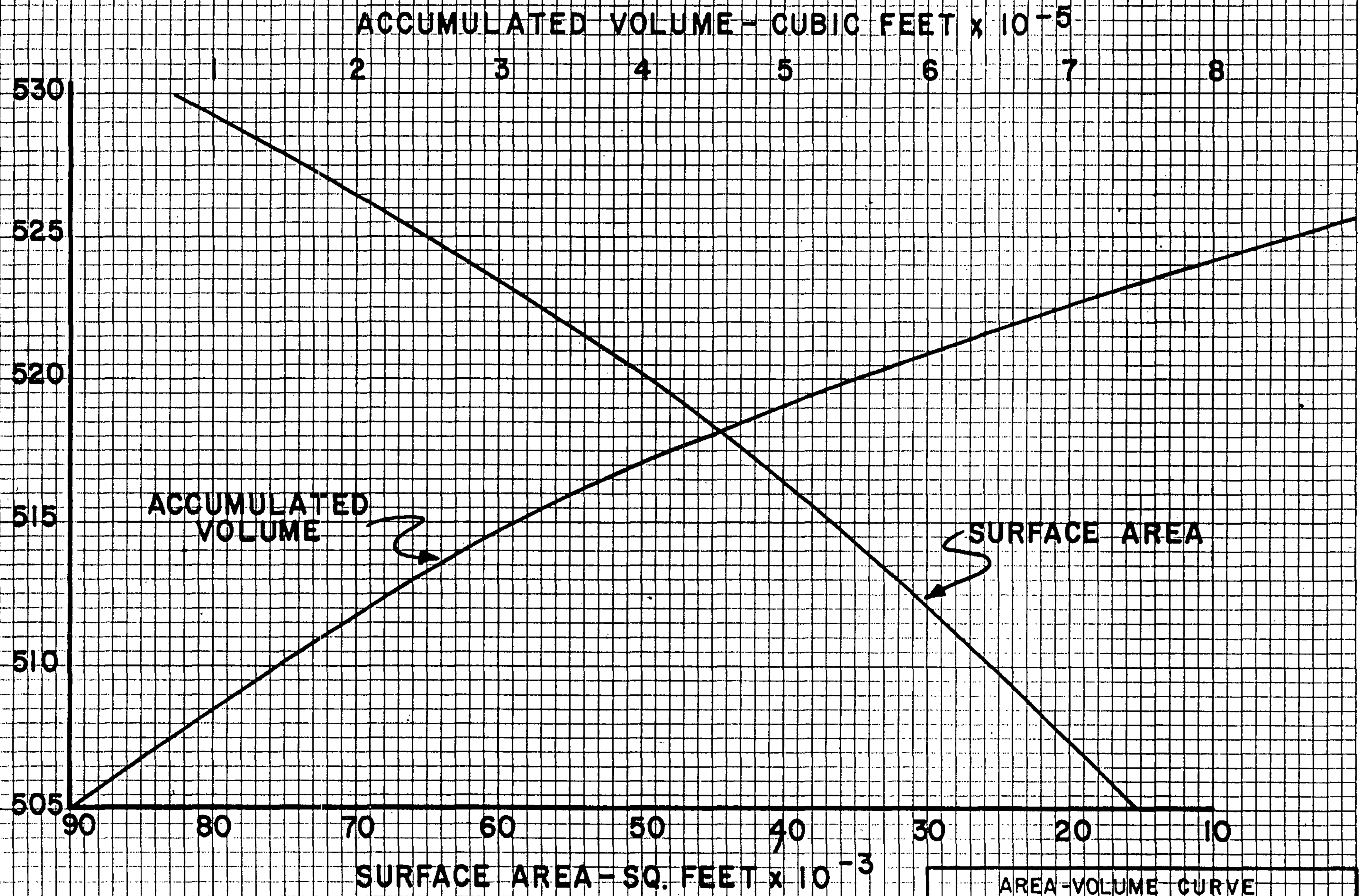


FIGURE 8

AREA-VOLUME CURVE
RETENTION POND STUDY
FANSTEEL METALS DIVISION

ITEM 6 Provide Your Proposed Operating Plan For the Waste System, Indicating Year-by-Year Water and Tailings Levels.

Provided by Fansteel.

Fansteel's Answer:

The proposed operating plan for this pond is to pump acid slurry residues containing about 35% solids into the pond. The solids will settle and a clear decantate will be transferred to the lime neutralization system. An estimated two to five feet of clear liquor will be maintained covering the residues at all times. The residues will gradually fill the pond over a period of eight to twelve years, depending on the quantity of raw material processed through the plant.

ITEM 7 Provide Analyses to Document That the Down-Stream Toe at the Dam Will Not Be Affected By Erosion Due to the Occurence of Floods (as Severe as the Probable Maximum Flood) on Adjacent Streams (Such as Arkansas River or Any Minor Drainage Course Where Floods Could Affect the Toe of the Embankment). The Analyses Should Include: (a) PMF Estimates (Discharge), (b) Water Surface Profiles With Stream Cross-Sections at the site For Each Critical Stream, (c) Estimates of Velocities at the Embankment Toe, (d) Estimates of Repriced Erosion Protection With Design Bases For This Protection (When Applicable).

Three rivers (the Arkansas, the Verdigris, and the Grand Rivers) join together just upstream from the plant to form the Arkansas River. This entire system is a controlled system from the confluence of the Arkansas and the Mississippi to the headwaters of each of the rivers named above. All three rivers have a series of dams and reservoirs operated by the U. S. Corps of Engineers. One of the major functions of this series of dams is to provide flood control for the entire system.

Depending on where a storm occurs in any of the drainage basins, reservoirs are lowered or filled by the proper manipulation of the gates on any of the dams. New dams are under construction, or are planned on many of the tributaries for the system. By proper manipulation, the surface elevation of each river is minimized.

Control for the reach of the Arkansas River passing the plant is the Webers Falls Lock and Dam. This dam is located about 25 river miles downstream. The site is at the extreme upstream reach of the Webers Falls pool. There are no minor streams that are influenced by the Arkansas River and also cross the site.

The greatest flood of record for the Arkansas River at Muskogee, Oklahoma is 400,000 cfs. During the design of the Webers Falls Dam, the U. S. Corps of Engineers, Tulsa office, took cross-sections of the Arkansas River and ran back water curves of different discharges. They selected 430,000 cfs as the flow during their "Standard Project Flood". A print out of the stream cross sections, and a print out of water surface elevations for the reach upstream and downstream of the plant site are presented . The plant is located about station 203 + 40. Here the water surface elevation is about 516.15 feet. This is about 17 feet below the crest of the dike.

ITEM 7 Continued

There is and old ox bow lake across the river from the plant. When the river overflows it banks on the east side, the ox bow serves as a temporary reservoir. This results in a dramatic velocity check between stations 175 + 80 and 252 + 30. Based on these data, it is estimated that the river velocity near the proposed basin is less than 8 feet per second.

Approx 5,5 mi/hr.

In Item 9, below, is presented the erosion protection that will be provided to protect the embankment during the maximum flood. This protection is designed to withstand a river velocity of 10 feet per second.

```
FANSTEEL RETENTION POND STUDY  (ARKANSAS RIVER FLOOD WAY)
STA.     BOT.     WATER     VEL.     HYD.
         EL.      SUR.               RAD.
0.       464.3    508.      10.      50.
     PTS  STA.    REACH      N      Q-CFS
       38  5020.  5020.    .035    430000.
   560.0     0000    521.5      .1      519.6     0100    517.0     0237    516.4     025
   515.1     0269    507.7    0289      504.7     0381    498.4     0396    499.1     042
   490.1     0432    474.8    0467      471.9     0485    471.9     0510    471.8     054
   471.8     0580    472.4    0613      473.2     0669    472.6     0756    472.6     084
   472.8     0881    472.6    0935      472.3     1024    473.9     1154    475.4     129
   476.3     1331    478.4    1479      480.4     1610    482.9     1666    495.9     181
   494.6     1870    492.8    2132      492.5     2218    488.6     2415    495.7     258
   497.5     2671    503.5    2755      560.0     2773       .                 .
       28 10405.  5385.    .035    430000.
   560.0     0000    525.5      .1      528.2     0065    530.1     0100    528.0     0148
   520.9     0153    506.7    0168      485.4     0192    479.3     0214    475.1     0245
   473.8     0310    471.5    0670      471.4     0900    477.4     1250    480.3     1319
   483.3     1346    486.0    1392      489.8     1402    492.1     1416    495.9     1421
   492.6     1500    498.6    1543      504.0     1573    507.0     1600    501.3     1700
   502.8     1837    501.4    1954      560.0     1955       .                 .
       2715580.  5175.     .035    430000.
   560.0     0000    522.6      .1      519.9     0073    516.3     0136    514.3     0146
   519.9     0163    516.3    0183      507.3     0194    480.2     0220    475.7     0244
   474.8     0364    473.7    0564      472.6     0924    471.4     1024    475.4     1174
   475.3     1244    476.8    1309      480.3     1312    488.6     1320    492.2     1345
   497.8     1376    502.3    1387      507.8     1396    505.6     1472    508.1     1517
   511.3     1534    560.0    1569        .                  .                 .
       23  17580. 2000.    .035    430000.
   560.0     0000    522.5      .1      529.3     0073    510.9     0085    495.6     0097
   487.6     0120    482.0    0177      482.0     0243    484.0     0321    477.5     0403
   473.2     0484    472.3    0591      473.2     0658    473.2     0742    472.5     0828
   472.1     0911    472.0    0998      473.0     1085    475.0     1169    484.0     1245
   489.6     1283    512.5    1367      560.0     1371       .                 .
       44 22170.  4590.    .035    430000.
   560.0     0000    516.7      .1      512.9     0192    495.2     0400    492.8     0640
   511.7     0705    497.0    0773      504.5     0800    510.9     0865    495.7     0900
   490.2     1016    483.2    1062      475.1     1150    472.6     1239    469.6     1321
   474.4     1422    469.4    1562      467.7     1732    467.8     1810    478.8     1906
   481.4     2204    494.2    2281      496.0     2414    492.4     2700    489.7     3098
   493.9     3281    496.4    3308      511.4     3400    500.5     4000    493.5     4015
   491.3     4206    498.7    4600      503.0     4900    507.1     6400    502.5     7600
   497.6     7700    492.5    7752      488.2     7938    491.3     8277    497.6     8307
   500.5     8505    507.7    8616      513.5     8805    560.0     8806
       20 25230. 3060.     .035    430000.
   560.0     0000    516.0      .1      511.6     0387    505.4     0514    502.3     0700



   497.1     0755    492.6    0909      494.9     1199    489.5     1244    481.8     1300
   481.4     1489    479.7    1563      473.6     1691    468.6     1880    466.0     2143
   469.7     2302    477.2    2347      486.7     2408    497.8     2489    560.0     2506
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BACKWATER PROFILE ANALYSIS

PROJECT - FANSTEEL RETENTION POND STUDY  (ARKANSAS RIVER FLOOD WAY)

  STATION    ELEV.    ELEV.   DEPTH    AREA      VEL.    HYDR.   REACH    AVG.    AVG.   FRICT.    EG1      EG2       N         Q
            BOTTOM    TOP                                RADIUS  LENGTH   VEL.   H-RAD.  LOSS

   0+ 0.0   464.30  508.00                      10.000  50.000

  50+20.0   471.80  510.37   38.57 63571.6     6.764  25.496  5020.0   8.382  37.748   1.545   37.754   37.745   0.0350 430000.

 104+ 5.0   471.40  512.08   40.68 52277.7     8.225  28.762  5385.0   7.494  27.129   2.058   39.690   39.681   0.0350 430000.

 155+80.0   471.40  514.01   42.61 46889.5     9.170  34.108  5175.0   8.697  31.435   2.189   41.740   41.730   0.0350 430000.

 175+80.0   472.00  514.81   42.81 46708.7     9.205  35.860  2000.0   9.188  34.984   0.818   43.319   43.309   0.0350 430000.

 221+70.0   467.70  517.04   49.34175678.8     2.447  19.904  4590.0   5.826  27.882   1.022   48.428   48.419   0.0350 430000.

 252+30.0   466.00  517.01   51.01 69048.2     6.227  27.469  3060.0   4.337  23.687   0.469   51.141   51.150   0.0350 430000.
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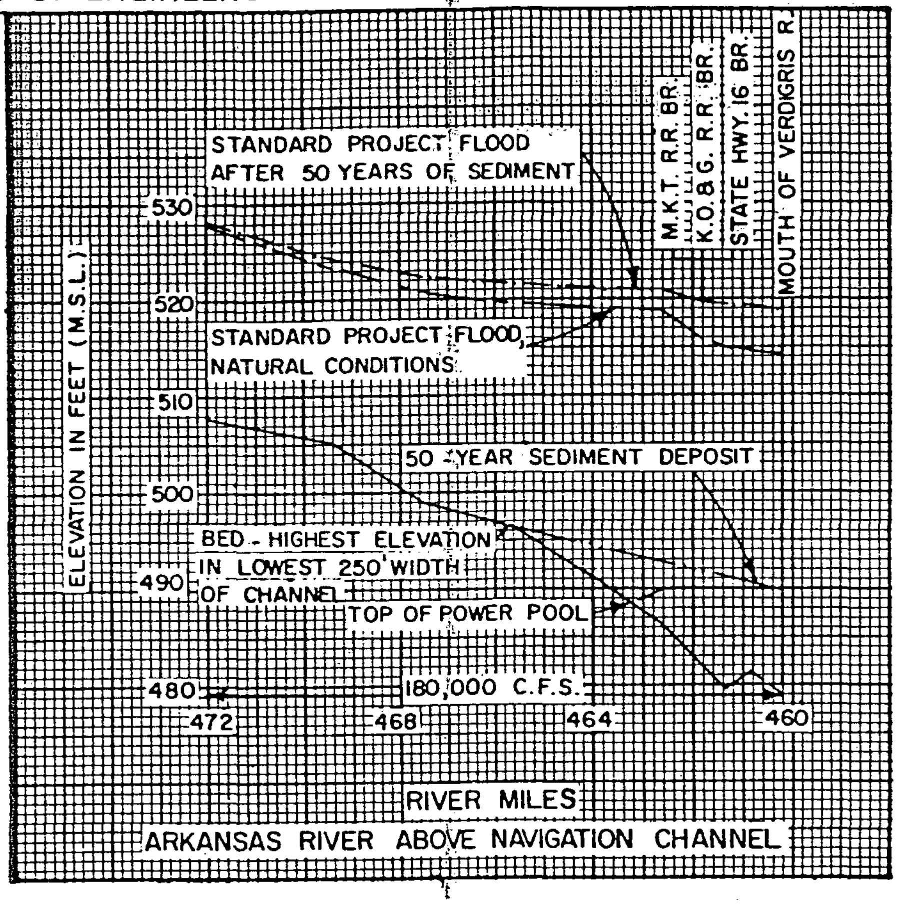
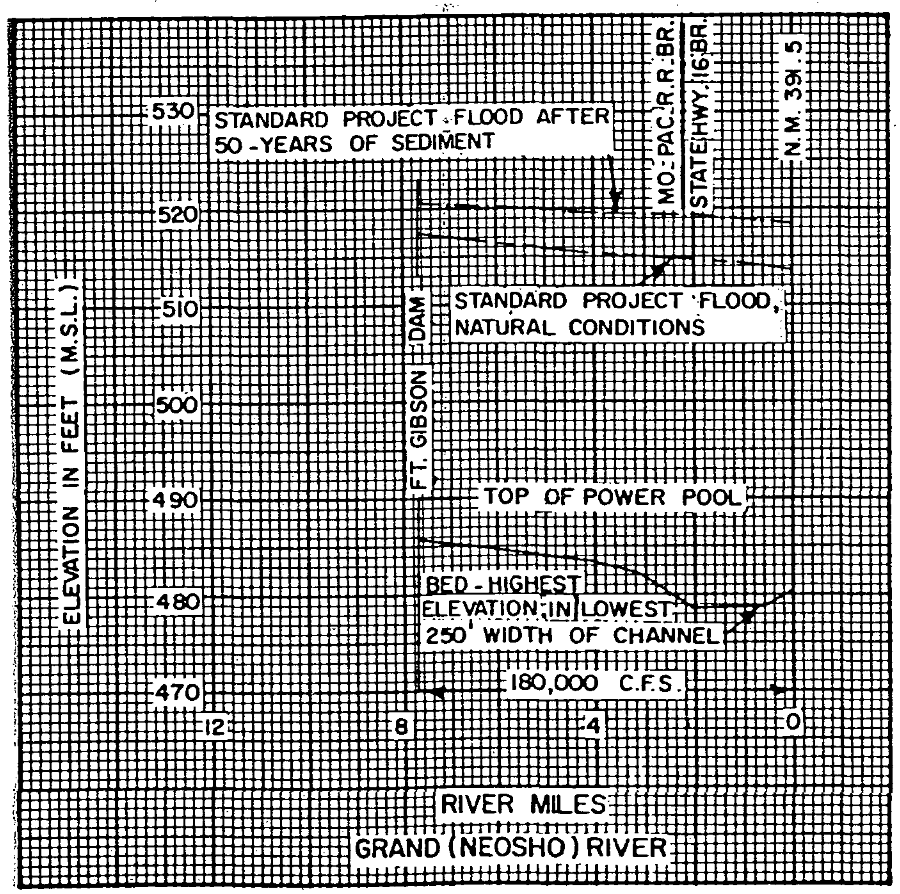




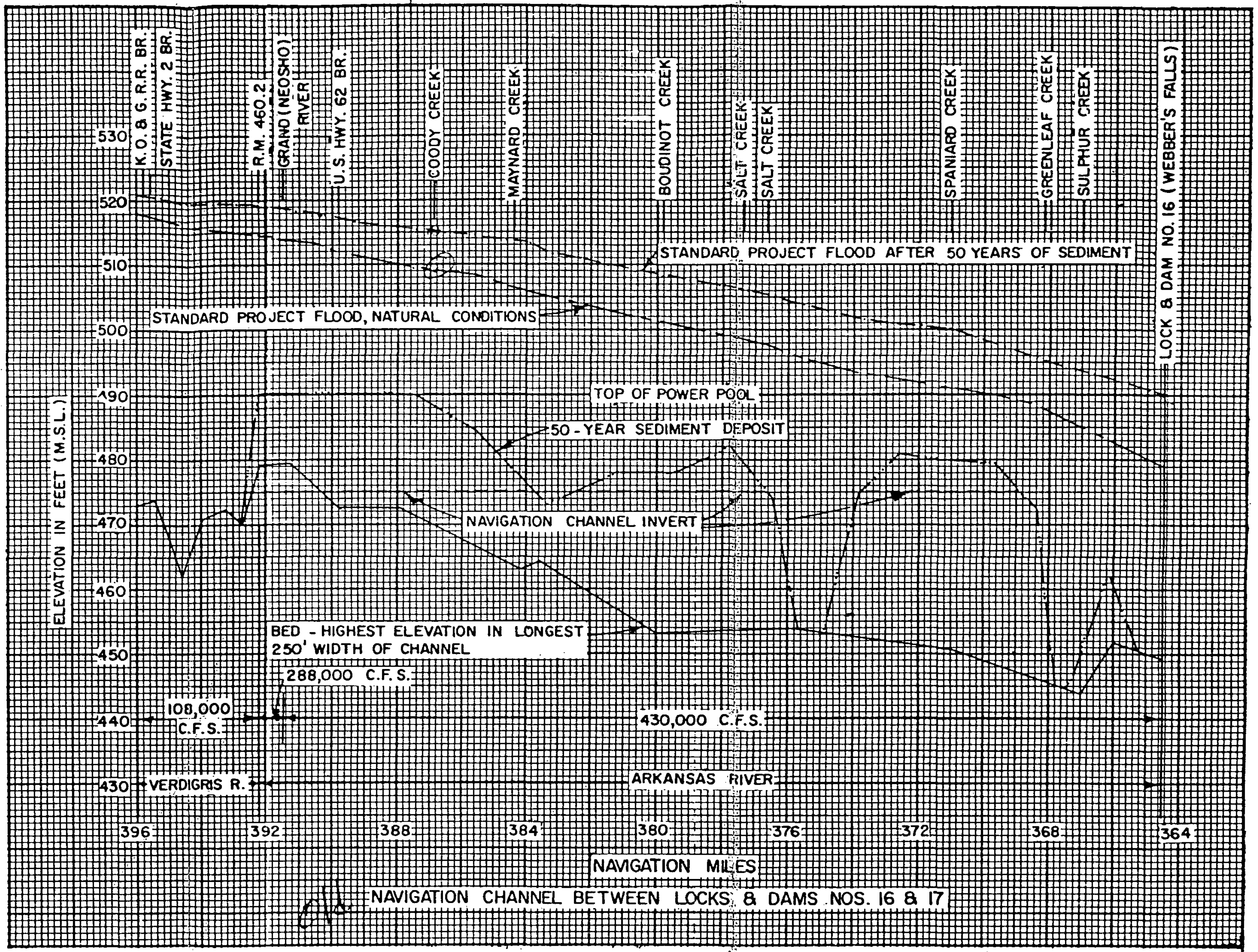


FIGURE 9

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA

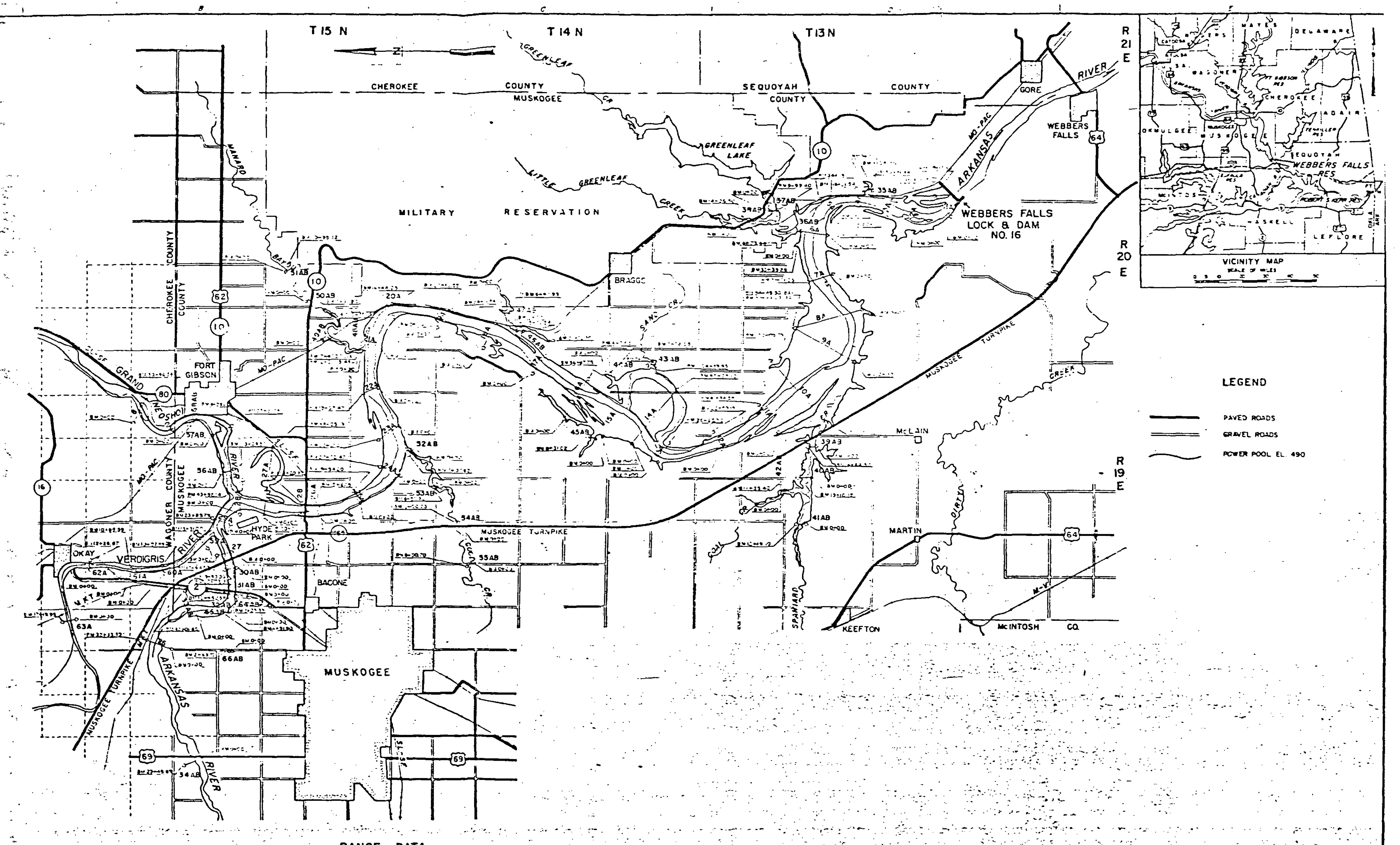
ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 16
WEBBERS FALLS

STANDARD PROJECT FLOOD PROFILE

U. S. ARMY ENGINEER DIST., TULSA, CORPS OF ENGINEERS NOV. 63
DRAWN: C.L.C.
CHECKED: B.C.K.
189-DM3-99/4

RANGE DATA

RANGE	MON. STA.	BOOK	PAGE	PHOTO	ELEV
SR 1A	0+00 0+52.30 27+15.95 [illegible]+61.90	A 3002	10 10 18 16	6-23	510.44 496.95 499.11 493.39
SR 2A	0+00 2+18.98 45+47.20 49+29.72	A 3002	20 20 27 27	6-20	501.72 499.16 493.94 470.51
SR 3A	0+00 2+02.25 23+31.25 30+21.48	A 3002	29 29 35 36	6-19	513.47 492.53 492.45 531.33
SR 4A	0+00 2+64.00 15+90.56 16+21.54	A 3009	1 1 4 5	6-18	493.62 494.09 507.30 523.15
SR 5A	0+00 12+55.56 33+74.82 34+75.21	A 3009	6 7 11 11	6-17	497.23 [illegible] 497.99 559.94
SR 6A	0+00 2+17.14 31+94.57 33+30.29	A 3009	14 14 18 19	6-17	494.23 494.51 503.52 519.4[illegible]
SR 7A	0+00 1+36.70 30+16.35 31+71.25	A 3009	20 20 25 25	7-8	515.09 499.50 498.24 524.5[illegible]
SR 8A	0+00 2+11.93 82+9.00 84+48.50= 83+42.39 SR 3A	A 3009	27 27 38 38	7-18	523.28 503.03 498.32 534.31
SR 9A	0+00 1+42.78 82+01.38 35+43.33= 84+48.50 SR 4A	A 3009	40 40 50 50	7-19	537.5[illegible] 517.59 505.11 534.31
SR 10A	0+00 1+29.50 36+35.70 120+27.75	A 3009	52 52 63 63	8-17	[illegible] [illegible] 497.57 515.51
SR 11A	0+00 10+27.35 39+77.79 41+34.58	A 3009	65 65 70 70	8-6	494.30 503.53 493.57 493.57
SR 12A	0+00 1+5.55 19+75.75 22+53.5	A 3011	2 2 6 7	8-5	523.77 503.24 495.[illegible] 493.29
SR 13A	0+00 2+45.70 24+54.20 26+55.00	A 3011	9 10 16 16	8-5	520.95 503.65 504.53 524.70
SR 14A	0+00 1+22.20 39+79.30 68+34.95 95+65.10	A 3011	18 18 25 27 30	9-14	524.37 492.98 492.35 502.13 490.43
SR 15A	0+00 1+41.82 10+43.30 104+29.35	A 3011	32 32 47 48	8-14	511.57 508.23 499.7[illegible] 513.45
SR 16A	0+00 2+34.92 51+55.58 56+83.75	A 3011	62 62 71 72	8-13	515.97 507.36 503.56 499.52
SR 17A	0+00 6+63.10 24+92.40 27+12.50	A 3011	55 56 61 61	8-12	506.43 499.70 506.11 502.32
SR 18A	0+00 2+72.00 32+85.12 34+11.53	A 3004	51 52 59 60	7-11	511.67 505.54 504.79 511.70
SR 19A	0+00 10+50.79 26+59.57 [illegible]+12.55	A 3004	42 44 48 48	7-10	506.37 497.79 519.74 540.93
SR 20A	0+00 2+03.33 15+72.35 16+44.05	A 3004	37 37 40 41	7-9	507.48 511.94 514.93 529.70
SR 21A	0+00 1+20.08 12+43.52 17+47.07= 12+61.05 SR 48AB	A 3004	30 30 33 35	8-9	511.70 494.12 499.82 497.28
SR 22A	0+00 2+09.57 17+42.98 19+69.40	A 3005	38 38 42 43	9-9	503.20 495.92 509.13 503.90
SR 23A	0+00 2+40.35 24+21.14 25+59.29 30+21.33	A 3005	30 31 36 37 37	8-8	503.94 502.33 490.25 494.44 500.25
SR 24A	0+00 2+58.32 25+67.05 27+72.47	A 3005	13 19 24 25	9-2	521.81 516.65 496.26 504.19
SR 25A	0+00 1+28.88 15+92.82 19+54.20	A 3005	46 46 50 51	9-3	525.33 530.30 507.36 501.94
SR 26A	0+00 1+22.65 1[illegible]+03.48 19+87.30	A 3005	56 56 59 60	9-8	523.15 520.18 507.01 512.25
SR 27A	0+00 1+18.05 24+06.35 27+91.40 85+69.26 88+05.19	A 3006	55 55 60 60 69 69	9-7	514.92 513.57 497.12 498.51 508.44 513.64
SR 28A	0+00 4+35.43 29+25.98 43+92.14	A 3006	47 47 51 52	9-7	516.04 513.81 497.02 500.71
SR 29A	0+00 9+38.84 21+94.97 23+39.79	A 3012	32 32 34 35	9-8	519.04 504.32 514.67 511.2[illegible]
SR 30AB	0+00 1+54.48 14+40.21 15+80.04	A 3007	17 17 21 21	10-8	522.83 [illegible] 519.28 513.65
SR 31AB	0+00 1+13.37 9+71.67 10+73.57	A 3007	22 22 25 26	10-6	527.49 529.72 509.91 524.00
SR 32AB	0+00 1+27.00 10+88.52 12+88.35	A 3007	27 27 30 30	10-9	527.20 531.80 511.79 517.98
SR 33AB	0+00 5+43.89 38+05.27 43+01.65	A 3007	40 40 46 46	10-5	507.20 507.19 514.31 519.90
SR 34AB	0+00 0+70.82 21+53.45 23+45.89	A 3012	39 39 42 43	12-5	529.62 512.46 516.52 523.2[illegible]
SR 35AB	0+00 0+54.98 40+[illegible] 40+[illegible]	A 3008	53 53 54 55	8-18	512.94 492.80 494.04 [illegible]
SR 36AB	0+00 1+48.97 4+55.88 6+73.44	A 3008	56 56 58 58	8-17	511.10 492.50 493.07 494.19



RANGE DATA

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SR 37AB	0+00 1+50.55 9+15.42 9+55.40	A 3008	45 45 47 48	6-16	491.72 491.31 497.98 520.14	SR 46AB	0+00 2+21.72 4+97.78 5+76.58	A 3004	24 24 25 26	7-12	499.95 494.31 509.94 504.98	SR 55AB	0+00 1+23.50 3+43.85 6+20.70	A 3003	44 44 45 45	10-11	512.43 512.71 519.64 513.94	SR 64AB	0+00 0+66.33 2+02.07 3+25.53	A 3003	62 62 63 63	11-6	507.09 506.23 502.72 504.07
SR 38AB	0+00 4+80.32 12+99.10 14+26.50	A 3008	49 50 52 52	6-16	493.42 498.75 491.01 512.11	SR 47AB	0+00 2+78.35 4+59.15 6+87.95	A 3004	12 12 13 13	7-12	506.42 491.83 492.11 497.07	SR 56AB	0+00 2+05.65 11+18.15 13+05.[illegible]	A 3006	23 23 28 28	9-6	526.45 509.26 499.41 497.29	SR 65AB	0+00 2+41.15 3+54.29 4+21.20	A 3007	47 47 48 48	11-6	500.48 504.12 501.28 501.95
SR 39AB	0+00 3+73.28 4+04.70 6+64.52	A 3008	59 59 60 60	9-14	504.59 492.41 492.57 492.91	SR 48AB	0+00 1+29.73 6+32.00 12+61.05= 17+47.07 SR 21A	A 3004	65 65 67 68	8-9	501.91 500.71 497.60 497.28	SR 57AB	0+00 0+65.97 7+10.45 10+22.[illegible] 20+31.94 23+31.78	A 3006	12 12 15 18 21 22	8-5	532.99 503.14 493.71 497.42 504.85 515.38	SR 66AB	0+00 0+92.75 2+08.20 2+62.70	A 3003	50 50 51 51	11-6	535.34 523.75 517.51 517.41
SR 40AB	0+00 1+53.43 12+23.59 19+[illegible]	A 3009	42 42 43 44	9-19	501.09 491.89 492.70 494.70	SR 49AB	0+00 2+27.20 4+63.70 10+35.05	A 3003	5 5 7 7	7-9	513.88 508.95 512.11 504.23	SR 58AB	0+00 0+85.97 6+41.07 8+29.00	A 3006	29 29 35 36	4-5	510.19 509.91 492.97 494.97	O.R. 8	0+00 11+84.70 30+05.78 30+78.34	A 3013	4 6 11 12	8-4	517.13 510.33 515.49 533.03
SR 41AB	0+00 4+79.40 9+59.93 17+[illegible]	A 3009	33 33 35 37	10-17	494.95 491.16 492.44 492.59	SR 50AB	0+00 3+10.00 6+11.10 7+99.80	A 3003	14 14 15 16	7-7	495.11 499.34 509.27 513.19	SR 59A	0+00 6+27.43 13+54.14 15+31.00	A 3012	45 45 47 47	10-9	501.01 513.17 479.93 519.9[illegible]	O.R. 24 (2)	0+00 22+34.75 47+34.39 87+54.30	A 3013	39 39 48 49		536.87 533.87 534.33 540.31
SR 42AB	0+00 2+27.90 6+54.22 11+35.40	A 3009	38 38 40 41	9-17	494.73 491.50 491.73 503.42	SR 51AB	0+00 2+57.15 4+40.20 10+29.32	A 3003	21 21 22 22	7-7	506.46 508.77 513.36 509.86	SR 60A	0+00 3+09.90 9+15.21 10+97.98	A 3014	49 49 [illegible] 50	10-5	512.37 513.50 [illegible] 517.94	O.R. 25 (2)	0+00 7+00.78 34+09.75 54+08.61	A 3013	30 31 37 37		524.67 521.80 523.78 573.70
SR 43AB	0+00 1+64.10 5+37.43 7+59.05	A 3011	49 49 50 51	9-14	502.17 504.32 502.16 501.31	SR 52AB	0+00 2+05.95 4+81.52 7+07.62	A 3003	31 31 33 33	9-10	512.83 507.40 509.32 512.47	SR 61A	0+00 2+19.80 10+18.12 13+[illegible].92	A 3014	52 52 54 54	10-2	514.[illegible] 504.96 513.39 [illegible]	O.R. 26	0+00 6+42.70 20+64.95 32+33.37	A 3013	23 23 28 29	11-5	504.[illegible] 504.61 512.72 515.46
SR 44AB	0+00 2+22.65 4+77.32	A 3011	52 52 53	8-13	501.40 501.62 502.24	SR 53AB	0+00 3+31.53 4+67.20 8+51.20	A 3003	52 52 53 53	9-11	510.23 502.77 496.75 507.14	SR 62A	0+00 1+27.94 10+[illegible] 12+[illegible]	A 3012	55 55 57 57	10-3	[illegible]	O.R. 27	0+00 0+57.31 19+64.37 17+84.57	A 3013	50 50 54 54	10-5	525.0[illegible] 514.38 507.18 [illegible]
SR 45AB	0+00 2+51.75 6+49.19 8+31.32	A 3011	73 73 74 75	9-13	502.91 [illegible] 503.30 [illegible]	SR 54AB	0+00 0+21.97 1+53.22 2+30.[illegible]	A 3003	36 36 37 37	10-11	519.05 [illegible] 503.72 507.44	SR 63A	0+00 2+09.82 15+01.74 17+19.99	A 3012	39 39 41 41	11-3	[illegible]	O.R. 28	0+00 7+47.25 12+87.08 15+70.32	A 3013	16 18 19 19	8-7	[illegible] 522.37 494.04 [illegible]

Notes:

(1) All photo numbers refer to the "WED" series dated 7-10-67.

(2) O.R. 24 & 25 are located to the West of the above map.

FIGURE 10

ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
WEBBERS FALLS
LOCK AND DAM 16

SEDIMENTATION RANGES

SCALE OF MILES

U.S. ARMY ENGINEER DISTRICT, TULSA, CORPS OF ENGINEERS — MAY 1966
BY - JAMES E. CURRY COMPANY
CONTRACT No. DACW 56-70-C-0044

1890-0M36-99/1

ITEM 8 Provide Analyses to Document the Ability of the Wast Retention Ponds to Safely Store or Discharge the Runoff of the Probable Maximum Precipitation (PMP) from the Appropriate Drainage Areas.

There are no storm water inlets into the system. The only storm water that can enter the system is precipitation falling directly on the surface of the basin.

Using data obtained from Chart 50, "Probable Maximum 6 Hour Precipitation For 10 Square Miles" and Chart 51, "Ratio of Probable Maximum 6 Hour Precipitation For 10 Square Miles to 100 Year 6 Hour Rainfall," both from Technical Paper No. 40, Rainfall Frequency Atlas of the United States, U.S. Department of Commerce, the following probable maximum precipitation for the project area may be obtained.

From Chart 50:

Probable maximum 6 hour precipitation = 29 inches.

From Chart 51:

Ratio of probable maximum 6 hour precipitation to 100 year 6 hour rainfall = 4.5.

The pond will only be operational until the surface reaches elevation 530. The elevation of the crest of the dikes is elevation 533. Assuming that the basin is full and the PMP occurs, the area that receives precipitation is 240 feet X 400 ft. = 96,00 ft.^{2} Exposed evaporating surface at elevation 530 = 212 X 372 = 78,864ft.^{2} Storage volume from elevation 530 to elevation 533 = 252,846 ft.^{3}

When the reservoir is full and a 29 inch (2.42Ft.) rain occurs, the storage volume is adequate because:

Precipitation volume is 2.42 X 96,000 = 232,000ft.^{3}
Storage volume is 252,846ft.^{3}
252,846>232,000, therefore storage is adequate.

In order to evaluate whether the reservoir would fill from precipitation during normal operations it is necessary to compare precipitation with evaporation.

Using the average precipitation over a 73 year period of record in Tulsa, Oklahoma (50 miles from project, but in the same climatological region), and evaporation studies at Ft. Gibson Dam (10 miles from project) conducted by the U. S. Corps of Engineers, the net difference between precipitation and evaporation is as follows:

ITEM 8 Continued

MONTH	PRECIPITATION, INCHES	EVAPORATION, INCHES
January	1.62	2.00
February	1.71	1.97
March	1.77	2.59
April	2.43	4.43
May	4.02	6.74
June	5.26	6.78
July	4.69	8.39
August	2.94	10.42
September	3.04	7.71
October	4.01	6.22
November	3.31	5.28
December	2.28	2.98
Total	37.08	65.51

The ratio of surface available for precipitation gain to maximum surface for evaporation is

$$\frac{96{,}000}{78{,}864} = 1.22$$

The ratio of evaporation loss to precipitation gain is

$$\frac{65.51}{37.08} = 1.77$$

Since 1.77>1.22, the basin will not experience a volume increase due to precipitation during its operational life.

```
FT. GIBSON DAM , OKLAHOMA                STATION NUMBER 004.          EVAPORATION---
      61    M   70     A       M       J       J                                N
70001.85  002.31  004.55  006.14  007.84  007.62  008.56  007.69  006.10  005.28
  002.72  001.56     .       .       .       .       .       .       .       .
  001.78  002.86  004.33  006.20  010.34  007.89  009.13  010.11  005.03  004.74
  002.77  001.66     .       .       .       .       .       .       .       .
  001.72  002.23  005.24  007.35  007.83  009.15  009.23  009.52  006.42  006.65
  003.77  001.69     .       .       .       .       .       .       .       .
  002.75  002.67  004.44  007.69  008.06  008.52  009.19  009.13  006.29  004.98
  003.10  002.23     .       .       .       .       .       .       .       .
  002.31  002.83  003.18  007.50  007.78  008.35  009.95  008.94  007.40  004.76
  002.88  001.95     .       .       .       .       .       .       .       .
  001.88  002.28  005.55  007.13  007.76  009.33  010.06  006.83  005.47  005.69
  003.85  002.46     .       .       .       .       .       .       .       .
  002.62  003.13  005.75  006.64  006.86  007.76  007.91  008.87  005.86  006.24
  002.50  001.78     .       .       .       .       .       .       .       .
  001.10  002.28  004.66  006.28  006.03  008.13  008.92  007.99  005.96  005.41
→ 007.47  002.31     .       .       .       .       .       .       .       .
  002.02  002.42  003.73  006.38  007.06  008.48  010.96  009.76  007.11  005.31
  002.84  001.80     .       .       .       .       .       .       .       .
  001.70    2.91  002.90  006.11  008.25  008.70  010.34  010.26  006.54  003.94
  002.87  002.54     .       .       .       .       .       .       .       .
```

HYDROLOGY OF THE TULSA METROPOLITAN AREA

BY U. S. ARMY CORPS OF ENGINEERS
HYDRAULICS BRANCH

Climatology. - The U. S. National Weather Service has a 73-year period of record at Tulsa, Oklahoma. The recording station is located at Tulsa International Airport. The normal annual temperature at Tulsa is 60.3 degrees F., with the recorded temperature extremes ranging from a maximum of 115 degrees F. on 10 August 1936 to a minimum of -16 degrees F. on 22 February 1930. The normal annual precipitation is 37.08 inches. The maximum annual precipitation recorded was 64.99 inches in 1941, and the minimum annual precipitation recorded was 23.22 inches in 1954.

During the past ten years (1961 through 1970) the average annual precipitation was 36.01 inches. The following table indicates the total annual precipitation recorded at the Tulsa station during this period.

YEAR	TOTAL ANNUAL PRECIPITATION IN INCHES
1961	51.39
1962	41.46
1963	28.80
1964	44.27
1965	30.69
1966	26.86
1967	36.91
1968	35.78
1969	29.95
1970	34.02

The Minimum total annual precipitation at the Tulsa station during the past ten years was 26.86 inches in 1966, and the maximum of 51.39 inches was recorded in 1961. Tabulated below are the 1970 monthly precipitation and temperature data for the Tulsa station. The normal precipitation and the normal temperature are the averages for the period of record during the indicated months.

1970

PRECIPITATION AND TEMPERATURE
DATA
TULSA INTERNATIONAL AIRPORT

	PRECIPITATION		TEMPERATURE			
Month	Precipitation (inches)	Normal Precipitation (inches)	Maximum Deg. F	Minimum Deg. F	Average Deg. F	Normal Deg. F
Jan	.41	1.71	70	2	29.7	36.2
Feb	.57	1.77	74	12	41.9	40.6
Mar	2.05	2.43	78	21	44.6	48.1
Apr	5.66	4.02	88	29	60.7	58.9
May	4.20	5.26	88	42	70.7	67.8
Jun	4.60	4.69	97	53	76.9	77.3
Jul	.13	2.94	104	55	82.8	82.2
Aug	1.85	3.04	110	60	84.8	81.6
Sep	6.73	4.01	97	47	74.5	73.8
Oct	5.83	3.31	87	33	58.9	62.8
Nov	.64	2.28	75	15	45.6	47.6
Dec	1.15	1.62	75	19	42.5	39.6

ITEM 9 Document the Ability of the Upstream Embankment Face to Withstand Severe Wind-Wave Action. If Erosion Protection will be Provided, Document the Adequacy of this Protection and Provide the Layer Thickness and Gradation of this Protection.

The upstream embankment face, which is the inside walls of the pond, will be protected from wind and water erosion by the impervious Shelterite liner. The pond is too small for any substantial waves, however, the State of Oklahoma directive is that a minimum of three (3) foot freeboard be maintained at all time on storage ponds. Normally the freeboard on this pond will be much more than the minimum requirement.

ITEM 10 Provide the Results of Site Specific Permeability and Porosity Tests For Downgradient Site Soils. If Credit is Taken For Ion Exchange, Provide Site Specific Values of Sorption Coefficients For Individual Radionuclides.

The values of the porosity and permeability of the soils at various depths in various bore holes are presented in the table that follows:

BORE HOLE	DEPTH	POROSITY, PER CENT	PERMEABILITY, CM/SEC.
1	9.5 - 10.5	31.6	2.6×10^{-8}
2	15.0 - 16.0	36.3	1.9×10^{-7}
3	18.0 - 19.0	35.9	6.7×10^{-8}

No credit is taken for ion exchange.

ITEM 11. Document the Hydrologic Design Bases Which Assure that 40 CFR 190 Requirements are met at the Site Boundary due to Seepage from the Existing and Proposed Reservoir. Provide Details of any Features used to Control Seepage. Provide Estimates of Travel Time and Dilution Factors as the Seepage Migrates to the Boundary or Arkansas River.

The system is designed for zero seepage. The entire floor and upstream embankment walls of the pond will be lined with a Shelterite SR-5 No. 8130 liner, or equal. In addition, the natural floor of the pond is composed of intact, unweathered, unfractured gray shale, which has a coefficient of permeability much less than 10^{-8} cm/sec. The embankment will be constructed of soil having a coefficient of permeability less than 1.9×10^{-7} cm/sec.

Under the liner a French drain with sump pump will be installed according to pond liner drawing. The sump will be monitored for seepage at regular intervals; if leakage were to occur a continuous pumping system would be installed for the transfer of liquid to the plant lime neutralization system.

There will be no outlet works of any type built into the system, so there can be no possibility of an accidental discharge of any fluid into the environment.

ITEM 12 Provide Information Regarding Your Proposed Monitoring Program for Ground Water and Surface Water.

Fansteel's Answer.

The Company has monitor wells placed at parameter locations of its property to monitor any possible seepage of contaminants.

As stated in 362.25, two observation wells are to be located, one on the North Dike, and a second on the South Dike of the proposed pond to monitor any seepage.

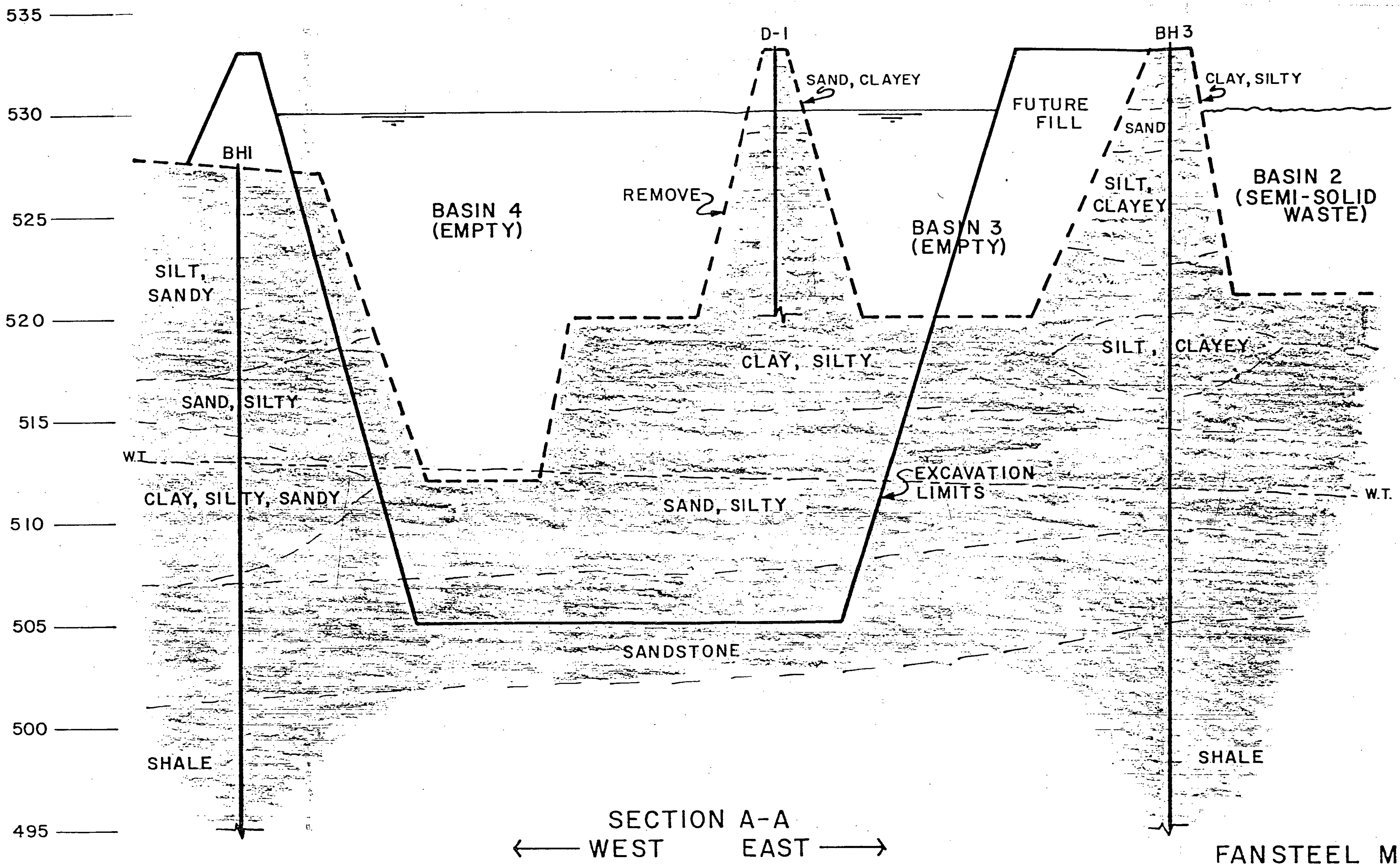
In addition, the exterior French drain system will discharge to 5' in diameter observation sump prior to overflowing to the river. The water at the observation sump will be routinely maintained.

ITEM 13 Discuss the Remedial Action that will be Taken if the Monitoring Program Indicates a Potential Problem.

Fansteel Answer:

The design and construction of this pond will eliminate any substantial risk that radioactive waste residues will be discharged. The floor and walls are covered with an impervious liner, the natural floor is an impervious shale, and the embankment will be constructed of clay with very low permiability.

In the event there was a potential problem, the Company will review the course of action to be taken with NRC and the appropriate agencies.



FANSTEEL METALS INC.
MUSKOGEE, OKLAHOMA

CONSULTING ENGINEERING • GEOLOGICAL INVESTIGATION • ENGINEERING INSPECTION

HEMPHILL CORPORATION
4834 South 83rd East Avenue
TULSA, OKLAHOMA 74145

OFFICE-(918) 622-5133 AFTER HOURS 587-5822

Date: 9/9/78	Drawn By: JRH
Scale: HOR. 1" = 50' VERT. 1" = 5'	Dwg. No. 717 - 1

SUBSURFACE PROFILE

ITEM 14 Provide Analyses to Document That 40 CFR 190 Requirements are Not Exceeded by an Accidental Release of Tailings From the Reservoir Area. Provide the Bases for Conclusions Reached and Assumptions Used in Your Analyses.

This question is not applicable. No outlet works of any kind are designed into the system. Since there are no outlets, there can be no accidental releases of fuilds for any reason.

C. Howell Mullis, Jr.

C. Howell Mullis, Jr., Ph.D., P.E.
Chief Engineer

CHM:sm

FANSTEEL RESPONSE TO:

REQUEST FOR ADDITIONAL INFORMATION

WASTE RETENTION POND

FANSTEEL METALS INC.

TAC NO. 4655

DOCKET NO. 040-07580

REVIEWED BY: M. FLIEGAL

ITEM 371.15

The ground water contour map presented with our March, 1978 response was incorrectly drawn, based on inadequate data. In our September, 1978 response, we have presented a revised ground water contour map (see Item 3). The contours were drawn from data obtained over a three year period. The maximum fluctuation of four feet occurred in Well No. 4. Otherwise, very little fluctuation was observed.

The water mound indicated on the March, 1978 map is incorrect. This mound is eliminated on the September, 1978 map.

After the French drain system is installed, the area below the basin and interior to the drain system will be dewatered to at least Elevation 502. An East - West cross-section, through the basin, is presented on the following page.

ITEM 371.16

Fansteel Answer:

The answer to this question is the same as 362.28.

362.28: The slurry type wastes will be discharged to the lined pond by gravity or pumping through a 1½" to 3" in diameter hose. The hose will extend into the pond to insure complete discharge into the pond. The slurry will be discharged into the pond on a daily routine, with an estimated 1,000 to 3,000 gallons being the daily quantity. After the solid settles out and an accumulation of 2' to 5' of clear decantate forms on the surface, an increment quantity of decantate will be removed regularly by a surface mounted sump pump to the lime neutralization system. At this time there are no plans to recover values from the solid wastes.

ITEM 371.17 Provide the Bases For Your Estimates of Probable Maximum Flood Elevation and Velocity. Provide the River Cross-Sections Used in Your Estimates. Document the Techniques Used In the Computations and Justify That They are Conservative (i.e., Lead to Higher Flood Levels and Velocities Than a More Realistic Approach) if They Cannot Be Shown to Be Realistic.

See Item 7, Fansteel response of September, 1978. The discharge and river cross-sections were obtained from the Tulsa office of the U. S. Corps of Engineers. These data are continually being refined and updated by the Corps. It is felt that these data are the most reliable that are available.

The water surface elevations and velocities were obtained from a computer solution to backwater curves for gradually varied flow.

Print outs for elevations, velocities, and river cross sections are presented as part of Item 7 of the Fansteel respose of September, 1978.

It is further felt that data presented is as realistic as is possible.

ITEM 371.18 Verify that the Drainage Ditch on the West and North sides of the Pond can Safely Pass the Local PMP Runoff Without Endangering the Pond. Provide the Bases for and Results of Your Computations for Discharge, Velocities, Water Levels and Erosion Protection.

The total land area that supplies surface runoff to the basin area was obtained from the U. S. Geological Survey Quadrangle map "Northeast Muskogee Quadrangle", and was determined to be 44 acres.

A hydrograph was developed for the 100 year storm using as a model the 100 year storm model for the City of Tulsa, Oklahoma. The maximum runoff from this storm was determined to be 290 cfs.

Using the multiplies described in Item 8 of Fansteel's September, 1978 response of 4.5. The maximum runoff for a 29 inch rainfall was 290 x 4.5 = 1305 cfs. This is the runoff that must be accomodated by the ditches.

One-third of surface area feeds runoff into the West ditch, and two-thirds feeds into the North ditch. This is 14.7 acres.

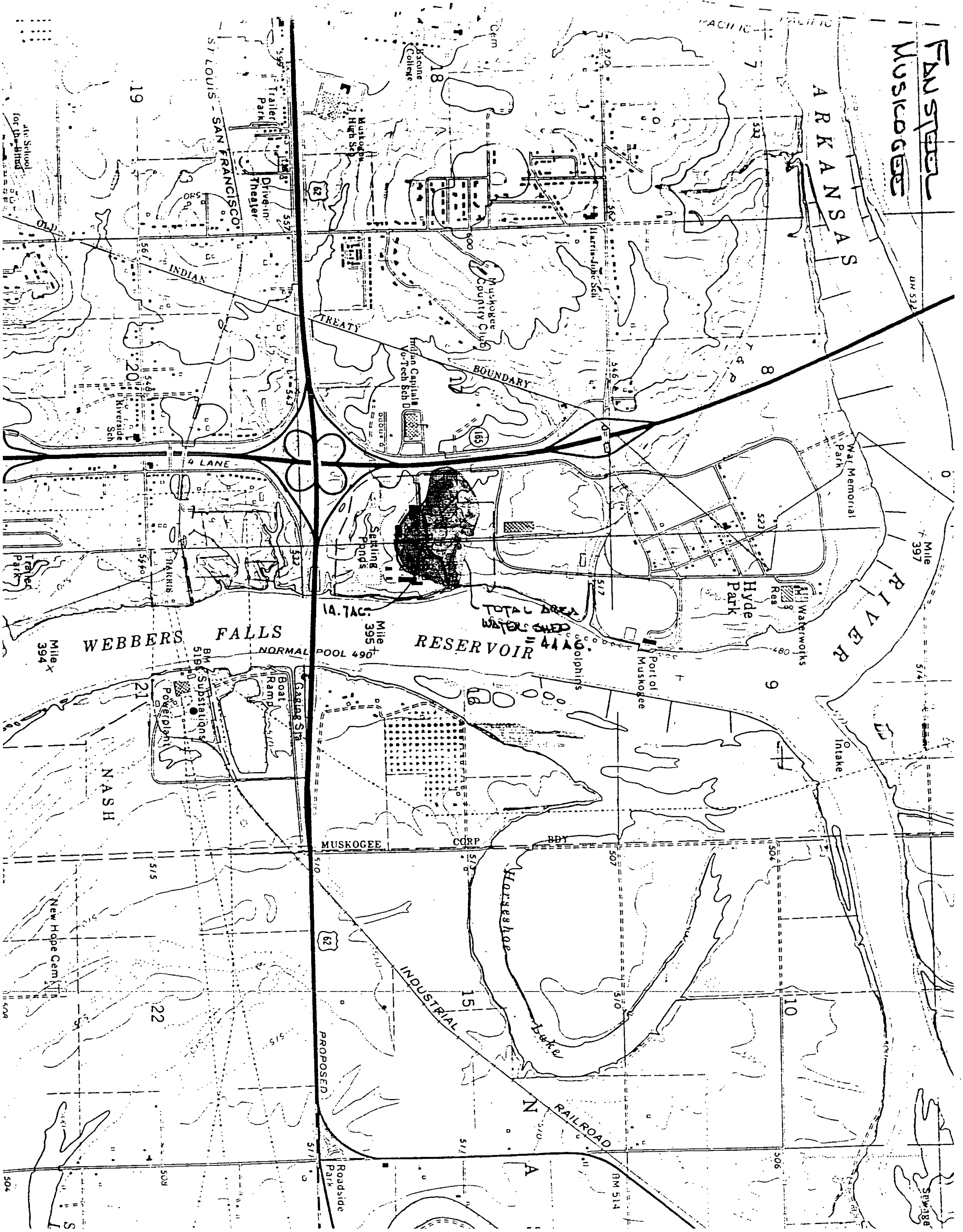
Discharge to the West ditch is 0.33 x 1305 cfs = 435 cfs. The North ditch must accomodate the entire discharge of 1305 cfs.

The slope for the West ditch is (520x3-513)/520 = 0.0140 or 1.4%. Assuming a trapezoidal channel section with side slopes of two horizontal to one vertical, a bottom width of five feet, and Manning's n of 0.035 yields a normal depth of 3.93 feet.

The slope of the North ditch is (522.1 - 505)/760 = 0.0225, or 2.25%. Assuming a trapezoidal ditch section with side elopes of two horizontal to one vertical, a bottom width of ten feet and a Manning's n of 0.035, the normal depth is 4.92 feet.

The 100 year storm hydrograph, the model storm and the quad sheet are presented overleaf.

FANSTEEL COMMENT: The proposed cross-section for the West and North side drainage area is given on the Pond Contour drawing DC-3-102-2, revised 9-8-78. The width of the proposed drainage ditch is significantly greater than the mathematical minimum given above.


FANSTEEL
MUSKOGEE
1A.7AC.
TOTAL AREA
WATER SHED
= 44AC.
ARKANSAS
RIVER
WEBBERS FALLS
RESERVOIR
NORMAL POOL 490
Mile 394
Mile 395
Mile 397
Settling Ponds
Hyde Park
Port of Muskogee
Dolphins
Waterworks
Res
Intake
War Memorial Park
Indian Capital Vo-Tech Sch
Muskogee Country Club
Harris-Jobe Sch
Muskogee High Sch
Bacone College
Cem
Trailer Park
Drive-in Theater
Riverside Sch
Sch for the Blind
OLD INDIAN TREATY BOUNDARY
ST LOUIS - SAN FRANCISCO
PACIFIC
4 LANE
62
165
Boat Ramp
Gaging Sta
Substations
Powerplant
BM 519
NASH
MUSKOGEE CORP BDY
Horseshoe Lake
INDUSTRIAL RAILROAD
PROPOSED
Roadside Park
New Hope Cem
BM 514
BM 532
HARRIS
7
8
9
10
15
18
19
20
21
22
0
N
A
S

```
PROJECT  FANSTEEL INC WATER SHED AT DITCH AT POND

AREA OF WATERSHED=   44.00 ACRES   STORM DURATION=   2.00 HRS. AT RETURN FREQ.= 100. YRS

AVERAGE SLOPE =  2.29 PERCENT  LENGTH = 2050. FT.    NATURAL   CN =70.00  URBANIZED CN = 72.80

IMPROVED CHANNEL FACTOR    - NAT  1.0000  URBAN -  0.4600

IMPERVIOUS SURFACES FACTOR - NAT  1.0000  URBAN -  0.9325

                   PROJECT HYDROGRAPH

             NATURAL                URBANIZED

        TIME         FLOW         TIME       FLOW
        MIN.         CFS.         MIN.       CFS.

        6.63         0.00         2.63       0.00
       13.27         0.00         5.27       0.00
       19.90         0.00         7.90       0.00
       26.54         0.00        10.54       0.00
       33.17         1.00        13.17       0.00
       39.81         4.13        15.81       0.00
       46.44        11.25        18.44       0.00
       53.08        22.81        21.08       0.00
       59.71        40.14        23.72       0.00
       66.35        66.99        26.35       0.00
       72.98       102.81        28.99       0.88
       79.62       141.40        31.62       3.72
       86.25       169.28        34.26       9.75
       92.89       179.07        36.89      18.41
       99.52       172.90        39.53      27.98
      106.16       155.43        42.16      37.57
      112.79       132.33        44.80      46.96
      119.43       110.80        47.44      55.94
      126.06        92.58        50.07      65.35
      132.70        76.76        52.71      76.28
      139.33        61.89        55.34      89.77
      145.97        48.26        57.98     107.17
      152.60        36.41        60.61     131.01
      159.24        26.71        63.25     164.17
      165.87        19.21        65.89     205.27
      172.51        13.82        68.52     247.50
      179.14         9.99        71.16     278.47
      185.78         7.23        73.79     290.67
      192.41         5.22        76.43     284.59
      199.05         3.79        79.06     264.42
      205.68         2.68        81.70     236.09
      212.32         1.85        84.33     206.64
```

```
       218.95          1.21          86.97         179.56
       225.59          0.75          89.61         155.67
       232.22          0.48          92.24         135.08
       238.86          0.31          94.88         117.95
       245.49          0.20          97.51         104.10
       252.13          0.12         100.15          92.99
       258.76          0.06         102.78          83.92
       265.40          0.03         105.42          76.31
       272.03          0.01         108.05          69.77
       278.67          0.00         110.69          63.96
       285.30          0.00         113.33          58.80
         0.00          0.00         115.96          54.24
         0.00          0.00         118.60          50.16
         0.00          0.00         121.23          46.51
         0.00          0.00         123.87          42.80
         0.00          0.00         126.50          38.53
         0.00          0.00         129.14          33.12
         0.00          0.00         131.78          26.92
         0.00          0.00         134.41          20.81
         0.00          0.00         137.05          15.41
         0.00          0.00         139.68          11.00
         0.00          0.00         142.32           7.85
         0.00          0.00         144.95           5.64
         0.00          0.00         147.59           4.06
         0.00          0.00         150.22           2.90
         0.00          0.00         152.86           2.07
         0.00          0.00         155.50           1.47
         0.00          0.00         158.13           1.04
         0.00          0.00         160.77           0.73
         0.00          0.00         163.40           0.51
         0.00          0.00         166.04           0.35
         0.00          0.00         168.67           0.24
         0.00          0.00         171.31           0.16
         0.00          0.00         173.94           0.10
         0.00          0.00         176.58           0.05
         0.00          0.00         179.22           0.02
         0.00          0.00         181.85           0.00

 PEAK NATURAL DISCHARGE =          179. CFS.

 PEAK URBANIZED FLOW =          290. CFS.

 TOTAL URBAN RUNOFF AT PEAK FLOW=       6.7413 ACRE-FT.

 URBAN - ORIGINAL RUNOFF=       6.1720 ACRE-FT.
```

100 YR

```
  5.0    0.0659
 10.0    0.0724
 15.0    0.0802
 20.0    0.0899
 25.0    0.1019
 30.0    0.1173
 35.0    0.1167
 40.0    0.1427
 45.0    0.1816
 50.0    0.2444
 55.0    0.3580
 60.0    0.6062
 65.0    0.8662
 70.0    0.4548
 75.0    0.2919
 80.0    0.2089
 85.0    0.1601
 90.0    0.1285
 95.0    0.1362
100.0    0.1091
105.0    0.0955
110.0    0.0848
115.0    0.0761
120.0    0.0690
```

STORM MODEL FOR 100 YR. FREQ. RAIN FALL

RAINFALL FOR 5 MIN. PERIOD IN INCHES

TIME IN MIN.