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Shoreline Length and Water Area in the Ocean, Coastal and Great Lakes Parks

Updated Statistics for Shoreline Miles and Water Acres

Natural Resource Report NPS/WASO/NRR—2011/282, rev1a

ON THE COVER
Drakes Bay, Point Reyes National Seashore
Photograph by Kristen Keteles

Shoreline Length and Water Area in the Ocean, Coastal and Great Lakes Parks

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U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Fort Collins, Colorado

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Executive Summary

This report documents the development of a servicewide, digital shoreline dataset for ocean, coastal, and Great Lakes units of the National Park Service (NPS). The goal of this project was to estimate and update the cumulative marine/estuarine/Great Lakes area and length of shoreline managed by the NPS using a geographic information systems (GIS) framework. Different estimates of these statistics have been published in the past and they vary significantly. The inconsistencies are due to multiple factors, including the scale, methodology, accuracy, and timeframe of the source data, and the specific parks included in the analysis.

Several shoreline datasets were examined park-by-park to identify the ones that most accurately reflect the shoreline as depicted in recent aerial or satellite imagery. For most parks, reference imagery was obtained from the ESRI image service within ESRI's ArcMap application. Shoreline data included several National Oceanic and Atmospheric Administration datasets, U.S. Geological Survey's National Hydrography Dataset, National Park Service boundary files, and others.

This project developed a shoreline dataset for ocean, coastal, and Great Lakes units and estimated statistics for the shoreline miles and marine/estuarine/Great Lakes water area managed by NPS that are more accurate than those previously published. Due to many factors, including the dynamic nature of park shorelines and boundaries, and the timing and methods of data collection, there will never be a consistent and definitive set of statistics for shoreline miles and water area for all of the ocean, coastal, and Great Lakes parks. Statistics for shoreline length and water area will be updated periodically as NPS boundary and shoreline datasets are updated or improved and as resources permit.

Acknowledgments

I thank the many park staff who assisted in providing data for this report and who work tirelessly to protect park resources. Thanks also go out to the many reviewers of the draft report for their valuable input and especially to Jeff Cross for his editing prowess.

Introduction

The Ocean and Coastal Resources Branch (OCRB) was established in 2007 to provide leadership and coordination in ocean, coastal and Great Lake resource stewardship for National Park Service (NPS) units in 22 states and four territories (American Samoa, Guam, Puerto Rico and the Virgin Islands). An initial assessment revealed widely differing statistics for total shoreline length and water surface area, as well as disagreement on the units included on the NPS list of ocean, coastal and Great Lakes parks. At the low end of shoreline length, and perhaps the most frequently quoted figure, is 5,100 miles (National Park Service 2007). Other estimates put the figure for NPS shoreline at over 15,000 miles.[1] Estimates for water surface area ranged from approximately 2.4 to 3.2 million acres.[2] The discrepancies are due to multiple factors, including the scale, methodology, accuracy, and timeframe of the source data and the specific parks included in an analysis.

This project was undertaken to address inconsistencies in the numbers reported in NPS publications. The goal was to analyze the best available data, document methods, and report the cumulative shoreline miles and marine/estuarine/Great Lakes water area managed by the NPS using a geographic information systems (GIS) framework. Two datasets were needed to calculate shoreline miles and marine/estuarine/Great Lakes acres: shorelines and NPS unit boundaries. Problems and challenges were discovered with both of these datasets, which are discussed in the Methods section.

[1] D. Warren, unpublished NPS report, 2009.
[2] E. Spencer, unpublished NPS spreadsheet, 2009.

Methods

List of Ocean and Coastal Parks

The first step in this process was to determine the park units to be included on the list of "ocean and coastal" parks. Several factors were considered, including proximity to the coast and cultural or geologic ties to the coastal or marine environment. It was decided that to be included on the list of ocean and coastal parks, a park had to be an official NPS unit (i.e., affiliated areas are not included) and had to meet at least one of the following criteria:

1. Unit includes shoreline on one of the Great Lakes (consistent with the Coastal Zone Management Act, 1972 (16 U.S.C. 1451 et seq.));

2. Unit includes shoreline on one of the oceans (e.g., mean high or mean low water); or

3. Unit includes shoreline on one of the tidally influenced estuaries (usually semi-enclosed by land, but with open, partly obstructed or sporadic access to the open ocean (Cowardin, et al. 1979)), where salt and fresh water mix throughout the water column resulting in regular saline concentrations ≥0.5 ppt.

Eighty-four parks met these criteria (Appendix A). Some of these parks have boundaries that coincide with the shoreline and some have offshore boundaries that include the shoreline plus offshore waters.

Source Data

Two datasets were needed to calculate NPS shoreline length and marine/estuarine/Great Lakes areas in a GIS framework: shorelines and NPS unit boundaries.

Shoreline Data

Several shoreline datasets were examined to identify those that were the most accurate and complete for NPS units when compared to recent orthorectified aerial or satellite imagery (described below). Shoreline data sources included several NOAA datasets (Composite Shoreline, Extracted Vector Shoreline (EVS), Extracted Navigational Charts (ENC), Medium Resolution Shoreline and National Shoreline), U.S. Geological Survey (USGS) National Hydrography Dataset, National Park Service boundary files, and state and local data.

The ideal situation would have been to identify a single shoreline dataset that covered all relevant NPS units, was consistent in scale, had a recent timeframe and was referenced to a consistent tidal datum (e.g., mean high water, mean lower low water, etc.). This was not the case. Scale, accuracy, and/or data collection dates varied significantly from area to area, both among the various datasets and within individual datasets. This variability often dwarfed the variation inherent in different tidal datums. Even among the various NOAA datasets, significant differences exist (Figure 1).

In addition to inaccuracies and differences in scale, significant errors and omissions were also found in the vector data or attributes of the national datasets. For example, in the Glacier Bay, Alaska area, the NOAA EVS dataset depicts thousands of miles of "shoreline" in interior mountainous terrain (Figure 2).

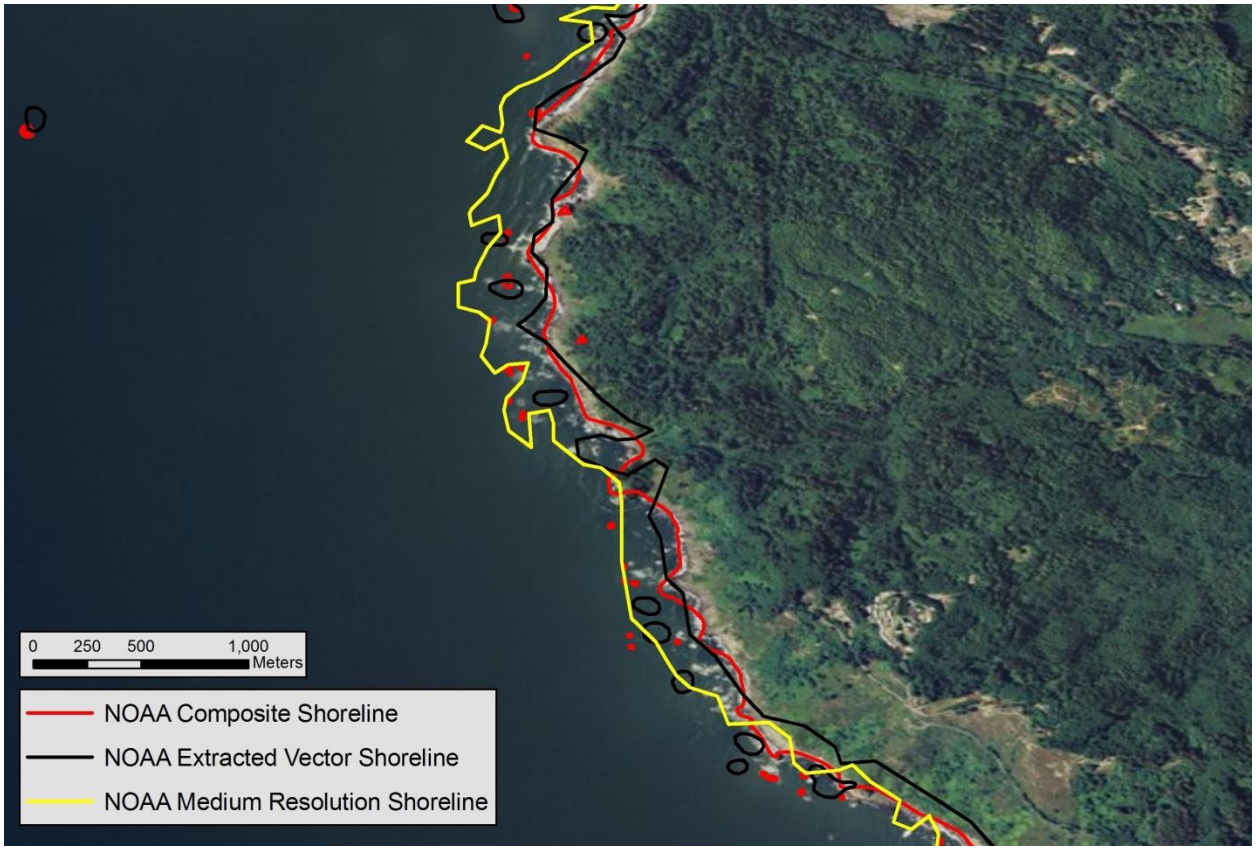

Figure 1. A comparison of three NOAA shoreline datasets in Redwood National and State Parks seen against a background of 2009 NAIP imagery.

In another example, a large gap in data coverage was discovered in the NOAA Composite Shoreline data in the area around Big Lostman's Bay in Everglades National Park (Figure 3). The spatial offset of shoreline relative to the imagery (seen in the eastern part of Figure 3) was also common in many of the shoreline datasets.

The data quality and data processing methods of the USGS National Hydrography Dataset (NHD) shoreline data varies significantly from state to state. Some states (e.g., AK, TX, NY, and NJ) have full-time editing staff so their datasets are better than others (S. Schupbach, NPS Natural Resource Program Center, Fort Collins, CO, 2010 pers. com.).

The NHD dataset includes three feature classes that may represent shorelines: NHDFlowline, NHDWaterbody, and NHDArea. For some areas, the shoreline is represented by only one of these feature classes; for other areas, it may be necessary to extract shoreline data from two or three feature classes. Areas of shoreline may be missing (Figure 4) or the shoreline represented in one feature class may not match that represented in the others.

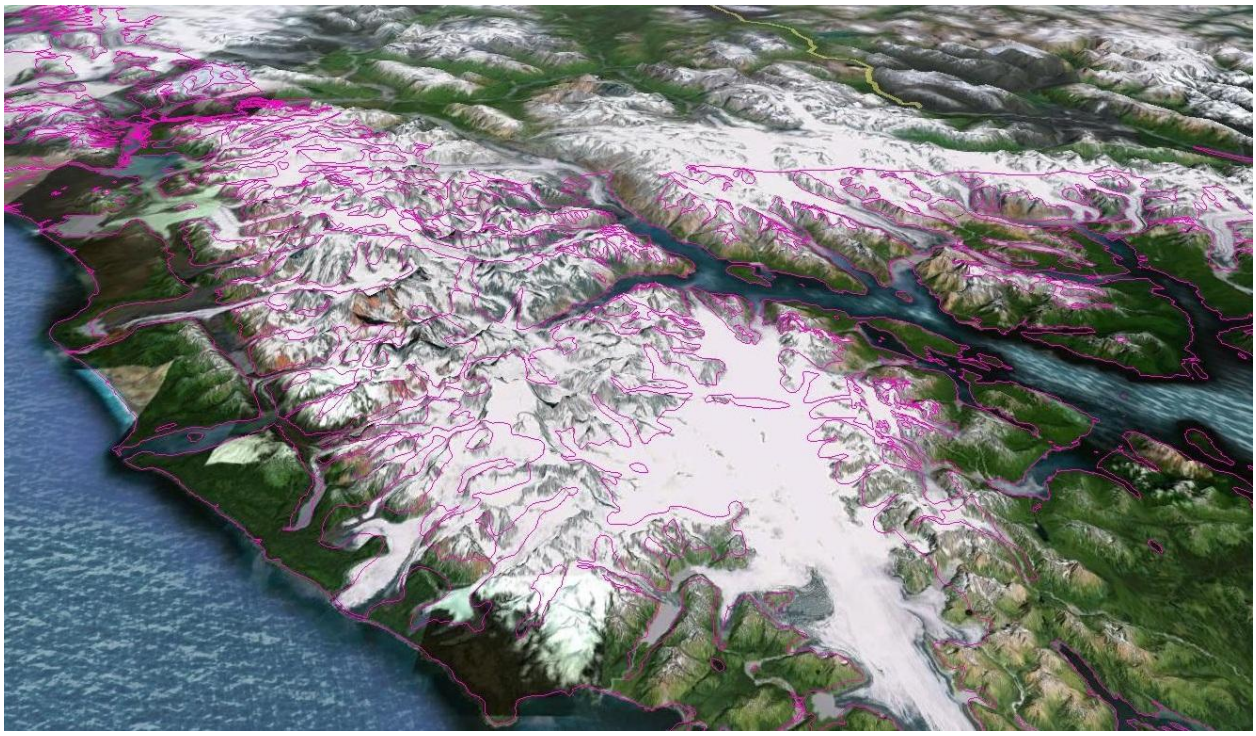

Figure 2. NOAA Extracted Vector Shoreline dataset indicating shoreline (magenta lines) in interior mountainous terrain of Glacier Bay National Park & Preserve, Alaska. Shoreline data are shown on top of an oblique view of Google Earth imagery and topography.

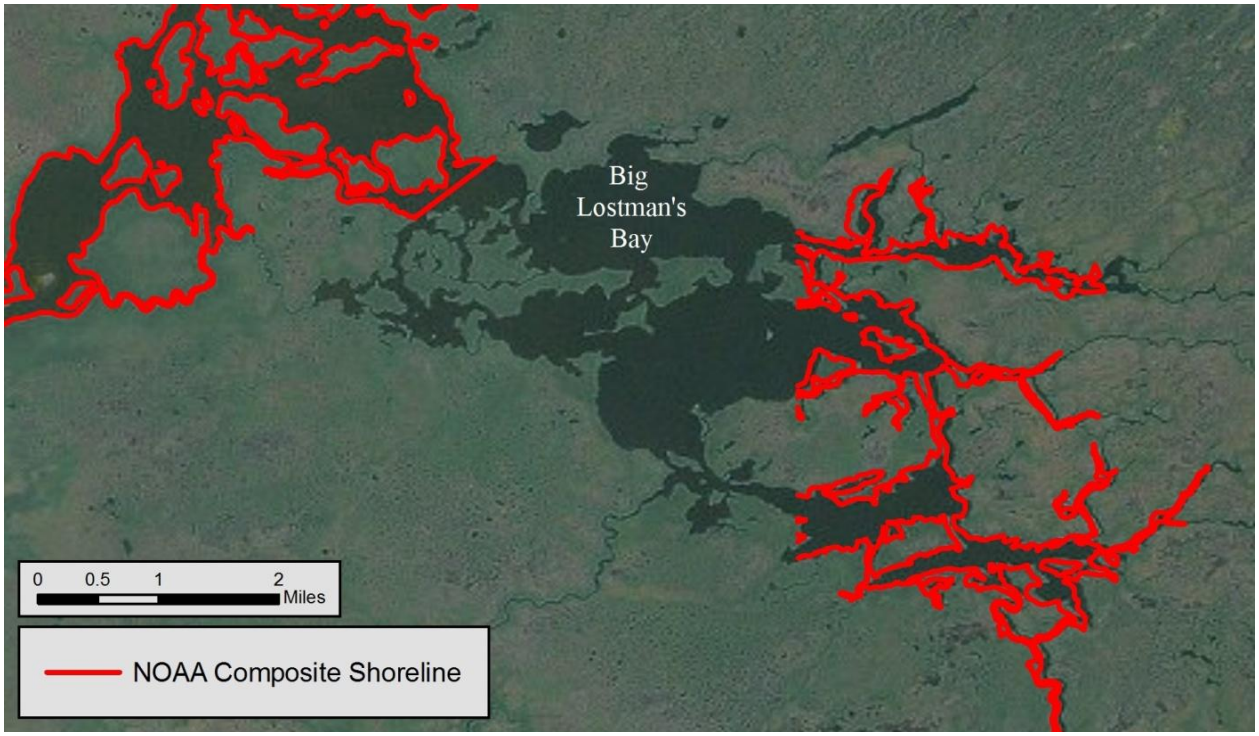

Figure 3. Missing shoreline data in the NOAA Composite Shoreline dataset in Everglades National Park, Florida, shown on a background of 2007 NAIP imagery.

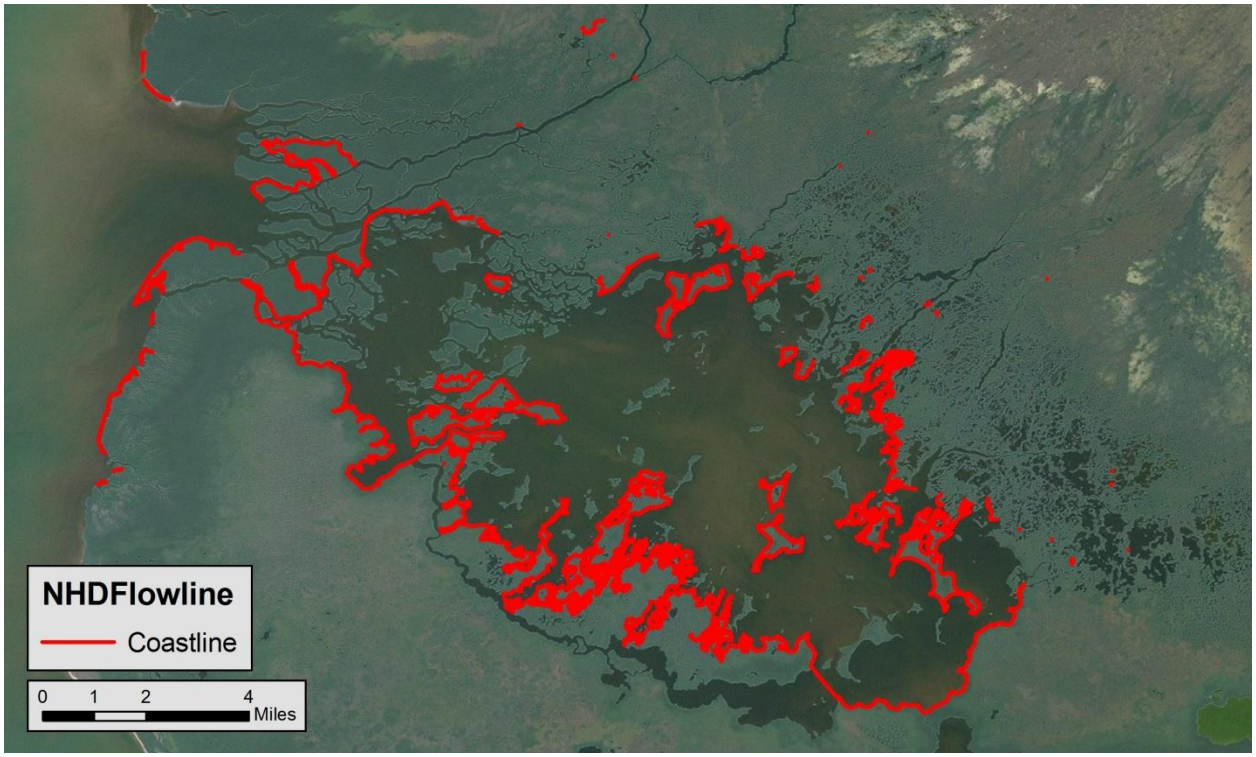

Figure 4. Incomplete shoreline data in the USGS NHDFlowline feature class dataset in Everglades National Park, Florida, shown on a background of 2007 NAIP imagery.

After a thorough examination of the appropriate datasets, it was determined that no single national dataset met the needs of this project. Therefore, a "best available data" approach was adopted park-by-park. Various shoreline datasets were examined and compared to recent orthorectified imagery (see Reference Imagery below) to choose the best shoreline data source(s) for each park. When possible, the data were used without modification. In a few cases where significant errors or omissions were detected, the selected datasets were edited or segments of new shoreline data were created by heads-up digitizing using ArcMap 9.3.1 and the reference imagery.

The incorporation of shoreline data from various sources introduces variability into the final NPS shoreline dataset. One source of variability is in the definition of "shoreline." Some datasets explicitly define shoreline in reference to a tidal datum (e.g., mean high water or mean lower low water), while others do not. When defining the total length of U.S. tidal shoreline, NOAA states, "Shorelines of outer coast, offshore islands, sounds, bays, rivers, and creeks were included to the head of the tidewater or to a point where tidal waters narrow to a width of 100 feet…There is no legal reference that designates one specific shoreline as the legal shoreline. Furthermore, there is no simple answer to this question as there are many legal, technical and general uses of the terms related to shoreline (shoreline, coastline, baseline, mean high water line, mean low water line, etc.)."[3] For the purposes of this project, the definition of shoreline was determined in part by the

[3] http://shoreline.noaa.gov/faqs.html

previously stated criteria used to define ocean, coastal, and Great Lakes parks, and may vary according to the definition in the source data.

A summary of the shoreline data sources used in this project is presented in Table 1. Appendix B provides a list of the ocean, coastal, and Great Lakes parks with their shoreline data sources. Appendix C contains brief descriptions of the NOAA datasets used in this project. The NOAA shoreline data and their complete descriptions can be found at http://shoreline.noaa.gov/data/. The shoreline data source for each line segment is included as an attribute in the final NPS shoreline shapefiles.

Table 1. Summary of shoreline data sources used in this project.

Shoreline Data Sources
1976 Survey Map, James Sewell Co., Old Town, ME (SACR island)
2007 Survey Map, Plisga and Day, Bangor, ME (SACR mainland)
Digitized from 0.3-meter 2007 AerialsExpress imagery
Digitized from 0.3-meter 2008 State imagery
Digitized from NAIP 1-meter imagery
NOAA Composite Shoreline
NOAA Electronic Navigational Chart (ENC)
NOAA Medium Resolution Shoreline
NOAA Merged Vector Shoreline (EVS)
NOAA National Shoreline
NOAA National Ocean Service (http://dusk.geo.orst.edu/djl/samoa/)
NPS Boundary
NPS GPS collection
NPS Tract Data
Olympic Coast National Marine Sanctuary
USGS Hawaii State and County
USGS National Hydrography Dataset

NPS Boundary Data

The NPS boundary dataset has its own problems and challenges, which also necessitated a "best available data" approach. The NPS Land Resources Division (LRD) (http://landsnet.nps.gov/) is the official steward of NPS boundary data and is currently involved in a multi-year effort to review, update, and approve boundaries based on a multitude of data sources. LRD reviews the enabling legislation, deeds, legal descriptions, surveys/plats, government datasets, imagery, and other available GIS data. As of October 2010, approximately 65% of all parks had LRD-approved boundaries. Of the 84 ocean, coastal, and Great Lakes parks, 45 had LRD-approved boundaries. Many of the remaining 39 legacy park boundaries appear to be spatially accurate when compared to reference imagery. In some cases, however, the legacy boundaries appear to be inaccurate. This often involves an offset where the shape of the park boundary describes landscape features visible in the imagery, but the boundary is offset from the landscape features (Figure 5).

Figure 5. Example of an offset legacy NPS boundary at Rosie the Riveter WWII Home Front National Historical Park (RORI)[4] in the San Francisco Bay against a background of 2009 NAIP imagery.

If the legacy NPS boundary was obviously offset or inaccurate, an attempt was made to obtain a more accurate boundary from the park. In four instances where a more accurate boundary file was not available, the existing legacy NPS boundary was manually shifted to achieve a best fit with features present in the reference imagery.

Reference Imagery

Reference imagery was usually obtained from the ESRI Image Server (http://www.esri.com/library/brochures/pdfs/esri-image-server.pdf) within ESRI's ArcMap 9.3.1 application and was used for data inspection and editing. Except for Alaska, reference imagery had a spatial resolution of 1 m or better and was accurate to within about 7 m or better. For Alaska, ESRI's Image Server provided imagery with 15 m spatial resolution. When possible, higher resolution imagery was used. A summary of reference image sources appears in Table 2 and the reference image source(s) for each park are documented in Appendix D.

[4] The boundary for RORI was updated and approved by the NPS Land Resources Division after the first draft of this report was written. The new boundary data and associated statistics were incorporated into the analyses and report, but Figure 5 was retained since it is an excellent illustration of an offset legacy NPS boundary.

Table 2. Summary of reference imagery sources.

Reference Imagery Sources
Digital Globe - Quickbird 2005 1-m
ESRI Image Server - AerialsExpress 2006 0.5-m
ESRI Image Server - AerialsExpress 2007 0.5-m
ESRI Image Server - AerialsExpress 2008 0.5-m
ESRI Image Server - AerialsExpress 2009 0.3-m
ESRI Image Server - AerialsExpress 2009 0.5-m
ESRI Image Server - eSAT 1999 15-m
ESRI Image Server - Federal_GIS 2006 1-m
ESRI Image Server - IKONOS 2000 1-m
ESRI Image Server - IKONOS 2001 1-m
ESRI Image Server - IKONOS 2002 1-m
ESRI Image Server - IKONOS 2002 1-m
ESRI Image Server - NAIP 2005 1-m
ESRI Image Server - NAIP 2006 1-m
ESRI Image Server - NAIP 2007 1-m
ESRI Image Server - NAIP 2008 1-m
ESRI Image Server - NAIP 2009 1-m
ESRI Image Server - StateGIS 2007 0.15-m
ESRI Image Server - StateGIS 2008 0.3-m
ESRI Image Server - StateGIS 2009 0.3-m
ESRI Image Server - Unknown source
ESRI Image Server - USGS 2006 0.3-m
ESRI Image Server - USGS 2007 0.3-m
ESRI Image Server - USGS 2006 1-m
ESRI Image Server - USGS 2007 1-m
ESRI Image Server - USGS 2008 1-m

Calculating Shoreline Length and Water Area

Map Projection

The spatial reference of most source data was a geographic coordinate system (degrees of latitude and longitude). To calculate shoreline length and water area, the data were converted to a projected coordinate system with measurable units of distance. To facilitate NPS-wide calculations, shoreline data from all parks were appended into a single shapefile with a common map projection.

Map projections allow the curved surface of the Earth to be represented on a flat map, but each map projection contains distortions in one or more of the following parameters: direction, distance, area, or shape. The Albers Equal Area Conic projection (AEAC) (http://egsc.usgs.gov/isb/pubs/MapProjections/projections.html) was chosen for this project for its ability to accurately represent area in the conterminous U.S. where the majority of coastal parks are located. The AEAC projection is defined by a central meridian, two standard parallels,

and latitude of origin; the values are chosen based on the area of interest. Parameters for the projection used in this project are commonly used by the USGS for maps showing the conterminous U.S. (CONUS) and are presented in Appendix E. While appropriate for the CONUS, some distortion of distance or area is expected at latitudes that are distant from the standard parallels of the AEAC projection.

The effects of this distortion were tested on two CONUS parks and on two non-CONUS parks. The non-CONUS parks were chosen because their latitudes are the farthest from the standard parallels used in the AEAC projection, and therefore would be expected to contain the greatest amount of distortion. The CONUS parks were expected to have minimal distortion. The source files for each of these parks were projected into the appropriate local Universal Transverse Mercator projection (UTM). The UTM projection shows little distortion in all parameters for local areas of interest within 15° of the central meridian (http://egsc.usgs.gov/isb/pubs/MapProjections/projections.html).

The UTM shoreline distance and water area were calculated and compared to those of the AEAC projection (Table 3). The differences were not significant for the water area calculations. However, the difference was 6.9% for shoreline miles for BELA (Bering Land Bridge National Preserve), a non-CONUS park in Alaska and 4.7% for NPSA (National Park of American Samoa).

Table 3. Effects of Albers Equal Area Conic projection (Albers) and the appropriate local Universal Transverse Mercator projection (UTM) on shoreline miles and water acres calculations. GUIS = Gulf Islands National Seashore, ISRO = Isle Royale National Park, BELA = Bering Land Bridge National Preserve, NPSA = National Park of American Samoa.

Region	Park	Shoreline Miles		Difference (Miles)	Percent Difference
		Albers	UTM		
CONUS	GUIS	259.10	259.29	0.19	0.07%
	ISRO	338.74	337.68	1.06	0.31%
non CONUS	BELA	570.61	531.35	39.26	6.88%
	NPSA	25.58	24.38	1.20	4.69%

Region	Park	Marine Acres		Difference (Acres)	Percent Difference
		Albers	UTM		
CONUS	GUIS	124,369.32	124,318.81	50.52	0.04%
	ISRO	408,338.77	408,204.19	134.58	0.03%
non CONUS	BELA	87,811.87	87,751.94	59.93	0.07%
	NPSA	3,190.85	3,192.34	1.49	0.05%

Because the area under consideration in the Pacific Islands parks is a small portion of the total NPS area, the differences attributed to the CONUS projection in the Pacific Islands parks were deemed acceptable for the purposes of this project.

Based on the UTM projection test results, and the fact that Alaska contains approximately 42% of all NPS shoreline and 29% of NPS water area, a local projection was considered for the

Alaska parks. Based on the recommendation of GIS personnel in the NPS Alaska Regional Office and the Alaska Land Resources Program Office, the Alaska Albers Equal Area Conic projection (AK-AEAC) was evaluated (see Appendix E for projection parameters). The AK-AEAC shoreline distance and water area were calculated for all of the coastal Alaska parks and compared to those with an AEAC projection. The differences were negligible for water area and shoreline miles (Table 4).

For the purposes of this project, the AEAC projection provided acceptable estimates. For projects with a local focus, a more accurate estimate could be obtained by projecting the local shoreline into the appropriate UTM zone and then calculating shoreline miles from the UTM-projected data.

Table 4. Effects of Albers Equal Area Conic projection, USGS version (CONUS parameters) and the Alaska Equal Area Conic projection (Alaska parameters) on the calculation of shoreline miles and water acres for all Alaska coastal parks.

Alaska Coastal Parks	CONUS Albers	Alaska Albers	Difference	Percent Difference
Total Shoreline Miles	3,639	3,578	61	1.70%
Total Water Acres	713,855	713,848	7	0.00%

Shoreline Length

NPS boundary files were used to separate park-specific shoreline data from the source datasets. When the shoreline data were wholly contained within the park boundary, the ArcMap Clip tool was used to clip the shoreline data to the park boundary. In some cases where the park boundary follows the shoreline, shoreline data were slightly different from the NPS boundary data resulting in a shoreline that crisscrosses the NPS boundary. In these cases, if the park boundary was not LRD-approved and appeared to be spatially inaccurate, and the source shoreline data appeared to be accurate relative to the reference imagery, the clip by boundary method was not used. Instead, the park boundary was used as a guide and the "Split" editing tool was used to manually separate the intact NPS-specific shoreline data from its source dataset. Figure 6 is an example of this situation at George Washington Birthplace National Monument.

If the park boundary was LRD-approved and coincided with the shoreline in the reference imagery, the relevant portions of the park boundary were considered to be a valid source of shoreline data for this project. This was the situation at De Soto National Memorial where the relevant portions of the NPS boundary were used as the shoreline data source (Figure 7).

The NPS-specific shoreline dataset for a park was isolated and subjected to an initial quality control (QC) process that consisted of detailed visual inspection and additional comparisons to orthorectified imagery. In some datasets, it was necessary to delete non-shoreline features such as piers and control points. In other cases, missing or erroneous data segments were corrected.

Shoreline data from each park were appended to a master NPS shoreline shapefile. The shapefile was then imported into an ArcMap file geodatabase where a topology layer was created. The topology layer facilitated additional QC procedures. For example, the topology rule called "must not overlap" was implemented which identified any duplicate line segments. Some source

datasets contain duplicate lines that, if not deleted, would result in erroneous calculations of shoreline length. After the topology QC procedures were implemented, shoreline miles were calculated on the field called "Length_mi" by right-clicking the column heading in the attribute table and using ArcMap's Calculate Geometry tool (Figure 8).

Water Area

Water area includes areas of open ocean, estuarine and intertidal areas and Great Lakes. To calculate water area, it was necessary to have a park boundary file and the shoreline data within the park boundary. The park-specific shoreline dataset for all coastal parks (described above) was appended to the park boundary file. This combined dataset was converted to a polygon shapefile and two fields were added to its attribute table: CoverType and Acres. Values of either "Land" or "Water" were assigned to the CoverType field for every polygon (Figure 9).

As with the master shoreline shapefile, the master water area shapefile was imported into an ArcMap file geodatabase where a topology layer was created. Topology rules were created that assisted in identifying any slivers created by overlapping polygons or minute gaps between polygons. Slivers and gaps sometimes occur in the NPS legacy boundary files between adjacent parks that share a common boundary (e.g., Everglades National Park and Big Cypress National Preserve). After the slivers and gaps were corrected, the Calculate Geometry tool was used to calculate acreage for each polygon. Summary statistics were then generated for all of the water polygons, which yielded total water acres for each park.

Figure 6. Example of source shoreline data used without modification even though it strays outside the indicated NPS boundary. The NOAA Composite Shoreline crisscrosses the George Washington Birthplace National Monument boundary, which is a legacy NPS boundary (not approved by the Land Resources Division) and appears to be spatially inaccurate.

Figure 7. Example of NPS Land Resources Division-approved park boundary data used as the shoreline data source. The NOAA Composite Shoreline crisscrosses the De Soto National Memorial boundary.

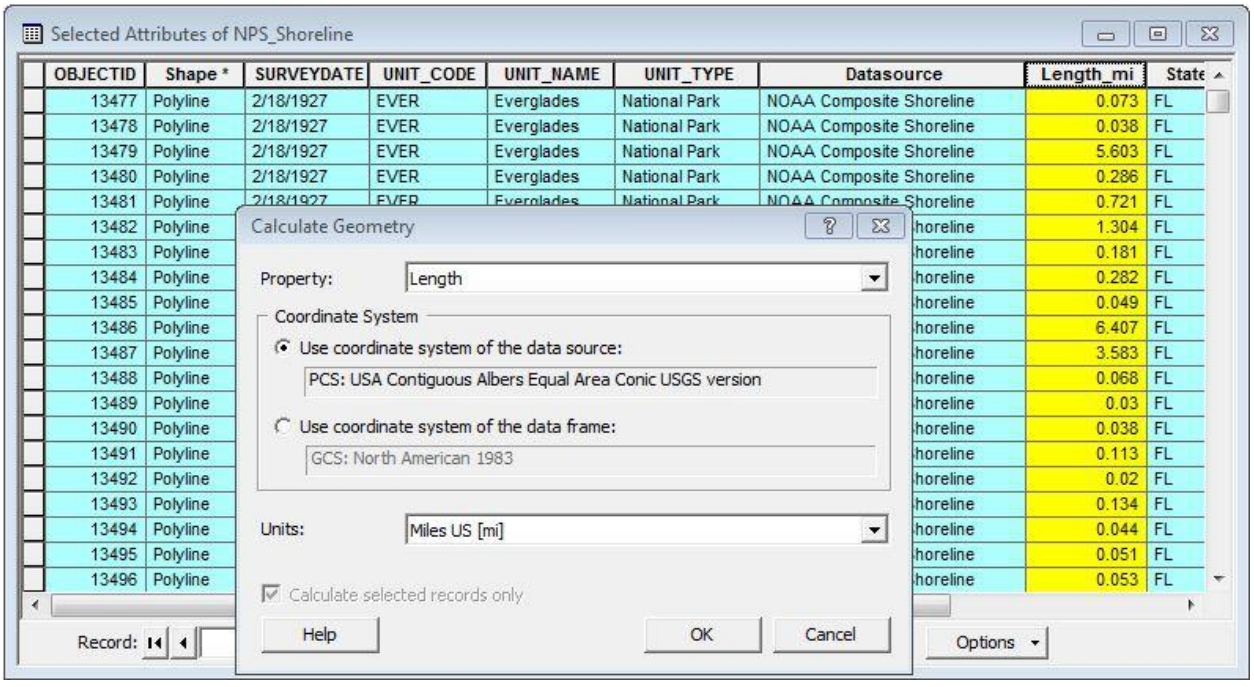

Figure 8. Calculating shoreline length in ESRI ArcMap 9.3.1.

Figure 9. Everglades and Biscayne National Parks and portions of Big Cypress National Preserve classified into land (brown) and water (light blue) defined by shoreline and park boundary data.

Results

The amount of shoreline miles and water area for each of the NPS ocean, coastal and Great Lakes parks is presented in Table 4. Based on these analyses, there are 11,217 miles of shoreline and 2,490,839 acres of water in the 84 ocean, coastal, and Great Lakes parks.

Table 5. Shoreline miles and water acres for the 84 NPS ocean, coastal and Great Lakes parks. See Appendix A for unit codes.

Unit Code	Shoreline Miles	Water Acres[5]
TOTAL	**11,217**	**2,490,839**
ACAD[6]	202	
ANIA	135	0
APIS	160	27,157
ASIS	357	32,409
BELA	571	87,808
BICY	24	373
BISC	139	164,864
BITH	4.7	0
BOHA	41	0
BOST	0.5	0
BUIS	2.6	18,816
CABR	1.5	5.1
CACO	124	13,721
CAHA	276	7,690
CAKR	375	27,349
CALO	343	12,063
CANA	308	37,825
CASA	0.3	0
CHIS	187	120,258
CHRI	0.2	0
COLO	60	0
CUIS	176	10,613
DESO	0.7	0
DRTO	5.4	65,476
EBLA	22	3,897
EVER	2,452	547,240
FIIS	94	14,292

[5] Water acres include ocean, estuarine, and intertidal areas and Great Lakes.
[6] ACAD has an undetermined amount of intertidal area.

Unit Code	Shoreline Miles	Water Acres[5]
FOCA[7]		0
FOFR	2.5	0
FOMA	5.0	0
FOMC	0.6	0
FOPO[8]		0
FOPU	99	861
FORA	1.0	0
FOSU	1.2	147
GATE	109	16,659
GEWA	1.7	0
GLBA	1,179	598,611
GOGA[9]	91	10,114
GOIS	0.1	0
GRPO	0.6	0
GUIS	230	110,387
HALE	2.5	0
HAVO	33	0
INDU	16	563
ISRO	339	408,339
JELA	87	1,546
KAHO	5.5	613
KALA	17	1,913
KATM	458	0
KEFJ	545	0
KLGO	0.5	33
LACL	220	0
LEWI	13	152
NEBE	0.01	0
NPSA	26	3,192
OLYM	93	4,432
PAIS	418	72,478
PEVI	0.6	0
PIRO	39	7,025
POCH[10]		

[7] FOCA is within TIMU and its shoreline miles are included in the TIMU statistic.
[8] FOPO is within GOGA and its shoreline miles are included in the GOGA statistic.
[9] GOGA shoreline miles include FOPO and SAFR shoreline miles.
[10] Boundary data were not available for POCH.

Unit Code	Shoreline Miles	Water Acres[5]
PORE	100	12,580
PUHE	0.3	5.3
PUHO	2.5	0
REDW	48	5,793
RORI	3.5	0
SACR	1.4	28
SAFR[11]		
SAHI	0.2	0
SAIR	0.6	2.0
SAJH[12]	7.3	
SAJU	2.7	0
SAMA	1.1	0
SAMO	40	0
SARI	5.4	618
SITK	1.2	55
SLBE	65	11,358
STLI	1.8	0
TIMU[13]	632	11,958
VALR[14]		
VICR[15]		12,725
VIIS[16]	47	5,807
WAPA	6.3	991
WRST	155	0

Data were lacking for several parks. ACAD has jurisdiction over some intertidal area, but the amount has not been determined. Boundary files were not available for POCH or VALR. Both are small units and the lack of data does not significantly affect the totals. It was not possible to calculate the water area for SAJH due to a lack of accurate shoreline data and jurisdictional uncertainties (National Park Service 2008).

[11] SAFR is within GOGA and its shoreline miles are included in the GOGA statistic.
[12] SAJH has an undetermined amount of intertidal area.
[13] TIMU shoreline miles include FOCA shoreline miles.
[14] Boundary data were not available for VALR.
[15] VICR shares a common shoreline with VIIS; shoreline miles for both parks are included in the VIIS statistic.
[16] VIIS shoreline miles include VICR shoreline miles.

Discussion

The goal of this project was to obtain better estimates of the total number of shoreline miles and water acres in NPS ocean, coastal, and Great Lakes parks. These numbers are often cited by NPS managers to describe the scale of NPS holdings and management responsibilities. Ideally, the datasets on which these calculations are based would have a consistent scale and time frame and be an accurate spatial representation of the NPS shoreline and water area. The desired consistency was not possible due to the variability and inaccuracies inherent in the existing datasets. As a result, there are scale differences and minor spatial inaccuracies in the datasets produced during this project (Figure 6). However, the goal of improving the estimate of NPS ocean, coastal, and Great Lakes shoreline miles and water area was achieved and documented.

Due to various factors, including the dynamic nature of park shorelines and boundaries (and the data that represent them), as well as the timing, scale, and methods of data collection, there will never be a single, consistent, definitive NPS shoreline dataset. Nor will there be a definitive set of statistics for shoreline miles and water area. Any estimates necessarily reflect a snapshot of current conditions and data. This is particularly true in Alaska where a pending legal review and a shoreline data improvement project are expected to have significant impacts on the amount of shoreline miles and water acres within NPS boundaries.

"For the NPS units in Alaska that were created or expanded by the Alaska National Interest Lands Conservation Act (ANILCA) of 1980, a legal review is pending to confirm the appropriate statutory basis of their coastal boundaries. Depending on the conclusions of the legal review, certain coastal waters (e.g., bays, river mouths, lagoons and estuaries) may lie within or outside NPS boundaries. Additionally, technical determinations on the locations of mean high water (MHW) may affect whether certain coastal waters lie within or outside NPS boundaries" (C. Gilbert, Chief, NPS Land Resources Program Center, Anchorage, AK, 2011 pers. com.).

Bering Land Bridge National Preserve (BELA) and Cape Krusenstern National Monument (CAKR) have extensive coastal lagoon systems that will likely be affected by the legal review and the determination of MHW locations. At BELA there are permanent channels and river mouths that connect the lagoons to the sea. The NPS boundary is drawn across the channels, which places the lagoon systems inside the park (Figure 10). If it is later determined that the lagoon systems should be excluded from BELA, approximately 88,000 acres of water and 360 miles of estuarine shoreline would be affected.

The situation at CAKR is more complicated because only two of the seven coastal lagoons (Sisualik and Ipiavik) have permanent channels connecting them to the sea. The remaining five lagoons (Akulaaq, Kotlik, Krusenstern, Imik, and Port) and the Tukrok River have intermittent or seasonal channels (Reynolds and Clough, 2009). The intermittent and seasonal channels are not represented in the shoreline data, which gives the false impression that the lagoons are isolated from the sea (Figure 11). Three lagoons (Akulaaq, Kotlik, and Krusenstern) were sampled in 2009 and exceeded the minimum salinity concentrations (≥0.5 ppt) of the Cowardin et al. (1979) standard for a tidally influenced estuary (Reynolds and Clough, 2009). Based on the Reynolds and Clough data and the current NPS boundaries, the statistics reported for CAKR include all coastal lagoon systems within NPS boundaries. If it is later determined that the

lagoon systems should be excluded from CAKR, approximately 27,000 acres of water and 600 miles of estuarine shoreline would be affected.

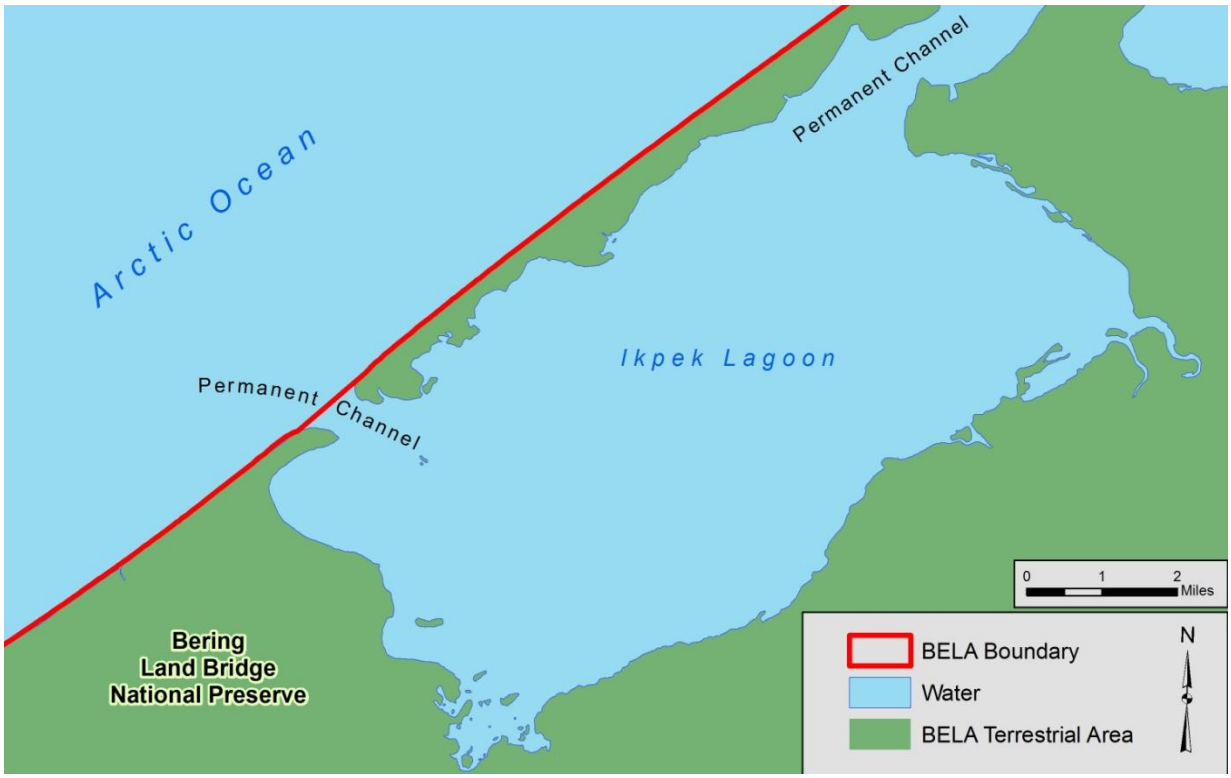

Figure 10. Example of a coastal lagoon with permanent channels in Bering Land Bridge National Preserve (BELA), Alaska. The BELA boundary as currently drawn does not follow the lagoon shoreline, but goes across the channel, thereby including the lagoon in the Preserve.

Despite the dynamic nature of shorelines and boundaries, and the potential impact of pending legal opinions, estimates presented in this report are a considerable improvement over the inconsistent and widely varying numbers that have been reported in the past. This project established criteria for identifying ocean, coastal, and Great Lakes parks; created a shoreline dataset for these parks with well-documented methods; and estimated shoreline miles and water acres for these parks. As NPS boundaries and shorelines change, and as the datasets that represent them improve, statistics for NPS shoreline length and water area will be updated as resources permit.

Figure 11. Example of a coastal river and lagoon in Cape Krusenstern National Monument (CAKR), Alaska, that have intermittent connections to the sea (Reynolds and Cough, 2009). No intermittent channels are present in the shoreline data.

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Appendix A. List of Ocean and Coastal Parks

Count	PARK CODE	PARK NAME	PARK TYPE
1	ACAD	Acadia	National Park
2	ANIA	Aniakchak	National Monument & Preserve
3	APIS	Apostle Islands	National Lakeshore
4	ASIS	Assateague Island	National Seashore
5	BELA	Bering Land Bridge	National Preserve
6	BICY	Big Cypress	National Preserve
7	BISC	Biscayne	National Park
8	BITH	Big Thicket	National Preserve
9	BOHA	Boston Harbor Islands	National Recreation Area
10	BOST	Boston	National Historical Park
11	BUIS	Buck Island Reef	National Monument
12	CABR	Cabrillo	National Monument
13	CACO	Cape Cod	National Seashore
14	CAHA	Cape Hatteras	National Seashore
15	CAKR	Cape Krusenstern	National Monument
16	CALO	Cape Lookout	National Seashore
17	CANA	Canaveral	National Seashore
18	CASA	Castillo De San Marcos	National Monument
19	CHIS	Channel Islands	National Park
20	CHRI	Christiansted	National Historic Site
21	COLO	Colonial	National Historical Park
22	CUIS	Cumberland Island	National Seashore
23	DESO	De Soto	National Memorial
24	DRTO	Dry Tortugas	National Park
25	EBLA	Ebey's Landing	National Historical Reserve
26	EVER	Everglades	National Park
27	FIIS	Fire Island	National Seashore
28	FOCA	Fort Caroline	National Memorial
29	FOFR	Fort Frederica	National Monument
30	FOMA	Fort Matanzas	National Monument
31	FOMC	Fort McHenry	National Monument and Historic Shrine
32	FOPO	Fort Point	National Historic Site
33	FOPU	Fort Pulaski	National Monument
34	FORA	Fort Raleigh	National Historic Site
35	FOSU	Fort Sumter	National Monument
36	GATE	Gateway	National Recreation Area
37	GEWA	George Washington Birthplace	National Monument
38	GLBA	Glacier Bay	National Park & Preserve

Count	PARK CODE	PARK NAME	PARK TYPE
39	GOGA	Golden Gate	National Recreation Area
40	GOIS	Governors Island	National Monument
41	GRPO	Grand Portage	National Monument
42	GUIS	Gulf Islands	National Seashore
43	HALE	Haleakalā	National Park
44	HAVO	Hawai'i Volcanoes	National Park
45	INDU	Indiana Dunes	National Lakeshore
46	ISRO	Isle Royale	National Park
47	JELA	Jean Lafitte	National Historical Park and Preserve
48	KAHO	Kaloko-Honokōhau	National Historical Park
49	KALA	Kalaupapa	National Historical Park
50	KATM	Katmai	National Park & Preserve
51	KEFJ	Kenai Fjords	National Park
52	KLGO	Klondike Gold Rush	National Historical Park
53	LACL	Lake Clark	National Park & Preserve
54	LEWI	Lewis and Clark	National Historical Park
55	NEBE	New Bedford Whaling	National Historical Park
56	NPSA	National Park of American Samoa	National Park
57	OLYM	Olympic	National Park
58	PAIS	Padre Island	National Seashore
59	PEVI	Perry's Victory & International Peace Memorial	National Memorial
60	PIRO	Pictured Rocks	National Lakeshore
61	POCH	Port Chicago Naval Magazine	National Memorial
62	PORE	Point Reyes	National Seashore
63	PUHE	Puʻukoholā Heiau	National Historic Site
64	PUHO	Puʻuhonua o Hōnaunau	National Historical Park
65	REDW	Redwood	National and State Parks
66	RORI	Rosie the Riveter WWII Home Front	National Historical Park
67	SACR	Saint Croix Island	International Historic Site
68	SAFR	San Francisco Maritime	National Historical Park
69	SAHI	Sagamore Hill	National Historic Site
70	SAIR	Saugus Iron Works	National Historic Site
71	SAJH	San Juan Island	National Historical Park
72	SAJU	San Juan	National Historic Site
73	SAMA	Salem Maritime	National Historic Site
74	SAMO	Santa Monica Mountains	National Recreation Area
75	SARI	Salt River Bay	National Historic Park and Ecological Preserve
76	SITK	Sitka	National Historical Park

Count	PARK CODE	PARK NAME	PARK TYPE
77	SLBE	Sleeping Bear Dunes	National Lakeshore
78	STLI	Statue of Liberty	National Monument
79	TIMU	Timucuan	Ecological & Historic Preserve
80	VALR	World War II Valor in the Pacific	National Monument
81	VICR	Virgin Islands Coral Reef	National Monument
82	VIIS	Virgin Islands	National Park
83	WAPA	War In The Pacific	National Historical Park
84	WRST	Wrangell - St Elias	National Park & Preserve

Appendix B. Shoreline Data Sources by Park

PARK CODE	PARK NAME	Shoreline Data Source
ACAD	Acadia National Park	NOAA Composite Shoreline
ANIA	Aniakchak National Monument & Preserve	NOAA National Shoreline - CM8200 and CM8309
APIS	Apostle Islands National Lakeshore	USGS NHD Waterbody
ASIS	Assateague Island National Seashore	USGS NHD Flowline
BELA	Bering Land Bridge National Preserve	USGS NHD Waterbody, NPS Boundary
BICY	Big Cypress National Preserve	NOAA Composite Shoreline
BISC	Biscayne National Park	NOAA Composite Shoreline
BITH	Big Thicket National Preserve	NPS Boundary
BOHA	Boston Harbor Islands National Recreation Area	NPS Boundary
BOST	Boston National Historic Park	NOAA National Shoreline - MA9901
BUIS	Buck Island Reef National Monument	NOAA Composite Shoreline
CABR	Cabrillo National Monument	NOAA ENC Data, NPS Boundary
CACO	Cape Cod National Seashore	NOAA Composite Shoreline
CAHA	Cape Hatteras National Seashore	NOAA Composite Shoreline
CAKR	Cape Krusenstern National Monument	NPS Boundary, NOAA National Shoreline - AK0302
CALO	Cape Lookout National Seashore	NOAA Composite Shoreline
CANA	Canaveral National Seashore	NOAA Composite Shoreline
CASA	Castillo De San Marcos National Monument	NPS Boundary
CHIS	Channel Islands National Park	NOAA Merged Vector Shoreline (EVS)
CHRI	Christiansted National Historic Site	NOAA Composite Shoreline
COLO	Colonial National Historical Park	NOAA Composite Shoreline, NPS Boundary
CUIS	Cumberland Island National Seashore	NOAA Medium Resolution Shoreline
DESO	De Soto National Memorial	NPS Boundary
DRTO	Dry Tortugas National Park	Digitized at unknown scale from NAIP 2007 1-meter imagery
EBLA	Ebey's Landing National Historic Reserve	NOAA Composite Shoreline, NPS Boundary, Digitized from ESRI imagery (AEX 207 0.3-meter)

PARK CODE	PARK NAME	Shoreline Data Source
EVER	Everglades National Park	NOAA Composite Shoreline, Digitized at 1:24,000 scale from ESRI image server imagery (NAIP 2007 1-meter)
FIIS	Fire Island National Seashore	NOAA Composite Shoreline, NPS Boundary, 1979 Park GPS
FOCA	Fort Caroline National Memorial	NOAA Composite Shoreline
FOFR	Fort Frederica National Monument	NPS Boundary
FOMA	Fort Matanzas National Monument	NPS Boundary
FOMC	Fort McHenry National Monument and Historic Shrine	NOAA Composite Shoreline
FOPO	Fort Point National Historic Site	NPS Boundary
FOPU	Fort Pulaski National Monument	NOAA Composite Shoreline
FORA	Fort Raleigh National Historic Site	NOAA Composite Shoreline
FOSU	Fort Sumter National Monument	NOAA Composite Shoreline
GATE	Gateway National Recreation Area	NOAA Medium Resolution Shoreline
GEWA	George Washington Birthplace National Monument	NOAA Composite Shoreline
GLBA	Glacier Bay National Park & Preserve	NPS Boundary
GOGA	Golden Gate National Recreation Area	NOAA Composite Shoreline, NPS Boundary
GOIS	Governor's Island National Monument	NPS Boundary
GRPO	Grand Portage National Monument	NPS Boundary
GUIS	Gulf Islands National Seashore	NOAA Composite Shoreline, NPS Boundary
HALE	Haleakalā National Park	NOAA Composite Shoreline
HAVO	Hawai'i Volcanoes National Park	NPS Boundary, NOAA (NOS) Shoreline of Hawaii Derived From IKONOS and Quick Bird Satellite Imagery, 2004-2006
INDU	Indiana Dunes National Lakeshore	Digitized at 1:3000 scale from ESRI image server imagery (NAIP 2008 1-meter, and USGS 20080415 0.3-meter)
ISRO	Isle Royale National Park	USGS NHD Flowline
JELA	Jean Lafitte National Historical Park	NOAA Merged Vector Shoreline (EVS), NPS Boundary, Digitized from ESRI imagery (USGS 2007 0.3-meter)
KAHO	Kaloko-Honokōhau National Historical Park	NOAA Composite Shoreline
KALA	Kalaupapa National Historical Park	NOAA Composite Shoreline
KATM	Katmai National Park & Preserve	NPS Boundary
KEFJ	Kenai Fjords National Park	NOAA EVS AK01B, AK01C and AK98B, NOAA ENC US4AK2FM, USGS NHD, NPS Boundary

PARK CODE	PARK NAME	Shoreline Data Source
KLGO	Klondike Gold Rush National Historical Park	NPS Tract 102-42
LACL	Lake Clark National Park & Preserve	NOAA National Shoreline - PH6301B, NPS Boundary
LEWI	Lewis & Clark National Historic Park	NOAA Composite Shoreline, NOAA Merged Vector Shoreline (EVS), Digitized at 1:1000 scale from ESRI Image Server imagery (NAIP 2006 1-meter)
NEBE	New Bedford Whaling National Historical Park	Digitized at 1:1,000 from ESRI image server imagery (NAIP 2008 1-meter)
NPSA	National Park of American Samoa National Park	NOAA National Ocean Service (from http://dusk.geo.orst.edu/djl/samoa/)
OLYM	Olympic National Park	NPS Boundary, Olympic Coast National Marine Sanctuary (offshore islands)
PAIS	Padre Island National Seashore	NOAA Composite Shoreline
PEVI	Perry's Victory & International Peace Memorial	Digitized at 1:1,000 from ESRI image server imagery (2009 1-meter NAIP)
PIRO	Pictured Rocks National Lakeshore	NOAA Composite Shoreline
POCH	Port Chicago National Memorial	No Boundary Data Available
PORE	Point Reyes National Seashore	NOAA Merged Vector Shoreline (EVS), NPS Boundary
PUHE	Puʻukoholā Heiau National Historic Site	USGS Hawaii State and County
PUHO	Puʻuhonua o Hōnaunau National Historical Park	NPS Boundary
REDW	Redwood National Park	USGS NHD Flowline
RORI	Rosie the Riveter WWII Home Front National Historical Park	NPS Boundary
SACR	Saint Croix Island International Historic Site	SACR_LandStatus_PY_2010
SAFR	San Francisco Maritime National Historical Park	NOAA Composite Shoreline
SAHI	Sagamore Hill National Historic Site	NOAA Composite Shoreline
SAIR	Saugus Iron Works National Historic Site	Digitized at 1:1,000 from ESRI image server imagery (State GIS 2008 0.3-meter)
SAJH	San Juan Island National Historical Park	NPS Boundary
SAJU	San Juan National Historic Site	NOAA National Shoreline - Shoreline Mapping Program of Bahia de San Juan, 2003
SAMA	Salem Maritime National Historic Site	Digitized at 1:1,000 from ESRI image server imagery (State GIS 2008 0.3-meter)
SAMO	Santa Monica Mountains National Recreation Area	NPS Boundary
SARI	Salt River Bay National Historic Park and Ecological Preserve	NOAA Composite Shoreline
SITK	Sitka National Historical Park	NOAA National Shoreline - AK9703B
SLBE	Sleeping Bear Dunes National Lakeshore	NOAA Medium Resolution Shoreline
STLI	Statue of Liberty National Monument	NOAA Composite Shoreline

PARK CODE	PARK NAME	Shoreline Data Source
TIMU	Timucuan Ecological & Historic Preserve	NOAA Medium Resolution Shoreline
VALR	World War II Valor in the Pacific National Monument	No Boundary Data Available
VICR	Virgin Islands Coral Reef National Monument	NOAA Medium Resolution Shoreline
VIIS	Virgin Islands National Park	NOAA Medium Resolution Shoreline
WAPA	War In The Pacific National Historical Park	NOAA National Ocean Service, NPS Boundary
WRST	Wrangell - St Elias National Park & Preserve	NPS Boundary

Appendix C. Descriptions of the National NOAA Shoreline Datasets Used in this Project

The datasets and complete descriptions are available at: http://shoreline.noaa.gov/data/.

The NOAA National Shoreline - These shoreline data represent a vector conversion of NOAA National Ocean Service (NOS) raster shoreline manuscripts (T-sheets) and aerial imagery from the year 1855 to the present. T-sheets are special-use planimetric or topographic maps that precisely define the shoreline and alongshore natural and man-made features, such as rocks, bulkheads, jetties, piers, and ramps. These data are derived from shoreline maps that were produced by NOS, including its predecessor agencies, and were based on analysts' interpretations of imagery or field surveys. Coverage includes the continental U.S., with Washington, Maine, and the Great Lakes only partially represented; Hawaii and portions of Alaska, Puerto Rico, and the U.S. Virgin Islands are also included. The published scale range is 1:5,000 to 1:20,000. [This is not a single dataset but a collection of many projects that can be downloaded individually via the NOAA Shoreline Data Explorer.]

The NOAA Composite Shoreline dataset is a high-resolution vector shoreline based on a multi-temporal collection of NOAA shoreline manuscripts (T-sheets). Where T-sheets are unavailable, NOAA's extracted vector shoreline (EVS) was used to compile seamless shoreline coverage for the continental U.S. and Hawaii. The average accuracy of the measured benchmarks is 3.06 meters (10 feet). This accuracy is stricter than national standards and four times the accuracy of current U.S. Geological Survey 1:24,000-scale topographic maps. [The Composite Shoreline dataset ranges in scale from 1:5,000 to 1:20:000, but the actual attribute values (when present) in the shapefile indicate a scale range of 1:500 to 1:1,200,000.]

NOAA Office of Coast Survey (OCS) Shorelines - provides two digital vector shorelines that are each extracted from large-scale NOAA nautical charts. Scales of both datasets are variable and based on charts with 1:10,000 to 1:80,000 scales. Descriptions of both datasets follow:

> *Extracted vector shoreline (EVS) - The EVS is not tidally referenced and can be downloaded as a single national merged dataset that covers Continental U.S., including the Great Lakes, Hawaii, Alaska, Puerto Rico, the U.S. Virgin Islands, and other U.S. trust territories and Caribbean and Pacific islands. The EVS is not currently maintained and may not reflect the shoreline on the latest edition paper chart.* [The published scale of EVS dataset ranges from 1:10,000 to 1:80,000, but the actual values in the shapefile range from 1:10,000 to 1:969,761.]
>
> *Electronic navigational chart (ENC) shoreline – The ENC is tidally referenced as MHW. The ENC shoreline is collected for navigable waters and more accurately depicts the tidally influenced shoreline, including waterways and tidal creeks, since it corresponds to the black line seen on the nautical charts. The ENC is available in many formats, such as ESRI shapefile, AutoCAD, and Google KML. Shorelines are not seamless and are distributed as line files downloadable by a user-specified extent.*

NOAA Medium Resolution Shoreline - a high-quality, geographic information system (GIS)-ready, general-use digital vector dataset created by the Strategic Environmental Assessments (SEA) Division of NOAA's Office of Ocean Resources Conservation and Assessment (ORCA). Compiled from hundreds of NOAA nautical charts, this product comprises over 75,000 nautical miles of coastline (nearly 2.5 million vertices), representing the entire continental United States of America. Average scale of 1:70,000. Actual resolution of the shoreline data does, however, vary locally as a result of non-continuous coverage of the U. S. Coast at the targeted scale. Actual source chart scales range from 1:10,000 to 1:600,000, depending on the particular section of coastline. These charts are advertised to meet or exceed current National Map Accuracy Standards when plotted as a hard-copy product to the appropriate source chart scale. However, in compiling this derived product, the developers made no attempt to ascertain the congruency between the charted data and the real world. Shorelines are distributed as a seamless shapefile that can be downloaded by geographic region.

Appendix D. Reference Imagery by Park

PARK CODE	Reference Imagery
ACAD	ESRI Image Service - NAIP 2007
ANIA	ESRI Image Service - eSAT 15-m 1999
APIS	ESRI Image Service - NAIP 2008
ASIS	ESRI Image Service - NAIP 2007 and 2008
BELA	ESRI Image Service - eSAT 15-m 1999
BICY	ESRI Image Service - NAIP 2007, AerialsExpress 2007 0.5-m
BISC	ESRI Image Service - NAIP 2007, AerialsExpress 2007 and 2008 0.5-m
BITH	ESRI Image Service - USGS 2008 1-m
BOHA	ESRI Image Service - StateGIS 2008 0.3-m
BOST	ESRI Image Service - StateGIS 2008 0.3-m
BUIS	ESRI Image Service - IKONOS 2002 1-m
CABR	ESRI Image Service - AerialsExpress 2009 0.3-m
CACO	ESRI Image Service - NAIP 2008
CAHA	ESRI Image Service - NAIP 2008
CAKR	ESRI Image Service - Unknown source
CALO	ESRI Image Service - NAIP 2008
CANA	ESRI Image Service - AerialsExpress 2009 0.5-m
CASA	ESRI Image Service - AerialsExpress 2009 0.5-m
CHIS	ESRI Image Service - NAIP 2009
CHRI	ESRI Image Service - IKONOS 2002 1-m
COLO	ESRI Image Service - NAIP 2008
CUIS	ESRI Image Service - AerialsExpress 2009 and 2008 0.5-m
DESO	ESRI Image Service - StateGIS 2009 0.3-m
DRTO	ESRI Image Service - NAIP 2007
EBLA	ESRI Image Service - AerialsExpress 2009 0.3-m
EVER	ESRI Image Service - NAIP 2007, AerialsExpress 2007 and 2008 0.5-m
FIIS	ESRI Image Service - NAIP 2008
FOCA	ESRI Image Service - AerialsExpress 2009 0.5-m
FOFR	ESRI Image Service - AerialsExpress 2008 0.5-m
FOMA	ESRI Image Service - AerialsExpress 2009 0.5-m
FOMC	ESRI Image Service - AerialsExpress 2008 0.5-m
FOPO	ESRI Image Service - NAIP 2009
FOPU	ESRI Image Service - NAIP 2009, AerialsExpress 2008 0.5-m
FORA	ESRI Image Service - NAIP 2008
FOSU	ESRI Image Service - NAIP 2009

PARK CODE	Reference Imagery
GATE	ESRI Image Service - NAIP 2008, AerialsExpress 2006 0.5-m
GEWA	ESRI Image Service - NAIP 2008, AerialsExpress 2008 0.5-m
GLBA	ESRI Image Service - Federal_GIS 2006 1-m
GOGA	ESRI Image Service - NAIP 2009
GOIS	ESRI Image Service - NAIP 2008
GRPO	ESRI Image Service - NAIP 2008
GUIS	ESRI Image Service - StateGIS 2007 0.15-m, AerialsExpress2007 0.5-m
HALE	ESRI Image Service - IKONOS 2000 1-m
HAVO	ESRI Image Service - IKONOS 2001 1-m
INDU	ESRI Image Service - NAIP 2008, USGS 0.3-m
ISRO	ESRI Image Service - NAIP 2005
JELA	ESRI Image Service - AerialsExpress 2006 0.5-m, USGS 0.3-m
KAHO	ESRI Image Service - IKONOS 2001 1-m
KALA	ESRI Image Service - IKONOS 2001 1-m
KATM	ESRI Image Service - eSAT 15-m 1999
KEFJ	ESRI Image Service - eSAT 15-m 1999
KLGO	ESRI Image Service - eSAT 15-m 1999
LACL	ESRI Image Service - eSAT 15-m 1999
LEWI	ESRI Image Service - NAIP 2006 and 2005
NEBE	ESRI Image Service - NAIP 2008
NPSA	Digital Globe - IKONOS 2002 1-m
OLYM	ESRI Image Service - NAIP 2006
PAIS	ESRI Image Service - NAIP 2008
PEVI	ESRI Image Service - NAIP 2009
PIRO	ESRI Image Service - NAIP 2005
POCH	ESRI Image Service - NAIP 2009
PORE	ESRI Image Service - NAIP 2009
PUHE	ESRI Image Service - IKONOS 2001 1-m
PUHO	ESRI Image Service - IKONOS 2001 1-m
REDW	ESRI Image Service - NAIP 2009
RORI	ESRI Image Service - NAIP 2009
SACR	ESRI Image Service - NAIP 2007
SAFR	ESRI Image Service - NAIP 2009
SAHI	ESRI Image Service - NAIP 2008
SAIR	ESRI Image Service - StateGIS 2008 0.3-m
SAJH	ESRI Image Service - NAIP 2006 and 2005

PARK CODE	Reference Imagery
SAJU	ESRI Image Service - USGS 2007 1-m
SAMA	ESRI Image Service - StateGIS 2008 0.3-m
SAMO	ESRI Image Service - AerialsExpress 2009 0.3-m
SARI	ESRI Image Service - IKONOS 2002 1-m
SITK	ESRI Image Service - USGS 2006 1-m
SLBE	ESRI Image Service - NAIP 2005
STLI	ESRI Image Service - NAIP 2008
TIMU	ESRI Image Service - AerialsExpress 2009 0.5-m
VALR	ESRI Image Service - USGS 2006 0.3-m
VICR	ESRI Image Service - IKONOS 2001 1-m
VIIS	ESRI Image Service - IKONOS 2001 1-m
WAPA	Quickbird 2005 1-m
WRST	ESRI Image Service - eSAT 15-m 1999

Appendix E. Projection Parameters

Parameters for Albers Equal Area Conic Projection (USGS Version)

USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
Projection: Albers
False_Easting: 0.000000
False_Northing: 0.000000
Central_Meridian: -96.000000
Standard_Parallel_1: 29.500000
Standard_Parallel_2: 45.500000
Latitude_Of_Origin: 23.000000
Linear Unit: Meter
GCS_North_American_1983
Datum: D_North_American_1983

Parameters for Alaska Albers Equal Area Conic Projection

NAD_83_Alaska_Albers
Projection: Albers
False_Easting: 0.000000
False_Northing: 0.000000
Central_Meridian: -154.000000
Standard_Parallel_1: 55.000000
Standard_Parallel_2: 65.000000
Latitude_Of_Origin: 50.000000
Linear Unit: Meter
GCS_North_American_1983
Datum: D_North_American_1983

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 999/106330, March 2011

National Park Service
U.S. Department of the Interior

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