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**Trip Report, Marine Mammal Monitoring
Mine Neutralization Exercise Events, October 2013
VACAPES Range Complex**

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List of Acronyms and Abbreviations

°	degree(s)
BSS	Beaufort Sea State
C-POD	Click-Porpoise Detector
DoN	Department of the Navy
EAR(s)	Ecological Acoustic Recorder(s)
EOD	explosive ordnance disposal
EDT	Eastern Daylight Time
ESA	Endangered Species Act
ft	foot/feet
GPS	global positioning system
km	kilometer(s)
kts	knot(s) (nautical mile(s) per hour)
lb	pound(s)
m	meter(s)
min	minute(s)
MMPA	Marine Mammal Protection Act
MINEX	mine neutralization exercise
MMO	marine mammal observer
nm	nautical mile(s)
NMFS	National Marine Fisheries Service
PMAP	Protective Measures Assessment Protocol
SEL	sound exposure level
SPL	sound pressure level
TEU	Training and Evaluation Unit
TTS	temporary threshold shift
U.S.	United States
VACAPES	Virginia Capes
yd	yard(s)

SECTION 1: INTRODUCTION

In order to comply with federal regulations, the United States (U.S.) Navy must obtain a Letter of Authorization (LOA) from the National Marine Fisheries Service (NMFS) under the Marine Mammal Protection Act (MMPA) and an Incidental Take Statement (ITS) under the Endangered Species Act (ESA) for training activities. The Virginia Capes (VACAPES) Range Complex Monitoring Plan (DoN 2009), finalized in June 2009, was developed with NMFS to comply with the requirements under the LOA obtained for explosives training (NMFS 2012).

The VACAPES Range Complex Monitoring Plan is one component of the overall effort the U.S. Navy is undertaking to understand its potential effects and the biological consequences of those effects to protected marine species. The VACAPES Range Complex Monitoring Plan has been designed as a collection of focused “studies” to gather data that will allow the U.S. Navy to address the following questions:

1. What are the behavioral responses of marine mammals and sea turtles that are exposed to explosives at specific levels?
2. Is the U.S. Navy’s suite of mitigation measures for explosives (e.g., Protective Measures Assessment Protocol [PMAP], major exercise measures agreed to by the U.S. Navy through permitting) effective at avoiding temporary threshold shift (TTS), injury, and mortality of marine mammals and sea turtles?

In order to answer these questions, data are to be collected through various means, including contracted vessel and aerial surveys, passive acoustics, and placing marine mammal observers (MMOs) aboard U.S. Navy assets.

A visual and real-time passive acoustic monitoring study was conducted in conjunction with a Mine Neutralization Exercise (MINEX) event. As part of this data collection effort, two teams (visual and acoustic) of U.S. Navy Marine Mammal Observers (MMOs) participated in monitoring the MINEX area and event from 24 – 26 October 2013. The MMOs were stationed aboard two vessels. The visual team consisted of Ms. Mandy Shoemaker, Ms. Sarah Rider, Ms. Jackie Bort (26 October only), Mr. Joel Bell, and Mr. Andrew DiMatteo stationed aboard either the Ocean Explorer operated by the Virginia Beach Aquarium (24 and 25 October) or the Matador (operated by a private charter vessel captain, 26 October). The acoustics team consisted of Mr. Anu Kumar, Ms. Jackie Bort (24 and 25 October), Ms. Susan Jarvis, Commander Carl Hager (24 and 25 October), Mr. Ron Filipowicz (26 October), and Dr. Cara Hotchkin stationed on the Instigator (operated by a private charter vessel captain).

For the visual survey, MMOs rotated positions throughout the day, with two MMOs stationed as observers on the viewing platform and one MMO stationed as a data recorder on the ship deck. For the acoustic survey, team members rotated as data recorder throughout the day.

The primary goal of the visual team (MMOs) and acoustic team was to collect data on marine mammals and sea turtles observed during training activities and to answer the follow questions:

1. Are marine mammals and sea turtles exposed to explosives?
2. If so, at what levels?
3. Did exposed marine mammals/sea turtles show a behavioral response?

A secondary goal for the monitoring was to determine if passive acoustics could be used to detect and track marine mammals in the activity area in real time, familiarize the MMOs with at-sea U.S. Navy operations and to gather information to facilitate future MMO opportunities. This secondary goal is captured as “lessons learned” in **Section 5.2**.

SECTION 2: MINE NEUTRALIZATION EXERCISE (MINEX) EVENT DESCRIPTION

During a MINEX training event, explosive ordnance disposal (EOD) training and evaluation unit (TEU) personnel detect, identify, evaluate, and neutralize practice mines. In this specific case, training mine shapes were deployed and then the EOD divers searched the area to locate the shapes. Once found, in order to neutralize the mine, the EOD divers placed an explosive charge on the mine. A timer on the charge was activated (~10 minutes [min]), and then the EOD divers swam over to nearby small boats where they were picked up by and taken a specified distance away from the charge for safety reasons. The detonation was a 10 pound (lb) explosive charge on the bottom. . The training event was performed on 25 October 2013 in the W-50A/R-6606 area and participants were members of the EODTEU-2 group located out of Dam Neck, Virginia.

SECTION 3: METHODS

3.1. SHIPBOARD MARINE MAMMAL MONITORING

The vessel surveys were conducted on the raised viewing platform of the vessel (either the Ocean Explorer or the Matador), with two observers. On-effort monitoring conducted before and after the event involved visual surveys using methods similar to those used during line-transect surveys. Observers would use the naked eye and 7X50 binoculars to scan the area from dead ahead to just abaft of the beam.

On-effort monitoring conducted during the event involved the ship being approximately 1,500 yards (yd) (1,372 meters [m]) away from the detonation site, where MMOs used naked eye and 7x50 binoculars to scan the detonation site and surrounding mitigation zone (within 1,183 yd of the detonation site for a MINEX event using a time delayed firing device with a 10 lb charge). MMOs observed on a not-to-interfere basis, which means that the MMOs were in addition to and did not replace required U.S. Navy lookouts as part of current mitigation and did not dictate operational requirements/maneuvers. The only exception would be if a marine mammal or sea turtle was sighted by the MMO within the mitigation zone, and was not sighted by the U.S. Navy lookout, the MMO would report the sighting to the lookout for appropriate reporting and action.

When an animal was visually detected, the MMO would collect information on sighting, environmental, and operational parameters (**Table 3-1**). When practicable, still photographs were obtained by the MMOs.

Table 3-1. MMO data category descriptions

Data Category	Description
Sightings Information	
Effort (on/off)	On effort means actively searching for marine mammals; time spent off effort could result from vacating the bridge wing for operational reasons.
Date	Format in mm/dd/yyyy.
Time	Time provided in Eastern Daylight Time (EDT).
Location	This is the location of the sighting, determined by data logging program (Mysticetus).
Species/group	Determined by the MMO.
Group size (best/max/min)	Estimated by the MMO.
# calves	Estimated by the MMO.
Behavior	<u>Individual behaviors:</u> breach, porpoise, spin, bowride, feeding, head slap, social, tail slap, pectoral fin slap, other <u>Whale behaviors:</u> blow, no blow rise, fluke up, peduncle arch, unidentified large splash <u>Group behaviors:</u> rest, mill, travel, surface active travel, surface active mill
Animal bearing (true)	Estimated by the MMO.
Animal motion relative to ship	Estimated by the MMO (none, closing, parallel, opening).
Ship bearing (true)	Determined by data logging program (Mysticetus) based on GPS.
Distance from ship (m)	Estimated by the MMO using reticled binoculars or naked eye.
Length of contact (min)	Estimated by the MMO.
Environmental Information	
Wave height (ft)	Estimated by the MMO.
Visibility	Estimated by the MMO.
Beaufort Sea State (BSS)	Estimated by the MMO.
% glare	Estimated by the MMO.
% cloud cover	Estimated by the MMO.
Operational Information	
Active sonar in use?	Specifically refers to mid-frequency active sonar (MFAS).
Explosives in use?	Determined by the MMO.
Mitigation implemented	If explosive exercise underway, the measures implemented, if any, by the U.S. Navy Operators.
Comments	Other comments as necessary.

3.2. ACOUSTIC MARINE MAMMAL MONITORING

Passive acoustic monitoring was conducted during this event in order to a) investigate differences in detection rates between visual and passive acoustic monitoring methods and b) test new technologies for detecting, locating, and tracking marine mammals in near real-time. Five moorings were deployed on each day. Each was equipped with an archival acoustic recorder and attached to a 53F or 53F-GPS DIFAR sonobuoy. Data from the sonobuoys was transmitted to a portable M3R receiver on the Instigator for real-time detection and analysis of marine mammal vocalizations.

3.3. SCHEDULE OF EVENTS

Table 3-2 shows the schedule of events for both the visual and acoustic vessels for each day.

Table 3-2. Schedule of events

Time	24 October 2013	Time	25 October 2013	Time	26 October 2013
0800	Visual vessel underway	0800	Visual vessel underway	0815	Visual vessel underway
0813	Visual MMOs on effort	0831	Visual MMOs on effort	0830	Acoustic vessel underway
0900	Acoustics vessel underway	0930	Acoustic vessel underway	0832	Visual MMOs on effort
0948	1 st buoy deployed	0954	1 st buoy deployed	0852	1 st buoy deployed
0950	Visual MMOs off effort*	1021	Last buoy deployed	0922	Last buoy deployed
1000	Visual vessel return to port	1158	Detonation	1211	MMOs off effort
1021	Last buoy deployed	1328	Visual MMOs off effort	1230	Visual survey vessel return to port
1525	1 st buoy retrieved	1344	1 st buoy retrieved	1353	1 st buoy retrieved
1549	Last buoy retrieved	1400	Visual vessel return to port	1423	Last buoy retrieved
1615	Acoustic vessel return to port	1503	Last buoy retrieved	1500	Acoustics vessel return to port
		1540	Acoustic vessel return to port		

* Visual vessel had to end survey early on 24 October due to offshore weather conditions.

SECTION 4: RESULTS

Visual

A total of 19 marine mammal sightings and a single unidentified hardshell turtle sighting were recorded by the MMOs (**Table 4-1**). All marine mammal sightings were of Atlantic bottlenose dolphins. Three marine mammal sightings occurred on 24 October, the day before the event, and are shown in **Figure 4-1**. The one sea turtle sighting on 25 October, the day of the MINEX event, are shown in **Figure 4-2** in relation to the detonation location. The 16 marine mammal sightings on 26 October, the day after the MINEX event, are shown in **Figure 4-3**. It is important

to note that sighting conditions were not optimal from 24-25 October with BSS ranging from 2-3. The turtle sighting on 25 October (day of event) was made approximately 70 min prior to the detonation, and was approximately 6,750 yd away from the detonation site. The sighting was brief, and the animal breathed twice and then dove. No unusual behavior was observed.

For the sea turtle sighting that was obtained 70 min prior to the detonation, calculations were made to determine whether it was probable the animal could have been exposed to the detonation. As shown in **Figure 4-1** the animal was far outside of the 1,183 yd mitigation zone at the time of the sighting. The 1,183 yd mitigation zone is used for MINEX events involving time-delay firing devices to ensure that animals do not have time to swim close enough after the fuse is lit, since the exercise cannot be stopped after this point for safety reasons. However, the estimated range to onset TTS for up to 20 lb charge is only at 700 yd, and the charge that occurred after the turtle sighting was a 10 lb charge.

Based on an average swim speed of 0.75 nm/hr (Meylan 1995), the turtle could have traveled approximately 0.875 nm (1,800 yd) before the detonation occurred. The turtle was sighted approximately 6,750 yd away from the detonation site, so even if the turtle was swimming directly towards the detonation it is unlikely that the turtle would have been closer than 4,950 yd away from the detonation. Although it is possible that the turtle could have been exposed to sound or energy levels that would cause a minor and temporary behavioral disturbance, it is unlikely that the sea turtle would have responded with more than just a brief startle response at that distance.

Acoustic

Deployment of the acoustic array was part of a preliminary study to determine whether real-time passive acoustic monitoring of marine mammals during the MINEX events is feasible. Five anchored moorings equipped with archival recorders and sonobuoys were deployed each day from the acoustic vessel *Instigator*. **Figure 4-4** shows the buoy deployment locations in relation to the planned detonation location for the 25 October MINEX event. Locations of the acoustic buoys on 24 October were based on the planned detonation location and are not consistent with the 25 and 26 October location due to a slight change in the actual detonation location. **Figure 4-5** and **Figure 4-6** show the buoy deployment and retrieval locations in relation to the actual detonation location for each respective day. Weather conditions differed greatly between the day of the event (25 October) and the other two monitoring days, with poor detection conditions on 25 October, including subsurface currents that affected the locations of the acoustic moorings. Conditions were markedly better on 24 and 26 October.

On 24 October, a number of marine mammal vocalizations were detected, localized, and tracked in near real-time with the portable M3R receiver located on the acoustics vessel (**Figure 4-7**), though no marine mammals were visually sighted by the acoustics vessel. On 25 October, no marine mammal vocalizations were detected in real-time, and no marine mammals were sighted by the acoustics vessel. On 26 October, many marine mammal vocalizations were detected, but there were no real-time localizations due to the high ambient noise in the survey area. On this day, bottlenose dolphins were sighted in and around the survey area, passing quite close to the anchored acoustics survey vessel (**Figure 4-8**). All data from the sonobuoys were recorded for

post-event processing and analysis in conjunction with data from the archival recorders deployed on the sonobuoy moorings, but analysis of these data has not been completed at this time. The real-time detections were mainly meant to cue the MMOs that marine mammals may be in the area. Additional work regarding the use of sonobuoys during monitoring events is planned for future events. Analysis and any results will be presented in a subsequent report for marine species monitoring within the East Coast Range Complexes.

Table 4-1. Marine species sightings data

Data Category	Sighting 1	Sighting 2	Sighting 3	Sighting 4	Sighting 5	Sighting 6	Sighting 7
Sightings Information							
Effort (on/off)	On	On	On	On	Off	Off	On
Date	10/26/2013	10/24/2013	10/24/2013	10/25/2013	10/26/2013	10/26/2013	10/26/2013
Time	08:48	9:11	9:25	10:49	08:27	08:29	08:33
Latitude (N)	36.88612	36.83917	36.83451	36.79940	36.71876	36.71950	36.72259
Longitude (W)	75.87245	75.84517	75.87948	75.81017	75.92679	75.92681	75.91484
Species/Group	Bottlenose dolphins	Bottlenose dolphins	Bottlenose dolphins	Unidentified hardshell turtle	Bottlenose dolphins	Bottlenose dolphins	Bottlenose dolphins
Group Size (best/max/min)	10/20/8	1/3/1	2/2/2	1/1/1	10/15/6	2/3/2	3/5/2
# Calves	No	No	No	No	No	No	No
Behavior	milling	traveling	traveling	breathed, then dove	milling	traveling	traveling
Animal bearing (true)	90	210	210	250	85	48	320
Animal motion relative to ship	none	parallel	closing	none	parallel	closing	closing
Ship bearing (true)	?	?	?	250	0	48	48
Distance from ship	30 m	50 m	50 m	50 m	30 m	10 m	3,000 m
Length of Contact	1 min	1 min	1 min	1 min	5 min	2 min	1 min
Environmental Information							
Wave height (ft)	moderate	moderate	moderate	light	light	light	light
Visibility	moderate	moderate	moderate	good	good	good	good
BSS	3	3	3	3	1	1	1
% Glare (port/starboard)	0/0	0/0	0/0	10/0	0/0	0/0	0/0
% Cloud Cover (port/starboard)	0/0	0/0	0/0	40/40	0/20	0/20	0/20
Operational Information							
Active sonar in use?	No	No	No	No	No	No	No
Explosives in use?	No	No	No	No	No	No	No
Mitigation implemented	No	No	No	No	No	No	No
Comments	GPS malfunctioned; no record of ship bearing.	GPS malfunctioned; no record of ship bearing.	GPS malfunctioned; no record of ship bearing.		Fish on fishfinder and birds in area.	Lost behind boat. Fish on fishfinder and birds in area.	

Table 4-1. Marine species sightings data (Continued)

Data Category	Sighting 8	Sighting 9	Sighting 10	Sighting 11	Sighting 12	Sighting 13	Sighting 14
Sightings Information							
Effort (on/off)	On						
Date	10/26/2013	10/26/2013	10/26/2013	10/26/2013	10/26/2013	10/26/2013	10/26/2013
Time	09:59	10:02	10:09	10:14	10:28	10:35	10:36
Latitude (N)	36.78777	36.78164	36.77214	36.76620	36.81142	36.82154	36.82276
Longitude (W)	75.86396	75.87935	75.91187	75.93568	75.95313	75.92161	75.917485
Species/Group	Bottlenose dolphins						
Group Size (best/max/min)	4/4/2	5/7/4	10/15/6	3/4/2	5/8/3	2/2/2	5/5/3
# Calves	No	No	Unknown	No	Unknown	No	No
Behavior	traveling						
Animal bearing (true)	220	45	315	300	170	20	100
Animal motion relative to ship	closing	parallel	parallel	parallel	parallel	parallel	closing
Ship bearing (true)	48	260	260	260	70	80	80
Distance from ship	6,000 m	400 m	700 m	400 m	500 m	500 m	20 m
Length of Contact	4 min	1 min	2 min	1 min	1 min	1 min	1 min
Environmental Information							
Wave height (ft)	light						
Visibility	good						
BSS	1	1	1	1	1	1	1
% Glare (port/starboard)	20/0	20/0	20/0	20/0	0/40	0/40	0/40
% Cloud Cover (port/starboard)	0/0	0/0	0/0	0/0	0/0	0/0	0/0
Operational Information							
Active sonar in use?	No						
Explosives in use?	No						
Mitigation implemented	No						
Comments							

Table 4-1. Marine species sightings data (Continued)

Data Category	Sighting 15	Sighting 16	Sighting 17	Sighting 18	Sighting 19	Sighting 20
Sightings Information						
Effort (on/off)	On	On	On	On	On	On
Date	10/26/2013	10/26/2013	10/26/2013	10/26/2013	10/26/2013	10/26/2013
Time	11:25	11:31	11:35	11:50	11:52	12:03
Latitude (N)	36.92499	36.91432	36.90709	36.88165	36.87903	36.85702
Longitude (W)	75.76390	75.79003	75.80977	75.87756	75.88453	75.93764
Species/Group	Bottlenose dolphins	Bottlenose dolphins	Bottlenose dolphins	Bottlenose dolphins	Bottlenose dolphins	Bottlenose dolphins
Group Size (best/max/min)	4/5/2	3/3/2	4/5/2	2/2/2	5/8/3	8/10/8
# Calves	No	No	Unknown	No	No	No
Behavior	feeding	?	feeding	feeding	traveling	feeding
Animal bearing (true)	340	0	230	0	340	260
Animal motion relative to ship	none	parallel	none	none	closing	none
Ship bearing (true)	222	233	230	238	226	224
Distance from ship	200 m	300 m	1,500 m	200 m	600 m	200 m
Length of Contact	2 min	1 min	5 min	1 min	1 min	3 min
Environmental Information						
Wave height (ft)	light	light	light	light	light	light
Visibility	good	good	good	good	good	good
BSS	1	1	1	1	1	1
% Glare (port/starboard)	0/30	0/30	0/30	0/30	0/30	0/30
% Cloud Cover (port/starboard)	0/0	0/0	0/0	0/0	0/0	0/0
Operational Information						
Active sonar in use?	No	No	No	No	No	No
Explosives in use?	No	No	No	No	No	No
Mitigation implemented	No	No	No	No	No	No
Comments	Feeding/fluking at surface on bait fish.		Passing front line; photos taken.		Traveling and splashing.	Two large bait balls sighted just prior to dolphins.

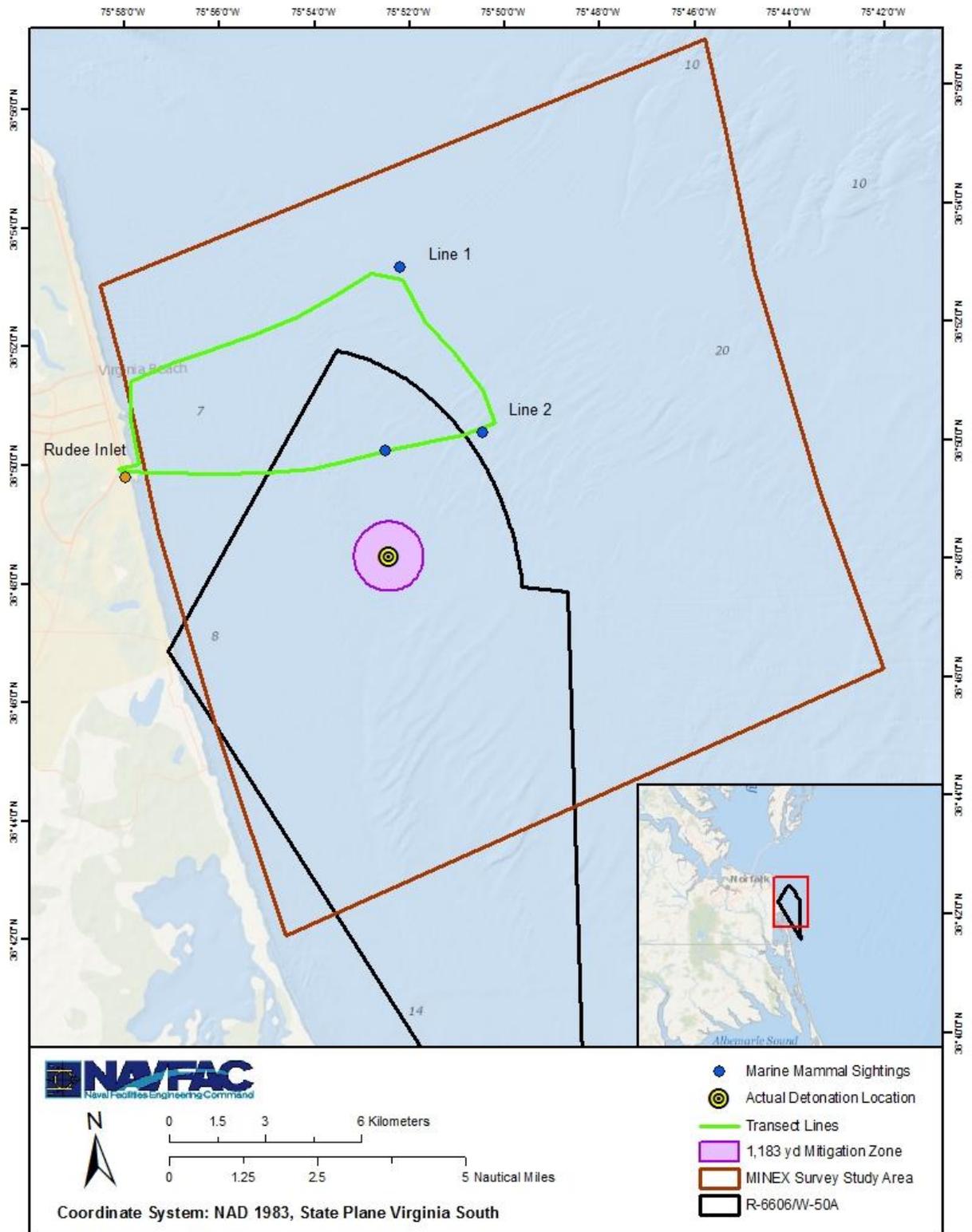


Figure 4-1. Pre-event visual survey tracklines and location of sightings on 24 October, 2013

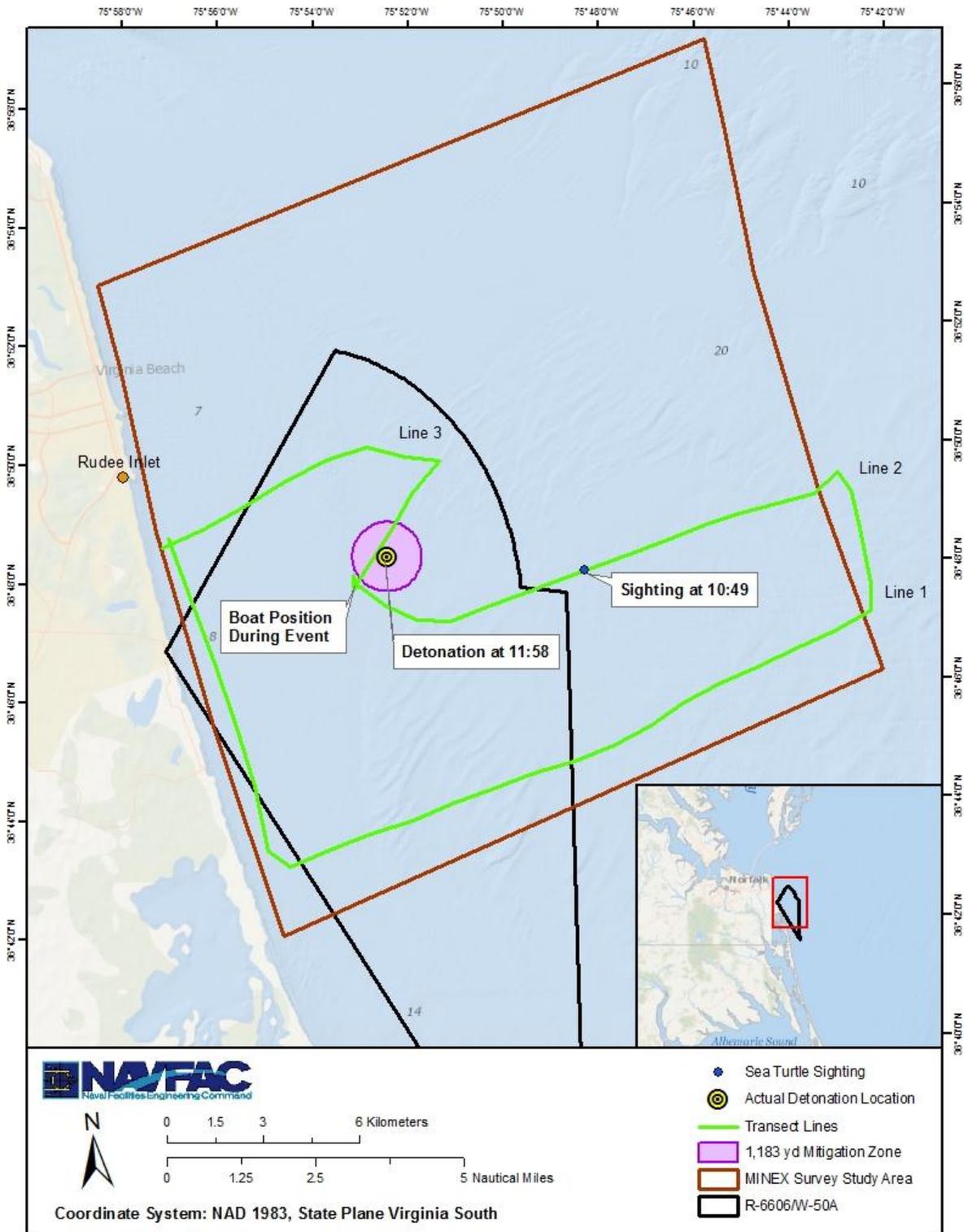


Figure 4-2. Visual survey tracklines, location of detonation event, and sightings on 25 October, 2013.

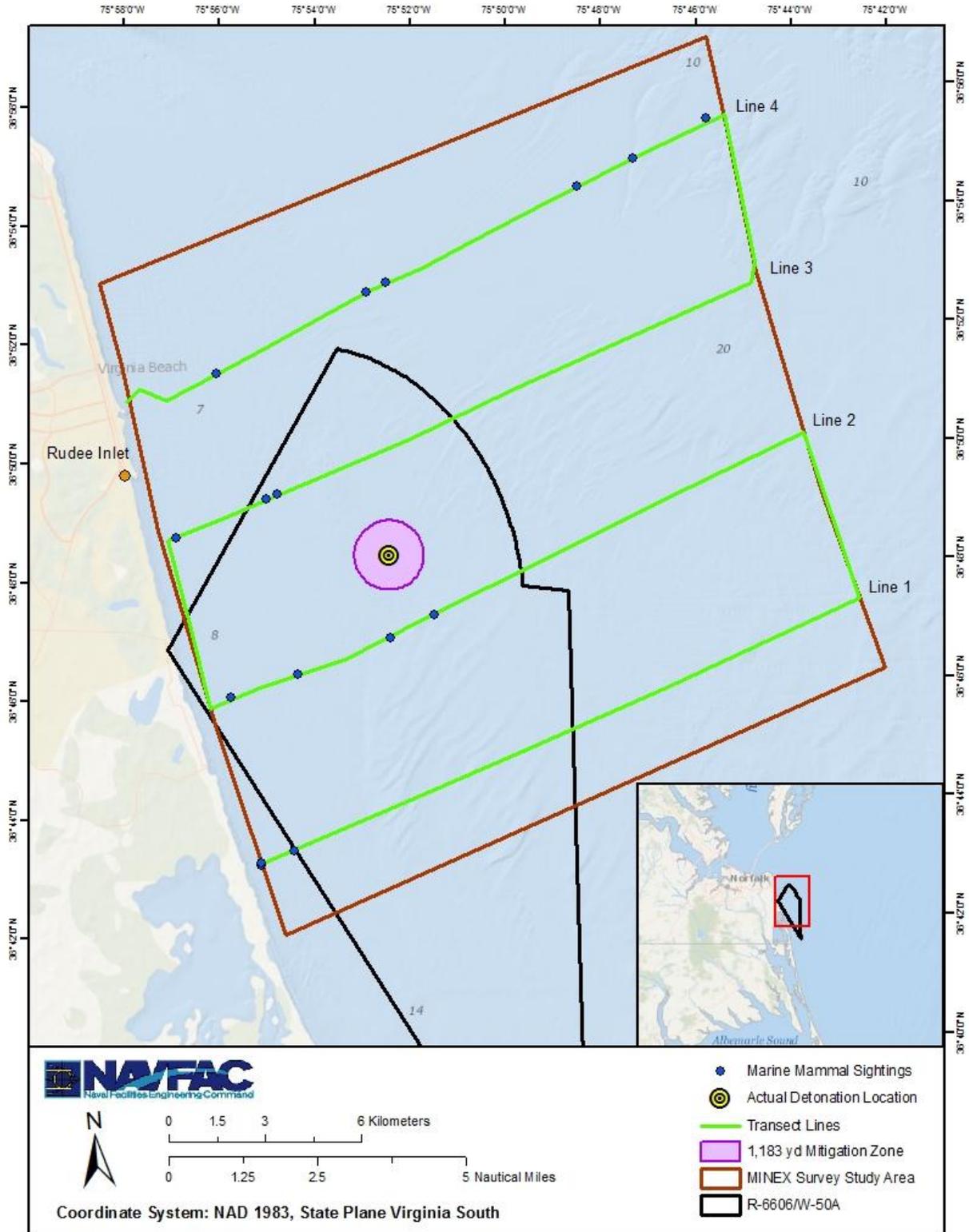


Figure 4-3. Post-event visual survey tracklines and location of sightings on 26 October, 2013.

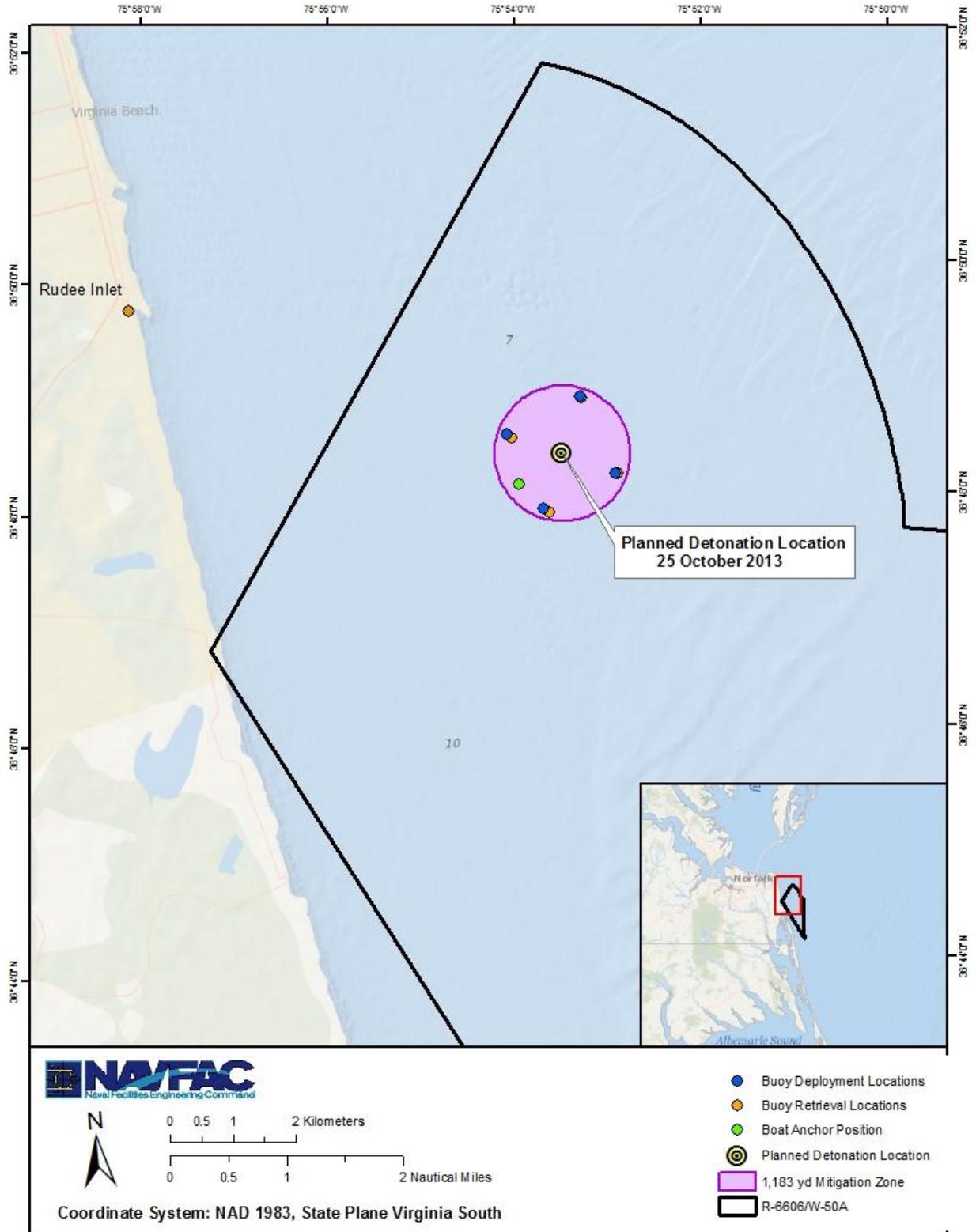


Figure 4-4. Pre-event location of acoustic data recording devices on 24 October, 2013.

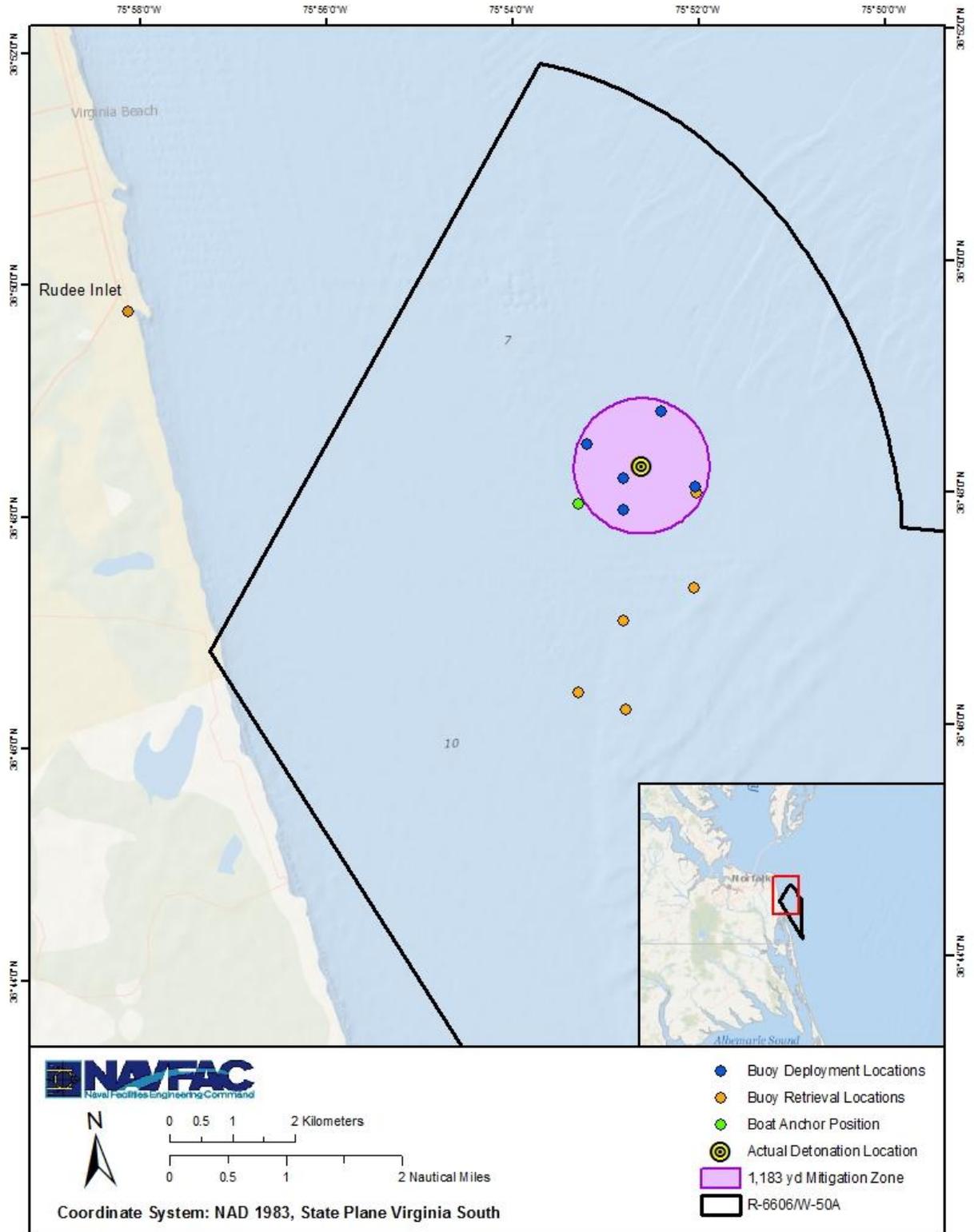


Figure 4-5. Location of acoustic data recording devices and detonation event on 25 October, 2013.

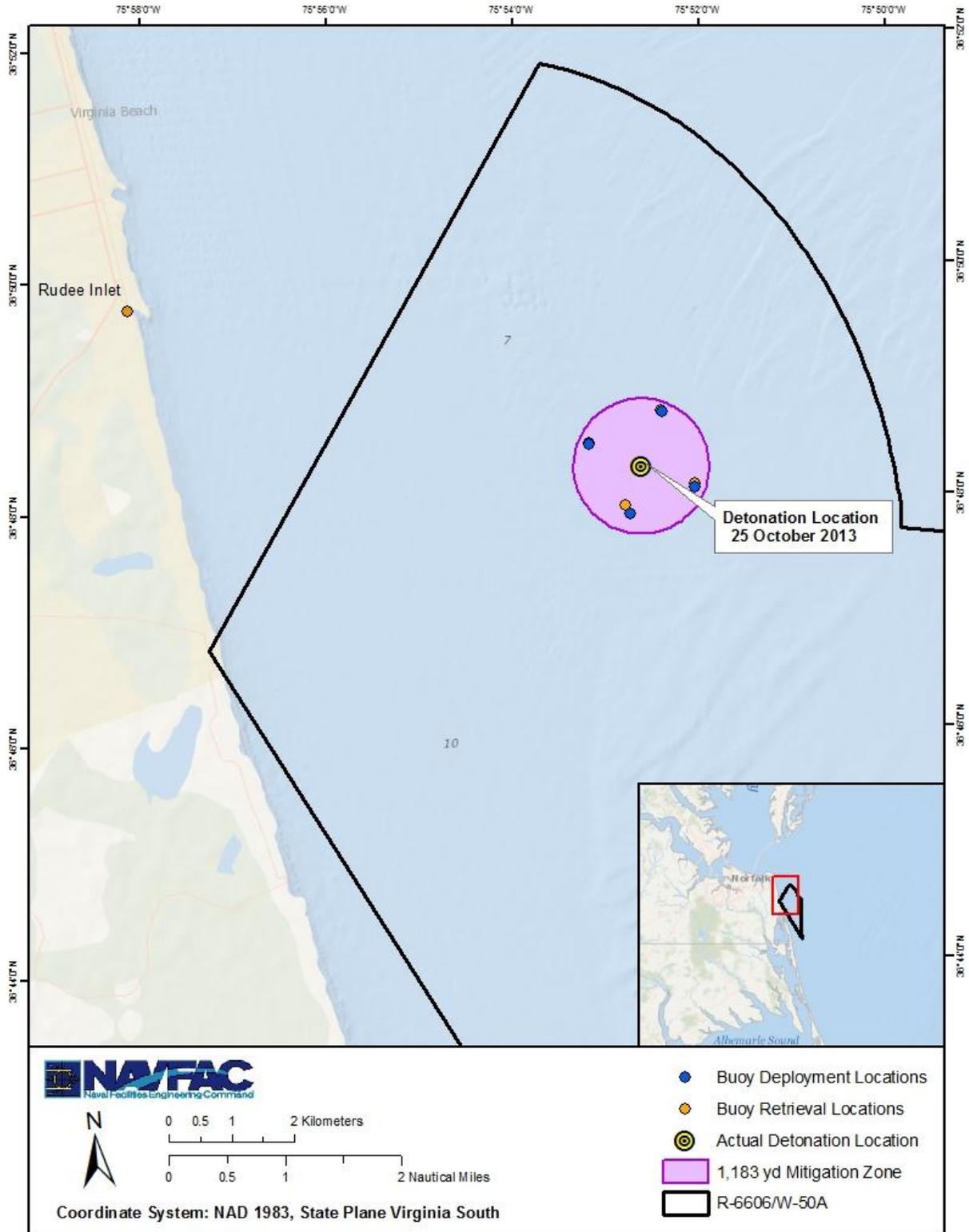


Figure 4-6. Post-event location of acoustic data recording devices on 26 October, 2013.

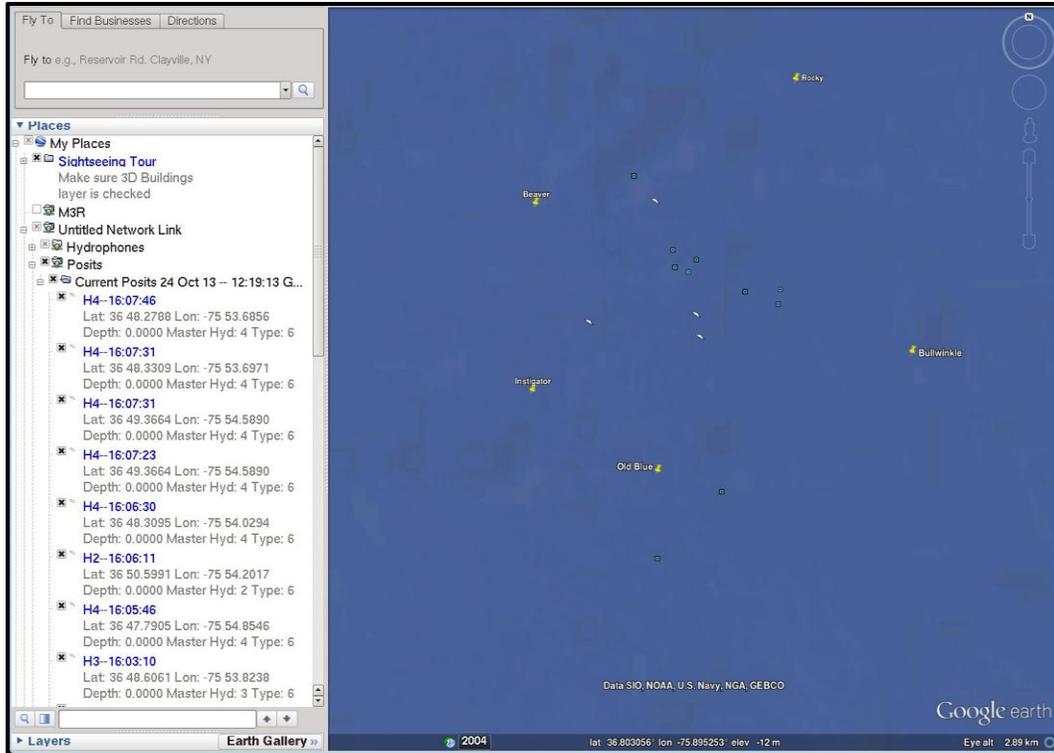


Figure 4-7. Real-time acoustic detections and localizations of marine mammal vocalizations, 24 October, 2013.



Figure 4-8. Acoustic recording buoy, visual survey vessel, and bottlenose dolphins, 26 October, 2013.

SECTION 5: CONCLUSION

5.1. MARINE MAMMAL MONITORING

The goal of the VACAPES MINEX monitoring effort is summarized below, with a conclusion regarding each of the specific questions that were asked:

1. Are marine mammals and sea turtles exposed to explosives?

Visual sightings and acoustic localizations of marine mammals were made on 24 October. In addition, visual sightings by both the visual and acoustic vessels were obtained on 26 October, indicating that bottlenose dolphins do occur in the VACAPES MINEX event area close to where the detonation event took place. No visual sightings or acoustic detections of marine mammals were made on 25 October. The sea turtle sighting obtained on 25 October (day of event) was made approximately 70 min prior to the detonation, and was approximately 6,750 yd away from the detonation site. The sighting was brief, and the animal breathed twice and then dove. No unusual behavior was observed.

2. If so, at what levels?

As discussed in **Section 4**, although it is possible that the sea turtle sighted on 25 October could have been exposed to sound or energy levels that would cause a minor and temporary behavioral disturbance, it is unlikely that the sea turtle would have responded with more than just a brief startle response at that distance.

With regards to the marine mammal acoustic detections obtained during the event, at this time it is unclear how far away the individuals were from the detonation site. If this information can be obtained, estimations can be made regarding the received levels at which the individuals may have been exposed. Any updates on future results will be included in a subsequent report for marine species monitoring within the East Coast Range Complexes.

3. Did exposed marine mammals/sea turtles show a behavioral response?

Three marine mammal sightings were visually detected on 24 October, the day before the event. No marine mammals were visually detected, but one unidentified sea turtle was visually detected on 25 October, the day of the event. The sea turtle sighting occurred before the event and no unusual behavior was observed. Sixteen marine mammal sightings were visually detected on 26 October, the day after the event. However, due to differences in environmental conditions on the three observation days, with the worst weather occurring on the event day, it is not possible to determine whether the event activity contributed to the observed differences in marine mammal distribution.

Marine mammals were acoustically detected and localized real-time on 24 October, the day before the event. No marine mammals were detected visually or acoustically on 25 October, before or after the detonation event. Marine mammals were acoustically and visually detected by the acoustic team the day after the event on 26 October; however, there were no real-time localizations. Due to differences in environmental conditions (both weather and ambient sound levels) on the three observation days, it is not possible to determine whether the event activity contributed to the observed differences in marine mammal distribution.

No behavioral data has been drawn from the acoustic data at this time, but any updates on future results will be included in a subsequent report for marine species monitoring within the East Coast Range Complexes.

4. Can passive acoustics be used to detect and track marine mammals in the activity area in real time?

Real-time passive acoustic detections and localizations of marine mammals were completed on 24 October, 2013, and marine mammals were detected but not localized on 26 October, 2013. A preliminary explanation for the varying results is that the higher noise floor on 26 October (due to more vessel traffic in the area) prevented accurate localizations. Preliminary analyses indicate that real-time acoustic detection and localization may be possible with continued development of detection and localization algorithms designed to compensate for high levels of ambient noise in the activity area.

No localization analyses have been completed on the archived acoustic data at this time, but any updates on future results will be included in a subsequent report for marine species monitoring within the East Coast Range Complexes.

5.2. LESSONS LEARNED

A few lessons learned were noted for the VACAPES MINEX event monitoring effort, and are separated into those for shipboard monitoring and operational information below.

5.2.1. Shipboard Marine Mammal Monitoring

- Continue to ensure that a detailed log (leave port, begin on-effort, begin event, end event, off-effort, return to port, and environmental conditions) is kept for each day of monitoring.
- Recommend that improvements continue to be made to ensure consistency among MMOs regarding filling out the sighting forms. Using global positioning system (GPS) units to collect position information is a big improvement from past events.

- Methods are needed to continue to improve the close-aboard distance estimation by MMOs. Reticled binoculars were used for longer-distance sightings, but this method was not useful for close aboard sightings. Suggest that MMOs practice close aboard distance estimation if possible.
- It is recommended that passive acoustic monitoring continue to be a priority in order to supplement the visual monitoring.
- Sonobuoy moorings on 25 October were affected by strong subsurface currents, potentially reducing the effectiveness of passive acoustic monitoring. Future moorings will use improved anchoring systems to reduce risk of being moved by high waves or currents.

5.2.2. Operational Information

- Future monitoring efforts should continue to make every attempt possible to organize a pre-event brief. This allows the environmental staff to present the goals of the monitoring and explain what information is needed for their planning efforts, as well as the opportunity to learn more about the event(s) that will be taking place.
- A field communication plan is extremely vital for successful monitoring on U.S. Navy ranges. It is imperative to have multiple forms of potential communication in case the preferred method does not work. Communication needs to take place in the event that range schedulers need to confirm that MMOs have permission to be on the range, as well as to get updates regarding schedule of events.
- Continue to improve pre-planning coordination between operators and MMOs to ensure that monitoring opportunities and data gathering are maximized.

SECTION 6: ACKNOWLEDGEMENTS

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