



Petrach
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Informal Note #48

ANALYSIS OF ELKHART YARD TRACK AND HUMP REQUIREMENTS

I INTRODUCTION

This informal note documents and summarizes the findings of an analysis of the latest Elkhart design plans. The plans call for a target throughput of 2915 cars humped per day.

The Elkhart yard was analyzed using the CAPACITY model. The initial assumptions in the analysis were:

- Maximum receiving track lengths of 120 cars
- Humping rate of .37 minutes per car (2.7 cars per minute)
- Two hump engines working per shift.

When the initial analysis was completed, two types of sensitivity analysis were conducted. First, the effect of slower humping rates was analyzed to simulate the effects of severe weather conditions. Second, the effect on track requirements of a ± 1 hour variation in arrival/ departure time was analyzed.

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II HUMP THROUGHPUT

The initial analysis assumes a humping rate of .37 minutes per car with crews and two hump engines synchronized and working at specified process rates. A sequence of CAPACITY simulation runs was performed, starting with a throughput of 2665 cars/day to 3200 cars/day. At 3200 cars/day the receiving yard experienced congestion; consequently we assumed the hump was saturated. The higher throughputs were accomplished by increasing the number and size of new inbound trains whose consists included BN, CNW, Milwaukee, MOPAC, Soo Line, Gibson, CJ-Ashland and ATSF cars.

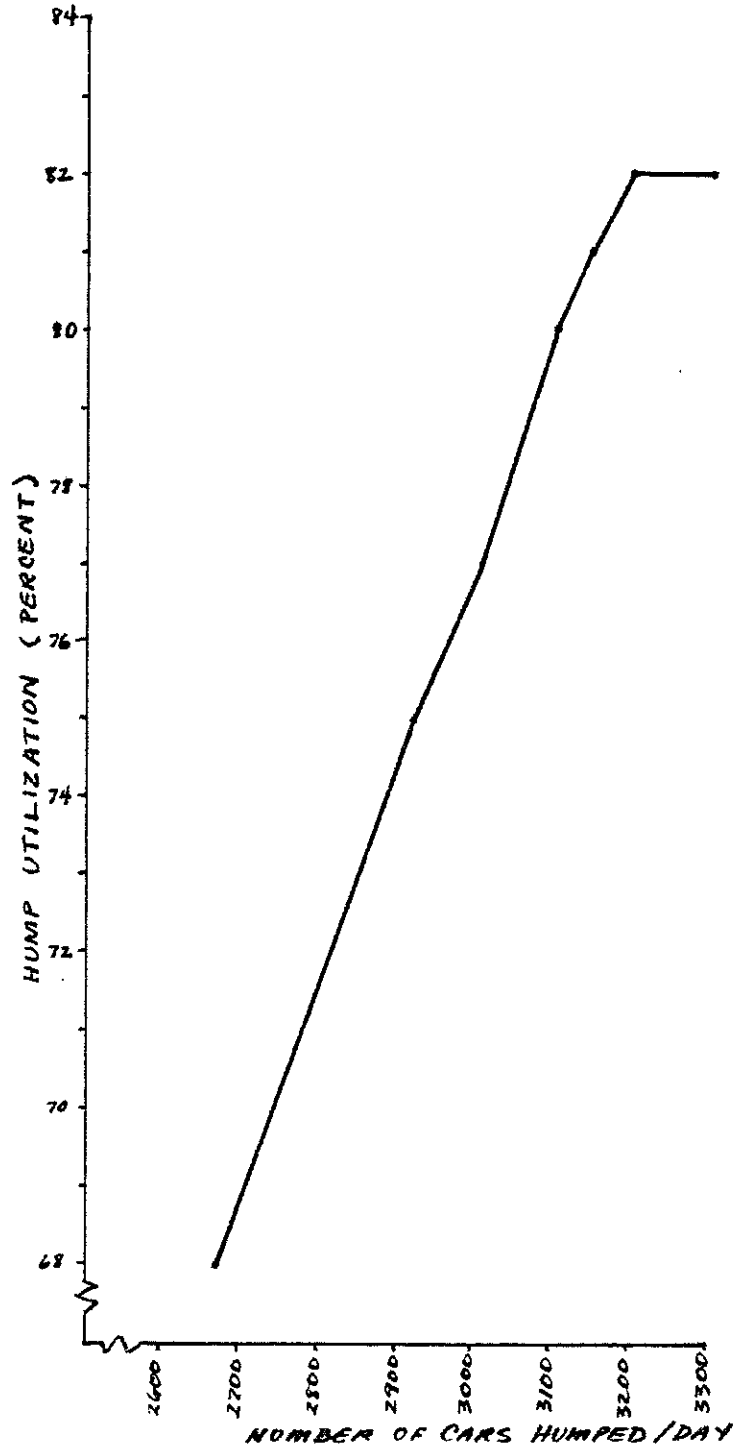
The base day consisted of 2665 cars humped/day (actual Elkhart traffic of 11-19-77); this resulted in a hump utilization of 68 percent. When the hump throughput was increased to the target 2915 cars/day, the hump utilization increased to 75 percent. When the hump was unable to handle additional cars at 3200 cars/day, the hump utilization peaked at 82 percent. The graph on the following page (Figure 1) depicts the percent of time that cars were passing over the hump during the third day of each simulation.

The above results indicate that the target throughput of 2915 cars/day is "theoretically" possible. However, a closer look at the simulation results shows the two hump engines utilizing the hump 75% of the time for humping. Our experience from a number of projects and railroads indicates that in actual practice, a 65% hump utilization is normal. The discrepancy arises because the CAPACITY simulation is optimistic; CAPACITY assumes the two hump engines are perfectly synchronized and the engines/crews are working at the standard process rates all the time. If in fact a 65% hump utilization figure is correct, then to achieve a throughput of 2915 cars per day, the hump speed must be raised to 3.1 cars per minute. With 65% utilization and 2.7 cars per minute, we would expect the throughput to be considerably less than the desired 2915 cars per day.

It should be noted that in poor weather conditions the 2.7 cars per minute hump rate may not be able to be sustained, thus further eroding hump throughput. If the hump rate is decreased to .41 minutes/car (i.e., 2.44 cars/min.) and the hump utilization is 65%, the throughput will decrease to 2283 cars/day.

Figure 1

REQUIRED HUMP UTILIZATION WITH VARIATIONS IN HUMP THROUGHPUT
(2 engines/shift and humping rate .37 min./car)



After assimilating all this data, we would suggest that the possibility of achieving 2915 cars per day is marginal. In order to insure reaching the target hump throughput, a higher humping rate is desirable.

III NUMBER OF TRACKS

CAPACITY graphically presents the time that each train is detained on a receiving or departure track. Although the data used in this study was real inbound traffic and scheduled outbound trains, we know that trains seldom arrive/depart at the scheduled time. Therefore, we performed a sensitivity analysis on the track requirements assuming trains arrive/depart \pm 1 hour from the schedule. This is accomplished by extending the track occupancy of each train by one hour either way and counting the maximum number of tracks occupied during any time over the 24 hour period depicted on CAPACITY graphs. Trains requiring track lengths greater than 120 cars were assumed to occupy two tracks.

The conclusions of this sensitivity analysis are the following track requirements for the target rate 2915 cars/day:

- 3 East receiving tracks
- 8 West receiving tracks
- 9 East departure tracks
- 9 West departure tracks.

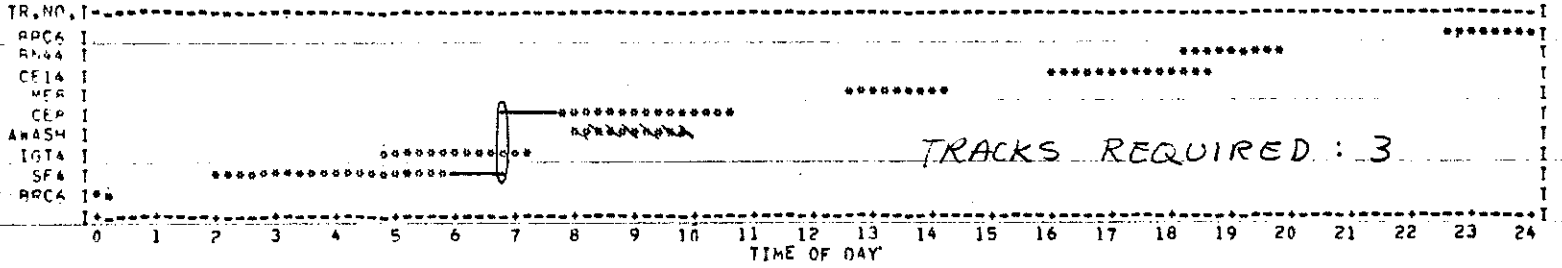
Supporting documentation is supplied in Figures 2, 3 and 4, which illustrate the receiving and departure yard requirements for a throughput of 2915 cars. The target throughput was achieved by adding 3 inbound trains (ADD1, ADD2, and ADD3) to the West receiving yard, requiring making up three new outbound trains (ABN1, ACNW, ANCl) departing from the East and West departure yards (see Tables 1 and 2) to carry the additional traffic.

Figure 2

EAST AND WEST RECEIVING TRACK REQUIREMENTS (2915 CARS/DAY, HUMPING RATE .37 MIN./CAR)

ELKHART CAPACITY DATA 11-19-77

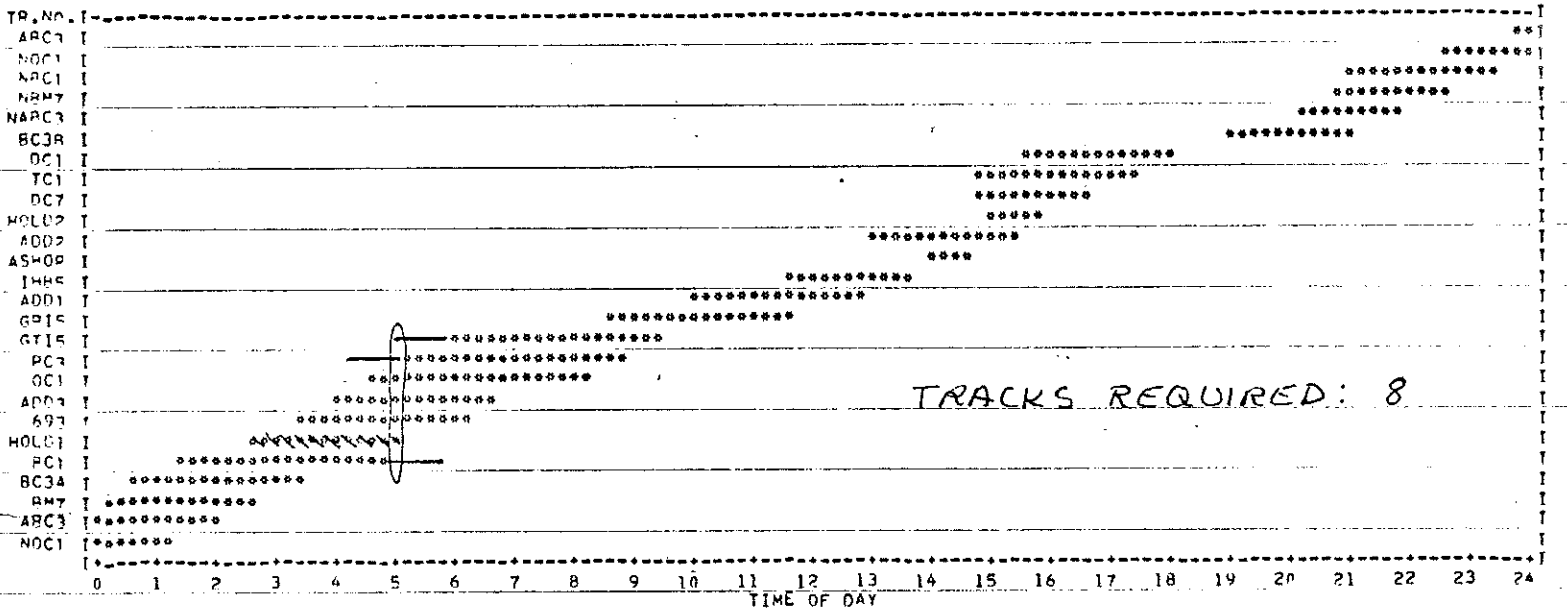
EAST RECEIVING YARD OCCUPANCY DIAGRAM FOR DAY 3 -



EAST RECEIVING YARD TRACK REQUIREMENTS -

TRACK NO.	MIN. LENG. REQUIRED (CARS)
1	120
2	73

WEST RECEIVING YARD OCCUPANCY DIAGRAM FOR DAY 3 -



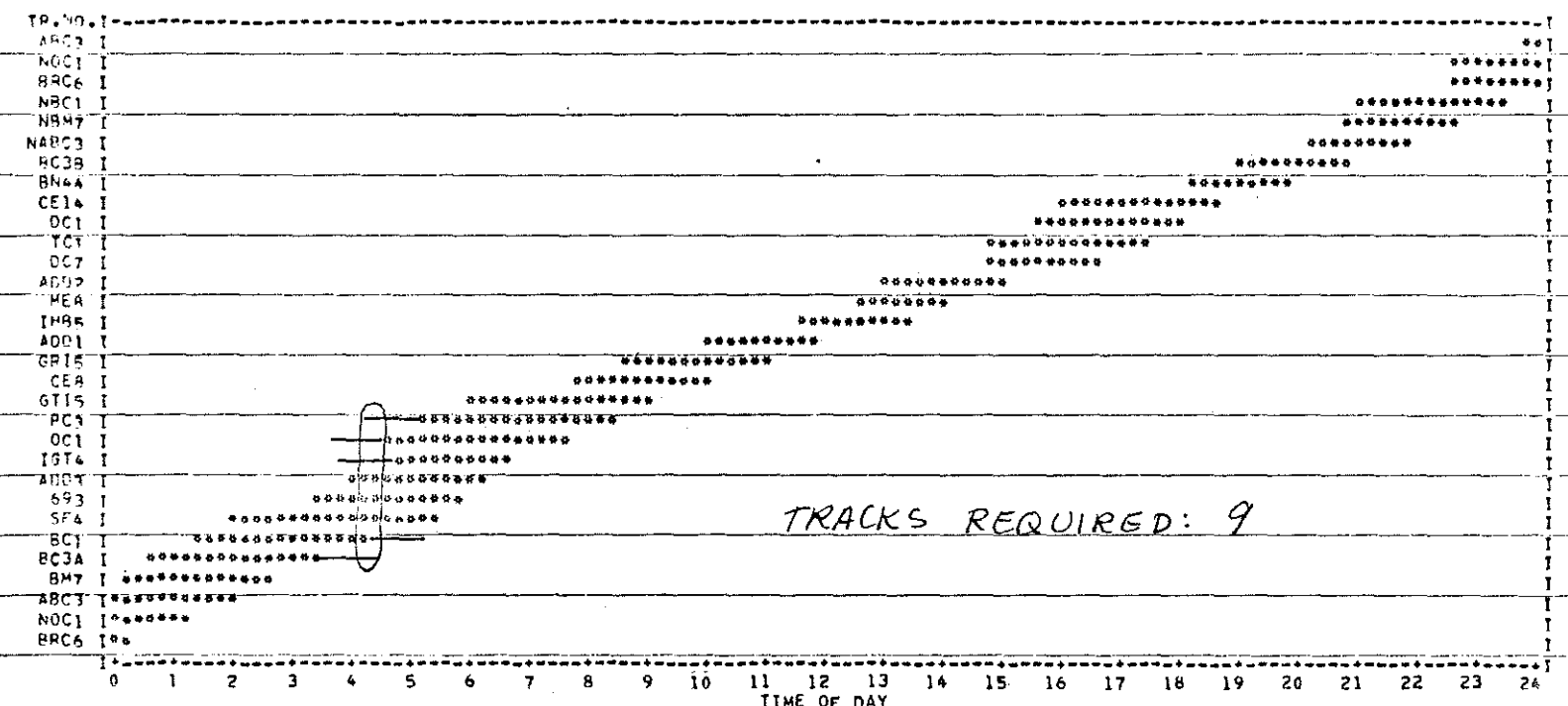
WEST RECEIVING YARD TRACK REQUIREMENTS -

TRACK NO.	MIN. LENG. REQUIRED (CARS)
1	162
2	123
3	183
4	95
5	46

Figure 3

COMBINED RECEIVING YARD TRACK REQUIREMENTS
(2915 CARS/DAY, HUMPING RATE .37 MIN./CAR)

RECEIVING YARD OCCUPANCY DIAGRAM FOR DAY 3 -



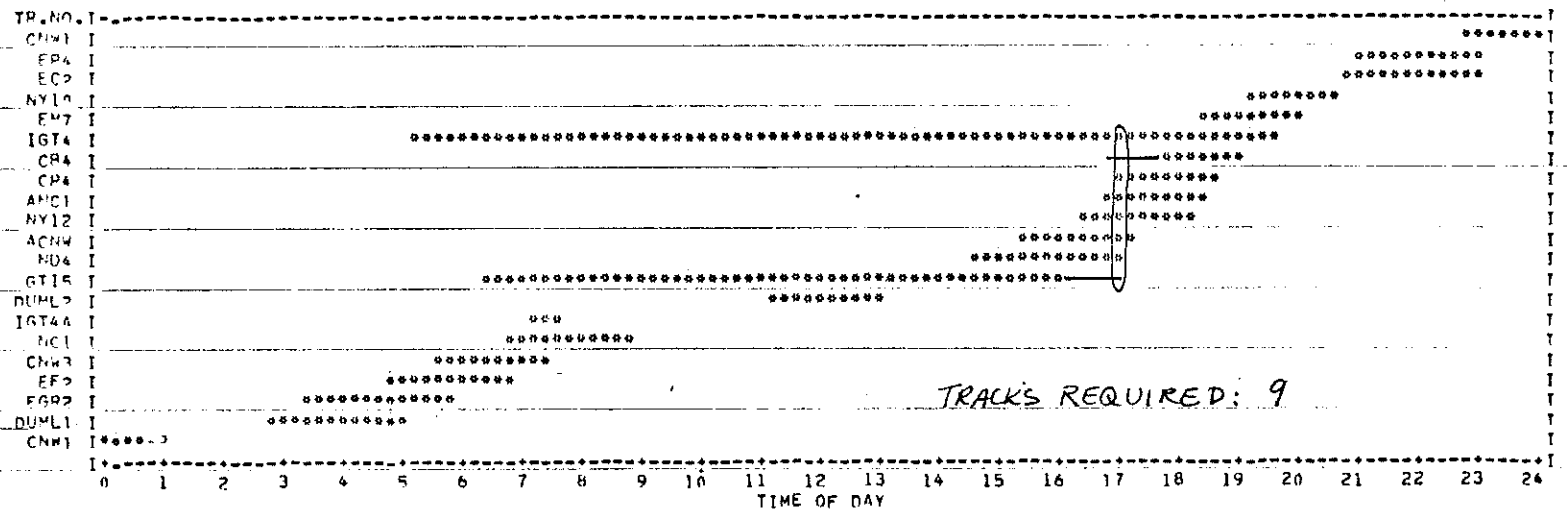
RECEIVING YARD TRACK REQUIREMENTS -

TRACK NO.	MIN. LENG. REQUIRED (CARS)
1	162
2	121
3	113
4	98
5	79
6	46

Figure 4

EAST AND WEST DEPARTURE YARD TRACK REQUIREMENTS
(2915 CARS/DAY, HUMMING RATE .37 MIN./CAR)

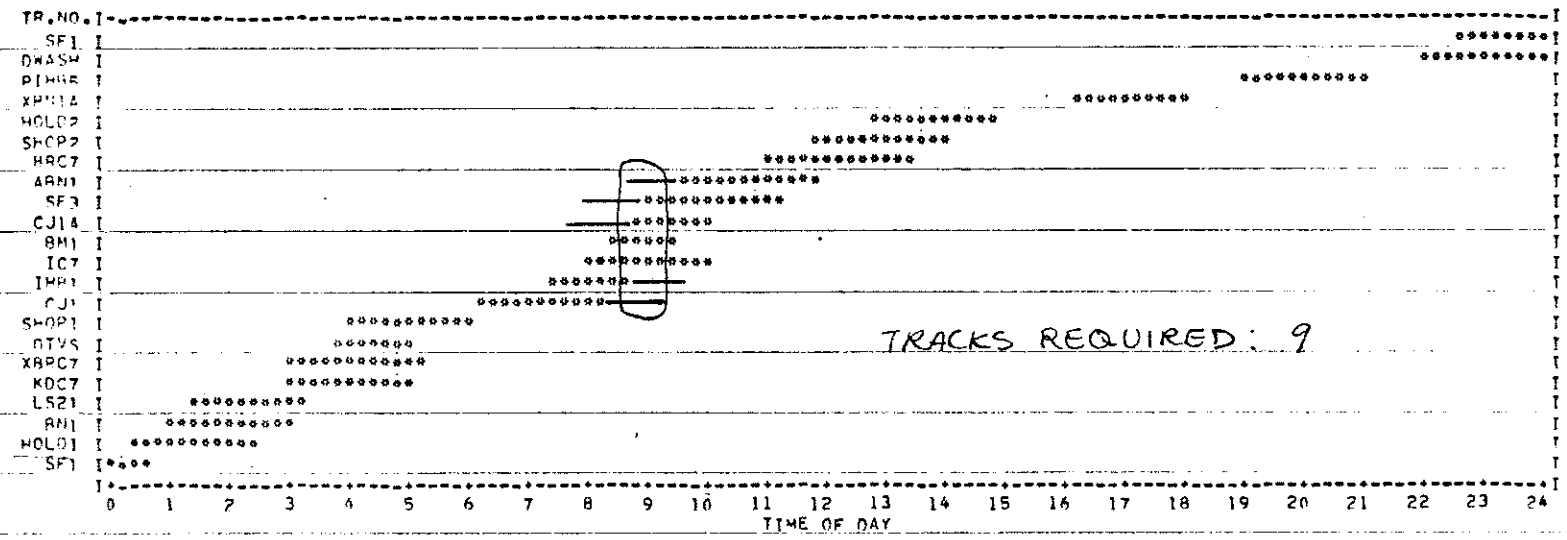
EAST DEPARTURE YARD OCCUPANCY DIAGRAM FOR DAY 3 -



EAST DEPARTURE YARD TRACK REQUIREMENTS -

TRACK NO.	MIN. LENG. REQUIRED (CAPS)
1	134
2	105
3	98
4	84
5	58

WEST DEPARTURE YARD OCCUPANCY DIAGRAM FOR DAY 3 -



WEST DEPARTURE YARD TRACK REQUIREMENTS -

TRACK NO.	MIN. LENG. REQUIRED (CAPS)
1	132
2	130
3	120
4	22

TABLE 1
ELKHART ARRIVING TRAIN HISTORY DURING THIRD DAY
(2915 CARS/DAY, HUMMING RATE .37 MIN/CAR)

TRAIN	E/W	NO. BYPASS CARS	NO. HUMP CARS	NO. TOTAL CARS	ARR. TIME	START INSP.	INSP. PERIOD	END INSP.	QUEUE TIME TO HUMP	START HUMP	HUMP PERIOD	END HUMP	END REC. YD. OCC.
RPCA	F	5	85	85	22235	22240	48	22320	8	22340	31	30011	30007
NOC1	W	0	162	162	22235	22240	131	30011	3	30010	100	30110	30114
APC3	W	0	98	98	22345	22350	55	30045	36	30125	36	30201	30157
RM7	W	0	79	79	30015	30020	44	30104	100	30208	29	30237	30233
PC3A	W	0	113	113	30040	30045	103	30148	52	30244	42	30326	30322
PC1	W	0	123	123	30120	30125	109	30234	125	30403	46	30449	30445
WCL01	W	0	35	35	30240	30240	0	30240	212	30456	33	30509	30505
SFA	F	0	100	100	30155	30200	56	30256	216	30516	37	30553	30549
693	W	0	46	46	30320	30350	26	30416	140	30600	17	30617	30613
ADU3	W	0	50	50	30400	30405	28	30433	147	30624	18	30642	30638
IC14	F	9	63	72	30445	30450	35	30525	120	30649	23	30712	30708
DC1	W	0	126	126	30430	30435	111	30546	134	30724	47	30811	30807
FC3	W	0	101	101	30515	30520	57	30617	157	30810	37	30855	30851
GT15	W	11	85	96	30600	30605	48	30653	205	30902	31	30933	30929
AWASH	F	0	26	26	30800	30800	0	30800	136	30940	10	30950	30946
CFR	F	0	120	120	30745	30750	107	30857	56	30957	44	31041	31037
GP15	W	0	140	140	30835	30840	118	30958	46	31040	52	31140	31136
AND1	W	0	100	100	31000	31005	56	31101	112	31217	37	31254	31250
JMS	W	0	109	109	31135	31150	101	31251	6	31301	40	31341	31337
MFA	F	0	80	80	31240	31245	45	31330	14	31348	30	31418	31414
ASHOP	W	0	37	37	31400	31400	0	31400	21	31425	14	31439	31435
ADU2	W	0	100	100	31300	31305	56	31401	41	31446	27	31523	31519
WCL02	W	0	51	51	31500	31500	0	31500	31	31535	19	31554	31550
DC7	W	0	96	96	31450	31505	54	31559	0	31603	26	31639	31635
TC1	W	0	100	100	31450	31505	56	31601	41	31646	27	31723	31719
CC1	W	0	103	103	31535	31540	58	31638	48	31730	28	31808	31804
CF14	E	0	73	73	31600	31605	41	31646	125	31815	27	31842	31838
DEMT	F	1	0	1	31800								NO CARS TO HUMP
RM44	F	0	99	99	31810	31815	55	31910	0	31914	27	31951	31947
RC3R	W	0	100	100	31905	31910	56	32006	18	32020	27	32105	32101
WAPC3	W	0	95	95	32015	32020	53	32113	0	32117	25	32152	32148
RM7	W	0	117	117	32045	32050	106	32156	0	32200	43	32243	32239
NPC1	W	0	103	103	32100	32105	58	32203	43	32250	28	32328	32324
RPCA	F	0	85	85	32235	32240	48	32328	8	32340	31	40011	40007
NOC1	W	0	162	162	32235	32240	131	40011	3	40010	100	40110	40114
APC3	W	0	98	98	32345	32350	55	40045	36	40125	36	40201	40157
		21	3260	3281			10505			10600			2005

RECEIVING YARD SUMMARY STATISTICS STRICTLY OVER THE 24 HOURS OF THE REQUESTED PRINT PERIOD --

	BYPASS	HUMP	BOTH
CARS IN	21	2915	2936
CARS OUT	21	2915	2936
TOTAL CAR HOURS	8.75	7453.83	7462.58
AVERAGE DETENTION TIME, HOURS	.42	2.56	2.54
HUMP UTILIZATION, PERCENT	NA	74.86	NA

TABLE 2
ELKHART DEPARTING TRAIN SCHEDULE
(2915 CARS/DAY)

ELKHART CAPACITY DATA 11-19-77

DEPARTURE TRAIN INPUT DATA -

DEPART. TRAIN NO.	E/W	SCHED. DEPART. TIME
SF1	W	30
CNW1	E	100
HOLD1	W	225
BN1	W	300
LS21	W	315
KDC7	W	500
XBRC7	W	500
DUML1	E	500
DTVS	W	500
EGR2	E	545
SHOP1	W	600
EF2	E	600
CNW3	E	600
CJ1	W	600
NC1	E	630
IGT4A	E	630
IHB1	W	800
IC7	W	830
BM1	W	900
CJ1A	W	1000
SF3	W	1030
ABN1	W	1100
BRC7	W	1300
DUML2	E	1300
SHOP2	W	1400
HOLD2	W	1445
GTI5	E	1600
ND4	E	1645
ACNW	E	1700
XBN1A	W	1800
NY12	E	1800
ANC1	E	1800
CR4	E	1830
CB4	E	1900
IGT4	E	1930
EM7	E	2000
PIH85	W	2000
NY10	E	2000
EC2	E	2300
EP4	E	2300
DWASH	W	2359