PORT WING

HARBOR

AUTHENTICATED
U.S. GOVERNMENT
INFORMATION
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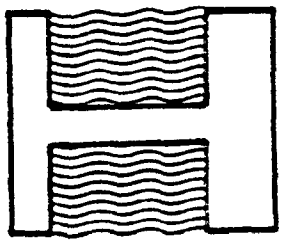

# PORT WING HARBOR DREDGING STUDY

Northwest REGIONAL Planning COMMISSION
an economic development district
302 Walnut Street Spooner, Wisconsin 54801 • 715 635-2197

# PORT WING HARBOR DREDGING STUDY

DECEMBER 1986

PREPARED BY THE NORTHWEST REGIONAL PLANNING COMMISSION

FINANCIAL ASSISTANCE PROVIDED BY: STATE OF WISCONSIN, BUREAU OF COASTAL MANAGEMENT, DEPARTMENT OF ADMINISTRATION, AND THE COASTAL ZONE MANAGEMENT IMPROVEMENT ACT OF 1980, AS AMDENDED, ADMINISTERED BY THE OFFICE OF COASTAL ZONE MANAGEMENT, NATIONAL OCEANIC ANMD ATMOSPHERIC ADMINISTRATION; AND, THE NORTHWEST REGIONAL PLANNING COMMISSION.

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# 1.0 INTRODUCTION

## 1.1 Historical Perspective

The United States Army Corps of Engineers (Corps) constructed the channel entrance to the Port Wing harbor basin in stages between 1903 and 1917 and has provided maintenance to the channel on a regular basis. The Corps policy through the early 1970's was to maintain the breakwater which is a federal structure, and to provided maintenance dredging to the designated federal channel. The authorized project depth for the channel and turning basin is fifteen feet.

During the 1970's, the State of Wisconsin expressed serious concerns about contamination of dredge materials and the deposition of pollutants in the Great Lakes. The State recognized that small amounts of pollutant material could have harmful effects on the human health. In 1975, the State, in keeping with it's committment to a high quality environment, requested that Corps dumping of dredge material in the adjacent waters of the state be stopped. Based on this request and others, in-water disposal was stopped in Wisconsin Great Lakes waters.

In the Early 1980's, the Governor requested that the Wisconsin Coastal Management Council define dredging needs and problems of Great Lakes harbors and to report on the impact of federal dredging policies upon the economic status of those harbors.

Since that time numerous proposals have been made by the federal government to charge a sizeable portion of the cost of harbor maintenance dredging to state and local governments. It is this perceived change in federal policy that now causes concern at the state and local level with the need to find methods of dredge disposal that are both cost-effective and environmentally compatable.

## 1.2 Plan Intent

Because of the importance of commercial and recreational navigation in the Great Lakes to the State of Wisconsin; the planning and management of the dredging of these waters are consistent with the State's duty and the public trust. Legislation currently proposed provides a balancing of the public interest in maintaining and improving harbors with the public interest in protecting, preserving and enhancing environmental quality.

In order to fully understand the balance, careful planning must be undertaken that is based upon knowledge of local conditions, proposed state and federal dredge disposal standards and the ability of governments to participate in the costs of dredging and disposal.

This planning effort offers opportunities to provide the public and local government officials with an understanding of the impacts of dredging and dredge material disposal.

This report includes an assessment of the resource base, sediment and water quality data which results in the identification of alternatives for action and the related costs of those actions.

# 2.0 PHYSICAL SETTING

## 2.1 Location

The Town of Port Wing is located in north central Bayfield County on the south shore of Lake Superior forty-five miles east of Superior and fifteen miles north of Iron River. The settlement of Port Wing covers approximately one square mile directly south and southeast of the harbor. The settlement is the only population concentration in the Town of Port Wing.

Port Wing is served by State Trunk Highway 13, and Bayfield County Trunk "A" both of which are in proximity to the harbor and provide easy access to the harbor from the Apostle Islands National Lakeshore, the Chequamegon National Forest and many inland lakes as well as neighboring communities.

## 2.2 Political Jurisdiction

The Town of Port Wing exercises corporate powers through Chapter 60 of the Wisconsin Statutes. The Town Board consists of a chairman and two supervisors. Town officers include a clerk, treasurer, assessor and a constable.

The Town of Port Wing does not have an established Harbor Commission. The harbor lands and basin are managed as a town park by the Town Board.

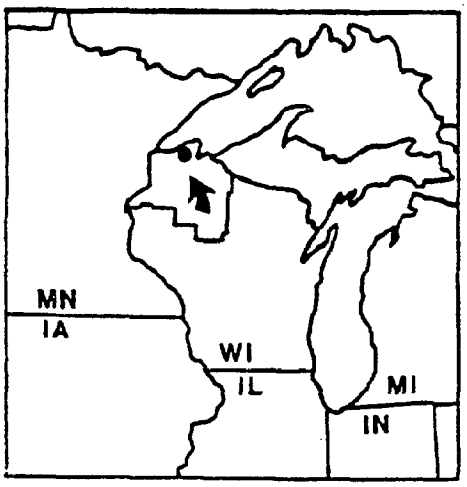
## 2.3 Transportation

Primary access through and to the Town of Port Wing is provided by S.T.H. 13, located 1/2 mile south of the lakeshore. Traffic counts conducted by the Wisconsin Department of Transportation show an annualized average daily traffic of 430 vehicles per day (1984). Projected counts for 1990 show a likely increase but is not expected to exceed the roads capacity to handle traffic.

North-south access to the Town is provided by Bayfield CTH "A", connecting the Town with Iron River and U.S. 2 fifteen miles to the south. This county trunk, near Port Wing, has a daily traffic count of 370.

Other than S.T.H. 13 and Bayfield County "A" the roads of the Town are under local jurisdiction and are gravel except for the paved streets of Port Wing.

No airport, bus, or rail service is available in Port Wing.




# REGIONAL LOCATION

SUPERIOR
PORT WING
APOSTLE ISLANDS
NAT'L LAKESHORE
DULUTH
LAKE
535
SUPERIOR
CORNUCOPIA
BAYFIELD
MADELINE IS.
13
WASHBURN
NORTH
0 Miles 13
BRULE RIVER STATE FOREST
2
ASHLAND
BAD RIVER INDIAN RES
HURLEY
MINN.
CHEQUAMEGON
MELLEN
MICH.
35
53
63
NATIONAL
DOUGLAS
27
BAYFIELD
77
GLIDDEN
51
N.S.R.
HAYWARD
FOREST
ASHLAND
IRON
PRICE
PARK FALLS
70
CHEQUAMEGON NATIONAL FOREST
SPOONER
WASHBURN
SAWYER
RUSK
RICE LAKE
8

PORT WING HARBOR DREDGING STUDY

MAP 1

## 2.4 Geology and Topography

Northern Bayfield County is located in the Lake Superior Lowland geographical province. The province occupies the northern portions of Douglas, Bayfield and Ashland Counties and is bounded on the south by the Northern Highlands Province, a low range of hills once the south shore of glacial Lake Duluth.

The region is characterized by a red clay-till lake plain, deeply incised by streams flowing north to Lake Superior. Pre-Cambrian sandstone of the Bayfield Group is found at depth.

Topographically, the region rises from 600 feet above sea level at Lake Superior to over 1000 feet above sea level to the south of Port Wing.

## 2.5 Climate

The climate of northern Bayfield county is classified as humid continental, which means that the region has very cold winters with rather short, moderately warm summers. Spring and fall are often short with sharp day-to-day temperature changes. All seasons have frequent weather changes as alternate high and low pressure systems move across the region.

The climate, however, is modified by the high heat and cold storage capacity of Lake Superior which tends to increase the number of frost free days along the lake and acts as a coolant in summer. As a result the Bayfield Peninsula has a longer growing season, cooler summers and more precipitation than the balance of the County. The lake modified climate is suited for apples and other fruit trees, berries and dairying.

Prevailing winds are westerly from early fall through early spring and easterly the balance of the year. Average annual precipitation is 30" with an average snowfall of 60 inches. August is the wettest month with an average of 4.0 inches.

# 3.0 CULTURAL AND ECONOMIC CHARACTERISTICS

## 3.1 Town History

Port Wing was first settled by Axel Johannson, who established a saw mill and post office at the mouth of the Flag River in 1881. Soon, commercial boats were picking up lumber and dropping off supplies on a routine basis. After the logging boom, commercial fishing became the primary source of income and employment for the residents and was partially responsible for the development of a federal channel in the early 1900's. The Corps constructed the east breakwall in 1903 with the west wall being completed in 1906. In 1917, the west wall was extended to the south.

Later, as a result of overfishing and predation by sea lamprey, fish stocks declined to the point where many commercial fishing operations in the area went out of business.

At this point the Town took steps to make the transition from a working harbor of refuge to a recreational boating harbor by making improvements necessary to attract tourism and bolster a sagging economy. With the establishment of other area marinas such as Cornucopia, Barker's Island and the complex of marinas in and about the Apostle Islands, power boating and sailing has increased. The Port Wing harbor is in a unique position to take advantage of the expanded market. It is the first harbor east of Barker's Island and is a logical stopping point for boats in route from Superior to the Islands.

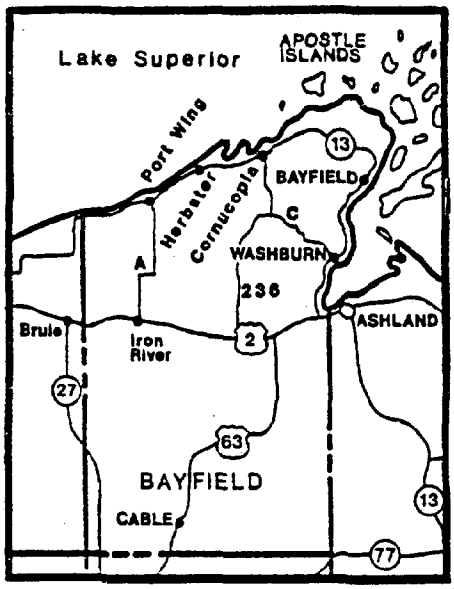
Today, tourism monies generated by the harbor are an important source of new dollars in the community. Lake Superior boater studies completed during 1984 and 1985 indicate that over $80.00 per day are spent by the average boating party. Those dollars spent by the boating tourist support five to ten jobs in the community.

This being the case, any condition such as excessive sedimentation that negatively impacts the harbor's ability to function and attract the recreational boater must be treated with the utmost care and minimized to the extent possible.

## 3.2 Town of Port Wing Land Use

The two principal uses of land in Port Wing are agriculture and forestry. Thirty five percent of the town's land is devoted to agriculture and thirty percent is dedicated to forestry. Between the U.S. Forest Service and The Bayfield County Forest, over 42% of the land is in public ownership

# TOWN OF PORT WING




LAKE SUPERIOR

Herbster

West Fork

Cranberry River

East

Port Wing

Bibon L.

13

CLOVER

Flag

E. Fork

PORT WING

Flag R.

Cr.

Lemmer

A

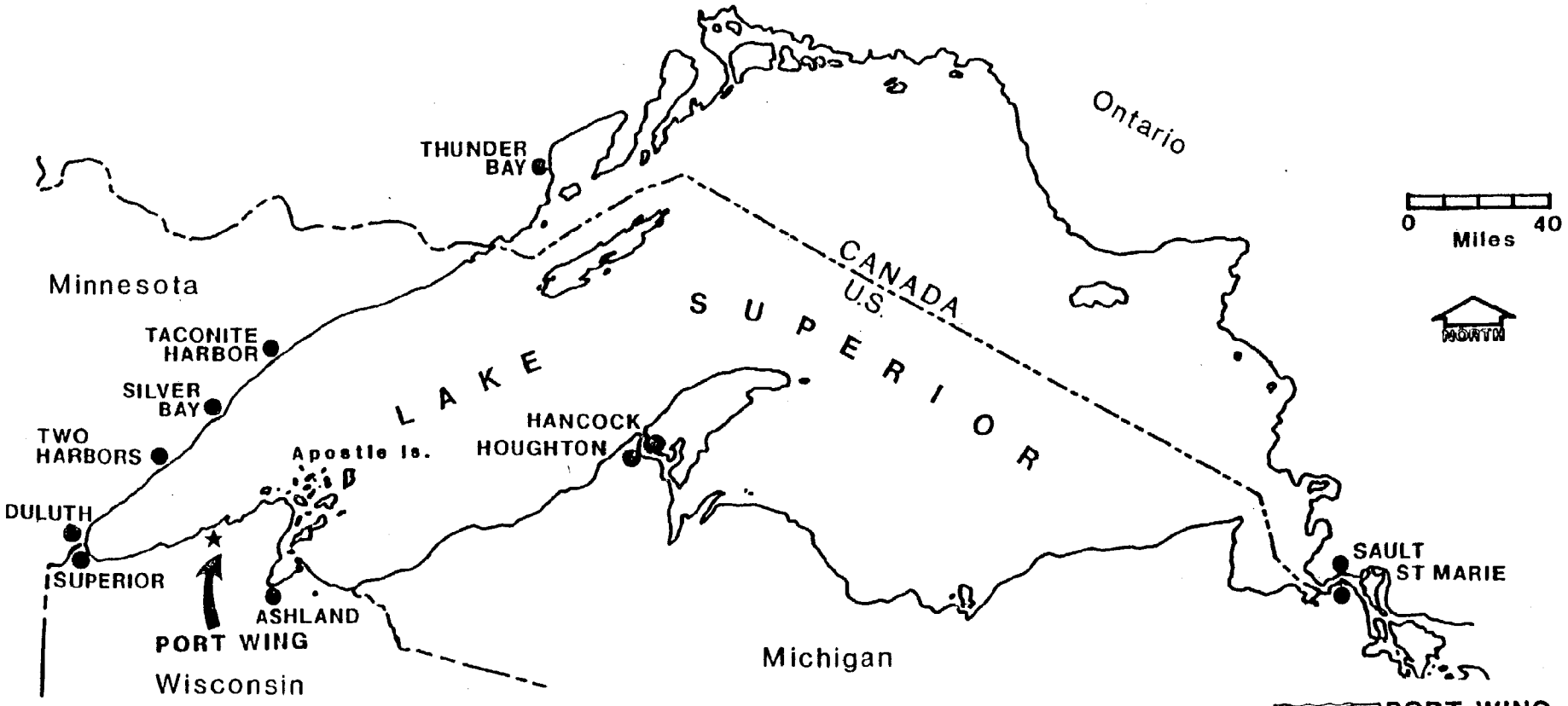
NORTH

CHEQUAMEGON NATIONAL FOREST

PORT WING HARBOR DREDGING STUDY

MAP 2

# LAKE SUPERIOR & THE APOSTLE ISLANDS




MAP 3

One development concentration exists, that is, the settlement of Port Wing, consisting of approximately one square mile containing 96 residences and 14 commercial establishments. Other than this concentration, development is sparse.

Dwelling counts show 246 year-around dwellings and 38 seasonal dwellings in a town of 104,400 acres.

## 3.3 Population

At the time of the 1980 census there were 542 persons living in the Town of Port Wing. The statistics show that the population declined between 1950 and 1970 to a low of 385 persons. Small area population projections made by the Northwest Regional Planning Commission suggest that the population will grow to approximately 608 by the year 2000. It must be recognized that a projection for an area of this size and population must be used with great caution since it is strongly influenced by in-out migration of a highly mobile population. It may also be strongly impacted by a relatively minor change in the economic structure of the town. One such change would be the expansion of the recreational harbor and the resultant need for additional goods and services.

## 3.4 Economy

The economy of northern Wisconsin has always been based on the utilization of it's natural resources. The principal resources of the region, historically, have been timber, metallic ores, fish, furs and recreational opportunities. Today, the region supports a good wood products industry, a weak fishing industry and an underdeveloped tourism industry. The manufacturing and service sectors of the economy have been growing in the region although not in the Town of Port wing.

Early in the century, fishing, lumbering and agriculture supported small but thriving communities along Lake Superior's south shore. As each of the resources declined in importance, employment shifts from resource utilization to other sectors occured with the end result being that workers had to seek employment in communities of the region with more job opportunities.

The level of information for employment in the Town of Port Wing is sketchy and because of low numbers is subject to dramatic shifts. Agriculture, construction and education are the stable features of the economy, with education accounting for one-half of the employment in the service sector of the town. No information is available for self-employed individuals. The statistics also do not account for the actual location of the employment. some of the workers have jobs in Washburn, Bayfield, Ashland, Iron River and Superior and commute on a regular basis.

The greatest opportunities for job creation exist in the service and recreation/tourism sectors of the economy provided that necessary improvments continue to be made to the harbor and that marketing of the excellent recreation/tourism opportunity is improved.

# 4.0 PORT WING HARBOR DRAINAGE BASIN

## 4.1 General Description

The drainage area tributary to the Port Wing harbor has two components: The first is the Flag River and it's East Fork and the second is Bibon (Flag) Lake and the streams tributary to it.

A. For the purposes of this study, the main branch of the Flag and the East Fork of the Flag River will be treated as one system. The Flag river system is fed by spring water sources and has a combined length of 16.4 stream miles. The source elevation is approximately 985 feet above sea level providing the river with an average gradient of 39 feet per mile although the East Fork has an average gradient of 112 feet per mile. The river is classified as trout water for it's entire length and 15.5 miles of the river is in public ownership (Bayfield County).

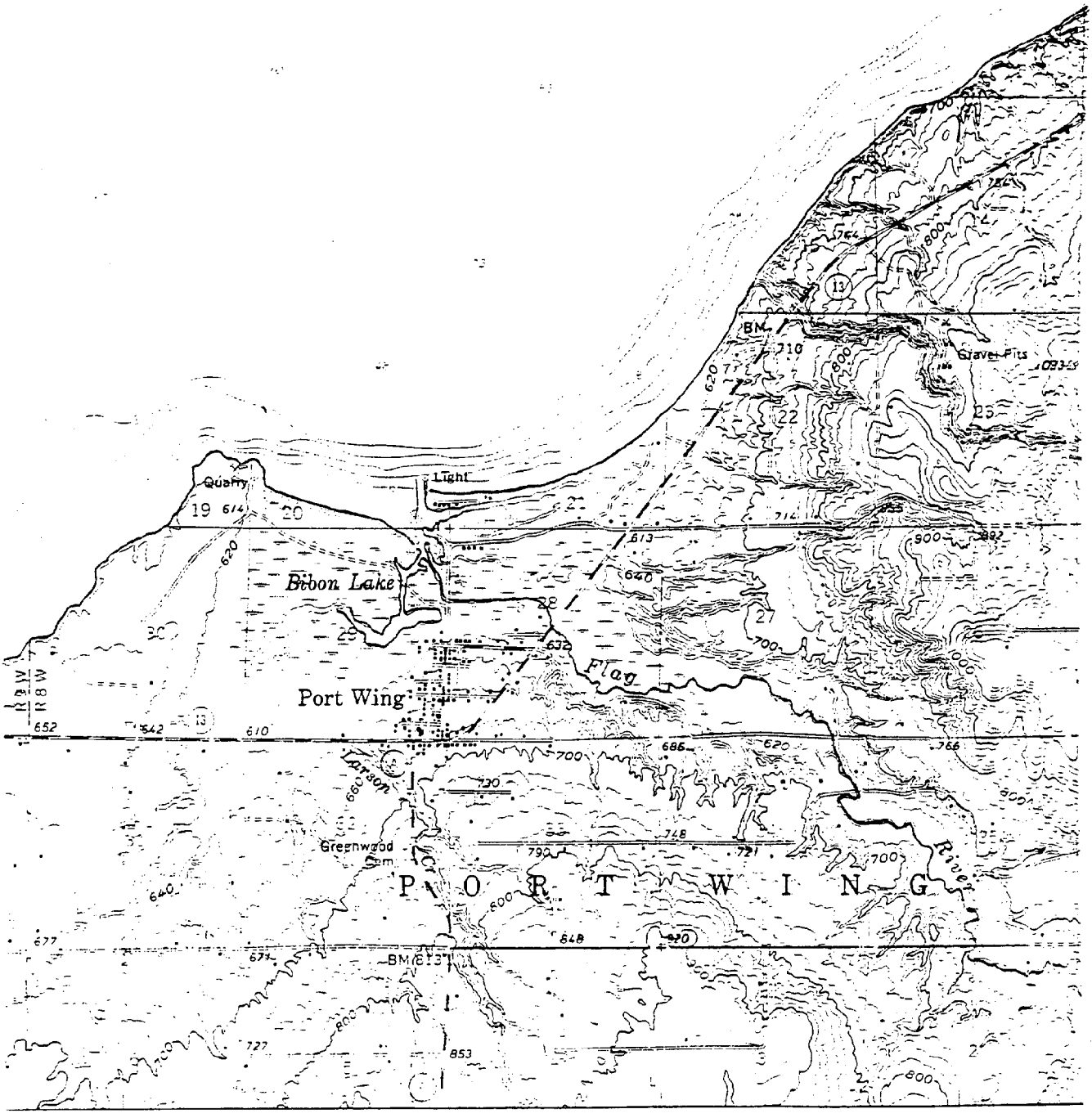
The watershed area of the river is approximately 48.7 square miles with a direct drainage of 29.9 sqyare miles. The main branch of the Flag has 12% in agricultural use and 88% in forest use. The East Fork has 2% in agricultural use and 98% in forest use. Two hundred ninety-four acres of wetland are adjacent to the main branch. The East fork has no adjoining wetlands.

The Flag River does not have an established monitoring station, however, normal flow has been estimated to be 20.6 cfs. Intermittent sampling by the Wisconsin Department of Natural Resources indicates a pH of 7.4; M.P.A. of 83 ppm and a specific conductance of 168 umhos. Water color is generally red due to suspended sediment. No estimates of suspended sediment loads or bed load are known to exist for the Flag River. However, United States Geological survey data indicates that 40 tons per square mile suspended sediment yield per year should be expected in the region.

B. Bibon Lake, a fifty acre hard water drainage lake is also tributary to the Port Wing harbor. The lake is fed by Larson Creek with a main branch and two subordinate branches approximately 4 miles in total length. The east branch flows through Twin Falls Park in the settlement of Port Wing. Although it has a small base flow, the stream is highly susceptable to storm event flooding. No flow or water quality data are available for this stream network.

Some quality of water data is available for Bibon Lake. This data indicate a pH of 7.1; M.P.A. of 91 ppm and specific conductacne of 181 umhos with a light brown color. At the time of investigation, the lake had a muck bottom.

# FLAG RIVER BASIN




PORT WING HARBOR DREDGING STUDY

MAP 4

Considering the small apparent normal flow of the tributary streams, the existence of a muck bottom; the conclusion may be reached that significant sediment is not entering the Port Wing harbor from Bibon Lake. Therefore it will not be discussed further.

Only one area within the drainage area is developed: That is the settlement of Port Wing, located near the harbor. Here approximately 110 structures exist served by central sewage treatment. No point sources or non-point sources are known to exist and no studies are in progress or planned.

## 4.2 Drainage Area Soils

The following major soil types are found in the drainage area:

Lake Beaches: A landform rather than a distinct soil type; beaches primarilly sand, are highly erodible and comprise about 5% of the soils in the area.

Ontonagon-Pickford: A fine textured soil of the lake plain consisting of clay and sand. These are highly erodible and comprise 40% of the drainage area.

Pickford-Bergland: A fine textured soil of the lake plain. These soils are generally level but are highly erodible where incised by streams. This type makes up approximately 10% of the soils in the area.

Ontonagon: A fine textured soil of the lake plain. This soil is highly erodible and makes up 30% of the soils in the region.

Peat: A very wet soil associated with the wetlands adjacent to the river.

## 4.3 Estimate of Sediment Volumes

As indicated previously, no estimates of sediment loads are available for the Flag River or Larson Creek systems. The only data available are from two nearby streams which monitor only suspended sediment and do not include data for bed load transport. Regional suspended sediment yield estimates by the U.S.G.S. are available, however the estimated yield of suspended sediment does not take in account the high rate of random catastrophic stream bank loss common in the region. Given the data available, it is not possible to correlate suspended sediment with actual deposition in the harbor since an unknown amount of bed load transport is occuring and the fact that only a portion of the suspended sediment may actually be deposited in the harbor

For the purpose of this study a more reliable method of estimating future dredge quantities is to examine historical dredging activities and make assumptions about the reliabilitiy of the data. It is recognized that this approach does not address the sediment entering the harbor and being deposited outside the arbitrary federal project dredge limits.

During the period from 1951 to 1985 the Corps dredged or contracted for dredging of the Port Wing federal project area. The following table identifies the years and the amount of material dredged. Since no precise records exist to document activities undertaken by others, these figures should be considered conservative and not reflective of the total dredging need.

| Year | Amount (cy) | Year | Amount (cy) |
|---|---|---|---|
| 1951 | 11,155 | 1963 | 5,125 |
| 1952 | 4,229 | 1974 | 32,740 |
| 1957 | 8,000 | 1985 | 11,142 |
| 1962 | 33,895 | | |
| | Total | | 106,286 cy |

If we can make the assumption that the data are correct and that the dredging indicated took place only in the federal channel, then two dredge quantities can be determined: first the annual average dredge quantity removed by the Corps. This figure can be determined by adding the dredge quantities for 1952 through 1985 and dividing that by 34, the total number of years represented by the data. This gives an annual average dredge quantity of 2,798 cy removed by the Corps program in the federal channel; second, some estimation of the amount of dredge material that could be removed form the harbor areas adjoining the federal project area should be made to reflect non-federal activity that may be related to future expansions. For this purpose of this study, it is assumed that deposition occurs each year over the area of the non-federal area at the same rate as in the federal project area (approximately 268,000 sf). It is recognized that this does not allow for flushing effects, or non-uniformity in deposition. The area of the non-federal area is approximately 175,000 sf. Extension of the calculation provides an estimate of 1,826cy of material that could be removed from the non-federal area on a yearly basis.

For the balance of this report we will assume that only the federal project area will be dredged. To provide a margin for error, the quantity of dredge materials anticipated will be adjusted upward from 2,798 cy to 3,000 cubic yeards per year even though the harbor may not be dredged each year.

## 5.0 HARBOR CONFIGURATION

### 5.1 Current Arrangement

The Port Wing harbor lies at the mouth of the Flag River approximately 1/2 mile north of the settlement of Port Wing. A town road connects the harbor with the settlement. A second town road connects with S.T.H. 13 one mile to the east of the harbor. A bridge maintained by the town crosses a slough that lies between the mainland and the sand spit upon which the harbor improvments have been made.

The channel entrance is protected by two breakwalls. The east breakwall was built in 1903 and a west breakwall in 1917. The channel is 150 feet wide and has an authorized project depth of 15 feet. The east pier is 835 feet long. The west pier is 824 long with an inward sheet pile extension of 192 feet to protect the inner harbor area. In 1950, the Corps reconstructed both piers with sheet piling and added a stone cap.

The federal project extends 800 feet south from the north edge of the channel entrance to the south edge of the turning basin. The east leg of the channel extends 1100 feet east on the south side of the sand spit to the Anderson Bridge. The authorized project depth for the east-west leg is 8 feet.

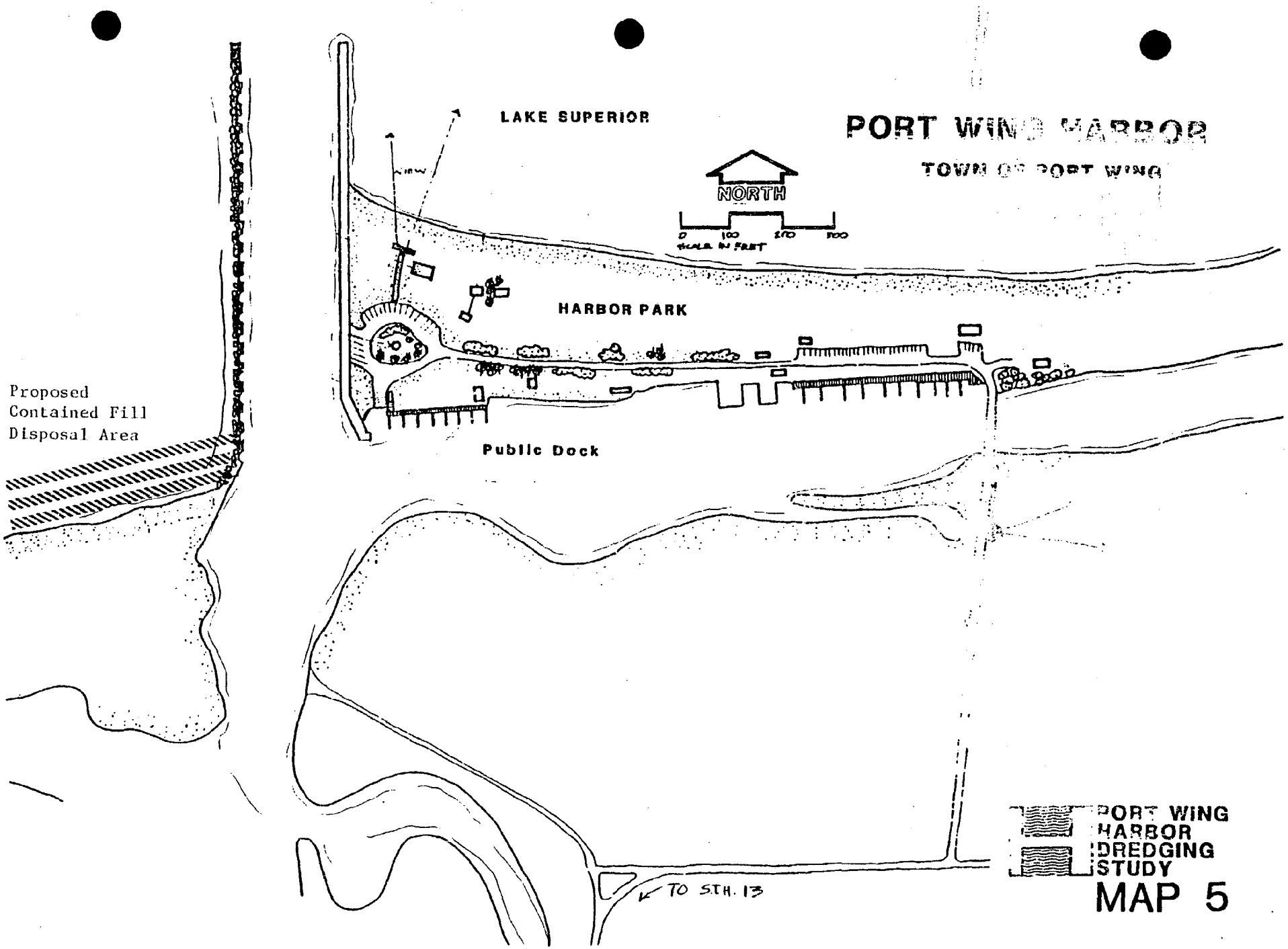
Inner harbor public improvements consist of a boat launch, transient boarding piers, restrooms, telephone, and drinking water. Also present are commercial fishing operations, a number of private docks and a marine sales/service establishment.

In 1978, the Department of Natural Resources and the Upper Great Lakes Regional Commission funded a study to explore opportunities for expansion and improvements to the harbor. As a result of that study new access piers, a new baot launch and rehabilitated bulkheads were installed in 1982. That study also recommended that an additional breakwall be installed to better protect the channel from northern storms that create dangerous wave conditions in the channel entrance.

### 5.2 Future Improvements

During the last ten years a number of proposals have been presented for expansion of recreational boating facilities in the harbor. Most of those proposals called for construction of new slips at the south end of the Anderson Bridge. The latest information indicates that town officials and a local private party are discussing a similar proposal although not enough information is available at this time to evaluate the viability of the proposal.

Whether or not future expansion of the facility occurs, the minimum harbor depth of 8 feet must be maintained in order for the harbor to continue as a viable recreation/tourism facility.


LAKE SUPERIOR
PORT WING HARBOR
TOWN OF PORT WING
NORTH
0 100 200 300
SCALE IN FEET
HARBOR PARK
Public Dock
Proposed
Contained Fill
Disposal Area
TO STH. 13
PORT WING
HARBOR
DREDGING
STUDY
MAP 5

# 6.0 PORT WING HARBOR ENVIRONMENTAL ASSESSMENT

This material is summarized from:

Wisconsin Department of Natural Resources: Port Wing Harbor Study, Upper Great Lake Regional Commission 1977.

U.S. Army Corps of Engineers: Section 404, Sediment and Benthos Analysis, 1983.

## 6.1 Terrestrial Vegetation

The three major terrestrial vegetation types in the harbor area are upland boreal forest, sedge mat bog-wetland and sand spit vegetation. These three vegetation types found in this relationship create a very unique ecosystem. This ecosystem, just east of the harbor road is in a nearly pristine state. Areas west of the harbor road have been modified by man.

The Wisconsin Department of Natural Resources and the Scientific Areas Preservation Council consider the wetland between the settlement and Lake Superior as significant. This wetland contains more than 1000 acres. The Flag River passes through nearly one mile of the wetland. In addition there are substantial values for fish spawning and rearing habitat, and migratory and breeding habitat for unique bird species.

## 6.2 Aquatic Vegetation

Aquatic vegetation found was no different than that of other Lake Superior harbors. No endangered or threatened species were found.

## 6.3 Wildlife

The presence of river otter, beaver and muskrat were noted. Amphibians noted were the Northern Leopard Frog and the American Toad.

## 6.4 Fish

The harbor has excellent spawning habitat for Northern Pike and Yellow Perch, particularly in the slough area on the east side of the town road. The fishery value of the project area is unique, as are other river harbors of Lake Superior because of spawning runs of anadromous fish.

## 6.5 Birds

The Port Wing harbor area is listed as one of the 90 most favored locations for bird study in Wisconsin. A total of 69 bird species breed within the study area; 58 species use the area as a stop over point and 35 species use the area for transitory purposes. The Port Wing Boreal Forest is the only place in Bayfield County where the Pine Sisken, Red Crossbill, White-winged Crossbill and the Yellow-throated Vireo can be found nesting in combination.

## 6.6 Historical and Archeological Sites

There are no known historical sites in the project area. Archeological sites probably exist but are not located.

## 6.7 Terrestrial Soils and Harbor Substrates

The terrestrial areas of the harbor consist of a sand spit (alluvium), low marshy areas of organic soils and some man-made areas

The harbor substrates consist primarily of sands, silts and coarse organic materials.

## 6.8 Water Quality

Results of the most recent water quality analyses are presented in the Appendix. Water quality conditions in the harbor probably change rapidly depending upon the movement of water masses within the harbor. A combination of lake seiche and stream water movement results in wide variations of quality values in each of the harbor areas.

## 6.9 Sediment Analysis

### Quantitative Analysis

The total volume of sediment that is anticipated to be removed on an annual average basis was calculated in Section 4 to be 3,000 cubic yards for the existing federal project area

Qualitative Analysis

A. Pollutant Analysis

During 1983, chemical quality analysis of bottom sediments was performed for three stations in the Port Wing harbor. The three stations depicted in the Appendix are: the mouth of the breakwall system, the upstream limit of the federal project area, and, the eastern extremity of the east-west harbor basin near the Anderson Bridge. Sampling station identification 1,2,3 relate to A,B, and C respectively.

Based upon current knowledge regarding in-water disposal of dredge materials, the WDNR is again considering the possibility of allowing in-water disposal of clean dredge spoil. The WDNR with the assistance of a technical subcommittee has developed guidelines for evaluating disposal options for dredge spoil based upon pollutant concentrations. The Department has developed criteria for in-water disposal as follows:

1. If any pollutant, or group of pollutants, of concern is found in concentrations greater than 125% of the criteria for that pollutant, in-water disposal will not be allowed.

2. If three or more pollutants are found in concentrations greater than 110% of the criteria for those pollutants, in-water disposal will not be allowed.

3. If one or two pollutants are found in concentrations within the range of 110% to 125% of the criteria for those same pollutants, in-water disposal will be determined on a case by case basis.

4. If all pollutants are found at concentrations of 110% or less than the criteria for those same pollutants, in-water disposal may be allowed.

5. For on-the-beach disposal the particle size of the dredged material must meet the following criteria: The average percent of spoil material finer than 0.074 millimeters (mm) must not exceed the average percentage of materials finer than 0.074mm in the existing beach by more than 15 percent. For in water disposal, particle size matching is not required.

According to the sediment analyses conducted on the three stations, concentrations of pollutants exceeded the proposed criteria three times for oil and grease, two times for arsenic, three times for cadmium, and once for lead, mercury and zinc. In addition, the following parameters were not tested for: dioxin, furan, toxaphene, chlordane, endrin, barium and selenium. The analysis was performed by Envirodyne Engineers Inc.

The following table presents a summary of the pollutant concentrations found for each sampling station in 1983 compared to the proposed maximum allowable concentration of pollutants for in-water disposal.

| Parameter | Maximum Allowable Concentrations | Detected Concentrations | | |
|---|---|---|---|---|
| | | Sites | | |
| | | A | B | C |
| ORGANICS | | | | |
| PCB's | .05 | + | + | + |
| Dioxin | 1.0 pg/g | Not Analyzed | | |
| Furan | 1.0 pg/g | Not Analyzed | | |
| PESTICIDES | | | | |
| Aldrin | .01 | + | + | + |
| Chlordane | .01 | Not Analyzed | | |
| Endrin | .05 | Not Analyzed | | |
| DDT | .01 | + | + | + |
| Dieldrin | .01 | + | + | + |
| Heptachlor | .05 | + | + | + |
| Lindane | .05 | + | + | + |
| Toxaphene | .05 | Not Analyzed | | |
| METALS | | | | |
| Arsenic | 10 | * 17.1 | 0.97 | * 14.8 |
| Barium | 500 | Not Analyzed | | |
| Cadmium | 1 | * 5.0 (1) | * 3.6 (1) | * 3.1 (1) |
| Chromium | 100 | 38.0 | {6.0 | 54.3 |
| Copper | 100 | 31.7 (1) | 3.1 | 46.6 |
| Lead | 50 | 38.6 | 1.56 | * 58.2 |
| Mercury | 0.1 | {0.1 (2) | 0.03 (1) | * {0.3 (4) |
| Nickel | 100 | 30.0 | 12.3 | 45.3 |
| Selenium | 1 | Not Analyzed | | |
| Zinc | 100 | 64.7 (1) | 9.4 | * 112.0 |
| OTHER | | | | |
| Oil/Grease | 1000 | * 4070 (2) | * 1130 (1) | * 3230 (2) |

Notes:

Unless otherwise noted, concentrations are ug/g
+ Positive result below detection limit
{ Less than
* 1983 concentration in excess of maximum allowable
() Numbers in parentheses represent previous (1968-1975) sample concentrations in excess of proposed maximum allowable. Data are found in Appendix.

While the table indicates uniform sampling stations, this was not the case. None of the previous studies made any attempt to utilize a standard set of sampling stations. For the purpose of this study, data from sampling stations in proximity to each other within the three general zones have been compared in the table above. The data presents historical evidence that several chemical parameters have regularly exceeded the proposed maximum allowable concentrations. An additional problem with the data exists since not all of the sampling regimes tested for the entire list of parameters. Incomplete historical records exist for most parameters. The 1983 sampling regime is the most complete compared to the parameters of concern in the Department's proposed criteria.

Taken as a whole the data indicate routine problems with arsenic, cadmium, mercury, zinc and oil/grease. Minor problems seem to be lead and copper. This is not to imply that other problems do not exist, since, as noted previously not all parameters have been tested for.

On a zone basis, the materials from zone B ( the upstream extremity of the federal project area) appear to be the least polluted, while the materials from zone C (the east-west extremity near Anderson Bridge) appear to be the most polluted with nearly one-half of the excessive concentrations reported.

At this time it is not possible to identify the source of the pollutants in excess of the proposed allowable concentrations. However, with the presence of so many metals in excess of the criteria, it would seem that the Department should proceed with a study of the immediate Port Wing area to determine the potential existence of pollutant sources. It may be possible that the sediments in the Port Wing harbor could eventually be "cleaned up" for in-water disposal through application of point-source pollution abatement techniques.

If the data are to be trusted, then clearly the dredge materials from the Port Wing harbor curently do not meet the in-water disposal criteria and must be placed either on land or in a contained fill facility.

B. Particle Size Analysis

In order for dredge mateials to be used for beach nourishment they must, in addition to the chemical quality criteria, also meet the particle size criteria noted as # 5 in the preceeding section: that is, for on-the-beach disposal, the particle size of materials finer than 0.074 mm must not exceed by 15 percentage points, the average disposal site material finer than 0.074 mm. To put this in perspective, 0.074 mm is often considered as the smallest diameter of a material that can be classified as very fine sand. This material will not pass through a # 200 seive. Materials smaller than this are classified as clays and silts.

The following table indicates the particle size distribution of sediments in the Port Wing harbor at the time of the 1983 study.

| Particle size range | A | B | C |
|---|---|---|---|
| Greater than 0.43mm % | 11 | 1 | 17 |
| Greater than 0.25mm % | 31 | 43 | 21 |
| Greater than 0.075mm % | 58 | 70 | 27 |
| Less than 0.075mm % | 42 | 30 | 73 |

In this case assuming equal volumes from each station were dredged, the average percentage of material finer than 0.075mm would be approximately 48.3 %. This would mean that utilizing the 15% criteria, the disposal site in-place material could contain no less than 33.3% material finer than 0.074mm.

To this time no particle size distribution analysis has been performed for potential beach nourishment sites in and near the Port Wing harbor. Casual site obsevations indicate the presence of sand beaches to the east and west of the harbor entrance and there is a possibility that these beaches would be suitable for beach nourishment. However until testing is complete particle size match is not assured.

Summary of Sediment Characteristics

Quantity: The anticipated volume of material to be dredged on an annualized average basis is approximately 3000 cubic yards.

Quality: On the basis of the stations sampled and the concentrations of pollutants analyzed for and detected; the material may be considered "polluted" and therefore is probably not suitable for in-water disposal.

Additional testing may be required for the parameters not tested for (dioxin, furan, chlordane toxaphene, endrin, barium and selenium)

Particle Size Matching: After testing of nearby beaches for particle size distribution match, the material may be found suitable for beach nourishment activities. Even though, from a sediment quality standpoint, the material may not be suitable.

## 7.0 ALTERNATIVES FOR MANAGMENT OF DREDGE MATERIALS

Many alternatives exist for the management of dredge materials including source abatement of dredge material volumes, beneficial reuse, outright disposal and a number of combinations therof. However it should be recognized that the final determinants for chosing an option are the suitability of the dredge materials for use, and if local governements must pay the entire cost, the availability of financial resources to implement the chosen alternative.

### 7.1 No Action

This alternative has obviously the least first cost. However, the negative impact of this alternative over time in terms of the loss of jobs and income to the area, not to mention the eventual closing of the harbor, is so great that it is no alternative at all and is rejected.

### 7.2 Abatement of Dredge Volumes

A. Upland Treatment--Approximately 10% of the 29.9 square mile direct drainage of the Flag River system is in agricultural use and potentially open to erosion. Soil loss, calculated from the Universal Soil Loss Equation, is less than 1 ton per acre per year. It should be recognized that the USLE does not address sediment delivery to streams, but, it is a useful indicator of the nature of the soils. Treatment of critical areas may be undertaken for less than $100 per acre, however little impact on sediment deposition in the harbor will be made. Landowners should be encouraged through United State Department of Agriculture programs to practice good conservation methods on their lands.

B. Stream Bank and Channel Protection--Most if not all of the sediment reaching the harbor is a result of erosion of the bank and channel of the Flag River system at high flow levels. Protective measures such as gabions, timber cribs and deflector wings can be utilized successfully to reduce erosion at critical sites with some improvment usually occuring to fish habitat. Considering that the river travels over 16 miles through highly erodible soils, only those areas exhibiting severe problems can be treated in a cost effective manner due to the relatively high cost of protection ($330/lf, 1977 Red Clay Project).

This alternative may reduce the volume of sediment reaching the harbor but it will not negate the need for dredging.

C. Floodwater and Sediment Retention--Since the majority of the erosion and sediment transport is at high flow levels, abatement of sediment volume reaching the harbor could be accomplished through the construction of floodwater and sediment retention structures. Such structures would retard floodwater, capture bed load and allow the settlement of some suspended sediment. Construction of effective retarding structures is a project requiring significant investment in engineering, construction and maintenance. First, the structure must be located so that it can capture an optimum amount of sediment for a long period of time to be cost effective. Second, it must be located in an accessible area since yearly and long term maintenance are required for proper operation and safety. Two earth filled structures of this type were constructed in similar terrain on red clay soils during the late 1970's. The average construction cost was $240,000 (1977). Engineering was an additional $50,000. Yearly maintenance has averaged $2,000. Those structures have a design capacity of approximately 15 years and at some point in the future, the sediment trapped behind the structure will have to be removed at an additional cost and then transported to a disposal site.

It is not known whether a site exists on the Flag River that would meet the necessary technical requirements for a structure. In addition, sediment retarding structures by their nature slow down the flow of water thus allowing the water temperature to rise and potentially making the channel above the strucuture unsuitable for cold water fish such as trout. Also, fish habitat below the structure may suffer detrimental change.

Finally, an unknown amount of sediment will still reach the harbor since a retarding structure is only effective for sediment generated above it and the terrain near the harbor is generally unsuitable for this type of structure.

Summary of Abatement Alternatives

A. Upland treatment can be effective for reducing a small amount of erosion and related sediment in the harbor. The cost is low and could be accomplished through an educational effort.

B. Streambank and Channel Protection. The cost of this alternative can be very high depending upon the length of stream to be protected. This alternative could be considered further in combination with other actions taken.

C. Floodwater and Sediment Retention. At this time no engineering has been done to identify the potential effectiveness of a structure. The capital and operation/maintenance cost is very high. Also unanswered at this time is the consequence of a structure of this type on the Flag River environment.

## 7.3 Dredge Spoil Pollution Abatement

As indicated previously, the harbor sediments can be characterized as "polluted" under the Department's proposed criteria. While this alternative is not a short range alternative, it could have significant long term benefits if the sources of pollution now entering the harbor could be identified and abated. It is recommended that the Department throughly investigate the immediate Port Wing area to determine possible sources of the pollutants.

## 7.4 Dredge Spoil Disposal Alternatives

These alternatives are basically of two types: in-water disposal and on-land disposal. They also represent the more traditional and straight forward approaches to dealing with the problem. Beneficial re-uses and potential cost saving techniques are identified where appropriate.

This section utilizes the following assumptions:

* Annualized average dredge requirement is 3,000 cubic yards.
* The dredge spoil is found to be "polluted".
* Particle size match exists with the adjacent beaches.
* Dredging cost @ $6.00/ cubic yard.
* Mobilization costs are not included but are assumed to be 1%.
* Engineering costs are not included but are assumed to be 9%.
* Debt service costs are not included but are assumed to be 10% with 20 year amortization.
* Construction costs are from regional estimates and are not "present worth"
* Sediment analysis costs are not included but are assumed for all alternatives.

A. In-water Disposal

If the assumptions are correct, this alternative will not be allowed under the Department's proposed disposal criteria.

The alternative has two possible actions: 1. Dredge the material from the harbor and dump offshore in deeper water. This action, if implemented properly could benefit fish by providing a reef-type habitat. Discussion with Department Fish Division (Bayfield) indicates that there is not a need for this type of habitat in the area at this time. 2. Dredge the material from the harbor and dump in the nearshore zone. This action would benefit starved beach areas near the harbor and make them less susceptable to erosion damage during high water. The costs for the two actions are essentially the same except that reef construction would require substantial engineering.

**Estimated Cost**

| | |
|---|---|
| Annually dredge and dispose of 3,000 cy @ $6.00/cy | $ 18,000.00 |
| Twenty year cost | 360,000.00 |

B. In-water Contained Disposal Facility

This alternative may be considered acceptable for "polluted spoil" by the Department depending upon design.

On the west side of the west breakwall is an area of starved beach that would be suitable for a contained disposal facility. The facility could be constructed of steel sheet piling, rubble mound or timber crib with a silt barrier that would prohibit the migration of polluted spoil into the adjacent waters of Lake Superior. The Town of Port Wing owns the property in the area of the proposed site, although access is poor from the land side. The location of the proposed site is shown on Map 5.

**Estimated Cost**

| | |
|---|---|
| Annually dredge and dispose of 3,000 cy @ $6.00/cy. | $ 18,000.00 |
| First cost of containment structure<br>20 yr. storage 2400 ft X 60 ft X 12 ft | 240,000.00 |
| Second handling of material @ $1.50/cy | 4,500.00 |
| Twenty year dredge and handling | 450,000.00 |
| Total twenty year cost | $ 690,000.00 |

C. On-land Disposal

There are several on-land beneficial re-uses of dredge material which will be noted here but not discussed in detail because they are generally not applicable to the Port Wing harbor situation, and because the Port Wing dredge materials are considered "polluted".

* Dune Construction and Management-Dredge materials are used to reconstruct dunes or maintain dune profiles after major storms. It can be used to enhance the quality of existing recreational areas by providing dune-like habitat.

* Wetland Renovation and Construction-Nutrient rich spoil has been used to create or restore wetland areas. This generally involves placing spoil in water to raise the bottom elevation to provide water depths suitable for growing aquatic vegetation.

* Wetland Protection-Materials are use to construct barrier reefs or barrier islands to reduce erosion damage to wetland complexes.

In addition to the re-uses mentioned above, several other uses have been discussed from time to time in the local area. These include use for road sand, soil conditioner and structural building materials. These uses are not given further consideration since they all require dewatering, multiple handling and extensive transportation systems. An additonal requirement is that the spoil be considered "clean".

1. On-land Disposal

On-land disposal, whether contained or not is the other alternative that may be selected for the disposal of "polluted" spoil. The alternative is expensive since it would require dewatering and multiple handling of the spoil material as well as the potential purchase of land suitable for spoil disposal. The Wisconsin Statutes, ch 346.94, prohibits the spilling of waste or foreign matter on or along highways. In addition, the Wisconsin Department of Transportation requires a permit for the transport of polluted spoil material. Added cost may be incurred as well by the community for repairs of damage caused to bridges and highways because of heavy traffic. The two bridges near the harbor would be particularly susceptable to damage by heavy traffic. A forty acre site would be suitable for over 50 years of spoil storage. Site preparation costs are unknown.

Estimated Cost

| | |
|---|---|
| Annual Dredge 3,000cy @ $6.00/cy. | $ 18,000.00 |
| Dewatering and temporary stockpiling @ $4.00/cy | 12,000.00 |
| Transfer to storage site @ $4.00/cy | 12.000.00 |
| Total yearly cost | 42,000.00 |
| One time land purchase | 5,000.00 |
| Twenty year cost | $ 845,000.00 |

7.5 Dredge Spoil Disposal Alternative Cost Summary

The costs shown below are the twenty year costs as determined in the previous section.

| | | |
|---|---|---|
| A. | In-water disposal | |
| | 1. Disposal in deep water | $ 360,000.00 |
| | 2. Disposal in nearshore zone | $ 360,000.00 |
| B. | In-water contained disposal facility | $ 690,000.00 |
| C. | On-land disposal | $ 845,000.00 |

7.6 Recommended Alternatives

A. If the material is found to be "polluted" as assumed, Alternatives B and C are the only alternatives that can be recommended. If the cost figures are accurate or even close, then Alternative B would be the preferred alternative.

B. If after additional testing shows the dredge spoil to be "clean" or if, at some future time the sources of the pollutants are found and abated, then either of Alternative A1 or A2 may be considered.

C. Ranking of Alternatives

Clean Material

| | | |
|---|---|---|
| 1. | Alternative A1 | $360,000.00 |
| 2. | Alternative A2 | $360,000.00 |

Polluted Material

| | | |
|---|---|---|
| 1. | Alternative B | $690,000.00 |
| 2. | Alternative C | $845,000.00 |

## 7.7 Fiscal Impact of Probable Alternative B

In 1980 the public debt per capita per year for the Town of Port Wing was $154.00 (all debt spread over permanent residents). The cost of the preferred alternative spread on a percapita basis will be approximately $66.00 per year (not including debt service), or a new total public debt load of $220.00. This debt and any other new debt incurred by the Town for such items as water, sewer, roads and general operations will naturally be passed down to the residents.

If the Town were to pass on part of the debt load to harbor users, the situation could be relieved somewhat, but, some residents have boats in the marina and they will be reluctant to pay twice for the privelege of using the marina. In addition, there is the possibility of discouraging harbor business and permanently damaging the recreation/tourism sector by the raising of harbor fees.

Unfortunately, the same situation may result if the harbor is not maintained. If a number of years go by without maintenance dredging, the harbor will become unuseable even to craft of shallow draft and subsequently destroy the economic viability of the harbor complex.

It is absoulutely necessary that the Corps maintenance dredging program be continued for the Port Wing harbor. Otherwise, an assistance program must be identified that can bear part of the cost of harbor maintenance for the public good. At present there are programs sponsored by several agencies which, if modified in scope and intent, could provide cost-sharing monies and thus reduce the local burden.

## 8.0 CONCLUSIONS

* The harbor dredging need is approximately 3,000 cubic yards on an annualized average basis.

* The harbor dredge material can be characterized as "polluted" for the pollutants analyzed for according to the proposed pollutant criteria.

* Additional testing of sediments may be required in the future.

* The estimated amount of dredge material less than 0.074mm is approximately 48.3%.

* There may not be a need to verify particle size match since a beach nourishment alternative will probably not be allowed.

* Available alternatives have been identified and costed.

* The alternatives have been ranked with the result that in-water contained disposal is considered the most cost-effective approach.

* Alternatives for abatement of dredge volumes exist at relatively high cost.

* An investigation of potential point sources of metals should be made in the Port Wing area.

* The Corps of Engineers maintenance dredging program should be continued for the Port Wing harbor.

* A cost sharing assistance program will be needed to reduce local cost if the Corps program is not continued

# APPENDIX A

PORT WING HARBOR

1983

DETROIT CORPS OF ENGINEERS
Port Wing Sediment Duplicates
1745-19200

| Parameter | Site | Sample Value | Duplicate Value |
|---|---|---|---|
| Ammonia | - | 14.5 | 15.7 |
| Total Phosphorous | - | 467 | 450 |
| Mercury | - | <0.1 | <0.1 |
| Arsenic | - | 7.16 | 9.17 |
| Iron | - | 10,600 | 16,200 |
| Cadmium | - | 9.6 | 8.0 |
| Copper | - | 29.9 | 31.2 |
| Chromium | - | 27.2 | 21.0 |
| Nickel | - | 17.9 | 26.2 |
| Manganese | - | 392 | 377 |
| TKN | C | 3,150 | 4,320 |
| Lead | - | 40.2 | 31.2 |
| Zinc | - | 92.9 | 93.5 |

Values are ug/g.

Where no site is identified, the duplicate was run on a sample from another harbor.

SECTION 404 SEDIMENT QUALITY EVALUATION

FOR FOUR O&M DREDGING PROJECTS

Port Wing

The physical and chemical sediment data attached show that most of the area may be characterized as inert sandy material mixed with degraded vegetation.

Site No. 1 is silty and mixed with peaty matter. Heavy metals do not show significant levels of concern. Chlorinated organics are below detection levels.

This material is suitable for open water or unconfined upland disposal provided the proposed location is not a biologically important area which could be harmed from physical effects.

Frank Snitz
Physical Scientist
Environmental Analysis Branch
Planning Division

I concur with this evaluation.

for Les E. Weigum
Chief, Environmental Analysis Branch
Planning Division

DETROIT CORPS OF ENGINEERS
1745-19200

Harbor Port Wing Sample Type Sediment Date Collected 8/5/83

| Parameter | Site A | Site B | Site C | | | |
|---|---|---|---|---|---|---|
| % Solids | 30.2 | 65.5 | 32.2 | | | |
| Total Volatile Solids | 7.1 | 0.4 | 17.7 | | | |
| Suspended Solids | | | | | | |
| Dissolved Solids | | | | | | |
| TOC | 13200 | 310 | 21300 | | | |
| BOD | | | | | | |
| COD | 76200 | 945 | 302000 | | | |
| Oil & Grease | 4070 | 1130 | 3230 | | | |
| Cyanide | <0.8 | <0.4 | <0.8 | | | |
| Phenols | <0.1 | <0.1 | <0.1 | | | |
| Total Phosphorous | 383 | <70 | 150 | | | |
| Dissolved Phosphorous | | | | | | |
| TKN | 1910 | 71 | 3150 | | | |
| Ammonia | 79.3 | 8.3 | 60.3 | | | |
| Arsenic | 17.1 | 0.97 | 14.8 | | | |
| Iron | 21100 | 1920 | 31100 | | | |
| Cadmium | 5.0 | 3.6 | 3.1 | | | |
| Copper | 31.7 | 3.1 | 46.6 | | | |
| Chromium | 38.0 | <6 | 54.3 | | | |
| Nickel | 30.0 | 12.3 | 45.3 | | | |
| Manganese | 483 | 51.7 | 359 | | | |
| Lead | 38.6 | 1.56 | 58.2 | | | |
| Mercury | <0.1 | 0.03 | <0.3 | | | |
| Zinc | 64.7 | 9.4 | 112 | | | |
| Total PCB's | <0.01 | <0.01 | <0.01 | | | |
| Chlorinated Pesticides | | | | | | |
| Lindane | <0.01 | <0.01 | <0.01 | | | |
| Heptachlor | <0.01 | <0.01 | <0.01* | | | |
| Aldrin | <0.01* | <0.01 | <0.01 | | | |
| Dieldrin | <0.01 | <0.01 | <0.01 | | | |
| Heptachlor epoxide | <0.01 | <0.01 | <0.01* | | | |
| Methoxychlor | <0.01 | <0.01 | <0.01 | | | |
| DDT | <0.01 | <0.01 | <0.01 | | | |
| DDE | <0.01 | <0.01 | <0.01 | | | |
| Fecal Coliform | NA | NA | NA | | | |
| Density (g/ml) | 1.61 | 1.70 | 1.11 | | | |
| Grain Size (%). | | | | | | |
| >0.42 mm | 11 | <1 | 17 | | | |
| 0.25 - 0.42 mm | 20 | 42 | 4 | | | |
| 0.15 - 0.25 mm | 13 | 24 | 3 | | | |
| 0.07 - 0.15 mm | 14 | 3 | 3 | | | |
| <0.07 mm | 42 | 4 | 73 | | | |

Values are ug/g dry weight except as noted.
NA = Not analyzed.

CORPS OF ENGINEERS

U. S. ARMY

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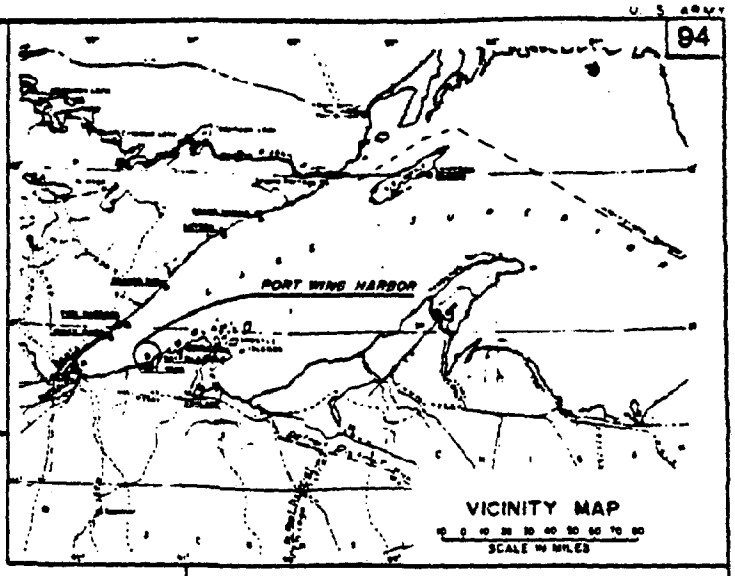
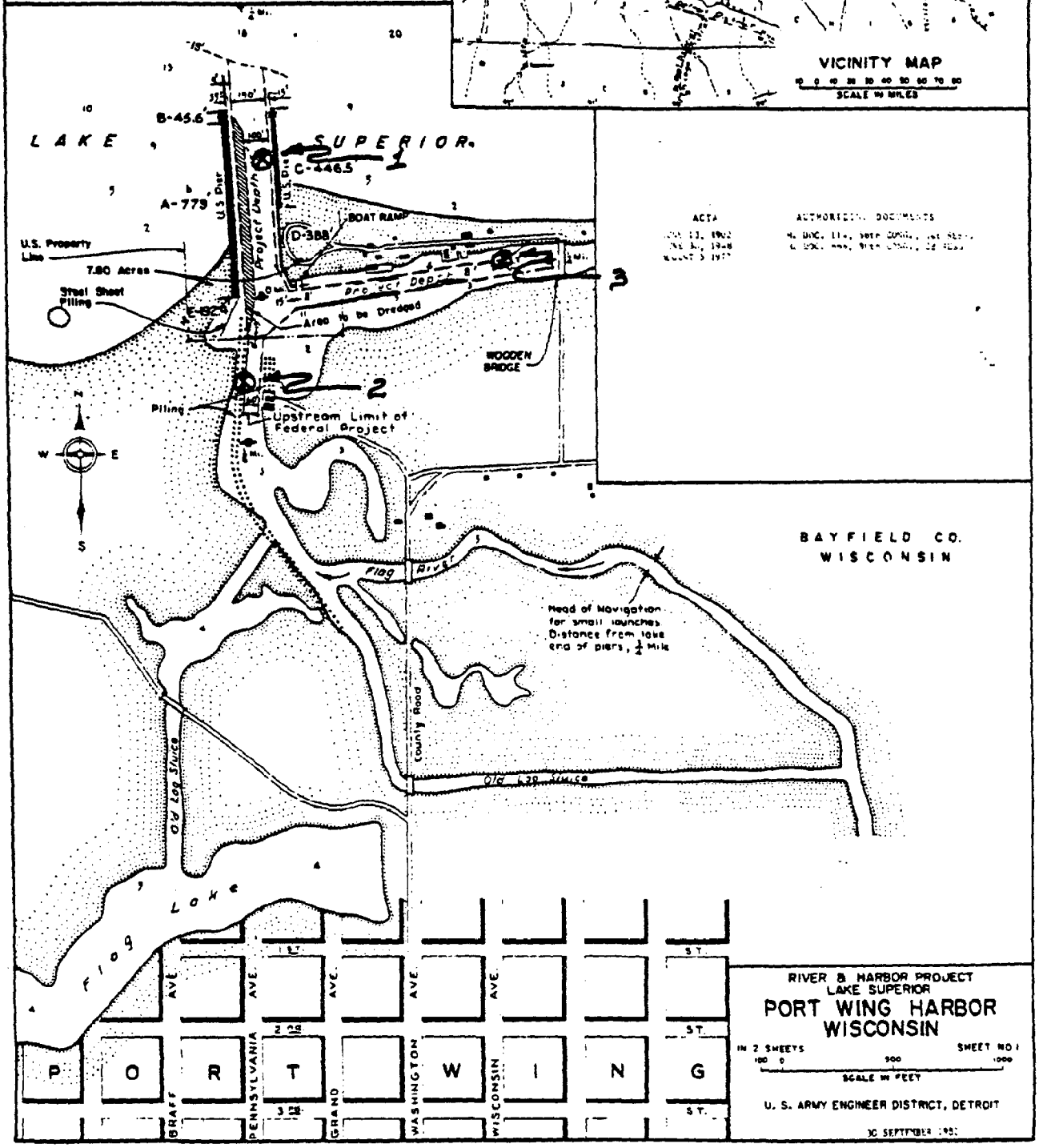
ATTACHMENT 9

(MCEPD-0142)

Note.
Project depths and soundings are referred to LWD 600.0 feet above MWL of Father Point, Quebec (IGLD 1955) (International Great Lakes Datum 1955).



## BENTHOS ANALYSIS

PORT WING, WISCONSIN
August 5, 1983

**SITE:** A
**SAMPLE NO.:** -
**DATE ENUMERATED:** 9/8/83

**EQUIPMENT:** Ponar (1)
**DEPTH:** 13.75'
**VOLUME:** 1800 mls
**DESCRIPTION:** 75% fine brown sand, 20% silt 5% coarse detritus
**VEGETATION:** none

### ORGANISMS RECOVERED

| CLASSIFICATION | KEY* | NUMBERS ACTUAL | NUMBERS PER SQ. METER | VOLUME (ml) ACTUAL | VOLUME (ml) PER LITER |
|---|---|---|---|---|---|
| Oligochaetae | | | | | |
| *Lumbriculus variegatus* | 1 | 194 | 3705 | 1.5 | 0.80 |
| Diptera | | | | | |
| *Palpomyia sp* | 1,3 | 1 | 19 | <0.1 | -- |
| *Tabanus sp* | 1,3 | 1 | 19 | <0.1 | -- |
| *Procladius sp* | 1,3 | 28 | 535 | 0.2 | 0.11 |
| *Pseudochironomus sp* | 1,3 | 19 | 363 | 0.15 | 0.08 |
| Chironomidae (pupal) | 1,3 | 6 | 115 | <0.1 | -- |
| *Cryptochironomus sp* | 1,3 | 25 | 478 | 0.15 | 0.08 |
| Trichoptera | | | | | |
| *Leptocerus americanus* | 1 | 20 | 382 | 0.15 | 0.08 |
| Ephemeroptera | | | | | |
| *Hexagenia sp* | 1 | 6 | 115 | <0.1 | -- |
| Amphipoda | | | | | |
| *Pontporreia hoyi* | 1 | 2 | 38 | <0.1 | -- |
| 10 taxa | **TOTALS:** | 302 | 5768 | 2.15 | 1.15 |

***see listing in Appendix**

**BENTHOS ANALYSIS**
PORT WING, WISCONSIN
August 5, 1983

**SITE:** C
**SAMPLE NO.:** -
**DATE ENUMERATED:** 9/9/83

**EQUIPMENT:** Ponar (1)
**DEPTH:** 7'7"
**VOLUME:** 2200 mls
**DESCRIPTION:** silty sand w/high coarse detritus
**VEGETATION:**

**ORGANISMS RECOVERED**

| CLASSIFICATION | KEY* | NUMBERS ACTUAL | NUMBERS PER SQ. METER | VOLUME (ml) ACTUAL | VOLUME (ml) PER LITER |
|---|---|---|---|---|---|
| Oligochaetae | | | | | |
| Lumbriculus variegatus | 1 | 22 | 420 | <0.1 | -- |
| Aeolosoma hemprichi | 1 | 5 | 96 | <0.1 | -- |
| Naididae | | | | | |
| Dero sp | 1 | 3 | 5.7 | <0.1 | -- |
| Diptera | | | | | |
| Procladius sp | 1,3 | 1 | 19 | <0.1 | -- |
| Isopoda | | | | | |
| Sphaeromidae | 1,6 | 1 | 19 | <0.1 | -- |
| Trichoptera | | | | | |
| Macronema sp | 1,2 | 1 | 19 | <0.1 | -- |
| Amphipoda | | | | | |
| Pontporreia hoyi | 1,2 | 4 | 76 | <0.1 | -- |
| 7 taxa | **TOTALS:** | 37 | 706 | -- | -- |

***see listing in Appendix**

# APPENDIX B

From 1977 EA for Port Wing Harbor

PHYSICAL AND CHEMICAL

Air Quality

No formal air quality information has been recorded in the Port Wing Harbor area.

Water Quality and Bottom Sediment Analysis

Port Wing Harbor is a river harbor. This, in addition to littoral drift, variation in lake level, wave action, and river current, influences the sedimentation in this harbor. Sediments originate from the natural shoreline of Lake Superior and from heavy sediment loads carried by the Flag River.

Between 1968 and 1975, Port Wing Harbor has been sampled by the Federal Water Pollution Control Administration (FWPCA), whose functions were administratively assumed by the creation of the United States Environmental Protection Agency (EPA). It has also been sampled by the National Biocentrics, Inc. (NBI), and Geotechnical Engineering Corporation (GEC). Sampling was contracted by the United States Army Corps of Engineering (USACE) for an environmental impact statement of their operations and maintenance activities in the harbor (USACE, July, 1975).

In order to permit comparison between areas of the Port Wing Harbor, it was divided into three zones (Appendix, Map 1). A large number of samples were collected and analyses revealed great diversity in most parameters. The analyses are presented on a zone by zone basis to facilitate a critical examination and to make the interpretating less complex.

Each zone, in addition to the overall influences of the harbor, is exposed to specific factors which influence the sediments within that zone.

In Port Wing Harbor, zone I, which represents the inner portion of the harbor, is the mooring area for the recreational and fishing boats using the harbor. This boat traffic and mooring activity contribute oil, grease, and other pollutional discharges to the water. These materials are readily absorbed to the fine particles which are present in the bottom sediments.

Zone II, that part of the project area located outside of the bend in Port Wing Harbor, is influenced by boat traffic and wave action of Lake Superior.

Zone III is an area located outside of the Port Wing Harbor proper. Samples were taken in this area in an attempt to characterize the nature of the bottom sediments in Lake Superior near Port Wing Harbor and to compare results of these samples with those taken inside of the harbor.

Bottom Sediment Analysis - FWPCA collected three samples from Port Wing Harbor in 1968. Analyses indicated that maximum acceptable values were exceeded for COD, TKN, and Zn (Appendix, Table 1). EPA guidelines for dredge sediments can be found in the Appendix, Exhibit 1. Further sampling and analyses of Port Wing Harbor by NBI in 1972 and 1973 generally confirmed FWPCA's finding but showed values for TP and oil and grease to exceed the maximum acceptable values as well. Only one parameter, oil and grease, in zone II had a mean value in excess of the EPA guidelines. This mean value was 1,520 mg/kg, as compared to the EPA guideline of 1,500 mg/kg. In 1973 EPA ran analyses on two more samples while the GEC collected and analyzed 12 samples from Port Wing Harbor in 1974 (Appendix, Map 2). These studies likewise showed the exceeded

parameters to occur predominantly in zone I. Except for one parameter, zinc, the GEC analysis shows no mean values in excess of the EPA guidelines in zone II. Data tables and more elaborate summaries of the chemical analyses of the bottom sediments collected in Port Wing Harbor are presented in the Appendix, Tables 1, 2, 3, and Exhibit 2. Included in the data is a table for the harbor listed by zone, the mean for each parameter, as well as the standard deviation for each mean, the range of values in each particular zone, and the number of observations for each parameter in the zone.

Water Quality - Water samples from Port Wing Harbor were also taken by NBI (USACE, July, 1975). Results of the water quality analysis are presented in the Appendix, Tables 4 and 5. Water quality conditions change readily depending upon the movement of water masses within the harbor. A combination of lake seiche and stream water movement result in variations of water quality within harbor boundaries. This variation in water quality was exhibited in the wide range of quality values obtained by NBI in its investigations.

Dissolved oxygen levels were generally high in all samples. Temperature values reflected the time of the year in which samples were collected. The pH values of the water sampled in the harbor were slightly alkaline. The pH values were consistent with what one would expect to find for natural waters in this area.

A water quality study of the Wisconsin waters of Lake Superior was conducted by the WDNR during the summer of 1968 (Winter, 1971). Three samples were taken in Lake Superior off of Port Wing Harbor. Sampling locations and water chemistries are shown in the Appendix, Table 6.

Map 1. Bottom sediment and water quality sampling sites of FWPCA and NBI, 1968 to 1973.

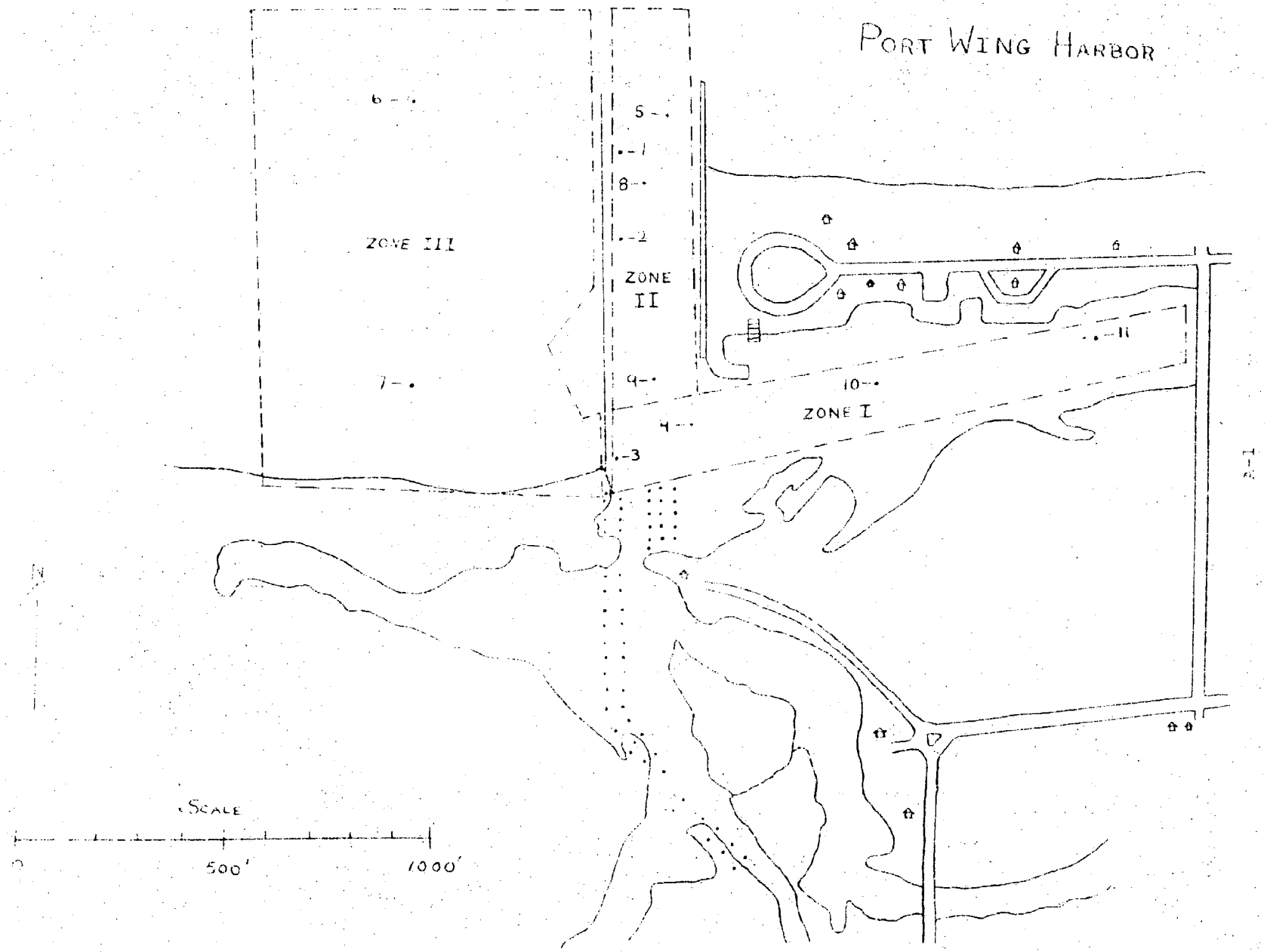


Table 1. Results of laboratory analysis of bottom sediment samples collected in Port Wing Harbor. Samples were collected and analyzed by FWPCA and NBI 1968 to 1973 inclusive.

| | | ZONE I | | | |
|---|---|---|---|---|---|
| | Agency: | FWPCA | NBI | NBI | NBI |
| | Date: | 4/68 | 11/72 | 7/73 | 7/73 |
| Evaluation Parameters | Sample: | 3 | 4 | 10 | 11 |
| % Volatile Solids | | 5.9 | .4 | 10.8 | .4 |
| Oil & Grease | | 565 | 578 | 707 | 2,860 |
| C.O.D. (mg/kg) | | 70,000 | 19,500 | 136,000 | 4,830 |
| T. Nitrogen (mg/kg) | | 1,660 | 331 | 3,790 | 372 |
| T. Phosphorus (mg/kg) | | 83 | 2,280 | 800 | 168 |
| pH | | -- | -- | 6.5 | 7.1 |
| Arsenic (mg/kg) | | -- | - | 4.5 | 1.70 |
| Cadmium " | | -- | -- | 8.00 | 1.80 |
| Copper " | | 41.00 | 2.80 | 27.20 | 7.30 |
| Lead " | | 32.00 | 10.80 | 28.60 | -- |
| Mercury " | | -- | .01 | .50 | .20 |
| Zinc " | | 35.00 | 10.80 | 65.30 | 19.40 |

Table 1. (Cont'd.) Results of laboratory analysis of bottom sediment samples collected in Port Wing Harbor. Samples were collected and analyzed by FWPCA and NBI 1968 to 1973 inclusive.

| | | ZONE II | | | | |
|---|---|---|---|---|---|---|
| Evaluation Parameters | Agency: | FWPCA | FWPCA | NBI | NBI | NBI |
| | Date: | 4/68 | 4/68 | 11/72 | 7/73 | 7/73 |
| | Sample: | 1 | 2 | 5 | 8 | 9 |
| % Volatile Solids | | .2 | .2 | .2 | .9 | 3.8 |
| Oil & Grease (mg/kg) | | -- | 33 | 585 | 3,170 | 2,290 |
| C.O.D. (mg/kg) | | -- | -- | 27,200 | 5,280 | 61,600 |
| T. Nitrogen (mg/kg) | | 207 | 62 | 255 | 530 | 1,140 |
| T. Phosphorus (mg/kg) | | -- | -- | 1,960 | 155 | 304 |
| pH | | -- | -- | -- | 6.5 | 6.6 |
| Arsenic (mg/kg) | | -- | -- | -- | .40 | 1.60 |
| Cadmium " | | -- | -- | -- | 7.00 | 9.20 |
| Copper " | | 222.00 | 74.00 | 10.90 | 4.20 | 21.90 |
| Lead " | | 16.00 | 24.00 | 9.10 | 3.50 | 7.70 |
| Mercury " | | -- | -- | .50 | .60 | .70 |
| Zinc " | | 131.00 | 33.00 | 11.80 | 16.40 | 32.00 |

Table 1. (Cont'd.) Results of laboratory analysis of bottom sediment samples collected in Port Wing Harbor. Samples were collected and analyzed by FWPCA and NBI 1968 to 1973 inclusive.

| Evaluation Parameters | Agency: | Zone III | |
|---|---|---|---|
| | Date: | NBI 11/72 | NBI 11/72 |
| | Sample: | 6 | 7 |
| % Volatile Solids | | .8 | .2 |
| Oil & Grease (mg/kg) | | 722 | 7,250 |
| C.O.D. (mg/kg) | | 9,180 | 12,500 |
| T. Nitrogen (mg/kg) | | 325 | 295 |
| T. Phosphorus (mg/kg) | | 646 | 660 |
| pH | | -- | -- |
| Arsenic (mg/kg) | | -- | -- |
| Cadium " | | -- | -- |
| Copper " | | 25.40 | 19.70 |
| Lead " | | 13.50 | 10.50 |
| Mercury " | | .01 | .20 |
| Zinc " | | 4.40 | 22.00 |

Exhibit 1. EPA guidelines for dredge sediments.

| Evaluation Parameters | EPA Guidelines |
|---|---|
| Volatile Solids | 6.0% |
| C.O.D. | 50,000 mg/kg |
| Total Kjeldahl Nitrogen | 1,000 mg/kg |
| Total Phosphorus | 1,000 mg/kg |
| Oil and Grease | 1,500 mg/kg |
| Mercury | 1.0 mg/kg |
| Lead | 50.0 mg/kg |
| Zinc | 50.0 mg/kg |

Map 2. Bottom sediment sampling sites of GEC in 1974.

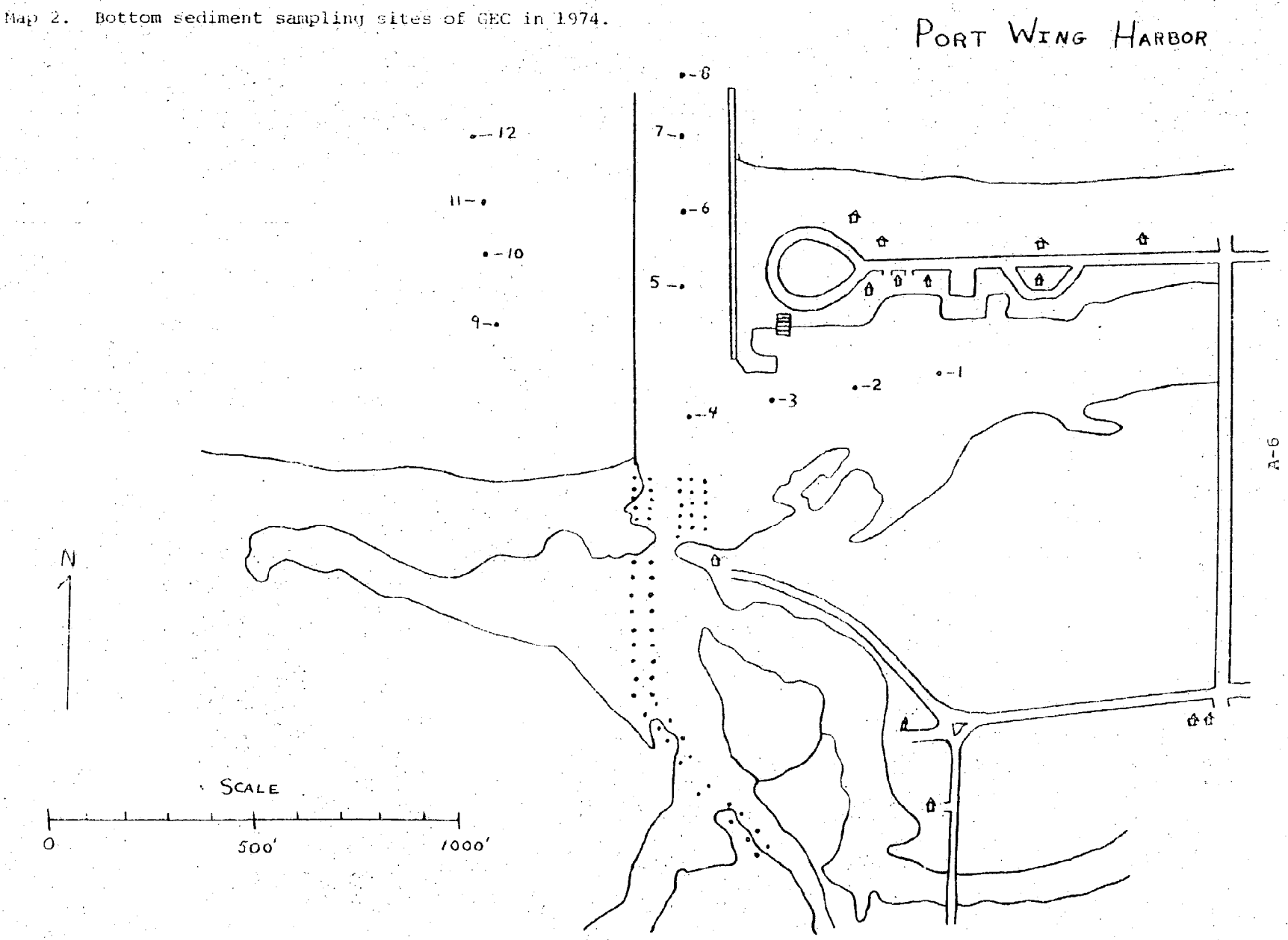


Table 2. Summary of the chemical data obtained on bottom sediment samples collected from each zone in Port Wing Harbor, Samples were collected by FWPCA and NBI between 1968 and 1973, TVS = Total Volatile Solids, O+G = Oil and Grease, COD = Chemical Oxygen Demand, TKN = Total Kjeldahl Nitrogen, TP - Total Phosphorus,

| Zone | | TVS % | O+G mg/kg | COD mg/kg | TKN mg/kg | TP mg/kg | pH |
|---|---|---|---|---|---|---|---|
| I | Mean | 4.4 | 1,180 | 57,600 | 1,540 | 834 | 6.8 |
| | Std. Dev. | 5.0 | 1,120 | 59,400 | 1,620 | 1,020 | 0.4 |
| | Range Hi | 10.8 | 2,860 | 136,000 | 3,790 | 2,280 | 7.1 |
| | Range Lo | 0.4 | 565 | 4,830 | 331 | 83 | 6.5 |
| | No. of Obs. | 4 | 4 | 4 | 4 | 4 | 2 |
| II | Mean | 1.1 | 1,520 | 31,400 | 438 | 805 | 6.5 |
| | Std. Dev. | 1.6 | 1,460 | 28,400 | 425 | 999 | 0.1 |
| | Range Hi | 3.8 | 3,170 | 61,600 | 1,140 | 1,960 | 6.6 |
| | Range Lo | 0.2 | 33 | 5,280 | 62 | 155 | 6.5 |
| | No. of Obs. | 5 | 4 | 3 | 5 | 3 | 2 |
| III | Mean | 0.5 | 3,980 | 10,900 | 310 | 653 | - |
| | Std. Dev. | 0.4 | 4,610 | 2,370 | 21 | 10 | - |
| | Range Hi | 0.8 | 7,250 | 12,500 | 325 | 660 | - |
| | Range Lo | 0.2 | 722 | 9,180 | 295 | 646 | - |
| | No. of Obs. | 2 | 2 | 2 | 2 | 2 | |
| TOTAL | Mean | 2.2 | 1,870 | 38,500 | 814 | 784 | 6.7 |
| | Std. Dev. | 3.4 | 2,180 | 43,800 | 1,090 | 802 | 0.3 |
| | Range Hi | 10.8 | 7,250 | 136,000 | 3,790 | 2,280 | 7.1 |
| | Range Lo | 0.2 | 33 | 4,830 | 62 | 10 | 6.5 |
| | No. of Obs. | 11 | 10 | 9 | 11 | 9 | 4 |

Table 2. (Cont'd.) Summary of the chemical data obtained on bottom sediment samples collected from each zone in Port Wing Harbor. Samples were collected by FWPCA and NBI between 1968 and 1973. As = Arsenic, Cd = Cadmium, Cu = Copper, Pb = Lead, Hg = Mercury, and Zn = Zinc.

| Zone | | As mg/kg | Cd mg/kg | Cu mg/kg | Pb mg/kg | Hg mg/kg | Zn mg/kg |
|---|---|---|---|---|---|---|---|
| I | Mean | 3.10 | 4.90 | 19.60 | 23.80 | .24 | 32.60 |
| | Std. Dev. | 1.98 | 4.38 | 17.80 | 11.40 | .25 | 24.00 |
| | Range Hi | 4.50 | 8.00 | 41.00 | 32.00 | .50 | 65.30 |
| | Range Lo | 1.70 | 1.80 | 2.80 | 10.80 | .20 | 10.80 |
| | No. of Obs. | 2 | 2 | 4 | 3 | 3 | 4 |
| II | Mean | 1.00 | 8.10 | 66.60 | 12.10 | .58 | 44.80 |
| | Std. Dev. | .85 | 1.56 | 91.10 | 8.00 | .08 | 49.10 |
| | Range Hi | 1.60 | 9.20 | 222.00 | 24.00 | .66 | 131.00 |
| | Range Lo | .40 | 7.00 | 4.20 | 3.50 | .50 | 11.80 |
| | No. of Obs. | 2 | 2 | 5 | 5 | 3 | 5 |
| III | Mean | - | - | 22.60 | 12.00 | .11 | 13.20 |
| | Std. Dev. | - | - | 4.00 | 2.10 | .13 | 12.40 |
| | Range Hi | - | - | 25.40 | 13.50 | .01 | 22.00 |
| | Range Lo | - | - | 19.70 | 10.50 | .20 | 4.40 |
| | No. of Obs. | - | - | 2 | 2 | 2 | 2 |
| TOTAL | Mean | 2.05 | 6.50 | 41.50 | 15.60 | .34 | 34.60 |
| | Std. Dev. | 1.74 | 3.26 | 63.20 | 9.50 | .27 | 36.00 |
| | Range Hi | 4.50 | 9.20 | 222.00 | 32.00 | .66 | 131.00 |
| | Range Lo | .40 | 1.80 | 2.80 | 3.50 | .20 | 4.40 |
| | No. of Obs. | 4 | 4 | 11 | 10 | 8 | 11 |

Table 3. Laboratory analysis bottom sediments, Port Wing Harbor; March 8, 1974. (CEC)

| Analysis, % Dry Weight | EPA Pollution Parameters | 74-1 | 74-2 | 74-3 | 74-4 | 74-5 | 74-6 |
|---|---|---|---|---|---|---|---|
| Volatile Solids | 6.0 | 33.6 | 12.6 | 0.5 | 0.7 | 0.4 | 0.6 |
| COD | 5.0 | 48.8 | 18.3 | 0.3 | 0.5 | 0.09 | 0.2 |
| Kjeldahl Nitrogen | 0.10 | 0.17 | 0.12 | 0.05 | 0.03 | 0.04 | 0.05 |
| Total Phosphorus | | 0.020 | 0.020 | 0.010 | 0.009 | 0.007 | 0.008 |
| Oil & Grease | 0.15 | 0.40 | 0.10 | 0.06 | 0.07 | 0.1 | 0.06 |
| Lead | 0.005 | $<0.001$ | $<0.001$ | $<0.001$ | $<0.001$ | $<0.001$ | $<0.001$ |
| Zinc | 0.005 | 0.0054 | 0.0047 | 0.0011 | 0.0008 | 0.0014 | 0.0014 |
| Mercury | 0.0001 | $2.2\times10^{-4}$ | $3.7\times10^{-4}$ | $2.8\times10^{-5}$ | $3.8\times10^{-5}$ | $8.6\times10^{-5}$ | $5\times10^{-5}$ |

Table 3. (Cont'd.) Laboratory analysis bottom sediments, Port Wing Harbor; March 8, 1974 (GEC).

| Analysis, % Dry Weight | EPA Pollution Parameters | 74-7 | 74-8 | 74-9 | 74-10 | 74-11 | 74-12 |
|---|---|---|---|---|---|---|---|
| Volatile Solids | 6.0 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 | 0.3 |
| COD | 5.0 | 0.05 | <0.08 | <0.06 | 0.05 | 0.04 | 0.15 |
| Kjeldahl Nitrogen | 0.10 | 0.06 | 0.12 | 0.08 | 0.03 | 0.03 | 0.03 |
| Total Phosphorus | | 0.009 | 0.007 | 0.010 | 0.009 | 0.009 | 0.008 |
| Oil & Grease | 0.15 | 0.07 | 0.06 | 0.06 | 0.01 | 0.009 | 0.01 |
| Lead | 0.005 | <0.003 | <0.003 | <0.001 | <0.001 | <0.001 | <0.001 |
| Zinc | 0.006 | 0.0014 | 0.0020 | 0.0012 | 0.0013 | 0.0016 | 0.0013 |
| Mercury | 0.001 | $4.2 \times 10^{-5}$ | $4.1 \times 10^{-4}$ | $9.6 \times 10^{-5}$ | $8.7 \times 10^{-6}$ | $9.5 \times 10^{-6}$ | $2.4 \times 10^{-4}$ |

Exhibit 2. Port Wing Harbor; Summary of chemical data

The highest mean value of total volatile solids was found in Zone I. Zone I was the only zone with a mean value that exceeded the EPA guideline of 6.0%. Only one sample, sample 10, had a value which exceeded the EPA guideline.

The highest mean value of oil and grease was found in Zone III. This is an area in Lake Superior near the harbor. The mean value from Zone III is greatly influenced by one sample, sample 7, which has a value of 7,000 mg/kg. And since, only two samples were collected from Zone III, the mean for that zone is influenced by this high sample value. The mean values from Zones II and III were in excess of the EPA guideline of 1,500 mg/kg.

The highest mean value of C.O.D. was found in Zone I. This was the only zone with a mean value which exceeded the EPA guideline of 50,000 mg/kg. Two samples from Zone I and one sample from Zone II had values which exceeded the EPA guideline.

The highest mean value for total nitrogen was found in Zone I. Zone I was the only zone with a mean value that exceeded the EPA guideline. There were two samples from Zone I and one sample from Zone II with values in excess of the EPA guideline.

The highest mean values for phosphorus were found in Zones I and II. All of the zones had mean values which were less than the EPA guideline of 1,000 mg/kg. There was one sample from Zone I and one sample from Zone II which exceeded the EPA guideline value.

Exhibit 2. (Cont'd.)

The overall mean of pH values obtained on bottom sediments obtained from the Port Wing Harbor study area was 6.7 units. The overall range was between 6.5 and 7.1. These values are consistent with that observed in other harbors on Lake Superior.

The overall mean of arsenic values obtained from the Port Wing Harbor study area was 2.05 mg/kg. There is no EPA guideline for arsenic in bottom sediments. Four samples were analyzed for arsenic from Port Wing Harbor and samples taken from Zone I had higher values than samples taken from Zone II. It is difficult to make conclusions based on the limited data available on arsenic from Port Wing Harbor.

The overall mean value of cadmium found in bottom sediments in the Port Wing Harbor study area was 6.50 mg/kg. Threr is no EPA guideline for cadmium in bottom sediments. Only four samples were analyzed for cadmium from Port Wing Harbor and it is difficult to make an assessment based on the limited data available.

The highest mean value for copper in Port Wing Harbor was found in Zone II. There is no EPA guideline for copper in bottom sediments. The values from Zone II are strongly influenced by two samples, one and two, which were collected by the FWPCA in April of 1968. These value were much higher than subsequent values obtained by NBI.

The highest mean value for lead was found in Zone I. All of the samples collected from the Port Wing Harbor study area had values which were less than the EPA guideline of 50.0 mg/kg.

The overall mean value for mercury in sediments collected from Port Wing Harbor was 0.34 mg/kg. All of the values obtained were less than the EPA guideline value of 1.0 mg/kg.

Exhibit 2. (Cont'd.)

The highest mean value of zinc was found in Zone II. All of the zones had mean values which were less than the EPA guideline of 50.0 mg/kg. The mean value from Zone II is strongly influenced by one sample, sample one, which was collected by the FWPCA in April of 1968, and had a value of 138 mg/kg.

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