Summary of Drainage Analyses
Upper Fourmile Creek Near
K-96 and Greenwich Road

- Summer/Fall 1996 – In conjunction with planning for Greenwich Business Park (now the Target Superstore area) and Regency Park (commercial area south of Stryker Soccer Field complex), MKEC evaluated watershed studies by others. These studies had provided the basis for sizing drainage facilities at K-96 and under 21st Street just west of Greenwich Road. Flow rates from others' analyses appeared to be unusually low, and prompted MKEC to complete a detailed evaluation of the Fourmile Creek watershed above 21st Street.
  - MKEC Report Findings:
    - The calculated 100-year peak flow rate at 21st Street should be ~1,800 cfs rather than ~1,080 cfs. The higher peak flow rate MKEC calculated corresponded closely to adjusted flow rates used by FEMA for detailed floodplain evaluation for Fourmile Creek south of 21st Street.
    - Hydrologic calculations for the culverts under K-96 from Webb to just east of Greenwich used an unusual method. This method yielded peak flow rates roughly half those calculated using standard methods. Culverts at K-96 were consequently under-sized.
    - Because the K-96 drainage facilities are undersized, significant flow can be expected through the bridge under K-96 at Greenwich during the 100-year event, even under pre-development conditions.
    - FEMA floodplain regulations were not considered during K-96 design and construction. Regulated floodplains north of K-96 were cut off from the Fourmile Creek channel south of K-96. Floodplain maps were not modified.
  - Preliminary Report Recommendations:
    - Increase design flows to the then-proposed 21st Street culvert (just west of Greenwich) from 1,080 cfs to 1,800 cfs.
    - Establish standard methods for drainage calculations.
    - Construct detention upstream from K-96 to prevent flows through the K-96/Greenwich bridge during the 100-year event.

- November 1996 – The MKEC report findings were presented to the City and County, as well as to the affected private sector community (engineering and development).
  - City and County Decisions:
    - Keep 21st Street culvert design flows at 1,080 cfs.
    - Require the private sector to provide detention as development occurs to protect property north of 21st Street.

- Stryker Soccer Complex/Regency Park Drainage (~1999)
  - MKEC planning and design adhered to City and County detention decision as well as the previous MKEC report. The development included extensive detention in the soccer fields as well as in the Regency Park plat.

- As part of the general watershed plan, MKEC developed specific detention recommendations for the southeast corner of Jabara Airport. A separate report regarding detention at Jabara was prepared and submitted to the City. Detention at Jabara has not been constructed.

- Greenwich Road Interchange (~2000)
  - MKEC's north ramp design matched the capacity of culverts under K-96. No measures were taken to address 100-year flows from Jabara Airport or from areas east of Greenwich that would pass under K-96 through the Greenwich Road bridge.
  - The project realigned a small part of the upper Fourmile Creek channel just south of the highway to pass through the RCB under the walking/bicycle trail.
  - The detention facility at Regency Lakes Residential was modified to discharge north toward the designed channel (instead of south toward the center of the commercial parcel (now Target)) under 100-year flow conditions.
  - The culvert under the walking/bicycle trail south of K-96 was sized to accommodate the higher MKEC peak flow rates (~1,800 cfs) calculated in 1996.

- Target Superstore Complex Design (~2002)
  - Appropriateness of the MKEC higher discharge at the 21st Street culvert is acknowledged. Two new barrels are added to the culvert under 21st Street in conjunction with Target construction to accommodate the new design conditions.
  - Culverts through the new commercial development are sized to accommodate the higher design flows.

- Remaining Issues
  - Peak flows from Jabara Airport may cause failure of the detention facilities east of the airport and north of K-96 during the 100-year event. Overflow would pass through the Greenwich Road bridge.
  - Peak flows to the 2-6x3 RCB culvert under K-96 east of Greenwich (MKEC 100-year Peak Q = 515 cfs) will exceed culvert capacity (~220 cfs). Full development in this watershed is expected. Under pre-developed conditions a significant portion of the 100-year and smaller events is expected to pass through the Greenwich Road bridge.
  - Facilities designed in conjunction with Greenwich Road improvements should carry some part of the 100-year discharge through the Greenwich Road bridge to the constructed channel at the north end of the Target development.

Hydrograph Return Period Recap

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	-------	-------	68.86	-------	-------	-------	175.75	207.29	235.04	Jabara Airport
2	SCS Runoff	-------	-------	24.76	-------	-------	-------	59.95	70.16	79.11	West Soccer Fields
3	SCS Runoff	-------	-------	23.95	-------	-------	-------	45.94	52.11	57.49	West Lot 9
4	Combine	1, 2, 3	-------	73.48	-------	-------	-------	185.31	218.53	247.76	To 6x3 @ K-96 Sta 443+00
5	Diversion1	4	-------	73.48	-------	-------	-------	115.00	115.00	115.00	Flow Under K-96 @ 443+00
6	Diversion2	4	-------	0.00	-------	-------	-------	70.31	103.53	132.76	Bypass to Regency Park
7	SCS Runoff	-------	-------	24.60	-------	-------	-------	62.59	73.78	83.65	East Soccer Fields
8	Reservoir	7	-------	7.78	-------	-------	-------	11.11	11.72	12.26	East Soccer Fld Det
9	SCS Runoff	-------	-------	80.51	-------	-------	-------	154.86	175.72	193.92	North Regency Park
10	Combine	8, 9	-------	83.32	-------	-------	-------	160.25	182.11	200.92	North Reg Pk Det Inflow
11	Reservoir	10	-------	8.04	-------	-------	-------	12.68	13.83	14.81	Regency Park North Det
12	SCS Runoff	-------	-------	67.36	-------	-------	-------	129.77	147.28	162.56	South Regency Park
13	Combine	6, 11, 12	-------	71.23	-------	-------	-------	178.21	224.41	264.96	South Reg Pk Det Inflow
14	Reservoir	13	-------	40.14	-------	-------	-------	87.34	102.03	115.28	Regency Park South Det
15	Diversion1	14	-------	40.14	-------	-------	-------	75.00	75.00	75.00	Flow Under K-96 @ 460+10
16	Diversion2	14	-------	0.00	-------	-------	-------	12.34	27.03	40.28	Bypass to Greenwich Underpass
17	SCS Runoff	-------	-------	173.03	-------	-------	-------	394.98	458.91	515.08	East Greenwich
18	Diversion1	17	-------	173.03	-------	-------	-------	221.00	221.00	221.00	Flow Under K-96 @ 470+50
19	Diversion2	17	-------	0.00	-------	-------	-------	173.98	237.91	294.08	Bypass to Greenwich Underpass
20	Combine	16, 19	-------	0.00	-------	-------	-------	185.03	261.43	327.88	To Greenwich Underpass

Proj. file: GreenwichK-96North.gpw

Run date: 05-18-2004

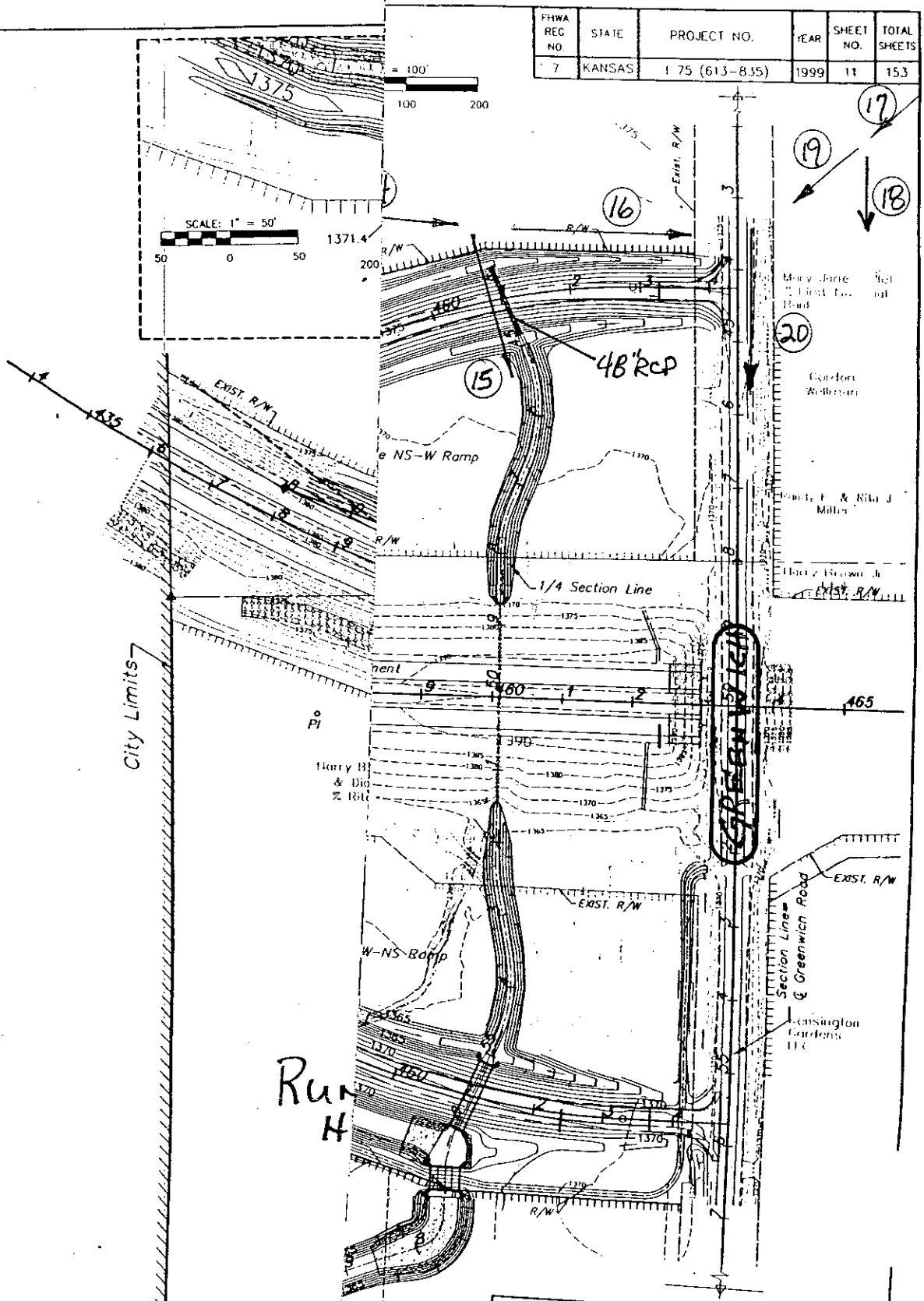
Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (acft)	Hydrograph description
1	SCS Runoff	207.29	6	768	41.486	----	------	------	Jabara Airport
2	SCS Runoff	70.16	6	720	4.986	----	------	------	West Soccer Fields
3	SCS Runoff	52.11	6	720	3.962	----	------	------	West Lot 9
4	Combine	218.53	6	762	50.434	1, 2, 3	------	------	To 6x3 @ K-96 Sta 443+00
5	Diversion1	115.00	6	714	40.631	4	------	------	Flow Under K-96 @ 443+00
6	Diversion2	103.53	6	762	9.804	4	------	------	Bypass to Regency Park
7	SCS Runoff	73.78	6	762	13.394	----	------	------	East Soccer Fields
8	Reservoir	11.72	6	852	13.394	7	194.57	6.971	East Soccer Fld Det
9	SCS Runoff	175.72	6	726	17.443	----	------	------	North Regency Park
10	Combine	182.11	6	726	30.837	8, 9	------	------	North Reg Pk Det Inflow
11	Reservoir	13.83	6	1188	30.837	10	188.57	14.832	Regency Park North Det
12	SCS Runoff	147.28	6	732	18.005	----	------	------	South Regency Park
13	Combine	224.41	6	726	58.646	6, 11, 12	------	------	South Reg Pk Det Inflow
14	Reservoir	102.03	6	786	58.646	13	185.18	10.428	Regency Park South Det
15	Diversion1	75.00	6	738	55.603	14	------	------	Flow Under K-96 @ 460+10
16	Diversion2	27.03	6	786	3.043	14	------	------	Bypass to Greenwich Underpass
17	SCS Runoff	458.91	6	762	92.702	----	------	------	East Greenwich
18	Diversion1	221.00	6	732	74.530	17	------	------	Flow Under K-96 @ 470+50
19	Diversion2	237.91	6	762	18.173	17	------	------	Bypass to Greenwich Underpass
20	Combine	261.43	6	768	21.216	16, 19	------	------	To Greenwich Underpass

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (acft)	Hydrograph description
1	SCS Runoff	235.04	6	768	47.127	----	------	------	Jabara Airport
2	SCS Runoff	79.11	6	720	5.644	----	------	------	West Soccer Fields
3	SCS Runoff	57.49	6	720	4.394	----	------	------	West Lot 9
4	Combine	247.76	6	762	57.164	1, 2, 3	------	------	To 6x3 @ K-96 Sta 443+00
5	Diversion1	115.00	6	714	43.707	4	------	------	Flow Under K-96 @ 443+00
6	Diversion2	132.76	6	762	13.457	4	------	------	Bypass to Regency Park
7	SCS Runoff	83.65	6	756	15.215	----	------	------	East Soccer Fields
8	Reservoir	12.26	6	864	15.215	7	194.79	8.126	East Soccer Fld Det
9	SCS Runoff	193.92	6	726	19.343	----	------	------	North Regency Park
10	Combine	200.92	6	726	34.558	8, 9	------	------	North Reg Pk Det Inflow
11	Reservoir	14.81	6	1188	34.557	10	188.93	16.360	Regency Park North Det
12	SCS Runoff	162.56	6	732	19.965	----	------	------	South Regency Park
13	Combine	264.96	6	726	67.980	6, 11, 12	------	------	South Reg Pk Det Inflow
14	Reservoir	115.28	6	792	67.980	13	185.84	13.403	Regency Park South Det
15	Diversion1	75.00	6	738	62.378	14	------	------	Flow Under K-96 @ 460+10
16	Diversion2	40.28	6	792	5.602	14	------	------	Bypass to Greenwich Underpass
17	SCS Runoff	515.08	6	762	104.354	----	------	------	East Greenwich
18	Diversion1	221.00	6	726	80.244	17	------	------	Flow Under K-96 @ 470+50
19	Diversion2	294.08	6	762	24.110	17	------	------	Bypass to Greenwich Underpass
20	Combine	327.88	6	768	29.711	16, 19	------	------	To Greenwich Underpass

FHWA REG NO.	STATE	PROJECT NO.	YEAR	SHEET NO.	TOTAL SHEETS
7	KANSAS	I 75 (613-835)	1999	11	153



KANSAS DEPARTMENT OF TRANSPORTATION

CONTOUR MAP
K-96 & GREENWICH INTERCHANGE

PROJECT NO. I 75 (613-835) SEDGWICK CO.

MID-KANSAS ENGINEERING CONSULTANTS, INC.
WICHITA, KANSAS

DESIGNED BY:	KJS	CHECKED BY:	MEV
DRAWN BY:	RSB	DATE:	SHEET

I:\CIVIL\98080\PAVE\98080GEN.DWG 3/10/99 10:46 AM CST

Summary of Drainage Calculations for K-96 from Sta 436+31.33 to Sta. 543+00

From KDOT Construction Plans Proj. No. 96-87 K-4434-01
Dated 1991

Station	D.A., ac	C	Q100, cfs	(Calculated) I, in/hr	Tc, min
443+00	161	0.35	122	2.16504	125
460+10	99	0.35	87	2.510823	107
465+50	212	0.36	232	3.039832	84
486+50	133	0.36	156	3.258145	76
537+50	50	0.56	149	5.321429	31
C100 Appendix D* =		0.63			

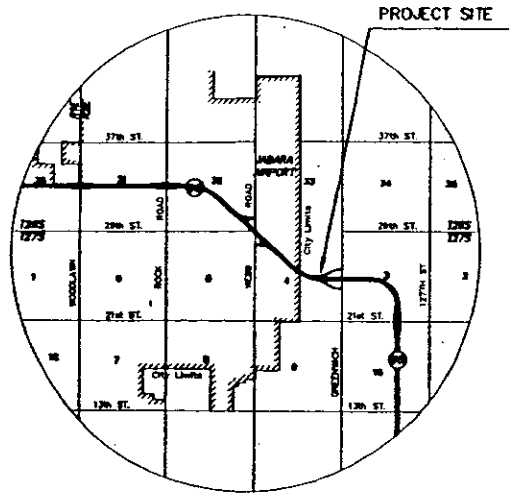
SCS Hydrologic Soil Group "D" (Urban Lawn areas, Slope < 1%)

Regression Equation Results, Sta 443+00

Source	Q100, cfs
USGS WIR 00-4079	716.7
USGS WIR 87-4008	591

PROJECT NO.	YEAR	SHEET NO.	TOTAL SHEETS
75)	1999	2	153

SEDGWICK COUNTY PUBLIC WORKS



VICINITY MAP

NOT TO SCALE

See Sheet No.2 for Index to Sheets.

K-96 to remain open to traffic.

Traffic to be carried through construction on all sideroads.

PROJECT NO. I 75 (613-
CONCRETE PAVEMENT
GRADING
FENCING
SEEDING
SIGNING AND PAVEMENT MARKING

PLAN AND PROFILE OF PROPOSED

K-96 BYPASS

AT

K-96 & GREENWICH INTERCHANGE

SEDGWICK COUNTY, KANSAS

KDOT PROJECT NO. 96-87 K-6452-01

DESIGN DESIGNATION

ADT	20,250
DHV	13%
D	50%
T	5%
V	70 mph Min.
Control of Access	FULL
Clear Zone	30 FT.

CONVENTIONAL SIGNS

- TELEPHONE POLE
- POWER POLE
- COMB. POWER & TELEPHONE
- WIRE FENCE
- RAILROADS
- SURVEY LINE
- RIGHT OF WAY
- TOWNSHIP LINE
- CONSTRUCTION LIMITS
- GUARD FENCE
- HEDGE ROW
- TREES

NET LENGTH OF PROJECT	2,552.36 FT.	0.483 MILES
NET LENGTH OF BRIDGES	0.00 FT.	0.000 MILES
NET LENGTH OF ROAD	2,552.36 FT.	0.483 MILES
EXCEPTIONS	0.00 FT.	0.000 MILES
ADDITIONS	0.00 FT.	0.000 MILES
GROSS LENGTH OF PROJECT	2,552.36 FT.	0.483 MILES

PLANS PREPARED BY:

MID-KANSAS ENGINEERING CONSULTANTS, INC.
WICHITA, KANSAS

APPROVED:

DAVID C. SPEARS, P.E.
DIRECTOR OF PUBLIC WORKS/COUNTY ENGINEER
DATE: 3/30/99

APPROVED:

CHAIRMAN, BOARD OF COUNTY COMMISSIONERS
DATE: 3-31-99

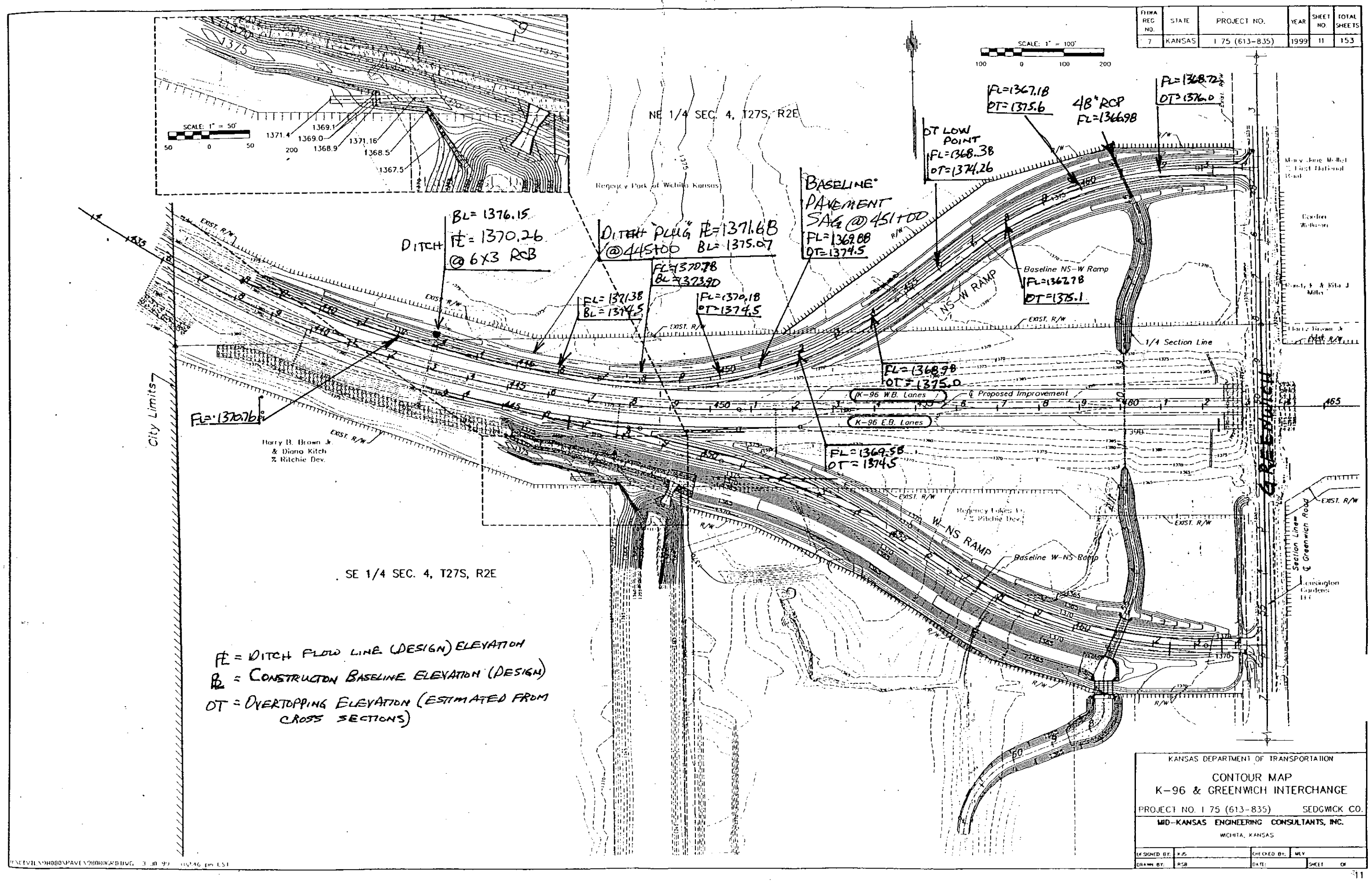
FILED IN THE OFFICE OF
THE SEDGWICK COUNTY CLERK

COUNTY CLERK
DATE: 3-31-99

3-30-99

MKEC

FHWA REG NO.	STATE	PROJECT NO.	YEAR	SHEET NO	TOTAL SHEETS
7	KANSAS	I 75 (613-835)	1999	11	153



FE = DITCH FLOW LINE (DESIGN) ELEVATION
BL = CONSTRUCTION BASELINE ELEVATION (DESIGN)
OT = OVERTOPPING ELEVATION (ESTIMATED FROM CROSS SECTIONS)

KANSAS DEPARTMENT OF TRANSPORTATION

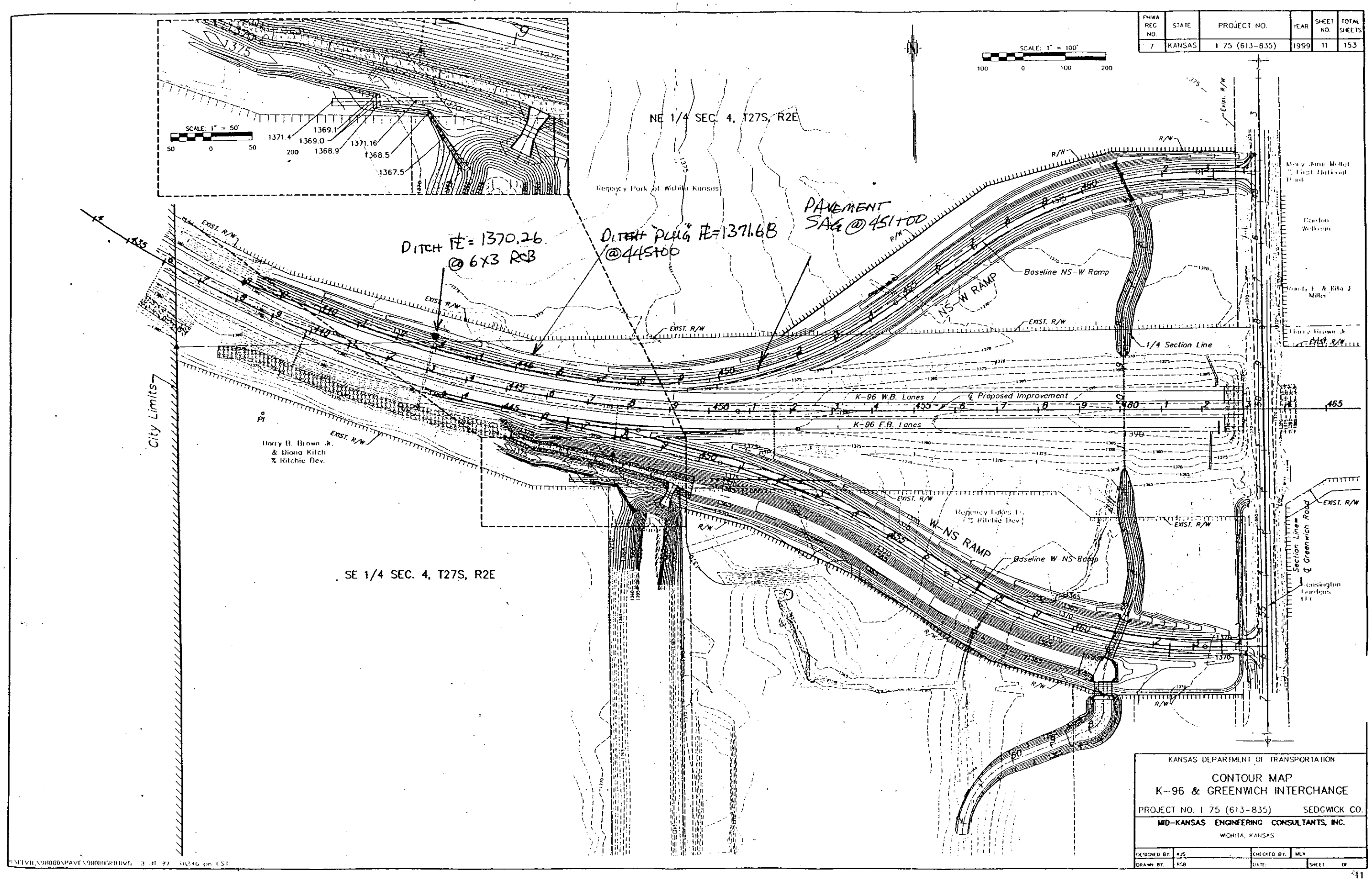
CONTOUR MAP
K-96 & GREENWICH INTERCHANGE

PROJECT NO. I 75 (613-835) SEDGWICK CO.

MID-KANSAS ENGINEERING CONSULTANTS, INC.
WICHITA, KANSAS

DESIGNED BY:	K.S.	CHECKED BY:	MLY
DRAWN BY:	RSB	DATE:	SHEET OF

FHWA REG NO.	STATE	PROJECT NO.	YEAR	SHEET NO.	TOTAL SHEETS
7	KANSAS	I 75 (613-835)	1999	11	153



KANSAS DEPARTMENT OF TRANSPORTATION

CONTOUR MAP
K-96 & GREENWICH INTERCHANGE

PROJECT NO. I 75 (613-835) SEDGWICK CO.

MID-KANSAS ENGINEERING CONSULTANTS, INC.
WICHITA, KANSAS

DESIGNED BY	KJS	CHECKED BY	MLY
DRAWN BY	RSD	DATE	SHEET OF

11

FHWA REG NO.	STATE	PROJECT NO.	YEAR	SHEET NO.	TOTAL SHEETS
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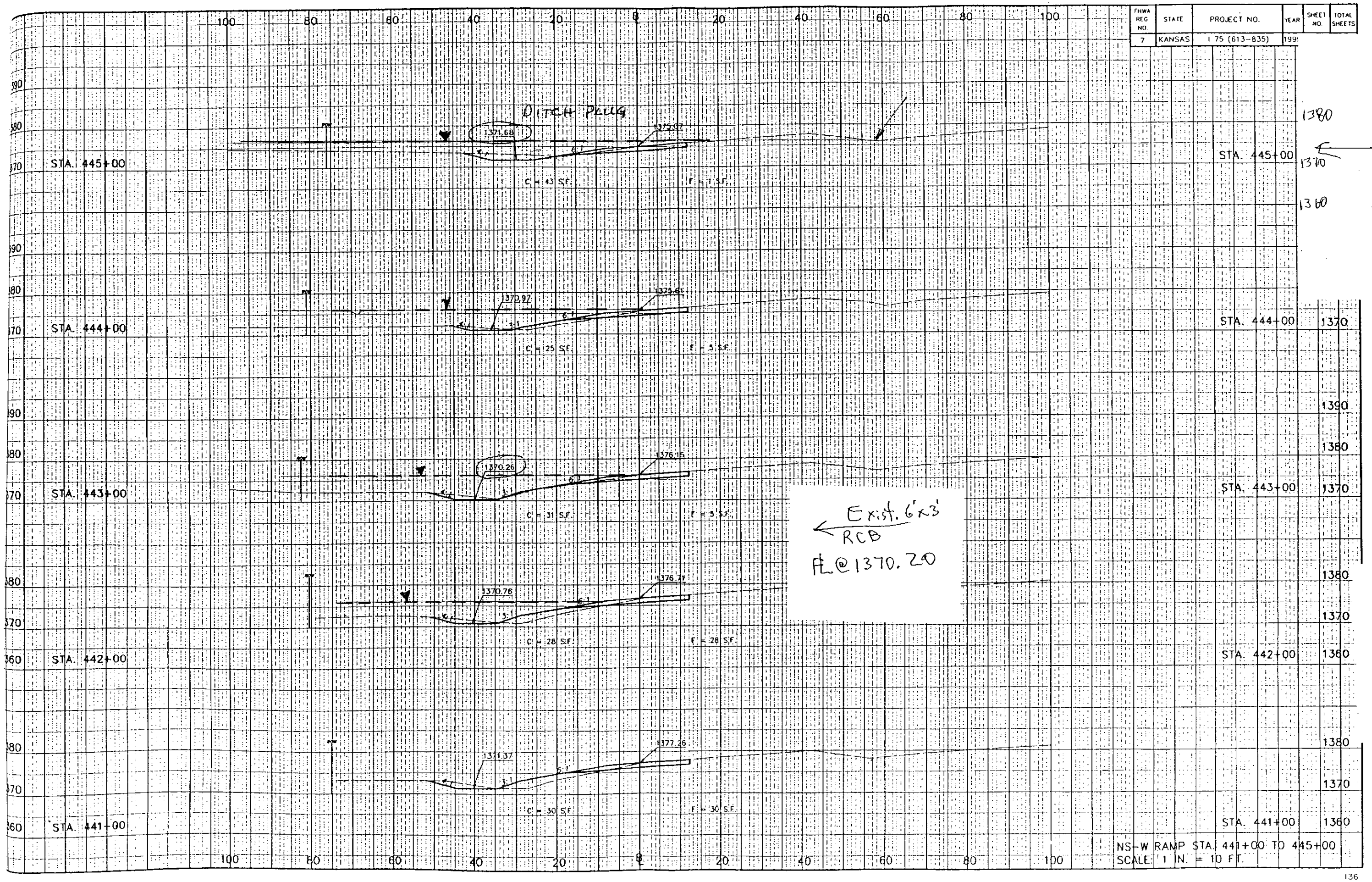

NS-W RAMP STA. 446+00 TO 450+00
SCALE 1 IN = 10 FT

STA 446+00 1360
STA 447+00 1360
STA 448+00 1370
STA 449+00 1370
STA 450+00 1370

FHWA REG NO.	STATE	PROJECT NO.	YEAR	SHEET NO.	TOTAL SHEETS
7	KANSAS	I 75 (613-835)	1999	137	153

FHWA REG NO	STATE	PROJECT NO.	YEAR	SHEET NO	TOTAL SHEETS
7	KANSAS	I 75 (613-835)	1999	138	153

NS-W RAMP STA. 451+00 TO 455+00
SCALE: 1 IN. = 10 FT.

FHWA REG NO.	STATE	PROJECT NO.	YEAR	SHEET NO.	TOTAL SHEETS
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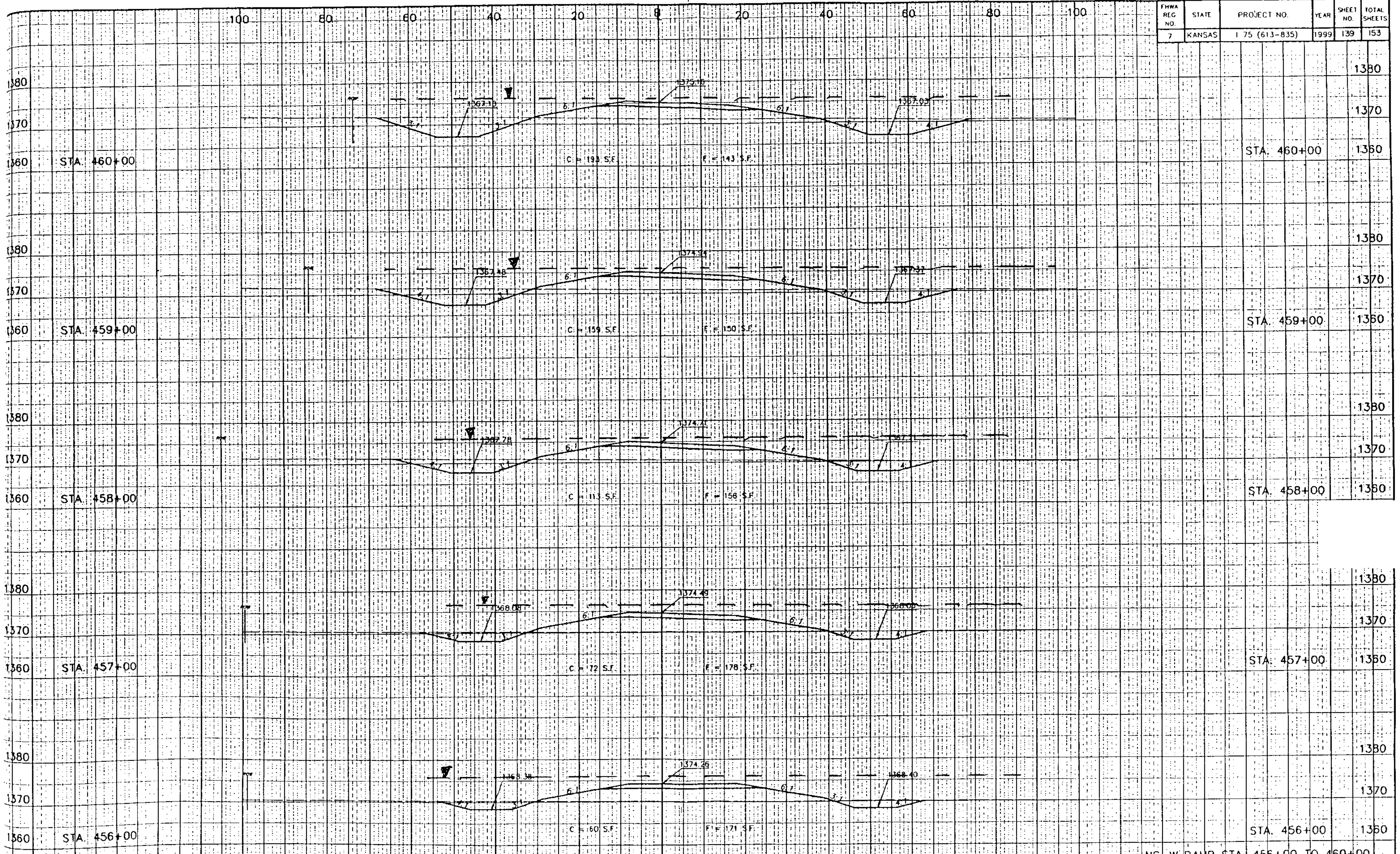

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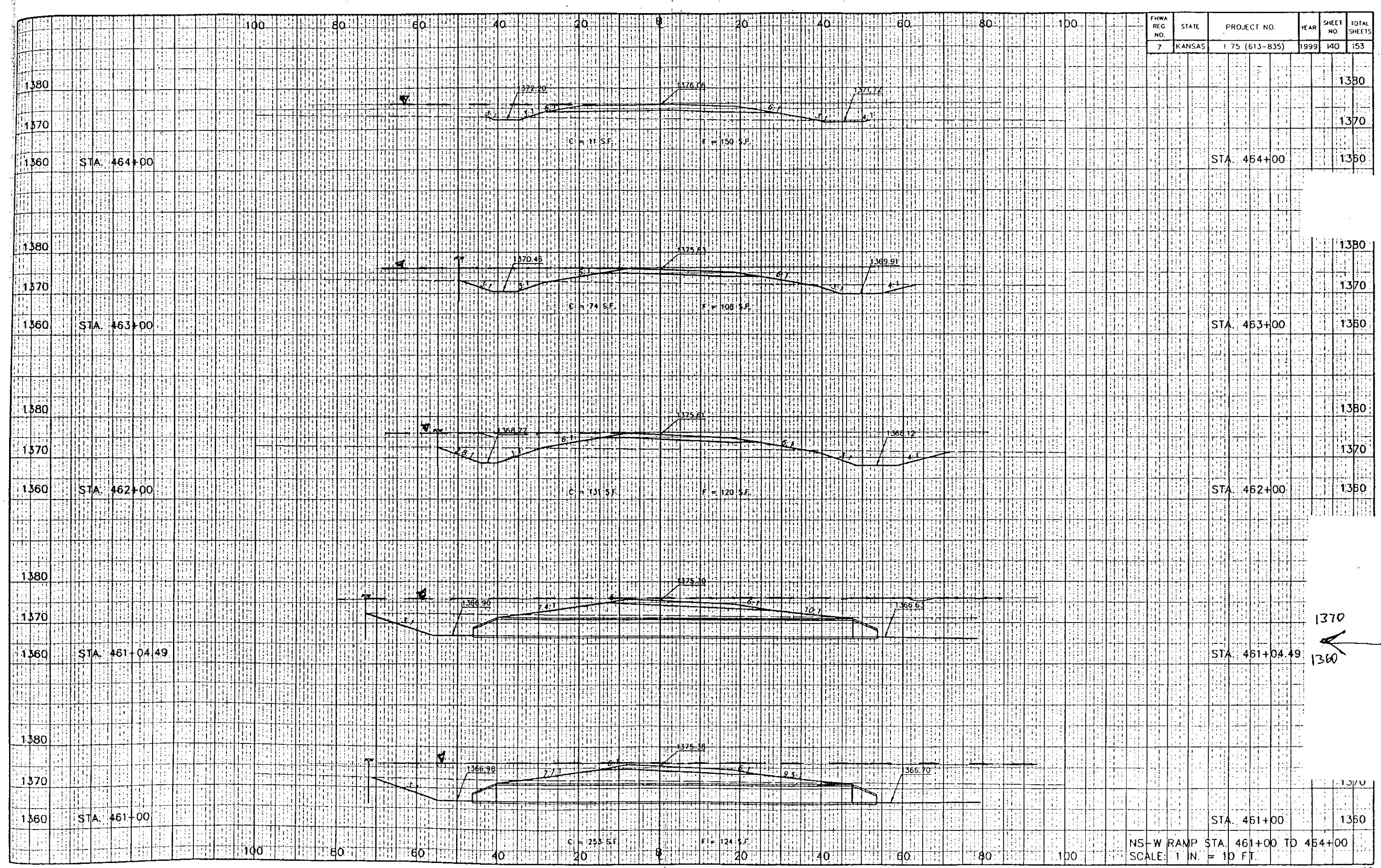

NS-W RAMP STA. 461+00 TO 464+00
SCALE: 1 IN. = 10 FT.

140