One if by Land, Two if by Sea

Ontological Modeling of Geographical Relationships for Map Generalization

One if by land, two if by sea;
And I on the opposite shore will be,
Ready to ride and spread the alarm
Through every Middlesex, village and farm,
For the country folk to be up and to arm.

-- Henry Wadsworth Longfellow,
"Paul Revere's Ride"

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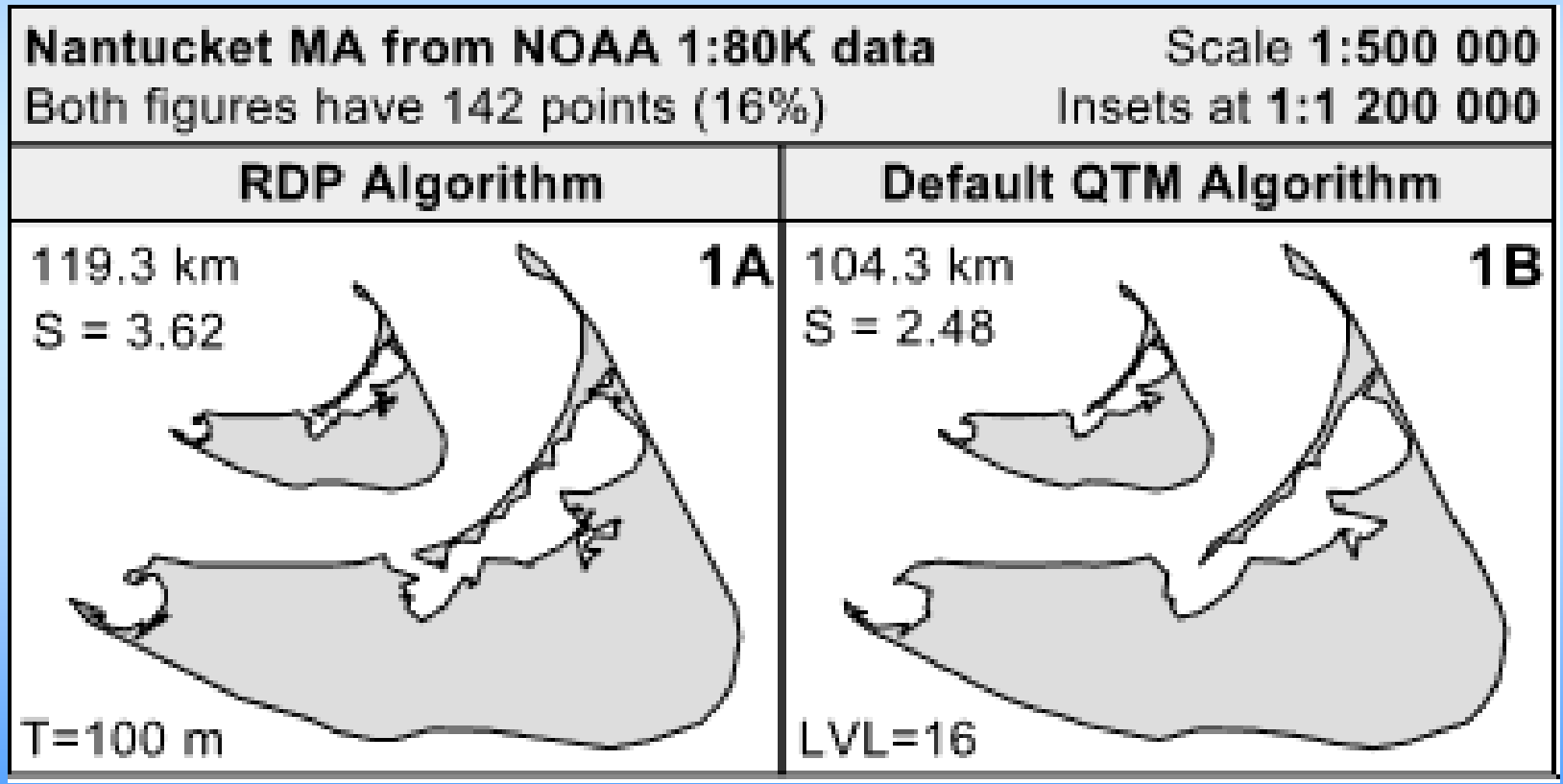
Noncontextual Generalization Is Dead

(Long live noncontextual generalization)



Generalization Contexts

In generalizing features, one may need to…

1. **Discover and convey how portions of them differ in character**
2. **Assess their intrinsic importance at presentation scale**
3. **Collapse or combine them in order to maintain their presence**
4. **Communicate their status to their neighbors**
5. **Adapt certain ones to changes in their neighbors**
6. **Consider the roles that they have in landscapes and maps**
7. **Switch context according to the purpose of the map**

Generalization Is Abstraction

You can't intelligently generalize *shapes* that represent *features* without abstracting their *conceptualizations*.

The first abstraction involves mapping identified features into geometric shapes and symbols with sizes, styles, and colors.

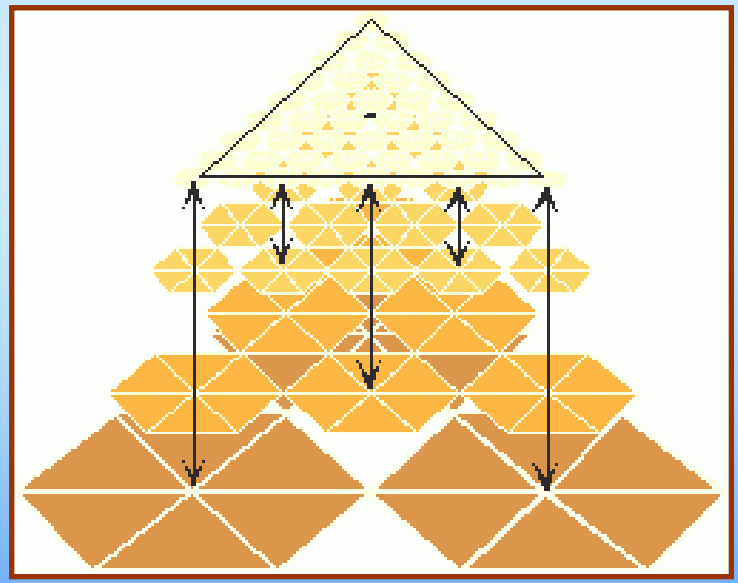
Generalization Is Abstraction

The next abstraction involves simplifying, culling, and coalescing graphic objects into smaller versions of the things they represent.

Much of the generalization literature is stuck at this level.

Generalization Is Abstraction

The third abstraction is to generalize the *concepts* that the symbols *represent*, and then depict those.

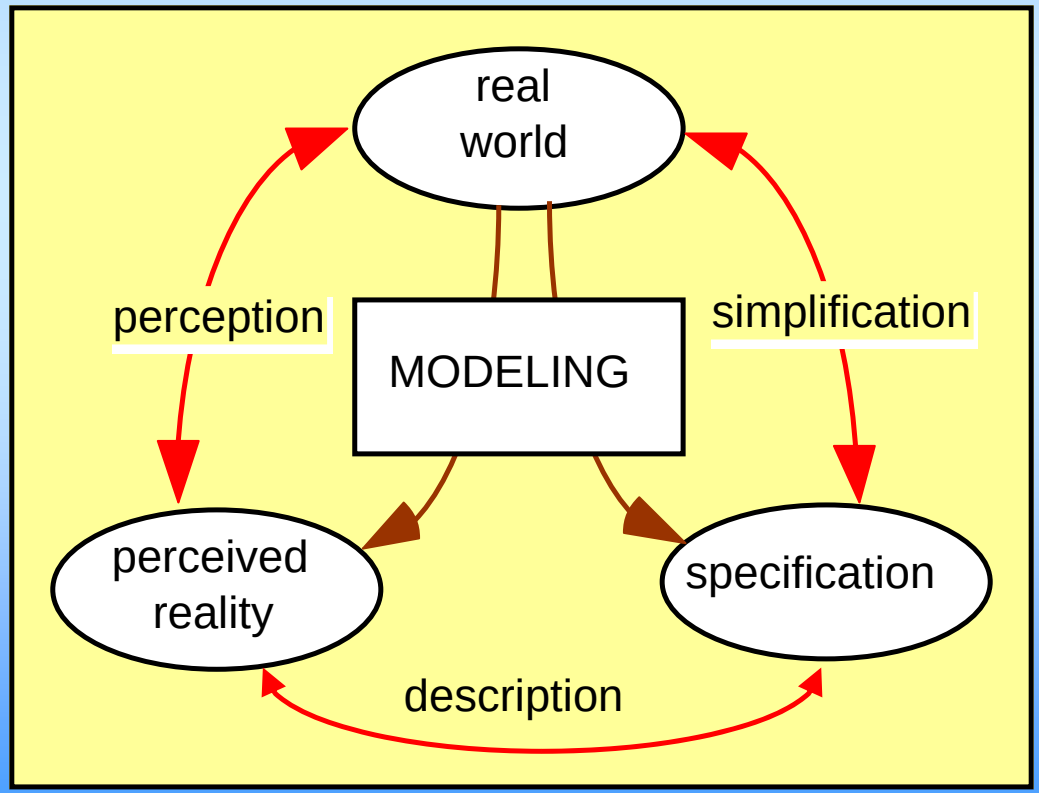


Here is where ontologies can make a difference.

What Kind of Abstraction?

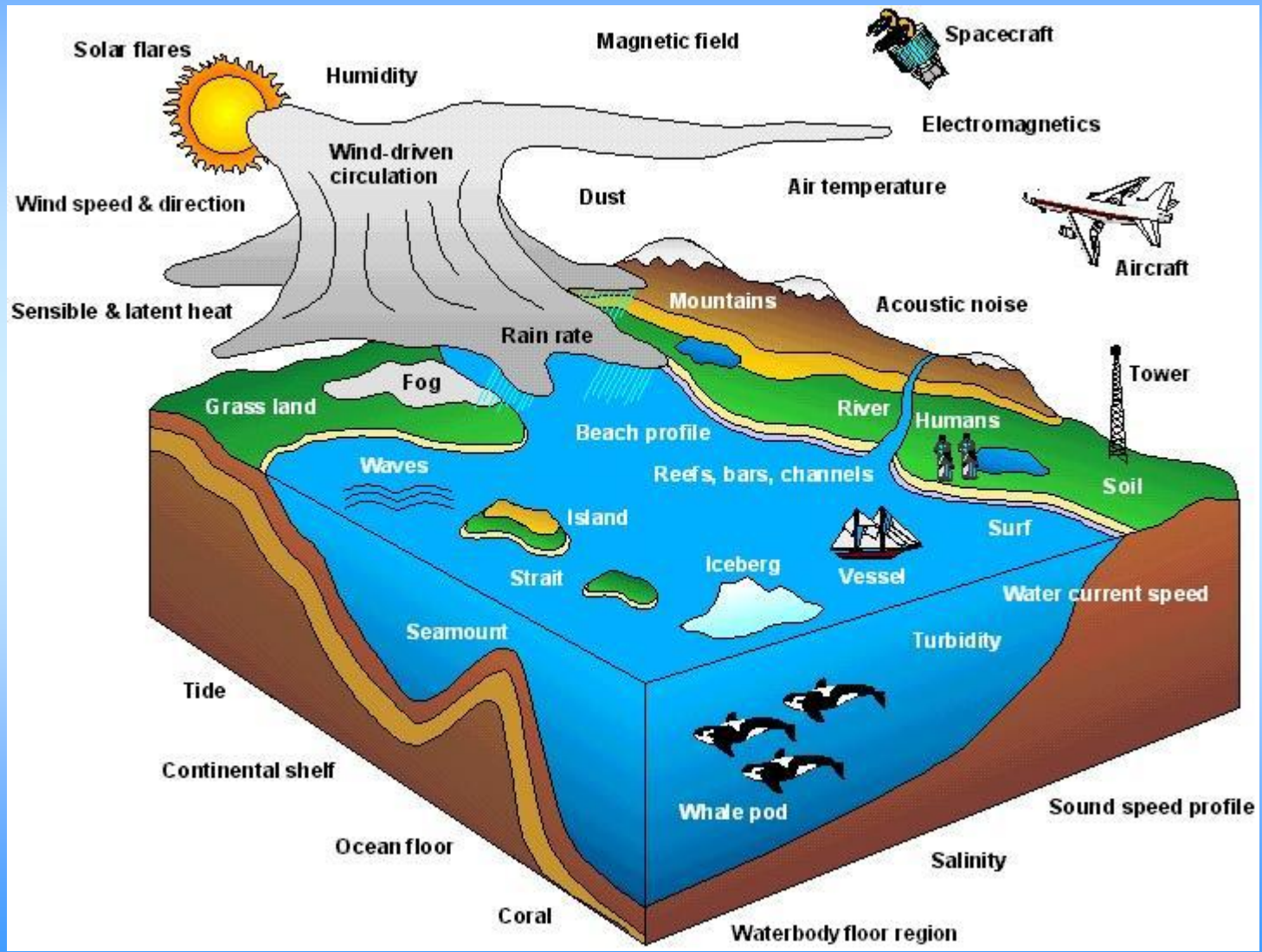
Often ignored is the role that *perception* has in specifying abstractions of *reality*

Adapted from Salgé, F. (1995). Semantic accuracy. *Elements of Spatial Data Quality*, In S.C. Guptill and J.L. Morrison (eds.), pp. 139-151. Pergamon



How you generalize maps depends on how you perceive the world and how you specify it.

What's Out There?



Why Is Some of it Ignored?

Its concern with authoritatively delineating public and private property has made cartography reluctant to deal with *fluid boundaries*, such as intertidal zones and subdivisions of waterbodies.

Yet, because the boundaries are fuzzy, we can define them almost at will, based on local knowledge

Missing Roles

What's the difference between a ***waterbody***, a ***sea***, a ***gulf***, a ***strait***, a ***sound***, a ***bay,*** and a ***cove***?

Or for that matter, a ***point***, a ***neck***, a ***headland***, and a ***cape***?

In what sense does do roles in a landscape matter?

How can a cartographic data base portray them?

Or is "capes and bays" geography irrelevant?

Missing Context

In what body of water is point **x**?

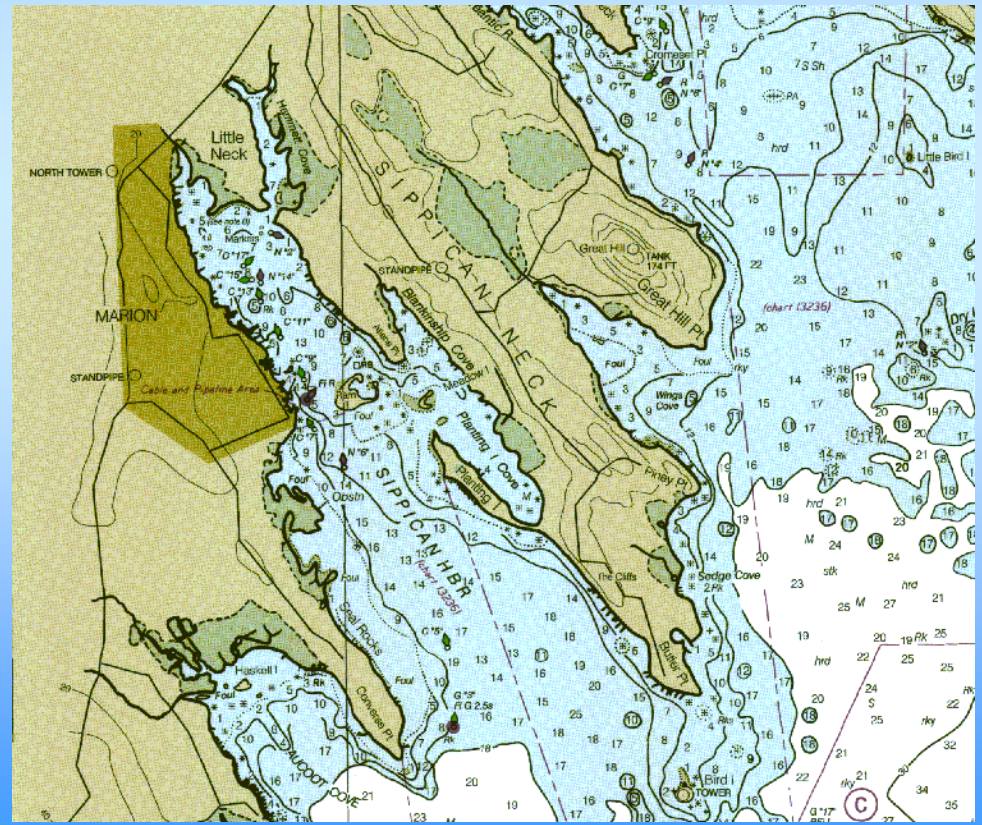
Establishing Context

We say x is in Nantucket Sound

Two Generalization Contexts

24K Topo Quads (left more recent)

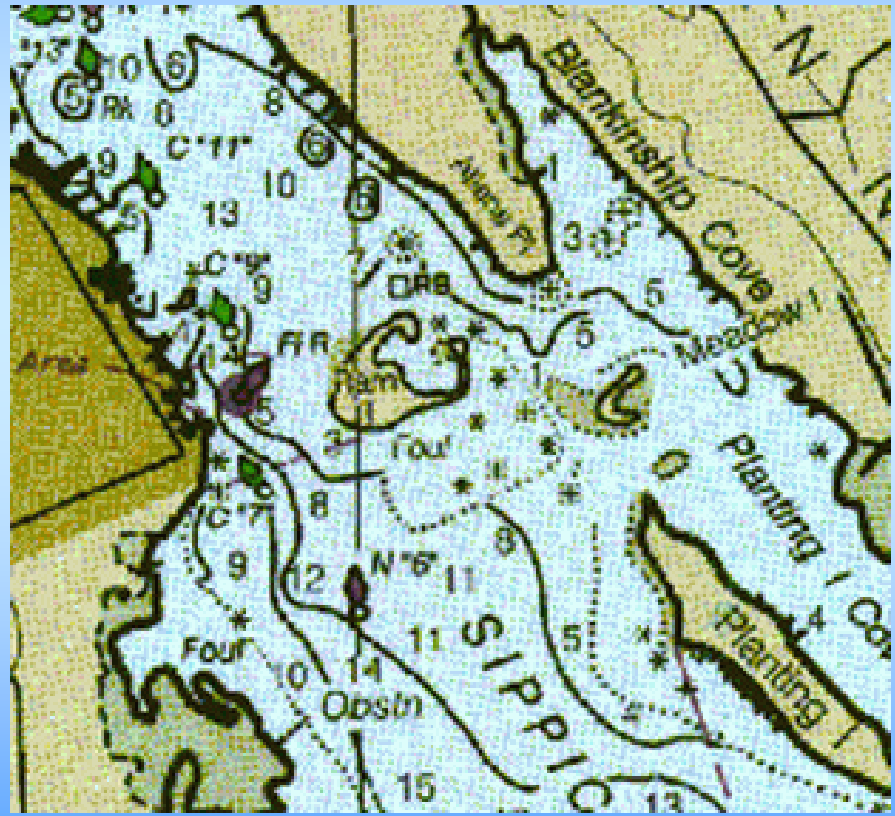
40K Navigation Chart



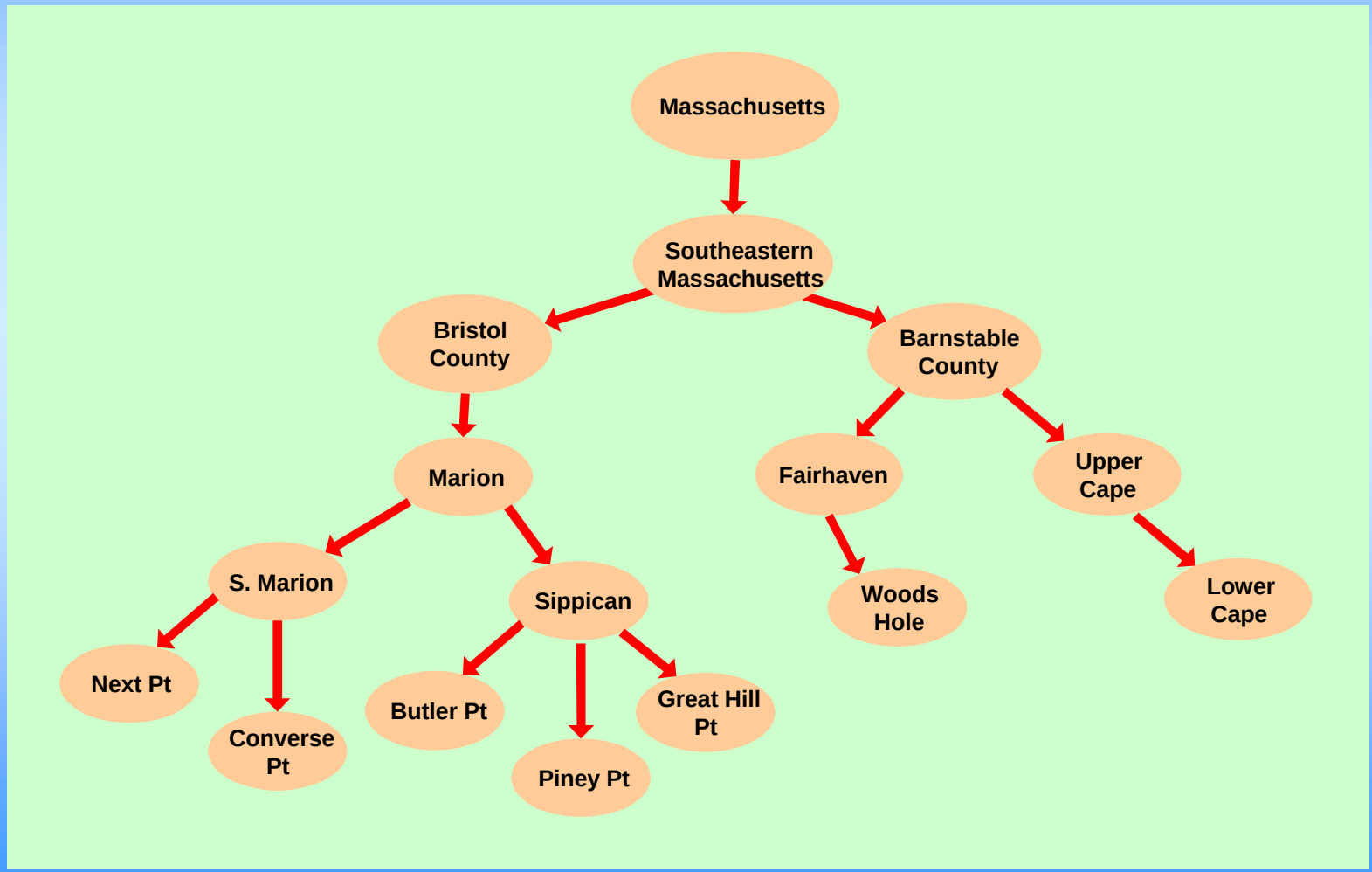
Two Generalization Contexts

Topographic Map	*Nautical Chart*
Simplify shapes of coast-lines and clusters of islands	Simplify coastlines and islands to preserve their importance to mariners
Depict geomorphologic features fairly uniformly	Depict geomorphologic fea-tures visible from offshore
Delete minor roads or those that dead-end	Preserve main roads and those accessing shorelines
Remove solitary buildings and structures	Depict buildings and struct-ures useful to navigation

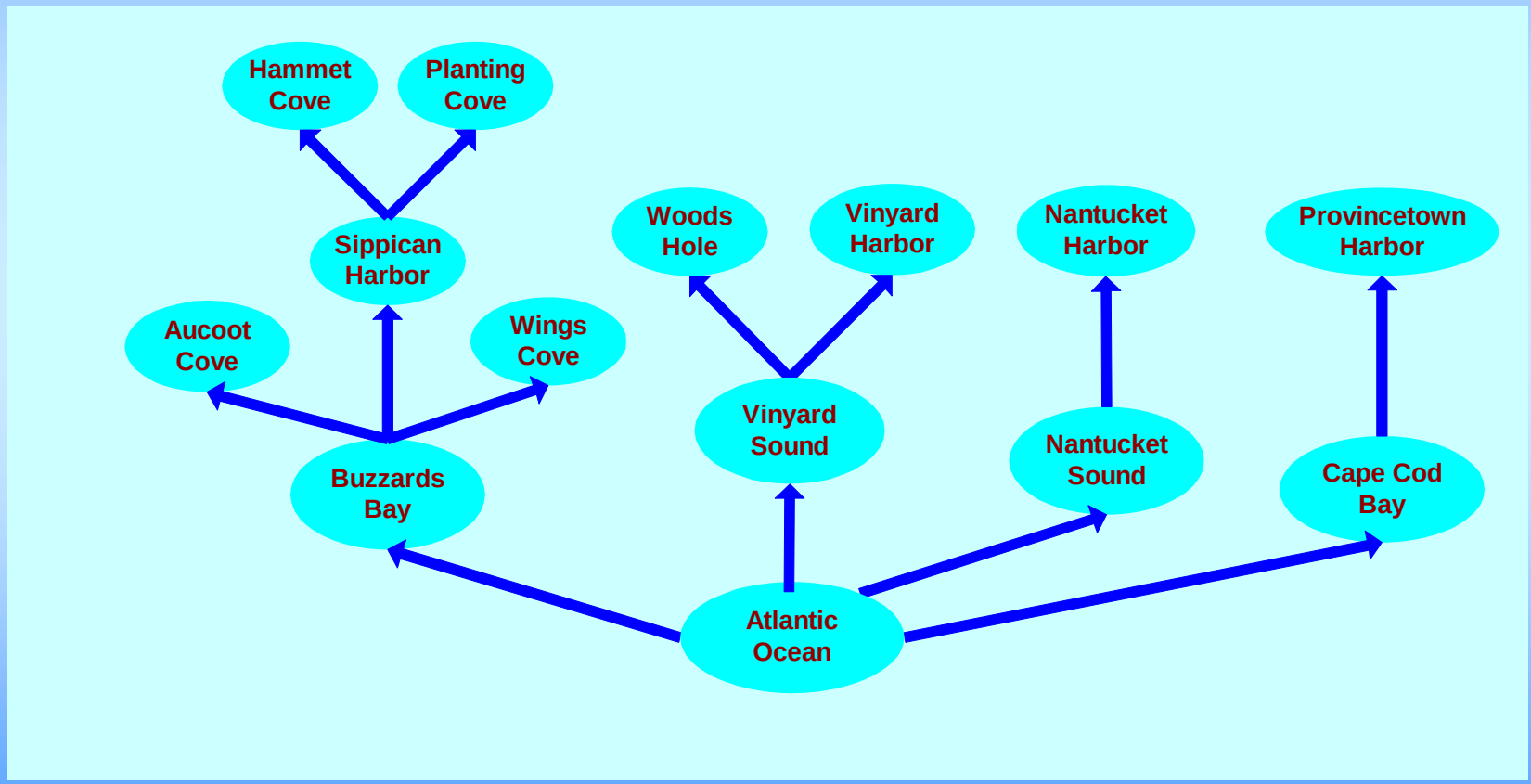
Two Generalization Contexts

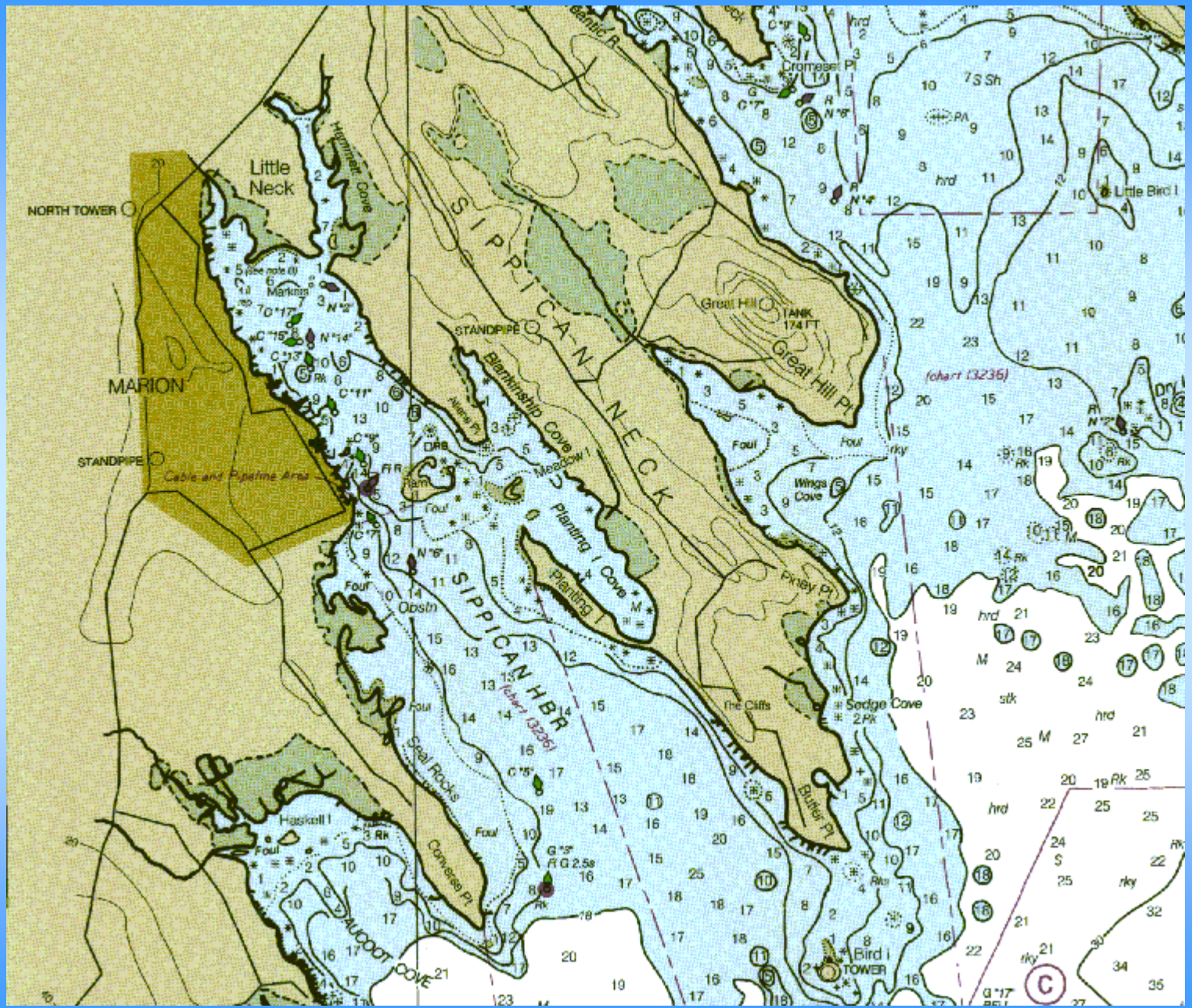


The Context from Land



The Context from Water




Little Neck
NORTH TOWER
MARION
STANDPIPE
Cable and Pipeline Area
Hummock Cove
SIPPICAN NECK
Great Hill
TANK 174 FT
Great Hill Pt
STANDPIPE
Blankinship Cove
Meadow I
Planting I Cove
Planting I
Pinkey Pt
SIPPICAN HBR
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Seal Rocks
Haskell I
Converse Pt
ALLOGOT COVE
The Cliffs
Sedge Cove
Butler Pt
Bird I
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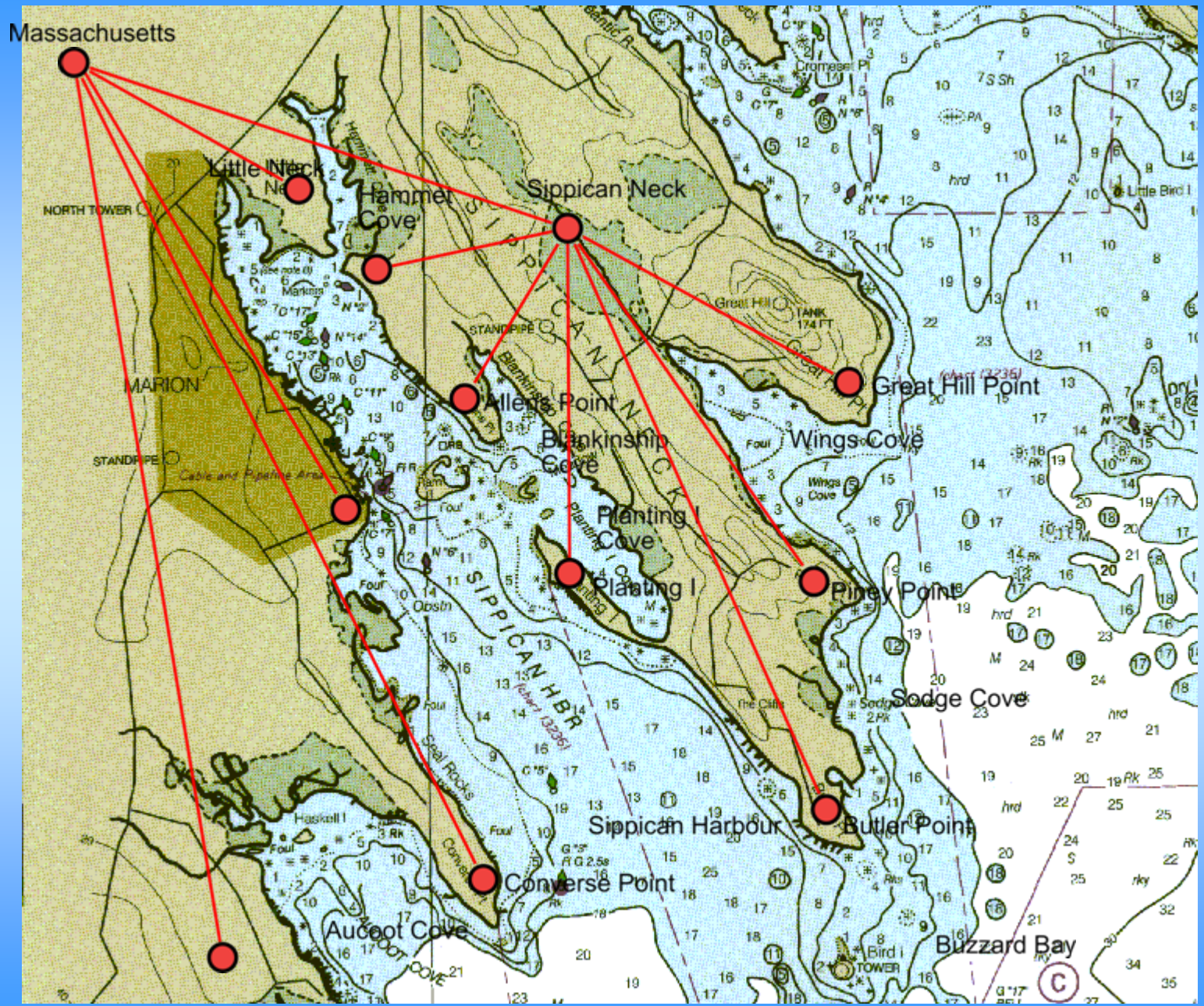
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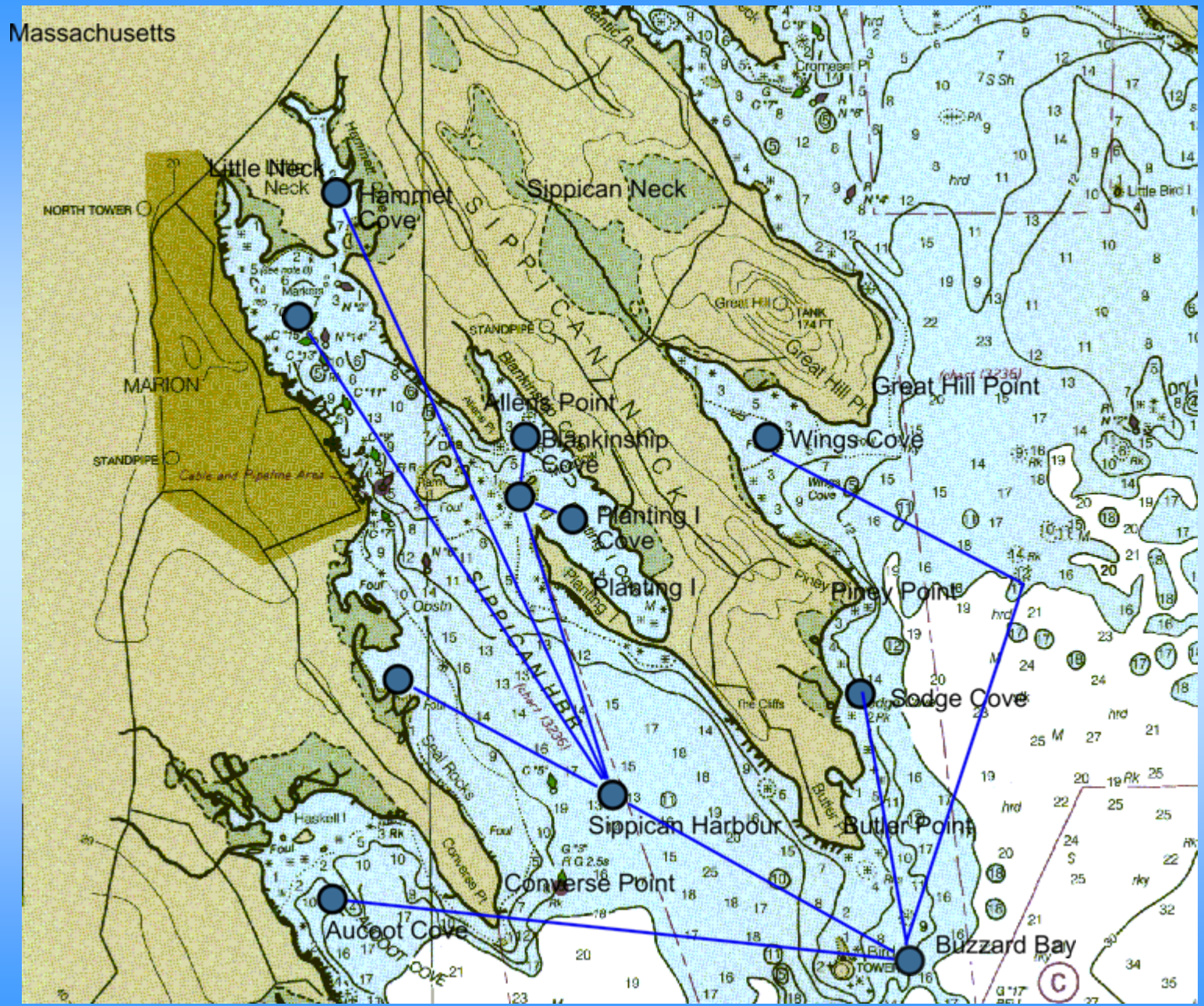
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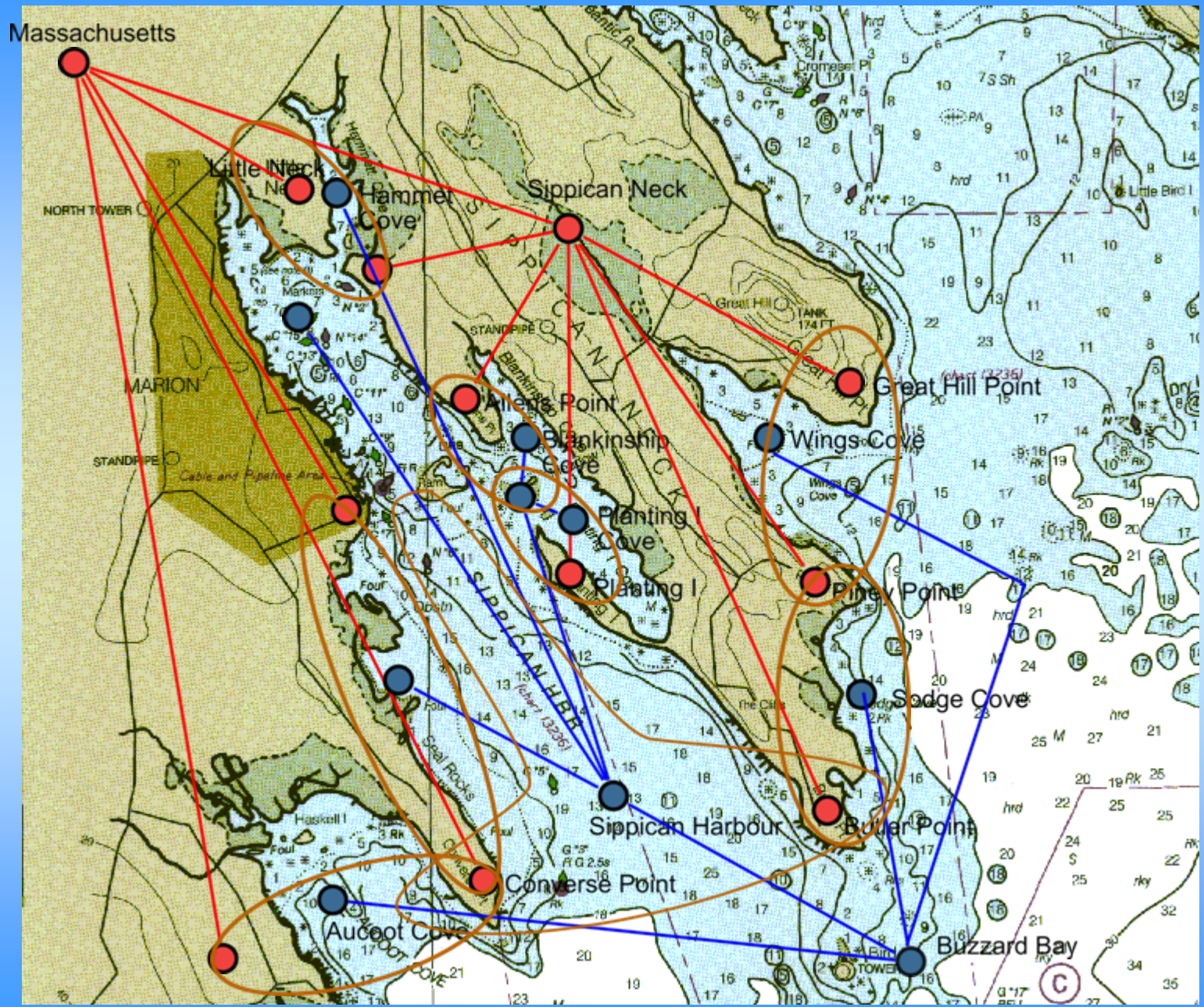
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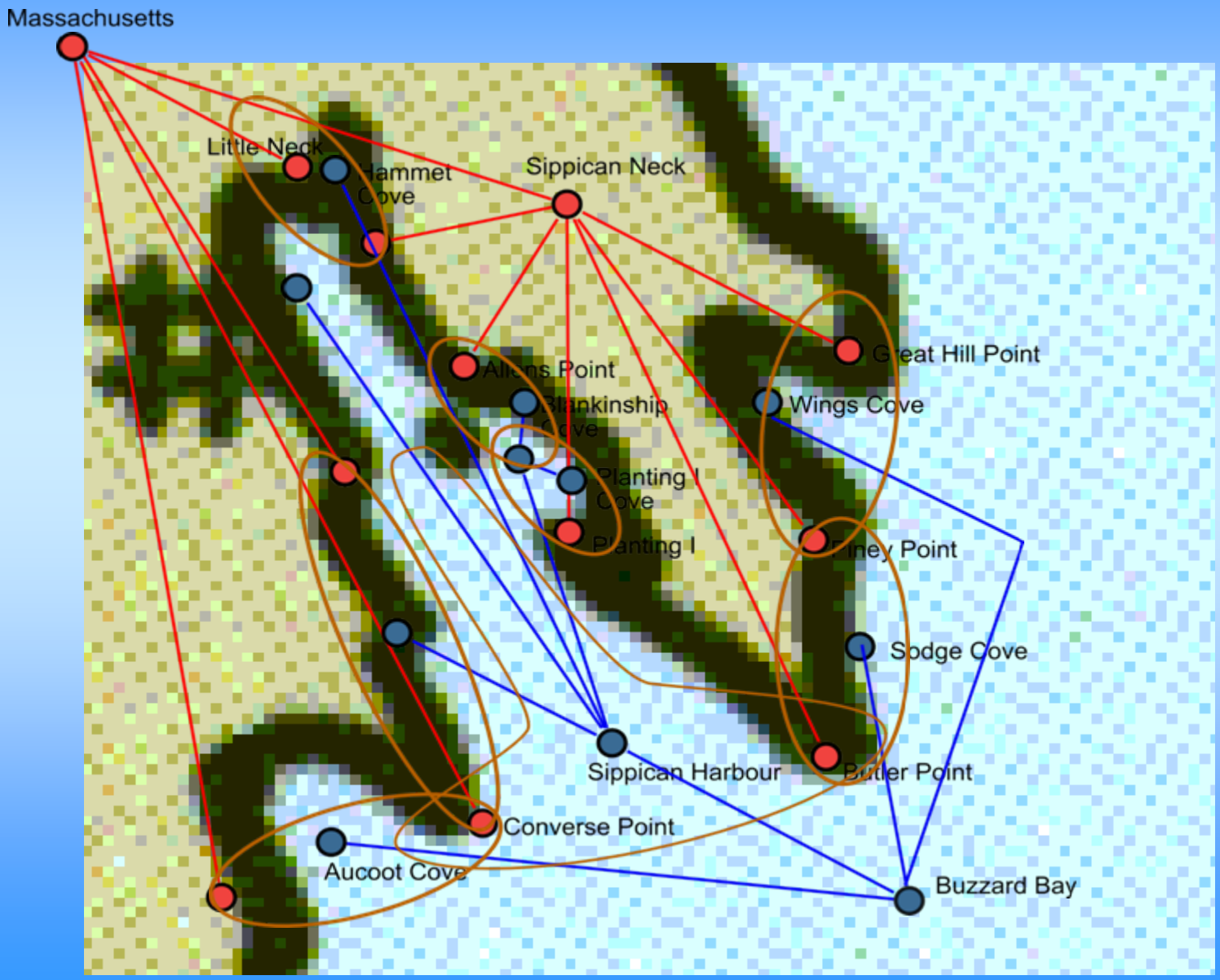


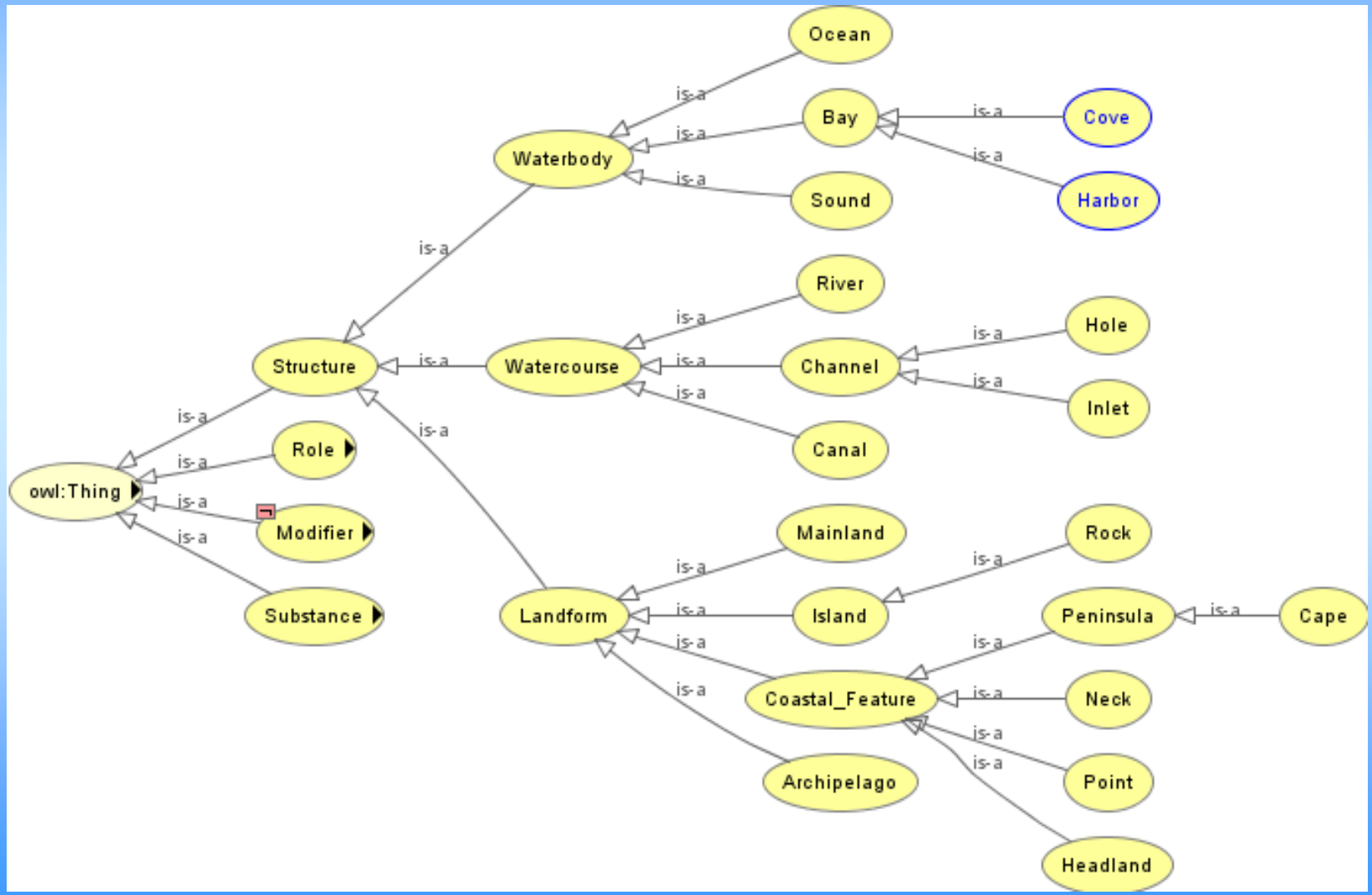
An Environmental Ontology

ISO/IEC 18025:2005(E)

- **Waterbody**: A particular, designated body of <WATER> forming a physiographic <OBJECT> [SOED, "waterbody"].
  EXAMPLES <LAKE>, <OCEAN>, <SEA>, <RIVER>.
- **Lake**: <INLAND_WATER> without significant flow that is surrounded by <LAND>; a lake.
- **Ocean**: One of the major divisions of an expanse of salt <WATER> covering a <PLANETARY_SURFACE>; an ocean.
- **Sea**: A salty <WATERBODY> more or less confined by continuous <LAND> or chains of <ISLAND>s and forming a distinct <REGION>; a sea.
- **River**: A natural flowing <WATERCOURSE>; a river or stream.
- **Estuary**: An arm of a <WATERBODY> that extends inland to meet the mouth of a <RIVER> and includes a mixture of fresh and salt <WATER>.
- **Watercourse**: An artificial or natural channel for the conveyance of <WATER>; a watercourse.
- **Waterbody Region**: A <REGION> of a <WATERBODY>.
- **Waterbody Basin**: A delimited, principal division of a <WATERBODY>; a waterbody basin.
  EXAMPLE <OCEAN_BASIN>.

http://standards.iso.org/ittf/PubliclyAvailableStandards/C030810E_FILES/MAIN_C030810E/index.html

Let's try to structure that…



Coupling Concepts…

One way to enrich cartographic data records without completely recompiling them is to build associated *ontologies* conveying the meaning of data items, their properties, and relationships for operational purposes.

Can we itemize their qualities in ways that inform their graphic representations?

… to Categories …

Ontology concerns the nature of being; computationally, specifying one boils down to compiling systematic inventories of what is known about a domain of knowledge.

Are we talking about knowledge of *maps* or of the *realities* they represent? And what kinds of knowledge?

… to Connections

Every mapmaker has a “worldview” used to choose, scale, and position graphic shapes on maps. Based on mapping standards and without a lot of thought, s/he sets down spatial semiotics to depict the real world with a host of tacit semantics.