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GREAT LAKES AND ST. LAWRENCE RIVER MEDIUM RESOLUTION VECTOR SHORELINE DATA

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Great Lakes and St. Lawrence River Medium Resolution Vector Shoreline Data[1]

Deborah H. Lee, Charles Morse, and Sameer Bandhu

ABSTRACT. Digital medium-resolution vector maps of the Great Lakes and St. Lawrence River shoreline are compiled by the Great Lakes Environmental Research Laboratory (GLERL), and translated into multiple common formats including the Topological Vector Profile of the Spatial Data Transfer Standard (SDTS), to enhance data accessibility. The data were originally produced by the Detroit District, U.S. Army Corps of Engineers and Water Issues Division of Environment Canada - Ontario Region for the International Joint Commission's Levels Reference Study, and used to assess the influence of lake levels on shore erosion. The vector maps include a three tier classification representing the shoreline geomorphic nature, the extent of shoreline protection, and the nearshore subaqueous geomorphic nature. Metadata, documented in accordance with SDTS specifications, accompanies the digital maps. This work was done in conjunction with the National Geophysical Data Center to develop medium resolution vector coastline data for the conterminous United States, and was funded by NOAA's Earth System Data and Information Management Program. Potential exists for use of the data in shoreline management and environmental and coastal processes studies.

1. INTRODUCTION

The development of geographic information system (GIS) technology now allows the digital manipulation and compilation of complex spatial datasets. However, proprietary data formats of commercial GIS software has limited the portability of datasets from their originators to other potential users. In recognition of this problem, the National Committee for Digital Cartographic Data Standards and the Standards Working Group of the Federal Interagency Coordinating Committee on Digital Cartography proposed the Spatial Data Transfer Standard (SDTS). After considerable review and testing, the standards were published as Federal Information Processing Standard (FIPS) 173 in 1992 (National Institute of Standards and Technology, 1992). The SDTS forms the cornerstone of the National Spatial Data Infrastructure (NSDI), created by Executive Order dated April 11, 1994. The NSDI requires all federal agencies to produce new, and to the extent practicable, existing geospatial data using the SDTS.

The Great Lakes Environmental Research Laboratory (GLERL), in conjunction with the National Geophysical Data Center, was funded by NOAA's Earth System Data and Information Management Program to produce medium resolution vector coastline data for the conterminous United States using the SDTS. This technical memorandum documents GLERL's compilation and translation of the Great Lakes and St. Lawrence River shoreline data to SDTS and other common formats.

2. GREAT LAKES-ST. LAWRENCE RIVER VECTOR SHORELINE DATA

The Great Lakes-St. Lawrence River shoreline (American and Canadian) was mapped and classified in support of the International Joint Commission's Levels Reference Study to assist in quantifying the effect of lake levels on erosion (Working Committee 2, 1993). A three tier classification scheme was used as shown in Table 1. The first tier classifies the shoreline by its geomorphic nature, the second tier by the percent of shore protection, and the third tier by the nearshore subaqueous type. The American shoreline was delineated based on aerial photography, mapped at a scale of 1:24,000, and was classified by the U.S. Army Corps of Engineers (United States Army Corps of Engineers, 1992). The Canadian shoreline was mapped by digitizing 1:50,000 scale National Topographic Series (NTS) maps for the lower Great Lakes, and 1:250,000 NTS maps for upper Lake Huron and Lake Superior, and was classified by Geomatics International for Environment Canada (Geomatics International, 1992). Figures 1-4 illustrate the mapped data for selected locations.

Table 1.--Three Tier Classification Scheme

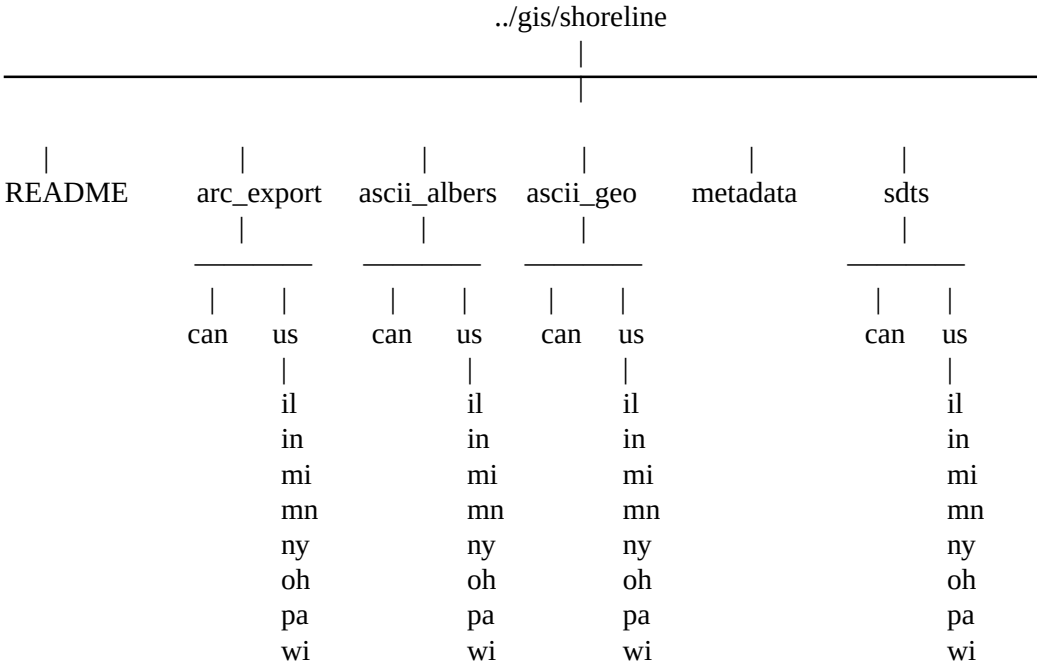
Shoreline Geomorphic Nature Classification		*Shoreline Protection Classification*	
1	High (>15m) Bluff	1	Highly Protected: 70-100 percent of reach/segment protected
2	High (>15m) Bluff with Beach	2	Moderately Protected: 40-70 percent of reach/segment protected
3	Low (<15m) Bluff	3	Minor Protection: 15-40 percent of reach/segment protected
4	Low (<15m) Bluff with Beach	4	No Protection: <15 percent of reach/segment is protected
5	Sandy/Silty Banks	5	No Protection: <15 percent of reach/segment is protected
6	Clay Banks	6	Unclassified
7	Sandy Beach/Dunes	9	Unclassified (coded by the compiler)
8	Coarse Beaches		
9	Baymouth-Barrier Beaches	*Nearshore Subaqueous Geomorphic Nature Classification*	
10	Bedrock (Resistant)	1	Clay
11	Bedrock (Non-resistant)	2	Sand
12	Low Riverine/Coastal Plain	3	Sand/Gravel Lag Over Clay
13	Open Shoreline Wetlands	4	Bedrock (Resistant)
14	Semi-Protected Wetlands	5	Bedrock (Non-Resistant)
15	Composite	6	Unclassified
16	U.S. Shore: Unclassified	9	Unclassified (coded by the compiler)
16	Canadian Shore: Artificial		
17	U.S. Shore: Artificial		
17	Canadian Shore: Unclassified		
99	Unclassified (coded by the compiler)		

Because these datasets resided in separate locations in different proprietary geographic information system formats, the complete database was not readily available to users. The Great Lakes Environmental Research Laboratory was uniquely positioned to create the unified database for distribution and archival because of established working relationships with all parties, the resources and experience of their geographic information system laboratory, and NOAA's desire to create medium resolution vector coastline data for the conterminous United States.

GLERL obtained the data from the Detroit District, U.S. Army Corps of Engineers and Water Issues Division of Environment Canada - Ontario Region and translated the data into the Topological Vector Profile of the Spatial Data Transfer Standard, as well as Arc/Info export and ASCII formats. To further enhance compatibility, the data were transformed from various projections to one common projection, Albers Equal Area, and also into geographic coordinates. The procedures used are detailed in the metadata found in Appendix A. The metadata were compiled in accordance with the Federal Geographic Data Committee's Content Standards for Digital Geospatial Metadata (Federal Geographic Data Committee, 1994).

3. DATA AVAILABILITY

The data are available to users via anonymous ftp over the Internet from GLERL's anonymous ftp site, **ftp.glerl.noaa.gov**. GLERL's ftp site can also be accessed from GLERL's web page, **www.glerl.noaa.gov**. The directory structure is shown on the following page:



The README file contains a brief abstract describing the dataset and a description of the subdirectories. The sub-directory naming conventions are

arc_export	ARC/INFO EXPORT format (Albers Equal Area projection)
ascii_albers	ARC/INFO UNGENERATE format (Albers Equal Area projection)
ascii_geo	ARC/INFO UNGENERATE format (geographic coordinates)
sdts	Spatial Data Transfer Standard format (geographic coordinates)
metadata	data documentation in Word, WordPerfect, and text format
can	Canadian shoreline data by region (lake or river)
us	U.S. shoreline data by state and county
il	Illinois
in	Indiana
mi	Michigan
mn	Minnesota
ny	New York
oh	Ohio
pa	Pennsylvania
wi	Wisconsin

Each format type subdirectory (arc_export, ascii_albers, ascii_geo, sdts, and metadata) contains a README file giving the file naming conventions. For the arc_export, ascii_albers and ascii_geo subdirectories, the file naming convention is based upon the U.S. county name or Canadian region, followed by a three letter extension. For the arc_export subdirectory, the file extension is .e00, as dictated by Arc/Info convention. For the ascii_albers and the ascii_geo subdirectories, the files with the .att extension contain the attribute data, and those with the .vec extension contain the vector coordinates. The U.S. counties and Canadian regions are listed below along with their associated file name. The asterisk represents the three letter extensions as described above.

Michigan

Alcona County	alcona.*
Alger County	alger.*
Allegan County	allegan.*
Alpena County	alpena.*
Antrim County	antrim.*
Arenac County	arenac.*
Baraga County	baraga.*
Bay County	bay.*
Benzie County	benzie.*
Berrien County	berrien.*
Charlevoix County	charlevoix.*
Cheboygan County	cheboygan.*
Chippewa County	chippewa1.*
Chippewa County	chippewa2.*
Chippewa County	chippewa3.*
Delta County	delta.*
Emmet County	emmet.*
Gogebic County	gogebic.*
Grand Traverse County	grandtrav.*
Houghton County	houghton.*
Huron County	huron.*
Iosco County	iosco.*
Isle Royale	isleroyale.*
Keweenaw County	keweenaw.*
Leelanau County	leelanau.*
Luce County	luce.*
Mackinac County	mackinac1.*
Mackinac County	mackinac2.*
Macomb County	macomb.*
Manistee County	manistee.*
Marquette County	marquette.*
Mason County	mason.*
Menominee County	menominee.*
Monroe County	monroe.*
Muskegon County	muskegon.*
Oceana County	oceana.*
Ontonagon County	ontonagon.*
Ottawa County	ottawa.*
Prseque Isle County	presqueisle.*
Sanilac County	sanilac.*
Schoolcraft County	schoolcraft.*
St. Clair County	stclair1.*
St. Clair County	stclair2.*
Tuscola County	tuscola.*
Van Buren County	vanburen.*
Wayne County	wayne1.*
Wayne County	wayne2.*

New York

Cayuga County	cayuga.*
Chautauqua County	chautauqua.*
Erie County	erie.*
Jefferson County	jefferson.*
Monroe County	monroe.*
Niagara County	niagara.*
Orleans County	orleans.*
Oswego County	oswego.*
Wayne County	wayne.*
St. Lawrence County	lawrence.*

Pennsylvania

Erie County	erie.*

Ohio

Ashtabula County	ashtabula.*
Cuyahoga County	cuyahoga.*
Erie County	erie.*
Lake County	lake.*
Lorain County	lorain.*
Lucas County	lucas.*
Ottawa County	ottawa.*
Sandusky County	sandusky.*

Indiana

Lake County	lake.*
La Porte County	laporte.*
Porter County	porter.*

Illinois

Cook County	cook.*
Lake County	lake.*

Wisconsin

Ashland County	ashland.*
Bayfield County	bayfield.*
Brown County	brown.*
Door County	door.*
Douglas County	douglas.*
Iron County	iron.*
Kenosha County	kenosha.*
Kewaunee County	kewaunee.*
Manitowoc County	manitowac.*
Marinette County	marinette.*
Milwaukee County	milwaukee.*
Oconto County	oconto.*
Ozaukee County	ozaukee.*
Racine County	racine.*
Sheboygan County	sheboygan.*

Minnesota

Cook County	cook.*
Lake County	lake.*
St. Louis County	stlouis.*

Canada

Lake Erie	erie.*
Lake Ontario (east)	ont_east.*
Lake Ontario (west)	ont_west.*
St. Lawrence River	stlawrence.*
Lake Huron	huron.*
Lake St. Clair	stclair.*
St. Marys River	stmary.*
Lake Superior	superior.*

The file naming convention for the SDTS subdirectory differs from the other subdirectories due to constraints placed by the Arc/Info SDTSEXPORT command. Only the first four characters of a file name are available for designation by the user. The remaining characters and extension (*.DDF) are dictated by Arc/Info and the SDTS. The naming convention is as follows:

New York

Cayuga County	NY01*.DDF
Chautauqua County	NY02*.DDF
Erie County	NY03*.DDF
Jefferson County	NY04*.DDF
Monroe County	NY05*.DDF
Niagara County	NY06*.DDF
Orleans County	NY07*.DDF
Oswego County	NY08*.DDF
Wayne County	NY09*.DDF
St. Lawrence County	NY10*.DDF

Pennsylvania

Erie County	PA01*.DDF

Indiana

Lake County	IN01*.DDF
La Porte County	IN02*.DDF
Porter County	IN03*.DDF

Illinois

Cook County	IL01*.DDF
Lake County	IL02*.DDF

Ohio

Ashtabula County	OH01*.DDF
Cuyahoga County	OH02*.DDF
Erie County	OH03*.DDF
Lake County	OH04*.DDF
Lorain County	OH05*.DDF
Lucas County	OH06*.DDF
Ottawa County	OH07*.DDF
Sandusky County	OH08*.DDF

Wisconsin

Ashland County	WI01*.DDF
Bayfield County	WI02*.DDF
Brown County	WI03*.DDF
Door County	WI04*.DDF
Douglas County	WI05*.DDF
Iron County	WI06*.DDF
Kenosha County	WI07*.DDF
Kewaunee County	WI08*.DDF
Manitowoc County	WI09*.DDF
Marinette County	WI10*.DDF
Milwaukee County	WI11*.DDF
Oconto County	WI12*.DDF
Ozaukee County	WI13*.DDF
Racine County	WI14*.DDF
Sheboygan County	WI15*.DDF

Michigan

Alcona County	MI01*.DDF	Leelanau County	MI25*.DDF
Alger County	MI02*.DDF	Luce County	MI26*.DDF
Allegan County	MI03*.DDF	Mackinac County	MI27*.DDF
Alpena County	MI04*.DDF	Mackinac County	MI28*.DDF
Antrim County	MI05*.DDF	Macomb County	MI29*.DDF
Arenac County	MI06*.DDF	Manistee County	MI30*.DDF
Baraga County	MI07*.DDF	Marquette County	MI31*.DDF
Bay County	MI08*.DDF	Mason County	MI32*.DDF
Benzie County	MI09*.DDF	Menominee County	MI33*.DDF
Berrien County	MI10*.DDF	Monroe County	MI34*.DDF
Charlevoix County	MI11*.DDF	Muskegon County	MI35*.DDF
Cheboygan County	MI12*.DDF	Oceana County	MI36*.DDF
Chippewa County	MI13*.DDF	Ontonagon County	MI37*.DDF
Chippewa County	MI14*.DDF	Ottawa County	MI38*.DDF
Chippewa County	MI15*.DDF	Prseque Isle County	MI39*.DDF
Delta County	MI16*.DDF	Sanilac County	MI40*.DDF
Emmet County	MI17*.DDF	Schoolcraft County	MI41*.DDF
Gogebic County	MI18*.DDF	St. Clair County	MI42*.DDF
Grand Traverse County	MI19*.DDF	St. Clair County	MI43*.DDF
Houghton County	MI20*.DDF	Tuscola County	MI44*.DDF
Huron County	MI21*.DDF	Van Buren County	MI45*.DDF
Iosco County	MI22*.DDF	Wayne County	MI46*.DDF
Isle Royale	MI23*.DDF	Wayne County	MI47*.DDF
Keweenaw County	MI24*.DDF		

Minnesota

Cook County	MN01*.DDF
Lake County	MN02*.DDF
St. Louis County	MN03*.DDF

Canada

Lake Erie	CA01*.DDF
Lake Ontario (east)	CA02*.DDF
Lake Ontario (west)	CA03*.DDF
St. Lawrence River	CA04*.DDF
Lake Huron	CA05*.DDF
Lake St. Clair	CA06*.DDF
St. Marys River	CA07*.DDF
Lake Superior	CA08*.DDF

The metadata subdirectory contains three files as follows:

metadata.doc	Word for Windows 95 Version 7.0a
metadata.wpd	WordPerfect Version 6.1 for Windows
metadata.txt	ASCII text file

4. ACKNOWLEDGMENTS

The assistance of Mr. Roger Gauthier, Detroit District, U.S. Army Corps of Engineers and Ms. Wendy Leger, Water Issues Division of Environment Canada - Ontario Region in providing the data is greatly appreciated. The technical advice of Ms. Lisa Jipping, Detroit District, U.S. Army Corps of Engineers was essential to completion of this project. The authors would also like to thank those who reviewed the dataset prior to its release and made useful and instructive comments: Mr. Kurt Kowalski, Great Lakes Science Center, National Biological

Survey, Dr. Yichun Xie, Eastern Michigan University, Dr. David Schwab, GLERL, and Mr. Ian Gillespie, Water Issues Division of Environment Canada - Ontario Region. This work was done in conjunction with Dr. George Sharman of the National Geophysical Data Center to develop medium resolution vector coastline data for the conterminous United States, and was funded by NOAA's Earth System Data and Information Management Program.

5. REFERENCES

Federal Geographic Data Committee. Content Standards for Digital Geospatial Metadata. U.S. Geological Survey, Reston, Virginia, 50 pp. plus Appendices (1994).

Geomatics International. Great Lakes Shoreline Classification and Mapping Study: Canadian Side. Final Report Submitted to the Erosion Processes Task Group, Working Committee 2, International Joint Commission Levels Reference Study, International Joint Commission, Washington, D.C. and Ottawa Canada, 44 pp. plus Appendices and Maps (1992).

National Institute of Standards and Technology. Federal Information Processing Standard Publication 173 (Spatial Data Transfer Standard), U.S. Department of Commerce, Washington, D.C. (1992).

United States Army Corps of Engineers. Summary, Shore Mapping and Classification Project: United States Shoreline. Memorandum for Record, Coastal Engineering Research Center, Vicksburg, Mississippi, 14 pp. (1992).

Working Committee 2. Annex 2, Land Use and Management. International Joint Commission Levels Reference Study, Great Lakes-St. Lawrence River Basin. International Joint Commission, Washington, D.C. and Ottawa, Canada (1993).

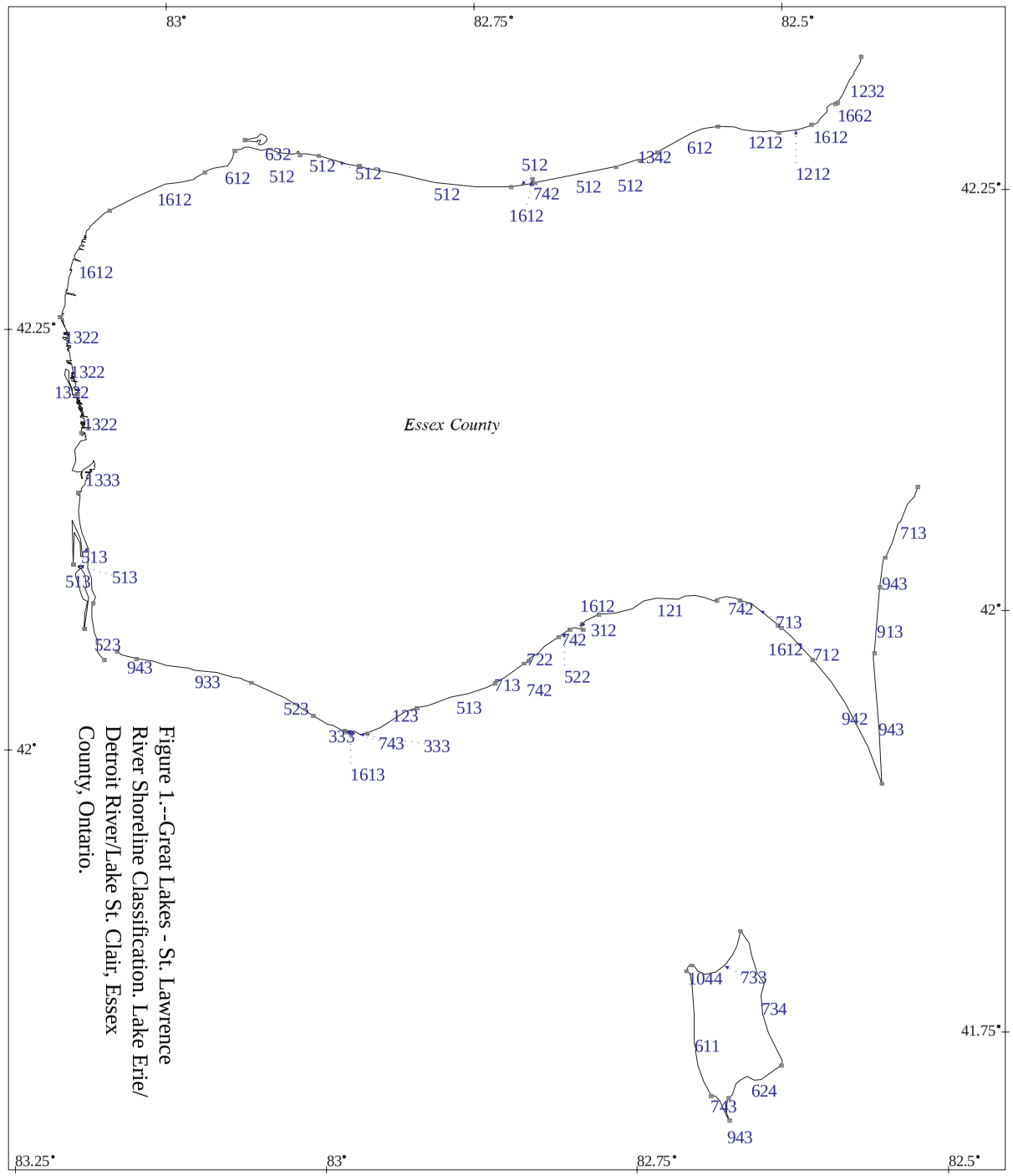


Figure 1.--Great Lakes - St. Lawrence River Shoreline Classification. Lake Erie/ Detroit River/Lake St. Clair, Essex County, Ontario.

Great Lakes - St. Lawrence River Shoreline Classification Lake Erie/Detroit River/Lake St. Clair Essex County, ON

Reference Map

Three-Tier Classification Scheme

Geomorphic Classification

1 High(>15m) Bluff
2 High (>15m) Bluff with Beach
3 Low (<15m) Bluff
4 Low (<15m) Bluff with Bleach
5 Sandy/Silty banks
6 Clay banks
7 Sandy Beach/Dunes
8 Coarse Beaches
9 Baymouth Barrier Banches
10 Bedrock (Resistant)
11 Bedrock (Non-Resistant)
12 Low Riverine/Coastal Plain
13 Open Shoreline Wetlands
14 Semi-Protected Wetlands
15 Composite
16 Artificial
17 Unclassified

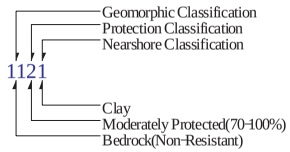
Protection Classification

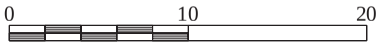
1 Highly Protected(70-100%)
2 Moderately Protected(40-70%)
3 Minor Protection(15-40%)
4 No Protection(<15 %)
5 Non-Structural
6 Unclassified

Nearshore Classification

1 Clay
2 Sand
3 Sand/Gravel Lag Over Clay
4 Bedrock(Resistant)
5 Bedrock(Non-Resistant)
6 Unclassified

Example





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Environment Canada Environnement Canada

NOAA

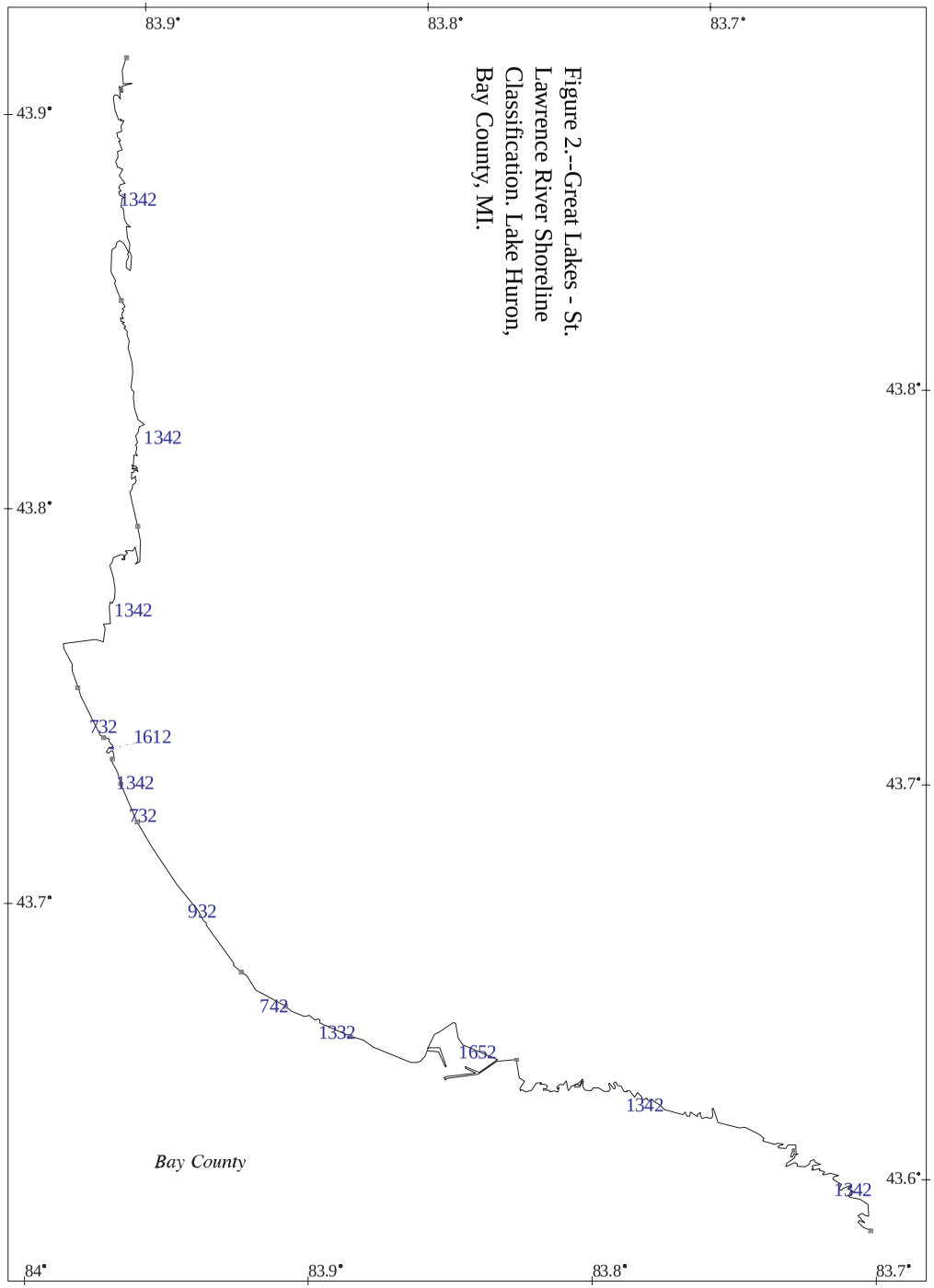

Figure 2.--Great Lakes - St. Lawrence River Shoreline Classification. Lake Huron, Bay County, MI.

Great Lakes - St. Lawrence River Shoreline Classification Lake Huron Bay County, MI

Reference Map

Three-Tier Classification Scheme

Geomorphic Classification

1 High(>15m)Bluff
2 High(>15m)Bluff with Beach
3 Low(<15m)Bluff
4 Low(<15m)Bluff with Bleach
5 Sandy/Silty banks
6 Clay banks
7 Sandy Beach/Dunes
8 Coarse Beaches
9 Baymouth Barrier Banches
10 Bedrock(Resistant)
11 Bedrock(Non-Resistant)
12 Low Riverine/Coastal Plain
13 Open Shoreline Wetlands
14 Semi-Protected Wetlands
15 Composite
16 Unclassified
17 Artificial

Protection Classification

1 Highly Protected(70-100%)
2 Moderately Protected(40-70%)
3 Minor Protection(15-40%)
4 No Protection(<15 %)
5 Non-Structural
6 Unclassified

Nearshore Classification

1 Clay
2 Sand
3 Sand/Gravel Lag Over Clay
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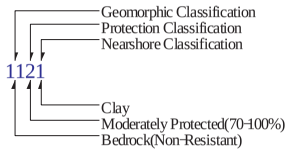
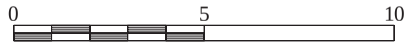
5 Bedrock(Non-Resistant)
6 Unclassified

Example





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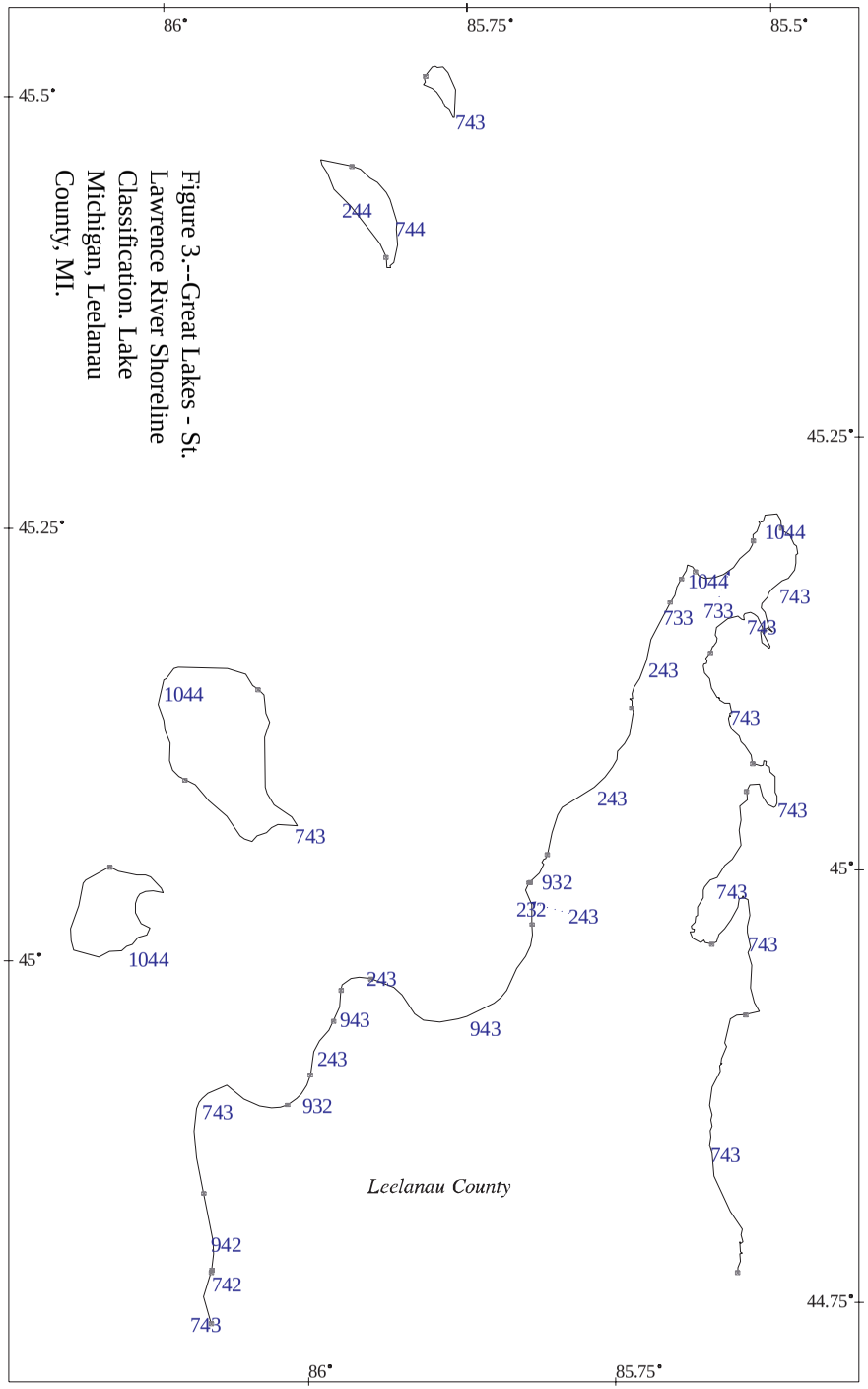

Figure 3.--Great Lakes - St. Lawrence River Shoreline Classification. Lake Michigan, Leelanau County, MI.

Great Lakes - St. Lawrence River Shoreline Classification Lake Michigan Leelanau County, MI

Reference Map

Three-Tier Classification Scheme

Geomorphic Classification

1 High(>15m)Bluff
2 High(>15m)Bluff with Beach
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4 Low(<15m)Bluff with Bleach
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Nearshore Classification

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2 Sand
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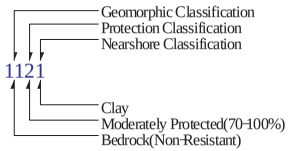


0 10 20
Kilometers

Projection: Albers

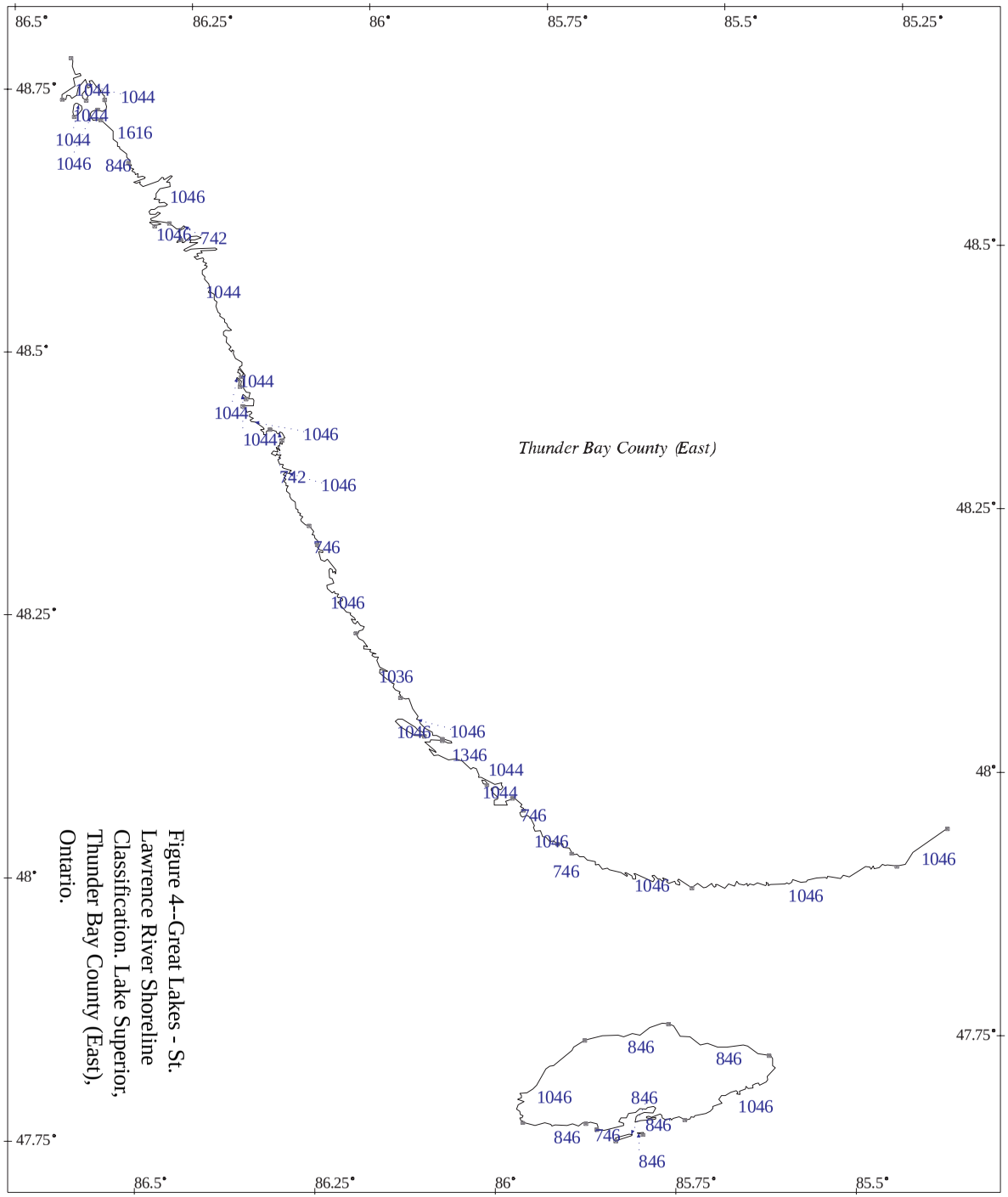
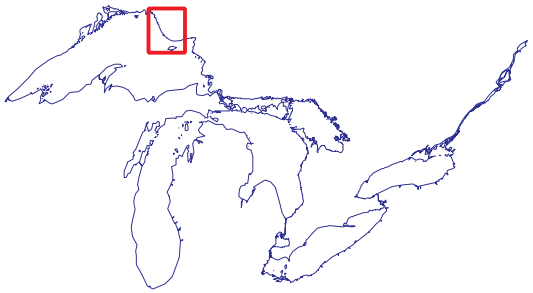


Figure 4--Great Lakes - St. Lawrence River Shoreline Classification. Lake Superior, Thunder Bay County (East), Ontario.

Great Lakes - St. Lawrence River Shoreline Classification
Lake Superior
Thunder Bay County (East), ON

Reference Map



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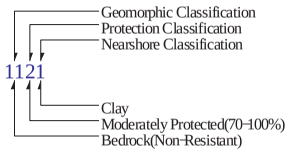
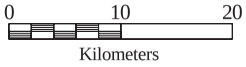
Example





Projection: Albers

Environment Canada Environnement Canada

Appendix A. Metadata

Metadata for the Great Lakes and St. Lawrence River Medium Resolution Vector Shoreline Data

Identification_Information:
Citation:
Originator: Great Lakes Environmental Research Laboratory (compiler)
Publication_Date: 19971201
Publication_Time: 00000000
Title: Great Lakes and St. Lawrence River Medium Resolution Vector Shoreline Data
Edition: 1.0
Geospatial_Data_Presentation_Form: Map
Publication_Information:
Publication_Place: Ann Arbor, MI, U.S.A.
Publisher: Great Lakes Environmental Research Laboratory
Other_Citation_Details: NOAA Technical Memorandum ERL GLERL-104
Online_Linkage: ftp://ftp.glerl.noaa.gov/gis/shoreline/
Larger_Work_Citation: Vector Coastline Data for the Conterminous U.S. including the Great Lakes, National Geophysical Data Center, Boulder, CO, USA.
Scale_Denominator: varies from 24000 to 250000

Description:
Abstract: A medium resolution vector map of the Canadian and U.S. Great Lakes and St. Lawrence River shoreline is segmented into reaches and classified using a three tier scheme representing the geomorphic nature of the shoreline, the extent of shoreline protection, and the geomorphic nature of the nearshore sub-aqueous shoreline. The classification scheme is as follows:

Shoreline Geomorphic Nature Classification:

1 High (>15m) Bluff
2 High (>15m) Bluff with Beach
3 Low (<15m) Bluff
4 Low (<15m) Bluff with Beach
5 Sandy/Silty Banks
6 Clay Banks
7 Sandy Beach/Dunes
8 Coarse Beaches
9 Baymouth-Barrier Beaches
10 Bedrock (Resistant)
11 Bedrock (Non-resistant)
12 Low Riverine/Coastal Plain
13 Open Shoreline Wetlands
14 Semi-Protected Wetlands
15 Composite
16 U.S. Shore: Unclassified
16 Canadian Shore: Artificial
17 U.S. Shore: Artificial
17 Canadian Shore: Unclassified
99 Unclassified (coded by the compiler)

Shoreline Protection Classification:

1 Highly Protected: 70-100 percent of reach/segment protected
2 Moderately Protected: 40-70 percent of reach/segment protected
3 Minor Protection: 15-40 percent of reach/segment protected
4 No Protection: <15 percent of reach/segment is protected
5 Non-Structural
6 Unclassified
9 Unclassified (coded by the compiler)

Nearshore Subaqueous Geomorphic Nature Classification:

1 Clay
2 Sand
3 Sand/Gravel Lag Over Clay
4 Bedrock (Resistant)
5 Bedrock (Non-Resistant)
6 Unclassified
9 Unclassified (coded by the compiler)

Combined Classification:

The above codes are appended into a 3 to 4 digit code representing the combined classification. The right-most digit represents the nearshore subaqueous classification, the second digit from the right represents the shoreline protection classification, and the left-most one or two digits represent the shoreline geomorphic classification.

Purpose:

The shoreline vectors and classification scheme were originally developed by Environment Canada and the U.S. Army Corps of Engineers to evaluate the influence of lake level effects on erosion for the International Joint Commission's Levels Reference Study. Potential exists for use of the data in shoreline management, and environmental and coastal processes studies.

Supplemental_Information:

Revisions: None

Reviews_Applied_to_Data:

The U.S. data were received from the U.S. Army Corps of Engineers, Detroit District. After conversion by GLERL of the data from INTERGRAPH vector format to the ARC/INFO vector format (see Procedures Used), the vector data were checked to ensure consistent topology. Visual inspection of the processed data overlaying the original data and other shoreline datasets was used to check for any gross processing errors. Shoreline classification codes in the processed U.S. data were verified manually by comparing computer and hard copy maps to hard copy maps provided by the Detroit District. Reviews applied during the production of the data by the originators are described in the references listed below (see Other References Cited).

The Canadian data was received from the Water Issues Division of Environment Canada, Ontario Region, in Arc/Info vector format. After modifying attribute item definitions and appending the attribute information to the vector files (see Procedures Used), the processed data were visually inspected as described above and the classification codes were verified by comparing computer and hard copy maps to hard copy maps provided by Environment Canada. Reviews applied during the production of the data by the originators are described in the references cited below (see Other References Cited).

Related_Spatial_and_Tabular_Data_Sets:

None.

Other_References_Cited:

Working Committee 2. Annex 2, Land Use and Management. International Joint Commission Levels Reference Study, Great Lakes-St. Lawrence River Basin. International Joint Commission, Washington, D.C. and Ottawa, Canada (1993).

United States Army Corps of Engineers. Summary, Shore Mapping and Classification Project: United States Shoreline. Memorandum for Record, Coastal Engineering Research Center, Vicksburg, Mississippi, 14 pp. (1992).

Geomatics International. Great Lakes Shoreline Classification and Mapping Study: Canadian Side. Final Report Submitted to the Erosion Processes Task Group, Working Committee 2, International Joint Commission Levels Reference Study, International Joint Commission, Washington, D.C. and Ottawa Canada, 44 pp. plus Appendices and Maps (1992).

Time_Period_of_Content:

Calendar_Date: Unknown

Currentness_Reference:

The aerial photography used to generate the U.S. shoreline vector data was acquired in 1979 for the State of Michigan and in 1987-1989 for the other seven Great Lakes. The time period of content for the Canadian shoreline vector data is unknown to the compiler.

The U.S. and Canadian shoreline classification was completed in 1992 from a variety of variously dated materials. The shoreline protection classification may change significantly as time increases from the date of the original classification. More information on the currentness of the vector and classification data is contained in the references cited above (see Other References Cited).

Access_Constraints:

There are no access constraints on the U.S. data. Unlimited use and reference of the Canadian shoreline data is granted upon condition that Water Issues Division of Environment Canada - Ontario Region is credited as the source.

Data_Set_Credit:

The data were originally produced by the U.S. Army Corps of Engineers and Environment Canada for the International Joint Commission's Levels Reference Study, Great Lakes-St. Lawrence River Basin, by Working Committee 2, Land Use and Management, and used to assess the influence of lake levels on shore erosion. The U.S. shoreline data were obtained from the Detroit District, U.S. Army Corps of Engineers, Detroit, Michigan. The Canadian shoreline data were obtained from Water Issues Division of Environment Canada - Ontario Region. The Great Lakes Environmental Research Laboratory, Ann Arbor, Michigan compiled the data and translated them into multiple common formats including the Topological Vector Profile of the Spatial Data Transfer Standard, to enhance the accessibility of the data. This work was done in conjunction with the National Geophysical Data Center to develop medium resolution coastline data for the conterminous United States, and was funded by NOAA's Earth System Data and Information Management Program.

Completeness_Report:

The data include vector representations of the Great Lakes shoreline, their connecting channels, the St. Lawrence River, and many (but not all) islands. Some man-made features such as the Keweenaw Waterway (Lake Superior) are excluded. The vector end-nodes of some of the U.S. counties and Canadian regions are not consistent with their adjacent county or region. Most of the shoreline is classified with the exception of most islands, Isle Royale (Lake Superior) being a notable exception.

Cloud_Cover:
Not applicable.

Status:
Progress: Complete
Maintenance_and_Update_Frequency: None planned

Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -92.42496472 decimal degrees
East_Bounding_Coordinate: -71.52364405 decimal degrees
North_Bounding_Coordinate: 49.18507357 decimal degrees
South_Bounding_Coordinate: 39.98076086 decimal degrees

Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Great Lakes, shoreline, coastline, geomorphic classification, shore protection classification
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: Great Lakes and St. Lawrence River
Stratum:
Stratum_Keyword_Thesaurus: None
Stratum_Keyword: Shoreline
Temporal:
Temporal_Keyword_Thesaurus: None
Temporal_Keyword: Contemporary

Use_Constraints:
Vector Shoreline:
The vector data are intended for general planning, study, and illustrative purposes. The data are not intended for uses that require a high degree of positional accuracy.

Shoreline classification:
The process of shoreline classification was essentially subjective and based almost entirely upon descriptive criteria. The classification of each reach was the result of the subjective interpretation of the individual doing the work and was based on their understanding of the classification scheme, the information available, and the experience of the individual. The shoreline protection classification may change significantly as time increases from the date of the original classification. Other limitations are the inadequacy of the classification scheme to encompass the complete range of shoreline characteristics, and insufficient detail of the data sources to permit classification. Inconsistencies in classification may exist.

Procedures_Used:
U.S. Data:
INTERGRAPH format shoreline files, by U.S. county, were obtained from the Detroit District U.S. Army Corps of Engineers ftp server, ftp://ftp@155.79.125.194/pub/. These files were stored on the HP 735/9000 GIS workstation at the Great Lakes Environmental Research Laboratory. The procedures used to convert and process a given INTERGRAPH file were essentially the same for all of the counties: a file was converted to two ARC/INFO vector format covers--one for the shorelines and one for the breaklines (hash marks that intersect the shorelines at the reach endpoints)--using the ARC command IGDSARC with the subcommand

shoreline 61 * * * * for shorelines and break 3 * * * * for breaklines. ARC attribute tables (AAT), in INFO format, were then generated for the shoreline and breakline covers using the ARC command BUILD with the line option. Next, the shoreline and breakline covers that were generated from the same INTERGRAPH file were appended together using the ARC command APPEND. An AAT was then built for the resulting appended cover using BUILD with the line option.

Canadian Data:

The Canadian data were obtained from Waters Issue Division, Environment Canada in ARC/INFO format. Some of these covers had items which were dropped from the covers' associated arc attribute tables. These items included PLOTKEY, REACHKEY, ITEM2, and ITEM1. This was done to prepare the AAT files before joining the INFO tables that contained the shoreline classification codes. The items in these tables included REACH_KEY, GEOMORF, PROTECTION, and NEARSHORE. The item GEOMORF was altered to spell GEOMORPH. Then these tables were joined to each shoreline cover's AAT using the ARC/INFO command, JOINITEM, specifying the cover-id item in the AAT as the relate item and using the LINK option. This process placed the Canadian data in the same format as the U.S. shoreline data.

U.S. and Canadian Data:

The covers were projected from their original projections and map coordinate systems to Albers Equal-Area Conic. This was done by using the ARC command PROJECT with the cover option and the appropriate input and output parameters, listed below. Note that for Michigan county shoreline covers, which were in the Michigan State Plane Coordinate System prior to projecting to Albers, ARC software permitted specifying "stateplane" for the projection, instead of specifying an actual projection and projection parameters. When stateplane is entered, the user is prompted for a FIPS code zone number (FIPSZONE). FIPSZONE numbers were determined from Table 4 in the ARC command reference for the PROJECT command. The FIPSZONES entered were 2111, 2112, and 2113 (North, Central, and Southern Michigan, respectively).

---Input (source) Projection Parameters Used---

For southern Michigan counties:
Projection: Lambert Conformal Conic
Units: Feet
FIPS code zone number: 2113
Datum: NAD27
Spheroid: Clarke 1866
1st Standard Parallel: 42 06 00 (degrees, minutes, seconds)
2nd Standard Parallel: 43 40 00
Central Meridian: -84 20 00
Origin (Latitude): 41 30 00
False Easting (m): 609,601.21920
False Northing (m): 0

For central Michigan counties:
Projection: Lambert Conformal Conic
Units: Feet
FIPS code zone number: 2112
Datum: NAD27
Spheroid: Clarke 1866
1st Standard Parallel: 44 11 00 (degrees, minutes, seconds)
2nd Standard Parallel: 45 42 00
Central Meridian: -84 20 00
Origin (Latitude): 43 19 00
False Easting (m): 609,601.21920
False Northing (m): 0

For northern Michigan counties:
Projection: Lambert Conformal Conic
Units: Feet
FIPS code zone number: 2111
Datum: NAD27
Spheroid: Clarke 1866
1st Standard Parallel: 45 29 00 (degrees, minutes, seconds)
2nd Standard Parallel: 47 05 00
Central Meridian: -87 00 00
Origin (Latitude): 44 47 00
False Easting (m): 609,601.21920
False Northing (m): 0

For counties in Wisconsin, Illinois, and Indiana:
Projection: Oblique Mercator
Units: meters
Spheroid: Clarke 1866
Projection Type: 2 (central line defined by one point and its angle of azimuth)
Scale factor at the projection center: 0.9999
Longitude of the projection center: -87.0
Latitude of the projection center: 44.0
Azimuth at the projection center: 15
False easting: -1000000.0
False northing: -4300000.0

For counties in Minnesota:
Projection: Oblique Mercator
Units: meters
Spheroid: Clarke 1866
Projection Type: 2 (central line defined by one point and its angle of azimuth)
Scale factor at the projection center: 0.9999
Longitude of the projection center: -88 50 00.256
Latitude of the projection center: 47 12 21.554
Azimuth at the projection center: 285.6952
False easting: 9000000.0
False northing: -1600000.0

For counties in Ohio and New York:
Projection: Oblique Mercator
Units: meters
Spheroid: Clarke 1866
Projection Type: 2 (central line defined by one point and its angle of azimuth)
Scale factor at the projection center: 0.9999
Longitude of the projection center: -78.0
Latitude of the projection center: 44.0
Azimuth at the projection center: 55.666670
False easting: -3950000.0
False northing: -3430000.0

All Canadian Shorelines:
Projection: Universal Transverse Mercator (UTM)

Units: Meters
UTM Zones:
Zone 16 for Canadian Shorelines of Lake Superior and St. Mary's River
Zone 17 for Canadian Shorelines of Lake Huron, St. Clair River, Lake St. Clair, Detroit River, Lake Erie, Western Lake Ontario, and the Niagara River
Zone 18 for Canadian Shorelines of Eastern Lake Ontario and the St. Lawrence River

--Output Projection Parameters Used--
Projection: Albers Equal-Area Conic
Units: meters
Spheroid: Clarke 1866
1st Standard Parallel: 29.5
2nd Standard Parallel: 45.5
Central Meridian: -96
Origin (Latitude): 23.0
False Easting (m): 0
False Northing (m): 0

U.S. Data:

The U.S. covers, when first converted from INTERGRAPH to ARC, had pseudonodes at every vertex. Thus, arc segments were very short and did not extend across the reach from one breakline to another. After projection to Albers Equal Area, the ARC command CLEAN was used to establish arc-node topology so that pseudo-nodes could be removed. The covers were processed using CLEAN with the line option, a dangle length of 0, and a fuzzy tolerance of 2 meters. The coordinate precision of the U.S. covers remained double precision. All covers were CLEANed only once. All pseudo-nodes were then removed by selecting all arcs using the ARC module ARCEDIT and then using the ARCEDIT command UNSPLIT with the none option. Changes to the edit coverage were saved and ARCEDIT was quit.

AATs were rebuilt using BUILD with the line option. Then ARCEDIT was again launched and a coverage chosen for editing. All arcs were selected, and the user-id (<cover>-id) was reset to equal the internal-id (<cover>#) using the ARCEDIT command CALCULATE. Then the items GEOMORPH, PROTECTION, NEARSHORE, and COMBINED were added to the AAT using the ARCEDIT command ADDITEM with input and output width of 4 and data type integer.

A graphical user interface was created to simplify the editing and coding of arcs. Arcs were selected and edited using ARCEDIT commands such as DELETE and UNSPLIT and coded using CALCULATE. Codes for the COMBINED item were determined from hardcopy maps generated from the original INTERGRAPH files, obtained from the Detroit District U.S. Army Corps of Engineers. An algorithm was developed to parse the COMBINED code into GEOMORPH, PROTECTION, and NEARSHORE values and automatically update these item values whenever a COMBINED code was entered for a selected arc. Arcs whose codes were ambiguous were given a combined value of 9999, which was also parsed, giving 99, 9, and 9 for the three classifications. All arcs representing breaklines were deleted, leaving only pseudonodes to mark the point along the shoreline where reaches end. In some cases, pseudo-nodes could not be removed (because ARC limits the number of vertices in an arc to 500). These pseudonodes can be distinguished from breakpoints because the codes of the adjoining arcs are the same.

U.S. and Canadian Data:

All covers in the Albers Equal Area projection were converted to ARC/INFO export files using the ARC command EXPORT with the COVER and FULL options. The covers were also converted to ASCII generate format files using the ARC command UNGENERATE with the LINE option. The companion INFO AAT tables were converted to comma delimited ASCII files using the ARC TABLES command UNLOAD with the

DELIMITED option. The covers were also projected and the same process used to create ASCII UNGENERATE files in geographic coordinates. To build polygon topology for conversion to SDTS, the covers projected to geographic coordinates were processed using the ARC command BUILD with the POLY option. These covers were then converted to SDTS Vector Topological Profile files using the ARC command SDTSEXPORT.

Point_of_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Deborah H. Lee
Contact_Organization: Great Lakes Environmental Research Laboratory
Contact_Position: Hydrologist
Contact_Address:
Address_Type: mailing and physical address
Address: 2205 Commonwealth Blvd.
City: Ann Arbor
State_or_Province: MI
Postal_Code: 48105-1593
Country: U.S.A.
Contact_Voice_Telephone: 313-741-2148
Contact_Facsimile_Telephone: 313-741-2055
Contact_Electronic_Mail_Address: lee@glerl.noaa.gov
Hours_of_Service: 8:00-4:30 Eastern

Security_Information:
Security_Classification_System: None
Security_Classification: Unclassified
Security_Handling_Description: None

Native_Data_Set_Environment: HP-UX UNIX, ARC/INFO version 7.0.4

Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: See Entity_Attribute_Information
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: See Explanation
Attribute_Accuracy_Explanation: Attribute accuracy is described, where present, with each attribute defined in the Entity and Attribute Section.
Logical_Consistency_Report: Chain-node topology present.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: The horizontal positional accuracy has not been determined.
Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report: N/A

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 0
SDTS_Point_and_Vector_Object_Type: String

Point_and_Vector_Object_Count: varies
SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 0

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar
Map_Projection:
Map_Projection_Name: ALBERS
Longitude_of_Central_Meridian: -96 decimal degrees
Latitude_of_Projection_Origin: 23 decimal degrees
Latitude_of_First_Standard_Parallel: 29.5 decimal degrees
Latitude_of_Second_Standard_Parallel: 45.5 decimal degrees
False_Easting: 0.00000
False_Northing: 0.00000
Geodetic Model
Horizontal_Datum_Name:
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6,378,206.4
Denominator_of_Flattening: 294.98

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: <cover>.AAT
Entity_Type_Definition: Arc Attribute Table
Entity_Type_Definition_Source: ESRI, Inc.
Attribute:
Attribute_Label: FNODE#
Attribute_Definition: Internal number of from-node
Attribute_Definition_Source: Computed
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: Sequential unique positive integer
Attribute:
Attribute_Label: TNODE#
Attribute_Definition: Internal number of to-node
Attribute_Definition_Source: Computed
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: Sequential unique positive integer
Attribute:
Attribute_Label: LPOLY#
Attribute_Definition: Internal number of poly to left of arc
Attribute_Definition_Source: Computed
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: Sequential unique positive integer
Attribute:
Attribute_Label: RPOLY#
Attribute_Definition: Internal number of poly to right of arc

Attribute_Definition_Source: Computed
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: Sequential unique positive integer
Attribute:
Attribute_Label: LENGTH
Attribute_Definition: Length of arc in coverage units
Attribute_Definition_Source: Computed
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: Positive real numbers
Attribute:
Attribute_Label: <cover>#
Attribute_Definition: Internal feature number
Attribute_Definition_Source: Computed
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: Sequential unique positive integer
Attribute:
Attribute_Label: <cover>-ID
Attribute_Definition: User-assigned feature number
Attribute_Definition_Source: User-defined
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: Integer
Attribute:
Attribute_Label: GEOMORPH
Attribute_Definition: Geomorphic Class
Attribute_Definition_Source: Working Committee 2, 1993. Annex 2, Land Use and Mgt., Levels Reference Study.
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 1
Enumerated_Domain_Value_Definition: High (>15m) Bluff
Enumerated_Domain_Value: 2
Enumerated_Domain_Value_Definition: High (>15m) Bluff with Beach
Enumerated_Domain_Value: 3
Enumerated_Domain_Value_Definition: Low (<15m) Bluff
Enumerated_Domain_Value: 4
Enumerated_Domain_Value_Definition: Low (<15m) Bluff with Beach
Enumerated_Domain_Value: 5
Enumerated_Domain_Value_Definition: Sandy/Silty Banks
Enumerated_Domain_Value: 6
Enumerated_Domain_Value_Definition: Clay Banks
Enumerated_Domain_Value: 7
Enumerated_Domain_Value_Definition: Sandy Beach/Dunes
Enumerated_Domain_Value: 8
Enumerated_Domain_Value_Definition: Coarse Beaches
Enumerated_Domain_Value: 9
Enumerated_Domain_Value_Definition: Baymouth-Barrier Beaches
Enumerated_Domain_Value: 10

Enumerated_Domain_Value_Definition: Bedrock (Resistant)
Enumerated_Domain_Value: 11
Enumerated_Domain_Value_Definition: Bedrock (Non-resistant)
Enumerated_Domain_Value: 12
Enumerated_Domain_Value_Definition: Low Riverine/Coastal Plain
Enumerated_Domain_Value: 13
Enumerated_Domain_Value_Definition: Open Shoreline Wetlands
Enumerated_Domain_Value: 14
Enumerated_Domain_Value_Definition: Semi-Protected Wetlands
Enumerated_Domain_Value: 15
Enumerated_Domain_Value_Definition: Composite
Enumerated_Domain_Value: 16
Enumerated_Domain_Value_Definition: US: Unclassified, Canada: Artificial
Enumerated_Domain_Value: 17
Enumerated_Domain_Value_Definition: US: Artificial, Canada: Unclassified
Enumerated_Domain_Value: 99
Enumerated_Domain_Value_Definition: Unclassified (coded by compiler)

Attribute:
Attribute_Label: PROTECTION
Attribute_Definition: Shoreline Protection Classification
Attribute_Definition_Source: Working Committee 2, 1993. Annex 2, Land Use and Mgt., Levels Reference Study.
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 1
Enumerated_Domain_Value_Definition: Highly Protected: 70-100 percent of reach/segment protected
Enumerated_Domain_Value: 2
Enumerated_Domain_Value_Definition: Moderately Protected: 40-70 percent of reach/segment protected
Enumerated_Domain_Value: 3
Enumerated_Domain_Value_Definition: Minor Protection: 15-40 percent of reach/segment protected
Enumerated_Domain_Value: 4
Enumerated_Domain_Value_Definition: No Protection: <15 percent of reach/segment is protected
Enumerated_Domain_Value: 5
Enumerated_Domain_Value_Definition: Non-Structural
Enumerated_Domain_Value: 6
Enumerated_Domain_Value_Definition: Unclassified
Enumerated_Domain_Value: 9
Enumerated_Domain_Value_Definition: Unclassified (coded by compiler)

Attribute:
Attribute_Label: NEARSHORE
Attribute_Definition: Nearshore Soil or Geologic Parent Material
Attribute_Definition_Source: Working Committee 2, 1993. Annex 2, Land Use and Mgt., Levels Reference Study.
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 1
Enumerated_Domain_Value_Definition: Clay
Enumerated_Domain_Value: 2
Enumerated_Domain_Value_Definition: Sand
Enumerated_Domain_Value: 3
Enumerated_Domain_Value_Definition: Sand/Gravel Lag Over Clay

Enumerated_Domain_Value: 4
Enumerated_Domain_Value_Definition: Bedrock (Resistant)
Enumerated_Domain_Value: 5
Enumerated_Domain_Value_Definition: Bedrock (Non-Resistant)
Enumerated_Domain_Value: 6
Enumerated_Domain_Value_Definition: Unclassified
Enumerated_Domain_Value: 9
Enumerated_Domain_Value_Definition: Unclassified (coded by compiler)

Attribute:
Attribute_Label: COMBINED
Attribute_Definition: 3 to 4 digit code of appended Geomorph, Protection, and Nearshore Codes
Attribute_Definition_Source: Working Committee 2, 1993. Annex 2, Land Use and Mgt. Levels Reference Study.
Overview_Description:
Entity_and_Attribute_Overview:
Entity_and_Attribute_Detail_Citation: Not Available

Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Deborah H. Lee
Contact_Organization: Great Lakes Environmental Research Laboratory
Contact_Position: Hydrologist
Contact_Address:
Address_Type: mailing and physical address
Address: 2205 Commonwealth Blvd.
City: Ann Arbor
State_or_Province: MI
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Country: U.S.A.
Contact_Voice_Telephone: 313-741-2148
Contact_Facsimile_Telephone: 313-741-2055
Contact_Electronic_Mail_Address: lee@glerl.noaa.gov
Hours_of_Service: 8:00-4:30 Eastern
Resource_Description: Great Lakes and St. Lawrence River Medium Resolution Vector Shoreline Data

Distribution_Liability:
DISCLAIMER:
The coastline data contained in this publication were generated for use by NOAA's Great Lakes Environmental Research Laboratory (GLERL). Although GLERL is making these data available to others who may find them of value, GLERL does not warrant, endorse, or recommend the use of these data for any given purpose. In no event will GLERL be liable to you or any third party for any direct, indirect, incidental, consequential, special, or exemplary damages or lost profits resulting from any use or misuse of these data.

Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Format_Name: SDTS Spatial Data Transfer Standards (FIPS 173)
Format_Name: ARC/INFO Export format (Albers Equal Area Projection)
Format_Name: ARC/INFO Generate format (Albers Equal Area Projection)

Format_Name: ARC/INFO Generate format (geographic coordinates)
Digital_Transfer_Option:
Online_Option:
Computer_Contact_Information:
Network_Address:
Network_Resource_Name: ftp://ftp.glerl.noaa.gov/
Access_Instructions: Connect to GLERL's anonymous ftp site - ftp.glerl.noaa.gov. Move to the subdirectory ../gis/shoreline. Download files as desired based upon format and geographic location. README files located in each subdirectory explain directory and file naming conventions.
Online_Computer_and_Operating_System: Hewlett Packard - HP-UX 9.05
Offline_Option:
Offline_Media: CD-ROM
Recording_Capacity:
Recording_Density:
Recording_Density_Units:
Fees: to be determined
Ordering_Instructions: Contact the National Geophysical Data Center, NOAA
Turnaround:
Custom_Order_Process: None
Technical_Prerequisites: Able to use/convert SDTS, ARC/INFO, or ASCII-UNGENERATE files.
Available_Time_Period:
Beginning_Date/Time: 19971201
Ending_Date/Time: Undetermined

Metadata_Reference_Section:
Metadata_Date: 19971201
Metadata_Contact: Deborah H. Lee
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: 19940608
Metadata_Time_Convention: Local Time
Metadata_Security_Information:
Metadata_Security_Classification_System: None
Metadata_Security_Classification: Unclassified
Metadata_Security_Handling_Description: None