

Marine Land Ownership & Leasing Spatial Database Template V.1

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LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

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Template Overview

Introduction: This template was developed in 2005-2006 as part of a cooperative project between The Nature Conservancy's (TNC) Global Marine Initiative, the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center, and Roger Williams University. The project's goals were to assess and help improve upon the marine land ownership and leasing¹ spatial databases in two pilot states and, based on the results of the spatial database assessment, explore opportunities for conservation of marine lands in the two states.

As part of the cooperative project, project managers developed this template to serve two primary functions:

¹ Throughout this document, "leasing" includes, but is not limited to, any type of proprietary use authorization, such as leases, easements, licenses, permits, and rights-of-entry.

- As a standardized format against which two pilot states' spatial databases for marine land ownership and leasing could be assessed and “measured” to determine their status relative to ideal conditions, allowing comparisons with other states' spatial databases; and
- As a guide for both process and products when developing, improving, managing, and maintaining two pilot states' (and possibly other states' in the future) spatial databases for marine land ownership and leasing.

The template is largely based on the experiences of past and present staff from the Washington State Department of Natural Resources (WADNR) who, over the past 10 years, have greatly evolved the spatial database for marine land ownership and leasing for Washington State marine lands. If successful, this template should also be capable of being applied to any state's marine land ownership and leasing spatial database, under the guise of future expanded iterations of the original cooperative project or for other database projects unrelated to the original project.

The template was not developed with the belief that it will be static or that it is the final and only process/product in regards to spatial database development for marine land ownership and leasing. To the contrary, it's expected that with each use the template will be modified and adapted to evolve, improve, become more realistic, and become more applicable to more states.

The template is structured as a chronological procedure with milestone deliverables and suggested considerations identified throughout the process. As such, when used to assess the current status of a given spatial database, the procedural steps, deliverables, and considerations may be used as a checklist to determine how developed the database is and how far it has to go to be “completed” (see Appendix A for an abbreviated spreadsheet version of the checklist).

1. Project Planning

The first step in assessing and developing a spatial database for marine land ownership and leasing is to determine the goal of the effort. The project's goal will depend in large part on how the information in the spatial database will ultimately be used and who the audience for the information will be.

The Nature Conservancy and NOAA, for example, will use the spatial database they develop to:

- Initiate and facilitate discussions with state marine land managers regarding conservation strategies and activities;
- Identify opportunities for private conservation leasing and ownership;

- Illustrate the relative proportion and distribution of private ownership and leasing activities on marine lands within state jurisdictions.

Another proposed goal for state-level marine land spatial database development is to assist states and local governments in managing marine lands by:

- Identifying the location and extent of marine lands they manage;
- Identifying where authorized uses of marine lands are located;
- Identifying areas important for conservation;
- Identifying areas appropriate for non-conservation activities;
- Identifying mechanisms and locations to achieve a balance of different public benefits.

To initiate the database development process, a project proposal should be prepared, submitted, and approved by decision-makers. Among other things, the proposal should state the goal, the level of effort, and the level of accuracy needed for the project, all of which will depend on the intended future use of the spatial data and type of users.

In developing the project proposal, the following considerations should be made:

Consideration	Description
Geographic Scope	The task of developing a spatial database which encompasses an entire state's submerged lands can be daunting, especially in large coastal states such as Florida, California, and Texas. Therefore, the scope of the project could be refined to include specific geographic areas (maybe those surrounding critical habitat) or specific components of the spatial database development given the resources, time, funding, personnel, and expertise available. These initial pilot projects should be developed so that they could be easily expanded to include a statewide coastal geographic extent.
Participant / Partner Buy-In	A project proposal framework that will benefit multiple users at different levels of government will achieve greater cooperation during project development and implementation.
Information Assessment	The scope of the project should consider how the information is recorded and how it can be retrieved. If marine land ownership, classification, leasing, habitat, and protection mechanisms are recorded together and can be retrieved together, then the project should consider whether all of the information should be included in the onset of the project as opposed to only gathering a subset of the available information, such as ownership and leasing. In addition, project scoping should include an assessment of data limitations and a gap analysis.
Budget and Staffing	The development of a spatial database requires, at a minimum, expertise in the

	<p>following areas: geographic information systems (GIS) data development, database management, project management, and professional surveying. The latter should ideally be consulted and used throughout the data creation process for quality assurance / quality control (QA/QC).</p>
Data Accessibility	<p>The proposal should address how the database information and related products will be made accessible to internal and external users, including technical users and the general public (e.g., web-based portals, data clearinghouses (Geospatial One-stop), etc.). In addition, accessibility by state agencies to hardware/software for data serving should be determined, and a host agency for the data and associated information gateway should be identified.</p>
Database Maintenance and Support	<p>Long-term maintenance and data stewardship needs should be part of the scoping and project proposal. State archives training may be necessary if the end result of the project changes the historical paper recording system into a digital recording system. There may be retention schedules and judicial inquiry considerations to make.</p>
Landowner Liability Issues	<p>Issues concerning landowner liability should be assessed. Under federal and state contamination laws, landowners may be at least partially liable for contamination of their property. Caution should be used when identifying marine land ownership if specific areas of marine lands are known or suspected of being contaminated or if cleanup actions, investigations, or negotiations are taking place.</p>
Terms and Definitions	<p>These will be crucial to the project and should be clarified at the earliest possible point in the process. This will be especially useful when approaching local governments with data requests. All technical terms related to the project (marine lands, parcel, submerged lands, submersible lands, tidelands, bedlands, nearshore, shoreline, etc.) should be clearly defined as local governments, states, and federal agencies use different terminology. Exactly what information is being sought for what types of properties along what water bodies (i.e., saltwater, freshwater, or both) also needs to be precisely defined.</p>

Once the project proposal has been completed, the project approval process should include, at a minimum, obtaining staffing approval, timeline and deliverable approval, budget approval, approval to cooperate with necessary partners, and political support.

The project initiation process has its own considerations which should be made. This includes, among other things, recruiting new staff, convening partners, and developing a detailed work plan. Care must be taken when developing the initial timeline for the proposed project if new staff recruitment or partnership development must occur. Either of these activities can take at least three to six months prior to beginning the actual database development work.

Process Outputs: Project Goal, Project Proposal

Estimated Level of Effort (% of project total): 2%

2. Information Assessment

Researching marine land ownership and transactions will require a large proportion of time when compared to the other phases of the project. The first step in the research process is to determine the physical marine lands (and exactly what interests in marine lands) that were legally transferred to the state from the federal government at statehood. State ownership of marine lands is an incident of statehood (under the equal footing doctrine all states enter into the union on an equal footing as to the original thirteen colonies). State ownership should not immediately be assumed to coincide on the landward side with the line of ordinary high water. Rather, the boundary between private and state ownership can vary from state to state (see Figure 1 for a detailed illustration). On the seaward side, state marine land ownership extends out to three nautical miles except for Texas and Florida where state ownership of marine lands extends out to nine nautical miles into the Gulf of Mexico. A review of the federal Aquatic Lands Act and relevant provisions within state constitutions and legislation will assist in identifying the foundation for state marine land ownership. Overlaps between state marine lands and the Territorial Sea must also be considered relative to the interest held and subsequently conveyed by states to other parties.

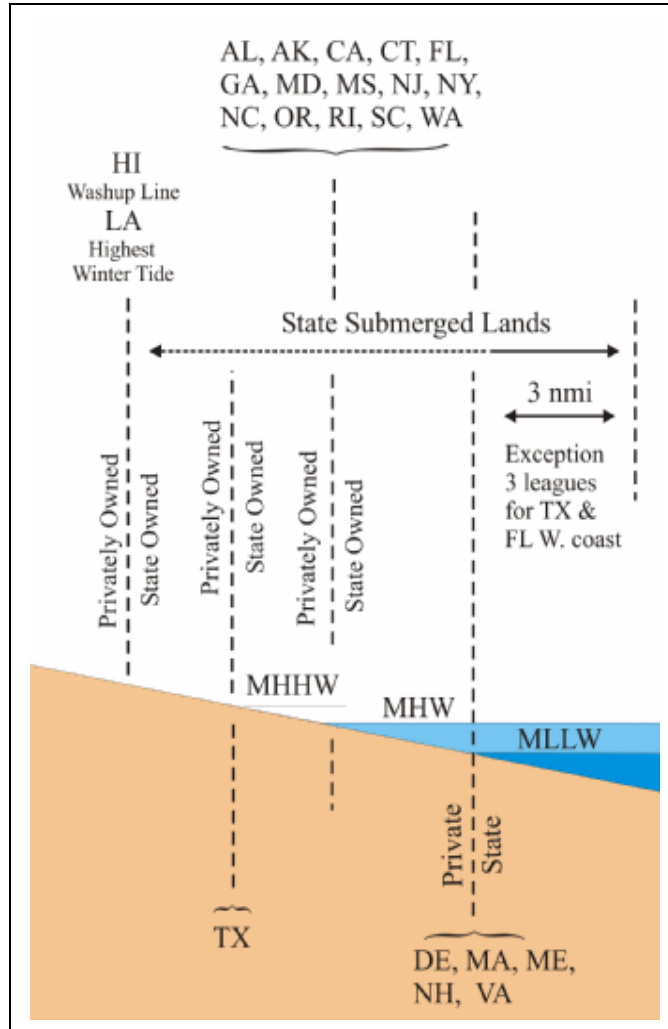


Figure 1 – An illustration of the various boundaries delineating upland private ownership and state submersible and submerged lands

Determining Ownership: One of the initial questions that need to be answered through the document search is whether a surveyed ownership line was completed at the time of statehood. This is followed up by a series of questions that indicate conditions of ownership associated with the surveyed line, and may be considered pre-statehood land transactions.

Situation	Consideration
Is the state one of the thirteen original colonies?	<p>If so:</p> <ul style="list-style-type: none"> ▪ What is the nature of the original land grant establishing the colony? ▪ What is the parameters of colonial or ‘commonwealth rights’ as determined by the courts? ▪ What is the nature of private rights? ▪ What is the nature of tribal rights (treaty or aboriginal) in relation to the marine lands—were there colonial treaties, etc. (this may require a colony-by-colony analysis)?
Was the land area that formed the state acquired from a foreign country, such as France or Spain, where private/or other public rights still exist?	<p>If so:</p> <ul style="list-style-type: none"> ▪ What rights, if any, were retained by private landholders upon statehood? ▪ What is the nature of these rights?
Is the state originally a territory (pre-statehood federal grants)?	<p>If so:</p> <ul style="list-style-type: none"> ▪ Analyze organic act, state constitution and any other acts associated with formation of the State. ▪ What federal actions occurred prior to statehood that may have affected ownership (in the Pacific Northwest, for example—donation land claims, federal ownership related to the Territorial Sea –riparian rights associated with the territorial sea--, etc.)? ▪ Were there pre-statehood Native American treaties (such as the Steven’s treaties in the Pacific Northwest) where not only reservations for the exclusive use of the tribes were established, but access rights to utilize natural resources were retained by the Tribes?
Is the state a riparian state (in this case, state ownership is generally a function of court decisions)?	<p>If so:</p> <ul style="list-style-type: none"> ▪ Do Native Americans still retain ownership rights in these riparian states? ▪ What interest do upland owners have on abutting marine lands? ▪ May the state sell tidelands not conditioned by riparian rights?
Is the state a non-riparian state such as Washington State (in this case, state ownership is based on the federal organic act and state constitution)?	<p>If so:</p> <ul style="list-style-type: none"> ▪ Are there any federal/state statutes that limit State ownership? ▪ Potential disposition of state marine lands is a function of state statute.
Do marine land classifications exist? These classifications are likely different from state-to-state.	<p>If so:</p> <ul style="list-style-type: none"> ▪ A determination of whether land classifications are considered merely physical characteristics of the land or legal classifications established by the legislature must be made. ▪ Legal land classification may define what lands may be conveyed by deed, lease, permit, etc. and the type of transactions that may be undertaken (i.e., tideland sales,

	<p>tideland leases, harbor area leases, bed land leases, waterway permits, etc.).</p> <ul style="list-style-type: none"> ▪ A determination should be made as to whether the land classifications are part of the legislative delegated authority to state agencies to dispose/manage marine lands. The nature and extent of this factor is a requirement prior to defining state land transactions.
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Once the above questions have been answered, the next step in the document search process should be an evaluation of legislative grants and condemnation actions. The state legislature may have granted marine lands back to the federal government for purposes such as lighthouses, military bases, and for reclamation purposes. The state legislature may also have granted marine lands to other state and local governments for purposes such as highways, parks, or other public purposes. The federal government or other state legislatively authorized entities may have condemned state marine lands for federal purposes such as navigation, flood control, and national security.

Ownership Transactions: Upon initiating the document research, it's important to understand that the only documents available may be transaction documents (see below for a list of example documents). There may not be documents that directly and explicitly indicate ownership boundaries per se. The available documents may only indicate transaction boundaries. So if a parcel was in some way transferred out of state ownership, there should be a transaction record indicating the geographic area involved in the transfer.

Most transactions on marine lands will likely not have any documentation related to them. For example, trespasses (i.e., illegal activities) or activities exempted from state processes (legal activities such as recreational docks in some states) may not be documented. Undocumented uses and transactions may be identified through field observations, aerial photography interpretation, or first-hand verbal reports.

Documents which may contain information on ownership transactions:	
State constitutions	Titles
State and federal legislation	Deeds
State agency regulations	Federal and state executive orders
State and federal agency orders	Consent decrees
Tribal reservations	Leases and easements
State and federal court rulings	Settlements
Land grants	

Next, the relationship between local, state, and federal ownership transaction information should be understood. State submerged land management transactions are often recorded on aquatic index plates whereas federal transactions (i.e., pre-statehood or post-statehood) or other state transactions (i.e., via the Governor as opposed to the Lands Commissioner) may not be recorded on the plates. Ownership transactions may have historically been driven by specific industries, such as shellfish or other aquaculture, railroads, ports, or commercial waterfront development. If this is the case, specific sets of transactions grouped by industry drivers may have specific conditions attributed to them such as reversionary clauses, rights transferred, use provisions, and public access provisions. In addition, based on the intended use by the industries, once large parcels may have been divided into numerous very small pieces.

Finally, an important consideration when researching ownership transaction is how they are indexed. These transactions may be recorded and filed as the original documents or they may be tracked by recording some or all of the transactions onto aquatic index plates.

Boundary Information: Once documents outlining ownership of marine lands have been located, the format of the corresponding boundary data should be determined. This boundary information is kept may be in several different forms (see below for examples). The form and format of the documents will determine the steps necessary to retrieve the data.

Examples of common boundary data formats:	
Hardcopy authorization / project documents	Hardcopy orthophotos
Hardcopy authorization / project drawings and maps	Digital orthophotos
Hardcopy / linen aquatic index plates / maps	Digital spatial databases
Digital authorization / project drawing and CAD maps	
Digital authorization / project non-spatial databases	

Additional Considerations: In researching documentation which reveals marine lands ownership, the following additional considerations should be made:

- The **temporal nature of the information** should be understood, including any possible implications on the data itself. Definitions that affect ownership may change over time.
- The **complete lineage of the information** should be investigated. It should be recognized that often times once a public marine land parcel is transferred out of state ownership into private ownership, the parcel is no longer tracked by the state. If tracking occurs, it likely occurs at the local level only. As such, the status of parcels that have been transferred out of state ownership is often times unknown or undocumented. Also, many changes to boundaries (i.e. subdivisions) occur within counties and municipalities and are not reported to the overarching state agency.
- The state's **historical and current interpretation and application of the Public Trust Doctrine over marine lands** should also be taken into consideration as this may affect how private ownership of marine lands is viewed relative to the bundle of rights transferred out of state ownership.
- Legislatively-defined **marine land classifications** may exist and may determine or otherwise limit the types of transactions and uses that can occur on state marine lands. State marine land classifications should be identified and considered throughout the project.

Information Assessment: After research is undertaken and a sound understanding of the information is achieved, an assessment of the data limitations should be made and, if necessary, reported back for possible project modification if sufficient documentation cannot be determined. At a minimum, this assessment should include the following:

Information Assessment Components:

- A list of all documents which reveal marine lands ownership
- A list of all documents / files which reveal associated boundary information
- The condition of the information / data
- The format of the information / data
- The currentness of the information / data

Process Outputs: Documents which reveal state marine lands leasing, licensing and ownership, Information Assessment

Estimated Level of Effort (% of project total): 12%

3. Data Identification and Retrieval

After a determination has been made as to the types of documents and databases that may reveal boundary (primarily ownership and leasing) information, the documents and databases must be physically located and the data must be retrieved from them. There are several important things to note when undertaking this effort:

- The source and location of original, official documents should be known. However, the official ownership and transaction documents are not needed as copies are sufficient.
- The documents and databases will more than likely be stored at numerous different locations, such as: federal and state agencies, federal and state archives, state libraries, federal and state courts, universities, and local governments.
- Often times, since local governments don't generate tax revenues from aquatic lands, they will not maintain records on aquatic land parcels. If the documents/data is at local government offices, it may be available in a very broad format which will be difficult to analyze; this will require assistance from the local government to interpret the data. Sometimes county-level data is available for a cost (usually around \$50 - \$100). If specific questions can be asked based on the results of scoping, defined terms, and type of data sought, this will make the local governments' task of delivering data easier, which will make data interpretation and use easier.
- Many of the source documents may be official, legal records that will not be allowed off-site of the agency premises. Project implementers must be prepared to work within agency facilities to copy or otherwise collect the needed information from the official documents.
- After locating and retrieving the documents and database information, an assessment of data limitations should be made and reported back for project modification if sufficient documents or data cannot be located and retrieved.

Some states have existing spatial databases for marine land ownership, leasing, habitats, species, protective status, and uses, among other things. In many cases, existing spatial databases have been developed (and are consequently maintained) by separate state or federal agencies. Also, often times the types of

information captured in spatial databases is not comprehensive. As such, any given state may have spatial data for ownership and leasing, but may not have spatial data for any other marine land feature. Conversely, all marine land features (i.e., habitat, bathymetry, species, protective statuses, etc.) may be captured in one or more spatial databases except for proprietary information related to ownership and leasing. This latter situation is likely more frequent than the previous in that proprietary information for marine lands in many states is not well developed. The availability of existing spatial databases will have to be investigated and assessed individually for each state. Initial information sources for existing spatial data include, but are not limited to:

- FGDC Cadastral Subcommittee Land Records Inventory, available on-line at: http://www.nationalcad.org/lr_index.asp.
- FGDC Marine Boundary Working Group Data Portal, available on-line at: http://www.csc.noaa.gov/mbwg/htm/boundary_summary2.htm.
- NOAA Ocean Planning Information System (OPIS), available on-line at: <http://www.csc.noaa.gov/opis/html/data.htm>.
- FGDC Geospatial One-stop data clearinghouse, available on-line at: <http://www.fgdc.gov/data/data.html>.

Organizing Source Data: Organizing the source data will require assembling hardcopy information, electronic files, retrieving data from spatial and non-spatial databases, and retrieving data from portals, among other things. The data should be organized into an indexed filing system that is able to accommodate all available information (from local, state, federal, private, district (PUDs, ports), etc.) gathered in order to take maximum advantage of the data now and into the future. The following are several items which should be taken into consideration during spatial data organization activities:

- If the information is taken directly from the hardcopy lease files, a standard typology for land use or lease types may be needed.
- The information may also be taken directly from aquatic index plates. The plates will have to be identified and compiled. The plates may be restricted from being offsite because they are legal documents.
- Note that in all likelihood, the record system will be incomplete and some records may be missing.

Interpreting Source Data: Interpreting source data for marine boundaries is complicated. There are numerous sources of information and numerous nuances

to take into consideration. As such, when interpreting source data for marine boundaries, several considerations should be made:

- The original statutory deed for each parcel should be reviewed to determine the originating authority for the transaction; the originating authority should also be reviewed.
- The rights conveyed (i.e., bundle of sticks) for each transaction should be determined (i.e., fee-title, less-than fee-title, public access reserved, mineral rights reserved, reversionary clauses, etc.). Parcels may be bifurcated by different rights being allocated to different entities and/or through spatial subdivisions (parcels such as this are sometimes referred to as “atomic parcels”).
- Many parcels may be filled and may look like and function as uplands.
- The information gathered from different sources may result in overlapping boundaries.
- If the information is recorded on Aquatic Plates:
 - Many of the boundaries may be referenced to federally-surveyed meander lines or other similar types of lines.
 - Plates may only be a spatial representation of the relative position of leases and may not be geo-spatially accurate.
 - Plates for urbanized areas (such as 1st class tidelands and harbor areas) may be at a higher resolution and larger scales than plates for rural areas.

After the source data has been interpreted, the data limitations should be assessed and reported back for project modification if data is not discernable or is insufficient to continue.

Process Outputs: Existing Spatial Data Inventory, Existing spatial data which delineates marine lands leasing, licensing, and ownership

Estimated Level of Effort (% of project total): 10%

4. Database Development

The design of an organizational framework (i.e., hardware, software, data management) and structure (i.e., attribute schema and domains) for a spatial database should be in place before data organization occurs, especially if database population will occur as part of the project. This process can be time-consuming. Depending on the complexity of the database, as much as six to nine months can be spent on structural development alone. Data models, such as the

National Cadastral Data Model, provide a standardized structure that can be used as a starting point in the database development process.

The following process should be followed when developing a spatial database:

1. The first step in developing the data standard and organizational framework is to investigate the existing data management structures, if they exist.
2. Determine how ownership & transaction information is stored. Is the information already in a relational database? If so, how can this information be linked to related spatial information? Is the information explicit, or does the organization use coded domains?
3. Determine accuracy of existing GIS data sets. Hopefully this information is contained in the metadata. If not, some ground truthing may need to be performed under the direction of a licensed surveyor.
4. Determine current and future accessibility for internal and external users.

The information from the document search may reveal multiple documents for one property. These documents, if only in hardcopy form, should be scanned and put into a digital database in chronological order. All related documents should be linked to specific parcels in the new spatial database. The information from these documents will be captured in the metadata.

Attribute Schema: In developing an attribute schema (structure) for the ownership and transaction information you wish to capture with your spatial data, utilize the existing National Cadastre Data Model (<http://support.esri.com/index.cfm?fa=downloads.dataModels.filteredGateway&mid=40>) as much as possible. This data model contains objects with standardized attribute schemas that structure the ownership and transactional information associated with cadastral data. The Marine Data Model (<http://support.esri.com/index.cfm?fa=downloads.dataModels.filteredGateway&mid=21>) is also available for use, but does not contain objects which model cadastral data in the coastal or marine environments. When developing an attribute schema, several considerations should be made:

- The existing cadastre models should be modified to accommodate aquatic parcel requirements and any existing aquatic land ownership data.
- There needs to be capacity for numerous attributes on a single parcel (i.e., public, private, tribal, 1st class, and 2nd class) and the attributes must include identification of land uses (i.e., oyster reserve, protected area, aquaculture, marinas, shipping terminals, and utility lines). These attributes must be adaptable over time and there must be capacity to create new attributes as the project progresses. New scenarios, codes, and values will likely be needed as the project progresses.

- There needs to be capacity to separate and combine attributes. For example, summarizing attributes to answer larger questions (i.e., show all public tidelands) and determining specific designations for single parcels should be possible.
- The data model should provide consistent symbolization.
- A baseline for data quality should be established, but it must be able to accept and adjust to different levels of accuracy due to huge scale differences in source data for different types of areas.

A draft data model has been created as part of this project. Developed using ESRI’s ArcGIS software, the data model organizes spatial data depicting marine lands leasing, licensing, and ownership into discrete feature classes within feature datasets. The following table illustrates the organizational structure of the data model:

Feature Dataset	Feature Classes
Jurisdictional Boundaries	<ul style="list-style-type: none"> ▪ Federal-State Boundary ▪ Municipal Boundary
Leases, Licenses and Permits	<ul style="list-style-type: none"> ▪ Leases ▪ License Points ▪ License Polys ▪ Permit Points ▪ Permit Polys
Ownership	<ul style="list-style-type: none"> ▪ Parcels
Physical Boundaries	<ul style="list-style-type: none"> ▪ Shorelines
Protected and Regulated Uses	<ul style="list-style-type: none"> ▪ Protected Areas ▪ Zoning
Tidelands	<ul style="list-style-type: none"> ▪ Filled Tidelands ▪ Submerged Tidelands ▪ Submersible Tidelands

The draft data model also includes several stand-alone tables which capture ownership information, which is related to the leasing, licensing, and ownership datasets. It is important to note that this data model is to be used as a guide, and can be modified to meet the needs of individual states and regions.

Spatial Reference: A spatial reference framework should be established. Georeferencing can be difficult for marine lands because there is no standard grid system such as the Public Lands Survey System (PLSS) that extends into the water. This represents a challenge when trying to analyze marine cadastral data with terrestrial cadastral data that is based on different types of reference

systems. Time will be saved if a standard grid system can be developed. In addition, the development of a cross identification system will aid in relating to other systems. When establishing a standard spatial reference system, a licensed surveyor and the end users of the database should be consulted. There are several options to consider:

- **State Plane Coordinate System (SPCS).** This system, developed on a state-by-state basis, uses meters or feet as its unit of measurement. Many states are divided into several zones, which minimize positional error. In those states where a statewide cadastral framework crosses zonal boundaries, the spatial data should be maintained as separate datasets within each zone.
- **Geographic Coordinate System (GCS).** This system utilizes latitude and longitude as its units of measurement. Positions are referenced to the earth by a datum (i.e. North American Datum of 1983, North American Datum of 1927) which is not interchangeable)
- **National Grid-based Systems** the Mineral Management Service (MMS) has divided federal marine waters into leasing blocks; a similar system could be developed and used in state marine waters).

Quality Control: A QA/QC protocol should be created for use during the development and eventual maintenance and use of the spatial database. Data quality can be maintained through the development and implementation of topological rules for the spatial data created as part of the project. These rules include ensuring that all aquatic parcels are closed features, and that no gaps or overlapping areas exist between adjacent parcels.

Metadata: or data documentation, is critical to the utility of the data created as part of a spatial database project. This documentation includes such information as:

- Who created the data
- The process that was used to create the data
- Any potential liability associated with the dataset
- The currentness of the data
- Attribute structure and definitions
- How to obtain the data

National standards for structure, language, and content have been developed and maintained by the Federal Geographic Data Committee (FGDC). In addition to the widely applicable Content Standard for Digital Geospatial Metadata (CSDGM), the FGDC maintains a Cadastral Data Content Standard (<http://www.nationalcad.org/showdoclist.asp?doctype=1&navsrc=Standards>) which should be used when creating metadata for the spatial data created as part of the spatial database project. Like the National Cadastral Data Model, this

standard should be used as a guide, and may need to be modified to capture all of the information in your database.

Guidance: Project implementers should not be surprised to find that “atypical parcels are typical.” In other words, parcels (and the data that describe them) may not have much in common with each other. To help address this, a database guidance document should be created for GIS staff and database managers who are developing, operating within, or using the spatial database information. The guidance document will be a sort of “user’s guide” that includes, among other things, consistency and decision rules (in vector and attributed form) for addressing types of information, problems, conflicts, data limitations, and minimum data requirements. When developing the guidance document, several considerations should be made:

- There are no “hard and fast rules.” Many of the guidance document rules may have to be developed or changed as the database development process proceeds. Due to contextual changes and adaptation to new information and interpretations, new decisions on rules will be needed and documented.
- The guidance should include digital submission standards.
- The guidance should include quality assurance / quality control (QA/QC) methods.

Process Outputs: Data Model, Organizational Framework (Guidance)

Estimated Level of Effort (% of project total): 10%

5. Spatial Data Development

The process to put marine boundary information into a digital format will be based on the format and accuracy of the original data, the resources available, and the desired accuracy of the new spatial database information. To begin the process a digital starting point based on the source information needs to be established to work from and develop. The primary goal of this template is to provide a framework for developing a marine land ownership and leasing spatial database. However, many of the documents that exhibit ownership and leasing boundaries may also reveal boundaries for land classifications, land uses, habitat features, species use, and protective status, among other things. Indeed, marine land classification may determine and limit the types of transactions and uses that are permissible in certain areas. Whether this additional information can be captured at the same time as the ownership and leasing information depends on

the resources available for the project and the ease in which the additional information can be incorporated into the spatial database. If resources are available and the process is acceptable, the maximum amount and type of boundary information should be captured at the same time. If a sufficient amount of resources is unavailable, this information should be prioritized, with higher priority given to leasing and ownership and lower priority given to habitat features and species use. Several considerations should be taken when plotting and/or digitizing the boundary information:

- The process should include rigorous QA/QC, ideally undertaken by a licensed professional land surveyor. QA/QC at this step will provide consistency in boundary delimitation (a critical but atypical element) and will reduce problems and needed corrections later. Original scanned ortho-photos and aquatic index plates can be used to QA/QC spatial data and attributes.
- The process should include immediate georeferencing. While this step can prove to be costly and time-consuming, it is necessary so that the data created in this project can be used with other spatial data. Depending on the needs and resources available, geo-referencing may be done later in the process.
- In those instances where the spatial representation of a parcel location exists solely as a series of coordinates, coordinate geometry (COGO) techniques can be used to create vector parcel data. The AutoCAD and ArcGIS software packages contain tools that automate this procedure..
- The attribute schema should be available and attribute information should be added as boundaries are digitized.
- Links may be made between tax parcel\assessor data (multiple records) with real property locations.
- It is critical to look at adjacent ownerships and jurisdictions when mapping plots, as others may have differing views of boundaries and uses.
- Problems may be encountered while digitizing data. For unanticipated problem areas, a “trouble flag” can be used as an attribute to denote the areas that may have to be reviewed and adjusted by a surveyor for accuracy. Examples of problems that may be encountered include the ambulatory nature of tidelands and the discrepancy as to where extreme low water and mean low water is located. In some instances, these lines may have been delineated by a predetermined buffer from the shoreline, which itself is ambulatory.

Wherever possible, the process and methods outlined in the *Marine Managed Areas: Best Practices for Boundary Making* publication, developed by the FGDC’s Marine Boundary Working Group

Once boundaries have been developed, a centralized database should be populated with ownership, licensing, and leasing data. This step may include loading and attributing existing local, state, and federal datasets as well as converting existing aquatic land ownership and leasing data for incorporation into the cadastral data model. Converting existing aquatic land ownership and leasing data for incorporation into an existing database may be a difficult and time-consuming step, depending on the format and condition of the existing data. Developing a data conversion matrix, which matches the legacy aquatic data to the data model, may facilitate the process. The conversion matrix will likely need to be assessed line by line to resolve exceptions to the data items.

Populating the central database should preserve the maximum integrity and intent of the data while keeping in mind several important aspects of the life of the project and the future of the database:

- Whether the database will be the final product or an interim product compared to the product that is to be distributed to the public.
- Whether the database development is a one-time effort only or on-going effort that will be maintained over time.
- Future changes to the structure and content of the database are likely, recognizing that there will be coding changes, blank/unknown values, and indiscernible values related to the boundaries, attributes, and metadata that will cause “growing pains.”

Process Outputs: Spatial data which delineates marine lands leasing, licensing, and ownership

Estimated Level of Effort (% of project total): 50%

6. Data Documentation and QA/QC

Data Documentation: Metadata should be developed once the spatial database is populated with data. Several tools are available for the creation of metadata, such as the Metadata Collector extension for ArcView 3.x, the metadata toolbar located in ArcCatalog for ArcGIS 8.x and 9.x, and MetaScribe. While developing the associated metadata, several considerations should be made:

- The FGDC cadastral profile should be assessed, modified if necessary, and used if possible.
- More detailed feature-level metadata should be developed for complex boundaries.

- Scales of appropriate use should be identified realizing that end-users will inevitably use the data beyond its limits.

Quality Assurance: The continuous QA/QC of the spatial data is one of the biggest challenges for the development of the spatial database. Ideally, a certified professional land surveyor should be used throughout the project for QA/QC of data and products. This will ensure positional accuracy and integrity. The following additional considerations should be made to ensure data quality:

- Data standards should be refined to facilitate consistency of data and system of input.
- Custom applications should be developed that will automate changes across plates.
- If aquatic plates are still being used to capture ownership transactions, the amended hardcopy plates must be rescanned on a regular basis. The amendments should also be stored in a separate database.
- A tracking system should be developed and implemented to track all changes made to the database.
- Data maintenance processes should be integrated into daily business practices.
- Editing tools that support typical maintenance operations should be made available. While custom tools for data entry within ArcGIS may be necessary, editing tools exist within the Advanced Editing Tools in ArcMap.

Known and discovered positional errors should be corrected. When users who have first-hand knowledge of specific sites start to access the data, numerous errors will be identified. A common error will likely be that many boundary lines are simply in the wrong place; this should not be a surprise, but should be anticipated. There may be numerous small (parcel-level) and huge (waterbody-level) errors in the data that require correction. Accuracy concerns related to the aquatic parcel data may be addressed by having all new lease transactions accompanied by a survey of the corresponding parcel(s).

Source data should be reviewed upon receipt to determine if all of the appropriate sources were identified and used to create the boundaries. Often times marine land boundaries are developed primarily from aquatic plates and have not taken into consideration boundaries created or changed by tribal treaties, other international treaties or agreements, federal or state legislation, judicial determinations, land replats and vacations, and recent fee-title land transactions.

Boundary data should be evaluated and updated as per natural boundary changes due to natural processes such as accretion, erosion, and reliction. Because of the ambulatory nature of shorelines and the fact that tidelands regularly become filled in, the use of historic shoreline data may help provide a historic perspective. T-sheets can be used for historic shoreline reference. However, simply using the historical or current tideland extent, while possible and useful, may not necessarily provide the necessary accuracy (in some cases up to five different tidal datums have been used as elevation standards). The relationship between regional data and local datum information from t-sheets\plates should be explored.

Process Outputs: FGDC-compliant metadata for all spatial data created as part of the project, Documented QA/QC procedures and reports on positional, attribute accuracy

Estimated Level of Effort (% of project total): 7%

7. Data Access

More than likely, existing and future spatial and non-spatial data belonging to public agencies regarding marine lands is available to the public through public disclosure requests. Public agencies may, however, facilitate data delivery to and use by the public by improving the format and accessibility of the data. The usefulness of the data provided to the public can be improved greatly if the data is organized in a logical and consistent framework, maintained and updated frequently, and is easily accessible through programs such as an Internet Map Server viewer. When determining when and how to improve the use and access of spatial data in a database, several considerations should be made:

- Establishing a Data Steward position that is responsible for the long-term maintenance and accessibility of the spatial database is essential if the database is to be made available to the public and kept up to date. If the position is not established, the data will quickly become outdated and the public's ability to use the data will decrease rapidly.
- The accuracy and intent of data use should help determine how, what, and when information will be made available to internal technical users, external technical users, and the non-technical, general public. These three different user groups may receive different types of access to the data and may receive access at different times
- The format and accuracy of the data may be such that only internal agency technical users will be able to understand and use it. In a slightly better scenario, internal and external technical users would be able to use it. More time, expense, and effort will be required for use of the data by

the general public which will likely require some form of easily transferable data and an Internet map server (IMS) viewer.

- The known data errors should be evaluated relative to the proposed use of the data; survey scale data can be used much differently than data in general GIS ownership databases.
- A data transfer standard should be created to allow external partners to contribute data to the framework database.
- The data access process and interface should be tested with different level users (local, state, federal, and public).
- The data should eventually be shared through an established data clearinghouse and/or the Internet. All appropriate authorities should be notified once the data is available.
- Several options are available for making the data accessible to users with different skill levels, such as quick data loaders for cartographers, internal ArcGIS tools for land management practitioners, and Internet Map Server viewers for the general public:
 - The business process for serving and maintaining the data for the general public may involve maintaining a development and production database internally and producing datasets from the production database on a weekly basis for posting on an external website.
 - Developing applications for data viewing and extraction, such as an external IMS site, is a time saving strategy that uses technology to make the data more accessible without the need for specialized GIS knowledge. Doing so also requires, however, additional time, funding, and resolution of firewall/security concerns.
 - Developing a user's guide will assist users in becoming acquainted with the spatial database and its capabilities. Self-guided tutorials, while not necessary, but may complement the user's guide.

Process Outputs: Data Access Plan, Mechanism for providing data access

Estimated Level of Effort (% of project total): 7%

Appendix A – Abbreviated Process Plan

Step	Process	Products	Estimated LOE
1	Project Planning	<ul style="list-style-type: none"> • Project Goal • Project Proposal 	<ul style="list-style-type: none"> • 1% • 1%
2	Information Assessment	<ul style="list-style-type: none"> • Documents Which Reveal State Submerged Lands Leasing, Licensing and Ownership • Information Assessment 	<ul style="list-style-type: none"> • 10% • 2%
3	Data Identification and Retrieval	<ul style="list-style-type: none"> • Existing Spatial Data Inventory • Spatial Data Which Delineates Submerged Lands Leasing, Licensing, and Ownership 	<ul style="list-style-type: none"> • 5% • 5%
4	Database Development	<ul style="list-style-type: none"> • Data Model • Organizational Framework 	<ul style="list-style-type: none"> • 10% • 5%

5	Spatial Data Development	<ul style="list-style-type: none"> Spatial Data Which Delineates Submerged Lands Leasing, Licensing, and Ownership 	<ul style="list-style-type: none"> 50%
6	Data Documentation and QA/QC	<ul style="list-style-type: none"> FGDC-compliant metadata Documented QA/QC procedures and reports on positional, attribute accuracy 	<ul style="list-style-type: none"> 5% 2%
7	Data Access	<ul style="list-style-type: none"> Data access plan 	<ul style="list-style-type: none"> 4%
TOTAL			100%