CHESAPEAKE BAY
EARTH SCIENCE ATLAS NO. 3

MAP 3—3

WATER CONTENT

BY

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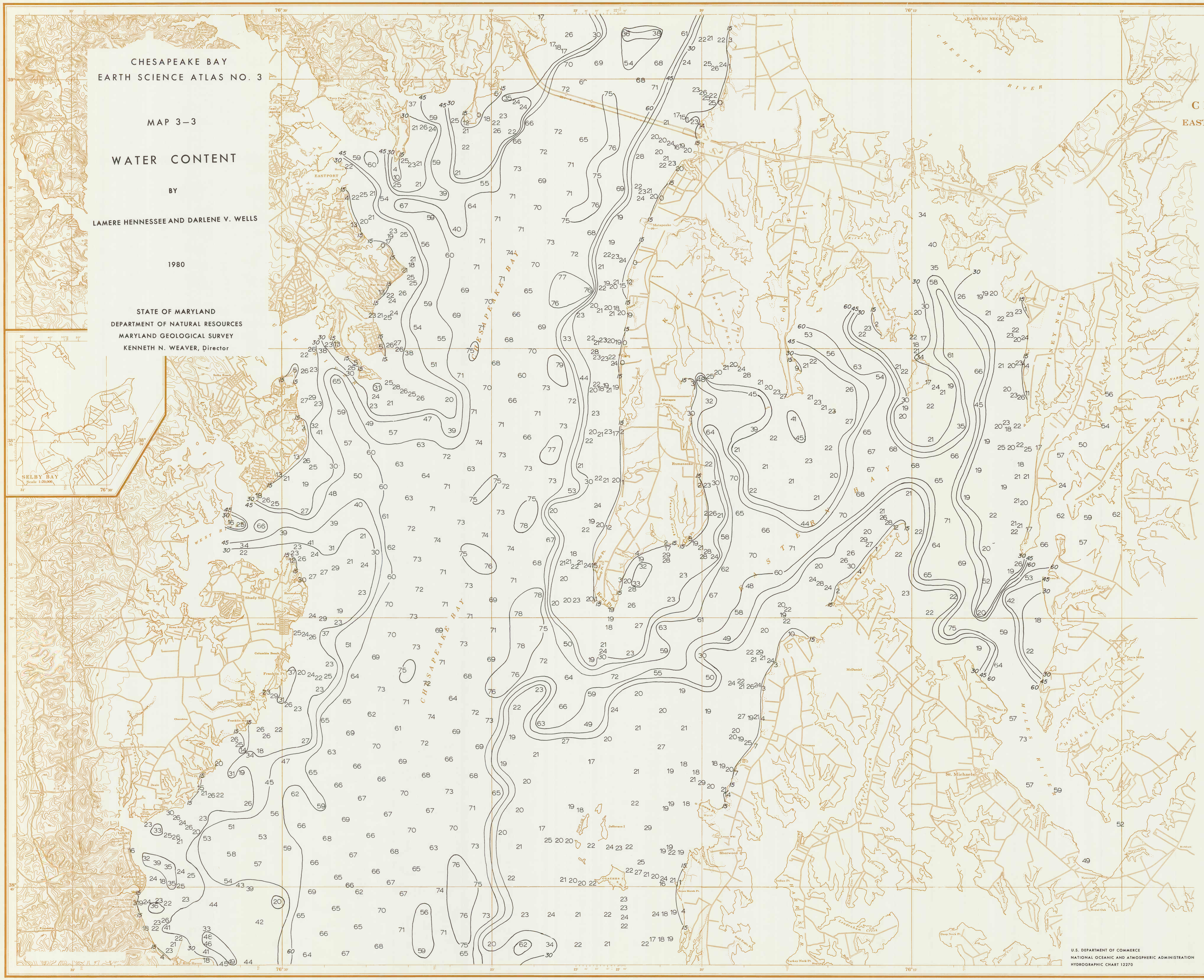
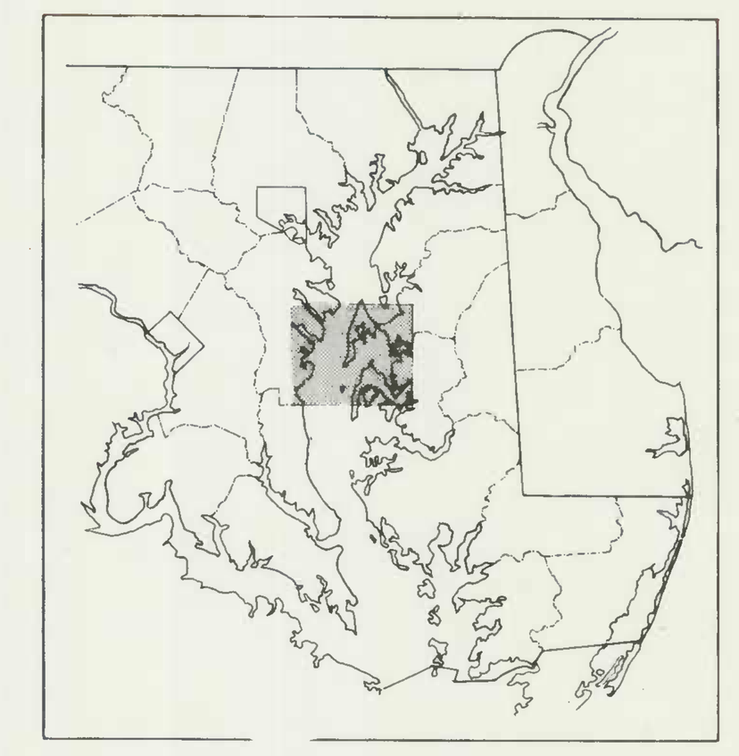


UNITED STATES - EAST COAST
MARYLAND

CHESAPEAKE BAY
EASTERN BAY AND SOUTH RIVER

Mercator Projection
Scale 1:40,000 at Lat. 38°52′
North American 1927 Datum



EXPLANATION

CONTOUR INTERVAL
15% WET WEIGHT

WATER CONTENT

Introduction

In the characterization of the surficial sediments of the Chesapeake Bay bottom, the sedimentary environment is defined as consisting of the particulate matter (inorganic and organic) plus water. This assumes that the surficial sediments are 100% saturated with free water, water that is not bound in the internal structure of the clay minerals. The content of water (in percent) in the sediments is calculated as:

$$\text{Water Content } \% = \frac{\text{weight of water (grams)}}{\text{wet weight of sample (grams)}} \times 100$$

The weight of the water is determined as the difference of the wet weight and dry weight of the sample following drying at 60°C. In engineering studies, water content is expressed as a percentage of the dry weight of the sample instead of the wet weight as reported here. Formulas are available that allow the conversion of the water content on a wet weight basis to water content on a dry weight basis and vice versa.

Water content is closely related to various physical and geotechnical properties of the sediment. Numerous investigations have shown that water content is directly proportional to porosity and organic carbon and inversely proportional to unit weight and grain size (Harrison, et. al., 1964; Keller, 1974). Water content also provides a first approximation of the cohesiveness and erodability of sediments, and insight into the consolidation history of these sediments, particularly the finer-grained muds (SILTY CLAYS, CLAYEY SILTS and CLAYS). Current velocity studies have shown that within a given sediment type the higher the water content the lower the current velocity needed to erode and transport the sediment.

Distribution

Water content appears related to grain size (Table 1). Generally, the SANDS average 21%, the SILTS, 50% and CLAYS, 70%, indicating that grain size is inversely correlated with water content. Within a given size class, the range of water content varies considerably. In the SANDS and SILTS categories the variation in water content is related to the various admixtures of finer or coarser grained particles within the sediment type. In the CLAY (SILTY CLAY and CLAY) and CLAYEY SILT categories, the wide range in water content appears to be related to other geologic processes, such as compaction. As finer grained sediments are buried they undergo compaction and pore water is expelled. The actual decrease in water content with depth depends not only on the grain size of the sediment but also on the overburden pressures and the length of burial time.

The lower water contents observed in the CLAYEY SILTS (30%), SILTY CLAYS (38%) and CLAY (58%) indicate sediments that have undergone burial and compaction and have subsequently been exposed on the Bay floor. Field observations of the lateral extension of onshore geological formations suggest that these "low-water" sediments are exposures of "bedrock" where bedrock is defined as the pre-Holocene sediments surrounding the atlas area. A few of these "bedrock" exposures have been tentatively identified as the Miocene Calvert Formation.

The distribution of water content in the bottom sediments conforms to the Bay geometry and correlates with the distribution of sediment types. Sediments (SILTY CLAYS - CLAYEY SILTS) with high water content (60-80%) are generally located in the main channel areas. Proceeding towards the shoreline, water content decreases to 20% for the SANDS of the nearshore areas, again closely correlating with the change in sediment type. In Eastern Bay, water content, on the average, is lower than in the main Bay, reflecting the coarser sediments found within Eastern Bay.

Table 1. Percent water measured in the different sediment size classifications.

TYPE	RANGE (%)H_2O	MEAN (%)H_2O	NUMBER
SAND	0-38.7%	20.7%	579
SILTY SAND	19.1-56.0%	31.3%	29
CLAYEY SAND	31.1-59.3%	42.8%	15
(SANDS)	(0-59.3%)	(21%)	(623)
SILT	-	-	-
SANDY SILT	31.7-40.5%	34.4%	9
CLAYEY SILT	30.3-78.6%	56.5%	25
(SILTS)	(30.3-78.6%)	(50.6%)	(34)
CLAY	57.6-74.6%	69.3%	43
SANDY CLAY	30.5%	30.5%	1
SILTY CLAY	38.1-82.4%	70.8%	210
(CLAYS)	(30.5-82.4%)	(70.4%)	(254)
SAND-SILT-CLAY	23.7-68.3%	49.3%	42

Harrison, W., M. Lynch, and A. Altschaefel, 1964, Sediments of Lower Chesapeake Bay, with emphasis on mass properties: Jour. of Sed. Petrol., vol. 34, pp. 727-755.

Keller, G., 1974, Marine geotechnical properties: interrelationships and relationships to depth of burial in Deep Sea Sediments, A.A. Inderbitzen, ed., pp. 77-100.

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