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SEP 79 J J CHERNY, R A SILVA , M R YOUNG
UNCLASSIFIED CGR/DC-6/79 USCG-D-70-79 NL

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LEVEL II

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MARINE TRAFFIC DATA OF THE DETROIT RIVER AND ST. CLAIR RIVER, MICHIGAN AREAS

J. J. Cherny III
M. R. Young
B. H. Charters
R. A. Silva
N. E. Bonneau

U.S. Coast Guard Research and Development Center
Avery Point, Groton, Connecticut 06340

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D. L. Birkimer

DONALD L. BIRKIMER, Ph.D., P.E.
Technical Director
U.S. Coast Guard Research and Development Center
Avery Point, Groton, Connecticut 06340

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16. Abstract

Data was collected on the marine traffic and VHF-FM marine communications channel usage at Detroit and Port Huron, Michigan, during the period of 6-24 July 1978. The marine traffic data was recorded by means of timelapse photography of a radar display. Recordings were made of the communications on VHF-FM maritime mobile Channel 16 as received at each site.

The daily average of marine traffic, including large and medium vessels, and tugs-in-tow on the Detroit River is 60, with the daily average of small vessels being 598.

The daily average of marine traffic, including large and medium vessels on the St. Clair River is 34, with the daily average of small vessels being 797.

Approximately 300 hours of communications on VHF-FM Channel 16 were recorded and monitored to determine channel efficiency (i.e., percentage of valid messages) and utilization. At Detroit, the efficiency is 55.85%, utilization 19.49%. At Port Huron, the efficiency is 59.50%, utilization 17.88%.

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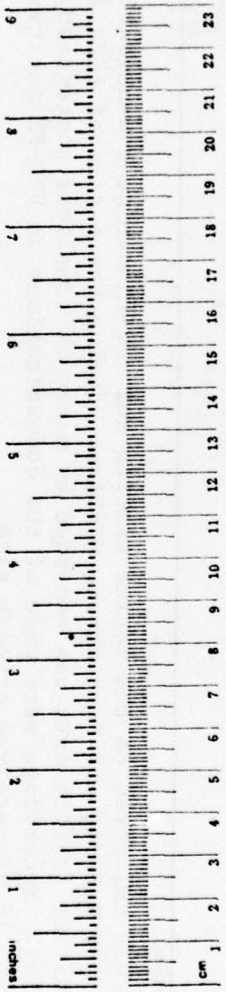
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METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

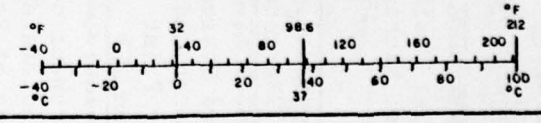


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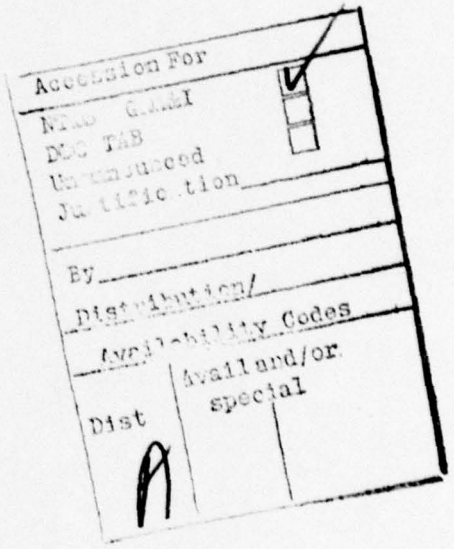
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1.0 INTRODUCTION

This report documents the data obtained on the marine traffic at Detroit and Port Huron, Michigan (Figure 1-1), by U.S. Coast Guard Research and Development Center (R&DC) personnel, using the Center's vessel traffic services data collection trailer during the period of 6 to 24 July 1978. The data consists of film recordings of a radar display and audio recordings of the activities on Channel 16 (156.80 MHz) of the maritime mobile VHF-FM band. The analysis consists of the preparation of statistical summaries of the activities recorded. The details of the procedure for recording and analyzing the data are presented in later paragraphs.

The data was obtained to establish the approximate amount of marine traffic presently transiting the Detroit River and St. Clair River areas. The data was collected as part of a larger plan to collect and analyze data from selected U.S. harbors as well as congested or complex portions of some rivers, channels, bays, and waterways. This effort is in response to the fact that, in recent years, the total volume of marine commerce has been increasing steadily, with the proportion of hazardous and/or polluting cargo rising sharply. Coupled with this growth in the volume and hazardous nature of the cargo there has been a trend toward larger tankers and other merchant vessels. Consequently, the potential damages of a collision or grounding have risen steadily with an attendant increase in the potential for loss of life and property and for ecological damage.

1.1 Site Selection

In order to obtain the best coverage of the marine traffic transiting the Detroit River and observe an area of concern of vessels meeting and overtaking, it was decided that the site that would afford the most (and most useful) data was the Dunbar and Sullivan Dredging Company property at Grosse Ile, Michigan, position 42°07'51"N, 83°08'18"W. The radar antenna, mounted on the roof of the data collection trailer, was approximately five meters above river level. From this site, all traffic transiting the Ballard Reef and Fighting Island Channels, the Upper Livingstone Channel, and the Amherstburg and Limekiln Reaches passed through the radar coverage area.

To obtain the best coverage of the marine traffic transiting the St. Clair River and observe the current's affect on the vessels while making their turns through the "S" portion of the river south of the Blue Water Bridge, it was decided that the site that would afford the most useful data was adjacent to the northeast corner of the railroad depot, at the former site of the Peerless Cement Company, Port Huron, Michigan, position 42°59'56"N, 82°25'33"W. The radar antenna, mounted on the roof of the data collection trailer, was approximately eight meters above river level.

1.2 Radar Data Collection Procedures

The R&DC data collection radar and associated equipment are mounted in a specially built trailer for ease of transportation, use, and protection from the elements.

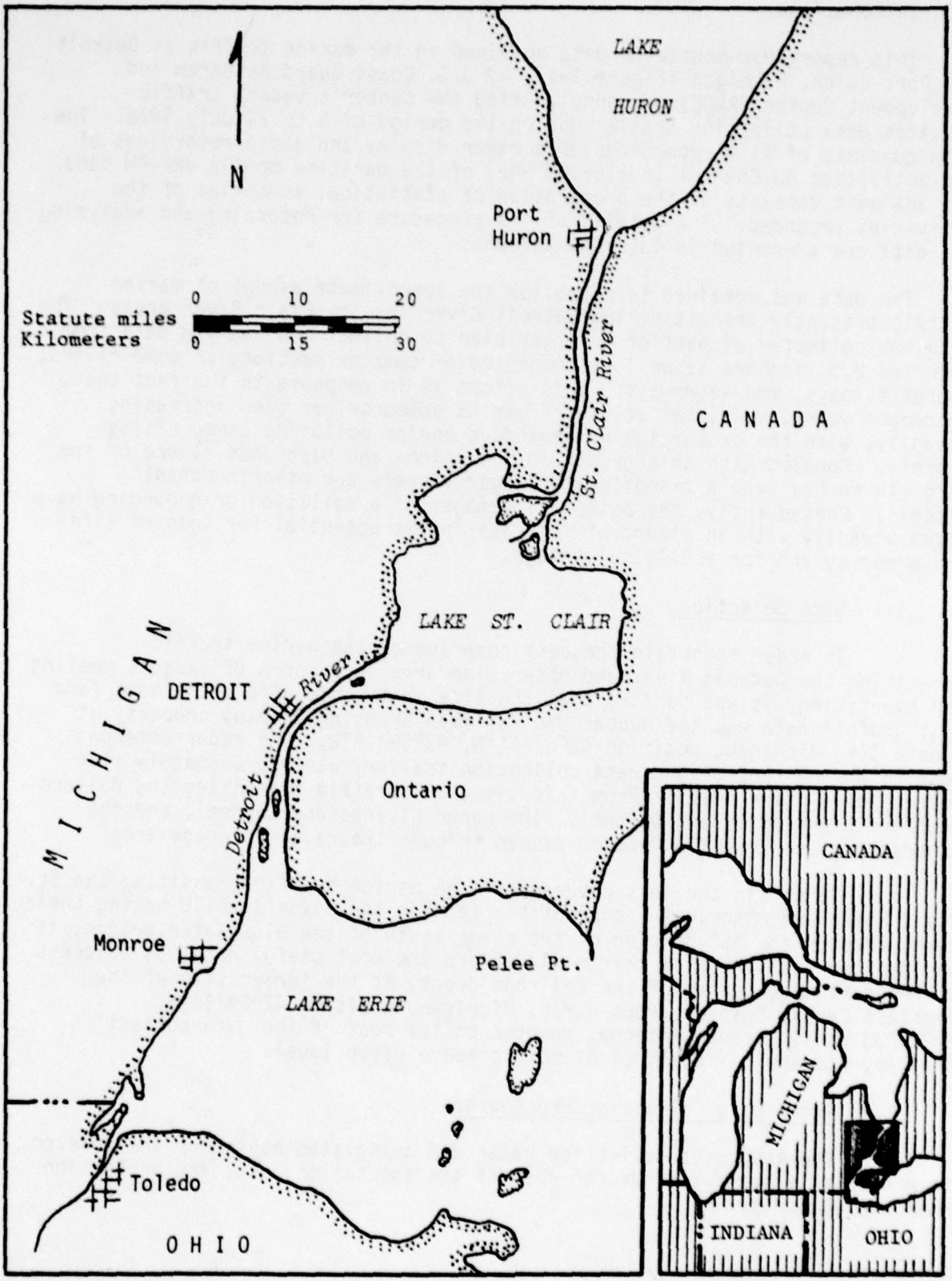


FIGURE 1-1: DETROIT RIVER AND ST. CLAIR RIVER

The radar used for data collection is a Decca Marine Model RM429 which operates in the frequency band of 9380 to 9440 MHz. The radar antenna has a horizontal beamwidth of 0.8 degrees at the -3 decibel points and the radar transmitter pulse length varies from 0.05 microseconds to 1.20 microseconds, depending on the range selected. A 16mm motion picture camera is mounted over the radar Plan Position Indicator (PPI) display and focused so that the PPI presentation fills the majority of the 16mm film area. (A hood is used to screen out ambient light.) The camera is operated in the single-frame, time-lapse mode with the shutter of the camera controlled by a solenoid. The solenoid is activated by the radar heading flasher switch so that the shutter is held open for one complete revolution of the radar antenna, then closed for the second revolution, open for the third revolution, and so on. As a result of this procedure, the film consists of "snapshots" of the entire sweep of the radar, which is more pleasing to the eye and easier to interpret than a conventional motion picture.

Mounted above and below the PPI display, and within the field of view of the camera, are small, alpha-numeric display panels. Auxiliary circuitry is used to display, on these panels, the date and time and geographic name of the radar site. As a result, each frame of the 16mm film contains the time it was exposed and the location of the radar at this time. This information simplifies the task of determining vessel speeds or the time an observed event occurred.

The radar has the capability for orienting the PPI display to any direction. The display is set up with true North at the top of the 16mm film frame when viewed so that the alpha-numeric characters are properly oriented. However, due to various limitations, the orientation of the film image with respect to true North is probably not accurate to better than ± 5 degrees.

The radar has also the capability of offsetting the antenna location from the center of the PPI display. This capability allows the PPI display to be oriented so that a particular area of interest fills a greater portion of the 16mm film frame than would otherwise be possible.

Although the radar is equipped with the usual heading flasher, fixed and variable range rings, and bearing cursor, they are usually suppressed and do not appear on the film imagery.

After the radar data collection trailer is located at a given site, tested and adjusted, data is usually recorded on a 24-hour-a-day basis for seven days, with a frame of film being exposed approximately every five seconds during this period. However, a few minutes of data are lost every five hours when the film is changed.

1.3 Communications Collection Procedure And Equipment

The data collection trailer is equipped, in addition to the radar system mentioned previously, with VHF-FM receivers tuned to Channels 13 and 16 of the maritime mobile band. Because Channel 13 is not used on the Detroit and St. Clair Rivers at the present time, Channel 13 was not monitored during this deployment. The audio output of these receivers and a time code are recorded on magnetic tape cassettes. In addition, the audio signal is sent to

an automated channel utilization recording system, to be described in a later paragraph. The purpose of these recording systems is to document the present utilization and efficiency of the monitored channel. Channel 16 is used to alert others to a distress or emergency situation, or to establish initial communications with another station (ship).

The contents of the tape cassettes are manually monitored and a statistical summary of the appropriateness of the communications is compiled. In addition, histograms of message activity versus time of day and other statistics are compiled during representative periods by means of an automated channel utilization recording system. In this system, an interface circuit accepts an audio input from the receivers and timing data from a digital clock. The output of the interface circuit causes a punch to record on paper tape the starting time (received from the digital clock) and the message length of each transmission. A block diagram of the system appears in Figure 1-2. The paper tape is then processed by a mini-computer to generate histograms of the number of transmissions versus time of day and message length. The computer program appears in Figure 1-3.

The receiver squelch settings are adjusted so that they open due to noise bursts relatively infrequently.

Personnel monitor the receivers frequently during the data-punching process to ensure the system is operating properly and that the data is reasonable.

The tape recorder amplifer gain is reset as required to provide a proper signal to the remainder of the system. The speed of the tape recorders is checked by monitoring the IRIG-format time code recorded on the Channel 16 track of the tape recorder.

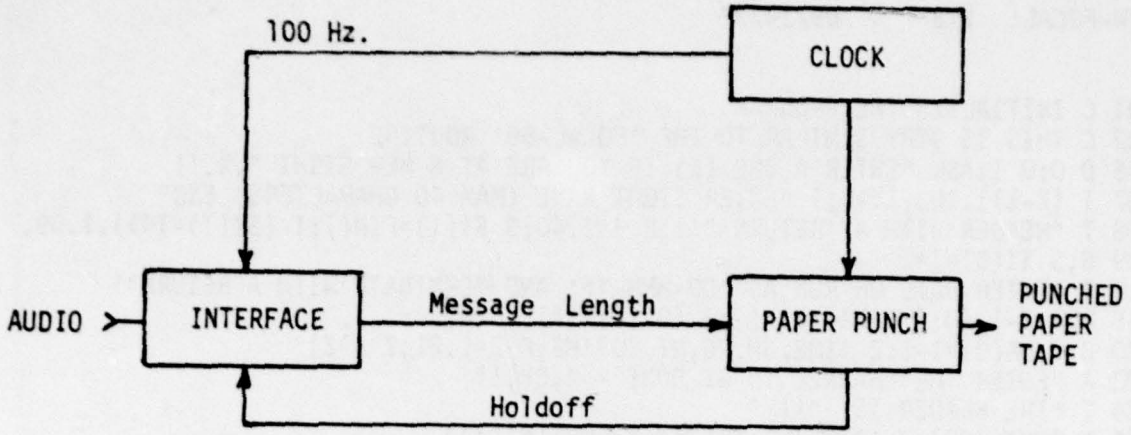


FIGURE 1-2: COMMUNICATIONS DATA COLLECTION

FIGURE 1-3: COMMUNICATIONS COMPUTER PROGRAM

```
C U/W-FOCAL:  VTS      09/14/77


01.01 C INITIALIZE THE PROGRAM
01.02 C THIS IS VERY SIMILAR TO THE 'FOCAL-69' ROUTINE
01.05 O 0;O I;ASK "ENTER A ONE (1) IF YOU ARE AT A NEW SIGHT ",X,!!
01.07 I (X-1)1.10,,1.10;T "ENTER SIGHT NAME (MAX 40 CHARACTERS) END"
01.08 T "HEADER WITH A 'RETURN'"!!;F I=1,40;S SI(I)=FIN();I (SI(I)-141),1.09,
01.09 B;S SI(0)=I=1
01.10 T "ENTER DATE OF RUN AS 'DD-MMM-YY' AND TERMINATE WITH A RETURN"!
01.15 FOR I-1,40;S DA(I)=FIN();I (DA(I)-141,1.20,
01.20 B;S DA(0)=I-1;Z TIME,SH,PG,NT,TOTIME;F Z=1,21;Z A(Z)
01.22 A "ENTER THE CHANNEL TO BE DONE = ",CH,!!
01.24 T "THE HEADER IS: "!!
01.25 X FOUT(140);T !!;F I=1;SI(0); X FOUT(SI(I))
01.26 T :35"VHF-FM CH",%2.00,CH
01.27 T :55;F I=1,DA(0);X FOUT(DA(I))
01.28 Y PG;T :70"PAGE"%1.00,PG,!!
01.30 A "ENTER A ZERO OR A RETURN IF ALL IS 'OK' ",X,!;I (X),1.35,;G
01.35 S TM=15;;Z PG
01.40 T "LOAD THE FIRST TAPE INTO THE READER.  TYPE ANY CHARACTER WHEN
READY"!
01.45 O 0 LPT:;0 I HSR
01.50 D 1.25,1.26,1.27,1.28;T !"TRANSMISSION TIME HISTOGRAM",!!
01.60 T "PERIOD ENDING:   NUMBER OF XMSNS:     MINUTES:
01.61 T "  PERCENT:",!!


02.10 A X;I (FTRM()-154),2.15,;I (3999-X)4.05,4.05,3.05
02.15 O 0;O I;A "MORE DATA TO ENTER (1=YES) ",X,
02.20 I (X-1)2.25,,2.25;T !LOAD THE TAPE INTO THE READER"!;D 2.30;G 2.10
02.25 O R 0;S X=6401;G 4.05
02.30 O R 0;0 I HSR:

03.04 C HANDLE DATA
03.05 I (X-1000)3.06;S X-X-1000
03.06 I X-1),,3.10;Y SHORTONES;G 2.10
03.10 S TIME=TIME+(X/10),TOTIME=TOTIME+(X/10),X=FMIN((FITR(X*.199)+1,21)
03.20 Y A(X),NT,NR;G 2.10


04.04 C HANDLE TIME INFORMATION
04.05 I (X-4000-TM)2.10
04.15 T  "  ",%6.00,TM,"      ",NT,"        ",%4.02,TIME/60
04.20 T  "       ",%6.02,TIME/9,!
04.25 I ((TM/100)-FITR(TM/100)-.40)4.30; S TM=TM+40
04.30 S TM=TM+15;Z TI,NT;I (TM-1215),4.45,;I
(TM-2400)4.05,,;I(X-6400)4.05,,;G
       5.05
04.45 D 1.50,1.60,1.61;I (TM-2400)4.05,,;I(X-6400)4.05,,

05.04 C DATA SUMMARY
05.05 D 1.25,1.26,1.27,1.28
05.10 T !!,"TOTAL NUMBER OF TRANSMISSIONS"     ",%5.00,NR,!
05.15 T "AVE. NUM. OF TRANSMISSIONS PER HOUR: ",%4.01,NR/24,!
05.20 T "TOTAL TRANSMISSION TIME:
```

```
05.21 T %5.03,TOTIME/3600," HOURS",!
05.25 T "AVERAGE LENGTH OF TRANSMISSION:      ",%5.02,TO/NR," SEC.",!
05.30 T "PERCENT CHANNEL UTILIZATION:         ",TO/864,"%",!!!!
05.35 T "MESSAGE LENGTH HISTOGRAM",!!
05.40 T "LENGTH OF XMSNS      NUMBER OF XMSNS       PERCENT",!
05.45 #=.4,F Z=1,1,20;D 6
05.50 T "LONGER THAN 10 SEC.:       ",%4.00,A(21),"          "
05.55 T %6.02,(A(21)/NR)*100,!!!!!!!!!!!!!!!
05.58 T "THREE WERE",%5.00,SH,"XMSNS of 00.1 AND 0.00"!
05.60 O C;O 0;O I;G

06.10 S TD=Z*.5; S PN=(A(Z)/NR)*100
06.15 T %3.01,TD-#,"-",TD," SEC.      ",%6.00,A(Z),"        "
06.16 T %6.02,PN,!;S #=.5
```

DEFINITION OF VARIABLES FOR "VTS"

A(Z)	Length of transmission count for Message Length Histogram.
DA(I)	Date of run, in special characters (DA(0) = number of characters in array)
CH	Channel being analyzed. Normally either 13 or 16
I	Loop counter used throughout program
NR	Total number of transmissions longer than 1 second
NT	Total number of transmissions in the 15 minute interval being analyzed. (Not including any of 00.1 duration)
PG	Page number
PN	Temporary variable used to establish percent of transmissions with specific message length.
SI(I)	Sight Identification in special characters (SI(0) = number of characters in array)
SHORTONES	Transmissions having a coded duration of either 00.0 or 00.1. These DO NOT appear in 'NR'
TD	Temporary variable used to establish length of transmissions for Message Length Histograms
TIME	Total time of transmissions found in 15 minute interval being analyzed (Not including any of 00.1 duration)
TM	Upper limit of 15 minute interval being analyzed
TOTIME	Total time of all transmissions (Not including any of 00.1 duration)
X	Number read from data tape, dummy variable in "HANDLE DATA", and dummy variable throughout "INITIALIZE"

2.0 DISCUSSION OF DATA

The information contained in this chapter was collected at the Detroit River (Grosse Ile, Michigan) during the period of 6-13 July 1978 and at the St. Clair River (Port Huron, Michigan) during the period of 17-24 July 1978. The radar was operated on the 3.0 nautical mile scale at Grosse Ile and the 0.75 nautical mile scale at Port Huron during the data collection periods. Figure 2-1 indicates the areas of radar coverage.

2.1 Vessel Activity

In general, the following information can be extracted from the time-lapse radar film:

1. Vessel density
2. Vessel speed
3. Destination
4. Anchorage locations
5. Closest point of approach (CPA) to other vessels
6. Number and time of occurrence of meeting situations
7. Number and time of occurrence of crossing situations
8. Number and time of occurrence of overtaking situations

Except for the St. Clair River at Port Huron, vessel density is defined as the count of all vessels present within the radar coverage area, taken at 30-minute intervals. The interval between counts was chosen to be equal to or less than the average vessel transit time through the radar coverage area. The vessels counted were classified by type and size, such as large (larger than 100 meters), medium, small (less than 30 meters), tug-in-tow, etc., determination of size being evaluated from the size relationship of the radar image. The "small" category includes fishing vessels, pleasure craft, and tugs that were not recognized as such. The data is presented as a histogram with time of day as the abscissa.

The vessel density on the St. Clair River at Port Huron has been defined as the number of vessels that passed through the radar coverage area in a 30-minute time period. This procedure was used instead of the one given above because of the many variations of time in which a vessel remained in the radar coverage area. Use of this procedure reduces the possibility of a vessel not being counted.

The vessel density within the radar coverage area on the Detroit River is presented in Figures 2-2 through 2-9. The vessel density on the St. Clair River, indicating the count of all vessels that passed through the radar coverage area in a 30-minute time period, is presented in Figures 2-28 through 2-35.

The maximum number of simultaneous movements observed on the Detroit River was 66, occurring at 1830 on Sunday, 9 July 1978. This number represents the presence of 1 large, 1 medium, and 64 small vessels. At Port Huron, the maximum number of vessel transits observed on the St. Clair River in a 30-minute period was 104, occurring between 1930 and 2000 on Thursday, 20 July 1978. This number represents the transits of 2 large and 102 small vessels.

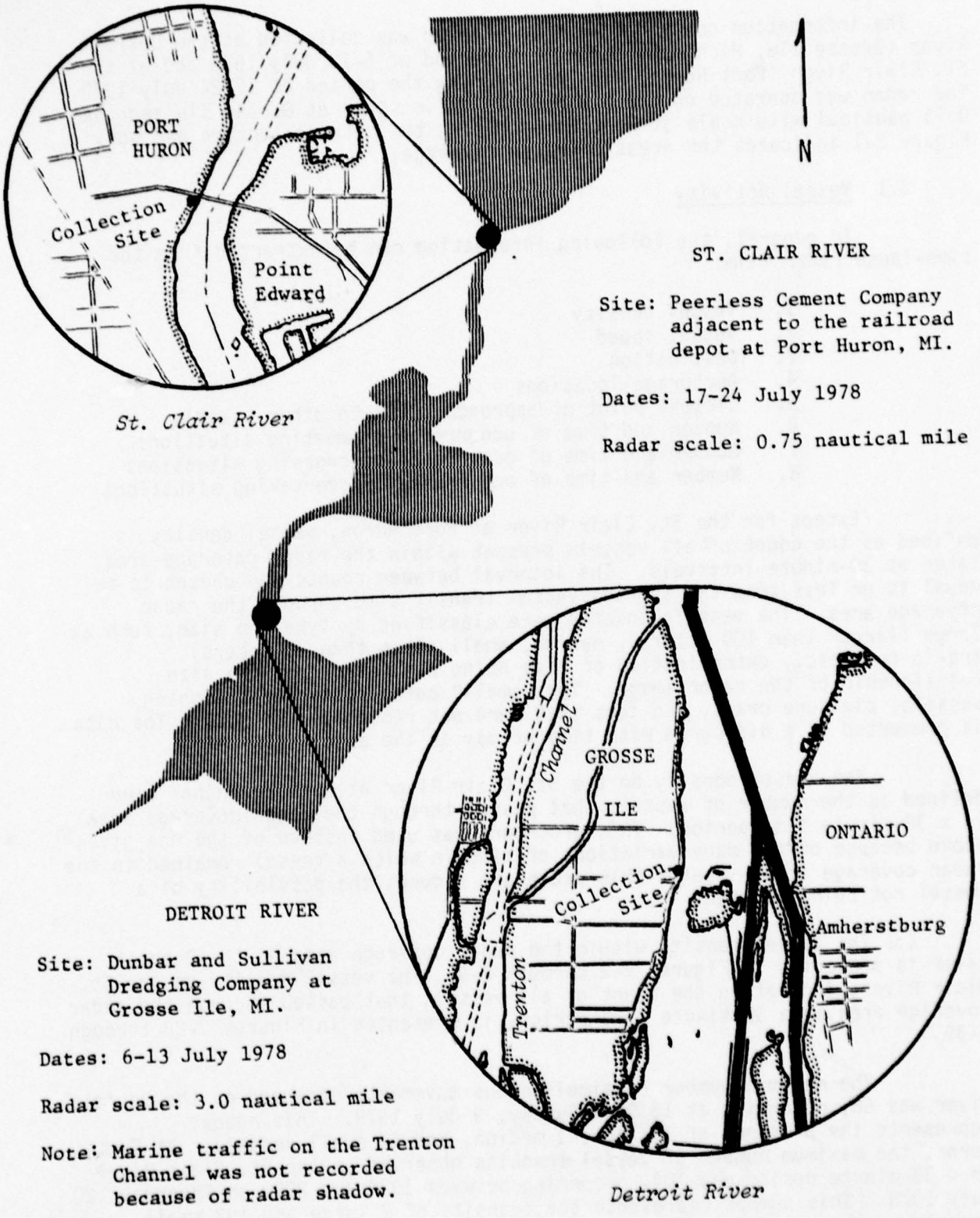


FIGURE 2-1: AREAS OF RADAR COVERAGE

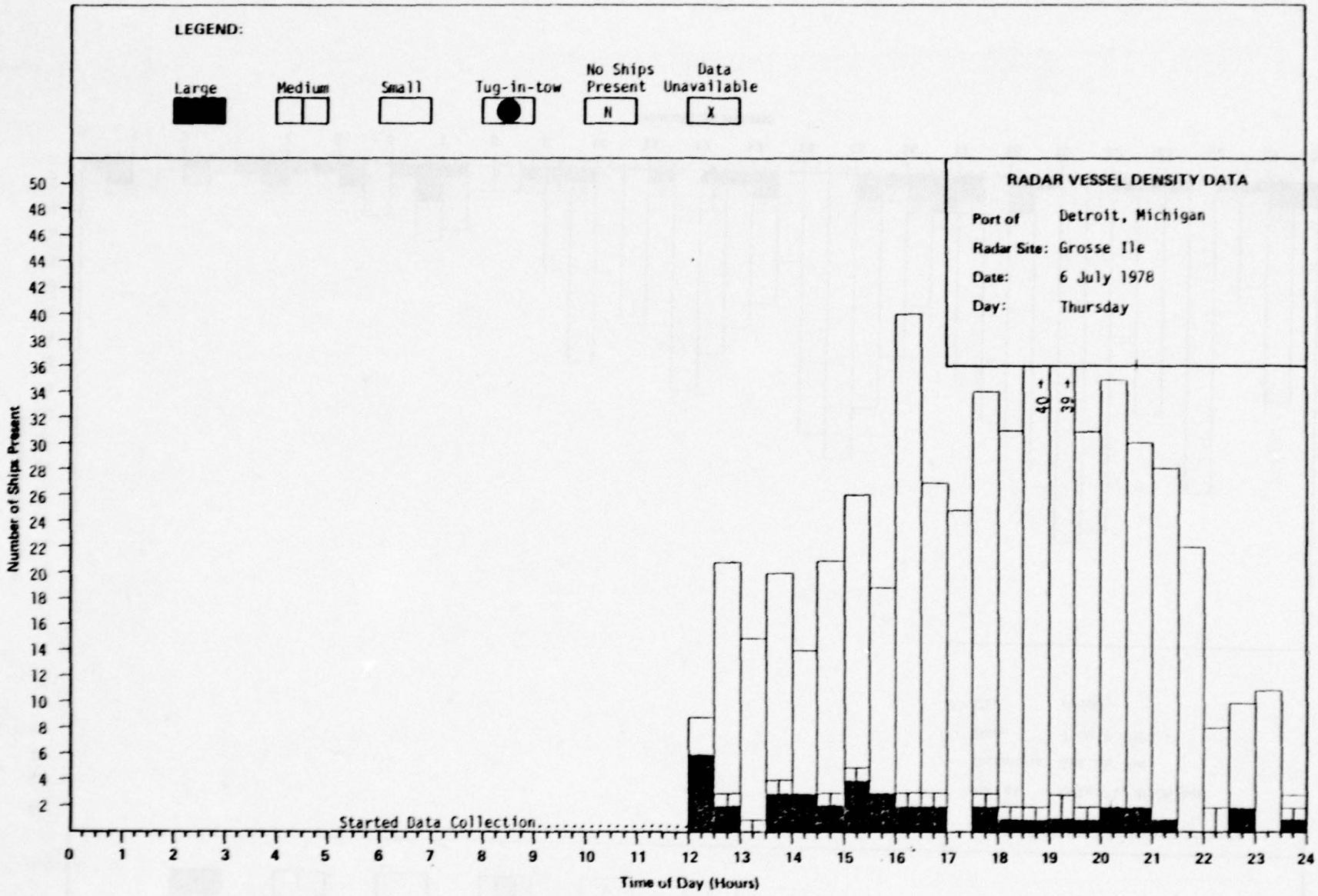

LEGEND:
Large
Medium
Small
Tug-in-tow
No Ships Present
N
Data Unavailable
X
RADAR VESSEL DENSITY DATA
Port of Detroit, Michigan
Radar Site: Grosse Ile
Date: 6 July 1978
Day: Thursday
Number of Ships Present
Time of Day (Hours)
Started Data Collection
40
39

Figure 2-2

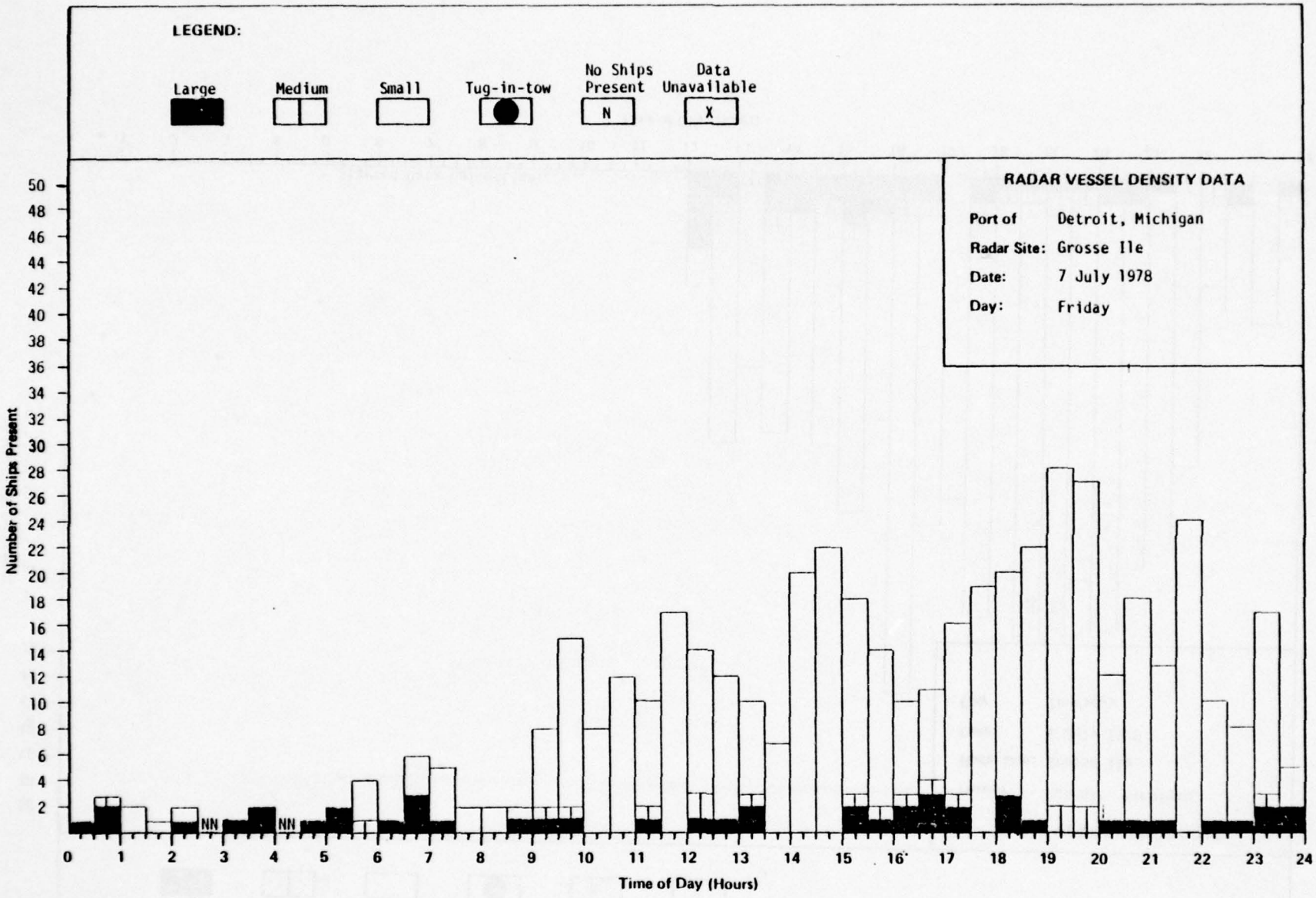

LEGEND:
Large
Medium
Small
Tug-in-tow
No Ships Present
N
Data Unavailable
X
RADAR VESSEL DENSITY DATA
Port of Detroit, Michigan
Radar Site: Grosse Ile
Date: 7 July 1978
Day: Friday
Number of Ships Present
Time of Day (Hours)
NN
NN

Figure 2-3

Figure 2-4

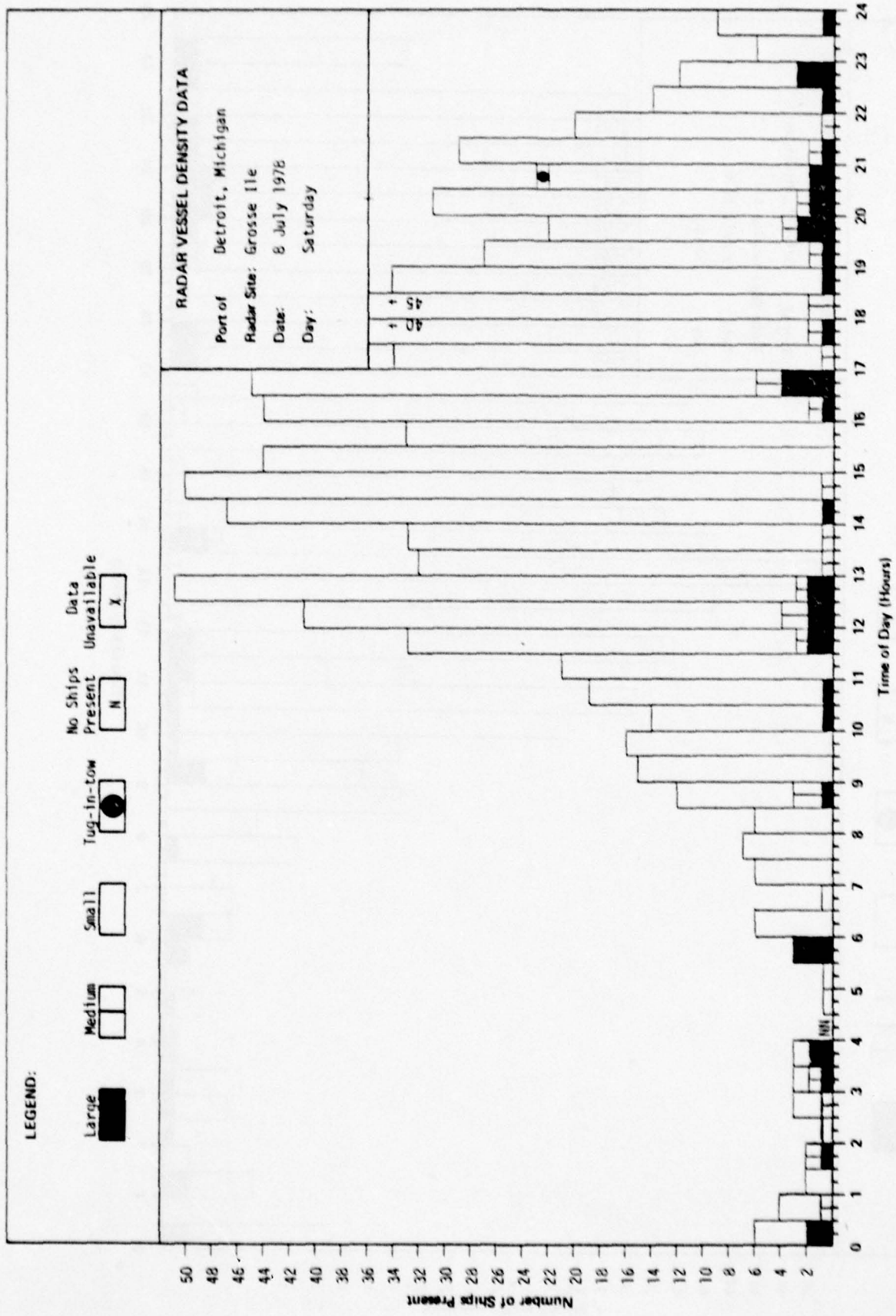
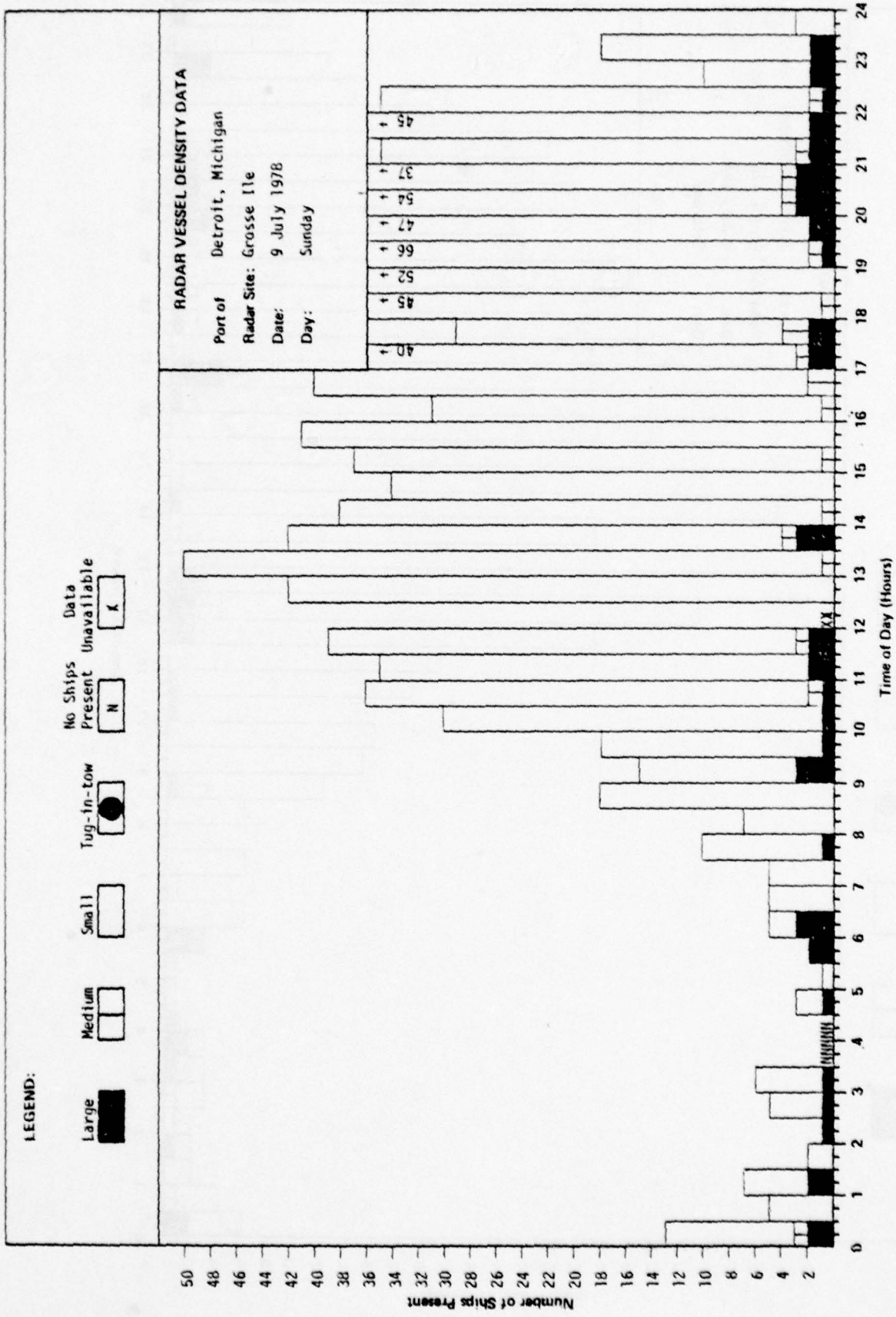

LEGEND:
Large
Medium
Small
Tug-In-tow
No Ships Present
N
Data Unavailable
X
RADAR VESSEL DENSITY DATA
Port of Detroit, Michigan
Radar Site: Grosse Ile
Date: 8 July 1978
Day: Saturday
40 +
45 +
Number of Ships Present
Time of Day (Hours)

Figure 2-5


LEGEND:
Large
Medium
Small
Tug-in-tow
No Ships Present
N
Data Unavailable
X
RADAR VESSEL DENSITY DATA
Port of Detroit, Michigan
Radar Site: Grosse Ile
Date: 9 July 1978
Day: Sunday
40
85
52
66
47
54
37
45
Number of Ships Present
Time of Day (Hours)

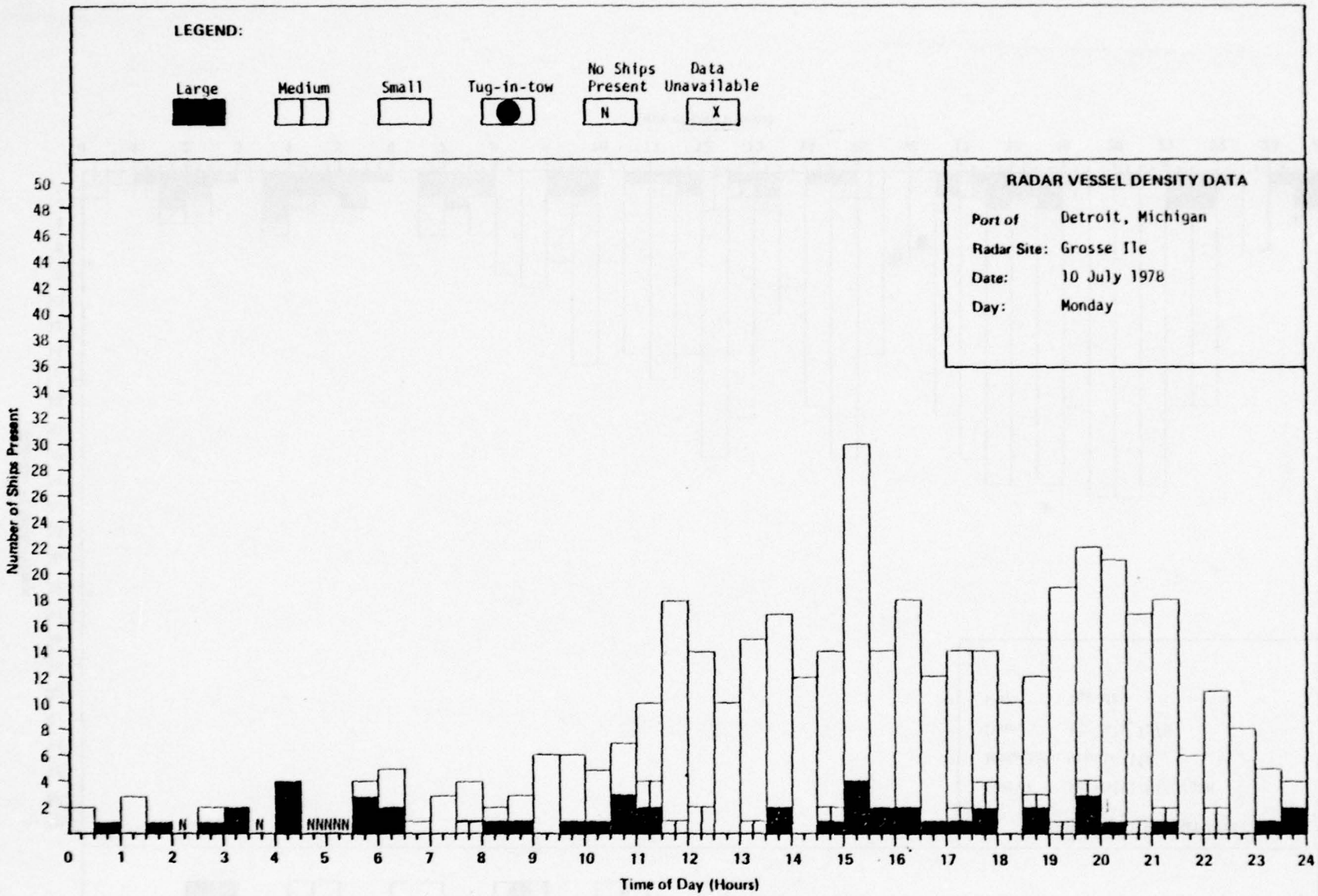

LEGEND:
Large
Medium
Small
Tug-in-tow
No Ships Present
N
Data Unavailable
X
RADAR VESSEL DENSITY DATA
Port of Detroit, Michigan
Radar Site: Grosse Ile
Date: 10 July 1978
Day: Monday
Number of Ships Present
Time of Day (Hours)
NNNNN

Figure 2-6

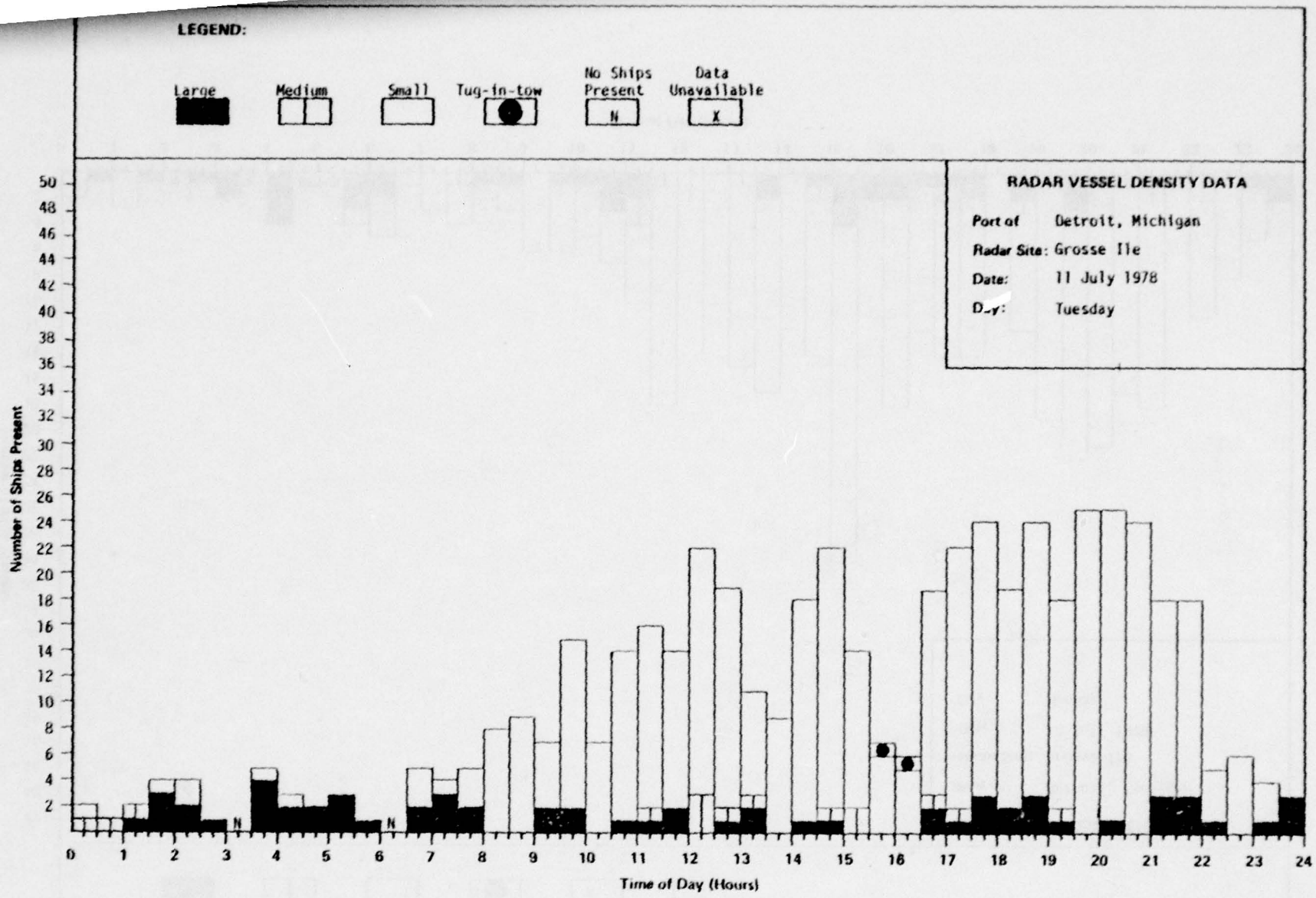
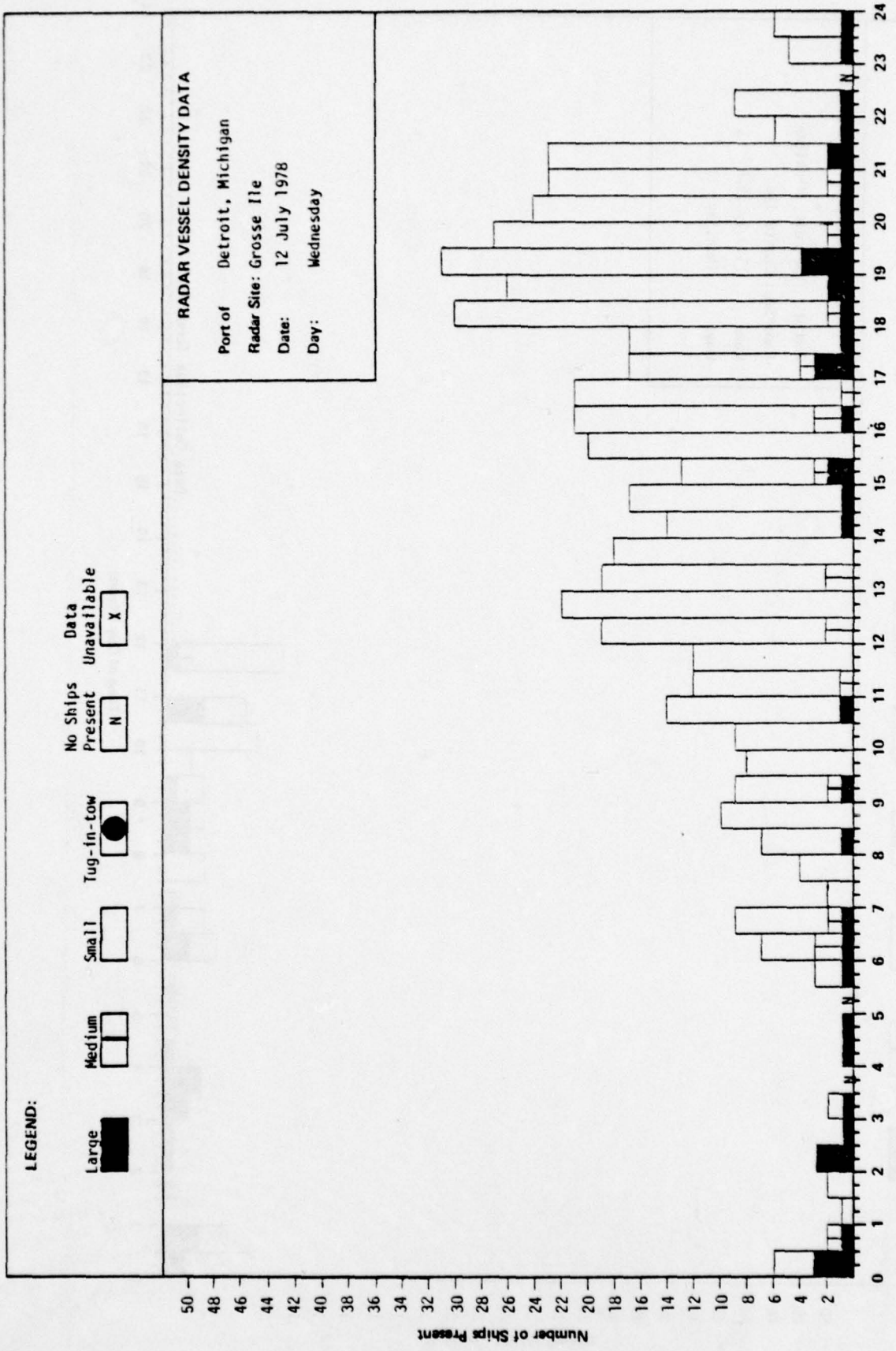

LEGEND:
Large
Medium
Small
Tug-in-tow
No Ships Present
N
Data Unavailable
X
RADAR VESSEL DENSITY DATA
Port of Detroit, Michigan
Radar Site: Grosse Ile
Date: 11 July 1978
Day: Tuesday
Number of Ships Present
Time of Day (Hours)

Figure 2-7

Figure 2-8


LEGEND:
Large
Medium
Small
Tug-in-tow
No Ships Present
N
Data Unavailable
X
RADAR VESSEL DENSITY DATA
Port of Detroit, Michigan
Radar Site: Grosse Ile
Date: 12 July 1978
Day: Wednesday
Number of Ships Present
Time of Day (Hours)

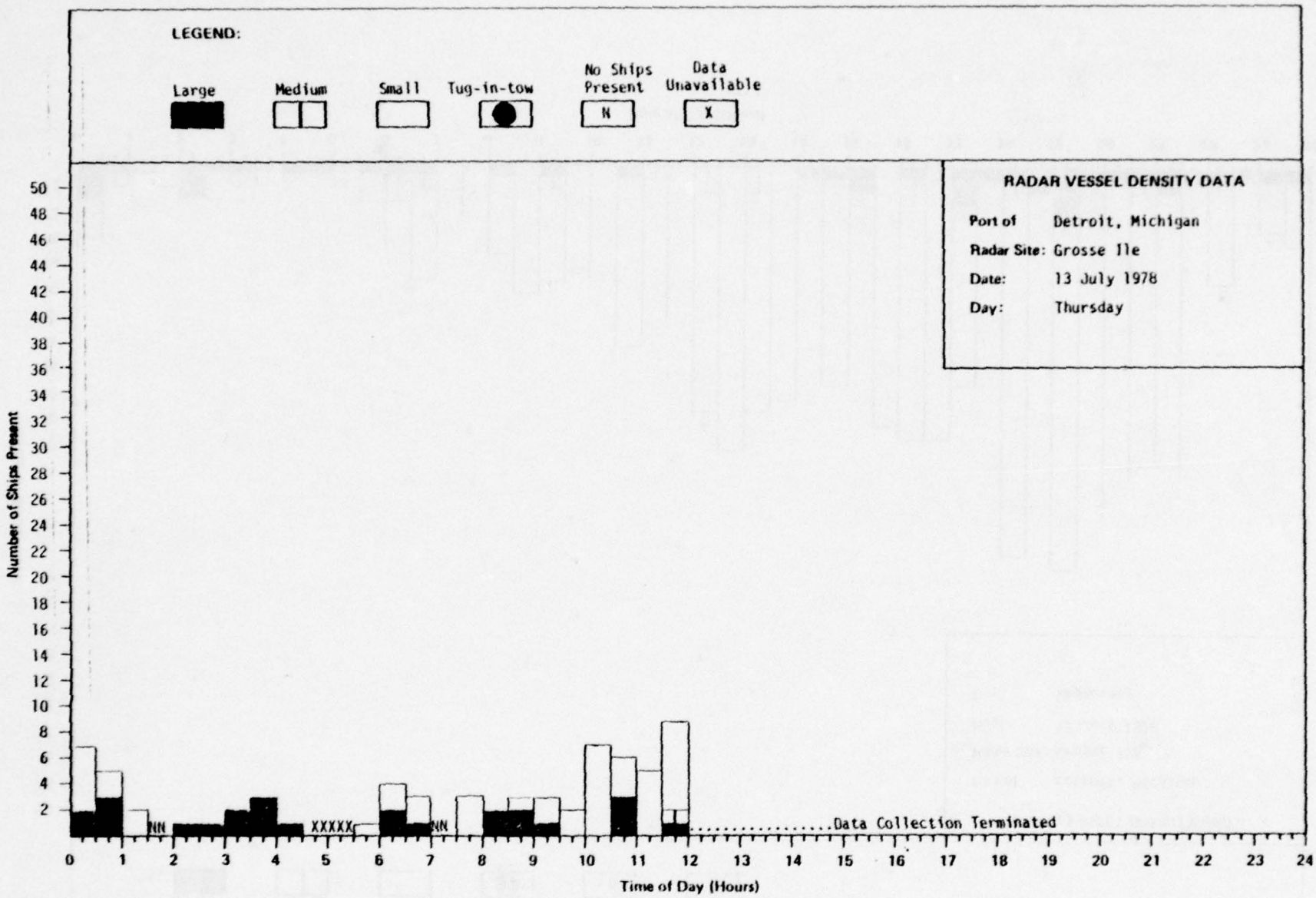

LEGEND:
Large
Medium
Small
Tug-in-tow
No Ships Present
N
Data Unavailable
X
RADAR VESSEL DENSITY DATA
Port of Detroit, Michigan
Radar Site: Grosse Ile
Date: 13 July 1978
Day: Thursday
Number of Ships Present
Time of Day (Hours)
NN
XXXXX
NN
Data Collection Terminated

Figure 2-9

The average of daily vessel transits regarding classification and direction is as follows:

Vessel Size	Detroit River Northbound	Detroit River Southbound	St. Clair River Northbound	St. Clair River Southbound
Large	23	20	22	12
Medium	7	8	0	0
Tug-in-tow	1	1	0	0

The average of daily transits of small vessels traveling in a northbound and southbound direction on the Detroit River is 598, with a maximum of 1,071 vessel transits occurring on Sunday, 9 July 1978. The daily average of northbound and southbound small vessel transits on the St. Clair River is 797, with a maximum of 1,581 vessel transits being observed on Saturday, 22 July 1978, and 1,244 small vessel transits occurring on Thursday, 20 July 1978.

The following overtaking, meeting, and close encounter situations between large and medium vessels were observed on the Detroit River and St. Clair River during the data collection period at those sites:

	Overtaking	Meeting	Close Encounter
Detroit River	2	68	70
St. Clair River	0	2	2

An encounter between two medium or large vessels is deemed a "close encounter" if the distance between the vessels at their closest point of approach is less than 100 meters. Because of the width of the navigable channel, every overtaking and meeting situation was deemed a close encounter.

The meeting situations observed at Port Huron, Michigan, occurred in the vicinity of Lighted Buoys #1 and #2, located just north of the mouth to the St. Clair River, in the lower part of Lake Huron.

2.2 Vessel Speeds

The vessel speed data is based on the speed of virtually all of the vessels imaged by the radar. Vessel speeds are determined by noting the distance in hundreds of yards that the vessel travels in three minutes, then applying the three-minute rule for speed, which states that the hundreds of yards a vessel travels in three minutes is its speed. Example, if a vessel travels 2,350 yards in three minutes, its speed is 23.5 knots.

The vessel speed data for the Detroit River is presented in Figures 2-10 through 2-17. A summary follows:

6 Jul - Thursday	3.0 - 36.0 knots	(12.7 knots average)
7 Jul - Friday	5.0 - 32.0 knots	(13.5 knots average)
8 Jul - Saturday	5.0 - 26.0 knots	(10.9 knots average)
9 Jul - Sunday	5.0 - 23.0 knots	(12.0 knots average)
10 Jul - Monday	3.0 - 27.0 knots	(13.7 knots average)
11 Jul - Tuesday	5.0 - 27.0 knots	(12.3 knots average)
12 Jul - Wednesday	2.0 - 30.0 knots	(13.0 knots average)
13 Jul - Thursday	4.0 - 23.0 knots	(12.1 knots average)

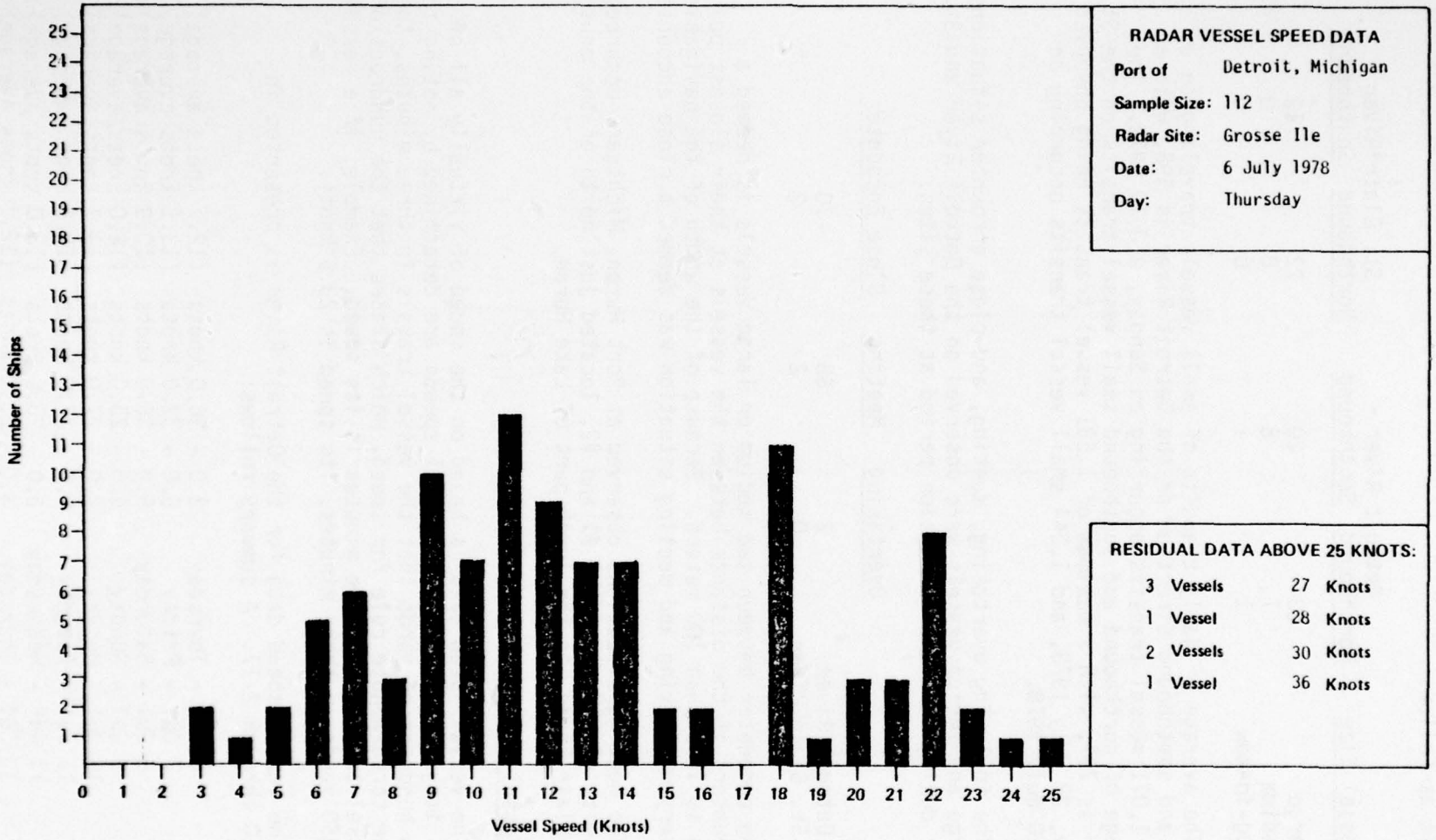

RADAR VESSEL SPEED DATA
Port of Detroit, Michigan
Sample Size: 112
Radar Site: Grosse Ile
Date: 6 July 1978
Day: Thursday
RESIDUAL DATA ABOVE 25 KNOTS:
3 Vessels 27 Knots
1 Vessel 28 Knots
2 Vessels 30 Knots
1 Vessel 36 Knots
Number of Ships
Vessel Speed (Knots)

Figure 2-10

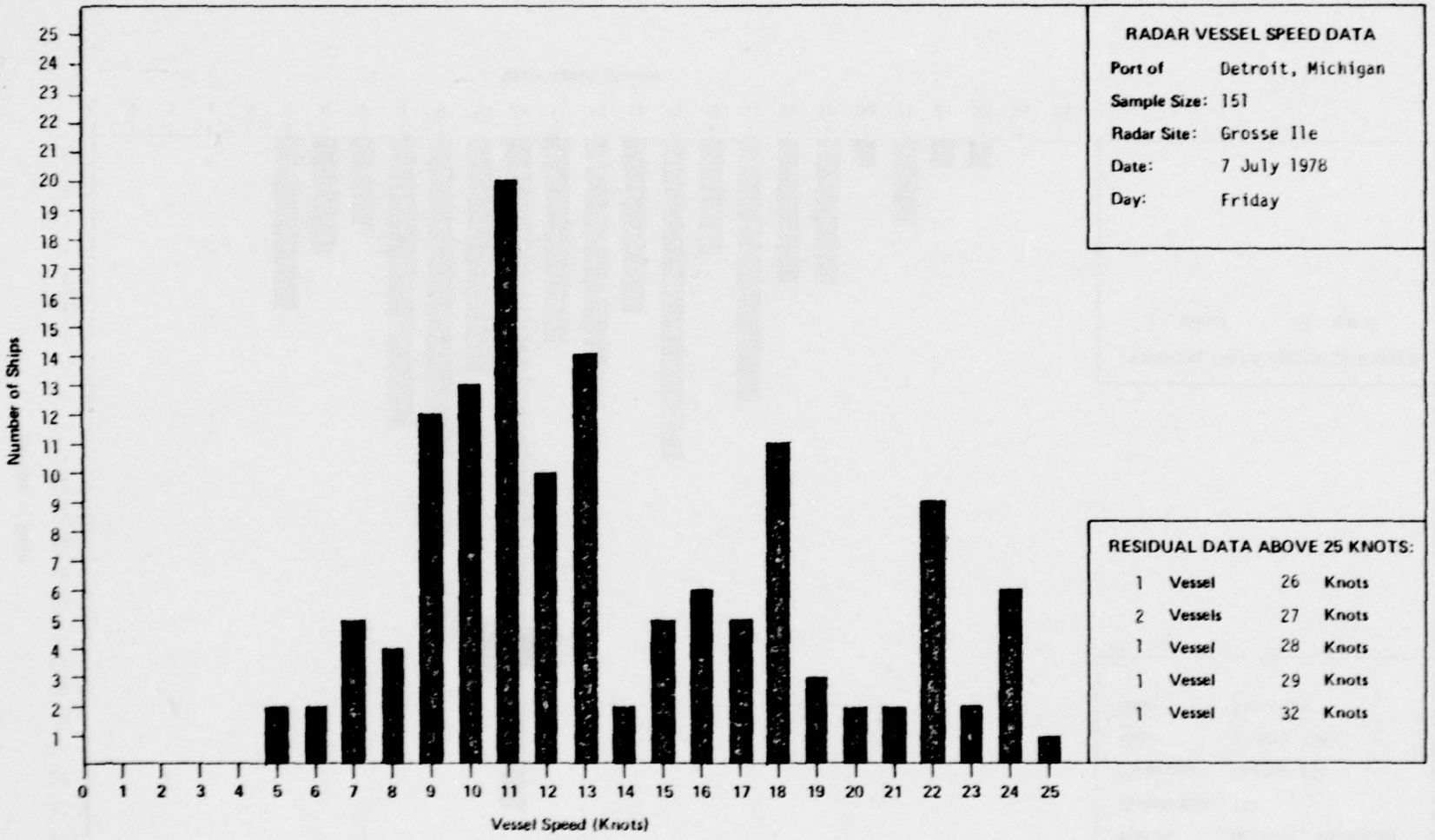

RADAR VESSEL SPEED DATA
Port of Detroit, Michigan
Sample Size: 151
Radar Site: Grosse Ile
Date: 7 July 1978
Day: Friday
RESIDUAL DATA ABOVE 25 KNOTS:
1 Vessel 26 Knots
2 Vessels 27 Knots
1 Vessel 28 Knots
1 Vessel 29 Knots
1 Vessel 32 Knots
Number of Ships
Vessel Speed (Knots)

Figure 2-11

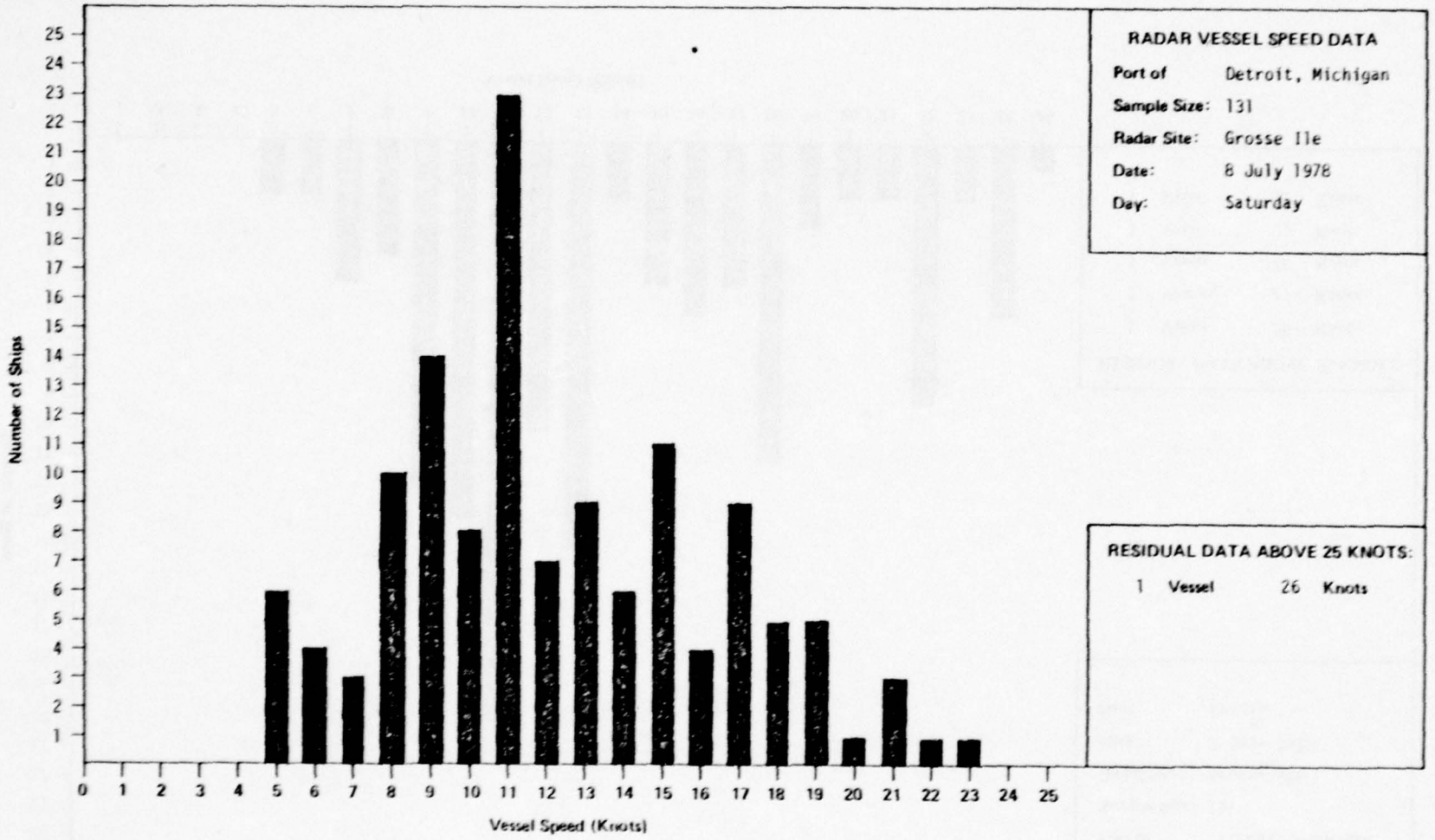
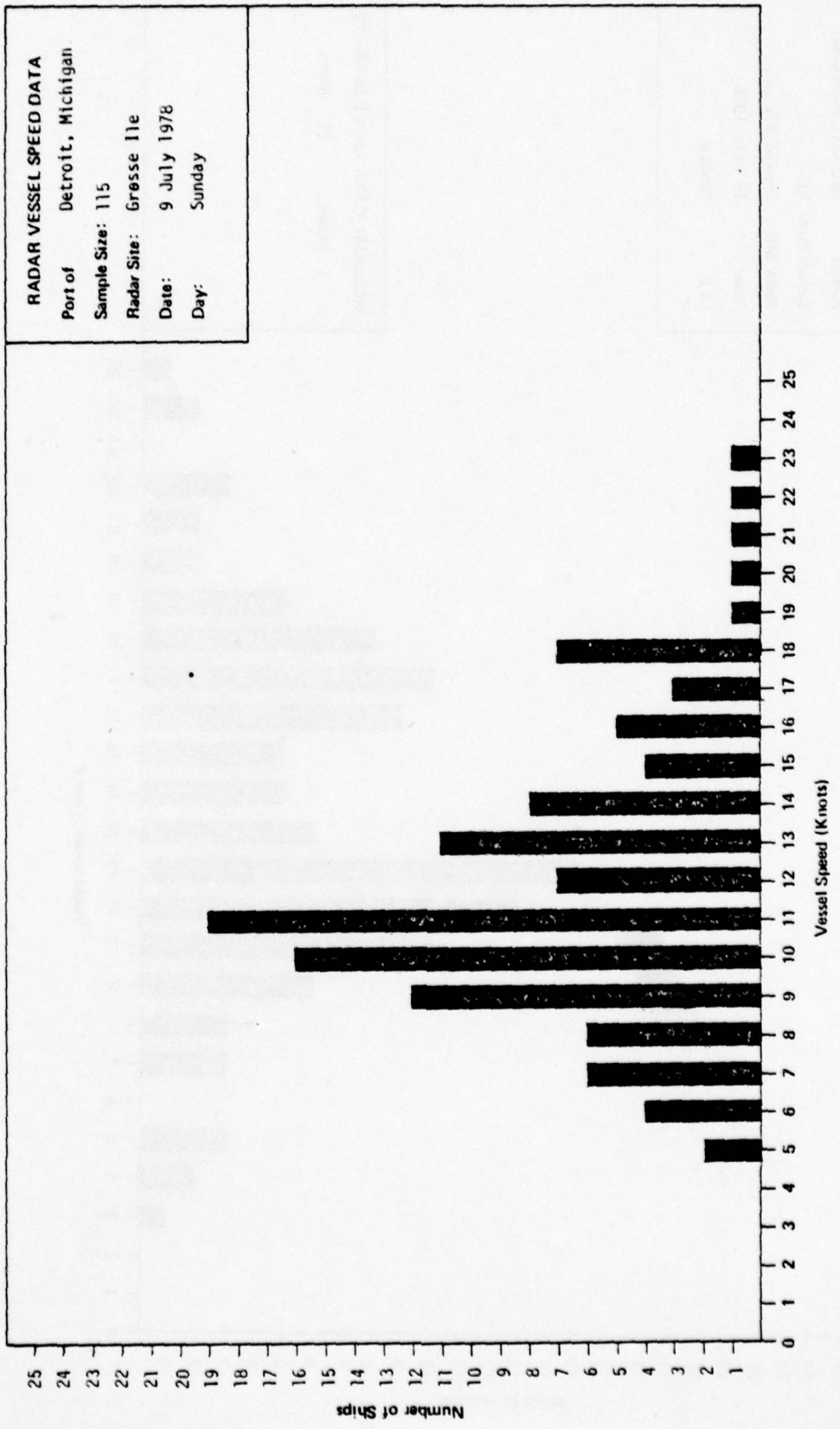

RADAR VESSEL SPEED DATA
Port of Detroit, Michigan
Sample Size: 131
Radar Site: Grosse Ile
Date: 8 July 1978
Day: Saturday
RESIDUAL DATA ABOVE 25 KNOTS:
1 Vessel 26 Knots
Number of Ships
Vessel Speed (Knots)

Figure 2-12

Figure 2-13


RADAR VESSEL SPEED DATA
Port of Detroit, Michigan
Sample Size: 115
Radar Site: Grosse Ile
Date: 9 July 1978
Day: Sunday
Number of Ships
Vessel Speed (Knots)

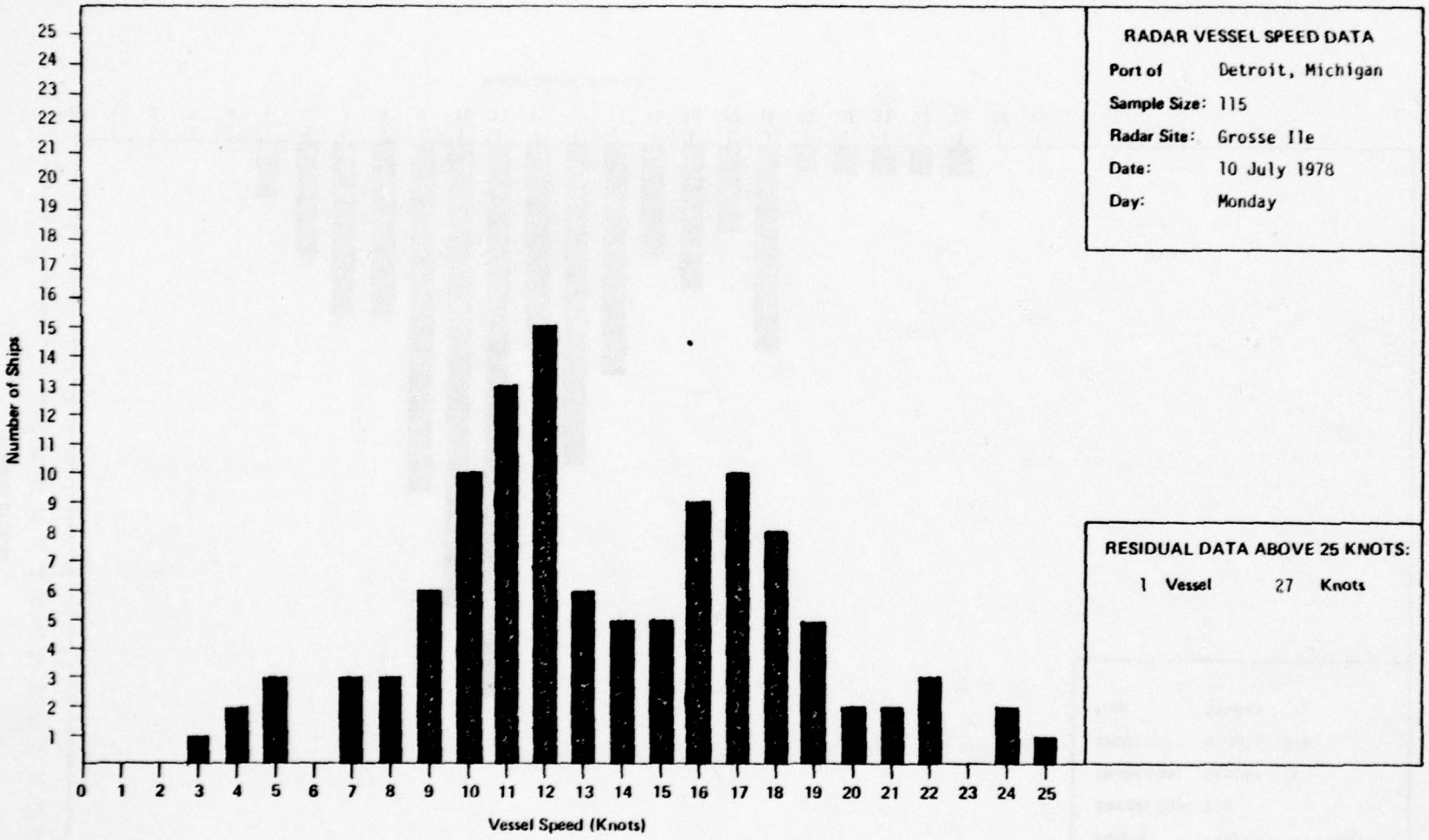
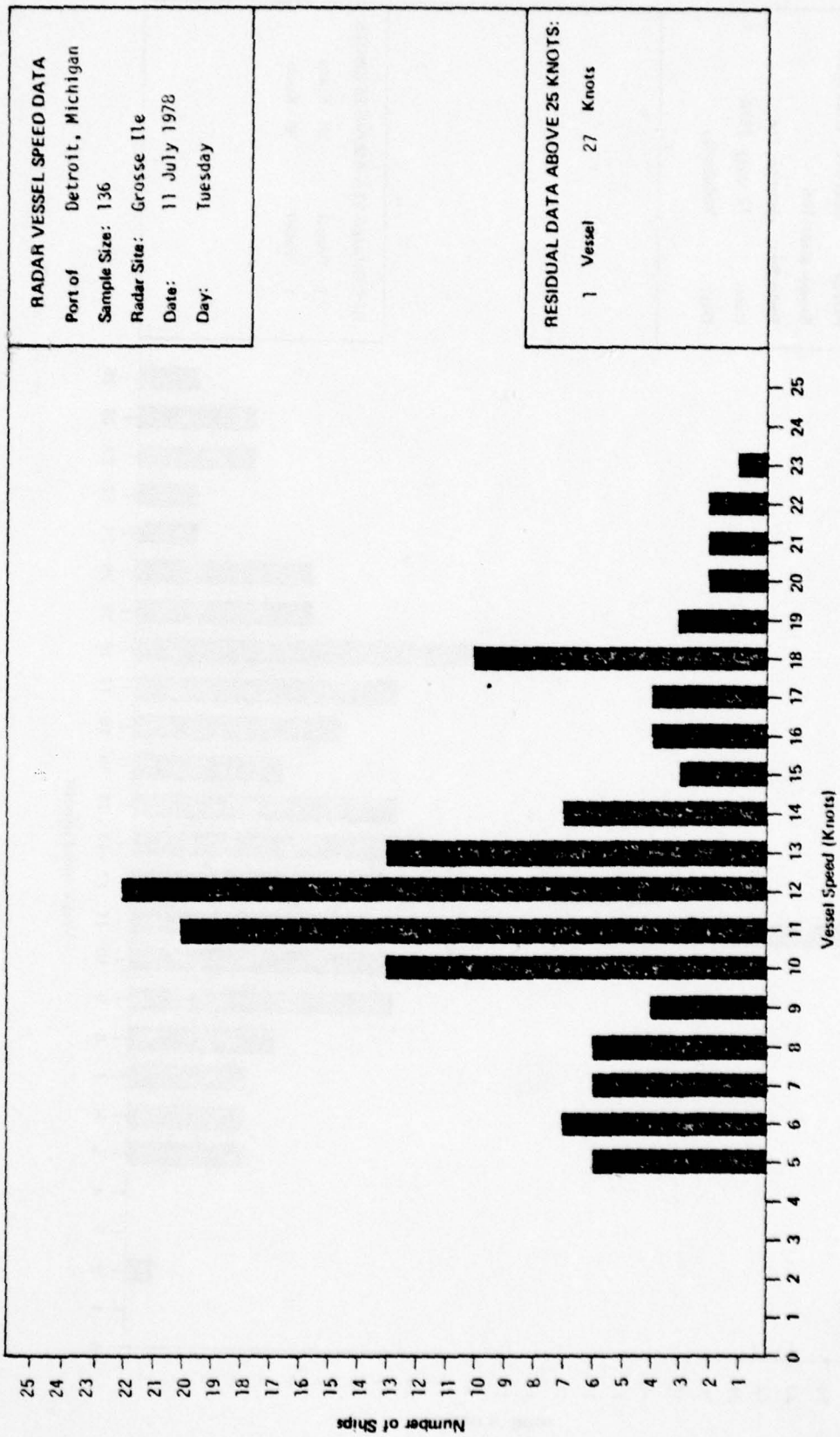

RADAR VESSEL SPEED DATA
Port of Detroit, Michigan
Sample Size: 115
Radar Site: Grosse Ile
Date: 10 July 1978
Day: Monday
RESIDUAL DATA ABOVE 25 KNOTS:
1 Vessel 27 Knots
Number of Ships
Vessel Speed (Knots)

Figure 2-14

Figure 2-15


RADAR VESSEL SPEED DATA
Port of Detroit, Michigan
Sample Size: 136
Radar Site: Grosse Ile
Date: 11 July 1978
Day: Tuesday
RESIDUAL DATA ABOVE 25 KNOTS:
1 Vessel 27 Knots
Number of Ships
Vessel Speed (Knots)

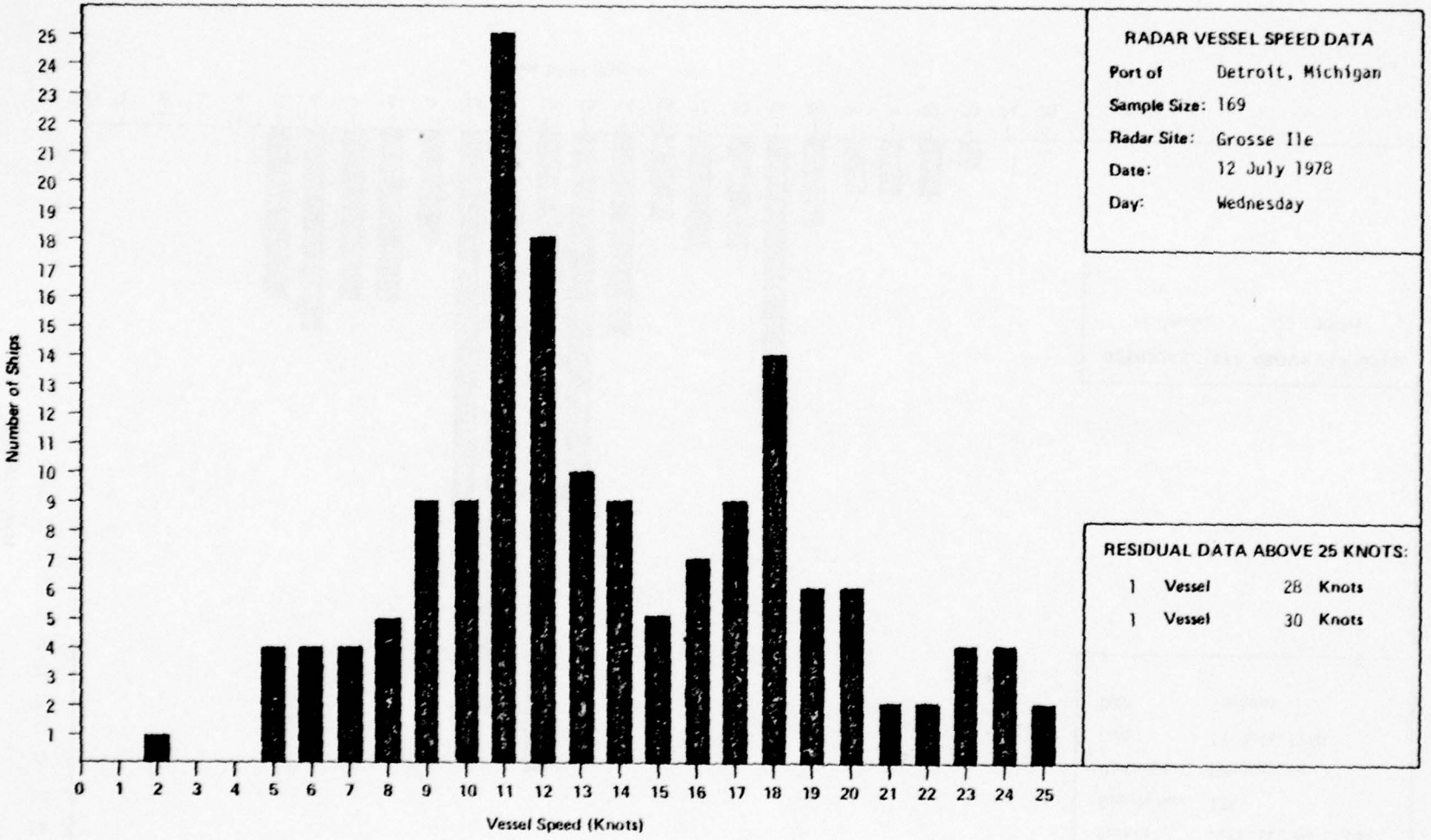
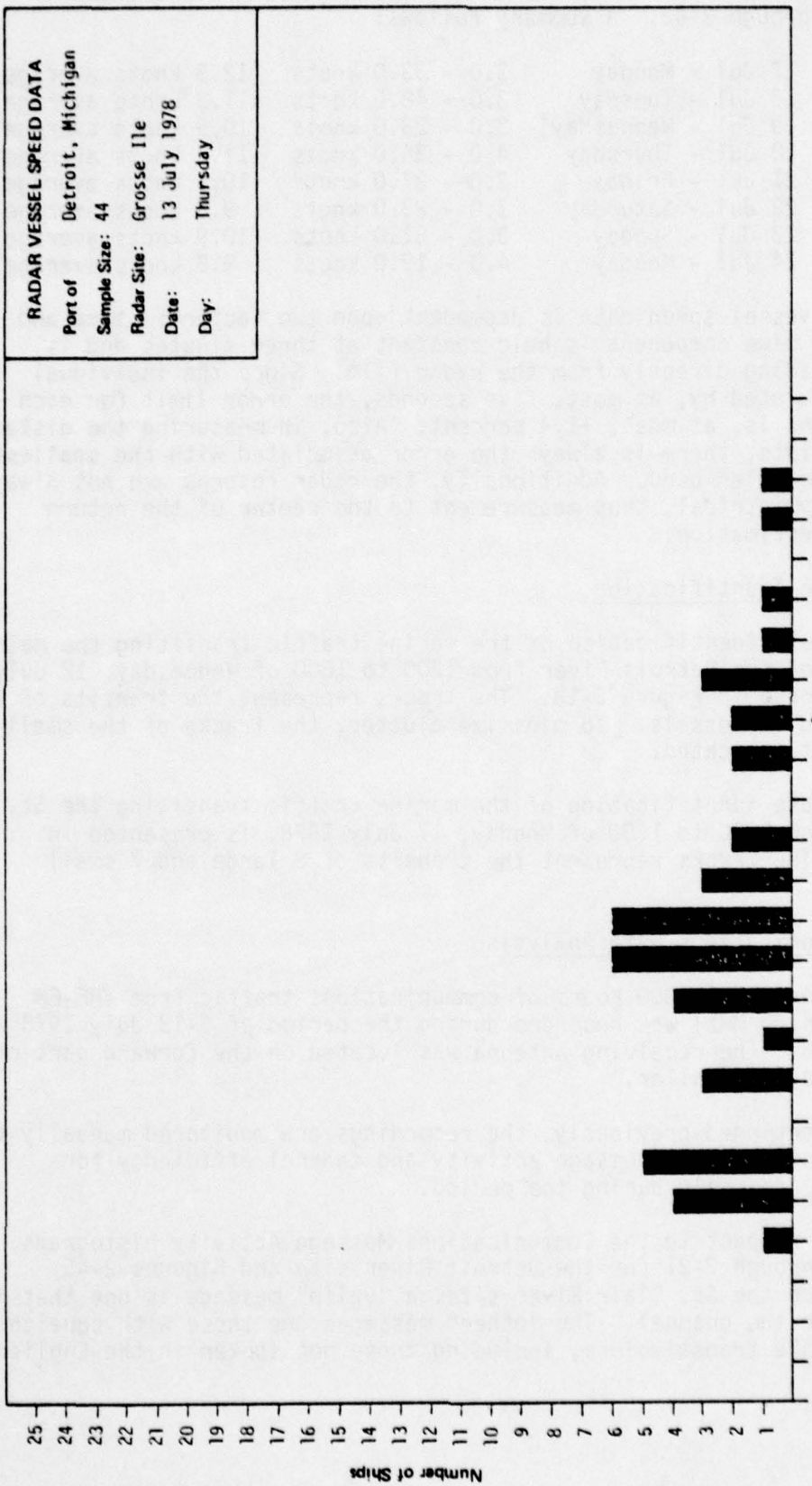

RADAR VESSEL SPEED DATA
Port of Detroit, Michigan
Sample Size: 169
Radar Site: Grosse Ile
Date: 12 July 1978
Day: Wednesday
RESIDUAL DATA ABOVE 25 KNOTS:
1 Vessel 28 Knots
1 Vessel 30 Knots
Number of Ships
Vessel Speed (Knots)

Figure 2-16

Figure 2-17


RADAR VESSEL SPEED DATA
Port of Detroit, Michigan
Sample Size: 44
Radar Site: Grosse Ile
Date: 13 July 1978
Day: Thursday
Number of Ships
Vessel Speed (Knots)

The vessel speed data for the St. Clair River is presented in Figures 2-36 through 2-43. A summary follows:

17 Jul - Monday	3.0 - 33.0 knots	(12.3 knots average)
18 Jul - Tuesday	3.0 - 48.0 knots	(11.3 knots average)
19 Jul - Wednesday	3.0 - 28.0 knots	(10.9 knots average)
20 Jul - Thursday	4.0 - 34.0 knots	(11.7 knots average)
21 Jul - Friday	3.0 - 27.0 knots	(10.9 knots average)
22 Jul - Saturday	3.0 - 23.0 knots	(9.6 knots average)
23 Jul - Sunday	3.0 - 31.0 knots	(10.9 knots average)
24 Jul - Monday	4.0 - 19.0 knots	(9.8 knots average)

All vessel speed data is dependent upon two factors: time and distance. The time component is held constant at three minutes and is measured by reading directly from the radar film. Since the individual frames are separated by, at most, five seconds, the error limit for each time measurement is, at most, ±1.4 percent. Also, in measuring the distance between two points, there is always the error associated with the smallest division of the ruler used. Additionally, the radar returns are not always distinct and symmetrical, thus measurement to the center of the return involves some estimation.

2.3 Route Identification

A route identification of the marine traffic transiting the main ship channels of the Detroit River from 1200 to 1800 of Wednesday, 12 July 1978, is presented in Figure 2-18. The tracks represent the transits of 8 large and 9 medium vessels. To minimize clutter, the tracks of the small vessels are not indicated.

A route identification of the marine traffic transiting the St. Clair River from 1100 to 1600 of Monday, 17 July 1978, is presented in Figure 2-44. The tracks represent the transits of 8 large and 7 small vessels.

2.4 Communications Data Analysis

Approximately 300 hours of communications traffic from VHF-FM Channel 16 (156.80 MHz) was recorded during the period of 6-13 July 1978 and 17-24 July 1978. The receiving antenna was located on the forward part of the data collection trailer.

As mentioned previously, the recordings are monitored manually to prepare the histograms of message activity and channel efficiency for representative intervals during the period.

With respect to the Communications Message Activity histograms, Figures 2-19 through 2-21 for the Detroit River site and Figures 2-45 through 2-47 for the St. Clair River site, a "valid" message is one that is appropriate for the channel. The "other" messages are those with squelch or indistinguishable transmissions, including those not spoken in the English language.

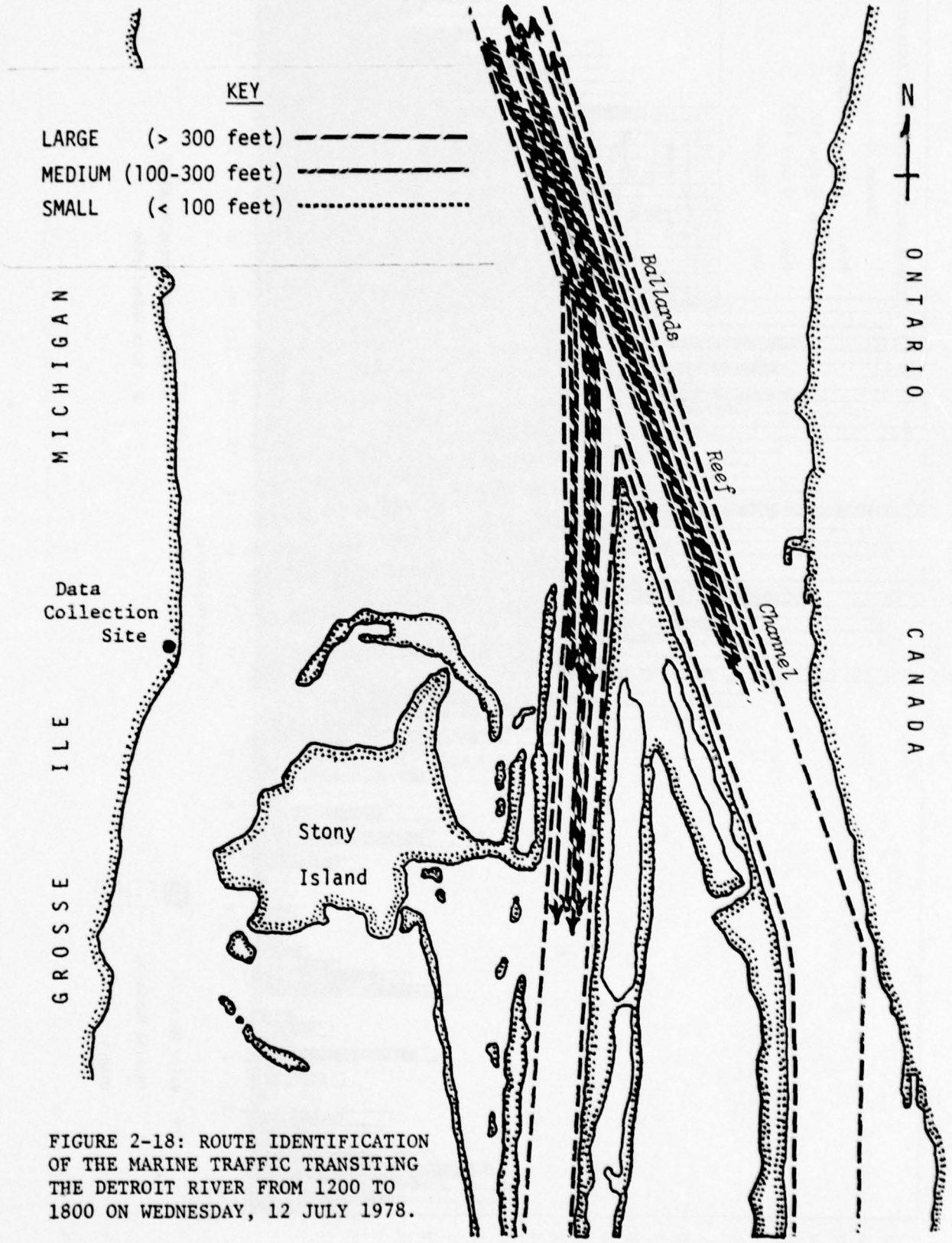


FIGURE 2-18: ROUTE IDENTIFICATION OF THE MARINE TRAFFIC TRANSITING THE DETROIT RIVER FROM 1200 TO 1800 ON WEDNESDAY, 12 JULY 1978.

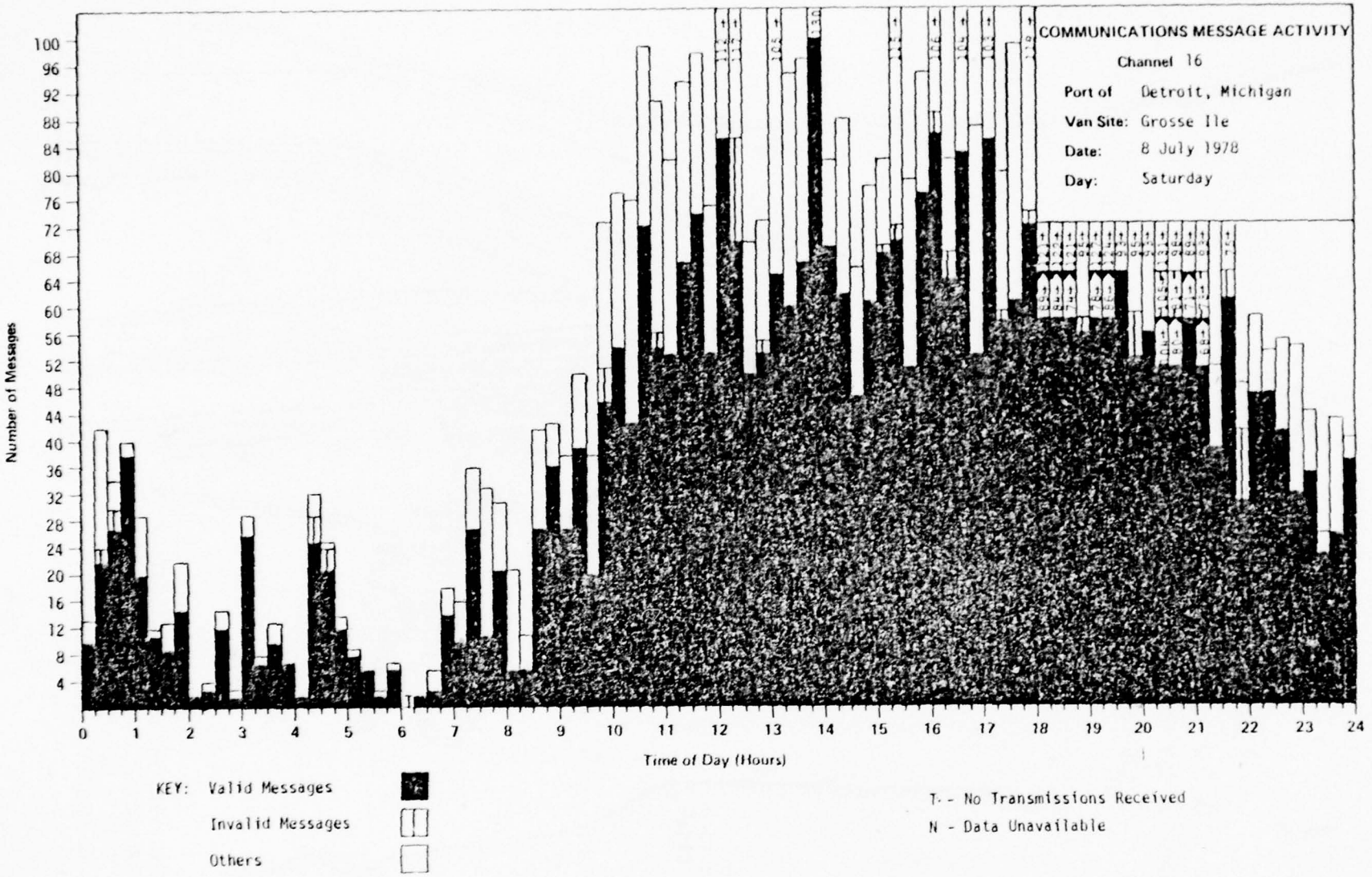
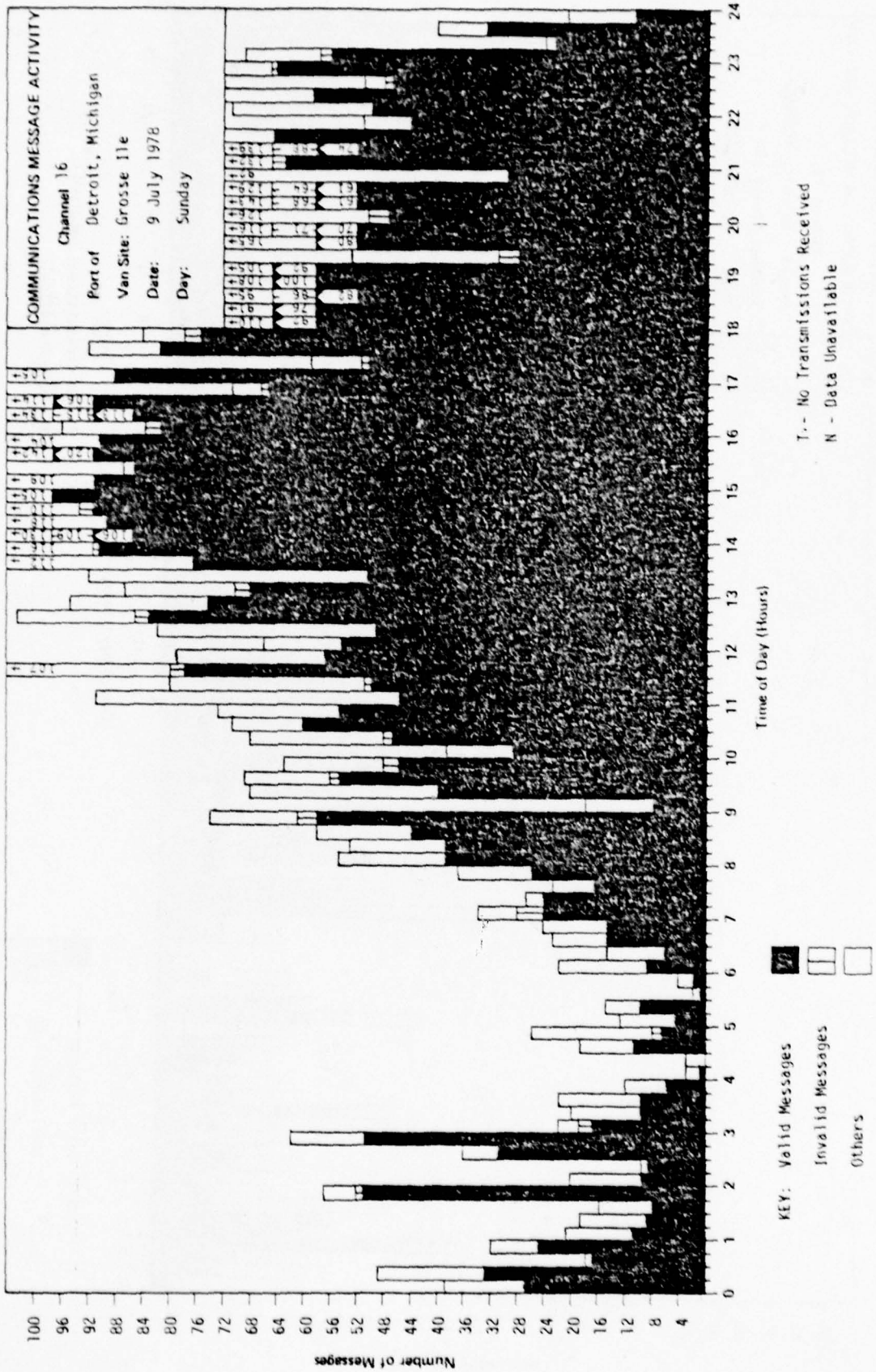

COMMUNICATIONS MESSAGE ACTIVITY
Channel 16
Port of Detroit, Michigan
Van Site: Grosse Ile
Date: 8 July 1978
Day: Saturday
Number of Messages
Time of Day (Hours)
KEY: Valid Messages
Invalid Messages
Others
T - No Transmissions Received
N - Data Unavailable

Figure 2-19

Figure 2-20


COMMUNICATIONS MESSAGE ACTIVITY
Channel 16
Port of Detroit, Michigan
Van Site: Grosse Ile
Date: 9 July 1978
Day: Sunday
Number of Messages
Time of Day (Hours)
KEY: Valid Messages
Invalid Messages
Others
T.- No Transmissions Received
N - Data Unavailable

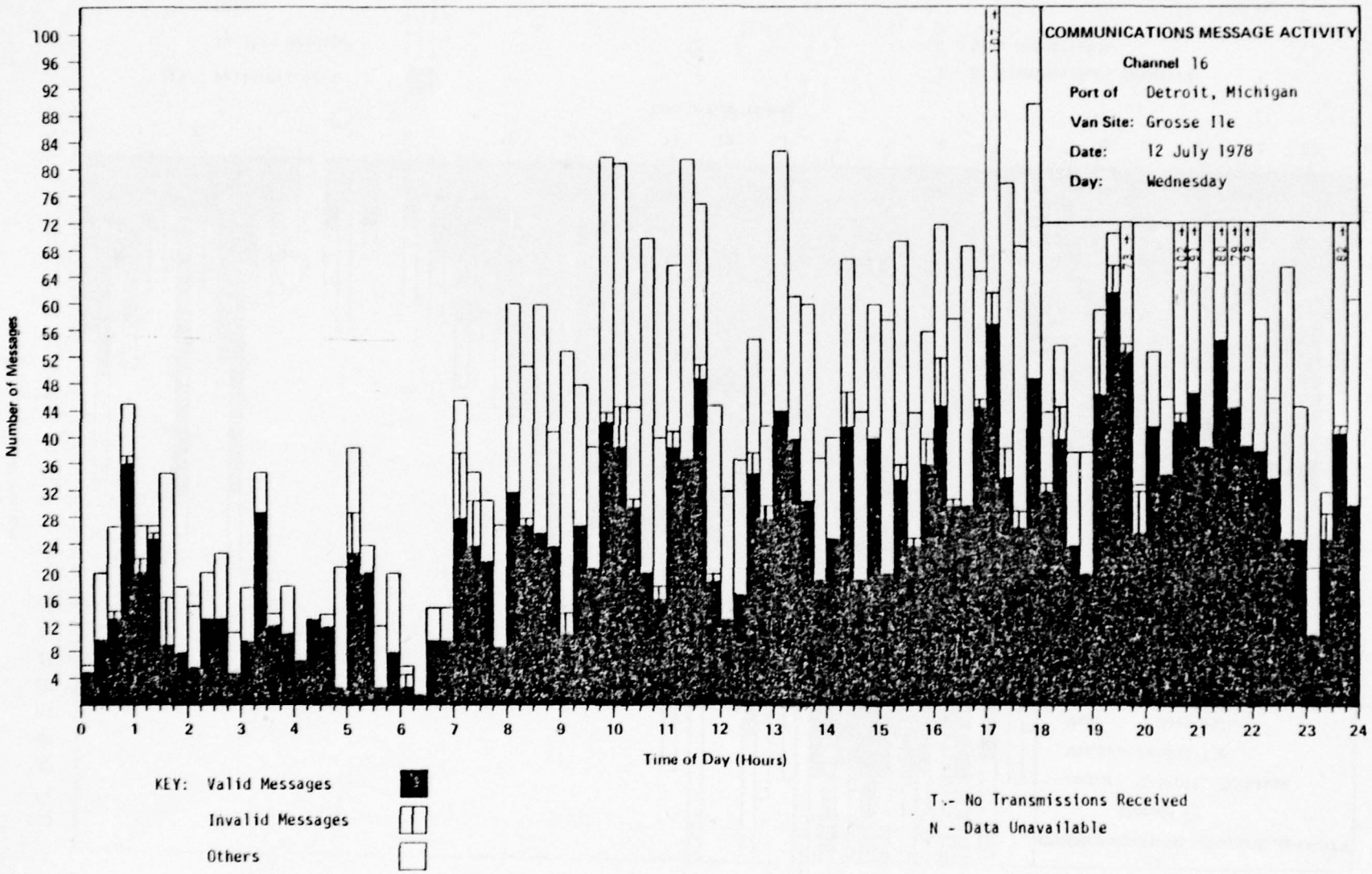

COMMUNICATIONS MESSAGE ACTIVITY
Channel 16
Port of Detroit, Michigan
Van Site: Grosse Ile
Date: 12 July 1978
Day: Wednesday
Number of Messages
Time of Day (Hours)
KEY: Valid Messages
Invalid Messages
Others
T.- No Transmissions Received
N - Data Unavailable

Figure 2-21

The Communications Channel Efficiency histograms, Figures 2-22 through 2-24 for the Detroit River site and Figures 2-48 through 2-50 for the St. Clair River site, indicate the percentage of the messages transmitted that were appropriate for the channel.

Regarding the computer-prepared histograms, Figures 2-25 through 2-27 for the Detroit River site and Figures 2-51 through 2-53 for the St. Clair River site:

- Note that the figures in the column headed "PERIOD ENDING" are time intervals printed without the customary leading zeros. Thus, the time "0015" is shown as "15." The "MINUTES" column contains the total time occupied by transmissions during the period, while the "PERCENT" column indicates the percentage of the given period during which the channel was in use.

- It is probable that a number of the messages of less than 0.5 second in length are simply noise bursts. However, since it is common practice to acknowledge a transmission by briefly keying the transmitter (with no voice modulation), it did not seem desirable to ignore any usable signal. Thus, the figures for messages of less than 0.5 second should be used with caution.

The "number of messages" counts occasionally differ between the manually-reduced data and the machine-reduced data. This difference is apparently due to the machine detecting breaks in the signals being transmitted that were either not detected or were ignored by the personnel performing the manual analysis. The figures on duration of channel utilization obtained manually agree well with those obtained by the automated equipment, indicating that the automated equipment is operating properly.

The Channel 16 efficiency (i.e., the percentage of valid messages) at the Detroit River and St. Clair River sites is as follows:

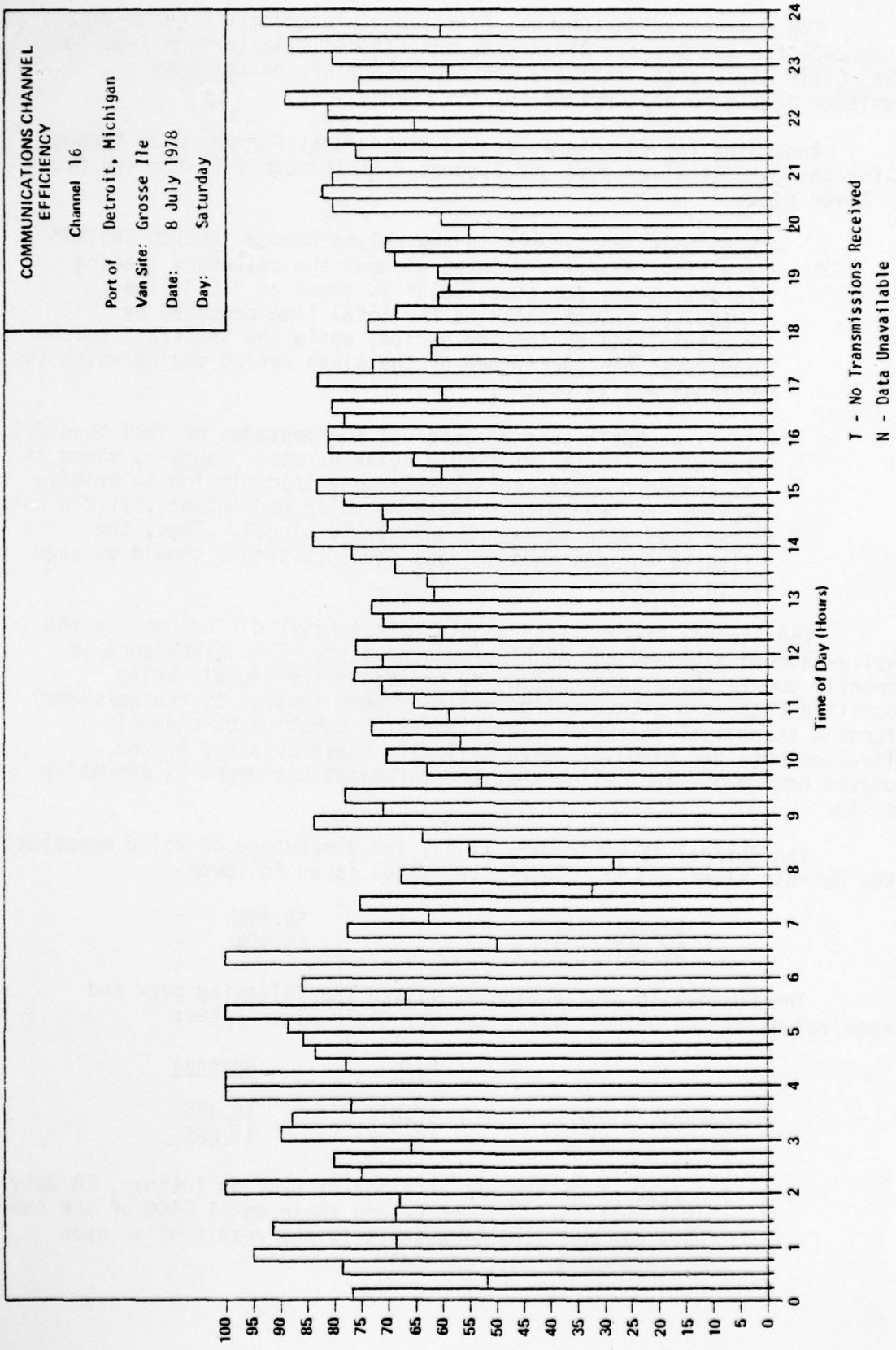
Detroit River	55.85%
St. Clair River	59.50%

The Channel 16 utilization exhibited the following peak and average values at the Detroit River and St. Clair River sites:

	Peak	Average
Detroit River	67.04%	19.49%
St. Clair River	46.61%*	17.88%

* A peak of 97.93% was attained at 0230 on Tuesday, 18 July 1978, but this percentage and those until 0400 of the same date was not used because it is the result of an open microphone on that channel.

Figure 2-22


COMMUNICATIONS CHANNEL EFFICIENCY
Channel 16
Port of Detroit, Michigan
Van Site: Grosse Ile
Date: 8 July 1978
Day: Saturday
Percentage of Valid Messages to Total Transmissions
Time of Day (Hours)
T - No Transmissions Received
N - Data Unavailable

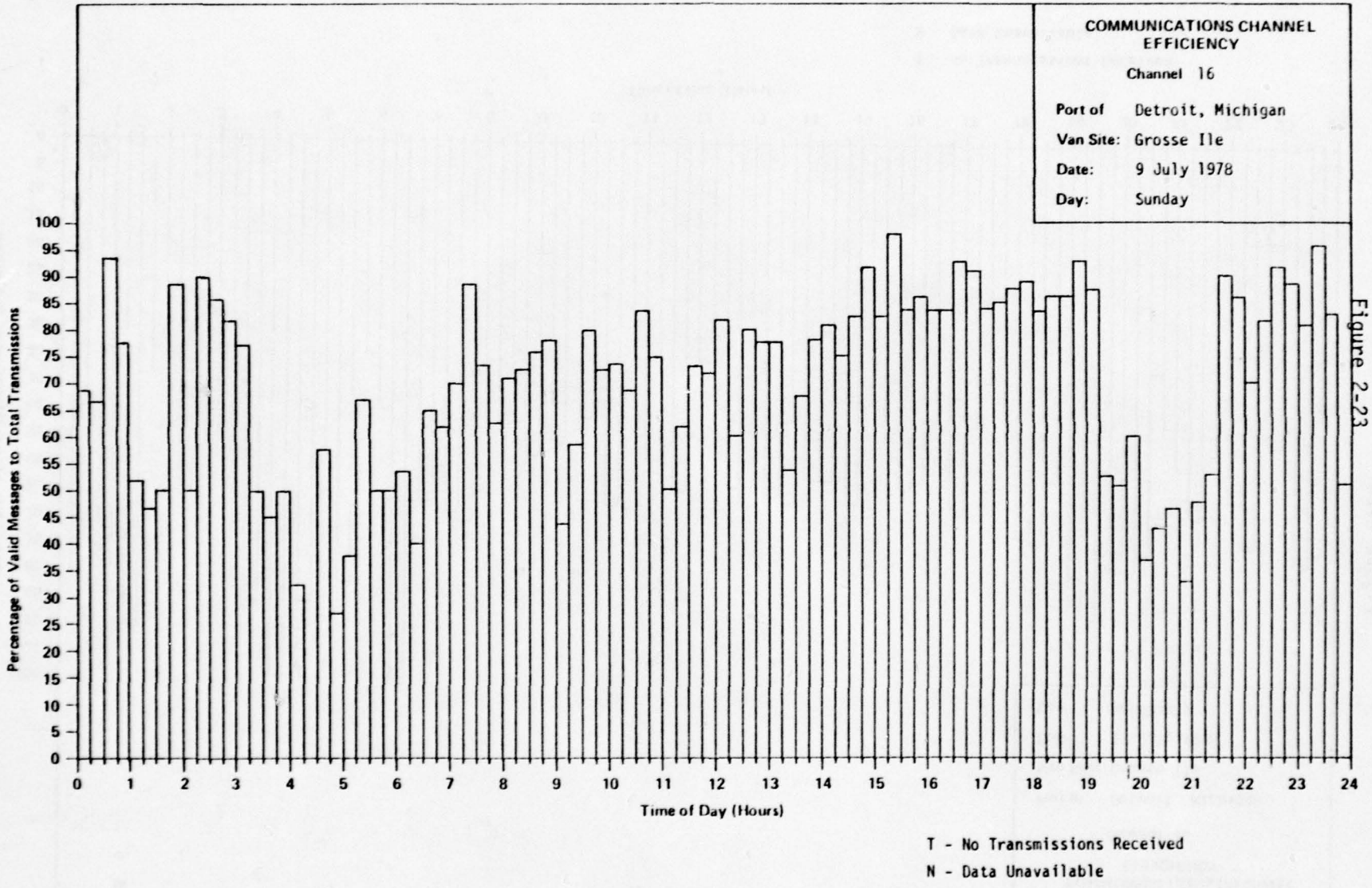
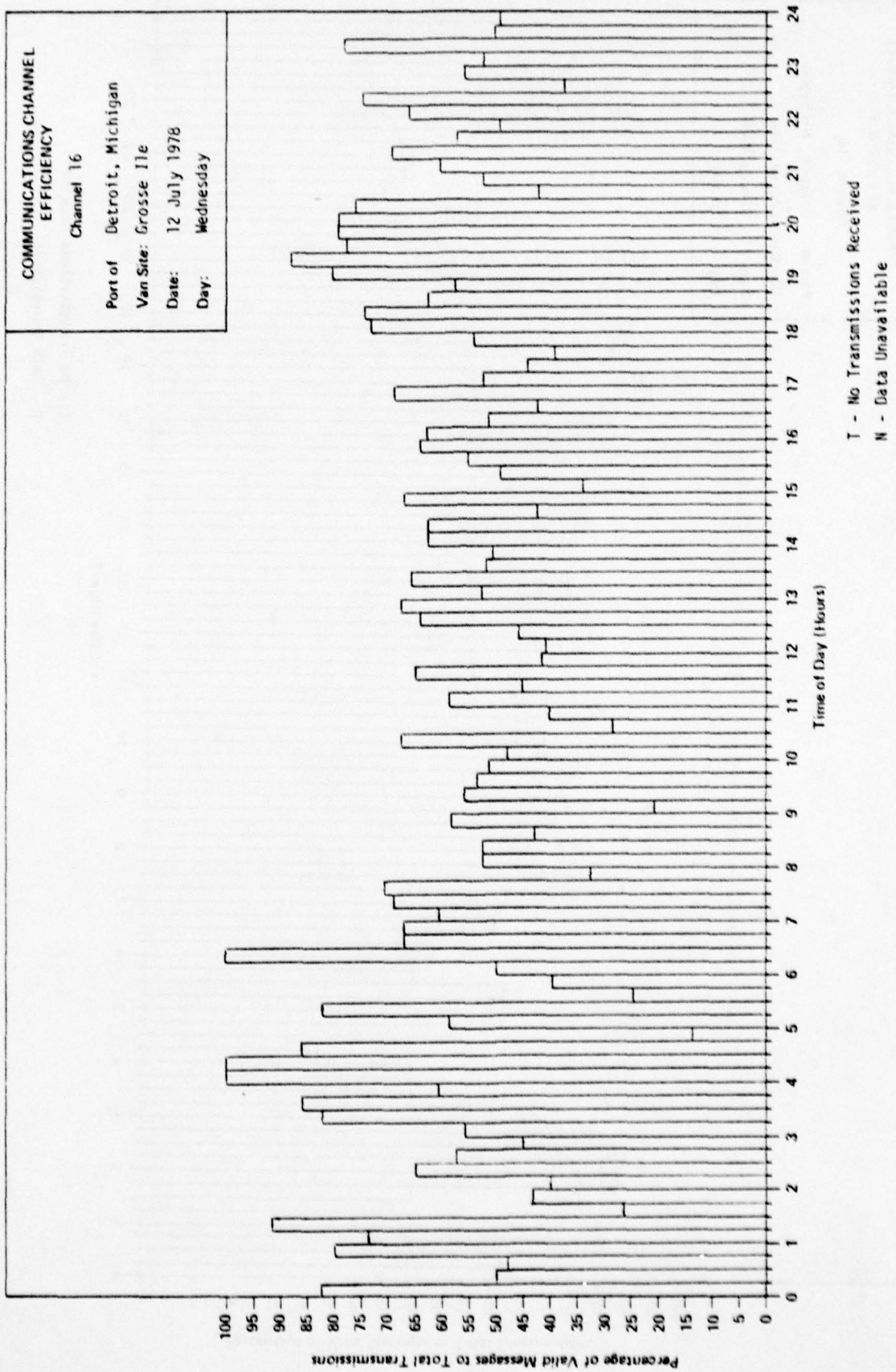

COMMUNICATIONS CHANNEL EFFICIENCY
Channel 16
Port of Detroit, Michigan
Van Site: Grosse Ile
Date: 9 July 1978
Day: Sunday
Percentage of Valid Messages to Total Transmissions
Time of Day (Hours)
T - No Transmissions Received
N - Data Unavailable

Figure 2-23

Figure 2-24


COMMUNICATIONS CHANNEL EFFICIENCY
Channel 16
Port of Detroit, Michigan
Van Site: Grosse Ile
Date: 12 July 1978
Day: Wednesday
Percentage of Valid Messages to Total Transmissions
Time of Day (Hours)
T - No Transmissions Received
N - Data Unavailable

DETROIT RIVER, MICHIGAN VHF-FM CH 16 08-JUL-78 PAGE 1

TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
15	32	1.25	8.32
30	76	1.54	10.26
45	122	3.26	21.77
100	76	2.68	17.90
115	49	2.58	17.19
130	68	1.95	12.98
145	32	0.97	6.47
200	48	1.78	11.90
215	14	0.46	3.10
230	14	0.49	3.27
245	69	1.92	12.79
300	22	0.25	1.69
315	57	1.73	11.51
330	23	1.40	9.32
345	23	0.71	4.76
400	14	0.32	2.14
415	6	0.35	2.31
430	84	2.60	17.31
445	28	1.12	7.44
500	25	0.87	5.78
515	14	0.37	2.47
530	8	0.30	2.01
545	5	0.05	0.30
600	13	0.50	3.31
615	0	0.00	0.00
630	3	0.21	1.41
645	13	0.29	1.94
700	43	1.08	7.22
715	39	1.17	7.80
730	80	2.31	15.43
745	85	1.35	8.98
800	76	2.04	13.58
815	61	1.42	9.49
830	53	1.27	8.46
845	132	3.23	21.53
900	152	3.89	25.93
915	180	3.99	26.63
930	171	3.97	26.50
945	129	2.64	17.63
1000	164	3.89	25.97
1015	218	6.45	43.03
1030	196	5.07	33.78
1045	245	5.65	37.66
1100	273	5.63	37.54
1115	246	5.16	34.40
1130	272	5.53	36.84
1145	241	6.96	46.38
1200	251	5.34	35.61

Figure 2-25

TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
1215	262	5.54	36.93
1230	235	10.54	70.26
1245	230	6.71	44.71
1300	189	4.93	32.88
1315	259	6.05	40.36
1330	229	5.57	37.11
1345	296	6.88	45.90
1400	312	8.03	53.51
1415	288	7.57	50.48
1430	269	6.66	44.38
1445	211	5.58	37.20
1500	233	7.20	48.02
1515	209	6.27	41.82
1530	244	7.24	48.26
1545	256	5.45	36.33
1600	232	8.75	58.36
1615	257	8.44	56.30
1630	212	6.80	45.31
1645	262	7.19	47.94
1700	174	5.99	39.94
1715	226	7.87	52.44
1730	199	5.59	37.30
1745	217	6.81	45.40
1800	237	7.98	53.22
1815	247	7.84	52.29
1830	196	7.48	49.88
1845	253	7.82	52.17
1900	192	6.41	42.71
1915	234	7.79	51.92
1930	201	9.83	65.53
1945	201	6.47	43.16
2000	187	5.78	38.57
2015	173	4.62	30.78
2030	188	6.02	40.12
2045	4	0.11	0.72
2100	252	6.78	45.22
2115	316	6.77	45.11
2130	192	4.81	32.10
2145	201	5.23	34.86
2200	138	3.67	24.44
2215	180	3.92	26.14
2230	168	4.28	28.54
2245	106	2.55	17.02
2300	153	3.74	24.91
2315	118	3.19	21.26
2330	66	2.04	13.62
2345	107	2.32	15.50
2400	80	2.17	14.47

Figure 2-25 (continued)

TOTAL NUMBER OF TRANSMISSIONS: 14136
AVE. NUM. OF TRANSMISSIONS PER HOUR: 589.0
TOTAL TRANSMISSION TIME: 6.589 HOURS
AVERAGE LENGTH OF TRANSMISSION: 1.68 SEC.
PERCENT CHANNEL UTILIZATION: 27.45%

MESSAGE LENGTH HISTOGRAM

LENGTH OF XMSNS	NUMBER OF XMSNS	PERCENT
0.1 - 0.5 SEC.	4603	32.56
0.5 - 1.0 SEC.	2456	17.37
1.0 - 1.5 SEC.	1601	11.33
1.5 - 2.0 SEC.	1121	7.93
2.0 - 2.5 SEC.	1650	11.67
2.5 - 3.0 SEC.	459	3.25
3.0 - 3.5 SEC.	389	2.75
3.5 - 4.0 SEC.	341	2.41
4.0 - 4.5 SEC.	638	4.51
4.5 - 5.0 SEC.	168	1.19
5.0 - 5.5 SEC.	132	0.93
5.5 - 6.0 SEC.	118	0.83
6.0 - 6.5 SEC.	81	0.57
6.5 - 7.0 SEC.	103	0.73
7.0 - 7.5 SEC.	50	0.35
7.5 - 8.0 SEC.	56	0.40
8.0 - 8.5 SEC.	33	0.23
8.5 - 9.0 SEC.	52	0.37
9.0 - 9.5 SEC.	14	0.10
9.5 - 10.0 SEC.	10	0.07
LONGER THAN 10 SEC. :	61	0.43

THERE WERE 4928 XMSNS OF 00.1 AND 00.0 DURATION

Figure 2-25 (continued)

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TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
15	120	2.25	15.01
30	142	3.66	24.43
45	35	1.36	9.07
100	58	2.77	18.44
115	80	1.76	11.73
130	34	0.98	6.57
145	87	3.77	25.13
200	48	1.79	11.93
215	25	1.11	7.42
230	14	0.82	5.44
245	49	3.69	24.62
300	74	4.12	27.49
315	24	0.88	5.84
330	31	1.40	9.32
345	50	1.61	10.76
400	14	0.53	3.52
415	4	0.05	0.32
430	17	0.39	2.61
445	37	1.57	10.44
500	57	1.25	8.32
515	27	0.79	5.30
530	35	1.19	7.93
545	45	1.99	13.26
600	7	0.51	3.42
615	27	0.77	5.14
630	30	0.56	3.76
645	47	1.22	8.12
700	37	1.84	12.29
715	87	2.28	15.19
730	44	2.03	13.57
745	49	1.63	10.90
800	55	1.89	12.61
815	80	2.73	18.21
830	109	3.96	26.41
845	158	4.93	32.87
900	86	5.02	33.47
915	124	4.22	28.16
930	101	3.42	22.78
945	149	4.36	29.08
1000	91	6.02	40.13
1015	144	4.37	29.17
1030	127	4.14	27.58
1045	128	5.08	33.84
1100	114	5.97	39.78
1115	185	5.94	39.59
1130	151	6.86	45.73
1145	179	7.08	47.19
1200	150	5.60	37.37

Figure 2-26

TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
1215	139	4.85	32.31
1230	201	7.01	46.77
1245	273	6.38	42.53
1300	314	7.00	46.70
1315	256	7.43	49.51
1330	239	6.24	41.61
1345	235	6.12	40.81
1400	238	6.03	40.21
1415	300	8.36	55.72
1430	279	8.42	56.17
1445	275	7.18	47.86
1500	244	7.40	49.36
1515	282	7.62	50.79
1530	302	10.02	66.78
1545	300	10.06	67.04
1600	268	7.43	49.54
1615	228	7.99	53.24
1630	258	7.51	50.07
1645	279	9.21	61.43
1700	252	6.88	45.90
1715	288	8.26	55.04
1730	288	7.91	52.77
1745	269	6.94	46.27
1800	219	5.88	39.23
1815	258	7.98	53.18
1830	230	5.72	38.17
1845	194	7.18	47.86
1900	207	8.48	56.53
1915	130	4.72	31.44
1930	205	7.42	49.48
1945	218	7.63	50.87
2000	195	6.85	45.64
2015	212	5.46	36.38
2030	182	5.77	38.48
2045	158	4.06	27.08
2100	115	2.52	16.83
2115	227	5.40	36.03
2130	180	5.47	36.50
2145	186	5.23	34.87
2200	165	4.34	28.91
2215	137	3.77	25.17
2230	158	4.14	27.63
2245	130	3.59	23.94
2300	160	5.43	36.20
2315	164	4.64	30.94
2330	110	3.55	23.69
2345	67	2.28	15.22
2400	70	2.30	15.32

Figure 2-26 (continued)

TOTAL NUMBER OF TRANSMISSIONS: 13850
AVE. NUM. OF TRANSMISSIONS PER HOUR: 577.1
TOTAL TRANSMISSION TIME: 7.238 HOURS
AVERAGE LENGTH OF TRANSMISSION: 1.88 SEC.
PERCENT CHANNEL UTILIZATION: 30.16%

MESSAGE LENGTH HISTOGRAM

LENGTH OF XMSNS	NUMBER OF XMSNS	PERCENT
0.1 - 0.5 SEC.	4072	29.40
0.5 - 1.0 SEC.	2139	15.44
1.0 - 1.5 SEC.	1410	10.18
1.5 - 2.0 SEC.	1132	8.17
2.0 - 2.5 SEC.	2296	16.58
2.5 - 3.0 SEC.	430	3.10
3.0 - 3.5 SEC.	381	2.75
3.5 - 4.0 SEC.	333	2.40
4.0 - 4.5 SEC.	618	4.46
4.5 - 5.0 SEC.	161	1.16
5.0 - 5.5 SEC.	130	0.94
5.5 - 6.0 SEC.	128	0.92
6.0 - 6.5 SEC.	107	0.77
6.5 - 7.0 SEC.	158	1.14
7.0 - 7.5 SEC.	47	0.34
7.5 - 8.0 SEC.	50	0.36
8.0 - 8.5 SEC.	24	0.17
8.5 - 9.0 SEC.	40	0.29
9.0 - 9.5 SEC.	26	0.19
9.5 - 10.0 SEC.	20	0.14
LONGER THAN 10 SEC.:	148	1.07

THERE WERE 4971 XMSNS OF 00.1 AND 00.0 DURATION

Figure 2-26 (continued)

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TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
15	21	0.68	4.57
30	36	1.27	8.47
45	36	1.31	8.74
100	57	2.78	18.52
115	35	1.84	12.30
130	23	1.24	8.24
145	52	1.52	10.11
200	20	0.49	3.30
215	24	1.35	8.99
230	26	1.61	10.71
245	25	1.25	8.36
300	33	1.48	9.84
315	23	1.22	8.11
330	41	2.69	17.93
345	23	1.12	7.50
400	29	1.40	9.36
415	7	0.42	2.81
430	20	1.39	9.24
445	11	0.29	1.91
500	36	0.90	6.00
515	63	2.22	14.79
530	40	1.53	10.18
545	11	0.45	2.98
600	26	0.85	5.66
615	7	0.42	2.81
630	2	0.48	3.21
645	14	0.87	5.79
700	20	0.90	6.00
715	57	3.21	21.39
730	34	1.87	12.50
745	39	1.79	11.97
800	55	1.62	10.82
815	69	3.12	20.78
830	76	2.52	16.83
845	56	2.95	19.69
900	66	2.68	17.87
915	65	1.67	11.17
930	52	2.33	15.51
945	75	2.64	17.58
1000	102	3.48	23.20
1015	96	3.88	25.89
1030	67	3.17	21.16
1045	81	2.64	17.62
1100	94	2.32	15.47
1115	85	3.48	23.23
1130	95	3.58	23.87
1145	82	5.77	38.50
1200	70	1.99	13.26

Figure 2-27

TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
1215	61	2.06	13.71
1230	54	1.65	10.98
1245	57	2.42	16.11
1300	76	4.73	31.52
1315	107	4.33	28.84
1330	80	3.75	24.99
1345	78	3.75	25.02
1400	41	1.75	11.68
1415	49	2.79	18.60
1430	62	3.80	25.32
1445	61	2.64	17.59
1500	69	3.41	22.76
1515	78	3.62	24.11
1530	94	3.64	24.30
1545	46	3.09	20.61
1600	70	3.70	24.70
1615	80	6.22	41.47
1630	53	2.43	16.21
1645	68	2.85	18.98
1700	102	5.61	37.42
1715	95	5.34	35.62
1730	100	4.51	30.04
1745	59	4.07	27.16
1800	78	3.30	22.02
1815	95	4.19	27.97
1830	90	3.19	21.30
1845	105	2.77	18.47
1900	72	2.69	17.94
1915	95	4.45	29.66
1930	79	4.37	29.12
1945	85	4.95	33.03
2000	89	3.88	25.89
2015	68	3.36	22.40
2030	119	3.48	23.22
2045	84	3.51	23.43
2100	142	4.92	32.82
2115	135	4.63	30.89
2130	109	4.14	27.58
2145	106	3.48	23.20
2200	135	4.58	30.56
2215	85	3.32	22.14
2230	73	3.12	20.81
2245	86	2.26	15.09
2300	65	2.10	13.98
2315	43	1.25	8.32
2330	52	2.39	15.92
2345	115	4.83	32.23
2400	41	1.30	8.68

Figure 27 (continued)

TOTAL NUMBER OF TRANSMISSIONS: 6063
AVE. NUM. OF TRANSMISSIONS PER HOUR: 252.6
TOTAL TRANSMISSION TIME: 4.323 HOURS
AVERAGE LENGTH OF TRANSMISSION: 2.57 SEC.
PERCENT CHANNEL UTILIZATION: 18.01%

MESSAGE LENGTH HISTOGRAM

LENGTH OF XMSNS	NUMBER OF XMSNS	PERCENT
0.1 - 0.5 SEC.	2029	33.47
0.5 - 1.0 SEC.	828	13.66
1.0 - 1.5 SEC.	497	8.20
1.5 - 2.0 SEC.	355	5.86
2.0 - 2.5 SEC.	314	5.18
2.5 - 3.0 SEC.	238	3.93
3.0 - 3.5 SEC.	232	3.83
3.5 - 4.0 SEC.	215	3.55
4.0 - 4.5 SEC.	240	3.96
4.5 - 5.0 SEC.	138	2.28
5.0 - 5.5 SEC.	152	2.51
5.5 - 6.0 SEC.	127	2.09
6.0 - 6.5 SEC.	98	1.62
6.5 - 7.0 SEC.	79	1.30
7.0 - 7.5 SEC.	65	1.07
7.5 - 8.0 SEC.	63	1.04
8.0 - 8.5 SEC.	57	0.94
8.5 - 9.0 SEC.	55	0.91
9.0 - 9.5 SEC.	34	0.56
9.5 - 10.0 SEC.	25	0.41
LONGER THAN 10 SEC.:	222	3.66

THERE WERE 3249 XMSNS OF 00.1 AND 00.0 DURATION

Figure 2-27 (continued)

2.5 Weather

Weather data, including the cloud coverage, wind direction and velocity, and visibility in nautical miles is collected every hour, on-the-hour.

The following visibilities were recorded at the Detroit River and St. Clair River sites:

Visibility	Detroit River	St. Clair River
6 nautical miles	62 percent	52 percent
4-6 nautical miles	18 percent	33 percent
1-3 nautical miles	20 percent	15 percent
1 nautical mile	0 percent	0 percent

The winds recorded at the Detroit River site were primarily from the south, with 2 percent of the winds from 6 to 10 knots velocity, 35 percent from 1 to 5 knots velocity, and 63 percent calm.

The winds recorded at the St. Clair River site were primarily from the south or southeast, with 6 percent of the winds from 6 to 10 knots velocity, 30 percent from 1 to 5 knots velocity, and 64 percent calm.

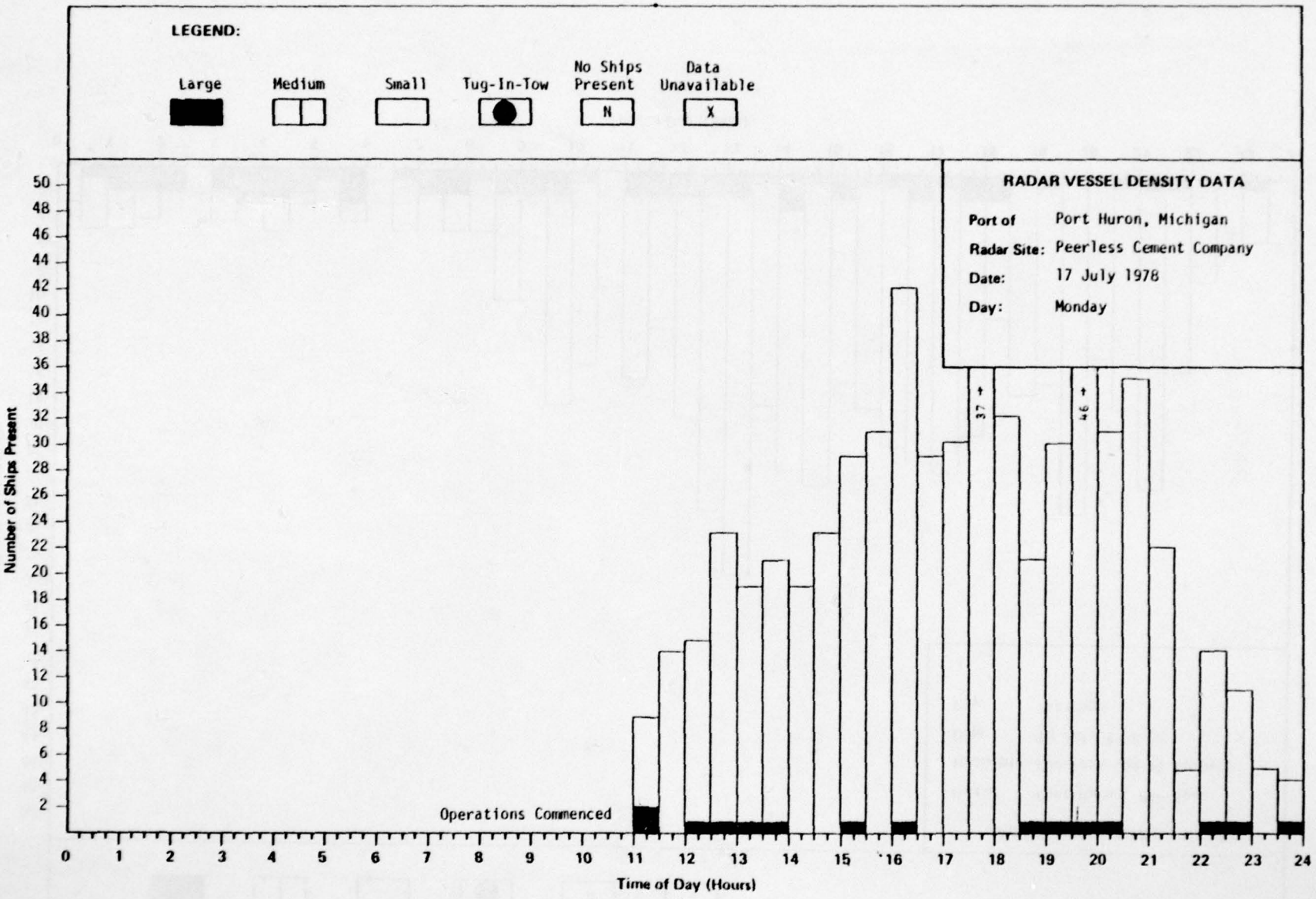

LEGEND:
Large
Medium
Small
Tug-In-Tow
No Ships Present
N
Data Unavailable
X
RADAR VESSEL DENSITY DATA
Port of Port Huron, Michigan
Radar Site: Peerless Cement Company
Date: 17 July 1978
Day: Monday
Number of Ships Present
Time of Day (Hours)
Operations Commenced
37
46

Figure 2-28

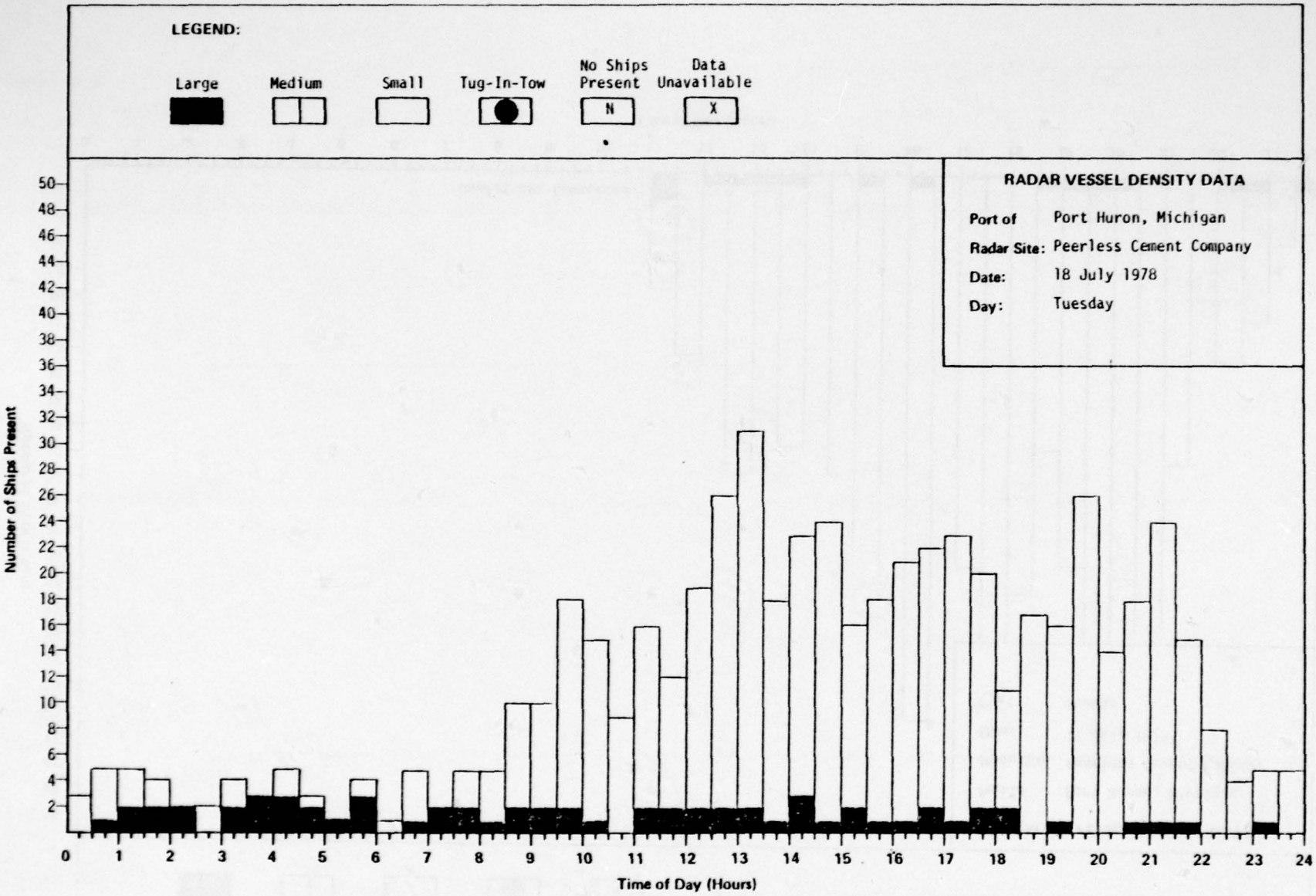
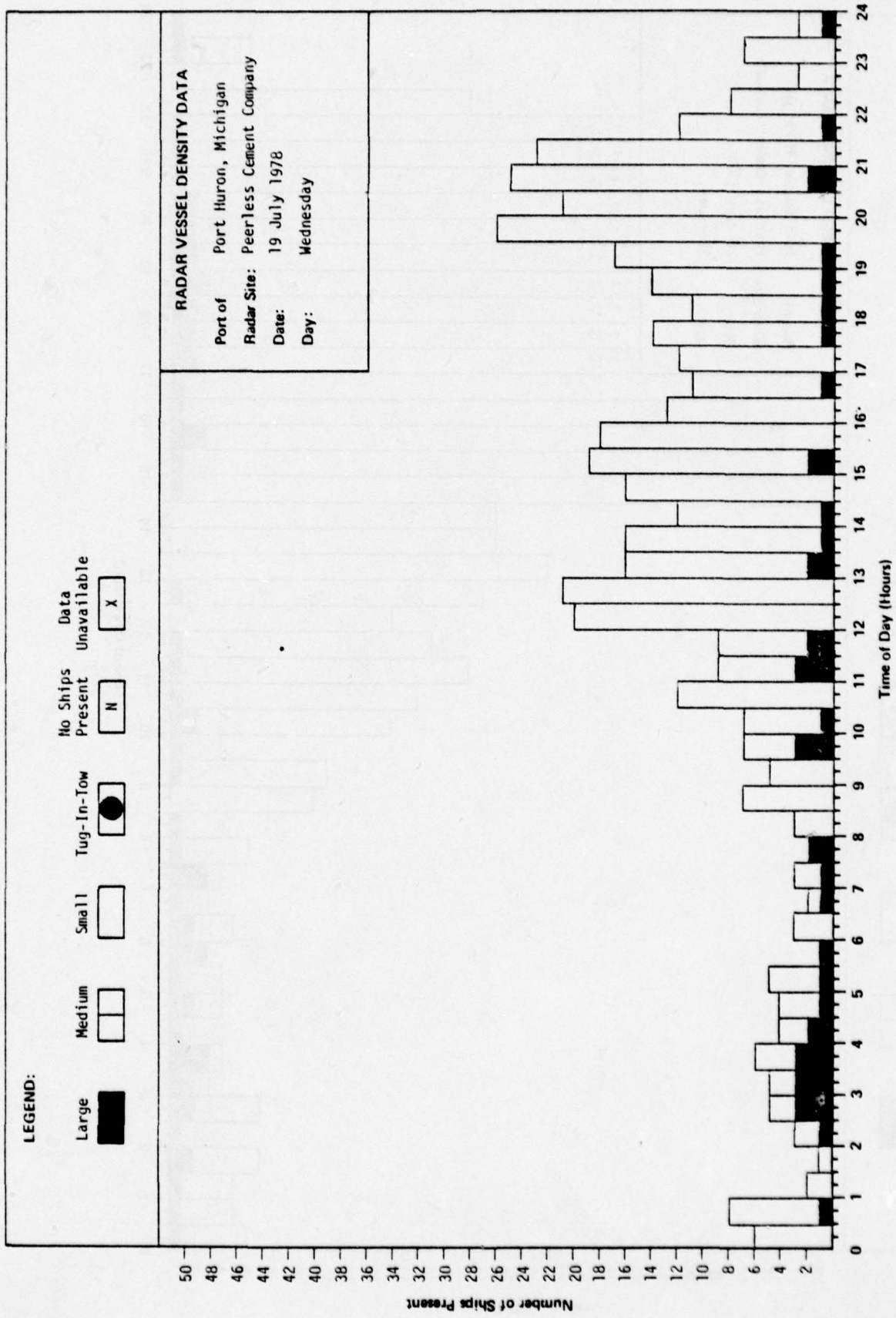

LEGEND:
Large
Medium
Small
Tug-In-Tow
No Ships Present
N
Data Unavailable
X
RADAR VESSEL DENSITY DATA
Port of Port Huron, Michigan
Radar Site: Peerless Cement Company
Date: 18 July 1978
Day: Tuesday
Number of Ships Present
Time of Day (Hours)

Figure 2-29

Figure 2-30


LEGEND:
Large
Medium
Small
Tug-In-Tow
No Ships Present
N
Data Unavailable
X
RADAR VESSEL DENSITY DATA
Port of Port Huron, Michigan
Radar Site: Peerless Cement Company
Date: 19 July 1978
Day: Wednesday
Number of Ships Present
Time of Day (Hours)

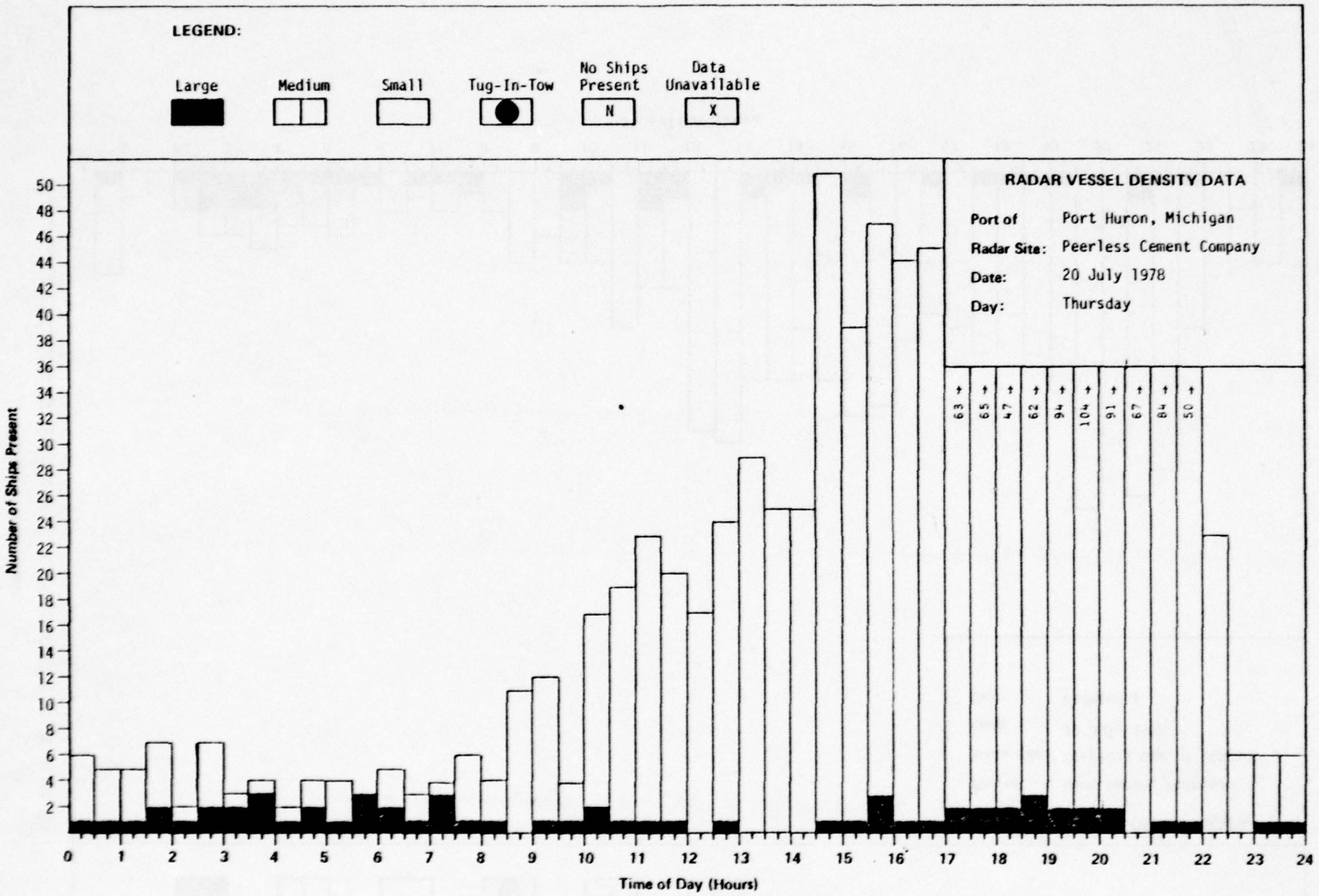
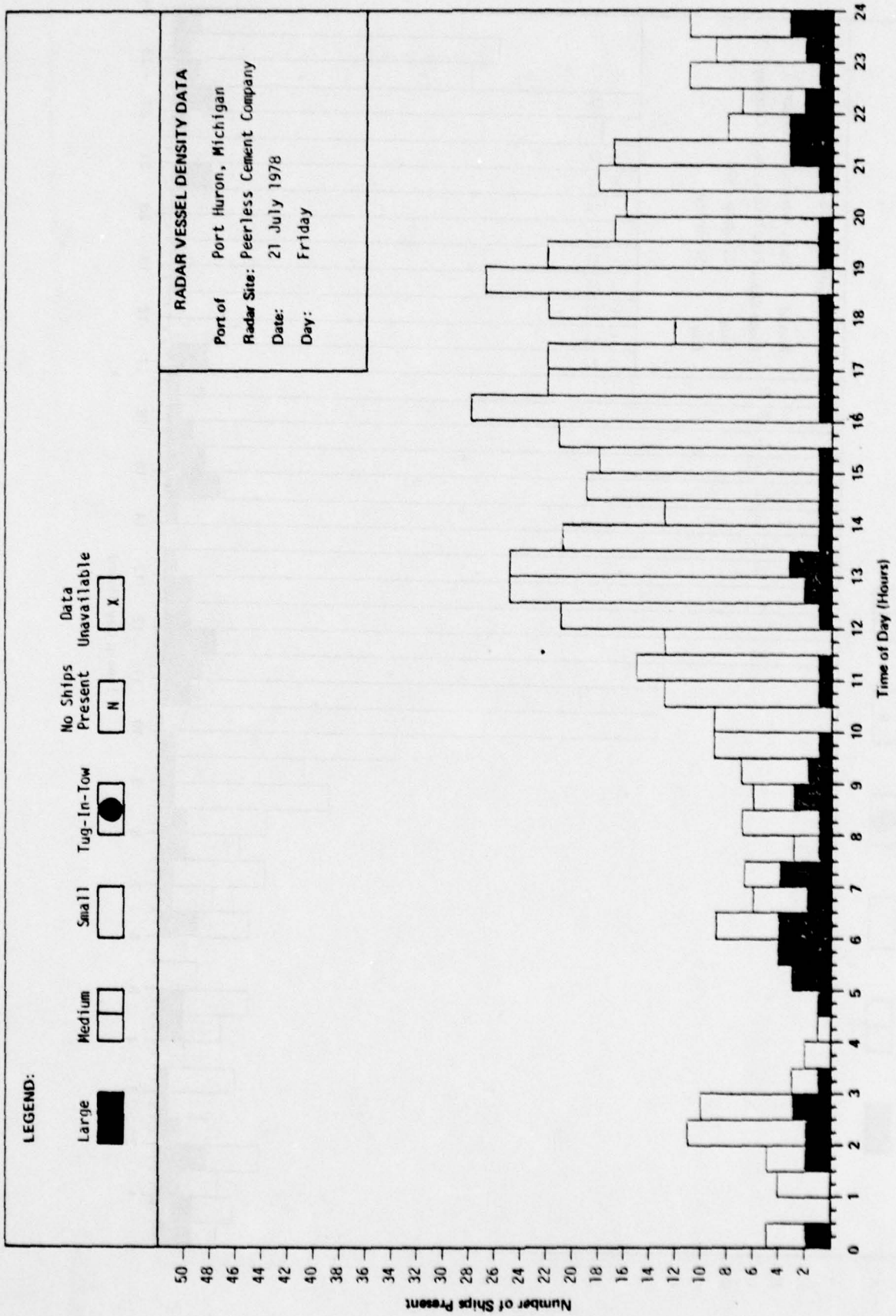

LEGEND:
Large
Medium
Small
Tug-In-Tow
No Ships Present
N
Data Unavailable
X
RADAR VESSEL DENSITY DATA
Port of Port Huron, Michigan
Radar Site: Peerless Cement Company
Date: 20 July 1978
Day: Thursday
+63
+55
+74
+62
+96
+401
+16
+29
+48
+50
Number of Ships Present
Time of Day (Hours)

Figure 2-31

Figure 2-32


LEGEND:
Large
Medium
Small
Tug-In-Tow
No Ships Present
Data Unavailable
N
X
RADAR VESSEL DENSITY DATA
Port of Port Huron, Michigan
Radar Site: Peerless Cement Company
Date: 21 July 1978
Day: Friday
Number of Ships Present
Time of Day (Hours)

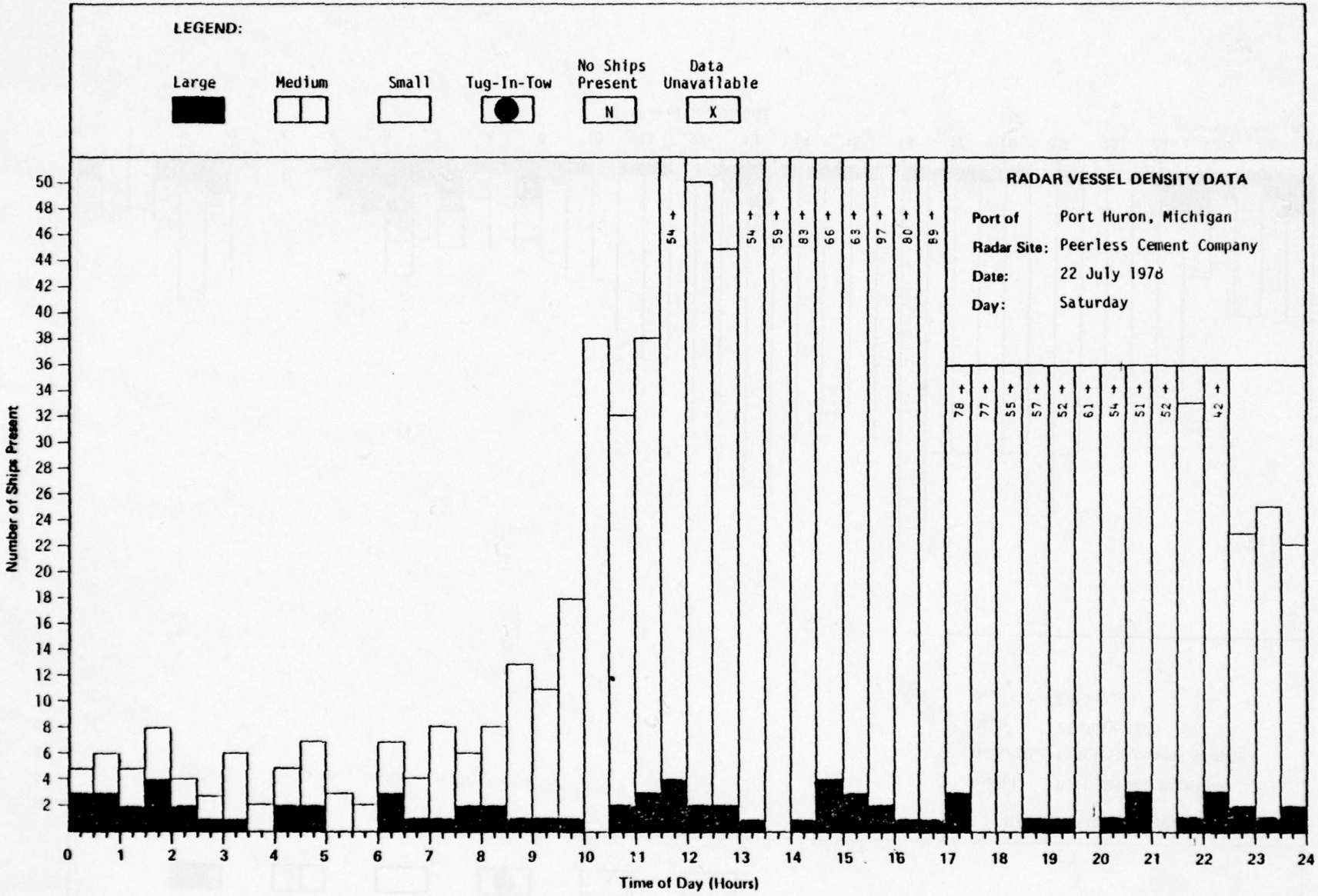

LEGEND:
Large
Medium
Small
Tug-In-Tow
No Ships Present
N
Data Unavailable
X
RADAR VESSEL DENSITY DATA
Port of Port Huron, Michigan
Radar Site: Peerless Cement Company
Date: 22 July 1978
Day: Saturday
Number of Ships Present
Time of Day (Hours)
54 → 54 → 59 → 83 → 66 → 63 → 97 → 80 → 69 →
78 → 77 → 55 → 57 → 52 → 61 → 54 → 51 → 52 → 42 →

Figure 2-33

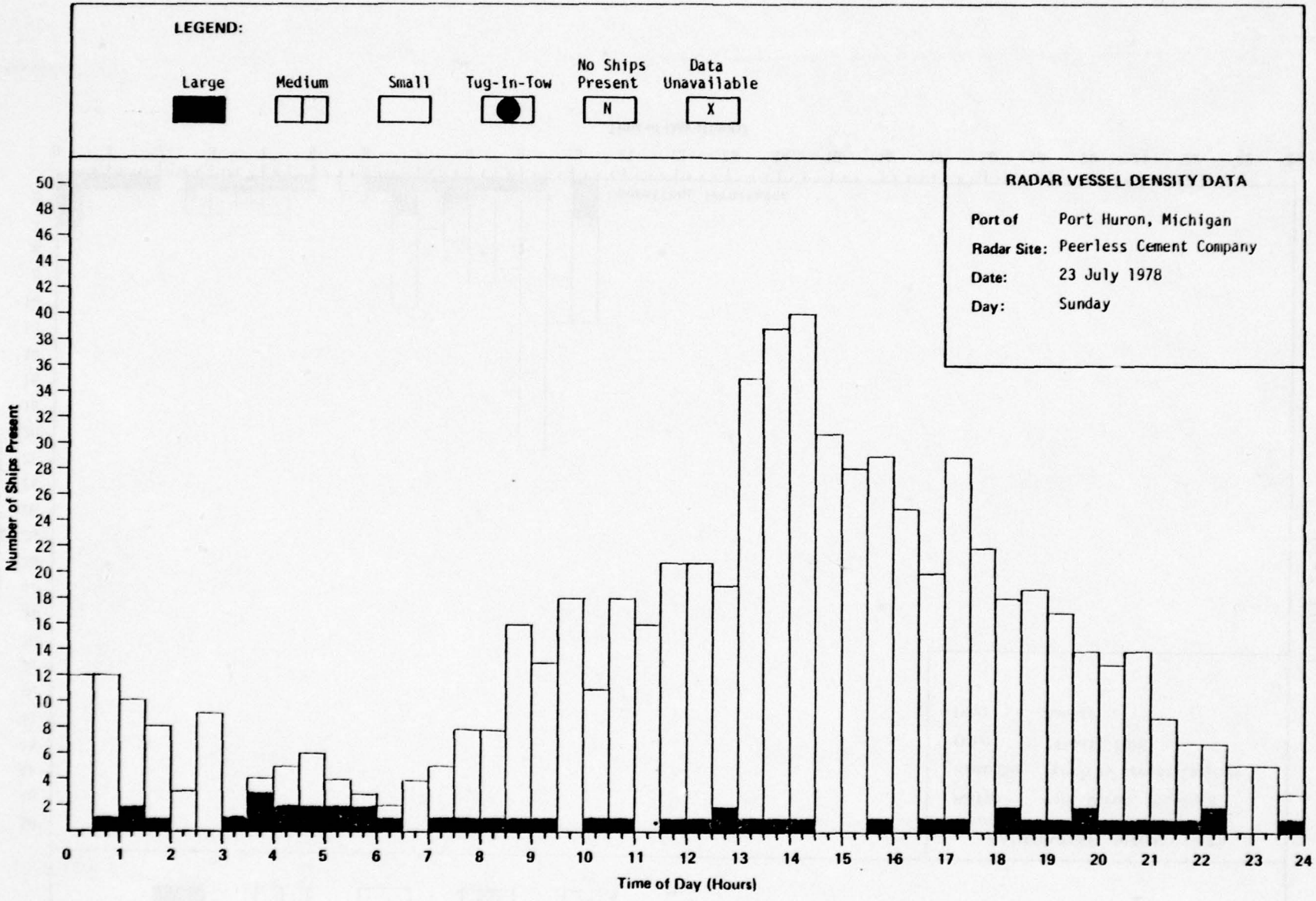

LEGEND:
Large
Medium
Small
Tug-In-Tow
No Ships Present
N
Data Unavailable
X
RADAR VESSEL DENSITY DATA
Port of Port Huron, Michigan
Radar Site: Peerless Cement Company
Date: 23 July 1978
Day: Sunday
Number of Ships Present
Time of Day (Hours)

Figure 2-34

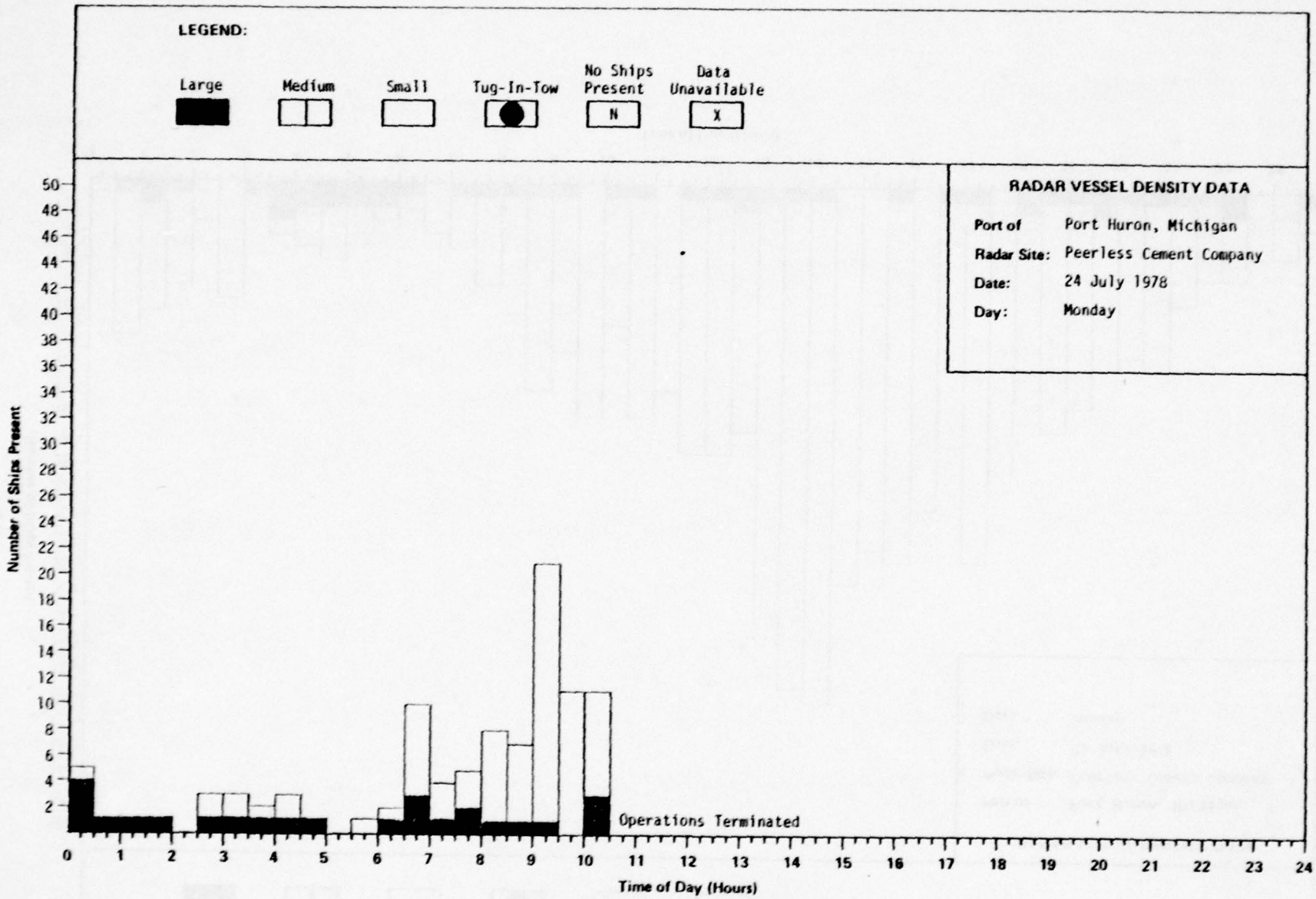

LEGEND:
Large
Medium
Small
Tug-In-Tow
No Ships Present
N
Data Unavailable
X
RADAR VESSEL DENSITY DATA
Port of Port Huron, Michigan
Radar Site: Peerless Cement Company
Date: 24 July 1978
Day: Monday
Number of Ships Present
Operations Terminated
Time of Day (Hours)

Figure 2-35

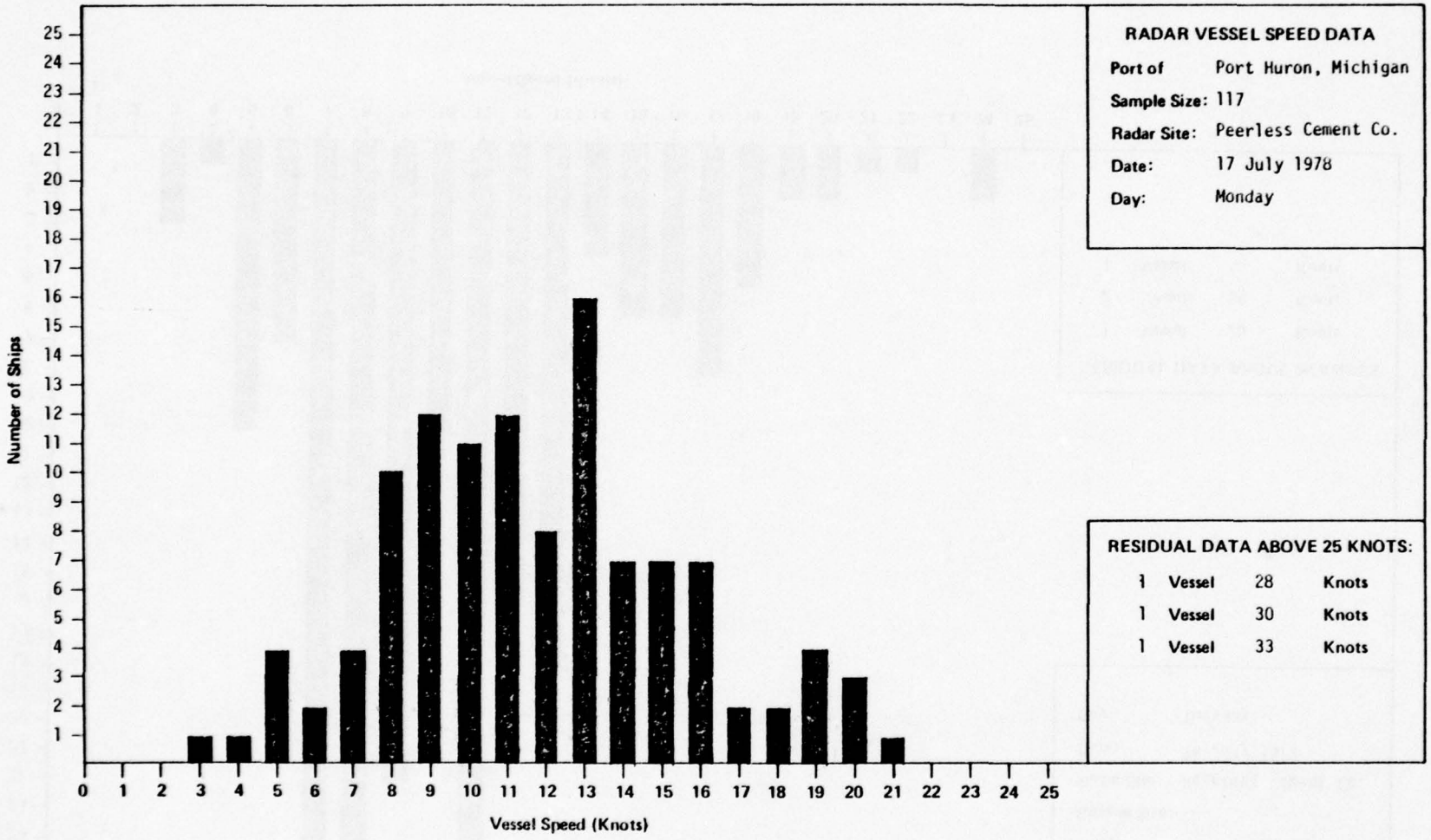

RADAR VESSEL SPEED DATA
Port of Port Huron, Michigan
Sample Size: 117
Radar Site: Peerless Cement Co.
Date: 17 July 1978
Day: Monday
RESIDUAL DATA ABOVE 25 KNOTS:
1 Vessel 28 Knots
1 Vessel 30 Knots
1 Vessel 33 Knots
Number of Ships
Vessel Speed (Knots)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

Figure 2-36

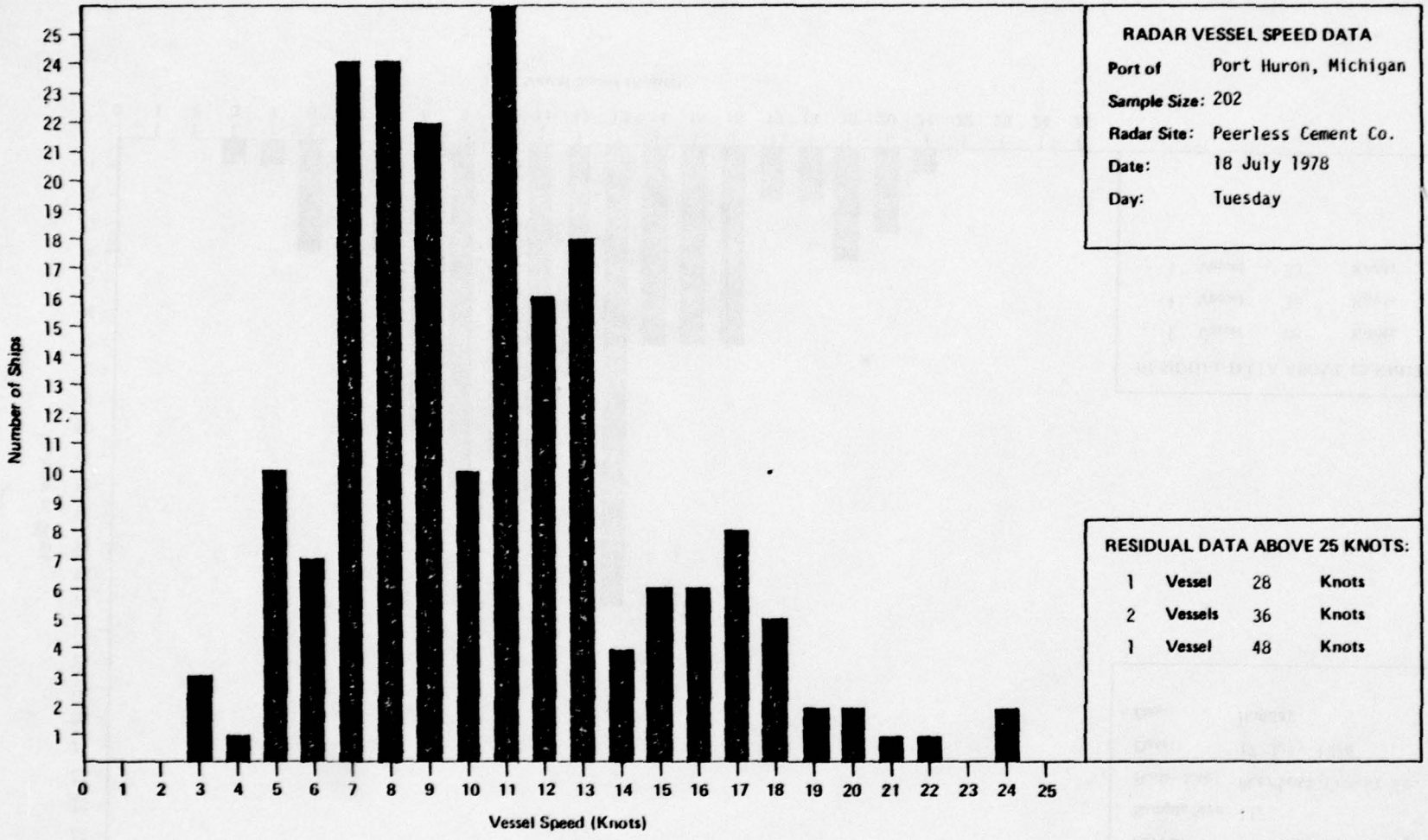

RADAR VESSEL SPEED DATA
Port of Port Huron, Michigan
Sample Size: 202
Radar Site: Peerless Cement Co.
Date: 18 July 1978
Day: Tuesday
RESIDUAL DATA ABOVE 25 KNOTS:
1 Vessel 28 Knots
2 Vessels 36 Knots
1 Vessel 48 Knots
Number of Ships
Vessel Speed (Knots)

Figure 2-37

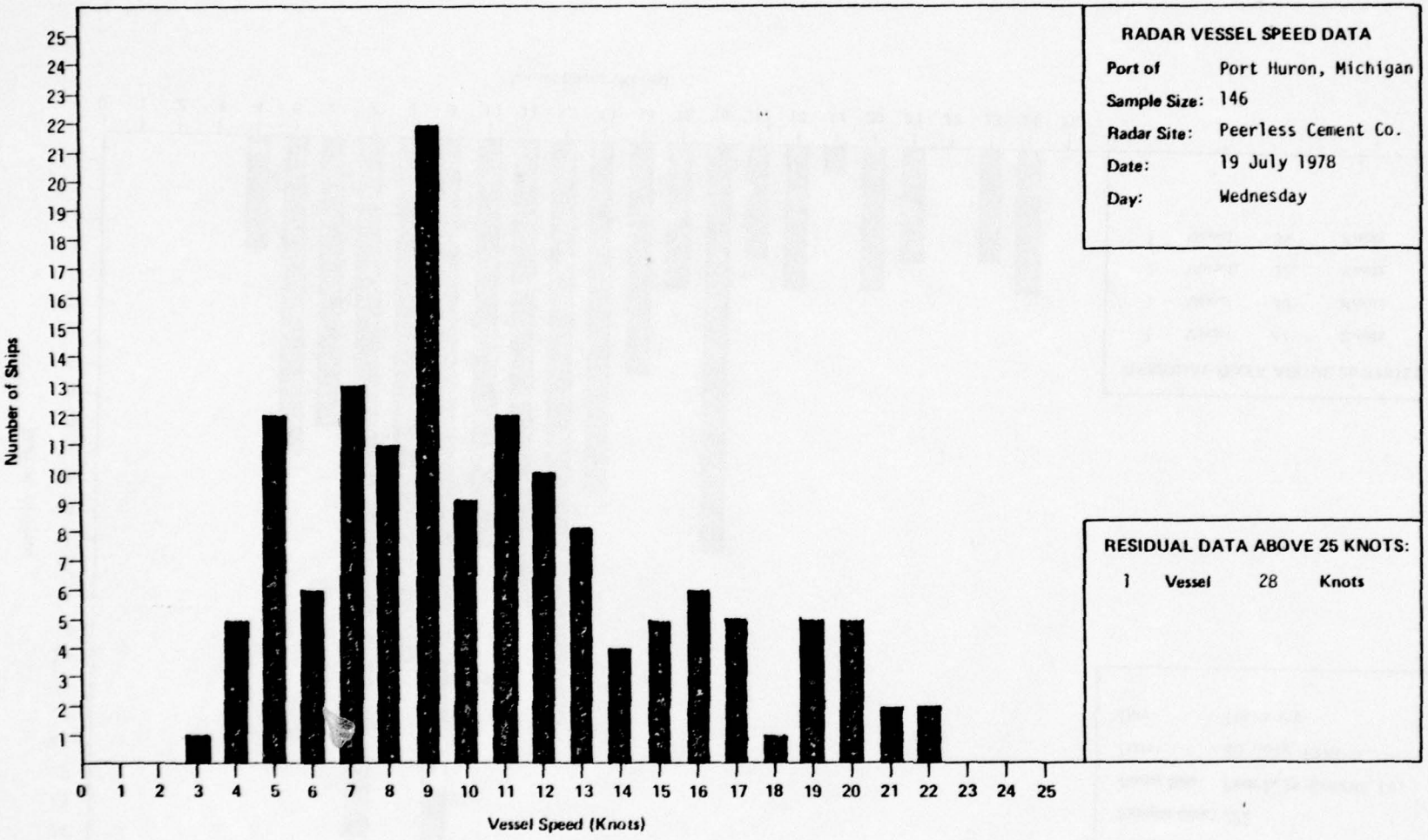

RADAR VESSEL SPEED DATA
Port of Port Huron, Michigan
Sample Size: 146
Radar Site: Peerless Cement Co.
Date: 19 July 1978
Day: Wednesday
RESIDUAL DATA ABOVE 25 KNOTS:
1 Vessel 28 Knots
Number of Ships
Vessel Speed (Knots)

Figure 2-38

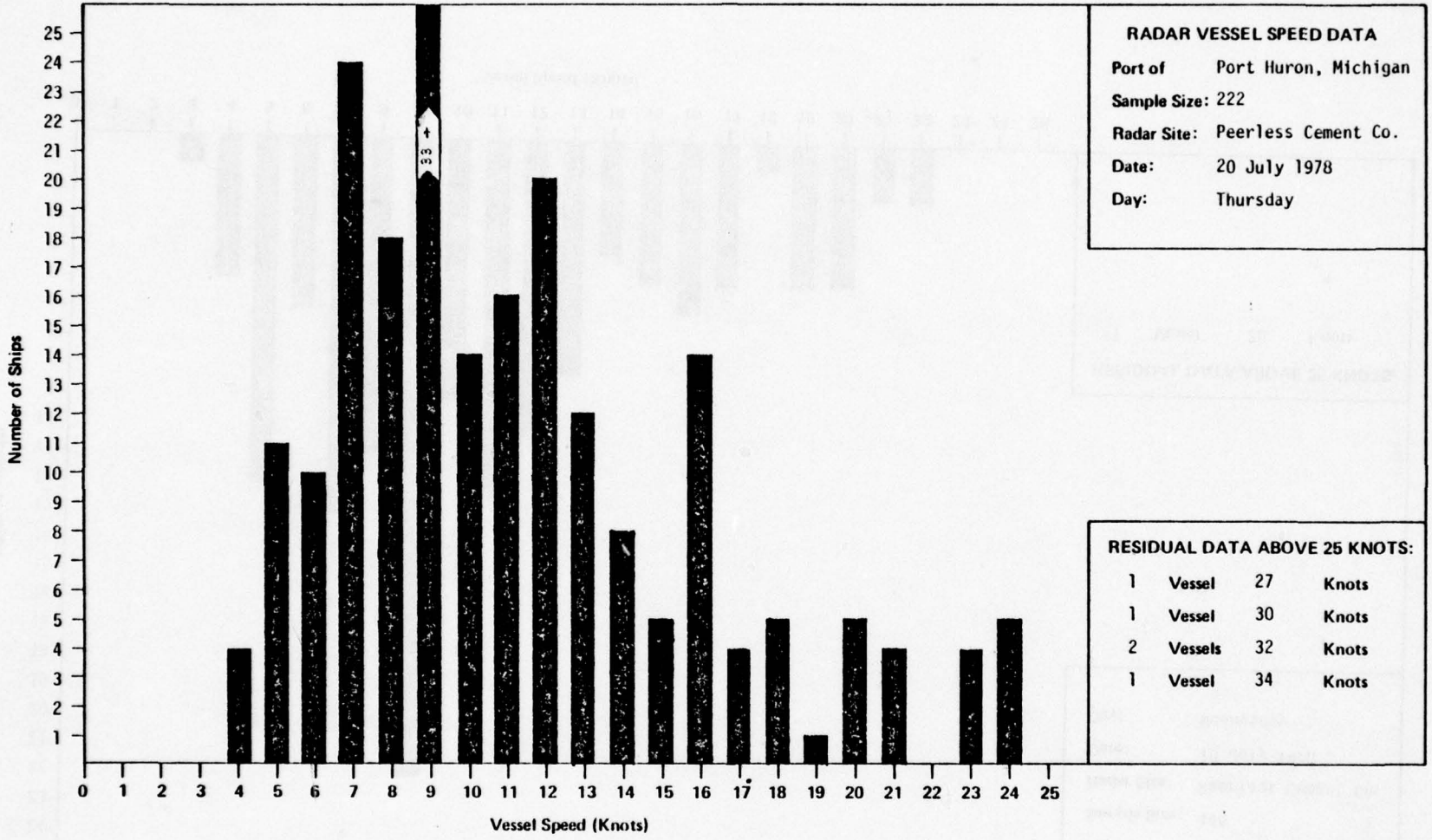

RADAR VESSEL SPEED DATA
Port of Port Huron, Michigan
Sample Size: 222
Radar Site: Peerless Cement Co.
Date: 20 July 1978
Day: Thursday
RESIDUAL DATA ABOVE 25 KNOTS:
1 Vessel 27 Knots
1 Vessel 30 Knots
2 Vessels 32 Knots
1 Vessel 34 Knots
Number of Ships
Vessel Speed (Knots)
33 +

Figure 2-39

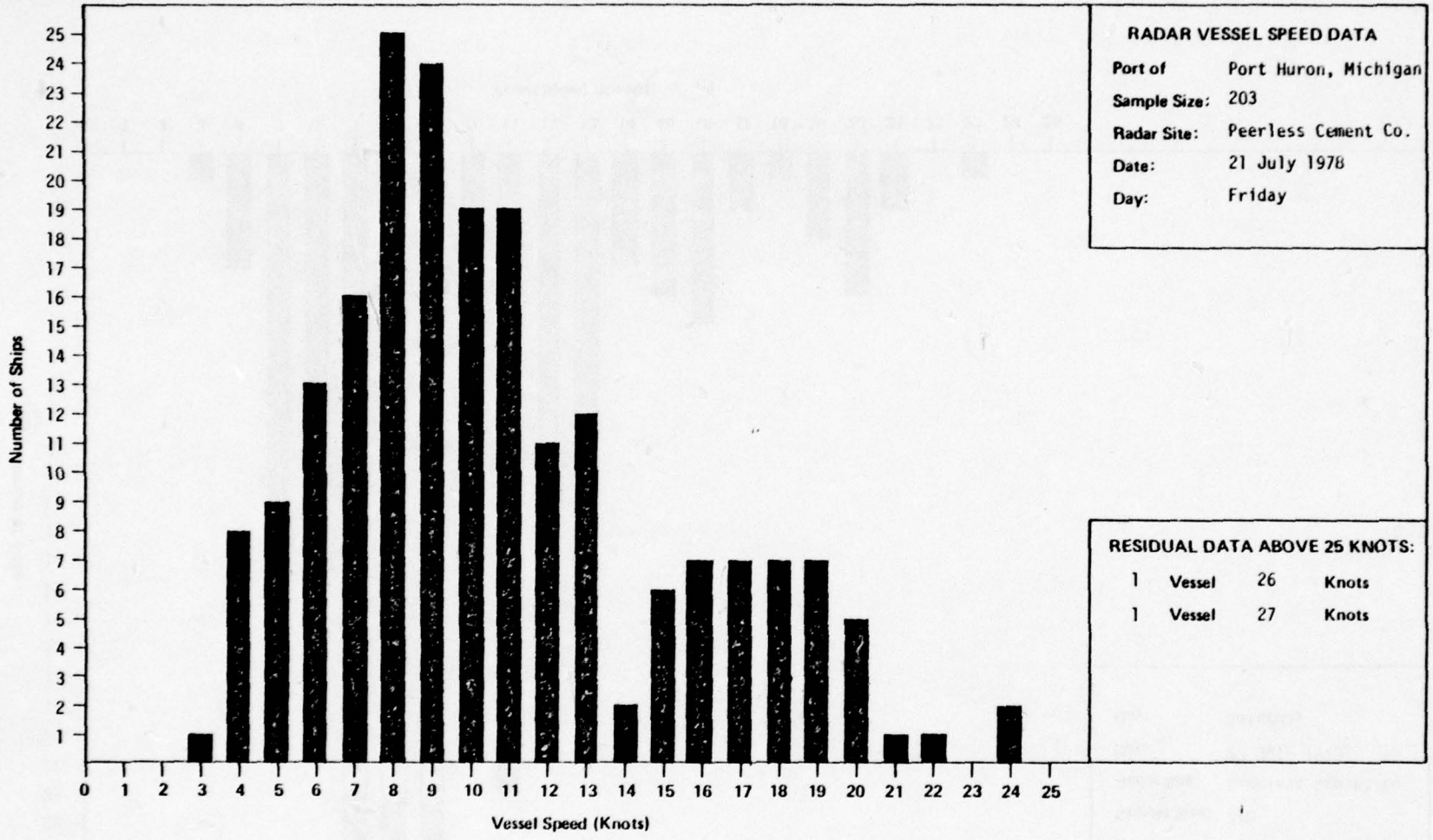

RADAR VESSEL SPEED DATA
Port of Port Huron, Michigan
Sample Size: 203
Radar Site: Peerless Cement Co.
Date: 21 July 1978
Day: Friday
RESIDUAL DATA ABOVE 25 KNOTS:
1 Vessel 26 Knots
1 Vessel 27 Knots
Number of Ships
Vessel Speed (Knots)

Figure 2-40

Figure 2-41

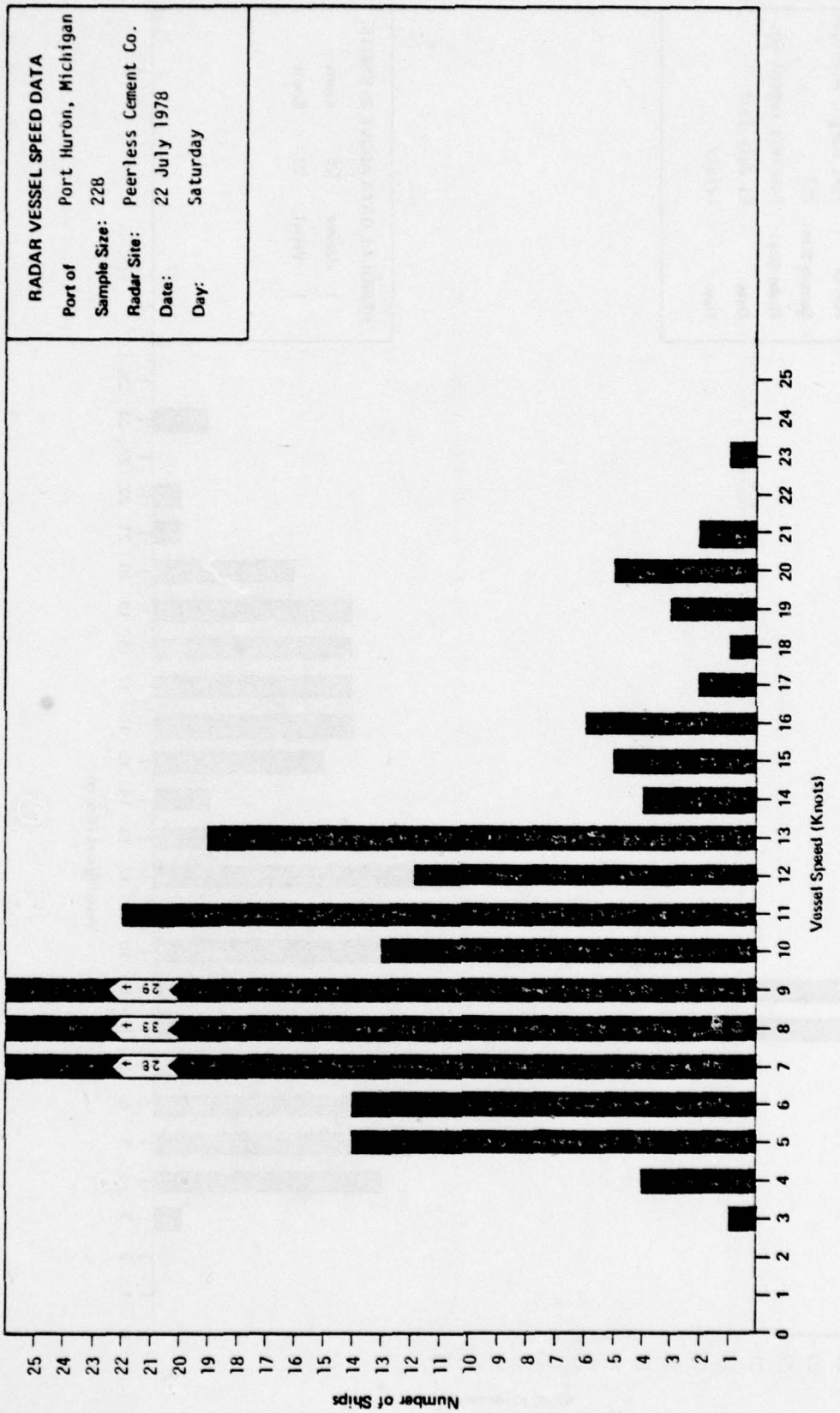

RADAR VESSEL SPEED DATA
Port of Port Huron, Michigan
Sample Size: 228
Radar Site: Peerless Cement Co.
Date: 22 July 1978
Day: Saturday
Number of Ships
Vessel Speed (Knots)
28
33
29

Figure 2-42

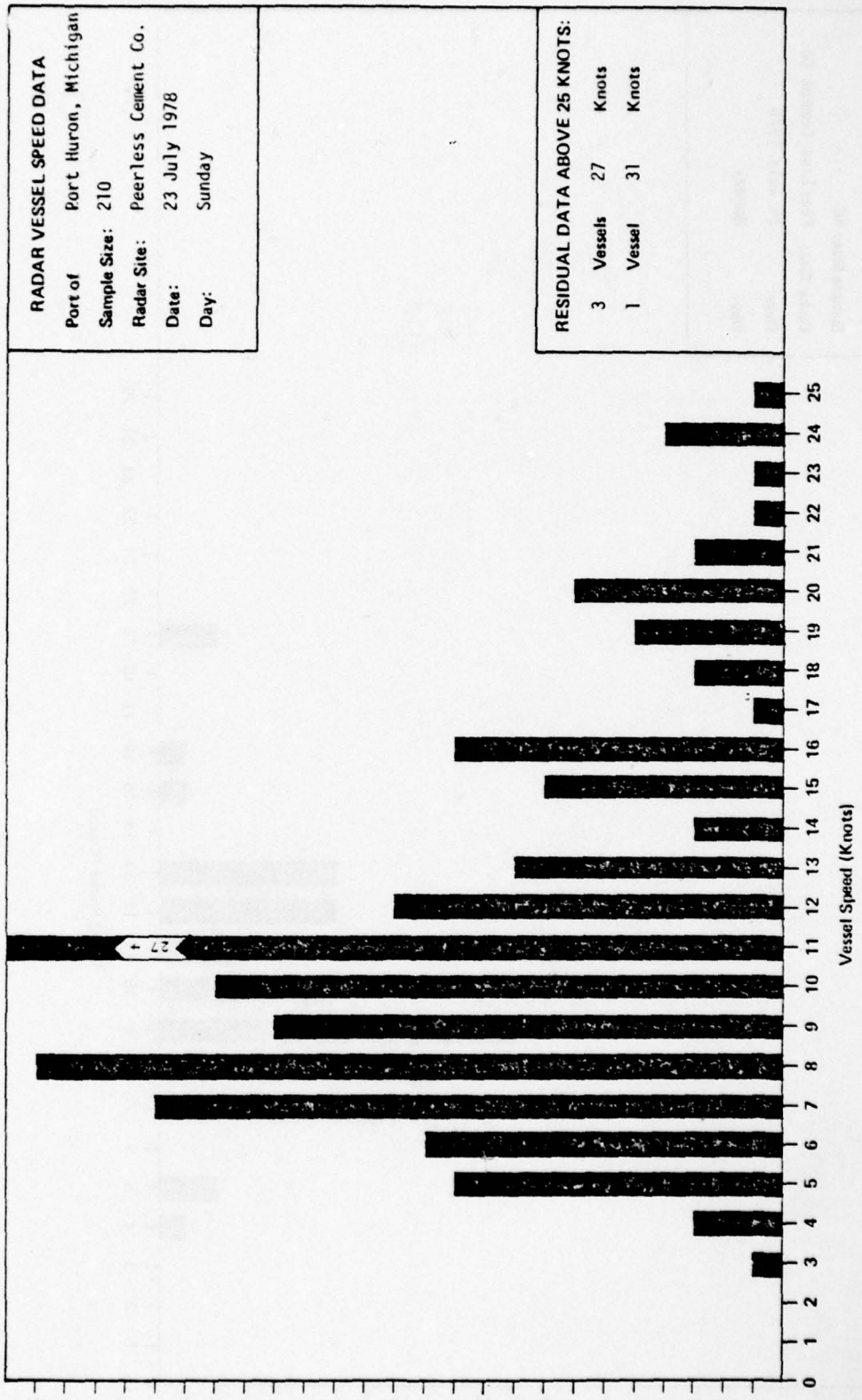
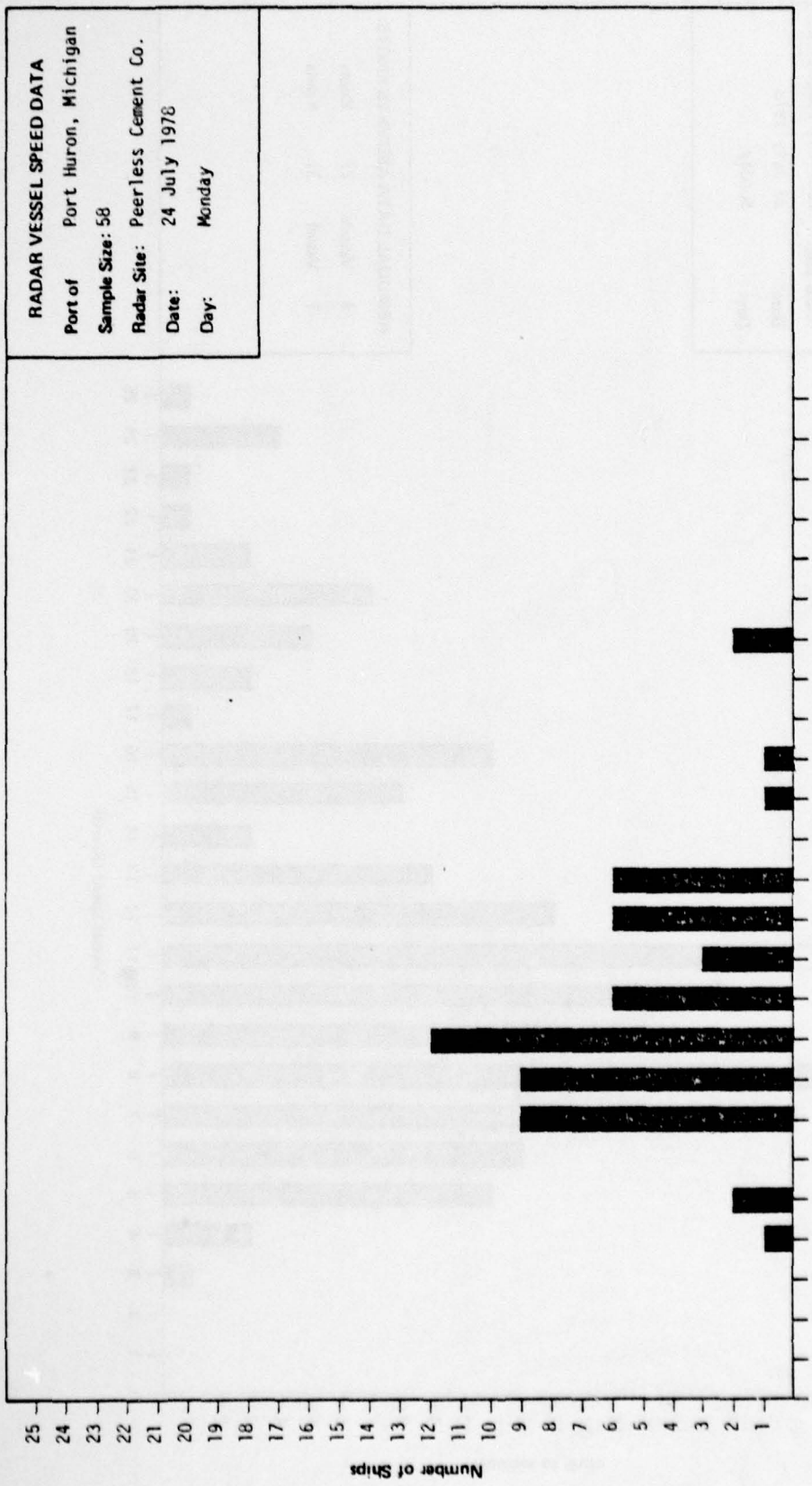

RADAR VESSEL SPEED DATA
Port of Port Huron, Michigan
Sample Size: 210
Radar Site: Peerless Cement Co.
Date: 23 July 1978
Day: Sunday
RESIDUAL DATA ABOVE 25 KNOTS:
3 Vessels 27 Knots
1 Vessel 31 Knots
27 +
Number of Ships
Vessel Speed (Knots)

Figure 2-43


RADAR VESSEL SPEED DATA
Port of Port Huron, Michigan
Sample Size: 58
Radar Site: Peerless Cement Co.
Date: 24 July 1978
Day: Monday
Number of Ships
Vessel Speed (Knots)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

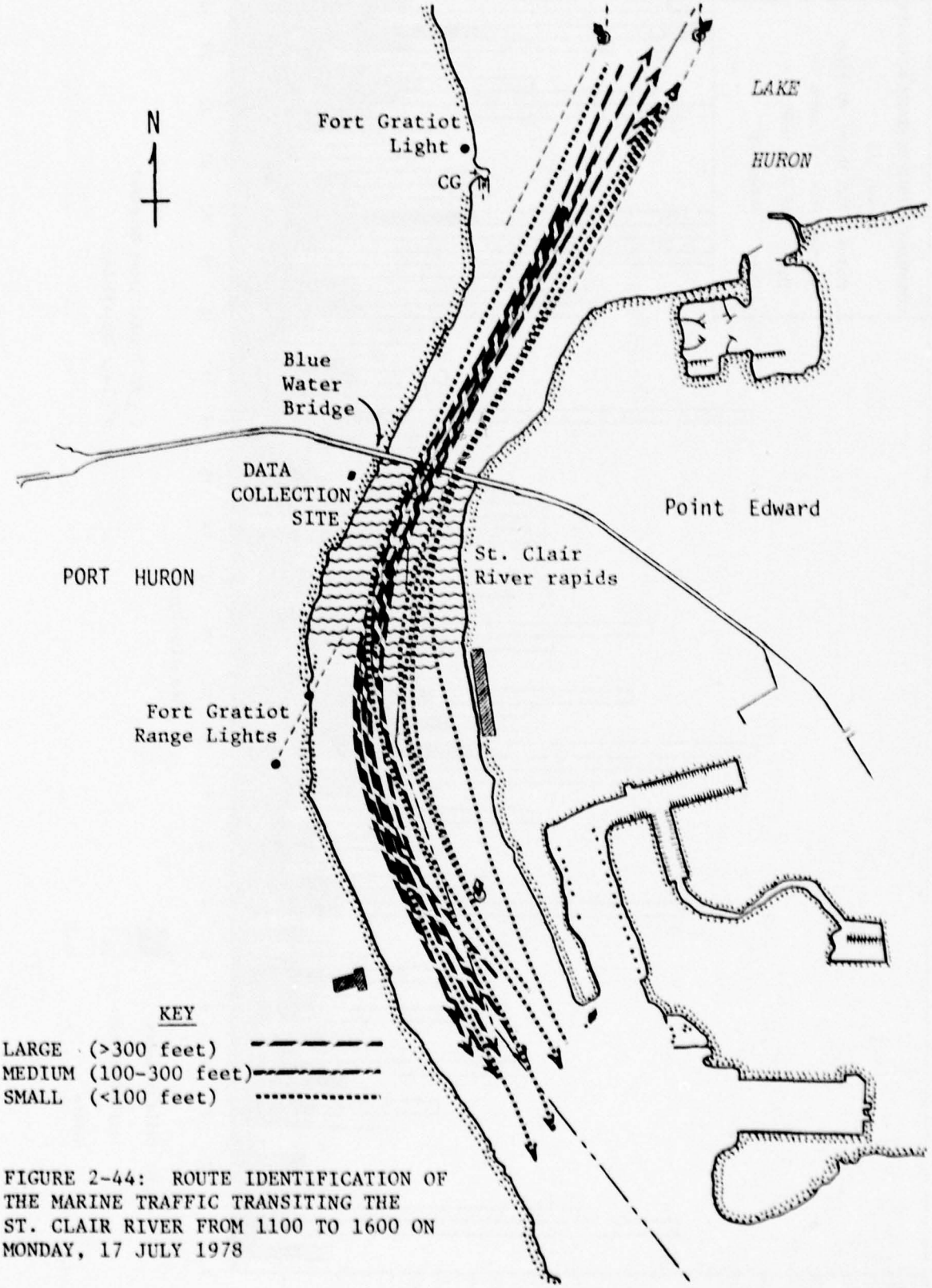


FIGURE 2-44: ROUTE IDENTIFICATION OF THE MARINE TRAFFIC TRANSITING THE ST. CLAIR RIVER FROM 1100 TO 1600 ON MONDAY, 17 JULY 1978

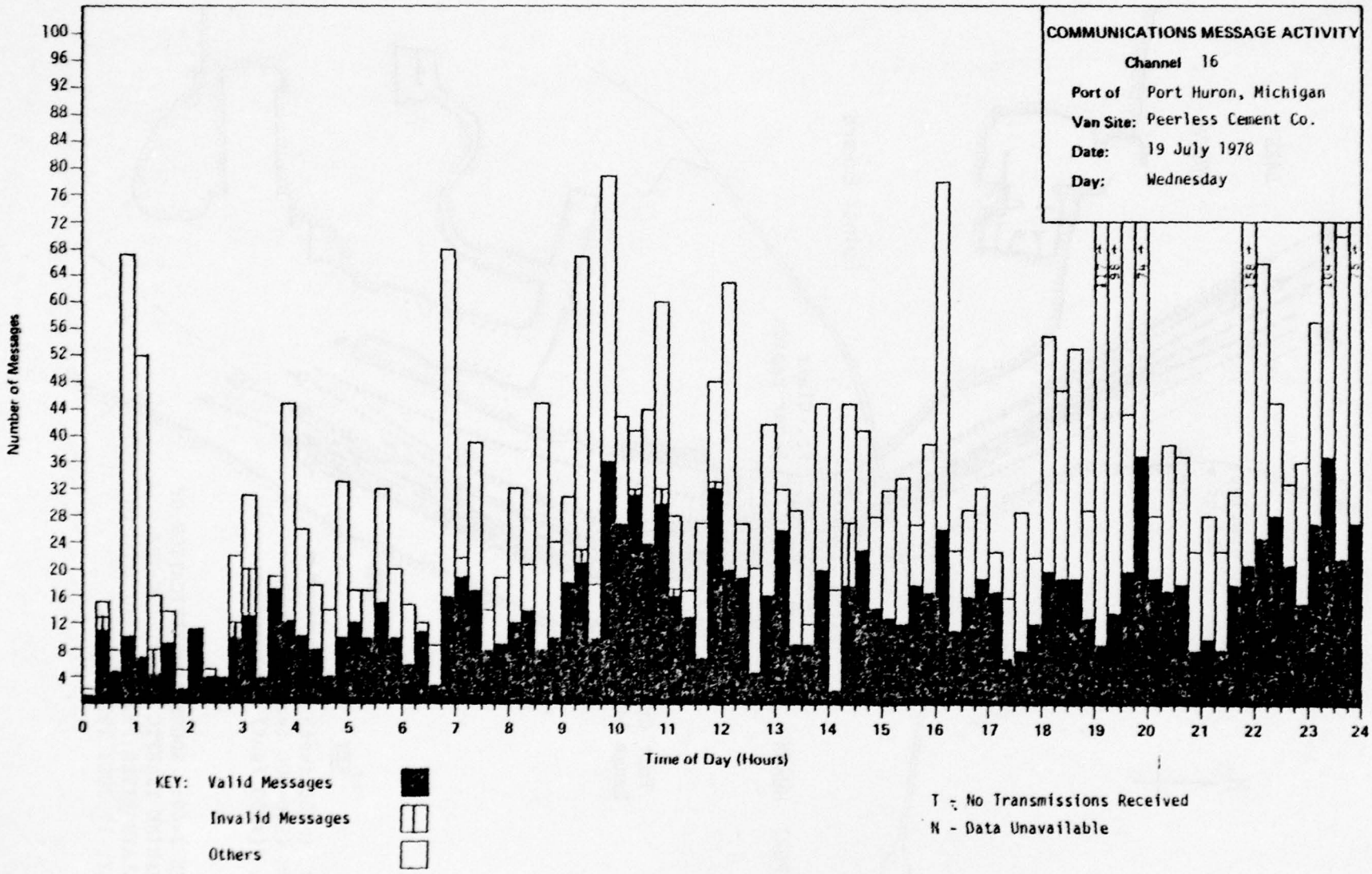

COMMUNICATIONS MESSAGE ACTIVITY
Channel 16
Port of Port Huron, Michigan
Van Site: Peerless Cement Co.
Date: 19 July 1978
Day: Wednesday
Number of Messages
Time of Day (Hours)
KEY: Valid Messages
Invalid Messages
Others
T - No Transmissions Received
N - Data Unavailable

Figure 2-45

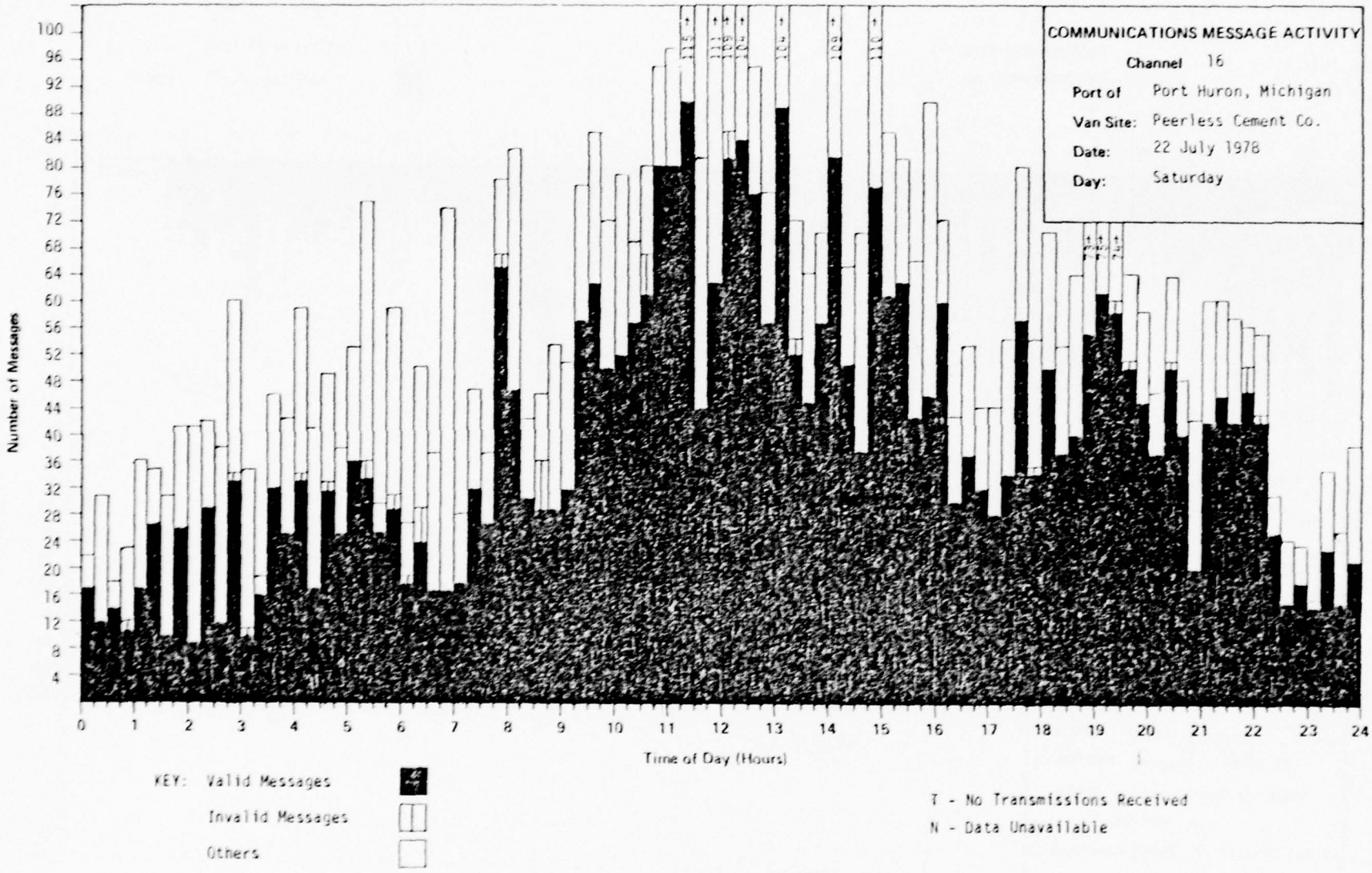

COMMUNICATIONS MESSAGE ACTIVITY
Channel 16
Port of Port Huron, Michigan
Van Site: Peerless Cement Co.
Date: 22 July 1978
Day: Saturday
Number of Messages
Time of Day (Hours)
KEY: Valid Messages
Invalid Messages
Others
T - No Transmissions Received
N - Data Unavailable

Figure 2-46

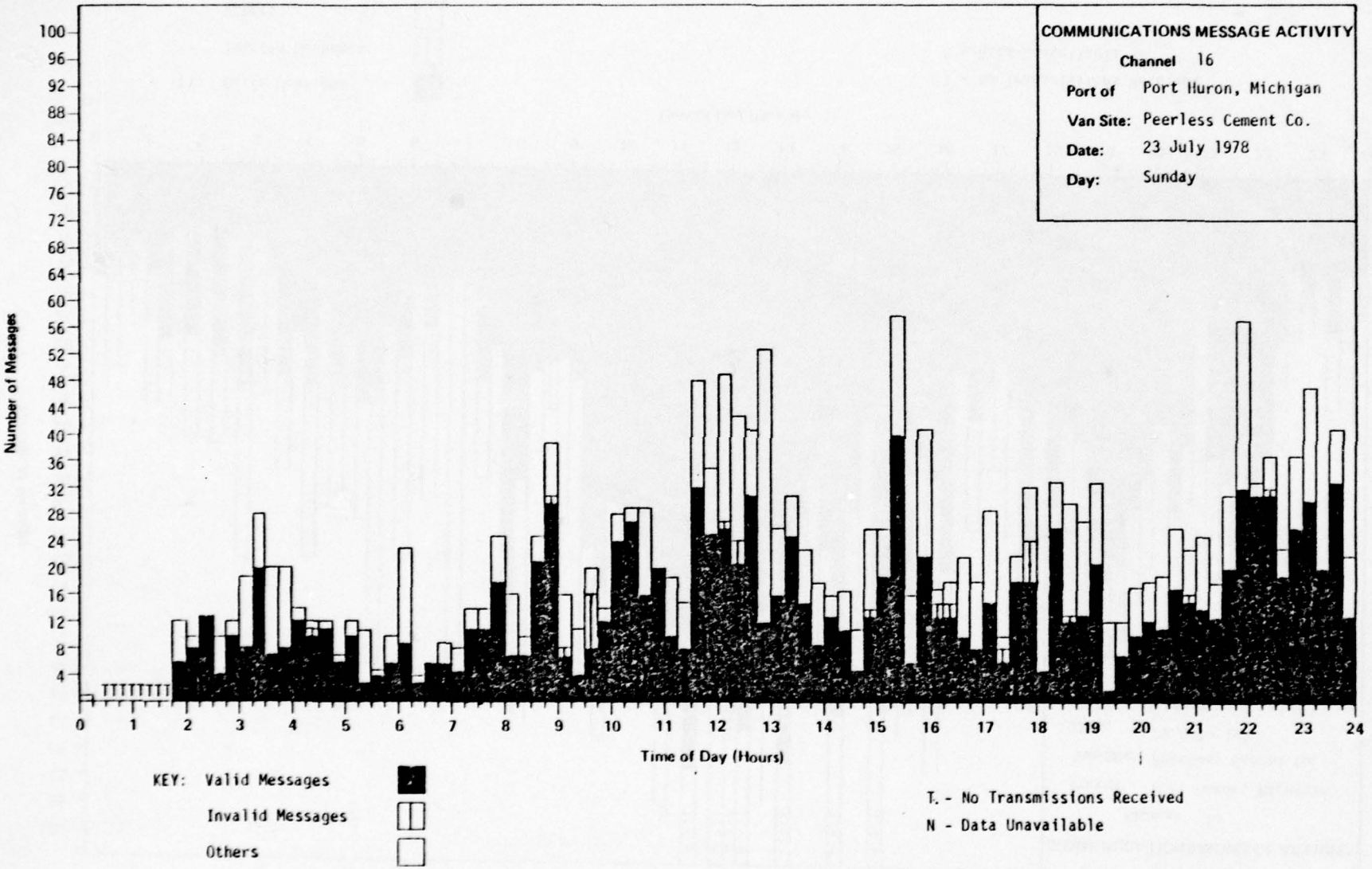
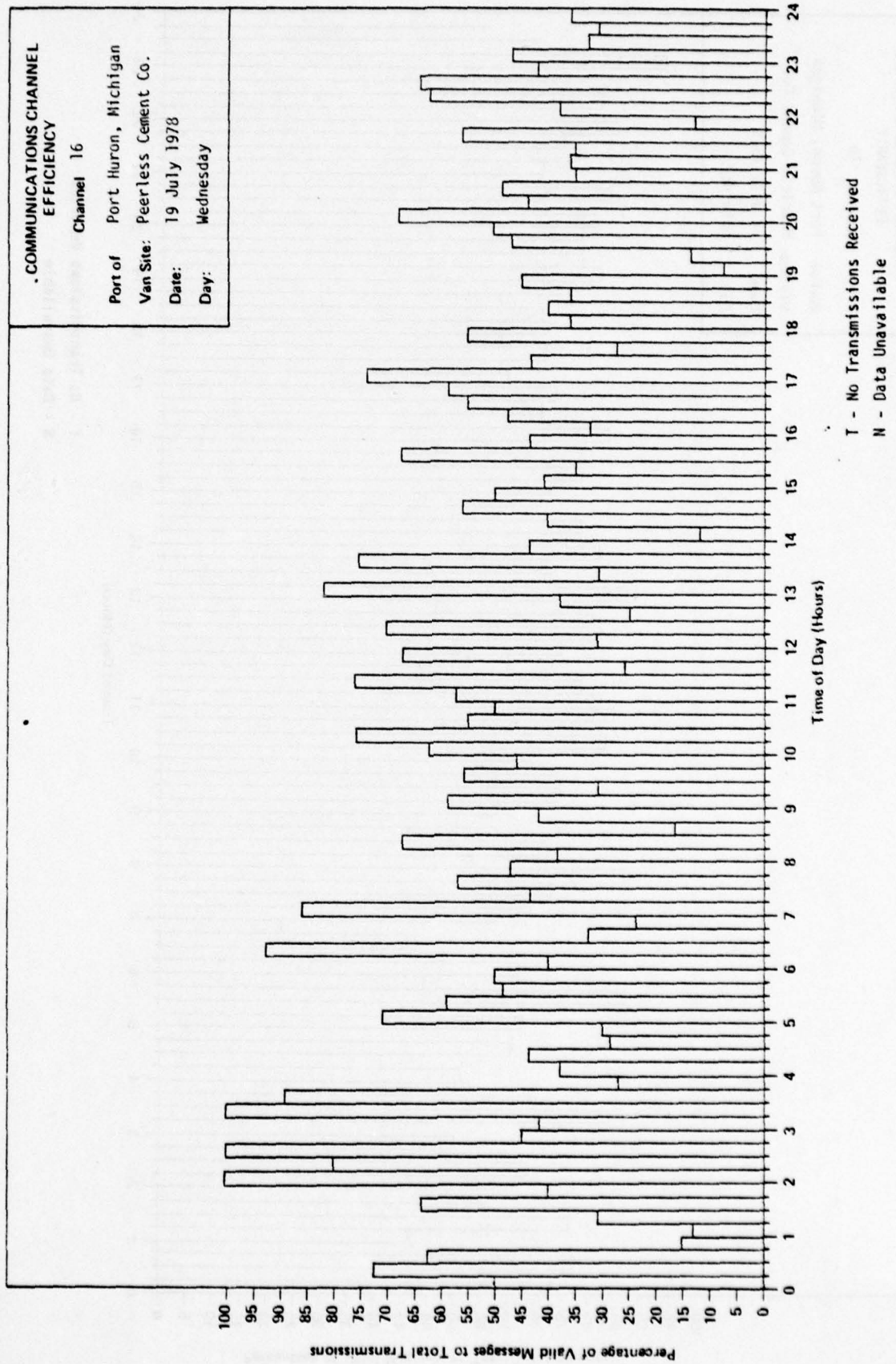

COMMUNICATIONS MESSAGE ACTIVITY
Channel 16
Port of Port Huron, Michigan
Van Site: Peerless Cement Co.
Date: 23 July 1978
Day: Sunday
Number of Messages
Time of Day (Hours)
KEY: Valid Messages
Invalid Messages
Others
T. - No Transmissions Received
N - Data Unavailable

Figure 2-47

Figure 2-48


.COMMUNICATIONS CHANNEL EFFICIENCY
Channel 16
Port of Port Huron, Michigan
Van Site: Peerless Cement Co.
Date: 19 July 1978
Day: Wednesday
Percentage of Valid Messages to Total Transmissions
Time of Day (Hours)
T - No Transmissions Received
N - Data Unavailable

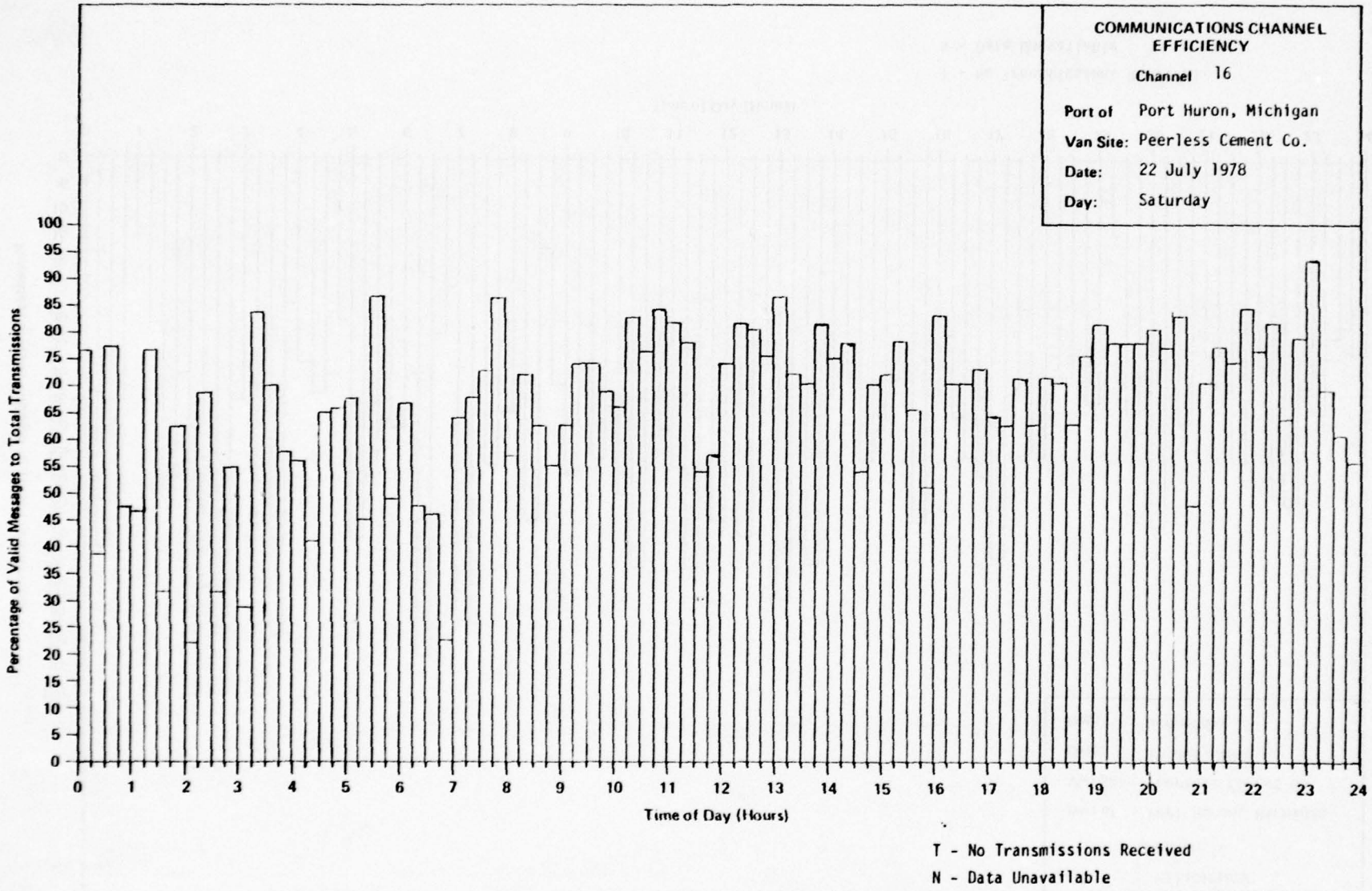
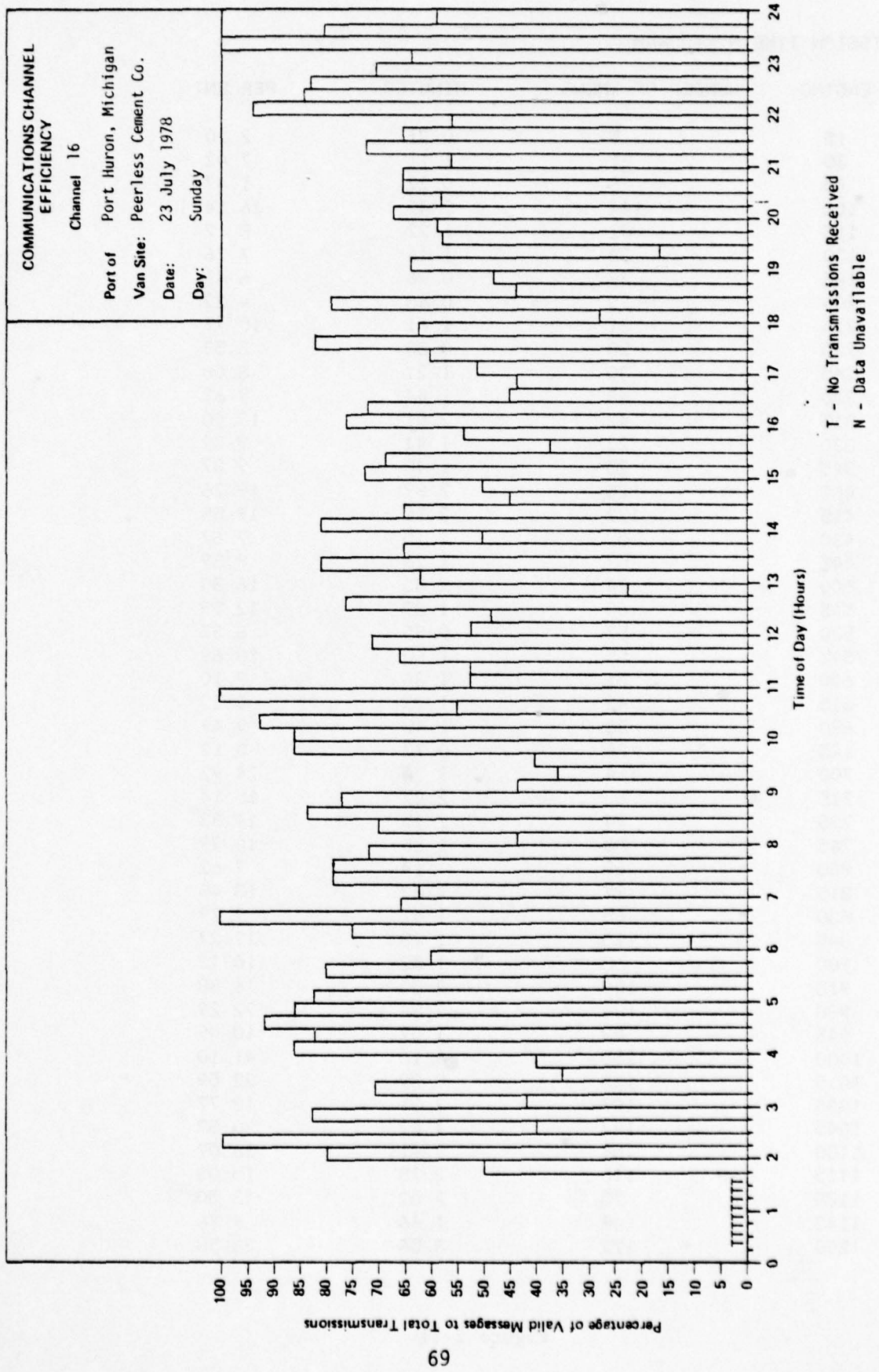

COMMUNICATIONS CHANNEL EFFICIENCY
Channel 16
Port of Port Huron, Michigan
Van Site: Peerless Cement Co.
Date: 22 July 1978
Day: Saturday
Percentage of Valid Messages to Total Transmissions
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Time of Day (Hours)
T - No Transmissions Received
N - Data Unavailable

Figure 2-49

Figure 2-50


COMMUNICATIONS CHANNEL EFFICIENCY
Channel 16
Port of Port Huron, Michigan
Van Site: Peerless Cement Co.
Date: 23 July 1978
Day: Sunday
Percentage of Valid Messages to Total Transmissions
Time of Day (Hours)
T - No Transmissions Received
N - Data Unavailable

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TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
15	5	0.31	2.10
30	21	1.11	7.42
45	6	0.22	1.47
100	144	2.42	16.14
115	82	1.22	8.12
130	32	1.16	7.76
145	29	0.96	6.42
200	25	0.63	4.22
215	31	1.61	10.77
230	28	0.83	5.53
245	30	1.21	8.06
300	43	1.44	9.63
315	43	2.01	13.40
330	22	1.41	9.39
345	25	1.48	9.87
400	125	2.89	19.26
415	122	2.98	19.88
430	55	1.15	7.67
445	57	1.26	8.39
500	94	2.45	16.34
515	60	1.89	12.59
530	57	0.95	6.37
545	55	1.60	10.69
600	51	1.36	9.10
615	42	1.23	8.23
630	36	1.42	9.49
645	26	0.77	5.12
700	164	3.74	24.92
715	68	2.27	15.14
730	94	2.15	14.33
745	80	1.65	10.99
800	68	1.14	7.62
815	87	2.02	13.48
830	65	1.47	9.79
845	123	1.83	12.22
900	68	1.52	10.12
915	100	2.53	16.88
930	136	3.34	22.29
945	83	1.57	10.49
1000	255	6.16	41.10
1015	125	3.39	22.59
1030	107	2.81	18.77
1045	197	4.62	30.83
1100	154	3.91	26.07
1115	110	2.25	15.03
1130	75	2.02	13.50
1145	68	1.46	9.76
1200	122	3.54	23.58

Figure 2-51

TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
1215	152	3.34	22.30
1230	69	1.89	12.59
1245	55	0.72	4.78
1300	137	3.32	22.17
1315	120	3.16	21.07
1330	88	2.12	14.16
1345	88	1.87	12.44
1400	136	3.35	22.33
1415	51	0.86	5.73
1430	130	3.73	24.84
1445	159	3.14	20.94
1500	180	3.48	23.18
1515	128	2.38	15.86
1530	107	1.77	11.82
1545	140	3.34	22.29
1600	116	2.07	13.80
1615	142	2.87	19.12
1630	105	2.05	13.67
1645	97	2.19	14.58
1700	107	2.39	15.97
1715	65	1.95	13.02
1730	37	1.13	7.51
1745	68	1.38	9.22
1800	59	1.70	11.34
1815	183	3.13	20.87
1830	113	3.51	23.40
1845	129	3.62	24.12
1900	73	1.85	12.31
1915	239	4.12	27.46
1930	158	2.59	17.24
1945	101	2.28	15.23
2000	124	3.18	21.22
2015	66	2.91	19.39
2030	70	2.61	17.39
2045	28	0.85	5.66
2100	95	1.74	11.62
2115	70	2.02	13.47
2130	61	1.56	10.43
2145	51	2.38	15.86
2200	217	4.11	27.41
2215	132	2.97	19.78
2230	84	3.02	20.12
2245	70	1.92	12.79
2300	76	1.83	12.18
2315	81	2.56	17.09
2330	126	3.53	23.57
2345	108	3.31	22.09
2400	111	4.06	27.04

Figure 2-51 (continued)

TOTAL NUMBER OF TRANSMISSIONS: 8797
AVE. NUM. OF TRANSMISSIONS PER HOUR: 366.5
TOTAL TRANSMISSION TIME: 3.588 HOURS
AVERAGE LENGTH OF TRANSMISSION: 1.47 SEC.
PERCENT CHANNEL UTILIZATION: 14.95%

MESSAGE LENGTH HISTOGRAM

LENGTH OF XMSNS	NUMBER OF XMSNS	PERCENT
0.1 - 0.5 SEC.	3235	36.77
0.5 - 1.0 SEC.	1680	19.10
1.0 - 1.5 SEC.	904	10.28
1.5 - 2.0 SEC.	607	6.90
2.0 - 2.5 SEC.	1082	12.30
2.5 - 3.0 SEC.	215	2.44
3.0 - 3.5 SEC.	196	2.23
3.5 - 4.0 SEC.	143	1.63
4.0 - 4.5 SEC.	343	3.90
4.5 - 5.0 SEC.	65	0.74
5.0 - 5.5 SEC.	61	0.69
5.5 - 6.0 SEC.	49	0.56
6.0 - 6.5 SEC.	29	0.33
6.5 - 7.0 SEC.	54	0.61
7.0 - 7.5 SEC.	14	0.16
7.5 - 8.0 SEC.	21	0.24
8.0 - 8.5 SEC.	11	0.13
8.5 - 9.0 SEC.	37	0.42
9.0 - 9.5 SEC.	7	0.08
9.5 - 10.0 SEC.	5	0.06
LONGER THAN 10 SEC. :	39	0.44

THERE WERE 3456 XMSNS OF 00.1 AND 00.0 DURATION

Figure 2-51 (continued)

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TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
15	36	1.45	9.66
30	51	1.37	9.16
45	44	1.75	11.64
100	53	1.88	12.53
115	87	2.75	18.34
130	58	2.09	13.96
145	55	1.40	9.33
200	95	3.05	20.34
215	99	1.68	11.22
230	72	1.87	12.47
245	72	1.40	9.31
300	84	2.22	14.81
315	72	1.26	8.38
330	57	1.96	13.08
345	65	1.97	13.12
400	85	2.69	17.93
415	99	2.96	19.73
430	75	2.22	14.79
445	98	2.49	16.63
500	63	2.22	14.82
515	86	2.42	16.12
530	136	4.84	32.30
545	51	1.56	10.43
600	109	2.90	19.34
615	54	1.58	10.56
630	79	2.42	16.13
645	102	2.05	13.69
700	156	4.04	26.92
715	60	1.90	12.66
730	78	2.88	19.23
745	63	1.98	13.22
800	143	4.76	31.76
815	132	3.26	21.77
830	97	2.52	16.80
845	94	3.11	20.76
900	72	2.51	16.71
915	99	3.34	22.28
930	143	4.25	28.37
945	165	5.01	33.43
1000	108	3.10	20.70
1015	176	4.01	26.74
1030	101	4.12	27.48
1045	139	6.10	40.64
1100	150	5.04	33.58
1115	156	6.04	40.27
1130	197	6.99	46.61
1145	133	3.41	22.74
1200	203	5.29	35.26

Figure 2-52 (continued)

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TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
1215	201	6.29	41.94
1230	203	6.23	41.57
1245	149	4.92	32.81
1300	151	4.02	26.82
1315	155	4.64	30.93
1330	174	4.92	32.80
1345	150	4.29	28.62
1400	133	4.69	31.28
1415	188	6.26	41.73
1430	144	3.88	25.88
1445	153	3.65	24.36
1500	217	6.55	43.64
1515	227	6.47	43.11
1530	140	4.95	32.98
1545	142	4.08	27.19
1600	212	4.52	30.14
1615	139	4.39	29.27
1630	89	2.76	18.41
1645	113	3.49	23.30
1700	112	2.69	17.96
1715	99	3.28	21.87
1730	92	2.85	18.99
1745	167	5.31	35.41
1800	148	3.37	22.44
1815	157	4.35	29.03
1830	118	3.96	26.40
1845	145	4.69	31.24
1900	140	4.62	30.80
1915	129	4.27	28.46
1930	137	4.52	30.11
1945	127	4.45	29.67
2000	135	3.65	24.31
2015	86	3.48	23.20
2030	132	4.16	27.76
2045	118	4.12	27.46
2100	89	2.26	15.04
2115	114	4.01	26.76
2130	110	3.95	26.37
2145	92	3.17	21.14
2200	119	4.12	27.46
2215	117	3.72	24.81
2230	65	2.43	16.23
2245	60	1.77	11.79
2300	33	1.39	9.30
2315	38	1.53	10.20
2330	94	2.81	18.74
2345	25	0.45	3.01
2400	132	4.61	30.76

Figure 2-52 (continued)

TOTAL NUMBER OF TRANSMISSIONS: 10912
AVE. NUM. OF TRANSMISSIONS PER HOUR: 454.7
TOTAL TRANSMISSION TIME: 5.553 HOURS
AVERAGE LENGTH OF TRANSMISSION: 1.83 SEC.
PERCENT CHANNEL UTILIZATION: 23.14%

MESSAGE LENGTH HISTOGRAM

LENGTH OF XMSNS	NUMBER OF XMSNS	PERCENT
0.1 - 0.5 SEC.	3061	28.05
0.5 - 1.0 SEC.	1639	15.02
1.0 - 1.5 SEC.	1170	10.72
1.5 - 2.0 SEC.	972	8.91
2.0 - 2.5 SEC.	1672	15.32
2.5 - 3.0 SEC.	414	3.79
3.0 - 3.5 SEC.	329	3.02
3.5 - 4.0 SEC.	307	2.81
4.0 - 4.5 SEC.	608	5.57
4.5 - 5.0 SEC.	123	1.13
5.0 - 5.5 SEC.	122	1.12
5.5 - 6.0 SEC.	84	0.77
6.0 - 6.5 SEC.	87	0.80
6.5 - 7.0 SEC.	168	1.54
7.0 - 7.5 SEC.	32	0.29
7.5 - 8.0 SEC.	22	0.20
8.0 - 8.5 SEC.	18	0.16
8.5 - 9.0 SEC.	25	0.23
9.0 - 9.5 SEC.	10	0.09
9.5 - 10.0 SEC.	6	0.05
LONGER THAN 10 SEC.:	43	0.39

THERE WERE 4203 XMSNS OF 00.1 AND 00.0 DURATION

Figure 2-52 (continued)

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TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
15	1	0.47	3.13
30	0	0.00	0.00
45	0	0.00	0.00
100	70	2.38	15.90
115	92	2.87	19.13
130	70	2.07	13.81
145	40	0.86	5.73
200	29	0.90	5.99
215	23	0.43	2.86
230	27	0.63	4.22
245	20	0.57	3.81
300	27	0.85	5.64
315	87	2.11	14.09
330	66	1.87	12.44
345	18	0.46	3.08
400	42	1.19	7.97
415	34	0.90	6.01
430	18	0.81	5.43
445	52	1.60	10.66
500	21	0.75	5.01
515	16	0.48	3.23
530	26	0.64	4.30
545	15	0.55	3.68
600	20	0.39	2.60
615	45	0.78	5.21
630	10	0.17	1.16
645	14	0.35	2.32
700	145	1.11	7.40
715	25	0.70	4.66
730	54	1.20	8.02
745	36	0.99	6.60
800	60	1.23	8.21
815	58	0.73	4.84
830	20	0.40	2.64
845	48	1.45	9.69
900	107	2.67	17.80
915	63	1.67	11.12
930	33	0.87	5.81
945	51	1.19	7.93
1000	54	1.31	8.73
1015	82	2.01	13.38
1030	85	3.12	20.81
1045	89	2.56	17.10
1100	106	2.80	18.69
1115	97	1.75	11.68
1130	44	2.19	14.63
1145	0	0.00	0.00
1200	28	1.27	8.50

Figure 2-53 (continued)

TRANSMISSION TIME HISTOGRAM

PERIOD ENDING:	NUMBER OF XMSNS:	MINUTES:	PERCENT:
1215	125	2.72	18.17
1230	180	3.47	23.12
1245	106	2.72	18.13
1300	289	3.49	23.28
1315	90	1.84	12.30
1330	52	0.87	5.82
1345	102	2.61	17.39
1400	63	1.62	10.81
1415	53	1.47	9.81
1430	29	0.65	4.33
1445	63	1.31	8.74
1500	67	1.09	7.28
1515	83	2.42	16.12
1530	100	3.23	21.51
1545	64	1.61	10.74
1600	221	3.04	20.30
1615	70	1.65	11.02
1630	63	1.59	10.63
1645	51	1.47	9.79
1700	35	0.84	5.60
1715	93	2.02	13.44
1730	52	1.27	8.50
1745	36	1.03	6.86
1800	109	3.89	25.92
1815	76	1.70	11.32
1830	87	2.11	14.06
1845	92	1.96	13.10
1900	170	2.26	15.07
1915	85	1.91	12.72
1930	36	0.71	4.73
1945	46	1.21	8.10
2000	41	0.82	5.49
2015	51	1.49	9.92
2030	54	1.47	9.82
2045	62	1.70	11.31
2100	54	1.63	10.86
2115	74	2.05	13.69
2130	33	1.10	7.36
2145	53	1.45	9.70
2200	122	3.32	22.11
2215	65	2.74	18.27
2230	57	2.14	14.24
2245	66	2.37	15.82
2300	56	2.40	16.01
2315	59	1.40	9.36
2330	40	1.44	9.61
2345	63	1.96	13.06
2400	47	1.84	12.26

Figure 2-53 (continued)

TOTAL NUMBER OF TRANSMISSIONS: 5953
AVE. NUM. OF TRANSMISSIONS PER HOUR: 248.0
TOTAL TRANSMISSION TIME: 2.458 HOURS
AVERAGE LENGTH OF TRANSMISSION: 1.49 SEC.
PERCENT CHANNEL UTILIZATION: 10.24%

MESSAGE LENGTH HISTOGRAM

LENGTH OF XMSNS	NUMBER OF XMSNS	PERCENT
0.1 - 0.5 SEC.	2364	39.71
0.5 - 1.0 SEC.	934	15.69
1.0 - 1.5 SEC.	562	9.44
1.5 - 2.0 SEC.	430	7.22
2.0 - 2.5 SEC.	703	11.81
2.5 - 3.0 SEC.	172	2.89
3.0 - 3.5 SEC.	145	2.44
3.5 - 4.0 SEC.	128	2.15
4.0 - 4.5 SEC.	225	3.78
4.5 - 5.0 SEC.	56	0.94
5.0 - 5.5 SEC.	44	0.74
5.5 - 6.0 SEC.	38	0.64
6.0 - 6.5 SEC.	36	0.60
6.5 - 7.0 SEC.	62	1.04
7.0 - 7.5 SEC.	6	0.10
7.5 - 8.0 SEC.	12	0.20
8.0 - 8.5 SEC.	6	0.10
8.5 - 9.0 SEC.	10	0.17
9.0 - 9.5 SEC.	1	0.02
9.5 - 10.0 SEC.	1	0.02
LONGER THAN 10 SEC. :	18	0.30

THERE WERE 2355 XMSNS OF 00.1 AND 00.0 DURATION

Figure 2-53 (continued)

APPENDIX A

GEOGRAPHICAL DESCRIPTION OF THE DETROIT RIVER AND ST. CLAIR RIVER AREAS

The following description of the Detroit and St. Clair Rivers area (Figures A-1 through A-3) was excerpted from the United States Coast Pilot, Volume 6 (April 1978), and is included here to make this report more complete and readily understandable.

A.1 DETROIT RIVER

The Detroit River has a length of about 51.5 kilometers (32 miles) from the Detroit River Light at its mouth in Lake Erie to its head at Windmill Point Light. The southerly or lower river is broad and is characterized by many islands and shallow expanses; in this portion, the banks are more flatly sloping than in the upper river and the bottom consists generally of earth and boulders with the exception of about 10 kilometers north of the south end of Bois Blanc Island, where the bottom is mainly bedrock and boulders. The limitations imposed by the natural formation of the lower river bed have necessitated very extensive rock excavation and dredging to provide channels of suitable width and depth for the large vessels engaged in lake commerce.

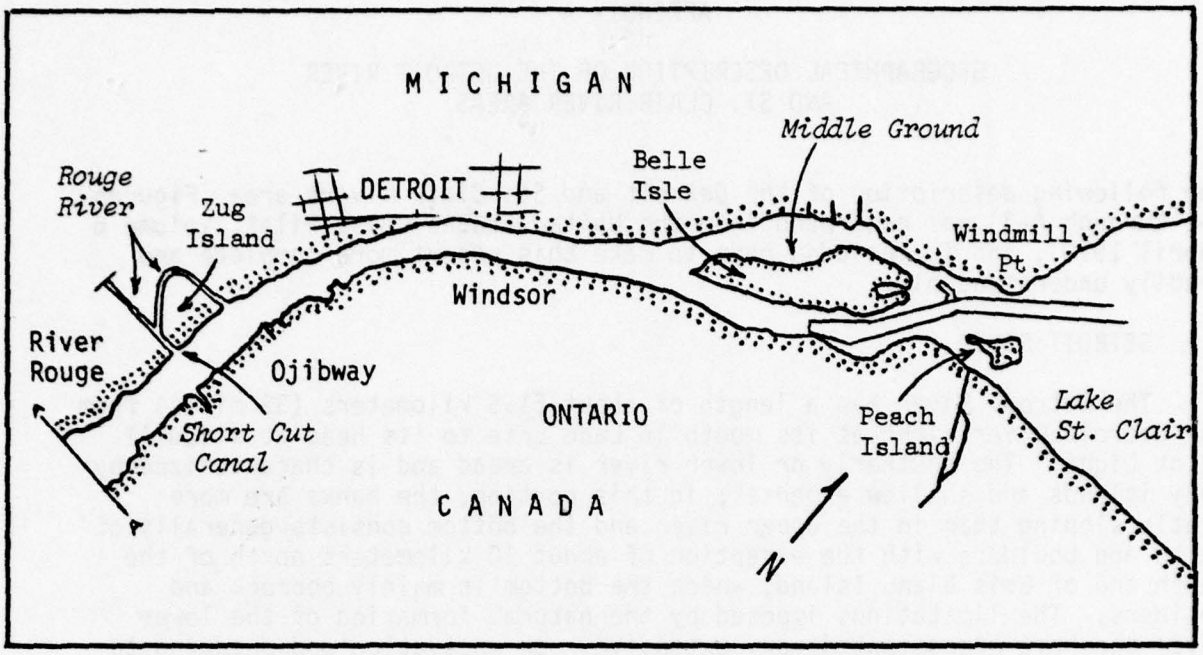
The channels from Lake Erie, proceeding north to a junction above the Detroit River, are the East Outer Channel and the West Outer Channel, merging into the Lower Livingstone Channel, all well marked with lights and buoys. The channels from the lower Detroit River into the deep section of Lake Erie require annual maintenance dredging to maintain minimum project depths. Maintenance of the East Outer Channel and Lower Livingstone Channel has not been performed since 1969.

The East Outer Channel extends about 12 kilometers from deep water in Lake Erie to the Detroit River Light. The channel is 366 meters wide, with a least depth of nine meters in September 1970.

The West Outer Channel, passing west of Detroit River Light, had a controlling depth of five meters for a midwidth of 168 meters in August 1975, extending about six kilometers lakeward from its junction with the 366-meter East Outer Channel just north of the light.

Under existing regulations, this channel may be used by downbound vessels moderately laden. Upbound vessels are prohibited from using this channel; the regulations do not apply to vessels under 100 gross tons.

From the Detroit River Light, the Lower Livingstone Channel, the single channel for two-way marine traffic, has a maximum width of 366 meters and in October 1974, had a controlling depth of nine meters for a midwidth of 305 meters, extending about four kilometers to the lower junction of the Amherstburg Channel and the Upper Livingstone Channel just southwest of Bar Point.



Feet 0 10 20
Meters 0 3 6
x 1,000

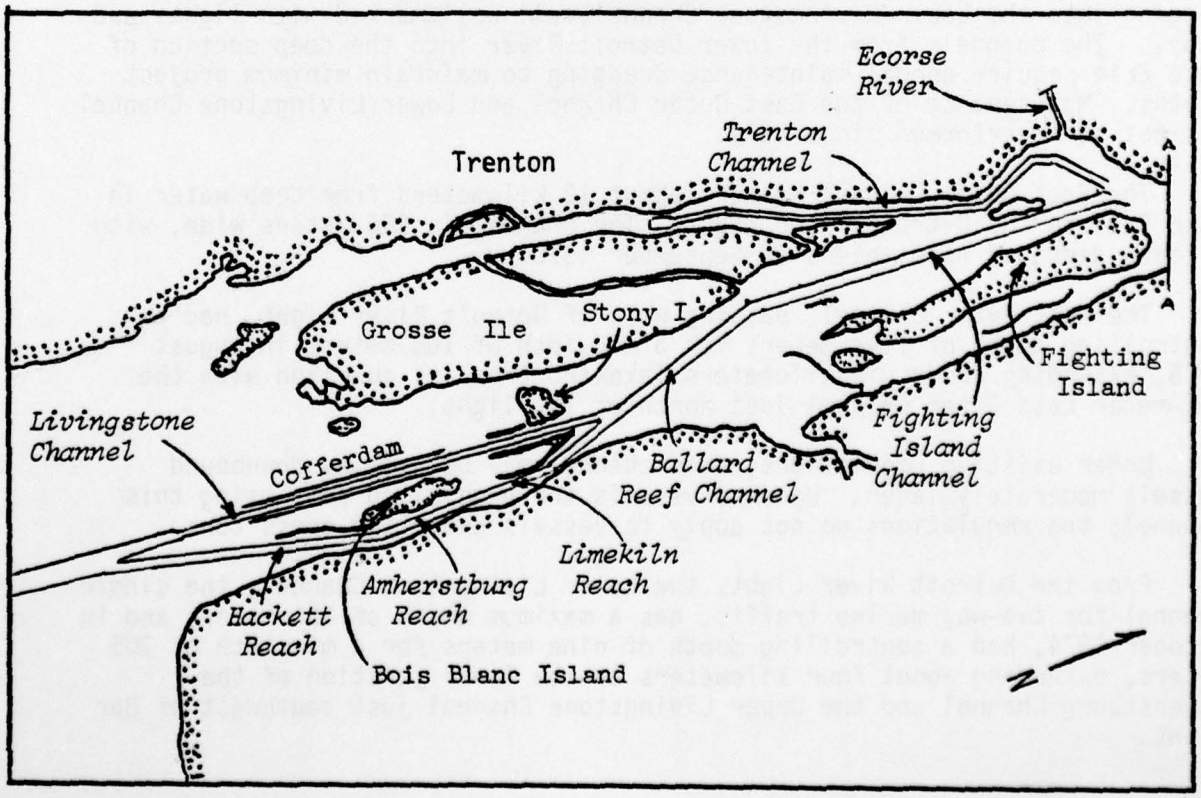


FIGURE A-1: DETROIT RIVER

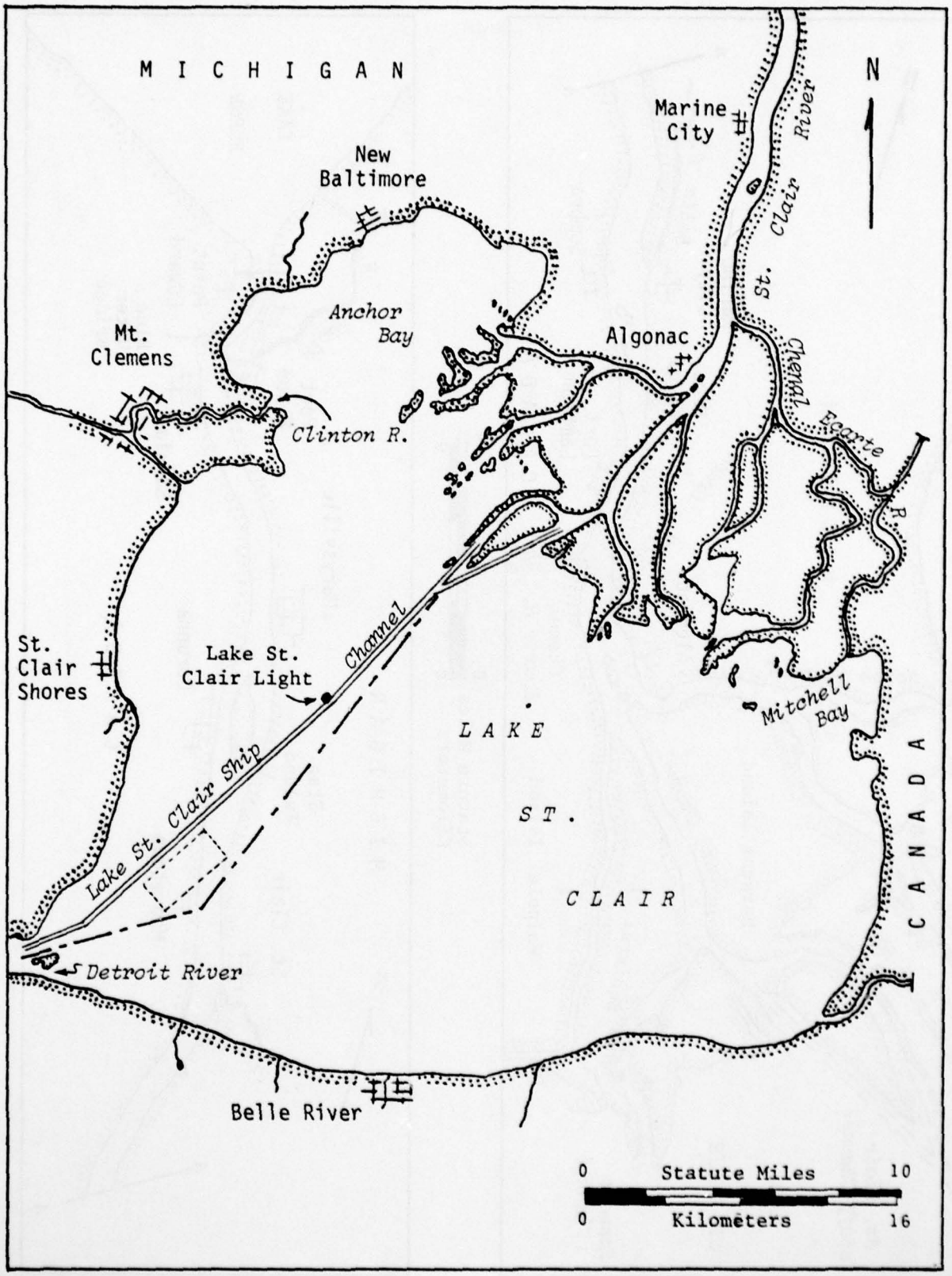


FIGURE A-2: LAKE ST. CLAIR

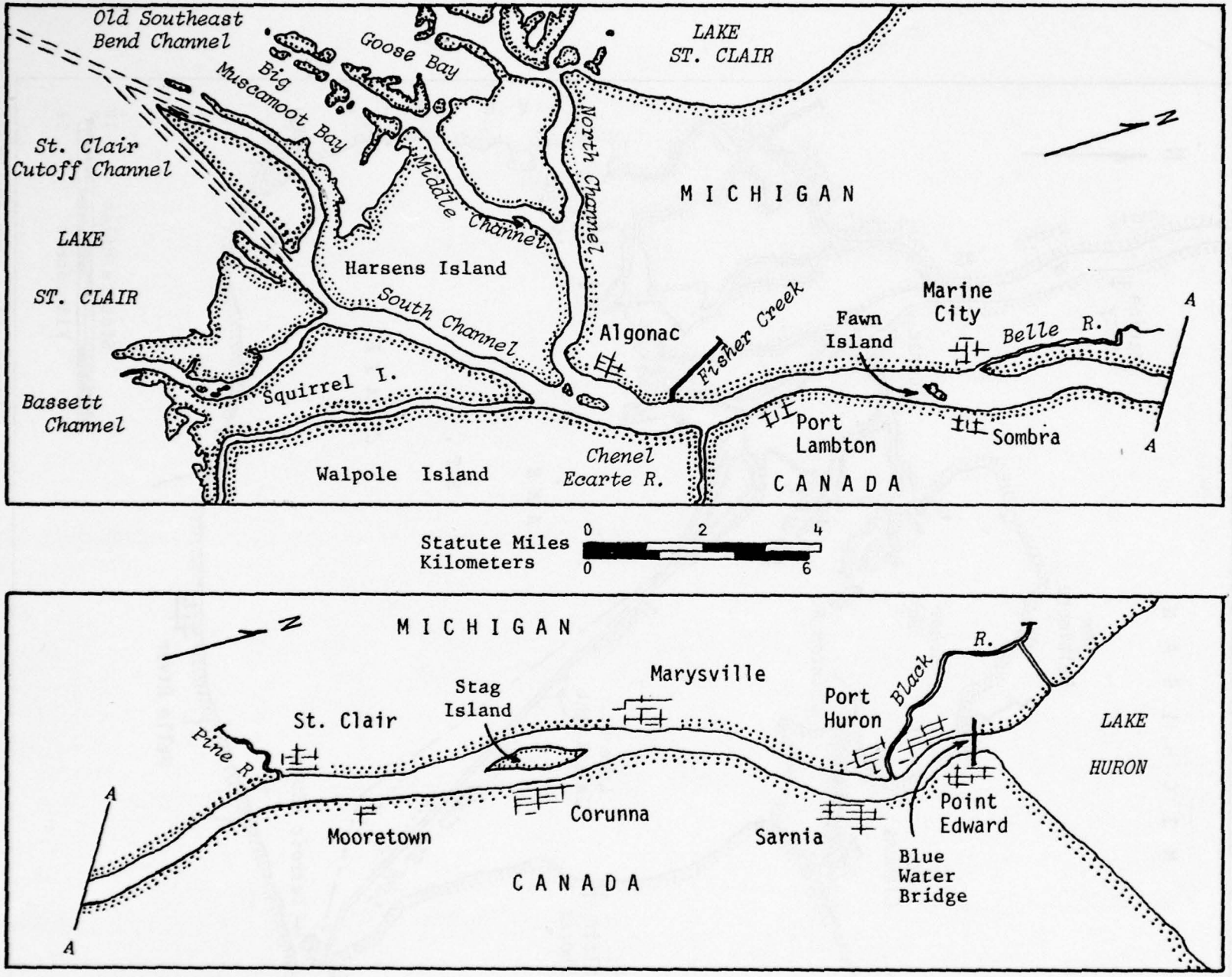


FIGURE A-3: ST. CLAIR RIVER

A.2 AMHERSTBURG CHANNEL

The Amherstburg Channel is the improved channel on the Canadian side, passing to the eastward of Bois Blanc Island. Between the southerly junction opposite Bar Point, on the Canadian side of the river and the northerly junction with Ballards Reef Channel, a distance of about ten kilometers, the channel follows through Hackett Reach, Amherstburg Reach, and the Limekiln Crossing Reach, all appropriately marked by lights and buoys.

Canadian Public Harbour Regulations, issued under Pt. 10 of the Canada Shipping Act for the Harbour of Amherstburg, Ontario, Section 72.(3b), specify "No vessel of 15 gross tons or over shall navigate the Amherstburg Channel between Bar Point Pier Light 29D and the Livingstone Channel Upper Entrance Light at a speed exceeding 10 statute miles (16 kilometers) per hour over the bottom."

Care should be exercised by vessels when anchoring in that part of the Amherstburg Channel between Ballards Reef and the south end of Bois Blanc Island. The current at this locality may cause the anchor to drag and overturn rocks which may then become obstructions. Such dragging of anchors can probably be lessened or entirely avoided by paying out sufficient length of chain before strain is brought on the anchor.

The Hackett Reach, in the Amherstburg Channel, is about six kilometers long and extends northeasterly from the lower junction of the Amherstburg and Upper Livingstone Channels to the lower end of Bois Blanc Island. The channel is nine meters deep in the westerly 91-meter portion of this reach and six meters in the easterly 91-meter portion. The deep-draft portion of the channel is marked by the Hackett Reach Range Lights at the northerly end. The front range light is 14 meters above the water on a mast on the east bank of the Detroit River at Amherstburg, Ontario, and the rear range light is 24 meters above the water on a white skeleton tower 303 meters 014°55' from the front light. The deep-draft channel in the Hackett Reach is well marked with buoys and lights on both sides while the easterly portion is well marked with lighted buoys on the westerly side and unlighted buoys on the easterly edge. The westerly edge of the deep-draft channel has a submerged high voltage cable extending outside the channel from Bar Point Range Front Light on Bois Blanc Island, along the buoys to the light at the lower junction of the Upper Livingstone and Amherstburg Channels. Small craft are cautioned not to anchor over the cable.

Mariners are advised to exercise caution when turning from Hackett Reach into Amherstburg Reach because of current effects.

The Amherstburg Reach, in the Amherstburg Channel, is about two kilometers long and extends from the upper end of the Hackett Reach to the lower end of the Limekiln Crossing Reach. The channel is eight meters deep in the westerly 91-meter portion and six meters deep in the 91-meter easterly portion of this reach. The deep-draft portion of the Amherstburg Reach is marked by the Amherstburg Range Lights at the northerly end on the dike above Bois Blanc Island. The deep-draft channel is well marked with buoys on both sides while the easterly portion is well marked with lighted buoys on the west side and unlighted buoys on the easterly edge.

The Limekiln Crossing Reach in the Amherstburg Channel is about two kilometers long and extends from the upper end of the Amherstburg Reach to the lower end of the Ballards Reef Channel. The channel is eight meters deep in the westerly 91-meter portion of the Limekiln Crossing Reach and six meters deep in the easterly 91-meter portion. The deep-draft portion of this reach is marked by the Limekiln Crossing Range Lights at the northerly end of the channel. The deep-draft channel of the reach is well marked with buoys on both sides while the easterly portion is marked with lighted buoys on the west side and unlighted buoys on the easterly edge.

A.3 BALLARDS REEF CHANNEL

The Ballards Reef Channel is about six kilometers long and 183 meters wide from its lower end at the junction with the Amherstburg Channel to its upper end at the junction with Fighting Island Channel. The center line is marked at the north end by two range towers showing fixed green lights located near the north end of Grosse Ile. The south end is marked by Fort Malden Range Lights with the front light located 13 meters above the water on a pyramidal skeleton tower on the east bank of the river and the rear light 21 meters above the water on a pyramidal skeleton tower 117 meters 162.5^{o} from the front light on the Canadian shore. The depth is nine meters in the four kilometers north of the Livingstone Channel where used for two-way traffic, and eight meters for about two kilometers south of that junction where normally used for upbound traffic.

There is also available for light-draft vessels an auxiliary channel about four meters deep and 85 meters wide, adjoining the 183-meter channel on its easterly side and outlined by buoys.

A.4 UPPER LIVINGSTONE CHANNEL

This channel, passing to the eastward of the lower half of Grosse Ile and to the westward of Bois Blanc Island, is about 11 kilometers long from its north entrance at Ballards Reef to its southerly junction with Amherstburg Channel opposite Bar Point. Ballards Reef Channel Light 81D, a light with fog signal attached, is mounted on a white square structure located 15 meters outside the channel limits and marks the west side of the downbound turn into the entrance to the Livingstone Channel at its junction with the Ballards Reef Channel. Due to the strong easterly set of the current at the junction of Ballards Reef and Livingstone Channels, mariners are advised to favor the western channel edge. Soundings taken in July 1970 indicated a controlling depth of eight meters over a width of 137 meters except for a somewhat increased width at the north end to provide easy entrance from Ballards Reef Channel and except for the lower one kilometer north of the southerly junction, which has a width of 244 meters. An enclosed steel tower on a white concrete base showing alternating flashing white and red marks the east side of the entrance of Livingstone Channel at its junction with Ballards Reef Channel.

The greater part of the Upper Livingstone Channel is revetted on both sides with the rock excavated from this channel. Most of this revetment is low and wooded. In addition, various forms of submerged and exposed compensating works extend to the west from the revetted channel line, connecting with Stony Island in the north part and extending to within 122 meters of Sugar Island at the midpoint of the channel.

There is a small craft channel passing west of Stony Island along the Grosse Ile shore, which also passes west of Sugar Island and on into the open part of the lower Detroit River. In the narrow part of this channel, between Stony Island and Grosse Ile, a line of submerged bridge abutments, with least depths of 0.15 meter, crosses the channel, and submerged cables follow the same path just to the south and north of the abutments. A buoy marks the west side of the most westerly crib and, in 1977, the best water was inside the buoy within 46 to 61 meters of the Grosse Ile shore. The westerly abutment is about 85 meters from shore. At about the midpoint of the Upper Livingstone Channel, there is an approximate 0.4-kilometer gap in the revetted wall known as "Sugar Island Cut," allowing passage for small craft across the main channel and on through the water area north of Bois Blanc Island with the Canadian mainland ahead to the east.

On the north end of the west pier of the Livingstone Channel "Sugar Island Cut," opposite the head of Bois Blanc Island, Light 19 is located 10 meters above the water on a small house on the pier. Protective riprap extends horizontally out from the base of the structure about nine meters and should not be passed close aboard even by vessels of shallow draft.

Numerous small craft have reported striking two submerged obstructions between the west side of the Bois Blanc Island and Livingstone Channel revetment. Caution is advised.

A.5 FIGHTING ISLAND CHANNEL

The removal of the points of shoals which formerly projected from each side into the river channel west of Fighting Island has secured a straight channel about seven kilometers long, with least width of 244 meters and depth of nine meters.

Just above the junction with the Ballards Reef Channel, Fighting Island Channel South Light is just east of the dredged channel line. The base of the structure is surrounded by protective riprap extending horizontally out from the structure about four meters. It should not be passed close aboard even by vessels of shallow draft. The main vessel course through the reach is the Fighting Island Channel and is well marked with lights and buoys.

An area of deep water adjoining the west side of the Fighting Island Channel at its southerly end, on a prolongation of the Ballards Reef Channel, is accessible as an anchorage ground when conditions are unfavorable for proceeding through the confined deep channel leading southward into Lake Erie. Vessels using this anchorage should be careful to avoid the long shoal extending below Mamajuda Island to a point about 213 meters south of the latitude of Grosse Ile south channel range front lights, its extremity being marked by a buoy. The westerly limits of the anchorage area are marked by buoys.

From the northwesterly section of the anchorage grounds, a buoyed channel about 76 meters wide and six meters or more in depth extends about three kilometers generally in a northerly direction between Point Hennepin on the west at the upper end of Grosse Ile and the Mamajuda Island Shoal area west of Mamajuda Island Light. The northerly end of the channel merges with the Trenton Channel opposite the city of Wyandotte, Michigan. The controlling depth through the middle of this lower channel is seven meters.

A.6 ECORSE CHANNEL

Ecorse Channel is a natural channel following the southwesterly curve of the Michigan shore from the upper end of the Trenton Channel-Fighting Island Channel junction to its lower junction with the Trenton Channel. It is a narrow channel of deep water, marked by buoys, and lies along the river front inside the Mud Island and the bank. The available depth is limited to four meters in the north entrance to this channel.

A.7 TRENTON CHANNEL

West of the north end of the Fighting Island North Light, a natural channel extends from the main ship channel to a point just below the Ecorse River and continues along the Michigan shoreline. This channel has been improved and buoyed to accommodate deep draft navigation.

The improvement by the United States has comprised dredging the Trenton Channel 91 meters wide and eight meters deep from the Detroit River to the Upper Grosse Ile Bridge, about nine kilometers, thence 8.5 meters deep and 91 meters wide below the Upper Grosse Ile Bridge to and including a turning basin 8.5 meters deep and six hectares (15 acres) in area outside the project limits. From this turning basin the channel is six meters wide, with increased widths at the bends for distance of about 5,121 meters to a point just above the Lower Grosse Ile Bridge, below Trenton, thence a length of about 152 meters with width reduced to 41 meters, through the westerly draw only, of the Lower Grosse Ile Bridge. Just below this bridge the channel terminates in a turning basin of irregular shape measuring about 457 meters along its easterly side in the continuation of the channel, and extending thence westerly about 305 meters with size contracting to a measurement of 137 meters along the westerly side adjacent to the Detroit Edison Company's plant.

The navigable depth from the lower end of the Trenton Channel turning basin down the back channel to the mouth of the river and Lake Erie is limited to about two meters through narrow and crooked channels.

A.8 ROUGE RIVER

This river discharges into the Detroit River at the southerly limits of the city of Detroit. Its natural course is generally about 46 meters wide in the lower river, below the junction with the short-cut canal (described below), and about 91 meters wide from the canal to the turning basin near the Ford Motor Company docks. The mouth of the river is flanked by large industrial plants.

The short-cut canal, an artificial connection about 914 meters long and originally constructed by private interests, extends from the Detroit River, about one kilometer below the mouth of the Rouge River, in a straight line to a bend in the Rouge River, thus avoiding an S-shaped curve in the lower river course and shortening the distance to upstream points by 1,707 meters. This short-cut canal, in conjunction with the natural old river channel, has created Zug Island.

The improvement by the United States has comprised the dredging of a channel six meters deep from the Detroit River, via the short-cut canal, up the river to the turning basin at the Ford Motor Company plant; also the dredging of a channel in the lower river with depths of 7.6 meters at and within the mouth for a distance of 396 meters, thence 5.5 meters for a further distance of 434 meters, and five meters thence upstream to the junction with the above-mentioned 6-meter channel.

The 6-meter project channel is about 5 kilometers long, with a bottom width of 122 meters at the entrance, narrowing to 61 meters in a distance of 610 meters; thence 61 meters wide at bottom, with flatly sloping banks and a width of 91 meters at the surface or between dock lines, extending to just above Dix Avenue, where it connects with the turning basin and slip at the ore docks and blast furnaces of the Ford Motor Company. Near its upper end, the channel follows a rectified line, eliminating two bends in the river between Fort Street and Dix Avenue. Due to the soft nature of the river bottom, the channel is subject to rapid shoaling. Soundings taken in August 1977 showed a controlling depth of six meters over the main part of the channel in the 6-meter project. There are a number of cables, water mains, and tunnels crossing under the canal and river; masters should use caution when dropping anchors.

The lower river, from the mouth to the junction with the 6-meter channel, is about two kilometers long. The channel has been dredged to a depth of 7.6 meters for a length of 3296 meters from the mouth, with a width of 73 meters at the entrance, reducing to 30.5 meters at the upper end; thence to a depth of 5.5 meters for a length of 434 meters and thence to a depth of five meters for 335 meters and thence to a depth of six meters to the junction of the old (river) channel with the short-cut canal, the latter two sections having widths of 30.5 meters. Rapid shoaling occurs in this channel. Soundings taken in July 1977 showed a controlling depth of five meters for a midwidth of 15 meters from the junction of the short-cut canal to the Detroit-Toledo and Ironton railroad bridge; thence five meters for a midwidth of 18 meters for about 412 meters to the foot of South Cary Avenue, extended; thence 5.5 meters for a midwidth of 21 meters to the overhead pipeline 414.5 meters above the natural mouth. There are a number of cables, water mains, and tunnels crossing under the river; masters should use caution when dropping anchors.

The north side of the canal entrance is marked by a buoy at the intersection with deep water in the Detroit River, and is in line with the north side of the canal and about 18 meters outside of the harbor line in the Detroit River.

A.9 CHANNELS AT BELLE ISLE

At the westerly or downstream end of Belle Isle, the Detroit River flows around the south side of the island with the main ship channel passing through Fleming Channel.

The Fleming Channel is the natural Detroit River deep water channel; in June 1974, the controlling depth was eight meters for a least width of 244 meters. The channel extends about six kilometers from the lower end of Belle Isle to the Lake St. Clair Ship Channel. A buoy, at the end of the

shoal extending downstream from Belle Isle, marks the lower division of the Fleming and American Channels. From the buoy, the channel passes south of Belle Isle to the turn to the northeast, around Belle Isle Light, and on to the turn above Peach Island Light. Above the Peach Island Light turn, the course is about three kilometers with the William Livingstone Memorial Light on Belle Isle directly astern. In this reach, Windmill Point Light is on the Michigan shoreline and marks the upper easterly end of the Detroit River at the lower westerly end of Lake St. Clair.

Under stress of weather, vessels may find temporary anchorage on the north side of the river from one to three kilometers below Belle Isle.

Peach Island, Ontario, with extensive shoal areas off the island west, north and east sides, lies to the south of Windmill Point Light.

A buoyed natural channel leads from the Fleming Channel, at the easterly end of Belle Isle, around the south and east sides of Peach Island and on into Lake St. Clair. Deep water is available in this channel for about three kilometers, but beyond that distance, the lake is only about two meters deep.

The American Channel, north of Belle Isle, is crooked and is little used except for local and pleasure craft.

No vessel having an overall length of less than 20 meters (65 feet) shall navigate between Belle Isle West End Lighted Buoy (U.S.) at the lower end of Belle Isle and Peach Island West Lighted Buoy No. 4 at the lower end of Peach Island at a speed exceeding 16 kilometers per hour.

No vessel shall navigate between Peach Island West Lighted Buoy No. 4 at the lower end of Peach Island and Peach Island Lighted Buoy at the upper end of Peach Island at a speed exceeding 10 kilometers (6 statute miles) per hour. No vessel shall, between Belle Isle West End Lighted Buoy (U.S.) at the lower end of Belle Isle and Peach Island, overtake another vessel having an overall length of 20 meters or more.

A.10 DETROIT RIVER CURRENT VELOCITIES

The following current velocities are based on the averages of water flow through the entire cross-section of the river, that is, from bank to bank and from the surface to the bottom during normal water flow conditions. Normal water flow conditions are encountered when there is no wind, Lake St. Clair is at a stage of 174.7 meters, and the lower Detroit River (Lake Erie) stage is 173.7 meters above the mean water level at Pointe-aux-Pere (Father Point), Quebec, on International Great Lakes Datum (1955), that is, +0.46 meter and +0.37 meter above their respective Low Water Datums. The current encountered at midstream is usually 1.5 times the average velocity. Greater velocities may be expected when the differences between the lake levels are greater, or when the lake stages are higher. When extreme conditions have existed, i.e., the lower Detroit River (Lake Erie) stage is higher than the Lake St. Clair stage, the current flow has reversed. The following are approximate average velocities through the indicated reaches: Amherstburg Channel: 2.3 kilometers per hour between

Lights 49D and 51D, 3.2 kilometers per hour at Light 75D; Livingstone Channel: 2.7 kilometers per hour between Lights 13 and 19, 3.7 kilometers per hour between Lights 21 and 25; 2.1 kilometers per hour at the head of Grosse Ile; 2.6 kilometers per hour at Ambassador Bridge; Belle Isle: 1.9 kilometers per hour at the foot, 2.3 kilometers per hour at the head; and 2.3 kilometers per hour at Windmill Point.

Each year the river rises and falls about 0.6 meter as measured by the monthly mean levels. Since 1900, the difference between the highest and the lowest monthly mean levels has been about 1.5 meters. However, occasional fluctuations in depth of several decimeters, produced by high easterly and westerly winds, respectively raise or lower the water level at the west end of Lake Erie and similarly affect the level of the lower Detroit River; such changes have been as much as two meters within eight hours. Water level fluctuations of 0.3 meter or more may occur with atmospheric presssure changes. Stage changes or water level differences in Lake Erie and Lake St. Clair may affect river flow velocities.

A.11 ST. CLAIR RIVER

The St. Clair River has two characteristic sections - the lower or delta portion and the upper or normal channel.

The delta portion, commonly known as the St. Clair Flats, is the land and water area at the lower end of the St. Clair River below Chenel Ecarte, Ontario, and formed by the division of the river into a number of distributaries. The most important branch, used for through navigation, is called the South Channel, and it connects Lake St. Clair with the main river through the St. Clair Cutoff Channel.

The distance from the southwest end of the St. Clair Cutoff Channel to the head of Chenel Ecarte via the South Channel is about 18 kilometers, making the total length of the vessel course from Lake St. Clair to Lake Huron about 63 kilometers.

The upper channel runs from the head of the Chenel Ecarte to Lake Huron, a distance by steamer track of about 45 kilometers. There are two islands in the upper portion of the river - Fawn (Woodtick) Island and Stag Island.

A.12 SPEED LIMITS

To reduce the deterioration of dykes and low farmland caused by wash, a speed limit of eight kilometers per hour (5 knots) has been established in the following areas:

1. On the Chanel Ecarte from the St. Clair River to Mitchell Bay, Ontario.
2. On the Sydenham River from the Chenel Ecarte to Dresden, Ontario (above Wallaceburg).
3. On the Thames River from Lake St. Clair to Chatham, Ontario.

AD-A077 156 COAST GUARD RESEARCH AND DEVELOPMENT CENTER GROTON CT F/G 15/5
MARINE TRAFFIC DATA OF THE DETROIT RIVER AND ST. CLAIR RIVER, M--ETC(U)
SEP 79 J J CHERNY, R A SILVA , M R YOUNG
UNCLASSIFIED CGR/DC-6/79 USCG-D-70-79 NL



A.13 CHENEL ECARTE AND SYDENHAM RIVER TO WALLACEBURG, ONTARIO

The entrance to the Sydenham River is through the Chenel Ecarte from the St. Clair River at the head of Walpole Island about two kilometers below Port Lambton.

The shoal area near the forks in the East Passage of Chenel Ecarte has been dredged to a depth of four meters, with controlling depths in 1964 of from three to four meters, for the accommodation of gravel traffic to Little Bear Creek, four kilometers south of the forks. Shoal areas at the mouth of Chenel Ecarte, Johnston Bend, Dark Bend, and near the sugar factory on the Sydenham River were dredged to six meters in 1956.

Wallaceburg, Ontario, is situated on the Sydenham River about 19 kilometers distant from the St. Clair River via the Chenel Ecarte and Sydenham River in which a channel 30.5 meters wide and 5.5 meters deep is to be maintained. The docking area in the slip of the Dominion Sugar Company has been dredged to 5.5 meters, and the area adjacent to the Libby's plant has been deepened to six meters.

A new Government wharf, 40 meters long, with a 24-meter by 9-meter warehouse and a turning basin capable of turning ships 122 meters long and 6-meter draft, has been constructed downstream of the railway and highway bridges. This facility is no longer maintained to its original standard.

West of the Chenel Ecarte is Johnston Channel, flowing south as a branch of the Chenel Ecarte, with Ste. Anne Island between these water areas. West of Johnston Channel and Chenel Ecarte is Walpole Island, Ontario, having several dredged cuts flowing generally south into Lake St. Clair. The westerly boundary of Walpole Island is generally the Chematogan Channel extending from the St. Clair River to Lake St. Clair. To the west of the Chematogan Channel is Squirrel Island fronting a section of the South Channel of the St. Clair River. Bassett Channel flows from the lower end of the South Channel junction with the new Southeast Bend Cutoff Channel, in a southerly direction into Lake St. Clair.

A.14 ST. CLAIR CUTOFF CHANNEL

The St. Clair Cutoff Channel, consisting of a channel 213 meters wide by 8,230 meters long, was dredged in 1961 to a controlling depth of eight meters. This is a straight channel starting at the Lake St. Clair Ship Channel below the St. Clair Flats earth dike and extending northeasterly between Seaway Island and Bassett Island to its junction with the turn in the South Channel just west of the Bassett Channel north entrance. The channel is maintained by the Canadian Government.

In July 1977, the controlling depth in the cutoff channel was about seven meters except for shoaling along the southeast channel limit and shoaling to about six meters in the northwest half of the channel at the junction with South Channel.

Vessels are directed not to meet in the St. Clair Cutoff Channel; vessel traffic is managed by the Canadian Coast Guard, Sarnia Vessel Traffic Center, on VHF-FM Channel 11 (156.55 MHz).

A lighted buoy is located on the east side at the junction of the Lake St. Clair Ship Channel and the Cutoff Channel extending northeast. Along the Cutoff Channel, a series of nine permanent white towers on concrete bases, each located 58 meters outside the channel limit and surrounded by protective riprap, display flashing green lights on the northwest side and flashing red lights on the southeast side. Both edges of the banks of the maintained channel are marked with unlighted buoys midway between the light towers. A black and red horizontal banded spar buoy marks the northeasterly junction of the Cutoff Channel and the St. Clair Flats Canal. The Squirrel Island Range Lights, exhibited from skeleton towers at the northeast end of the new channel, display fixed yellow lights with rectangular orange daymark and black vertical stripe. The rear light is 1,069 meters 064.25° from the front light.

A.15 ST. CLAIR FLATS CANAL - SOUTH CHANNEL

This channel was the main route of through navigation prior to 1962, and extends northeasterly from the lower end of the St. Clair Flats earth dike to a bend around the lower end of Harsens Island, to the upper junction with the Southeast Bend Cutoff Channel, and on through the South Channel southeast of Harsens Island. The distance through the South Channel, from the junction with the north end of the Cutoff Channel to abreast of Russell Island Shoal Light Buoy, is about ten kilometers.

This winding channel has good available depths and is marked by a number of range and passing lights maintained by the United States along its northerly side, and by passing lights maintained by the Canadian Government on its southerly side. The American shoreline is characterized by the many summer cottages and clubhouses with landings for excursion and summer resort traffic. With the opening of the new St. Clair Cutoff Channel, that part of the old Southeast Bend Section of the St. Clair Flats Canal South Channel between the head and the mouth of the new Cutoff Channel, is not maintained as a deep-draft navigation channel.

The South Channel was deepened to eight meters or more for a minimum width of 213 meters through the Southeast Bend section, for a width of 305 meters or more elsewhere. Maintenance dredging in 1975 restored full project depths from Russell Island Shoal Lighted Buoy to the north end of the Cutoff Channel.

To the northwest of the St. Clair Flats Canal, Southeast Channel is the Middle Channel. Between these channels are Russell Island at the most northerly end, and Harsens Island with Little Muscamoot Bay and then Big Muscamoot Bay extending into Lake St. Clair. The North Channel flows from the St. Clair River in a westerly direction around the Michigan Mainland and into Anchor Bay. The island betweeen the Middle Channel flowing southwest from the North Channel, and the North Channel, is Dickinson Island with Fisher Bay at the west side of the island extending into Goose Bay which in turn opens into Anchor Bay. There are many channels from the westerly end of the North Channel with most of them passing into only about a meter of water.

A.16 MAIN SHIP CHANNEL

Algonac is cut off from direct access to the main or South Channel of the St. Clair Flats by Russell Island Shoal, a shallow bank extending in a northeasterly direction about 793 meters from the head of Russell Island. At the outer end of the shoal is a black and red striped lighted buoy, which marks the midstream dividing point of the North and South Channels of the St. Clair River delta. The east and northeast parts of the original shoal have been removed in order to enlarge and straighten the entrance to the main or South Channel. The main channel at this locality is eight meters deep.

The channel passing to eastward of Fawn (Woodtick) Island and the middle ground has a width of not less than 122 meters and depth of 5.5 meters of water, but is slightly winding and unmarked and is less frequently used than the main channel west of Fawn (Woodtick) Island.

Above Fawn (Woodtick) Island, the shoal area extends approximately two kilometers further opposite Marine City. The shoal ground has a minimum depth of four meters on the International Boundary opposite the city.

The main vessel channel passes on the west or Michigan side of the island and middle ground shoals with a width of 305 meters of water, eight meters or more in depth. It is well marked by a light and lighted buoys.

The river opposite the city of St. Clair is divided into two channels by the middle ground shoals which extend about two kilometers from just below the outlet of the Pine River, northerly to about opposite Mooretown, Ontario. The deep draft channel for traffic is around the westerly side of the middle ground shoal and has a minimum width of 305 meters with a depth of eight meters or more. Mariners should exercise caution while negotiating the westerly turn when downbound to avoid the middle ground shoals at St. Clair. The lower and upper mid-river points of these shoals are marked with buoys. Buoys also mark the edge of the middle ground on the east line of the American channel, at points between the two end buoys mentioned above. The Canadian Channel, formerly for upbound traffic, and not to be maintained, had a depth of seven meters or more with a minimum width of about 122 meters in 1961.

The main channel follows the western side of the river above St. Clair and about one kilometer above the upper middle ground buoy opposite Mooretown, Ontario, continues about six kilometers to the west of the shoal area extending below Stag Island, Ontario, around Stag Island and the shoal area north of Stag Island and opposite Marysville, Michigan. The lower end of the shoal below Stag Island is marked with a lighted buoy at mid-river, two buoys along the easterly channel edge opposite Stag Island, and a lighted buoy at mid-river at the northerly end of the shoal. Buoys mark the west channel bank at the bend at the south end of the channel. Stag Island Middle Light is on the west channel (Marysville) bank between the north and south ends of Stag Island. The westerly bank is also marked by a light on the upstream corner of the dock in Marysville. The main channel, used since 1962 for all traffic, has a minimum width of 305 meters, with a depth of eight meters.

The Canadian channel, formerly for upbound traffic and not to be maintained, had a depth of six meters or more for a minimum width of 152 meters at a point near the upper end of Stag Island, as determined by sounding in 1950. A light, shown from a tower near the south end of the shallow area extending downstream from Stag Island, marks the former lower entrance, and the Corunna range marks the upper entrance to the Canadian channel.

A shoal area with a least depth of five meters is located on the east side of the St. Clair River opposite the Morton Salt Company in Marysville, Michigan. A buoy marks the southerly side of the shoal.

The St. Clair River above Marysville and Stag Island flows southwest under the Blue Water Bridge between the cities of Port Huron, Michigan, on the west bank and Sarnia, Ontario, on the east bank, and comes from the dredged channel in the shallow section at the lower end of Lake Huron. The rapids section of the river at Port Huron extends from 61 to 91 meters below to about 305 meters above the Blue Water Bridge. The Fort Gratiot range, located on the shore about one kilometer south of Fort Gratiot Lighthouse, guides 207.25^{0} through the rapids from the intersection of this range with the Point Edward range.

The improvement by the United States has consisted of the removal of an extensive shallow area which originally obstructed the American side of the St. Clair River along the lower part of the Port Huron front, from a little above to well below the mouth of the Black River and reaching to or beyond midstream. As a result of this work, the full width of the river has been made available to navigation for both upbound and downbound traffic. The river has a depth of eight meters over a width of 244 meters or more. At midstream, just about a point opposite the mouth of the Black River, a special-purpose buoy marks the separation for upbound and downbound traffic.

At the upper end of the American or downbound channel, between the Port Huron waterworks and the Blue Water Bridge, will be found at times a current of six kilometers or more per hour. Masters of vessels are warned to hold well up when turning into the downbound channel because of the velocity of flow and the cross currents which tend to carry vessels to the eastward.

By reason of the proximity of this channel to Port Huron wharves and shipping, vessel masters should check speed to the lowest safe limit and be careful to avoid damage or hazard to such shipping.

A.17 BLACK RIVER

The Black River passes through the city of Port Huron in a southeasterly direction and empties into the St. Clair River about four kilometers below its head, or the foot of Lake Huron.

Improvement in the Black River by the United States has consisted of dredging a channel from the mouth of the river to 427 meters upstream of the Black River Drainage Canal, a distance of about seven kilometers, the width varying from 49 meters at the mouth to 23 meters between the Tenth Avenue

Bridge and the Grand Trunk Western railroad bridge, and 30.5 meters from the railroad bridge to upper limits. The improved depths are six meters from the mouth upstream for three kilometers, two meters for the last 0.4 kilometer downstream of the I-94 bridge and two meters from the I-94 bridge to the upper limit of the project. The channel is subject to shoaling.

Soundings completed in June 1977 indicated controlling depths as follows: 5.5 meters from the mouth of the Black River to the Military Street Bridge; 3.4 meters to Tenth Avenue Bridge; 2.4 meters to the Grand Trunk Western railroad bridge; 2.1 meters to the I-94 bridge; 1.8 to 1.5 meters to the upper project limit.

Each year the level of the Black River rises and falls from 1.2 to 1.8 meters due to the fact that the spring freshets raise the level considerably above the normal. From day to day the level changes somewhat due to wind, such changes amounting to several centimeters.

A light is maintained on the north side of the mouth of the Black River.

A.18 ST. CLAIR RIVER CURRENT VELOCITIES AND RIVER FLUCTUATIONS

The following current velocities are based on averages of water flow through the entire cross section of the river, that is, from bank to bank and from the surface to the bottom during normal flow conditions. Normal water flow conditions are encountered when there is no wind, Lake Huron is at a stage of 176.0 meters and Lake St. Clair is at a stage of 174.7 meters above mean water level at Pointe-Aux-Pere (Father Point), Quebec, on the International Great Lakes Datum (1955), that is, +0.21 meter and +0.46 meter above their respective low water datums. The current encountered at midstream is usually about 1.5 times the average velocity. Greater velocities may be expected when the difference between the lake levels are greater, or the lake stages are higher. The following are approximate average velocities through the indicated reaches: between Southeast Bend and Sans Souci, 2.1 kilometers per hour; at Port Lambton, Ontario, 2.9 kilometers per hour; at Marine City, Michigan, 2.6 kilometers per hour; at Hart's Landing Light, 3.3 kilometers per hour; at the head of Stag Island, 2.7 kilometers per hour; at the Blue Water Bridge, 6.1 kilometers per hour. The rapids section extends from about 305 meters above to 61 to 91 meters below the Blue Water Bridge. During periods of sustained high north or northeast winds on Lake Huron, velocities in the upper St. Clair River are increased to as high as 19 kilometers per hour. The banks of the river are clay and sand, and usually quite steep.

Each year the St. Clair River rises and falls about 0.3 meter, mainly in consonance with the seasonal level variations on Lake Huron, as measured by monthly average levels. Since 1900, the difference between the highest and lowest monthly average level has been about two meters. Occasional rapid fluctuations of 0.61 meter up or down have occurred because of higher wind. Mariners are cautioned that such fluctuations in level may result in avilable depths being less than charted depths.

A.19 BLUE WATER BRIDGE

The Blue Water Bridge, completed in 1938, extends from Port Huron, Michigan to Point Edward, Ontario. The bridge has a cantilever span across the river, with vertical underclearance for a length of 61 meters at midstream of 47.3 meters (155.2 feet), decreasing to 41 meters at points 91 meters east and west of the center of the span. Four fixed red lights mark the channel limits and two flashing green lights are located at the center of the span on the axis of the Fort Gratiot range; the lights are suspended from the lower chords of the bridge.

APPENDIX B

STATISTICS OF THE WATERBORNE COMMERCE OF THE
DETROIT AND ST. CLAIR RIVERS AREA

The following data was excerpted from Waterborne Commerce of the United States, Calendar Year 1976, Part 3 (Great Lakes), published by the Department of the Army, Corps of Engineers.

B.1 COMPARATIVE STATEMENT OF TRAFFIC, DETROIT RIVER

Section included: Entire length of the Detroit River and Rouge River to head of project. Navigation dates: 1 March to 30 December.

Year	Traffic of Ports		Through Traffic*		Total	
	Tons	Passengers	Tons	Passengers	Tons	Passengers
1967	32,588,028	18,813	85,899,421	29	118,487,449	18,842
1968	32,573,123	104	90,029,960	8	122,603,083	112
1969	30,260,763	236	92,593,144	----------	122,853,907	236
1970	31,628,368	149	93,963,598	77	125,591,966	226
1971	30,051,909	172	85,690,069	4	115,741,978	176
1972	29,913,128	229	89,077,917	10	118,991,045	239
1973	31,541,566	1,110,670	100,134,816	2	131,676,382	1,110,672
1974	27,562,952	1,141,012	82,952,901	182	110,515,853	1,141,194
1975	26,491,966	968,844	73,927,310	----------	100,419,276	968,844
1976	26,407,938	837,725	78,143,875	2,608	104,551,813	840,333

*Traffic moving through a waterway to and from points on other waterways

B.2 COMPARATIVE STATEMENT OF TRAFFIC, CHANNELS IN LAKE ST. CLAIR

Section included: Improved ship channels connecting the Detroit River and the St. Clair River across Lake St. Clair, entrance channels to mouth of the Clinton River and the Canadian channel to the mouth of the Thames River.

Year	Tons	Passengers	Year	Tons	Passengers
1967	103,324,996	5,472	1972	105,329,967	10
1968	107,327,581	8	1973	117,817,614	2,258
1969	109,823,768	----------	1974	99,318,310	3,784
1970	112,319,026	77	1975	88,954,414	4,416
1971	101,864,092	4	1976	92,441,331	5,822

B.3 COMPARATIVE STATEMENT OF TRAFFIC, ST. CLAIR RIVER

Section included: Entire length of the St. Clair River and the Black River up to Washington Avenue in Port Huron. Navigation dates: 1 March to 30 December.

Year	Traffic of Ports		Through Traffic*		Total	
	Tons	Passengers	Tons	Passengers	Tons	Passengers
1967	5,416,199	193,387	95,608,260	5,472	101,024,459	198,859
1968	5,654,167	195,363	101,482,613	8	107,136,780	195,371
1969	6,129,208	170,010	103,144,802	----------	109,274,010	170,010
1970	5,919,012	191,724	103,303,685	63	109,222,697	191,787
1971	5,688,999	202,853	97,203,129	----------	102,892,128	202,853
1972	5,600,885	243,663	100,863,737	10	106,464,622	243,673
1973	4,572,884	238,866	114,336,877	----------	118,909,761	238,866
1974	4,211,684	232,047	97,233,746	182	101,445,430	232,229
1975	3,611,744	235,590	88,099,532	----------	91,711,276	235,590
1976	4,303,948	269,489	92,056,242	2,608	96,360,190	272,097

*Traffic moving through a waterway to and from points on other waterways

B.4 COMPARATIVE STATEMENT OF TRAFFIC, DETROIT HARBOR, MICHIGAN

Section included: U.S. bank of the Detroit River from Lake St. Clair to the western extreme of Zug Island. Data is included in total of Detroit River.

Year	Tons	Passengers	Year	Tons	Passengers
1967	13,450,418	18,813	1972	11,939,006	229
1968	12,948,839	104	1973	13,266,519	1,110,670
1969	12,781,774	236	1974	11,230,023	994,686
1970	12,977,245	149	1975	11,103,247	848,124
1971	12,755,891	172	1976	10,371,555	837,725

B.5 COMPARATIVE STATEMENT OF TRAFFIC, ROUGE RIVER, MICHIGAN

Section included: From the mouth of the Short Cut Canal to the Ford Motor Company and from the mouth of the Old Channel to the junction with the Short Cut Canal. Data is included in the total of Detroit River.

Year	Tons	Passengers	Year	Tons	Passengers
1967	11,209,868	----------	1972	13,057,711	----------
1968	13,302,008	----------	1973	12,738,121	----------
1969	11,922,798	----------	1974	10,900,719	----------
1970	12,744,011	----------	1975	10,284,421	----------
1971	11,985,048	----------	1976	11,061,877	----------

B.6 COMPARATIVE STATEMENT OF TRAFFIC, ECORSE, MICHIGAN

Section included: U.S. shore of Detroit River from Great Lakes Avenue to the Ecorse River. Data is included in total of Detroit River.

Year	Tons	Passengers	Year	Tons	Passengers
1967	793,192	----------	1972	737,664	----------
1968	1,124,545	----------	1973	711,827	----------
1969	1,057,880	----------	1974	647,501	----------
1970	969,579	----------	1975	715,437	----------
1971	822,598	----------	1976	635,556	----------

B.7 COMPARATIVE STATEMENT OF TRAFFIC, WYANDOTTE, MICHIGAN

Section included: U.S. shore of Detroit River from the Ecorse River to and including the Pennsalt Chemical Corporation's property. Data is included in total of Detroit River.

Year	Tons	Passengers	Year	Tons	Passengers
1967	2,821,485	----------	1972	1,593,597	----------
1968	2,375,690	----------	1973	1,865,385	1,278
1969	2,263,718	----------	1974	1,632,678	151,210
1970	1,918,163	----------	1975	1,497,875	125,442
1971	1,850,726	----------	1976	1,584,311	1,338

B.8 COMPARATIVE STATEMENT OF TRAFFIC, TRENTON, MICHIGAN

Section included: U.S. shore of Detroit River from the foot of Sibley Road to the foot of Parkway Drive. Data is included in total of Detroit River.

Year	Tons	Passengers	Year	Tons	Passengers
1967	4,367,088	----------	1972	3,060,776	----------
1968	2,859,437	----------	1973	3,230,249	----------
1969	2,308,170	----------	1974	3,496,446	----------
1970	3,163,415	----------	1975	3,120,639	----------
1971	3,012,795	----------	1976	3,059,758	----------

B.9 COMPARATIVE STATEMENT OF TRAFFIC, MARYSVILLE, MICHIGAN

Section included: West bank of St. Clair River at Marysville, Michigan. Data is included in total of St. Clair River.

Year	Tons	Passengers	Year	Tons	Passengers
1967	647,732	----------	1972	633,656	----------
1968	673,905	----------	1973	606,591	----------
1969	654,749	----------	1974	577,663	----------
1970	537,830	----------	1975	559,728	----------
1971	678,524	----------	1976	516,713	----------

B.10 COMPARATIVE STATEMENT OF TRAFFIC, ST. CLAIR, MICHIGAN

Section included: West bank of St. Clair River at St. Clair, Michigan. Data is included in total of St. Clair River.

Year	Tons	Passengers	Year	Tons	Passengers
1967	3,755,094	----------	1972	3,950,487	----------
1968	3,488,126	----------	1973	3,338,058	----------
1969	4,146,656	----------	1974	3,075,056	----------
1970	3,997,186	----------	1975	2,686,497	----------
1971	3,994,987	----------	1976	3,355,109	----------

B.11 FREIGHT TONS OF UNITED STATES TRAFFIC CARRIED ON THE GREAT LAKES BY AREA, CALENDAR YEAR 1976 (SHORT TONS)

Area	Foreign				Domestic						
	Overseas		Canadian		Coastwise		Lakewise		Internal		Local
	Receipts and Shipments	Through	Receipts and Shipments	Through	Receipts and Shipments	Through	Receipts and Shipments	Through	Receipts and Shipments	Through	Receipts and Shipments
Lake Superior	2,595,336	---	6,727,022	---	---	---	65,446,628	---	---	---	9,342
St. Mary's River	235	2,595,336	451,537	18,419,108	---	---	2,293,955	65,210,468	---	---	98
Lake Michigan - including the port of Chicago*	3,950,648	---	9,820,939	---	42,172	---	73,859,557	---	19,885,838	7,187	4,146,474
Lake Huron	34,318	6,546,219	4,999,113	15,018,181	---	---	28,729,158	76,853,518	12,130	6,720	504,017
St. Clair River-including channels in Lake St.Clair	35,599	6,580,537	220,345	18,019,229	---	---	4,047,004	67,444,813	---	11,663	---
Detroit River	2,130,296	6,617,136	3,313,684	16,132,082	79,983	---	20,461,062	55,382,994	2,016	11,663	420,897
Lake Erie - including Upper Niagara River	3,002,160	8,747,432	36,423,831	11,063,137	---	79,983	69,210,318	91,282	29,175	13,679	1,177,914
Welland Canal	---	11,749,592	965,217	32,074,102	---	79,983	---	217,868	---	42,854	---
Lake Ontario - including Lower Niagara River	11,007	11,749,592	12,082,463	21,411,419	---	79,983	77,792	140,076	42,239	112,265	118
St. Lawrence River - between International Boundary & Lake Ontario	408	11,760,599	278,882	22,002,949	7,018	79,983	140,076	---	71,949	---	---

* Port of Chicago includes Chicago Harbor, North Branch, South Branch, Sanitary Ship Canal, Calumet-Sag Channel, Lake Calumet and Calumet Harbor and River.

APPENDIX C

MARINE TRAFFIC TRANSITING THE TRENTON CHANNEL

The following information was collected from the official records of the Detroit Edison Company (Table C-1) and the McLouth Steel Company (Table C-2) and is included here to supplement the data collected on the Detroit River.

The figures denote the number of dry cargo vessels which berthed at the Detroit Edison Company's and McLouth Steel Company's facility on the Trenton Channel during the month and year indicated. Vessels did not use the channel during the winter months of January through March, unless otherwise noted.

	1976	1977	1978
April	0	5	10
May	8	9	17
June	9	10	13
July	7	11	3*
August	4	11	NA
September	6	14	NA
October	7	15	NA
November	2	10	NA
December	0	1	NA

TABLE C-1

	1975	1976	1977	1978
January	--	--	--	8
February	--	--	--	2
March	--	--	--	--
April	NA	3	6	9
May	NA	12	10	9
June	7	12	16	9
July	12	NA	18	15**
August	13	12	9	16
September	11	11	4	12
October	10	12	2	9
November	7	14	11	NA
December	11	9	14	NA

TABLE C-2

* Indicates the number of vessels prior to/during data collection operations
** Includes 2 tugs/barges
NA Data nota available

APPENDIX D

CANADIAN COAST GUARD VESSEL TRAFFIC SYSTEM
1977 VOLUME OF TRAFFIC

The following statistics were received from the Canadian Coast Guard Vessel Traffic Management Center at Sarnia, Ontario. The totals represent the number of vessels participating in the system.

MONTH	AMERICAN (U.S.)	CANADIAN	OTHER (OCEANIC)	TOTAL
Jan	48 - 75%	16 - 25%	0 - 0%	64
Feb	32 - 63%	19 - 37%	0 - 0%	51
Mar	67 - 64%	37 - 36%	0 - 0%	104
Apr	451 - 55%	318 - 38%	55 - 7%	824
May	901 - 57%	479 - 30%	203 - 13%	1,583
Jun	950 - 57%	531 - 32%	176 - 11%	1,657
Jul	1,027 - 62%	467 - 28%	157 - 10%	1,650
Aug	706 - 53%	461 - 35%	161 - 12%	1,328
Sep	565 - 47%	446 - 37%	187 - 16%	1,198
Oct	549 - 42%	519 - 40%	240 - 18%	1,308
Nov*	383 - 43%	340 - 38%	177 - 19%	900
Dec	520 - 54%	307 - 32%	139 - 14%	966
1977 Total	6,199 - 53%	3,940 - 34%	1,495 - 13%	11,634
Average:				
12-month	517 - 53%	328 - 34%	125 - 13%	970
9-month	672 - 53%	430 - 34%	166 - 13%	1,268

*CGTC Sarnia not in operation November 15 to 22 inclusive.

APPENDIX E

MSO DETROIT NAVIGATION SURVEY*

To best facilitate MSO Detroit's efforts in drawing up proposed changes to the Navigation Regulations governing the St. Clair River, Lake St. Clair, Detroit River and Rouge River, Michigan, a survey was conducted directed at the maritime industry and operating personnel in particular. Questionnaires were distributed to interested parties, primarily to Great Lakes masters and pilots. Of the 300 mailed out, 37 completed questionnaires were returned.

Depicted in the following pages is each individual response to each question posed. It should be noted that not every respondent made response to each and every question. Information was used to get an overall view of the navigation problems in the Detroit River/St. Clair River System. This was the concentration of the survey rather than just evaluating each individual question.

The following general attitudes were expressed in the survey:

There is a need for the St. Clair Cut-Off Channel to be dredged. This present condition poses a hazard.

There is an excess of voice traffic on Channel 16 during the pleasure boating season.

There should be a uniform speed limit throughout the Detroit River/St. Clair River System.

The zone of no meeting, overtaking or coming about regulation from Lake Huron Cut Lighted Buoy 1 and Port Huron Traffic Lighted Buoy should remain in effect.

There should be no pickup or discharge of pilots in the zone from Lake Huron Cut Lighted Buoy 1 to Port Huron Traffic Lighted Buoy.

The following zones were expressed as the most hazardous:

From Lake Huron Cut Lighted Buoy 1 to Port Huron Traffic Lighted Buoy.

From Harsens Island Range to St. Clair Cut-Off Channel.

From Fighting Island South Light to Livingstone Channel Upper Entry.

*From Encl. (2) to MSO Detroit ltr 16700 dtd 6 March 1978

1. Does this present navigation regulation present a problem to you or your vessel?

a. Mis-representation of vessel position.
b. Have had occasional loss of time. Have not encountered any major problem in this area prior to regulation.
c. Mis-representation of vessel position. Difficult to "hold" vessel position at times due to weather.
d. Unnecessary time delays due to frequent mis-representation of vessel position and time required to transit zone.
e. Certain vessels do not abide by these regulations or purposely lie about their position to gain the advantage of continuing. This causes those abiding by the rules to have to wait extra time.
f. Time delay: We have had as much as 1 hour and 20 minutes delay while upbound, waiting for downbound traffic that was bunched up for some reason.
g. Have to get vessel information two or three hours ahead of passage time to regulate passage, building tension. No particular problems prior to regulations.
h. When vessels line up one behind the other, when you are either upbound or downbound; sometimes it is hard to stay checked slow enough to let them through. This is really bad in times of high winds.
i. For years we have transited through the zone, up and down, meeting ships, and have encountered no problems.
j. When downbound and you have a wind on the ship's head, it makes it hard to hold in channel. Any question on close timing, downbound should have the right-of-way; east to hold in river.
k. Time delays to 30 minutes. Some false positions given by some masters. No problems encountered with two way traffic.
l. Canadian and American ships leaving fueling docks into flow of traffic and sometimes immediately in front of upbound or downbound traffic.
m. In strong winds, is sometimes difficult to hold ship in position. Good regulations, keep as at present.
n. Mis-representation of upbound vessel position. Downbound vessels at buoys 11 and 12 should have the right-of-way over upbound vessels or below Polymer Plant.
o. An occasional sheer, but no big problems
p. Mis-representation of vessel positions from buoys 7 and 8 down to traffic buoy; possible hazards are near collisions due to current, etc.
q. Time delay - mis-representation of vessel position. Low powered vessels cause a time delay.
r. Vessel leaving the docks above buoy 58 and below the traffic buoy do not wait until downbound traffic clears.

2. What specific area(s) within the no passing zone is/are most hazardous?

a. Strong northerly winds in Lake Huron cut; trying to hold for slow upbound vessels.
b. Just below the bridge.
c. Between the traffic buoys, down to buoys 7 and 8.
d. The rapids below the Blue Water Bridge.
e. Under the Blue Water Bridge.
f. Immediately under bridge.
g. The turn at buoy 1.

h. In the current below the Blue Water Bridge.
i. From one mile below to 1/2 mile above the Blue Water Bridge.
j. Light #2, Southeast Bend.
k. On the turn from Lake Huron cut buoy 1 onto Fort Gratiot Range or upbound.
l. Right under the Blue Water Bridge..
m. Right at the Blue Water Bridge.
n. Right under the Blue Water Bridge.
o. From buoys 1 and 2 to the Blue Water Bridge.
p. Turning at buoys 1 and 2; could be dredged in area of buoy 1.
q. Directly under the Blue Water Bridge.
r. From 1,000 feet above to 1,000 feet below the Blue Water Bridge.
s. Under the Blue Water Bridge.
t. From the Blue Water Bridge to 1,000 feet below. Meeting traffic at the turn of buoys 1 and 2.
u. Port Huron rapids.
v. Between bridge and buoys 1 and 2.
w. Blue Water Bridge area.
y. Below by #7 and #8, Lake Huron cut to the bridge.
z. Upstream and downstreams of Fort Gratiot Range line.
aa. Between the bridge and buoys 1 and 2.
bb. In the rapid area.
cc. Below the Blue Water Bridge. Lake Huron cut onto Fort Gratiot Range.
dd. Under the Blue Water Bridge.

3. What conditions that may only happen occasionally create a hazard in the zone.

a. High winds on the lake or in the river. Hard to hold position.
b. Sudden change in visibility. Strong current due to winds on Lake Huron. Loss of power.
c. Vessel changing pilots around the Blue Water Bridge.
d. Visibility, and traffic pick-up.
e. Strength of winds off Lake Huron. Current changes the direction.
f. Hazy visibility. If a vessel stalls.
g. Strong northerly winds increasing current.
h. Northerly winds for downbound vessels.
i. Meeting traffic.
j. Salt water ships changing pilots between Blue Water Bridge and buoy 1.
k. Vessels unable to delay above buoy 1 due to gale winds or weather conditions.
l. When two vessels pass there is a strong beam wind.
m. As above strong northerly winds create strong current. Ice jamming in spring.
n. Grouped traffic.
o. Changing pilots.
p. Low visibility.
q. Poor seamanship, piloting; improper reporting of passing area.
r. Meeting on the corner at Lake Huron cut buoy 1.
s. Heavy traffic. Ice conditions.
t. Passing under the Blue Water Bridge.
u. Wind; either direction it is hard to hold in high winds.
v. Vessel out of position.
w. Meeting 1,000-foot vessels.

x. Vessels arrriving or departing government dock at Sarnia.
y. Strong winds and seas in Lake Huron cut.
z. Low powered vessels unable to recover from taking a sheer.
aa. Vessels stopping to change pilots.
bb. Poor visibility; vessels crossing the river.

4. Are there any additional comments or recommendations you would like to make concerning this zone?

a. That the one-way traffic be discontinued; retain the safety calls; masters that feel their equipment and personnel are not good enough to meet could stop and wait until traffic clears.
b. Vessels should be prohibited from changing pilots in the channel. On one occasion there was a vessel stopped to change pilots on Canadian side across from the pilot station.
c. Remember, collisions can be avoided by never leaving the dock. Traffic control. Safety calls, call in points, awareness of traffic and experience are more seamanlike solution than a stop and go light.
d. Have vessels report to Port Huron CG or Sarnia and spot check vessels to prevent mis-representation of position - vessel could meet above traffic.
e. Keep regulation in force. Too many violators.
f. Increase speed limit upbound for better steerage.
g. Vessels fueling should not be allowed to leave fueling dock until the river is clear of all traffic.
h. Speed limit increased to 12 mph upbound from Port Huron traffic buoy.
i. Downbound should have right-of-way when the wind is blowing 25 knots or more on Lake Huron.
j. I think it should be left up to the masters, weather they want to meet in the zone or not, after giving security calls.
k. You should be able to meet other vessels in this zone, if in your opinion that it would be safer than trying to check speed.
l. Would like to see two-way traffic again, except for the few larger ships.
m. I think the regulation is very good in its present form, but would like to see some form of monitoring of vessels that tend to stretch the times at the various calling in points. If everything and everyone complied with the regulation as outlined it would continue to be a big safety factor.
n. I would like to see two-way traffic started up again.
o. Vessels at times are not honest with their position or ETA's.
p. No pilots to change either upbound or downbound.
q. Take down rear range light, leave front range light as a lead light for upstream and downstream reference.
r. Masters should be allowed to meet in zone at their discretion.
s. Keep in force.
t. Discontinue no passing regulation. Continue regulation concerning present security calls; regularly scheduled visibiltiy reports from P.H. and Flats CG when visibility falls below 1/2 mile in river.

5. Which of these calls are the most important?

a. Upbound - Belle Isle - Lake St. Clair Crib; see call 27 Cut Off Channel light #2.
Downbound - Salt Dock - light 23; Harsens Island light 13 security call.
Upbound - security call at light 10 in South Channel.

b. All are important - helps guage speed required.
c. Lake St. Clair Light, Light 23 downbound.
d. The first 4 upbound and the first 3 downbound.
e. Downbound - Salt Dock Light; Upbound - Lake St. Clair crib.
f. All are valuable except as noted below.
g. Light #2 and Harsens Island #13.
h. Lake St. Clair Crib light upbound; Light 23 downbound.
i. Lake St. Clair Crib light upbound; Light 23 downbound.
j. All of these calls are important however, the need to make security call and call to Sarnia traffic control is redundant (see reverse #1).
k. I consider all as important however, Lake St. Clair Crib and at Salt Dock, the mariner has the advantage of contacting the ships involved and reducing speed to advantage.
l. Abeam Salt Dock light.
m. All are important.
n. Upbound - all except light #23; Downbound - all except Lake St. Clair light.
o. Upbound - abeam St. Clair Crib light; upbound - St. Clair Cut Off light #2; downbound - abeam Salt Dock light, abeam lights 2, 13, and 23.
p. Downbound at light 23.
q. Light 23 downbound; Lake St. Clair Light upbound.
r. They are allright as long as the channel is narrowed down. When they get it deepened they will all be unnecessary.
s. I think the calls to Sarnia traffic center are unnecessary, we could give our own security calls and control our movements with other ships. If the channel was dredged there would be no need for security calls.
t. Light #13. Salt Dock.
u. Lake St. Clair Crib Cut Off light #2. Lights 13 and 23.
v. Lights 2 and 13, and Crib Light in St. Clair.
w. None of them. Vessels are in voice contact anyways.
x. Abeam Salt Dock downbound. Abeam light 23 downbound.
y. Upbound 1, 2, 3. Downbound 1, 3, 4.
z. All are important when one-way traffic is in effect in St. Clair Cut Off.
aa. Abeam Salt Dock light.
bb. All are important to evaluate the meeting situation.
cc. Abeam Lake St. Clair Light upbound; Harsens Island light #13 downbound.
dd. None.

6. Which of these calls are the least important?
a. -
b. X
c. All help to regulate one's meeting time.
d. The last 2 upbound and the last 2 downbound.
e. Lake St. Clair Light downbound and Grande Point Light upbound.
f. None.
g. Belle Isle downbound.
h. All are important.
i. Fighting Island north light.
j. None.
k. Detroit River Light.
l. They are all very important. Mostly for vessels coming out of the Rouge River.

m. Downbound - Lake St. Clair Crib. Upbound - light 23.
n. Actually all are important.
o. Upbound - abeam light 23. Downbound - Lake St. Clair light.
p. Downbound - abeam of Cut Off light 2. Abeam Lake St. Clair Crib.
q. Up 4 and 5, down 2 and 5.
r. Upbound - abeam St. Clair South Channel light 23.
s. Each call helps to evaluate the meeting situation.
t. Abeam light 23 upbound; abeam Lake St. Clair light downbound.
u. All of them.

7. What voluntary security calls do you make in the Detroit River?

a. Downbound - Belle Isle. Upbound - Fighting Island south light.
b. Belle Isle CG - Woodward Avenue - Ambassador Bridge when downbound to Hanna Furnance. Fighting Island north light when upbound.
c. Upbound at Fighting Island north light to alert traffic departing Rouge. Downbound at Ambassador Bridge to notify ships of turn into Hanna Furnace, Detroit.
d. When downbound at Woodward Avenue and Ambassador Bridge for turning into the furnace, Great Lakes Steel.
e. The calls vary from trip to trip.
f. During periods of foul weather or concentration of traffic when such call may serve other vessels in area.
g. At Fighting Island north light and Belle Isle CG Station - Bar Point, by buoy 2.
h. Upbound - Fighting Island north light; inbound East Outer Channel. Downbound - Belle Isle CG Station.
i. None - only leaving all docks.
j. Only as necessary. The FM calling frequency is cluttered as indicated (See #2).
k. Downbound - abeam of Detroit Harbor Terminal. Upbound - abeam of Fighting Island North light (Rouge traffic).
l. Up or down at Fighting Island north light.
m. Fighting Island north light, Rouge entry, Belle Isle CG Station, and Lake St. Clair buoy #1.
n. Fighting Island north light upbound when entering and leaving Rouge River, docking.
o. Upbound - at Fighting Island north light; downbound - at Belle Isle Coast Guard Station.
p. Downbound - Fighting Island north light; downbound - Willow Point.
q. Any that appear necessary, depending on the situation and all Sarnia center requests.
r. Belle Isle Coast Guard Station, Ambassador Bridge, Fighting Island north and south lights.
s. Before entering and departing the Rouge River, leaving docks, and whenever low visibility.
t. Upbound - Fighting Island north light.
u. Downbound - Marysville Dock, Willow Point, Belle Isle Coast Guard Station. Upbound - Bar Point buoy 1, Fighting Island North light, and Courtright light.
v. Fighting Island south light, Ambassador Bridge, and Rouge River.
w. None - unless I'm making dock in this area.
x. All of them.
y. Abeam of Belle Isle, upbound.

z. Woodward Avenue and Ambassador Bridge when preparing to make the turn for Hanna Furnace.
aa. Upbound - Fighting Island north light. Downbound - Belle Isle Coast Guard Station.
bb. Presently I am not operating in the Detroit River. Normally I would give security calls which would advise other vessels of any planned diversion from a normal passage; plus I would advise others of my position in low visibility.
cc. All of the above.
dd. Security calls are useless during the summer time because of the noise on Channel 16.
ee. Inbound Rouge River.

8. Which of these calls are the most important?

a. Both.
b. I consider them all important.
c. Regard them both important.
d. During period of reduced visibility all calls are helpful.
e. All.
f. All are important in maintaining your position relative to position of other vessels with the river.
g. All are important.
h. Departing dock or docking and turning around in the river.
i. Both.
j. Downbound Willow Point.
k. Varies according to conditions.
l. They are all very important. Mostly for vessels coming out of docks or the Rouge River.
m. Low visibility.
n. Fighting Island north light and Belle Isle Coast Guard. This gives ships docking and undocking in the Detroit and Windsor areas a general idea of the traffic movement.
o. Possibly St. Clair Crib and the Salt Dock, Crib #23.
p. Both of above.
q. Both.
r. All.
s. Inbound and outbound Rouge.

9. Which of these calls are the least important?

a. -
b. X
c. Regard them both important.
d. During the summer months the pleasure boat, rapid traffic, "covers over" security calls.
e. None.
f. Belle Isle downbound.
g. All are important.
h. Fighting Island north light.
i. None.
j. Detroit River Light.
k. Same as above.
l. The calls listed upbound from Belle Isle to Light 23, and downbound from Salt Dock to Light 2.

m. Marysville dock and Bar Point buoy 1.
n. Detroit River.
o. None.
p. Once the cut-off is dredged and the buoys removed or repositioned. The one-way traffic is not needed.
q. In clear weather security calls are not important with the exception of vessels leaving docks.

10. List three areas within the St. Clair-Detroit River system you feel to be the most hazardous.

a. Huron Cut buoy 1 to Port Huron Waterworks. Ambassador Bridge to Nicholson Dock, Rouge River. The turns at the upper and lower end of the St. Clair Cut-Off Channel.
b. Blue Water Bridge. Entering Livingstone Channel. Below buoy 13 to St. Clair Cut-Off Channel.
c. Downbound turn at light 13, if upbound ship is not clear of green buoy marking shoal spot for deep draft ships.
d. Too much yacht radio-telephone traffic; passing ships and tows going in same direction (overtaking); ships turning in the river.
e. Junction at the Livingstone-Ballards Reef. Turn at light 13, St. Clair River. Fort Gratiot Light to Fort Gratiot front range light.
f. Harsens Island range to light 2, downbound. Because of shoaling area, Cut-Off Canal. Light 2 to light 13 upbound.
g. St. Clair Cut-Off Channel between lights 2 and 6; St. Clair River between Port Huron Waterworks and Lake Huron buoys 1 and 2; and St. Clair River buoy 13 to Harsens Island rear range light.
h. Blue Water Bridge; Cut-Off Channel; From light 2 to lights 5 and 6 at present time.
i. Southeast Bend abreast light 13 at St. Clair River. Blue Water Bridge area. Cut-Off light 2, as the area continues to shoal.
j. Blue Water Bridge area, upbound. Ballards Reef Channel, area of entering Livingstone Channel, when meeting upbound ships in area of crossing light. Off Windmill Point, while turning around to enter the channel above Belle Isle and going to Conner's Edison; also, departing Conner's Edison dock when mariners in area do not respond to security calls.
k. Barlum Point; Zug Island area; Middle Ground at St. Clair.
l. Rapids at Port Huron; Cut-Off Channel buoy 2; Ballard Reef.
m. Outbound Rouge River entering Detroit River; Lake St. Clair Cut-Off between buoy 13 and post light 2, upbound and downbound; Port Huron traffic buoy to Lake Huron Cut buoy 1, both upbound and downbound.
n. Blue Water Bridge area; St. Clair Cut-Off, because it isn't dredged - it is a disgrace to let this condition go as long as it has; Rouge River when entering and leaving.
o. St. Clair Cut-Off from light 2 to light 13 ("only now dug to shoaling"); Under Blue Water Bridge; Amherstburg Channel.
p. Under Blue Water Bridge; Turn at light 13; Turn into Livingstone Channel, downbound.
q. River bend at light 13 (St. Clair River); Amherstburg Channel; Livingstone Channel upper entrance (downbound vessels at cut-off light 2 tend to turn into Lake St. Clair Channel too soon - somehow area needs another marker or lead light).
r. Southeast Bend; Blue Water Bridge; Amherstburg Channel; Rouge entry.

s. There are none that I feel are real hazardous if every master and pilot follows the pilot rules and the salt water vessels have good pilots aboard.
t. Most hazardous - waiting on Lake St. Clair below light 2. When you have a ship in ballast it is very hard to maintain position in narrow channel. Under windy conditions upbound ships should have right-of-way to get off Lake St. Clair (20 knots or more wind).
u. Upbound Amherstburg Channel from light 53D to light 75D; downbound or upbound meeting at head of Cut-Off Channel light 13; upbound from Port Huron Waterworks to the Blue Water Bridge.
v. Southeast Bend (St. Clair River); Recors Point (St. Clair River); Fighting Island south light area.
w. Between St. Clair Cut-Off light 2 and Harsens Island light 13; under the Blue Water Bridge.
x. None.
y. Below Blue Water Bridge; Middle Stag Island light to below city of St. Clair; Harsens Island range to new cut-off channel, Southeast Bend.
z. Turning to go into docks at Detroit or any turning process in the St. Clair-Detroit River area.
aa. Blue Water Bridge; Southeast Bend; Rouge cut-off area. (All of rivers when navigated by United States Steel ships and PM ships).
bb. Between Huron Cut buoys 1 and 2 and the Fort Gratiot rear range; Between buoy 15 and light 8, St. Clair Cut-Off; Between Fighting Island south light and Livingstone upper entry light.
cc. Limekiln Crossing, Lower Detroit River; the turn into the Livingstone Channel, downbound; off Rouge River short-cut canal, Detroit River.
dd. From buoys 11 and 12 down to traffic buoy; head of Fighting Island Channel down to Detroit River light; Amherstburg Channel.
ee. Cut-Off Channel with the present shoaling conditions.

11. Where would you recommend additional security calls be made?

a. None - just keep honest on ETA's at points.
b. -
c. Too much radio traffic now on the air, additional radio channels needed.
d. None - radio congestion during small boat season causes overloaded air waves already.
e. None.
f. None.
g. None.
h. No.
i. None.
j. No.
k. "No."
l. None
m. Anytime when someone is turning in the rivers. At light 2 when entering the old channel, upbound.
n. Present system is good.
o. No.
p. I think it would help to have the salt water ships answer security calls when they are given in regards to entering the Detroit River from the Rouge River.

q. At present time and with the number of ships running , I feel that there are enough security calls made.
r. Fighting Island south light.
s. No.
t. Nowhere, as there are too many calls being made at the present time.
u. None, except in case of fog.
v. Upbound, Fighting Island Middle Light; Downbound, Belle Isle Coast Guard Station.
w. As required by good seamanship.
x. No, just that vessel positions not be mis-represented.
y. None.
z. No.

12. Do you have any additional comments or recommendations concerning hazard or voluntary security calls within the Detroit-St. Clair River system?

a. No.
b. -
c. Present status satisfactory when the reception of calls is not blocked by excessive and unnecessary radio transmissions.
d. Better maintenance of aids to navigation and dredging of channels to remove shoaling.
e. None.
f. No.
g. Ship unloading in Rouge River give a security call every 30 minutes when unloading and blocking river.
h. Get the St. Clair Cut-Off channel dredged as it should be. Get the "play" boaters off Channel 16.
i. Only that the Canadians get on the stick and start dredging the St. Clair Cut-Off.
j. Dredge the cut-off canal; resume two-way traffic at Port Huron; remove the green lights from the center of the Blue Water Bridge (as with the Mackinaw Bridge, most pilots have inherent determination to come under the exact center of the bridge).
k. Make it mandatory for Belle Isle, Ambassador Bridge, and Fighting Island north and south lights. During the summer time, there are so many small boats on Channel 16 that it is impossible to make any calls that mean anything. Give them a channel of their own.
l. None.
m. Some salt water ships with their limited experience navigating in confined waters even with pilots, at times, I feel, do create a hazard in the rivers.
n. With all the pleasure craft and security calls going on during the navigation season, I feel enough is enough.
o. There are too many unnecessary calls through the Canadian Coast Guard Traffic Center.
p. Voluntary departing and entering Rouge River Short-Cut Canal.
q. In addition to the security calls, etc., remove any doubt by blowing whistle signals as required in the Rules of the Road.
r. Racon on light 2 in the cut-off, Lake St. Clair Light, Peach Island front range: should be in operation year around, with increased intensity of the lights on the Peach Island range.
s. See below.
t. Discontinue some of the garbage on the air.

13. Do you have any additional comments or recommendations concerning navigation in general within the Detroit-St. Clair River System?

a. Steering light lower end St. Clair Cut-Off Channel.
b. In clear weather, security calls should be limited to the Blue Water Bridge area and the cut-off, Lake St. Clair. During poor visibility, additional calls can be made as needed. Now, some vessels are giving security calls at every turning point and it just clutters up the channels.
c. Traffic Center Sarnia doing a very commendable and highly useful service.
d. Not presently involved, except with the consequence of mishaps, and not in a position to make an intelligent comment. I do, however, find the increasing use of security calls to be counter-productive, even considering the supplementing of whistle signals with radio contact.
e. Racon beacon on fixed fixture, light 13. Year around operation.
f. None.
g. Keep speed to 1976 level.
h. Coordinate speed limit with Windsor Harbormaster. Compromise or do what you must. To have such a wide variance in speed limits in accordance to which side of the line a ship is on is confusing.
i. None.
j. Ship unloading on the north bank of the Rouge River at Great Lakes Steel should be required to get up close to the bank. Tugs doubling up barges at the Detroit Edison plant at mouth of the Rouge River - these barges are not lighted at night. Is hard to make the turn in or out of the Rouge River when there is a ship unloading on the North Bank.
k. Same as above.
l. No.
m. Twelve miles per hour speed limit is much easier to control than ten miles per hour, 11 mph would be better than 10 mph. Should require speed meters on commercial ships as we can only determine speed over some distance, as not instantly or constantly as with your doppler radars.
n. Keep the speed limits where they are in the Great Lakes Pilot.
o. Before we had all these security calls in the system, whenever we heard a security call we would take notice of it, because we knew it meant a danger; now there are so many you have a tendency to overlook them. Also, I think the various Coast Guard Stations should cut down on their repeat of saying securite, securite, securite whenever they have a notice to broadcast. Channel 16 is too confusing with traffic as it is.
p. In the summer months the hundreds of small craft at times along with the sail boats on Lake St. Clair creates some bad moments for ship-board officers while transiting the area. Get after the FCC to assign radio frequencies for small craft in the summer, on a weekend it is but near impossible to make or hear a phone call as the channels are so cluttered. Place more lighted aids to navigation in the Trenton Channel. Get after the Canadians to dredge out the St. Clair Cut-Off Channel.
q. None.

r. The Canadian Coast Guard Traffic Center at Sarnia is requesting ships to call when they leave the no passing zones. And ships are also giving security calls when they are leaving the zones. This is all unnecessary cluttering up of the airways that already are overloaded. If any ship is waiting to enter the no passing zone then he is close enough to see the ship leaving the zone, so security calls such as at Huron Cut buoy 1 upbound and Port Huron Traffic buoy downbound and St. Clair Cut-Off downbound are just nuisance calls in clear weather.

s. Racon be used year around at Huron Cut buoys 11 and 12; Lake St. Clair Crib light; buoy 14 East Outer Channel and buoy 1 East Outer Channel.

t. Eliminate the zone of no meeting between Lake Huron Cut lighted buoy 1 and the Port Huron Traffic lighted buoy. Sarnia Traffic Control seems to do good work and the licensed captain of any vessel, armed with knowledge of other ships in his vicinity, should be trusted to sail his own ship.

u. The above would be of great assistance for winter navigation and during period of limited visibility. The racons are of great value when buoys are carried off position by ice and during the yachting season periods of limited visibility when Lake St. Clair is covered with yachts as targets on the radar screen. The presence of yachts make it difficult to pick out buoys. Clarify vessels downbound from 11 and 12 shall have the right-of-way over vessels that have not reached Polymer Plant upbound.

v. At the present time no comments other than the yachts using the calling channel. These small boats should have a radio system of their own. During the summer months it is almost impossible to use the radio-telephone, and when one spends four hours listening to all the chatter, the important message don't seem to come through. It's very easy to miss "security calls."

w. Set a uniform speed of 12 miles per hour from Huron Cut buoys 11 and 12 to Detroit River light. This will eliminate the passing of the salties in Lake St. Clair. It is not safe to pass another vessel doing over 20 knots, which happens quite often.