DISTRIBUTION AND RELATIVE ABUNDANCE OF SUBMERSED AQUATIC MACROPHYTES IN THE ST. CLAIR-DETROIT RIVER ECOSYSTEM

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Abstract

An extensive survey was conducted in fall 1978 at 595 stations throughout the St. Clair-Detroit River Ecosystem (SCDRE) to determine the distribution and relative abundance of submersed aquatic macrophytes. Macrophytes were widely distributed in the SCDRE, being found at 68% of all stations; 88 and 90% of the stations in the St. Clair River and Anchor Bay, respectively, and 16 and 58% of the stations in Lake St. Clair and the Detroit River, respectively. Macrophyte beds of higher density were found in the St. Clair and Detroit rivers than in Anchor Bay or Lake St. Clair proper. In the St. Clair and Detroit rivers, macrophyte beds adjacent to river channels used by commercial vessels passing between Lakes Huron and Erie (shipping channels) were generally less dense than those adjacent to river channels not used by commercial vessels (non-shipping channels).

Of the 19 macrophyte taxa identified, 9 were abundant, being found at 6-37% of all stations. In decreasing order of abundance, these taxa were: Vallisneria americana, Characeae, Potamogeton richardsonii, Myriophyllum spicatum, Elodea canadensis, Heteranthera dubia, narrow-leaved Potamogeton spp., Najas flexilis, and Potamogeton gramineus. The greatest change in the species composition of macrophytes in the SCDRE over the last 70 to 80 years, has been the appearance of an exotic species, Myriophyllum spicatum, that has invaded the river system and is now the fourth most abundant plant.

Introduction

Submersed aquatic macrophytes are a prominent feature of littoral waters that border the more than 600 km of shoreline in the St. Clair-Detroit River Ecosystem (SCDRE) (Figure 1). These macrophytes contribute to the production of valuable fish and wildlife populations in the river system by providing food, shelter, and other beneficial habitat requirements (Dawson 1975; Great Lakes Fishery Laboratory, unpublished data). Jaworski and Raphael (1978) showed that 72% of wetlands adjacent to U.S. waters of Lake St. Clair have been destroyed by dredging, bulkheading, and filling within the past 100 years. The submersed aquatic macrophyte communities of the SCDRE may also have been adversely affected during this period by activities such as navigation, but the information required to document any such changes is generally lacking. This report describes the results of a survey conducted in 1978, to provide a baseline description of the submersed aquatic macrophyte communities throughout the SCDRE, against which future changes could be measured and evaluated.

Methods

Our sampling locations and sampling procedures were designed to adequately describe the distribution and relative abundance of submersed macrophytes present from August 23 to October 13, 1978 throughout the SCDRE. Not all macrophytes attain maximum biomass during this period (e.g., Harmon 1970; Craig 1976), but it is a time when a relatively large number of taxa are abundant in these waters (Schloesser 1982). Macrophytes that are present only from early spring through midsummer (e.g. Potamogeton crispus) were not adequately assessed in this survey.

Sampling was conducted at 595 stations throughout the SCDRE, including 217 stations in the St. Clair River, 60 in Anchor Bay, 55 in Lake St. Clair, and 263 in the Detroit River (Appendix I). In the rivers and along the perimeter of Anchor Bay, stations were established at 1-2 km intervals and located by reference to navigational aids (e.g., channel markers, towers, and buoys). In the open waters of Anchor Bay and Lake St. Clair, and along the perimeter of Lake St. Clair proper, stations were established by latitude-longitude coordinates at 1-5 km intervals and located by time-distance runs from known locations. In river channels, we sampled submersed vegetation growing from the shoreline (or the offshore edge of emergent vegetation) out to about the 10-m depth contour. Sampling was not conducted at greater depths in river channels because the literature indicated macrophytes typically are limited to depths less than 10 m (Hutchinson 1975); are most abundant in lakes at depths less than 4 m (Spence 1975; Crowder et al. 1977; Sheldon and Boylen 1977); and, in preliminary sampling, we seldom found macrophytes growing in river channels at depths greater than 7 m.

Macrophytes were sampled with a grapnel lined with 1-cm square mesh hardware cloth (Figure 2). A grapnel was used by Pieters (1893) and Hunt (1963) in earlier surveys of macrophytes in parts of the SCDRE and it is a recommended device for collecting macrophytes in a wide variety of habitats (Slack et al. 1973). At each station, the grapnel was dragged along the bottom for a distance of 10 m six times; these drags were arranged in one of

four patterns depending on the width of the littoral zone (Figure 3). As illustrated in Figure 3, at stations where there was little variation in water depth (e.g., stations 8, 260, and 388), six drags were made in series along a straight line, each closely following the preceeding one (pattern A). At stations where water depth changed more rapidly (i.e., near drop-offs; e.g., stations 7 and 370), drags were made perpendicular to depth contours following pattern B, C, or D. The width of the littoral zone also determined, in part, which of the four patterns was used. Macrophytes collected in all six drags at a station were pooled to provide a sample from which the distribution, relative abundance, and density were determined. The distribution of each macrophyte taxon was expressed as the percent frequency of occurrence at all stations within each waterbody segment and within the SCRDE as a whole. From visual inspection of the pooled macrophyte sample collected at each station we estimated the relative abundance (percent composition) of each macrophyte taxon and the density of all macrophytes combined (Appendix II). Macrophyte density (a relative estimate of the standing crop biomass of all macrophyte taxa in the pooled sample at each station) was recorded as low, medium, or high. A comparison of density estimates obtained in the manner described in this paper with density estimates obtained from weighed samples collected with the Ponar grab is given in Schloesser et al. (In prep.). Macrophytes we collected were identified after Voss (1972) and Fassett (1969). Characae and some Potamogeton spp. that we found infrequently were not identified beyond the family, generic, or sub-generic level.

Because our observations suggested that beds of submersed macrophytes adjacent to shipping channels were less dense than those near non-shipping channels, a secondary objective of this investigation was to determine if any detrimental effects of commercial navigation on submersed aquatic macrophytes could be demonstrated using our survey data. (In this report, river channels in the SCDRE used by commercial lake carriers passed between Lakes Huron and Erie are defined as "shipping channels" and those not so used as "non-shipping channels"). The distribution, abundance, and density of macrophytes at stations adjacent to shipping channels were tested by chi-square in 2 x 2 contingency tables (Snedecor and Cochran 1973) against those at stations adjacent to non-shipping channels to determine if significant differences existed.

Results

Distribution

Macrophytes were found at 88% of the stations in the St. Clair River, 90% of the stations in Anchor Bay, 16% of the stations in Lake St. Clair proper and 58% of the stations in the Detroit River (Table 1). From these results we conclude that submersed macrophytes were more widely distributed in Anchor Bay and the St. Clair River than in the Detroit River and Lake St. Clair proper. In the St. Clair River, macrophytes were found more frequently in the lower (deltaic) reaches than in the upper reaches. In Lake St. Clair, few macrophytes were found beyond 1.25 km from shore.

Throughout the SCDRE Vallisneria americana occurred most frequently, i.e., was most widely distributed (Table 2). This plant was more widely distributed in the Detroit River and Anchor Bay than in the St. Clair River

and Lake St. Clair proper. Characeae, Potamogeton richardsonii, Myriophyllum spicatum, Elodea canadensis, and narrow-leaved Potamogeton spp. were more widely distributed in the St. Clair River and Anchor Bay than in Lake St. Clair or the Detroit River. Heteranthera dubia was more widely distributed in the Detroit River and Lake St. Clair than in the St. Clair River and Anchor Bay.

Areas within the waterway where the distribution of macrophytes was limited by the availability of suitable substrate included the sandy bottom in open waters of Lake St. Clair, the bulkheaded western shoreline of the Detroit River between Lake St. Clair and Lake Erie, and the bulkheaded or rip-rapped shorelines on both sides of the lower Amherstburg Channel in the Detroit River.

Relative Abundance

Of the 19 macrophyte taxa identified in this survey, 16 were present in the St. Clair River, 12 in Anchor Bay and 13 in the Detroit River, and 7 in Lake St. Clair proper (Table 2). The most abundant macrophyte, i.e., that found to occur most frequently at greater than 1% of the stations, was wild celery (Vallisneria americana) in Lake St. Clair and the Detroit River and muskgrass (Characeae) in the St. Clair River and Anchor Bay. V. americana and Characeae were found throughout the waterway, being present at about 37% of all 595 stations. Redhead grass (Potamogeton richardsonii), Eurasian watermilfoil (Myriophyllum spicatum), and the waterweed (Elodea canadensis) were found at 22, 19, and 19% of all stations, and water stargrass (Heteranthera dubia), narrow leaved Potamogeton spp., bushy pondweed (Najas flexilis), and variable pondweed (P. gramineus) were found at 6-15% of all stations. Other incidental taxa, found at 1% or less of all stations, included coontail (Ceratophyllum demersum), watermilfoil (Myriophyllum exalbescens), water lily (Nymphaea sp.), pondweeds (broad-leaved Potamogeton spp., P. crispus, P. illinoensis, P. natans, P. nodosus, and P. zosteriformis), and water buttercup (Ranunculus sp.).

Macrophytes beds of low, medium, and high density were found in about the same proportion of stations in the St. Clair (31, 39, and 30%, respectively) and Detroit rivers (25, 39, and 36%, respectively) (Appendix II). In Lake St. Clair and Anchor Bay, macrophyte density was low at about two thirds of the stations sampled (67 and 61%, respectively); was medium at less than one fourth of the stations (22%); and was high at less than one fifth of the stations (11 and 17%, respectively). We found a significantly larger number of low density beds and significantly smaller numbers of medium and high density beds in Anchor Bay and Lake St. Clair than in the St. Clair and Detroit rivers ($p = 0.05$, chi-square test) therefore, in general, the density of macrophyte beds in Lake St. Clair and Anchor Bay was lower than that of beds in the St. Clair and Detroit rivers.

Shipping versus Non-shipping Channels

Overall, we found vegetation more frequently at stations adjacent to non-shipping channels than at stations adjacent to shipping channels, however, not all taxa were found more frequently at stations adjacent to non-shipping

channels (Table 3). For example, in the St. Clair River, V. americana, narrow-leaved Potamgeton spp., P. richardsonii, and P. gramineus were found more frequently adjacent to shipping channels but M. spicatum and E. canadensis were found more frequently adjacent to non-shipping channels. In the Detroit River, P. richardsonii, N. flexilis, and Characeae were found more frequently adjacent to shipping channels but M. spicatum, E. canadensis, and H. dubia were found more frequently adjacent to non-shipping channels. One taxon in the St. Clair River (Characeae) and one in the Detroit River (V. americana) were found with about equal frequency adjacent to both shipping and non-shipping channels. Some taxa (e.g., P. flexilis and H. dubia in the St. Clair River and P. gramineus in the Detroit River) were found too infrequently to make valid, statistical comparisons.

Because we observed that submersed macrophytes not only occurred less frequently adjacent to shipping channels but also that beds adjacent to shipping channels were less dense than beds adjacent to non-shipping channels, we performed a chi-square test of significance using our density data to determine whether beds adjacent to shipping channels were less dense than adjacent to non-shipping channels. In the St. Clair and Detroit rivers, the percentage of high density macrophyte beds was significantly lower adjacent to shipping channels than adjacent to non-shipping channels (Table 4). In the St. Clair River, the percentage of beds that were low or medium in density was higher adjacent to the shipping channels than that of beds adjacent to non-shipping channels. In the Detroit River, the percentage of beds that were low or medium in density was significantly higher adjacent to shipping channels than adjacent to non-shipping channels ($p = 0.01$). In general, in both rivers, we found that the density of macrophyte beds adjacent to shipping channels was lower than that adjacent to non-shipping channels.

Discussion

Our finding that submersed macrophytes occurred at 68% of our 595 stations illustrated that macrophytes are widely distributed and relatively abundant in the SCDRE. Annual surveys performed from 1971 to 1977 in Chesapeake Bay, the only other large riverine ecosystem studied in detail thus far, revealed that macrophytes were present at only 9 to 29% of the stations (Stevenson and Confer 1978). We could find no information in the literature about the distribution and abundance of submersed macrophytes in other connecting waterways of the Great Lakes.

A comparison of our results with those of Hunt (1963), who used similar survey methods, indicated that the distribution and abundance of macrophytes had changed in the lower Detroit river over the past 25 years. Hunt's maps show that macrophytes were present along the west shore of the Detroit River between Calf Island and Sturgeon Bar from 1951 to 1954 (Hunt 1963). We found no vegetation in this section of the river. Since Hunt's 1951-54 survey, narrow-leaved Potamogeton spp. and P. richardsonii have decreased in relative frequency of occurrence from second and third most widely distributed to sixth and seventh most widely distributed, respectively. Coontail (C. demersum) also declined in the Detroit River from seventh in 1951-54 to thirteenth in 1978. Some species have, however, become relatively more widely distributed in the lower Detroit River since 1954; these include H. dubia (from fourth to

second), E. canadesis (from fifth to third), and Myriophyllum spp. (from eighth to fourth). The taxon we found most frequently throughout the SCDRE, V. americana, was also the one found most frequently by Hunt (1963).

All macrophyte taxa identified in this study were previously reported in the SCDRE (Campbell 1886; Pieters 1893; Farwell 1901; Dodge 1899, 1914; Hunt 1963; Dawson 1975). Two exotic taxa found in the survey, P. crispus and M. spicatum, were not found in the river system around the turn of the century but were reported by Hunt (1963) and Dawson (1975). P. crispus, is generally assumed to have been introduced from Europe, and was first recorded in the Great Lakes in 1946 (Voss 1972). M. spicatum first invaded the Great Lakes in 1961 (Aiken et al. 1979), but subtle taxonomic differences between M. spicatum and M. exalbescens, another species common elsewhere in the Great Lakes basin have resulted in inadequate records of the invasion by of the Great Lakes by M. spicatum (Coffey and McNabb 1974; Reed 1977). By 1975, M. spicatum had become the most abundant taxon in Anchor Bay (Dawson 1975). Our results show that M. spicatum has, 13 years after its reported invasion, become the fourth most abundant macrophyte throughout the SCDRE.

M. spicatum is a strong competitor and is considered to be a very troublesome weed (Grace and Wetzel 1978). In Chesapeake Bay, M. spicatum was first recorded in 1902 (Nichols and Mori 1971), but did not become a nuisance until 1959 when it formed beds sufficiently dense to render the water from shore to a depth of 6 m visually obnoxious and useless for recreation activities (Stennis et al. 1962). When M. spicatum declined in abundance by about 95% in Chesapeake Bay between 1965 and 1967 owing to natural causes (Bayley et al. 1968), many of the nuisance problems associated with the luxurient growth of this plant in that water body were eliminated (ibid.; Stevenson and Confer 1978). To date, insufficient data are available to determine if M. spicatum in the SCDRE or in the Great Lakes is presently following the pattern of prolific growth and rapid decline it followed in Chesapeake Bay. In the St. Lawrence River in 1978, M. spicatum was not found frequently by Raynal and Geis (1978).

The relatively limited distribution of submersed macrophytes in the Detroit River and Lake St. Clair compared with that in the St. Clair River and Anchor Bay can, in part, be attributed to the availability of suitable substrate for macrophyte attachment. Our observations indicate that extensive dredging and bulkheading to build deepwater, port facilities along the western shore of the Detroit River have eliminated littoral substrate needed for macrophyte attachment. Beside bulkheads fronting much of these facilities, the river bottom is hard and forms a slope approaching 90° to a water depth of 7 to 15 m. These conditions prevent macrophyte attachment and growth. Plants are more widely distributed in the St. Clair River than in the Detroit River (Table 1) because, much less of the shoreline in the former is bulkheaded. In Lake St. Clair and Anchor Bay, water depth increases gradually from shore to about 7 m near the center of the lake (U.S. Dept. of Interior 1970). In open waters of Lake St. Clair (i.e., 1.25 km or more from the shoreline); we found vegetation at only 1 of 24 stations. We believe that wind-driven water currents generated by the long fetch across Lake St. Clair (40 km) and the lakes shallow depth scour the bottom and prevent macrophyte growth in open waters. In contrast, we found submersed macrophytes or Characeae throughout Anchor Bay. This bay supports more macrophytes than the lake proper partly

because it has a shorter fetch (17 km) than the lake proper, is therefore less subject to current scour, and accumulates silty substrates (Hiltunen and Manny 1982) that are suitable for colonization by macrophytes.

Our finding that the percentage of high density macrophyte beds was significantly lower adjacent to shipping channels than adjacent to non-shipping channels suggests that vessel passage may have reduced the density of macrophyte beds adjacent to channels used for shipping in the SCDRE. Support for our finding is given by Raynal and Geis (1978) who reported that the density of submersed macrophytes in winter in beds near shipping channels (mean dry weight of 15 g/m^2) was lower than in beds remote from shipping channels (mean dry weight of 36 g/m^2). Raynal and Geis (1978) concluded that the lower density or submersed macrophytes adjacent to shipping channels was due to ship passage, but provided no further explanation.

We believe that an explanation for the lower density of submersed macrophytes adjacent to shipping channels may lie in the effect of vessel passage on the flow regime in littoral waters. Studies conducted in the St. Marys River (Alger, 1979) showed that the passage of large commercial vessels during the period of ice cover caused rapid, short-lived disruptions of the normally unidirectional flow pattern in littoral waters adjacent to the navigation channel; in the more extreme situations the direction of water flow rotated a full 360 degrees as the vessel passed the study site. We believe that such vessel-induced disruptions of the flow regime occur both under ice and during the ice-free period in Great Lakes connecting waters and that these disruptions may contribute to fragmentation of macrophyte stems and the consequent reduction in plant bed density that we observed immediately adjacent to shipping channels.

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Table 1. Distribution of submersed macrophytes in the St. Clair-Detroit River Ecosystem, August 23 to October 13, 1978.

Area and station numbers[a]	Total Number of stations sampled	Stations with vegetation	
		Number	Percent of Total
St. Clair River			
Lake Huron to Algonac[b] 1-88, 90	89	73	82
Algonac to Lake St. Clair[b] 91-122	32	30	94
South Channel[c] 123-141	19	15	79
North Channel 89, 142-174	34	34	100
Middle Channel 175-198	24	23	96
Chenal Bout Rond 199-217	19	17	89
	217	192	88
Anchor Bay			
Perimeter (<0.75 km from shore) 273-307	35	30	86
Open water (>0.75 km from shore) 308-332	25	24	96
	60	54	90
Lake St. Clair Proper			
Perimeter (<1.25 km from shore) 218-248	31	8	26
Open water (>1.25 km from shore) 249-272	24	1	4
	55	9	16
Detroit River			
Belle Isle--north shore 349-363/o, 362, 364	10	5	50
Belle Isle--south shore[b] 350-360/e	6	5	83
Lake St. Clair to Fighting Is.--east shore[b] 333-338, 340-348/e, 366-416/o	37	23	62
Lake St. Clair to Fighting Is.--west shore[b] 339-347/o, 365-423/o	35	2	6
Mud Is. to Lake Erie--west shore 425-437/o, 445-475/o, 479, 481, 489-493	30	2	7
Grosse Ile--west shore 444-462/e	10	9	90
Grosse Ile--west shore 464-488/e, 477, 483-487/o	17	17	100
Grosse Ile--east shore[b] 495-505/o, 506-509	10	8	80

Table 1. (continued)

Area and station numbers[a]	Total Number of stations sampled	Stations with vegetation	
		Number	Percent of Total
Grosse Ile--east shore 511-521/o, 527-530	10	8	80
Fighting Island--east shore 535-539/o, 547-557/o	9	8	89
Fighting Island--west shore[b] 422, 428, 430, 434-438/e, 494-504/e	12	12	100
Fighting Is. to Amherstburg Channel--east shore 418, 420, 536-566/e, 541-545/o, 559-567/o	26	24	92
Amherstburg Channel[b] 568-586	19	5	26
Shallow littoral[b] 424, 426, 432, 439-443	8	8	100
Shallow littoral 510-522/e, 523-526, 531-534	15	12	80
Shallow littoral--east side of Livingstone Channel 587-595	9	4	44
	263	152	58
Grand total for the entire SCDRE	595	407	68

a/ /e and /o indicate even or odd numbered stations, respectively, that were included in the given series.
b/ Areas adjacent to active shipping lanes.
c/ Old shipping lane now used intermittently by ships.

Table 2. Distribution and relative abundance of submersed macrophytes in the St. Clair-Detroit River Ecosystem, August 23 to October 13, 1978 (Tabular values are the percent frequency of occurrence among stations sampled in various water body segments of the system and throughout the system as a whole).

Taxa	Distribution				
		Lake St. Clair			
	St. Clair River	Anchor Bay	Lake Proper	Detroit River	Whole SCDRE
Vallisneria americana Michx. (Wild celery)	28	42	11	49	37
Characeae (Muskgrass)	68	62	7	9	36
Potamogeton richardsonii (Benn.) Rydb. (Redhead grass)	49	13	4	4	22
Myriophyllum spicatum L. (Eurasian watermilfoil)	28	30	5	13	19
Elodea candensis Michx. (Waterweed)	36	20	4	7	19
Heteranthera dubia (Jacq.) Mac M. (Water stargrass)	<1	2	4	31	15
Potamogeton spp. narrow-leaf forms	24	12	0	3	11
Najas flexilis (Willd.) Rostk. & Schmidt (Bushy pondweed)	<1	43	2	5	7
Potamogeton gramineus L. (Variable pondweed)	11	3	0	3	6
Ceratophyllum demersum L. (Coontail)	0	3	0	<1	<1
Myriophyllum exalbescens Fern. (Watermilfoil)	<1	2	0	0	<1
Nymphaea sp. (Water-lily)	0	0	0	<1	<1
Potamogeton spp. broad-leaf forms	2	0	0	0	<1
Potamogeton crispus L. (Curly pondweed)	2	0	0	0	<1
Potamogeton illinoensis Morong. (Illinois pondweed)	0	0	0	<1	<1
Potamogeton natans L. (Floating-leaf pondweed)	<1	0	0	0	<1
Potamogeton nodosus Poiret (Long-leaf pondweed)	2	0	0	1	1
Potamogeton zosteriformis Fern. (Flatstem pondweed)	<1	0	0	0	<1
Ranunculus sp. (Buttercup)	2	2	0	0	<1
Total number of macrophyte taxa	16	12	7	13	19

Table 3. Distribution of abundant macrophyte taxa, (expressed as the percent of all stations) adjacent to shipping or non-shipping channels in the St. Clair and Detroit rivers, August 23 to October 13, 1978, and results of chi-square tests[a/] illustrating statistically significant differences in distribution.

	St. Clair River[b/]			Detroit River[b/]		
Taxa	Shipping channels		Non-shipping channels	Shipping channels		Non-shipping channels
Vallisneria americana	37	***	11	41		57
Potamogeton spp. narrow-leaf forms	33	***	7	4		3
Potamogeton richardsonii	52	**	45	6	*	3
Potamogeton gramineus	14	**	5	5		1
Najas flexilis	1		0	18	**	1
Characeae	67		71	14	***	4
Myriophyllum spicatum	12	***	58	9	*	18
Elodea canadensis	28	**	50	<1	**	10
Heteranthera dubia	0		1	10	***	51

a/ Levels of confidence: *** = 0.01; ** = 0.05; and * = 0.10; N = 118 and 74 for shipping and non-shipping channels in the St. Clair River and 63 and 89 for shipping and non-shipping in the Detroit River, respectively.

b/ See Appendix I for station designations in shipping and non-shipping channels.

Table 4. Percent of low, medium, and high density macrophyte beds found adjacent to shipping and non-shipping channels of the St. Clair and Detroit rivers from August 23 to October 13, 1978, and results of chi-square tests[a] illustrating statistically significant differences in density.

Density	St. Clair River[b]			Detroit River[b]		
	Shipping channels		Non-shipping channels	Shipping channels		Non-shipping channels
Low	33		27	43	***	11
Medium	48	***	25	55	***	28
High	19	***	48	2	***	61

[a] Level of confidence; *** = 0.01; N = 108 and 64 for shipping and non-shipping channels in the St. Clair River and 62 and 87 for shipping and non-shipping channels in the Detroit River, respectively.

[b] See Appendix I for station designations in shipping and non-shipping channels.

Figure 1. The St. Clair-Detroit River Ecosystem.

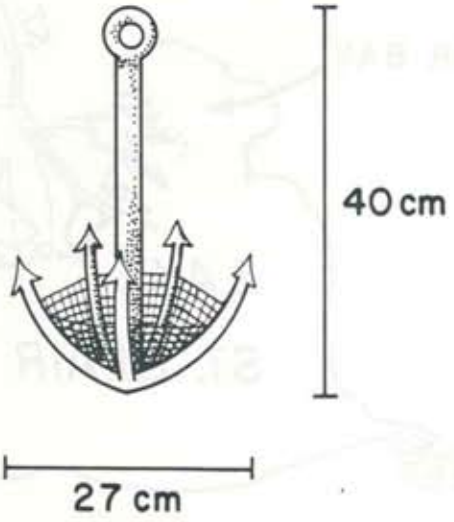


Figure 2. Diagram of five-pronged grapnel, lined with 1-cm square hardware cloth, used in this investigation.

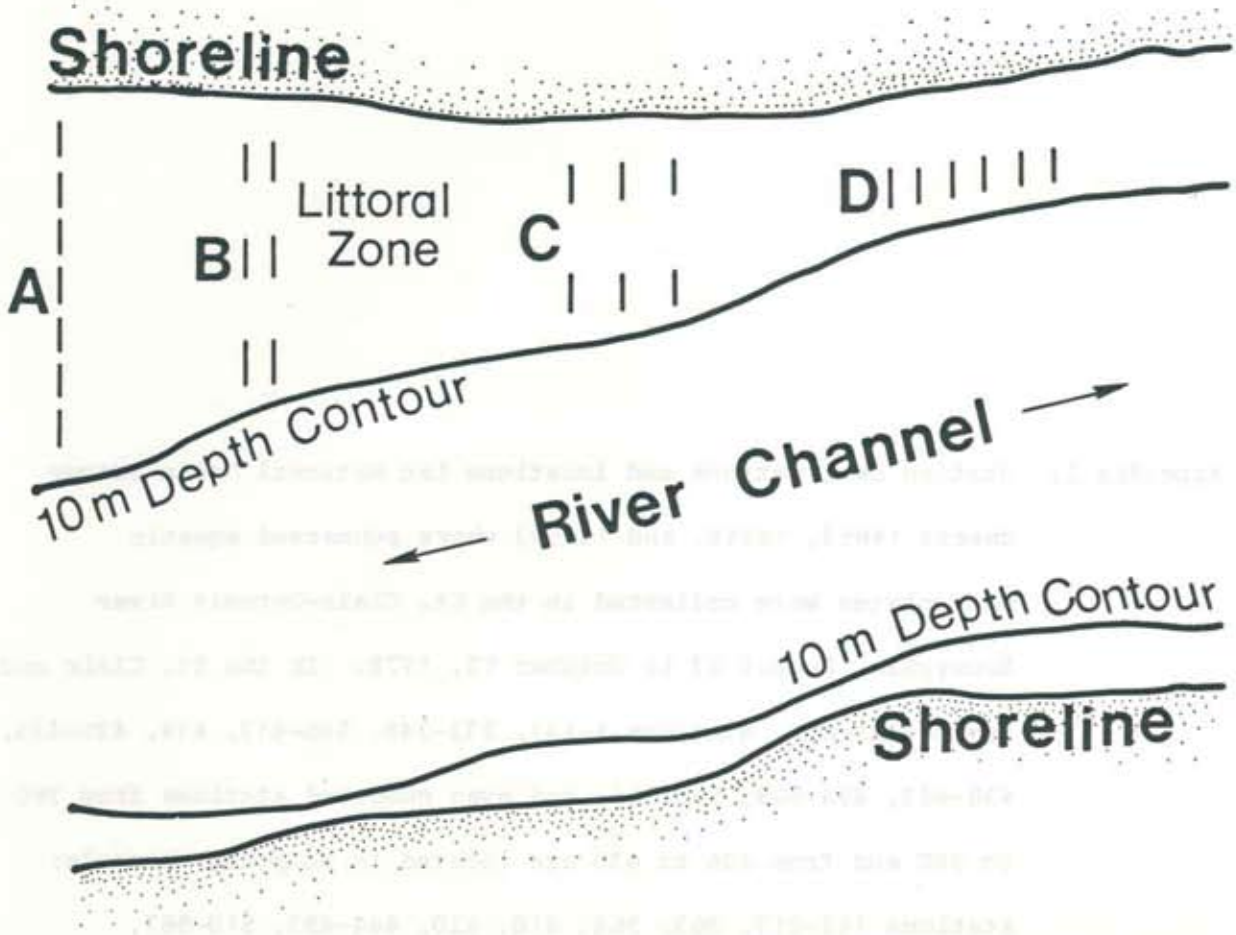
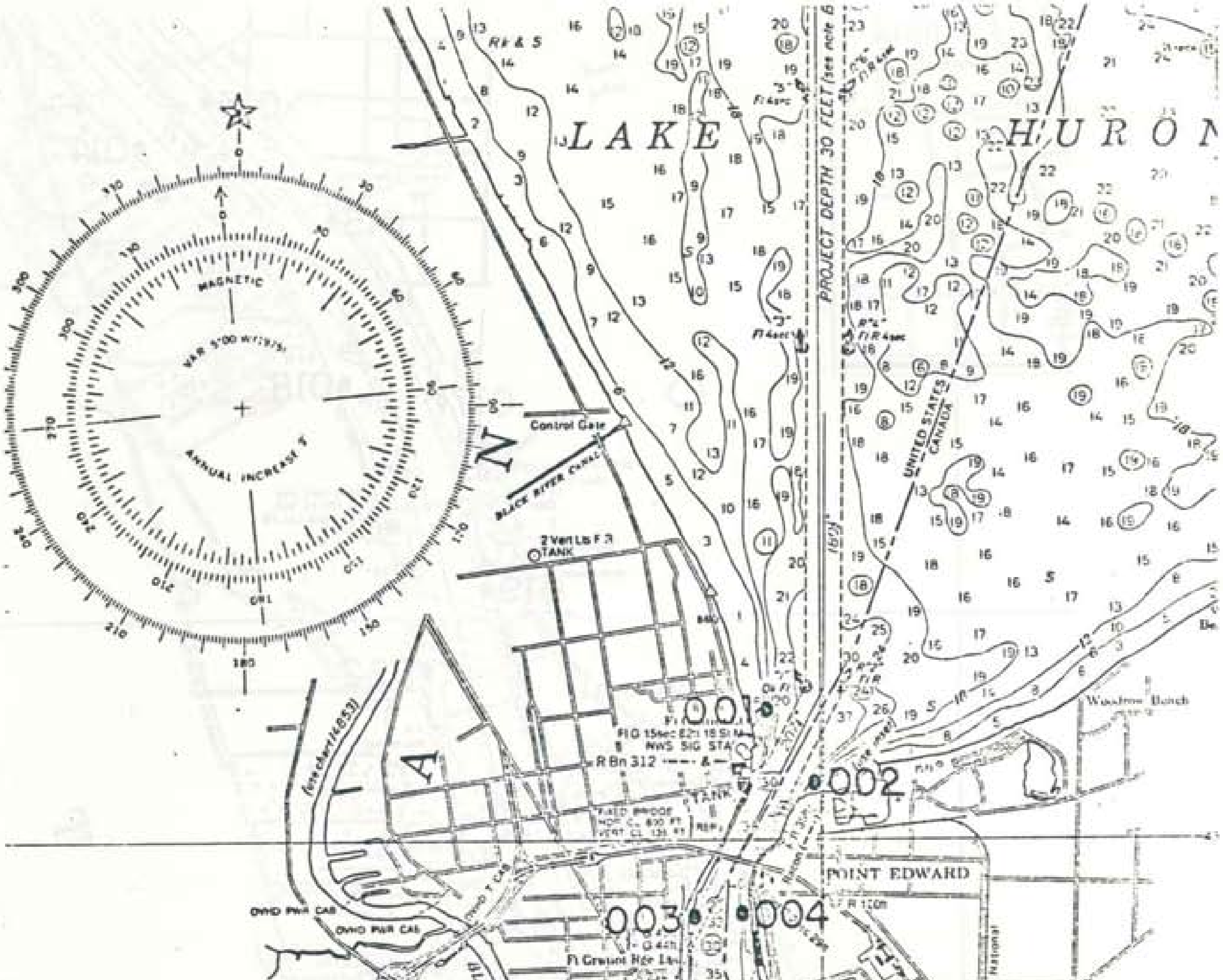
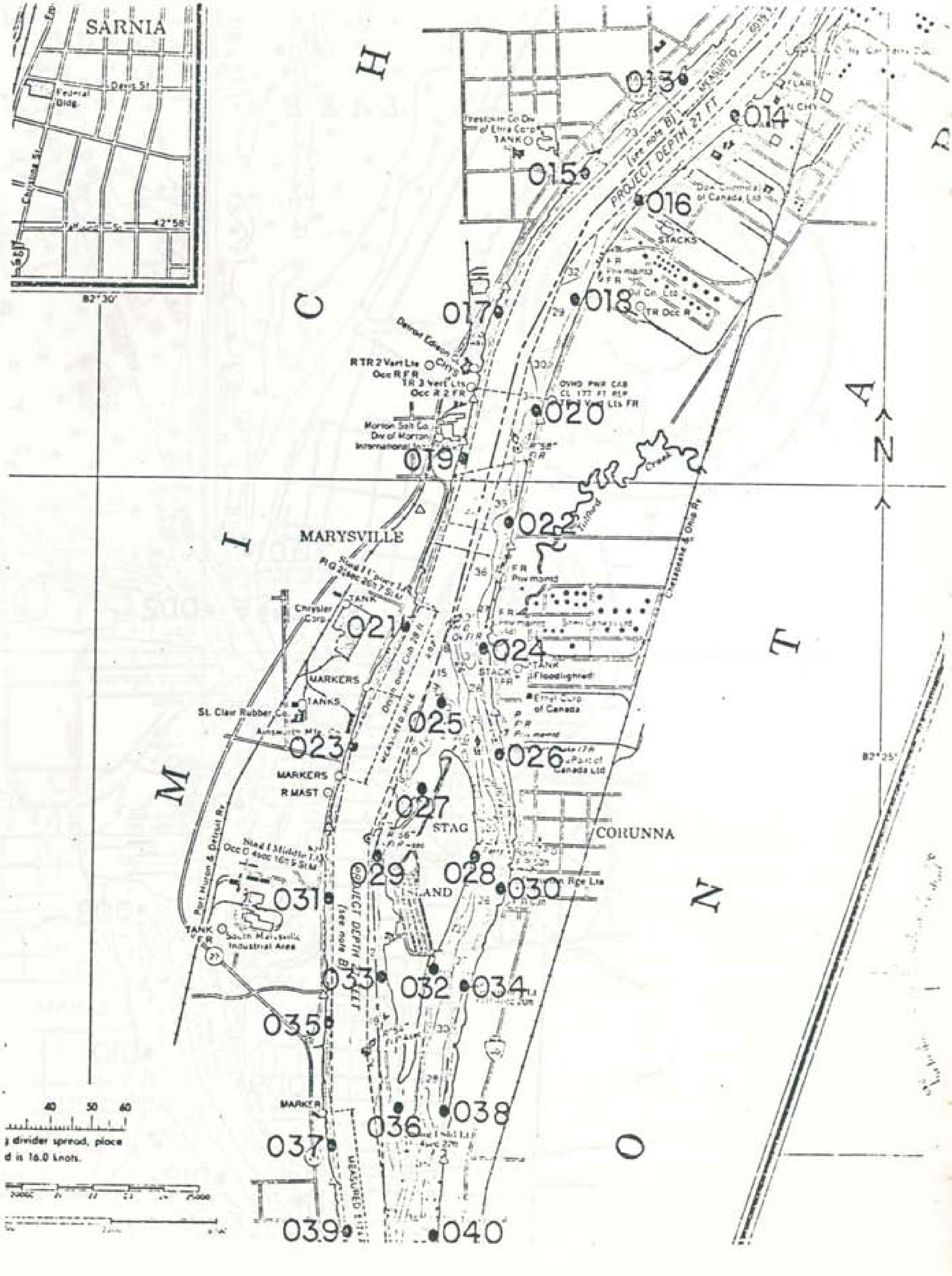
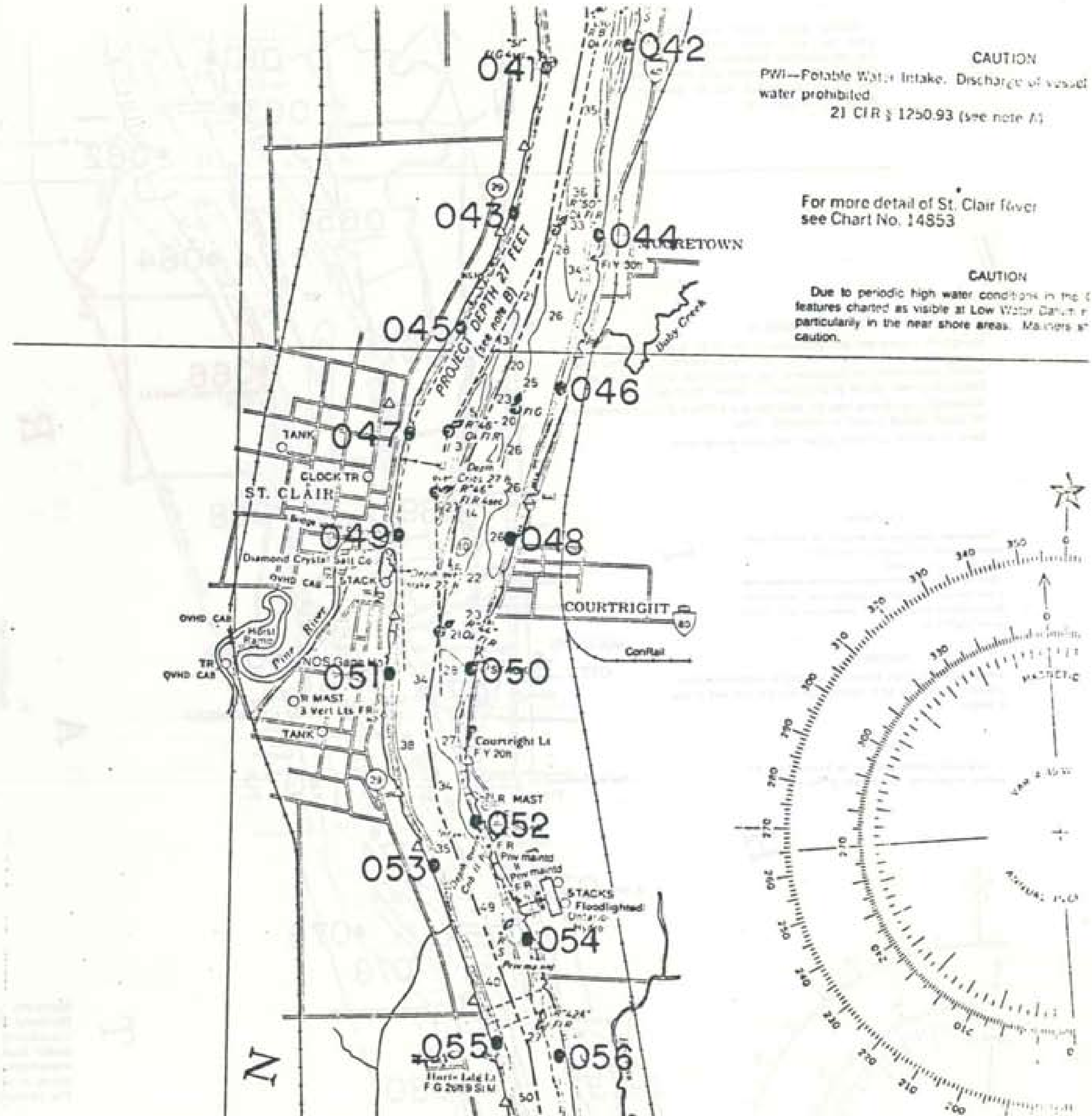


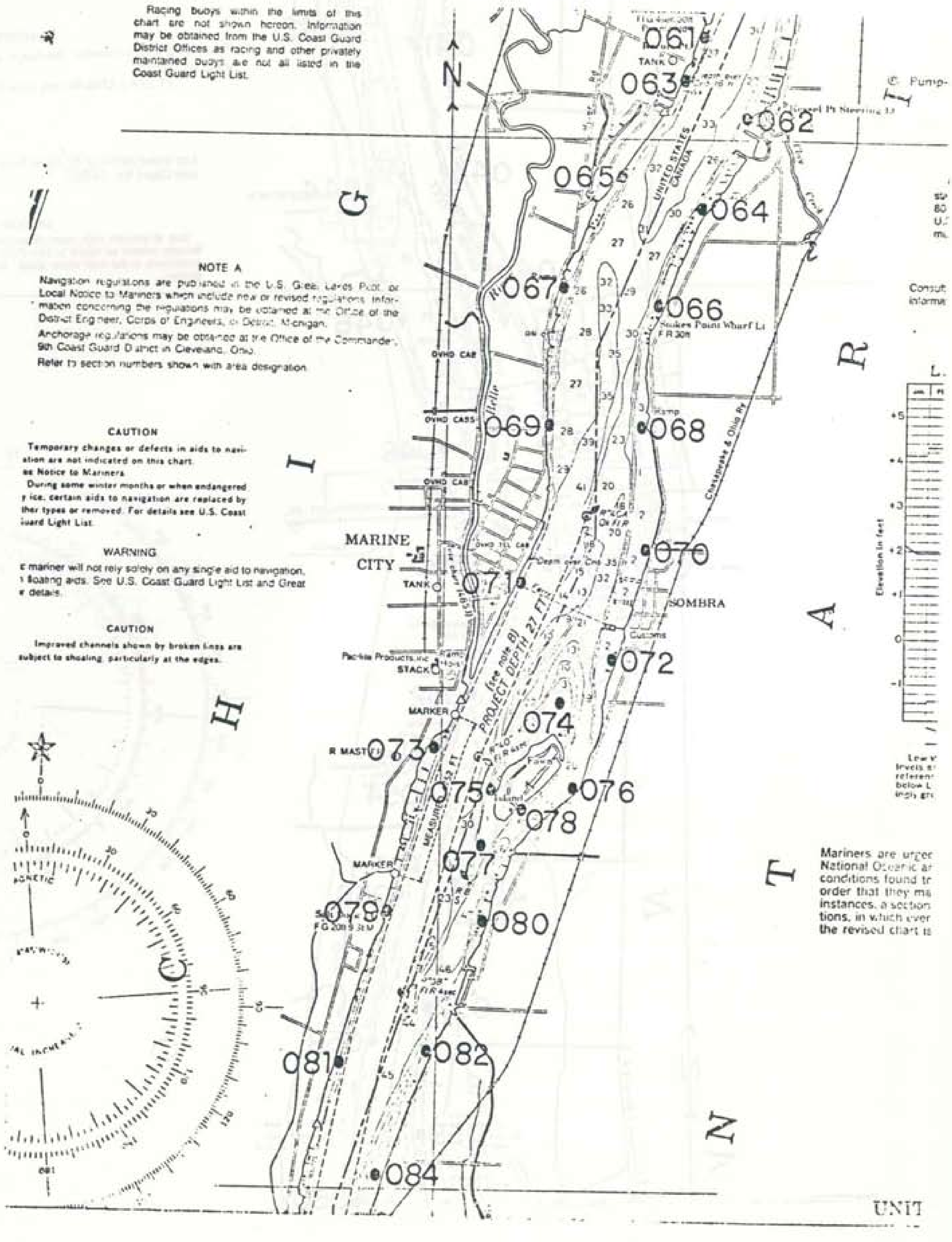
Figure 3. Patterns in which a grapnel was deployed to collect submersed macrophytes throughout the St. Clair-Detroit River Ecosystem from August 23 to October 13, 1978.

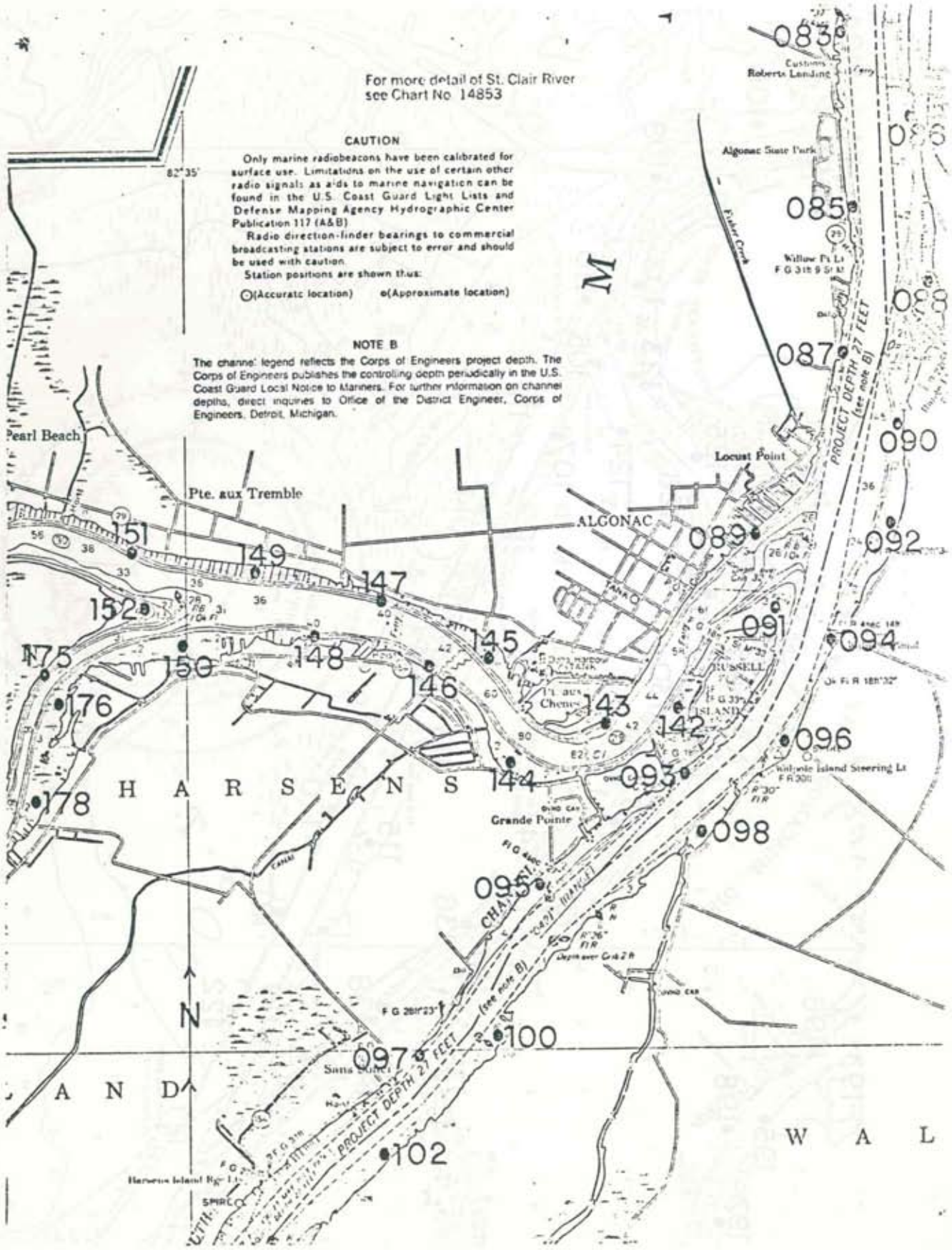
Appendix I. Station designations and locations (on National Ocean Survey charts 14853, 14848, and 14852) where submersed aquatic macrophytes were collected in the St. Clair-Detroit River Ecosystem, August 23 to October 13, 1978. In the St. Clair and Detroit Rivers, stations 1-141, 333-348, 365-417, 419, 421-424, 438-443, 494-509, 568-586, and even numbered stations from 350 to 360 and from 426 to 436 are located in shipping channels; stations 142-217, 363, 364, 418, 420, 444-493, 510-567, 587-595, and odd numbered stations from 349 to 363 and from 425 to 437 are in nonshipping channels (see text for definition of shipping and nonshipping channels).

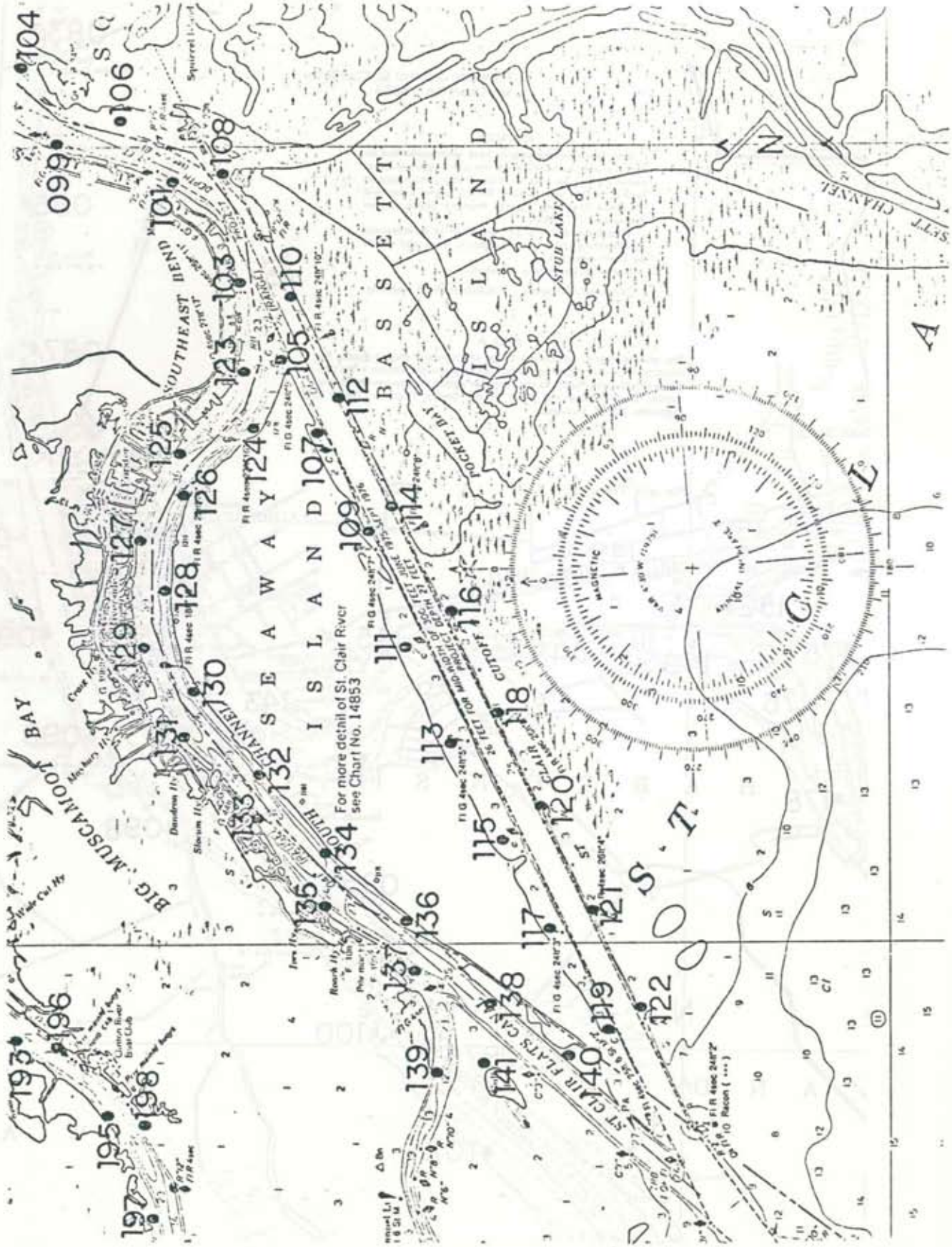

LAKE HURON
PROJECT DEPTH 30 FEET (see note 6)
UNITED STATES
CANADA
Control Gate
BLACK RIVER CANAL
MAGNETIC
VAR 5°00'W (1975)
ANNUAL INCREASE 5'
POINT EDWARD
PORT HURON
SARNIA
BLACK RIVER
Woodrow Beach
Grand Trunk Western R R
001
002
003
004
005
006
007
008
009
010
011
012

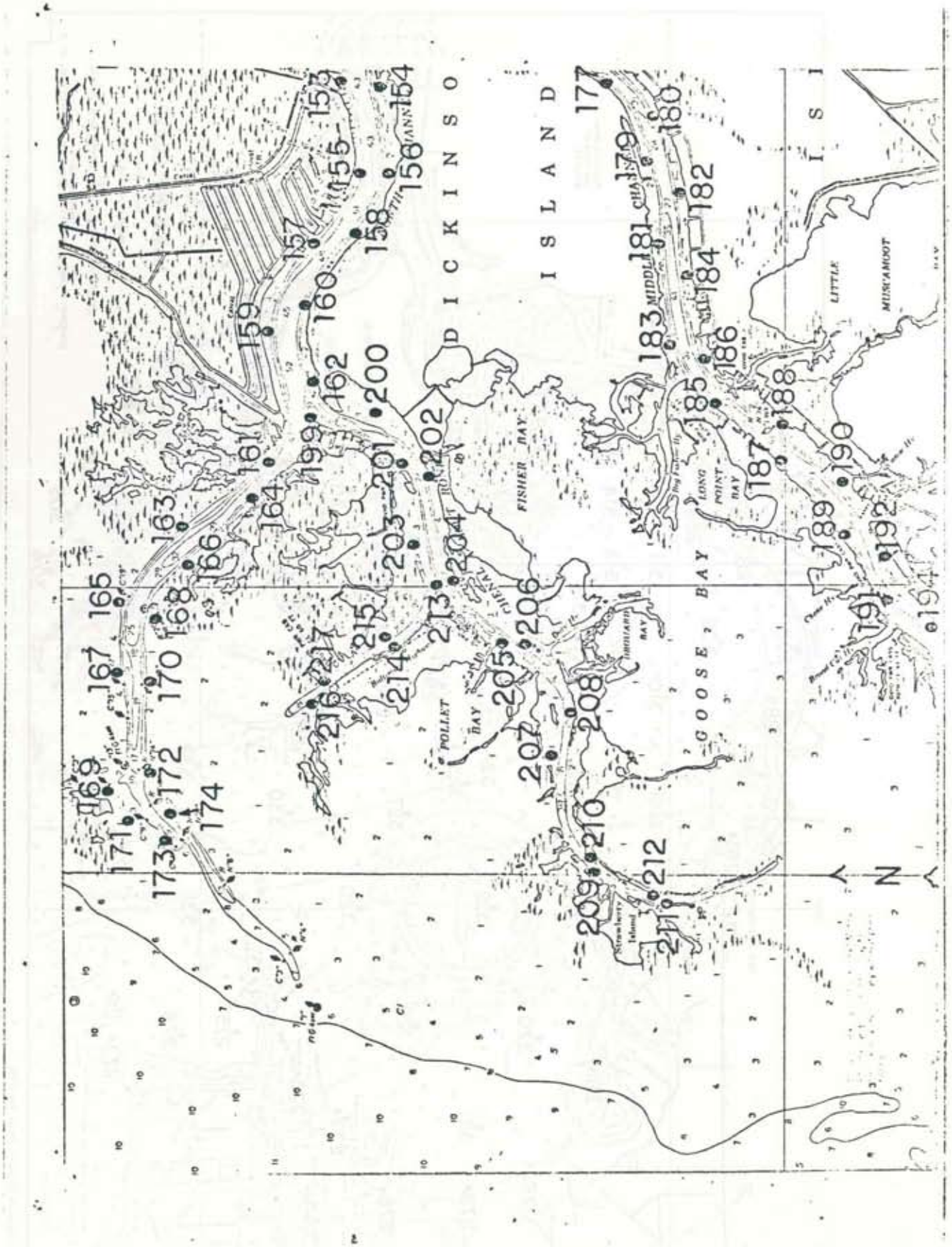

SARNIA
Federal Bldg.
Davis St
82°30'
MICHIGAN
ONTARIO
MARYSVILLE
STAG
ISLAND
CORUNNA
013
014
015
016
017
018
019
020
021
022
023
024
025
026
027
028
029
030
031
032
033
034
035
036
037
038
039
040
PROJECT DEPTH 27 FT
(see note B)
TANK
STACKS
MARKERS
TANKS
St. Clair Rubber Co.
Chrysler Corp.
Morton Salt Co.
Div of Morton
International
R MAST
MARKER
South Marysville
Industrial Area
Port Huron & Detroit Ry
Chesapeake & Ohio Ry
Ethyl Corp of Canada
Dow Chemical of Canada Ltd
82°25'
40 50 60

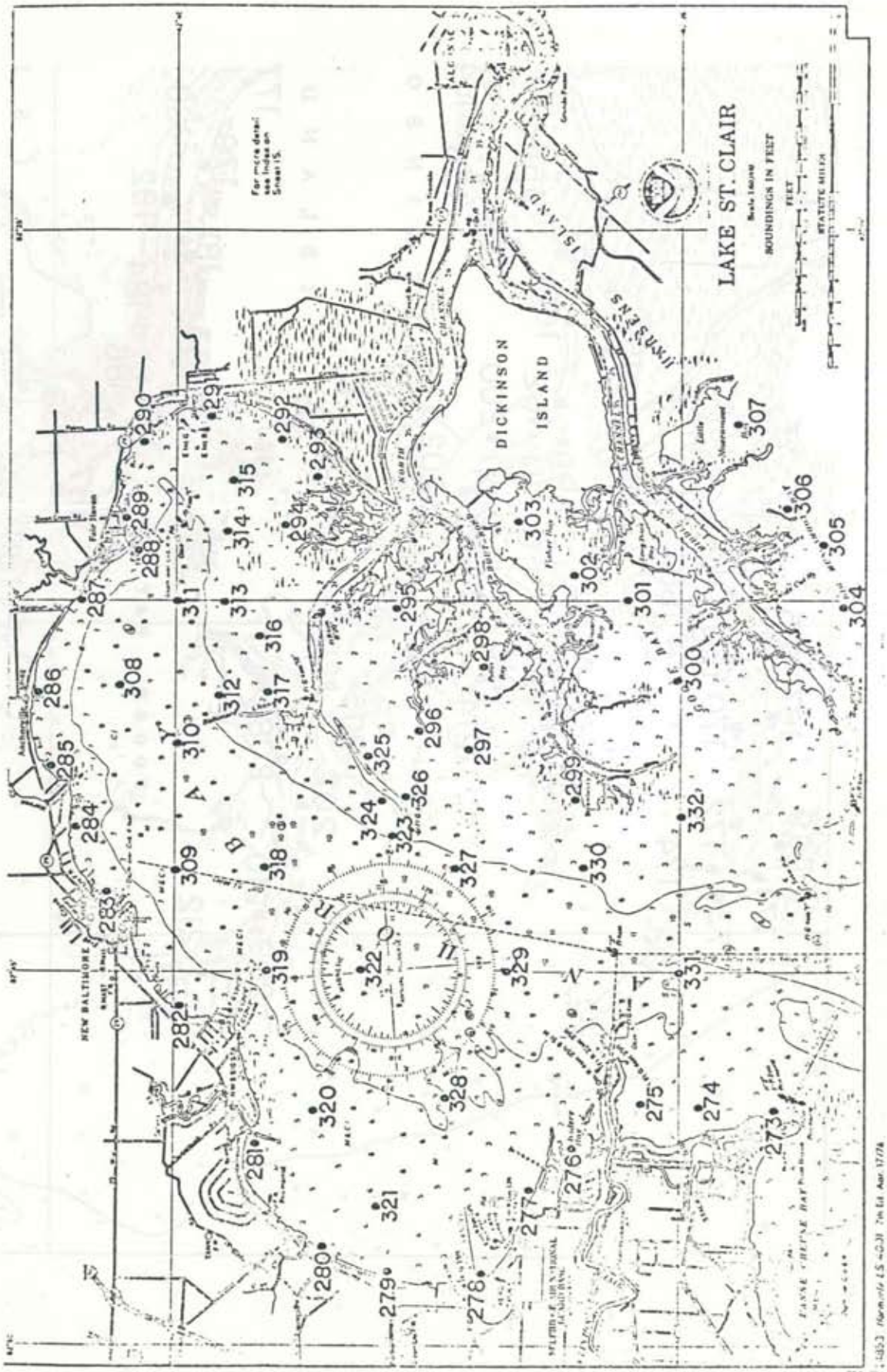

041
042
CAUTION
PWI—Potable Water Intake. Discharge of vessel water prohibited
21 CFR § 1250.93 (see note A)
043
044
For more detail of St. Clair River see Chart No. 14853
CAUTION
PROJECT DEPTH 27 FEET
045
046
047
TANK
CLOCK TR
ST. CLAIR
049
048
Diamond Crystal Salt Co
COURTRIGHT
ConRail
OVHD CAB
051
050
TANK
Courtright Lt
052
053
STACKS
Floodlighted
054
055
056
N
057
058
059
060
A
Z
O

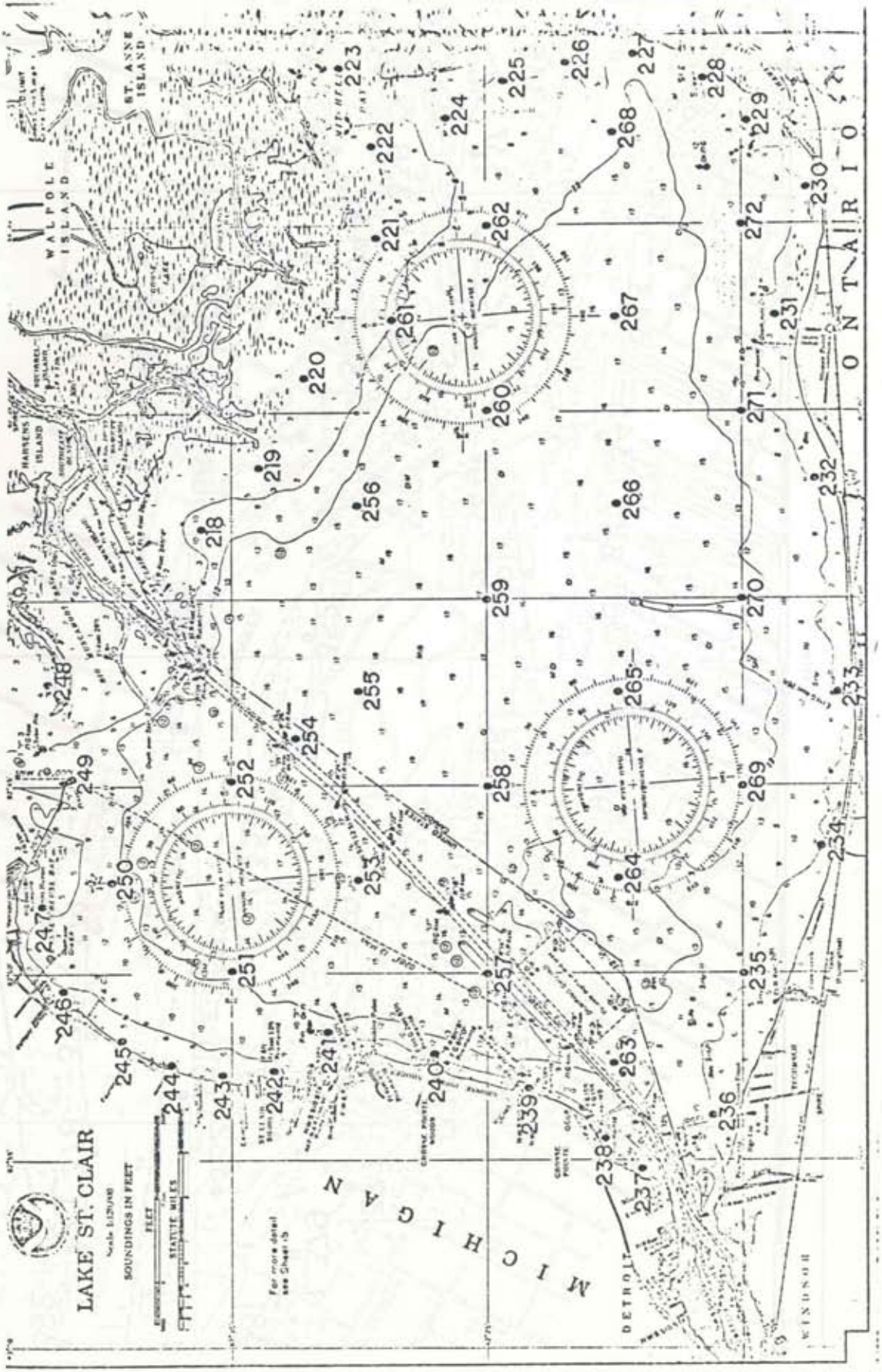

Racing buoys within the limits of this chart are not shown hereon. Information may be obtained from the U.S. Coast Guard District Offices as racing and other privately maintained buoys are not all listed in the Coast Guard Light List.
NOTE A
Navigation regulations are published in the U.S. Great Lakes Pilot or Local Notice to Mariners which include new or revised regulations. Information concerning the regulations may be obtained at the Office of the District Engineer, Corps of Engineers, in Detroit, Michigan.
Anchorage regulations may be obtained at the Office of the Commander, 9th Coast Guard District in Cleveland, Ohio.
Refer to section numbers shown with area designation.
CAUTION
Temporary changes or defects in aids to navigation are not indicated on this chart.
WARNING
CAUTION
Improved channels shown by broken lines are subject to shoaling, particularly at the edges.
MARINE CITY
SOMBRA
UNITED STATES
CANADA
PROJECT DEPTH 27 FT
Stokes Point Wharf Lt
Chesapeake & Ohio Ry
TANK
STACK
MARKER
R MAST
061
062
063
064
065
066
067
068
069
070
071
072
073
074
075
076
077
078
079
080
081
082
084
Mariners are urged
UNIT

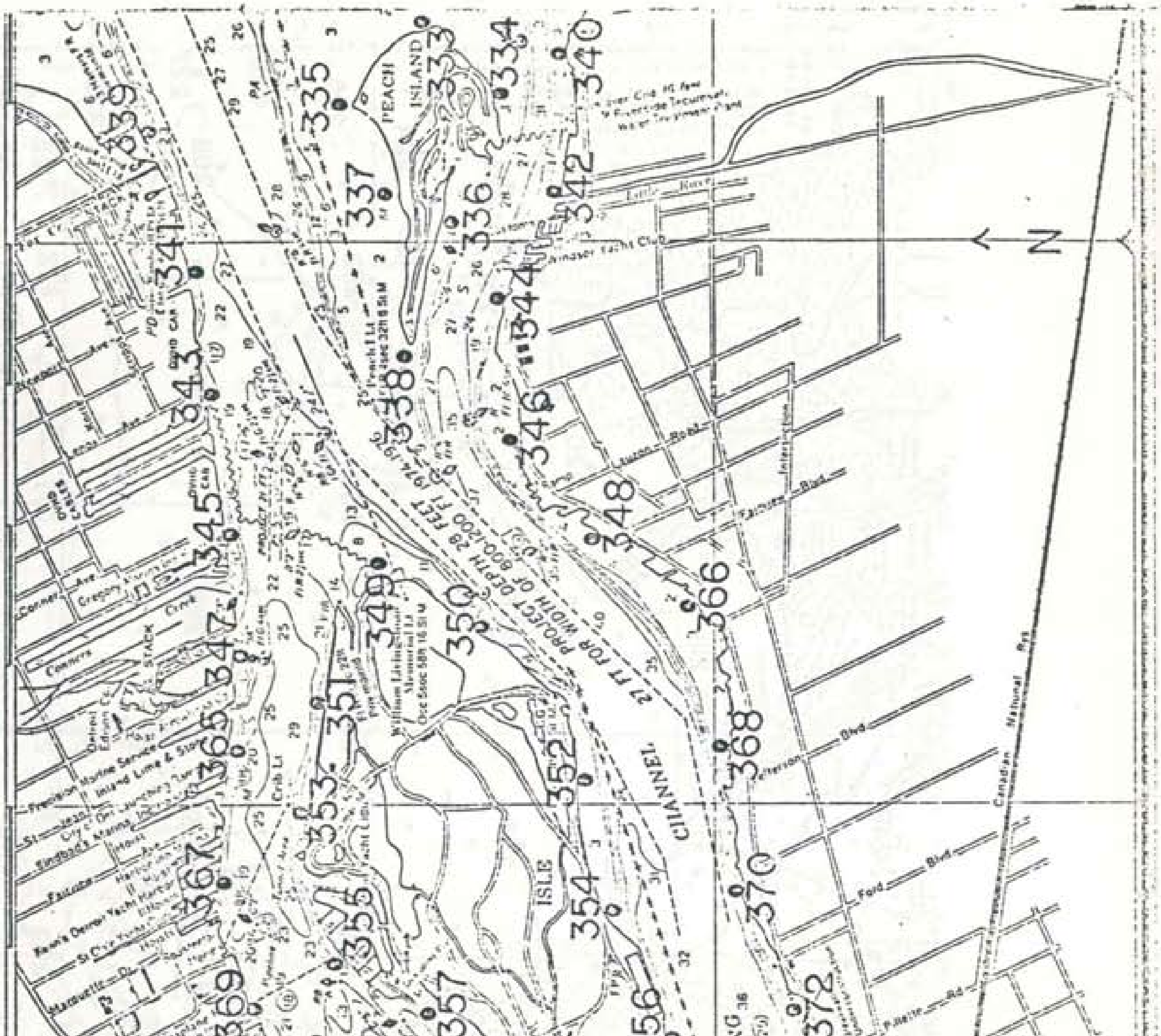

For more detail of St. Clair River see Chart No 14853
CAUTION
Only marine radiobeacons have been calibrated for surface use. Limitations on the use of certain other radio signals as aids to marine navigation can be found in the U.S. Coast Guard Light Lists and Defense Mapping Agency Hydrographic Center Publication 117 (A&B).
Radio direction-finder bearings to commercial broadcasting stations are subject to error and should be used with caution.
Station positions are shown thus:
⊙(Accurate location) ⊙(Approximate location)
NOTE B
The channel legend reflects the Corps of Engineers project depth. The Corps of Engineers publishes the controlling depth periodically in the U.S. Coast Guard Local Notice to Mariners. For further information on channel depths, direct inquiries to Office of the District Engineer, Corps of Engineers, Detroit, Michigan.
Pearl Beach
Pte. aux Tremble
Locust Point
ALGONAC
Grande Pointe
HARSENS
ISLAND
PROJECT DEPTH 27 FEET (see note B)
151
149
147
152
150
148
146
145
144
143
142
175
176
178
083
085
087
089
090
091
092
093
094
096
098
095
097
100
102
N
M


SOUTHEAST BEND
SOUTH CHANNEL
ST. CLAIR FLATS CANAL
ST. CLAIR CUTOFF
POCKET BAY
STUB LAKE
BIG MUSCAMOOT BAY
For more detail of St. Clair River see Chart No. 14853
MAGNETIC


DICKINSON ISLAND
FISHER BAY
POLLET BAY
GOOSE BAY
LONG POINT BAY
MIDDLE CHANNEL
LITTLE MUSKAMOOT BAY
N


LAKE ST. CLAIR
DICKINSON ISLAND
NEW BALTIMORE


LAKE ST. CLAIR
MICHIGAN
ONTARIO
WALPOLE ISLAND
ST. ANNE ISLAND
DETROIT
WINDSOR


PEACH ISLAND
BELLE ISLE
FLEMING CHANNEL
PROJECT DEPTH 28 FEET FOR WIDTH OF 800-1200 FT
27 FT FOR WIDTH OF
333
334
335
336
337
338
339
340
341
342
343
344
345
346
347
348
349
350
351
352
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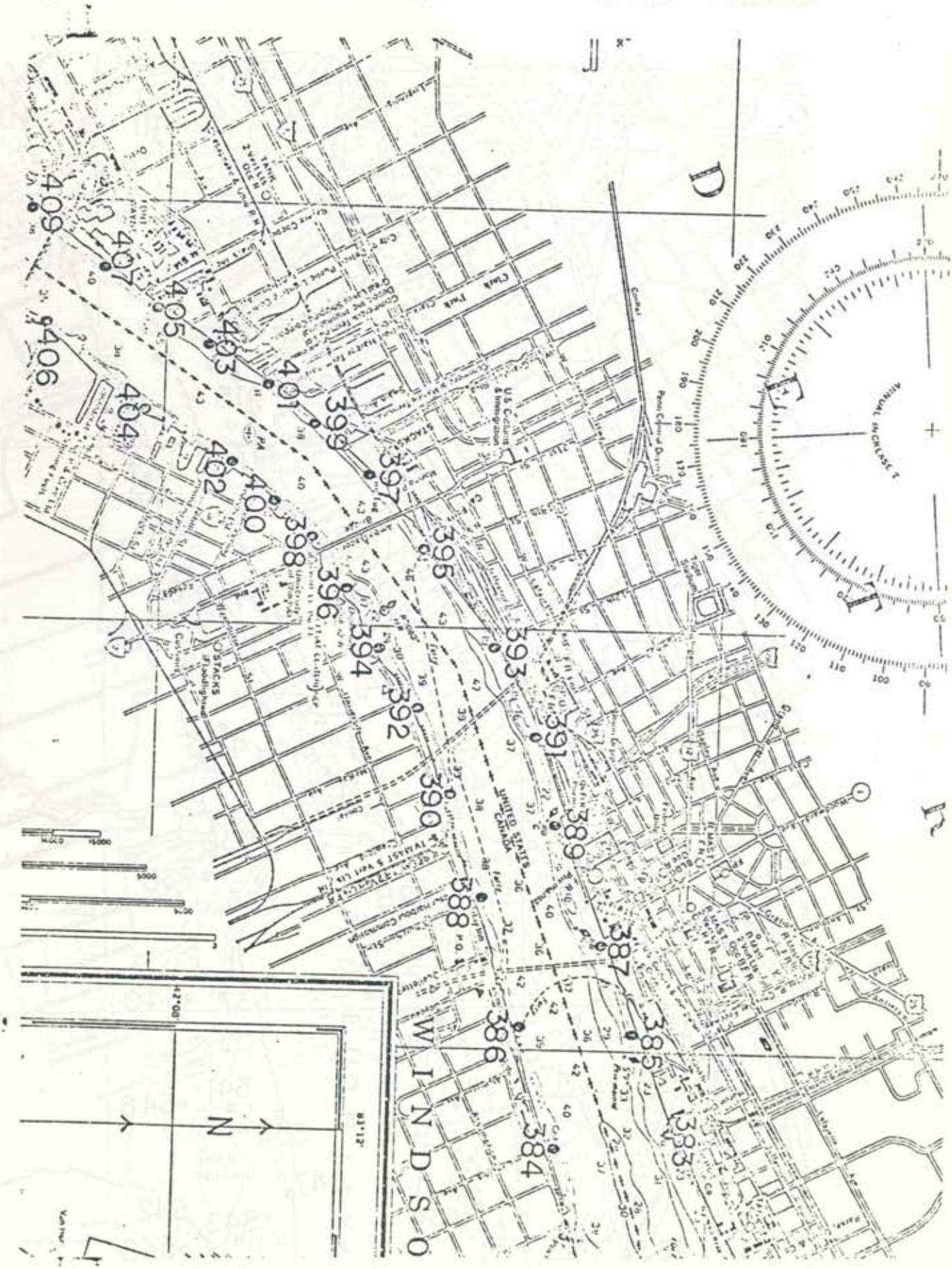
378
379
380
381
382
N
T
R


409
407
405
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403
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392
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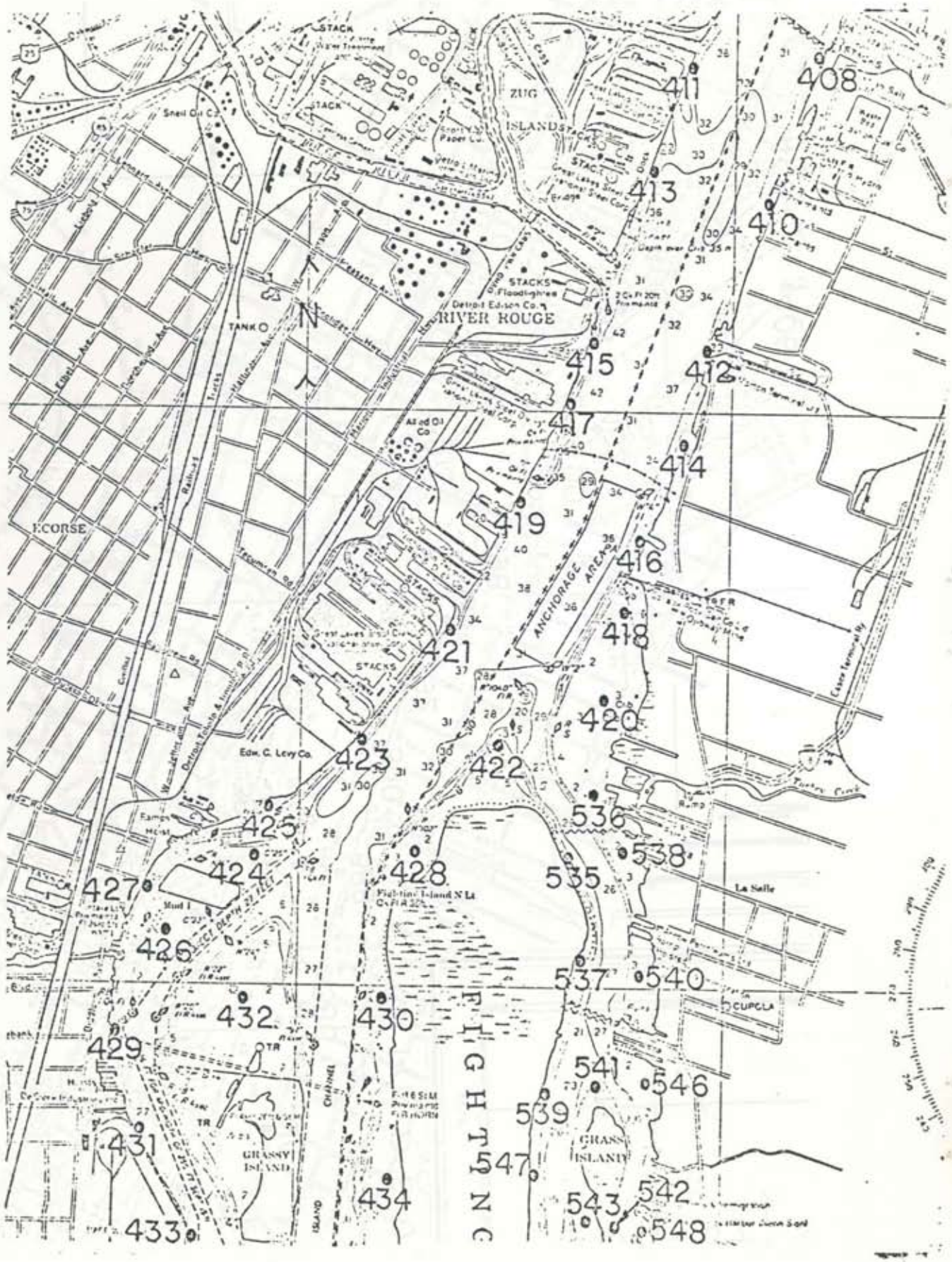
389
388
387
386
385
384
383
D
E
F
N
WINDSOR
ANNUAL INCREASE
STACKS
UNITED STATES
CANADA


RIVER ROUGE
ZUG ISLAND
ECORSE
GRASSY ISLAND
GRASS ISLAND
CUPOLA
ANCHORAGE AREA
Edw. C. Levy Co.
Detroit Edison Co.
STACKS
TANK
408
410
411
412
413
414
415
416
417
418
419
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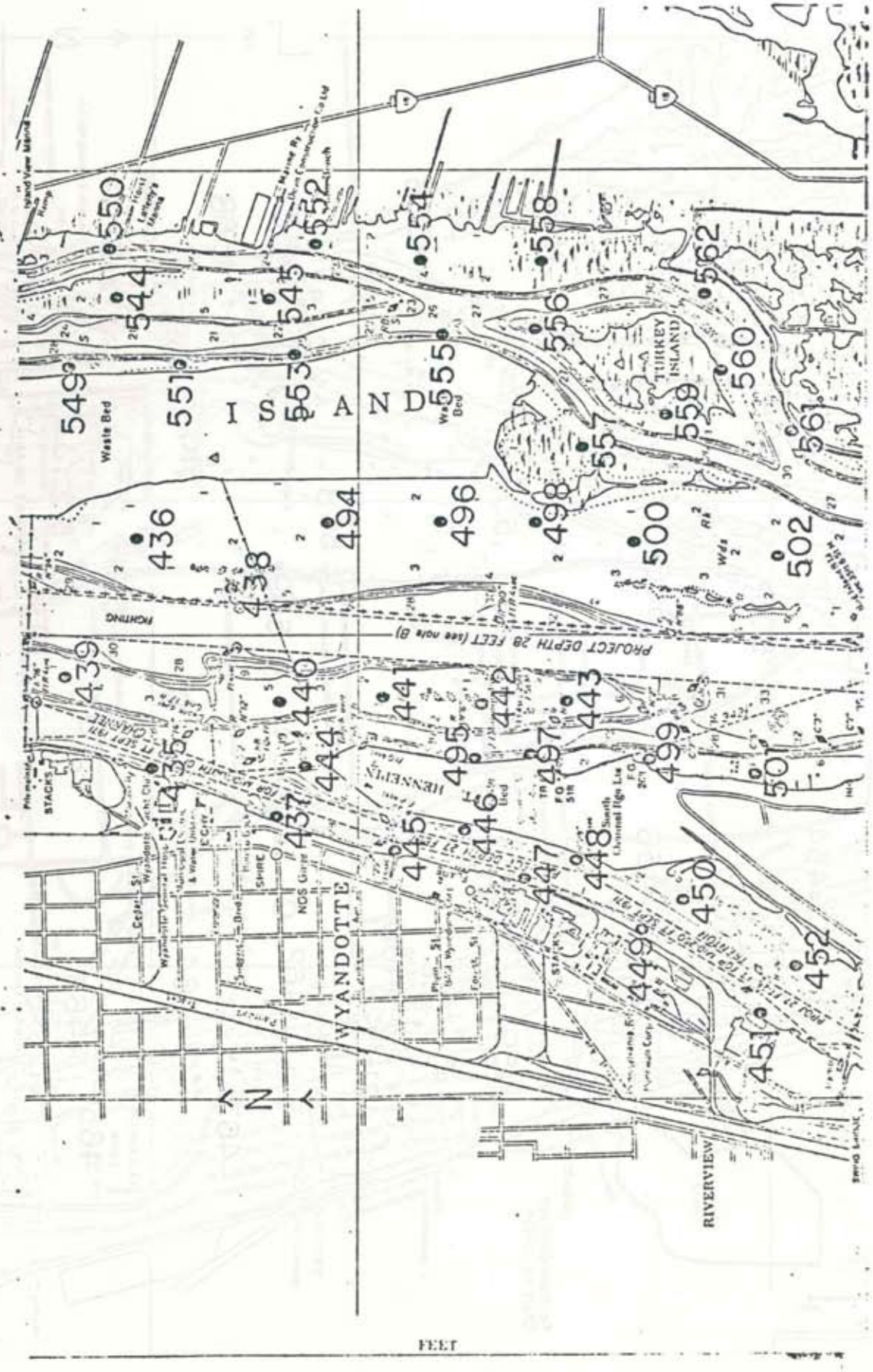
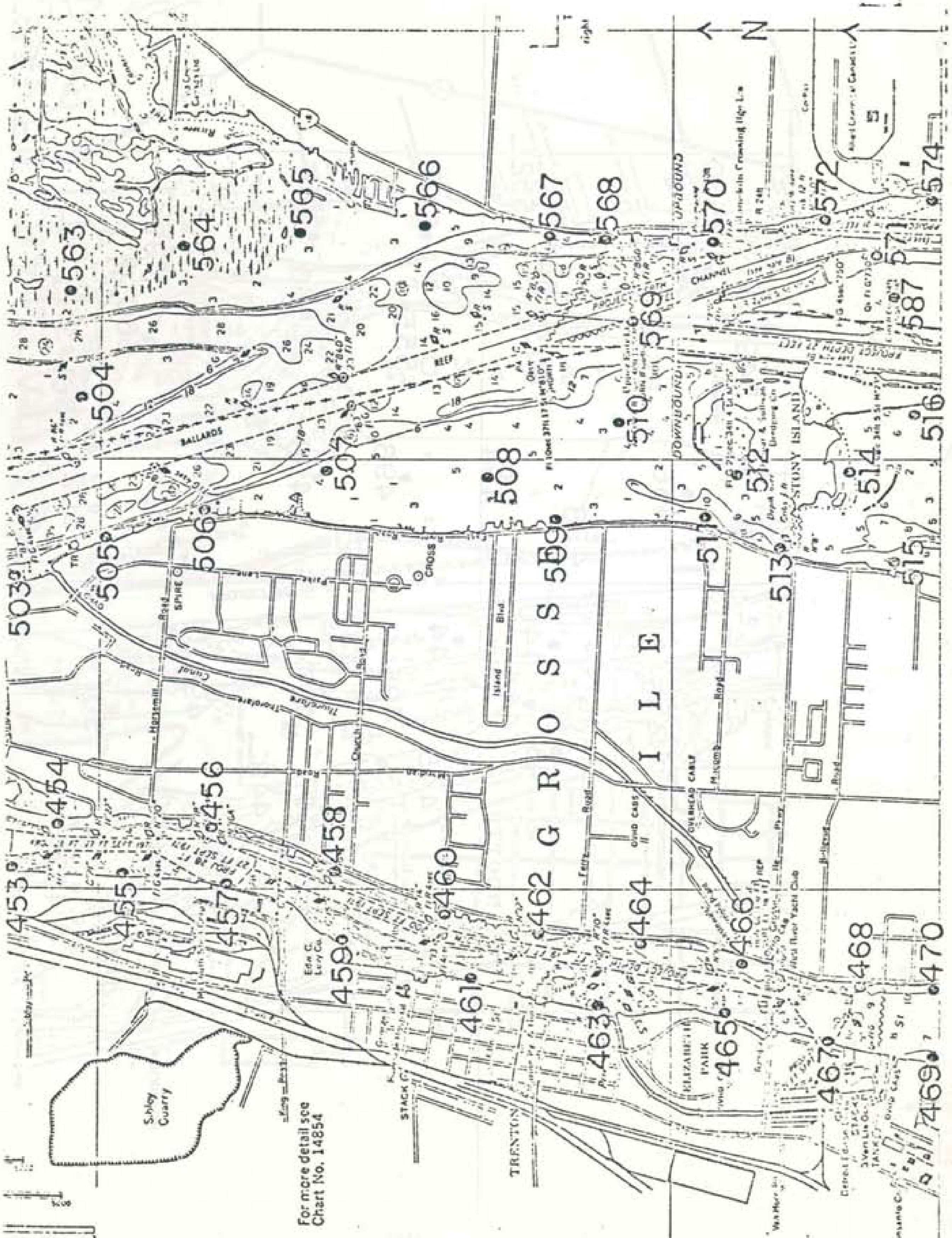

ISLAND
WYANDOTTE
TURKEY ISLAND
RIVERVIEW
Waste Bed
PROJECT DEPTH 28 FEET (see note B)
FEET


GROSSE ILE
TRENTON
STONY ISLAND
ELIZABETH PARK
BALLARDS REEF
CHANNEL
UPBOUND
DOWNBOUND
OVERHEAD CABLE
Sibley Quarry
For more detail see Chart No. 14854
453
454
455
456
457
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459
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463
464
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466
467
468
469
470
503
504
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506
507
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509
510
511
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514
515
516
563
564
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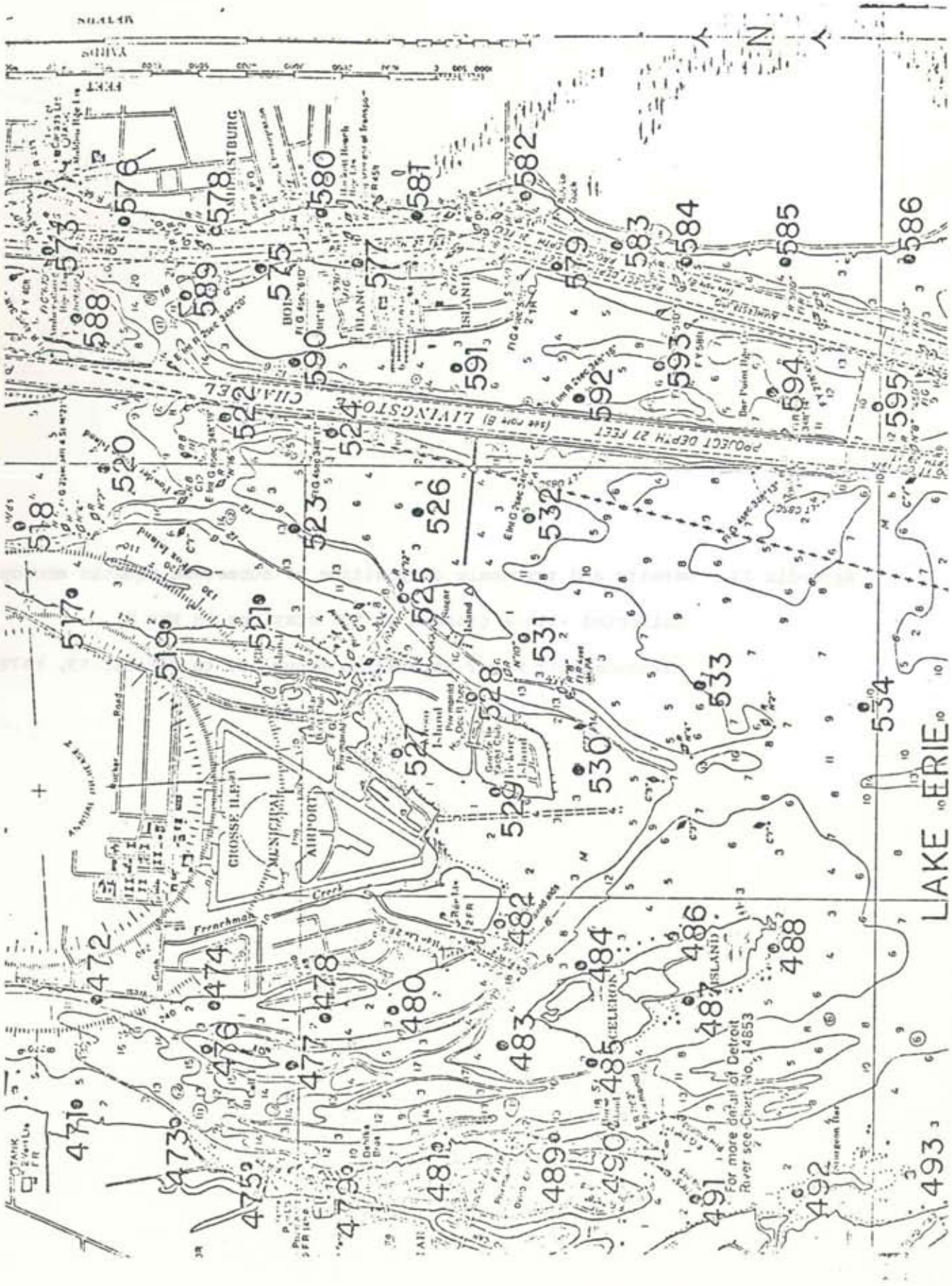
574
587


LAKE ERIE
LIVINGSTONE CHANNEL
PROJECT DEPTH 27 FEET
MONROE
GROSSE ILE
MUNICIPAL AIRPORT
CELERON ISLAND
For more detail of Detroit River see Chart No. 14853

Appendix II. Density and taxonomic composition of submersed aquatic macrophytes collected with a grapnel at 595 stations in the St. Clair-Detroit River Ecosystem, August 23 to October 13, 1978.

Appendix II.

Water Body	Station no.	Sampling date	No. grapnel drags with plants	Density[a]	Composition of Sample[b]
St. Clair River	1	9/07/78	0		
	2		0		
	3		0		
	4		0		
	5		0		
	6		5	H	11(40), 18(25), 14(25), 2(10)
	7		0		
	8		5	M	7(30), 8(30), 2(15), 21(15), 20(10)
	9		0		
	10		0		
	11		5	H	11(50), 18(25), 21(25)
	12		0		
	13		5	H	11(50), 18(35), 21(15)
	14		5	H	21(80), 11(20)
	15		4	M	11(40), 21(30), 18(25), 3(5)
	16		6	H	18(90), 11(10)
	17		5	L	11(40), 18(40), 21(20)
	18		5	M	18(60), 11(25), 14(15)
	19		4	*[c]	11(90), 2(5), 21(5)
	20		3	M	11(90), 18(10)
	21		5	M	11(40), 2(30), 18(20), 21(10)
	22		5	M	11(80), 18(20)
	23		5	M	11(50), 18(40), 2(10)
	24		5	H	18(60), 11(30), 14(10)
	25		0		
	26		6	H	18(80), 14(20)
	27		5	H	18(70), 13(30)
	28		6	H	18(40), 14(40), 2(20)
	29		5	M	2(50), 11(30), 18(20)
	30		6	H	18(80), 14(20)
	31		5	M	11(70), 2(20), 21(10)
	32		6	M	2(50), 11(25), 18(20), 14(5)
	33		4	H	14(50), 11(30), 2(20)
	34		5	H	18(70), 11(30)
	35		4	M	11(50), 18(25), 2(15), 3(10)
	36		4	M	2(40), 14(20), 18(20), 3(10), 11(10)
	37		5	M	2(45), 21(40), 11(15)
	38		6	M	18(65), 11(20), 3(15)
	39		5	M	2(60), 11(30), 21(10)
	40		3	M	18(50), 11(50)
	41		4	M	2(60), 11(20), 21(20)
	42		6	M	2(50), 3(25), 11(25)
	43		5	M	11(50), 2(30), 21(20)
	44		6	M	2(45), 3(35), 11(20)
	45		4	M	2(50), 3(20), 21(20) 11(10)
	46		4	L	2(75), 14(25)
	47		2	L	21(100)
	48		5	M	2(50), 14(25), 21(15), 3(10)
	49		0		
	50	9/08/78	5	M	3(20), 18(40), 21(40)
	51		0		
	52		5	M	2(40), 18(20), 21(20), 14(10), 11(10)
	53		2	L	2(60), 11(20), 18(20)
	54		5	H	2(30), 18(35), 21(20), 3(10), 11(5)

Appendix II. Cont'd.

Water Body	Station no.	Sampling date	No. grapnel drags with plants	Density[a]	Composition of Sample[b]
St. Clair River (cont'd.)	55	9/08/78 (cont'd.)	0		
	56		5	M	2(40), 21(40), 18(20)
	57		4	M	11(50), 21(25), 2(20), 18(5)
	58		5	M	2(50), 21(40), 18(10)
	59		3	*[c]	2(50), 21(35), 11(15)
	60		5	H	21(60), 7(30), 18(10)
	61		0		
	62		5	H	21(60), 7(30), 18(10)
	63		4	M	2(45), 21(40), 3(15)
	64		3	L	21(60), 2(40)
	65		4	M	7(50), 11(50)
	66		2	L	21(60), 2(40)
	67		5	M	2(40), 18(20), 21(20), 7(10), 11(10)
	68		4	L	21(60), 2(40)
	69		2	L	2(60), 21(40)
	70		4	*[c]	21(50), 2(40), 3(10)
	71		0		
	72		4	M	2(70), 13(30)
	73		4	M	11(35), 2(30), 21(25), 3(5), 7(5)
	74		6	H	2(50), 12(30), 18(20)
	75		3	L	2(80), 18(15), 14(5)
	76		3	*[c]	2(70), 21(30)
	77		6	*[c]	2(60), 18(30), 12(10)
	78		6	H	21(50), 3(40), 2(10)
	79		0		
	80		5	L	2(50), 21(35), 3(10), 11(5)
	81		4	*[c]	2(30), 11(30), 21(30), 3(10)
	82		5	*[c]	2(65), 21(25), 7(5), 3(5)
	83		4	*[c]	2(55), 21(40), 18(5)
	84		4	*[c]	2(50), 18(25), 21(25)
	85		3	L	2(40), 21(30), 18(30)
	86		4	H	2(50), 3(45), 21(5)
	87		5	*[c]	2(60), 18(20), 21(15), 14(5)
	88		5	M	2(60), 3(30), 21(10)
	89		6	H	3(100)
	90		5	M	2(70), 21(25), 18(5)
	91		6	*[c]	11(30), 18(30), 2(20), 14(15), 3(5)
	92		5	M	2(70), 21(25), 18(5),
	93	8/24/78	3	M	16(50), 18(50)
	94	9/08/78	4	M	2(60), 21(25), 14(15)
	95	8/24/78	3	M	2(55), 18(20), 3(10), 7(10)
	96		4	L	2(40), 18(40), 3(20)
	97		2	L	2(90), 21(5), 18(5)
	98		6	L	2(90), 18(10)
	99	9/27/78	3	L	2(80), 18(15), 14(5)
	100	8/24/78	3	L	2(90), 18(5), 21(5)
	101	9/27/78	2	L	2(100)
	102	8/24/78	3	L	2(90), 18(5), 21(5)
	103	9/26/78	3	M	2(60), 18(20), 7(20)
	104	8/24/78	6	H	3(35), 2(25), 18(20), 7(10), 11(10)
	105	9/27/78	4	H	11(40), 3(30), 18(30)
	106		4	M	2(75), 18(15), 21(10)
	107		3	M	2(80), 3(10), 18(10)
	108		3	L	2(75), 18(15), 21(10)
	109		4	M	2(80), 11(15), 3(5)
	110		2	L	2(80), 18(15), 3(5)
	111		3	L	2(100)

Appendix II. Cont'd.

Water Body	Station no.	Sampling date	No. grapnel drags with plants	Density[a]	Composition of Sample[b]
St. Clair River (cont'd.)	112	9/27/78 (cont'd.)	4	M	2(60), 7(15), 11(10), 18(10), 3(5)
	113		1	L	2(100)
	114		4	M	2(90), 3(5), 18(5)
	115		1	L	2(95), 11(5)
	116		3	M	2(90), 11(5), 18(5)
	117		1	L	2(80), 14(10), 18(10)
	118		3	L	2(90), 18(10)
	119		0		
	120		1	L	2(90), 14(5), 18(5)
	121		2	L	2(90), 14(5), 18(5)
	122		0		
	123	9/26/78	4	M	3(60), 7(20), 18(20)
	124		4	M	2(80), 3(10), 18(10)
	125		1	L	2(50), 18(40), 7(10)
	126		3	M	3(60), 2(30), 18(10)
	127		3	L	7(70), 3(20), 2(10)
	128		3	M	2(65), 3(15), 18(15), 7(5)
	129		2	L	2(80), 3(15), 18(5)
	130		4	M	2(80), 3(10), 18(10)
	131		3	L	2(70), 3(10), 18(10)
	132		3	L	2(100)
	133		2	L	2(100)
	134		2	L	2(100)
	135		2	L	2(90), 7(10)
	136		3	M	2(80), 3(5), 7(10), 21(5)
	137		0		
	138	9/27/78	0		
	139		0		
	140		0		
	141		3	L	2(100)
	142	8/24/78	6	H	3(40), 18(30), 13(10), 2(10), 11(5), 21(4), 7(1)
	143		2	*[c]	11(50), 18(50)
	144		3	M	7(50), 3(25), 2(10), 12(8), 18(7)
	145		6	H	7(50), 3(25), 2(20), 12(5)
	146		2	L	2(100)
	147		3	M	7(100)
	148		3	L	7(75), 3(20), 12(5)
	149		6	*[c]	7(60), 2(30), 3(5), 18(5)
	150		6	H	3(40), 2(39), 7(20), 20(1)
	151		6	*[c]	7(60), 2(30), 3(5), 18(5)
	152		6	H	11(35), 18(35), 2(20), 7(10)
	153		6	*[c]	7(60), 2(30), 3(5), 18(5)
	154		4	M	2(50), 7(30), 21(20)
	155		*[c]	*[c]	7(30), 2(25), 3(25), 18(20)
	156		4	*[c]	2(100)
	157		4	M	7(50), 2(35), 3(15)
	158		4	*[c]	2(100)
	159		4	L	2(100)
	160		3	M	3(60), 7(40)
	161		6	*[c]	7(35), 3(30), 2(25), 18(10)
	162		6	H	3(45), 7(40), 2(15)
	163		6	H	7(75), 18(25)

Appendix II. Cont'd.

Water Body	Station no.	Sampling date	No. grapnel drags with plants	Density[a]	Composition of Sample[b]
St. Clair River (cont'd.)	164	8/24/78 (cont'd.)	5	M	2(80), 7(15), 18(5)
	165	8/23/78	6	H	7(80), 18(20)
	166	8/24/78	5	*[c]	2(40), 18(40), 11(20)
	167	8/23/78	3	H	17(80), 2(10), 18(10)
	168	8/24/78	6	H	7(80), 18(20)
	169	8/23/78	6	H	7(85), 2(10), 3(5)
	170		6	H	17(75), 18(25)
	171		5	L	2(85), 17(10), 18(5)
	172		6	H	7(75), 3(20), 17(5)
	173		4	L	7(50), 18(20), 3(15), 19(15)
	174		6	H	7(50), 2(30), 3(15), 18(5)
	175	8/24/78	*[c]	L	2(100)
	176		4	M	2(34), 3(33), 7(33)
	177		*[c]	L	2(100)
	178		6	H	3(40), 2(35), 21(25)
	179	9/21/78	1	M	2(90), 18(10)
	180	8/24/78	3	M	2(40), 18(40), 7(20)
	181	9/21/78	2	L	2(95), 18(7)
	182		5	H	2(55), 3(40), 7(5)
	183		1	L	2(100)
	184		5	H	2(40), 3(30), 7(30)
	185		4	M	2(80), 7(20)
	186		3	M	2(70), 7(20), 3(10)
	187		2	L	2(100)
	188		4	M	2(80), 7(20)
	189		6	H	*[c](50), 3(30), 2(15), 20(5)
	190		6	H	2(50), 7(40), 3(5), 21(5)
	191		5	H	3(50), 7(40), 2(5), 21(5)
	192		4	H	3(30), 7(30), 2(30), 21(10)
	193		4	H	3(40), 7(40), 18(20)
	194		6	H	3(45), 7(40), 18(10, 2(5)
	195		0		
	196		5	H	7(40), 3(20), 18(20), 13(10), 21(10)
	197		5	L	2(85), 18(10), 14(5)
	198		5	L	2(90), 14(5), 18(5)
	199	9/28/78	5	H	18(50), 3(40), 11(5), 14(5)
	200		5	H	3(75), 4(15), 2(10)
	201		6	H	2(50), 3(40), 7(5), 18(5)
	202		6	H	7(90), 18(10)
	203		4	L	2(95), 21(5)
	204		1	L	2(100)
	205		4	M	2(60), 18(15), 3(10), 14(10), 13(5)
	206		6	H	7(85), 18(10), 3(5)
	207		6	H	7(100)
	208		5	M	7(50), 2(30), 18(15) 3(5)
	209		1	L	2(100)
	210		3	M	3(90), 13(10)
	211		0		
	212		0		
	213		6	H	18(60), 3(20), 7(20)
	214		1	L	2(100)
	215		5	M	2(40), 20(30), 3(15), 6(15)
	216		6	H	7(100)

Appendix II. Cont'd.

Water Body	Station no.	Sampling date	No. grapnel drags with plants	Density[a]	Composition of Sample[b]
St. Clair River (cont'd.)	217	9/28/78	1	L	2(100)
Lake St. Clair	218	8/30/78	0		
	219		0		
	220		0		
	221		0		
	222		6	H	21(80), 7(20)
	223		4	M	2(90), 7(10)
	224		0		
	225		3	L	21(70), 4(20), 2(10)
	226		0		
	227		0		
	228		1	L	2(100)
	229		0		
	230		0		
	231		6	L	21(100)
	232	10/13/78	0		
	233		0		
	234		0		
	235		0		
	236		0		
	237		6	L	21(90), 18(10)
	238		6	L	21(90), 18(10)
	239		0		
	240		0		
	241		0		
	242		0		
	243	10/11/78	0		
	244		0		
	245		0		
	246		0		
	247		5	L	4(60), 8(20), 21(10), 3(5), 7(5)
	248	9/21/78	0		
	249	8/30/78	0		
	250	8/31/78	3	M	2(95), 3(5)
	251	10/11/78	0		
	252	8/30/78	0		
	253	10/13/78	0		
	254	8/30/78	0		
	255		0		
	256		0		
	257	10/13/78	0		
	258		0		
	259	8/30/78	0		
	260		0		
	261		0		
	262		0		
	263	10/13/78	0		
	264	8/30/78	0		
	265		0		
	266		0		
	267		0		
	268		0		
	269	10/13/78	0		
	270		0		
	271		0		
	272	8/30/78	0		
Anchor Bay	273	9/21/78	4	L	21(80), 8(10), 18(10)
	274		5	L	21(60), 11(10), 7(10), 3(5), 8(5)
	275		5	L	21(60), 11(20), 7(10), 3(5), 8(5)
	276		6	H	21(60), 11(15), 7(10), 8(10), 3(3), 1(2)
	277		4	M	21(60), 2(20), 18(10), 3(5), 8(5)

Appendix II. Cont'd.

Water Body	Station no.	Sampling date	No. grapnel drags with plants	Density[a]	Composition of Sample[b]
Anchor Bay (cont'd.)	278	9/21/78 (cont'd.)	1	L	7(50), 11(50)
	279		0		
	280	9/06/78	4	M	7(50), 21(50),
	281		5	M	21(50), 7(30), 18(10), 3(5), 8(5)
	282		6	M	21(95), 7(5)
	283		6	H	21(80), 8(10), 2(10)
	284		0		
	285		3	M	21(100)
	286		1	L	11(50), 7(25), 21(25)
	287		2	L	8(40), 21(40), 2(20)
	288		6	M	18(40), 21(40), 8(20)
	289		6	H	21(60), 2(15), 8(10), 3(5), 4(5), 7(5)
	290	9/20/78	6	H	21(85), 2(10), 8(5)
	291		5	M	2(50), 21(40), 18(10)
	292		1	L	2(100)
	293		1	L	2(90), 6(10)
	294		4	L	2(100)
	295	8/23/78	1	L	2(100)
	296		0		
	297		1	L	2(100)
	298		0		
	299		0		
	300	9/20/78	2	L	2(70), 8(30)
	301		6	M	2(70), 8(30)
	302		6	L	2(70), 8(25), 14(5)
	303		6	L	2(50), 8(40), 7(5), 21(5)
	304		3	L	2(100)
	305		3	L	2(90), 8(10)
	306		5	L	2(90), 21(10)
	307		6	H	2(40), 8(30), 18(15) 14(10), 21(5)
	308	9/22/78	5	L	2(95), 3(5)
	309		6	L	2(100)
	310		6	L	2(55), 18(25), 8(10), 3(5), 11(5)
	311		6	L	2(90), 8(5), 21(5)
	312	9/28/78	5	H	7(100)
	313		4	H	7(100)
	314		2	H	7(100)
	315	9/20/78	6	M	8(90), 2(10)
	316		6	M	2(50), 8(45), 21(5)
	317	9/28/78	6	H	7(100)
	318	9/22/78	6	M	7(70), 3(15), 8(10), 21(5)
	319		5	L	2(90), 21(10)
	320	9/21/78	5	L	2(60), 8(20), 21(20)
	321		3	L	2(70), 8(30)
	322		2	L	2(80), 8(20)
	323	8/23/78	4	L	2(100), 1(40), 3(40), 7(10), 21(10)
	324		6	M	2(100)
	325		2	L	7(90), 20(10)
	326		3	L	2(100)
	327	9/22/78	4	L	2(95), 3(5)
	328	9/21/78	3	L	2(70), 8(30)
	329	9/22/78	5	L	2(45), 18(30), 3(20), 7(5)
	330		4	L	2(90), 11(10)
	331		1	L	2(100)
	332		0		
Detroit River	333	9/19/78	1	L	2(60), 14(30), 18(10)
	334		4	M	11(50), 14(50)
	335		2	L	2(90), 14(10)

Appendix II. Cont'd.

Water Body	Station no.	Sampling date	No. grapnel drags with plants	Density[a]	Composition of Sample[b]
Detroit River (cont'd.)	336	9/19/78 (cont'd.)	5	*[c]	1(40), 3(40), 4(10), 21(10)
	337		2	L	2(90), 14(10)
	338		1	L	2(80), 18(10), 21(10)
	339		0		
	340		0		
	341		0		
	342		3	L	21(100)
	343		0		
	344		1	L	21(100)
	345		0		
	346		5	M	21(100)
	347		0		
	348		2	L	21(100)
	349		0		
	350		5	M	21(70), 18(20), 8(10)
	351		0		
	352		6	M	2(35), 8(35), 7(15), 21(15)
	353		0		
	354		5	M	2(50), 8(20), 21(20), 7(10)
	355		0		
	356		2	L	21(100)
	357		6	H	2(40), 21(30), 7(25), 4(5)
	358		2	L	21(70), 2(30)
	359		6	H	2(40), 21(35), 3(15), 7(10)
	360		0		
	361		6	H	8(40), 21(35), 7(20), 2(5)
	362		5	L	21(80), 2(10), 8(10)
	363		0		
	364		4	M	21(70), 7(15), 8(15)
	365		6	M	21(60), 11(20), 18(20)
	366		6	M	21(100)
	367		0		
	368		1	L	21(100)
	369		0		
	370		4	L	21(100)
	371		0		
	372		5	M	21(100)
	373		0		
	374		5	M	21(100)
	375		0		
	376		5	M	21(100)
	377		0		
	378		0		
	379		0		
	380		0		
	381		0		
	382		0		
	383	8/29/78	0		
	384		0		
	385		0		
	386		0		
	387		0		
	388		0		
	389		0		
	390		0		
	391		0		
	392		1	L	7(100)
	393		0		
	394		1	L	7(100)
	395		0		

Appendix II. Cont'd.

Water Body	Station no.	Sampling date	No. grapnel drags with plants	Density[a]	Composition of Sample[b]
Detroit River (cont'd.)	396	8/29/78 (cont'd.)	0		
	397		0		
	398		5	M	21(85), 7(15)
	399		0		
	400		5	M	21(85), 7(15)
	401		0		
	402		3	M	21(60), 7(40)
	403		0		
	404		0		
	405		0		
	406		0		
	407		0		
	408		0		
	409		0		
	410		0		
	411		0		
	412		0		
	413		0		
	414		1	L	21(60), 18(40)
	415		0		
	416		1	L	21(60), 18(40)
	417	9/12/78	1	L	11(100)
	418	8/29/78	6	H	21(70), 4(20), 7(5), 11(5)
	419	9/12/78	0		
	420	8/29/78	6	H	21(70), 4(20), 7(5), 11(5)
	421	9/12/78	0		
	422		6	H	21(55), 8(30), 17(15)
	423		0		
	424	9/08/78	2	L	2(60), 11(20), 18(20)
	425	9/12/78	0		
	426		6	M	21(85), 4(15)
	427		0		
	428		5	M	14(50), 2(30), 21(10), 8(10)
	429		0		
	430		6	M	8(75), 14(25)
	431		0		
	432		6	M	21(70), 4(20), 11(10)
	433		0		
	434		6	M	21(95), 2(5)
	435		0		
	436		6	M	21(80), 2(10)
	437		0		
	438		6	M	21(60), 2(40)
	439		6	M	21(100)
	440		6	M	21(100)
	441		6	M	21(90), 4(10)
	442		6	M	21(90), 4(10)
	443	10/03/78	6	L	21(95), 4(5)
	444	9/12/78	5	*[c]	21(45), 4(25), 11(20), 18(10)
	445		0		
	446	9/12/78	0		
	447	9/14/78	0		
	448		3	H	21(60), 4(40)
	449		0		
	450		5	H	4(70), 21(30)
	451		0		
	452		5	H	4(50), 21(50)
	453		0		
	454		6	H	4(80), 3(10), 21(10)
	455		0		
	456		6	H	3(90), 4(5), 21(5)
	457		0		

Appendix II. Cont'd.

Water Body	Station no.	Sampling date	No. grapnel drags with plants	Density[a]	Composition of Sample[b]
Detroit River (cont'd.)	458	9/14/78 (cont'd.)	6	H	4(60), 3(30), 21(10)
	459		0		
	460		6	H	4(60), 3(30), 21(10)
	461		0		
	462		6	H	4(55), 7(25), 3(15), 21(5)
	463		0		
	464		6	H	4(60), 3(10), 21(20)
	465		0		
	466		6	H	4(65), 3(30), 21(5)
	467		0		
	468		6	H	4(100)
	469	9/15/78	0		
	470		6	H	4(100)
	471		1	L	4(100)
	472		6	H	4(80), 21(15), 3(5)
	473	9/14/78	1	L	4(100)
	474	9/15/78	5	M	4(70), 21(25), 17(5)
	475		0		
	476		6	H	4(60), 21(35), 3(5)
	477		5	H	4(70), 21(30)
	478		6	*[c]	4(70), 3(15), 21(15)
	479		0		
	480		6	H	4(60), 21(40)
	481		0		
	482		6	H	4(50), 21(50)
	483		4	H	21(50), 4(30), 17(20)
	484		6	H	4(80), 21(20)
	485		6	H	4(60), 21(40)
	486		6	H	4(80), 21(20)
	487		3	H	4(95), 21(5)
	488		3	M	4(70), 18(10), 7(10)
	489		0		
	490		0		
	491		0		
	492		0		
	493		0		
	494	9/12/78	6	M	21(60), 2(40)
	495		0		
	496		6	M	21(50), 2(50)
	497	10/03/78	0		
	498		6	L	8(90), 21(10)
	499		5	M	4(95), 13(5)
	500		6	L	8(60), 21(20), 2(10), 7(10)
	501		5	M	4(90), 21(10)
	502		6	L	2(95), 8(5)
	503		3	M	4(90), 21(10)
	504		6	L	2(100)
	505		3	L	4(60), 21(40)
	506		4	L	21(90), 4(10)
	507		4	M	21(100)
	508		6	M	21(100)
	509		5	M	21(95), 4(5)
	510	10/02/78	6	M	21(100)
	511		0		
	512		3	M	4(40), 21(40), 7(20)
	513		0		
	514		6	H	4(80), 21(20)
	515		5	H	4(50), 21(50)
	516		2	L	21(90), 4(10)
	517		6	H	21(90), 4(10)
	518		3	M	4(75), 21(25)
	519		5	H	4(80), 21(20)
	520		0		
	521		5	H	21(100)

Appendix II. Cont'd.

Water Body	Station no.	Sampling date	No. grapnel drags with plants	Density[a]	Composition of Sample[b]
Detroit River (cont'd.)	522	10/02/78 (cont'd.)	2	L	21(90), 4(10)
	523		6	M	21(90), 4(10)
	524		1	H	7(100)
	525		5	M	15(50), 21(50)
	526		2	M	4(50), 21(30), 7(20)
	527		6	H	4(80), 3(20)
	528		4	M	21(70), 4(30)
	529		4	H	21(60), 4(30), 3(10)
	530		5	M	21(100)
	531		4	L	21(90), 4(10)
	532		1	M	4(80), 7(20)
	533		0		
	534		0		
	535	9/13/78	3	L	21(80), 2(20)
	536	8/29/78	3	L	21(70), 4(20), 7(5), 11(5)
	537	9/13/78	3	M	21(60), 2(10), 7(15), 18(5)
	538	8/29/78	6	H	21(60), 4(40)
	539	9/13/78	5	H	21(75), 4(25)
	540	8/29/78	6	H	21(60), 4(40)
	541	9/13/78	6	H	21(60), 7(15), 18(15), 4(10)
	542		3	L	14(70), 3(10), 10(10)
	543		6	H	21(45), 4(45), 7(10)
	544		6	H	21(40), 4(40), 7(20)
	545		6	H	21(45), 4(45), 7(10)
	546		6	H	21(40), 4(30), 7(20), 3(10)
	547		5	H	21(70), 4(30)
	548		5	H	4(35), 21(35), 10(30)
	549		5	M	21(75), 4(25)
	550		6	H	4(50), 21(45), 7(5)
	551		6	M	21(100)
	552		6	H	4(70), 21(30)
	553		0		
	554		6	H	4(60), 21(35), 7(5)
	555		6	H	21(75), 4(25)
	556		4	M	21(60), 4(25), 7(15)
	557		6	M	21(100)
	558		6	H	21(70), 4(30)
	559		6	M	21(95), 4(15)
	560		5	M	4(70), 21(30)
	561		3	M	21(100)
	562		4	M	21(90), 4(10)
	563	10/03/78	4	M	21(95), 3(5)
	564		6	M	21(100)
	565		3	L	21(100)
	566		0		
	567		0		
	568	10/02/78	0		
	569		0		
	570		0		
	571		0		
	572		3	M	21(100)
	573		0		
	574		0		
	575		0		
	576		0		
	577		0		
	578		0		
	579		0		
	580		0		
	581		0		
	582		6	M	21(60), 4(40)
	583		2	L	21(100)

Appendix II. Cont'd.

Water Body	Station no.	Sampling date	No. grapnel drags with plants	Density[a]	Composition of Sample[b]
Detroit River (cont'd.)	584	10/02/78 (cont'd.)	1	L	21(100)
	585		2	L	21(100)
	586		0		
	587		6	H	3(60), 7(20), 4(10), 21(10)
	588		0		
	589		0		
	590		6	H	21(60), 7(30), 2(5), 3(5)
	591		6	H	21(50), 4(30), 7(20)
	592		1	L	8(100)
	593		0		
	594		0		
	595		0		

a/ Low (L), medium (M), or high (H); see text for additional explanation.
b/ Each taxon present in the sample is listed by code number followed by the percentage of the total sample contributed by that taxon in parentheses. Taxon numbers are as follows:

1 Ceratophyllum demersum
2 Characeae
3 Elodea canadensis
4 Heteranthera dubia
6 Myriophyllum exalbescens
7 M. spicatum
8 Najas flexilis
10 Nymphaea sp.
11 Potamogeton spp. narrow-leaf forms
12 P. spp. broad-leaf forms
13 P. crispus
14 P. gramineus
15 P. illinoensis
16 P. natans
17 P. nodosus
18 P. richardsonii
19 P. zosteriformis
20 Ranunculus sp.
21 Vallisneria americana

c/ Missing data.