SUBAQUEOUS SOIL-LANDSCAPE RELATIONSHIPS

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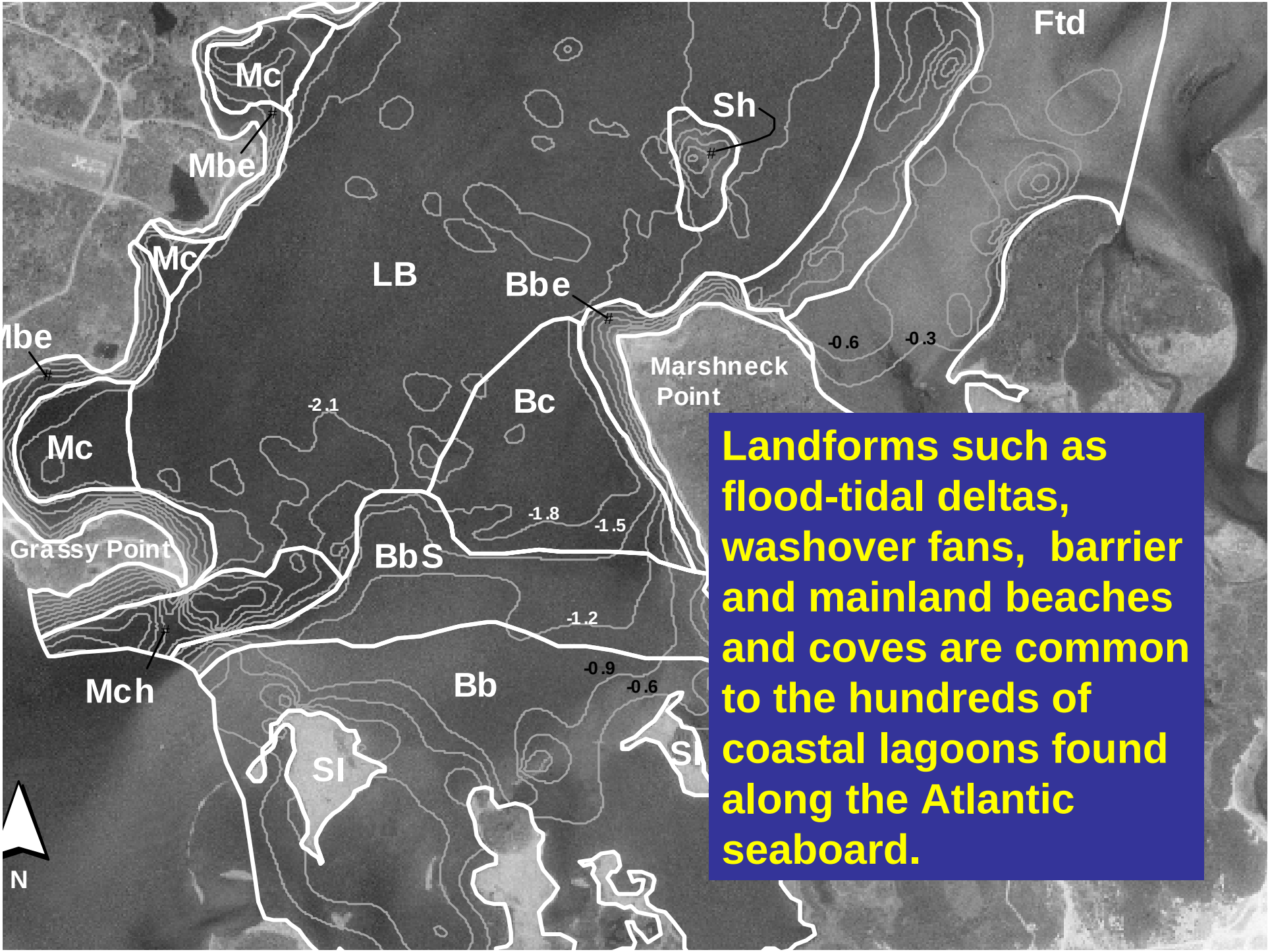
The purpose of a soil survey is to delineate areas of landscape into units that have similar properties and characteristics. In the soil survey process, soil mappers use a conceptual model to predict where the various soils will be found on the landscape.


Subaqueous landscapes are
fundamentally the same as
terrestrial systems in that they have
a discernable topography from
which subaqueous landforms and
landscape units may be identified



Landforms such as flood-tidal deltas, washover fans, barrier and mainland beaches and coves are common to the hundreds of coastal lagoons found along the Atlantic seaboard.

Landscape Characteristics

Landscape Unit	Water Depth Range (m)	Slope (%)	Landscape Description
Lagoon Bottom	1.1-2.0	0.1	Slightly undulating microrelief
Storm-surge Washover Fan Flat	0-0.8	0.2	Linear-linear
Flood-tidal Delta Flat	0-1.1	0.3	Undulating due to dissecting channels
Storm-surge Washover Fan Slope	0-1.4	1.0	Linear-linear
Flood-tidal Delta Slope	0.8-1.1	1.0	Linear-linear and convex-convex
Barrier Cove	0.5-1.7	0.6	Linear-concave
Mainland Submerged Beach	0-1.4	6	Variable; linear-linear, linear-concave, linear-convex

Landscape Characteristics

Landscape Unit	Water Depth Range (m)	Slope (%)	Landscape Description
Mainland Cove	0-1.4	0.6 – 1.6	Variable; concave linear and linear-concave
Mainland Shallow Cove	0-1.1	1.7	Linear-linear
Mid-lagoon Channel	1.4-2.3	0.5	Linear-linear
Barrier Submerged Beach	0-1.4	5	Linear-linear, linear-convex, linear-concave
Shoal	0.8-1.4	2.4	Convex-convex

Parent Materials and Soil Classification

Landscape Unit	Parent Materials	Soil Subgroup Classification
Lagoon Bottom	Silt, fine sand, and organic material	Typic Hydraquent (14) Typic Endoaquent (4) Typic Fluvaquent (2)
Storm-surge Washover Fan Flat	Holocene sand	Typic Sulfaquent (3)
Flood-tidal Delta Flat	Holocene sand	Typic Psammaquent (2) Typic Fluvaquent (1)
Storm-surge Washover Fan Slope	Holocene sand	Typic Fluvaquent (2)
Flood-tidal Delta Slope	Holocene sand	Typic Fluvaquent (2) Typic Psammaquent (2) Typic Endoaquent (1)
Mainland Submerged Beach	Glacial fluvial sand and gravel	Typic Endoaquent (12)

Parent Materials and Soil Classification

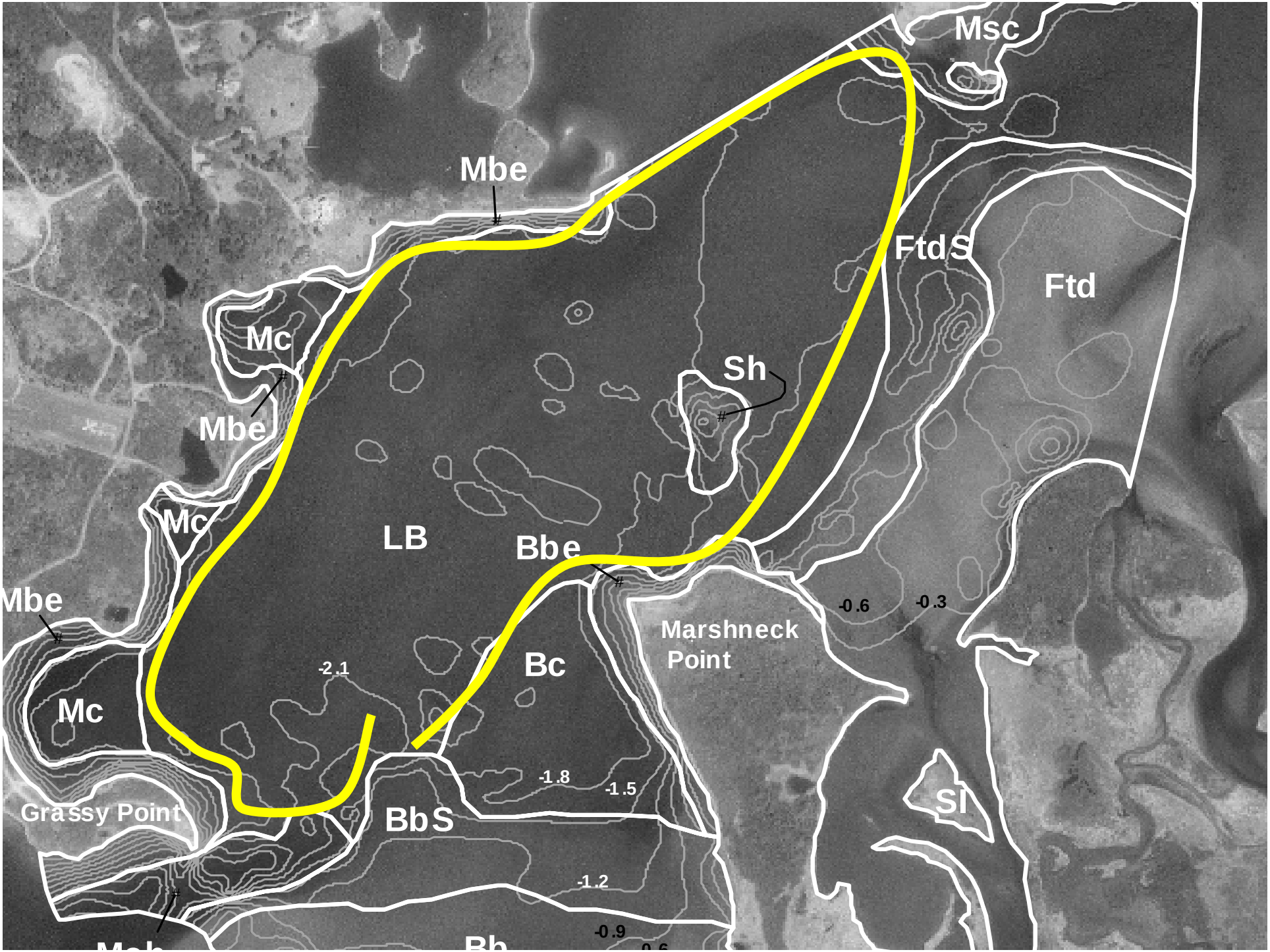
Landscape Unit	Parent Materials	Soil Subgroup Classification
Barrier Cove	Silt, fine sand and organic material over glacial fluvial sand and gravel or Holocene sand	Typic Sulfaquent (2)
Mainland Shallow Cove	Holocene sand over glacial fluvial sand and gravel	Typic Endoaquent (3)
Mid-lagoon Channel	Glacial fluvial sand and gravel	Typic Endoaquent (3)
Barrier Submerged Beach	Glacial fluvial sand and gravel	Typic Endoaquent (6) Typic Fluvaquent (1)
Shoal	Glacial fluvial sand and gravel	Typic Endoaquent (3) Typic Fluvaquent (1)
Mainland Cove	Silts, fine sand and organic material over buried organic material	Thapto-histic Hydraquent (3) Typic Hydraquent (1) Typic Endoaquent (1)

Accuracy of a Soil Survey

- Testing the accuracy of a soil survey is often done by examining the taxonomic purity of the various mapping units;
- For the 12 map units that were used, only the Flood-tidal Delta Slope unit had <50% taxonomic purity;
- Six of the 12 map units had purities of 100%;
- In terrestrial soil mapping, consociations are defined as those map units with > 50% of the soils of the named taxa;
- Eleven of the 12 map units, defined at the subgroup taxonomic level, meet consociation criterion.

Lagoon Bottom Characteristics

- Most of the soils (70%) classified as Typic Hydraquents;
- colors range from greenish black (10Y 2.5/1), black (N 2.5/), and very dark gray (5Y 3/1);
- textures range from silty clay loams, silt loams, and very fine sandy loams with high soil fluidity (N value >1);
- thin sand lenses (5 – 10 cm) may occur at almost any depth;
- organic carbon contents are > 33 g kg^{-1} to depths of a meter or more;
- eelgrass rhizomes and fragments, and periwinkle shells can generally be found throughout the soil profile;
- 1 – 2 m of water cover the landform.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Grassy Point
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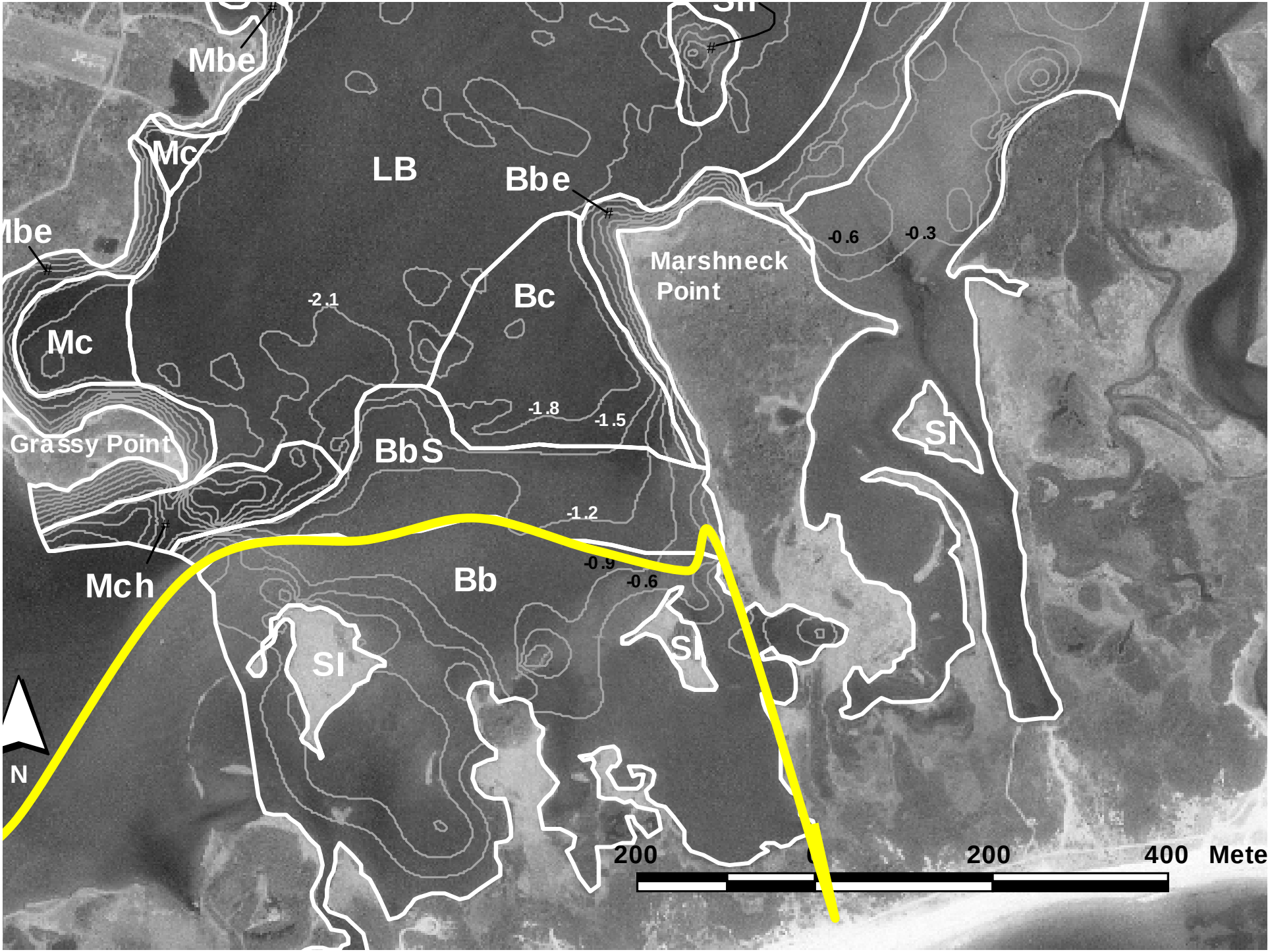
Soil-Landscape Relationships
Lagoon Bottom

- Fine textures: one of the deepest areas of the estuary, mostly located away from the strong currents, current speeds are quite low and the finer textured materials (silt and clay) are allowed to settle out of suspension.
- Organic carbon levels are generally high throughout the profile: eelgrass often covers nearly 100% of the landscape; carbon may also be added from the organic materials suspended in the water column derived from organisms such as algae. These materials are filtered out of the water column by the dense eelgrass cover.

Storm-surge Washover Fan Flat

- shallow water (<1.1 m);
- flat topography;
- virtually no eelgrass cover;
- horizons consist of very dark gray (5Y 3/1) and dark gray (5Y 4/1) fine sand and sand;
- organic carbon levels generally < 3 g kg^{-1};
- subaqueous soils classify as Typic Sulfaquents.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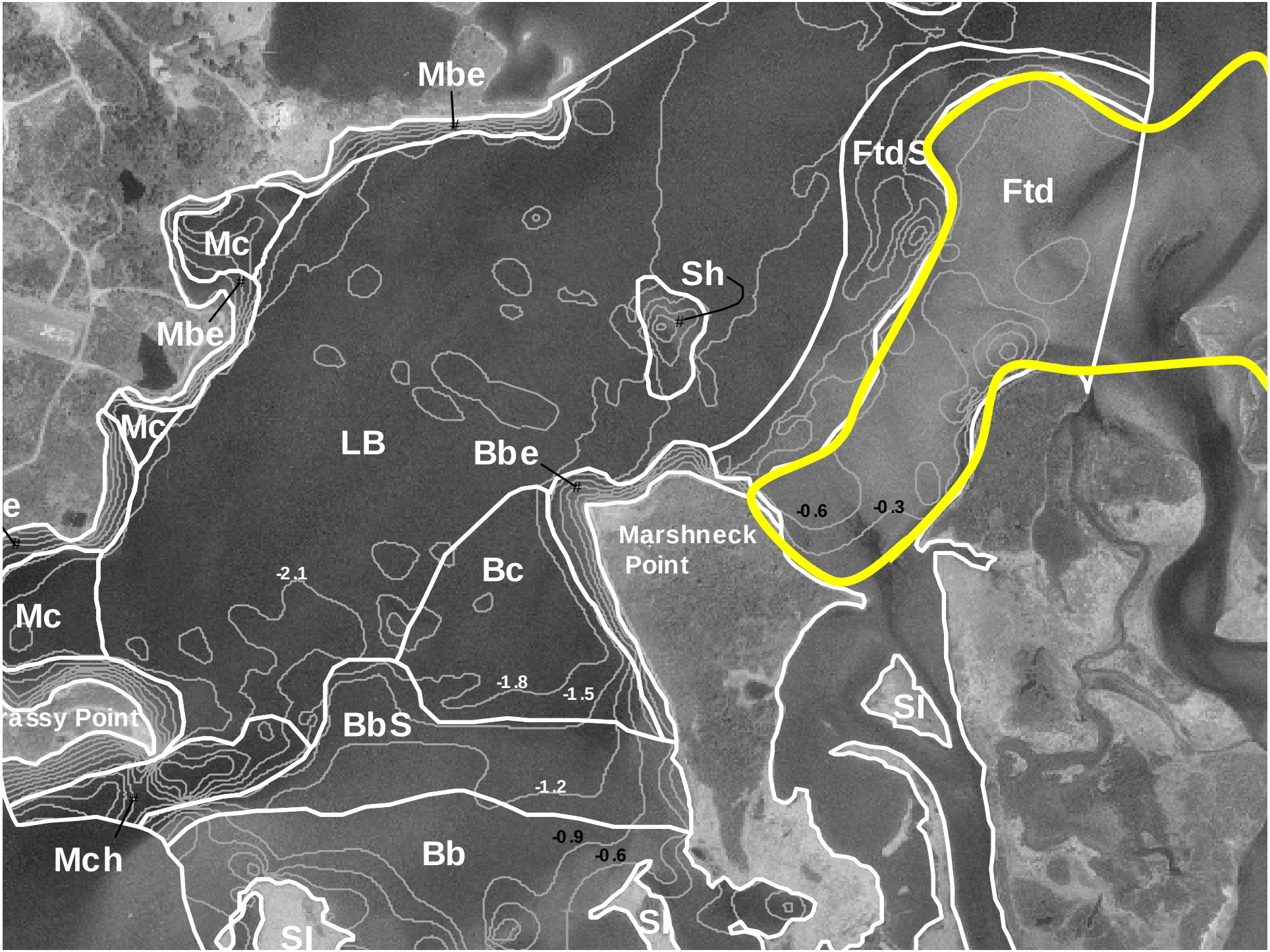
Soil-Landscape Relationships

Storm-surge Washover Fan Flat

- Sandy textures: additions from barrier island beach and dune deposits;
- Low organic carbon levels: minimal vegetation, considerable energy at times;
- Sulfidic Materials: additions from aerobic environment (possibly relatively Fe rich), mostly relatively low energy environment.

Flood-tidal Delta Flat

- shallow water (<1.1 m);
- flat topography;
- virtually no eelgrass cover;
- horizons consist of very dark gray (5Y 3/1) and dark gray (5Y 4/1) fine sand and sand;
- organic carbon levels generally <1 g kg^{-1};
- mostly classified as Typic Psammaquents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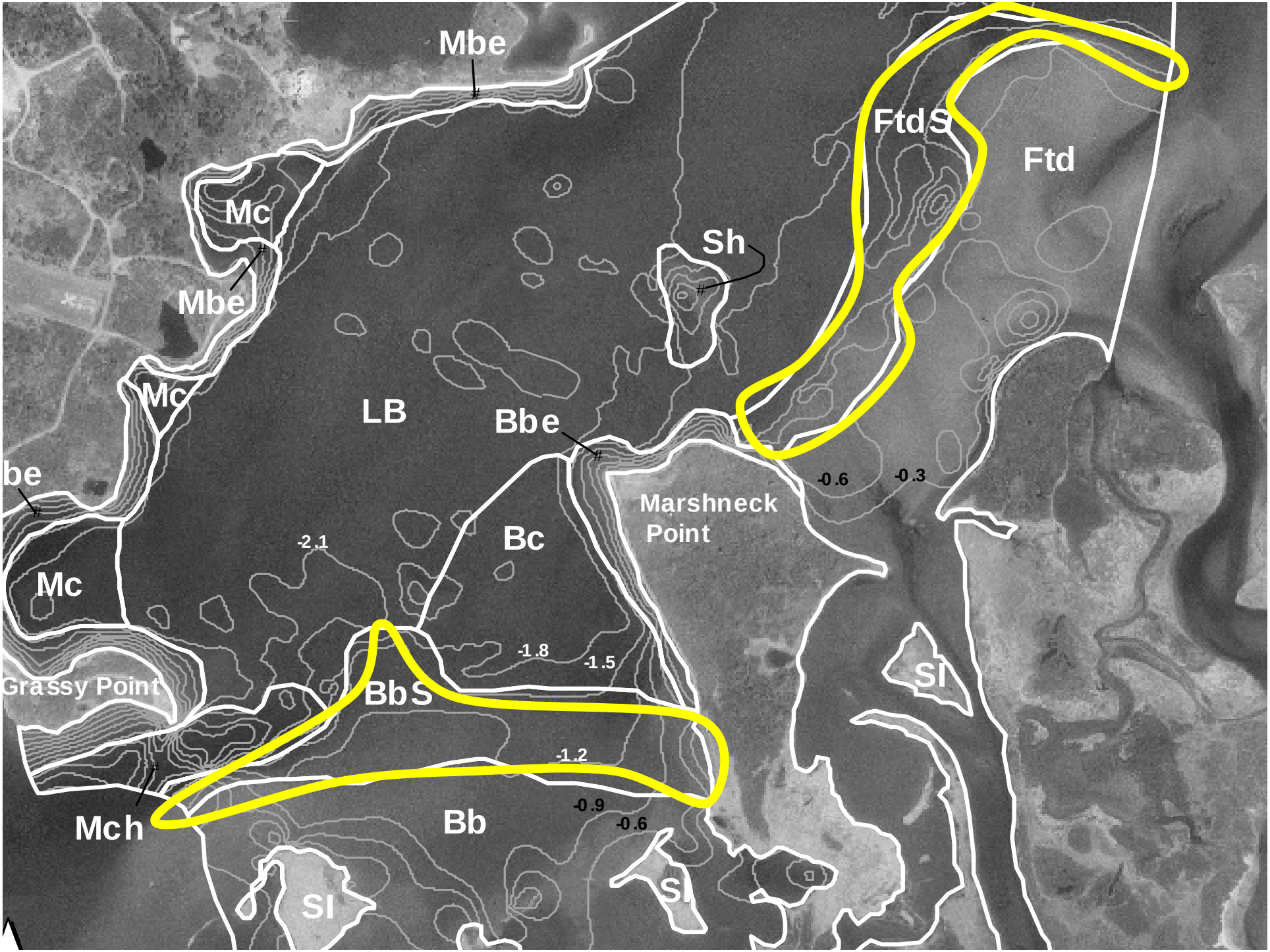
Soil-Landscape Relationships

Flood-tidal Delta Flat

- Psammaquents: additions from ocean and barrier island beach, considerable energy at times;
- Very Low organic carbon levels: minimal vegetation, considerable energy at times;
- A horizons absent: daily erosion and deposition of sediment on tidal cycle.

Storm-surge Washover Fan Slope Flood-tidal Delta Slope

- Multiple buried A horizons (Fluvaquents);
- Mostly loamy soils, Flood-tidal Delta Slope may contain Psammaquents;
- Organic carbon levels 5 – 30 g kg^{-1}.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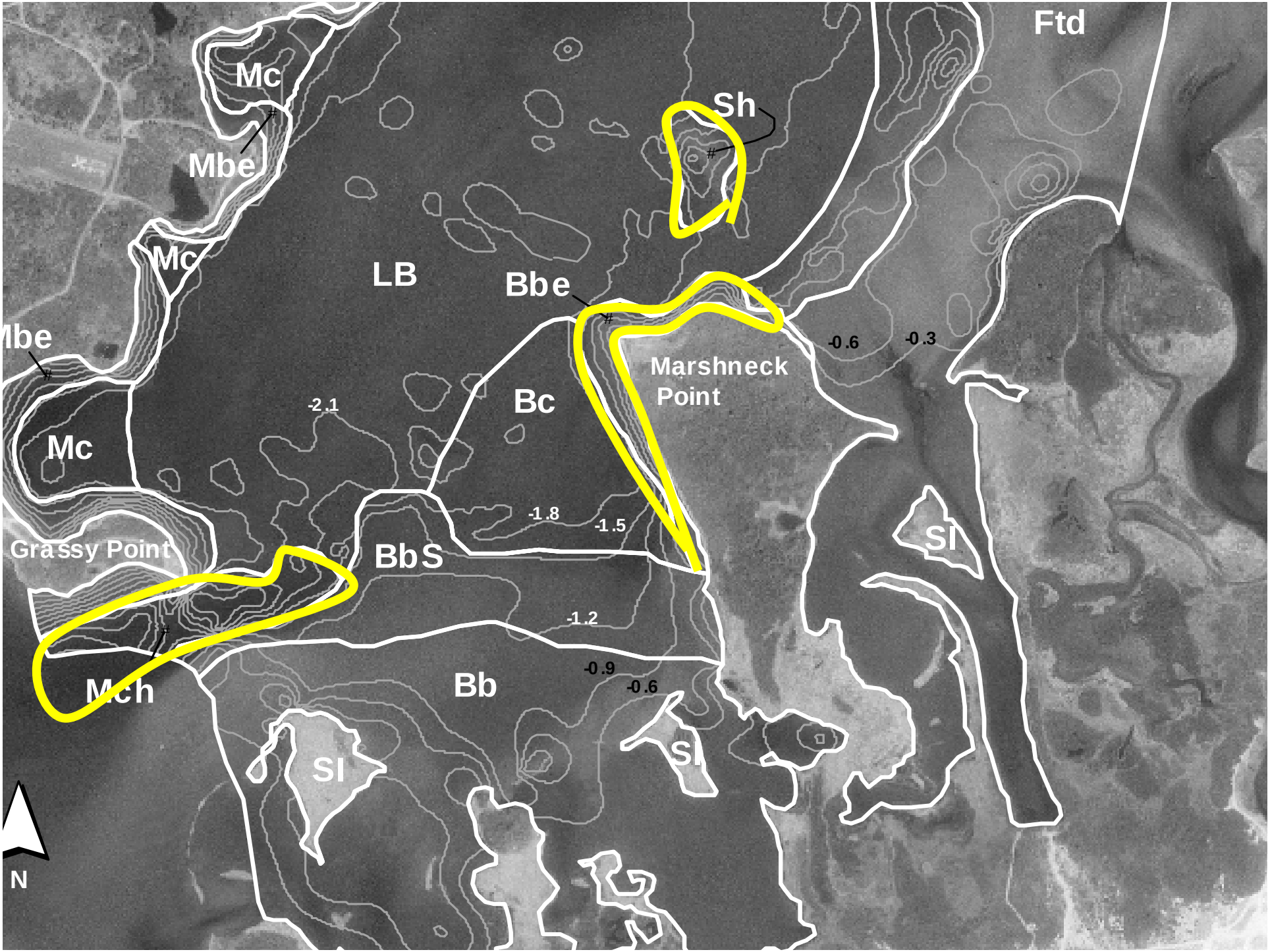
Soil-Landscape Relationships

Storm-surge Washover Fan Slope
Flood-tidal Delta Slope

- Muliple buried A horizons: burial occurs as a result of a shift in the position of the tidal inlet following a particularly large storm event, on the Storm-surge Washover Fan Slope burial occurs as a result of transport sand from the barrier into the lagoon during a large storm;
- Loamy textures: transitional landform between flats and lagoon bottom;
- Moderate to high levels of organic carbon: vegetated with eelgrass or has considerable eelgrass plant remains within buried horizons.

Beach, Shoal, and Channel Landscape Units

- consisted of solely of glaciofluvial sand and gravel (terrestrial soil parent materials).
- black (5Y 2.5/1) and dark olive gray (5Y 3/2) loamy sand and coarse sand with 15– 70% gravel and cobbles in virtually all horizons;
- A horizons typically display black (5Y 2.5/1) iron mono-sulfide coatings and low (<2 g kg-1) amounts of organic carbon below surface;
- subaqueous soils classify as Typic Endoaquents.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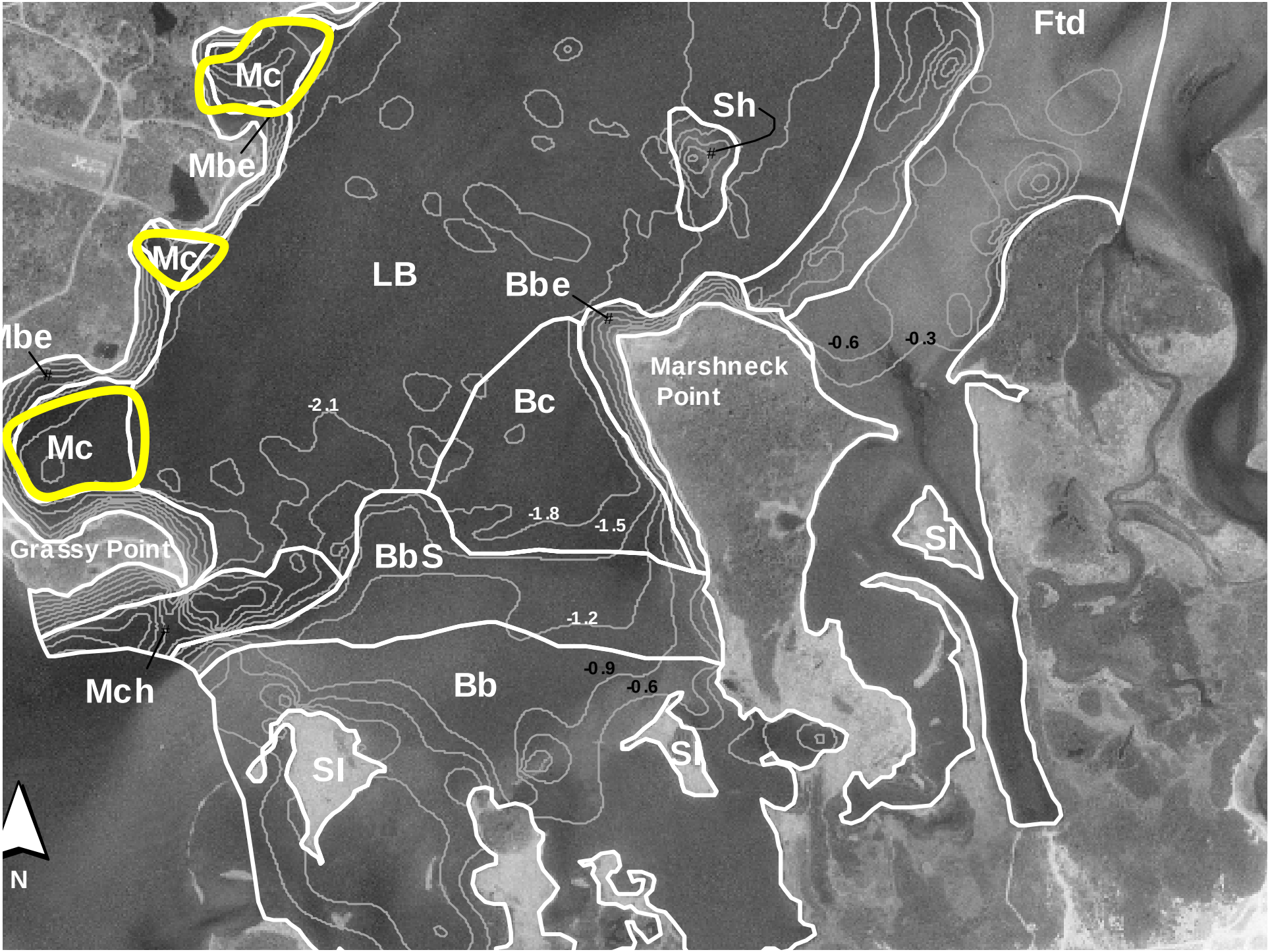
Soil-Landscape Relationships

Beach, Shoal, and Channel

- Endoaquents: particle size dependent upon upland parent materials;
- Low organic carbon except at the surface: minimal vegetation, carbon added as detritus along beachfronts;
- Monosulfides just below oxidized surface: source of Fe in the terrestrial parent materials, carbon additions at the surface.

Mainland Cove

- Soils classify as Thapto-histic Hydraquents and Typic Hydraquents and Endoaquents;
- Mineral horizons are black (5Y 2.5/1), very dark gray (5Y 3/1), and dark gray (5Y 4/1), loamy sand, fine sandy loams and silt loam;
- Two types of buried organic horizons (300 g kg-1 organic carbon) are observed: 1) reddish black (7.5YR 2.5/1) in color, no sulfide odors, low electrical conductivity; 2) yellowish black (5Y 3/1), smells of hydrogen sulfide, high electrical conductivity.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Soil-Landscape Relationships

Mainland Cove

- Loamy mineral horizons: low energy environment in protected cove, deeper coves (Hydraquents) generally have finer textures and higher N-values than shallow (Endoaquents);
- Buried organic materials: former wetlands which were covered with water as a result of rapid sea-level rise during the Holocene, organic horizons with low salinity and no sulfides likely an Atlantic White Cedar swamp, organic horizons with sulfides and elevated salinity likely buried salt marsh peat.

Glacial vs Coastal Plain

- In some cases, the subaqueous soil-landscape relationships observed in our study were similar to those established in Sinapuxent Bay by George Demas.
- However, the lack of Hydraquents and Endoaquents, and the ubiquitous distribution of Psammaquents in the Mid-Atlantic estuary, suggests that subaqueous soil-landscape relationships can differ substantially between regions.
- Maybe the differences are related to characteristics of the coastal lagoon, most likely the differences are a combination of both.