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# The shallow sediments of the middle Chincoteague Bay area in Maryland: physical and chemical characteristics

by

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## ABSTRACT

The Maryland Geological Survey, Resource Assessment Service, initiated a multi-year investigation of the character of the shallow sediments of Maryland's Chincoteague and Sinepuxent Bays. This report presents the results of the third year study which focused on the physical and chemical characteristics of the surficial sediments of the lower half of the Maryland portion of Chincoteague Bay (*i.e.*, middle Chincoteague Bay). This year's study was funded by a grant/agreement from the National Oceanic and Atmospheric Administration, Award #NA67OZ0302.

Five sediment cores and 341 surficial sediment samples were collected in the middle Chincoteague Bay. The core and surficial sediments were analyzed for water content, textural properties, total nitrogen, carbon and sulfur, and for six metals: Cr, Cu, Fe, Mn, Ni, and Zn. Results from these analyses were used to map the distribution of sediment type, nitrogen, carbon and sulfur contents and relative enrichment of the six metals in the surficial sediments.

The five cores were collected in a variety of sedimentary environments, ranging from shallow tidal flats adjacent to Assateague Island to low energy lagoonal deposits within Johnson Bay area. Cores 1 and 5 were analyzed for $^{210}$Pb activity, obtaining estimated average sedimentation rates of 0.17±0.08 and 0.25±0.14 cm/yr respectively. Although these rates are low compared to those reported for other areas of the coastal bays, they are probably representative of sedimentation rates within the Johnson Bay area.

Based on the textural analyses of surficial sediment samples, the average textural composition of the bay bottom sediments is 49% sand, 35% silt and 16% clay. Sand is the dominant sediment type found in the eastern half of the study area. Within Johnson Bay and along the western margin of the study area, clayey silt is the predominant sediment type, reflecting low energy conditions. Intermediate sized sediments such as sand-silt-clay, sandy silt, and silty sand are mapped along the central axis of the study area. These sediment represent transitional zones between the high energy sand and low energy clayey silt. Pockets of coarser material are mapped adjacent to the numerous islands, the erosion of which is the primary source of sediment to this area. As sediment is eroded, the coarser fraction stays in place while the fine fraction is winnowed out and redeposited in more sheltered areas.

Nitrogen, carbon, and sulfur contents reported are slightly less than those reported for Newport and Sinepuxent Bay and half of the values reported for Assawoman and Isle of Wight Bays. The lower contents are related to several factors. Overall, the lower values are related to low clay content. In addition, the fairly coarse sediments and shallow water promote aerobic bottom conditions, allowing reactive carbon to be oxidized before it is buried. As a result, a disproportionate amount of non-reactive carbon is left. Nitrogen contents, which mimic the behavior of carbon, show similar trends. Likewise, sulfur is lower as a result of the less reactive carbon being buried and available for anaerobic decay.

Metal data also indicate that the middle Chincoteague Bay is less affected by anthropogenic activities compared to the northern coastal bays. Of the metals measured, Cr, Cu, Fe Mn, and Ni show no significant increase over calculated historical levels. Zn is found to be elevated, with

levels higher than those reported for the upper Chincoteague Bay but less than the levels reported for Isle of Wight and Assawoman Bays.

# INTRODUCTION

The Maryland coastal bay system consists of five bays: Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, Newport Bay and Chincoteague Bay. These coastal bays are valuable resources both economically and environmentally. During the last two decades, development pressures along the shoreline around the bays have raised concerns about the "health" of the bays. Yet, there is a paucity of environmental data available to adequately assess and monitor the bays.

An important component of the coastal bays aquatic ecosystem is the sediments, which have a controlling influence on both the biology and chemistry of the ecosystem. Benthic communities are largely controlled by physical and chemical characteristics of the bottom sediments. Studies in the Chesapeake Bay have shown that the greatest abundance and diversity of benthic organisms occur in mixed sediment environments.(Reinharz and O'Connell, 1981).

Sediments serve as both sinks and sources for pollutants. Many pollutants and nutrients introduced into the bays tend to accumulate and remain in the sediment which function as a sink. The amount of pollutants contained in a sediment is controlled by sediment texture. Pollutants, such as toxic metals and organics, are usually associated with fine grained, or muddy, sediments. The sediments can act as a source of pollutants, either through remobilization of these pollutants by way of natural processes *(i.e.*, diagenetic reactions), or by physical disturbance or mixing. Because the bays are shallow, with water depths averaging less than 2 meters, wind generated waves easily cause mixing of bottom sediments with overlying water. Likewise, human activities, such as dredging and boating, can also resuspend sediments. Nutrients and pollutants in sediments may be released into the water column during resuspension, thus affecting overlying water chemistry.

Sediment data are vital to two major projects recently initiated in the coastal bays. The first project is the Ocean City Water Resources Study, a current joint effort involving the U.S. Army Corps of Engineers, National Park Service, Maryland Department of Natural Resources, Worcester County and the Town of Ocean City. This project addresses a variety of problems including dredging and maintenance of navigation channels, regional sand management for Ocean City and Assateague Island, and environmental restoration in the back bays. The data from this study are directly applicable to the joint effort to assess dredged sediment taken from the various channels, to identify suitable sediment for island creation and wetland restoration, and to interpret hydrodynamic model results. The second project is the Environmental Protection Agency's National Estuarine Program (NEP). Recently, Maryland's coastal bays were accepted into the NEP. The sediment data from this study are essential in characterizing the bays, the first step toward developing management strategies for the NEP.

In order to obtain the necessary sediment data for the coastal bays, the Maryland Geological Survey began mapping physical and geochemical characteristics of the shallow sediments of the coastal bays. Isle of Wight and Assawoman Bays were completed in 1993 during a two year effort funded by the Minerals Management Service through the Association of American State Geologist Continental Margins Program (Wells and others, 1994a, 1994b). In 1994, under a grant from NOAA's CZM program, the Maryland Geological Survey began the investigation of the character of the shallow sediments of Maryland's lower coastal bays which include Sinepuxent, Newport and Chincoteague Bays. The area of study for the first year was Sinepuxent and Newport Bays (Wells and others, 1996) and for the second year was the upper half of the Maryland portion of Chincoteague Bay (Wells and others, 1997). This report presents the results of the third year study which focused on the physical and chemical characteristics of the surficial sediments of the lower half of the Maryland portion of Chincoteague Bay (referred as the middle Chincoteague Bay).

The objectives of this study are to:

1) document selected physical and chemical characteristics of the shallow sediment column (upper 1 to 1.5 meter);
2) map the areal distribution of the surficial sediments and their characteristics;
3) establish a reference data set documenting the textural and chemical character of the bays to be used for future comparisons; and
4) develop a geochemical model specific to the sediments found in the coastal bays; the model can be used as an environmental assessment tool.

Presented in this report are the results and interpretation of the data collected in the study area. Results include the textural and chemical data from analyses of 341 surficial sediment samples and five sediment cores.

## PREVIOUS STUDIES

Early studies focused primarily on water quality monitoring in the bays (Sieling 1958, 1959, 1960; Cerco and others, 1978; Allison 1975; and Fang and others, 1977). Water column studies conducted by Allison (1975) measured pH, salinity, water temperature, dissolved oxygen (DO), nutrients, chlorophyll-a, total iron, heavy metal and pesticide concentrations, turbidity, and fecal coliform bacteria. At two sites in the middle Chincoteague Bay area, Allison analyzed bottom sediments for six metals: Cu, Cr, Pb, Zn, Cd, and Hg. Although Allison concluded that the metals concentrations in the sediments were not significantly high, he did not elaborate on any relationship between sediment and water quality data.

Several studies examined the physical character of sediments from Chincoteague Bay (Bartberger and Biggs, 1970; Bartberger, 1973; 1976). These studies involved the analyses of sediments for grain size characteristics in order to determine the origin, distribution, and rates of accumulation of sediments in Sinepuxent, Newport and Chincoteague Bays (39 of the 147 samples, were collected in the middle Chincoteague Bay area). Sediments were measured for grain size and organic carbon. Results showed that the sandy sediments were found on the eastern margins of Chincoteague Bay. Fine grained sediments were located in the deeper areas and along the western shore areas. Organic carbon, measured in 135 samples, ranged from 0.0% to 3.9%. Only six of the 135 samples had carbon contents exceeding 2.0%. Bartberger considered the organic carbon contents to be lower than expected which he attributed to fairly low sedimentation rates in the bay. The primary source of sand was from Assateague Island in the form of overwash, aeolian transport, and sediment run-off. By comparison, sediment input from streams was minor.

In 1993, the Maryland Department of the Environment conducted an assessment of Maryland's coastal bay aquatic ecosystem and terrestrial pollutant loadings into the bays (UM and CESI, 1993). The assessment, based on existing information, examined data for trends in the overall quality of the bays ecosystem. Objectives of the study were to identify water quality problems and to develop strategies for the effective management of the bay system. The study identified several areas within the coastal bays, including Newport Bay, as areas exhibiting serious water quality problems as a result of several factors including poor flushing, development along the shorelines, and high nutrient loadings. Estimates of nutrient loading rates for total nitrogen, total phosphorous, total suspended solids, zinc, lead and biochemical oxygen demand were calculated to be very high for Newport Bay compared to those observed for selected portions of the Chesapeake Bay and other coastal bays. However, the study pointed out that there is a general lack of information regarding the toxic contamination in the coastal bays and recommended developing a baseline for priority pollutants in sediments and biota.

The Coastal Bays Joint Assessment Project (CBJA), a collaboration between Delaware, Maryland, and EPA (Region III), was conducted to assess the ecological conditions of the Delmarva coastal bay system and fill a data void identified by previous studies (Chaillou and Weisberg, 1995). The study area included Indian River, Rehoboth, Assawoman, Isle of Wight, Newport and Chincoteague Bays. In 1993, water, sediment and biological samples were taken at more than 200 locations and analyzed following methods and QA/QC procedures used by the EPA Environmental Monitoring and Assessment Program (EMAP). Sampling sites were selected using a stratified random sampling design which allowed assessment of the coastal bays on different levels: coastal bays as a whole; each of the four major subsystems (*i.e.*, Chincoteague Bay) and smaller target areas of special interests (*i.e.*, upper Indian River, St. Martin River, Trappe Creek and artificial lagoons). Therefore, sampling sites were not evenly spaced throughout the study areas but were clustered. Although the emphasis of this study was biological assessment, sites were sampled for sediments to be analyzed for NOAA National Status and Trends suite of contaminants. However, due to costs constraints, only 21 sediment samples were analyzed. Results from CBJA indicated that a large portion of the coastal bays suffered from degraded environmental conditions, with more than 75% of the bay areas not meeting Chesapeake Bay Program Submersed Aquatic Vegetation (SAV) restoration goals. Of the four subsystems Chincoteague Bay was in the best condition. Results from CBJA were included in the document to nominate the Coastal Bays to the NEP.

# STUDY AREA

## GEOLOGIC SETTING

The study area is located on the Atlantic coast of the Delmarva Peninsula and lies between 38°7' N and 38° 0' N. The study area extends from Scott Hammocks/Wittington Pt south to the Maryland-Virginia state line, encompassing approximately the lower half of the Maryland portion of Chincoteague Bay (Figure 1).

Chincoteague Bay is separated from the Atlantic Ocean by Assateague Island which is part of the barrier island/southern spit unit of the Delmarva coastal compartment (Fisher, 1967). The bay is underlain by unconsolidated Coastal Plain sediments, the upper-most 60 meters of which are

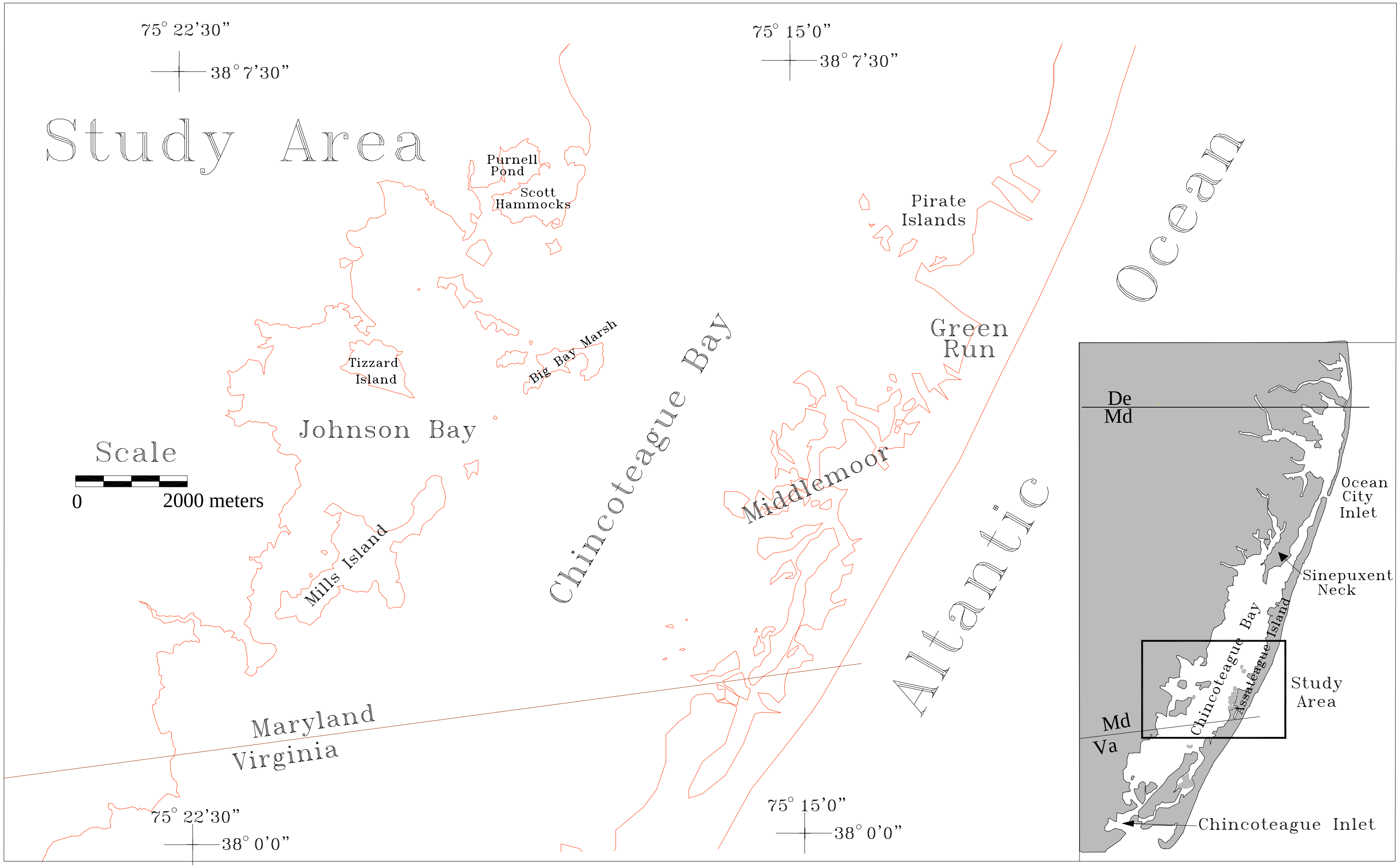



**Figure 1.** Study area.

Cenozoic in age. Sediments of the Sinepuxent Formation are exposed along much of Maryland's coastal area from Bethany Beach, Delaware, southward to the Maryland-Virginia border and directly underlie the study area (Figure 2). The Sinepuxent Formation was described by Owens and Denny (1979) based on information from drill holes along Sinepuxent Neck, the designated type locality for the Formation. The Sinepuxent Formation is composed of dark colored, poorly sorted, silty fine to medium sand with thin beds of peaty sand and black clay. Heavy minerals are abundant and consist of both amphibole and pyroxene minerals. All of the major clay mineral groups: kaolinite, montmorillonite, illite and chlorite, are represented. The sand consists of quartz, feldspar and abundant mica (muscovite, biotite, and chlorite). The high mica content makes the Sinepuxent Formation lithologically distinct from underlying older units (Owens and Denny, 1979).

The Sinepuxent Formation is interpreted to be a marginal marine deposit. Owens and Denny (1979) had assigned a mid-Wisconsin age (24-30 ka) to the formation based on $^{14}C$ data. Later studies correlated the Sinepuxent Formation to the offshore Q2 deposits which were determined to be of oxygen-isotope Stage 5 age (between 80 to 120 ka) based on amino-acid racemization (Toscano, 1992; Toscano and others, 1989; Toscano and York, 1992).

Within most of the coastal bay area, the Sinepuxent rests unconformably on top of the Beaverdam Sand Formation which is Pliocene in age (Owens and Denny, 1979) (Figure 3). The western edge of the Sinepuxent formation butts up against the Ironshire Formation which consists of pale yellow to white sand and gravelly sand. Although the Ironshire Formation sits unconformably on top of the Beaverdam, at no point does it underlie the Sinepuxent Formation (Owens and Denny, 1979). Curiously, both Beaverdam Sand and Ironshire Formations are absent in the Johnson Bay area, thus the Sinepuxent rests directly on top of the Yorktown Formation (Miocene) and abuts the Omar Formation (Owens and Denny, 1978).

## PHYSICAL CHARACTERISTICS

Chincoteague Bay is a microtidal (<2 m tidal range) coastal lagoon. The bay is very shallow, the average water depth being less than a meter. Within the study area, depths greater than 2 meters occur locally along the western side of the main central axis of the bay (Figure 4).

The shallow bathymetry and restricted access to the ocean contribute to poor circulation and flushing within the study area. Chincoteague Bay is connected to the Atlantic Ocean through two inlets: Ocean City Inlet (through Sinepuxent Bay) to the north, and Chincoteague Inlet in Virginia to the south (Figure 1). The study area includes a portion of Chincoteague Bay located closer to Chincoteague Inlet in Virginia. Although Chincoteague Inlet probably has a greater influence with regard to tidal effect, overall influence from the ocean is minimal within the study area. Reported estimates for turn-around time in Chincoteague Bay range from 63 days (Pritchard, 1960) to 200 days (Sieling, 1958). Circulation patterns and bay water levels are controlled primarily by wind conditions. Casey and Wesche (1981) reported at a site near Public Landing (mid-point Chincoteague Bay) negligible tidal currents, but wind currents up to 12 cm/sec. At this site, tidal amplitude was measured at 17 cm. However, during storm conditions, they observed water levels varying as much as 63 cm.

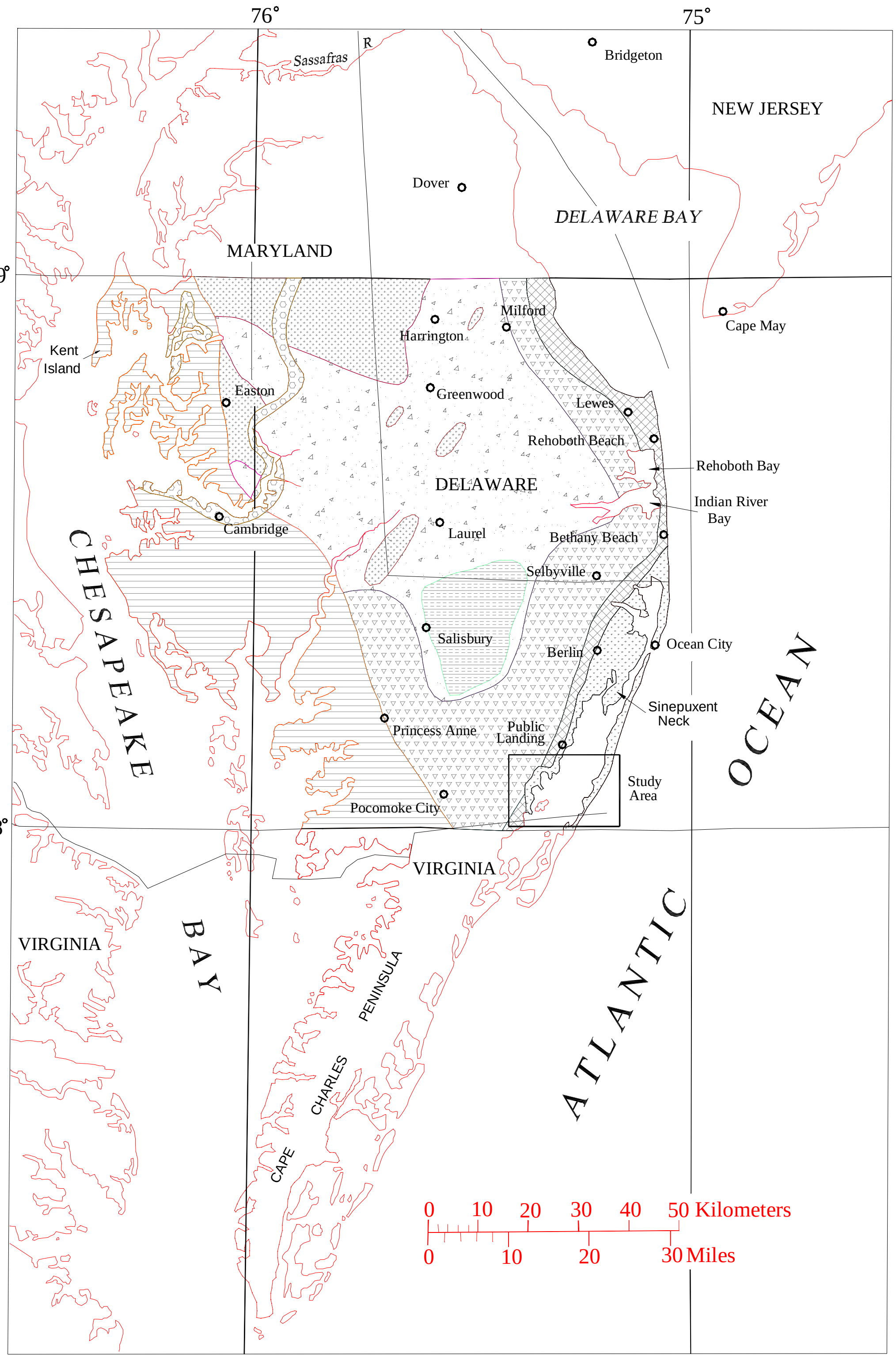
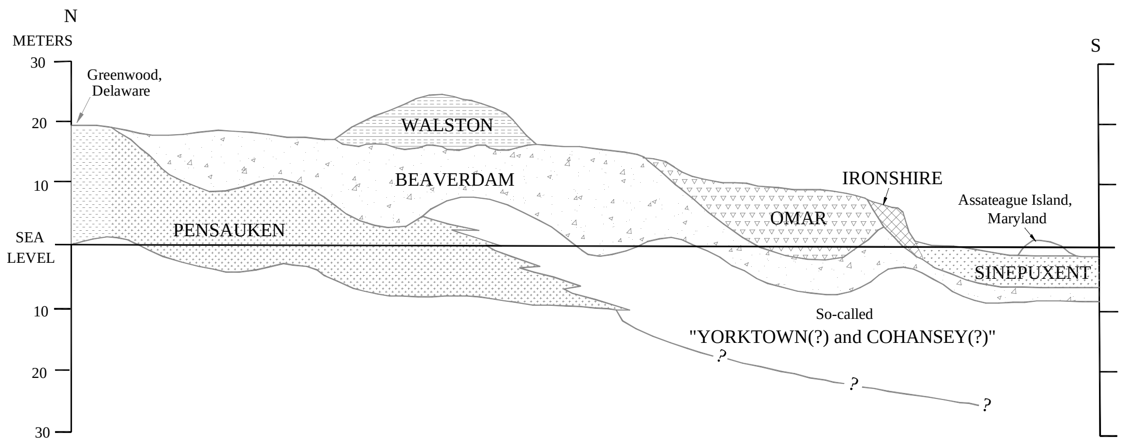



**Figure 2.** Generalized geologic map of central Delmarva Peninsula with study area shown (boxed) (modified from Owens and Denny, 1979). See Figure 3 for pattern key.



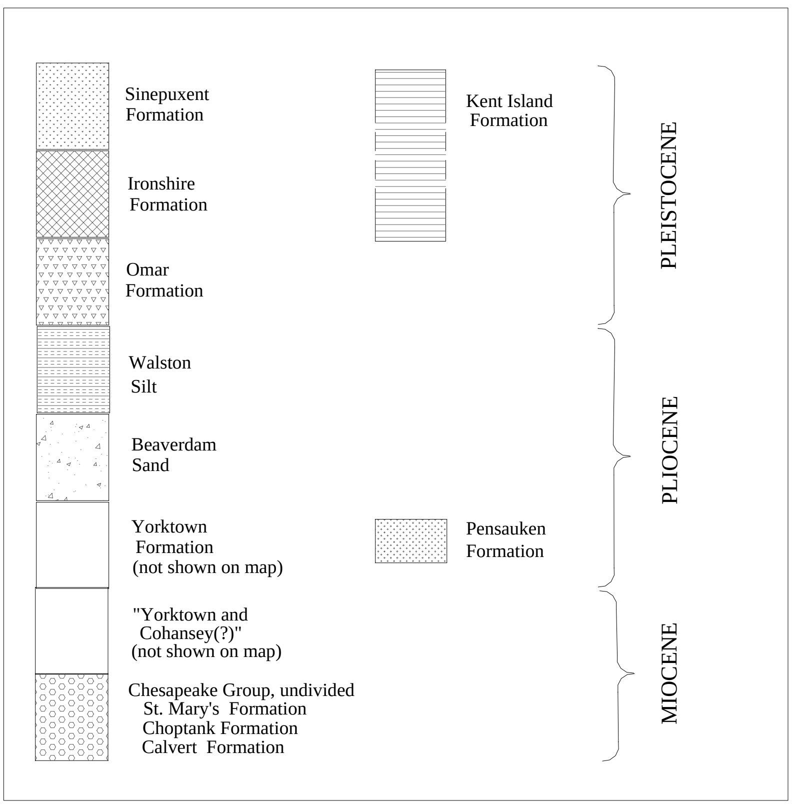




**Figure 3.** Cross-section showing stratigraphic relationship of geologic formations (from Owens and Denny, 1979) and pattern key (modified from Owens and Denny, 1979) for geologic map shown in the cross-section above and in Figure 2.

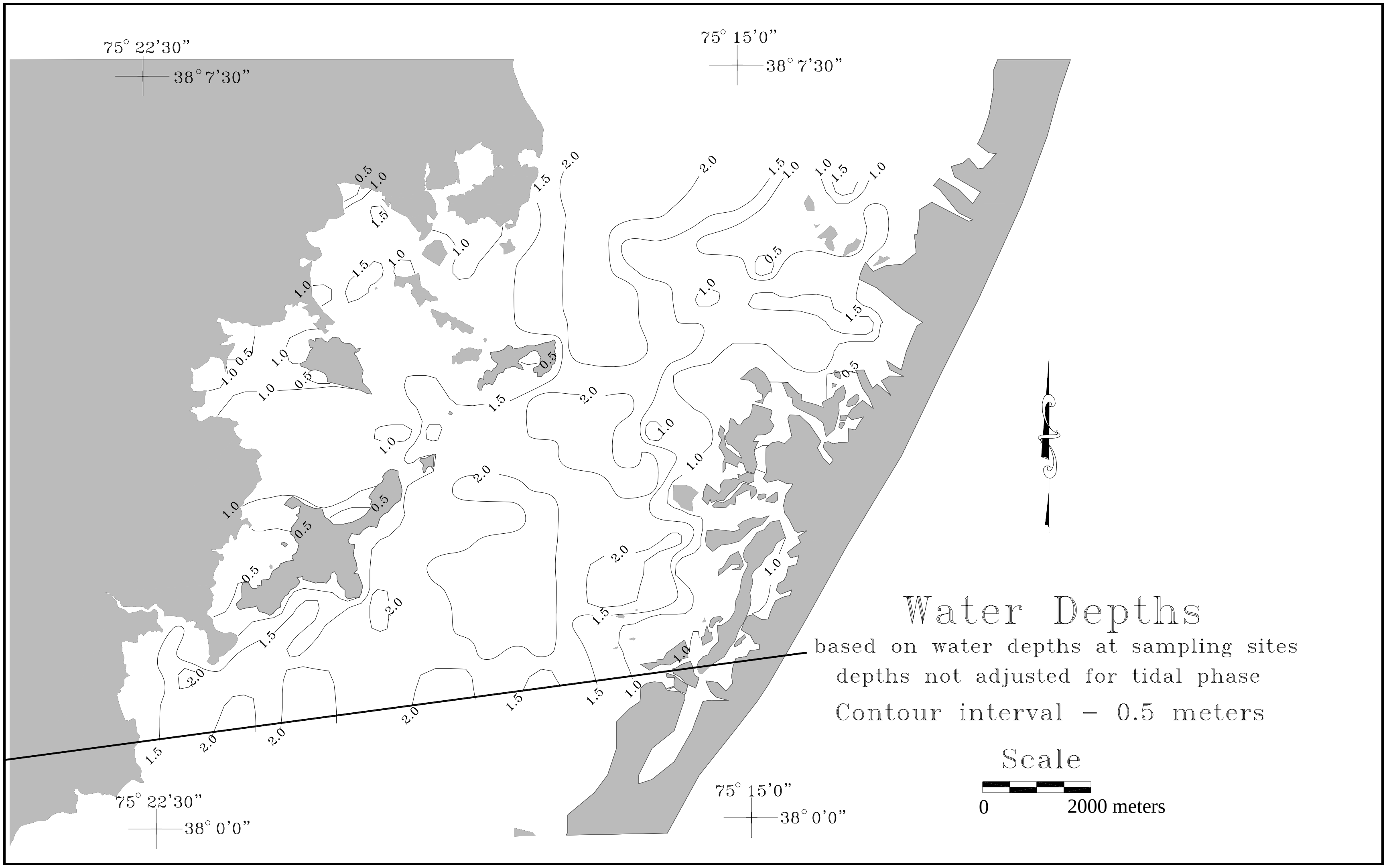



**Figure 4.** Water depths within the study area.

Salinity within Chincoteague Bay varies depending on season. Average salinity in mid-Chincoteague Bay averages 30.2 ppt (UM and CESI, 1993). However, due to high evaporation and poor circulation during the late summer, salinity will often approach or exceed that of sea water (32 ppt). Maximum salinity measured during the summer (Casey and Wesche, 1981) ranged from 31 ppt near Inlet Slough (Jim's Gut) on Assateague Island to 34 ppt just east of Public Landing. These two sites are just north of the the study area.

Within the study area, there are two significant marshy areas: Johnson Bay on the mainland side and Middlemoor Island complex on Assateague Island (Figure 1). Numerous eroding islands and low salt marsh margins characterized the Johnson Bay area. Many of the islands, such as Mills Island, are associated with sandy deposits. These islands align with Sinepuxent Neck (to the north) which is interpreted to be Pleistocene beach ridges (Rasmussen and Slaughter, 1955). Therefore, it is believed that many of the islands in the Johnson Bay area are Pleistocene in age rather than early Holocene. These islands are eroding at a rapid rate with Big Bay Islands having the highest rate of 8,740 $m^3$ per year (Singewald and Slaughter, 1949). This rate is about four times that of the mainland shore bordering Johnson Bay (Table I). Shoreline segments subjected to highest erosion rates ( 0.6 to 2.4 m/yr) are those exposed to the NE and ENE direction (Conkwright, 1975).

**Table I.** Shoreline erosion and/or accretion data for the study area (lower half of Maryland portion of Chincoteague Bay (from Singewald and Slaughter, 1949, and Bartberger, 1973).

| Shoreline Segment (See Figure 5) | Time Interval [1] (yrs) | Length of shoreline measured (km) | Area lost (-) or gain (+) per km per year ($m^2$/km/yr) | Ave. land height [2] (m) | Vol. lost per km per yr. ($m^3$/km/yr) |
|---|---|---|---|---|---|
| I. Chincoteague Bay, west shore from Scott Hammock to Va. State line. | 92 | 20.76 | -150.9 | 0.91 | -137.3 |
| II. Big Bay Islands (inc. Rattlesnake Isl) | 92 | 17.54 | -653.8 | 0.76 | -496.9 |
| III. Tizzard Island | 92 | 3.70 | -326.9 | 0.76 | -248.4 |
| IV. Mills Island | 92 | 12.39 | -452.7 | 0.76 | -344.1 |
| V. Chincoteague Bay east shore, Lat. 38° 7' 30" to Va. State line. | 92 | 31.70[3] | +452.7 | 0.76 | +344.1 |

[1] Time interval based on comparisons between 1850 shoreline and 1942 shoreline.
[2] Elevations estimated by Bartberger (1973).
[3] Includes segment of shoreline north of study area.

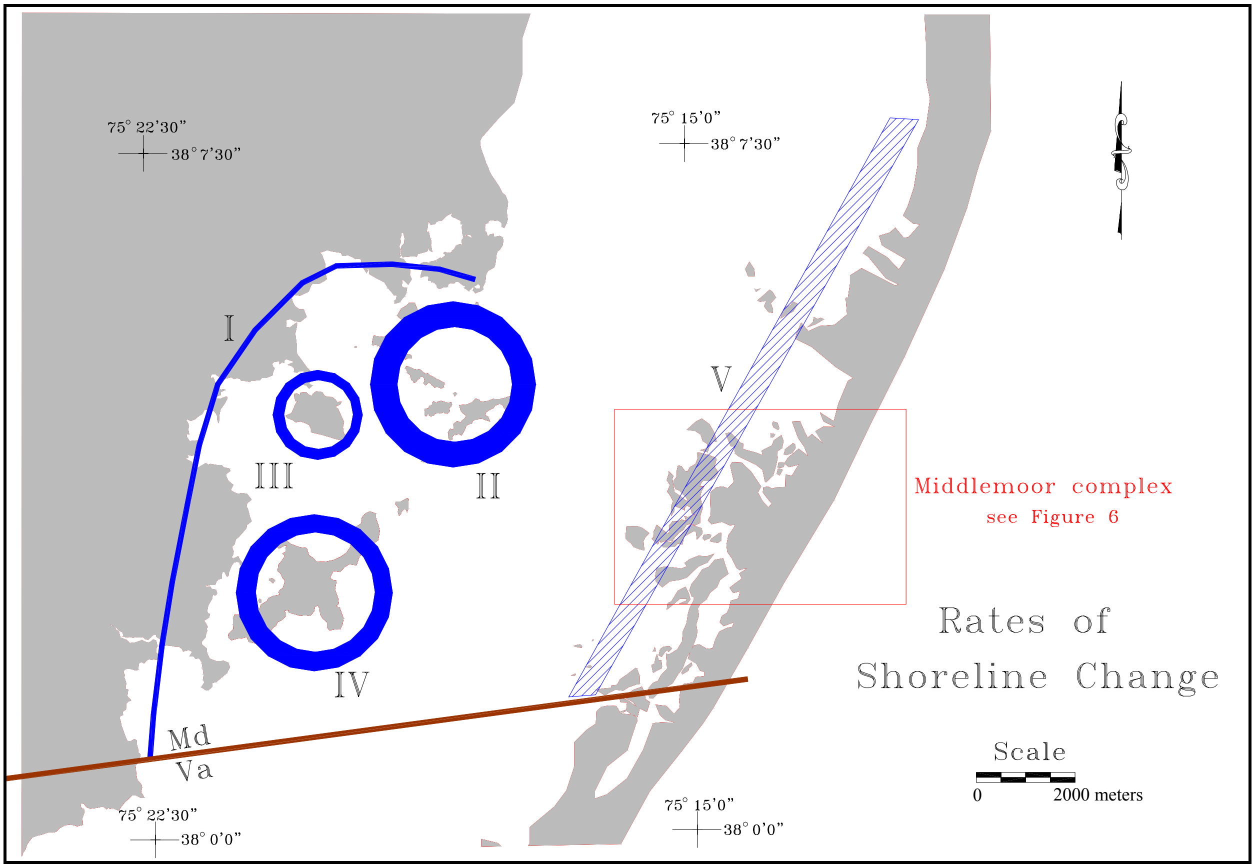



**Figure 5.** Map showing shoreline segments measured for rates of erosion and accretion listed in Table I. Solid fill indicates shoreline segments undergoing erosion. Stippled fill indicates shoreline segments undergoing net accretion. (modified from Bartberger, 1973). Historical shorelines for the Middlemoor Island complex (boxed) are detailed in Figure 6.

On the bay side of Assateague Island, opposite of Johnson Bay, is the Middlemoor Island marsh, the site of Green Run Inlet. The inlet was open in 1850, but by 1900, had closed (Figure 6). There have been other historical accounts of earlier inlets at this site. Remnants of a tidal delta formed from Green Run Inlet has since been incorporated in the Middlemoor Marsh. The other islands west of the marsh existed before the formation of Green Run Inlet (or at least the last account of the inlet) and may be remnant tidal deltas from even earlier inlets existing at this site. While the inlet was opened, this area had experienced accretion. However, since the early 1900s, some of the islands in the Middlemoor complex have undergone some erosion.

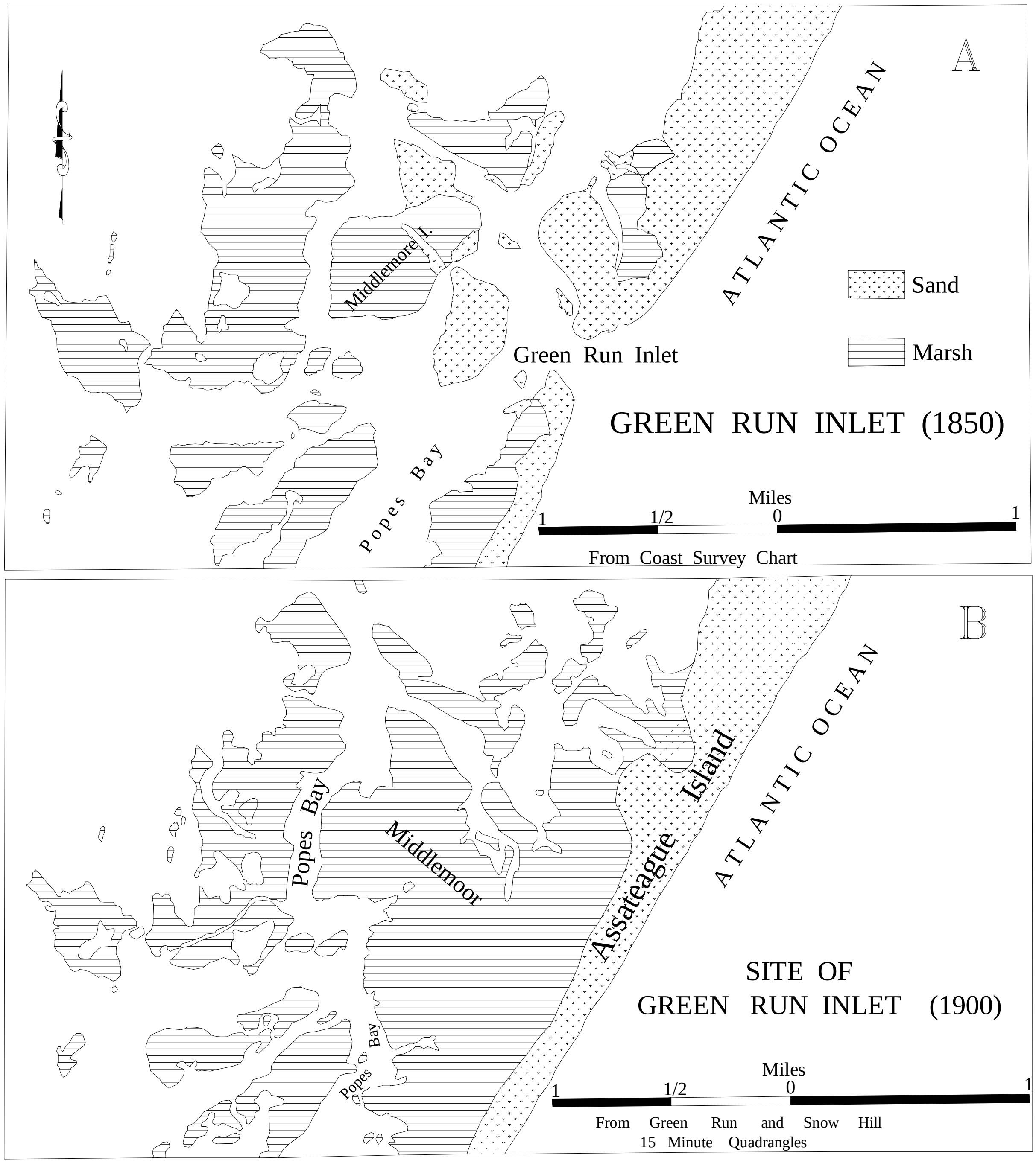



**Figure 6**. Middlemoor complex as it existed in: a)1850 when Green Run Inlet was opened; and b) 1900 after Green Run Inlet closed (from Biggs, 1970).

# METHODS

## STUDY APPROACH

The study involved two tasks. The first task consisted of the collection and analysis of a series of shallow sediment cores to define the vertical sequences in the sediment column. Based on downcore changes in chemical components, pre-anthropogenic sediments were identified and used to develop a predictive geochemical model by which surficial sediments can be evaluated. The second task involved the systematic collection of surficial sediments, and subsequent analyses of these sediments. The physical and chemical data from the surficial sediments were mapped defining the areal distribution of these characteristics.

## FIELD METHODS

### Coring Techniques

Cores were collected during the spring of 1997. Locations of the five (5) coring stations are shown in Figure 7. Positions of these stations were determined using an Ashtech ACA-12 GPS receiver, interfaced with a Starlink MRB-2A MSK Radiobeacon Differential GPS (DGPS) receiver. This GPS system is capable of real-time location accuracy of 2 to 4 meters. Latitude and longitude (NAD83) for each core are reported in Appendix I.

Five cores were collected within the deeper portions of the bays in order to sample a vertical sequence of fine grained, modern lagoonal muds. The cores were collected using a Benthos Gravity corer, Model #2171. Clear cellulose acetate butyrate (CAB) tubes, 6.7 cm in diameter, were used as core liners for both coring methods. As soon as the cores were collected, they were cut at the sediment-water interface and sealed. Once in the laboratory, the cores were refrigerated at 4°C until analysis.

### Surficial Sample Collection

During the fall of 1996, surficial sample collection was conducted onboard an 18 ft whaler. The Ashtech ACA-12 GPS unit, described in previous section, was used for navigation. A sampling grid based on 500 by 500 meter spacing was used to determine sample locations. A total of 341 sediment samples were collected. Sample locations are shown in Figure 8. Latitude and longitude for each station are presented in Appendix II.

Sediment samples were collected using a hand-operated LaMotte stainless-steel dredge which sampled a bottom surface area of 19 cm x 14 cm. Upon collection, the samples were described and then placed in Whirl-Pak™ bags. Field descriptions of the samples are presented in Appendix II.

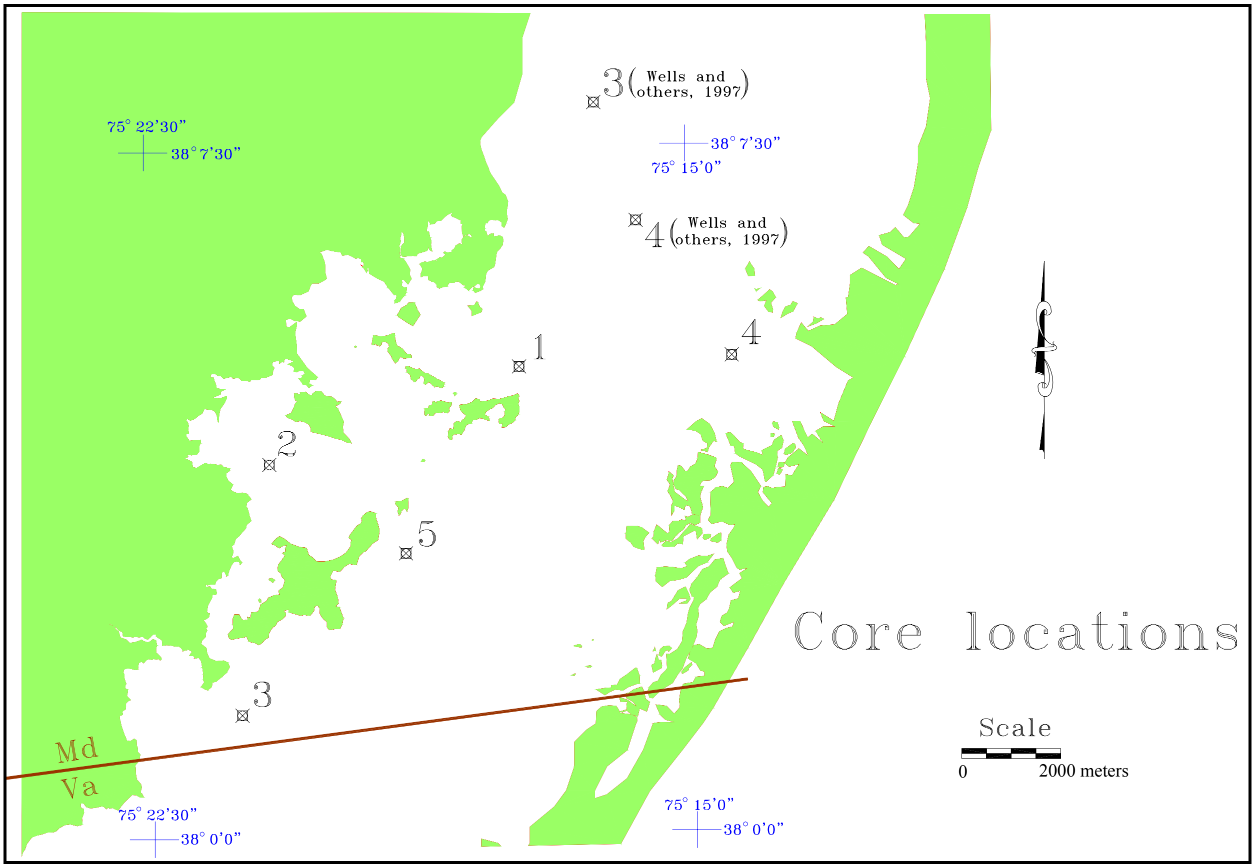



**Figure 7.** Core locations.

## LABORATORY ANALYSES

Cores and surficial sediment samples were prepared and analyzed using the methods described in Wells and others (1996). Brief descriptions of these methods are presented in this report.

### Xeroradiography and Initial Core Processing

Prior to analyses, the cores were x-rayed using a TORR-MED medical X-ray unit. After x-raying was completed, each core was extruded (or cut) from the plastic liner, split, photographed and described, noting any sedimentological structures and lithological changes. Xero-radiographs (X-rays) and core logs are presented in Appendix I. Sediment samples were taken at specific locations in the cores based on the visual and radiographic observations.

### Textural Analyses

Sediment samples were analyzed for water content and grain size (sand, silt, clay content). Sand, silt and clay contents were determined using the textural analysis detailed in Kerhin and

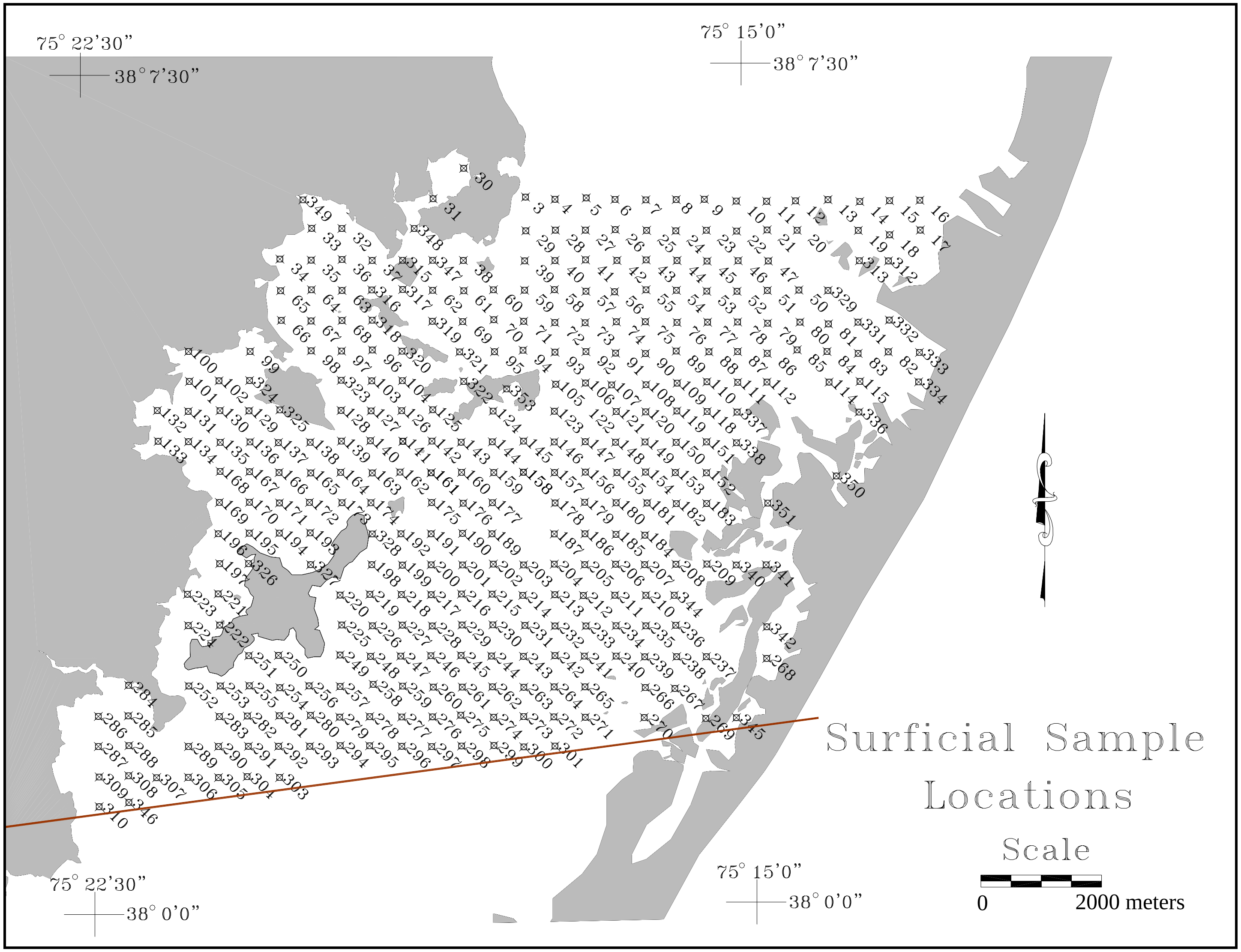



**Figure 8.** Surficial sample locations.

others, (1988). The sediments were categorized according to Shepard's (1954) classification based on percent sand, silt and clay components. The results of the textural analyses for core samples and surficial sediments are listed in Appendix I and II respectively. Quality assurance/quality control (QA/QC) for textual analyses is detailed in Appendix III.

### Chemical Analyses

Sediments dried for water content determination were analyzed for total elemental nitrogen, carbon, sulfur, and six metals: Cr, Cu, Fe, Mn, Ni, and Zn. The sediments were analyzed for total nitrogen, carbon and sulfur (NCS) using a Carlo Erba NA1500 analyzer. The NA1500 Analyzer was configured for NCS analysis using the manufacturer's recommended settings. As a primary standard, 5-chloro- 4-hydroxy- 3-methoxy- benzylisothiourea phosphate was used. Blanks (tin capsules containing only vanadium pentoxide) were run after every 12 samples (unknowns) and standards. Replicates of every fifth sample were run. As a secondary standard, a National Institute of Standards and Technology reference material (NIST SRM #1646 - Estuarine Sediment) was run every 6 to 7 samples. Comparison of results of standard reference materials to their certified or reported values are presented in the QA/QC discussion (Appendix III).

Concentrations of the six metals were determined using a microwave digestion technique, followed by analyses of the digestate on an Inductively Coupled Argon Plasma Spectrophotometer (ICAP). The microwave digestion technique is detailed in Wells and others (1994a).

A Thermo Jarrel-Ash Atom Scan 25 sequential ICAP was used for the metal analysis. The wavelengths and conditions selected for the metals of interest were determined using digested bottom sediments from the selected sites in the Chesapeake Bay and reference materials from the NIST (NIST SRM #1646 - Estuarine Sediment; NIST SRM #2704 - Buffalo River Sediment) and the National Research Council of Canada (PACS-1 - Marine Sediment). Quality control was maintained using the method of bracketing standards (Van Loon, 1980) and include running a suite of the reference materials with every sample set. Results of the SRM analyses are presented in the QA/QC discussion (Appendix III).

# RESULTS

## SEDIMENT TEXTURE

### Cores

Cores were collected in several different depositional environments. All cores showed some degree of bioturbation (refer to Appendix I). Silt, the dominant component, decreased slightly with depth in all cores. Textural data for the cores are presented in Appendix I.

Core 1 was collected in the northern part of the study area, just north of Big Bay Marsh (Figure 7). The core which was collected in 1.8 meter of water, penetrated 0.5 meters into the sediment. The sediments consisted of greenish black to greenish grey clayey silts. Clay increased with depth.

Core 2 was collected Johnson Bay just south of Tizzard Island, in 1.4 meters of water. The core penetrated sediments consisting of greenish grey silty clay grading into sand silt clay at 20 cm below the surface. The sediments were fairly bioturbated, and punctuated with large oyster shells.

Core 3 which penetrated 57 cm, was collected in the southern end of the study area, off Purnell's Point, in 2 meters of water. This core consisted of firm greenish grey clayey silt. The bottom of the core penetrated coarser sand-silt-clays. The central section of core was dominated by a large burrow filled with black, very smooth cohesive silty clay. The texture of the fill was unexpected in that it represented one of the finest grained sediment encountered in the lower coastal bays. The only other silty clays encountered were in Newport Bay (Wells and others, 1996).

Core 4 was collected on the east side of the study area near Green Run. The water depth at this core location was 2 meters. Although the area in which this core was collected was predominately sandy, the core penetrated over 63 cm of firm greenish grey to black mixture of sand silt clay, clayey silt and sandy silt.

Cores 5 was collected in the mid bay area just east of Mills Island, in 2 meters of water. The core penetrated sediments consisting of greenish black to grey clayey silt. Sand content decreased with depth. This core was very similar both in appearance and texture to core 1.

Based on relatively low levels of bioturbation and fairly fine grained texture, cores 1 and 5 were selected for $^{210}$Pb activity analysis to determine sedimentation rates at these sites. The $^{210}$Pb activity data are presented in Appendix I. For the top of the cores (upper 12 to 16 cm), sedimentation rates averaged 0.17±0.08 cm/yr and 0.25±0.14 cm/yr for core 1 and core 5 respectively. However, the $^{210}$Pb activities measured in the cores were low, and the vertically integrated activities were calculated to be 9 dpm/cm$^2$ for core 1 and 18 dpm/cm$^2$ for core 5. These activities are much lower than those expected from atmospheric loading, which is 30 to 35 dpm/cm$^2$. These lower than expected activities may be an effect of how sediments accumulate at these coring sites. Accumulation may not be a steady process. There may be periods of erosion or no accumulation; these periods cannot be distinguished in the sediment column. Accumulating sediments may include older material eroded from nearby islands.

Biggs (1970) estimated sedimentation rates, which ranged from 0.095 cm/yr to 0.185 cm/yr along a transect across the bay at Pirate Islands (Figure 9), were based on depth to basal peats, the ages of which were determined by $^{14}$C isotopic dating. The depths of these basal peats ranged between 9.5 to 10 meters below MSL under the Pirate Islands. Biggs' rates are based on the total sediment column which consisted of a broad range of sediment types. Some of the sediments would be somewhat dewatered due to compaction. Biggs' rates are probably a little lower than those based on sediments fully saturated with water. The sedimentation rates of 0.17 cm/yr and 0.25 cm/yr reported for this report are based on sediment saturated with water (water content ranging from 35 to 50%). The rates based on depth to basal peat represent the average sedimentation rate for the entire time sequence (between 4,000 to 5,500 years- refer to Figure 9) and rates for a smaller time period may vary significantly. For example, the sedimentation rates for 2 cm intervals in cores 1

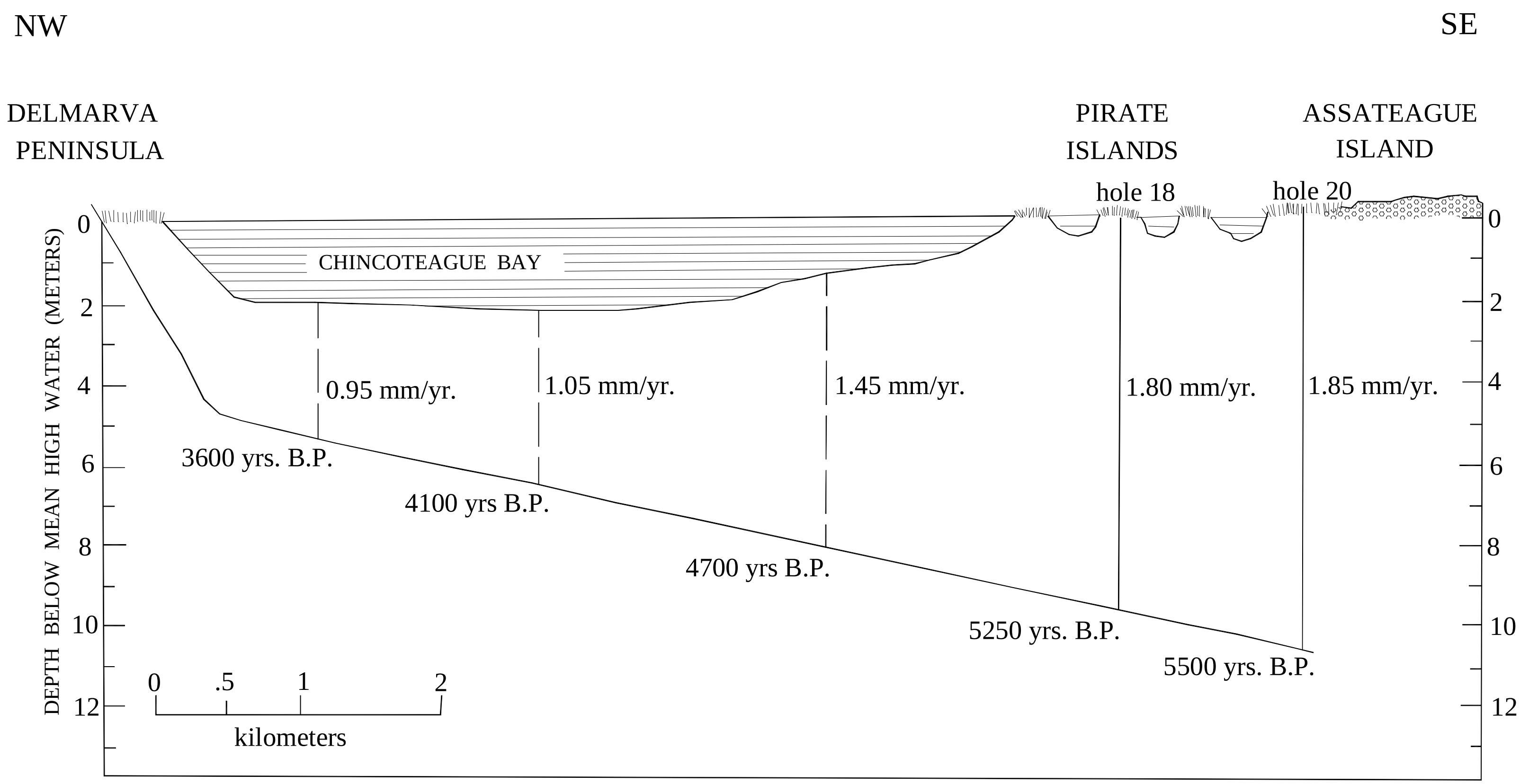



**Figure 9**. NW-SE cross section through Chincoteague Bay at Pirate Islands showing rate of Holocene sedimentation at five locations where cores were collected. Numbered cores refer to borings made by Biggs (1970) (from Bartberger, 1976).

and 5 range from 0.052 cm/yr to 0.389 cm/yr (Table VIII, Appendix I)

The sedimentation rates determine from cores 1 and 5 are also within those $^{210}$Pb-derived rates reported for Newport Bay (rate of 0.14 cm/yr- Wells and others, 1996) and northern Chincoteague Bay (rate of 0.33 cm/yr- Wells and others, 1997). A rate of 0.35 cm/yr was reported for Assawoman Bay (Wells and others, 1994a) and rates of 0.26 cm/yr and 0.57 cm/yr have been reported for Rehoboth Bay and Indian River Bay, respectively (Chrzastowski, 1986). It may be noted that the sedimentation rates determined by $^{210}$Pb activity are valid only for the fine grained lagoonal sediments in the immediate vicinity of the two sites in Chincoteague Bay, and not adjacent areas. $^{210}$Pb -derived sedimentation rates can only be determined for fine grained sediments which absorb the isotope. Results cannot be extrapolated to adjacent sediments that contain little or no silt- or clay-sized particles. In addition, these rates were obtained from cores collected in the vicinity of moderately eroding islands (Mill Island and Big Bay Island); therefore, the sedimentation rates reflect the influx of reworked sediments.

## Surficial Sediments

Based on the textural analyses of 341 surficial sediment samples (representing top 5 cm of sediment column), the average textural composition of the bay bottom sediment within the study area (middle Chincoteague Bay) is 49 % sand, 35% silt, and 16% clay. Overall, bottom sediments are less sandy compared to northern portion of Chinoteague Bay or Sinepuxent/Newport Bay Gravel is an extremely minor component. Only six samples contained gravel, all less than 1%.

Six of the ten Shepard's (1954) classifications are represented in the bottom sediments. Table II presents a summary of the classification of the surficial sediments collected in the middle Chincoteague Bay. Approximately one-third (32%) of the samples are classified as sand. Twenty-eight percent of the samples are classified as clayey silt. These percentages are different than those reported for the upper Chincoteague Bay and Sinepuxent/Newport Bay. They are more like those reported for Assawoman and Isle of Wight Bays (Wells and others, 1994b)

Along the eastern half of the middle Chincoteague Bay area, the predominate sediment type is sand with some pockets of sandy silt and silty sand (Figure 10). The coarser grained sediment is transported into the bay either by storm overwash across Assateague Island, by wind, or through former inlets. The area adjacent to Assateague Island is shallow with water depths less than 1.5 meters. Wind-generated waves constantly rework bottom sediments, removing finer grained materials, which eventually settle in sheltered areas such as the channels within the Middlemoor area, or in deeper water. There are several pockets of finer grained sediment; silty sand, sandy silt and sand-silt-clay, associated with small islands along the bay side of Assateague, and most likely represent sediment eroded from these islands. Very fine grained sediments are found in the channels between the islands

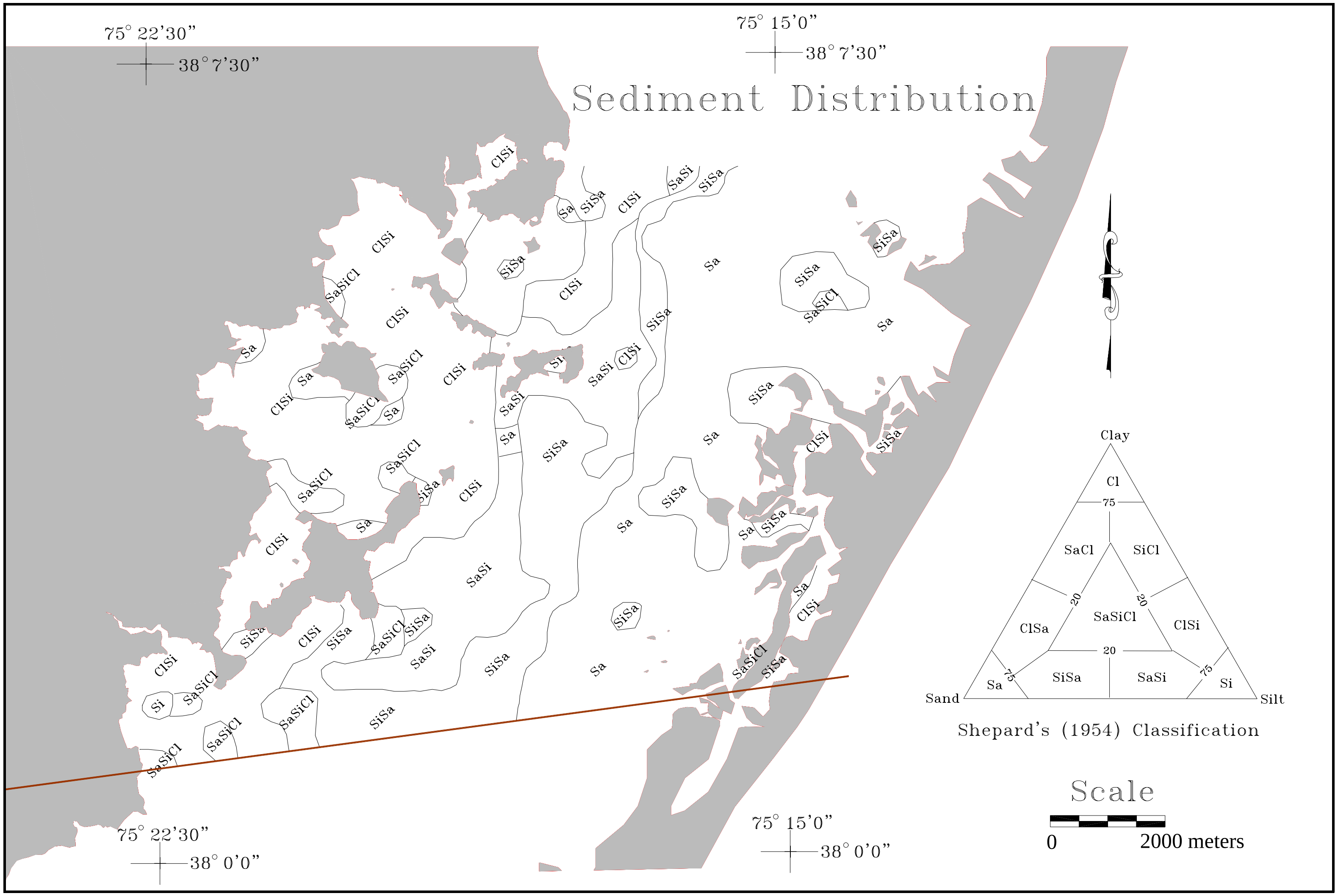



**Figure 10.** Distribution of sediment type based on Shepard's (1954) classification.

**Table II.** Summary of water content, percent nitrogen, carbon and sulfur for each sediment type for surficial sediments collected in the middle Chincoteague Bay area. The total number of surficial sediments analyzed is 341.

| Sediment Type (Shepard's (1954) Classification) | Number of samples | %of total samples | Mean | | | |
|---|---|---|---|---|---|---|
| | | | Water (% wet weight) | Nitrogen (%dry weight) | Carbon (%dry weight) | Sulfur (%dry weight) |
| SAND | 110* | 32.3 | 24.5 ±3.4 | 0.03 ±0.01 | 0.33 ±0.18 | 0.08 ±0.03 |
| SILTY SAND | 64 | 18.8 | 28.2 ±4.4 | 0.06 ±0.02 | 0.82 ±0.69 | 0.18 ±0.08 |
| SANDY SILT | 42 | 12.3 | 33.9 ±3.2 | 0.07 ±0.01 | 0.94 ±0.35 | 0.26 ±0.04 |
| SAND-SILT-CLAY | 28 | 8.2 | 39.8 ±4.0 | 0.11 ±0.02 | 1.27 ±0.29 | 0.32 ±0.12 |
| CLAYEY SILT | 96 | 28.2 | 45.8 ±4.8 | 0.13 ±0.03 | 1.50 ±0.38 | 0.42 ±0.19 |
| SILT | 1 | 0.3 | 42.9 | 0.1 | 0.86 | 0.28 |

*The number of sand samples used to calculate means for nitrogen, carbon, and sulfur values was 54. Fifty-six sand samples were not analyzed for chemistry due to the difficulty in grinding the coarser sand particles in preparation for analyses.

Westward across the bay, sandy sediments grade into sandy silts, silty sands, and sand-silt-clays. These sediments represent transitional zones between the high-energy sand deposits and low-energy clayey silt deposits. Clayey silts are mapped in the Johnson Bay area and along the western margin of the study area. These broad areas of fine grained clayey silts most likely reflects both lower energy conditions and proximity to an eroding marsh shoreline which contribute muddy sediments. The pockets of sand-silt-clays, silty sand, sandy silt and sand are associated with the numerous islands in Johnson Bay and Scott Hammock neck. The source of these sediments is most likely shore erosion.

## WATER CONTENT

Water contents in cores sample ranged from 31% to 51%. The highest content was measured in the silty clay burrow fill sampled from core 3. For the other cores, water content was fairly constant with depth, variation depending on changes in texture.

Water contents in the surficial sediments range from 19% for sand to 59% for clayey silt.

Correlation coefficients for surficial sediment indicate that water contents are strongly associated with the textural components of the sediments (Table III). There is a high positive correlation between percent water and clay content (r = 0.94) and a negative correlation between percent water and sand content (r = -0.89). Association between water content and silt is fairly strong (r = 0.82), but weaker than the correlations with the other grain size fractions.

## GEOCHEMISTRY

### Carbon

Total carbon contents measured in the core sediments range from 0.78 to 2.04% with a mean value of 1.33%. The highest carbon value (2.04%) was obtained from the silty clay burrow fill found in core 3. (see Appendix I: Core 2, 20-27 cm). Carbon contents measured in the surficial sediments range from 0.10 to 4.65%, averaging 1.00% for the study area. The highest value was obtained for a sample containing abundant shell hash and is treated as an anomaly. Although the overall carbon contents are slightly higher than those obtained for the upper portion of Chincoteague Bay (Wells and others, 1997), they are overall lower than those obtained in Isle of Wight and Assawoman Bays (Wells and others, 1994b) and slightly lower than those obtained in Sinepuxent and Newport Bays (Wells and others, 1996). Comparisons of summary statistics for sediment type from this study (Table I) and the Isle of Wight/Assawoman Study (see Wells and other, 1994b) indicate that the finer grained sediments (*i.e.*, sand-silt-clay, clayey silt, and silty clay) in the middle Chincoteague Bay area contain less than half the amount of total carbon as those sediments found in the upper two bays.

Correlations analysis of surficial sediment data for middle Chincoteague Bay yielded lower coefficient values compared to those obtained for other study areas in the coastal bays. Nevertheless, this year's results reveal a strong association between carbon content and percent water (r = 0.81) (Table III). Correlation coefficients (r) between carbon content and sand, silt, clay contents are -0.73, 0.65 and 0.80, respectively, indicating that carbon has the highest association with the clay fraction.

The carbon content distribution generally follows the sediment distribution. The lowest carbon contents are found in areas characterized by sandy sediments (Figure 11). Along the eastern half of the study area, carbon content is relatively low, averaging less than one percent for the sediments analyzed. Higher energy conditions are characteristic of this fairly shallow area, where the mean water depth is less than one meter. Here, constant reworking of the sediments by wave action results in the removal of the fine grained materials, including the organics. Higher carbon is found locally corresponding to those isolated spots of fine grained sediments, or area where shell fragment have accumulated (such as samples 187, 278, 280 and 344- refer to field descriptions in Appendix II).

**Table III**. Correlation matrix for metal concentrations and sediment textural data based on all surficial sediment samples. The correlations were done using Pearson product-moment technique (Johnson and Wichern, 1982). Correlation analysis was conducted pairwise, to include all samples with missing parameter values. Values listed in table are Pearson correlation coefficients (r). Sample sizes for individual correlations range from 262 to 339. Significant levels for all values are less than 0.01 (critical value of r at 99% = 0.479).

| | $H_2O$ | %Sand | %Silt | %Clay | N | C | S | Cr | Cu | Fe | Mn | Ni | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| %Water ($H_2O$) | 1.000 | | | | | | | | | | | | |
| %Sand | -0.886 | 1.000 | | | | | | | | | | | |
| %Silt | 0.815 | -0.983 | 1.000 | | | | | | | | | | |
| %Clay | 0.939 | -0.942 | 0.864 | 1.000 | | | | | | | | | |
| %Nitrogen (N) | 0.912 | -0.853 | 0.750 | 0.942 | 1.000 | | | | | | | | |
| %Carbon (C) | 0.807 | -0.733 | 0.650 | 0.799 | 0.845 | 1.000 | | | | | | | |
| %Sulfur (S) | 0.882 | -0.752 | 0.679 | 0.797 | 0.893 | 0.728 | 1.000 | | | | | | |
| Chrome (Cr) | 0.900 | -0.956 | 0.885 | 0.977 | 0.909 | 0.755 | 0.767 | 1.000 | | | | | |
| Copper (Cu) | 0.608 | -0.591 | 0.516 | 0.648 | 0.615 | 0.473 | 0.514 | 0.655 | 1.000 | | | | |
| Iron (Fe) | 0.900 | -0.958 | 0.889 | 0.974 | 0.908 | 0.764 | 0.778 | 0.994 | 0.639 | 1.000 | | | |
| Manganese(Mn) | 0.623 | -0.783 | 0.783 | 0.697 | 0.622 | 0.627 | 0.513 | 0.777 | 0.424 | 0.799 | 1.000 | | |
| Nickel (Ni) | 0.817 | -0.809 | 0.719 | 0.870 | 0.835 | 0.613 | 0.718 | 0.877 | 0.614 | 0.869 | 0.605 | 1.000 | |
| Zinc (Zn) | 0.909 | -0.952 | 0.876 | 0.984 | 0.925 | 0.768 | 0.778 | 0.995 | 0.657 | 0.991 | 0.754 | 0.870 | 1.000 |

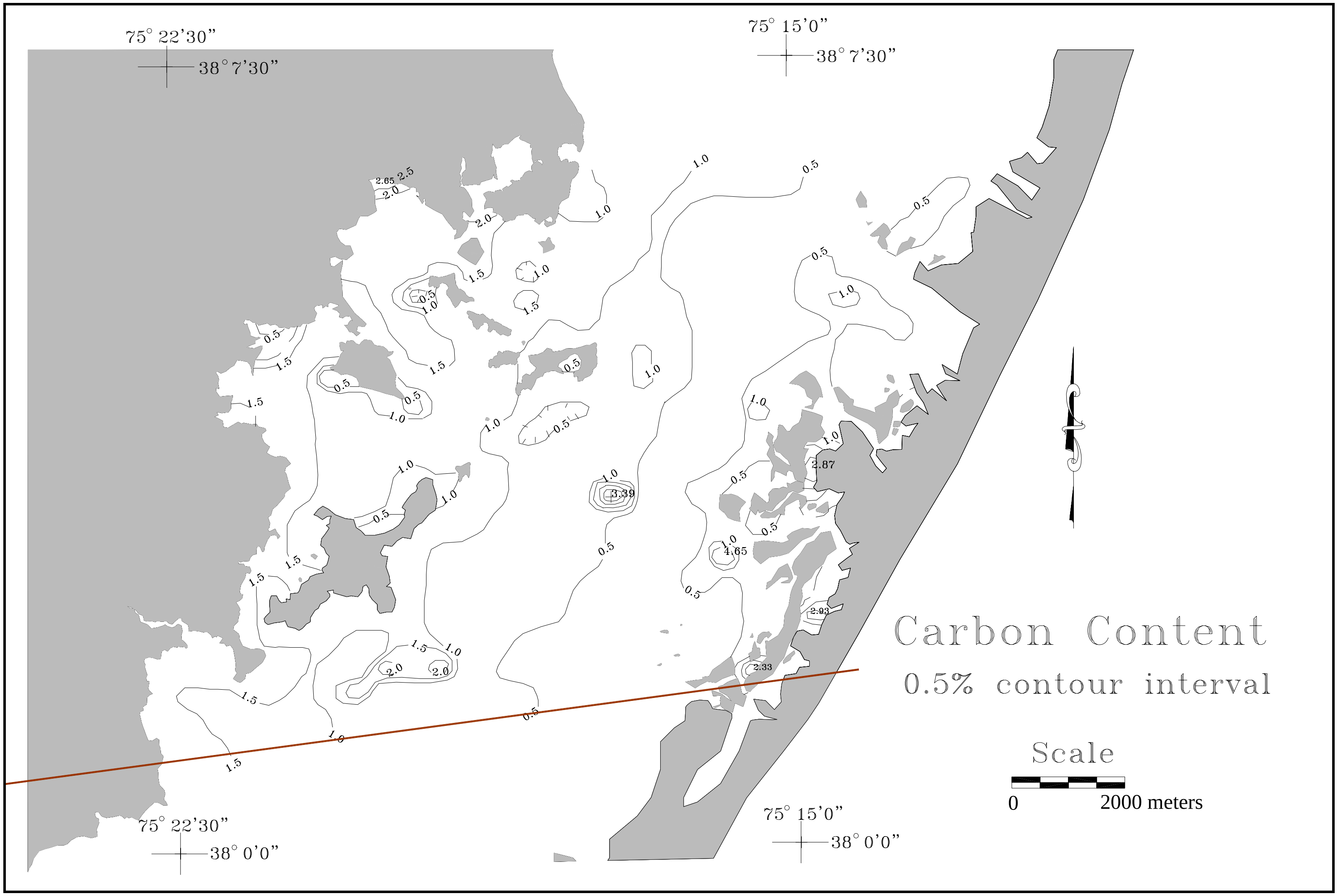



**Figure 11.** Distribution of total carbon in surficial sediments.

Higher carbon contents (%C > 1.0) were found in sediments collected from the western margin of the study area. Areas of higher carbon content correspond to areas of finer grained sediments, which accumulate under lower-energy conditions, such as in deeper water or sheltered areas. Within this study area, the finer grained material with higher carbon contents are found primarily in the more sheltered areas such as Johnson Bay, in the channels in the Middlemoor complex and in Purnell Pond (behind Scott Hammock).

## Nitrogen

Total nitrogen contents in the core sediments range from 0.06% to 0.17% and average 0.10%. The highest nitrogen value was obtained from the fine grained burrow fill sediment in Core 3. Based on surficial sediments, nitrogen contents range from 0.01 to 0.29%, averaging 0.08%. The highest values for surficial sediments were obtained from clayey silts collected in the channel in the Middlemoor complex (samples 268, 269,and 351) and in the sheltered aeas in Purnell Pond (samples 30 and 31) and Boxiron Creek (sample 349) (Figure 12). Overall, the finer grained sediments (*i.e.*, sand-silt-clay, and clayey silt) in the middle Chincoteague Bay contain slightly less total nitrogen than the sediments found in the Sinepuxent and Newport Bays.

Correlation analysis of the chemical and textural data for surficial sediments show that nitrogen content of sediments is very strongly related to carbon content ( $r = 0.94$) (Table III). The strong relationship between nitrogen and carbon reflects the fact that nitrogen comes primarily from organic matter found in the sediments (Hill and others, 1992). The relative amounts of carbon and nitrogen vary for different types of organic material. In this report, type of organic material refers to either marine organic material or terrestrial organic material. Marine organic material which includes that from primary production, consists primarily of planktonic derived material which contains proteins and amino acids and tends to be more reactive and higher in nitrogen content. The N/C ratio for this type of organic material would approach 0.176, the ratio calculated for Redfield's average composition of plankton (Redfield and others, 1963). Terrestrial organic material consists of land derived plant debris which tends to be less reactive and low in nitrogen content. N/C values for terrestrial organic material is expected to be much lower than that of plankton. Intermediate values for N/C reflect a mixture of the two types of organic material.

The N/C ratios for surficial sediment samples average $0.086 \pm 0.015$, which is slightly lower than that obtained for Newport and Sinepuxent Bays (mean = 0.1) and much lower than the average ratio of $0.142 \pm 0.16$ obtained for sediments collected in Isle of Wight and Assawoman Bays (Wells and others, 1994b). The average N/C ratio calculated from this study is half of Redfield's value. Similar low values were calculated from cores sediment collected in the northern Chesapeake Bay. The Chesapeake Bay values were attributed to high terrestrial input as further evident from $\delta^{13}C$ data (Cornwell and Sampou, 1995). The low N/C ratios for the middle Chincoteague Bay area suggest that a higher proportion carbon found in sediments comes from terrestrial organic material compared to sediments from Isle of Wight and Assawoman Bays. N/C ratios calculated for core sediments obtain for this study are fairly constant with depth.

## Sulfur

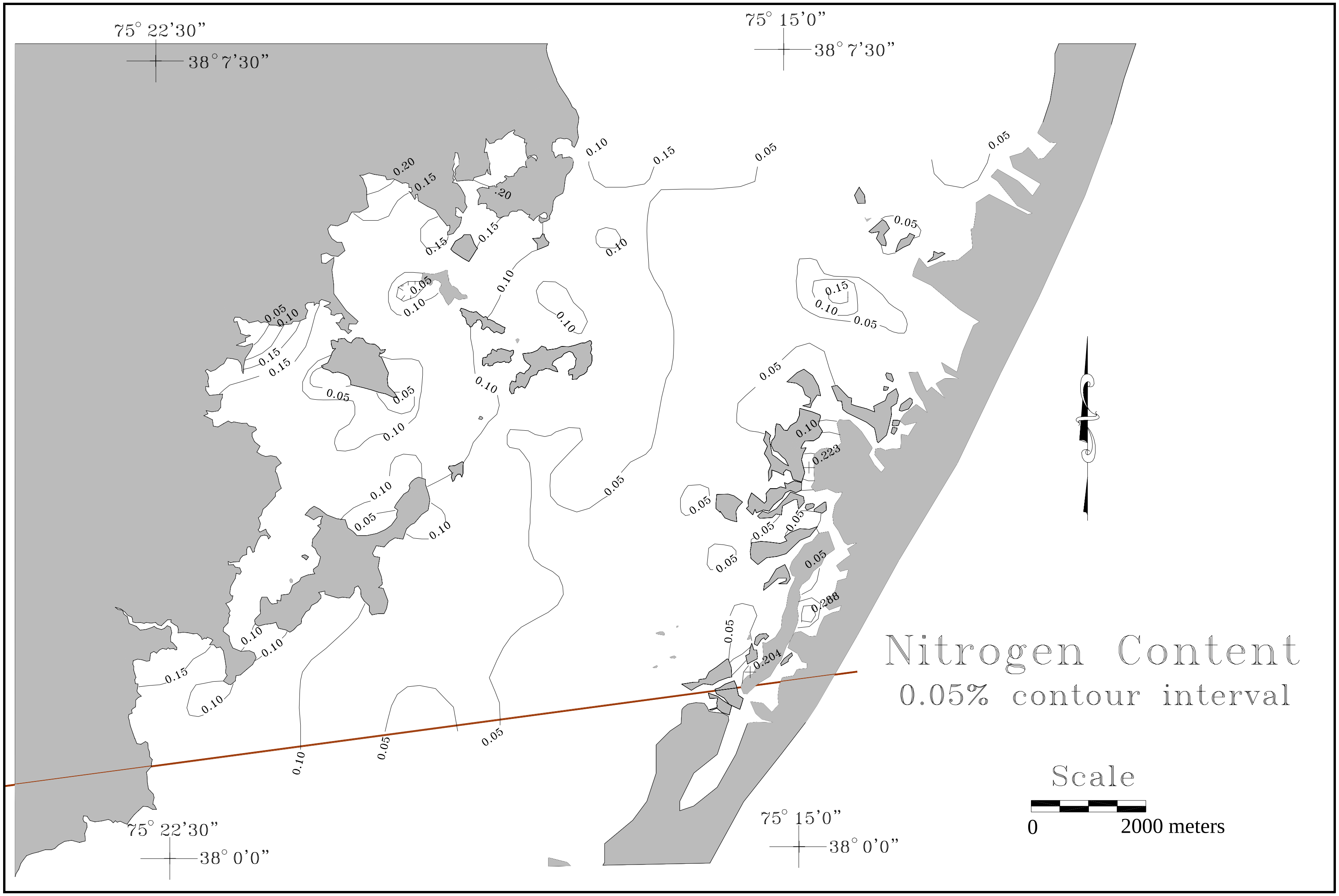



**Figure 12.** Distribution of total nitrogen in surficial sediments.

Sulfur in sediments is found primarily as inorganic metal sulfides. These sulfides form as a result of a bacterially mediated reaction during which organic carbon is oxidized using dissolved sulfate ($SO_4^{-2}$) from seawater as an oxidant (Berner, 1967, 1970; Goldhaber and Kaplan, 1974). During the process that occurs under anaerobic conditions, sulfate is reduced to sulfide. The sulfide reacts with ferrous iron ($Fe^{+2}$) forming an iron monosulfide precipitate which further reacts with elemental sulfur to form $FeS_2$ (pyrite and its polymorph, marcasite) (Berner, 1970). As a result of this process, sulfur is enriched and preserved in the sediments as the amount of carbon is depleted.

Total sulfur contents for core samples range from 0.28 to 1.70% and average 0.78%. Sulfur contents increased with depth in all cores. Total sulfur contents measured in surficial sediments are lower, ranging from 0.01% to 1.38% and averaging 0.26%. The sediments from this study contain about a third of the amount of sulfur measured in the sediments from Isle of Wight and Assawoman Bays.

Results of correlation analysis on surficial sediment data show moderately strong associations between sulfur and clay content ( $r = 0.79$), carbon content ( $r = 0.73$), and water content ( $r = 0.81$) Correlation between sulfur and silt is weaker ( $r = 0.68$). These correlation values are less that those obtained for sediments in the upper Chincoteague Bay. Nevertheless, the association between sulfur and carbon reflects the process by which sulfur is "fixed" in the sediments as a result of the anaerobic decay of organic carbon. As with carbon, sulfur also is associated with the finer grained (*i.e.*, clay) sediments. Figure 13 presents the distribution of sulfur content in surficial sediments. The distribution of sulfur reflect the sediment texture. Highest sulfur contents were obtained from fine grained sediments collected in the more sheltered areas such as channels in the Middlemoor complex and Purnell Pond.

The carbon to sulfur (C/S) ratios for surficial samples average $4.13 \pm 2.33$. These values are much higher than the C/S ratio reported for modern marine sediments, $2.8 \pm 1.5$ (Berner and Raiswell, 1984). The higher ratios most likely reflect the oxygenated conditions at the sediment/water column interface. In most of the study area, the shallow water and the relatively coarse texture of the sediments (*i.e.*, silt and sand) contribute to conditions by which the bottom sediments are mixed and well oxygenated. Under aerobic conditions, sulfur is not reduced and preserved. However, at fairly shallow depths in the sediment column, anoxic conditions are established, allowing sulfate reduction. The ratio of carbon to sulfur decreases rather rapidly in the top 10 to 20 cm, leveling off between 1.0 and 1.5 (Figure 14 ). The C/S ratios for deeper sediments are similar to values Berner and Raiswell (1984) reported for core sediment obtained in Chesapeake Bay in salinities greater than $19^{0}/_{00}$. This downcore decrease is expected as sediments become enriched with sulfur over time (*i.e.* increased depth of burial) while carbon is metabolized.

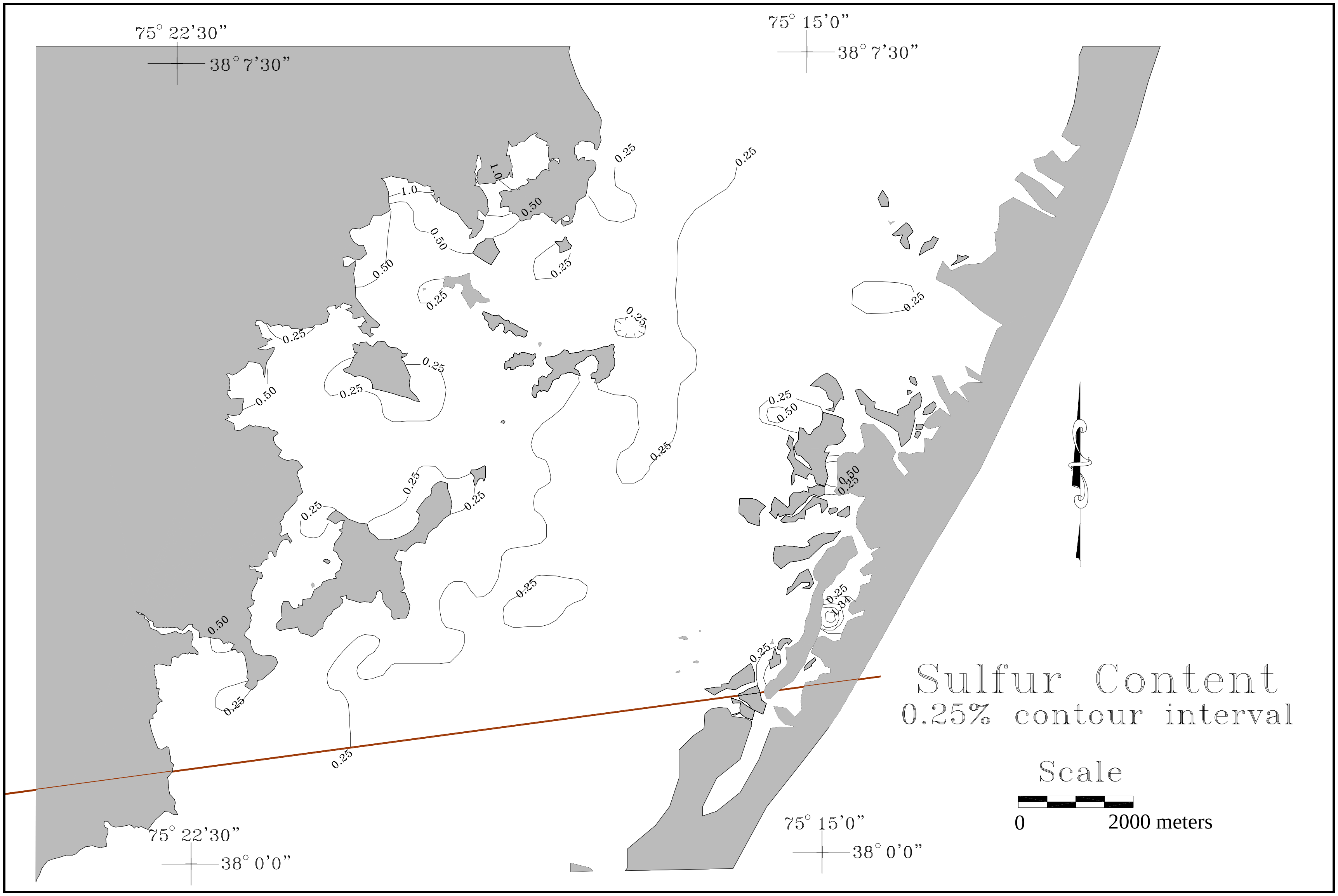



**Figure 13.** Distribution of total sulfur in surficial sediments.

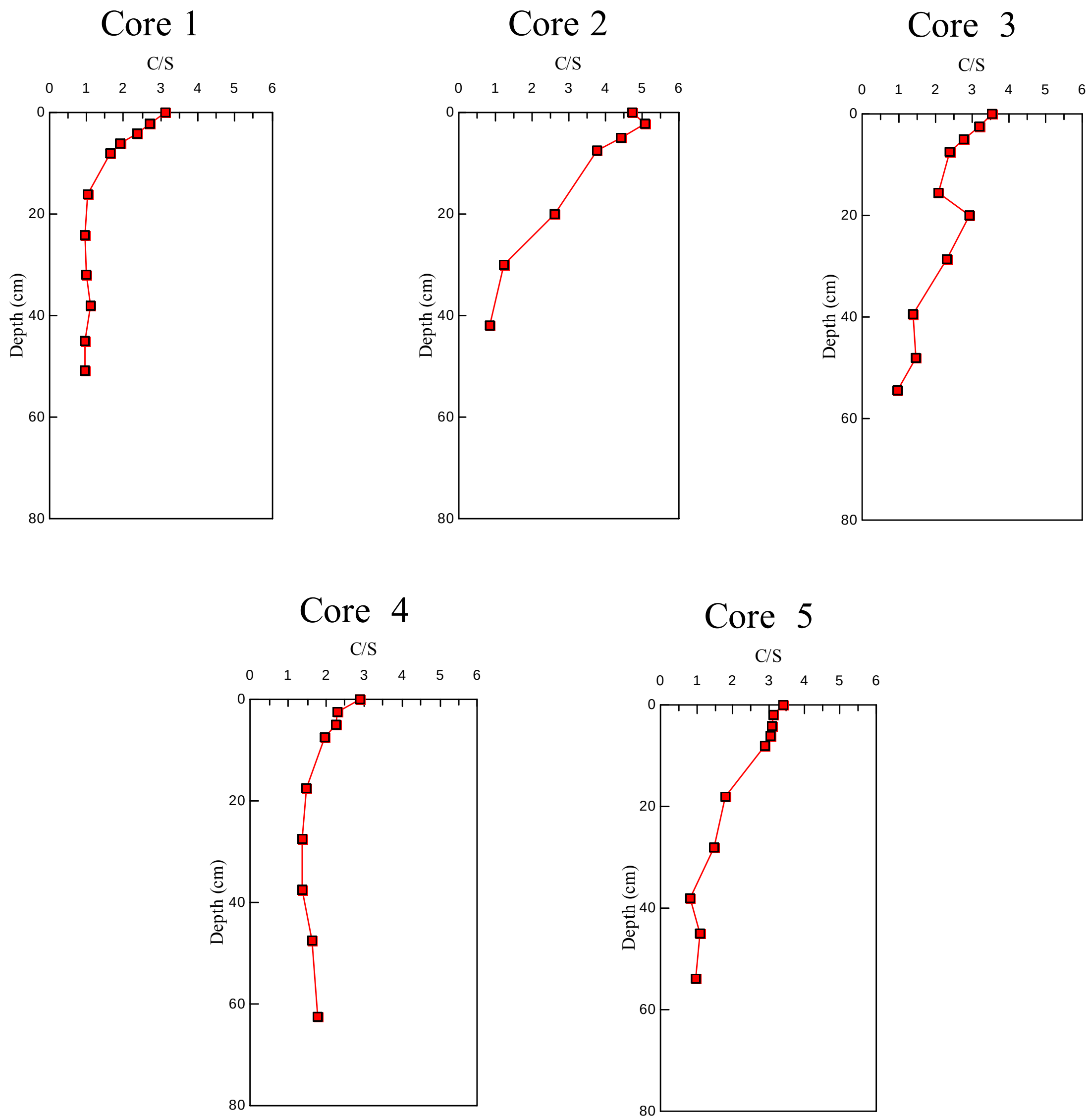



**Figure 14.** Plots of C/S versus depth in cores.

## Metals

Correlation analysis indicate a very strong relationship between clay percent and Cr, Fe, Ni, and Zn contents in surficial sediments; correlation coefficients are 0.977, 0.974 , 0.87,and 0.984 respectively. These metals typically are associated with clay minerals as they are either components of the mineral lattice structure or absorbed onto clay surfaces (Cantillo, 1982). Clay minerals make up a significantly large portion of the fine (clay size) sediment fraction. Likewise, carbon and nitrogen in the form of organic compounds is absorbed onto clay surfaces. The metal show an equally strong correlation with nitrogen. Three of these metals show a good relationship with carbon content, coefficients for Cr, Fe, and Zn are, 0..755, 0.764, and 0.768, respectively. Among the metals themselves, there are strong correlations between Fe and Cr ( r = 0.994), Fe and

Zn ( r= 0.991); Cr and Zn ( r=0.995); Cr and Ni ( r= 0.877) and Ni and Zn ( r= 0.869).

## Enrichment Factors

To reduce the effect of grain size, metal concentrations may be discussed in terms of enrichment factors (EF). The use of enrichment factors also allows for comparisons of sediments from different environments and the comparisons of sediments whose trace metal contents were obtained by different analytical techniques (Cantillo, 1982; Hill and others, 1990; Sinex and Helz, 1981).

Enrichment factor is defined as:

$$EF_{(X)} = \frac{(X/Fe)_{sample}}{(X/Fe)_{reference}} \quad \textbf{(1)}$$

where:

$EF_{(x)}$ is the enrichment factor for the metal X;
$X/Fe_{(sample)}$ is the ratio of the concentrations of metal X to Fe in the sample;
$X/Fe_{(reference)}$ is the ratio of the concentrations of metal X to Fe in a reference material, such as an average crustal rock.

Fe is chosen as the element for normalizing because anthropogenic sources for Fe are small compared to natural sources (Helz, 1976). Taylor's (1964) average continental crust is used as the reference material. Average crustal abundance data may not be representative of the coastal bay sediments because there is a higher proportion of sand in the coastal bay sediments compared to the average crustal rock. However, abundance data is useful as a relative indicator. Also, Taylor's averages have been used in other studies involving coastal bays (Sinex and Helz, 1981).

Enrichment factors were calculated for the core sediments and plotted with depth. The core sediments are enriched with Cr and Zn with respect to Taylor's average continental crust, enrichment values averaging 1.45 for Cr and 2.01 for Zn. For the other metals, enrichment values are below one. When plotted with depth for each core, EF values for all metals except Zn show no discernable trends. On the other hand, all cores show a noticeable decrease in EF values for Zn (Figure 15). Plots of $EF_{(Zn)}$ with depth show values decrease with depth, leveling off to 1.75 - 1.5 at 20 to 25 cm below sediment surface in all most cores. This down-core decrease in $EF_{(Zn)}$ has been observed in most other cores collected in coastal bays for this study. Based on $^{210}Pb$ sedimentation rates calculated for cores 1 and 5, Zn enrichment began to increase around 100 to

120 years ago (*i.e.*- 20-30 cm below sediment surface). Sediments below this depth represent pristine or historical deposits (*i.e.* sediments deposited before anthropogenic influence).

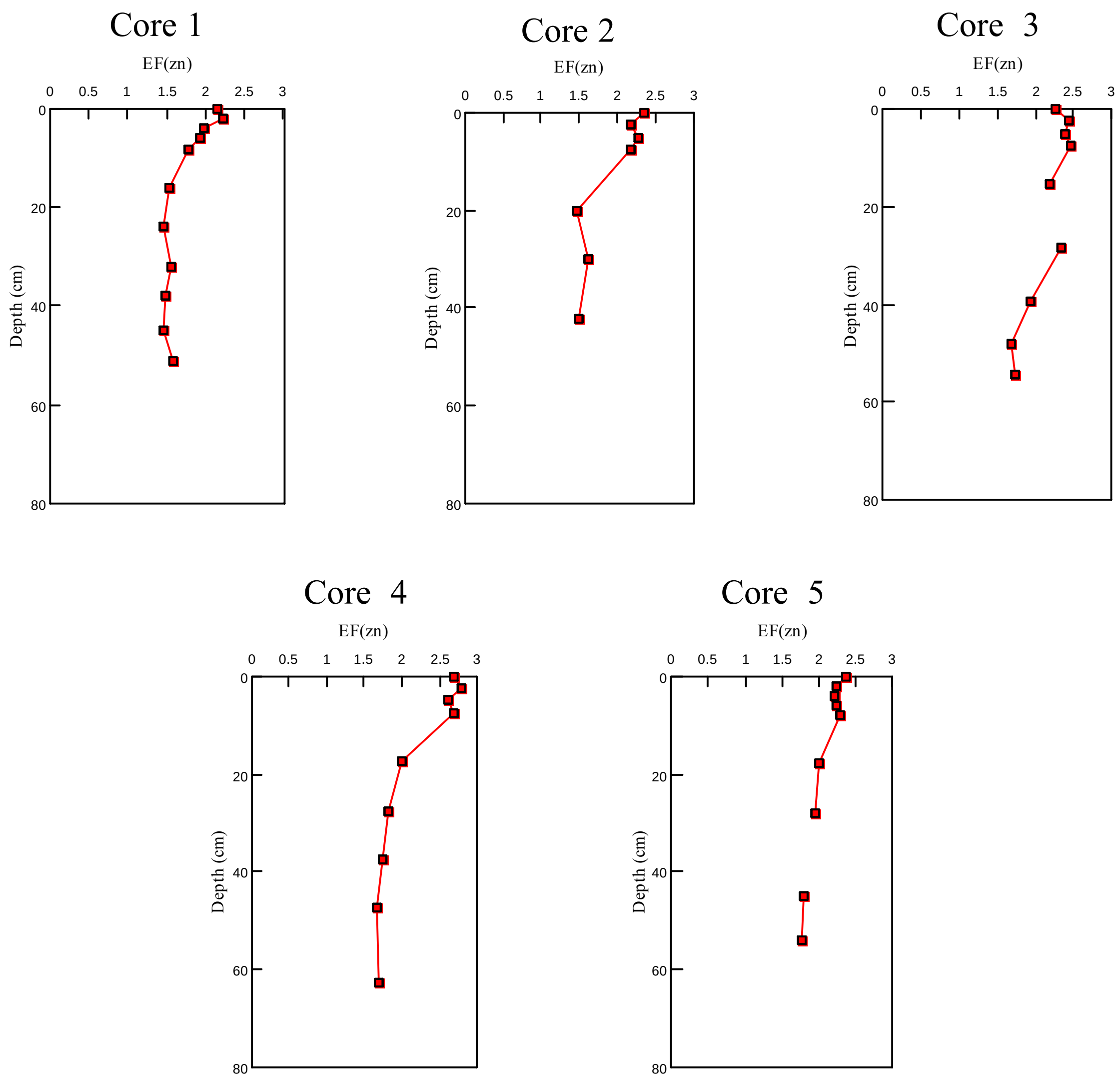



**Figure 15.** Plots of EF for Zn versus depth in cores.

Enrichment factors for the five metals were calculated for the surficial sediments. Middle Chincoteague Bay sediments are enriched in Cr and Zn with respect to crustal rock. The average enrichment factor values for Cr and Zn are 1.34 and 2.15, respectively. The surficial sediments are not enriched in Cu, Mn, and Ni relative to average crustal rock. EF values average less than one for Cu, Mn, and Ni (0.28, 0.74, and 0.54, respectively). The average EF values are very similar to those obtained for the upper Chincoteague, Sinepuxent, and Newport Bays. The low values for these three metals (Cu, Mn and Ni) simply mean that these metal are not as abundant in sediments in this area compared to *average crustal rock*.

Although enrichment factors are used to offset the effect of grain size, distribution of EF values for Cr, Cu and Mn show a general trend, relating to textural control over metal content.

The areas with the lowest EF values correspond to sandy sediments generally found in the mid-bay portion. Distributions of EF values for Ni and Zn reveal no discernable pattern.

## Variation from Historical Norms

The "degree" of metal enrichment in sediments relative to a regional norm or historical levels can be assessed by correlating metal concentrations with grain size composition. By comparing predicted metal levels based on textural composition with metal levels actually measured in the sediments, variation or enrichment over background levels can be quantified. This technique has been very successful in monitoring subtle increases in metals in bottom sediments around the Hart-Miller Island dredge disposal site in Chesapeake Bay (Hennessee and others, 1990; Hill and others, 1990). Likewise, results from this technique has proven particularly sensitive in defining areas in Isle of Wight and Assawoman Bays that are enriched in Zn and Cu over background levels (Wells and others, 1994a, 1994b).

Based on the downcore decrease in Zn enrichment factor values, metal concentrations of sediments below the depth at which $EF_{(Zn)}$ values level off are interpreted to represent the historical, or background, norm for the study area. For the five cores collected for this study and two cores collected during the previous year's study (Wells and others, 1997: cores #3 and #4- see Figure 6), metal concentration values for the sediments having the low EF values, which, hereon, will be referred to as *historical sediments*, were fitted to the following equation:

$$X = a(SAND) + b(SILT) + c(CLAY) \qquad \textbf{(2)}$$

where:

*X* is the metal of interest;

*a, b, and c* are the proportionality coefficients determined for the sand, silt and clay components, respectively; and

*SAND, SILT, and CLAY* are grain size fractions of the sediment sample.

Using an algorithm developed by Marquardt (1963), least square coefficients were calculated. Data from the two cores collected during the previous year study were included to increase the number of samples used for the regression analyses for statistical purposes. The results are presented in Table IV. With the exception of Mn, the correlations are good for all of the metals, and are similar to those calculated for the Sinepuxent and Newport Bay data set (Wells and others, 1996), and upper Chincoteague Bay data set (Wells and others, 1997). The values for the coefficients indicate that clay fractions account for a significant portion of the metal concentrations measured in the sediments. The estimated coefficients for Mn indicate that the metal is not associated with any particular size fraction. For both Sinepuxent/Newport Bays and the two northern most bays, the clay fraction figured prominently in predicting Mn concentrations.

When regression analysis were preformed on a subset of the historical data set, including only those samples from cores collected in the Johnson Bay area (cores 1, 2, 3 and 5), estimates of coefficients for silt increased significantly for both Fe and Mn, becoming the dominant size fraction in predicting the concentration of those two metals. Estimates of coefficients for Fe were calculated as 0.49, 4.03, and 3.31, and for Mn were 122, 466, and 180 for sand, silt and clay respectively. The associations of Fe and Mn with the coarser size fraction are similar to those observed in the northern Chesapeake Bay and are attributed to grain coatings indicative of fresh water mixing.

**Table IV.** Least squares coefficients for metal data. Metal concentration values for the historical sediment set (see Table VI in Appendix I) were fitted to equation 2 . The total number of samples used for regression analysis was 31 for each metal except copper. Twenty eight samples were used for regression analysis to obtain the estimates of coefficients for copper.

| | Estimates of coefficients | | | | | |
|---|---|---|---|---|---|---|
| | Cr | Cu | Fe | Mn | Ni | Zn |
| SAND | 29.33 | 0.25 | 1.00 | 211 | 4.90 | 19.81 |
| SILT | 53.41 | 0.03 | 2.01 | 335 | 12.28 | 19.57 |
| CLAY | 141.8 | 29.45 | 5.85 | 330 | 50.78 | 148.60 |
| $R^2$ | 0.86 | 0.91 | 0.86 | 0.37 | 0.73 | 0.94 |

By substituting the least squares coefficients from Table IV in equation 2, "predicted" metal concentrations were calculated for the historical sediments. These predicted metal concentration values represent the expected historical levels of metals based on grain size composition of the sediment. To determine variations from historical norms, the predicted metal concentrations were compared to the measured values using equation 3. Negative values indicate depletion and positive values indicate enrichment relative to historical levels.

$$Variation_X = \left(\frac{Measured_X - Predicted_X}{Predicted_X}\right) \quad \textbf{(3)}$$

Variation values calculated for historical sediment set were analyzed according to Gaussian statistics. Variation values for all metals exhibit near-normal distributions with mean values close to zero. Mean variation values and standard deviations for each metal are presented in Table V. The standard deviation (σ or **sigma**) can be used to measure the significance of the variation values. For example, in a normal distribution, 68% of the values fall within 1σ of the mean; 95.5% of the values fall within 2σ of the mean. Values greater than 3σ are considered significant beyond the normal, or background, population dispersion.

**Table V**. Mean and standard deviation (σ) of the variation values calculated for historical sediment set (from cores collected in the middle Chincoteague Bay). The mean and 3σ values are used to identify significantly low or high variation values calculated for modern sediments.

| Metal | Mean | σ | 2σ | 3σ |
|---|---|---|---|---|
| Cr | -0.001 | ±0.082 | ±0.164 | ±0.245 |
| Cu | -0.025 | ±0.159 | ±0.319 | ±0.478 |
| Fe | 0.000 | ±0.078 | ±0.157 | ±0.235 |
| Mn | 0.001 | ±0.109 | ±0.219 | ±0.328 |
| Ni | -0.001 | ±0.172 | ±0.345 | ±0.517 |
| Zn | -0.000 | ±0.056 | ±0.112 | ±0.168 |

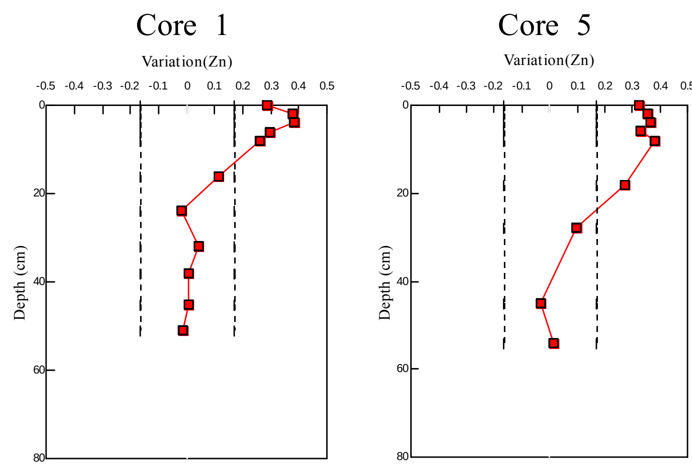



**Figure 16.** Plots of variation values for Zn versus depth for cores 1 and 5. The dashed lines define the envelope of values within three standard deviations or sigma levels for the historical sediment set (see Table V). Variation values falling with the envelope (*i.e.*, three sigma units or less) are considered to be within normal background levels. Those values in the top of the core are greater that 3 sigma units and are considered significantly "enriched" above historical levels.

The variation values for each metal were calculated for all core sediments. Downcore plots for Cr, Fe, Mn and Ni variation values show no appreciable trends. For Cu, variation values decrease with depth in cores 1 through 4. However, Zn variation values decrease with depth in all cores. Zn variation values plotted against depth for cores 1 and 5 (Figure 16) show that values level off at 22 cm and 40 cm respectively, similar to the EF profiles (Figure 15).

The variation values were calculated for all surficial sediments. Most variation values for Cr, Cu, Fe, Mn, and Ni are within three standard deviations (three sigma units) from historical levels. The overall values calculated for this study area tend to be lower than those obtained for the upper Chincoteague Bay and Sinepuxent and Newport Bays. Variation values for Zn are higher, averaging 30% more than historical levels, with most values exceeding 3 sigma units.

Variation levels for Zn were mapped in terms of sigma units (Figure 17). Variation levels for Zn are greater than 6 sigma units above background for much of the study area, particularly in the western half. Variation levels greater than 9 sigma units were mapped in some areas such as Taylor's Landing and in isolated pockets in Johnson Bay. The areas characterized by lower sigma levels ( < 3 units) are restricted to the sandy area along the eastern margin. This area is subjected to periodic influx of coarser grained sediments either blown across Assateague Island, or wash over from the ocean. These coarser grained sediments do not contain appreciable amounts of Zn compared to the historical set. Distribution of variation levels for the other metals were not mapped because they did not exhibit any trends outside of the normal background behavior.

## DISCUSSION

In the middle Chincoteague Bay, the distribution patterns of both textural and chemical characteristics observed in the bottom sediments reflect basin geometry, energy conditions and sediment source. Sediment is introduced into the study area through a number of processes. Fine sands and coarse silts are transported across Assateague Island by wind (eolian transport). During more severe weather, medium sand may be carried across the island as overwash. The overwash processes are restricted to those areas where the island is narrowest, such as the Green Run area. Elsewhere, the width of the island and development of a maritime forest prevent overwash from occurring, and to a lesser extend, minimize wind transport of sand except during the most severe weather events. In the past, a large quantity of sediment was transported into the bay when the Green Run inlet was open, which would account for some of the medium to coarse sand found today. It is doubtful, given the distance from Chincoteague Inlet, that sand coming through the inlet reaches the study area.

Most land-derived sediment is contributed through shoreline erosion. Because of the relatively small size of the streams and even smaller area of the watershed, fluvial contribution of sediments into the middle Chincoteague Bay is insignificant. Bartberger (1973) estimated that, for the entire Chincoteague Bay, the contribution of fine grained material from shore erosion is approximately eight times that introduced by streams. Shore erosion is also the source for coarser grained sediment. Sediment distribution map shows pockets of coarse grained sediment: sand, silty sand and sandy silt, associated with the islands in Johnson Bay. These islands, thought to be remnant Pleistocene beach ridges, are actively eroding and are a source of coarse grained sediments as well as some finer grained material. As material is eroded from the island shores, the finer grained portion is winnowed out leaving the sand in place. The fine grained portion is transported and deposited in sheltered areas where there is very little wave activity. Such areas include Johnson Bay, particularly on the west side of the islands (leeward side) and in the many channels in the Middlemoor complex.

Compared to the quantity of sediment eroded from the islands, mainland shoreline erosion is less significant (Table I). This is due to several factors. The mainland shore is sheltered from the direction of highest winds (fetch) and much of the shoreline is comprised of coastal marsh which tends to stabilize the shoreline.

The bayside of Assateague Island within the study area is also dominated by numerous islands of the Middlemoor complex. Many of these islands were formed when Green Run Inlet was formed, and continued to grow while the inlet was opened and provided a conduit for sediments from the ocean. Since 1900, when the inlet closed, many of the islands have undergone some erosion (Figure 6).

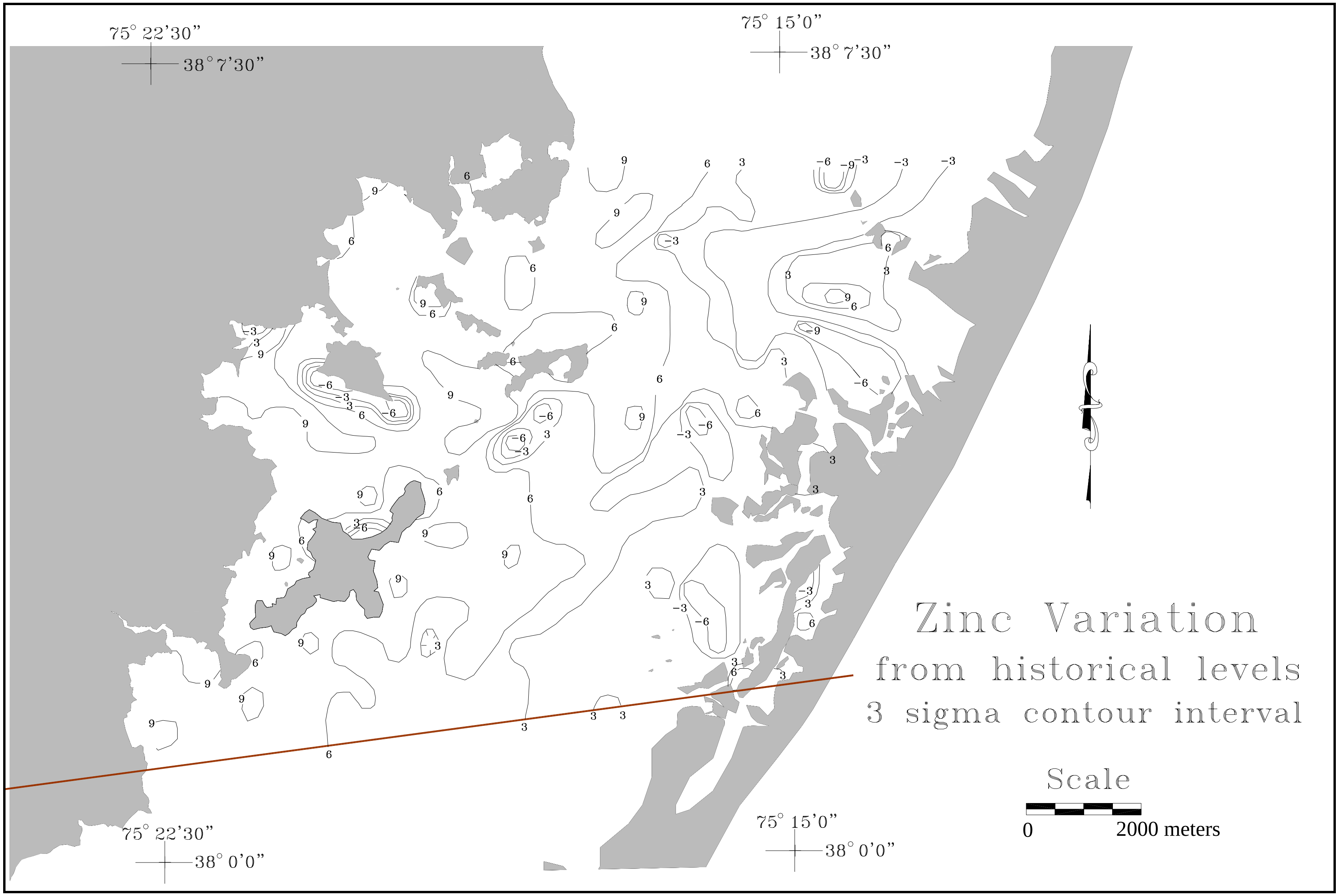



**Figure 17.** Distribution of sigma levels for Zn variation from historical levels in surficial sediments.

The sedimentation rates of 0.17± 0.08 and 0.25±0.14 cm/yr based on $^{210}$Pb activity for cores 1 and 5 are probably representative of the current rate accumulation of fine grained sediments in this portion of the Chincoteague Bay. Sedimentation rates will vary significantly depending on proximity to sediment source and depositional/erosional processes. Chrzastowski (1986) reported a wide range of sedimentation rates for Rehoboth and Indian River Bays based on bathymetric comparisons. Rates ranged from -0.04 cm/yr (erosion) to 1.47 cm/yr (accumulation) for the past 100 years. The highest sedimentation rates in Rehoboth and Indian River Bays were associated with the easterly sand dominated areas; illustrating the importance of ocean derived sediments, primarily through Indian River Inlet, but also those sediments carried (as overwash or blown by wind) across the barrier spits. The sedimentation rate in Sinepuxent Bay is very high as a result of the landward migration of Assateague Island. In contrast, sedimentation rates in sheltered areas on the mainland side of the bays are lower because of a restricted sediment supply. Therefore, the sedimentation rates of 0.17 cm/yr and 0.25 cm/yr reported for the middle Chincoteague Bay as well as the rate of 0.14 cm/yr reported for Newport Bay (Wells and others, 1996) are reasonable.

Sedimentation rates will also vary over time as sediment source and processes change. Rates determined by $^{210}$Pb reflect those accumulation rates for the top 20 to 30 cm of sediment column. Rates for smaller time periods vary significantly. The sedimentation rates calculated for 2 cm intervals for the top 10 to 12 cm in cores 1 and 5 range from 0.052 cm/yr to 0.389 cm/yr (Table VIII, Appendix I).

Carbon, sulfur and nitrogen contents measured in middle Chincoteague Bay are lower than the average values reported for Newport and Sinepuxent Bays and about half of those reported for Isle of Wight and Assawoman Bays. These relatively low values are attributed in part, to the low clay contents of sediments. The contents are however slightly higher than those reported for the upper Chincoteague Bay, the higher values attributed to slightly more clayey sediments found in the study area, particularly in the Johnson Bay area. Regression analysis of carbon versus clay show that, given the relatively low clay contents, total carbon for the middle Chincoteague Bay area is about 2/3 that of Sinepuxent and Newport Bay and 1/3 that of Isle of Wight and Assawoman Bays (Figure 18). The higher carbon reported for Isle of Wight and Assawoman Bays reflects “anthropogenic loading” with St. Martin River being the primary source of the loading (UM and CESI, 1993).

It should be noted in Figure 18 the sharp lower boundary of the data points in the plot. Clay content is a very good indicator of minimum values for clay content. For example, given a sediment consisting of 25% clay size particles, we can expect that sediment to contain at least 1.0% total carbon. The upper edge of the line of data points is not so well define. The data points above the regression line are those sediments containing amounts of carbon above what is expected. The additional amounts are attributed to an abundance of plant material such as those samples, noticeable in Figure 11 as the localized hot spots, collected in channels in Middlemoor complex. Other samples with higher than expected carbon contained abundant shell fragments which were not removed before analysis. Examples of these samples are those collected just south of Mills Island in an area where a remnant oyster bar was encountered. Overall, anthropogenic loading in the middle Chincoteague Bay is not a significant source of carbon.

The low N/C ratios in Chincoteague Bay indicate that carbon measured comes primarily from terrestrial or plant sources. The apparent deficit in planktonic carbon suggests that one of the following conditions may exist. 1) Primary productivity (planktonic production) is lower in Chincoteague Bay compared to the upper bays. 2) Primary productivity is the same but a portion of carbon (or organic matter) that accumulates on the bottom of the study area is actively being metabolized, leaving a higher proportion of inert carbon (*i.e.*, plant cellulose which contain very little nitrogen). The latter condition is most likely the process responsible for the low N/C ratios. Given the low sedimentation rates for this study area, any organic material settling to the bottom of the bay has a chance to be reworked or recycle before being buried.

Overall, EF values for surficial sediments collected for this study are lower than those calculated for the northern coastal bays. As with other areas in the coastal bays, the sediments in the middle Chincoteague Bay are not enriched in Cu, Mn, and Ni, relative to average crustal rock (*i.e.*, EF < 1) and slightly enriched in Cr, with EF values averaging 1.34. The sediments are also enriched in Zn, with EF values averaging 2.15. This average is slightly lower those obtained in the upper Chincoteague Bay and the northern coastal bays. Average EF values for Zn in the upper Chincoteague Bay were 2.25, for Sinepuxent and Newport Bays, 2.3, and for Isle of Wight and Assawoman Bays, 2.5. This overall enrichment in Zn is understandable. Zn is ubiquitous; it is the fourth most widely used industrial metal. Zinc is used as a protective coating on steel, particularly steel used in marine related industries. Therefore, some enrichment is expected even in seemingly pristine environments.

When metals are normalized to textural components and referenced to historical levels predicted for the study area, results indicate the same trends as with the enrichment factors. Cr, Cu, Fe, Mn, and Ni do not show no significant increase over historical levels within the study area. However, in a large portion of the study area, Zn shows up as "enriched" compared to older sediments. Zn is mapped at 3 to 6 sigma levels greater than historical levels throughout the western half of the study area, basically corresponding to finer grained sediments in deeper water . Similar levels were reported for Isle of Wight and Assawoman Bays. These levels of Zn represent a base level for modern sediments in this region, the bulk of the contamination attributed to atmospheric fallout based on metal behavior in the Chesapeake Bay (Sinex and others, 1981; Cantillo, 1982; and Helz and others, 1985). In the coastal bays, local "hot spots" characterized by levels of Zn higher than this base level are attributed to additional contamination from activities such as boating and the use of crab pots. The Johnson Bay area has been a popular area for crabbing and clamming. The area may be popular for recreational boating, but not at the level as in Isle of Wight and Assawoman Bays. Another possible source of the localized hot spots may be oysters which are common in this portion of Chincoteague Bay. Oysters tend to accumulate Zn in their soft tissue (Hill and Helz, 1973). When the oyster dies, the Zn is released into the sediment producing localized hot spots.

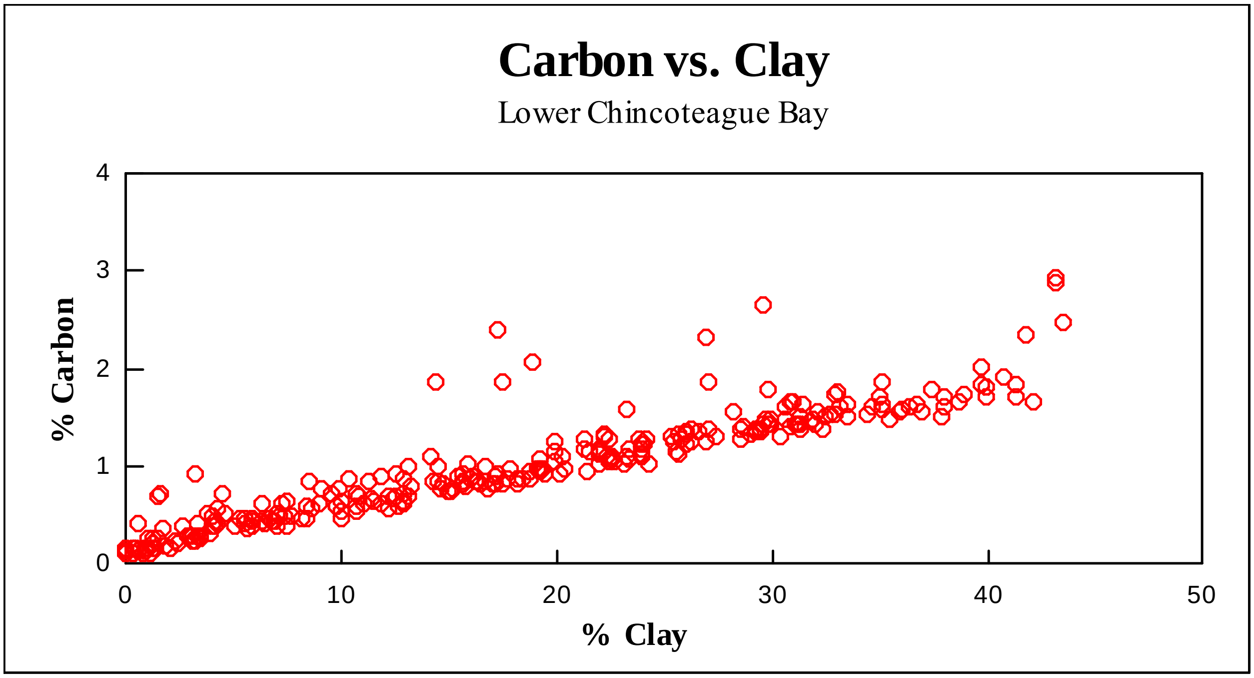



**Figure 18.** Total carbon versus clay for surficial sediments collected in the middle Chincoteague Bay (excluding samples 187 and 344 which were treated as outliers). Carbon content is most strongly associated with clay content. Linear regression of % total carbon ($C_T$) versus % clay is:

$$\%C_T = 0.21 + 0.04(\%\ CLAY) \qquad R^2 = 0.839$$

This relationship is almost identical to that obtained for the data set from the upper Chincoteague Bay. Overall, the sediments collected in Chincoteague Bay contain about 2/3 the amount of carbon than those from Sinepuxent/Newport Bays and 1/3 the amount of carbon reported for Isle of Wight and Assawoman Bay.

The linear regression for % total carbon ($C_T$) versus % clay for Sinepuxent and Newport Bays is:

$$\%C_T = 0.18 + 0.06(\%\ CLAY) \qquad R^2 = 0.734$$

and for Isle of Wight and Assawoman Bays is:

$$\%C_T = 0.03 + 0.11(\%\ CLAY) \qquad R^2 = 0.805$$

The existence of Johnson Bay itself presents somewhat of a curiosity. The bay is shallow circular embayment along an otherwise straight trending mainland, and is not associated with any significant stream. All of the streams draining into the Johnson Bay are fairly short; the watershed for Johnson Bay is extremely narrow. Both the Beaverdam Sand and Ironshire Formations are absent in the Johnson Bay area; thus the Sinepuxent rests directly on top of the Yorktown Formation (Miocene) and abuts the Omar Formation. Johnson Bay feature corresponds to topographically low feature that existed prior to the Holocene. During early Holocene, Johnson Bay area may have been an upland bog which eventually became flooded as sea level rose. This may explain the associations of Fe and Mn with the coarser size fraction observed in the historical data set taken from the cores collected for this study year. The associations are similar to those observed in the northern Chesapeake Bay and is attributed to grain coatings indicative of fresh water mixing (Helz and others, 1982; Hill and Parks, 1996). There may have been, sometime in the recent past (last 100 to 200 years), and may still be an influx of fresh water (via ground water flow) into Johnson Bay.

## CONCLUSIONS

In the middle Chincoteague Bay, the distribution patterns of both textural and chemical characteristics observed in the bottom sediments reflect basin geometry, energy conditions and sediment source. Both fine grained and coarse grained sediments found in this portion of Chincoteague Bay are reworked material eroded primarily from the numerous islands in the Johnson Bay area and to a lesser extent, some islands of the Middlemoor complex. Both ocean derived and stream derived sediment are minor by comparison. The sedimentation rates obtained from two cores are low and most likely are representative of rates for fine grained lagoonal sediments in Chincoteague Bay.

The relatively low nitrogen, carbon and sulfur contents are related to textural composition of the sediments as well as overall energy conditions found within the study area. There is very little anthropogenic loading of nutrients in the middle Chincoteague Bay. The lower contents are related to energy conditions in the bay. The shallow water and the relatively coarse texture of the sediments *(i.e.* silty as opposed to clayey) contribute to conditions by which the bottom sediments are mixed and oxygenated. Therefore, much of the reactive carbon on the bottom is oxidized (*via* aerobic decay) before it can be buried, leaving a proportionately lower carbon content which is less reactive. With less carbon available for anaerobic decay, sulfur reduction is limited, accounting for the low sulfur contents. The remaining carbon consists of non-reactive material such as plant cellulose, which is lower in nitrogen compared to other organic material such planktonic debris (marine derived). This accounts for the low N/C ratios indicative of terrestrial (plant derived) carbon observed within the study area.

Metal data also indicate that the upper Chincoteague Bay is less influenced by anthropogenic activities compared to the northern coastal bays. Of the metals measured, Cr, Cu, Fe Mn, and Ni show no increase over calculated historical levels. The sediments are enriched in Zn, although not to the same levels reported for the northern coastal bays. Zn variation levels are greater than 3 sigma levels above historical levels for those areas covered with finer grained sediments. These levels reflect a regional influx of Zn, most likely from atmospheric input, and localized influx from commercial fishing activities.

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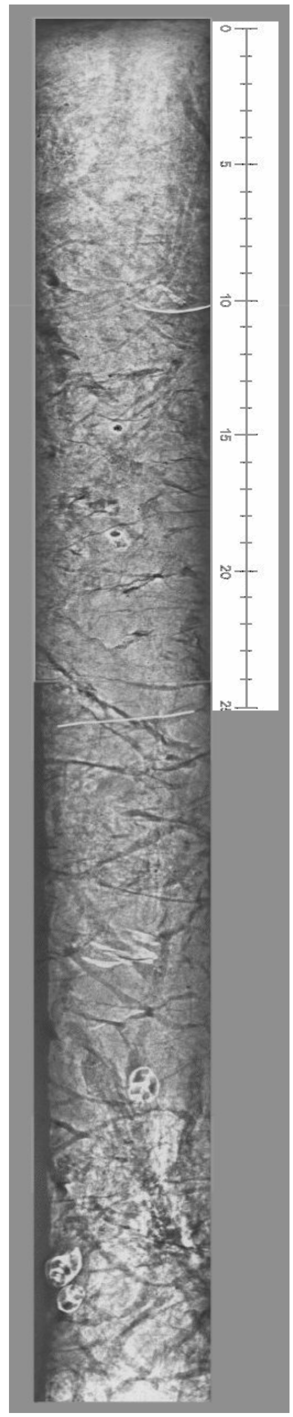
# Appendix I - Sediment Core Data

- Lithologic logs for sediment cores collected in the middle Chincoteague Bay area
- Textural and chemical data for core samples
- $^{210}Pb$ activity data for sediment samples from Cores 1 and 5

Lithologic logs and xeroradiographs for sediment cores collected in the middle Chincoteague Bay area. Geographic coordinates and general information for coring stations are included. Sediment color descriptions for both core sediments and surficial sediments (see Appendix II) are referenced to the GSA Rock-Color Chart which is based on the Munsell system of color identification.

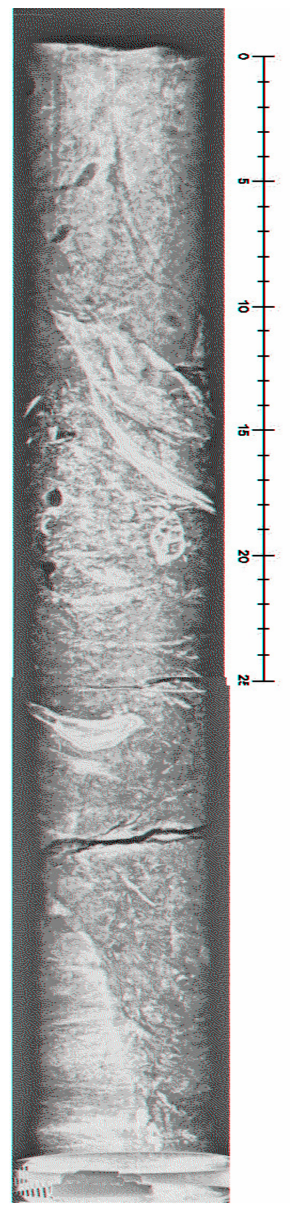
Core 1 Chincoteague Bay

| | |
|---|---|
| Latitude: 38° 05' 05.64" N | Water Depth: 1.83 meters |
| Longitude: 075° 17' 21.01" W | Core Type: Gravity core |
| Date: 5/29/97 | Core Length: 51 cm |

| Depth (cm) | Description | Xero-radiograph |
|---|---|---|
| 0 - 0.3 | Olive grey (5Y 4/1) oxidized mud, some plant material |  |
| 0.3 - 10 | Mottled greenish black (5G 2/1) to dark greenish grey (5GY 4/1) watery mud | |
| 10 - 35 | Dark greenish grey (5G 4/1), more compact (less watery) mud, plant rhizome casts filled with oxidized mud and brown (5YR 3/4) peat, rhizomes extend from 11.5 cm to 18 cm, large burrow filled with dark greenish black (5G 2/1) mud, shell fragments at 11 cm and 35 cm | |
| 35 - 51 | Dark greenish grey (5GY 4/1) firm, uniform mud, occasional peat strings (rhizome casts) throughout section, strong $H_2S$ odor toward bottom of core | |

Core 2    Johnson Bay

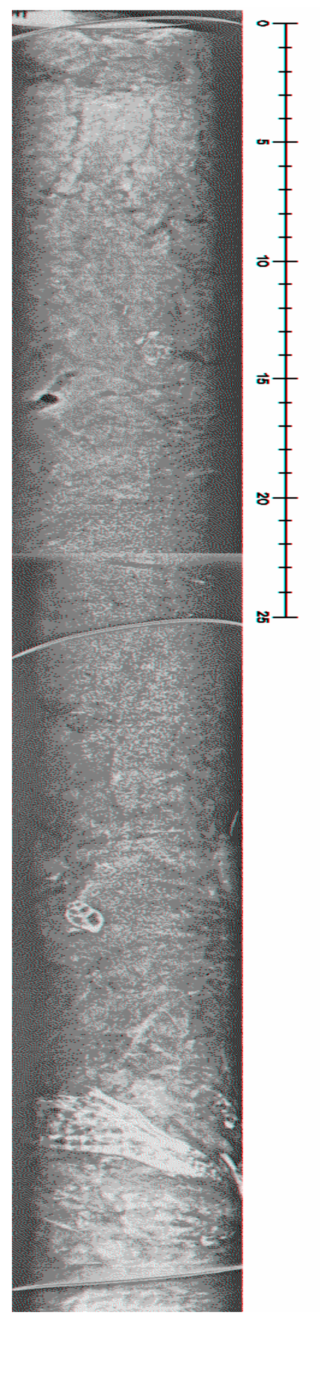
Latitude: 38° 04' 04.11" N    Water Depth: 1.37 meters
Longitude: 075° 20' 49.79" W    Core Type: Gravity core
Date: 5/24/97    Core Length: 44.5 cm

| Depth (cm) | Description | Xero-radiograph |
|---|---|---|
| 0 -12 | Dark greenish grey (5G 5/1) firm mud, large oxidized burrow extending to 7 cm |  |
| 12 - 36 | Greenish grey (5G 2/1) more watery, mud, water content increases down section, large oyster shells at 12 to 20 cm and 25 to 29 cm, slight H2S odor at 30-32.5 cm | |
| 36 - 44.5 | Greenish grey (5G 2/1) watery, mud, shell fragments throughout | |

Core 3 Chincoteague Bay

Latitude:38° 01' 20.14" N    Water Depth: 2.13 m
Longitude:075° 21' 15.77" W    Core Type: Gravity core
Date: 5/20/97    Core Length: 57.5 cm

| Depth (cm) | Description | Xero-radiograph |
|---|---|---|
| 0 - 0.5 | Olive grey (5Y 4/1) oxidized mud | |
| 0.5 - 18 | Mottled dark greenish grey (5GY 4/1) firm mud with darker greenish grey (5G 4/1) mud | |
| 18 - 46 | Dark greenish grey very firm silty mud, very large burrow filled with very watery greenish black(5G 2/1), very smooth cohesive mud, containing little (~ 1 mm) clay balls (Note: muddy fill shows up in radiograph as granular), no H2S odor, large burrow truncated by large fragment of oyster shell at 46 cm, *Nassarius sp*. at 35 cm | |
| 46 - 57.5 | Dark greenish grey (5GY 4/1) very firm mud, some shell hash throughout, slight $H_2S$ odor at bottom of core | |



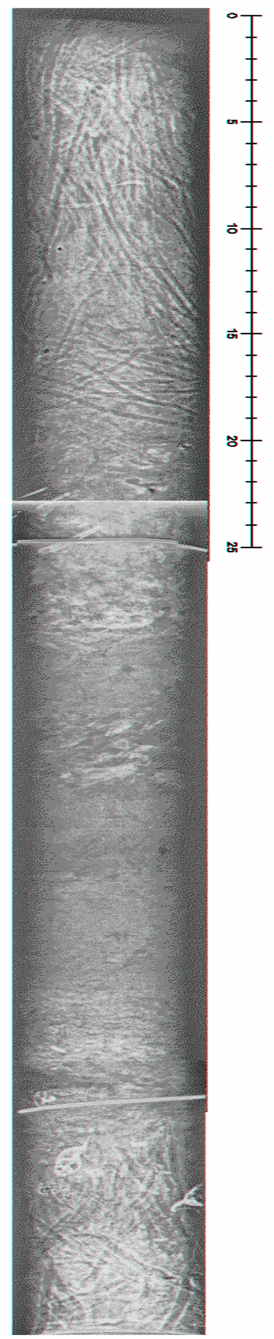
Core 4 Green Run Bay

Latitude:38° 05' 10.91" N
Longitude:075° 14' 24.20" W
Date: 5/29/97

Water Depth: 1.98 m
Core Type: Gravity core
Core Length: 63 cm

| Depth (cm) | Description |
|---|---|
| 0 - 0.5 | Olive grey (5Y 4/1) oxidized silty mud, worm tubes on top |
| 0.5 - 24 | Mottled greenish black (5G 2/1) to dark greenish grey (5G 4/1) somewhat firm mud, more watery at 4 to 7 cm (may be large filled burrow as indicated in radiograph) |
| 24 - 63 | Greenish black (5G 2/1) firm micaceous mud, occasional small shell fragment, $H_2S$ odor, water content decreases with depth, very stiff mud at bottom of core, *Nassarius sp.* at 55 cm |

Xero-radiograph



Core 5 Chincoteague Bay

Latitude: 38° 03' 04.56" N
Longitude: 075° 18' 57.69" W
Date: 5/29/97

Water Depth: 1.98
Core Type: Gravity core
Core Length: 58 cm

| Depth (cm) | Description |
|---|---|
| 0 - 0.3 | Olive grey (5Y 4/1) watery silty mud |
| 0.3 - 15 | Mottled dark greenish grey (5GY 4/1) to greenish black (5G 2/1), somewhat watery mud, large burrow extending down to 15 cm, filled with darker, more watery and siltier mud |
| 15 - 34 | Mottled, dark greenish grey (5GY4/1) to greenish black 5GY 2/1) firm mud, some oxidized plant material scattered throughout |
| 34 - 58 | Dark greenish grey (5G 4/1) firm silty mud |

Xero-radiograph

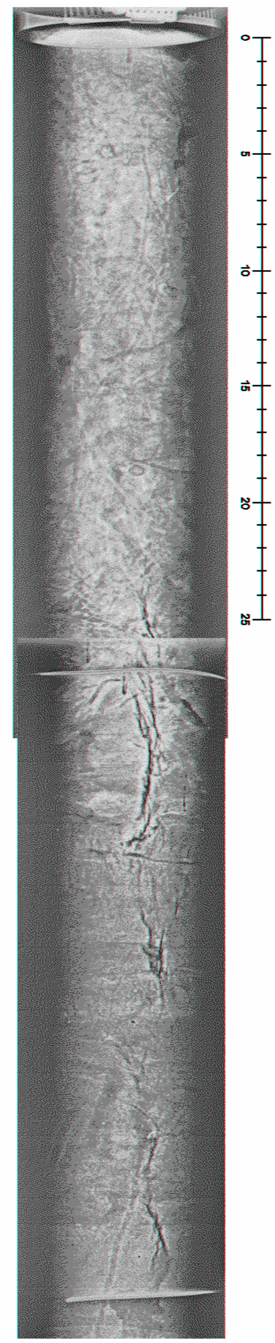


**Table VI.** Textual and chemical data for core samples. Samples included in the historical data set are **bolded**.

| | Sample Interval | | Textural Data | | | | | | Chemical Data | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Core | Upper (cm) | Lower (cm) | Water (%) | Gravel (%) | Sand (%) | Silt (%) | Clay (%) | Shepard's (1954) Classification | Nitrogen (%) | Carbon (%) | Sulfur (%) | Cr (µg/g) | Cu (µg/g) | Fe (%) | Mn (µg/g) | Ni (µg/g) | Zn (µg/g) |
| C1 | 0 | 2 | 32.35 | 0 | 17.69 | 68.00 | 14.30 | Sandy-Silt | 0.07 | 0.88 | 0.28 | 40.8 | 6.8 | 1.82 | 184 | 15.9 | 48.9 |
| C1 | 2 | 4 | 33.09 | 0 | 17.55 | 67.08 | 15.37 | Sandy-Silt | 0.07 | 0.96 | 0.35 | 44.4 | 7.7 | 1.96 | 196 | 16.6 | 54.4 |
| C1 | 4 | 6 | 33.90 | 0 | 16.53 | 65.93 | 17.54 | Clayey-Silt | 0.08 | 1.26 | 0.53 | 54.0 | 9.7 | 2.38 | 243 | 15.9 | 58.5 |
| C1 | 6 | 8 | 34.13 | 0 | 16.44 | 63.01 | 20.55 | Clayey-Silt | 0.09 | 1.35 | 0.71 | 57.9 | 11.6 | 2.51 | 234 | 18.6 | 59.8 |
| C1 | 8 | 10 | 36.96 | 0 | 11.65 | 61.89 | 26.46 | Clayey-Silt | 0.10 | 1.41 | 0.86 | 67.9 | 9.9 | 3.05 | 288 | 20.5 | 67.9 |
| C1 | 10 | 12 | 38.54 | | | | | | | | | | | | | | |
| C1 | 12 | 14 | 42.28 | | | | | | | | | | | | | | |
| C1 | 14 | 16 | 41.94 | | | | | | | | | | | | | | |
| C1 | 16 | 18 | 42.56 | 0 | 3.64 | 62.06 | 34.29 | Clayey-Silt | 0.10 | 1.44 | 1.38 | 80.1 | 12.6 | 3.71 | 358 | 24.3 | 71.1 |
| C1 | 18 | 20 | 44.40 | | | | | | | | | | | | | | |
| C1 | 20 | 22 | 44.61 | | | | | | | | | | | | | | |
| C1 | 22 | 24 | 44.71 | | | | | | | | | | | | | | |
| **C1** | **24** | **26** | **46.07** | **0** | **1.73** | **56.60** | **41.66** | **Clayey-Silt** | **0.10** | **1.37** | **1.47** | **88.7** | **13.0** | **3.96** | **389** | **27.9** | **72.1** |
| C1 | 26 | 28 | 43.62 | | | | | | | | | | | | | | |
| C1 | 28 | 30 | 43.52 | | | | | | | | | | | | | | |
| C1 | 30 | 32 | 42.73 | | | | | | | | | | | | | | |
| **C1** | **32** | **34** | **42.46** | **0** | **1.06** | **59.94** | **38.99** | **Clayey-Silt** | **0.09** | **1.18** | **1.19** | **86.4** | **12.3** | **3.78** | **367** | **30.8** | **73.0** |
| C1 | 34 | 36 | 43.15 | | | | | | | | | | | | | | |
| C1 | 36 | 38 | 45.36 | | | | | | | | | | | | | | |
| **C1** | **38** | **40** | **48.10** | **0** | **1.27** | **61.90** | **36.83** | **Clayey-Silt** | **0.10** | **1.52** | **1.35** | **80.7** | **10.8** | **3.69** | **355** | **28.4** | **67.5** |
| **C1** | **45** | **47** | **44.08** | **0** | **1.16** | **63.67** | **35.17** | **Clayey-Silt** | **0.09** | **1.33** | **1.37** | **83.0** | **10.3** | **3.64** | **335** | **30.9** | **65.5** |
| **C1** | **51** | **53** | **44.47** | **0** | **0.46** | **57.96** | **41.58** | **Clayey-Silt** | **0.11** | **1.44** | **1.48** | **90.8** | **11.6** | **3.68** | **337** | **29.4** | **72.4** |
| C2 | 0 | 2.5 | 37.90 | 0 | 13.53 | 57.84 | 28.63 | Clayey-Silt | 0.12 | 1.45 | 0.31 | 73.1 | 12.2 | 2.97 | 237 | 28.0 | 87.1 |
| C2 | 2.2 | 5 | 37.97 | 0 | 13.06 | 55.12 | 31.82 | Clayey-Silt | 0.12 | 1.44 | 0.28 | 76.4 | 12.4 | 3.15 | 259 | 26.0 | 85.5 |
| C2 | 5 | 7.5 | 38.97 | 0 | 13.14 | 54.46 | 32.40 | Clayey-Silt | 0.12 | 1.45 | 0.33 | 77.2 | 12.1 | 3.19 | 262 | 24.8 | 90.0 |
| C2 | 7.5 | 10 | 38.63 | 0 | 12.68 | 52.33 | 34.99 | Clayey-Silt | 0.12 | 1.44 | 0.38 | 79.7 | 12.3 | 3.24 | 262 | 27.3 | 87.7 |
| **C2** | **20** | **22.5** | **34.69** | **0** | **22.56** | **45.79** | **31.64** | **Sand-Silt-Clay** | **0.08** | **1.96** | **0.75** | **64.1** | **9.6** | **2.85** | **300** | **16.4** | **52.3** |
| **C2** | **30** | **32.5** | **45.53** | **0** | **21.73** | **43.54** | **34.72** | **Sand-Silt-Clay** | **0.09** | **1.08** | **0.87** | **77.1** | **9.1** | **3.22** | **327** | **24.4** | **65.1** |
| **C2** | **42** | **44.5** | **37.49** | **0** | **28.38** | **41.21** | **30.41** | **Sand-Silt-Clay** | **0.06** | **0.78** | **0.94** | **68.0** | **8.0** | **3.02** | **263** | **18.6** | **56.1** |
| C3 | 0 | 2.5 | 44.32 | 0 | 11.64 | 56.63 | 31.74 | Clayey-Silt | 0.13 | 1.49 | 0.42 | 92.8 | 12.0 | 3.32 | 321 | 24.1 | 93.9 |
| C3 | 2.5 | 5 | 39.07 | 0 | 10.36 | 57.56 | 32.08 | Clayey-Silt | 0.12 | 1.43 | 0.45 | 78.0 | 12.4 | 2.78 | 252 | 21.8 | 84.1 |

**Table VI.** Textual and chemical data for core samples. Samples included in the historical data set are **bolded**.

| | Sample Interval | | Textural Data | | | | | | Chemical Data | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Core | Upper (cm) | Lower (cm) | Water (%) | Gravel (%) | Sand (%) | Silt (%) | Clay (%) | Shepard's (1954) Classification | Nitrogen (%) | Carbon (%) | Sulfur (%) | Cr (µg/g) | Cu (µg/g) | Fe (%) | Mn (µg/g) | Ni (µg/g) | Zn (µg/g) |
| C3 | 5 | 7.5 | 39.76 | 0 | 10.03 | 58.74 | 31.23 | Clayey-Silt | 0.11 | 1.40 | 0.50 | 77.0 | 12.4 | 2.70 | 256 | 20.2 | 80.6 |
| C3 | 7.5 | 10 | 41.15 | 0 | 9.75 | 56.40 | 33.85 | Clayey-Silt | 0.13 | 1.59 | 0.67 | 89.8 | 13.8 | 3.05 | 267 | 21.5 | 93.7 |
| C3 | 15.5 | 18 | 41.27 | 0 | 9.09 | 52.50 | 38.40 | Clayey-Silt | 0.13 | 1.53 | 0.74 | 91.7 | 13.6 | 3.26 | 286 | 25.5 | 88.7 |
| C3 | 20 | 27 | 51.46 | 0 | 2.70 | 46.43 | 50.87 | Silty-Clay | 0.17 | 2.04 | 0.69 | | | | | | |
| C3 | 28.5 | 31 | 49.55 | 0 | 9.33 | 49.03 | 41.63 | Clayey-Silt | 0.15 | 1.82 | 0.79 | 107.6 | 15.1 | 3.57 | 323 | 28.4 | 103.7 |
| C3 | 39.5 | 42 | 40.64 | 0 | 19.15 | 44.35 | 36.50 | Clayey-Silt | 0.10 | 1.29 | 0.94 | 80.9 | 11.0 | 2.95 | 273 | 25.4 | 70.7 |
| **C3** | **48** | **50.5** | **32.65** | **0** | **35.74** | **39.66** | **24.60** | **Sand-Silt-Clay** | **0.06** | **1.11** | **0.75** | **71.2** | **7.6** | **2.53** | **280** | **16.2** | **53.3** |
| **C3** | **54.5** | **57** | **36.32** | **0** | **25.47** | **45.58** | **28.95** | **Sand-Silt-Clay** | **0.07** | **0.93** | **0.96** | **75.5** | **10.2** | **2.84** | **291** | **21.4** | **61.6** |
| C4 | 0 | 2.5 | 43.16 | 0 | 26.90 | 51.06 | 22.04 | Sand-Silt-Clay | 0.12 | 1.33 | 0.46 | 62.7 | 9.8 | 2.19 | 214 | 16.5 | 73.3 |
| C4 | 2.5 | 5 | 38.12 | 0 | 28.59 | 50.46 | 20.95 | Sand-Silt-Clay | 0.10 | 1.05 | 0.45 | 50.5 | 8.1 | 1.81 | 171 | 16.3 | 62.8 |
| C4 | 5 | 7.5 | 34.69 | 0 | 32.78 | 52.39 | 14.83 | Sandy-Silt | 0.09 | 1.01 | 0.45 | 52.9 | 8.4 | 1.87 | 199 | 16.5 | 60.3 |
| C4 | 7.5 | 10 | 34.89 | 0 | 28.18 | 52.24 | 19.58 | Sandy-Silt | 0.10 | 1.08 | 0.55 | 56.3 | 9.8 | 2.01 | 197 | 16.8 | 66.9 |
| C4 | 17.5 | 20 | 36.87 | 0 | 19.89 | 55.13 | 24.97 | Clayey-Silt | 0.11 | 1.30 | 0.88 | 69.0 | 9.8 | 2.49 | 279 | 19.2 | 61.7 |
| C4 | 27.5 | 30 | 48.19 | 0 | 4.86 | 61.33 | 33.81 | Clayey-Silt | 0.15 | 1.64 | 1.19 | 81.7 | 11.1 | 2.91 | 297 | 22.8 | 65.5 |
| **C4** | **37.5** | **40** | **49.38** | **0** | **2.68** | **57.40** | **39.92** | **Clayey-Silt** | **0.15** | **1.69** | **1.24** | **85.2** | **12.3** | **3.07** | **270** | **21.1** | **66.6** |
| **C4** | **47.5** | **50** | **46.65** | **0** | **16.34** | **55.39** | **28.27** | **Clayey-Silt** | **0.13** | **1.68** | **1.02** | **70.5** | **8.3** | **2.61** | **239** | **17.3** | **54.0** |
| **C4** | **62.5** | **65** | **35.47** | **0** | **28.13** | **51.42** | **20.44** | **Sand-Silt-Clay** | **0.10** | **1.26** | **0.70** | **53.1** | **7.2** | **2.11** | **219** | **15.4** | **44.6** |
| C5 | 0 | 2 | 36.05 | 0 | 13.80 | 63.90 | 22.31 | Clayey-Silt | 0.09 | 1.08 | 0.32 | 56.9 | 7.7 | 2.18 | 218 | 16.7 | 64.0 |
| C5 | 2 | 4 | 35.05 | 0 | 16.85 | 63.41 | 19.74 | Clayey-Silt | 0.08 | 1.11 | 0.36 | 55.2 | 8.1 | 2.19 | 213 | 14.2 | 61.2 |
| C5 | 4 | 6 | 35.14 | 0 | 17.24 | 63.44 | 19.33 | Clayey-Silt | 0.09 | 1.17 | 0.38 | 57.9 | 8.1 | 2.22 | 230 | 14.6 | 60.8 |
| C5 | 6 | 8 | 30.75 | 0 | 17.14 | 62.12 | 20.74 | Clayey-Silt | 0.08 | 1.11 | 0.36 | 56.0 | 7.6 | 2.21 | 218 | 14.4 | 61.6 |
| C5 | 8 | 10 | 33.42 | 0 | 16.36 | 60.51 | 23.12 | Clayey-Silt | 0.09 | 1.21 | 0.41 | 65.6 | 9.1 | 2.41 | 251 | 23.8 | 68.2 |
| C5 | 10 | 12 | 35.12 | | | | | | | | | | | | | | |
| C5 | 12 | 14 | 33.60 | | | | | | | | | | | | | | |
| C5 | 14 | 16 | 34.68 | | | | | | | | | | | | | | |
| C5 | 16 | 18 | 33.38 | | | | | | | | | | | | | | |
| C5 | 18 | 20 | 33.47 | 0 | 16.31 | 61.14 | 22.55 | Clayey-Silt | 0.09 | 1.13 | 0.63 | 66.8 | 12.0 | 2.48 | 235 | 26.5 | 61.9 |
| C5 | 20 | 22 | 32.51 | | | | | | | | | | | | | | |
| C5 | 22 | 24 | 35.24 | | | | | | | | | | | | | | |
| C5 | 24 | 26 | 37.59 | | | | | | | | | | | | | | |
| C5 | 26 | 28 | 39.31 | | | | | | | | | | | | | | |

**Table VI.** Textual and chemical data for core samples. Samples included in the historical data set are **bolded**.

| Core | Sample Interval | | Textural Data | | | | | | Chemical Data | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Upper (cm) | Lower (cm) | Water (%) | Gravel (%) | Sand (%) | Silt (%) | Clay (%) | Shepard's (1954) Classification | Nitrogen (%) | Carbon (%) | Sulfur (%) | Cr (µg/g) | Cu (µg/g) | Fe (%) | Mn (µg/g) | Ni (µg/g) | Zn (µg/g) |
| C5 | 28 | 30 | 41.39 | 0 | 6.61 | 53.45 | 39.94 | Clayey-Silt | 0.10 | 1.29 | 0.88 | 95.4 | 12.6 | 3.23 | 307 | 30.5 | 78.0 |
| C5 | 30 | 32 | 39.12 | | | | | | | | | | | | | | |
| C5 | 32 | 34 | 45.35 | | | | | | | | | | | | | | |
| C5 | 34 | 36 | 46.37 | | | | | | | | | | | | | | |
| C5 | 36 | 38 | 46.47 | | | | | | | | | | | | | | |
| C5 | 38 | 40 | 48.60 | 0 | 1.61 | 50.59 | 47.80 | Clayey-Silt | 0.11 | 1.38 | 1.70 | | | | | | |
| **C5** | **45** | **47** | **40.81** | **0** | **4.12** | **51.64** | **44.24** | **Clayey-Silt** | **0.10** | **1.40** | **1.28** | **93.1** | **12.6** | **3.32** | **311** | **28.1** | **74.2** |
| **C5** | **54** | **56** | **45.81** | **0** | **2.56** | **52.28** | **45.16** | **Clayey-Silt** | **0.11** | **1.37** | **1.44** | **97.1** | **12.7** | **3.62** | **311** | **33.4** | **79.1** |

## $^{210}$ Pb-based sedimentation rate for cores 1 and 5

Sediment samples were taken from cores 1 and 5 at 2 cm intervals (other cores were sampled at 2.5 cm intervals). Samples were analyzed for water content (see **Methods** in main report). A two gram sub-samples was split from the dried water content sample, and sent to the University of Maryland, Horn Point Environmental Laboratory. The samples were analyzed by Dr. Jeffrey Cornwell, who also calculated the sedimentation rate from the $^{210}$ Pb activity data. The activity data which, in this case, are values for $^{210}$Po which is in secular equilibrium with $^{210}$Pb, are presented in Table VII. Activity values are reported as **d**isintegrations **p**er **m**inute per **g**ram or **dpm/g**.

**Table VII**. $^{210}$Pb activity data for sediments from cores 1 and 5.

| Core 1 Depth (cm) | $^{210}$Po Activity (dpm $g^{-1}$) | Counting Error | | Core 5 Depth (cm) | $^{210}$Po Activity (dpm $g^{-1}$) | Counting Error |
|---|---|---|---|---|---|---|
| 0-2 | 1.49 | 0.06 | | 0-2 | 1.89 | 0.08 |
| 2-4 | 1.33 | 0.06 | | 2-4 | 1.70 | 0.07 |
| 4-6 | 1.42 | 0.09 | | 4-6 | 1.61 | 0.09 |
| 6-8 | 1.24 | 0.05 | | 6-8 | 1.42 | 0.06 |
| 8-10 | 1.21 | 0.08 | | 12-14 | 1.55 | 0.07 |
| 10-12 | 1.16 | 0.08 | | 14-16 | 1.43 | 0.06 |
| 12-14 | 0.90 | 0.04 | | 16-18 | 1.24 | 0.05 |
| 18-20 | 0.73 | 0.02 | | 18-20 | 0.70 | 0.12 |
| 28-30 | 0.68 | 0.05 | | 22-24 | 0.66 | 0.03 |
| 38-40 | 0.63 | 0.05 | | 28-30 | 0.71 | 0.10 |
| 51-53 | 0.66 | 0.05 | | 38-40 | 0.36 | 0.09 |
| | | | | 45-47 | 0.69 | 0.04 |
| | | | | 54-56 | 0.83 | 0.18 |

Based on downcore profiles of $^{210}$Po activity values, an average sedimentation rates for the top of the cores were calculated to be 0.17±0.08 and 0.25±0.14 cm $yr^{-1}$ for cores 1 and 5 respectively. The rates were calculated using the CRS (Constant Rate of Supply) model for sedimentation. In the CRS model, it is assumed that $^{210}$Pb fluxes into the sediment are constant, but the flux of sediment particles may be variable (Appleby and Oldfield, 1978). By determining a time for each sediment interval, the sedimentation rate can be determine throughout the core

(Table VIII).

**Table VIII**. Interval ages and sedimentation rates for cores 1 and 5, calculated by the CRS model.

| Core 1 Depth (cm) | Age (yr) | Accretion Rate (cm/yr) | | | Core 5 Depth (cm) | Age (yr) | Accretion Rate (cm/yr) | |
|---|---|---|---|---|---|---|---|---|
| | | Wet | Dry | | | | Wet | Dry |
| 2 | 7.8 | 0.257 | 0.170 | | 2 | 5.1 | 0.389 | 0.247 |
| 4 | 15.6 | 0.255 | 0.166 | | 4 | 10.4 | 0.383 | 0.246 |
| 6 | 27.5 | 0.169 | 0.110 | | 6 | 16.0 | 0.353 | 0.226 |
| 8 | 40.5 | 0.153 | 0.099 | | 8 | 22.4 | 0.330 | 0.222 |
| 10 | 59.2 | 0.107 | 0.068 | | 12 | 40.5 | 0.109 | 0.070 |
| 12 | 97.6 | 0.052 | 0.032 | | 14 | 57.1 | 0.120 | 0.078 |
| | | | | | 16 | 83.6 | 0.076 | 0.049 |
| Average | | 0.17 | 0.11 | | Average | | 0.25 | 0.16 |

# Appendix II- Surficial Sediment Data

- Location data and field descriptions for surficial samples
- Textural and chemical data for surficial samples

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| 3 | 38 | 6 | 20.34 | 75 | 17 | 28.55 | 1.8 | Dark greenish grey (5 GY 4/1) mottled with darker grey, muddy, fine sand, plant fragments, worm tubes, worm, algae |
| 4 | 38 | 6 | 18.84 | 75 | 17 | 8.52 | 2.3 | Dark greenish grey (5 GY 4/1), slightly gritty mud, reddish brown floc, worm tubes, shell |
| 5 | 38 | 6 | 19.27 | 75 | 16 | 47.24 | 2.4 | Greenish black (5 GY 2/1), very slightly gritty mud, worm tubes,arthropods |
| 6 | 38 | 6 | 18.17 | 75 | 16 | 27.69 | 2.3 | Dark greenish grey (5 GY 4/1), slightly gritty gelatinous mud, darkens with depth, lots of worm tubes |
| 7 | 38 | 6 | 17.59 | 75 | 16 | 6.68 | 2.1 | Olive grey (5 Y 4/1), cohesive gelatinous firm gritty mud, worm tubes, worm, *Zostera marina*, algae |
| 8 | 38 | 6 | 17.44 | 75 | 15 | 46.08 | 2.1 | Olive grey (5 Y 4/1), very fine sandy mud, few worm tubes, some shells |
| 9 | 38 | 6 | 17.32 | 75 | 15 | 26.91 | 1.8 | Olive grey (5 Y 4/1), muddy sand, some grass, SAV, worm tubes, shell fragments |
| 10 | 38 | 6 | 16.02 | 75 | 15 | 5.18 | 1.8 | Dark greenish grey (5 GY 4/1) mottled with olive grey (5 Y 4/1), muddy very fine sand, SAV, worm tubes, worm, live shells (*Gemma gemma)*, polychaete |
| 11 | 38 | 6 | 15.61 | 75 | 14 | 44.58 | 1.5 | Olive grey (5 Y 4/1), muddy very fine sand, green seaweed on top of some shells (*Gemma gemma*), stringy algae |
| 12 | 38 | 6 | 15.53 | 75 | 14 | 24.88 | 0.9 | Brownish grey (5 YR 4/1) to olive grey (5 Y 4/1), fine to very fine sand, live shells |
| 13 | 38 | 6 | 15.85 | 75 | 14 | 2.83 | 0.9 | Brownish grey (5 YR 4/1), very fine sand, grey seaweed attached to shells, gastropod shells and fragments, *Gemma gemma*, worms |
| 14 | 38 | 6 | 14.51 | 75 | 13 | 41.19 | 1.8 | Olive grey ( 5 Y 4/1), stiff hard sand with shells, worm tube, shell fragments, some mud |
| 15 | 38 | 6 | 14.65 | 75 | 13 | 20.95 | 0.9 | Olive grey (5 Y 4/1) to dark greenish grey (5 GY 3/1), very fine to fine sand, fairly clean sand, lots of shells, *Gemma gemma* |
| 16 | 38 | 6 | 14.56 | 75 | 13 | 0.30 | 0.6 | Olive grey (5 Y 4/1), very fine sand, lots of worm tubes, grass (*Zostera marina*) |
| 17 | 38 | 5 | 58.57 | 75 | 13 | 0.41 | 0.6 | Light olive grey (5 Y 5/2) to olive grey (5 Y 3/2), fine sand, grass shrimp, shell fragments |
| 18 | 38 | 5 | 56.33 | 75 | 13 | 21.36 | 1.5 | Olive grey (5 Y 4/1), very fine sand, lots of shellfragments, approximately 40 m south edge of *Zostera marina* bed |
| 19 | 38 | 5 | 59.03 | 75 | 13 | 42.59 | 0.6 | Olive grey (5 Y 4/1), fine to very fine sand, fairly clean, *Zostera marina* bed |
| 20 | 38 | 5 | 59.76 | 75 | 14 | 24.20 | 0.8 | Light olive grey (5 Y 5/2), fine sand, few worm tubes, very small shells and shell fragments |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| 21 | 38 | 6 | 0.23 | 75 | 14 | 44.59 | 0.9 | Olive grey (5 Y 4/1), fine to very fine sand, turning brown and olive black (5 Y 2/1) with depth, pretty stiff, small live shells *(Gemma gemma)* |
| 22 | 38 | 5 | 59.93 | 75 | 15 | 5.37 | 1.5 | Olive grey (5 Y 4/1), muddy fine sand, turning olive black (5 Y 2/1) with depth, green seaweed |
| 23 | 38 | 6 | 0.66 | 75 | 15 | 25.96 | 1.5 | Greenish black (5 GY 2/1), muddy fine to very fine sand, worm tubes, small shell fragments, including scallop shell fragments |
| 24 | 38 | 6 | 0.68 | 75 | 15 | 46.73 | 1.7 | Dark greenish grey (5 GY 4/1), muddy very fine sand, olive grey (5 Y 4/1) floc, confusing brown seaweed, worm tubes |
| 25 | 38 | 6 | 1.24 | 75 | 16 | 6.58 | 2.1 | Olive grey(5 Y 4/1), curdled or cottage cheese texture, muddy very fine sand, worm tubes, shell fragments, live *Gemma gemma*, grass shrimp |
| 26 | 38 | 6 | 1.98 | 75 | 16 | 27.91 | 2.1 | Olive grey (5 Y 4/1) mottled with olive black (5 Y 2/1), very fine sandy mud, pretty firm, oxidized worm tubes, occasional shell fragments, live *Gemma gemma* |
| 27 | 38 | 6 | 1.99 | 75 | 16 | 48.19 | 2.1 | Dark greenish grey (5 GY 4/1) to greenish black (5 GY 3/1), very silty mud, worm tubes |
| 28 | 38 | 6 | 2.30 | 75 | 17 | 8.62 | 2.0 | Olive grey (5 Y 4/1), muddy, watery, very fine sand, worm tubes, worms, few shell fragments |
| 29 | 38 | 6 | 2.24 | 75 | 17 | 28.78 | 1.5 | Olive grey (5 Y 4/1), muddy to fine sand, worm tubes, shells |
| 30 | 38 | 6 | 36.39 | 75 | 18 | 10.21 | 0.8 | Dark greenish grey (5 GY 4/1), mud, olive grey (5 Y 4/1) floc, cottage cheese texture, watery, worm tubes, some worms, plant material, red algae mat |
| 31 | 38 | 6 | 20.35 | 75 | 18 | 31.44 | 0.9 | Dark greenish grey (5 GY 4/1), mud, olive grey (5 Y 4/1) floc, cottage cheese texture, watery, worm tubes, plant material, red algae mat |
| 32 | 38 | 6 | 5.30 | 75 | 19 | 33.86 | 1.8 | Dark greenish grey (5 GY 4/1), mud, worm tubes, algae mat, green seaweed, orange sponge |
| 33 | 38 | 6 | 5.66 | 75 | 19 | 54.38 | 1.2 | Olive grey (5 Y 4/1), mud, worm tubes |
| 34 | 38 | 5 | 49.50 | 75 | 20 | 16.39 | 1.5 | Greenish black (5 GY 2/1), smooth gelatinous mud, olive grey (5 Y 4/1) floc, worms |
| 35 | 38 | 5 | 48.61 | 75 | 19 | 55.10 | 1.4 | Olive grey(5 Y 4/1) to dark greenish grey (5 GY 4/1), coarse silty mud, lots of worm tubes, worms |
| 36 | 38 | 5 | 48.67 | 75 | 19 | 34.17 | 1.2 | Olive grey (5 Y 4/1), slightly silty mud, worm tubes, grass shrimp, lots of algae, green seaweed |
| 37 | 38 | 5 | 47.88 | 75 | 19 | 13.62 | 1.2 | Olive grey(5 Y 4/1), gritty mud, lots of worm tubes, worms, shell fragments, algae mat |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| | | | | | | | | on top |
| 38 | 38 | 5 | 46.98 | 75 | 18 | 11.62 | 0.9 | Olive grey, silty mud, cottage cheese texture, worm tubes, worms, shell fragments, plant mat, red algae mat |
| 39 | 38 | 5 | 46.17 | 75 | 17 | 29.86 | 1.8 | Dark greenish grey (5 GY 4/1), very gritty mud, cohesive, worm tubes, shells |
| 40 | 38 | 5 | 45.99 | 75 | 17 | 9.25 | 2.1 | Olive grey (5 Y 4/1) oxidized, silty mud, very cohesive, sticky |
| 41 | 38 | 5 | 46.07 | 75 | 16 | 48.48 | 2.1 | Olive grey (5 Y 3/2), muddy very fine sand, lots of worm tubes, small sample, mostly shell fragments |
| 42 | 38 | 5 | 45.43 | 75 | 16 | 27.11 | 1.5 | Medium olive brown (5 Y 4/4), fine sand, live *Gemma gemma* |
| 43 | 38 | 5 | 45.42 | 75 | 16 | 7.29 | 1.5 | Olive grey (5 Y 4/1) with a hit of brown, very fine sand, clean sample |
| 44 | 38 | 5 | 44.78 | 75 | 15 | 46.25 | 1.2 | Olive grey (5 Y 4/1), fine to very fine sand, clumps of confusing brown seaweed with shell fragments, grass shrimp, live *Gemma gemma* |
| 45 | 38 | 5 | 44.15 | 75 | 15 | 25.82 | 0.9 | Dark yellow brown (10 YR 4/2), fine sand, became darker with depth, grass shrimp, couple of live *Gemma gemma* |
| 46 | 38 | 5 | 44.06 | 75 | 15 | 4.73 | 0.9 | Light yellow brown (10 YR 4/2), fine sand, plant material, grass shrimp, live *Gemma gemma* |
| 47 | 38 | 5 | 43.59 | 75 | 14 | 44.21 | 0.8 | Light olive grey (5 Y 5/2) to dark yellow brown (10 YR 4/2), fine to medium sand, occasional shell fragments, live *Gemma gemma* |
| 48 | 38 | 5 | 43.72 | 75 | 14 | 23.11 | | Station too hazardous to reach |
| 49 | 38 | 5 | 42.48 | 75 | 13 | 0.48 | | Too shallow to reach, no sample |
| 50 | 38 | 5 | 27.70 | 75 | 14 | 23.75 | 1.3 | Dark greenish grey (5 GY 4/1), muddy very fine sand, fairly firm, worm tubes |
| 51 | 38 | 5 | 27.80 | 75 | 14 | 45.21 | 0.5 | Neutral olive grey (5 Y 4/1), slightly muddy very fine sand, plants, lots of *Zostera marina* |
| 52 | 38 | 5 | 27.66 | 75 | 15 | 5.86 | 1.1 | Olive grey (5 Y 4/1), very fine sand, worm tubes, grass shrimp, *Zostera marina*, green seaweed |
| 53 | 38 | 5 | 28.01 | 75 | 15 | 26.46 | 1.1 | Dark greenish grey (5 GY 4/1) to greenish black (5 GY 2/1), very fine sand, *Zostera marina,* little arthropods |
| 54 | 38 | 5 | 28.80 | 75 | 15 | 47.08 | 1.2 | Dark greenish grey (5 GY 4/1), fine to very fine sand, clean sand, live *Gemma gemma* |
| 55 | 38 | 5 | 29.40 | 75 | 16 | 7.71 | 1.2 | Olive grey (5 Y 4/1), fine to very fine sand, live *Gemma gemma*, green seaweed, darker |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| | | | | | | | | with depth |
| 56 | 38 | 5 | 28.66 | 75 | 16 | 29.16 | 1.8 | Olive grey (5 Y 4/1), muddy sand, worm tubes, plant material |
| 57 | 38 | 5 | 29.21 | 75 | 16 | 48.64 | 2.1 | Olive grey (5 Y 4/1), very fine sandy mud, worm tubes, lots of seaweed, green seaweed on top |
| 58 | 38 | 5 | 30.40 | 75 | 17 | 10.04 | 2.1 | Dark greenish grey (5 GY 4/1), slightly silty mud, cohesive, worm tubes, kinda watery |
| 59 | 38 | 5 | 30.41 | 75 | 17 | 30.35 | 1.8 | Dark greenish grey (5 GY 4/1), slightly gritty mud, worm tubes, occasional shell fragments |
| 59R | 38 | 5 | 30.41 | 75 | 17 | 30.35 | 1.8 | Dark greenish grey (5 GY 4/1), very fine sandy mud, somewhat watery |
| 60 | 38 | 5 | 30.95 | 75 | 17 | 51.52 | 1.5 | Dark greenish grey (5 GY 4/1), muddy fine sand, cottage cheese texture, worm tubes, lots of shell fragments |
| 60R | 38 | 5 | 30.95 | 75 | 17 | 51.52 | 1.7 | Dark greenish grey (5 GY 4/1), sandy mud, worm tubes, live worms, lots of shells, oyster shell hash, red algae |
| 61 | 38 | 5 | 30.73 | 75 | 18 | 11.72 | 1.2 | Olive grey (5 Y 4/1), silty mud, cottage cheese texture, some worm tubes, red algae mat on top |
| 61R | 38 | 5 | 30.73 | 75 | 18 | 11.72 | 1.2 | Olive grey (5 Y 4/1), muddy sand, pretty stiff, worm tubes, some oxidized, couple worms, green seaweed |
| 62 | 38 | 5 | 31.26 | 75 | 18 | 32.84 | 0.6 | Dark greenish grey (5 GY 4/1), slightly silty mud, very fine sand with coarse silt, cottage cheese texture, fairly cohesive, worm tubes |
| 62R | 38 | 5 | 31.26 | 75 | 18 | 32.84 | 1.2 | Dark greenish grey (5 GY 4/1), mud, shell fragments, confusing brown seaweed |
| 63 | 38 | 5 | 32.06 | 75 | 19 | 34.55 | 1.8 | Dark greenish grey (5 GY 4/1) to greenish black (5 GY 2/1), lumpy mud, slightly silty, lots of worm tubes |
| 64 | 38 | 5 | 32.72 | 75 | 19 | 55.35 | 1.4 | Dark greenish grey, mud, worm tubes, worm, polychaetes, small sample |
| 65 | 38 | 5 | 32.51 | 75 | 20 | 16.28 | 1.2 | Dark greenish grey (5 GY 4/1), slightly gritty mud, lumpy sand pockets, pretty firm, live *Ensis sp.* |
| 66 | 38 | 5 | 16.64 | 75 | 20 | 16.24 | 0.9 | Dark greenish grey (5 GY 4/1), gritty mud, pretty cohesive, worm tubes, live *Gemma gemma* |
| 67 | 38 | 5 | 16.03 | 75 | 19 | 55.94 | 1.8 | Dark greenish grey (5 GY 4/1), silty mud, worm tubes, shell fragments, sea cucumber |
| 68 | 38 | 5 | 15.98 | 75 | 19 | 34.93 | 1.2 | Dark greenish grey (5 GY 4/1), gritty mud, cottage cheese texture, lumpy, some worm |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| | | | | | | | | tubes, worms |
| 69 | 38 | 5 | 14.17 | 75 | 18 | 12.80 | 1.4 | Dark greenish grey (5 GY 4/1), silty mud, worm tubes, lots of shell and oyster fragments |
| 70 | 38 | 5 | 14.89 | 75 | 17 | 51.65 | 1.5 | Olive grey (5 Y 4/1), silty mud, worm tubes, worms, shell fragments |
| 71 | 38 | 5 | 13.72 | 75 | 17 | 31.36 | 1.8 | Mottled dark greenish grey (5 GY 4/1) with greenish black (5 GY 2/1), slightly silty mud, lots of worm tubes, worms, plant material |
| 72 | 38 | 5 | 12.76 | 75 | 17 | 10.17 | 2.1 | Dark greenish grey (5 GY 4/1), fairly smooth mud, worm tubes, worms, shell fragments, plant material |
| 73 | 38 | 5 | 12.35 | 75 | 16 | 49.57 | 2.4 | Greenish black (5 G 2/1), very stiff silty mud, worm tubes, shell fragments |
| 74 | 38 | 5 | 12.55 | 75 | 16 | 28.31 | 2.3 | Greenish black (5 GY 2/1), very fine sandy mud, worm tubes, plant material, live *Gemma gemma* |
| 75 | 38 | 5 | 12.26 | 75 | 16 | 8.62 | 1.8 | Olive grey (5 Y 4/1), slightly muddy, very firm, very fine sand, worm tubes, live worms, confusing brown seaweed, live *Gemma gemma* |
| 76 | 38 | 5 | 11.61 | 75 | 15 | 47.09 | 1.4 | Olive black (5 Y 2/1), fine to very fine sand, fairly clean, small shell fragments, live *Gemma gemma* |
| 77 | 38 | 5 | 11.40 | 75 | 15 | 26.28 | 0.9 | Olive grey (5 Y 4/1), fine sand, very small sample |
| 78 | 38 | 5 | 11.18 | 75 | 15 | 5.85 | 1.2 | Olive grey (5 Y 4/1), fine to very fine sand, trace mud, shell fragments |
| 79 | 38 | 5 | 10.23 | 75 | 14 | 45.48 | 1.8 | Greenish black (5 GY 2/1), muddy very fine sand, dark greenish grey floc, lots of worm tubes |
| 80 | 38 | 5 | 10.48 | 75 | 14 | 23.47 | 2.0 | Greenish black (5 GY 4/1), silty mud, worm tubes, shell fragments |
| 81 | 38 | 5 | 9.21 | 75 | 14 | 4.09 | 1.8 | Dark greenish grey, muddy very fine sand, shell fragments, lots of confusing brown seaweed, very small sample |
| 82 | 38 | 4 | 53.63 | 75 | 13 | 23.76 | 1.7 | Dark greenish grey (5 GY 4/1), slightly muddy very fine sand, lots of worm tubes |
| 83 | 38 | 4 | 53.11 | 75 | 13 | 44.29 | 1.7 | Dark greenish grey (5 GY 4/1), slightly muddy very fine sand, worm tubes, small shell fragments, live *Gemma gemma* |
| 84 | 38 | 4 | 54.44 | 75 | 14 | 5.44 | 1.2 | Olive grey (5 Y 4/1) to dark greenish grey (5 GY 4/1), fine sand, grass shrimp, live *Gemma gemma* |
| 85 | 38 | 4 | 55.65 | 75 | 14 | 25.72 | 1.2 | Olive grey (5 Y 4/1), clean fine sand, live *Gemma gemma* |
| 86 | 38 | 4 | 54.08 | 75 | 14 | 46.07 | 1.2 | Olive grey (5 Y 4/1), fine sand, fairly clean, green seaweed, other plant material, live |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| | | | | | | | | *Gemma gemma* |
| 87 | 38 | 4 | 55.33 | 75 | 15 | 6.28 | 1.4 | Mottled olive grey (5 Y 4/1) with dark greenish grey (5 GY 4/1), fine to very fine sand, worm tubes, grass shrimp, shell fragments, live *Gemma gemma* |
| 88 | 38 | 4 | 55.53 | 75 | 15 | 25.76 | 1.5 | Dark greenish grey (5 GY 4/1), fine sand, solitary worm tube |
| 89 | 38 | 4 | 56.25 | 75 | 15 | 48.03 | 1.5 | Dark greenish grey (5 GY 4/1), fine to very fine sand, few worm tubes, shell fragments |
| 90 | 38 | 4 | 55.20 | 75 | 16 | 8.90 | 1.8 | Olive grey (5 Y 4/1), fine to very fine sand, green seaweed, live *Gemma gemma* |
| 91 | 38 | 4 | 55.77 | 75 | 16 | 29.25 | 2.3 | Dark greenish grey (5 GY 4/1), 50/50 sand-mud, worm tubes, very small sample |
| 92 | 38 | 4 | 56.88 | 75 | 16 | 49.41 | 2.3 | Dark greenish grey (5 GY 4/1), very fine sandy mud, moderately firm, cohesive, worm tubes, green seawedd |
| 93 | 38 | 4 | 56.86 | 75 | 17 | 10.42 | 2.0 | Dark greenish grey (5 GY 4/1) to greenish black (5 GY 3/1), very fine sandy mud, relatively cohesive, firm, worm tubes, plant material |
| 94 | 38 | 4 | 58.23 | 75 | 17 | 32.18 | 1.8 | Dark greenish grey (5 GY 4/1), silty mud, pretty cohesive, worm tubes, worms, plant material |
| 95 | 38 | 4 | 57.73 | 75 | 17 | 51.56 | 1.5 | Olive grey (5 Y 4/1) to dark greenish grey (5 GY 4/1), very fine sandy mud, lots of worm tubes, live *Gemma gemma* |
| 96 | 38 | 4 | 59.89 | 75 | 19 | 14.66 | 1.2 | Dark greenish grey (5 G 4/1), slightly gritty mud, coarse silt, worm tubes, shell fragments, some plant material, fecal pellets, watery |
| 97 | 38 | 4 | 59.58 | 75 | 19 | 35.55 | 1.3 | Dark greenish grey (5 G 4/1), slightly gritty mud, coarse silt, worm tubes, shell fragments, fecal pellets, watery |
| 98 | 38 | 5 | 0.04 | 75 | 19 | 56.27 | 1.2 | Dark greenish grey (5 GY 4/1 and 5 G 4/1), gritty mud (on sand), worm tubes, worms, algea/seaweed mat, some root material, watery |
| 99 | 38 | 5 | 0.25 | 75 | 20 | 37.75 | 0.9 | Dark greenish grey (5 GY 4/1), slightly gritty mud, pretty stiff, cohesive, sticky, worm tubes, shell fragments |
| 100 | 38 | 5 | 0.88 | 75 | 21 | 19.64 | 0.5 | Olive grey (5 Y 4/1), fine to very fine sand, darker towards bottom dark greenish grey (5 GY 4/1), worm tubes |
| 101 | 38 | 4 | 44.79 | 75 | 21 | 19.47 | 0.5 | Mottled olive brown (5 Y 4/4) with olive grey (5 Y 3/2), slightly silty medium to fine sand, shell fragments, algae mat |
| 102 | 38 | 4 | 44.86 | 75 | 20 | 59.28 | 0.9 | Dark greenish grey (5 GY 4/1), lumpy mud, very cohesive, worm tubes, worms, shell fragments, algae mat, seaweed |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| 103 | 38 | 4 | 43.33 | 75 | 19 | 15.41 | 1.4 | Dark greenish grey (5 GY 4/1), mud, worm tubes, shell fragments, watery |
| 104 | 38 | 4 | 43.12 | 75 | 18 | 54.61 | 1.2 | Dark greenish grey (5 GY 4/1), coarse silty mud, worm tubes, watery |
| 105 | 38 | 4 | 39.64 | 75 | 17 | 10.34 | 2.0 | Dark greenish grey (5 GY 4/1) to greenish black (5 GY 3/1), very fine sandy mud, firm, cohesive, worm tubes, abundant shell fragments, brown and green seaweed |
| 106 | 38 | 4 | 40.05 | 75 | 16 | 50.06 | 2.4 | Dark greenish grey (5 GY 4/1), very fine sandy silty mud, olive grey (5 Y 4/1) floc, *Zostera marina*, shell fragments |
| 107 | 38 | 4 | 38.72 | 75 | 16 | 32.40 | 2.4 | Dark greenish grey (5 GY 4/1), very fine sandy mud, curdled texture, worm tubes, worms, shell fragments, |
| 108 | 38 | 4 | 38.50 | 75 | 16 | 8.98 | 2.0 | Olive grey ( 5 Y 4/1) to dark greenish grey (5 GY 4/1), slightly muddy fine sand, worm tubes, couple shell fragments |
| 109 | 38 | 4 | 39.02 | 75 | 15 | 47.79 | 1.8 | Olive grey (5 Y 4/1), very fine sand, worm tubes, occasional shell fragments, very small sample |
| 110 | 38 | 4 | 39.43 | 75 | 15 | 27.51 | 1.2 | Olive grey (5 Y 4/1), fine sand, plant material, *Zostera marina*, live *Gemma gemma* |
| 111 | 38 | 4 | 38.85 | 75 | 15 | 6.55 | 0.8 | Mottled olive grey (5 Y 4/1) with olive black (5 Y 2/1), worm tubes, plant material (*Zostera marina*), live *Gemma gemma* |
| 112 | 38 | 4 | 38.72 | 75 | 14 | 46.69 | 0.8 | Olive grey (5 Y 4/1) to dark greenish grey (5 gy 4/1), fine sand, trace silt, very healthy *Zostera marina* bed |
| 113 | 38 | 4 | 38.49 | 75 | 14 | 25.48 | | Too shallow, SAV |
| 114 | 38 | 4 | 38.01 | 75 | 14 | 4.44 | 1.2 | Greenish black (5 G 2/1), fine sand, grass shrimp, occasional shell fragments, live *Gemma gemma* |
| 115 | 38 | 4 | 38.04 | 75 | 13 | 43.43 | 0.6 | Mottled olive grey (5 Y 4/1) with dark greenish grey (5 GY 4/1), fine sand, flattened worm tubes, grass shrimp, live *Gemma gemma* |
| 116 | 38 | 4 | 21.53 | 75 | 14 | 4.72 | | Too shallow to sample |
| 117 | 38 | 4 | 21.95 | 75 | 14 | 25.89 | | Too shallow to sample |
| 118 | 38 | 4 | 23.51 | 75 | 15 | 27.73 | 0.6 | Olive grey (5 Y 4/1), very fine sand, brown seaweed, *Zostera marina*, rooted *Zostera marina* |
| 119 | 38 | 4 | 24.11 | 75 | 15 | 48.35 | 0.9 | Olive black (5 Y 2/1), very fine sand, grass shrimp, *Zostera marina* |
| 120 | 38 | 4 | 23.94 | 75 | 16 | 9.53 | 1.8 | Olive grey (5 Y 4/1), very slightly muddy very fine sand, plant material shell fragments |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| 121 | 38 | 4 | 24.43 | 75 | 16 | 29.50 | 1.8 | Dark greenish grey (5 GY 4/1), muddy very fine sand, worm tubes, live worms |
| 122 | 38 | 4 | 25.01 | 75 | 16 | 50.54 | 1.8 | Dark olive grey (5 Y 4/1), silty mud, slightly gritty, worm tubes, shell fragments |
| 123 | 38 | 4 | 25.19 | 75 | 17 | 11.58 | 1.8 | Greenish black (5 GY 2/1), slightly silty mud, very cohesive, *Ruppia maritima*, live *Gemma gemma*, worms |
| 124 | 38 | 4 | 25.91 | 75 | 17 | 53.30 | 1.2 | Dark greenish grey (5 GY 4/1), very fine sand, coarse silt mud |
| 125 | 38 | 4 | 27.25 | 75 | 18 | 34.30 | 1.1 | Dark greenish grey (5 G 4/1) with olive grey (5 Y 4/1), mud, occasional worm tubes, red seaweed |
| 126 | 38 | 4 | 27.01 | 75 | 18 | 55.44 | 1.5 | Olive grey (5 Y 4/1), gritty mud, occasional worm tubes |
| 127 | 38 | 4 | 27.22 | 75 | 19 | 16.24 | 1.5 | Dark greenish grey (5 GY 4/1), gritty mud, couple worm tubes, plant material |
| 128 | 38 | 4 | 27.74 | 75 | 19 | 36.62 | 1.2 | Dark greenish grey (5 GY 4/1), very, very fine sandy mud, curdled texture, worm tubes, shell fragments, trace plant material, algae mat, somewhat watery |
| 129 | 38 | 4 | 28.45 | 75 | 20 | 39.26 | 0.8 | Dark yellowish brown (10 YR 4/2) to greenish black (5 GY 2/1), coarse fine sand, lumps of muddy sand, worm tubes, 1/2 worm, shell fragments, plant material (rhizomes) |
| 130 | 38 | 4 | 28.83 | 75 | 20 | 58.99 | 0.9 | Dark greenish grey (5 GY 4/1), smooth mud, gelatinous, lots of worms, algae mat |
| 131 | 38 | 4 | 28.75 | 75 | 21 | 20.58 | 0.9 | Olive grey (5 Y 4/1), slightly gritty mud, worm tubes, shell fragments (oyster), algae mat, plant mat, fecal pellets |
| 132 | 38 | 4 | 29.50 | 75 | 21 | 41.57 | 1.2 | Dark greenish grey (5 GY 4/1), slightly gritty mud, worm tubes, algae mat, somewhat watery |
| 133 | 38 | 4 | 12.99 | 75 | 21 | 41.41 | 0.8 | Dark greenish grey (5 GY 4/1), gritty mud, worm tubes, lots of worms, shell fragments (*Ensis*) |
| 134 | 38 | 4 | 12.47 | 75 | 21 | 20.78 | 1.1 | Dark greenish grey (5 GY 4/1) with olive grey (5 Y 4/1), smooth very slightly gritty mud, cohesive, worm tubes, worms, shell fragments, watery |
| 135 | 38 | 4 | 11.83 | 75 | 20 | 59.17 | 1.2 | Dark greenish grey (5 GY 4/1), smooth mud, cohesive, worm tubes, worms, shell fragments, watery |
| 136 | 38 | 4 | 11.74 | 75 | 20 | 38.95 | 1.2 | Dark greenish grey (5 GY 4/1) with olive grey (5 Y 4/1), slightly gritty mud, seaweed |
| 137 | 38 | 4 | 11.14 | 75 | 20 | 19.64 | 1.2 | Greenish black (5 G 2/1), slightly gritty mud, cohesive, solid, worm tubes, shell fragments, algae mat |
| 138 | 38 | 4 | 10.99 | 75 | 19 | 58.02 | 1.2 | Greenish black (5 GY 2/1), muddy fine to medium sand, lots of plant material, seaweed, |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| | | | | | | | | *Ruppia maritima* |
| 139 | 38 | 4 | 11.30 | 75 | 19 | 36.80 | 1.1 | Olive black (5 Y 2/1) with some olive grey (5 Y 4/1), fine to very fine sand, slightly silty, big worm tubes, seaweed (in place) live *Gemma gemma* |
| 140 | 38 | 4 | 11.20 | 75 | 19 | 17.06 | 1.2 | Dark greenish grey (5 GY 4/1), smooth mud, gelatinous, worm tubes |
| 141 | 38 | 4 | 10.62 | 75 | 18 | 55.00 | 1.5 | Olive grey (5 Y 4/1), mud, worm tubes, shell fragments, grass shrimp, oyster shell, watery |
| 142 | 38 | 4 | 10.43 | 75 | 18 | 35.27 | 1.5 | Dark greenish grey (5 GY 4/1), mud, worm tubes |
| 143 | 38 | 4 | 9.53 | 75 | 18 | 15.39 | 1.5 | Olive grey (5 Y 4/1) to dark greenish grey (5 GY 4/1), mud, worm tubes, shell fragments |
| 144 | 38 | 4 | 9.44 | 75 | 17 | 54.22 | 1.5 | Olive grey (5 Y 4/1), muddy very fine sand, worm tubes, green seaweed, other plant material |
| 145 | 38 | 4 | 9.52 | 75 | 17 | 32.96 | 2.4 | Olive grey (5 Y 4/1), silty mud, worm tubes, shell fragments, live *Gemma gemma* |
| 146 | 38 | 4 | 8.75 | 75 | 17 | 12.10 | 2.4 | Dark greenish grey (5 GY 4/1), coarse silty mud, shell fragments |
| 147 | 38 | 4 | 8.54 | 75 | 16 | 50.97 | 2.1 | Olive grey (5 Y 4/1), very fine sandy mud, cohesive, worm tubes, grass shrimp |
| 148 | 38 | 4 | 7.97 | 75 | 16 | 30.43 | 2.4 | Greenish black (5 GY 2/1), slightly muddy fine sand, worm tubes, shell fragments |
| 149 | 38 | 4 | 7.83 | 75 | 16 | 10.33 | 1.5 | Dark greenish grey (5 GY 4/1), fine sand, grass shrimp, shell fragments |
| 150 | 38 | 4 | 7.29 | 75 | 15 | 49.17 | 1.5 | Olive grey (5 Y 4/1), very fine sand, red algae, roots of *Zostera marina* |
| 151 | 38 | 4 | 7.24 | 75 | 15 | 28.53 | 0.9 | Olive grey (5 Y 4/1) to olive black (5 Y 2/1), mud, curdled cottage cheese texture, lots of worm tubes, shell fragments |
| 152 | 38 | 3 | 50.63 | 75 | 15 | 28.97 | 1.2 | Dark greenish grey (5 GY 4/1) with some olive black (5 Y 2/1), muddy fine to very fine sand, shell fragments, brown seaweed, *Zostera marina*, *Ensis* shell |
| 153 | 38 | 3 | 51.08 | 75 | 15 | 50.13 | 1.2 | Olive grey (5 Y 4/1), fine sand, some worm tubes |
| 154 | 38 | 3 | 51.68 | 75 | 16 | 10.39 | 0.6 | Olive grey (5 Y 4/1), fine to very fine sand, little tiny shells, green seaweed on top, *Zostera marina* |
| 155 | 38 | 3 | 51.68 | 75 | 16 | 29.88 | 1.8 | Olive grey (5 Y 4/1), very fine sand, some silt, shell fragments, old oyster bed, plant material |
| 156 | 38 | 3 | 52.26 | 75 | 16 | 51.28 | 2.4 | Greenish black (5 GY 2/1), slightly gritty mud, plant material, possible *Zostera marina*, orange sponge like thing |
| 157 | 38 | 3 | 52.31 | 75 | 17 | 12.28 | 2.4 | Greenish black (5 GY 2/1), gritty mud, live worms, plant material |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| 158 | 38 | 3 | 52.78 | 75 | 17 | 33.40 | 2.1 | Olive grey (5 Y 4/1), slightly muddy very fine sand, worm tubes, lots of shell fragments |
| 159 | 38 | 3 | 52.98 | 75 | 17 | 53.54 | 1.8 | Olive grey (5 Y 4/1), slightly muddy very fine sand, worm tubes, live worms |
| 160 | 38 | 3 | 53.37 | 75 | 18 | 15.48 | 1.8 | Olive grey (5 Y 4/1),medium to fine sand, shell fragments, small sample |
| 161 | 38 | 3 | 53.45 | 75 | 18 | 36.16 | 1.8 | Olive grey (5 Y 4/1), mud, cohesive, worm tubes, shell fragments |
| 162 | 38 | 3 | 54.08 | 75 | 18 | 57.36 | 2.4 | Olive grey (5 Y 4/1) to dark greenish grey (5 GY 4/1), mud, few worm tubes, few shell fragments, plant material, green seaweed on top |
| 163 | 38 | 3 | 53.97 | 75 | 19 | 16.23 | 0.6 | Dark greenish grey (5 GY 4/1), mud, confusing brown seaweed, shell fragments, *Ensis* |
| 164 | 38 | 3 | 54.57 | 75 | 19 | 37.68 | 0.6 | Dark greenish grey (5 GY 4/1), slightly gritty mud, cohesive, worm tubes, worms, shell fragments, green seaweed |
| 165 | 38 | 3 | 54.54 | 75 | 19 | 58.03 | 1.5 | Dark greenish grey (5 GY 4/1), slightly gritty mud, live worms, shell fragments |
| 166 | 38 | 3 | 55.08 | 75 | 20 | 19.55 | 1.4 | Greenish black (5 G 2/1), smooth mud, firm cohesive, worm tubes, shell fragments |
| 167 | 38 | 3 | 55.79 | 75 | 20 | 39.64 | 1.4 | Greenish black (5 G 2/1), smooth mud, worm tubes, occasional shell fragments |
| 168 | 38 | 3 | 56.27 | 75 | 20 | 59.61 | 1.2 | Olive black (5 Y 2/1) to olive grey (5 Y 4/1), smooth mud, oyster shell, other shell fragments, lots of plant material, green and brown seaweed, algae mat |
| 169 | 38 | 3 | 39.61 | 75 | 21 | 0.53 | 1.0 | Greenish black (5 G 2/1), medium sandy mud, pretty firm, cohesive, worm tubes, lots of oyster shells, plant material |
| 170 | 38 | 3 | 39.45 | 75 | 20 | 40.06 | 1.2 | Dark greenish grey (5 G 4/1), medium to fine sand, gritty mud, occasional worm tubes, some plant material, more watery |
| 171 | 38 | 3 | 38.77 | 75 | 20 | 19.68 | 1.5 | Dark greenish grey (5 G 4/1), mud, worm tubes, occasional shell fragments |
| 172 | 38 | 3 | 38.76 | 75 | 19 | 59.25 | 1.5 | Dark greenish grey (5 GY 4/1), mud, (color mix of greenish black (5 GY 2/1) and more olive grey (5 Y 4/1)), worm tubes, shell fragments |
| 173 | 38 | 3 | 38.28 | 75 | 19 | 37.19 | 1.4 | Olive grey (5 Y 4/1), fine to very fine sandy mud, lots of worm tubes, shell fragments |
| 174 | 38 | 3 | 37.96 | 75 | 19 | 17.51 | 1.5 | Olive grey (5 Y 4/1), very fine sandy mud, worm tubes |
| 175 | 38 | 3 | 37.49 | 75 | 18 | 36.20 | 1.8 | Dark greenish grey (5 GY 4/1), silty mud, gritty |
| 176 | 38 | 3 | 36.82 | 75 | 18 | 14.76 | 1.8 | Olive grey (5 Y 4/1), silty mud, few worm tubes, watery, *Ensis* shells |
| 177 | 38 | 3 | 36.79 | 75 | 17 | 54.91 | 1.8 | Olive grey (5 Y 4/1), muddy very fine sand, lots of worm tubes, shell fragments, *Ensis* shell |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| 178 | 38 | 3 | 36.06 | 75 | 17 | 12.26 | 2.1 | Olive grey (5 Y 4/1), very fine sand, worm tubes, lots of shells, grass shrimp |
| 179 | 38 | 3 | 36.12 | 75 | 16 | 52.11 | 2.1 | Greenish black (5 GY 2/1), slightly muddy very fine sand, few worm tubes |
| 180 | 38 | 3 | 35.51 | 75 | 16 | 30.75 | 1.8 | Olive grey (5 Y 4/1), fine sand, worm tubes, shell hash |
| 181 | 38 | 3 | 35.09 | 75 | 16 | 9.76 | 2.4 | Olive grey (5 Y 4/1), slightly muddy very fine sand, few worm tubes, plant material |
| 182 | 38 | 3 | 34.44 | 75 | 15 | 49.88 | 1.5 | Olive grey (5 Y 4/1), fine sand, worm tubes, shell fragments, green seaweed, sea squirt (*Styela*?) |
| 183 | 38 | 3 | 34.16 | 75 | 15 | 29.25 | 0.9 | Olive grey (5 Y 4/1), slightly silty very fine sand, shell fragments, *Zostera marina*, small sample |
| 184 | 38 | 3 | 17.83 | 75 | 16 | 11.61 | 2.1 | Olive grey (5 Y 4/1), silty very fine sand, worm tubes, grass shrimp, abundant shell hash |
| 185 | 38 | 3 | 18.55 | 75 | 16 | 31.32 | 2.1 | Dark greenish grey (5 GY 4/1), silty fine to very fine sand, plant material |
| 186 | 38 | 3 | 19.19 | 75 | 16 | 52.39 | 1.8 | Olive grey (5 Y 4/1), muddy very fine sand, worm, plant material, live and dead *Gemma gemma* |
| 187 | 38 | 3 | 19.43 | 75 | 17 | 13.27 | 1.8 | Olive grey (5 Y 4/1), muddy very fine sand, 30% shell hash, lots of shell fragments |
| 188 | 38 | 3 | 19.72 | 75 | 17 | 34.84 | 2.4 | Clam bed, too hard, 5 tries, no sample |
| 189 | 38 | 3 | 20.12 | 75 | 17 | 55.55 | 2.1 | Dark greenish grey (5 GY 4/1), slightly silty very fine sand, worm tubes, shell fragments |
| 190 | 38 | 3 | 20.65 | 75 | 18 | 15.64 | 2.1 | Dark greenish grey (5 GY 4/1), very fine sandy mud, lots of worm tubes, shell fragments |
| 191 | 38 | 3 | 20.70 | 75 | 18 | 36.97 | 2.1 | Dark greenish grey (5 GY 4/1), coarse silty mud, few shell fragments, quaghog 3.5 inches (*Mercenaria mercenaria*) |
| 192 | 38 | 3 | 21.03 | 75 | 18 | 57.47 | 1.8 | Dark greenish grey (5 GY 4/1), slightly gritty mud, cohesive, shell hash, little seaweed on top, sea slug? |
| 193 | 38 | 3 | 22.41 | 75 | 19 | 59.14 | 1.4 | Dark greenish grey (5 G 4/1) with olive grey (5 Y 4/1), slightly gritty mud, worm tubes, shell fragments, live *Ensis* |
| 194 | 38 | 3 | 22.62 | 75 | 20 | 20.10 | 1.2 | Greenish black (5 GY 2/1), very fine sandy mud, worm tubes, shell fragments, kinda watery |
| 195 | 38 | 3 | 22.85 | 75 | 20 | 40.56 | 1.1 | Dark greenish grey (5 GY 4/1), fine sandy mud, cohesive, worm tubes, worms, couple shell fragments, algae mat, seaweed |
| 196 | 38 | 3 | 22.86 | 75 | 21 | 1.61 | 1.1 | Dark greenish grey (5 GY 4/1) to olive grey (5 Y 4/1), lumpy mud, some coarse silt, worm tubes |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| 197 | 38 | 3 | 6.79 | 75 | 21 | 1.03 | 0.6 | Dark greenish grey (5 GY 4/1) with olive grey (5 Y 4/1), mud, worm tubes, worms |
| 198 | 38 | 3 | 4.75 | 75 | 19 | 17.70 | 1.5 | Dark greenish grey (5 GY 4/1), silty mud, cohesive, worm tubes |
| 199 | 38 | 3 | 4.22 | 75 | 18 | 56.88 | 1.8 | Dark greenish grey (5 GY 4/1) to greenish black (5 GY 2/1), slightly gritty mud, firm, few worm tubes, live worms, some shell fragments |
| 200 | 38 | 3 | 4.13 | 75 | 18 | 37.31 | 1.8 | Dark greenish grey (5 GY 4/1) to greenish black (5 GY 2/1), slightly gritty mud, somewhat cohesive, occasional shell fragments |
| 201 | 38 | 3 | 3.72 | 75 | 18 | 16.03 | 1.8 | Dark greenish grey (5 GY 4/1), slightly gritty mud, worm tubes, occasional shell fragments |
| 202 | 38 | 3 | 3.83 | 75 | 17 | 55.07 | 1.8 | Dark greenish grey (5 GY 4/1), muddy very fine sand, stiff, worm tubes, worms, shell fragments |
| 203 | 38 | 3 | 3.14 | 75 | 17 | 34.54 | 2.1 | Dark greenish grey (5 GY 4/1), very gritty mud, worm tubes, plant material, oyster shells, shell hash |
| 204 | 38 | 3 | 3.22 | 75 | 17 | 13.65 | 1.8 | Olive grey (5 Y 4/1), slightly silty very fine sand, worm tubes, lots of shells, old oyster bed, small sample |
| 205 | 38 | 3 | 2.62 | 75 | 16 | 52.95 | 1.8 | Olive grey (5 Y 4/1), slightly silty very fine sand, worm tubes, occasional shell fragments, *Ruppia maritima*, green seaweed, live *Gemma gemma* |
| 206 | 38 | 3 | 2.57 | 75 | 16 | 31.91 | 1.8 | Olive grey (5 Y 4/1) to dark greenish grey (5 GY 4/1), muddy very fine sand, worm tubes, grass shrimp, plant material, live *Gemma gemma* |
| 207 | 38 | 3 | 2.01 | 75 | 16 | 12.23 | 1.5 | Olive grey (5 Y 4/1), slightly muddy very fine sand, worm tubes, fragments of *Zostera marina*, live *Gemma gemma* |
| 208 | 38 | 3 | 1.95 | 75 | 15 | 50.95 | 1.2 | Olive grey (5 Y 4/1), muddy very fine sand, worm tubes, occasional shell fragments, *Zostera marina*, leaves |
| 209 | 38 | 3 | 1.73 | 75 | 15 | 29.87 | 0.6 | Olive grey (5 Y 4/1) to dark greenish grey (5 GY 4/1), slightly muddy fine to very fine sand, worm tubes, fragments of *Zostera marina* |
| 210 | 38 | 2 | 45.59 | 75 | 16 | 11.77 | 1.8 | Olive grey (5 Y 4/1) to dark greenish grey (5 GY 4/1), slightly silty fine sand, worm tubes |
| 211 | 38 | 2 | 45.94 | 75 | 16 | 32.84 | 1.8 | Olive grey (5 Y 4/1), silty very fine sand, worm tubes, live *Gemma gemma* |
| 212 | 38 | 2 | 46.13 | 75 | 16 | 54.29 | 1.8 | Dark greenish grey (5 GY 4/1), slightly silty very fine sand, green seaweed, live *Gemma gemma* |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| 213 | 38 | 2 | 46.87 | 75 | 17 | 13.59 | 1.8 | Olive grey (5 Y 4/1) to dark greenish grey (5 GY 4/1), fine to very fine sand, trace mud, worm tubes, shells |
| 214 | 38 | 2 | 46.81 | 75 | 17 | 35.41 | 2.1 | Dark greenish grey (5 GY 4/1), slightly muddy very fine sand |
| 215 | 38 | 2 | 47.76 | 75 | 17 | 56.27 | 2.1 | Dark greenish grey (5 GY 4/1), very fine sand, shell fragments, *Ensis* |
| 216 | 38 | 2 | 48.13 | 75 | 18 | 17.06 | 2.1 | Greenish black (5 GY2/1), silty mud, worm tubes, shell fragments, green dead seaweed, dead *Ensis* |
| 217 | 38 | 2 | 48.11 | 75 | 18 | 37.73 | 1.8 | Greenish black (5 G 2/1), silty mud, coarse, cohesive, lots of live worms |
| 218 | 38 | 2 | 48.44 | 75 | 18 | 57.90 | 1.8 | Olive grey (5 Y 4/1) to dark greenish grey (5 GY 4/1), silty mud, worm tubes |
| 219 | 38 | 2 | 48.88 | 75 | 19 | 19.35 | 1.8 | Olive grey (5 Y 4/1) to dark greenish grey (5 GY 4/1), very fine sandy mud, green seaweed, shell fragments |
| 220 | 38 | 2 | 48.79 | 75 | 19 | 39.65 | 1.5 | Dark greenish grey (5 GY 4/1) to greenish black (5 GY 2/1), slightly gritty mud, worm tubes |
| 221 | 38 | 2 | 50.59 | 75 | 21 | 2.43 | 0.5 | Dark greenish grey (5 GY 4/1), mud, worm tubes, shell fragments |
| 222 | 38 | 2 | 33.88 | 75 | 21 | 1.78 | 0.5 | Greenish black (5 GY 2/1) with olive grey (5 Y 4/1), smooth mud, lots of worm tubes |
| 223 | 38 | 2 | 50.73 | 75 | 21 | 23.38 | 0.3 | Dark greenish grey (5 GY 4/1), lumpy mud, worm tubes, worms, watery |
| 224 | 38 | 2 | 33.89 | 75 | 21 | 23.15 | 0.5 | Dark greenish grey (5 GY 4/1) to greenish black (5 GY 2/1), mud, firm, cohesive, worm tubes, a few shells, grass shrimp |
| 225 | 38 | 2 | 32.75 | 75 | 19 | 38.83 | 1.8 | Olive grey (5 Y 4/1), very fine sandy mud, cohesive, worm tubes |
| 226 | 38 | 2 | 31.99 | 75 | 19 | 17.97 | 1.8 | Dark greenish grey (5 GY 4/1) to greenish black (5 GY 2/1), very fine sandy mud, worm tubes, shell fragments |
| 227 | 38 | 2 | 32.05 | 75 | 18 | 57.67 | 2.1 | Dark greenish grey (5 GY 4/1), very fine sandy mud, cohesive, few worm tubes, shell fragments |
| 228 | 38 | 2 | 31.34 | 75 | 18 | 37.34 | 2.4 | Dark greenish grey (5 GY 4/1) to greenish black (5 GY 2/1), very firm cohesive silty mud, many worm tubes |
| 229 | 38 | 2 | 31.52 | 75 | 18 | 17.08 | 2.1 | Olive black (5 Y 2/1), cohesive mud, worm tubes, shell fragments |
| 230 | 38 | 2 | 31.31 | 75 | 17 | 56.12 | 2.1 | Dark greenish grey (5 GY 4/1), mud, few worm tubes, shell fragments |
| 231 | 38 | 2 | 30.67 | 75 | 17 | 34.36 | 2.1 | Olive grey (5 Y 4/1), very fine sand, worm tubes, shell fragments, *Ruppia maritima*, small sample |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| 232 | 38 | 2 | 30.07 | 75 | 17 | 13.95 | 1.8 | Olive grey (5 Y 4/1), very fine sand, worm tubes, shell fragments |
| 233 | 38 | 2 | 29.76 | 75 | 16 | 52.87 | 2.1 | Olive grey (5 Y 4/1), very fine sand, worm tubes, green seaweed, live *Gemma gemma* |
| 234 | 38 | 2 | 29.59 | 75 | 16 | 32.45 | 2.1 | Greenish black (5 GY 2/1), muddy very fine sand, worm tubes, shell fragments |
| 235 | 38 | 2 | 29.22 | 75 | 16 | 12.16 | 1.8 | Olive grey (5 Y 4/1) to greenish black (5 GY 2/1), medium to fine sand, worm tubes, shells |
| 236 | 38 | 2 | 29.24 | 75 | 15 | 51.86 | 0.9 | Olive grey (5 Y 4/1), fine to very fine sand, red algae on top, *Zostera marina* bed |
| 237 | 38 | 2 | 12.06 | 75 | 15 | 31.43 | 0.6 | Olive grey (5 Y 4/1), silty very fine sand, red algae, rooted SAV, *Zostera marina* |
| 238 | 38 | 2 | 12.37 | 75 | 15 | 51.65 | 1.5 | Olive grey (5 Y 4/1), fine sand, worm tubes, grass shrimp |
| 239 | 38 | 2 | 12.66 | 75 | 16 | 13.33 | 1.8 | Olive grey (5 Y 4/1), slightly silty very fine sand, some medium sand, shell fragments, live *Gemma gemma* |
| 240 | 38 | 2 | 13.31 | 75 | 16 | 32.80 | 2.1 | Dark greenish grey (5 GY 4/1), muddy very fine sand, worm tubes, shell fragments |
| 241 | 38 | 2 | 13.60 | 75 | 16 | 54.37 | 2.1 | Olive grey(5 Y 4/1), slightly silty very fine sand, worm tubes, shell fragments |
| 242 | 38 | 2 | 14.22 | 75 | 17 | 14.28 | 1.8 | Dark greenish grey (5 GY 4/1), slightly silty very fine sand, worm tubes, shell fragments, green seaweed |
| 243 | 38 | 2 | 14.08 | 75 | 17 | 35.74 | 2.1 | Dark greenish grey (5 GY 4/1), very fine sand, worm tubes, very small shell fragments, live *Gemma gemma* |
| 244 | 38 | 2 | 14.60 | 75 | 17 | 57.46 | 2.4 | Dark greenish grey (5 GY 4/1), muddy very fine sand, plant material |
| 245 | 38 | 2 | 15.22 | 75 | 18 | 18.16 | 2.4 | Greenish black (5 GY 2/1), silty mud, worm tubes, watery |
| 246 | 38 | 2 | 15.36 | 75 | 18 | 38.66 | 2.1 | Dark greenish grey (5 GY 4/1), coarse silty mud, cohesive, worm tubes, green algae |
| 247 | 38 | 2 | 15.47 | 75 | 18 | 59.16 | 1.8 | Dark greenish grey (5 GY 4/1), silty mud, worm tubes, shell fragments |
| 248 | 38 | 2 | 15.64 | 75 | 19 | 19.67 | 1.8 | Olive grey (5 Y 4/1), very fine sandy mud, shells, shell hash, old oyster bed |
| 249 | 38 | 2 | 16.65 | 75 | 19 | 40.40 | 2.1 | Olive grey (5 Y 4/1) to dark greenish grey (5 GY 4/1), lots of worm tubes, little crab, shell fragments, few grass leaves |
| 250 | 38 | 2 | 17.03 | 75 | 20 | 22.26 | 1.5 | Dark greenish grey (5 GY 4/1), silty mud, worm tubes, somewhat cohesive, occasional shell fragments |
| 251 | 38 | 2 | 17.19 | 75 | 20 | 42.39 | 1.5 | Olive black (5 Y 2/1) to greenish black (5 GY 2/1), silty mud, worm tubes, plant roots, oyster fragments |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| 252 | 38 | 2 | 1.49 | 75 | 21 | 23.52 | 0.6 | Greenish black (5 GY 2/1), very fine sandy mud, solid oyster shells |
| 253 | 38 | 2 | 1.22 | 75 | 21 | 2.12 | 1.2 | Olive grey (5 Y 4/1), mud, fine to medium trace sand, worm tubes, worms |
| 254 | 38 | 1 | 59.70 | 75 | 20 | 21.72 | 1.5 | Dark greenish grey (5 GY 4/1), muddy very fine sand, worm tubes, shell fragments |
| 255 | 38 | 2 | 1.04 | 75 | 20 | 42.40 | 1.8 | Olive grey (5 Y 4/1), very fine sandy mud, worm tubes, shell fragments, plant material, |
| 256 | 38 | 2 | 0.42 | 75 | 20 | 1.81 | 1.8 | Dark greenish grey (5 GY 4/1), very fine sandy mud, worm tubes, shell fragments |
| 257 | 38 | 1 | 59.79 | 75 | 19 | 40.75 | 2.1 | Greenish black (5 GY 2/1), very fine sandy mud, worm tubes, live worms, lots of shell fragments |
| 258 | 38 | 2 | 0.57 | 75 | 19 | 18.25 | 1.8 | Olive black (5 GY 2/1), very fine sandy mud, cohesive, worm tubes, lots of shell fragments |
| 259 | 38 | 1 | 59.33 | 75 | 18 | 58.27 | 1.8 | Greenish black (5 GY 2/1), silty mud, worm tubes, shells, clam shell |
| 260 | 38 | 1 | 58.51 | 75 | 18 | 37.37 | 2.1 | Very fine sandy mud, worm tubes, shell fragments, green seaweed |
| 261 | 38 | 1 | 58.25 | 75 | 18 | 17.74 | 2.1 | Olive grey (5 Y 4/1), slightly silty very fine sand, worm tubes, shell fragments |
| 262 | 38 | 1 | 58.08 | 75 | 17 | 57.19 | 2.1 | Olive grey (5 Y 4/1), muddy very fine sand, shell fragments, seldom worm tubes |
| 263 | 38 | 1 | 57.54 | 75 | 17 | 35.92 | 2.1 | Olive grey (5 Y 4/1), slightly silty very fine sand, shell fragments, seaweed |
| 264 | 38 | 1 | 57.43 | 75 | 17 | 15.30 | 1.5 | Olive grey (5 Y 4/1), medium to fine sand, shell fragments, live green seaweed, live *Gemma gemma* |
| 265 | 38 | 1 | 57.15 | 75 | 16 | 54.35 | 1.5 | Olive grey (5 Y 4/1), fine to medium sand, worm tubes, shell fragments, plant material, live *Gemma gemma* |
| 266 | 38 | 1 | 56.15 | 75 | 16 | 13.36 | 0.9 | Olive grey (5 Y 4/1), fine sand, worm tubes, live *Gemma gemma* |
| 267 | 38 | 1 | 55.36 | 75 | 15 | 53.24 | 0.9 | Olive grey (5 Y 4/1) to dark greenish grey (5 GY 4/1), fine sand, worm tubes, plant material, small sample |
| 268 | 38 | 2 | 10.50 | 75 | 14 | 50.46 | 1.2 | Greenish black (5 G 2/1), mud, very organic rich |
| 269 | 38 | 1 | 39.03 | 75 | 15 | 32.60 | 1.8 | Mud with trace very fine sand, gelatinous, cohesive, worm tubes, taken in channel |
| 270 | 38 | 1 | 40.11 | 75 | 16 | 14.48 | 0.9 | Olive grey (5 Y 4/1), fine sand, trace silt, worm tubes, live worms |
| 271 | 38 | 1 | 40.84 | 75 | 16 | 54.49 | 1.5 | Olive grey (5 Y 4/1), fine sand, worm tubes, occasional shell fragments |
| 272 | 38 | 1 | 41.35 | 75 | 17 | 15.84 | 1.8 | Olive grey (5 Y 4/1), very fine sand, trace silt, worm tube, shell fragments, live *Gemma gemma*, green seaweed, *Zostera marina* |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| 273 | 38 | 1 | 41.82 | 75 | 17 | 36.38 | 2.1 | Olive grey (5 Y 4/1), silty very fine sand, worm tube |
| 274 | 38 | 1 | 41.76 | 75 | 17 | 56.72 | 1.8 | Slightly silty fine sand, worm tubes, shell fragments, algae, green seaweed, small sample |
| 275 | 38 | 1 | 43.19 | 75 | 18 | 19.07 | 2.1 | Dark greenish grey (5 GY 4/1), coarse silty mud, worm tubes, few shell fragments |
| 276 | 38 | 1 | 42.56 | 75 | 18 | 38.32 | 1.8 | Dark greenish grey( 5 GY 4/1), silty very fine sand, very small sample |
| 277 | 38 | 1 | 42.84 | 75 | 18 | 59.23 | 1.8 | Olive grey (5 Y 4/1), very fine sandy mud, shell fragments |
| 278 | 38 | 1 | 43.32 | 75 | 19 | 20.95 | 1.8 | Dark greenish grey, gritty mud, worm tubes, lots of shells, abundant shell hash |
| 279 | 38 | 1 | 43.39 | 75 | 19 | 41.41 | 1.8 | Dark greenish grey (5 GY 4/1), gritty mud, lots of shells, asundant shell hash |
| 280 | 38 | 1 | 44.58 | 75 | 20 | 1.19 | 1.8 | Dark greenish grey (5 GY 4/1), gritty mud, pockets of anoxic (greenish black (5 GY 2/1)), worm tubes, lots of shells, shell hash |
| 281 | 38 | 1 | 44.69 | 75 | 20 | 22.35 | 1.8 | Dark greenish grey (5 GY 4/1), coarse silty mud, worm tubes, shelly bottom, shells, shell fragments |
| 282 | 38 | 1 | 44.87 | 75 | 20 | 44.12 | 1.5 | Dark greenish grey (5 GY 4/1), very fine sandy mud, worm tubes, plant material, shell fragments |
| 283 | 38 | 1 | 44.85 | 75 | 21 | 3.15 | 1.8 | Slightly very fine sandy mud, worm tubes, worms, shells |
| 284 | 38 | 2 | 2.46 | 75 | 22 | 4.47 | 1.5 | Dark greenish grey (5 GY 4/1) to greenish black (5 GY 2/1), smooth mud, some worm tubes, lots of plant material, dead *Ruppia maritima* |
| 285 | 38 | 1 | 46.09 | 75 | 22 | 5.04 | 0.0 | Dark greenish grey (5 GY 4/1) to greenish black (5 GY 2/1), smooth mud, worm tubes, brown seaweed, red algae on top, below floc layer band of very black material |
| 286 | 38 | 1 | 46.09 | 75 | 22 | 25.42 | 1.2 | Dark greenish grey (5 GY 4/1), slightly gritty mud, worm tubes |
| 287 | 38 | 1 | 29.94 | 75 | 22 | 25.74 | 1.5 | Olive grey (5 Y 4/1), mud, little coarse silt, shell fragments |
| 288 | 38 | 1 | 30.10 | 75 | 22 | 4.95 | 1.2 | Olive grey (5 Y 4/1) to dark greenish grey (5 GY 4/1), fine sandy mud, some coarse material, plant material |
| 289 | 38 | 1 | 29.07 | 75 | 21 | 24.50 | 1.8 | Greenish black (5 GY 2/1), slightly gritty mud, worms tubes, worms, shell fragments, plant material |
| 290 | 38 | 1 | 28.78 | 75 | 21 | 4.13 | 1.8 | Dark greenish grey (5 GY 4/1), coarse silty mud, cohesive, worm tubes, fecal pellets, plant material |
| 291 | 38 | 1 | 28.59 | 75 | 20 | 43.80 | 1.8 | Greenish black (5 GY 2/1), silky mud, cohesive, worm tubes, shell fragments |
| 292 | 38 | 1 | 28.32 | 75 | 20 | 23.30 | 2.1 | Dark greenish grey (5 GY 4/1), gritty mud, worm tubes, shell fragments, shell hash |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| 293 | 38 | 1 | 28.02 | 75 | 20 | 2.11 | 2.1 | Dark greenish grey (5 GY 4/1), silty mud, worm tubes, shells, shell of oyster drill? |
| 294 | 38 | 1 | 28.04 | 75 | 19 | 41.36 | 1.8 | Olive grey (5 Y 4/1), slightly silty very fine sand, worm tubes, lots of shells, oyster hash |
| 295 | 38 | 1 | 27.69 | 75 | 19 | 21.44 | 1.8 | Dark greenish grey (5 GY 4/1), slightly silty very fine sand, shell bottom, shells, oyster shell, small sample |
| 296 | 38 | 1 | 27.11 | 75 | 18 | 59.55 | 1.8 | Dark greenish grey (5 GY 4/1), silty fine to very fine sand, worm tubes, shelly |
| 297 | 38 | 1 | 26.65 | 75 | 18 | 39.23 | 2.1 | Olive black (5 Y 2/1) to greenish black (5 GY 2/1), muddy very fine sand, worm tubes, plant material |
| 298 | 38 | 1 | 26.68 | 75 | 18 | 18.93 | 2.1 | Greenish black, very fine sandy mud, worm tubes |
| 299 | 38 | 1 | 26.61 | 75 | 17 | 56.91 | 1.8 | Olive grey (5 Y 4/1), shell fragments, red algae/seaweed |
| 300 | 38 | 1 | 25.57 | 75 | 17 | 36.68 | 1.8 | Dark greenish grey (5 GY 4/1), slightly silty fine to very fine sand, worm tubes, few shell fragments, red algae on top |
| 301 | 38 | 1 | 25.68 | 75 | 17 | 15.43 | 1.2 | Olive grey (5 Y 4/1), fine to very fine sand, worm tubes, some shell fragments, live *Gemma gemma* |
| 302 | 38 | 1 | 10.92 | 75 | 20 | 2.05 | 1.8 | Oyster bar, No sample |
| 303 | 38 | 1 | 11.58 | 75 | 20 | 22.99 | 2.1 | Olive grey (5 Y 4/1), silty very fine sand, worm tubes, shell fragments, small sample |
| 304 | 38 | 1 | 12.35 | 75 | 20 | 44.99 | 2.1 | Greenish black (5 GY 2/1), gritty mud, worm tubes, shell fragments |
| 305 | 38 | 1 | 12.15 | 75 | 21 | 4.55 | 1.8 | Dark greenish grey (5 GY 4/1), cohesive mud, worm tubes, some worm tubes highly oxidized, shell fragments |
| 306 | 38 | 1 | 12.54 | 75 | 21 | 25.04 | 2.1 | Dark greenish grey (5 GY 4/1), mud, worm tubes, shell fragments |
| 307 | 38 | 1 | 12.68 | 75 | 21 | 46.53 | 1.8 | Olive grey (5 Y 4/1) to dark greenish grey (5 GY 4/1), fine to very fine sandy mud, worm tubes |
| 308 | 38 | 1 | 13.99 | 75 | 22 | 5.52 | 1.8 | Dark greenish grey ( 5 GY 4/1), slightly silty mud, plant material, watery |
| 309 | 38 | 1 | 13.59 | 75 | 22 | 25.54 | 1.5 | Olive grey (5 Y 4/1) to dark greenish grey ( 5 GY 4/1), lumpy mud, cohesive, worm tubes |
| 310 | 38 | 0 | 57.67 | 75 | 22 | 25.94 | 1.5 | Dark greenish grey (5 GY 4/1), very fine sandy mud, cohesive, few worm tubes, worms, shell fragments |
| 311 | 38 | 6 | 14.07 | 75 | 12 | 39.29 | | Too shallow, no sample |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| 312 | 38 | 5 | 42.37 | 75 | 13 | 22.48 | 1.1 | Moderate olive brown , fine to very fine sand, worm tubes, shell fragments, SAV |
| 313 | 38 | 5 | 42.77 | 75 | 13 | 42.25 | 0.6 | Medium olive grey (5 Y 4/2), curdled cottage cheese texture, gritty mud, worm tubes, *Ruppia maritima* |
| 314 | 38 | 5 | 43.71 | 75 | 14 | 3.37 | | Too hazardous to reach |
| 315 | 38 | 5 | 47.61 | 75 | 18 | 52.90 | 1.1 | Dark greenish grey (5 GY 4/1), slightly silty mud, curdled cottage cheese texture, shell fragments |
| 316 | 38 | 5 | 32.06 | 75 | 19 | 14.28 | 0.9 | Dark greenish grey (5 GY 4/1), pretty smooth mud, lots of worm tubes, *Ensis* shells, pretty watery |
| 317 | 38 | 5 | 31.98 | 75 | 18 | 53.22 | 1.1 | Dark greenish grey (5 GY 4/1), lumpy, silty mud, worm tubes |
| 318 | 38 | 5 | 15.84 | 75 | 19 | 14.37 | 1.5 | Dark greenish grey (5 GY 4/1), slightly gritty, lumpy, cottage cheese texture, worm tubes, plant material |
| 319 | 38 | 5 | 14.66 | 75 | 18 | 33.48 | 1.1 | Dark greenish grey (5 GY 4/1), very fine sandy, silty mud, lots of worm tubes, plant material |
| 320 | 38 | 4 | 58.91 | 75 | 18 | 54.41 | 1.2 | Dark greenish grey (5 G 4/1) and greenish black (5 G 2/1 and 5 G3/1), slightly gritty mud, coarse silt, worm tubes, shell fragments, some plant material, fecal pellets, watery |
| 321 | 38 | 4 | 57.95 | 75 | 18 | 15.28 | 1.2 | Dark greenish grey (5 GY 4/1), very fine sand, olive grey (5 Y 4/1) floc, worm tubes, very watery |
| 322 | 38 | 4 | 42.09 | 75 | 18 | 12.86 | 1.2 | Greenish black (5 GY 2/1), very fine sandy mud, worm tubes, plant material |
| 323 | 38 | 4 | 43.92 | 75 | 19 | 36.20 | 1.5 | Dark greensih grey (5 GY 4/1) with olive grey (5 Y 4/1), slightly gritty mud, curdled texture, some worms, algae mat, watery |
| 324 | 38 | 4 | 44.69 | 75 | 20 | 38.52 | 1.2 | Dark greenish grey (5 GY 4/1), smooth mud, shell fragments, plant material, algae mat, pretty watery |
| 325 | 38 | 4 | 28.66 | 75 | 20 | 18.21 | 0.5 | Olive grey (5 Y 4/1), fine to very fine sand, very clean sand, worm tubes, algae mat, grass shrimp |
| 326 | 38 | 3 | 6.54 | 75 | 20 | 41.43 | 0.6 | Dark greenish grey (5 GY 4/1) to greenish black (5 GY 2/1) with some olive grey (5 Y 4/1), gelatinous mud, worm tubes, some plant material |
| 327 | 38 | 3 | 5.35 | 75 | 19 | 59.24 | 0.5 | Dark yellowish brown (10 YR 4/2), fine to very fine sand, big worm tubes |
| 328 | 38 | 3 | 21.25 | 75 | 19 | 16.99 | 1.5 | Olive grey (5 Y 4/1) to olive black (5 Y 2/1), very slightly silty very fine sand, oyster shells |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| 329 | 38 | 5 | 27.17 | 75 | 14 | 3.94 | 1.2 | Olive grey (5 y 4/1) to dark greenish grey (5 GY 4/1), fine to very fine sand, slightly muddy, *Zostera marina*, seaweed |
| 330 | 38 | 5 | 27.02 | 75 | 13 | 42.93 | | Too shallow, no sample taken |
| 331 | 38 | 5 | 9.84 | 75 | 13 | 44.01 | 1.4 | Dark greenish grey (5 GY 4/1)( maybe a bit darker), muddy fine to very fine sand, worms, plant material, red algae mat |
| 332 | 38 | 5 | 10.65 | 75 | 13 | 22.69 | 0.9 | Dark greenish grey (5 GY 4/1) to greenish black (5 GY 2/1), fine sand, fairly clean, plant material, *Ensis* |
| 333 | 38 | 4 | 52.98 | 75 | 13 | 2.60 | 0.9 | Dark greenish grey (5 GY 4/1), fine sand, olive grey (5 Y 4/1) top, grass shrimp, live *Gemma gemma* |
| 334 | 38 | 4 | 37.17 | 75 | 13 | 3.57 | 0.9 | Olive grey (5 Y 4/1), muddy very fine sand, worm tubes, worms, plant material |
| 335 | 38 | 4 | 37.50 | 75 | 13 | 23.18 | | Too shallow, no sample |
| 336 | 38 | 4 | 21.61 | 75 | 13 | 44.49 | 0.3 | Medium olive grey (5 Y 5/1), fine sand |
| 337 | 38 | 4 | 22.91 | 75 | 15 | 7.35 | 0.8 | Dark greenish grey (5 GY 4/1) to greenish black (5 GY 2/1), sandy gelatinous mud, many worm tubes, *Zostera marina* |
| 338 | 38 | 4 | 6.44 | 75 | 15 | 8.20 | 0.6 | Greenish black (5 GY 2/1), very fine sandy mud, oxidized worm tubes, worms, dead *Zostera marina* |
| 340 | 38 | 3 | 0.91 | 75 | 15 | 9.91 | 0.8 | Olive grey (5 Y 4/1), slightly muddy very fine sand, worm tubes, grass shrimp, reddish algae on top |
| 341 | 38 | 3 | 0.70 | 75 | 14 | 49.61 | 0.6 | Olive grey (5 Y 4/1), fine to medium sand, worm tubes, shell fragments, plant material, 25 feet from point of marsh; *Juncus roemerianus* marsh |
| 342 | 38 | 2 | 27.49 | 75 | 14 | 49.92 | 1.1 | Dark greenish grey (5 GY 4/1) to olive grey (5 Y 4/1), slightly muddy sand, mossy, a fern like plant, *Ruppia maritima* |
| 343 | 38 | 2 | 28.24 | 75 | 15 | 30.59 | | Too shallow, grass bed |
| 344 | 38 | 2 | 45.30 | 75 | 15 | 52.45 | 2.1 | Very fine sand, some silt, 30-50% shell, worm tubes, old oyster bed, lots of shell hash |
| 345 | 38 | 1 | 39.07 | 75 | 15 | 11.85 | 1.5 | Greenish black (5 G 2/1), very fine sandy mud, worm tubes, algae on top |
| 346 | 38 | 0 | 59.65 | 75 | 22 | 5.68 | 1.8 | Dark greenish grey (5 GY 4/1), very slightly silty mud, cohesive, fecal pellets |
| 347 | 38 | 5 | 47.31 | 75 | 18 | 32.51 | 0.9 | Olive grey (5 Y 4/1), silty mud, lumpy, cottage cheese texture, worm tubes, occasional shell fragments, pretty watery |

**Table IX.** Location coordinates and field descriptions of surficial samples collected in the in the middle Chincoteague Bay area. Location coordinates (latitude and longitude) are based on 1983 North American Datum (NAD83).

| Station # | Latitude | | | Longitude | | | Water Depth (cm) | Description |
|---|---|---|---|---|---|---|---|---|
| | DD | MM | SS.SS | DD | MM | SS.SS | | |
| 348 | 38 | 6 | 4.59 | 75 | 18 | 44.62 | 0.9 | Olive grey (5 Y 4/1), silty mud, worm tubes, few shells |
| 349 | 38 | 6 | 21.06 | 75 | 19 | 59.98 | 0.5 | Greenish black (5 G 2/1), very slightly gritty mud, worm tubes, worms, plant material (rhizomes) |
| 350 | 38 | 3 | 47.61 | 75 | 14 | 0.75 | 0.5 | Greenish black (5 G 2/1), muddy fine sand, fairly cohesive, substituted for 339 as we were not sure we could get into it |
| 351 | 38 | 3 | 33.76 | 75 | 14 | 47.70 | 0.5 | Greyish black (N1), smooth mud, shell hash, oyster, algae mat on top, in Middlemoor Thorofare, $H_2S$ odor |
| 352 | | | | | | | --- | No station with this number |
| 353 | 38 | 4 | 37.64 | 75 | 17 | 43.79 | 0.5 | Olive grey (5 Y 4/1), very fine sand/silt, brown seaweed, micaceous |

**Table X.** Textural and chemical data for surficial sediment samples collected in the middle Chincoteague Bay. BDL refers to "below detection limit." Average detection limits for the metals are listed in Table XIV (Appendix III). Fifty-six coarse-grained samples were not analyzed for chemistry, and are indicated by blank cells.

| Sample ID | Textural Data | | | | | | | Chemical Data | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water % | Bulk Density ($g/cm^3$) | Gravel % | Sand % | Silt % | Clay % | Shepard"s (1954) Classification | Nitrogen % | Carbon % | Sulfur % | Cr µg/g | Cu µg/g | Fe % | Mn µg/g | Ni µg/g | Zn µg/g |
| 3 | 26.52 | 1.87 | 0.00 | 68.33 | 20.39 | 11.29 | Silty-Sand | 0.061 | 0.852 | 0.207 | 38.3 | 3.9 | 1.69 | 181 | 14.6 | 44.1 |
| 4 | 45.23 | 1.53 | 0.00 | 13.96 | 56.31 | 29.72 | Clayey-Silt | 0.120 | 1.472 | 0.434 | 77.7 | 9.5 | 3.25 | 275 | 29.0 | 88.7 |
| 5 | 44.39 | 1.54 | 0.00 | 8.20 | 65.53 | 26.26 | Clayey-Silt | 0.106 | 1.246 | 0.389 | 73.2 | 8.0 | 3.11 | 321 | 17.1 | 79.8 |
| 6 | 39.88 | 1.61 | 0.00 | 14.55 | 63.12 | 22.32 | Clayey-Silt | 0.095 | 1.106 | 0.327 | 66.4 | 5.9 | 2.76 | 301 | 21.0 | 72.2 |
| 7 | 36.18 | 1.68 | 0.00 | 36.76 | 46.17 | 17.07 | Sandy-Silt | 0.080 | 0.891 | 0.275 | 52.7 | 4.3 | 2.34 | 272 | 9.7 | 61.2 |
| 8 | 28.21 | 1.83 | 0.00 | 71.96 | 19.69 | 8.35 | Silty-Sand | 0.058 | 0.588 | 0.156 | 34.4 | 2.3 | 1.51 | 203 | 8.1 | 40.3 |
| 9 | 23.14 | 1.95 | 0.00 | 82.17 | 11.59 | 6.25 | Sand | 0.051 | 0.606 | 0.111 | 24.4 | 2.5 | 1.08 | 208 | 6.8 | 30.2 |
| 10 | 23.95 | 1.93 | 0.00 | 83.57 | 10.57 | 5.85 | Sand | | | | | | | | | |
| 11 | 23.39 | 1.94 | 0.00 | 84.66 | 9.84 | 5.50 | Sand | 0.045 | 0.463 | 0.099 | 25.0 | 1.4 | 1.11 | 187 | 8.4 | 28.9 |
| 12 | 26.09 | 1.88 | 0.00 | 99.09 | 0.64 | 0.27 | Sand | 0.013 | 0.141 | 0.039 | 8.7 | 1.8 | 0.38 | 76 | 6.0 | 9.8 |
| 13 | 30.93 | 1.78 | 0.00 | 95.70 | 3.13 | 1.17 | Sand | 0.020 | 0.241 | 0.053 | 17.4 | BDL | 0.85 | 265 | 8.8 | 18.1 |
| 14 | 30.48 | 1.78 | 0.00 | 87.62 | 8.11 | 4.27 | Sand | 0.037 | 0.406 | 0.110 | 25.3 | 1.8 | 1.14 | 193 | 10.6 | 28.1 |
| 15 | 25.59 | 1.89 | 0.00 | 98.36 | 1.64 | 0.00 | Sand | 0.012 | 0.139 | 0.036 | 9.5 | BDL | 0.44 | 98 | BDL | 11.3 |
| 16 | 21.35 | 1.99 | 0.05 | 91.74 | 4.51 | 3.70 | Sand | 0.054 | 0.509 | 0.101 | 20.8 | 3.5 | 0.84 | 169 | 4.1 | 23.0 |
| 17 | 22.62 | 1.96 | 0.00 | 99.37 | 0.64 | 0.00 | Sand | | | | | | | | | |
| 18 | 29.08 | 1.81 | 0.00 | 92.81 | 4.04 | 3.15 | Sand | 0.038 | 0.916 | 0.089 | 15.6 | 0.7 | 0.82 | 255 | 3.9 | 20.6 |
| 19 | 26.45 | 1.87 | 0.00 | 96.19 | 2.62 | 1.20 | Sand | 0.021 | 0.211 | 0.051 | 11.8 | 0.5 | 0.57 | 120 | 2.2 | 15.2 |
| 20 | 20.65 | 2.01 | 0.00 | 97.34 | 2.66 | 0.00 | Sand | | | | | | | | | |
| 21 | 24.04 | 1.92 | 0.00 | 97.83 | 2.17 | 0.00 | Sand | | | | | | | | | |
| 22 | 22.57 | 1.96 | 0.00 | 79.63 | 14.82 | 5.55 | Sand | 0.036 | 0.363 | 0.105 | 23.7 | 1.3 | 1.02 | 196 | 5.1 | 25.4 |
| 23 | 22.52 | 1.96 | 0.00 | 75.63 | 17.78 | 6.59 | Sand | 0.042 | 0.460 | 0.127 | 27.6 | 1.6 | 1.24 | 162 | 7.0 | 34.0 |
| 24 | 24.35 | 1.92 | 0.00 | 81.51 | 13.43 | 5.07 | Sand | 0.033 | 0.369 | 0.107 | 25.5 | 1.8 | 1.17 | 218 | 6.0 | 29.7 |
| 25 | 24.90 | 1.90 | 0.00 | 77.23 | 16.40 | 6.37 | Sand | 0.038 | 0.399 | 0.121 | 31.7 | 1.6 | 1.40 | 244 | 11.8 | 34.8 |
| 26 | 23.12 | 1.95 | 0.00 | 71.89 | 21.26 | 6.86 | Silty-Sand | | | | | | | | | |
| 27 | 41.77 | 1.58 | 0.00 | 13.80 | 63.68 | 22.52 | Clayey-Silt | 0.095 | 1.091 | 0.377 | 66.6 | 7.5 | 2.96 | 317 | 22.7 | 73.3 |
| 28 | 29.65 | 1.80 | 0.00 | 61.49 | 27.44 | 11.07 | Silty-Sand | 0.053 | 0.606 | 0.179 | 36.2 | 4.6 | 1.57 | 167 | 16.5 | 40.3 |
| 29 | 24.71 | 1.91 | 0.00 | 77.85 | 13.79 | 8.35 | Sand | | | | | | | | | |
| 30 | 59.27 | 1.35 | 0.00 | 1.12 | 55.35 | 43.53 | Clayey-Silt | 0.209 | 2.481 | 1.198 | 93.2 | 11.7 | 4.29 | 290 | 30.4 | 97.4 |

**Table X.** Textural and chemical data for surficial sediment samples collected in the middle Chincoteague Bay. BDL refers to "below detection limit." Average detection limits for the metals are listed in Table XIV (Appendix III). Fifty-six coarse-grained samples were not analyzed for chemistry, and are indicated by blank cells.

| Sample ID | Textural Data | | | | | | | Chemical Data | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water % | Bulk Density (g/cm$^3$) | Gravel % | Sand % | Silt % | Clay % | Shepard"s (1954) Classification | Nitrogen % | Carbon % | Sulfur % | Cr µg/g | Cu µg/g | Fe % | Mn µg/g | Ni µg/g | Zn µg/g |
| 31 | 59.06 | 1.35 | 0.00 | 5.57 | 52.63 | 41.80 | Clayey-Silt | 0.200 | 2.341 | 1.204 | 83.7 | 11.3 | 3.91 | 252 | 32.6 | 93.2 |
| 32 | 49.28 | 1.47 | 0.00 | 2.95 | 64.10 | 32.95 | Clayey-Silt | 0.140 | 1.729 | 0.652 | 77.9 | 9.8 | 3.71 | 271 | 17.5 | 89.0 |
| 33 | 54.90 | 1.40 | 0.00 | 5.98 | 54.03 | 39.98 | Clayey-Silt | 0.156 | 1.814 | 0.481 | 90.4 | 10.6 | 4.17 | 308 | 33.4 | 106.2 |
| 34 | 47.22 | 1.50 | 0.00 | 2.80 | 59.38 | 37.83 | Clayey-Silt | 0.127 | 1.509 | 0.579 | 70.2 | 8.1 | 3.26 | 255 | 21.4 | 82.2 |
| 35 | 46.77 | 1.51 | 0.00 | 4.38 | 56.96 | 38.66 | Clayey-Silt | 0.140 | 1.650 | 0.436 | 89.4 | 9.7 | 3.92 | 311 | 27.6 | 102.3 |
| 36 | 50.22 | 1.46 | 0.00 | 3.63 | 60.04 | 36.34 | Clayey-Silt | 0.143 | 1.603 | 0.440 | 94.3 | 8.6 | 3.99 | 344 | 31.7 | 98.8 |
| 37 | 53.20 | 1.42 | 0.00 | 6.64 | 53.66 | 39.70 | Clayey-Silt | 0.158 | 1.843 | 0.508 | 89.0 | 10.9 | 3.94 | 315 | 25.1 | 99.8 |
| 38 | 42.39 | 1.57 | 0.00 | 40.74 | 38.00 | 21.26 | Sand-Silt-Clay | 0.108 | 1.282 | 0.313 | 61.2 | 6.8 | 2.82 | 267 | 18.2 | 67.8 |
| 39 | 40.12 | 1.61 | 0.00 | 36.37 | 39.75 | 23.88 | Sand-Silt-Clay | 0.092 | 1.111 | 0.309 | 60.7 | 6.1 | 2.55 | 221 | 17.7 | 69.9 |
| 40 | 42.88 | 1.57 | 0.00 | 9.02 | 67.07 | 23.91 | Clayey-Silt | 0.108 | 1.224 | 0.390 | 70.8 | 6.2 | 3.03 | 295 | 21.9 | 77.8 |
| 41 | 40.70 | 1.60 | 0.00 | 20.03 | 60.75 | 19.21 | Sandy-Silt | 0.098 | 1.068 | 0.318 | 59.0 | 4.9 | 2.58 | 283 | 20.1 | 65.8 |
| 42 | 25.36 | 1.89 | 0.00 | 97.93 | 2.07 | 0.00 | Sand | 0.012 | 0.130 | 0.043 | 8.5 | BDL | 0.42 | 116 | BDL | 13.1 |
| 43 | 26.95 | 1.86 | 0.00 | 94.45 | 4.26 | 1.29 | Sand | 0.017 | 0.159 | 0.052 | 15.3 | BDL | 0.74 | 239 | 4.3 | 18.0 |
| 44 | 19.59 | 2.03 | 0.00 | 94.43 | 4.33 | 1.24 | Sand | | | | | | | | | |
| 45 | 25.95 | 1.88 | 0.00 | 96.09 | 2.97 | 0.94 | Sand | 0.016 | 0.138 | 0.046 | 13.2 | BDL | 0.60 | 163 | 5.6 | 14.9 |
| 46 | 25.57 | 1.89 | 0.00 | 94.72 | 3.80 | 1.47 | Sand | 0.022 | 0.264 | 0.047 | 12.0 | BDL | 0.58 | 133 | 6.1 | 14.9 |
| 47 | 19.61 | 2.03 | 0.00 | 97.42 | 2.58 | 0.00 | Sand | | | | | | | | | |
| 50 | 23.70 | 1.93 | 0.00 | 69.59 | 23.79 | 6.62 | Silty-Sand | 0.043 | 0.458 | 0.129 | 28.3 | 3.3 | 1.19 | 154 | 8.7 | 33.6 |
| 51 | 34.71 | 1.70 | 0.00 | 49.35 | 38.79 | 11.86 | Silty-Sand | 0.088 | 0.882 | 0.198 | 38.8 | 3.5 | 1.71 | 289 | 9.0 | 45.1 |
| 52 | 22.22 | 1.97 | 0.00 | 84.80 | 12.48 | 2.72 | Sand | | | | | | | | | |
| 53 | 23.99 | 1.93 | 0.00 | 96.46 | 2.99 | 0.54 | Sand | | | | | | | | | |
| 54 | 27.43 | 1.85 | 0.00 | 96.99 | 2.05 | 0.96 | Sand | 0.017 | 0.151 | 0.049 | 11.3 | 0.9 | 0.55 | 113 | 4.3 | 15.4 |
| 55 | 25.58 | 1.89 | 0.00 | 97.93 | 1.55 | 0.53 | Sand | 0.054 | 0.411 | 0.062 | 12.0 | 1.1 | 0.58 | 124 | BDL | 17.5 |
| 56 | 24.94 | 1.90 | 0.00 | 70.73 | 21.99 | 7.28 | Silty-Sand | 0.044 | 0.479 | 0.113 | 30.0 | 2.4 | 1.27 | 186 | 6.3 | 35.6 |
| 57 | 35.84 | 1.68 | 0.00 | 25.48 | 57.09 | 17.44 | Sandy-Silt | 0.071 | 0.824 | 0.259 | 47.7 | 5.3 | 2.09 | 236 | 11.3 | 55.4 |
| 58 | 41.17 | 1.59 | 0.00 | 10.07 | 68.00 | 21.93 | Clayey-Silt | 0.091 | 1.029 | 0.319 | 59.0 | 6.8 | 2.57 | 270 | 10.4 | 67.6 |
| 59 | 40.72 | 1.60 | 0.00 | 40.64 | 39.15 | 20.21 | Sand-Silt-Clay | 0.090 | 1.102 | 0.331 | 53.8 | 6.8 | 2.35 | 196 | 12.0 | 63.2 |
| 59r | 37.10 | 1.66 | 0.00 | 33.86 | 43.08 | 23.07 | Sand-Silt-Clay | 0.082 | 1.029 | 0.300 | 55.9 | 5.8 | 2.33 | 217 | 10.2 | 62.8 |

**Table X.** Textural and chemical data for surficial sediment samples collected in the middle Chincoteague Bay. BDL refers to "below detection limit." Average detection limits for the metals are listed in Table XIV (Appendix III). Fifty-six coarse-grained samples were not analyzed for chemistry, and are indicated by blank cells.

| Sample ID | Textural Data | | | | | | | Chemical Data | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water % | Bulk Density ($g/cm^3$) | Gravel % | Sand % | Silt % | Clay % | Shepard"s (1954) Classification | Nitrogen % | Carbon % | Sulfur % | Cr µg/g | Cu µg/g | Fe % | Mn µg/g | Ni µg/g | Zn µg/g |
| 60 | 39.53 | 1.62 | 0.00 | 40.57 | 36.97 | 22.46 | Sand-Silt-Clay | 0.092 | 1.068 | 0.264 | 58.7 | 7.4 | 2.46 | 217 | 11.3 | 65.9 |
| 60r | 30.50 | 1.78 | 0.00 | 58.45 | 27.04 | 14.52 | Silty-Sand | 0.064 | 1.001 | 0.173 | 39.0 | 5.3 | 1.71 | 164 | 8.1 | 45.2 |
| 61 | 27.52 | 1.85 | 0.00 | 68.59 | 21.41 | 10.00 | Silty-Sand | 0.060 | 0.630 | 0.141 | 36.9 | 3.4 | 1.63 | 168 | 4.2 | 41.7 |
| 61r | 29.17 | 1.81 | 0.00 | 66.88 | 21.71 | 11.41 | Silty-Sand | 0.061 | 0.662 | 0.155 | 38.6 | 4.4 | 1.73 | 176 | 7.7 | 43.7 |
| 62 | 41.29 | 1.59 | 0.00 | 31.53 | 43.14 | 25.32 | Sand-Silt-Clay | 0.106 | 1.291 | 0.295 | 68.4 | 7.4 | 2.94 | 251 | 17.3 | 75.4 |
| 62r | 41.29 | 1.59 | 0.00 | 31.87 | 42.51 | 25.62 | Sand-Silt-Clay | 0.111 | 1.312 | 0.299 | 72.4 | 7.2 | | | 14.7 | 79.6 |
| 63 | 47.48 | 1.50 | 0.00 | 3.68 | 60.30 | 36.02 | Clayey-Silt | 0.130 | 1.569 | 0.356 | 82.3 | 8.9 | 3.55 | 285 | 22.3 | 91.2 |
| 64 | 50.61 | 1.45 | 0.00 | 5.68 | 57.61 | 36.72 | Clayey-Silt | 0.141 | 1.637 | 0.387 | 88.2 | 10.1 | 3.69 | 323 | 20.5 | 98.5 |
| 65 | 48.04 | 1.49 | 0.00 | 4.82 | 60.23 | 34.95 | Clayey-Silt | 0.146 | 1.707 | 0.509 | 79.8 | 10.3 | 3.41 | 253 | 21.2 | 93.3 |
| 66 | 42.24 | 1.58 | 0.00 | 21.66 | 49.70 | 28.64 | Sand-Silt-Clay | 0.117 | 1.391 | 0.351 | 70.7 | 8.8 | 3.05 | 260 | 18.1 | 77.6 |
| 67 | 42.38 | 1.57 | 0.00 | 7.43 | 58.17 | 34.40 | Clayey-Silt | 0.125 | 1.537 | 0.337 | 83.6 | 9.4 | 3.52 | 294 | 21.3 | 91.9 |
| 68 | 45.35 | 1.53 | 0.00 | 7.37 | 59.11 | 33.52 | Clayey-Silt | 0.024 | 0.230 | 0.061 | 17.5 | 1.4 | 0.80 | 139 | 6.5 | 20.8 |
| 69 | 36.77 | 1.67 | 0.00 | 38.07 | 38.70 | 23.24 | Sand-Silt-Clay | 0.093 | 1.590 | 0.261 | 57.5 | 6.3 | 2.54 | 234 | 13.3 | 65.3 |
| 70 | 42.30 | 1.57 | 0.00 | 15.21 | 55.35 | 29.43 | Clayey-Silt | 0.114 | 1.368 | 0.378 | 72.7 | 8.4 | 3.07 | 239 | 22.7 | 83.4 |
| 71 | 39.38 | 1.62 | 0.00 | 14.18 | 61.52 | 24.31 | Clayey-Silt | 0.085 | 1.025 | 0.425 | 66.4 | 7.6 | 2.72 | 291 | 22.2 | 69.2 |
| 72 | 36.95 | 1.66 | 0.00 | 16.22 | 65.09 | 18.68 | Clayey-Silt | 0.075 | 0.867 | 0.284 | 55.8 | 7.1 | 2.43 | 270 | 12.4 | 62.6 |
| 73 | 34.96 | 1.70 | 0.00 | 28.53 | 57.27 | 14.20 | Sandy-Silt | 0.068 | 0.829 | 0.260 | 53.6 | 4.9 | 2.26 | 265 | 14.6 | 58.9 |
| 74 | 24.93 | 1.90 | 0.00 | 53.75 | 36.48 | 9.77 | Silty-Sand | 0.050 | 0.584 | 0.209 | 41.0 | 4.5 | 1.69 | 242 | 13.7 | 43.7 |
| 75 | 26.45 | 1.87 | 0.00 | 76.19 | 18.29 | 5.52 | Sand | 0.040 | 0.413 | 0.115 | 28.7 | 2.3 | 1.28 | 223 | 14.0 | 34.8 |
| 76 | 20.73 | 2.01 | 0.00 | 95.71 | 3.06 | 1.24 | Sand | | | | | | | | | |
| 77 | 28.98 | 1.82 | 0.00 | 97.45 | 2.14 | 0.40 | Sand | 0.017 | 0.143 | 0.047 | 12.4 | 0.9 | 0.56 | 138 | 6.5 | 15.3 |
| 78 | 21.21 | 1.99 | 0.00 | 92.93 | 4.82 | 2.25 | Sand | | | | | | | | | |
| 79 | 30.06 | 1.79 | 0.00 | 55.59 | 33.59 | 10.82 | Silty-Sand | 0.067 | 0.695 | 0.203 | 42.9 | 4.9 | 1.77 | 243 | 17.6 | 47.1 |
| 80 | 45.25 | 1.53 | 0.00 | 26.79 | 50.97 | 22.25 | Sand-Silt-Clay | 0.121 | 1.324 | 0.487 | 64.3 | 9.2 | 2.53 | 259 | 14.4 | 74.2 |
| 81 | 33.79 | 1.72 | 0.00 | 49.32 | 37.55 | 13.14 | Silty-Sand | 0.091 | 0.988 | 0.328 | 46.8 | 7.1 | 1.87 | 223 | 21.7 | 53.7 |
| 82 | 25.48 | 1.89 | 0.00 | 81.37 | 12.78 | 5.85 | Sand | 0.046 | 0.468 | 0.137 | 25.2 | 3.9 | 1.03 | 139 | 5.9 | 29.7 |
| 83 | 24.76 | 1.91 | 0.00 | 79.66 | 13.38 | 6.96 | Sand | 0.052 | 0.511 | 0.135 | 28.3 | 5.2 | 1.16 | 156 | 8.2 | 34.1 |
| 84 | 20.78 | 2.00 | 0.00 | 97.44 | 1.78 | 0.78 | Sand | | | | | | | | | |

**Table X.** Textural and chemical data for surficial sediment samples collected in the middle Chincoteague Bay. BDL refers to "below detection limit." Average detection limits for the metals are listed in Table XIV (Appendix III). Fifty-six coarse-grained samples were not analyzed for chemistry, and are indicated by blank cells.

| Sample ID | Textural Data | | | | | | | Chemical Data | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water % | Bulk Density ($g/cm^3$) | Gravel % | Sand % | Silt % | Clay % | Shepard"s (1954) Classification | Nitrogen % | Carbon % | Sulfur % | Cr µg/g | Cu µg/g | Fe % | Mn µg/g | Ni µg/g | Zn µg/g |
| 85 | 21.50 | 1.99 | 0.00 | 98.17 | 1.31 | 0.52 | Sand | | | | | | | | | |
| 86 | 27.24 | 1.85 | 0.00 | 97.00 | 2.29 | 0.71 | Sand | 0.014 | 0.110 | 0.043 | 9.3 | 1.8 | 0.35 | 97 | 4.6 | 10.1 |
| 87 | 26.94 | 1.86 | 0.00 | 90.04 | 6.99 | 2.97 | Sand | 0.028 | 0.277 | 0.063 | 15.6 | 3.0 | 0.66 | 146 | 6.8 | 18.4 |
| 88 | 19.98 | 2.02 | 0.00 | 94.34 | 4.15 | 1.52 | Sand | | | | | | | | | |
| 89 | 21.09 | 2.00 | 0.00 | 92.01 | 5.82 | 2.17 | Sand | | | | | | | | | |
| 90 | 20.33 | 2.02 | 0.00 | 85.03 | 11.35 | 3.62 | Sand | | | | | | | | | |
| 91 | 29.49 | 1.80 | 0.00 | 52.89 | 34.28 | 12.83 | Silty-Sand | 0.062 | 0.701 | 0.222 | 44.4 | 4.5 | 1.94 | 252 | 16.5 | 48.3 |
| 92 | 32.97 | 1.74 | 0.00 | 27.07 | 55.90 | 17.03 | Sandy-Silt | 0.076 | 0.816 | 0.262 | 51.1 | 6.5 | 2.27 | 259 | 9.4 | 57.9 |
| 93 | 30.55 | 1.78 | 0.00 | 38.03 | 50.13 | 11.84 | Sandy-Silt | 0.053 | 0.614 | 0.222 | 42.5 | 5.2 | 1.90 | 248 | 12.5 | 46.4 |
| 94 | 39.75 | 1.62 | 0.00 | 10.73 | 65.12 | 24.15 | Clayey-Silt | 0.104 | 1.266 | 0.446 | 70.1 | 9.3 | 2.91 | 290 | 19.0 | 74.9 |
| 95 | 36.22 | 1.68 | 0.00 | 36.60 | 46.70 | 16.69 | Sandy-Silt | 0.073 | 0.847 | 0.289 | 48.4 | 5.4 | 2.09 | 219 | 16.6 | 54.0 |
| 96 | 42.80 | 1.57 | 0.00 | 15.10 | 55.42 | 29.48 | Clayey-Silt | 0.113 | 1.351 | 0.336 | 77.6 | 9.1 | 3.36 | 313 | 25.2 | 82.6 |
| 97 | 48.52 | 1.48 | 0.00 | 6.01 | 58.07 | 35.92 | Clayey-Silt | 0.129 | 1.552 | 0.342 | 87.0 | 10.3 | 3.71 | 338 | 27.1 | 93.2 |
| 98 | 46.41 | 1.51 | 0.00 | 18.01 | 48.55 | 33.44 | Clayey-Silt | 0.132 | 1.502 | 0.291 | 81.2 | 10.4 | 3.67 | 298 | 25.2 | 93.6 |
| 99 | 46.86 | 1.51 | 0.00 | 2.95 | 66.40 | 30.65 | Clayey-Silt | 0.144 | 1.605 | 0.442 | 76.2 | 10.6 | 3.35 | 259 | 25.3 | 87.1 |
| 100 | 22.82 | 1.95 | 0.00 | 90.87 | 5.78 | 3.35 | Sand | 0.031 | 0.286 | 0.078 | 16.7 | 3.6 | 0.69 | 98 | 5.9 | 18.3 |
| 101 | 19.84 | 2.03 | 0.00 | 86.22 | 7.48 | 6.30 | Sand | | | | | | | | | |
| 102 | 52.72 | 1.43 | 0.00 | 2.60 | 57.45 | 39.96 | Clayey-Silt | 0.154 | 1.719 | 0.362 | 88.4 | 12.7 | 3.72 | 271 | 29.0 | 104.9 |
| 103 | 47.62 | 1.50 | 0.00 | 8.02 | 59.03 | 32.95 | Clayey-Silt | 0.128 | 1.539 | 0.332 | 90.2 | 10.9 | 3.63 | 338 | 29.0 | 97.7 |
| 104 | 43.89 | 1.55 | 0.00 | 8.17 | 60.63 | 31.20 | Clayey-Silt | 0.121 | 1.440 | 0.392 | 73.8 | 8.3 | 3.32 | 314 | 17.8 | 83.7 |
| 105 | 35.82 | 1.68 | 0.00 | 23.69 | 59.84 | 16.47 | Sandy-Silt | 0.072 | 0.825 | 0.270 | 52.4 | 5.1 | 2.43 | 275 | 16.2 | 55.5 |
| 106 | 45.18 | 1.53 | 0.00 | 14.24 | 61.89 | 23.87 | Clayey-Silt | 0.098 | 1.092 | 0.325 | 67.9 | 6.9 | 3.05 | 350 | 19.3 | 74.0 |
| 107 | 29.70 | 1.80 | 0.00 | 39.34 | 45.63 | 15.03 | Sandy-Silt | 0.068 | 0.726 | 0.286 | 48.8 | 4.6 | 2.18 | 249 | 15.3 | 53.1 |
| 108 | 23.77 | 1.93 | 0.00 | 77.49 | 16.64 | 5.88 | Sand | 0.039 | 0.374 | 0.111 | 27.9 | 2.2 | 1.27 | 201 | 6.6 | 32.7 |
| 109 | 26.03 | 1.88 | 0.00 | 84.36 | 13.09 | 2.55 | Sand | 0.038 | 0.385 | 0.088 | 24.1 | 0.9 | 1.15 | 231 | 5.0 | 27.8 |
| 110 | 29.69 | 1.80 | 0.00 | 96.14 | 2.92 | 0.94 | Sand | 0.021 | 0.256 | 0.049 | 11.6 | BDL | 0.56 | 116 | BDL | 13.8 |
| 111 | 24.60 | 1.91 | 0.00 | 96.18 | 2.89 | 0.93 | Sand | | | | 21.0 | 2.2 | 0.93 | 164 | 3.9 | 26.2 |
| 112 | 29.97 | 1.79 | 0.00 | 78.30 | 17.29 | 4.41 | Sand | 0.066 | 0.703 | 0.152 | | | | | | |

**Table X.** Textural and chemical data for surficial sediment samples collected in the middle Chincoteague Bay. BDL refers to "below detection limit." Average detection limits for the metals are listed in Table XIV (Appendix III). Fifty-six coarse-grained samples were not analyzed for chemistry, and are indicated by blank cells.

| Sample ID | Textural Data | | | | | | | Chemical Data | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water % | Bulk Density ($g/cm^3$) | Gravel % | Sand % | Silt % | Clay % | Shepard"s (1954) Classification | Nitrogen % | Carbon % | Sulfur % | Cr µg/g | Cu µg/g | Fe % | Mn µg/g | Ni µg/g | Zn µg/g |
| 114 | 26.20 | 1.88 | 0.00 | 98.17 | 1.51 | 0.32 | Sand | 0.015 | 0.110 | 0.042 | 9.1 | BDL | 0.42 | 84 | BDL | 10.1 |
| 115 | 19.51 | 2.04 | 0.00 | 99.00 | 1.05 | -0.05 | Sand | | | | | | | | | |
| 118 | 31.33 | 1.77 | 0.00 | 50.11 | 42.47 | 7.41 | Silty-Sand | | | | | | | | | |
| 119 | 20.25 | 2.02 | 0.00 | 97.53 | 2.23 | 0.24 | Sand | | | | | | | | | |
| 120 | 21.10 | 2.00 | 0.00 | 78.31 | 15.87 | 5.83 | Sand | 0.044 | 0.441 | 0.101 | 29.1 | 2.3 | 1.32 | 227 | 6.4 | 33.6 |
| 121 | 22.76 | 1.95 | 0.00 | 67.94 | 23.81 | 8.25 | Silty-Sand | | | | | | | | | |
| 122 | 34.79 | 1.70 | 0.00 | 27.66 | 52.48 | 19.85 | Sandy-Silt | 0.078 | 1.035 | 0.319 | 58.0 | 6.6 | 2.72 | 265 | 19.7 | 64.2 |
| 123 | 29.33 | 1.81 | 0.00 | 18.40 | 66.19 | 15.41 | Sandy-Silt | 0.072 | 0.890 | 0.287 | 49.6 | 7.4 | 2.30 | 215 | 14.3 | 55.9 |
| 124 | 39.28 | 1.62 | 0.00 | 25.34 | 58.74 | 15.93 | Sandy-Silt | 0.073 | 0.870 | 0.255 | 53.8 | 6.0 | 2.46 | 344 | 17.5 | 56.4 |
| 125 | 40.88 | 1.60 | 0.00 | 12.55 | 65.47 | 21.98 | Clayey-Silt | 0.092 | 1.152 | 0.318 | 66.8 | 8.4 | 2.97 | 290 | 16.9 | 72.4 |
| 126 | 45.63 | 1.52 | 0.00 | 9.15 | 60.30 | 30.55 | Clayey-Silt | 0.120 | 1.473 | 0.427 | 85.3 | 10.2 | 3.72 | 324 | 23.7 | 91.0 |
| 127 | 46.10 | 1.52 | 0.00 | 8.22 | 56.30 | 35.48 | Clayey-Silt | 0.123 | 1.475 | 0.344 | 89.1 | 9.9 | 3.98 | 335 | 18.0 | 97.2 |
| 128 | 39.58 | 1.62 | 0.00 | 37.51 | 39.29 | 23.20 | Sand-Silt-Clay | 0.094 | 1.094 | 0.221 | 62.8 | 8.0 | 2.72 | 248 | 15.5 | 68.0 |
| 129 | 26.31 | 1.87 | 0.00 | 92.63 | 4.13 | 3.23 | Sand | 0.023 | 0.236 | 0.047 | 14.1 | 2.2 | 0.64 | 76 | BDL | 15.5 |
| 130 | 53.25 | 1.42 | 0.00 | 1.03 | 57.68 | 41.29 | Clayey-Silt | 0.149 | 1.711 | 0.359 | 93.5 | 12.3 | 4.14 | 286 | 26.4 | 110.7 |
| 131 | 50.00 | 1.46 | 0.00 | 11.17 | 46.66 | 42.17 | Clayey-Silt | 0.147 | 1.664 | 0.303 | 98.9 | 12.9 | 4.21 | 299 | 27.9 | 112.6 |
| 132 | 48.19 | 1.49 | 0.00 | 4.52 | 58.06 | 37.42 | Clayey-Silt | 0.154 | 1.792 | 0.555 | 91.4 | 21.3 | 3.92 | 260 | 27.2 | 110.4 |
| 133 | 46.40 | 1.51 | 0.00 | 16.87 | 53.27 | 29.86 | Clayey-Silt | 0.127 | 1.485 | 0.415 | 71.4 | 14.1 | 3.19 | 211 | 17.3 | 84.5 |
| 134 | 51.44 | 1.44 | 0.00 | 12.41 | 49.56 | 38.03 | Clayey-Silt | 0.143 | 1.713 | 0.367 | 96.2 | 15.4 | 4.04 | 288 | 20.5 | 105.6 |
| 135 | 50.38 | 1.46 | 0.00 | 5.27 | 55.83 | 38.90 | Clayey-Silt | 0.144 | 1.724 | 0.280 | 88.6 | 11.8 | 4.00 | 282 | 25.9 | 104.5 |
| 136 | 45.17 | 1.53 | 0.00 | 9.13 | 61.26 | 29.61 | Clayey-Silt | 0.120 | 1.418 | 0.283 | 88.4 | 11.0 | 3.77 | 326 | 19.9 | 92.6 |
| 137 | 46.36 | 1.51 | 0.00 | 3.05 | 61.86 | 35.09 | Clayey-Silt | 0.132 | 1.583 | 0.295 | 82.6 | 12.5 | 3.75 | 275 | 23.1 | 94.2 |
| 138 | 34.57 | 1.71 | 0.00 | 49.32 | 30.56 | 20.11 | Sand-Silt-Clay | 0.079 | 0.908 | 0.158 | 56.5 | 8.9 | 2.47 | 252 | 19.4 | 60.1 |
| 139 | 25.20 | 1.90 | 0.00 | 95.52 | 2.66 | 1.82 | Sand | 0.016 | 0.169 | 0.040 | 10.0 | 2.4 | 0.52 | 87 | 1.6 | 11.4 |
| 140 | 46.96 | 1.50 | 0.00 | 6.28 | 62.69 | 31.02 | Clayey-Silt | 0.116 | 1.419 | 0.352 | 84.5 | 11.2 | 3.51 | 304 | 28.2 | 88.4 |
| 141 | 45.36 | 1.53 | 0.00 | 8.67 | 58.96 | 32.37 | Clayey-Silt | 0.111 | 1.374 | 0.389 | 82.3 | 9.0 | 3.51 | 315 | 20.5 | 90.7 |
| 142 | 43.46 | 1.56 | 0.00 | 7.39 | 63.37 | 29.24 | Clayey-Silt | 0.106 | 1.351 | 0.303 | 75.9 | 9.1 | 3.30 | 282 | 25.2 | 86.3 |
| 143 | 36.47 | 1.67 | 0.00 | 19.63 | 62.59 | 17.78 | Sandy-Silt | 0.075 | 0.962 | 0.281 | 60.8 | 6.8 | 2.61 | 287 | 21.0 | 66.2 |

**Table X.** Textural and chemical data for surficial sediment samples collected in the middle Chincoteague Bay. BDL refers to "below detection limit." Average detection limits for the metals are listed in Table XIV (Appendix III). Fifty-six coarse-grained samples were not analyzed for chemistry, and are indicated by blank cells.

| Sample ID | Textural Data | | | | | | | Chemical Data | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water % | Bulk Density (g/cm$^3$) | Gravel % | Sand % | Silt % | Clay % | Shepard"s (1954) Classification | Nitrogen % | Carbon % | Sulfur % | Cr µg/g | Cu µg/g | Fe % | Mn µg/g | Ni µg/g | Zn µg/g |
| 144 | 20.00 | 2.02 | 0.00 | 67.66 | 25.41 | 6.93 | Silty-Sand | 0.050 | 0.368 | 0.060 | 24.6 | 2.5 | 1.07 | 168 | 10.2 | 27.8 |
| 145 | 23.46 | 1.94 | 0.00 | 64.35 | 27.93 | 7.72 | Silty-Sand | 0.054 | 0.479 | 0.085 | 33.6 | 3.1 | 1.44 | 207 | 10.8 | 36.5 |
| 146 | 29.02 | 1.81 | 0.00 | 37.63 | 50.00 | 12.37 | Sandy-Silt | 0.068 | 0.650 | 0.180 | 44.5 | 2.7 | 2.05 | 244 | 10.8 | 50.4 |
| 147 | 37.66 | 1.65 | 0.00 | 25.33 | 55.19 | 19.48 | Sandy-Silt | 0.087 | 0.918 | 0.286 | 62.7 | 5.7 | 2.55 | 275 | 17.2 | 67.9 |
| 148 | 20.83 | 2.00 | 0.00 | 81.73 | 14.16 | 4.11 | Sand | | | | | | | | | |
| 149 | 28.13 | 1.83 | 0.00 | 97.63 | 1.80 | 0.57 | Sand | 0.014 | 0.125 | 0.038 | 9.5 | 1.3 | 0.38 | 74 | 1.7 | 12.2 |
| 150 | 23.93 | 1.93 | 0.00 | 89.82 | 7.84 | 2.34 | Sand | | | | | | | | | |
| 151 | 38.71 | 1.63 | 0.00 | 44.90 | 39.29 | 15.81 | Silty-Sand | 0.090 | 1.007 | 0.540 | 48.5 | 4.8 | 2.04 | 221 | 14.6 | 57.9 |
| 152 | 25.46 | 1.89 | 0.00 | 75.29 | 17.47 | 7.24 | Sand | 0.048 | 0.621 | 0.162 | 27.3 | 2.1 | 1.17 | 148 | 2.4 | 32.0 |
| 153 | 26.59 | 1.87 | 0.00 | 92.48 | 6.64 | 0.89 | Sand | 0.015 | 0.124 | 0.044 | 10.8 | 1.2 | 0.51 | 87 | 1.1 | 14.5 |
| 154 | 21.55 | 1.98 | 0.00 | 95.43 | 3.37 | 1.20 | Sand | | | | | | | | | |
| 155 | 23.63 | 1.93 | 0.00 | 89.97 | 7.21 | 2.82 | Sand | 0.025 | 0.284 | 0.060 | 19.3 | 1.8 | 0.92 | 179 | 1.0 | 23.9 |
| 156 | 29.49 | 1.80 | 0.00 | 42.74 | 44.13 | 13.13 | Sandy-Silt | 0.059 | 0.693 | 0.290 | 52.6 | 4.5 | 2.16 | 285 | 15.5 | 54.5 |
| 157 | 29.60 | 1.80 | 0.04 | 43.97 | 42.83 | 13.16 | Silty-Sand | 0.064 | 0.794 | 0.240 | 49.8 | 4.9 | 2.10 | 249 | 10.2 | 54.9 |
| 158 | 26.75 | 1.86 | 0.00 | 49.70 | 39.62 | 10.68 | Silty-Sand | 0.047 | 0.574 | 0.186 | 39.8 | 3.4 | 1.74 | 260 | 10.3 | 43.6 |
| 159 | 27.21 | 1.85 | 0.00 | 54.71 | 34.64 | 10.66 | Silty-Sand | 0.050 | 0.543 | 0.161 | 40.3 | 4.0 | 1.75 | 279 | 5.2 | 42.9 |
| 160 | 26.24 | 1.87 | 0.00 | 85.09 | 11.84 | 3.07 | Sand | 0.019 | 0.276 | 0.055 | 11.9 | 2.0 | 0.54 | 122 | BDL | 13.7 |
| 161 | 38.44 | 1.64 | 0.00 | 16.04 | 65.20 | 18.75 | Clayey-Silt | 0.078 | 0.932 | 0.291 | 60.7 | 7.6 | 2.49 | 283 | 17.3 | 63.7 |
| 162 | 41.89 | 1.58 | 0.00 | 11.93 | 65.66 | 22.40 | Clayey-Silt | 0.102 | 1.280 | 0.405 | 68.0 | 9.1 | 2.88 | 289 | 17.9 | 76.2 |
| 163 | 43.74 | 1.55 | 0.00 | 9.40 | 64.79 | 25.81 | Clayey-Silt | 0.106 | 1.286 | 0.287 | 63.6 | 8.6 | 2.69 | 261 | 16.8 | 75.0 |
| 164 | 41.93 | 1.58 | 0.00 | 18.57 | 54.09 | 27.34 | Clayey-Silt | 0.105 | 1.289 | 0.322 | 65.8 | 9.3 | 2.75 | 235 | 15.8 | 77.9 |
| 165 | 40.29 | 1.61 | 0.00 | 13.84 | 59.29 | 26.88 | Clayey-Silt | 0.107 | 1.253 | 0.274 | 78.5 | 8.8 | 0.23 | 11 | 20.2 | 82.4 |
| 166 | 40.58 | 1.60 | 0.00 | 8.90 | 67.13 | 23.97 | Clayey-Silt | 0.098 | 1.173 | 0.266 | 71.5 | 8.1 | 3.07 | 305 | 18.5 | 76.2 |
| 167 | 42.94 | 1.56 | 0.00 | 6.80 | 67.77 | 25.44 | Clayey-Silt | 0.106 | 1.242 | 0.305 | 72.2 | 9.4 | 3.13 | 306 | 10.5 | 79.9 |
| 168 | 45.46 | 1.53 | 0.00 | 13.58 | 55.06 | 31.36 | Clayey-Silt | 0.142 | 1.630 | 0.354 | 78.5 | 10.9 | 3.32 | 289 | 27.0 | 88.0 |
| 169 | 41.70 | 1.58 | 0.00 | 22.29 | 49.57 | 28.14 | Sand-Silt-Clay | 0.122 | 1.545 | 0.411 | 70.5 | 9.1 | 2.99 | 226 | 14.4 | 79.8 |
| 170 | 46.82 | 1.51 | 0.00 | 4.43 | 64.27 | 31.31 | Clayey-Silt | 0.122 | 1.494 | 0.314 | 75.0 | 11.5 | 3.20 | 279 | 21.8 | 89.2 |
| 171 | 44.19 | 1.55 | 0.00 | 6.56 | 62.13 | 31.30 | Clayey-Silt | 0.115 | 1.372 | 0.289 | 81.8 | 10.2 | 3.34 | 298 | 23.9 | 88.7 |

**Table X.** Textural and chemical data for surficial sediment samples collected in the middle Chincoteague Bay. BDL refers to "below detection limit." Average detection limits for the metals are listed in Table XIV (Appendix III). Fifty-six coarse-grained samples were not analyzed for chemistry, and are indicated by blank cells.

| Sample ID | Textural Data | | | | | | | Chemical Data | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water % | Bulk Density (g/cm$^3$) | Gravel % | Sand % | Silt % | Clay % | Shepard"s (1954) Classification | Nitrogen % | Carbon % | Sulfur % | Cr µg/g | Cu µg/g | Fe % | Mn µg/g | Ni µg/g | Zn µg/g |
| 172 | 44.29 | 1.54 | 0.00 | 12.22 | 59.26 | 28.53 | Clayey-Silt | 0.110 | 1.284 | 0.287 | 67.7 | 7.3 | 3.08 | 297 | 20.9 | 78.1 |
| 173 | 31.14 | 1.77 | 0.00 | 48.23 | 31.41 | 20.37 | Sand-Silt-Clay | 0.080 | 0.971 | 0.228 | 50.8 | 7.0 | 2.30 | 233 | 15.7 | 56.5 |
| 174 | 45.29 | 1.53 | 0.00 | 14.74 | 55.43 | 29.82 | Clayey-Silt | 0.117 | 1.420 | 0.373 | 76.9 | 9.6 | 3.45 | 340 | 20.9 | 83.5 |
| 175 | 37.69 | 1.65 | 0.00 | 13.17 | 61.29 | 25.54 | Clayey-Silt | 0.099 | 1.157 | 0.345 | 69.7 | 9.1 | 3.15 | 325 | 24.0 | 76.5 |
| 176 | 37.52 | 1.65 | 0.00 | 29.96 | 51.00 | 19.04 | Sandy-Silt | 0.078 | 0.973 | 0.290 | 56.8 | 5.2 | 2.60 | 302 | 12.7 | 64.1 |
| 177 | 24.24 | 1.92 | 0.00 | 51.67 | 38.36 | 9.97 | Silty-Sand | 0.043 | 0.536 | 0.128 | 39.4 | 1.2 | 1.89 | 284 | 1.2 | 42.5 |
| 178 | 36.79 | 1.67 | 0.00 | 37.19 | 47.23 | 15.58 | Sandy-Silt | 0.075 | 0.905 | 0.259 | 46.8 | 4.1 | 2.21 | 235 | 6.6 | 55.1 |
| 179 | 24.33 | 1.92 | 0.00 | 61.84 | 28.24 | 9.92 | Silty-Sand | 0.042 | 0.452 | 0.149 | 31.4 | 2.7 | 1.49 | 184 | 2.5 | 37.2 |
| 180 | 19.72 | 2.03 | 0.00 | 92.33 | 5.50 | 2.17 | Sand | | | | | | | | | |
| 181 | 26.59 | 1.87 | 0.00 | 71.98 | 19.65 | 8.37 | Silty-Sand | 0.048 | 0.460 | 0.125 | 29.9 | 1.6 | 1.40 | 203 | 9.0 | 36.7 |
| 182 | 27.17 | 1.85 | 0.00 | 92.91 | 5.53 | 1.56 | Sand | 0.027 | 0.720 | 0.046 | 12.3 | BDL | 0.64 | 168 | -2.8 | 16.5 |
| 183 | 31.56 | 1.76 | 0.00 | 85.14 | 11.59 | 3.27 | Sand | 0.039 | 0.404 | 0.112 | 20.4 | BDL | 0.99 | 180 | 7.1 | 23.2 |
| 184 | 25.92 | 1.88 | 0.00 | 72.93 | 18.10 | 8.97 | Silty-Sand | 0.054 | 0.600 | 0.150 | 32.0 | 1.9 | 1.48 | 237 | 9.6 | 37.7 |
| 185 | 23.22 | 1.94 | 0.00 | 74.85 | 18.60 | 6.55 | Silty-Sand | | | | | | | | | |
| 186 | 22.46 | 1.96 | 0.00 | 76.05 | 17.11 | 6.84 | Sand | 0.043 | 0.429 | 0.115 | 29.3 | 3.0 | 1.37 | 207 | 2.4 | 35.1 |
| 187 | 33.42 | 1.73 | 0.00 | 74.68 | 19.89 | 5.44 | Silty-Sand | 0.050 | 3.392 | 0.102 | 21.5 | 0.8 | 1.16 | 210 | -4.5 | 25.5 |
| 189 | 23.64 | 1.93 | 0.00 | 58.74 | 33.20 | 8.06 | Silty-Sand | | | | | | | | | |
| 190 | 31.01 | 1.77 | 0.00 | 30.20 | 54.63 | 15.17 | Sandy-Silt | 0.068 | 0.776 | 0.219 | 50.3 | 5.3 | 2.29 | 283 | 10.4 | 55.3 |
| 191 | 38.72 | 1.63 | 0.00 | 14.07 | 63.51 | 22.42 | Clayey-Silt | 0.084 | 1.051 | 0.327 | 62.4 | 7.4 | 2.80 | 285 | 15.2 | 67.9 |
| 192 | 40.39 | 1.61 | 0.00 | 18.71 | 58.76 | 22.53 | Clayey-Silt | 0.087 | 1.073 | 0.321 | 66.0 | 7.1 | 2.82 | 294 | 16.8 | 69.9 |
| 193 | 43.37 | 1.56 | 0.00 | 6.13 | 65.28 | 28.58 | Clayey-Silt | 0.116 | 1.372 | 0.338 | 77.4 | 8.1 | 3.21 | 291 | 16.7 | 85.3 |
| 194 | 40.83 | 1.60 | 0.00 | 24.64 | 46.12 | 29.24 | Sand-Silt-Clay | 0.128 | 1.380 | 0.281 | 69.7 | 7.0 | 3.03 | 249 | 18.4 | 80.2 |
| 195 | 40.21 | 1.61 | 0.00 | 33.72 | 39.26 | 27.02 | Sand-Silt-Clay | 0.124 | 1.372 | 0.271 | 66.4 | 8.3 | 2.86 | 234 | 19.9 | 75.6 |
| 196 | 46.97 | 1.50 | 0.00 | 4.65 | 62.20 | 33.15 | Clayey-Silt | 0.142 | 1.616 | 0.353 | 80.7 | 8.7 | 3.52 | 276 | 23.4 | 91.6 |
| 197 | 43.52 | 1.56 | 0.00 | 6.72 | 69.29 | 23.99 | Clayey-Silt | 0.109 | 1.231 | 0.242 | 72.7 | 7.2 | 3.11 | 316 | 22.8 | 74.7 |
| 198 | 41.12 | 1.59 | 0.00 | 15.69 | 60.53 | 23.78 | Clayey-Silt | 0.103 | 1.265 | 0.377 | 70.4 | 7.0 | 3.01 | 286 | 24.0 | 75.7 |
| 199 | 36.36 | 1.67 | 0.00 | 17.18 | 62.89 | 19.93 | Clayey-Silt | 0.088 | 1.145 | 0.375 | 66.5 | 6.7 | 2.86 | 293 | 14.0 | 69.2 |
| 200 | 34.31 | 1.71 | 0.00 | 26.58 | 57.15 | 16.27 | Sandy-Silt | 0.072 | 0.843 | 0.263 | 54.5 | 4.6 | 2.55 | 317 | 15.5 | 60.3 |

**Table X.** Textual and chemical data for surficial sediment samples collected in the middle Chincoteague Bay. BDL refers to "below detection limit." Average detection limits for the metals are listed in Table XIV (Appendix III). Fifty-six coarse-grained samples were not analyzed for chemistry, and are indicated by blank cells.

| Sample ID | Textural Data | | | | | | | Chemical Data | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water % | Bulk Density (g/cm$^3$) | Gravel % | Sand % | Silt % | Clay % | Shepard"s (1954) Classification | Nitrogen % | Carbon % | Sulfur % | Cr µg/g | Cu µg/g | Fe % | Mn µg/g | Ni µg/g | Zn µg/g |
| 201 | 36.79 | 1.67 | 0.00 | 29.70 | 54.64 | 15.66 | Sandy-Silt | 0.070 | 0.809 | 0.253 | 53.1 | 5.0 | 2.55 | 324 | 14.9 | 57.5 |
| 202 | 26.02 | 1.88 | 0.00 | 44.55 | 44.01 | 11.44 | Silty-Sand | 0.039 | 0.626 | 0.130 | 38.4 | 2.8 | 1.89 | 263 | 12.8 | 45.6 |
| 203 | 25.80 | 1.88 | 0.00 | 52.02 | 37.61 | 10.36 | Silty-Sand | 0.040 | 0.873 | 0.159 | 41.8 | 3.0 | 1.98 | 304 | 9.5 | 44.8 |
| 204 | 30.51 | 1.78 | 0.00 | 75.03 | 19.74 | 5.23 | Sand | 0.028 | 0.449 | 0.113 | 30.1 | 2.4 | 1.48 | 261 | 4.2 | 33.4 |
| 205 | 20.32 | 2.02 | 0.00 | 81.91 | 13.45 | 4.64 | Sand | | | | | | | | | |
| 206 | 22.42 | 1.96 | 0.00 | 83.41 | 12.73 | 3.86 | Sand | 0.021 | 0.294 | 0.078 | 21.6 | BDL | 1.01 | 181 | 2.2 | 25.1 |
| 207 | 21.66 | 1.98 | 0.00 | 90.53 | 7.10 | 2.37 | Sand | 0.014 | 0.207 | 0.059 | 16.1 | 1.0 | 0.83 | 173 | 2.5 | 20.7 |
| 208 | 27.27 | 1.85 | 0.00 | 73.44 | 19.18 | 7.38 | Silty-Sand | 0.042 | 0.636 | 0.224 | 30.3 | 3.3 | 1.40 | 197 | 2.5 | 33.2 |
| 209 | 21.30 | 1.99 | 0.00 | 81.17 | 14.89 | 3.94 | Sand | 0.024 | 0.372 | 0.104 | 21.0 | 2.2 | 0.90 | 142 | 7.3 | 23.0 |
| 210 | 23.31 | 1.94 | 0.00 | 77.57 | 16.13 | 6.31 | Sand | | | | | | | | | |
| 211 | 22.55 | 1.96 | 0.00 | 87.19 | 9.80 | 3.01 | Sand | | | | | | | | | |
| 212 | 28.70 | 1.82 | 0.00 | 86.73 | 10.21 | 3.06 | Sand | 0.014 | 0.223 | 0.069 | 20.6 | 1.7 | 0.95 | 189 | 6.3 | 24.0 |
| 213 | 24.88 | 1.90 | 0.00 | 88.08 | 8.94 | 2.98 | Sand | | | | | | | | | |
| 214 | 35.14 | 1.70 | 0.00 | 58.32 | 33.11 | 8.58 | Silty-Sand | 0.038 | 0.552 | 0.157 | 40.5 | 2.9 | 1.86 | 320 | 6.3 | 43.4 |
| 215 | 24.06 | 1.92 | 0.00 | 44.39 | 43.92 | 11.69 | Silty-Sand | | | | | | | | | |
| 216 | 35.46 | 1.69 | 0.00 | 30.20 | 54.14 | 15.65 | Sandy-Silt | 0.060 | 0.836 | 0.240 | 58.6 | 5.7 | 2.57 | 333 | 14.4 | 63.9 |
| 217 | 29.32 | 1.81 | 0.00 | 25.38 | 58.58 | 16.04 | Sandy-Silt | 0.055 | 0.890 | 0.249 | 52.3 | 5.0 | 2.22 | 257 | 7.2 | 58.0 |
| 218 | 34.04 | 1.72 | 0.00 | 25.58 | 56.08 | 18.34 | Sandy-Silt | 0.058 | 0.870 | 0.255 | 57.4 | 6.4 | 2.59 | 300 | 13.8 | 61.8 |
| 219 | 36.36 | 1.67 | 0.00 | 24.98 | 55.87 | 19.15 | Sandy-Silt | 0.063 | 0.933 | 0.264 | 61.7 | 6.5 | 2.77 | 322 | 16.4 | 66.6 |
| 220 | 42.64 | 1.57 | 0.00 | 14.35 | 63.44 | 22.21 | Clayey-Silt | 0.087 | 1.290 | 0.411 | 64.1 | 8.4 | 2.86 | 281 | 18.2 | 71.8 |
| 221 | 39.31 | 1.62 | 0.00 | 7.45 | 66.61 | 25.94 | Clayey-Silt | 0.101 | 1.355 | 0.280 | 73.6 | 9.5 | 3.32 | 313 | 16.7 | 79.8 |
| 222 | 51.65 | 1.44 | 0.00 | 1.31 | 67.70 | 30.99 | Clayey-Silt | 0.131 | 1.660 | 0.486 | 79.8 | 11.4 | 3.65 | 324 | 22.3 | 86.7 |
| 223 | 49.15 | 1.47 | 0.00 | 4.62 | 61.85 | 33.53 | Clayey-Silt | 0.133 | 1.640 | 0.392 | 87.0 | 11.3 | 3.90 | 353 | 23.3 | 93.3 |
| 224 | 45.82 | 1.52 | 0.00 | 5.79 | 64.32 | 29.90 | Clayey-Silt | 0.112 | 1.416 | 0.313 | 77.8 | 10.6 | 3.39 | 311 | 21.1 | 86.3 |
| 225 | 39.59 | 1.62 | 0.00 | 25.17 | 54.97 | 19.86 | Sandy-Silt | 0.082 | 1.240 | 0.407 | 64.4 | 8.2 | 2.85 | 309 | 15.9 | 68.4 |
| 226 | 30.81 | 1.78 | 0.00 | 37.86 | 47.73 | 14.42 | Sandy-Silt | 0.049 | 0.848 | 0.211 | 48.1 | 4.9 | 2.27 | 297 | 8.3 | 56.2 |
| 227 | 33.24 | 1.73 | 0.00 | 36.50 | 44.28 | 19.22 | Sandy-Silt | 0.066 | 0.963 | 0.260 | 60.2 | 7.4 | 2.69 | 310 | 19.7 | 64.4 |
| 228 | 30.01 | 1.79 | 0.00 | 31.93 | 55.22 | 12.86 | Sandy-Silt | 0.042 | 0.626 | 0.192 | 43.9 | 4.7 | 2.03 | 254 | 13.8 | 48.8 |

**Table X.** Textural and chemical data for surficial sediment samples collected in the middle Chincoteague Bay. BDL refers to "below detection limit." Average detection limits for the metals are listed in Table XIV (Appendix III). Fifty-six coarse-grained samples were not analyzed for chemistry, and are indicated by blank cells.

| Sample ID | Textural Data | | | | | | | Chemical Data | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water % | Bulk Density (g/cm$^3$) | Gravel % | Sand % | Silt % | Clay % | Shepard"s (1954) Classification | Nitrogen % | Carbon % | Sulfur % | Cr µg/g | Cu µg/g | Fe % | Mn µg/g | Ni µg/g | Zn µg/g |
| 229 | 32.88 | 1.74 | 0.00 | 31.40 | 53.68 | 14.91 | Sandy-Silt | 0.062 | 0.745 | 0.253 | 48.4 | 5.9 | 2.18 | 219 | 15.4 | 55.0 |
| 230 | 33.97 | 1.72 | 0.00 | 32.85 | 50.02 | 17.13 | Sandy-Silt | 0.075 | 0.823 | 0.251 | 49.7 | 6.9 | 2.30 | 263 | 8.8 | 56.2 |
| 231 | 26.83 | 1.86 | 0.00 | 67.29 | 25.61 | 7.10 | Silty-Sand | 0.039 | 0.474 | 0.119 | 32.3 | 2.4 | 1.60 | 243 | 9.6 | 37.3 |
| 232 | 28.85 | 1.82 | 0.00 | 85.33 | 11.24 | 3.44 | Sand | 0.026 | 0.265 | 0.070 | 21.5 | 1.8 | 1.14 | 202 | 1.6 | 25.7 |
| 233 | 21.58 | 1.98 | 0.00 | 96.54 | 2.50 | 0.96 | Sand | | | | | | | | | |
| 234 | 23.57 | 1.94 | 0.00 | 77.62 | 16.07 | 6.31 | Sand | 0.043 | 0.439 | 0.108 | 33.1 | 3.4 | 1.57 | 270 | 9.8 | 35.4 |
| 235 | 25.24 | 1.90 | 0.00 | 94.82 | 3.69 | 1.49 | Sand | 0.017 | 0.689 | 0.058 | 12.9 | 1.7 | 0.68 | 130 | BDL | 13.4 |
| 236 | 36.42 | 1.67 | 0.00 | 91.93 | 6.37 | 1.70 | Sand | 0.038 | 0.359 | 0.071 | 12.7 | 2.1 | 0.63 | 65 | 3.3 | 16.1 |
| 237 | 33.64 | 1.72 | 0.00 | 83.85 | 11.94 | 4.21 | Sand | 0.057 | 0.567 | 0.075 | 18.1 | 2.4 | 0.78 | 93 | 8.4 | 21.8 |
| 238 | 27.99 | 1.84 | 0.00 | 96.23 | 2.46 | 1.31 | Sand | 0.016 | 0.143 | 0.041 | 10.7 | 1.6 | 0.46 | 37 | 5.3 | 13.5 |
| 239 | 22.04 | 1.97 | 0.00 | 87.58 | 7.89 | 4.54 | Sand | | | | | | | | | |
| 240 | 24.99 | 1.90 | 0.00 | 79.37 | 13.82 | 6.81 | Sand | 0.043 | 0.427 | 0.125 | 26.4 | 2.5 | 1.14 | 146 | 11.5 | 30.8 |
| 241 | 23.18 | 1.94 | 0.00 | 73.53 | 18.56 | 7.91 | Silty-Sand | | | | | | | | | |
| 242 | 21.72 | 1.98 | 0.00 | 85.92 | 9.84 | 4.25 | Sand | | | | | | | | | |
| 243 | 21.10 | 2.00 | 0.00 | 76.69 | 18.64 | 4.67 | Sand | | | | | | | | | |
| 244 | 24.80 | 1.91 | 0.00 | 53.35 | 34.49 | 12.16 | Silty-Sand | 0.050 | 0.550 | 0.151 | 37.9 | 3.4 | 1.68 | 221 | 4.1 | 42.7 |
| 245 | 36.71 | 1.67 | 0.00 | 29.06 | 54.13 | 16.80 | Sandy-Silt | 0.072 | 0.769 | 0.258 | 51.2 | 5.3 | 2.30 | 227 | 17.9 | 57.0 |
| 246 | 35.20 | 1.69 | 0.00 | 29.48 | 52.82 | 17.70 | Sandy-Silt | 0.073 | 0.856 | 0.277 | 52.7 | 6.1 | 2.40 | 243 | 17.0 | 60.4 |
| 247 | 33.25 | 1.73 | 0.00 | 34.37 | 51.05 | 14.58 | Sandy-Silt | 0.058 | 0.750 | 0.217 | 43.0 | 3.8 | 1.96 | 195 | 14.7 | 49.8 |
| 248 | 34.22 | 1.71 | 0.00 | 44.09 | 39.24 | 16.67 | Silty-Sand | 0.072 | 0.986 | 0.243 | 47.6 | 5.8 | 2.17 | 242 | 13.0 | 53.7 |
| 249 | 39.69 | 1.62 | 0.00 | 27.53 | 50.55 | 21.92 | Sand-Silt-Clay | 0.090 | 1.109 | 0.354 | 57.6 | 6.5 | 2.63 | 218 | 22.6 | 65.3 |
| 250 | 41.81 | 1.58 | 0.00 | 14.36 | 59.68 | 25.96 | Clayey-Silt | 0.104 | 1.325 | 0.411 | 69.2 | 7.7 | 3.05 | 280 | 25.5 | 72.7 |
| 251 | 39.19 | 1.62 | 0.00 | 16.70 | 57.09 | 26.21 | Clayey-Silt | 0.118 | 1.388 | 0.360 | 63.0 | 8.7 | 2.91 | 241 | 18.4 | 71.3 |
| 252 | 33.84 | 1.72 | 0.00 | 59.31 | 26.61 | 14.08 | Silty-Sand | 0.075 | 1.089 | 0.373 | 39.0 | 5.5 | 1.76 | 115 | 13.3 | 45.3 |
| 253 | 45.07 | 1.53 | 0.00 | 16.15 | 52.61 | 31.24 | Clayey-Silt | 0.123 | 1.437 | 0.318 | 81.5 | 9.6 | 3.41 | 295 | 25.8 | 87.3 |
| 254 | 28.83 | 1.82 | 0.00 | 56.77 | 30.42 | 12.81 | Silty-Sand | 0.056 | 0.622 | 0.176 | 43.5 | 3.8 | 1.92 | 230 | 15.2 | 47.2 |
| 255 | 46.87 | 1.51 | 0.00 | 15.80 | 52.42 | 31.79 | Clayey-Silt | 0.120 | 1.449 | 0.382 | 80.7 | 8.3 | 3.61 | 268 | 26.6 | 91.1 |
| 256 | 35.99 | 1.68 | 0.00 | 45.67 | 36.14 | 18.19 | Silty-Sand | 0.073 | 0.869 | 0.271 | 52.0 | 5.4 | 2.22 | 196 | 17.8 | 59.1 |

**Table X.** Textural and chemical data for surficial sediment samples collected in the middle Chincoteague Bay. BDL refers to "below detection limit." Average detection limits for the metals are listed in Table XIV (Appendix III). Fifty-six coarse-grained samples were not analyzed for chemistry, and are indicated by blank cells.

| Sample ID | Textural Data | | | | | | | Chemical Data | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water % | Bulk Density (g/cm$^3$) | Gravel % | Sand % | Silt % | Clay % | Shepard"s (1954) Classification | Nitrogen % | Carbon % | Sulfur % | Cr µg/g | Cu µg/g | Fe % | Mn µg/g | Ni µg/g | Zn µg/g |
| 257 | 37.72 | 1.65 | 0.00 | 34.66 | 44.09 | 21.25 | Sand-Silt-Clay | 0.084 | 1.167 | 0.308 | 59.7 | 6.4 | 2.50 | 209 | 19.8 | 66.7 |
| 258 | 36.32 | 1.67 | 0.00 | 35.79 | 45.44 | 18.77 | Sandy-Silt | 0.079 | 0.932 | 0.324 | 44.9 | 8.7 | 2.22 | 208 | 24.4 | 43.1 |
| 259 | 29.92 | 1.80 | 0.00 | 40.33 | 47.52 | 12.15 | Sandy-Silt | 0.061 | 0.699 | 0.233 | 42.9 | 3.4 | 2.08 | 262 | 15.1 | 49.7 |
| 260 | 33.40 | 1.73 | 0.00 | 46.04 | 41.34 | 12.62 | Silty-Sand | 0.056 | 0.590 | 0.164 | 43.6 | 3.7 | 2.15 | 325 | 16.4 | 48.8 |
| 261 | 27.89 | 1.84 | 0.00 | 70.83 | 22.31 | 6.86 | Silty-Sand | 0.039 | 0.437 | 0.111 | 29.2 | 2.4 | 1.39 | 231 | 5.3 | 30.6 |
| 262 | 22.54 | 1.96 | 0.00 | 66.56 | 26.00 | 7.44 | Silty-Sand | 0.036 | 0.388 | 0.114 | 30.1 | 2.0 | 1.43 | 195 | 13.5 | 34.0 |
| 263 | 20.94 | 2.00 | 0.00 | 83.11 | 11.97 | 4.92 | Sand | | | | | | | | | |
| 264 | 21.07 | 2.00 | 0.00 | 98.94 | 1.06 | 0.00 | Sand | | | | | | | | | |
| 265 | 22.31 | 1.97 | 0.00 | 97.83 | 2.17 | 0.00 | Sand | | | | | | | | | |
| 266 | 22.86 | 1.95 | 0.00 | 88.62 | 7.66 | 3.71 | Sand | | | | | | | | | |
| 267 | 29.78 | 1.80 | 0.00 | 98.57 | 1.43 | 0.00 | Sand | 0.012 | 0.102 | 0.039 | 10.2 | BDL | 0.49 | 106 | 7.0 | 10.0 |
| 268 | 57.90 | 1.36 | 0.00 | 3.15 | 53.72 | 43.13 | Clayey-Silt | 0.288 | 2.932 | 1.337 | 91.0 | 15.4 | 4.37 | 329 | 30.4 | 111.2 |
| 269 | 50.86 | 1.45 | 0.00 | 36.65 | 36.44 | 26.90 | Sand-Silt-Clay | 0.204 | 2.330 | 0.814 | 65.5 | 10.6 | 3.15 | 278 | 28.8 | 76.9 |
| 270 | 23.89 | 1.93 | 0.00 | 88.90 | 6.74 | 4.35 | Sand | | | | | | | | | |
| 271 | 24.99 | 1.90 | 0.00 | 97.25 | 1.81 | 0.94 | Sand | | | | | | | | | |
| 272 | 21.22 | 1.99 | 0.00 | 89.45 | 7.53 | 3.01 | Sand | 0.023 | 0.222 | 0.071 | 19.2 | BDL | 1.03 | 195 | 4.2 | 22.0 |
| 273 | 22.32 | 1.97 | 0.00 | 83.56 | 12.12 | 4.32 | Sand | | | | | | | | | |
| 274 | 29.54 | 1.80 | 0.00 | 85.58 | 11.12 | 3.30 | Sand | 0.030 | 0.272 | 0.085 | 25.5 | BDL | 1.31 | 260 | 8.2 | 26.0 |
| 275 | 30.67 | 1.78 | 0.00 | 60.88 | 30.95 | 8.17 | Silty-Sand | 0.046 | 0.458 | 0.131 | 38.7 | 1.7 | 1.99 | 348 | 12.2 | 41.1 |
| 276 | 24.08 | 1.92 | 0.00 | 64.44 | 28.85 | 6.71 | Silty-Sand | | | | | | | | | |
| 277 | 31.49 | 1.76 | 0.00 | 41.18 | 42.56 | 16.26 | Sandy-Silt | 0.072 | 0.842 | 0.211 | 54.9 | 4.0 | 2.79 | 472 | 15.6 | 56.4 |
| 278 | 28.55 | 1.82 | 0.00 | 35.91 | 46.84 | 17.25 | Sandy-Silt | 0.072 | 2.395 | 0.177 | 48.7 | 1.9 | 2.36 | 367 | 6.8 | 52.4 |
| 279 | 34.48 | 1.71 | 0.00 | 35.93 | 46.57 | 17.49 | Sandy-Silt | 0.074 | 1.860 | 0.235 | 52.1 | 3.4 | 2.32 | 301 | 10.1 | 55.2 |
| 280 | 31.91 | 1.76 | 0.00 | 36.70 | 44.49 | 18.82 | Sandy-Silt | 0.077 | 2.057 | 0.211 | 46.4 | 3.6 | 2.10 | 241 | 10.9 | 52.7 |
| 281 | 35.88 | 1.68 | 0.00 | 38.21 | 42.45 | 19.33 | Sandy-Silt | 0.078 | 0.962 | 0.304 | 53.1 | 5.4 | 2.31 | 231 | 14.0 | 60.5 |
| 282 | 33.35 | 1.73 | 0.15 | 52.95 | 31.11 | 15.79 | Silty-Sand | 0.069 | 0.791 | 0.207 | 50.8 | 3.5 | 2.15 | 238 | 17.6 | 54.7 |
| 283 | 44.01 | 1.55 | 0.00 | 14.37 | 52.94 | 32.69 | Clayey-Silt | 0.127 | 1.529 | 0.414 | 81.5 | 9.8 | 3.33 | 297 | 30.7 | 89.6 |
| 284 | 47.20 | 1.50 | 0.00 | 5.68 | 67.34 | 26.98 | Clayey-Silt | 0.153 | 1.859 | 0.598 | 72.8 | 9.7 | 3.08 | 265 | 24.9 | 83.1 |

**Table X.** Textural and chemical data for surficial sediment samples collected in the middle Chincoteague Bay. BDL refers to "below detection limit." Average detection limits for the metals are listed in Table XIV (Appendix III). Fifty-six coarse-grained samples were not analyzed for chemistry, and are indicated by blank cells.

| Sample ID | Textural Data | | | | | | | Chemical Data | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water % | Bulk Density (g/cm$^3$) | Gravel % | Sand % | Silt % | Clay % | Shepard"s (1954) Classification | Nitrogen % | Carbon % | Sulfur % | Cr µg/g | Cu µg/g | Fe % | Mn µg/g | Ni µg/g | Zn µg/g |
| 285 | 46.90 | 1.51 | 0.00 | 4.37 | 62.64 | 32.99 | Clayey-Silt | 0.144 | 1.772 | 0.478 | 83.5 | 13.4 | 3.31 | 256 | 21.3 | 96.6 |
| 286 | 49.71 | 1.47 | 0.00 | 7.37 | 51.28 | 41.34 | Clayey-Silt | 0.157 | 1.846 | 0.390 | 91.8 | 13.7 | 3.79 | 272 | 26.5 | 105.8 |
| 287 | 42.86 | 1.57 | 0.00 | 3.41 | 75.05 | 21.55 | Silt | 0.102 | 1.153 | 0.276 | 61.5 | 9.1 | 2.62 | 230 | 11.9 | 70.2 |
| 288 | 36.58 | 1.67 | 0.00 | 22.44 | 55.64 | 21.92 | Sand-Silt-Clay | 0.098 | 1.178 | 0.234 | 59.6 | 6.5 | 2.39 | 244 | 15.1 | 66.4 |
| 289 | 43.79 | 1.55 | 0.00 | 17.31 | 50.55 | 32.14 | Clayey-Silt | 0.135 | 1.549 | 0.351 | 90.1 | 11.6 | 3.55 | 319 | 25.5 | 94.1 |
| 290 | 39.68 | 1.62 | 0.00 | 27.16 | 47.18 | 25.66 | Sand-Silt-Clay | 0.100 | 1.133 | 0.339 | 68.4 | 8.0 | 2.77 | 272 | 18.2 | 75.9 |
| 291 | 36.52 | 1.67 | 0.00 | 38.93 | 39.63 | 21.45 | Sand-Silt-Clay | 0.084 | 0.951 | 0.263 | 66.2 | 68.8 | 2.68 | 289 | 23.7 | 70.7 |
| 292 | 28.95 | 1.82 | 0.00 | 51.92 | 33.71 | 14.37 | Silty-Sand | 0.067 | 1.854 | 0.133 | 46.2 | 4.5 | 2.00 | 275 | 5.5 | 49.2 |
| 293 | 31.54 | 1.76 | 0.00 | 46.10 | 36.66 | 17.24 | Silty-Sand | 0.073 | 0.911 | 0.227 | 51.8 | 5.6 | 2.29 | 297 | 14.6 | 57.3 |
| 294 | 24.50 | 1.91 | 0.00 | 64.70 | 25.09 | 10.21 | Silty-Sand | | | | | | | | | |
| 295 | 33.83 | 1.72 | 0.00 | 62.16 | 29.36 | 8.48 | Silty-Sand | 0.045 | 0.840 | 0.134 | 33.5 | 2.5 | 1.60 | 262 | 9.6 | 38.1 |
| 296 | 22.92 | 1.95 | 0.00 | 63.44 | 28.07 | 8.49 | Silty-Sand | | | | | | | | | |
| 297 | 24.54 | 1.91 | 0.00 | 61.84 | 28.41 | 9.75 | Silty-Sand | 0.054 | 0.586 | 0.173 | 37.0 | 2.5 | 1.61 | 235 | 11.3 | 41.7 |
| 298 | 24.51 | 1.91 | 0.00 | 70.14 | 21.35 | 8.51 | Silty-Sand | | | | | | | | | |
| 299 | 21.56 | 1.98 | 0.00 | 97.39 | 2.61 | 0.00 | Sand | | | | | | | | | |
| 300 | 26.52 | 1.87 | 0.00 | 88.67 | 7.36 | 3.98 | Sand | 0.044 | 0.483 | 0.099 | 19.7 | 2.0 | 0.91 | 159 | BDL | 24.4 |
| 301 | 26.60 | 1.87 | 0.00 | 95.87 | 2.95 | 1.19 | Sand | 0.016 | 0.163 | 0.048 | 10.5 | BDL | 0.53 | 97 | BDL | 14.4 |
| 303 | 29.04 | 1.81 | 0.00 | 55.95 | 31.50 | 12.55 | Silty-Sand | 0.056 | 0.692 | 0.160 | 42.0 | 4.5 | 1.85 | 263 | 13.6 | 47.6 |
| 304 | 38.90 | 1.63 | 0.43 | 26.39 | 49.83 | 23.35 | Sand-Silt-Clay | 0.094 | 1.075 | 0.298 | 71.1 | 8.9 | 3.10 | 367 | 28.1 | 74.5 |
| 305 | 40.88 | 1.60 | 0.00 | 12.89 | 58.08 | 29.03 | Clayey-Silt | 0.110 | 1.319 | 0.379 | 82.0 | 8.8 | 3.52 | 351 | 27.3 | 83.6 |
| 306 | 43.50 | 1.56 | 0.00 | 13.17 | 54.81 | 32.02 | Clayey-Silt | 0.118 | 1.433 | 0.363 | 78.4 | 11.0 | 3.45 | 364 | 30.1 | 88.4 |
| 307 | 35.42 | 1.69 | 0.00 | 39.54 | 37.08 | 23.38 | Sand-Silt-Clay | 0.102 | 1.166 | 0.260 | 61.7 | 8.5 | 2.76 | 278 | 21.6 | 67.5 |
| 308 | 43.24 | 1.56 | 0.00 | 10.96 | 62.52 | 26.52 | Clayey-Silt | 0.113 | 1.344 | 0.409 | 70.0 | 8.9 | 3.07 | 306 | 26.3 | 75.9 |
| 309 | 47.44 | 1.50 | 0.00 | 8.55 | 56.33 | 35.12 | Clayey-Silt | 0.149 | 1.871 | 0.416 | 95.7 | 13.5 | 4.25 | 361 | 36.8 | 103.2 |
| 310 | 44.80 | 1.54 | 0.00 | 20.12 | 50.06 | 29.82 | Sand-Silt-Clay | 0.140 | 1.797 | 0.494 | 68.9 | 12.2 | 3.06 | 250 | 27.3 | 85.0 |
| 312 | 20.68 | 2.01 | 0.00 | 95.26 | 4.74 | 0.00 | Sand | | | | | | | | | |
| 313 | 29.64 | 1.80 | 0.00 | 52.39 | 38.56 | 9.05 | Silty-Sand | 0.074 | 0.764 | 0.216 | 39.8 | 4.7 | 1.67 | 234 | 17.1 | 44.2 |
| 315 | 52.92 | 1.42 | 0.00 | 9.17 | 50.11 | 40.72 | Clayey-Silt | 0.164 | 1.907 | 0.573 | 96.8 | 12.5 | 4.03 | 317 | 36.1 | 104.5 |

**Table X.** Textural and chemical data for surficial sediment samples collected in the middle Chincoteague Bay. BDL refers to "below detection limit." Average detection limits for the metals are listed in Table XIV (Appendix III). Fifty-six coarse-grained samples were not analyzed for chemistry, and are indicated by blank cells.

| Sample ID | Textural Data | | | | | | | Chemical Data | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water % | Bulk Density (g/cm$^3$) | Gravel % | Sand % | Silt % | Clay % | Shepard"s (1954) Classification | Nitrogen % | Carbon % | Sulfur % | Cr µg/g | Cu µg/g | Fe % | Mn µg/g | Ni µg/g | Zn µg/g |
| 316 | 46.12 | 1.52 | 0.00 | 4.89 | 64.79 | 30.33 | Clayey-Silt | 0.113 | 1.305 | 0.347 | 76.1 | 9.3 | 3.28 | 274 | 23.8 | 86.5 |
| 317 | 48.19 | 1.49 | 0.00 | 4.62 | 57.44 | 37.94 | Clayey-Silt | 0.140 | 1.613 | 0.408 | 90.9 | 11.0 | 3.93 | 306 | 32.5 | 102.2 |
| 318 | 44.89 | 1.54 | 0.00 | 6.50 | 62.67 | 30.83 | Clayey-Silt | 0.124 | 1.394 | 0.340 | 83.7 | 10.0 | 3.62 | 328 | 28.0 | 90.6 |
| 319 | 39.80 | 1.61 | 0.00 | 23.21 | 50.82 | 25.97 | Sand-Silt-Clay | 0.104 | 1.227 | 0.301 | 70.3 | 8.9 | 2.97 | 267 | 27.6 | 79.1 |
| 320 | 44.83 | 1.54 | 0.00 | 8.08 | 60.06 | 31.85 | Clayey-Silt | 0.122 | 1.474 | 0.374 | 79.2 | 10.1 | 3.43 | 318 | 30.0 | 90.2 |
| 321 | 33.37 | 1.73 | 0.00 | 27.64 | 49.68 | 22.68 | Sand-Silt-Clay | 0.091 | 1.037 | 0.273 | 65.8 | 7.2 | 2.75 | 295 | 24.4 | 71.0 |
| 322 | 30.91 | 1.78 | 0.00 | 30.14 | 51.72 | 18.14 | Sandy-Silt | 0.071 | 0.815 | 0.268 | 51.5 | 5.8 | 2.20 | 235 | 19.0 | 54.6 |
| 323 | 47.25 | 1.50 | 0.00 | 9.76 | 53.35 | 36.89 | Clayey-Silt | 0.132 | 1.544 | 0.362 | 88.1 | 10.9 | 3.74 | 321 | 29.9 | 97.9 |
| 324 | 45.67 | 1.52 | 0.00 | 3.64 | 61.70 | 34.66 | Clayey-Silt | 0.142 | 1.604 | 0.377 | 83.6 | 11.4 | 3.72 | 322 | 28.1 | 96.0 |
| 325 | 26.30 | 1.87 | 0.00 | 95.15 | 2.85 | 2.00 | Sand | 0.015 | 0.143 | 0.036 | 13.0 | 0.9 | 0.56 | 123 | 7.5 | 13.1 |
| 326 | 45.45 | 1.53 | 0.00 | 8.38 | 60.77 | 30.85 | Clayey-Silt | 0.140 | 1.663 | 0.489 | 76.6 | 10.0 | 3.27 | 293 | 29.2 | 79.1 |
| 327 | 28.98 | 1.82 | 0.00 | 97.27 | 1.61 | 1.12 | Sand | 0.013 | 0.101 | 0.030 | 8.3 | 1.5 | 0.29 | 71 | 8.5 | 8.1 |
| 328 | 27.02 | 1.86 | 0.00 | 59.51 | 25.73 | 14.75 | Silty-Sand | 0.066 | 0.827 | 0.200 | 43.2 | 6.3 | 1.81 | 189 | 17.1 | 46.6 |
| 329 | 24.11 | 1.92 | 0.00 | 75.19 | 18.38 | 6.43 | Sand | | | | | | | | | |
| 331 | 24.69 | 1.91 | 0.00 | 78.68 | 17.23 | 4.09 | Sand | 0.041 | 0.389 | 0.066 | 23.5 | 3.4 | 0.99 | 153 | 12.5 | 27.4 |
| 332 | 19.00 | 2.05 | 0.00 | 96.52 | 3.48 | 0.00 | Sand | | | | | | | | | |
| 333 | 20.34 | 2.02 | 0.00 | 95.44 | 4.56 | 0.00 | Sand | | | | | | | | | |
| 334 | 24.43 | 1.92 | 0.00 | 79.28 | 14.53 | 6.19 | Sand | | | | | | | | | |
| 336 | 29.22 | 1.81 | 0.00 | 97.37 | 2.63 | 0.00 | Sand | 0.016 | 0.131 | 0.038 | 10.9 | 1.0 | 0.43 | 79 | 12.0 | 12.1 |
| 337 | 28.16 | 1.83 | 0.00 | 65.95 | 23.39 | 10.67 | Silty-Sand | 0.069 | 0.714 | 0.210 | 35.6 | 4.8 | 1.47 | 176 | 8.4 | 40.1 |
| 338 | 31.64 | 1.76 | 0.00 | 44.04 | 43.07 | 12.89 | Silty-Sand | 0.084 | 0.867 | 0.337 | 42.1 | 4.3 | 1.79 | 202 | 13.2 | 47.8 |
| 340 | 24.69 | 1.91 | 0.00 | 64.59 | 25.87 | 9.54 | Silty-Sand | 0.063 | 0.704 | 0.161 | 33.6 | 3.1 | 1.42 | 178 | 15.0 | 36.3 |
| 341 | 25.11 | 1.90 | 0.00 | 83.34 | 12.05 | 4.61 | Sand | 0.048 | 0.518 | 0.078 | 19.5 | 1.9 | 0.85 | 127 | 7.8 | 21.7 |
| 342 | 24.78 | 1.91 | 0.00 | 90.58 | 5.31 | 4.11 | Sand | 0.042 | 0.419 | 0.119 | 19.2 | 2.1 | 0.79 | 121 | 12.1 | 20.0 |
| 344 | 41.60 | 1.59 | 0.00 | 64.24 | 24.61 | 11.16 | Silty-Sand | 0.078 | 4.648 | 0.015 | 23.3 | 1.5 | 1.19 | 401 | 1.2 | 27.8 |
| 345 | 32.90 | 1.74 | 0.00 | 67.20 | 20.24 | 12.56 | Silty-Sand | 0.081 | 0.928 | 0.208 | 42.6 | 4.9 | 1.68 | 176 | 14.6 | 46.2 |
| 346 | 44.86 | 1.54 | 0.00 | 7.94 | 56.99 | 35.07 | Clayey-Silt | 0.135 | 1.632 | 0.366 | 86.2 | 10.8 | 3.48 | 329 | 27.0 | 92.8 |
| 347 | 47.10 | 1.50 | 0.00 | 24.12 | 43.38 | 32.50 | Sand-Silt-Clay | 0.128 | 1.494 | 0.335 | 82.7 | 10.0 | 3.26 | 272 | 31.3 | 86.6 |

**Table X.** Textural and chemical data for surficial sediment samples collected in the middle Chincoteague Bay. BDL refers to "below detection limit." Average detection limits for the metals are listed in Table XIV (Appendix III). Fifty-six coarse-grained samples were not analyzed for chemistry, and are indicated by blank cells.

| Sample ID | Textural Data | | | | | | | Chemical Data | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water % | Bulk Density (g/cm$^3$) | Gravel % | Sand % | Silt % | Clay % | Shepard"s (1954) Classification | Nitrogen % | Carbon % | Sulfur % | Cr µg/g | Cu µg/g | Fe % | Mn µg/g | Ni µg/g | Zn µg/g |
| 348 | 54.67 | 1.40 | 0.00 | 5.89 | 54.41 | 39.70 | Clayey-Silt | 0.173 | 2.028 | 0.701 | 90.5 | 12.1 | 3.85 | 291 | 23.0 | 97.5 |
| 349 | 54.34 | 1.41 | 0.00 | 2.23 | 68.25 | 29.52 | Clayey-Silt | 0.203 | 2.650 | 1.111 | 82.2 | 11.5 | 3.47 | 257 | 24.3 | 94.4 |
| 350 | 28.29 | 1.83 | 0.00 | 74.53 | 15.57 | 9.90 | Silty-Sand | 0.076 | 0.762 | 0.224 | 31.7 | 4.3 | 1.23 | 130 | 11.8 | 37.0 |
| 351 | 57.14 | 1.37 | 0.00 | 2.87 | 54.00 | 43.13 | Clayey-Silt | 0.223 | 2.873 | 0.772 | 76.3 | 11.8 | 3.10 | 271 | 26.6 | 95.8 |
| 353 | 22.50 | 1.96 | 0.00 | 65.23 | 32.50 | 2.27 | Silty-Sand | 0.024 | 0.226 | 0.054 | 18.5 | BDL | 0.86 | 199 | BDL | 18.3 |

# Appendix III - Quality Assurance/Quality Control

- Textural analyses
- NCS analyses
- Metal analyses

**Textural Analyses- Quality Assurance/Quality Control**

Although the techniques used to determine grain size are based on traditional analytical methods developed for the sedimentology lab, some analytical error is inherent to the techniques. For example, results can be affected by level of technician skill and/or changes in laboratory conditions (such as sudden temperature changes). Furthermore, there is no standard reference material available that includes the broad range of particle sizes and shapes contained in a natural sediment. To maximize consistency of textural analysis, several "checks" are used to monitor results. The calculated sand, silt, clay, (and gravel) percentages are checked against 1)sample field descriptions; 2) calculated water contents; and 3) calculated weight loss of sample during cleaning process. These comparisons are made to determine if the size components match the visual description of the sample and/or fall within an expected range of values for water content and weight loss. Any discrepancy is "flagged"and the results are further reviewed to determine if re-analysis is warranted. In addition, new technicians analyze, as their first samples,a suite of randomly selected samples that have been analyzed previously (by an experience technician) and the results are compared.

The criteria for each of the internal checks are as follows:

1) Calculated sand, silt, clay, (and gravel) percentages and Shepard's classification of the sediments are compared to the visual description (both field description and lab description). This criteria is fairly straightforward. If the results indicate an entirely different sample than what was described when collected, then the sample is re-analyzed.

2) Percentages are compared to calculated water contents. Table XI lists the expected ranges of water content for each sediment type. Mean and ranges are based on sediments collected in Isle of Wight and Assawoman Bays.

3) Sample loss (% dry weight) during cleaning is calculated for each sample. The calculated water content, which usually is measured immediately after the sample is collected, is used to determine weight loss. If the sediment dried out, even slightly, before it was sub-sampled for textural analysis, then the amount of weight loss would be under estimated, and, in some instances, negative. The degree of weight loss during the cleaning process is related to sediment type (grain size) as well as the organic content of the sediment. Organic rich, fine grained sediments (*i.e.*, silty clay and clayey silt) may lose up to 30% dry weight during the cleaning process. Sand, which is fairly clean, usually yields the smallest weight loss, and often shows a negative weight loss due to error inherent to water content determinations. Table XI lists the ranges of weight loss percentages for each group of sediments. Mean and ranges are based on sediments collected in Isle of Wight and Assawoman Bays

**Table XI.** Mean and range of water contents and calculated weight loss after cleaning for each sediment type (Shepard's Classification) based on sediments collected in Isle of Wight and Assawoman Bays (Wells and others, 1994b). Means are rounded to nearest whole percentage. Range values are based on standard deviation from the mean.

| Sediment Type | Water content (% wet weight) | | Weight loss (% dry weight) | |
|---|---|---|---|---|
| | Mean | Range | Mean | Range |
| SAND | 22 | 17 - 27 | 1 | -4 - 6 |
| SILTY SAND | 39 | 31 - 47 | 7 | 2 - 12 |
| CLAYEY SAND | 47 | 41 - 53 | 3 | 0 -6 |
| SANDY SILT | 48 | 42 - 54 | 13 | 5 - 21 |
| CLAYEY SILT | 60 | 53 - 67 | 20 | 13 - 27 |
| SILTY CLAY | 70 | 67 - 73 | 28 | 23 - 33 |
| SAND SILT CLAY | 56 | 49 - 63 | 13 | 2 - 24 |

For this study, 42 (12% of total samples) surficial samples were duplicated for textural analyses and 1 samples was analyzed for a third time (triplicate). Table XII lists the results of the replicated analyses. Thirty-four of the 42 duplicates analyses yielded sand, silt, clay percentages within 5% of their first analyses. Of the ones that did not, most exceeded 5% differences in silt and sand content, which reflect the differences in technicians' sieving skills. These differences are not surprising because these sediments contained very fine sand and coarse silt, particles sizes matching the diameter of the mesh opening in the sieve used. As a result, sieving these samples was very difficult.

**Table XII.** Comparison of results of replicate (designated by *redo*) and triplicate (*T*) textural analyses of selected surficial samples. Replicate samples having greater than 5% differences in textural parameters are bolded.

| Sample ID | % Water | % Sand | % Silt | % Clay | Shepard's Classification | Δ Sand | Δ Silt | Δ Clay | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 16 | 43.34 | 92.67 | 4.06 | 3.27 | Sand | | | | |
| 16 redo | 21.35 | 91.74 | 4.51 | 3.70 | Sand | 0.93 | 0.45 | 0.43 | No change in classification |
| **35** | **49.80** | **1.52** | **70.82** | **27.66** | **Clayey-Silt** | **2.69** | **14.45** | **11.75** | **No change in classification, but high silt% in first analysis was suspect; accepted 2nd and 3rd results, results of first analysis attributed to pipetting error.** |
| **35 redo** | **46.77** | **4.38** | **56.96** | **38.66** | **Clayey-Silt** | **2.86** | **13.86** | **11.00** | |
| **35 T** | **46.77** | **4.21** | **56.37** | **39.41** | **Clayey-Silt** | **0.17** | **0.59** | **0.76** | |
| 46 | 25.57 | 94.85 | 5.15 | 0.00 | Sand | | | | |
| 46 redo | 25.57 | 94.72 | 3.80 | 1.47 | Sand | 0.13 | 1.35 | 1.47 | No change in classification |
| **58** | **41.17** | **10.07** | **68.00** | **21.93** | **Clayey-Silt** | | | | |
| **58 redo** | **41.17** | **18.43** | **59.04** | **22.53** | **Clayey-Silt** | **8.36** | **8.96** | **0.60** | **No change in classification; difference in Sa:Si ratio** |
| 59 | 40.72 | 40.64 | 39.15 | 20.21 | Sand-Silt-Clay | | | | |
| 59 redo | 40.72 | 39.40 | 38.32 | 22.28 | Sand-Silt-Clay | 1.24 | 0.83 | 2.07 | No change in classification |
| 59R | 37.10 | 33.86 | 43.08 | 23.07 | Sand-Silt-Clay | | | | |
| 59R redo | 37.10 | 34.65 | 41.46 | 23.89 | Sand-Silt-Clay | 0.79 | 1.62 | 0.83 | No change in classification |
| 60 | 39.53 | 40.57 | 36.97 | 22.46 | Sand-Silt-Clay | | | | |
| 60 redo | 34.37 | 40.41 | 36.50 | 23.09 | Sand-Silt-Clay | 0.15 | 0.47 | 0.62 | No change in classification |
| 60R | 30.50 | 58.45 | 27.04 | 14.52 | Silty-Sand | | | | |
| 60R redo | 28.91 | 57.46 | 25.88 | 16.67 | Silty-Sand | 0.99 | 1.16 | 2.15 | No change in classification |
| 62 | 41.29 | 31.53 | 43.14 | 25.32 | Sand-Silt-Clay | | | | |
| 62 redo | 41.29 | 31.87 | 42.51 | 25.62 | Sand-Silt-Clay | 0.34 | 0.64 | 0.30 | No change in classification |
| 62R | 41.66 | 25.24 | 46.91 | 27.85 | Sand-Silt-Clay | | | | |
| 62R redo | 41.66 | 25.27 | 47.47 | 27.26 | Sand-Silt-Clay | 0.03 | 0.56 | 0.59 | No change in classification |
| 63 | 47.48 | 3.68 | 60.30 | 36.02 | Clayey-Silt | | | | |
| 63 redo | 47.48 | 3.73 | 60.43 | 35.84 | Clayey-Silt | 0.05 | 0.13 | 0.18 | No change in classification |
| 64 | 50.61 | 5.68 | 57.61 | 36.72 | Clayey-Silt | | | | |
| 64 redo | 50.61 | 5.67 | 58.35 | 35.98 | Clayey-Silt | 0.00 | 0.74 | 0.74 | No change in classification |

**Table XII.** Comparison of results of replicate (designated by *redo*) and triplicate (*T*) textural analyses of selected surficial samples. Replicate samples having greater than 5% differences in textural parameters are bolded.

| Sample ID | % Water | % Sand | % Silt | % Clay | Shepard's Classification | Δ Sand | Δ Silt | Δ Clay | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 65 | 48.04 | 4.82 | 60.23 | 34.95 | Clayey-Silt | | | | |
| 65 redo | 48.04 | 4.84 | 60.21 | 34.95 | Clayey-Silt | 0.02 | 0.01 | 0.00 | No change in classification |
| 66 | 42.24 | 21.66 | 49.70 | 28.64 | Sand-Silt-Clay | | | | |
| 66 redo | 42.24 | 21.75 | 49.62 | 28.63 | Sand-Silt-Clay | 0.09 | 0.08 | 0.01 | No change in classification |
| 86 | 27.24 | 97.00 | 2.29 | 0.71 | Sand | | | | |
| 86 redo | 27.24 | 96.64 | 3.36 | 0.00 | Sand | 0.36 | 1.07 | 0.71 | No change in classification |
| 87 | 26.94 | 90.04 | 6.99 | 2.97 | Sand | | | | |
| 87 redo | 26.94 | 89.65 | 7.13 | 3.22 | Sand | 0.40 | 0.14 | 0.25 | No change in classification |
| 94 | 39.75 | 10.73 | 65.12 | 24.15 | Clayey-Silt | | | | |
| 94 redo | 39.75 | 13.54 | 61.23 | 25.24 | Clayey-Silt | 2.80 | 3.89 | 1.09 | No change in classification |
| **118** | **31.33** | **50.11** | **42.47** | **7.41** | **Silty-Sand** | | | | |
| **118 redo** | **31.33** | **54.30** | **36.79** | **8.91** | **Silty-Sand** | **4.19** | **5.68** | **1.49** | **No change in classification** |
| **122** | **34.79** | **27.66** | **52.48** | **19.85** | **Sandy-Silt** | | | | |
| **122 redo** | **34.79** | **34.88** | **43.97** | **21.14** | **Sand-Silt-Clay** | **7.22** | **8.51** | **1.29** | **Change in classification due to difference in Sa:Si ratio; attributed to sieving technique** |
| 131 | 50.00 | 11.27 | 48.23 | 40.50 | Clayey-Silt | | | | |
| 131 redo | 50.00 | 11.17 | 46.66 | 42.17 | Clayey-Silt | 0.10 | 1.57 | 1.67 | No change in classification |
| 172 | 44.29 | 12.22 | 59.26 | 28.53 | Clayey-Silt | | | | |
| 172 redo | 44.29 | 16.12 | 54.38 | 29.50 | Clayey-Silt | 3.90 | 4.88 | 0.97 | No change in classification |
| 182 | 27.17 | 92.91 | 5.53 | 1.56 | Sand | | | | |
| 182 redo | 27.17 | 94.97 | 5.03 | 0.00 | Sand | 2.06 | 0.50 | 1.56 | No change in classification |
| 184 | 25.92 | 73.21 | 18.95 | 7.83 | Silty-Sand | | | | |
| 184 redo | 25.92 | 72.93 | 18.10 | 8.97 | Silty-Sand | 0.28 | 0.85 | 1.14 | No change in classification |
| 187 | 33.42 | 74.68 | 19.89 | 5.44 | Silty-Sand | | | | |
| 187 redo | 33.42 | 75.11 | 18.81 | 6.08 | Sand | 0.43 | 1.07 | 0.64 | Change in classification due to slight difference in sand percentages |
| 195 | 40.21 | 33.72 | 39.26 | 27.02 | Sand-Silt-Clay | | | | No change in classification |

**Table XII.** Comparison of results of replicate (designated by *redo*) and triplicate (*T*) textural analyses of selected surficial samples. Replicate samples having greater than 5% differences in textural parameters are bolded.

| Sample ID | % Water | % Sand | % Silt | % Clay | Shepard's Classification | Δ Sand | Δ Silt | Δ Clay | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 195 redo | 40.21 | 33.65 | 38.11 | 28.24 | Sand-Silt-Clay | 0.07 | 1.15 | 1.22 | |
| 214 | 35.14 | 58.32 | 33.11 | 8.58 | Silty-Sand | | | | |
| 214 redo | 35.14 | 62.16 | 28.96 | 8.88 | Silty-Sand | 3.85 | 4.15 | 0.30 | No change in classification |
| 219 | 36.36 | 24.98 | 55.87 | 19.15 | Sandy-Silt | | | | |
| 219 redo | 36.36 | 27.48 | 52.33 | 20.19 | Sand-Silt-Clay | 2.50 | 3.55 | 1.04 | Change in classification due to slight difference in Sa:Si ratios |
| 257 | 37.72 | 34.66 | 44.09 | 21.25 | Sand-Silt-Clay | | | | |
| 257 redo | 37.72 | 37.94 | 40.60 | 21.46 | Sand-Silt-Clay | 3.28 | 3.49 | 0.21 | No change in classification |
| **268** | **57.90** | **3.15** | **53.72** | **43.13** | **Clayey-Silt** | | | | |
| **268 redo** | **57.90** | **3.92** | **52.19** | **43.89** | **Clayey-Silt** | **0.77** | **1.53** | **0.76** | **No change in classification** |
| **278** | **28.55** | **35.91** | **46.84** | **17.25** | **Sandy-Silt** | | | | |
| **278 redo** | **28.55** | **42.93** | **39.02** | **18.05** | **Silty-Sand** | **7.01** | **7.81** | **0.80** | **Change in classification due to difference in Sa:Si ratios** |
| **279** | **34.48** | **35.93** | **46.57** | **17.49** | **Sandy-Silt** | | | | |
| **279 redo** | **34.48** | **42.03** | **39.42** | **18.55** | **Silty-Sand** | **6.10** | **7.15** | **1.05** | **Change in classification due to difference in Sa:Si ratios** |
| **280** | **31.91** | **36.70** | **44.49** | **18.82** | **Sandy-Silt** | | | | |
| **280 redo** | **31.91** | **41.81** | **38.62** | **19.57** | **Silty-Sand** | **5.11** | **5.86** | **0.76** | **Change in classification due to slight difference in Sa:Si ratios** |
| 287 | 42.86 | 3.41 | 75.05 | 21.55 | Silt | | | | |
| 287 redo | 42.86 | 4.96 | 71.56 | 23.48 | Clayey-Silt | 1.56 | 3.49 | 1.93 | Change in classification due to slight change in silt percentage |
| 292 | 28.95 | 51.92 | 33.71 | 14.37 | Silty-Sand | | | | |
| 292 redo | 28.95 | 53.04 | 31.50 | 15.46 | Silty-Sand | 1.12 | 2.21 | 1.09 | No change in classification |
| 303 | 29.04 | 55.95 | 31.50 | 12.55 | Silty-Sand | | | | |
| 303 redo | 29.04 | 59.74 | 28.48 | 11.78 | Silty-Sand | 3.79 | 3.03 | 0.76 | No change in classification |
| **304** | **38.90** | **26.39** | **49.83** | **23.35** | **Sand-Silt-Clay** | | | | |
| **304 redo** | **38.90** | **31.32** | **44.59** | **23.64** | **Sand-Silt-Clay** | **4.93** | **5.24** | **0.29** | **No change in classification; difference in Sa:Si ratio** |
| 310 | 44.80 | 20.12 | 50.06 | 29.82 | Sand-Silt-Clay | | | | |
| 310 redo | 44.80 | 20.09 | 49.03 | 30.82 | Sand-Silt-Clay | 0.03 | 1.02 | 1.00 | No change in classification |

**Table XII.** Comparison of results of replicate (designated by *redo*) and triplicate (*T*) textural analyses of selected surficial samples. Replicate samples having greater than 5% differences in textural parameters are bolded.

| Sample ID | % Water | % Sand | % Silt | % Clay | Shepard's Classification | Δ Sand | Δ Silt | Δ Clay | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 336 | 29.22 | 97.37 | 2.63 | 0.00 | Sand | | | | |
| 336 redo | 29.22 | 97.31 | 2.69 | 0.00 | Sand | 0.06 | 0.06 | 0.00 | No change in classification |
| 344 | 41.60 | 64.24 | 24.61 | 11.16 | Silty-Sand | | | | |
| 344 redo | 41.60 | 66.97 | 23.17 | 9.87 | Silty-Sand | 2.73 | 1.44 | 1.29 | No change in classification |
| 346 | 44.86 | 7.94 | 56.99 | 35.07 | Clayey-Silt | | | | |
| 346 redo | 44.86 | 10.27 | 54.08 | 35.65 | Clayey-Silt | 2.33 | 2.91 | 0.57 | No change in classification |
| 347 | 47.10 | 24.12 | 43.38 | 32.50 | Sand-Silt-Clay | | | | |
| 347 redo | 47.10 | 25.69 | 40.87 | 33.44 | Sand-Silt-Clay | 1.56 | 2.51 | 0.94 | No change in classification |
| 349 | 54.34 | 2.23 | 68.25 | 29.52 | Clayey-Silt | | | | |
| 349 redo | 54.34 | 2.48 | 67.76 | 29.75 | Clayey-Silt | 0.25 | 0.49 | 0.23 | No change in classification |

**Nitrogen, Carbon and Sulfur Analyses- Quality Assurance/Quality Control**

As part of the QA/QC protocol, a NIST reference material (NIST SRM #1646 - Estuarine Sediment) is used as a secondary standard, run every 6 to 7 samples (unknowns). Table XIII presents the comparisons of the MGS results and the certified values for total carbon, nitrogen and sulfur contents for the NIST standard. There is excellent agreement between the NIST values and MGS's results. Recoveries averaged 100% that of certified values. Detection limit for this method is 0.001% for nitrogen, carbon and sulfur (.

**Table XIII.** Results of nitrogen, carbon, and sulfur analyses of NIST-SRM #1646 (Estuarine Sediment) compared to the certified or known values. MGS values were obtained by averaging the results of all SRM analyses (n=51) run during this study. All samples (surficial and core) were analyzed over a four week period.

| Element Analyzed | Certified Values* (% by weight) | MGS Results (this study) |
|---|---|---|
| Nitrogen | 0.18 | 0.18 ±0.01 |
| Carbon | 1.72 | 1.71 ±0.03 |
| Sulfur | 0.96 | 1.05 ±0.05 |

* The value for carbon is certified by NIST. The sulfur value is the non-certified value reported by NIST. The value of nitrogen was obtained from repeated analyses in-house and by other laboratories (Haake Buchler Labs and U.S. Dept. of Agriculture).

**Metal Analyses- Quality Assurance/Quality Control**

For metal analyses, quality control was maintained using the method of bracketing standards (Van Loon, 1980). Blanks were run every 12 samples. Replicates of every tenth sample were run. A set of reference materials (NIST #1646, NIST #2704, and PACS-1) was analyzed every ten to fifteen samples. Results of the analyses of the three standard reference materials are compared to the certified values in Tables XIV and XV. Separate SRM results are presented for surficial samples and core samples because the two sediment sets were analyzed at different times

The MGS's results indicate better than 90% recovery for most of the metals and better than 85% for all metal except Mn. The lower recovery values for Mn (ES and PAC) may be due to incomplete digestion during sample preparation or matrix problem during analysis.

**Table XIV.** Results of metal analyses of standard reference materials compared to the certified values for metal analyses of the core sediments.

| Metals | Certified Values | | | MGS Results | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | BR* | ES* | PAC* | BR* | % recovery | ES* | % recovery | PAC* | % recovery |
| Cr (µg/g) | 135 ±5 | 40.9 ±1.9 | 113 ±8 | 131.8 ±4.27 | 97.6 | 44.1 ±1.75 | 107.9 | 108.9 ±4.45 | 96.4 |
| Cu (µg/g) | 98.5 ±5 | 10.0 ±0.34 | 452 ±16 | 97.2 ±3.84 | 98.6 | 9.4 ±1.31 | 93.7 | 433.0 ±23.91 | 100.2 |
| Fe (%) | 4.11 ±0.1 | 2.01 ±0.04 | 4.87 ±0.12 | 4.03 ±0.21 | 98.0 | 1.98 ±0.11 | 98.6 | 4.59 ±0.28 | 94.3 |
| Mn (µg/g) | 555 ±19 | 234.5 ±2.8 | 470 ±12 | 540 ±25.8 | 97.4 | 173 ±9.63 | 73.9 | 336 ±19.40 | 71.6 |
| Ni (µg/g) | 44.1 ±3 | 23[T] | 44.1 ±2 | 39.2 ±2.95 | 89.0 | 21.2 ±2.82 | 92.3 | 42.1 ±2.5 | 95.4 |
| Zn (µg/g) | 438 ±12 | 48.9 ±1.6 | 824 ±22 | 429.1 ±14.3 | 98.0 | 43.2 ±1.61 | 88.4 | 797.8 ±27.4 | 96.8 |

*BR = NIST-SRM #2704 - Buffalo River Sediment
*ES = NIST SRM #1646a - Estuarine Sediment
*PAC= National Research Council of Canada PACS-1 - Marine Sediment
[T] Noncertified value reported by NIST

**Table XV.** Results of metal analyses of standard reference materials compared to the certified values for metal analyses of the surficial sediments.

| Metals | Certified Values | | | MGS Results | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | BR* | ES* | PAC* | BR* | % recovery | ES* | % recovery | PAC* | % recovery |
| Cr (µg/g) | 135 ±5 | 40.9 ±1.9 | 113 ±8 | 129.3 ±2.5 | 95.8 | 43.3 ±1.8 | 105.8 | 113.1 ±4.1 | 100.1 |
| Cu (µg/g) | 98.5 ±5 | 10.0 ±0.3 | 452.0 ±16 | 100.0 ±3.6 | 101.5 | 9.2 ±0.7 | 91.5 | 461.7 ±19.5 | 102.2 |
| Fe (%) | 4.11 ±0.1 | 2.01 ±0.04 | 4.87 ±0.12 | 4.12 ±0.24 | 100.1 | 2.10 ±0.21 | 104.7 | 4.96 ±0.24 | 101.8 |
| Mn (µg/g) | 555 ±19 | 234.5 ±2.8 | 470 ±12 | 547 ±28 | 98.5 | 190.3 ±50.9 | 81.2 | 370 ±25 | 78.8 |
| Ni (µg/g) | 44.1 ±3 | 23[T] | 44.10 ±2 | 39.8 ±4.4 | 90.4 | 20.8 ±3.0 | 90.6 | 40.5 ±4.4 | 91.7 |
| Zn (µg/g) | 438 ±12 | 48.9 ±1.6 | 824.0 ±22 | 444.4 ±6.3 | 101.5 | 44.5 ±7.0 | 91.0 | 837.4 ±10.8 | 101.6 |

*BR = NIST-SRM #2704 - Buffalo River Sediment
*ES = NIST SRM #1646a - Estuarine Sediment
*PAC= National Research Council of Canada PACS-1 - Marine Sediment
[T] Noncertified value reported by NIST

**Table XVI.** Average detection limits for the metals based on the methods used in this study. Detection limits were derived from a Quality Assurance/Quality Control study conducted by Hill and others (1997).

| Metal | BKG[1] (µg/g) | WQ-MGS[2] (µg/g) |
|---|---|---|
| Cr | 0.3 | 0.17 |
| Cu | 0.2 | 0.39 |
| Fe | 0.00 | 0.00 |
| Mn | 0.00 | 0.67 |
| Ni | 2.0 | 2.77 |
| Zn | 1.7 | 1.20 |

[1] Based on surficial sediments collected around Poplar Island for back ground assessment.
[2] Based on surficial sediments collected at the water quality sites around Poplar Island.