Marine Managed Areas:

Best Practices for Boundary Making

Marine Boundary Working Group
Federal Geographic Data Committee

Acknowledgments

These guidelines, written by the Federal Geographic Data Committee's (FGDC) Marine Boundary Working Group and sponsored by the National Marine Protected Areas (MPA) Center, represent the current best practices for marine boundary delimitation. The handbook was prepared by a field of experts, including cartographers, lawyers, regulators, spatial data analysts, surveyors, and other professionals with an interest in marine management. Coordination and funding of the printing of this publication were provided by the National Oceanic and Atmospheric Administration (NOAA).

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June 2006

In memory of

Paul H. Rogers

1944–2006

This handbook is dedicated to the memory of Paul H. Rogers for the numerous contributions he made to marine boundaries.

Rogers was born in Brookfield, Missouri, in 1944. He earned a B.S. degree in geography at the University of Kansas, where he also entered the master's program.

For 30 years Rogers held various positions within the Department of the Interior's Bureau of Land Management and the Minerals Management Service, where he was actively involved in surveying and mapping efforts. He applied his many years of experience and professional knowledge to promote mapping issues and was instrumental in the development of the "Implementation Plan for the Multipurpose Marine Cadastre."

People who knew Rogers would describe him as professional, energetic, persistent, meticulous, dedicated, and always willing to help others. He loved his work, which was apparent by his attitude and the way he set about doing his day-to-day tasks. He was proactive, always seeking to resolve issues in a positive manner while never losing perspective or his sense of humor in the process.

Rogers truly lived the advice he so often gave others: "People can give you all kinds of gifts, but the most important gift is the one you give yourself—the gift of integrity."

Paul Rogers lost his courageous fight against non-Hodgkin's lymphoma on January 22, 2006. He is survived by his wife Donna and son Brian.

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Introduction

Purpose of This Manual

A law or regulation for a marine area cannot have its fully intended effect if the boundary description is vague, inaccurate, or incorrectly represented on a map. For this reason, the authors of this manual have attempted to outline clear best practices for marine boundary developers, or those who write and map marine managed area boundaries.

This manual also attempts to ease the transition from traditional to modern mapping techniques for marine managed areas. Digital boundaries will provide managers and users of marine resources with accurate and readily available data—benefits that are in step with electronic-government goals.

These pages provide a short, useful guide—best practices—for writing boundary descriptions for federal, state, or local marine managed areas within U.S. waters and for developing those boundaries within a computer mapping environment, or geographic information system (GIS). Although many of the examples in this manual are federal, the development principles apply to state and local boundary making, and are appropriate for policy and mapping experts at all levels.

Boundary developers have learned the best practices represented in this manual from experience, including many hard lessons from resolving boundary issues:

> "Experience indicates that it can average between 5 to 20 years to resolve a marine boundary issue. . . . Our approach to boundaries is to develop appropriate collaborative partnerships, look at the issue(s) surrounding a particular geographic area, gather all the relevant information, if available, which is sometimes the very problem, and . . . then perform the necessary effort to mathematically define the various alternatives and the areal measurements associated with them. *Having a proactive and collaborative approach to boundaries has proven over and over to be the most effective and efficient method to resolving marine boundary issues* [emphasis added]." (Thormahlen and others 2004)

This manual attempts to provide guidelines to reduce boundary misunderstandings and litigation. Haste, inexperience, and lack of consulting with boundary experts are common reasons for poor boundary development. The lesson that this experience teaches is important: boundary developers must resolve or account for all boundary issues before they can develop effective boundaries. Heeding this advice and employing best technical practices are beneficial to creating effective marine boundaries.

How to Use This Manual

Follow the Best Practices

- This manual is organized—in general—by the best practices needed to delimit boundaries in the marine environment.
- Related best practices are organized under three broad categories, or steps—Conceptualize the Marine Managed Area (Step 1), Describe the Marine Boundary (Step 2), and Generate the Digital Boundary (Step 3)—although the order of those tasks may vary. For example, GIS mapping work may begin at the same time as planning work.
- Boundary description writers (often legal and policy experts) will find the sections on conceptualizing and describing boundaries to be the most useful in their work. Mapping professionals will refer most often to the sections on describing and generating boundaries. This manual often uses the general term ***boundary developer*** in reference to either of these roles.
- Boundary developers (writers and mapping professionals) should understand the best practices of the whole process to develop effective and accurate boundaries. For this reason, an overall best practice for developing boundaries is to commit the resources of an individual or group to know, work on, and follow through on *all the best practices* listed in this manual.

Read the Appropriate Level of Detail

- Each section contains essential and direct guidance, as well as supporting technical information that provides more context and detail.
- Because marine boundary delimitation draws upon many disciplines—including law, surveying, cartography, public policy, and scientific and technical fields—even those experienced in boundary delimitation may need guidelines to navigate through the complicated process. Boundary developers should collaborate with experts in different aspects of boundary making and consult standard reference works listed in this manual.

Delimitation – The determination of a boundary.
Delimitation includes all phases of boundary development.

A Note on the Terminology within This Work

Where appropriate, this manual defines important terms within the text or in text boxes, such as the word ***delimitation*** above. Following is a discussion of some of the more important concepts used throughout this manual.

This manual generally uses the terms ***marine boundary*** and ***limit*** interchangeably in the context of how to describe or fix the limits of marine managed areas. Readers should not confuse these terms with ***maritime boundary***, which in the international context is the boundary between two countries where their maritime zones would otherwise overlap. ***Maritime zones*** refer to the zones off the coast of a country over which it exercises sovereignty (territorial sea) or sovereign rights (exclusive economic zone or continental shelf).

In the context of U.S. domestic law, the term ***boundary*** also refers generally to the fixing of a limit or extent of private or public property in dry terrestrial lands, inland waters, and tidelands, as opposed to submerged lands in which there are very limited private property rights or interests.

The next section explores the meanings of the terms ***marine managed area*** and ***marine protected area***. However, a summary of the *definitions that this manual uses* would state that marine protected areas, which include no-take and other types of conservation areas, fall within the larger category of marine managed areas. Marine managed areas encompass both protected areas and those not necessarily established primarily for conservation purposes. Since the term *marine protected area* applies to many of the examples in this manual, *protected* often appears in the discussion, and readers can usually substitute *managed* for the purposes of this best practices manual. There are many parallels and overlaps of boundary terms, whether working with terrestrial lands, inland waters, tidelands, submerged lands, or marine zones.

An Overview of Marine Managed Areas and Marine Boundary Making

What Are Marine Managed Areas?

Marine managed areas, in the broadest sense, are geographic areas designed to protect or manage resources within the marine environment. This manual employs a broad definition of marine managed areas to promote sound boundary descriptions that will benefit all jurisdictions within the coastal zone and marine waters.

These management areas exist in many shapes and forms and include such sites as national marine sanctuaries, fishery management zones, national seashores, national parks, national monuments, critical habitats, national wildlife refuges, aquatic preserves, and national estuarine research reserves. The areas can include vertical components of marine space: the seabed and what lies below it, the water column, the water surface, and airspace.

In a broader sense, marine managed areas can include areas not necessarily established for conservation purposes, such as shellfish closure sites, anchorage areas, no-discharge zones, sewage discharge areas, safety zones, and pipeline and cable corridors.

Whether marine managed areas shelter resources, allowing little, if any, human activity, or follow a design to enhance ocean use, they define zones for managing resources or activities.

Managed versus Protected

Executive Order 13158, signed on May 26, 2000, defines a marine *protected* area as "any area of the marine environment that has been reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein."

Because this definition excludes certain areas, and to calm public concern that protected zones meant no-take zones, the National Marine Protected Areas (MPA) Center employed the term ***marine managed area*** (MMA) in 2002. This term includes marine *protected* areas but creates a larger umbrella under which to include a wider range of marine areas. To promote the development of sound legal boundary descriptions, this best practices manual includes management areas not necessarily established for conservation purposes.

Who Creates Marine Managed Areas?

Any agency that has jurisdiction in the marine environment can create marine managed areas. A creating agency could be a federal, state, territorial, tribal, or local government—an independent agency, such as the Federal Communications Commission (FCC)—or a regional entity with resource authority, such as a fisheries management council. The U.S. Department of the Interior and the U.S. Department of Commerce are the lead agencies in the designation of federal MMAs. The agency responsible for defining and creating a national system of these existing marine protected (or managed) areas is the Marine Protected Areas Center, established by the same executive order within the National Oceanic and Atmospheric Administration (NOAA). Individual state, territorial, and tribal governments work within their own mandates to create MMAs in their jurisdictional waters. In many cases, multiple levels of government work together to create cross-jurisdictional MMAs, or individual MMAs may have overlapping jurisdictions.

The MPA Inventory

The MPA Center maintains an inventory of marine managed areas to discover common threads and to establish a more focused definition of both marine protected and marine managed areas. This inventory (*www.mpa.gov*) contains federal, state, commonwealth, and territorial sites.

Figure 1. State and Federal Marine Managed Areas in the Florida Keys

As the MPA Center adds more sites to the inventory, and as agencies designate additional marine managed areas in a finite amount of ocean space, jurisdictional overlaps will arise. For example, in the Florida Keys today, as in other areas, several boundaries overlap and share jurisdiction. Boundary developers and resource managers would benefit from a complete and accurate inventory of sites, as well as a diligent process for developing boundaries for new sites, to avoid jurisdictional conflicts and to enable effective law enforcement and management within marine areas.

Table 1. A Sampling of Marine Managed Areas and Their Responsible Agencies

Types of MMAs	Agency
Fisheries Management Zones, Threatened and Endangered Species Protected Areas, and Critical Habitats	NOAA National Marine Fisheries Service (Commerce)
Marine Sanctuaries, Ecosystem and Research Reserves	NOAA National Marine Sanctuary Program (Commerce)
National Parks, National Seashores, and National Monuments	National Park Service (Interior)
National Wildlife Refuges	U.S. Fish and Wildlife Service (Interior)
Lease Blocks	Minerals Management Service (Interior)
Disposal Sites, No Discharge Areas	U.S. Environmental Protection Agency
Military Restriction Zones	U.S. Department of Defense and U.S. Department of Homeland Security
Manatee Speed Zones	Florida Fish and Wildlife Conservation Commission
Safety Zones	State and Federal Law Enforcement Agencies
Native Fishing Rights	Bureau of Indian Affairs
Aquatic Preserves	States

What Is the Outlook for Digital Depictions of Marine Boundaries?

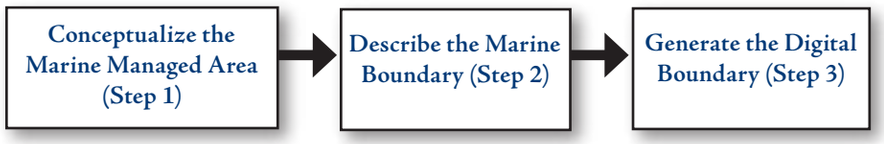
The era of paper maps and charts created by hand is not far in the past. Only since the 1980s have computers become the mainstay in cartography, but the presence today of geographic information systems (GIS), electronic charting systems, and other electronic mapping tools ensures a digital future for the designation and interpretation of boundaries.

The rise of GIS and other technologies in the management and use of marine resources is also increasing the demand for digital boundaries. The official legal notice of federal MMA boundaries is published in the *Code of Federal Regulations*, but the depiction of these boundaries on digital charts will likely help law enforcement and the lawful use of such areas by the public and private interests.

This shift to electronic tools is a significant change and will become more important as MMAs increase in number and their boundaries begin to match or overlap. To ensure that MMA boundaries are ready for a digital future, this manual will outline steps necessary to create viable boundary descriptions that complement electronic mapping technologies.

Best Practices for Boundary Making

The best practices in this manual are those for creating boundaries for marine managed areas. The manual lists the best practices under three broad categories, or steps, that outline the general boundary delimitation process and the knowledge that a boundary developer must draw upon.



This manual will guide boundary developers—those who conceptualize, describe, and generate marine boundaries—and point them to information and resources they may need. The best practices follow a logical order, useful for illustrating the steps that take place in creating a boundary, but the distinct parts of this manual will likely blend together, occur in a different order, or take place simultaneously when put into practice.

Summary of Best Practices

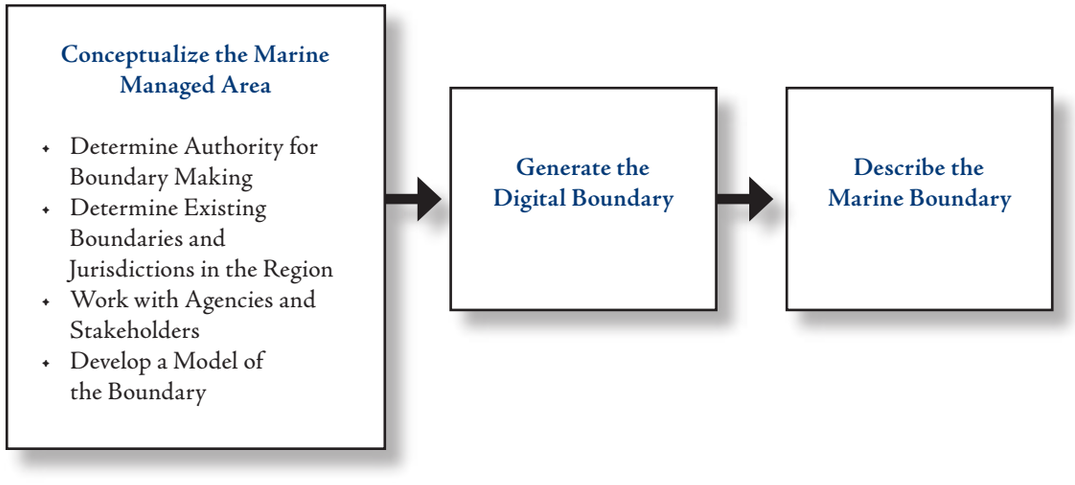
- Create a defensible and inclusive boundary-making process with your organization by identifying a team to understand, work on, and follow through on all the best practices listed in this manual.
- Understand how decisions made by boundary description writers affect the ability to depict a boundary graphically.
- Have a proactive and collaborative approach to boundary making by including relevant agencies and stakeholders in the process.
- Employ a comprehensive process to assess the quality and availability of information suitable to support the boundary-making effort.
- Evaluate the scale of the source data or map to determine the appropriate precision for reporting measurements.
- Test newly generated boundaries for accuracy and completeness. Whenever possible, ground-truth boundaries.
- Publish the boundary description in appropriate government notices for public access.
- Publish data and metadata to the Web through appropriate government clearinghouses.

Step 1: Conceptualize the Marine Managed Area

Introduction
This step explores the context and circumstances surrounding the creation of a new marine managed area that a boundary developer should examine as part of the development process. The boundary developer should address the following questions:

1. What is the legal authority, policy, or law to create and implement the proposed marine managed area, or MMA?
2. What is the area of interest? What are the overlapping and surrounding jurisdictions (i.e., the study area)?
3. Who are the stakeholders affected by the proposed MMA?
4. What is the intended outcome of the MMA (e.g., ecological protection, individual species protection, pollution prevention, homeland defense, personal safety)?
5. What features will delineate the MMA (e.g., shoreline, buffers, submerged features)?

The boundary developer needs to determine the legislative authority for creating the area and create an inventory of the surrounding activities and jurisdictions, both on land and in the water.



A. Determine Authority for Boundary Making

Research is necessary to determine the authority for the MMA and its resulting marine boundary. Although, in general, acts of Congress and state legislation establish, protect, and assign management responsibilities for marine managed areas, a review of the scope of authority may express limits or restrictions that can affect marine managed area boundaries.

Best Practices

- Gain a full understanding of the underlying statute's scope of authority and jurisdiction before engaging in the development of a marine boundary.
- Ensure that the development of a legal marine boundary description for an MMA is consistent with local, state, U.S., and international laws that apply to that particular area of interest. For example,
  - Enforcement of MMA regulations against foreign vessels and nationals must be consistent with international law;
  - MMA boundaries and regulations should not limit innocent passage or other rights under international law;
  - Boundary developers must consider the balance of responsibilities, rights, authorities, and jurisdictions under international law in various maritime zones;
  - Boundaries of U.S. federal MMAs must not exceed the 200-nautical-mile exclusive economic zone and continental shelf; and
  - Boundaries for local and state MMAs must be within local and state jurisdictional waters.

Technical Considerations

Consistency with International Law

The 1982 United Nations Convention on the Law of the Sea provides the framework for the U.S. and other coastal countries, or States, to prescribe and enforce laws consistent with international law. Generally, a coastal State has jurisdiction to develop regulations for MMAs within its territorial waters. Without question, the U.S. has jurisdiction to enforce such MMA regulations over U.S. flagged vessels, U.S. nationals, and others that may be subject to *in personam* jurisdiction in U.S. courts. However, the enforceability of regulations against the activities of foreign-flagged vessels and nationals must follow generally recognized principles of international law. For example, if the boundary of the MMA is within the territorial sea, then international law recognizes that the coastal State has full sovereignty over that area subject to the right of innocent passage of foreign-flagged vessels in the territorial sea.

> ***State*** – with an uppercase "S," refers to a nation state or country.
> ***state*** – with a lowercase "s," refers to a state within the United States.

Example: To protect the coral reefs in the Florida Keys from destruction caused by ship anchoring, the National Oceanic and Atmospheric Administration (NOAA) established no-anchoring areas authorized by the International Maritime Organization. However, NOAA respected the right of innocent passage in its regulation and MMA boundary. A no-entry area would have been consistent with international law, as long as the regulation had recognized the right of innocent passage through a navigable portion of the territorial sea. Boundary developers determined that the passage of vessels over the coral reef was not a threat, and so the regulation addresses only the anchoring of vessels. The regulation identifies areas of reasonable anchorage outside of the no-anchoring area but near the regular routes of navigation.

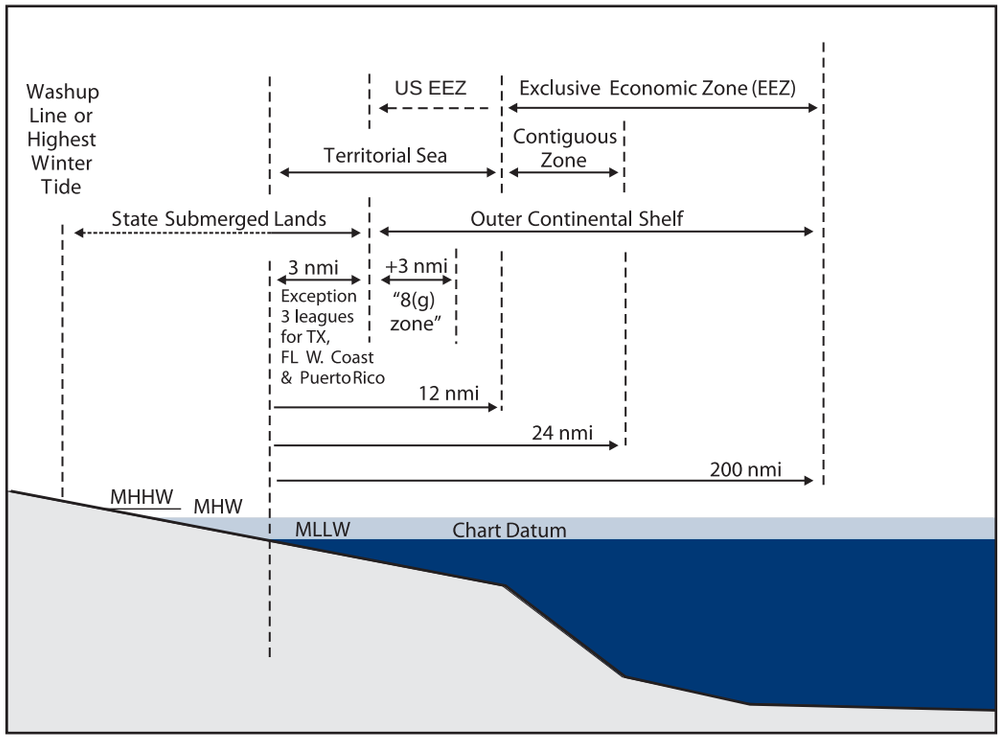


Figure 2. Boundaries Delimiting U.S. Maritime Zones.
See Appendix B for detailed descriptions.

Consistency with U.S. Law

Designating federal areas within the limits of state submerged lands and waters raises significant concerns about the effect on the sovereignty of the states, Indian tribes, Alaskan native and village corporations, and territories, as well as the constitutional principle of federalism. Concerns also exist about the effects of regulations and management of MMAs on private property, particularly in certain states where private property rights may extend into the marine environment. As a result, those establishing MMAs, such as the Stellwagen Bank National Marine Sanctuary, often refer to state or federal limits or boundaries in an effort to respect state, tribal, or native sovereignty or avoid constitutional problems. The Florida Keys National Marine Sanctuary has partnered with the State of Florida to ensure the coordination of all sanctuary activities with the state and Monroe County. This partnership works through a sanctuary advisory council.

This issue of state, tribal, territorial, or native sovereignty pertains only to MMAs well within the 12-nautical-mile territorial sea and is generally limited to those MMAs within 3 nautical miles of the shoreline. International issues become of greater concern for MMAs in the exclusive economic zone (EEZ) or on the continental shelf beyond the territorial sea. The exceptions are those states that share a boundary line with Canada in the Great Lakes and those states and commonwealths that have a seaward limit of 9 nautical miles: Texas, Gulf Coast of Florida, and Puerto Rico. (See Step 1B, "Determine Existing Boundaries and Jurisdictions in the Region," for caution on using disputed or imprecise boundaries in MMA descriptions.)

> ***Marine League*** – A unit of length equivalent to 3 nautical miles.
>
> ***Nautical Mile* vs. *Statute Mile*** – A ***nautical mile*** is a unit of length equivalent to the distance spanned by 1 minute of arc in latitude at the equator, or 1,852 meters. A ***statute mile*** is defined as a unit of length equal to 1,609.344 meters. One nautical mile is equal to approximately 1.15 statute miles.

In addition, the ***scope of authority*** of a congressional act may reveal express limits or restrictions to MMA boundary delimitation.

Example: The withdrawal of submerged lands by the U.S. Department of the Interior's Minerals Management Service under the Outer Continental Shelf Lands Act (OCSLA) (title 43, *U.S. Code*, sections 1331 and following) has been used to protect special marine areas such as coral reefs from the threats posed by the exploration and exploitation of oil, gas, and minerals. However, since the scope of

OCSLA is limited to those resources and activities, such withdrawal would not provide the jurisdiction and authority to address threats to the coral reef area that may be posed by fishing, boat anchoring, groundings, treasure salvage, and other activities.

Example: The statutory authority for *national parks* is generally found in enabling legislation for each specific park. See title 16, *U.S. Code*, section 410gg, for enabling legislation for Biscayne National Park (*www.nps.gov/bisc/manage/enleg.htm*). The statutory authority for *national wildlife refuges* is similarly found in special acts of Congress or in the underlying organic authority, the National Wildlife Refuge System Administration Act of 1966 (title 16, *U.S. Code*, sections 668dd to 668ee). See Alaska Maritime National Wildlife Refuge, Alaska—Act of Dec. 2, 1980, Public Law 96-487.

Example: The National Marine Sanctuaries Act, or NMSA (title 16, *U.S. Code*, sections 1431 and following), provides broad express authority to NOAA, through the secretary of commerce, to establish *national marine sanctuaries* in the coastal and ocean waters and submerged lands over which the U.S. exercises jurisdiction, including the 200-nautical-mile exclusive economic zone, or EEZ (title 16, *U.S. Code*, sections 1431 and 1432 [3]). U.S. Department of Commerce (NOAA) authority under the National Marine Sanctuaries Act would not provide authority for an MMA in the high seas, which is beyond the reach of the national jurisdiction and sovereign rights of the U.S.

Consistency with Individual State (state), Territory, and Commonwealth Law

In the U.S., each state has the authority and responsibility for managing the submerged lands, waters, and living resources within its borders (CSO 1997). The public trust doctrine is an important part of the body of law that applies to this area. No one single public trust doctrine exists, only multiple applications unique to each state, territory, or commonwealth. The trustees of the law, the state legislatures, generally delegate their responsibility to the state coastal management agencies, commissions, or local municipalities.

Public trust lands generally include those lands below navigable waters, tidelands, and shorelands of navigable lakes and rivers, as well as the land beneath the ocean, lakes, and rivers. Figure 3 shows that the boundary (legally, the tidal datum) between private and state ownership varies from state to state. The differences reflect historical conditions set upon the state at the time the state entered the union. After achieving statehood, each state creates laws that, if not in conflict with federal law, determine the ownership and rights associated with public trust lands (CSO 1997). Because each state and territory applies the doctrine uniquely, if the MMA in development lies in state or territorial waters, boundary developers must consult that state's or territory's laws and regulations. In addition, there are certain instances where private ownership can exist seaward of the historically established public–private ownership boundary.

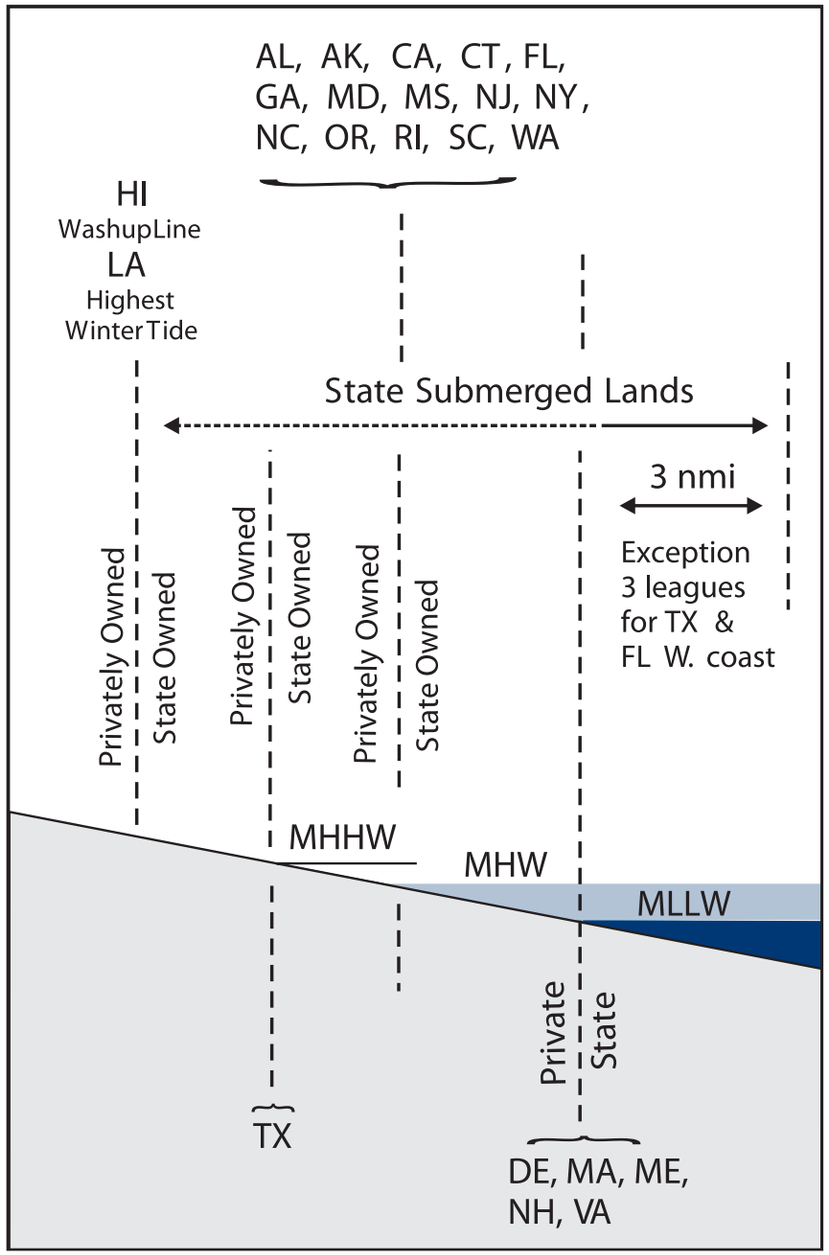


Figure 3. Boundaries between Private Uplands and State Submerged Lands

B. Determine Existing Boundaries and Jurisdictions in the Region

In this part of the process, the boundary developer should determine the existing boundaries and jurisdictions surrounding or overlapping the proposed MMA. Existing boundary lines may exist in a wide range of digital and paper formats, including proprietary file formats, historical maps and charts, and textual descriptions. Many federal agencies and coastal states are developing and publishing geospatial data in support of their marine management efforts.

Searching a state's informational resources may provide additional data for the region of interest. Note that the information available will vary in age, scale, and quality, and many of the maps may have been generalized or cartographically altered and may not represent the exact legal position of a boundary. The boundary developer should consult the ***metadata***, or data about data, to assess the condition of geospatial data sets. See Step 3B, "Create and Document the Digital Boundary," for more discussion on metadata. Appendix F lists some federal data sources for boundaries and regulations.

Best Practices

- Inventory and characterize existing jurisdictions and boundaries in the region of interest.
- Be aware that MMA legal descriptions that reference boundaries of neighboring states, sovereign States, or other jurisdictions may inherit any disputes or imprecision associated with those boundaries.
- Use GIS data or hard copy maps to assess the gaps and overlaps within the existing regulatory framework.
- Identify the ecological and socioeconomic effects of the proposed MMA.
- Refer to the legislation to determine the purpose of the existing managed areas and of the proposed MMA.

Technical Considerations

Inventory of Existing Boundaries and Authorities

One of the first steps a boundary developer should take is to identify all existing boundaries and authorities in and around the area of interest. This will identify all the potential stakeholders and provide the framework for collaboration. An inventory in the form of a matrix is one way to characterize the current regulatory framework of an area (see Table 2).

Table 2. Organizational Approach for Inventorying Multiple MMAs within a Region (Tampa Bay)

General Description	Geography Covered	Responsible Agency	Purpose
State, Federal, and Local Natural Resource Protection Areas	Throughout Tampa Bay	U.S. Fish and Wildlife Service, Florida Department of Environmental Protection, Pinellas County Parks and Recreation Department	Recreation, Ecological Protection
Federal Security Zones and Prohibited Areas	• MacDill Air Force Base • Sunshine Skyway Bridge • Port Manatee	U.S. Department of Homeland Security, Florida Wildlife Commission, Local Law Enforcement, U.S. Air Force	Homeland Security
Transportation and Utility Rights of Way	• Intracoastal Waterway • Egmont Key Utility Right of Way • Howard Frankland Bridge Transportation Right of Way	U.S. Army Corps of Engineers, Florida Department of Transportation, Tampa Port Authority	Commerce
State and County Boating Speed Zones (not manatee-related)	• Pinellas Bayway Bridges C and E • Tom Stewart Causeway • Corey Causeway • Fort DeSoto Park	Florida Wildlife Commission, Pinellas County Parks and Recreation Department	Boating Safety
Manatee Protection	• Manatee County	Florida Wildlife Commission	Species Conservation

Suitability Analysis

Using this type of regulatory characterization, boundary developers can analyze the existing conditions of an area of interest to determine the best possible placement and configuration of the MMA. This effort could take the form of a suitability analysis where overlaid maps or data layers show how the proposed MMA might align with the existing management framework. See Figure 4 for a map-based illustration of this type of assessment.

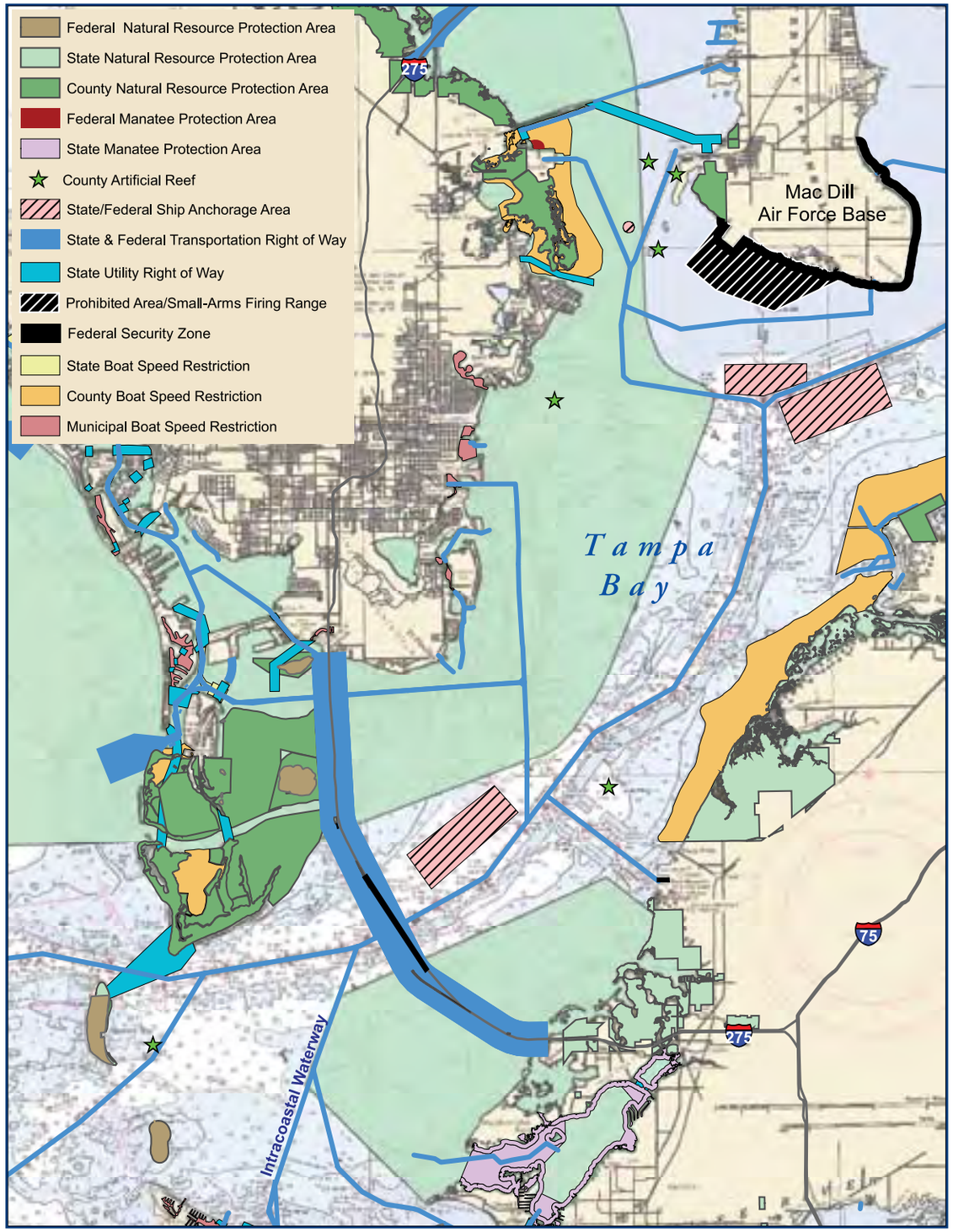


Figure 4. Map Showing the Existing MMAs in Tampa Bay. Boundary developers should consider these areas when creating a new MMA.

C. Work with Agencies and Stakeholders

The boundary developer should work closely with stakeholders and agencies in the region when planning an MMA, being aware of affected groups and their concerns. According to a 2002 needs assessment of marine protected area (MPA) managers, "There is a broad consensus that participation of all stakeholders, including the local community, is critical if MPAs are to be effective." By engaging stakeholders, decision makers invite them to be part of the solution, which can have many benefits:

- Stakeholders are an important source of information.
- Stakeholders who have been engaged in the process are more likely to accept the resulting decisions.
- Stakeholder participation can be a strategy to manage or minimize conflicts among users.
- Stakeholder participation can be an opportunity to advertise or foster ongoing support for a management plan or decision.
  (NOAA Coastal Services Center 2002)

Best Practices

- Involve the public to a greater extent than what is required by law.[2]
- Assess the history of a community (e.g., stakeholder dynamics) and consider the social, political, and economic environments affecting various stakeholder groups.[1,2]
- Assess the capacity of the lead agency and stakeholders so that factors such as time, money, and expertise do not become barriers later in the process.[2]
- Establish goals for the participation process early and communicate them clearly.[2]
- Know "how, when, and under what authority" for each step of the decision-making process.[1]
- Cultivate leadership at all levels (political, agency, interest group).[1]
- Communicate the big picture often so that participants do not lose sight of the goals, or develop unrealistic expectations about the results of their input.[1]
- Consider how maps are developed, what information they contain, and how and when they are used.[1]
- Commit key program staff members to the process from start to finish; they must be able to understand and influence the evolution of the process.[1]
- Design evaluation measures into the process to evaluate decisions and improve future efforts.[1,2]

([1]Bernstein, Iudicello, and Stringer 2004; [2]National MPA Center 2004)

Technical Considerations

Both boundary developers and stakeholders benefit by bringing in local knowledge of the resources and human uses (NOAA Coastal Services Center 2002). Stakeholder buy-in often leads to compliance, a perception that decisions are legitimate, and an opportunity to educate participants about the issues involved (NOAA National MPA Center 2004). Furthermore, federal acts or regulations may require public comment if a federal agency's proposed action significantly affects the quality of the human environment (e.g., legislation or another action that would establish new marine boundaries or change existing marine boundaries). Information about the National Environmental Policy Act (NEPA) (title 42, *U.S. Code*, sections 4321 and following) and Council on Environmental Quality (CEQ) regulations (title 40, *Code of Federal Regulations*, parts 1500 to 1508) is available on the NOAA Web site: *www.nepa.noaa.gov*.

Stakeholder participation, although important, does not come without its challenges. Potential issues with stakeholder involvement may include delays in decision making, increased need for resources such as staff time and money, and tension among stakeholder groups. While increased stakeholder participation demands more resources and effort at the initial stages of MMA planning, this work can also save in the long run by increasing the likelihood that the plan will be approved, implemented, and enforced (NOAA National MPA Center 2004; Brody, Godschalk, and Burby 2003; Kelleher and Kenchington 1992).

Steps for Engaging Stakeholders in Decision Making

Boundary developers should plan carefully for stakeholder participation before launching into the process. Many items may become barriers to participation unless boundary developers sufficiently address these factors in the early stages of creating a participation strategy—and not as an afterthought (National MPA Center 2004). The information below highlights steps involved in engaging stakeholders in a participatory process, and questions to consider throughout each step.

Table 3. Steps for Engaging Stakeholders in Decision Making

1. Set the Stage	• Clarify Goals and Motivation – What are the goals for the MMA? – What are the goals for participation and what, specifically, do you want from the stakeholders? • Understand Underlying Authority – What are the legal mandates? – Who makes the ultimate decision? – How much weight does stakeholder input have? • Identify Stakeholders – Who will be impacted (positively or negatively) by the decision? – Will anyone's livelihood be impacted? – Does anyone research this issue? – Who may be indirectly impacted? – Who is involved in managing the issue, especially where overlapping jurisdictions are concerned? • Assess Context – What are the attitudes, perceptions, beliefs, and values of the stakeholders involved? – What is a community's past experience with, or perceptions of, management agencies? Other stakeholder groups? – What are existing methods utilized for public involvement (e.g., public notice, public meetings)? • Assess Capacity – Are there time or money constraints? – Are staff members properly trained (e.g., facilitation, conflict resolution skills)? (Bernstein, Iudicello, and Stringer 2004; National MPA Center 2004)
2. Design the Participation Process	• Establish the level of stakeholder involvement (e.g., top-down process versus bottom-up process) required or desired given the factors listed above. • Determine what participatory methods may be most appropriate given the goals of participation. – Gather information: focus groups, facilitated workshops; interviews, and surveys. – Distribute information: presentations to community groups, Web sites, newspaper inserts, public service announcements. – Deliberate: facilitated public hearings or meetings, citizen advisory committees, negotiated rule making, mediation processes.
3. Manage the Process and Decision Making	• Consider the political climate. • Evaluate the presence or absence of effective leadership. • Consider the role and timing of map making. • Assess conflict management techniques. • Manage stakeholder expectations by clearly communicating the stakeholder role in decision making: – Is the process collaborative, consensus-building, or merely input for the agency? – Where does decision-making authority lie? – What happens to participant input once the process is over? (Bernstein, Iudicello, and Stringer 2004)
4. Evaluate the Process	• Evaluate both the degree to which the MMA is meeting its stated goals and the effectiveness of the participatory process itself. • Identify lessons learned about the process of engaging stakeholders: – What worked well? – What did not work well? – How could this process be improved? (Bernstein, Iudicello, and Stringer 2004, National MPA Center 2004)

D. Develop a Model of the Boundary

A boundary must meet the requirements, or purpose, of the MMA, be unambiguous administratively and legally, and serve both the user and mapping communities. Previous sections looked at an MMA's underlying authority, existing boundaries in a region, and the rights and interests of stakeholders.

Here, the boundary developer should understand the legal, management, and technical consequences of using particular boundary components—including straight lines, buffers, shared components, shoreline, and geographic features and place names—and use the knowledge gained in previous sections to develop appropriate boundaries.

Best Practices

- Create boundaries that are clearly defined and thus easy to interpret.
- Keep the user and intent of the boundary in mind, and make the boundaries and boundary information as simple as possible.
- Develop legally defensible boundaries by using unambiguous terms and precise locational references.
- Review all existing boundaries and rules in the area of interest.
- Pay special attention to boundaries, or parts of a boundary, that are ambulatory. If these pieces move (for example, state seaward boundaries), then the boundary may need to be revised.
- Ensure that you are using the proper source data and name of the feature. The official repository of domestic geographic names data for all federal electronic and printed products is the Geographic Names Information System (*http://geonames.usgs.gov*). State-level boundary developers should contact their Geographic Names Authority for information on state practice (*http://www.cogna50usa.org/authorities.htm*).

Technical Considerations

Often the boundary developer needs to reference the boundary to some existing natural feature, such as shoreline, or by using a spatial offset, such as the distance from a point. In some cases, the reference to a feature is helpful for locating the MMA. Considering the intent of the MMA, the tools used in marine navigation, and enforcement and management techniques may help the boundary developer choose whether a reference to a feature is appropriate. While physical demarcation helps enforcement and management personnel locate boundaries (with markers and buoys), the cost of this demarcation for large marine areas is prohibitive. For this reason, boundary developers do not demarcate most marine boundaries but rather delineate them on a map or in a geographic information system (GIS).

Demarcation – The physical marking of the boundary line on the ground or on the water.
Delineation – The detailed portrayal of a marine boundary on a map or in a GIS.

Common Boundary Components

Several boundary components are common in the delineation of marine boundaries: straight lines, buffers, shared components, shoreline, and geographic features and place names.

Straight Line – A straight line is the line of shortest distance between two points in a specified space. On a curved surface, such as the surface of the Earth, a straight line is called a ***geodesic line***. Because boundary surveys in marine environments are expensive, a common practice is to develop the boundary using a nautical chart. These charts commonly use the ***Mercator*** map projection, in which all meridians and parallels intersect at right angles. This property makes a Mercator chart ideal for navigation. However, a straight line derived from a Mercator-based nautical chart is not actually a straight line, but rather an arc on the surface of the Earth. This type of line is called a ***loxodrome or rhumb line***, and differs from a geodesic line in that it does not represent the shortest distance between two points on the Earth's surface. A geodesic line appears as a curved line feature on a Mercator chart (see Appendix C for further explanation of boundary line types).

Also, Mercator projections distort area, and on a global scale this distortion increases with increased distance from the equator. At chart scale, the distortion increases with increased distance from the latitude of true scale. As a result, area calculations derived from boundaries delineated using a Mercator-based chart may contain inaccuracies. Straight boundary lines specifically defined as either geodesic or rhumb lines with visible on-water reference points are generally easier to enforce and understand than other types of boundaries.

Buffer – A buffer often describes a marine area surrounding a geographic feature or fronting a portion of a shoreline. The buffer projects a specified distance from a point or geographic or linear feature. Measurements of distance can range from feet or meters to miles, kilometers, or nautical miles. An example of a buffer might be all waters extending out from an island for a distance of 3 nautical miles. Computer-mapping software packages can assist in the development of buffers, but note that precise results may vary by software.

Locating and enforcing buffers can pose problems, however. For example, a problematic buffer might include the description, "3 miles from the 1000-meter isobath." Less sophisticated users may have difficulty locating the isobath and the distance from this feature. This reference has an additional complexity because the term isobath is a reference to a depth contour on a specific nautical chart developed on a specific date.

Charting professionals use point soundings to calculate depth curves, but using different parameters can ultimately create different isobath lines. Also, the bottom depth is constantly changing, requiring new depth surveys, new isobath calculations, and potentially a new buffer. For these reasons, the boundary developer should keep the intended user and navigation technology in mind before selecting a buffer as part of the boundary description.

Shared or Coincident Boundary – In many cases, marine boundaries reference existing boundaries as part of their description. The boundary developer must understand the issues associated with the shared boundary before including it in a boundary description and the resulting digital boundary. Developing a boundary that shares lines with a boundary from a state or another agency is practicable only if those boundaries are undisputed and precisely defined within the MMA boundary description.

Shoreline – Marine boundary descriptions can cite shoreline of the mainland, islands, or islets, as well as ***shoreline features*** such as rocks, reefs, spires, pinnacles, points, capes, headlands, bluffs, or man-made features such as jetties. A shoreline boundary may also follow a river, going upstream from its mouth for a specified distance. Including the shoreline of inland waterways or lagoons as part of the marine boundary is also common.

Table 4. Shoreline Terms for Marine Boundaries

Good

- Mean lower low water (offshore and tidelands)
- Mean low water
- Mean higher high water
- Mean high water (tidelands and upland)

Ambiguous or Imprecise

- Shoreline
- Mean Sea Level
- U.S. Coastline
- General contour of the coast
- High water line
- Vegetation line
- Debris line
- Ordinary low water
- Ordinary high water (Inland waters)

Shoreline is a common reference feature but one of the most complex to portray accurately. Ambiguities in a shoreline description can call into question the precise location of the MMA. Also, natural processes such as tides, weather, and climate can significantly change the location of the shoreline over time. If the MMA boundary's intent is to reflect these natural changes, then using shoreline features in the boundary description may be appropriate. Boundary developers should reference the official ***tidal datum***, such as the line of mean lower low water. The tidal datum should remain consistent for the entire description of the marine boundary, if possible (see Table 4 for acceptable and unacceptable shoreline terms).

Mapping the tidal datum requires some specialized and often expensive surveying techniques and, therefore, common practice is to select the shoreline data from the largest-scale and most current nautical chart (see Step 3, "Generate the Digital Boundary"). If the boundary developer uses the nautical chart, then the boundary description should contain the chart name, scale, and date, along with the tidal datum. The boundary developer should not select a shoreline from a map, photograph, or plat that does not clearly indicate the state of the tide, collection method, and date. The boundary developer must also understand that referencing the shoreline in the boundary description creates the additional burden of having to update the ambulatory shoreline continuously.

Submerged Feature – Marine boundary descriptions can also employ submerged features such as depth contours (derived from seafloor topography), seamounts, reefs, banks, shoals, and shipwrecks. As is true with the other features, the purpose of the MMA will help determine whether referencing submerged features is appropriate. These submerged features may or may not be clearly marked on nautical charts, or they may be ambulatory and require that the boundary developer revisit the boundary periodically to make corrections. However, in some cases, the ambulatory nature is exactly the reason the developer would reference the feature in the boundary, such as to define natural resource areas like oyster reefs or mangrove marsh.

Other reasons exist to reference underwater features. For example, in the 1990s, NOAA began the preferred practice of including references to submerged lands and primary feature(s) it wished to protect, as well as the waters. NOAA now expressly includes specific references to named banks, as well as the surrounding waters and submerged lands. Although the use of coordinates makes it easier for the mariner to locate the boundary, reference to such features is helpful for underwater users. Both methods enhance the public notice and record and assist in enforcement actions against violators.

The following chart summarizes the characteristics of each boundary component and refers to relevant examples. These examples appear in Appendix A.

Table 5. Common Boundary Components and Characteristic Issues. The left-hand column refers to examples of marine managed areas that use these boundary components.

Boundary Component	Definition	Jurisdictional Issues	Digital Mapping Issues	Other Considerations
Straight Line *See Examples 1 and 2 in Appendix A*	The line of shortest distance between two points. See Appendix C for explanation of line types.	This component is the easiest to create and enforce if properly defined.	This component is the most easily mapped if properly defined.	Using straight-line segments to create a simple polygon is easiest to depict and enforce, but a polygon may generalize the area you plan to manage.
Buffer *See Example 1 in Appendix A*	A buffer is a boundary projected a set distance from a point or linear feature, such as a shoreline.	The reference feature may move, so this boundary type could be ambulatory.	Most geographic information systems can easily create a buffer; however, not all buffers are necessarily alike because of the different ways of creating a buffer.	Replicating this type of boundary component can be difficult. Defining the type of mathematical computation is critical to ensure that others can easily re-create the boundary.
Shared *See Example 2 in Appendix A*	This component is an already established boundary line, such as the outer limit of a maritime zone or another MMA, including state and local MMAs.	This component has no jurisdictional issues as long as the shared boundary is clearly defined (see other boundary components for possible issues).	This component has no digital mapping issues as long as the shared boundary is clearly defined (see other boundary components for possible issues).	Shared boundaries could be ambulatory or difficult to replicate and enforce. You must understand the nature of the shared boundary line before adopting it.
Shoreline *See Example 2 in Appendix A*	This component is a line delineating the land–sea interface. It can be described by various tidal datums: for example, mean high water (MHW) or mean lower low water (MLLW).	Shoreline is ambulatory and can be problematic to enforce if it is not clear to the public or enforcement officials where the boundary begins and ends.	Shoreline can be used as long as it references the depiction on charted products, such as NOAA's nautical charts.	When describing shoreline, you must identify a tidal datum. Preferably, you should use commonly charted datums, such as MLLW or MHW. Avoid using ambiguous terms such as "coastline" or "shoreline" unless they are qualified.
Geographic Feature/Place Name *See Example 1 in Appendix A*	This component can be a variety of submerged, emergent marine, submergent, or terrestrial (land-based) features. Examples might include references to depth contours, seamounts, reefs, rocks awash, jetties, bridges, or an entrance to a river.	References to geographic features are good for clarifying the intent of a boundary; however, it is always good to identify geographic coordinates for enforceability.	There are no digital mapping issues as long as properly defined geographic coordinates help locate the geographic feature. If a boundary follows a depth contour, data must be available, preferably on a nautical chart, to create the boundary line.	A geographic feature can move or even disappear; therefore, your boundary could become ambiguous.

Step 2:
Describe the Marine Boundary

Introduction
This step provides guidance for writing a description of a marine boundary. A good boundary description uses clear, concise, and technically sound language to locate and depict the intended geographic area with such certainty as to exclude all other possible interpretations. The components of the boundary description need to abide by both legal and modern mapping standards to meet these goals.

The boundary developer must clearly state the extent of the area being described, the intent of the marine managed area (MMA), and the associated rights and responsibilities. As Figure 5 illustrates, the description may include potential rights in the marine managed area, such as wind energy and radio spectrum leasing within the airspace, fishing or other natural resources within the water column, sand and gravel on the seabed, and oil and gas within the subsoil.

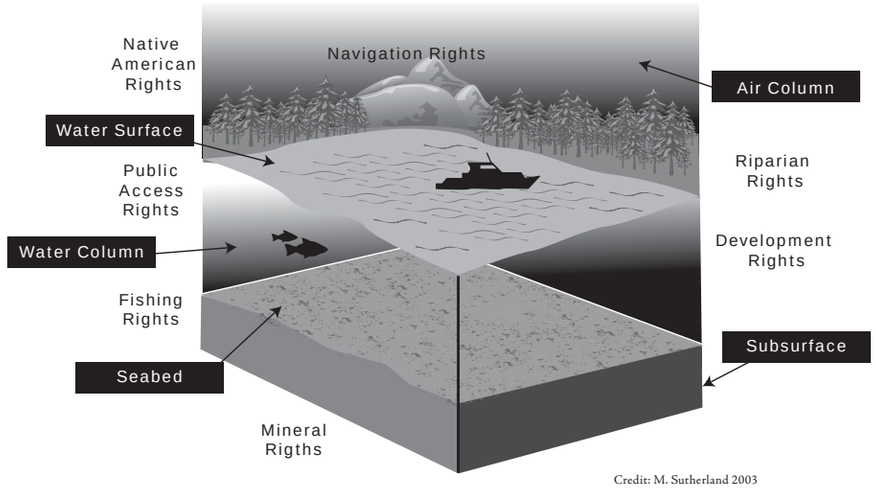


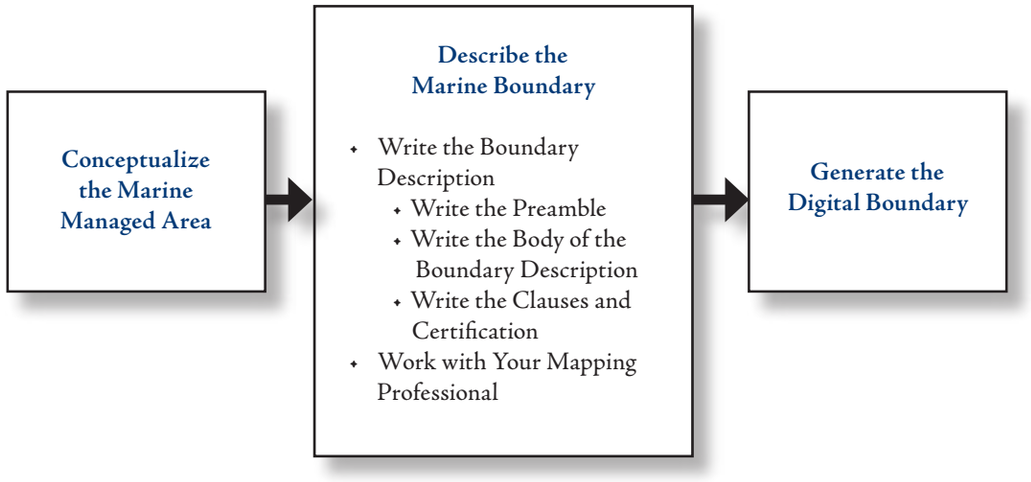
Figure 5. Potential Rights That May Be Represented in a Boundary Description

Many of the standard protocols for land surveying, as well as the legal best practices of land boundary determination, apply to the marine environment. The boundary developer must first focus on the issues of significance to the marine environment and lay out the three sections of the marine boundary description: the preamble, the body, and any limiting or augmenting clauses.

The boundary developer must also work with a mapping professional—because the originating agency is responsible for the authenticity and accuracy of the data it bases its marine boundary description on. Throughout the boundary delimitation process, the boundary developer should keep in mind the following elements:

- MMA users, specifically native languages and customs
- Access to information and the public notification process
- The ability to demarcate the boundary or provide signage
- Legal defensibility
- Methods for enforcement

For a checklist that captures the documentation requirements of several approaches to boundary making, see Appendix D, "Checklist for Writing a Boundary Description."



A. Write the Boundary Description

1. Write the Preamble of the Boundary Description

The preamble of a boundary description, often only one paragraph in length, contains vital information. The preamble states 1) the name of the boundary and the agency administering the marine managed area; 2) the general location of the area and the name of the state, territory, insular possession, county, borough, parish, municipality, township, range, meridian, city, town, or village, if applicable; 3) the purpose of the marine managed area; 4) the features to which the boundary applies (e.g., uplands, submerged lands, water column, water surface, and seabed); 5) and the adjacent jurisdictions. The preamble should also note any documents that provide information essential to the description, such as land orders, proclamations, deeds, charts, or maps.

2. Write the Body of the Boundary Description

The boundary developer must write a careful, unambiguous, and technically complete description of the boundary. The body of the boundary description presents the information necessary to describe the exact location of the marine managed area. Each detail, including punctuation and formatting, is critical for creating a clear boundary, and boundary developers must follow good practices for constructing those details to eliminate ambiguities. Creating a marine boundary poses some special challenges because of the lack of physical demarcation or "signposts" that are used in land surveying and because of the ambulatory or changing nature of the sea and the shoreline.

The boundary developer must carefully choose the appropriate method for describing the boundary. An MMA can be divided into two types: those that have some shoreline or dry land component and those that do not (see Figure 6). The clearest, least ambiguous manner for describing all MMAs is through the use of coordinates. This is especially true for MMAs that lie entirely offshore. However, those MMAs that have some shoreline or dry land component may reference other boundaries and man-made or natural features as part of the boundary description. If this is the case, the boundary developer should use, if at all possible, fixed features such as lighthouses instead of features that can move, such as buoys. For examples, see Appendix A.

At all times, the boundary developer must keep in mind the precision or accuracy needed to meet the original purpose of the MMA, the end users whose activities are impacted, and the ease of enforcement of rules, all of which will help determine the appropriate method. Consideration and use of the tools of navigation are prudent substitutes for the signage and fences that are generally impractical in the marine environment, except perhaps for the landward component of an MMA.

The body of the description should always end with a statement on the size of the area (water and land separately, as necessary). See Appendix D for a checklist of these details.

Figure 6. Examples of Land–Water (left) and Water Only (right) MMAs

In land surveying, a ***point of commencement***, which is usually a known reference monument on land, helps to locate a starting point for the boundary. Courses and distances are listed from the point of commencement to the ***point of beginning*** of the boundary description. Then a series of directions and measurements identifies other defining points on the boundary, including a return to the original point, which creates a closed area. In the marine environment, a known physical marker is often nonexistent, so a coordinate is used. In some cases where the boundary touches land, physical markers (e.g., the corner of a Public Land Survey System grid or an elevation monument) may be used as the starting reference point. This will tie the MMA boundary to the upland and tideland boundaries, facilitating a seamless onshore–offshore cadastre.

Cadastre – A record of interests in land, including both the nature and extent of interests. Usually this means maps and other descriptions of land parcels, as well as the identification of who owns certain legal rights to the land. (Berry 1993)

3. Write Clauses and Certification

Boundary developers use limiting clauses or qualifiers to identify or preserve some rights or to recognize a previous conveyance. Limiting clauses or qualifiers can also grant or recognize a right (such as an easement) of a third party. For instance, the term ***subject to*** refers to a right or grant already in existence. Boundary developers often include qualifying clauses in the description to ensure continued passage with each successive conveyance. Augmenting clauses attach a right or privilege to the land or water area that a boundary developer is describing. The term ***together with*** adds rights specific to the land or water area.

The boundary description's certification includes the author and the author's title, as well as the authoring agency and date.

B. Work with Your Mapping Professional

When describing a marine boundary, the boundary developer should work with a mapping professional (also a boundary developer) for technical guidance. Mapping professionals can include geographers, cartographers, geodesists, and surveyors, among others. Listed below are some of the technical issues that boundary developers must address.

Best Practices

- Work with a mapping professional for technical guidance when writing a boundary description.
- Record geographic coordinates in degrees, minutes, and seconds.
- Use a precision (number of decimal places) that matches the originating chart, survey, or source data.
- Clearly state the horizontal datum, using NAD83, WGS84, or ITRF 1992–2000 (see "Datums" in Step 2B below for definitions of these datums).
- Annotate all measurements with a clear statement of units.
- Describe shorelines with a clear statement of the tidal datum.
- Define the type of straight lines that connect the geographic coordinates (see Appendix C).
- Include marine managed area references, such as water column, submerged lands, surface, and so on.
- Keep the end-user and ease of enforcement in mind when defining the boundary.

Technical Considerations

Coordinate Descriptions

The least ambiguous boundary would be defined by a series of geographic coordinates stated in degrees, minutes, and seconds of an appropriate precision, with a clear description of the horizontal datum. An example coordinate is North 48°20'16", West 125°22'48". Three recommended horizontal datums are the North American Datum of 1983 (NAD83), the World Geodetic System of 1984 (WGS84), or the International Terrestrial Reference Frame (ITRF) of 1992–2000 (see "Datums" section below). If the marine boundary description references a shoreline, the description must also clearly state an official tidal datum, such as mean high water. International practice for describing linear distances requires the use of geographic or nautical miles as units offshore and statute miles onshore. For shorter distances, boundary developers should use feet or meters. Best practices always require a clear statement of measurement units.

Nautical Mile* vs. *Statute Mile – A ***nautical mile*** is a unit of length equivalent to the distance spanned by 1 minute of arc in latitude at the equator, or 1,852 meters. A ***statute mile*** is defined as a unit of length equal to 1,609.344 meters. One nautical mile is equal to approximately 1.15 statute miles.

There is no official standard international abbreviation for nautical mile. Some common abbreviations are ***NM***, ***nmi***, and ***nm*** (not to be confused with *nm*, official for nanometer).

Coordinates appear in a number of alternative notations (see Table 6), each of which has implications for accuracy and precision (see "Coordinate Accuracy and Precision" below). Many computer-based mapping systems store geographic coordinates in decimal degrees. In this notation, the degree units remain the same, but the smaller increments (minutes and seconds) appear as a decimal of a degree. For example, the above-mentioned coordinate pair would be North 48.3378°, West 125.3800°. Another common format for navigational equipment such as Global Positioning System (GPS) receivers or chart plotters is degrees and decimal minutes. In this notation, the above coordinate pair would be North 48°20.27', West 125°22.80'. Several on-line utilities are available for conversion between these notations.

Table 6. Coordinate Notations. Decimal places vary depending on the level of precision.

DDD° MM' SS.S"	Degrees, Minutes, and Seconds
DDD° MM.MMM'	Degrees and Decimal Minutes
DDD.DDDDD°	Decimal Degrees

Map Scale

Map or chart scale is the proportion between a length on a map or chart and the corresponding length on the Earth (see figure 7), and is usually expressed as a ratio (e.g., 1:24,000). Large-scale maps and charts, such as 1:10,000, depict smaller areas of the Earth (e.g., Key West Harbor) than do small-scale maps and charts, such as 1:1,000,000, which depict large areas (e.g., the Gulf of Alaska). This seemingly backwards way of defining scale is easy to understand using the following illustration: 1:1,000,000 and 1:10,000 scales are actually the fractions 1/1,000,000 and 1/10,000. These translate into 0.000001 and 0.0001 respectively, with 0.000001, the small scale, being much smaller than 0.0001, the large scale. Note that all maps depict only selected physical features, and the symbols used for those features are often displaced and proportionally larger, especially as the map or chart scale becomes smaller.

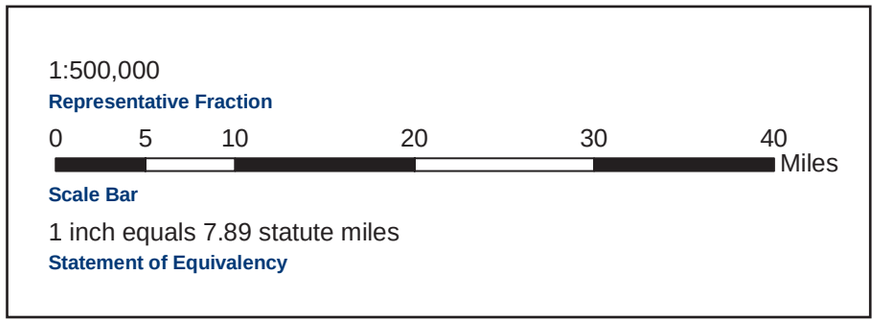


Figure 7. Map Scale Representation

Map Projections

A ***map projection*** is a mathematical model that transforms the locations of features on the Earth's curved surface to locations on a two-dimensional surface (ESRI 2001). All maps and nautical charts are "distortions of the truth," since map and chart projections cannot preserve the true spatial relationships among features in a three-dimensional world when they are portrayed on a two-dimensional surface.

Note that many projected coordinate systems are in use today for describing marine boundaries. Examples of these are the Universal Transverse Mercator (UTM) and State Plane Coordinate System (SPCS). Mapping professionals commonly use these planar systems on land, but the systems can be problematic if used offshore. This is especially true for large areas that may cross zones and whose mapped area will become distorted over distance. Boundary developers for MMAs with land components may need to address this issue. Fortunately, computer mapping programs have standard algorithms that can convert between coordinate systems.

Coordinate Accuracy and Precision

Accuracy and precision are key elements in defining and portraying marine boundaries. The source map or technology that the boundary developer uses for the boundary survey will dictate the inherent level of accuracy, which in turn should dictate boundary and coordinate precision, or the intent of the MMA may dictate the boundary precision. Boundary developers should pay particular attention to the precision that geographic information system (GIS) technologies can produce from various source data. Specifically, GIS technologies may generate map data with precision values that are not supported by the source data. Note that precision and accuracy are different terms with different meanings. For example, a map could be highly precise but inaccurate.

Accuracy refers to how a mapped boundary matches its exact position on the surface of the Earth and is dictated by factors such as the scale of the map or the accuracy of the survey instrument used to develop the boundary. For example, a map at a scale of 1:24,000 that meets national map accuracy standards has a horizontal accuracy of ± 40.00 feet (see Table 7).

Precision refers to the exactness with which a boundary can be realistically described in a boundary description or on a map. For example, if the user uses the decimal degree notation and carries out the coordinate to four decimal places, then the horizontal accuracy is within ± 36.432 feet. Three decimal places would imply a horizontal accuracy of ± 364.32 feet. Coordinate precision should reflect the accuracy of the source map or boundary survey. Any attempt to use more decimal places would create false accuracy in the boundary's location. Because of the many inherent complexities in mapping in the marine environment, the boundary developer is responsible for selecting a level of precision that best matches the source data.

Table 7. The Relation of Map Scale to Coordinate Precision

MAP ACCURACY *National Map Accuracy Standard*		**CORRESPONDING COORDINATE PRECISION ***	
Map Scale	**Map Accuracy**	**Precision in Degrees (D), Minutes (M), Seconds (S)**	**Precision in Decimal Degrees (DD)**
1:1,200	**± 3.33 feet**	**DDD MM SS.SS ≈ 1.01 feet**	**DDD.DDDDD ≈ 3.6432 feet**
1:10,000	**± 27.78 feet**	**DDD MM SS.S ≈10.1 feet**	**DDD.DDDD ≈ 36.432 feet**
1:24,000	**± 40.00 feet**	**DDD MM SS ≈ 101 feet**	**DDD.DDDD ≈ 36.432 feet**
1:100,000	**± 166.7 feet**	**DDD MM SS ≈ 101 feet**	**DDD.DDD ≈ 364.32 feet**
Degrees of latitude and longitude are only equivalent at the Equator. Closer to the poles, the distance between meridians of longitude decreases.			DDD.DD ≈ 3,643.2 feet DDD.D ≈ 36,432 feet

** A best practice is not to exceed the source data's inherent level of horizontal accuracy (map accuracy) by overstating coordinate precision. However, the boundary developer must decide whether a slight overstatement of precision is acceptable (as illustrated in some examples in this table). The mapping professional should guide this decision.*

Datums

Boundary developers must reference all coordinates to a specific datum or the coordinates' accuracy and precision will be meaningless. The two principal types of datums are horizontal and vertical.

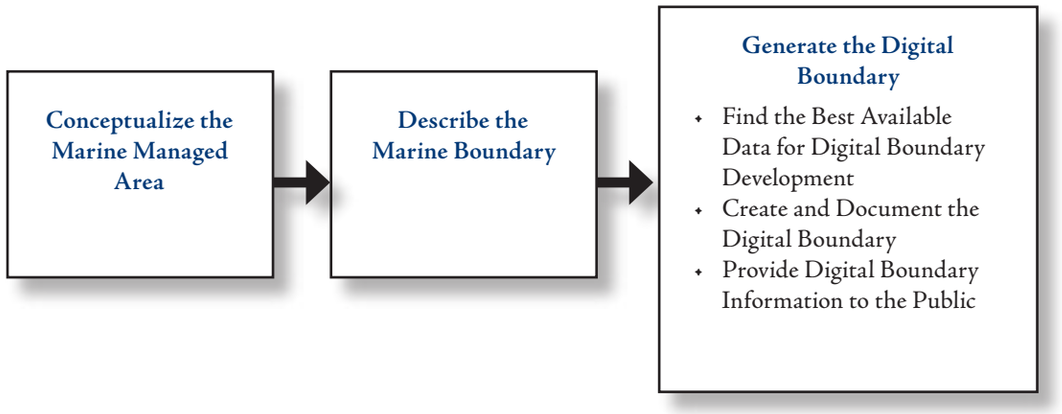
Horizontal Datum – A horizontal datum is the set of parameters and control points used to accurately define positions on the three-dimensional model of the Earth. The boundary description must clearly state the datum description alongside the coordinate list. In the U.S., the North American Datum of 1983 (NAD83), the World Geodetic System of 1984 (WGS84), or the International Terrestrial Reference Frame (ITRF) of 1992–2000 are all acceptable horizontal datums and are considered to be equal to each other for most positional accuracy requirements. In the search for adjacent or existing data, the boundary developer may find other international, historical, or local datums but should use only the three horizontal datums named above.

Vertical Datum – Vertical datums come in three categories: ***orthometric datums***, based on gravity potential; ***tidal datums***, based on tidally derived surfaces such as mean high or low water; and ***three-dimensional datums***, realized through space-based systems such as the Global Positioning System. Orthometric datums include the North American Vertical Datum of 1988 (NAVD 88) or the older National Geodetic Vertical Datum of 1929 (NGVD 29). Examples of tidal datums include mean high water (MHW) and mean low water (MLW). Marine boundaries often reference a tidal datum. The tidal datum, which is not level, has its origins in the need to reference depth soundings that are taken at different stages of the tide during hydrographic surveys to a common level. References to shoreline should include a specific statement of the tidal datum, such as mean high water. Conversion between two vertical datums is not as straightforward as the transformation between horizontal datums. Therefore, this manual recommends that boundary developers use the tidal datum specified on the latest edition of U.S. nautical charts when developing an MMA, with references to features above or below sea level. On U.S. charts, this tidal datum is generally mean lower low water.

Step 3:
Generate the Digital Boundary

Introduction
Technological advances in mapping, such as the use of Global Positioning System (GPS) receivers and geographic information systems (GIS), have enhanced and complicated the development, implementation, and enforcement of boundaries for marine managed areas. Depleted marine resources, increased threats by man-made pollutants, and the need for exploring alternative energy sources are forcing many jurisdictions to increase law enforcement and begin comprehensive planning for the offshore environment. As a result, the need is great for accurate, useable, and accessible digital boundaries that define marine managed areas.

This step illustrates the process for generating digital marine boundaries, which can take place at any stage of the boundary development process. If a boundary developer writes a legal or official boundary description using the best practices suggested in this manual, digital boundary development should be uncomplicated. However, the practice of developing boundaries in a GIS is specific to the particular agency and software. For that reason, this manual addresses fundamentals such as digitizing and attribution, but not software-specific methods. This section points boundary developers to authoritative data sources and provides sound practices for developing, documenting, and disseminating digital boundary files.



A. Find the Best Available Data for Digital Boundary Development

Boundary developers must have authoritative information sources to create good digital boundaries. As described in Step 1D, "Develop a Model of the Boundary," the most commonly referenced components in marine boundary descriptions include shoreline, bathymetry, geographic features, and other boundaries. This section provides sources for those commonly referenced components, with Web links for downloading data. These sites are current as of June 2006.

Technical Considerations

Digital Data Sources

Shoreline – Shoreline is the line of contact between land and a body of water (Shalowitz 1962). On NOAA nautical charts and surveys, the shoreline approximates the mean high water line; however, some states define shorelines differently. For examples of how shoreline is referenced in boundary descriptions, see Example 2 in Appendix A.

NOAA's tidally derived shoreline is available at the following Web sites.

Extracted Vector Shoreline Project
http://nauticalcharts.noaa.gov (see "GIS Products & Services")
The Extracted Vector Shoreline Project provides public access to an accurate vector version of the coastline and shoreline data from NOAA nautical charts. The project targeted scales between 1:10,000 and 1:80,000, with emphasis on the larger scales. Software and processes designed by the Cartographic and Geospatial Technology Programs (CGTP) automatically extracted the vector data from the NOAA nautical charts.

National Geodetic Survey Shoreline
www.ngs.noaa.gov/RSD/shoredata/NGS_Shoreline_Products.htm
The Remote Sensing Division of the National Geodetic Survey plans and acquires aerial photography and compiles shoreline data, primarily for nautical charts produced by NOAA's Office of Coast Survey. Data from recent years are in digital form and are available through the division's on-line mapping application.

T-sheet Shoreline Data – *www.csc.noaa.gov/shoreline/*
The NOAA Coastal Services Center's T-sheet shoreline information is a high-resolution vector shoreline it obtained from a historical multi-year collection of NOAA coastal survey maps. These data are available by coastal state.

Bathymetry – Bathymetry is a measurement of the depth of the seafloor referenced from the water surface and is the marine equivalent to topography. Many digital data sources exist for bathymetry, including charted soundings, interpolated grids, and derived source data.

The following Web sites provide references to commonly used bathymetric data sets.

NOAA Electronic Navigational Charts
http://nauticalcharts.noaa.gov/ (see "Electronic Navigational Charts")
The NOAA Office of Coast Survey has been involved in the development of a NOAA Electronic Navigational Chart (ENC) suite to support the marine transportation infrastructure and coastal management. The NOAA ENC supports all types of marine navigation by providing the official database for electronic charting systems. Bathymetry is a key data set in the ENC, and a nonproprietary tool called ENC Direct, found on this Web page, will extract this bathymetry. Shoreline data are also available from this site.

Bathymetry, Topography, and Relief
www.ngdc.noaa.gov/mgg/bathymetry/relief.html
The NOAA National Geophysical Data Center (NGDC) has an interactive database management system for the assimilation, storage, and retrieval of geophysical data, including marine trackline geophysical data, hydrographic (bathymetric) survey data, aeromagnetic survey data, multibeam bathymetric data, and gridded bathymetry and topography.

NOAA National Ocean Service's Estuarine Bathymetry
http://spo.nos.noaa.gov:16080/bathy/
NOAA's estuarine bathymetry is a digital raster compilation of hydrographic survey data for selected U.S. estuaries. The 70 estuarine bathymetry data sets are available in both 30-meter and 3-arc-second resolutions. The gridded bathymetry is an interpolated data set representing the most up-to-date depth-sounding information that was available at the time of publication (1998).

Nautical Charts – *http://nauticalcharts.noaa.gov*
The NOAA Office of Coast Survey is responsible for developing the country's official nautical charts. In addition to nautical charts, in paper and digital formats, the Office of Coast Survey creates products for the development of marine boundaries.

Other Boundaries – A boundary description often references coincident and adjacent boundaries. Although there are many sources for these digital boundaries, it is critical that boundary developers use the original source for that boundary whenever possible. For an example of referencing coincident boundaries in a boundary description, see Example 2 in Appendix A.

The following Web sites provide references to commonly used marine boundaries. In addition, see Appendix F for a listing of select federal data sources.

Marine Boundary Working Group Data Portal – *www.csc.noaa.gov/mbwg/*
This data portal provides users with access to digital marine boundary data distributed by various federal agencies. The working group adds new marine boundary data to the portal as they become available.

Marine Protected Areas – *www.mpa.gov*
The data at this site are for marine managed areas (MMAs) in the MMA inventory database that meet the criteria set forth by the National Marine Protected Areas Center. Data collection is ongoing.

Geographic Features and Place Names – *http://geonames.usgs.gov*
Boundary developers often use prominent geographic features such as headlands, rivers, and offshore rocks as points of reference in a boundary description (see Example 1 in Appendix A). Boundary developers should ensure that they use the proper name for a given feature. Federal boundary developers are required to use the U.S. Geological Survey's Geographic Names Information System (GNIS) place names for their mapping requirements. For undersea feature names beyond 12 nautical miles, the National Geospatial-Intelligence Agency maintains a database called the GEOnet Names Server (GNS) at *http://earth-info.nga.mil/gns/html/index.html*.
State-level boundary developers should contact their Geographic Names Authority for information on state practice. A list of contacts is located at *www.cogna50usa.org/authorities.htm*

State, regional, and local agencies can provide useful digital data to an MMA boundary-making effort. Nongovernmental organizations and universities are other sources of information. The National States Geographic Information Council (NSGIC) (*www.nsgic.org/index.cfm*) home page lists individual state points of contact for geographic information.

B. Create and Document the Digital Boundary

This section lays out the proper process for developing and documenting digital boundaries. Mapping professionals can develop digital boundaries in many software environments using standards and methods specific to their agency or industry. An agency responsible for digital boundary development should develop internal protocols or production rules to ensure consistency and boundary integrity.

After developing the boundary, the mapping professional must write ***metadata***, or data about data, to document the content, quality, condition, process steps, and other pertinent information about the data set. Unfortunately, many data sets have little or no documentation. In the geospatial data world, this presents the immediate problem of not knowing critical information such as the data source, collection date and time, coordinate system, or contact information for questions. Furthermore, if a boundary developer were to use these undocumented data in the development of a boundary, the boundary's validity would always be in question. Data for enforcement, regulatory, or jurisdictional purposes must be documented and traceable to a source.

Best Practices

- Use the official source for the referenced data when developing a digital marine boundary.
- Develop mapping specifications or a standard operating procedure for developing boundaries within an organization.
- Use the largest scale map or chart available (map with the most detail) when developing a boundary from a hard copy document.
- Use a projected coordinate system when performing any type of buffering or area calculation.
- Develop metadata using approved national standards to help strengthen the validity of the data.
- Budget ample time in the data development process for metadata creation.
- Take advantage of tools that were developed for metadata creation.
- Don't feel restricted by what the Federal Geographic Data Committee (FGDC) metadata standard requires. There are places in the metadata for supplemental information.
- Develop more detailed feature-level metadata for complex boundaries.
- Keep a detailed log of the entire boundary development process, including all process steps.
- Submit the metadata record to a clearinghouse registered with the National Spatial Data Infrastructure or other Web portal.

Technical Considerations

Geographic Information System Requirements

Boundary developers may wish to generate MMA boundaries digitally by using GIS technologies. Many GIS software packages are available, and they vary greatly in breadth and complexity. However, boundary developers should focus on four fundamental considerations when generating digital information:

1. **Technical Training** – The mapping professional should be skilled in using the software package's functions and have a sound background in creating and using spatial data. Specifically, this person should know and understand the relationships between the following:
    a. Scale, precision, and accuracy
    b. The effects map projections and coordinate systems have on distance and area computations (e.g., equal area projections versus Universal Transverse Mercator)
    c. The effects of combining "best available data" that were created at varying time periods, resolutions, and purposes (e.g., overlaying 1:500,000-scale habitat maps with survey data collected using GPS from a research cruise).
    d. Topology and coincident boundaries (e.g., the creation of sliver polygons, overshoots, undershoots, and label errors)
    e. The use of bearings and distances to generate boundaries (e.g., 10 miles on a bearing of 270^0 from the Cape Lookout Lighthouse)
    f. The use of overlay or proximity analysis techniques to generate boundaries (e.g., overlay hard bottom habitat located in 30 to 50 feet of water, within the state jurisdictional boundary)

2. **Source Material** – Digital information will only be as accurate as the source material a mapping professional uses to create the boundary. For example, if a mapping professional were to digitize a boundary from a 1:80,000-scale NOAA Nautical Chart, the resulting data could only be as accurate as that source scale. This holds true as well for source data that are digital. GIS technologies may allow a user to "zoom in" and digitize information at a resolution greater than is appropriate given the scale of the source material. However, the resulting data are only as accurate as the source. For example, 1:24,000-scale source material is only accurate to that scale, or approximately 2,000 feet for every one inch on the map.

3. **Quality Assurance and Quality Control (QA/QC)** – The mapping professional should employ a QA/QC method that ensures that all aspects of data handling, manipulation, and interpretation will support defensible decision making. A correctly implemented QA/QC process can aid in systematically capturing data that are accurate and compatible—and will form the basis for high-quality metadata. A properly employed QA/QC process can address six key areas of concern:

a. ***Metadata*** are information that describe the origin, content, properties, and characteristics of spatial data. The existence of high-quality metadata is critical to using GIS data with confidence (see "Metadata" section below).

b. ***Spatial accuracy*** is the degree to which the horizontal and vertical positions of features in the GIS database reflect their true position on the Earth's surface.

c. ***Attribute accuracy*** is the degree to which descriptive items in the GIS database accurately describe the spatial features in the database.

d. ***Logical consistency*** is concerned with the validity of the data, the establishment of correct topological relationships, the logical design of database objects, and compliance with minimum data standards.

e. ***Completeness*** of a data set refers to the extent to which the data set includes all existing features and their attributes, given the resolution (scale) of the data.

f. ***Geometric fidelity*** refers to the degree to which two separate GIS databases can be overlaid and a known point in each of the two databases will be spatially coincident.

Although all these database characteristics contribute to the accuracy of a given GIS layer, geometric fidelity and logical consistency are of extreme importance. Boundary developers should pay close attention to these issues in particular.

4. **Attribution –** Digital boundaries require proper attribution to assist with future analyses and characterizations that may support the MMA.

   Standardized attribute schemas or feature-level metadata provide ways to describe the quality, currentness, and accuracy of each geospatial feature in a data set. Feature-level metadata differ from Federal Geographic Data Committee (FGDC) metadata in that they capture additional information at the "feature level" (that is, a segment of a boundary). Since marine boundaries often come from various sources, feature-level metadata will capture this information and ensure data integrity and utility.

   Examples of feature-level metadata may include attributes such as area, date, datum, scale, site, and status. Mapping professionals can capture feature-level metadata, or data attribution, in the "entity and attribute" section of the metadata record (see section below). Boundary developers should use the FGDC *Cadastral Data Content Standard* to aid in the development of attribute schemas and data dictionaries for marine boundaries.

Metadata – Data Documentation

Metadata are a component of data that describe the data. Imagine trying to find a book in the library without the help of a card catalog or computerized search interface. These information sources are essentially metadata about the books housed at that library or other libraries. Metadata for a geospatial data set are similar in that they describe the content, quality, condition, and other characteristics of the data—answering the who, what, when, where, why, and how about a data set. Without proper documentation, a data set is incomplete.

Critical metadata elements for the boundary developer – The FGDC *Content Standard for Digital Geospatial Metadata* (version 2.0) spells out mandatory elements for a metadata record. Marine boundary metadata developers must pay close attention to the following elements, because they will help end users better understand some of the unique aspects of marine boundary data.

Title – The name of the data set, which must be as descriptive as possible.

Originator – The organization or individual who developed the data set. This element is critical because it assigns responsibility for the data in question. Users of marine boundary data need to know the originator to confirm the validity of the data.

Status – The state of the data set. This answers the question of whether an agency has approved or sanctioned the data.

Use Constraints – Restrictions and legal prerequisites for using the data set. This statement should convey how users could employ the data. Boundary developers should consult with their legal offices to craft some standardized language for this element.

Horizontal Positional Accuracy – An estimate of the accuracy of horizontal positions of spatial objects in a data set. This element is particularly important for enforcing boundary encroachments.

Source Scale – The scale of a boundary or map from which a data set is derived. Typically, the larger the scale (more detailed), the more accurate the boundary.

Projection – The name of the map projection used to present the data.

Horizontal Datum – The reference system that defines the coordinates of a data set.

Vertical Datum – The reference frame or system from which vertical distances (altitudes or depths) are measured. The FGDC metadata standard refers to a vertical datum as a vertical coordinate system.

Process Description – An explanation of the steps a boundary developer performed to create the boundary, as well as the techniques, parameters, and reference to a published or internal protocol.

Supplemental Information – Supplemental information is a catchall element that includes any other descriptive information about the data set.

Entity and Attribute Information – The description of the entities, attributes, attribute values, and related characteristics encoded in a data set. These elements provide the meaning of a data set and should be well thought out or even standardized before development.

Resources – The following Internet sites provide additional information about metadata:

Federal Geographic Data Committee (FGDC) Home Page – *www.fgdc.gov*
Home page of the FGDC, which links to information about standards, tools, the National Geospatial Data Clearinghouse, ways to submit metadata to a clearinghouse, and many other metadata issues.

U.S. Geological Survey (USGS) Metadata in Plain Language
http://geology.usgs.gov/tools/metadata/tools/doc/ctc/
This interview-style document from the USGS provides plain language descriptions of the FGDC standard elements.

The FGDC *Content Standard for Digital Geospatial Metadata* (CSDGM)
www.fgdc.gov/standards/standards_publications/index_html
This page has links to download the CSDGM in various formats, including text and portable document format (PDF) versions.

Graphical Version of the *Content Standard for Digital Geospatial Metadata*
http://biology.usgs.gov/fgdc.metadata/version2/
This graphical version is similar to the one included with the workbook and is one of the best tools available for understanding the structure of the FGDC metadata standard. Different colors and graphical styles are used to put an emphasis on different element types.

The NOAA Coastal Services Center's Coastal Metadata Web Site
www.csc.noaa.gov/metadata/
This Web site has information about standards, tools, training materials, and partnership and funding opportunities.

In addition to generating metadata about the MMA boundary, boundary developers should keep detailed notes on their methods, decisions, and courses of action in the mapping process. This could be a simple history file that chronologically records actions taken to create the boundary, capturing the nuances of the process that may get lost in a metadata record or forgotten with all the details of the effort. Entries in notes like this may address these issues:

- Why boundary developers chose a certain data set over another data set
- What data sets they used in an overlay process to produce an intermediate data set
- Who decided that one boundary alternative was more appropriate than another—and when.

The notes can be as detailed as the boundary developer wishes to make them. Along with metadata, these notes will complete the documentation that will describe both the process and resulting boundary information for users and stakeholders.

C. Provide Digital Boundary Information to the Public

The boundary developer should follow a process for sharing digital boundaries with others who can use it. Since data sharing is a critical component of an agency's data management system, a developer should make digital boundaries available through the Internet as soon as possible. The developer can make a boundary available either on an agency home page or through some of the larger state and U.S. data-sharing initiatives. Some effective ways to share digital boundary data are as follows:

- Make FGDC-compliant metadata available on the National Spatial Data Infrastructure (NSDI) Clearinghouse system. The NSDI Clearinghouse is a decentralized system of servers, located on the Internet, that contain field-level descriptions of available digital spatial data. This descriptive information (metadata) is in a standard format to facilitate queries and provide a consistent presentation across multiple participating sites. Boundary developers can place metadata on the NSDI Clearinghouse by submitting to existing nodes, or metadata servers, on the system or by creating their own node. Information about how to participate in the clearinghouse system is located at *www.fgdc.gov/dataandservices/*.

- Boundary developers can also post metadata directly to the E-Gov Geospatial One-Stop (GOS) Portal. The portal is a catalog of geospatial information, containing thousands of metadata records, downloadable data sets, images, map files, links to clearinghouses, live maps, features, and catalog services, and more. Government agencies and individuals submit metadata records to the portal, located at *www.geodata.gov*, or the portal can harvest the data from geospatial clearinghouses.

- Another way to share boundary data with the public is to inform the FGDC's Marine Boundary Working Group, which will post links to the data to its boundary portal located at *www.csc.noaa.gov/mbwg/*. Additionally, boundary developers can register data and metadata for marine protected areas at *www.mpa.gov*.

By providing metadata to the above systems, a boundary developer does not have to release the actual digital data. The metadata can simply serve as a way for others to discover existing data sets. The responsible agency can decide how to release the data.

Appendix A:
Examples – Marine Managed Area Legal Descriptions

The following examples are hypothetical marine managed area boundary descriptions, which follow many of the best practices found throughout the handbook. Specifically, these descriptions contain all the boundary components listed in Table 5, "Common Boundary Components and Characteristic Issues." Note that stated distances and areas are presented for illustration only and are not necessarily accurate.

EXAMPLE 1 – Seagull Islands Marine Managed Area

Preamble

The following is a description of the boundary of the Seagull Islands Marine Managed Area (MMA), located in the Mitchell Islands in Southeastern Lakasa. The MMA lies in federal waters, approximately five miles southwest of the City of Umbrella Harbor, State of Lakasa, within the Gulf of Purdue, North Pacific Ocean. The Seagull Islands MMA is administered by the U.S. Fish and Park Administration, as authorized by Public Law 95-266 of August 18, 1995. The purpose of the Seagull Islands MMA is to protect seabird and marine mammal habitat. The MMA includes the Seagull Islands, Otter Rocks, all rocks and islets, the water column, and underlying seabed within a rectangular area. The base map used to delimit this boundary is the 1:60,000-scale National Charting Agency (NCA) nautical chart "Seagull Islands", dated June 1990.

The boundary of the Seagull Islands MMA is more particularly described in coordinates referenced to the North American Datum of 1983 (NAD83) as follows:

Body

COMMENCING AT U.S. Coast and Geodetic Survey station "OLE", located within the City of Umbrella Harbor on a bluff overlooking the shoreline of Don Harbor at latitude North 59 DEG 33' 20.16" and longitude West 139 DEG 50' 40.69";

THENCE on a bearing of South 45 DEG 45' 50" West, a distance of 5 nautical miles to Corner No. 1, latitude North 59 DEG 29' 16" and longitude West 139 DEG 56' 12", the TRUE POINT OF BEGINNING for the area to be described;

THENCE described by the following series of coordinates connected by geodesic lines;
Corner No. 2: North 59 DEG 29' 16" West 140 DEG 16' 12"
Corner No. 3: North 59 DEG 09' 16" West 140 DEG 16' 12"
Corner No. 4: North 59 DEG 09' 16" West 139 DEG 56' 12"
THENCE to Corner No. 1, the TRUE POINT OF BEGINNING;

Comprising an area of approximately 990 square nautical miles of water and 9 square nautical miles of land.

Clauses and Certification

SUBJECT TO the reservation for the Campbell Radio Communication Tower, located on North Seagull Island at latitude North 59 DEG 21' 02" and longitude West 140 DEG 21' 09". The 1 square nautical mile reservation is described by a buffer with a radius of 3,428 feet from the center of the tower.

EXAMPLE 2 – Guano Rock Marine Managed Area

Preamble

The following is a description of the boundary of the Guano Rock Marine Managed Area (MMA), located in the Mitchell Islands in Southeastern Lakasa. The MMA lies in federal and state waters, adjacent to the City of Umbrella Harbor, State of Lakasa, within the Gulf of Purdue, North Pacific Ocean. The Guano Rock MMA is administered jointly by the U.S. Park and Refuge Administration and the State of Lakasa Department of Natural Resources, as authorized by Executive Order 10815 of June 19, 1996. The purpose of the Guano Rock MMA is to preserve and protect the historic and cultural resources of Guano Rock and its surrounding waters, including the wreck of the SS *Bass*. The MMA includes Guano Rock, the water column, and underlying seabed including Esch Bank. The base map used to delimit this boundary is the 1:40,000-scale National Charting Agency (NCA) nautical chart 17125 entitled "Guano Rock", 2nd Edition, dated October 1994.

The boundary of the Guano Rock MMA is more particularly described in coordinates referenced to the North American Datum of 1983 (NAD83) as follows:

Body

COMMENCING AT a cast iron pipe located at the witness corner to the meander corner of Sections 6 and 7, of Township 66 South, Range 25 East of the Smith Meridian, State of Lakasa;

THENCE due west with the section line along the line of latitude North 59 DEG 24' 15" approximately 124 feet to the intersection of the ambulatory shoreline of the Gulf of Purdue at Mean High Water (MHW), the TRUE POINT OF BEGINNING of the area to be described;

THENCE in a southeasterly direction following the MHW line to a point on the north bank of the Ash River within Section 35 of Township 66 South, Range 25 East of the Smith Meridian, State of Lakasa;

THENCE along a line across two headlands at the mouth of the Ash River,* using the shortest distance from the north bank to the line of MHW on the south bank;

THENCE continuing along the MHW line in a southeasterly direction to a point within Section 23 of Township 67 South, Range 26 East of the Smith Meridian, State of Lakasa, at the intersection of the line of latitude at North 59 DEG 09' 16";

THENCE due west along the line of latitude at North 59 DEG 09' 16" to the eastern boundary of the Seagull Islands MMA at longitude West 139 DEG 56' 12";

THENCE due north with the eastern boundary of the Seagull Islands MMA to a point at the intersection of latitude North 59 DEG 24' 15";

THENCE due east to the TRUE POINT OF BEGINNING;

Comprising an area of approximately 100 square nautical miles of water and 2 square nautical miles of land.

Clauses and Certification

SUBJECT TO the reservation for the Naito Native Corporation for subsistence activities at the mouth of the Ash River. The members of the Naito Native Corporation are allowed to harvest fish within the Guano Rocks MMA within a rectangular-shaped area extending 1 nautical mile seaward from a point 1 nautical mile northerly of the north bank of the Ash River and from a point 1 nautical mile southerly of the south bank of the Ash River.

* *The agency creating the boundary must determine the procedure it will use to close a river mouth, creek, or small bay. Whatever mapping procedure an agency uses, it must consistently apply that procedure to every instance.*

Appendix B:
Primer on Marine Boundaries

Submerged Lands Act Line – This line is also referred to as the state seaward boundary. The Submerged Lands Act of 1953 (title 43, *U.S. Code*, section 1301) grants most coastal states rights out to 3 nautical miles (9 nautical miles for Texas and the Gulf coast of Florida, as well as Puerto Rico). Submerged Lands Act boundaries between states and the U.S. are ambulatory unless they are fixed by a deliberate action of the U.S. Supreme Court, that is, by a decree "fixing" the boundary by coordinates.

Revenue Sharing Line – This line, also referred to as the Limit of '8(g) Zone,' extends 3 nautical miles beyond the state seaward boundary, or the Submerged Lands Act line. Revenues generated from resources such as oil and gas within this area are shared between the federal government and the coastal state. Any Limit of '8(g) Zone' line based on a fixed Submerged Lands Act line is by default also fixed. Note that the Submerged Lands Act and Limit of '8(g) Zone' lines are unique to the U.S. In most other countries, offshore territory is controlled by the federal government.

Territorial Sea – The territorial sea, previously at 3 nautical miles, was extended to 12 nautical miles from the U.S. baseline by Presidential Proclamation 5928 in 1988, in accordance with the United Nations Convention on the Law of the Sea (UNCLOS). The U.S. claims sovereignty in this area from the airspace down through the water column and into the subsoil.

Contiguous Zone – Established by Presidential Proclamation 7219 in 1999, this area, which extends offshore in the area between 12 and 24 nautical miles from the U.S. baseline, grants the U.S. the "control necessary to prevent infringement of its customs, fiscal, immigration or sanitary laws, and regulations within its territory or territorial sea."

Exclusive Economic Zone – Presidential Proclamation 5030 created the 200-nautical-mile exclusive economic zone (EEZ) in 1983. The EEZ of the U.S. is an area beyond and adjacent to the territorial sea of the U.S., or, for purposes of domestic fisheries laws, extending from the state seaward boundary. Within the EEZ, the U.S. has (a) sovereign rights for the purpose of exploring, exploiting, conserving, and managing natural resources, whether living and nonliving, of the seabed and subsoil and the superjacent waters, and with regard to other activities for the economic exploitation and exploration of the zone, such as the production of energy from the water, currents, and winds; (b) jurisdiction as provided for in international law with regard to the establishment and use of artificial islands, installations and structures, marine scientific research, and the protection and preservation of the marine environment, and (c) other rights and duties provided for under international law.

Continental Shelf – Under international law, the Continental Shelf is defined to include the seabed and subsoil beyond the continental margin out to a distance of 200 nautical miles from the baseline.

Note: The territorial sea, contiguous zone, and EEZ are measured from baseline points, which are established along the mean lower low water (MLLW) line and may include offshore rocks and islands. Part II, Article 5, of UNCLOS states that the baseline for measuring the breadth of the territorial sea is the low-water line along the coast as marked on officially recognized, large-scale nautical charts. The term ***low water*** does not reference a specific tidal datum; however, the lowest charted datum in the U.S. is MLLW, and that is the tidal datum of reference for the baseline. The Submerged Lands Act and revenue sharing lines are also measured from the baseline as described under Article 5 of UNCLOS; however, some U.S. domestic policy exceptions may apply when defining the coastline under the Submerged Lands Act.

Also important is the fact that, with erosion and accretion, the coastline can move. When that happens, the baseline and associated boundaries will all move with it. Maritime boundaries established through treaties with neighboring foreign States are permanent and will not be affected by any change in the baseline. Finally, all these boundaries are in nautical miles. Other offshore boundaries include those for national parks, marine sanctuaries, and so on.

Other Domestic Marine Boundaries

NOAA Three Nautical Mile Line – The three nautical mile line, previously identified as the outer limit of the territorial sea, is retained on NOAA's nautical charts because it continues to depict the jurisdictional limit of certain state and federal laws.

NOAA National Marine Sanctuary – The purpose of the Marine Protection, Research, and Sanctuaries Act of 1972 was to prevent "unregulated dumping of material into the oceans, coastal, and other waters" that endanger "human health, welfare, and amenities, and the marine environment, ecological systems and economic potentialities." Within this law, the transportation and dumping of radioactive, chemical, or biological substances were forbidden. Title III of this act, later called the National Marine Sanctuaries Act (title 16, *U.S. Code*, sections 1431 and following), charged the secretary of commerce to identify, designate, and manage marine sites for their conservational, ecological, recreational, historical, aesthetic, scientific, or educational value within significant national ocean and Great Lake waters. The NOAA National Marine Sanctuary Program is the agency of responsibility for establishing sanctuary boundaries. Boundary developers should obtain official boundary coordinates and associated information from the sanctuary program.

Marine Protected Areas – Marine protected areas differ in location and jurisdiction. Some are in federal waters only and are managed under federal laws by federal agencies. Some are found only in state waters where both state and federal laws may apply. Marine protected areas may overlap other areas and share jurisdiction over some ocean waters. Finally, some marine protected areas include both marine and land areas. NOAA, the National Park Service, and the U.S. Fish and Wildlife Service are currently the agencies of responsibility for marine protected areas. Boundary developers should obtain official boundary coordinates and associated information from the appropriate agency of responsibility.

Fish and Wildlife Refuges – There are over 540 National Wildlife Refuges in the U.S. These areas are managed by the U.S. Fish and Wildlife Service (USFWS) for the continuing protection and conservation of fish and wildlife. One-hundred-sixty-nine of these national wildlife refuges have a boundary that includes a marine component. That is, the refuge boundary, or a portion of the boundary, comes into contact with saltwater (or waters of the Great Lakes). The list of 169 refuges, which make up the initial MPA Inventory for USFWS, includes refuge boundaries that follow the coastline of the mainland or an offshore island, or the shoreline of a river that is tidally influenced. The list also includes refuge boundaries that extend offshore to include waters and possibly submerged lands. These offshore boundaries may follow Public Land Survey System township and range lines (e.g., Key West National Wildlife Refuge, Florida), unknown tidal datums such as "extreme low water" (e.g., Arctic National Wildlife Refuge, Alaska), or the 12-nautical-mile limit of the territorial sea (e.g., Navassa Island National Wildlife Refuge in the Caribbean Sea).

National Park Service Designations – Several of the 390 units managed by the National Park Service (NPS) have marine components. Glacier Bay National Park has both marine submerged lands and lands above mean high water on all islands out to a distance of 3 miles from the coastline. This ***National Park*** designated area offers the full resource protection of a traditional park. ***National Preserves*** are established primarily for the protection of certain resources. Activities such as hunting, fishing, or the extraction of minerals and fuels may be permitted if they do not jeopardize the natural values. ***National Reserves*** are similar to preserves, although management may be transferred to local or state authorities. ***National Lakeshores*** and ***National Seashores*** focus on the preservation of natural values while at the same time providing water-oriented recreation. Additionally, ***National Recreation Areas*** encompass land and waters set aside for recreational use by acts of Congress. ***National Monuments*** like Fort Sumter, ***National Historical Parks*** like Salt River Bay, and ***National Memorials*** like the USS *Arizona* are a few samples of NPS commemorative site designations that often contain marine components.

Other – Offshore are many other types of boundaries—for example, military disposal areas, restricted areas, no discharge areas, and prohibited areas. Boundary developers should obtain official boundary coordinates and associated information for these and other boundaries from the appropriate agency of responsibility.

Appendix C:
Boundary Line Types

Because straight lines can be defined in many different ways, this appendix describes some of the more commonly used line types. When a non-projected boundary is described by coordinates, the boundary developer should clearly state the type of line connecting the turning points.

Geodesic (Geodetic) Line – "A geodesic line is the shortest distance between any two points on a mathematically defined surface" (U.S. Department of Defense 1981). A geodesic line on an ellipsoid surface is a great circle on a sphere. When drawn on a rectangular latitude and longitude grid, a geodesic line appears to be a curve.
Great Circle Line – "A circle on the surface of the Earth, the plane of which passes through the center of the Earth" (U.S. Department of Defense 1981). "A great circle arc and a geodesic [line] are similar and the difference between them, depending on chart scale, may not be discernible. . . . The difference will depend on the length of the boundary segment and the latitude" (Smith 1982).
Small Circle Line – A circle on the surface of the earth, the plane of which does not pass through the earth's center (Smith 1982).
Rhumb Line – A rhumb line is a line on the Earth's surface that cuts all meridians at the same angle. A rhumb line is a straight line on a Mercator projection and a curved line on all other projections. Rhumb lines are also referred to as loxodromes. These lines represent a line of constant bearing. (Most NOAA nautical charts are on the Mercator projection.)

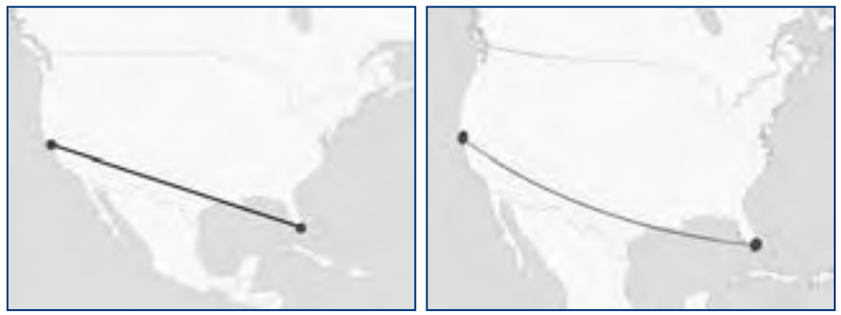


Figure 8. Rhumb Line Connecting Miami with San Francisco. The map on the left shows a rhumb line in a Mercator projection (straight line), while the map on the right shows this same line on an unprojected geodesic model of the Earth (curved line).

Apparent Straight Line – Depending on the map or chart projection and scale used to depict a boundary line, the line *may appear* to be a straight line. If a legal description or metadata record does not clearly state the type of line connecting turning points, the user should not make an assumption as to the type of line. Boundary developers should contact the agency of responsibility for the correct information.

Azimuth and Bearing – The bearing of a line is the angle of the line measured from a north or south reference meridian, to the east or west. It is always 90° or less, and includes letters to indicate the quadrant and reference meridian orientation. The azimuth of a line is the angle measured clockwise from a reference meridian and ranges from 0° to 360.° Azimuths are measured from either true or magnetic north, but true is preferable, since magnetic north changes with time. See examples in Table 8 below.

Table 8. Relationship of Bearings and Azimuths

Bearing	Azimuth
N45°00'E	45°00'
S56°43'E	123°17'
N47°25'W	312°35'

Appendix D:
Checklist for Writing a Boundary Description

The information below derives from a checklist for creating land-based legal descriptions. Boundary developers can apply many of these same principles to the marine environment, as this manual explains in Step 2, "Describe the Marine Boundary," and illustrates in Appendix A, "Examples – Marine Managed Area Legal Descriptions." Boundary developers should use this section as a compendium for writing an MMA description.

Writing the Description: General Guidelines

- ☐ The information should be presented for easy verification
  - ○ Use a colon to end the preamble
  - ○ Begin each course or set of coordinates on a new line of text
  - ○ Underline, boldface, capitalize, or italicize important aspects of the description (such as *Point of Beginning* or *Thence*)
  - ○ Use a semicolon to end each course or set of coordinates
- ☐ Writing style should be consistent and clear
  - ○ Avoid unnecessary capitalization
    - ▪ Do not capitalize adjectives describing a line (e.g., *southwesterly along the line of mean high tide*)
    - ▪ Do not capitalize general directional calls
  - ○ Do not use abbreviations (e.g., use *north* instead of N; *feet* instead of ft.)

Writing the Preamble of the Boundary Description

- ☐ Name of the unit or area
- ☐ Agency of jurisdiction
- ☐ Location information for unit or area
  - ○ State, territory, or possession
  - ○ County, borough, or parish
  - ○ District, municipality, city, town, or village
  - ○ Subdivision: name, number, date, and place of recording
  - ○ Legislative plat or map: law number, date, title, or other information necessary for identification
  - ○ Recorded document: book and page, where filed, date, title, and other identifying information
  - ○ Public Land Survey System: township, range, section, lot, aliquot part, date accepted
  - ○ Land grant: name, date, court case number, and other identifying information
  - ○ Chart or map: name, number, sheet number, date published
- ☐ Identification of adjacent landowners or administrators (senior and junior rights)

Writing the Body of the Boundary Description*

(Please note that this section lists several approaches to boundary making, not all of which would necessarily be applicable for a specific area.)*

- ☐ Point of commencement
- ☐ Point of beginning
- ☐ Physical monuments, found or set
- ☐ Natural monuments
- ☐ Directions
  - ○ Basis of bearing (astronomic north, magnetic north, assumed, grid)
  - ○ All bearings on same basis
  - ○ Directional calls along a monument (e.g., southerly along shoreline)
  - ○ Directional calls along geometric or irregular lines (e.g., westerly with the 100-fathom contour)
  - ○ Bearings: correct quadrant (northeast, southeast, southwest, northwest)
  - ○ Azimuth: definition of reference meridian (south or north)
  - ○ Grid: definition of reference meridian

- ☐ Distance: consistent units and definition of units where necessary

- ☐ Curves: adequate information supplied
  - ○ Curves are considered tangent unless otherwise stated
  - ○ At least two parameters to a horizontal curve
    - ▪ Tangent distance
    - ▪ Radius
    - ▪ Chord distance
    - ▪ Arc distance
    - ▪ Deflection angle
    - ▪ Delta angle
    - ▪ Degree of curvature (arc or chord)
  - ○ Direction of curvature (a curve can have adequate parameters to describe it, but the direction it bends or arcs may still be unknown)
    - ▪ Direction of curvature
    - ▪ Direction of radius at point of intersection or point of tangency
    - ▪ Deflection: left or right
    - ▪ Curves: tangent or not

- ☐ Coordinates: adequate information
  - ○ Geographic position (latitude/longitude)
  - ○ Plane coordinates (X and Y)
  - ○ Procedure used to determine coordinates
  - ○ Control used to determine coordinates
  - ○ Datum used for coordinates
  - ○ State Plane / UTM coordinates
    - ▪ Reductions applied (convergency, scale, elevation factors)
    - ▪ Datum (e.g., North American Datum of 1927 or 1983, etc.)
    - ▪ Reference to system used (zone, state, local, city, or project datum)

- ☐ Mathematics
  - ○ Units
  - ○ All bearings and distances on same reference system, and figure should close mathematically
  - ○ Consistency of parts (length of arc, central angle, radius, etc.)
  - ○ All coordinates on same reference system
  - ○ All lines and parts defined by consistent dimensions
  - ○ Consistency of significant figures

- ☐ Tidal datum
  - ○ Mean high water
  - ○ Mean higher high water
  - ○ Mean low water
  - ○ Mean lower low water

- ☐ Area
  - ○ Units (acres or hectares)
  - ○ Land component
  - ○ Water component

Writing the Clauses and Certification

- ☐ Clauses
  - ○ Limiting clauses (all easements)
  - ○ Augmenting clauses

- ☐ Certification of description
  - ○ Author, title
  - ○ Agency, date

Development Approaches

There are several approaches or methods for developing a marine boundary description. Because of the many features that marine boundaries reference, marine boundary descriptions are often a combination of the traditional surveying methods.

Metes and Bounds – Metes and bounds is a method of describing parcels by measure of length (metes) of the boundary lines (bounds). The most common method is to recite direction and length of each line, as if walking around the perimeter of the parcel being described. In general, the "metes" and "bounds" can be recited by reference to record, natural, or artificial monuments at the corners; and record, natural, or cultural boundary lines.

A true metes and bounds description contains information on the vicinity in which the parcel lies; a call for all ties and monuments, either record or physical, that determine the boundaries; all references to adjoining lands by name and record; and a full dimensional recital of the boundary courses, which close mathematically, in succession around the boundary.

Public Land Survey System (PLSS) – This system refers to a method of describing the rectangular system of surveys inaugurated by the Continental Congress on May 20, 1785, for the survey of the public lands of the U.S. In rectangular surveys, parcels are divided by a baseline intersected at right angles by a principal meridian. The intersection is the initial point from which the partitions are subdivided into equal size townships containing 36 sections. Generally, these parcels are described by reference to a township plat of the public land survey, containing reference to section, township, range, meridian, and state: for example, Section 20, Township 40 North, Range 5 East of the 4th Principal Meridian, Wisconsin.

Bounds – A bounds description uses specific terms to reference the adjoining or bounded parcels, such as, "That parcel of land bounded on the North by Lake Superior, on the West by the Brule River, on the East by Ontonagon Creek." It is also called a description by recital, since it is based upon recorded information or documents of official character and shown on plat maps or charts filed in a public office of record.

This type of description is effective when a survey cannot be performed, but boundary developers should clearly identify the intent of the description so the boundary can be accurately located in the future.

Appendix E:
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Appendix F:
Federal Data Sources

Code of Federal Regulations **–** The *Code of Federal Regulations* is an annual codification of the general and permanent rules published in the *Federal Register* by the executive departments and agencies of the federal government. The *Code of Federal Regulations* is available in an electronic format and a traditional hard copy (book) format (*www.gpoaccess.gov/cfr/*).

As appropriate, all federal agencies must ensure that their official boundary coordinates or other associated boundary information is published in the *Code of Federal Regulations*.

Federal Register **–** The *Federal Register* is a legal document published every business day by the National Archives and Records Administration. It contains federal agency regulations; proposed rules and notices; and executive orders, proclamations, and other presidential documents. The *Federal Register* informs citizens of their rights and obligations and provides access to a wide range of federal benefits and opportunities for funding. The National Archives and Records Administration's Office of the Federal Register prepares the *Federal Register* for publication in partnership with the Government Printing Office, which distributes it in paper, on microfiche, and on the World Wide Web (*www.gpoaccess.gov/fr/*).

All federal agencies must ensure that their official boundary coordinates and other appropriate marine cadastre information is published in the *Federal Register.*

Marine Protected Areas (MPA) Center – The MPA Web site provides details on the data being collected from federal, state, commonwealth, territory, tribal, and local sites as part of the marine managed areas (MMA) inventory. Several search features are available to help access the information contained in the inventory. Maps, downloadable features, and graphs and charts are available (*www.mpa.gov* and *www.mpa.gov/inventory/inventory.html*).

Minerals Management Service (MMS) – The MMS Offshore Leasing Program has a variety of GIS data and maps available by region (*www.mms.gov/ld/Maps.htm*).

National Oceanic and Atmospheric Administration (NOAA) – The NOAA Office of Coast Survey is responsible for producing the nation's official nautical charts and depicting the maritime zones. In addition to nautical charts, in paper and digital formats, the Office of Coast Survey develops a suite of products that can be used in the development of marine boundaries. These data products include nautical charts, electronic navigational charts, the coastal map, extracted vector shoreline, territorial limits and boundaries, and other GIS products (*www.nauticalcharts.noaa.gov*).

United States Geological Survey (USGS) – USGS maps depict the coastal zone and nearshore areas. Under its current map revision policies, USGS relies on shoreline data from NOAA, "when it's available." USGS generally will not revise the shoreline depicted on its maps from aerial photography alone, unless 1) there are obvious man-made changes or 2) when the aerial photography was acquired at mean high water.

Most maps are also available in one or more digital formats. Two National Hydrography Dataset Standards (map scales of 1:100,000 and smaller and larger than 1:100,000) are available on-line (*http://rockyweb.cr.usgs.gov/nmpstds/nhdstds.html*).

In digital form, USGS has available Digital Line Graphics (the line work in USGS topography maps), Digital Raster Graphics (pictures of actual USGS topography maps), and Digital Ortho Quads (aerial photos of sections of USGS maps). It is important to always check the metadata for source, scale, accuracy, and currentness of the geospatial data.

Bureau of Land Management (BLM) – The BLM Lands and Realty, and Cadastral Survey Programs are responsible for 1) public land conveyance data of all past, current, and future right, title, and interest in real property; 2) federal land ownership status of all title, estate, or interest of the federal government in a parcel of real and mineral property, by the portrayal of title for all federal estates or interests in land; and 3) cadastral data describing the geographic extent of past, current, and future right, title, and interest in real property, and the framework to support the description of that geographic extent, which includes survey and land description parcel by parcel. The title and boundary data are documents and survey plats in paper and digital formats.

Information and data on ownership and boundaries of federal interest lands is available on the GeoCommunicator home page (*www.geocommunicator.gov*).

Specific title or boundary information and data are available on the BLM home page by selecting the state office of interest (*www.blm.gov/nhp/index.htm*).

National Park Service (NPS) – The National Park Service provides boundary data for all the national Parks (*www.nps.gov/gis/*).

United States Fish and Wildlife Service (USFWS) – USFWS provides boundary data and related geospatial data for all of its refuges (*www.fws.gov/data/datafws.html*).

Appendix G:
Acronyms

AVIRIS	Airborne Visible and Infrared Imaging Spectrometer
BLM	Bureau of Land Management (U.S. Department of the Interior)
CEQ	Council on Environmental Quality
CGTP	Cartographic and Geospatial Technology Programs (NOAA)
CO-OPS	Center for Operational Oceanographic Products and Services (NOAA)
CSDGM	Content Standard for Digital Geospatial Metadata
CSO	Coastal States Organization
DD	decimal degrees
DMS	degrees minutes seconds
DOI	Department of the Interior
ECS	electronic charting systems
EEZ	exclusive economic zone
ENC	Electronic Navigational Chart (from NOAA)
ESRI	Environmental Systems Research Institute
FCC	Federal Communications Commission
FGDC	Federal Geographic Data Committee
FMRI	Florida Marine Research Institute
GEODAS	Geophysical Data System (NOAA)
GIS	geographic information system
GNIS	Geographic Names Information System (USGS)
GNS	GEOnet Names Server
GOS	Geospatial One-Stop
GPS	Global Positioning System
IHO	International Hydrographic Organization
ITRF	International Terrestrial Reference Frame
LOS	Law of the Sea
MHHW	mean higher high water
MHW	mean high water
MLLW	mean lower low water
MLW	mean low water
MMA	marine managed area
MMS	Minerals Management Service (U.S. Department of the Interior)
MPA	marine protected area
NAD	North American Datum
NAVD	North American Vertical Datum
NEPA	National Environmental Policy Act
NESDIS	National Environmental Satellite, Data, and Information Service (NOAA)
NGDC	National Geophysical Data Center (NOAA)
NGO	nongovernmental organization
NGVD	National Geodetic Vertical Datum
NHAP	National High Altitude Photography
nmi	nautical mile (also NM, and nm)
NMS	National Marine Sanctuary
NMSA	National Marine Sanctuaries Act
NMSP	National Marine Sanctuary Program
NOAA	National Oceanic and Atmospheric Administration (U.S. Department of Commerce)
NOS	National Ocean Service (NOAA)
NPS	National Park Service (U.S. Department of the Interior)
NSDI	National Spatial Data Infrastructure
NSGIC	National States Geographic Information Council
OCS	Office of Coast Survey (NOAA)
OCSLA	Outer Continental Shelf Lands Act
OGC	Office of General Counsel (NOAA)
PDF	portable document format
PLSS	Public Land Survey System
QA/QC	quality assurance and quality control
SLA	Submerged Lands Act
SPCS	State Plane Coordinate System
UNCLOS	United Nations Convention on the Law of the Sea
USAEC	U.S. Army Environmental Center
USFWS	U.S. Fish and Wildlife Service (U.S. Department of the Interior)
USGS	U.S. Geological Survey (U.S. Department of the Interior)
UTM	Universal Transverse Mercator
WGS	World Geodetic System

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