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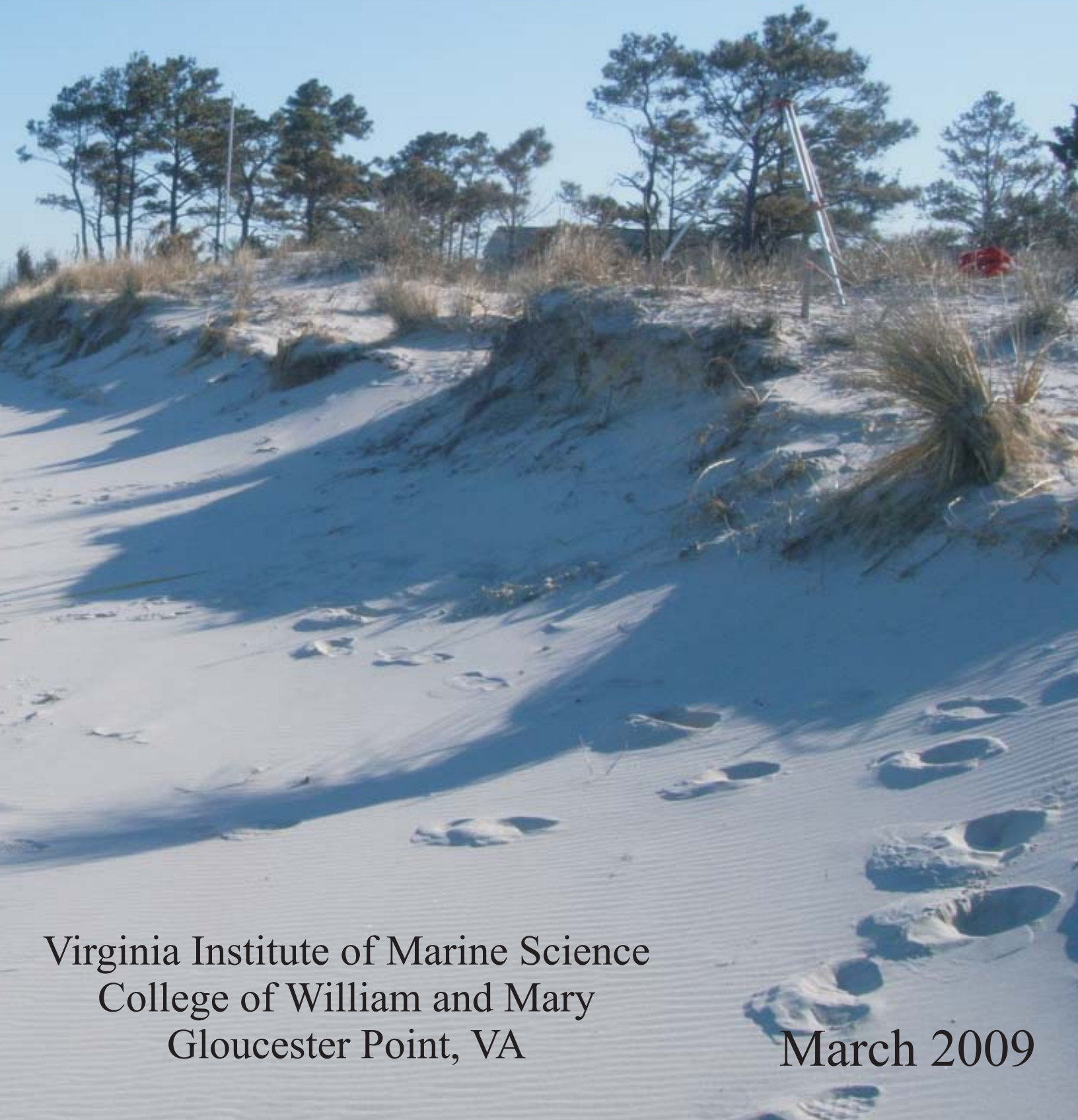
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Dune Monitoring Data Update Summary



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March 2009

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March 2009

Introduction

The Shoreline Studies Program at VIMS established a beach and dune monitoring program for nine sites around the Virginia portion of Chesapeake Bay (Milligan *et al.*, 2005). These sites were monitored twice yearly for four years (2001-2004). In addition to three years of relatively calm conditions, these data included the impact of Hurricane Isabel, a nearly 100-yr event, on the Bay's shorelines. The shoreline's change due to the storm and their subsequent short-term recovery was documented by this data. However, since the end of the monitoring program, other events have impacted Chesapeake Bay shorelines. In order to document the longer-term recovery of these systems, additional monitoring is necessary. Several of these sites are man-influenced and have upland development behind the dune. Understanding storm impacts and shoreline recovery is critical knowledge when determining the suitability of living shoreline options (*i.e.* beach/dune) in higher energy environments. In addition, the overall stability of these sites and their response to physical forces can provide important information when developing guidelines for beach and dune encroachment.

The present effort re-occupied the monitoring site profiles and provided new data on the long-term evolution of these sites. Six sites were surveyed:

Site MA3: Chesapeake/Bavon Beach, Mathews County. This site represents a linear dune field that has faced developmental pressures for the past 20 years (Figure 1).

Site NH10: Just north of Silver Beach, Northampton County. This Bay site is part of a dune field that is both natural and man-influenced (Figure 2).

Site NH17: Floyd's Farm on Savage Neck, Northampton County. This site transitions along a natural spit which includes a primary dune only. The adjacent land use is agricultural, but the shore a block to the north is being developed. Potential exists for shoreline hardening and subsequent downdrift impacts in the near future (Figure 3).

Site NH51: Pond Drain, Northampton County. A Department of Conservation and Recreation natural site with an extensive dune field and no potential for development except for on adjacent properties (Figure 4).

Site NL58: East side of Hack Creek, Northumberland County. This dune field site has been impacted by jetties at Hack Creek and by a few groins, but the upland is undeveloped (Figure 5).

Site NL 59: West side of Hack Creek, Northumberland County. This dune field has elements of primary and primary/secondary dunes that are in transition and are being impacted by development and significantly impacted by groins and Hack Creek jetties (Figure 6).

Methods

Several cross-shore profiles with benchmarks were established at each site (Milligan *et al.*, 2005). Each surveyed transect used the crest of the primary dune as the horizontal control and mean low water (MLW) as the vertical control. The MLW line is indirectly obtained from water level measurements. The water level position and elevation are checked in the lab against measured tidal elevations (at the nearest NOAA tide station) and time of day to establish MLW for the profile. At each survey, cross-sectional profiles and ground photos were taken. These data were used to determine the changes at each site. The sites were surveyed on March 18th through the 20th and the 23rd of 2009 with the use of a Zeiss Ni2 Level to determine the elevations and distances along the dune, beach and nearshore. Care was taken to measure the same dune and beach system components. Each site has a continuous sand feature that extends from the offshore landward that consists of a 1) nearshore region seaward of MLW; 2) an intertidal beach, berm and backshore region, the latter of which may be vegetated, between MLW and base of primary dune; 3) a primary dune from bayside to landside including the crest and foredune where present; and 4) a secondary dune region where present. All profiles extended beyond MLW (seaward) to the back of the primary dune (landward). If a secondary dune was present at the site, the back or landward extent of the secondary dune may not have always been reached, but the crest was always surveyed. The two-dimensional data are represented in an Excel spreadsheet. This data was analyzed using the Beach Morphology and Analysis Program (BMAP) (Veritech, 2004).

Results and Discussion

MA3 is a secondary dune site with a low upland that is controlled by two marsh headlands and nearshore attached bars (Milligan *et al.*, 2005). The source of sand for dune development at this site is from these nearshore bars. This abundance of sand has elevated the toe of the beach such that sand is available for aeolian transport to the backshore and dune area. The residents of the local communities have enhanced this process by installing dune fencing and planting dune grasses. Dunes have existed at this site since at least 1973. When Hurricane Isabel impacted the shore in September 2003, a wide beach was left as sand was eroded from the dunes and deposited close by (Milligan *et al.*, 2005). The residents reinstalled dune fencing to help the dunes recover, and many of the dunes are rebuilding at the same location. Before the storm, most of the beach was accretionary as only the southern end was eroding, and the dunes were stable overall. Due to the storm, the dune crest heights decreased along the site, and the position of the crest moved towards the water in most cases. The only exception to this was at profile MA3-7 which was completely removed during the storm. Since the storm, the site has been surveyed twice more on July 26, 2007 and March 23, 2009 (Figure 7A-D), and these surveys reveal accretion for most of the primary dunes on the site. With the exceptions of MA3-6 and MA3-8, the profiles are showing growth and stability including the primary dune on MA3-7 (Figure 8) which is starting to grow back well, but is still not as large as it was before Isabel. MA3-1 to MA3-3 and MA3-5 has had growth to the primary dune and has advanced. MA3-4 has grown but has stayed at the same position. MA3-6 is eroding at the beach face and upper beach while MA3-8 is eroding along both the beach and dune.

NH10 is a dune site backed by a fastland bank. Only the middle profile has a secondary dune while the other two profiles only have primary dunes. A great deal of sand exists in the nearshore attached bar system. This section of shore has the widest bar system leading to the most stable beach. Generally, this reach is a nodal point inside the larger reach that has had little change. Patchy dunes have existed at this site from 1949 through 1973, but by 1989, the dune field had matured (Milligan *et al.*, 2005). Over the course of the earlier monitoring period (2001-2004), the dune crest height has accreted about 0.5 ft. During the hurricane, significant southerly transport allowed the beach, backshore and dune to accrete (Milligan *et al.*, 2005). The storm created stable beaches that have become accretionary but now, six years later, the site is exhibiting signs of major erosion (Figure 7E-F). The beach particularly, has eroded back as much as 40 ft as was the case of the upper beach on the middle profile (Figure 9). The back of the primary dune is the only section of the site that is stable. The site is somewhat man-influenced due to the presence of a groin at the southern end of the site.

The present day dune at NH17 developed on a spit that formed in 1955. The dunes were established by 1972. This site also has nearshore attached bars which provide a large amount of sand for dune creation. NH17 is backed by a high upland bank which has been farmed for several generations. The entire reach is slightly erosional updrift and downdrift of the dune site, but the dune site itself has been accretionary even after Hurricane Isabel impacted the shore (Milligan *et al.*, 2005). Presently, the dune crest itself has remained in the same position while the beach has started to accrete on NH17-1 and NH17-2 (Figure 9). However, the shore at NH17-3 and NH17-4 has eroded and may soon impact the crest (Figure 7F-H). Significant foredune growth has occurred at the southern end of the site which decreased the width of the backshore.

Site NH51 is part of a larger dune system that has existed since 1807. Since that time, this system has been fragmenting. Yet, the same shore morphology has occurred at this site since 1863 and, the dunes at NH51 are shown in the 1937 aerial photography (Milligan *et al.*, 2005). This large headland morphology is controlled by geology, and the nearshore attached and offshore bars. The wave climate at the site is a blend of ocean and bay. The dune field sits against a high upland bank whose erosion updrift and downdrift have been a source of sand for the site. Part of the site was stable before Hurricane Isabel, but the most northern section was erosional (Milligan *et al.*, 2005). The southern section of the site is erosional both on the beachface and upper beach, but the dune has remained stable (Figure 10). The northern section of this site is relatively accretionary and while some growth to the dune crest has occurred, the crests themselves have retreated several feet (Figure 7H-I).

NL58 and NL59 are similar sites that exist on either side of a tidal creek emptying into the Potomac River. Eroding fastland updrift provides the sediment necessary for dune growth. NL58 has had a dune field since 1937 which has allowed a secondary dune field to become established along sections of the shore (Milligan *et al.*, 2005). However, as development of the shore occurred, groins were installed along the shoreline leading to the degradation of the dune field downdrift. Groins were built at the site by 1987. Before the hurricane, the shoreline was accretionary at NL58-1 and NL58-2 while the more downdrift profile NL58-3 was erosional

(Milligan *et al.*, 2005)(Figure 11). Even before the monitoring program, this profile was receding. What was originally thought to be a primary dune was actually a secondary dune whose primary dune had been eroded. The hurricane caused the shoreline to become erosional overall (Milligan *et al.*, 2005). To this day, the site is still slightly erosional, but there are some signs of growth with the NL58-3 front dune face and beach accreting since 2004 (Figure 7J-K).

Portions of NL59 are adjacent to the creek mouth barrier of Black Pond, but much of it abuts the adjacent upland. It is wider toward Hack Creek since sand tends to accumulate at the jetties. Groins were installed along the shore in the 1960s, and by 1976, these had accreted a wide enough beach for a dune to develop (Milligan *et al.*, 2005). Most of the site was erosional over the course of the monitoring program. Between 2004 and 2007, the primary dune at NL59-1 and NL59-2 was completely eroded, but at NL59-1, the dune is starting to show signs of growth (Figure 11). Profile NL59-3 lost its primary dune making the secondary dune the primary (Milligan *et al.*, 2005). It has been relatively stable between 2007 and 2009 (Figure 7K-L).

Conclusion

Maintaining a monitoring site provides invaluable scientific data on the rates and patterns of change. These particular sites were chosen for monitoring based on their variability of settings within Chesapeake Bay and their dune types. These sites were monitored semiannually for four years, which includes the impacts of Hurricane Isabel. With all the surveys, including the most recent ones, we have been able to document the sites for over eight years. In addition, the benchmarks have been reset in case another storm impacts the area.

In summary, the sites had a wide variety of situations. At MA3, the dune is accreting on the northernmost section and the beach is stable. However, at the southern end, the results were mixed with some beach and/or dune erosion although MA3-7 is stable/accretionary. At NH10, the beach is erosional, but the dune area has not changed much. NH17 is accreting on its southern end, but the northern section is erosional. The southern section at NH51 is erosional while the northern section is accretionary. NL58 is slightly erosional with a couple areas of accretion. NL59 is erosional with its western end no longer having a dune and the primary dune at the eastern end having become the secondary dune.

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Milligan, D.A., C.S. Hardaway, Jr., G.R. Thomas, L.M. Varnell, T. Barnard, W. Reay, T.R. Comer, and C.A. Wilcox, 2005. Chesapeake Bay Dune Systems: Monitoring Final Report. Virginia Institute of Marine Science, College of William & Mary, Gloucester Point, Virginia.

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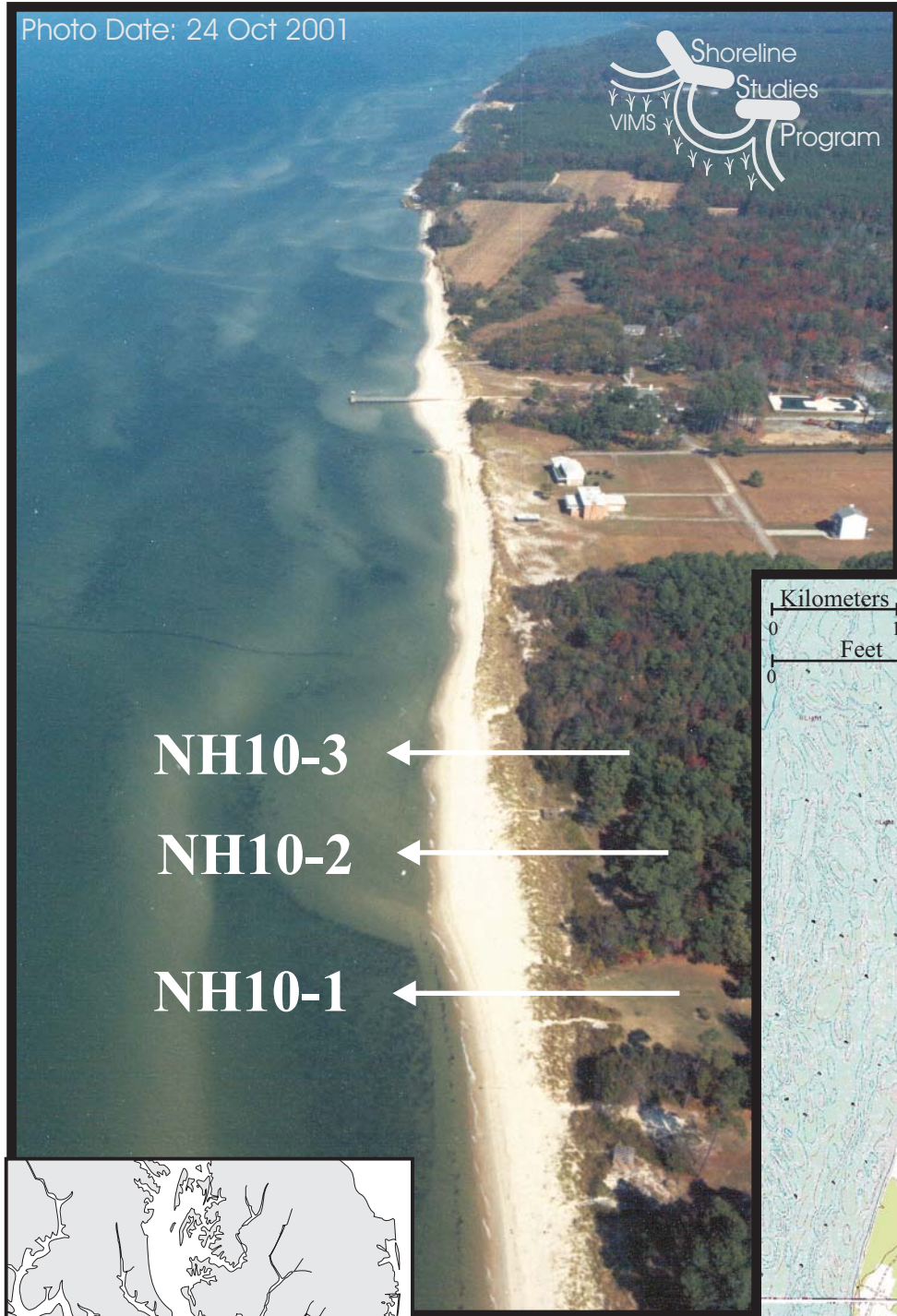
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Figure 1. Location of site Ma3 in Mathews County with approximate position of cross-shore beach profiles.

Photo Date: 24 Oct 2001



NH10-3

NH10-2

NH10-1

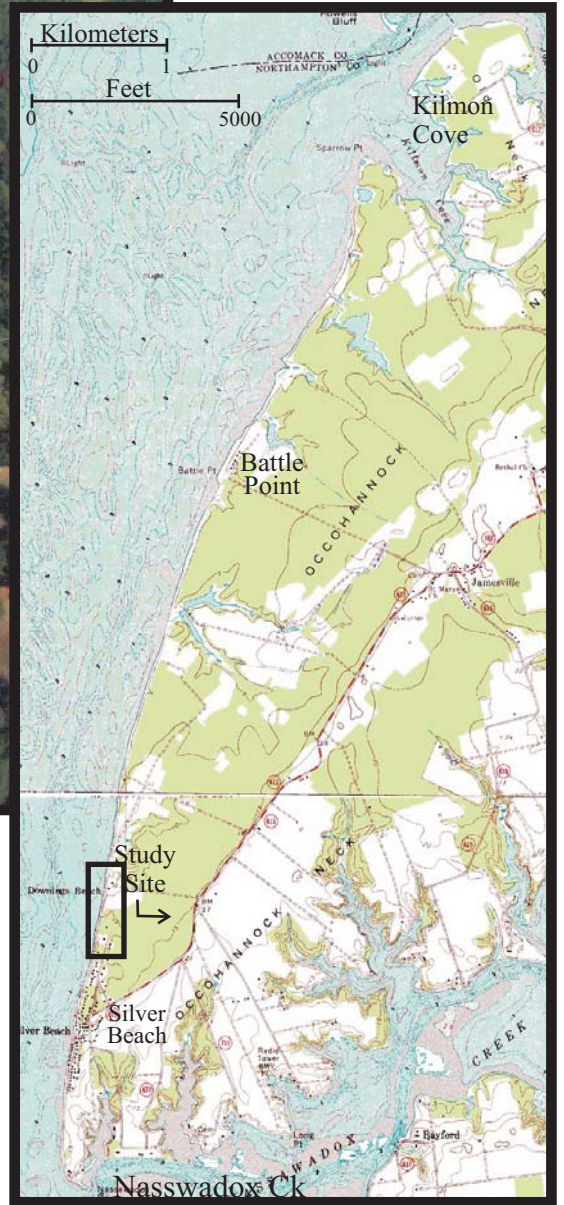
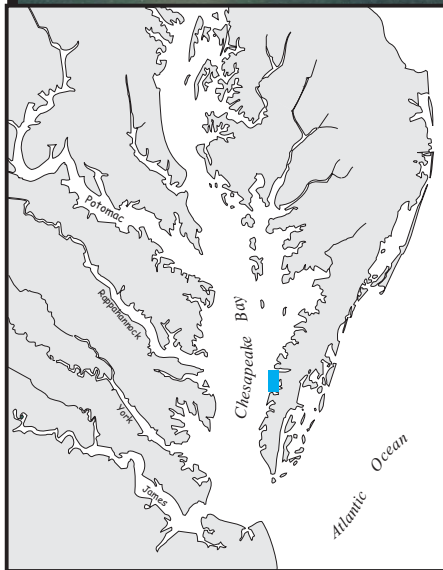


Figure 2. Location of site NH10 in Northampton County with approximate position of cross-shore beach profiles

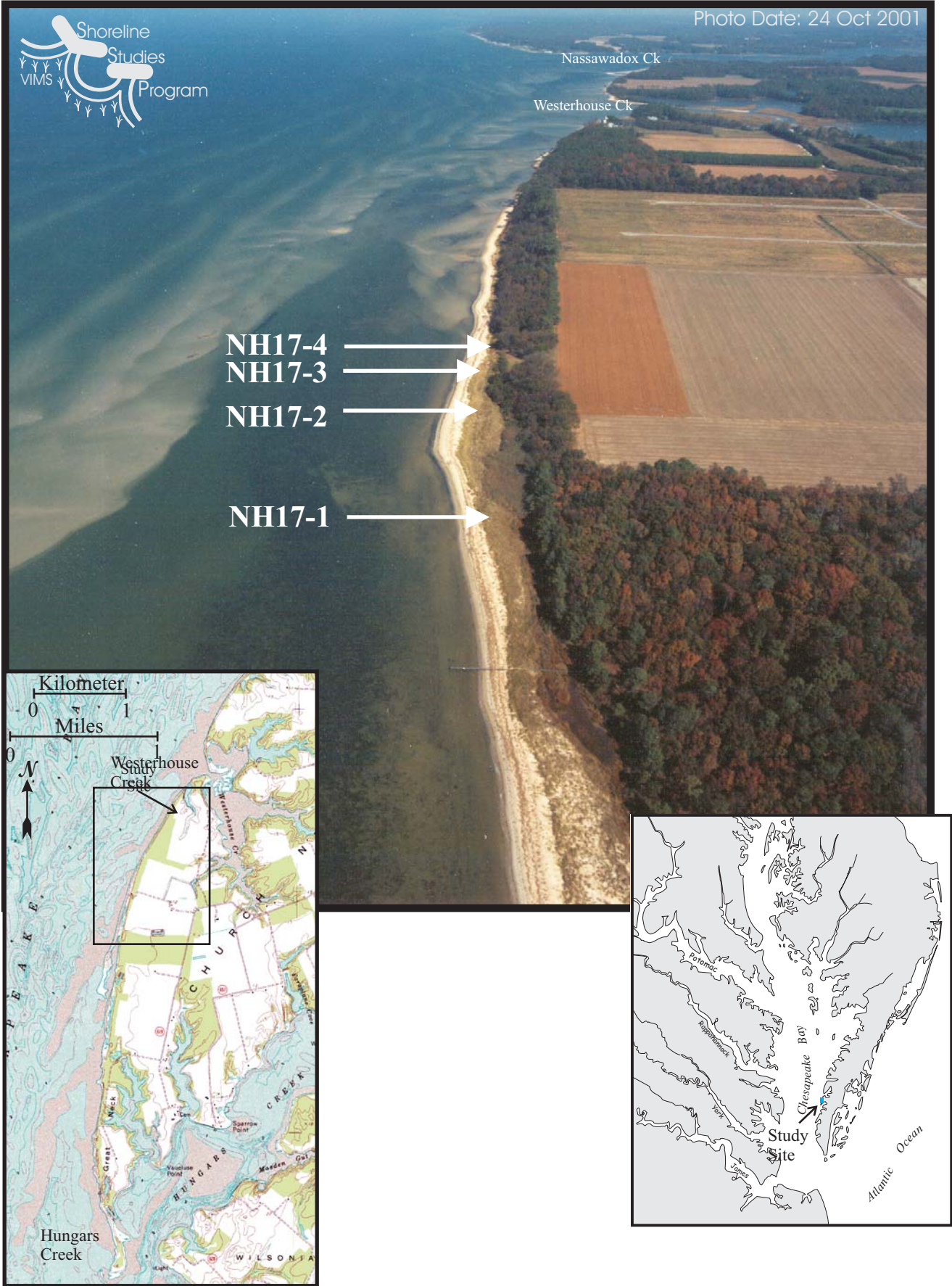


Figure 3. Location of site NH17 in Northampton County with approximate position of cross-shore beach profiles.

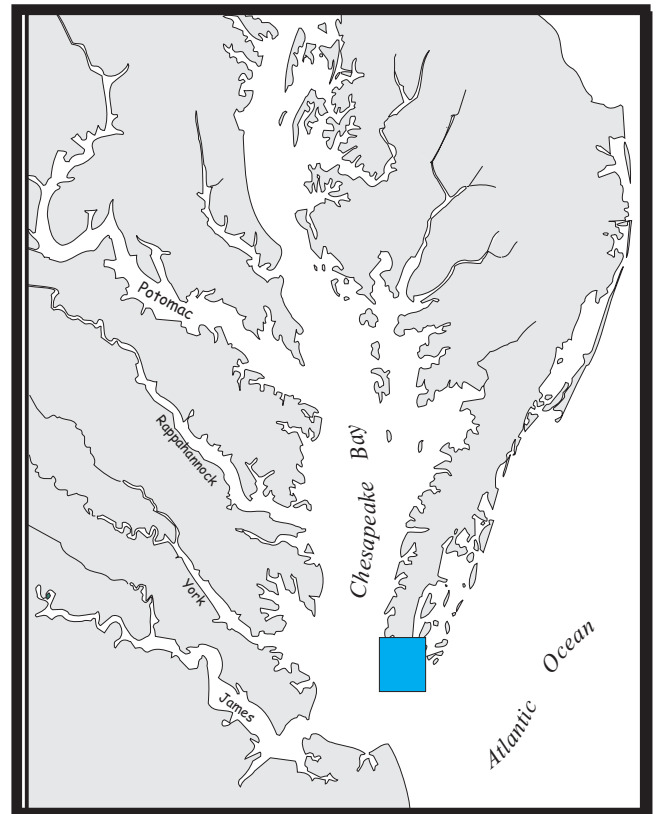
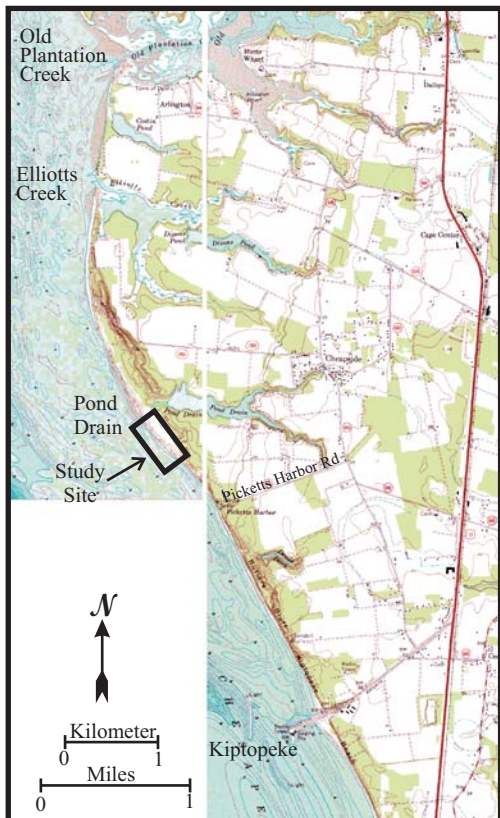
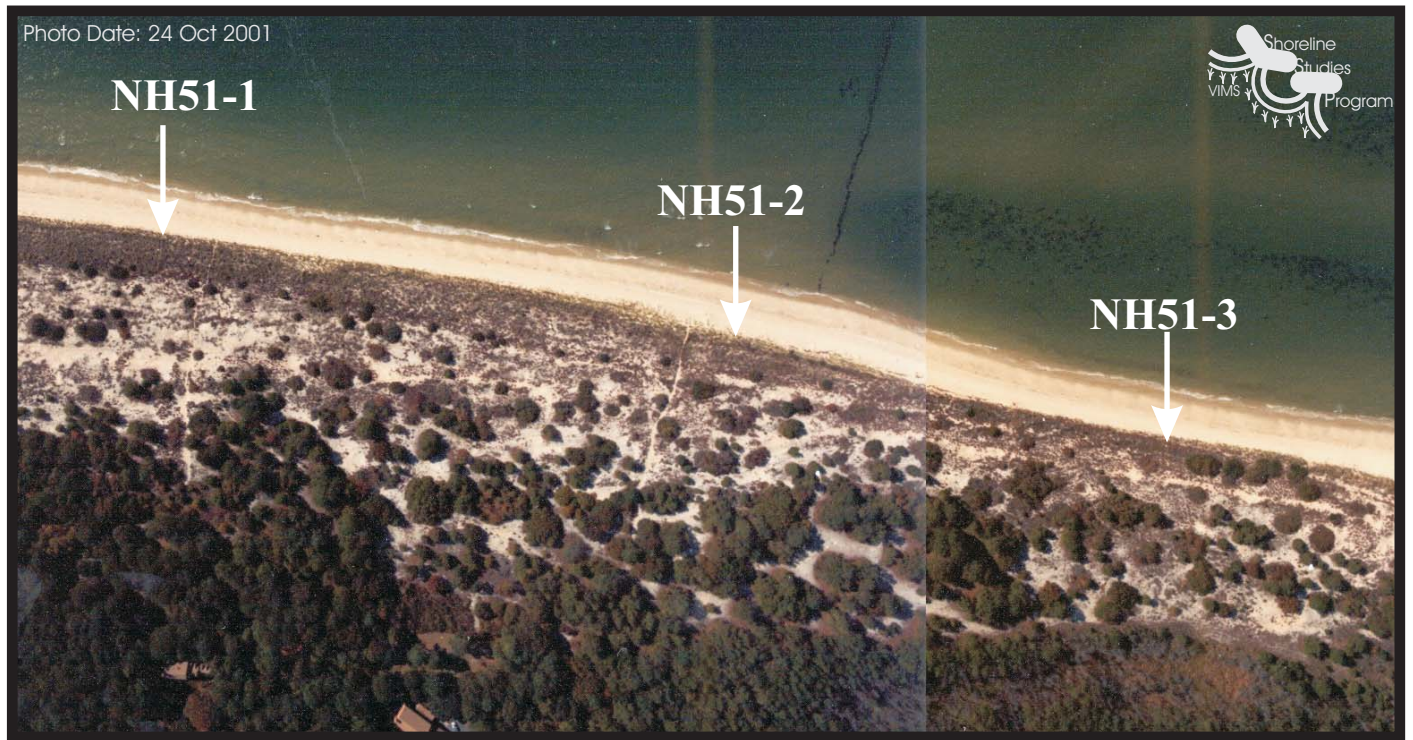


Figure 4. Location of site NH51 in Northampton County with approximate position of cross-shore beach profiles.

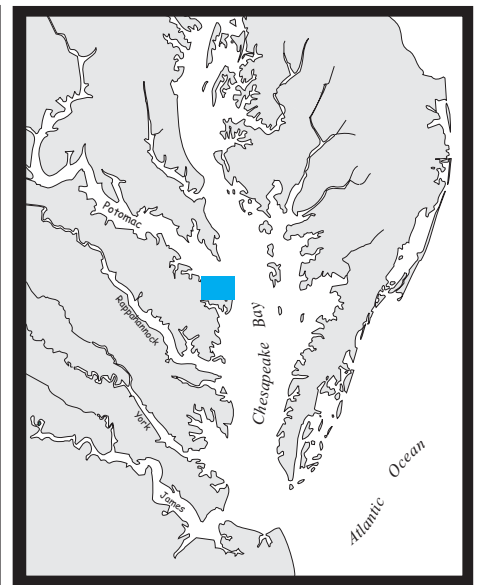
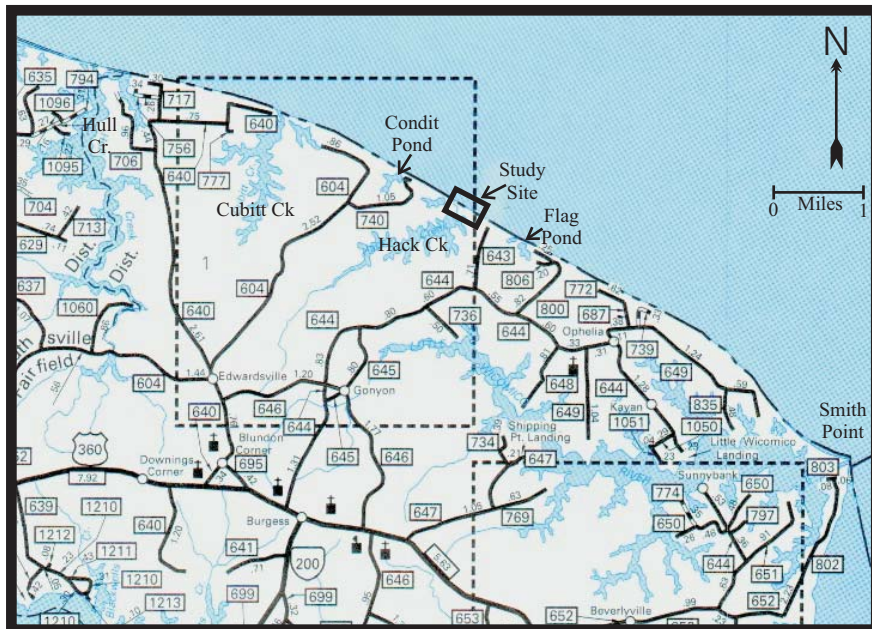


Figure 5. Location of site NL58 in Northumberland County with approximate position of cross-shore beach profiles.

Photo Date: 24 Oct 2001



NL59-3 →

NL59-2 →

NL59-1 →

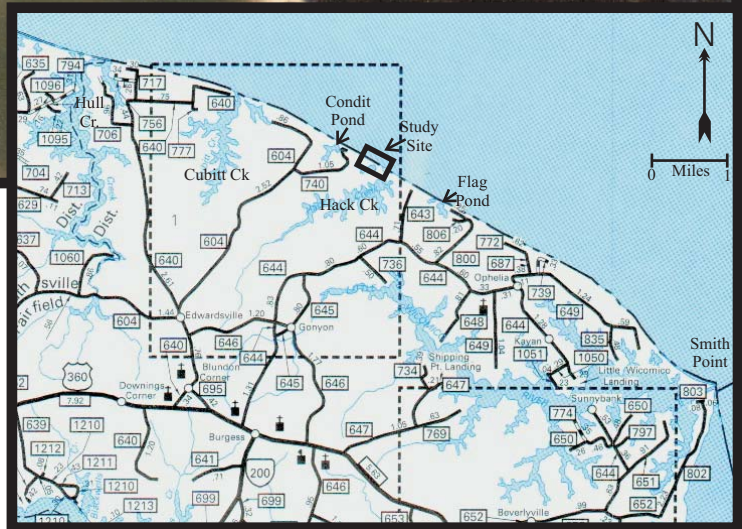
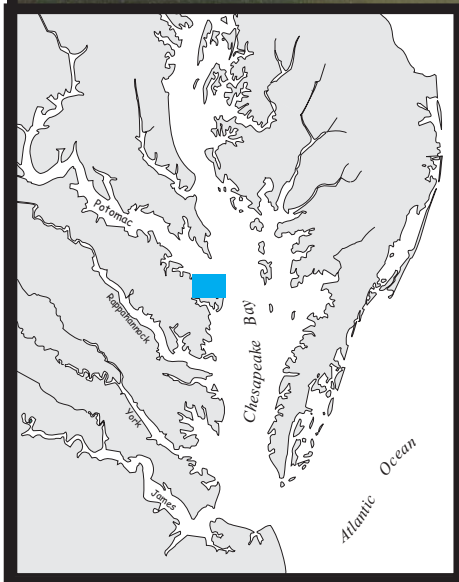
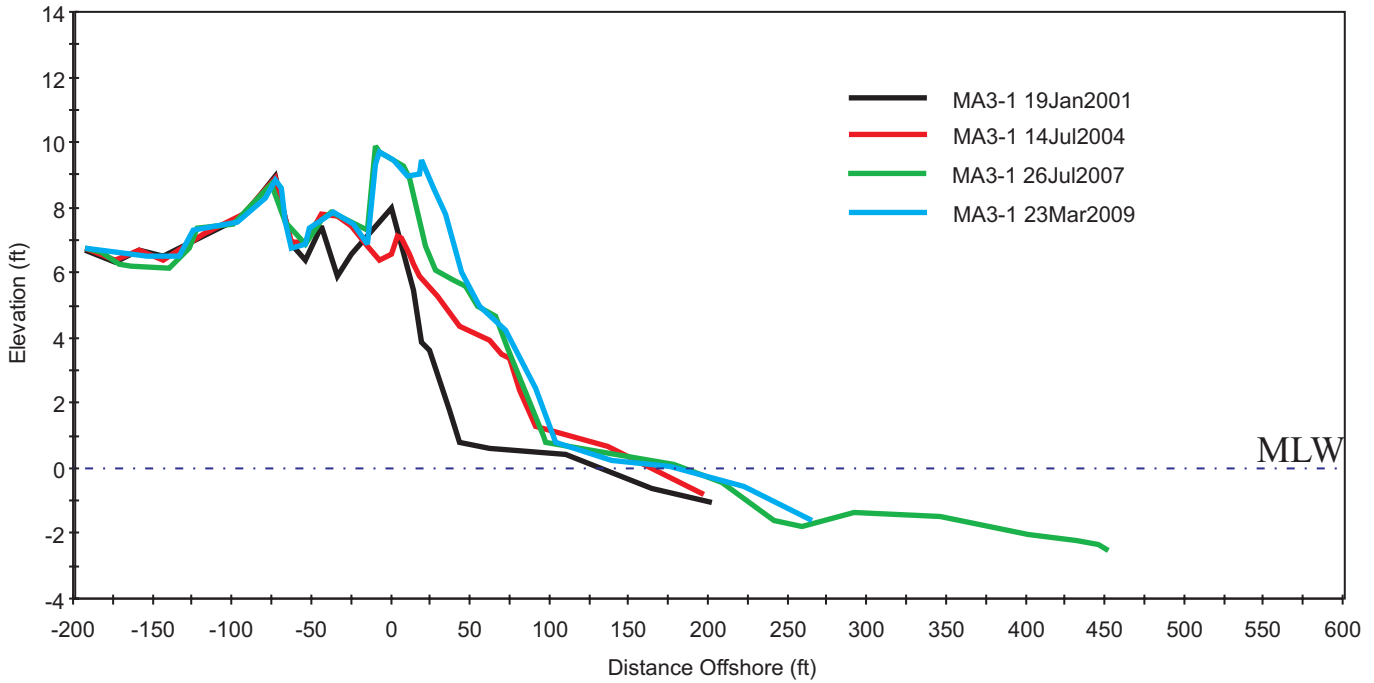


Figure 6. Location of site NL59 in Northumberland County with approximate position of cross-shore beach profiles.

Mathews County Dune Monitoring



Mathews County Dune Monitoring

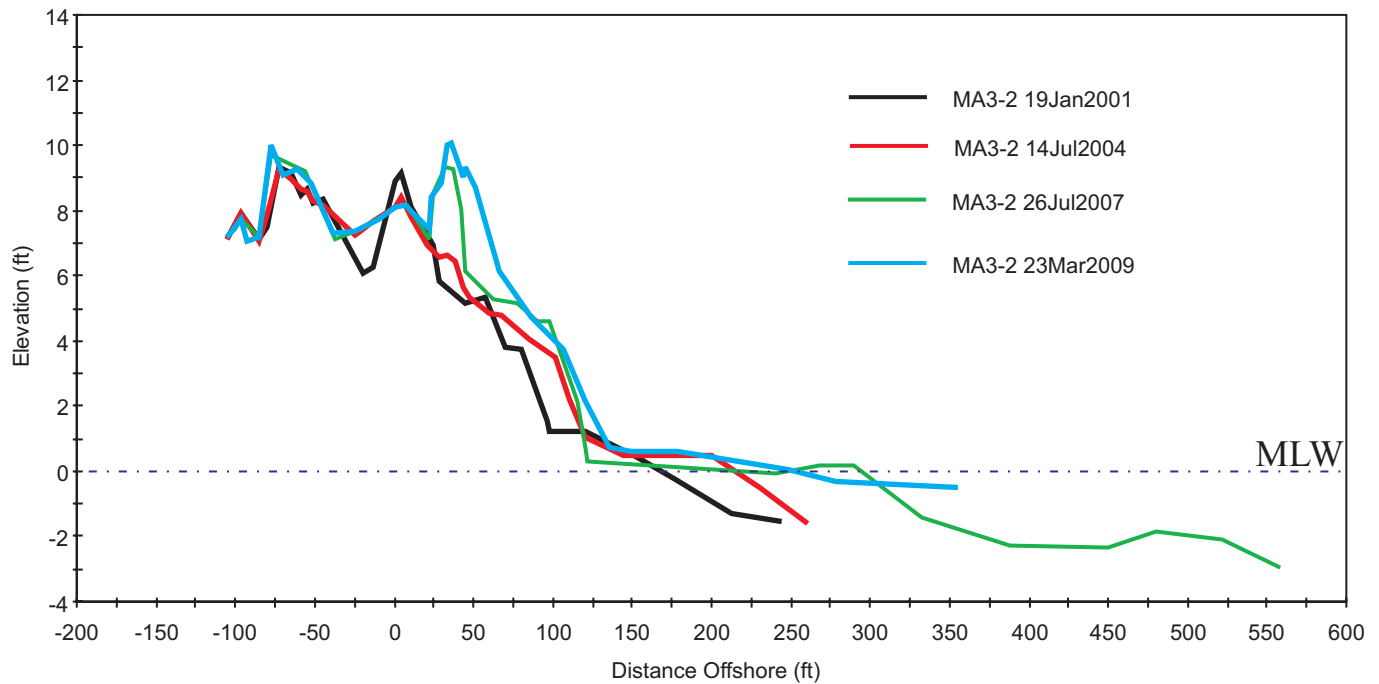
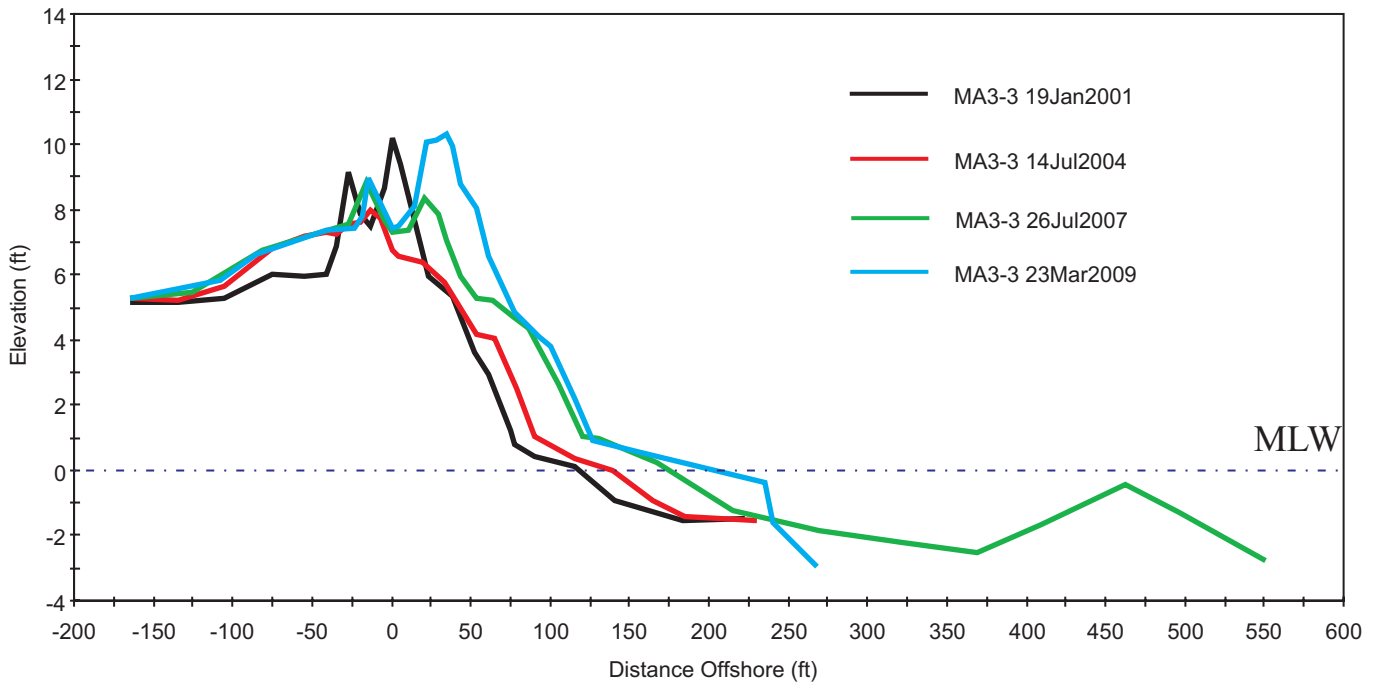


Figure 7A. Individual profile change through time.

Mathews County Dune Monitoring



Mathews County Dune Monitoring

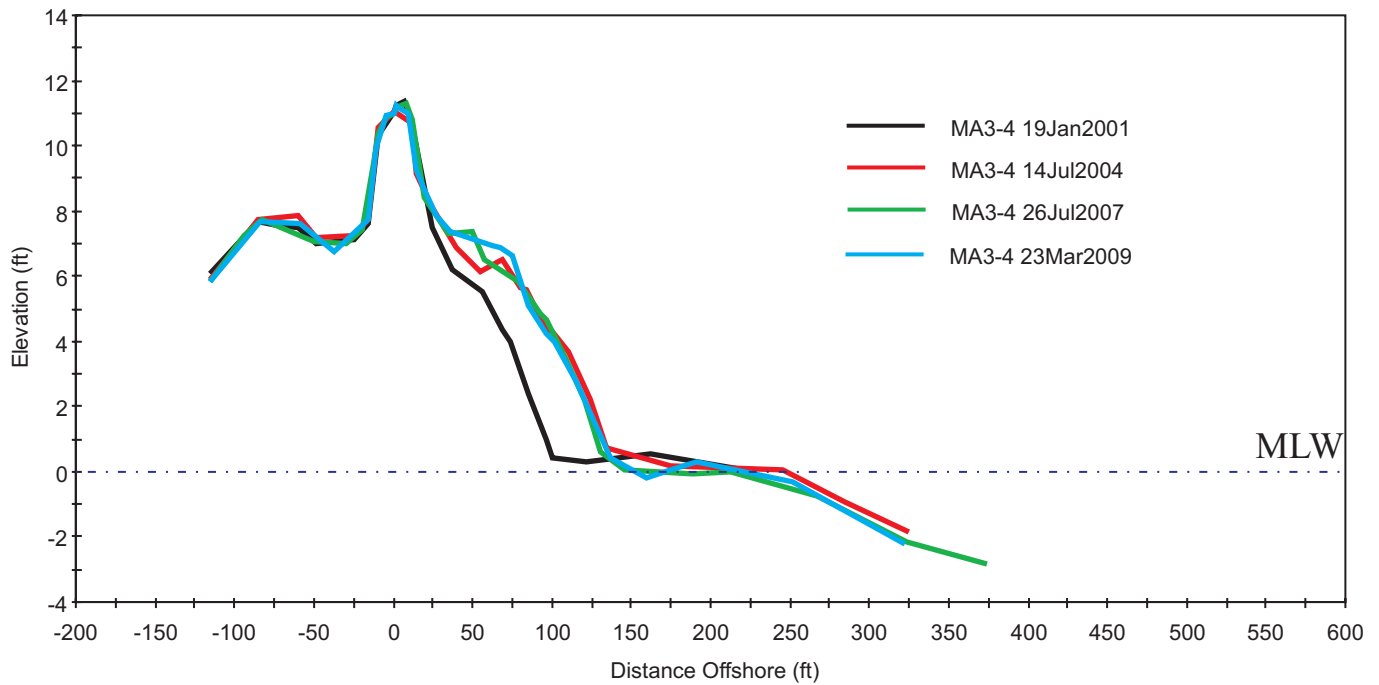
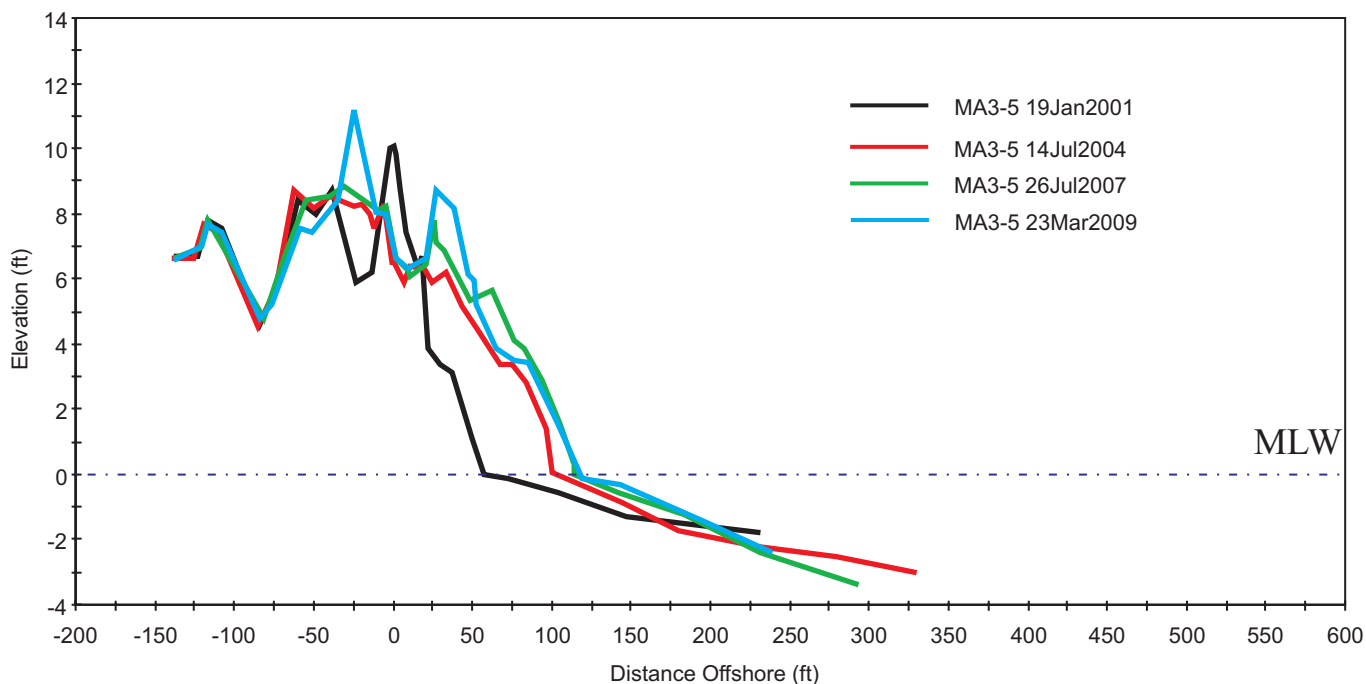


Figure 7B. Individual profile change through time.

Mathews County Dune Monitoring



Mathews County Dune Monitoring

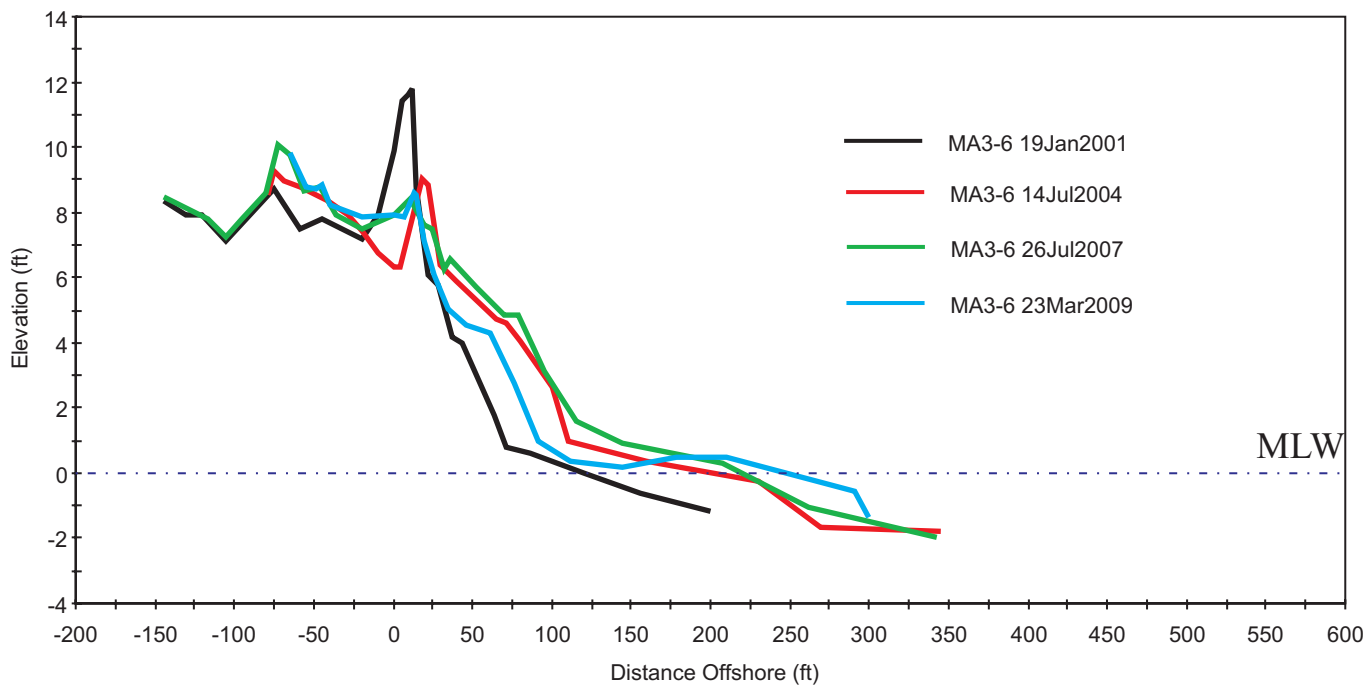
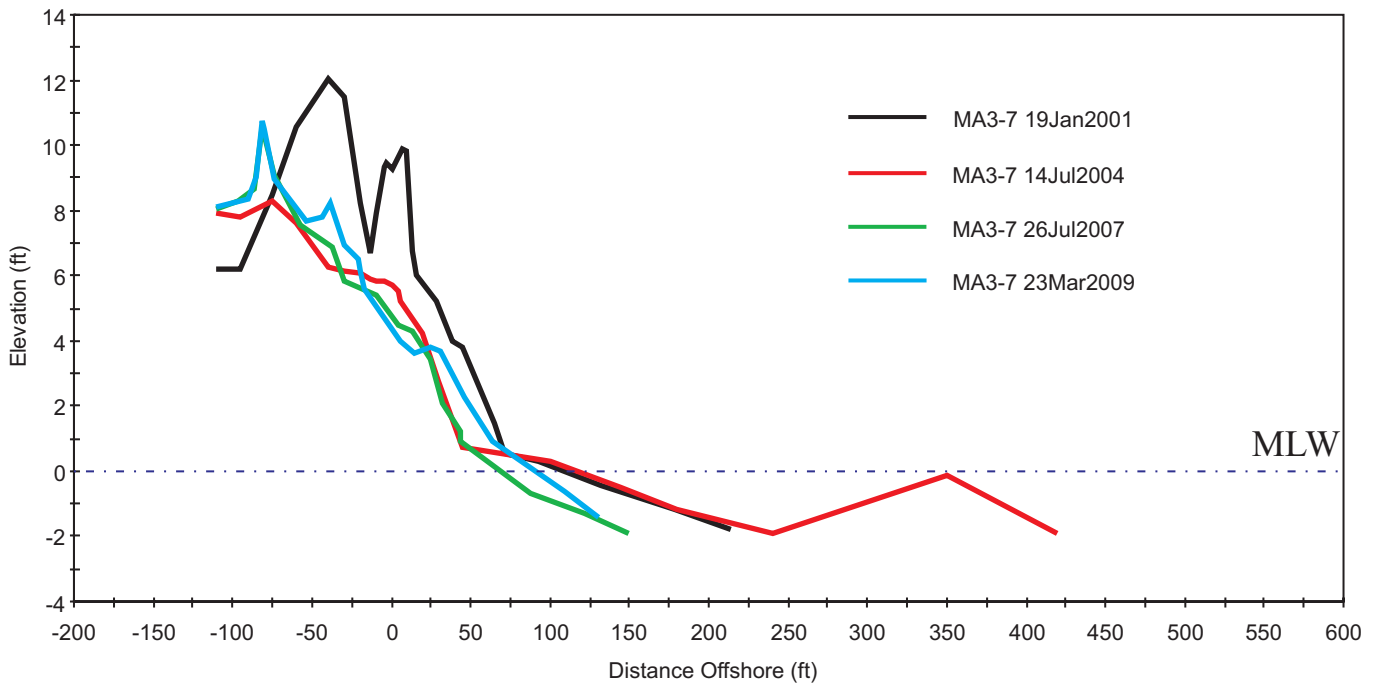


Figure 7C. Individual profile change through time.

Mathews County Dune Monitoring



Mathews County Dune Monitoring

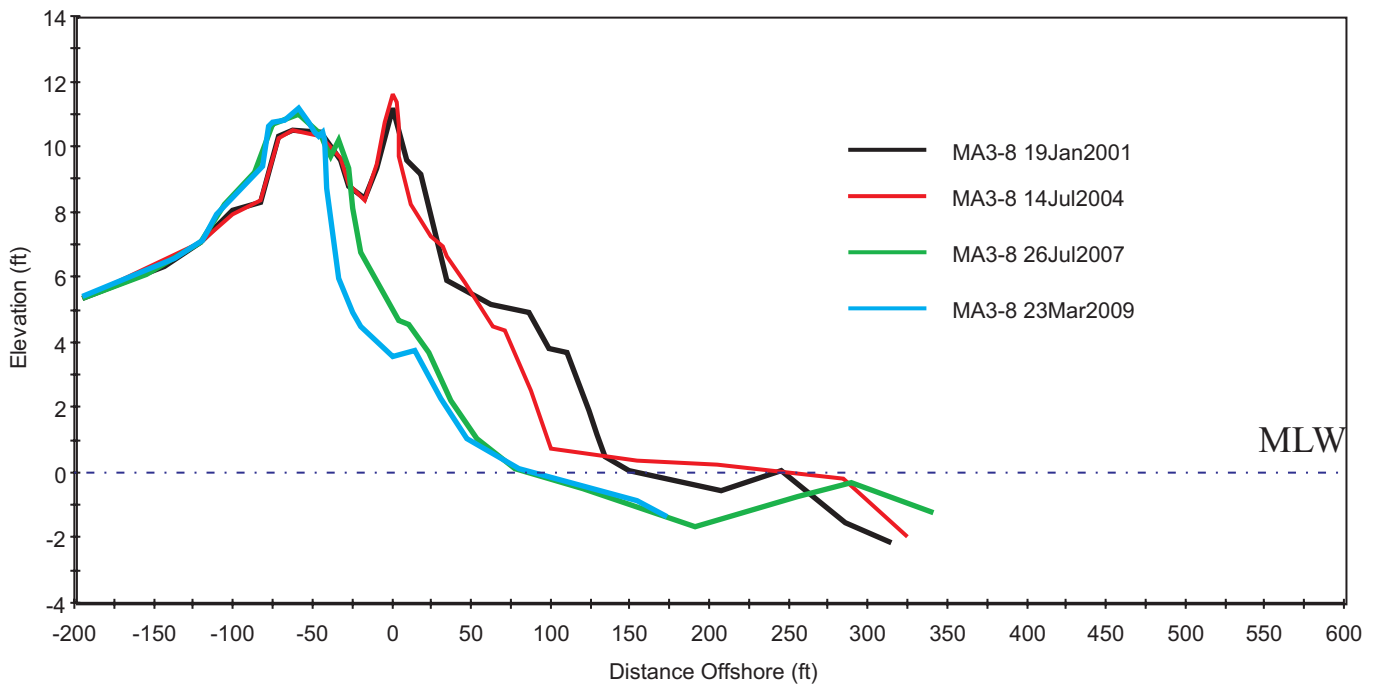
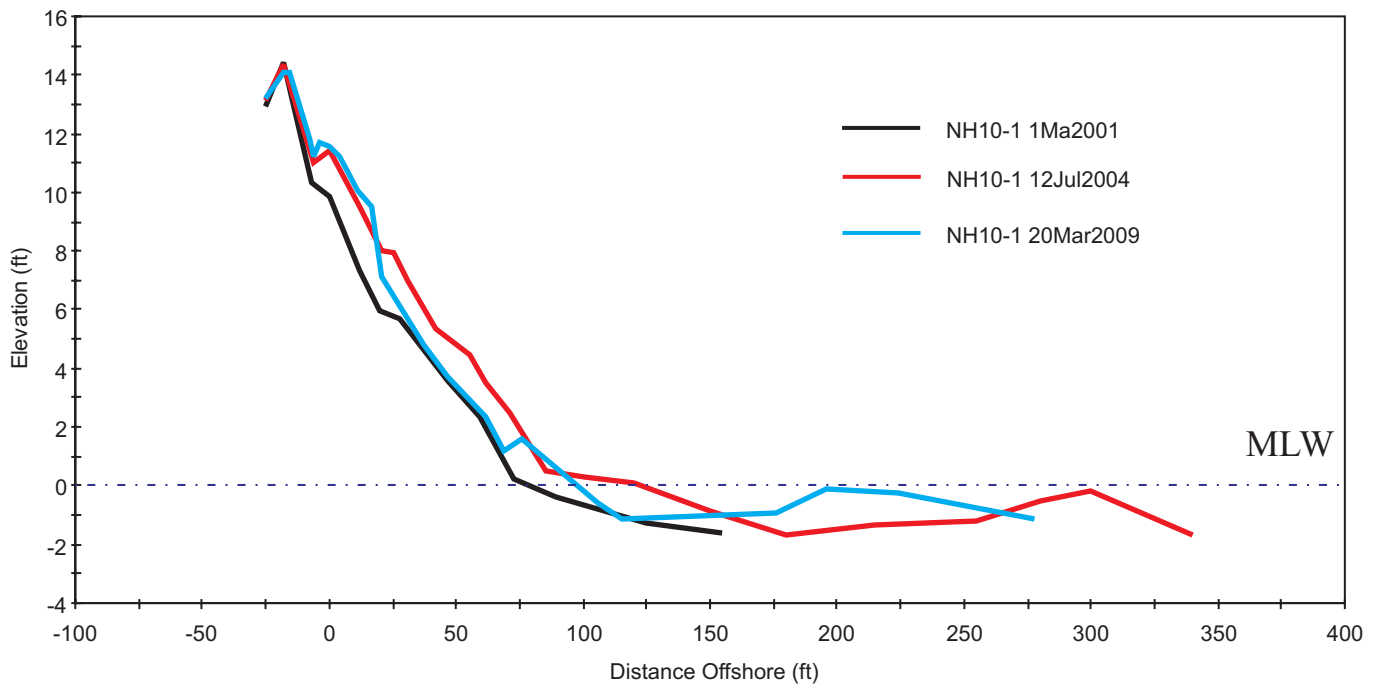


Figure 7D. Individual profile change through time.

Northampton Dune Monitoring



Northampton Dune Monitoring

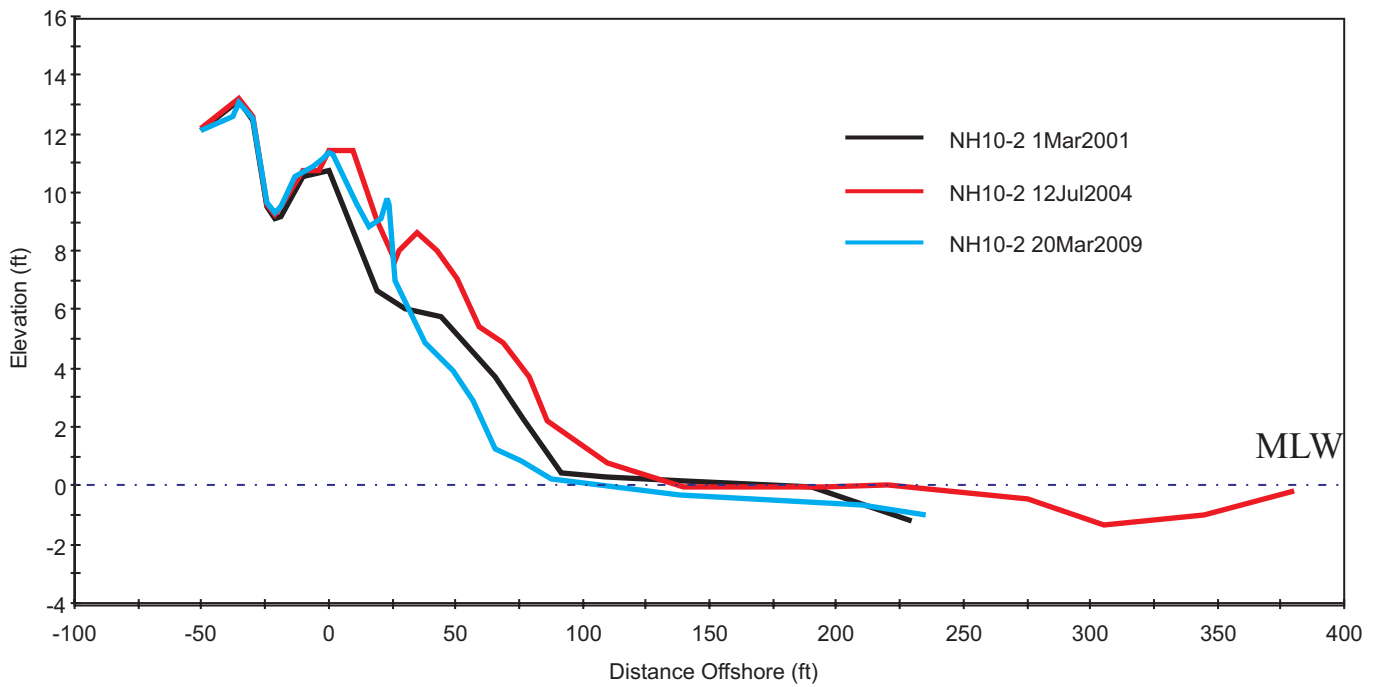
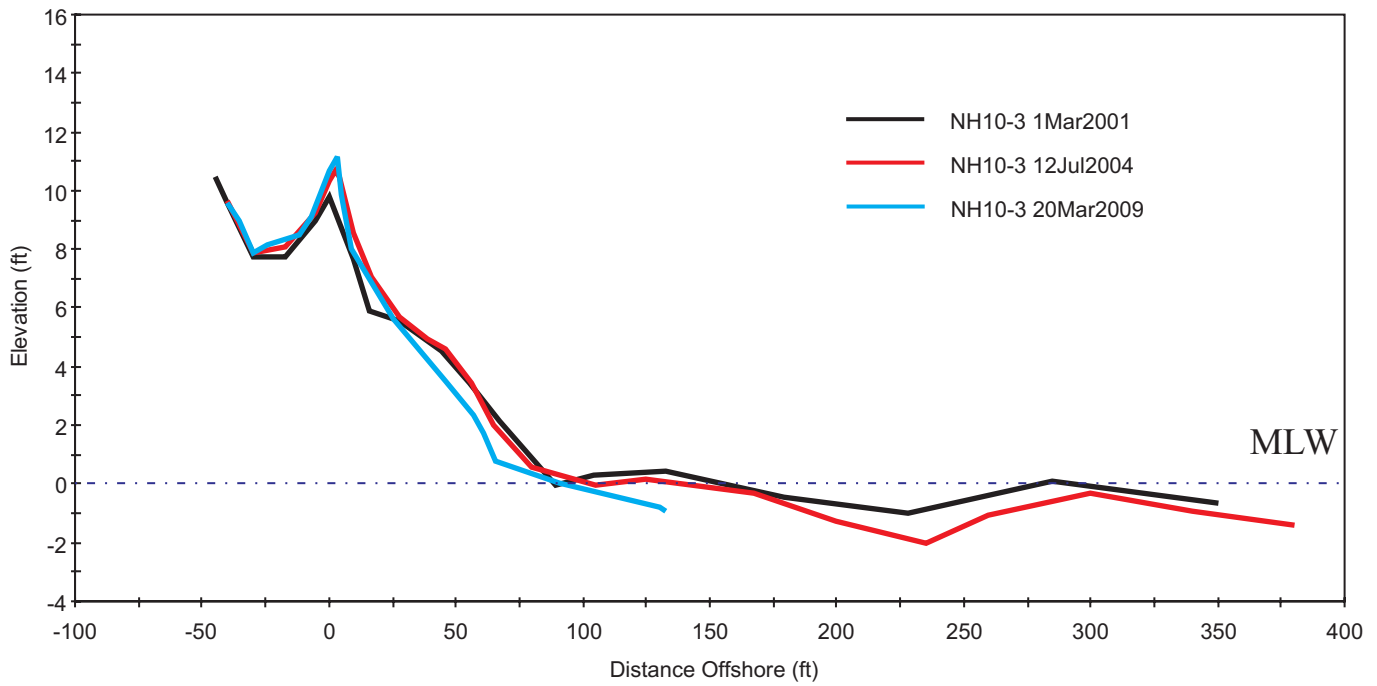


Figure 7E. Individual profile change through time.

Northampton Dune Monitoring



Northampton Dune Monitoring

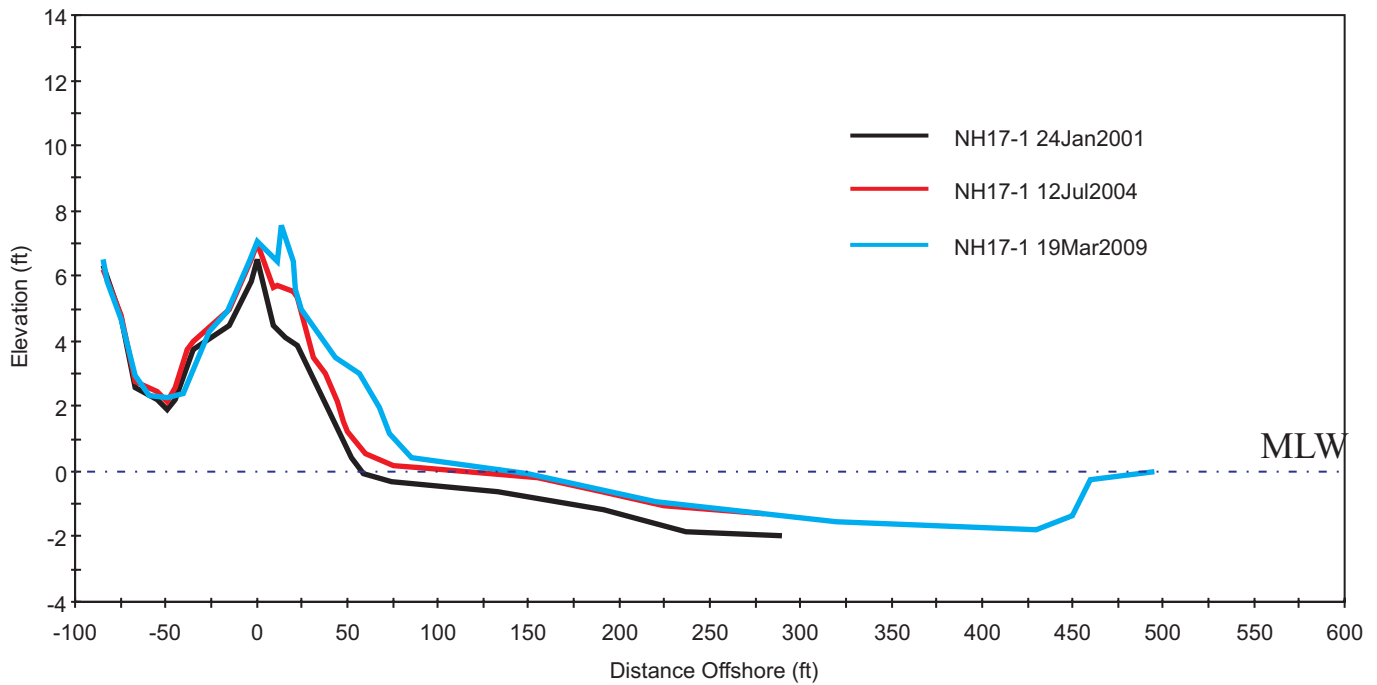
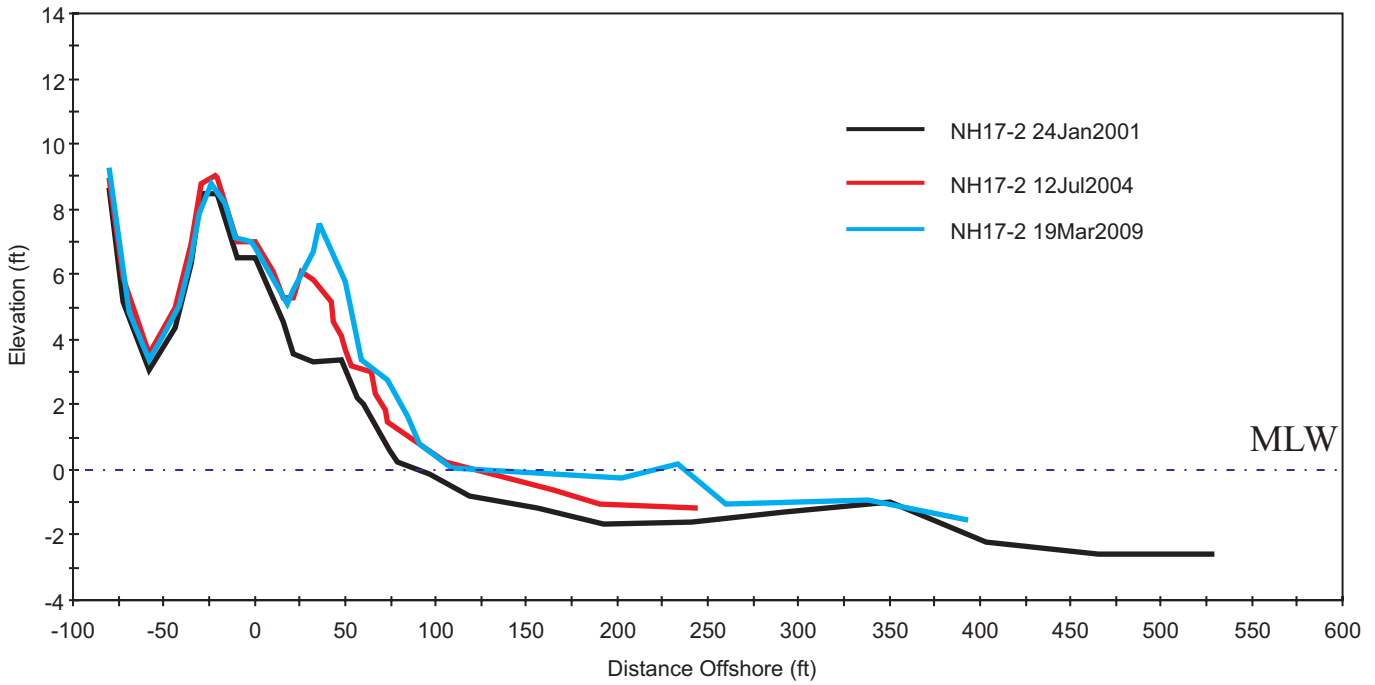


Figure 7F. Individual profile change through time.

Northampton Dune Monitoring



Northampton Dune Monitoring

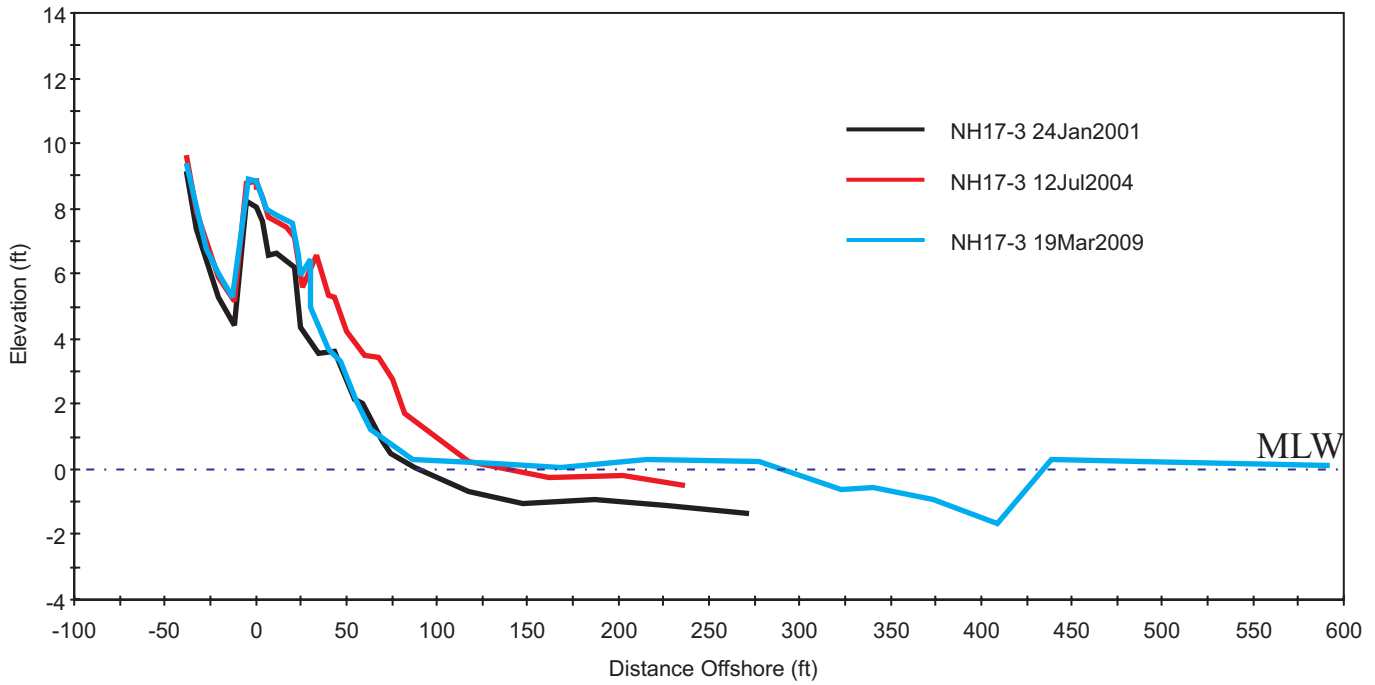
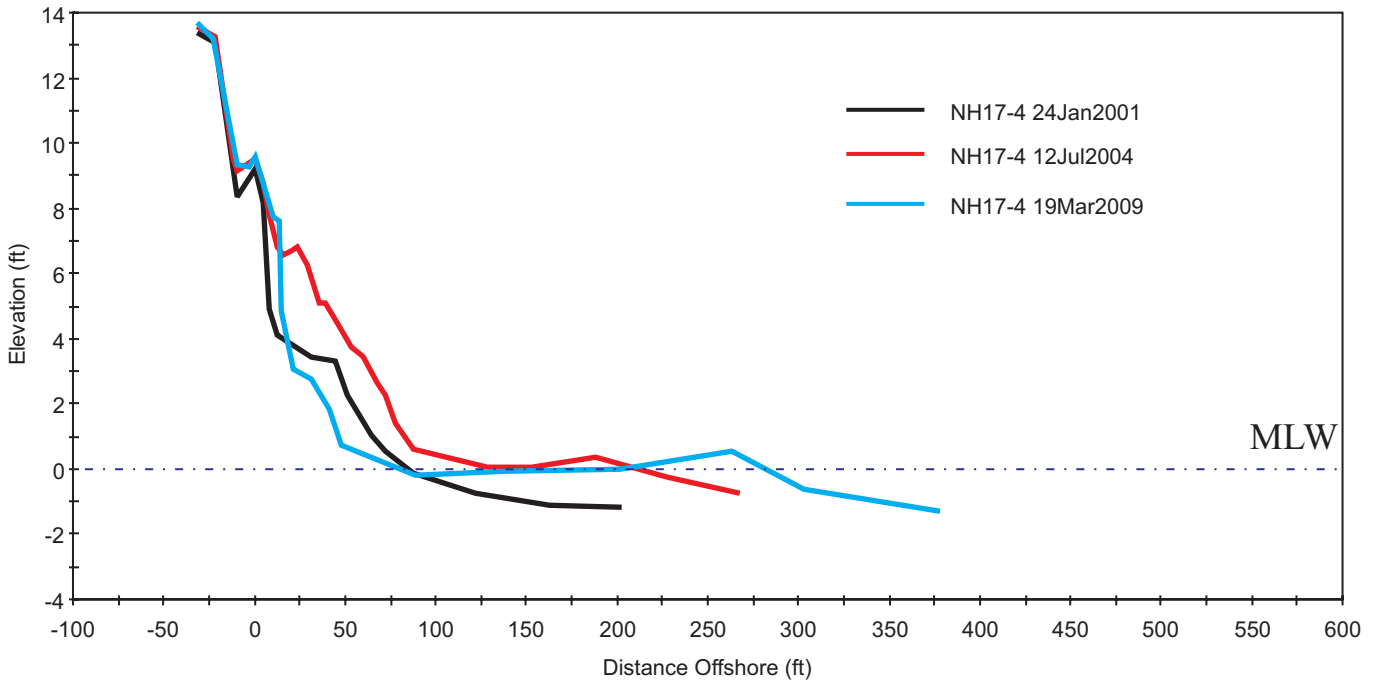


Figure 7G. Individual profile change through time.

Northampton Dune Monitoring



Northampton Dune Monitoring

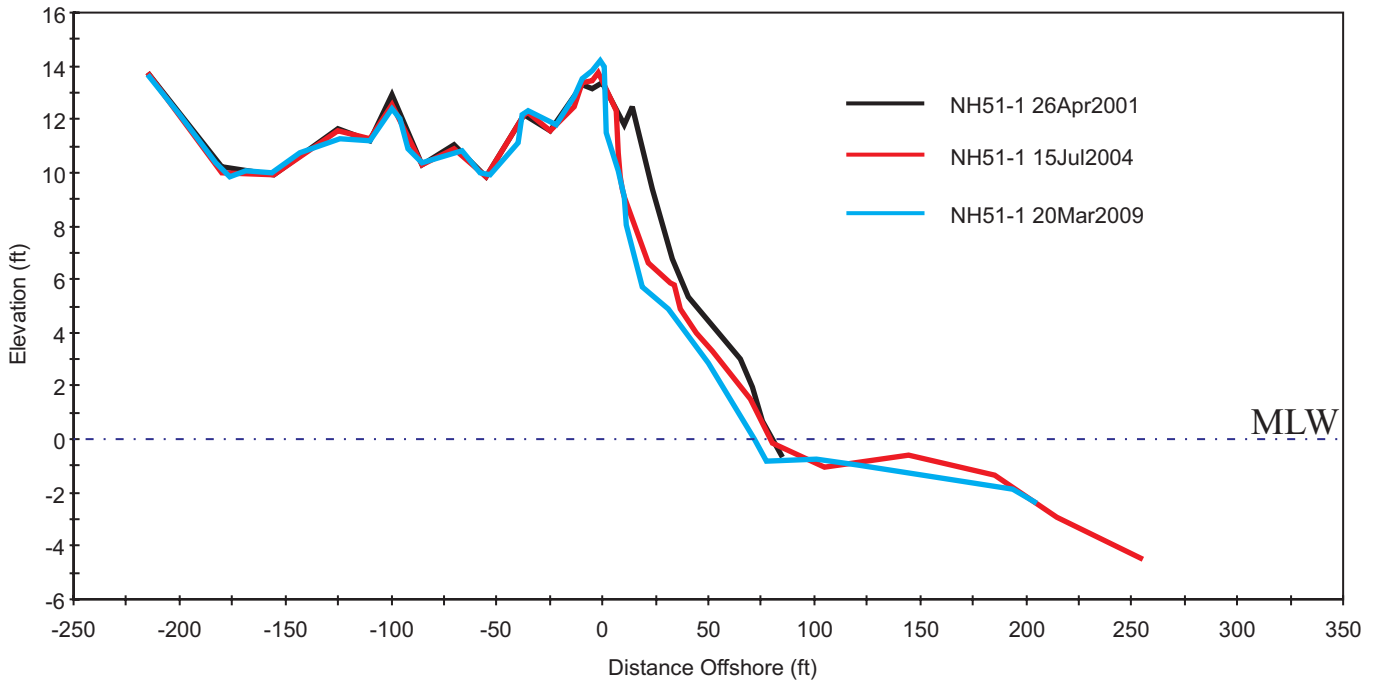
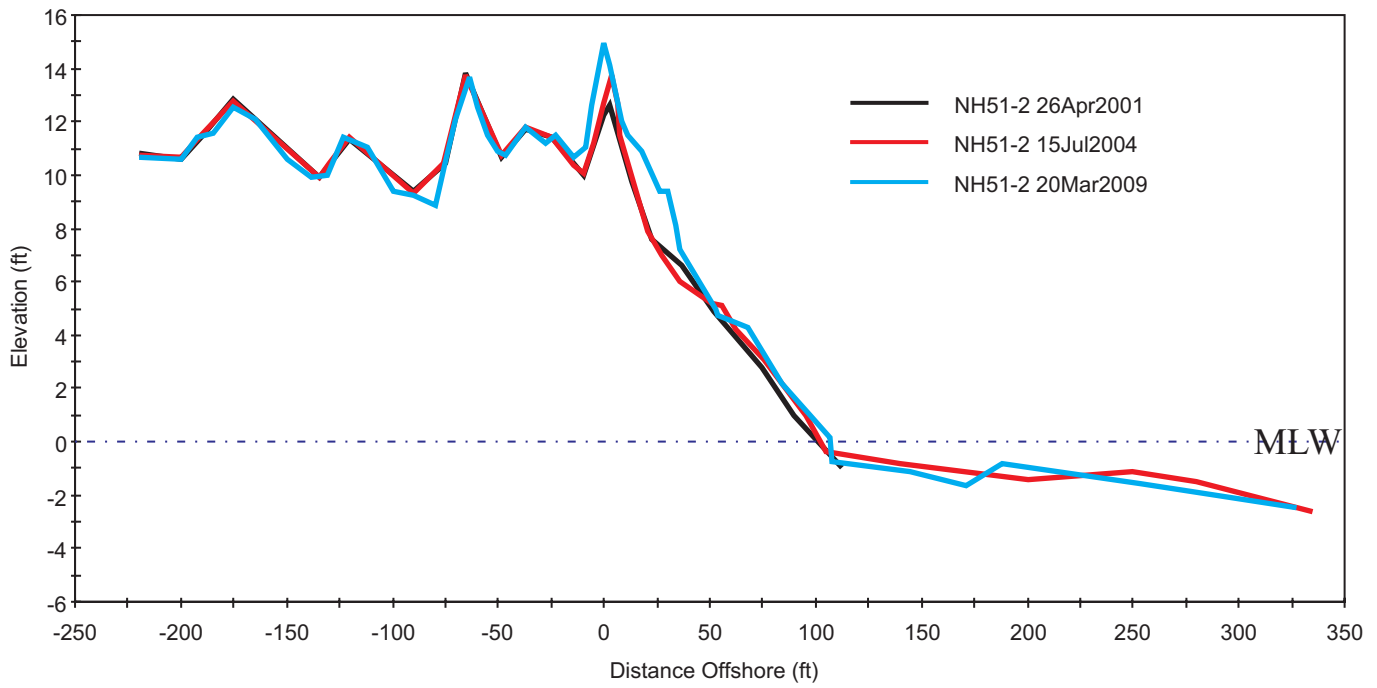


Figure 7H. Individual profile change through time.

Northampton Dune Monitoring



Northampton Dune Monitoring

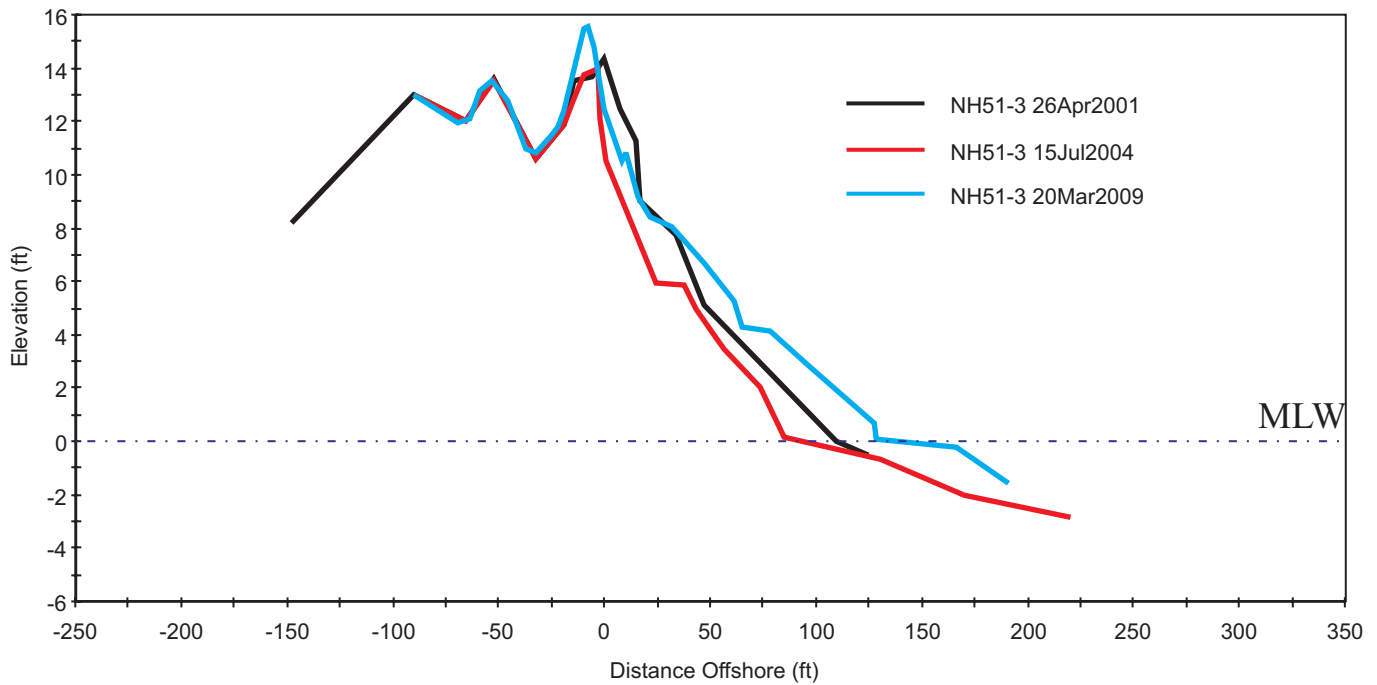
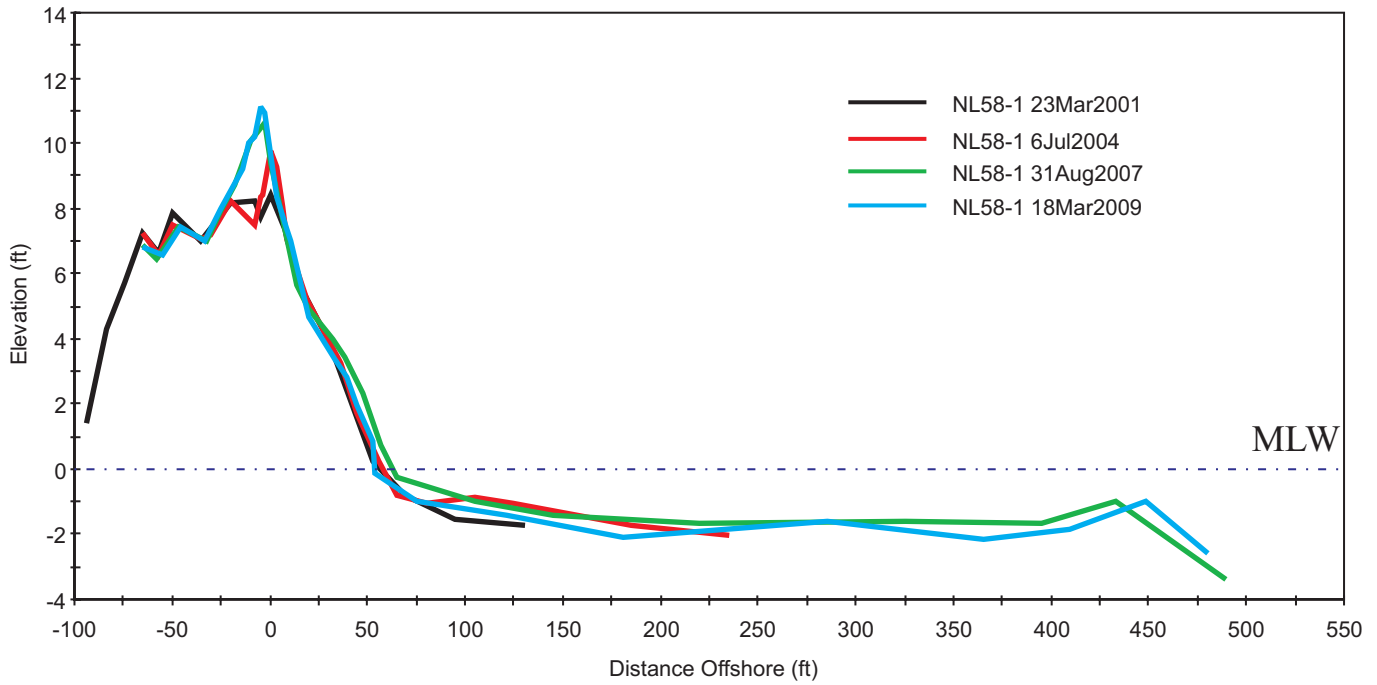


Figure 7I. Individual profile change through time.

Northumberland Dune Monitoring



Northumberland Dune Monitoring

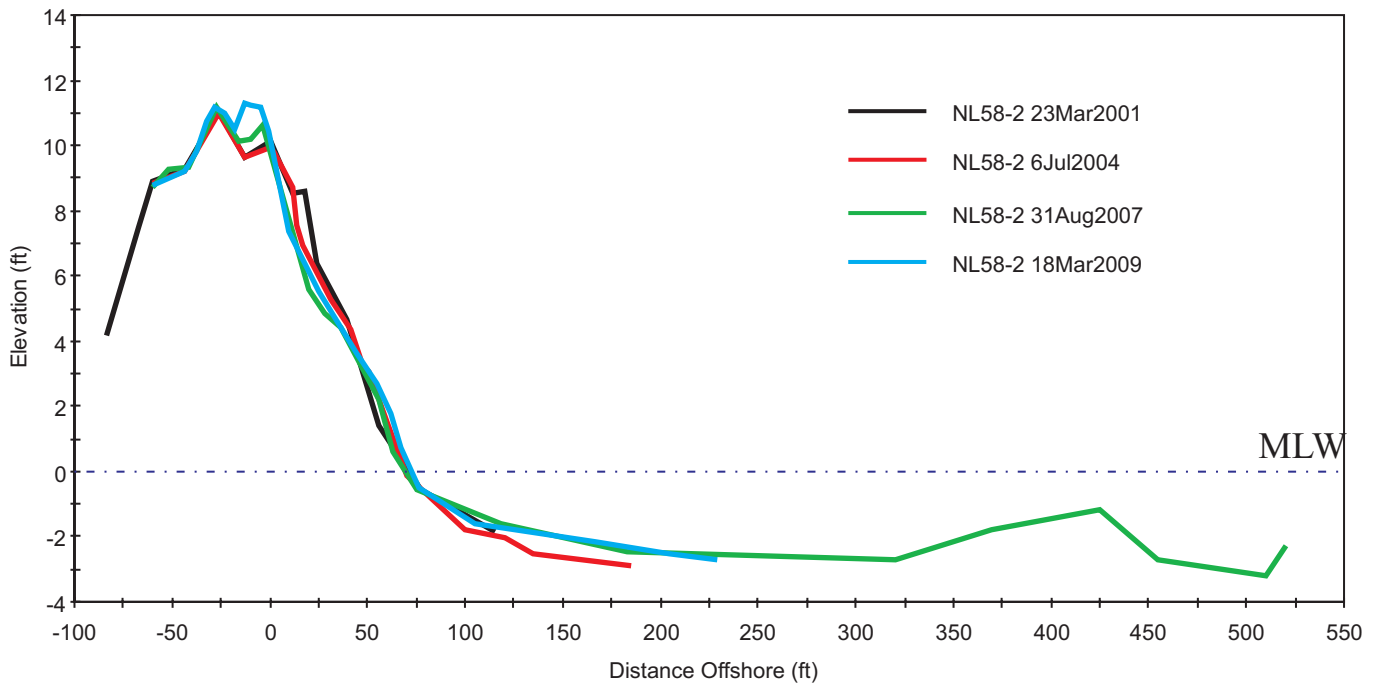
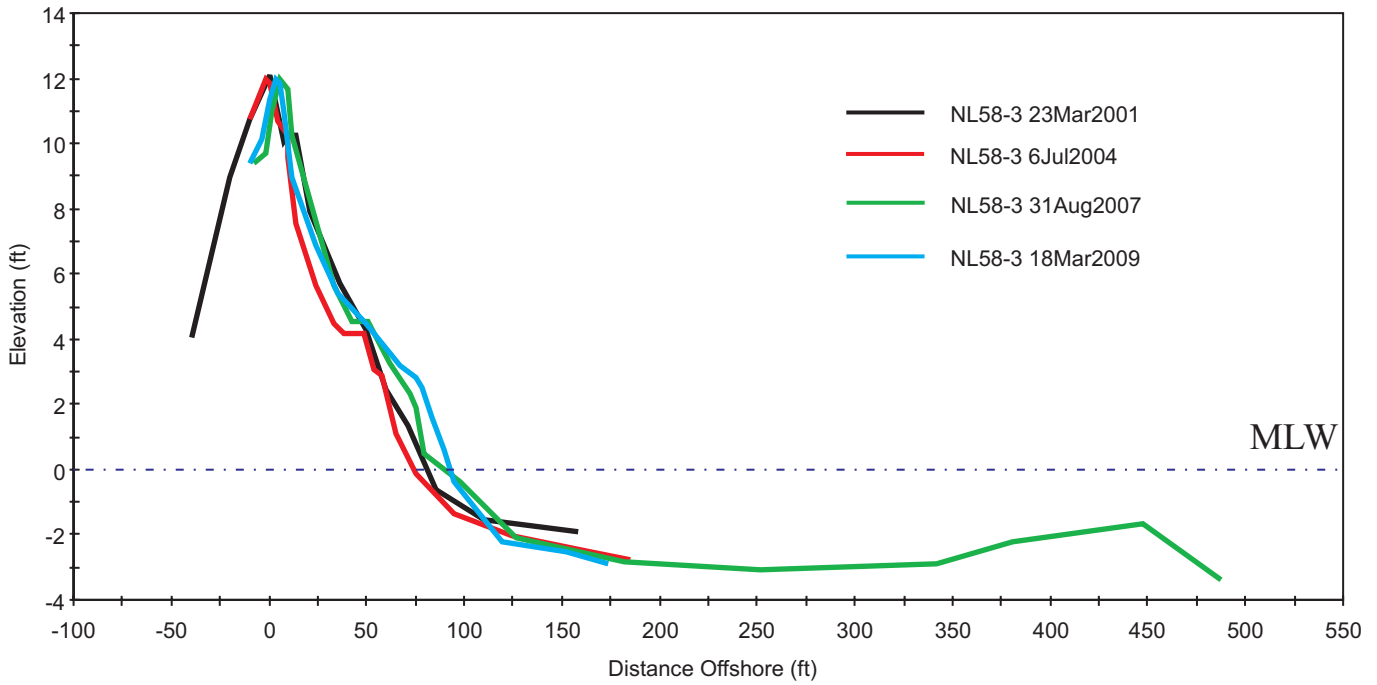


Figure 7J. Individual profile change through time.

Northumberland Dune Monitoring



Northumberland Dune Monitoring

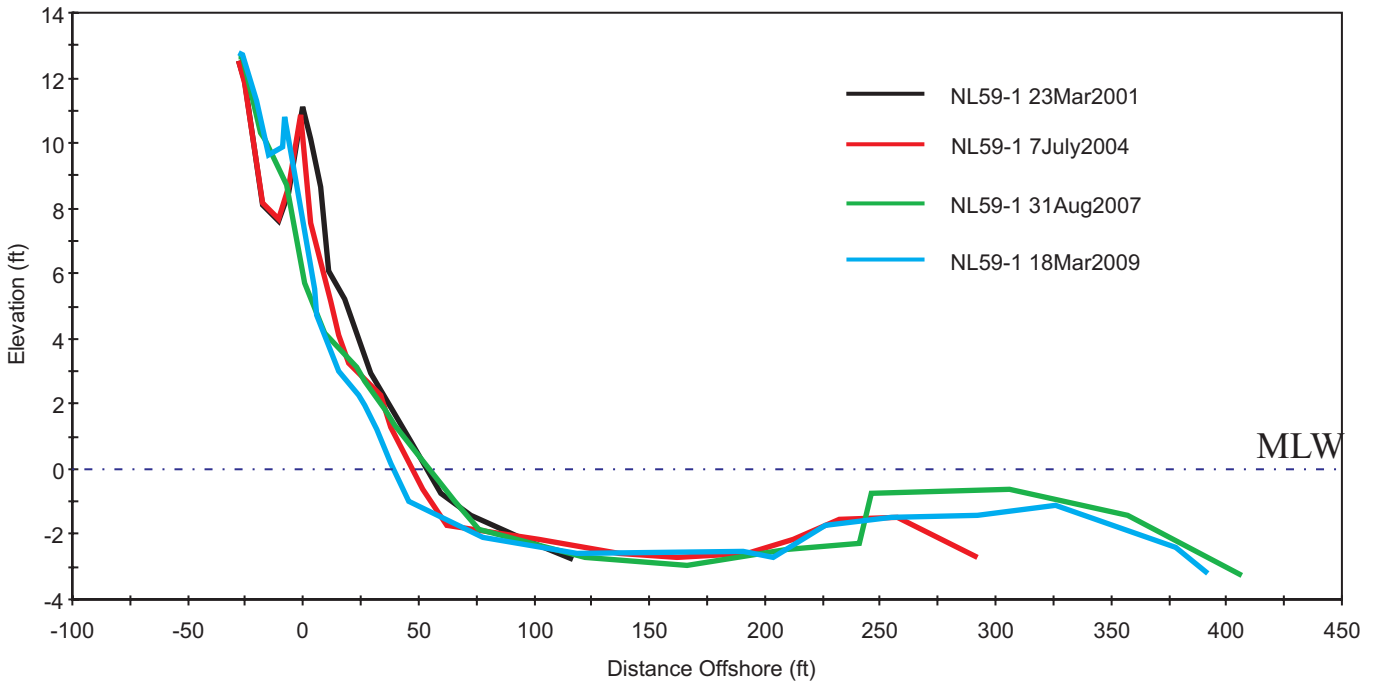
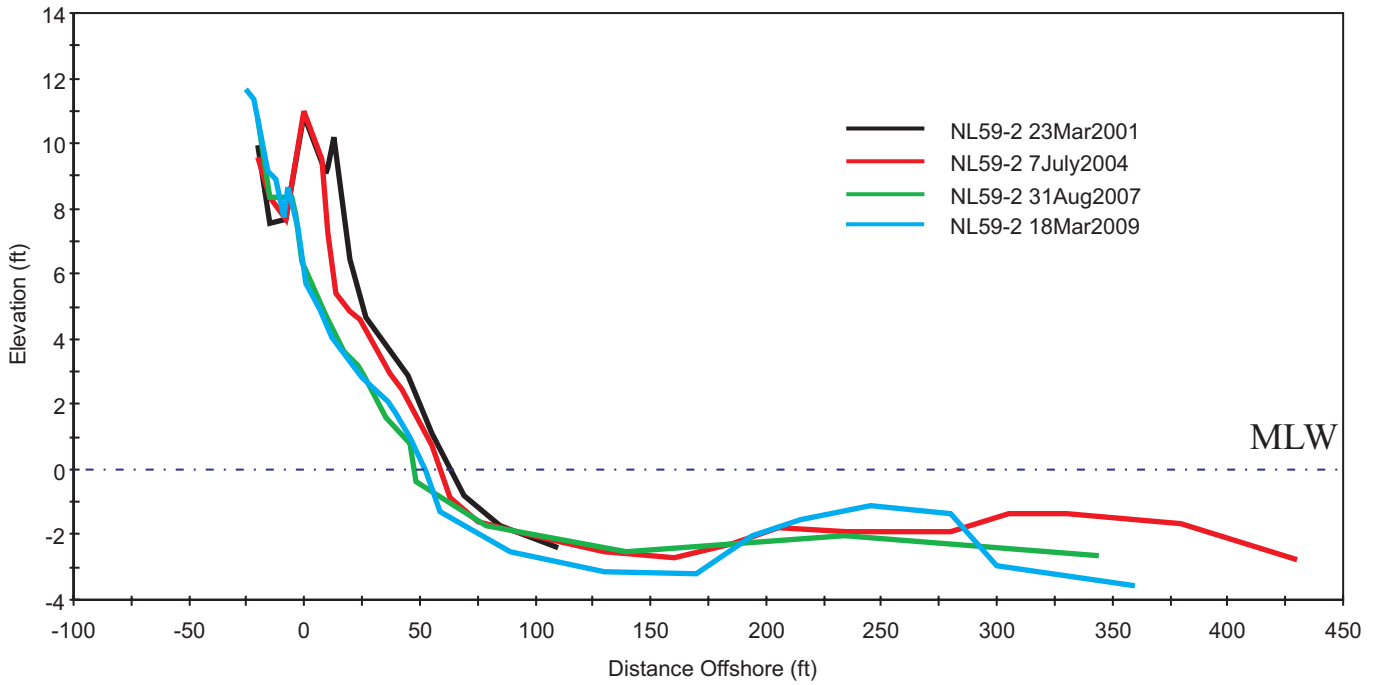


Figure 7K. Individual profile change through time.

Northumberland Dune Monitoring



Northumberland Dune Monitoring

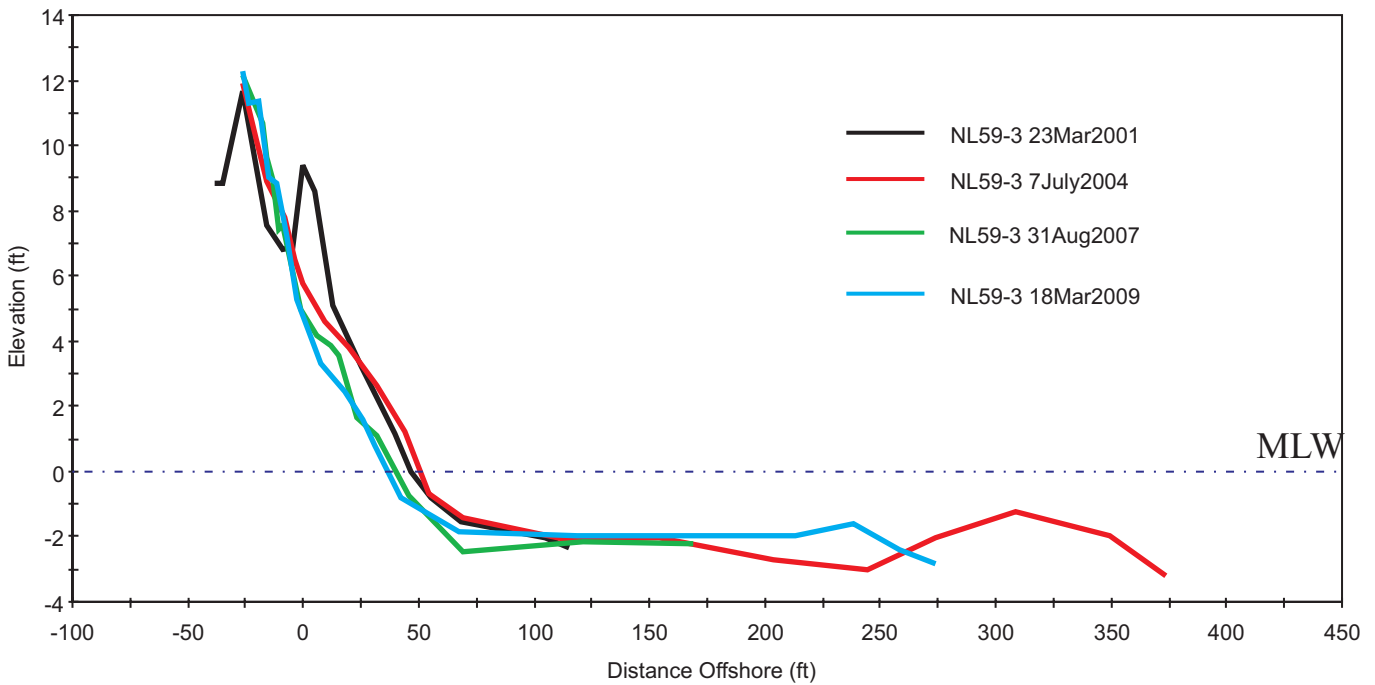


Figure 7L. Individual profile change through time.

MA3-1

MA3-7



Figure 8. Photographs of Ma3 during the course of surveying.

NH10-3



NH17-1



Figure 9. Photographs of NH10 and NH17 during the course of surveying.

NH51-1



Figure 10. Photographs of NH51 during the course of surveying.

NL58-1



NL59-2



Figure 11. Photographs of NL58 and NL59 during the course of surveying.