Deepwater Horizon Oil Spill (DWHOS)

Water Column and Fish Technical Working Group

Summary of Historical Shelf and Offshore SEAMAP Fish and Plankton Data

April 2, 2011

The NMFS/NOAA SEAMAP program is a fishery-independent State/Federal/university cooperative data collection program that covers nearly all of the Gulf of Mexico. With over 25 years of data, this program is a significant resource for understanding the characteristics of the Gulf of Mexico biological community. The SEAMAP program includes numerous surveys that sample egg, larval, juvenile, and adult life stages of fish and invertebrates throughout the year, with surveys ranging from shore to 500 m depth (Table 1). Each survey typically covers a portion of the Gulf of Mexico (Figure 1 – 12). The SEAMAP program includes dedicated plankton surveys, shrimp/groundfish/pelagic trawl surveys, longline surveys, and trap/video surveys. The strength of the SEAMAP data set is its longevity; 2010 was the 29th year (GSFMC 2010a). Unfortunately, surveys that cover the offshore areas of the Gulf of Mexico are more limited in time-series and seasonal coverage (only the Spring Plankton Survey has sampled offshore areas since the 1980s).

Table 1. A summary of NMFS/NOAA SEAMAP surveys. Information from GSMFC (2010a-b), Henwood *et al.* (2010a-d), NMFS and GSFMC (2001), and Rester (2010).

Survey	Location	Gear	Sampling Period	Years
SEAMAP Spring Plankton Survey	• Offshore Texas to Florida beyond the 200 m depth contour. • Florida continental shelf in recent years. • Stations are located at approximately ½ degree intervals (~56 km).	• 61 cm bongo net with 0.335 mm mesh. • Single or double 2 m x 1 m neuston net with 0.950 mm mesh. • 1 m MOCNESS used in recent years only. • some CUFES[1] data in recent years.	April through early June	1982 – present
SEAMAP Fall Plankton Survey	• Continental shelf from Brownsville, Texas to Key West, Florida, generally within the 200 m depth contour. • Stations are located at approximately ½ degree intervals (~56 km).	• 61 cm bongo net with 0.335 mm mesh. • Single or double 2 m x 1 m neuston net with 0.950 mm mesh. • 1 m MOCNESS[2] used in recent years only. • some CUFES data in recent years.	Late August through mid-October	1986 – present
SEAMAP Winter Plankton Survey	• Continental shelf and slope from Brownsville, Texas to Key West, Florida. • Stations are located at approximately ½ degree intervals (~56 km).	• 61 cm bongo net with 0.335 mm mesh. • Single or double 2 m x 1 m neuston net with 0.950 mm mesh. • some CUFES data in recent years	January through March	1983, 1984, 1993, 1996, 2007 – present

[1] Continuous Underway Fish Egg Sampler/Thermosalinograph.
[2] Multiple Opening and Closing Net, with an Environmental Sensing System.

Survey	Location	Gear	Sampling Period	Years
SEAMAP Summer Shrimp/Groundfish and Plankton Survey	• Continental shelf from Brownsville, Texas to Mobile Bay, Alabama (~88°W). • Early in the time series, sampling extended almost to Key West, Florida. • Stations are stratified by depth and NMFS statistical shrimp zones.	• 40-ft or 20-ft otter trawl[3]. • Trawl tow duration is variable from 10 min to 55 min. • 61 cm bongo net with 0.335 mm mesh. • Single or double 2 m x 1 m neuston net with 0.950 mm mesh.	June and July	1982 – present (SEAMAP protocol adopted in 1987)
SEAMAP Fall Shrimp/Groundfish and Plankton Survey	• Continental shelf from Brownsville, Texas to Mobile Bay, Alabama (~88°W). • Early in the time series, sampling extended almost to Key West, Florida.	• 40-ft or 20-ft otter trawl[3]. • Trawl tow duration is variable from 10 min to 55 min. • 61 cm bongo net with 0.335 mm mesh. • Single or double 2 m x 1 m neuston net with 0.950 mm mesh.	late September to early December	Mid-1950s –1972: exploratory surveys, 1972: resource assessment survey, 1985 – present (SEAMAP protocols were adopted in 1987)
SEAMAP Winter Shrimp/Groundfish and Plankton Survey	Texas to Alabama	Similar protocols to other shrimp/groundfish and plankton surveys	January to February	2009 – present
SEAMAP Spring Shrimp/Groundfish and Plankton Survey		Similar protocols to other shrimp/groundfish and plankton surveys	March to April	2009 – present

[3] NMFS, Alabama, Mississippi, and Louisiana State stations are sampled with a 40-ft otter trawl. Texas State stations are sampled with a 20-ft otter trawl.

Survey	Location	Gear	Sampling Period	Years
Bottom Longline Survey	• Continental Shelf from Brownsville, Texas to Key West, Florida. • Depths from 9 m to 366 m. • Stations are stratified by depth and NMFS statistical shrimp zones.	• Each line is 1 nmi. long, 100 hooks per line, 12 ft. ganglions, #15/0 circle hooks, baited with Atlantic mackerel. • Soak time = 1 hour.	July to September	1995 – present
SEAMAP Inshore Longline Survey	Nearshore from Texas to Alabama.	Each line is 1 nmi. long	March to October	2008 – present
Alabama Vertical Longline Survey	• Coastal Alabama • Targets artificial reefs and other areas.	• Vertical longline reels, baited with Atlantic mackerel or squid. • Soak time = 5 min.	April to June	2010 – present
SEAMAP Reef Fish Survey	• Continental shelf from Texas to Key West, Florida. • Depths from 10 m to 150 m.	• Camera array, baited with squid, soak time = approximately 30 minutes. • Fish traps, baited with squid, soak time = approximately 1 hour.	May to August	1992 – 1997, 2001 – 2002, 2004 - present
Small Pelagics/Deepwater Trawl Survey	• Offshore from Brownsville, Texas to Sarasota, Florida. • Depths from 50 to 500 m.	• 90-ft high opening bottom trawl. • 30 minute tow duration (timed from when the trawl arrives at the bottom). • Tow speed is 3 to 3.5 knots.	October to November	2002 – present

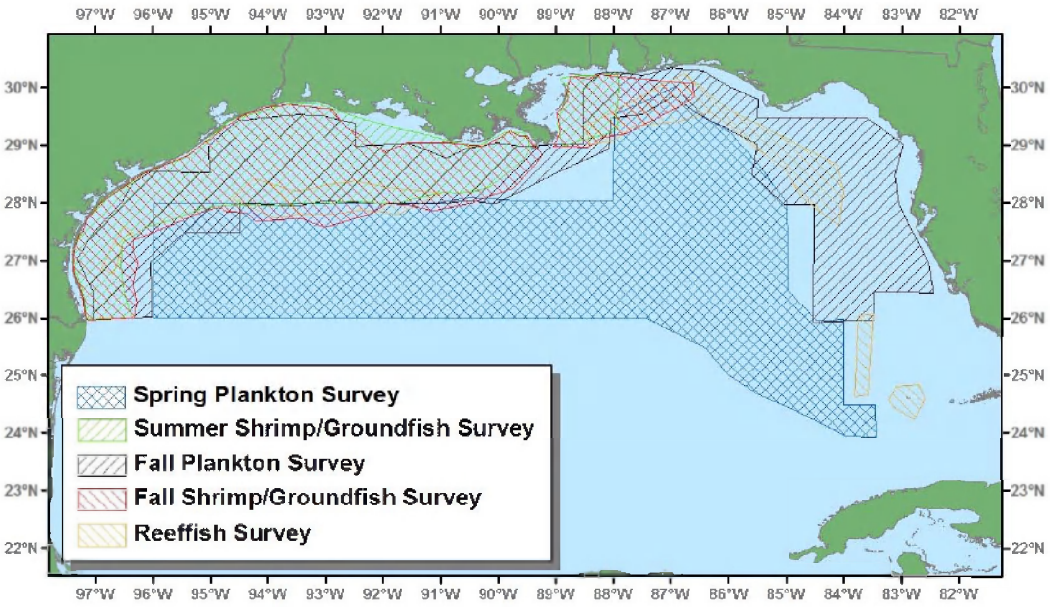

Figure 1. Spatial coverage of some SEAMAP surveys (Rester 2010).

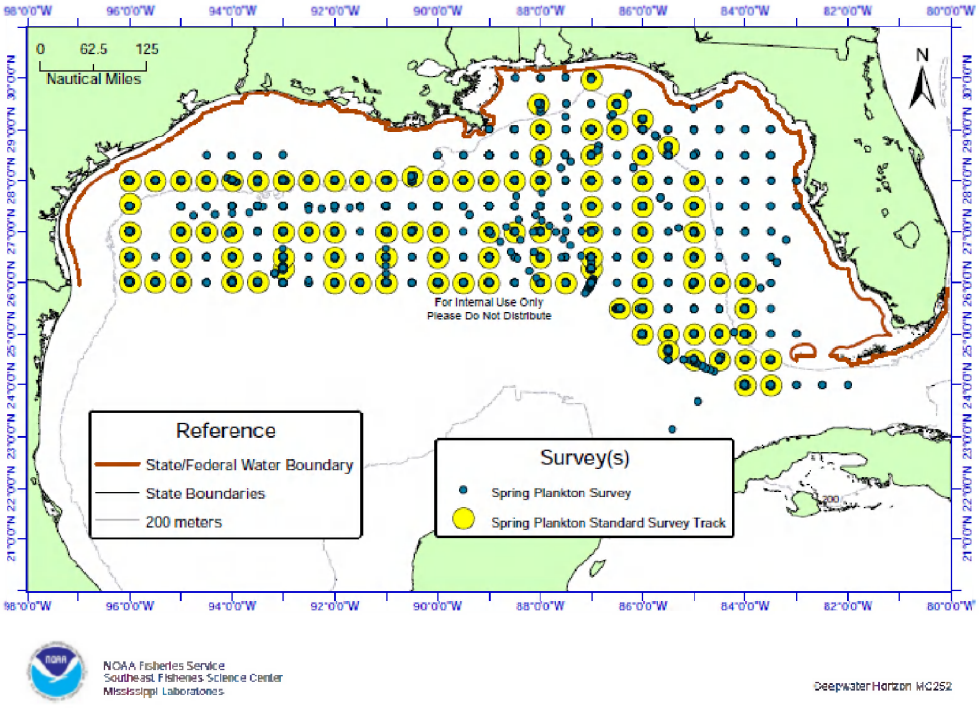

Figure 2. Locations of SEAMAP Spring Plankton Survey effort from 1982-2008.

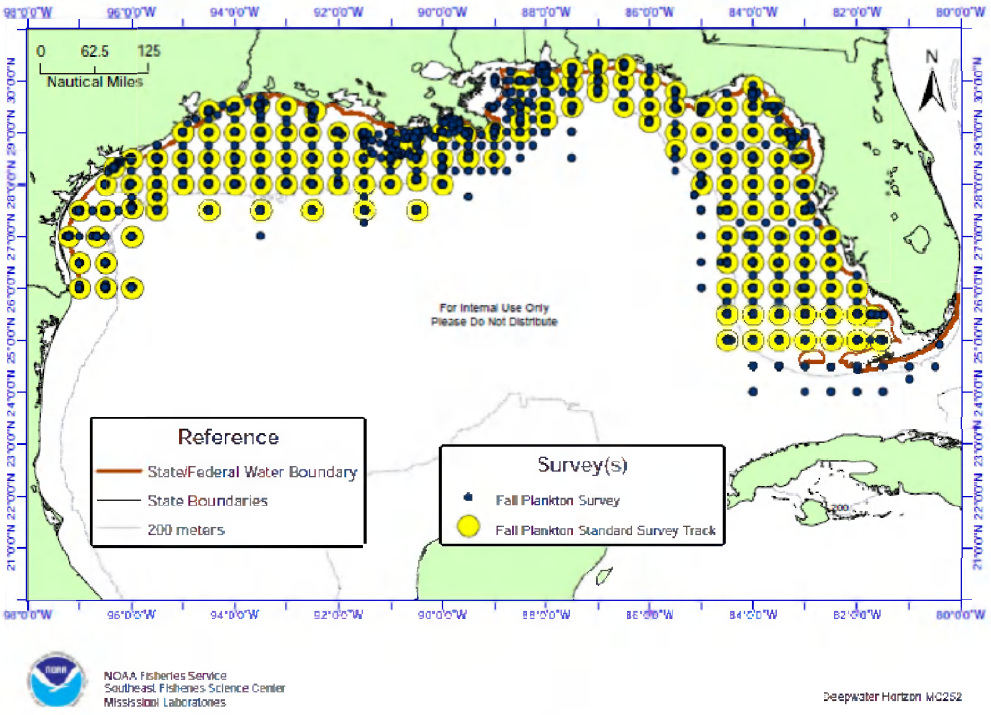

Figure 3. Locations of SEAMAP Fall Plankton Survey effort from 1986-2008.

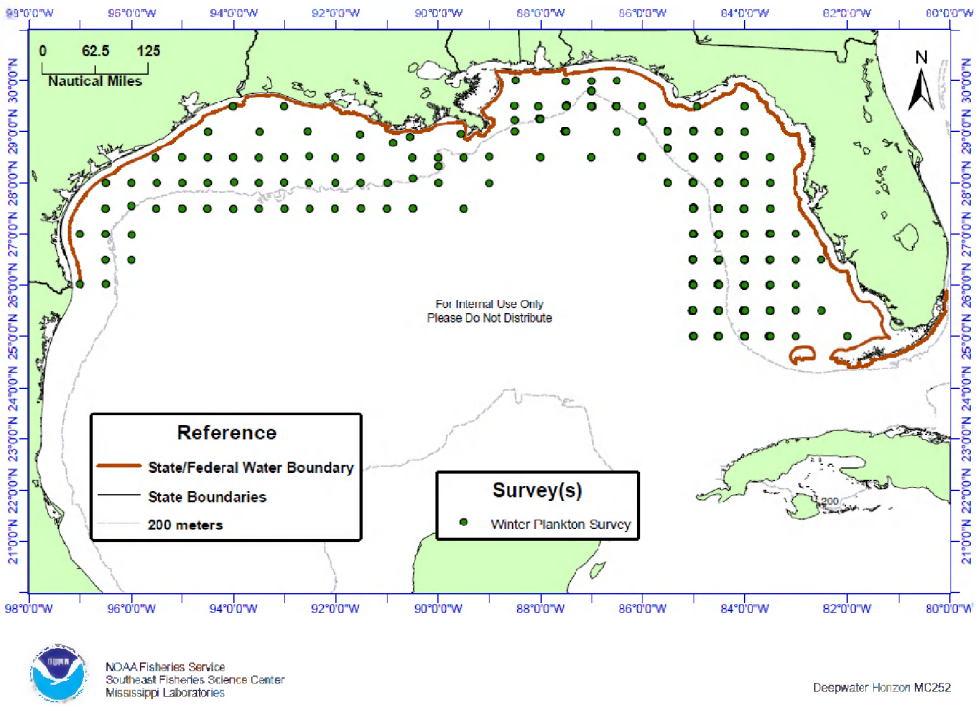

Figure 4. Locations of SEAMAP Winter Plankton Survey effort during 2007 and 2008.

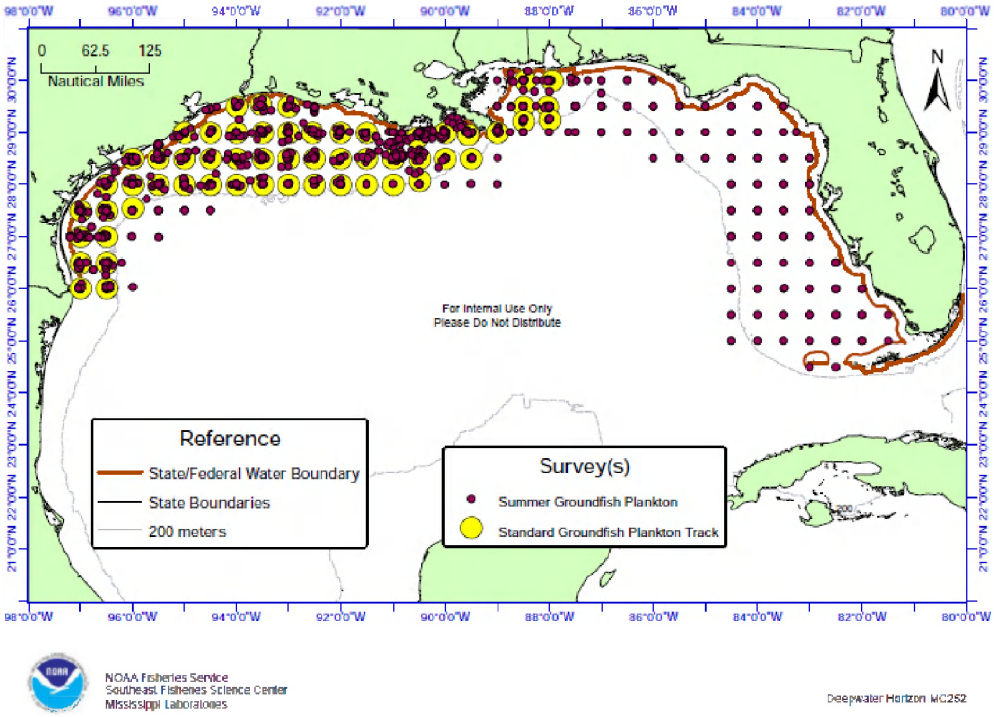

Figure 5. Locations of SEAMAP Summer Shrimp/Groundfish and Plankton Survey plankton sampling effort from 1982-2008.

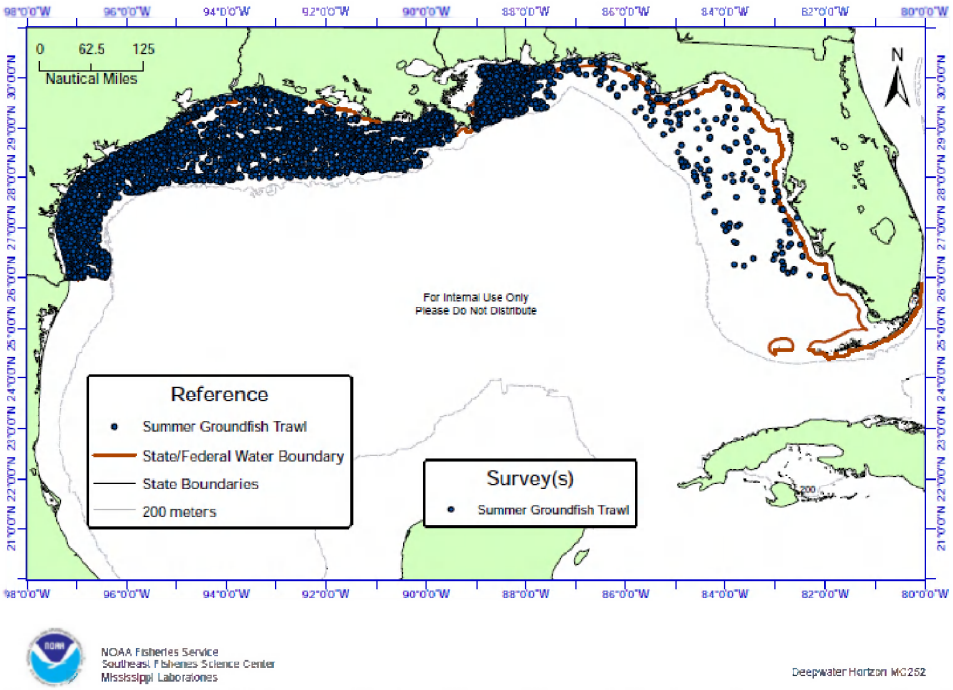

Figure 6. Locations of SEAMAP Summer Shrimp/Groundfish and Plankton Survey trawl effort from 1987-2009.

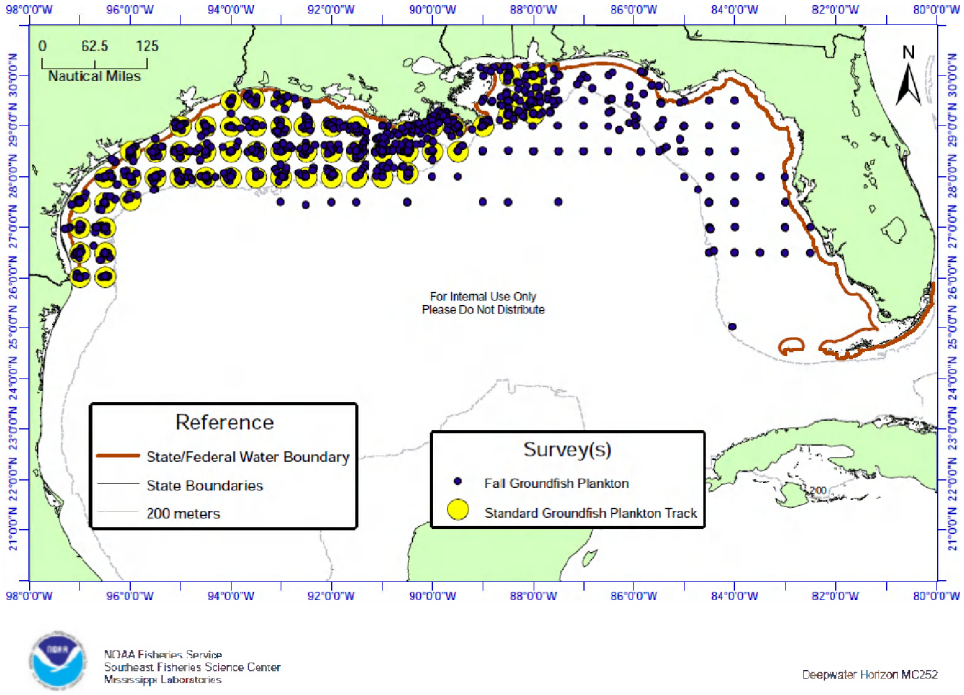

Figure 7. Locations of SEAMAP Fall Shrimp/Groundfish and Plankton Survey plankton sampling effort from 1986-2006.

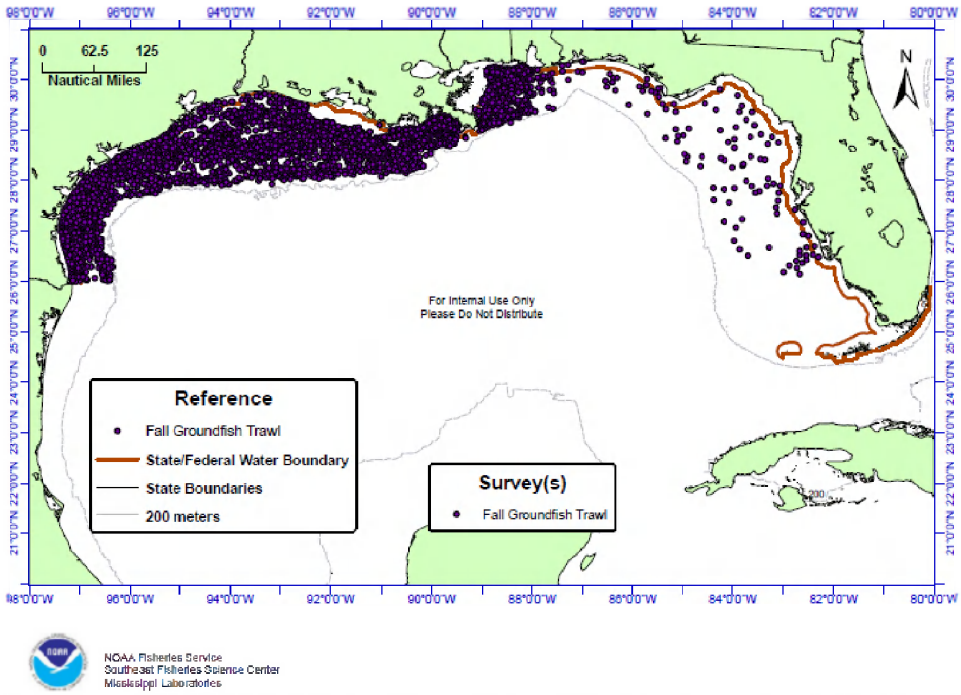

Figure 8. Locations of SEAMAP Fall Shrimp/Groundfish and Plankton Survey trawl effort from 1987-2009.

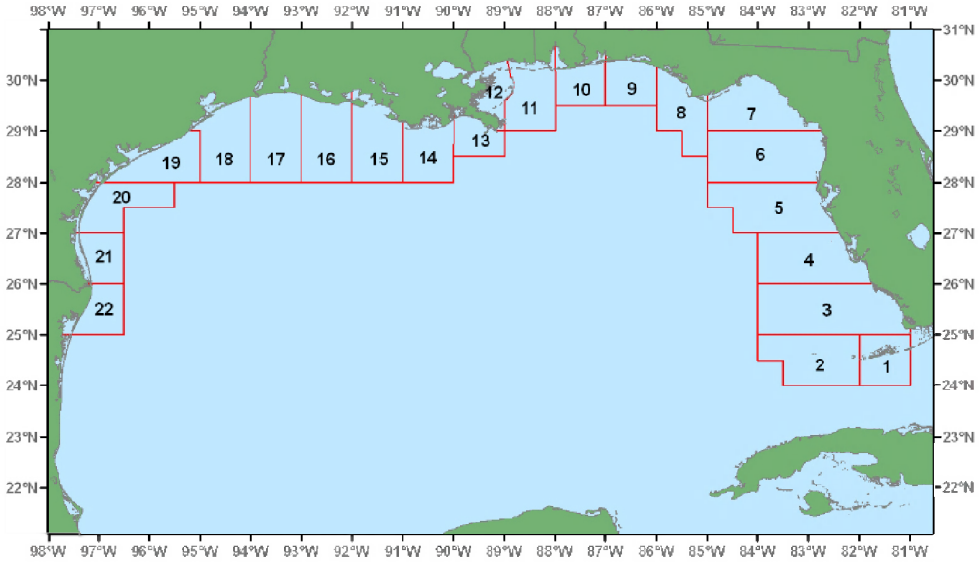

Figure 9: NMFS statistical shrimp zones in the Gulf of Mexico (Rester 2010).

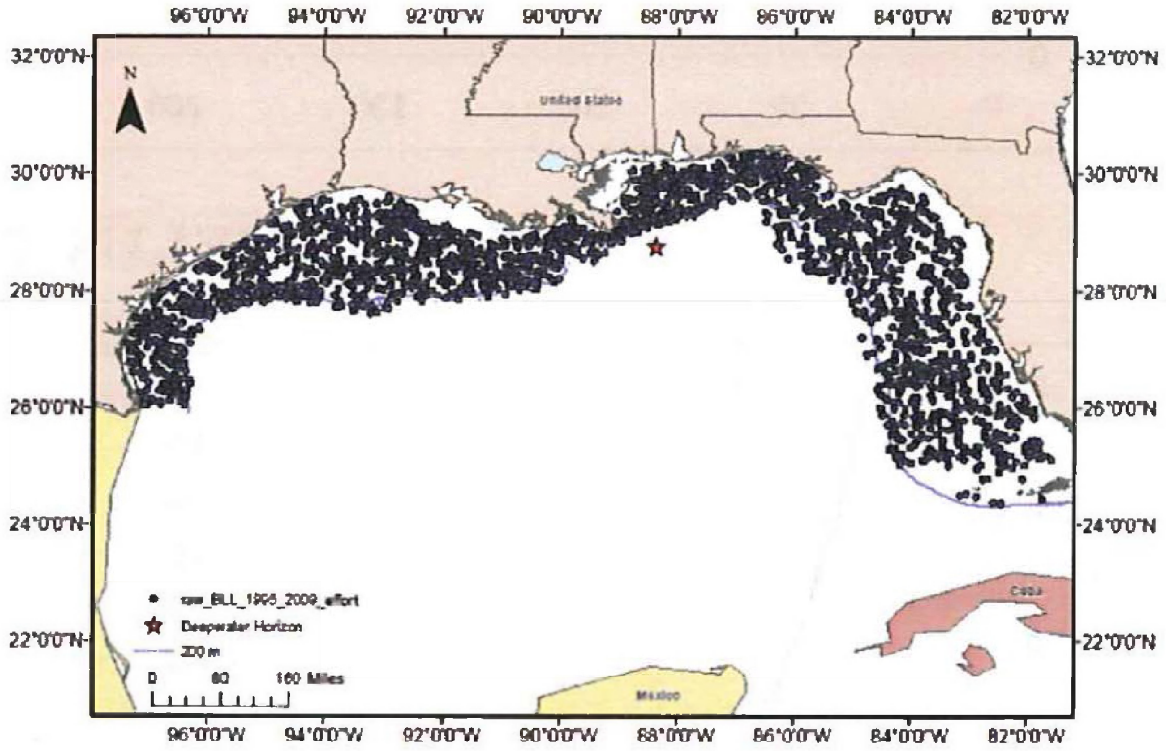

Figure 10. Bottom Longline Survey effort from 1995-2009.

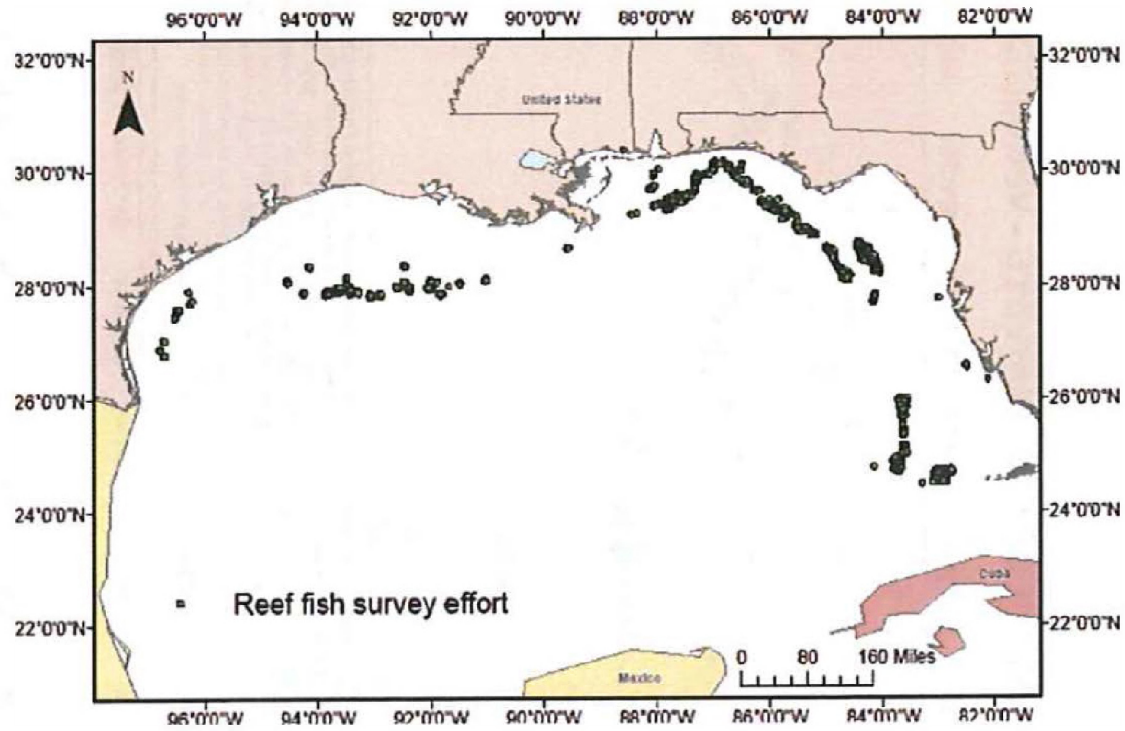

Figure 11. SEAMAP Reef Fish Survey effort 1992-2009.

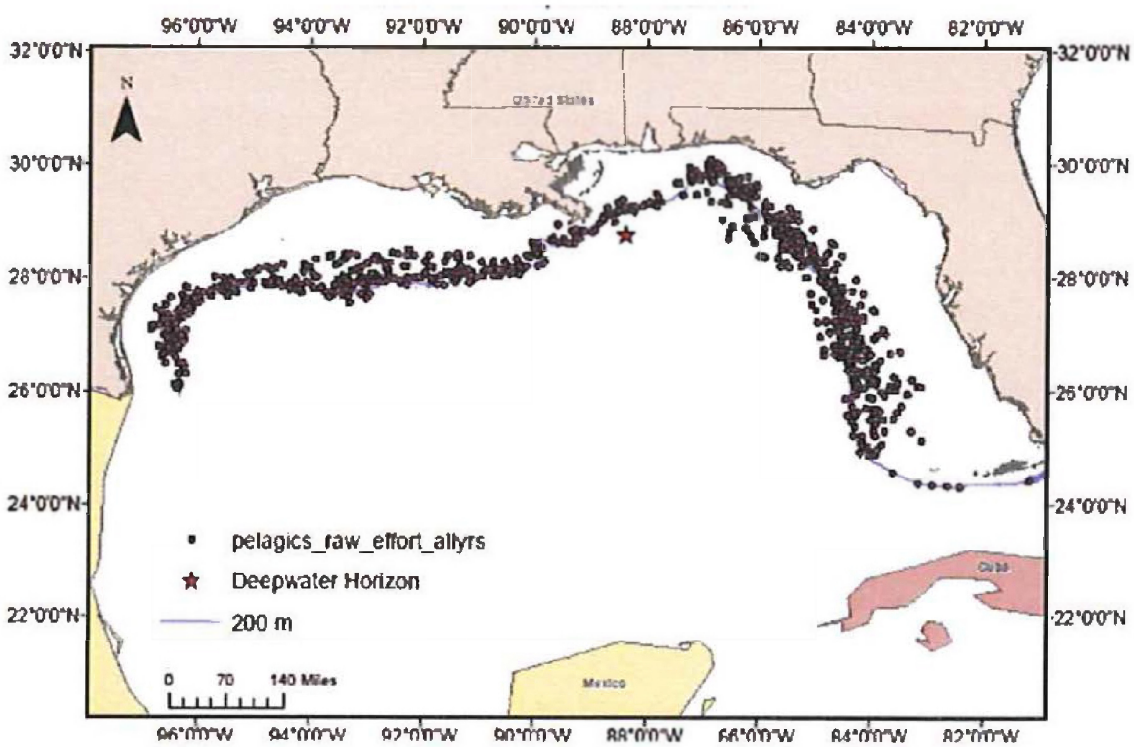

Figure 12. Small Pelagics/Deep Water Trawl Survey effort 2002-2004 and 2006-2009.

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National Marine Fisheries Service (NMFS) and Gulf States Marine Fisheries Commission (GSMFC). 2001. SEAMAP Field Operations Manual for Collection of Data. October 2001 (Revision No. 4).

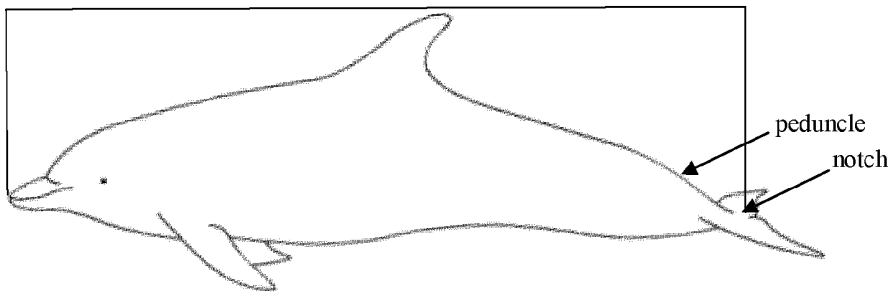
Rester, J.K., *editor*. 2010. Environmental and biological atlas of the gulf of Mexico. Gulf States Marine Fisheries Commission (GSMFC). Number 179. June, 2010.

NMFS' PROTOCOL FOR DEAD ENTANGLED SMALL CETECEANS

In the event of a small cetacean mortality that is incidentally captured, please document the following items:

1. Latitude and longitude of entanglement.
2. Photograph entire animal before removing from gear (with a scale bar if possible).
3. Photograph lateral view of dorsal fin (for photo-identification) with no gear (with a scale bar if possible).
4. Measure standard length (from tip of upper jaw to notch in the tail; see picture below).

Standard length



5. Photograph ventrum, including genital slits so sex can be determined (with a scale bar if possible).
6. After removal of gear, photograph any obvious signs of net impressions/lacerations or rope wounds (with a scale bar if possible).
7. Document where in the gear the animal was entangled/caught and how gear was wrapped around animal.
8. Document reason dolphin could not be hauled aboard the vessel.

Compiled by: Barbie L. Byrd, NNFS/SEFSC, Beaufort, NC and Stacey Horstman, NMFS/SERO, St. Petersburg, FL

Sea Turtle Resuscitation Guidelines

If a turtle appears to be unconscious or comatose, attempt to revive it before release. Turtles can withstand lengthy periods without breathing; a living comatose sea turtle may not move, breathe voluntarily, or show reflex responses or other signs of life. In other cases, a lightly comatose turtle may show shallow breathing or reflexes such as eyelid or tail movement when touched. Use the following method of resuscitation in the field if veterinary attention is not immediately available:

- Place the turtle on its plastron (lower shell) and elevate the hindquarters approximately 15 - 30 degrees to permit the lungs to drain off water for a period of 4 up to 24 hours. A board, tire or boat cushion, etc. can be used for elevation.

- Periodically, rock the turtle gently left to right and right to left by holding the outer edge of the carapace and lifting one side about 3 inches, then alternate to the other side.

- Keep the turtle in the shade, at a temperature similar to water temperature at capture. Keep the skin (especially the eyes) moist while the turtle is on deck by covering the animal's body with a wet towel, periodically spraying it with water, or by applying petroleum jelly to its skin and carapace. Do not put the turtle into a container with water.

- Do not put the turtle on its carapace (top shell) and pump the plastron (breastplate) or try to compress the turtle to force water out, as this is dangerous to the turtle and may do more harm than good.

- Periodically, gently touch the corner of the eye or eyelid and pinch the tail near the vent (reflex tests) to monitor consciousness.

- Sea turtles may take some time to revive; do not give up too quickly. Turtles that are successfully resuscitated benefit from being held on deck as long as possible (up to 24 hours) to fully recover from the stress of accidental forced submergence.

- Release successfully resuscitated turtles over the stern of the boat, when fishing or scientific collection gear is not in use, the engine is in neutral, and in areas where they are unlikely to be recaptured or injured by vessels. A turtle that has shown no sign of life after 24 hours on deck may be considered dead and returned to the water in the same manner.

NMFS/SEFSC Photos

References:

Federal Register, December 31, 2001. Government Printing Office, Washington DC 66 (250), pp. 67495- 67496.

July 2009

Protected Species Interaction Prevention Procedures for No-impact Gear Types

For data collection efforts involving a number of gear types that are routinely deployed for measuring physical properties of the ocean or collecting plankton samples, the trustees and BP have determined that there will be no effect on protected species (endangered and threatened species, and marine mammals) under the Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA) if deployed according to standard protocols.

Endangered and threatened species considered to potentially occur in the sampling area.

Common Name	Scientific Name	Status
leatherback sea turtle	*Dermochelys coriacea*	endangered
loggerhead sea turtle	*Caretta caretta*	threatened
Kemp's ridley sea turtle	*Lepidochelys kempii*	endangered
green sea turtle	*Chelonia mydas*	threatened
hawksbill sea turtle	*Eretmochelys imbricata*	endangered
sperm whale	*Physeter macrocephalus*	endangered

In depths greater than 200 m, Kemp's ridley, green, and hawksbill sea turtles are expected to occur in such low abundances that they are discounted from any potential effects occurring to these species. Leatherback and loggerhead sea turtles, and sperm whales are considered further for potential adverse effects. In addition, non-listed species of marine mammals are also considered for the potential of incidental capture and entanglement occurring,

These gear types considered for their potential to incidentally capture or entangle protected species include:

- CTD and rosette samplers and instruments attached to these arrays
- Radiometers
- Bongo nets
- Neuston nets
- Vertically deployed or towed imaging systems
- 1m MOCNESS
- 10m MOCNESS

CTD and rosette samplers (with associated instrument packages) and radiometers are typically deployed in a vertical cast. The instruments are deployed on a cable and have no loose lines or other entanglement hazards for protected species.

Bongo nets are typically deployed on a cable down to a depth of up to 200 m and neuston nets are deployed in the upper 1 m of the water column. The small size of these nets (neuston net 2 square meters, 2 bongo nets of 0.5 square meters each) and the lack of a loose line makes the likelihood of capture or entanglement of a marine mammal or sea turtle exceedingly small. In more than two decades of the SEAMAP program conducting bongo and neuston tows, no incidental captures of marine mammals or sea turtles have occurred.

Imaging systems such as the Digital Automatic Video Plankton Recorder (DAVPR) are either lowered vertically through the water column or towed on a conducting cable. The overall footprint of the instrument package is small and the wire is kept tight for proper deployment. No loose lines are present.

Neuston net – 2square meters
Bongos are each ½ square meter for a total of 1 square meter
Manta Neuston net – approximately 0.5 square meter

1m MOCNESS and 10m MOCNESS nets are deployed up to 2000m or more in depth (typically targeting 1500m). The net system is mounted on a rigid frame and no loose lines are hanging in the water. Although larger than bongo and neuston nets, these nets are still relatively small and only sweep a very small percentage of the water volume. The heavy, rigid frame results in a sinking rate of approximately 20m/s and thus the net is descending through the upper water column quickly. The nets are towed at 1.5 to 2.5 knots and tows last about 4 – 6 hours. Thus, for the 10m MOCNESS, the average volume swept in a deployment (assuming 1500m descent and a 5 hour tow at 2 knots) is approximately 215,000 cubic meters of water. Since sampling stations are on 30 nautical mile centers, the percentage of volume swept by a 10m MOCNESS, not including the volume below 1500m is 0.0000046% or approximately 1 in 215,165. Given that the most abundant turtle species, the leatherback has approximately 1 animal per 417 sq km of ocean in waters greater than 200m depth, if it is assumed that this density remains the same for waters in excess of 1500m, there are approximately 7.4 leatherbacks per 30 nm x 30 nm cell. Thus, if the animals were randomly distributed within the water volume and did not move, the probability of capturing one in the 10m MOCNESS is 1 in approximately 29,000 tows. Similarly, loggerheads are expected to be present at a density of about 1 animal per 500 square km and have a catch probability of 1 in 34,900 tows. However, since much of the tow time of the MOCNESS net is well below the foraging depth of turtles, the probability of capture is in fact, much lower.

Although a no impact determination on endangered species from these gear types has been made, and the likelihood of capture or entanglement of marine mammals in these gear types is exceedingly small during the deployment and retrieval of the nets from deep water tows, the following mitigating measures will be taken to assure that potential interactions with protected species are minimized to discountable levels.

1. **Marine mammal and sea turtle observers.** Prior to deploying any sampling equipment, at least one observer shall be established to keep dedicated watch for marine mammals and sea turtles. The observer's sole purpose shall be to scan for marine mammals or sea turtles, with a focus of monitoring 180 degrees in front of the vessel's course, prior to the deployment of sampling gear. Since the intent of scanning for marine mammals and turtles is to assure that the gear is not deployed if marine mammals or turtles are shipside, a visual scan of the deployment area should be conducted for at least 30 minutes prior to deploying sampling gear. During night deployments night-vision binoculars or deck lighting with the naked eye may be used for monitoring. If marine mammals or turtles are observed in the vicinity of the vessel, deployment of sampling gear should not occur until protected species are verified to be clear of the area, or if not resighted, 30 minutes

after the initial sighting, until the chief scientist, in consultation with the captain deem that it is safe to do so.

2. **Keep all cables tight on sampling gear.** Protected species may become entangled in loose lines associated with sampling gear. Dolphins are known to become entangled in lazy lines on shrimp trawl nets, float lines of trap/pot gear, and buoy lines of gillnet gear, etc. Although none of the gear types under consideration here have lazy lines or other rope types, and cables are unlikely to entangle protected species, lines should not be allowed to become slack.

3. **If protected species are observed during sampling.** It is possible that marine mammals or turtles will be observed after sampling gear has been deployed but before sampling is complete. Given the small size of nets, the slow ship speeds, and the other factors outlined above for these sampling gears, any injurious interaction between the sampling gear and a turtle or marine mammal is still extremely small. However, if an observation is made while gear is in the water, the proximity of the observed animal to the sampling gear should be closely monitored and the gear should be removed from the water if there appears to be any potential for capture or entanglement.

If a protected species take occurs, the following measures shall be conducted:

1. **Report any marine mammal capture/entanglement immediately.** Marine mammal entanglements (live or dead) must be reported immediately to 1-877-WHALE HELP (1-877-942-5343).

2. **Report any sea turtle capture/entanglement immediately.** Immediately report any sea turtle takes to takereport.nmfsser@noaa.gov or Bob Hoffman at the NMFS Southeast Regional Office (727-403-2641). In the event of any unauthorized takes of sea turtles, sampling should cease until the harm avoidance measures can be reviewed with NMFS Southeast Regional Office, Protected Resources Division, and modified as needed.

3. **In the event of a live animal capture/entanglement within sampling gear,** work from the vessel as quickly and carefully as possible to disentangle the animal for prompt release. Ensure the marine mammal's blowhole and sea turtle's mouth are kept at the surface to ensure it can continue to breathe while disentangling. If possible, the animal shall be identified, photographed, and released directly back into the water to avoid further injury from being brought aboard the ship. If the animal is not able to be released directly back into the water, the animal and sampling gear shall be carefully placed on the deck of the ship, preventing the animal from falling on the deck and becoming further injured. For turtles, follow the turtle resuscitation guidelines (attached). For marine mammals, ensure the animal's blowhole is free of obstructions and work quickly and carefully to return the animal to the water.

4. **In the event of a mortality,** the animal shall be retained and guidance shall be given on how to maintain the carcass. The Principal Investigator shall seek guidance from Wendy

Teas (305-361-4595) for sea turtles and Blair Mase (305-361-4586) for marine mammals at the NMFS, Southeast Fisheries Science Center on how to retain the carcasses (i.e., whether they should be put in the cooler and immediately brought back to shore for sampling, or frozen for future sampling). Photos, measurements, and entanglement information shall also be documented per "NMFS' Protocol For Dead Entangled Small Cetaceans" attached or a sea turtle stranding form filled out and sent to Wendy Teas. Reports should also include whether mitigation measures were followed, and if not, an explanation provided.

Deepwater Horizon Oil Spill (DWHOS)

Water Column Technical Working Group

NRDA Spring 2011 Ichthyoplankton Sampling Cruise Plan

Sampling Vessel: *Bunny Bordelon*

April 15, 2011

This attachment contains a figure and table of the stations included in the NRDA Spring 2011 Ichthyoplankton Sampling Cruise Plan aboard the *Bunny Bordelon* (April 16 – May 25, 2011).

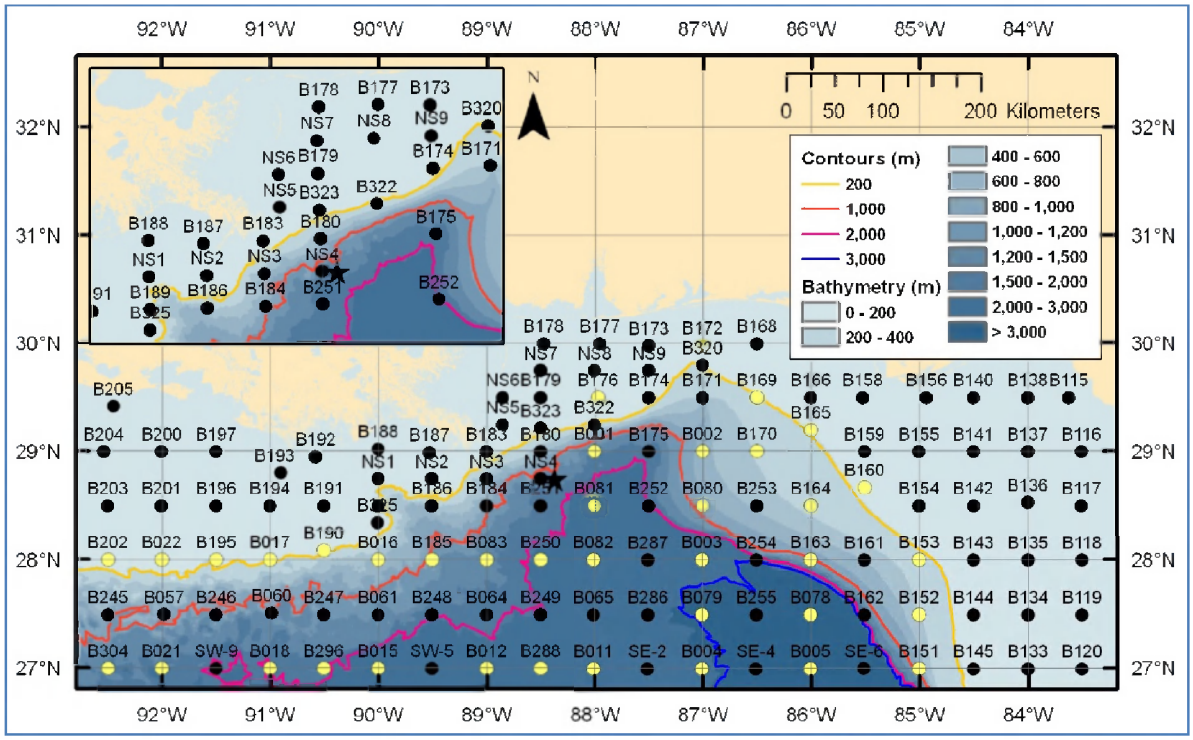


Figure 1. 2011 NRDA spring 2011 plankton stations (black circles) and SEAMAP spring 2011 cruise for the *Gordon Gunter* (yellow circles).

Table 1. Plankton station locations to be sampled as part of the NRDA Spring 2011 plan. Black circles in Figure 1.

Station Number	Longitude (W)	Latitude (N)
B057	-92	27.5
B060	-91	27.5
B061	-90	27.5
B064	-89	27.5
B065	-88	27.5
B115	-83.62	29.5
B116	-83.5	29
B117	-83.5	28.5
B118	-83.5	28
B119	-83.5	27.5
B120	-83.5	27
B133	-84	27
B134	-84	27.5
B135	-84	28
B136	-84	28.53
B137	-84	29
B138	-84	29.5
B140	-84.5	29.5
B141	-84.5	29
B142	-84.5	28.5
B143	-84.5	28
B144	-84.5	27.5
B145	-84.5	27

Station Number	Longitude (W)	Latitude (N)
B154	-85	28.5
B155	-85	29
B156	-84.93	29.5
B158	-85.52	29.5
B159	-85.5	29
B161	-85.5	28
B162	-85.5	27.5
B166	-86	29.5
B168	-86.5	30
B171	-87	29.5
B173	-87.5	30
B174	-87.5	29.5
B175	-87.5	29
B177	-88	30
B178	-88.5	30
B179	-88.5	29.5
B180	-88.5	29
B183	-89	29
B184	-89	28.5
B186	-89.5	28.5
B189	-90	28.5
B196	-91.5	28.5
B200	-92	29
B201	-92	28.5

Station Number	Longitude (W)	Latitude (N)
B203	-92.5	28.5
B204	-92.54	29
B205	-92.45	29.42
B245	-92.5	27.5
B246	-91.5	27.5
B247	-90.5	27.5
B248	-89.5	27.5
B249	-88.5	27.5
B251	-88.5	28.5
B252	-87.5	28.5
B253	-86.5	28.5
B254	-86.5	28
B255	-86.5	27.5
B286	-87.5	27.5
B287	-87.5	28
B320	-87	29.8
B322	-88	29.25
B323	-88.5	29.22
B325	-90	28.34
SE-6	-85.5	27
SE-4	-86.5	27
SE-2	-87.5	27
SW-5	-89.5	27
SW-9	-91.5	27

Station Number	Longitude (W)	Latitude (N)
NS-1	-90	28.75
NS-2	-89.5	28.75
NS-3	-89	28.75
NS-4	-88.5	28.75
NS-5	-88.85	29.25
NS-6	-88.85	29.5
NS-7	-88.5	29.75
NS-8	-88	29.75
NS-9	-87.5	29.75

SUBJECT: Safety Plan

PREPARED FOR: NRDA (Natural Resources Damage Assessment) Field Operations

REVISION: December 8, 2010

1. INTENT

1.1. The intent of this Field Safety Plan is to establish a structured process and disciplined approach to the mitigation of health, safety and environmental risks associated with our operations and activities. This safety plan applies to the Natural Resources Damage Assessment (NRDA) Team. This plan does not apply under the following situations:

- When water and air temperatures are both below 50 degrees Fahrenheit
- In air temperatures below 38 degrees Fahrenheit
- During small craft advisories
- When wind speeds exceed 25 knots
- Operations during dusk/evening
- In bad visibility and bad weather
- Offshore operations

If it is deemed necessary for operations to continue in any of the conditions outlined above, a separate job hazard evaluation must be approved and authorized by the NRDA On-Site Lead, BP-Cardno Entrix, applicable trustee representatives, the NRDA Safety Officer and NRDA Field Operations.

2. COMMUNICATIONS

2.1. A central responsible person not in the field should be aware of the daily plan, work locations, and team members for each team.

2.2. NRDA Field Teams will contact NRDA Operations (located at ICP New Orleans) as identified below to help ensure personnel accountability. Human Use field teams will report to Stratus Headquarters in Boulder, CO.

2.2.1. Departing for daily op area.

2.2.2. Mid day.

2.2.3. Termination of operations (e.g. transition to over-the-road vehicle and/or arrival place of lodging).

2.2.4. As soon as practical to report any health, safety, security, or environmental incident.

2.2.5. Using the 700mhz Radio and/or one of the following NRDA Ops contact numbers:

2.2.5.1. PRIMARY - NRDA Field Ops 504-303-2086/504-335-0863

2.2.5.2. SECONDARY – NRDA On-Site Lead 985-291-5186 (cell); noaa.mc252.nrdacoord@noaa.gov

2.2.5.3. For non-routine issues and the two above numbers can not be reached, CALL Nir Barnea (NOAA Safety) - 2 0 6 – 3 6 9 – 5 0 1 5 [nir.barnea@noaa.gov] or Troy Baker (ARD SE Regional Manager) – 225 -326-9765 [troy.baker@noaa.gov].

2.3. NRDA Team Members at ICP New Orleans will update the Field Teams Status Display upon notification from a NRDA Field Team.

2.4. Each NRDA Field Team will be provided with a copy of this safety plan

3. MINIMUM EQUIPMENT/RESOURCES FOR NEARSHORE AND SHORE-BASED OPERATIONS

3.1. One primary form of communication directly to the non-field responsible person (i.e. Cell Phone, 700/800 MHz Radio, or equivalent).

3.2. Secondary form of communication capable of directly reaching rescue personal in case of an emergency (i.e. Cell Phone or Marine VHF, etc.)

3.3. Marine VHF is required for all vessel-based operations. All vessels must have a fixed mount (not handheld)VHF Marine radio on board. Handheld GPS

3.4. First Aid Kit

3.5. Foul Weather Gear (rain jacket/pants)

3.6. PFD, Float Coat, and/or Immersion Suit as appropriate to Job Hazard Analysis

3.7. Cold Weather Kit (Dry Bag, Emergency Blanket, Warm Blanket, Dry Cloths, and Hand/Feet Warmers)

4. VEHICLE SAFETY

4.1. Pre-Trip Plan (Maps, directions)

4.2. Seat Belt use is mandatory

4.3. Observe posted safety notifications and speed limits.

4.4. DRIVER - Cell phone use both hand-held and hands-free, texting, and e-mailing is prohibited while driving. If necessary, park in a safe location (off the road) and use while parked.

5. ACCIDENTS – INJURIES – SPILLS – NEAR MISSES

5.1. Accidents and injuries should first be reported to an entity that can provide emergency assistance, if needed (USCG, 911, etc.)

5.2. Accidents, injuries, spills or near misses should then be reported to NRDA Field Ops within 15 minutes.

5.3. As soon as practical (but generally within 1 hour) accidents, injuries, spills or near misses must be reported by the NRDA Field Ops to the NRDA On-Site Lead. Required documentation will be managed by the NRDA On-Site Lead with assistance by involved personnel. The NRDA On-Site Lead will notify appropriate Incident

Management Team personnel including the BP Safety Officer at the Incident Command Post.

5.4. The NRDA On-Site Lead will report accidents, injuries, spills, or near misses to the all relevant federal, state, contractor, and BP/Entrix managers by email as soon as practicable following the incident.

6. TRAINING

6.1. Any member of a NRDA Field Team is required to have the following Safety Training.

- Level I and II BP Safety Induction
- HAZWOPER Certification
- PHI Helicopter Pre-Flight Safety Briefing (if flying in helicopters)
- Heat stress and cold stress training/awareness

7. PERSONAL PROTECTIVE EQUIPMENT

7.1. NRDA Field Team members are expected to utilize Personal Protective Equipment for the activity being performed. A task requiring PPE shall not be performed unless PPE is used (refer to the Job Hazard Analysis incorporated with this document).

7.2. Staff must adhere to and follow pilot/captain/operators safety related instructions at all times. The NRDA On-Site Lead is responsible for directing team activities and will help decide if safety issues preclude scheduled activities. All team members are responsible for individual and collective safety.

8. PRE OPERATION MEETING (Tail Gate Meeting)

A daily pre-operations meeting will be conducted on-site with each team by the field team leader. Job Hazard Analysis' are located below. Specific topics of discussion will include:

- Lessons learned from the prior day's mission or other missions
- Current weather and short-term forecast
- PPE requirements
- Communications / Notification Requirements
- Food and Water
- Location of nearest treatment facility or hospital
- Potential hazards to watch out for
- Overall situational awareness

9. JOB HAZARD ANALYSIS (see following pages)

- Shore Operations
- Small Boat / Air Boat Operations
- Helicopter Operations
- Fixed Wing Operations for biological aerial surveys

- Fencing/Station marking operations
- Pom-pom inspections
- Chain drags
- Oyster sample collection
- Water quality testing
- Sampling in Phragmites
- Marine-based operations in cold weather

10. DWH NRDA SAFETY, COMMUNICATION, AND ACCOUNTABILITY CHECKLIST

Technical Working Group:_____ State:_____

Field Activity:_____

Number of Teams:_____ Persons p/Team:_____ Duration:_____

Activity Type (check as appropriate): ☐ Shore-based Activity (i.e. does not require boat/aircraft) ☐ Small Boat/Shore Activity (i.e. requires small boat transport to sampling location) ☐ Vessel-Based Activity	**Cell Phone Service Availability** (check as appropriate): ☐ Reliable cell phone service from ALL major providers, at all times. ☐ Reliable cell phone service from some providers at all times. ☐ Limited or no cell phone service at some times.
Access to Emergency Assistance (check as appropriate): ☐ Direct access to local EMS services within 15 minutes. ☐ Delayed access to local EMS services (15-45 minutes). ☐ EMS access requires vessel and/or air evacuation.	**Accountability System** ☐ NRDA ICP Houma Field Ops ☐ NRDA Offshore Cruises ☐ MC252 Air Ops ☐ Alternative System: Responsible Person: _____ 24hr Phone#:_____
Primary Form of Communication (check one or more): ☐ Cell-Phone ☐ Satellite Phone ☐ Two-way Radio System	**Secondary Form of Communication** (check as appropriate): ☐ Cell-Phone ☐ Satellite Phone ☐ Two-way Radio System ☐ Marine VHF ☐ EPRIB/PLB or SPOT Tracker
Additional Safety and Accountability Resources (check as appropriate): ☐ Directions to Medical Facilities / Staging Areas ☐ First Aid Kit ☐ Advanced First Aid Kit ☐ Medically Trained Personnel ☐ Handheld GPS	

TASK	**NRDA Shore Survey Operations**	**PERFORMED BY**	Caleb T. King (Coast Guard - Safety)
LOCATION	Various locations of affected areas	**REVIEWED BY**	Lisa DiPinto (NOAA - NRDA Coordinator)
DATE PREPARED	5/8/2010 New **X** Revised	**PPE REQUIREMENTS**	Personal Flotation Device (PFD) Safety Glasses or Goggles *(tinted as necessary)* Tyvek Coveralls and Boot Covering Nitrile Gloves

Issue of Concern / Activity	Potential Hazards	Control Measures
Entering / Departing Boat	Wet surfaces, change in stability	Watch where you step; use available handrails; assistance by others.
Walking Shore	Heat Stress	Stay hydrated and take breaks. Monitor each other. Know symptom of heat stress and how do address them.
	Sun Burn	Apply sunscreen to exposed skin. Wear a hat with a brim to shade face.
	Insect Bites / Stings	Use mosquito repellant; and maintain Sting Swabs in First Aid Kit.
	Eye strain (sun light)	Wear tinted eyewear.
	Animals (snakes, alligators, and other non-domestic types)	Careful placement of feet and hands; No open toed shoes.
	Fall Into Water	Wear Personal Flotation Device when 10-feet or closer to water.
	Loss of Communication	Establish and maintain communications with ICP Houma, other vessels, and never separate NRDA workers from vessel where communications cannot be maintained.
	Working alone	Maintain buddy system at all times, personnel should not work alone
Activity where Personal Contamination is Anticipated	Hand contamination and/or other exposed skin as well as clothing	Wear Tyvek (or similar) boot covering and coveralls; Nitrile gloves; Safety Glasses or Goggles depending on liquid splash potential.
Use of Tools	Cuts / Scrapes	Use tools as designed and refrain from over-exerting shovel tips where loss of control could happen.

TASK	**Small Boat / Air Boat Operations**	**PERFORMED BY**	Caleb T. King (Coast Guard - Safety)
LOCATION	Various locations of affected areas	**REVIEWED BY**	Lisa DiPinto (NOAA - NRDA Coordinator)
DATE PREPARED	5/8/2010 New [X] Revised [ ]	**PPE REQUIREMENTS**	Personal Flotation Device (PFD) Safety Glasses or Sun Glasses Hearing Protection

Issue of Concern / Activity	Potential Hazards	Control Measures
Entering / Departing Boat	Wet surfaces, change in stability	Watch where you step; use available handrails; assistance by others.
Vessel in Transit	Fall Overboard	Personal Flotation Device.
	No communication to/from vessel	All vessels must have a VHF Marine radio on board, permanently bolted to the structure
	Collision, Allision, or Grounding	Follow Navigational Rules of the Road; Maintain awareness; Know location; Maintain Communications.
	Overloading Vessel	Distribute weight evenly and do not exceed vessel capacity plate.
	Mechanical Issues	Keep spare parts, tools, etc. onboard and always know your fuel levels.
	Airborne Particulates and Insects	Wear safety glasses or safety goggles.
	Heat Stress	Stay hydrated and take breaks. Monitor each other. Know symptom of heat stress and how do address them.
	Sun Burn	Apply sunscreen to exposed skin. Wear a hat with a brim to shade face.
	Pinch Points	Maintain control of doors/hatches; Keep fingers and feet clear of lines/ropes
	Noise	Double hearing protection must be worn onboard air boats.

TASK	**Air Operations**	**PERFORMED BY**	Caleb T. King (Coast Guard - Safety)
LOCATION	Heliports and along affected areas	**REVIEWED BY**	Lisa DiPinto (NOAA - NRDA Coordinator)
DATE PREPARED	5/8/2010 New X Revised	**PPE REQUIREMENTS**	Hearing Protection Personal Flotation Device (PFD)

Issue of Concern / Activity	Potential Hazards	Control Measures
Boarding Helicopter	Noise, Tail Rotor, Rotor Wash	Hearing Protection, Never walk behind helicopter, keep all items secured
In Flight	Noise, Water Landing, Motion Sickness	Hearing Protection, PFD, Medication
Departing Helicopter	Noise, Tail Rotor, Rotor Wash	Hearing Protection, Never walk behind helicopter, keep all items secured

TASK	**Fencing/marking operations**	**PERFORMED BY**	Nir Barnea (Safety Officer)
LOCATION	Affected area	**REVIEWED BY**	
DATE PREPARED	11/22/2010 New [X] Revised [ ]	**PPE REQUIREMENTS**	• Work gloves • Goggles • Hearing Protection • Hard toe boots • Personal Flotation Device (PFD) if near water

Issue of Concern / Activity	Potential Hazards	Control Measures
Driving stakes in the ground	• Hand, finger and foot injury from hammer impact • Hand and finger injury from slivers and sharp stakes • Eye injury from flying particles • Hearing impact from excessive noise • Drowning if work is near water	**PPE:** Use gloves, goggles, hard toe boots, hearing protection, and PFD (when working near water) **Administrative:** • Do not perform work requiring PPE until PPE is available and used. • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available

TASK	**Pom-Pom Inspection**	**PERFORMED BY**	Stephanie Fardy
LOCATION	Boat Launches/Marinas in Louisiana, Alabama, Mississippi and Florida	**REVIEWED BY**	Nir Barnea (Safety Officer)
DATE PREPARED	11/23/2010 New [X] Revised [ ]	**PPE REQUIREMENTS**	• Plate Glass in UV Box • Goggles (if plate glass is absent) • Nitrile Gloves

Issue of Concern / Activity	Potential Hazards	Control Measures
Pom-pom inspection under ultra violet light	• Skin irritation is possible if exposure occurs for long periods of time. • Eye inflammation and irritation is possible if looking directly at the source of radiation	**PPE:** Plate glass should be in place in the UV box. Goggles (or glasses) should be worn if plate glass is missing. Nitrile gloves should be worn when handling pom-poms. **Administrative:** • Do not perform work requiring PPE until PPE is available and used. • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available

TASK	**Chain drags**
LOCATION	Nearshore locations in Louisiana, Mississippi, Alabama and Florida
DATE PREPARED	11/23/2010 New [X] Revised [ ]

PERFORMED BY	Stephanie Fardy
REVIEWED BY	Nir Barnea (Safety Officer)
PPE REQUIREMENTS	• Nitrile Gloves • Safety Glasses • PFDs

Issue of Concern / Activity	Potential Hazards	Control Measures
Lifting and handling the chains	• Back strain from handling chain with improper form • Hand contamination • Potential hand or finger injury if catches in the chain.	**PPE:** Nitrile gloves should be worn if there is potential for contamination when handling sentinels, pom-poms, chains and seawater and other materials. PFDs should be worn on the water **Administrative:** • Do not perform work requiring PPE until PPE is available and used. • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available
Activity where Personal Contamination is Anticipated	Hand contamination and/or other exposed skin	Nitrile gloves; Safety Glasses or Goggles depending on liquid splash potential.

TASK	**Use of sharp objects (Scissors, wire cutters)**
LOCATION	Nearshore waters and shoreline from Louisiana to Florida
DATE PREPARED	11/23/2010 New [X] Revised [ ]

PERFORMED BY	Stephanie Fardy
REVIEWED BY	Nir Barnea (Safety Officer)
PPE REQUIREMENTS	• Kevlar work gloves • PFD (if on the water)

Issue of Concern / Activity	Potential Hazards	Control Measures
Use of sharp objects	• Cuts, scrape, etc.	**PPE:** Wear knit Kevlar work gloves when using sharp tools and a risk of cutting exists **Administrative:** • Do not perform work requiring PPE until PPE is available and used. • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available

TASK	**Oyster sample collection**
LOCATION	Nearshore waters in Louisiana, Mississippi, Alabama and Florida
DATE PREPARED	11/23/2010 New [X] Revised [ ]

PERFORMED BY	Alāna Wilson
REVIEWED BY	Nir Barnea (Safety Officer)
PPE REQUIREMENTS	• Nitrile gloves • Knit Kevlar work gloves • PFD

Issue of Concern / Activity	Potential Hazards	Control Measures
Dredging	• Heavy lifting	**PPE:** • PFD (both on the water and when collecting samples from shore) **Administrative:** • Follow proper ergonomic behavior for heavy lifting • Do not perform work requiring PPE until PPE is available and used. • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available
Collection of oyster samples (via dredge, quadrat or by hand)	• Contact with sharp objects • Slippery footing in intertidal zones	**PPE:** • Wear disposable knit Kevlar work gloves OVER nitrile gloves anytime handling sharp objects (e.g. oysters) • PFD (both on the water and when collecting samples from shore) • Waders, with proper grip for walking during intertidal sampling

TASK	**Water quality testing**
LOCATION	Nearshore waters in Louisiana, Mississippi, Alabama and Florida
DATE PREPARED	11/23/2010 New [X] Revised [ ]

PERFORMED BY	Alāna Wilson
REVIEWED BY	Nir Barnea (Safety Officer)
PPE REQUIREMENTS	• Nitrile gloves • Goggles to prevent eye contact with the calibration solution if splash occurs

Issue of Concern / Activity	Potential Hazards	Control Measures
Calibration of water quality meter	• Contact with calibration solution	**PPE:** Wear nitrile gloves and goggles when calibrating the water quality meters **Administrative:** • Include MSDS in meter kit
Measurement of water quality parameters	• Contact with potentially contaminated seawater	**PPE:** Wear nitrile gloves when handling the meter probe and when lowering it into or pulling it out of the water

TASK	**Sampling in Phragmites**	**PERFORMED BY**	Allan Hooker
LOCATION	Phragmites stands	**REVIEWED BY**	Nir Barnea (Safety Officer)
DATE PREPARED	12/04/2003 New [X] Revised [ ]	**PPE REQUIREMENTS**	• Kevlar gloves • Fully enclosed goggles • Full length, heavyweight shirt and pants • PFD (if on water)

Issue of Concern / Activity	Potential Hazards	Control Measures
Performing any work within Phragmites	• Eye injury • Skin punctures/abrasions • Drowning if work in near water	**PPE:** Kevlar gloves and full length shirt and pants should be worn to prevent skin punctures/abrasions. Fully enclosed goggles should be worn to protect the eyes. A PFD should be worn when working on or near the water. **Administrative:** • Only perform work if PPE is worn • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available

TASK	**Marine-based Operations in Cold Weather**	**PERFORMED BY**	Stephanie Fardy
LOCATION	Throughout Louisiana, Mississippi, Alabama and Florida	**REVIEWED BY**	Nir Barnea (Safety Officer)
DATE PREPARED	12/06/2010 New [X] Revised [ ]	**PPE REQUIREMENTS**	• Float Coats • Warm clothing

Issue of Concern / Activity	Potential Hazards	Control Measures
Performing any marine based operations when water temperatures are below 60 degrees Fahrenheit.	• Cold Stress (Hypothermia, Frostbite, Trench Foot, Chilblain-Red, Surface Transportation and Icing)	**PPE:** Multiple layers of clothing should be worn and clothing to protect the hands, feet and head should be worn to minimize effects of the cold. A float coat must be worn when water temperatures are below 60 degrees at any time during operations. **Administrative:** • Only perform work if PPE is worn • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available • Marine based operations must cease when air and water temperatures are both below 50 degrees Fahrenheit • No operations at night, in bad visibility, bad weather, when wind speed >25 knots, when small craft advisory issued • No operations on any vessel deemed unsafe for any reason or missing any necessary equipment such as VHF radio.

TASK	**Fill in general task**
LOCATION	Fill in location
DATE PREPARED	Xx/xx/xxxx New [X] Revised [ ]

PERFORMED BY	Fill in person performing hazard analysis
REVIEWED BY	Fill in person reviewing and approving
PPE REQUIREMENTS	• PPE 1 • PPE 2 • PPE 3

Issue of Concern / Activity	Potential Hazards	Control Measures
Fill in activity	• Hazard 1 • Hazard 2 • Hazard 3 • Etc.	**PPE:** Fill in specific PPE used **Administrative:** • Do not perform work requiring PPE until PPE is available and used. • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available

SIMOPS and Offshore Reporting Procedures for the MC252 NRDA Scientific Fleet
Updated 4/7/11

All NRDA Scientific Vessels must adhere to these guidelines for simultaneous operations (SIMOPS) when conducting operations in conjunction with the MC-252 Deepwater Horizon Incident. Vessels must supply information regarding cruise operations 48 hours prior to departure as well as daily during cruises. SIMOPS procedures may be modified at any time, resulting in changes that would be communicated to NRDA vessels while at sea.

SIMOPS Procedures

1. Provide information on cruise and equipment 48 hours prior to departure.

Inform the following individuals via e-mail of your anticipated departure time, closest point of approach to the MC-252 wellhead, nature of activities, general equipment to be used, and the make, model, and frequency of any acoustic devices to be employed. E-mail subject line should be "[Vessel Name]: Pre-departure Contact" and should be sent to:

chad.smith@darkwatermarine.com	Joint NRDA Vessel Operations Coordinator (NOAA Rep)
jodi.harney@cardno.com	Vessel Committee (Cardno ENTRIX Representative)
dwhnrdafieldops@gmail.com	NOAA/Trustee Distribution List Manager

2. Submit Daily Situation Reports ("SITREPs").

Prior to departure, begin submitting a Vessel Situation Report (form provided in PDF format) by 0800 daily. E-mail subject line should be "[Vessel Name]: Daily Vessel SITREP [Date]" and should be sent to:

chad.smith@darkwatermarine.com	Joint NRDA Vessel Operations Coordinator (NOAA Rep)
jodi.harney@cardno.com	Vessel Committee (Cardno ENTRIX Representative)
dwhnrdafieldops@gmail.com	NOAA/Trustee Distribution List Manager
geir.karlsen@bp.com	BP SIMOPS lead, Houston
craig.scherschel@bp.com	BP Science & Technology, Houston
jeffrey.dingler@bp.com	BP AUV MC-252 Well Abandonment Survey Manager
rdaileytx@gmail.com	Captain of the vessel *Miss Ginger*, AUV operations

Safety Information

1. Acoustics

When using acoustic devices, frequencies must be coordinated with SIMOPS 48 hours prior to departure to avoid interference. Acoustic devices include echo sounders and USBL, ADCP, and multibeam systems. The vessel must be prepared to discontinue acoustic transmission immediately if SIMOPS or any vessel in the field reports any interference. VHF and SAT phone must be monitored closely for such contact. Rapid response and monitoring of communications in this situation is an absolute safety imperative.

2. Vessel-to-Vessel Communications

At present, there is no required call-in for vessel operating in the field. Vessels should provide the *Miss Ginger* a three-mile berth at all times and should communicate directly via VHF or SAT phone when working near the vessel. If approach is unavoidable, VHF communications must me established with the vessel in question and a passing arrangement agreed to in accordance with the International Rules of

the Road. The *Miss Ginger* can be reached at the following sat phone numbers and monitor 16, 18, and 64.

Bridge: 337-769-9032 (Captain)
Lab: 337-769-9033 (Richard Daily)

3. MC-252 Wellhead Access and Hazard Avoidance

There is a court-ordered exclusion zone around the wreckage of the Deepwater Horizon located near the MC-252 wellhead (position 28° 44.483' N, 88° 22.050' W). No vessels are permitted within 750' of this location. Other mapped and unmapped hazards may exist in the water column and on the seafloor in the area. Navigators from Continental Shelf Associates (CSA) on board NRDA fleet vessels will be supplied with the location and nature of known, mapped hazards.

Definitions

1. SIMOPS

Simultaneous Operations exists as to provide coordination and information exchange with the mission to facilitate safe and coordinated operations at and around the Deepwater Horizon incident site in Mississippi Canyon Block 252. Strict protocols were employed during the Response and initial NRDA phases. Reduced vessel traffic reduced the need for daily check-in calls, but compliance with SIMOPS procedures is still an expectation of all vessels in the area.

2. NRDA Vessel Coordination Committee

A group which coordinates the needs of offshore vessels, proposed cruise plans, and vessel operations. The committee includes representatives from BP, Trustees, CSA, and Cardno ENTRIX. A conference call is held every Monday at 1530 CDT.

3. NRDA Field Ops

Trustee NRDA Field Ops facilitates the placement of crews on NRDA vessels and assists with general logistics.

Contacts

Name	Role, Affiliation	Email	Phone
Cragan, Jenna	Project Scientist, ASA/NOAA	jcragan@asascience.com	(401) 316-5600
Graham, Eileen	Project Scientist, ASA/NOAA	egraham@asascience.com	(443) 745-5323
Harney, Jodi	Project Scientist, Cardno ENTRIX	jodi.harney@cardno.com	(813) 373-8479
Karlsen, Geir	SIMOPS Lead, BP Houston	geir.karlsen@bp.com	(281) 366-4315
Mulcahy, Bob	Operations Lead, Continental Shelf Associates	rmulcahy@conshelf.com	(561) 758-7152
NOAA NRDA Field Ops	Trustee Logistics	dwhnrdafieldops@gmail.com	(504) 410-7787
Smith, Chad	Joint NRDA Vessel Operations Coordinator, NOAA Rep	chad.smith@darkwatermarine.com	(617) 999-4163

DWH Vessel Daily SitRep

Vessel Name: | In Port ○ | Underway ◉ | Date:

Next Port of Call: | ETA/ETD:

Current Position: | Time (24 hr):

Latitude: | Longitude:

Cruise Plan Title:

Current Operations:

Operating within 15 NM/28 km of Wellhead? YES ◉ NO ○

If yes, list acoustic instrumentation onboard and frequencies used.

Operational Issues:

Additional Comments:

Submitted by:

Email daily by 0800 to:

chad.smith@darkwatermarine.com (Vessel Ops)
dwhnrdafieldops@gmail.com (Trustee Rep)
jodi.harney@cardno.com (BP Rep)

NRDA Field Sampler Data Management Protocol

10-22-2010

MS Canyon 252 (Deepwater Horizon) Oil Spill

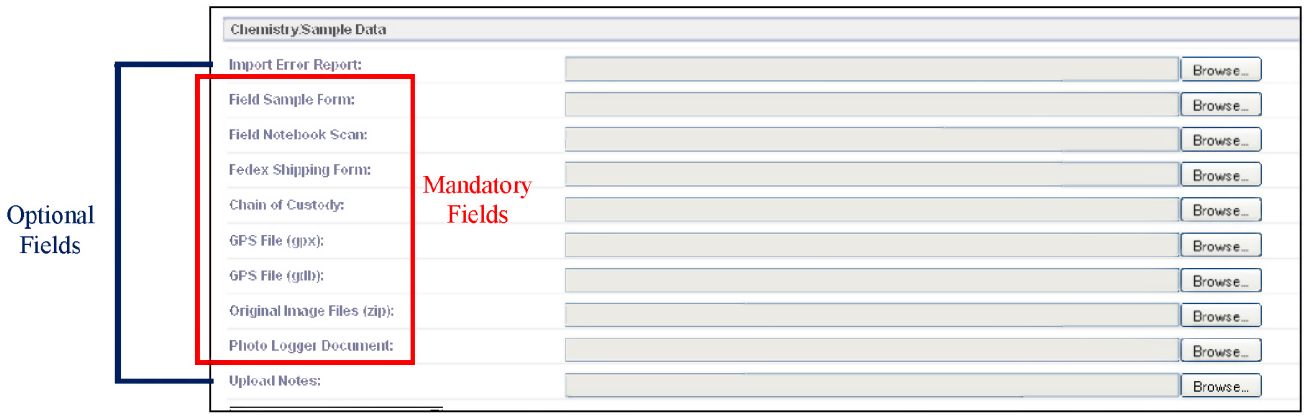
NOTE: THESE INSTRUCTIONS REPLACE ALL PREVIOUS INSTRUCTIONS.

These instructions update the protocol for preparing field sample records and uploading field sampling data into NOAA's NRDA Content Management System (www.noaanrda.org) and match the sampling forms version 16.2.1 updated in July 2010. NRDA samples submitted for chemistry must comply with the documentation requirements set forth in the NOAA field sampling form documentation and outlined below. Samples that do not meet these requirements will not be processed by the laboratory. Individuals who submit samples that do not comply with documentation requirements will be instructed on proper procedures and be given the opportunity to correct any deficiencies; however, this will delay data acquisition. This system was developed with both legal and scientific considerations. Prior to undertaking any sampling, please familiarize yourself with all of the required data elements on the forms relevant to your effort. These documentation requirements are relevant to all work groups, with the exception of the sub-surface multi-depth water sampling conducted on research cruises, which is subject to its own documentation requirements (see Cruise Data Protocol document).

A weekly Q&A session for field samplers (Wednesday at 4pm CDT) goes through the contents of this protocol. Please join the webinar if you are new to NRDA Field Sampling or if you have questions about field sampling protocol. The number to call in to the webinar is 866-763-3375 and the Participant Code is 9557764, and the webinar is presented at https://www1.gotomeeting.com/join/454999441

NRDA Sample Data Requirements

All analytical sample data must be submitted through the NOAA NRDA Content Management System. A complete file collection must include those listed as Mandatory in the graphic below. In the event that all Mandatory files are not uploaded, the sampling event will not be included the database and you will be notified by a representative from the NRDA Data Management team. The only optional fields include Import Error Report and Upload Notes.



To gain access to the NOAA NRDA Content Management Site, users must request access via support@noaanrda.org or call (866) 974-0614. Each component of a complete file collection is discussed below.

Field Sample Documentation

The NRDA Field Sample Form and related guidance documents are located on the NOAA NRDA site (*Documents* > *Field Sample Form*). When a sample is collected for chemical analysis, the following documentation is required and must be provided in order for the samples to be accepted for analysis:

- **Sample collection information**: **All** fields on the applicable NRDA Sample Collection Form (Oil-Tarball-Water, Soil-Sediment, or Tissue-Wrack) must be filled out, with the exception of those fields noted below. There are three options to record this required information:
    a. Use the matrix-specific NRDA Sample Collection Forms;
    b. Record **all** the required information on paper (e.g, other form, log book); or
    c. Record **all** the required information directly into a spreadsheet.
- **NRDA Chain of Custody (CoC) Form**: Complete all fields in the COC form with the exception of the fields noted below. NOTE: Written documentation must be in the NRDA format for this project.
- **Field log books:** If a log book is used, either the log book must be submitted for scanning or appropriate scanned pages must be delivered with the samples. Originals may be demanded in the future; they must be kept by your agency or turned in to the SIC or other NOAA representative.

All data fields on the forms are to be ***completely*** filled out. Exceptions to the data field requirements are very limited:

- NRDA CoC form
    - Analyses Requested (if uncertain, select "As per sample plan" in picklist)
    - Lab Name (if unknown, please write "Lab")
    - Waybill Number (Laboratory will fill in if coolers are sealed prior to obtaining waybill number)
    - Turn Around Time
- NRDA Sample Collection Forms
    - Resource Group Leader (Preferred, but not legally required)
    - Chain of Custody Field CoC information (Only if an intermediary delivers samples from sample site to SIC)
    - Notes sections (The notes sections are not mandatory; however samplers are encouraged to use these sections to provide additional detail.

Pre-Field Sampling Protocol

I. Before going into the field for the first time, the NRDA field sampler should watch the sample training videos and review the Field Form User Guide (Documentation > Sampling Training Session). Any outstanding questions can be addressed via email (dwhnrda@gmail.com), the **Field Sample Form helpline at (985) 746-1394**, or through attending the weekly Q&A session. This explains the official NOAA NRDA field sampling form.

II. Before going into the field *each day*, the NRDA field samplers should generally complete two tasks.

1. Print necessary field sampling forms (*Documentation > Field Sampling Form*).

2. Determine your NRDA Sampling Grid Location Code (*Documentation > NRDA Grid Location Code Maps*).

Near-Shore/Land Sampling:
a. Choose the index map for the state in which you will be sampling.
b. Find the sampling grid map corresponding to the specific area in which you will be working.
(*Documentation > NRDA Grid Location Code Maps*)

c. Use the sampling grid map to find the grid in which you will be working. The codes are noted in the center of each cell.

Water-Based Sampling:
Given the extent of the Gulf activities, for open water-based sampling please use the following convention:
- GU (for Gulf of Mexico) or EC (for East Coast, east of the Florida Keys)
- Degree Latitude
- Degree Longitude

For example, in the Gulf of Mexico sampling location 27.30 North and -88.30 West code would be GU2788.

Sample Collection Information Options

With every chemistry sampling event, the information on both the matrix-specific NRDA Sample Collection Forms and the NRDA Chain of Custody Form must be collected. For legal defensibility, original copies of all documents must be retained. Individual agencies may choose to retain custody of these documents (field forms, log books) and

provide only electronic copies to NOAA; in this case, the individual agency is responsible for providing the material in the event of a discovery request. Alternatively, the original documents may be signed over to NOAA and its contractors, and will be retained in secure document storage.

Some sampling teams may find it convenient or necessary to use formats besides the NRDA Sampling Collection Form to capture this information. There are three options to record this information. If you do multiple days of sampling, you need to fill out one electronic field form per day.

1. ***Use the NRDA Sample Collection Form for the specific matrix you are working with*** (strongly recommended option). The three NRDA Sample Collection Forms are:
   - Oil/Tarball/Water (use separate forms to track water versus oil/tarball)
   - Tissue/Wrack
   - Soil/Sediment

   The completed original NRDA Sample Collection Form is turned in with the samples when using a Sample Intake Center (SIC). If the sampling team is not using a SIC, the data from this form are entered electronically into either the MS Excel-based Field Sample Workbook or Flat File forms and uploaded to the NOAA NRDA site. Copies of the hand-written form must be scanned and uploaded to the NOAA NRDA site with the data spreadsheet. Originals may be retained by individual agencies or submitted in hard-copy via a traceable carrier (e.g. U.S. registered mail, FedEx, UPS or similar) to the NRDA document manager:

   NRDA Document Manager
   c/o Industrial Economics
   2067 Massachusetts Avenue
   Cambridge, MA 02140

2. ***Use a form other than the NRDA Sample Collection Form for recording the required information.*** The information can be recorded on another form or in a field log book. It is imperative that **all** required fields from the NRDA Sample Collection Form be recorded (see above requirements). When using a form other than the NRDA Sample Collection Form, the original form or field log book must be turned into the SIC. If the sampling team is not using a SIC, the data from the form or field log book are entered electronically into either the MS Excel-based Field Sample Workbook or Flat File forms and uploaded to the NOAA NRDA site. Copies of the hand-written form must be scanned and uploaded with the data spreadsheet. Originals may be retained by individual agencies or submitted in hard-copy to the NRDA document manager (see address above).

3. ***Use a computer to input the information directly into a spreadsheet***. The required information from the NRDA Sample Collection Form can be recorded directly into a computer provided the following steps are followed:
   a. The computer file is recorded on a CD/DVD (non-rewritable) at the end of each field day.
   b. The following is recorded on the CD/DVD label:
      i. Name of person entering data into the computer system
      ii. Date of sample collection/data input
      iii. Make and serial number of the computer
      iv. Software used and version number
   c. A NRDA Chain of Custody is completed for transfer of the CD/DVD
   d. The files on the CD/DVD are uploaded to the NOAA NRDA website.

   The original file is kept on the computer system until it is verified that the CD/DVD recorded properly. This CD/DVD is turned in with the samples if using a SIC. If the sampling team is not using a SIC, this CD/DVD must be sent to the NRDA document manager under chain of custody (i.e., with a CoC form and using a secure carrier such as FedEx).

If you have questions or need assistance with the workbook please first look for the answer in the User Guide, then try to attend the weekly webinar. If you cannot attend the webinar, you may call the field sampling form/COC **helpline number at (985) 746-1394**. Again, general questions regarding the forms may posted to NRDA Gmail address (dwhnrda@gmail.com); inquiries are usually responded to within 24 hours.

Regardless of which reporting approach you choose, name the file using the following naming convention. The date is the **date sampled** (if multiple sampling days *on cruises only*, use the last day of samples).

<<YYYY>>_<<MMDD>>_<<LAST NAME>>_<<FIRST_NAME>>_<<FILE_TYPE>>.xls

For example:
2010_0701_SMITH_JOHN_FieldSampleForm.xls

Scanning Field Form Documents

Scans of all paper forms used in the field and any log book entries must be included in the file collection upload. All sample intake centers have scanners.

Chain of Custody (COC) Forms and Mailing Labels

Please scan your ***signed*** COC forms and mailing labels. Note that the NOAA Spreadsheet will create a custom COC form based on your inputs. NOAA NRDA samples require the use of the NOAA NRDA COC.

Photos and GPS

Photos are taken in the field for two primary reasons: to validate the field sampling effort and to provide a visual description of field conditions and operations. The GPS is required to geo-locate the photos to a particular time and place for legal reasons. Samples will be accepted without photo documentation, but any submitted photos must follow the NRDA documentation requirements.

Pre-Field Photo/GPS Protocol

I. Read through the field photo validation documents located on NOAA NRDA (*Documentation > Photos and GPS*) which include: NRDA Field Photography Guidance, Basic GPS Skills and Garmin MapSource

II. Make sure digital camera has charged batteries, is set to a high resolution, and uses JPEG file format (not RAW).

III. Set the camera to local time and date; the time should be in 24h military time.

IV. Have a back up of all past information, and clear camera and GPS before each sampling day.

V. Set the GPS to Datum - WGS 1984, 24h military time with the correct time and date, set the track log to "wrap when full", and make sure the GPS is set in decimal degrees. The batteries for the GPS should also be fully charged.

Field Photo and GPS Protocol

I. Turn on your GPS. Leave it on for the entire sampling day.

II. Take one photo of your GPS screen which displays the time (including seconds) and date clearly. Make sure the GPS screen is clear in the photo. This will be used with the GPS track log to geo-locate the photos.

III. Take photos of the field samples and sampling effort. Remember, for legal reasons, do not delete or rename photos.

Post-Field Photo and GPS Protocol

I. Download your photos from that day's sampling only. Place them in a folder called Photos to be included in the zip file. Do not open, delete or rename any of the photos. If you wish to view your photos, you may download them again to your own personal folder and view them. Sample Intake Centers can also upload your photos.

II. Download the GPS Track Log and way points using Garmin MapSource. Save the points twice from MapSource: once as a Garmin Database file (.gdb) and once as a GPS exchange file (.gpx). If you have other non-Garmin GPS/latitude longitude information, please provide GPS locations in a format (e.g., excel) that links the photo name with its coordinates. If the field locations are staffed with members of the data management team, they can assist you with this process.

III. Fill out the NRDA Photo Logger form. This is required and located on NOAA NRDA *(Documentation > Photos and GPS*). Without the form, the data management team will not be able to log your photos.

Uploading the File Collection to the NOAA NRDA Website

Naming Convention for Uploaded Files

Naming files in a consistent way will greatly speed up the processing of the sampling information. Please use the following naming convention (the date field representing the sample date):

<<YYYY>>_<<MMDD>>_<<LAST NAME>>_<<FIRST_NAME>>_<<FILE_TYPE>>

For example:
2010_0505_SMITH_JOHN_PhotologgerForm.PDF

Uploading Sample Information and Notifying Data Management

To upload all associated with a sample and/or observation event, go to the NOAA NRDA site at: www.noaanrda.org

On the left-hand navigation columns, click on "Data Entry/Data Exports" under the **Access/Post Data** heading. From here, users will notice a link to the Uploading Tool. Under the **Workgroup:** dropdown menu, choose "-All Sample Data/Chemistry" and click on the **Upload** control button in the upper right-hand corner. This will navigate the user to the actual page for file collection uploads.

Choose the Workgroup and Workplan related to your sample team (if you do not know this, contact your Technical Workgroup lead). From here you will be asked whether observational data was also collected during the sampling event. If you have observational data, you will be prompted to enter this information in a portion of the NOAA NRDA site dedicated to observation data (from there, users can also upload sample data). Otherwise, if a user does not have observational data, a series of data entry prompts will appear. This includes prompts to enter general information about the sampling event and places to upload specific files. Note that the NOAA NRDA site currently has a limit of 1 GB *per file.* If you have files that are larger than 1 GB, please split into multiple files, label appropriately, and enter in the additional files using the dropdown that the bottom of the Sample/Chemistry Data section. Here, users can specify the type of auxiliary document associated with the file collection.

Also, please do not scan documents at a resolution higher than 300 DPI. This will help keep file size down.

*******IMPORTANT*******

Once you have uploaded the file collection to NOAA NRDA, you must alert the data management staff. Please send an email to the Gmail account (dwhnrda@gmail.com) as notification. Specifically, please use the following subject heading: SAMPLE TO NOAA NRDA<<YYYY>>_<<MMDD>>_<<LAST NAME>>_<<FIRST_NAME>> For example: SAMPLE TO NOAA NRDA 2010_0505_SMITH_JOHN

Once again, thank you very much for following these procedures. Assistance from all sampling teams will improve efficiency and reduce our need to call you back for missing information.

Transfer of Personnel and Material at Sea

Purpose

This protocol applies to vessel operations involving the joint research being conducted aboard the Entrix/CSA research vessels in conjunction with the MC -252 Deepwater Horizon Spill Response efforts.

The type of water sampling being conducted on this mission requires lab analysis ashore of samples within 7 days from the time they are taken. Sample degradation occurs rapidly, necessitating supply vessels to recover these samples within 72 to 96 hours of collection from the sampling vessels or at other regular intervals on extended missions. Other supplies including food, equipment or spare parts may be transferred also. In addition to samples and supplies, personnel issues may require transfer of personnel from one vessel to another. These circumstances may arise from a medical emergency or other significant personal issue. This protocol is to provide safety guidance when conducting these operations at sea. This protocol is designed to apply to operations where the following conditions are true:

1. A vessel or vessels need supplies, equipment or spare parts,
2. A vessel or vessels need to discharge samples
3. Items to be transferred consist of scientific supplies to support the mission.
4. Personnel emergencies

For the purposes of this mission, all materials to be transferred are items that can be carried by 1 or 2 people. The bulk of these supplies include scientific equipment, water samples and personal effects. These rules do not apply to visitors to the ship including press, family members and USCG boarding personnel.

Application

It is the ultimate responsibility of the Master of each vessel involved to ensure the safety of all personnel involved in the operation. The Master of either vessel shall call off the operations if he or she believes it to be unsafe for any reason. Nothing in this protocol relieves the Master of this responsibility. The Master's judgment shall take into account (but is not limited to) the following factors:

1. Sea conditions
2. Weather conditions
3. Vessels involved
4. Crew fatigue
5. Crew experience
6. Equipment
7. Type and quantity of material to be transferred

This operation, except in the event of an emergency, shall not be conducted in the following conditions:

1. Night,

2. Restricted visibility,
3. Where traffic proximity is cause for concern and may involve a risk of collision,
4. Over a World Meteorological Organization (WMO) sea state of 3,
5. Where transferring goods at the dock is possible and practical,
6. Communications between the 2 vessels has not been established,
7. Where the Master of either vessel has any doubt.

Procedure

All at sea transfers shall be conducted only in daylight and at the discretion of the Master.

The method of approach shall be agreed upon by the Masters of both vessels. It is the choice of the Master to select the approach that is safest with regard to vessel type, configuration, fendering, deck height, vessel maneuverability as well as any other factors which may affect the operation. The operation described herein is common practice for such operations and shall be regarded as the default plan for all such operations.

Communication via VHF radio will be established and maintained throughout the entire operation.

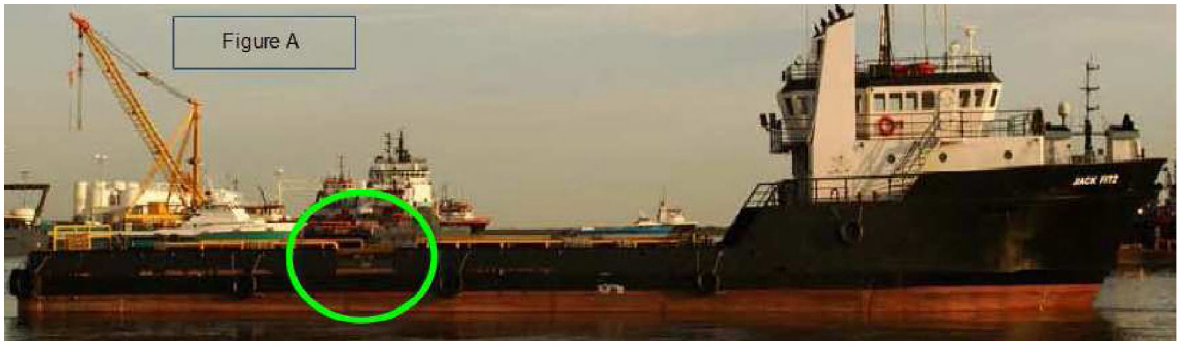
The wheelhouses of both vessels shall be manned during the entire operation.

One individual aboard the Vessel other than the person(s) manning the wheelhouse shall supervise the operation on site and be in communication with the Vessel wheelhouse.

One individual on the Vessel shall be designated to stand by the transfer site with a life ring at the ready in the event of a man overboard. This individual will also be equipped with a radio.

The Vessel shall, where practicable, be positioned in such a manner as to provide a lee and shelter the pilot boat from wind and waves.

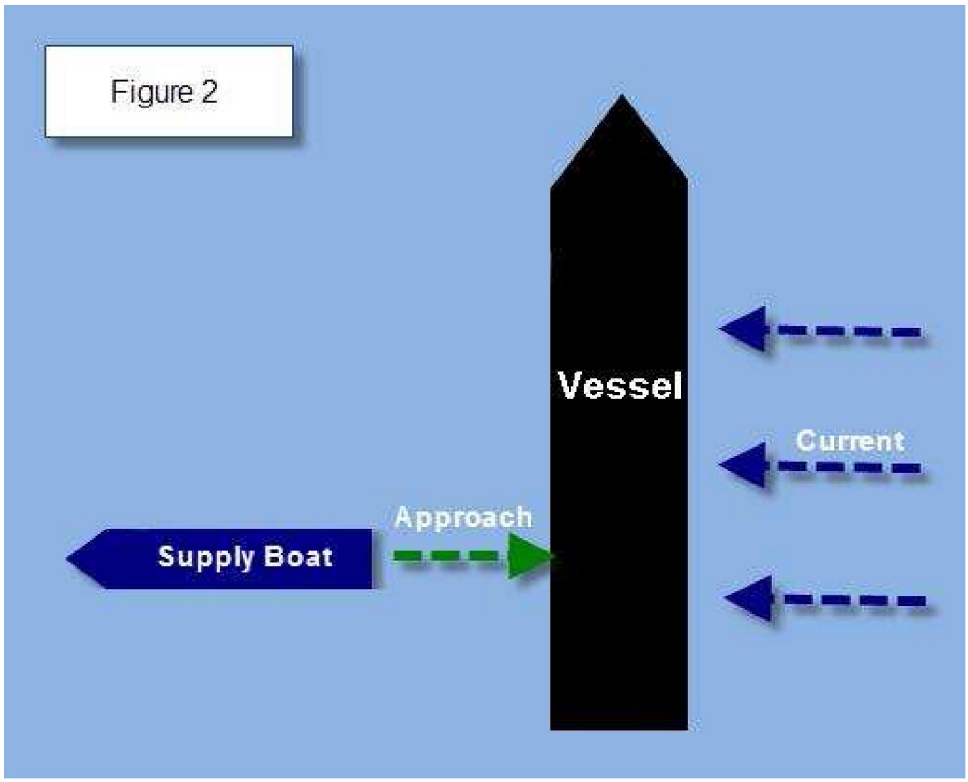
The Vessel shall load from her aft deck either port or starboard side where the break in the gunwale provides the best access to the waterline with the least freeboard to the deck as shown in Figure A.



The vessel shall make no way as the supply vessel approaches.

The supply vessel will make contact with her centerline perpendicular to the hull of the Vessel (see fig. 2).

The supply vessel, where properly fendered, shall approach the Vessel down current and stern to (see fig 2).



Contact between the vessels shall be made while coasting at a safe and minimal speed. Forward propulsion by the supply boat may be used to slow the approach. If during the approach the docking angle is lost, the vessels shall reposition where safe and appropriate for another attempt.

No lines or entanglements shall make fast one vessel to the other.

If the vertical distance between the 2 decks used in the operation on either vessel is greater than 12 inches, then a pilot ladder or other approved boarding equipment shall be used.

Material shall be transferred in a slow and deliberate manner.

If a crane is available, all materials shall be handed across using the crane to move materials from one vessel to another.

Other than in an emergency, vessels will break contact only under the following conditions:

1. The supervisor has ensured all personnel are in a safe position to break contact,
2. The pilot ladder has been recovered,
3. The Masters of both vessels involved agree to end the operation,
4. It is safe to do so.

PPE

All personnel on deck must wear an approved buoyant work vest.

All personnel involved in the operation on deck shall wear an approved hard hat, safety glasses, long pants and closed toe shoes/steel toe shoes where company safety regulations apply.

Requisition

At sea transfer missions shall be requested prior to the Vessel's departure from the port and incorporated into the vessel's mission planning.

Emergency

Nothing in this protocol shall prevent the master of either vessel from taking action in an emergency. This protocol governs only routine scientific supply transfers. The ability of the master to transfer personnel, stores or equipment in a safety or medical emergency shall not be infringed.

MC 252 Standing Order		
TO: All Personnel assigned to MC252 Response		
FROM: Tad Lynch	POSITION: Houston IC Safety Officer	
SUBJECT: Incident Reporting	DATE: 02 May 2010	Time: 1630 hrs

1.0 PURPOSE AND SCOPE

The purpose of this Standing Order is to establish a consistent HSSE incident reporting process for MC252 response personnel. Response personnel include all Federal employees, BP employees, Contractors, Visitors, and other third parties. These minimum reporting requirements are for response operations and are not intended to replace site or project-specific incident and emergency response procedures and policies. The ultimate purpose is to enable and foster a culture of sharing and continuous improvement through identifying trends, special focus needs, case management, HSSE performance and sharing lessons learned.

2.0 RESPONSIBILITIES

All personnel involved in the MC 252 response who are personally involved in, or witness an incident or near miss; are required to immediately notify the person in charge or BP Supervisor who is responsible for the work being conducted. The person in charge or BP Supervisor is responsible for making timely notifications to the appropriate Incident Command or Unified Area Command - Safety Officer (currently Houma, Houston, Mobile, and Robert).

Robert SO (985) 709-5522 **Houma SO (985) 493-7812**
Houston SO (281) 366-6916 **Mobile SO (251) 445-8690**

3.0 NOTIFICATION REQUIREMENTS

Incident Classification	**Notification Time**
Major Incident (MIA), High Potential Incident (HiPo), or Loss of Primary Containment (Spills)	Immediately
Recordable Injuries (DAFWC / Restricted Duty /Medical Treatment), First Aids, or Near Miss	Within 2 hours

4.0 REPORTING STRUCTURE

Safety Officers and/or Health & Safety Unit Leaders are required to report all incidents and near misses to the Safety Officer in Robert, La. - **(985) 709-5522.** After verbal notification has been made, send written incident reports and associated documentation to *MC252Safety@bp.com*.

Input into Traction will be completed by an HSSE Technician in Houston. The Tech will access information via the above e-mail location.

NOTE: If you are a Safety Officer and are not on the MC252Safety@bp.com distribution list, contact the number above and they will submit your information to IT&S to get you set up.

5.0 REQUIRED INFORMATION

Instructions: The Initial Incident Report should be completed using the attached GoM Preliminary HSSE Incident Report "Short Form", or an equivalent contractor supplied form. At a minimum, information should include the following and sent to MC252Safety@bp.com.

C:\Documents and Settings\churchtr\My

Minimum information to include:

Report Date:
Date / Time Occurred:
Date / Time Reported:
Type of Incident: First Aid, Recordable, Near Miss, Spill, HIPO, MIA
Location (Circle One): Offshore or Onshore
Site / Vessel:
Company/Agency/Volunteer Group involved:
Event Description:
Completed by:
Contact Phone #:

6.0 INCIDENT INVESTIGATION

The level of investigation performed will depend on the actual and potential severity outcomes. The level of investigation and responsible organization are listed below.

Incident Classification	**Investigation Requirements**
Major Incident (MIA), High Potential Incident (HiPo), or Loss of Primary Containment (Spills)	Houston Safety Officer and Tim Church will determine level of investigation and team make-up.
Recordable Injuries (DAFWC / Restricted Duty /Medical Treatment),	Local investigation. One-page Lessons Learned document will be developed by Tim Church from local investigation report.
First Aids, or Near Miss	Local investigation. Incident report containing information outlined in Section 5.

7.0 HSSE PERFROMANCE SCORECARD

The Safety Officer in Robert will report incidents to the Unified Area Command BP Liaison and BP Aide de Camp. They will also update and distribute the HSSE Performance summary and scorecard daily by 1100 hrs. It is responsibility of each IC Safety Officer to distribute the information to appropriate command and planning staff.

Safety Officer Name:	Date:
Signature:	Approval Signature:

ANALYTICAL QUALITY ASSURANCE PLAN

MISSISSIPPI CANYON 252 (DEEPWATER HORIZON) NATURAL RESOURCE DAMAGE ASSESSMENT

Version 2.2

Prepared for:

U.S. Department of Commerce
National Oceanic and Atmospheric Administration

January 20, 2011

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VERSION 2.2 CHANGES FROM VERSION 2.1:

<table>
<tr><th>Page</th><th>Change</th></tr>
<tr><td>Cover</td><td>Updated version # & date</td></tr>
<tr><td>Acronyms</td><td>Inserted DOSS</td></tr>
<tr><td>4</td><td>Inserted discussion re: Corexit Indicator Compound analysis (see below)
Corexit indicator compounds can be identified and (semi-) quantified by conventional GC/MS-SIM. The indicator compounds presently identified include: 2-butoxyethanol, three closely-eluting glycol ether isomers (reported together as a single analyte), and bis-(2-ethylhexyl)fumarate (the latter of which is a thermal degradation product of DOSS formed in the GC injection port). These indicator compounds can be identified in samples prepared for alkylated PAH analysis using conventional solvent extraction and preparation. These indicator compounds can be analyzed for concurrently with the alkylated PAHs during the same GC/MS acquisition by adding appropriate ions to the file. Suggested ions for monitoring are listed in Table 1.1.g. Indicator compound identifications are confirmed by analyzing a Corexit standard (i.e., a mixture of Corexit 9500 and 9527) under the same conditions as used for samples by comparing ion patterns and GC retention times. Semi-quantitative results for these indicator compounds can be based on a normalized response factor of 1 (without surrogate correction), and then the concentrations reported flagged by the laboratory as semi-quantitative.</td></tr>
<tr><td>4</td><td>Corrected table reference – Table 1.1g to Table 6.1g</td></tr>
<tr><td>5</td><td>In table removed X from SHC/TEH for Tissue</td></tr>
<tr><td>7</td><td>Removed Water (TEH) from Target MDL</td></tr>
<tr><td>7</td><td>Added Target Reporting Limit for Water (TEH/TEM) at 200 ug/L</td></tr>
<tr><td>10</td><td>Added T22a-Gammacerane/C32-diahopane to Table 1.1e –Petroleum Biomarkers</td></tr>
<tr><td>11</td><td>Added Corexit Indicator Compounds table (Table 1.1g)
TABLE 1.1g
Corexit Indicator Compounds for Qualitative Analysis in Water Only (monitoring mass/charge ion)<table><tr><td>2-Butoxyethanol (m/z 87, 75)</td></tr><tr><td>Glycol ether Isomers (m/z 59, 103)</td></tr><tr><td>Bis-(2-ethylhexyl) fumarate (m/z 112, 211)</td></tr></table></td></tr>
<tr><td>13</td><td>Corrected Greg Salata email address to gsalata@caslab.com</td></tr>
<tr><td>14</td><td>Added two rows to preservation and holding time table – Sediment for VOC, and Water for DOSS<table><tr><td>Section 3.1</td><td></td><td></td><td></td></tr><tr><td>Sediment for VOC</td><td>Refrigeration 4°+ 2C</td><td>14 days</td><td>Not Applicable</td></tr><tr><td>Water for DOSS</td><td>Frozen, 15mL plastic centrifuge tubes so entire container can be solvent rinsed</td><td>Not established</td><td>Not established</td></tr></table></td></tr>
<tr><td>14</td><td>Table under Section 3.1: Changed header “Holding Time for Extracts” to read “Holding Time to Analysis”</td></tr>
<tr><td>14</td><td>For VOC stated Not Applicable in “Holding Time to Extraction” and moved holding times to last column (Holding Time to Analysis)</td></tr>
<tr><td>14</td><td>In last column – changed the footnote numbers from “9” to “12”</td></tr>
</table>

DWH-AR0014299

<table>
<tr><th>Page</th><th>Change</th></tr>
<tr><td>14</td><td>Replaced the rows for Sediment and Tissue matrices with the rows below.
<table>
<tr><th>Matrix</th><th>Storage for Samples</th><th>Holding Time to Extraction</th><th>Holding Time to Analysis</th></tr>
<tr><td>Sediment/Soil for PAH, SHC/TEH, Biomarkers, total solids, grain size and TOC</td><td>Frozen; except Grain Size should not be frozen - store at 4°C ±2°</td><td>1 Year; except not applicable for grain size, total solids and TOC.</td><td>40 days from extraction[12]; except biomarkers grain size and TOC no holding time.</td></tr>
<tr><td>Tissue for PAH, SHC/TEH, Biomarkers, and Total Extractable Organics (TEO, aka Lipids)</td><td>Frozen</td><td>1 Year</td><td>40 days from extraction[12]; except biomarkers and TEO no holding time.</td></tr>
</table></td></tr>
<tr><td>20</td><td>First line: changed 10X to 5X, removed "(whichever is lower)"</td></tr>
<tr><td>21</td><td>Changed Mass Discrimination MQO to read Ratio for the “concentration” (rather than raw area)</td></tr>
<tr><td>24, 25</td><td>Removed "Draft" from table titles</td></tr>
<tr><td>26</td><td>Table 6.1f: Changed “Grain Size” method description to the following:
Grain Size (apparent): ASTM D422. If using sieve analysis only, report as percent gravel, coarse sand, medium sand, fine sand, very fine sand, and silt/clay. If using sieve and hydrometer, report as percent gravel, coarse sand, medium sand, fine sand, very fine sand, silt, and clay.</td></tr>
<tr><td>26</td><td>Added web address for Plumb method reference;
http://yosemite.epa.gov/r10/CLEANUP.NSF/ph/T4%20Technical%20Documents/$FILE/Plumb.pdf</td></tr>
</table>

DWH-AR0014300

Acronyms and Abbreviations

%D	Percent difference
%R	Percent recovery
ASTM	American Society for Testing and Materials
BS/BSD	Blank spike/blank spike duplicate
CCV	Continuing calibration verification
CRM	Certified reference material
DISP	Dispersant
DOSS	Dioctylsulfosuccinate salt
DOT	U.S. Department of Transportation
DQO	Data quality objectives
EDD	Electronic data deliverable
EIP	Extracted ion Profile
EPA	U.S. Environmental Protection Agency
GC/MS-SIM	Gas chromatography with low resolution mass spectrometry using selected ion monitoring
GC-FID	Gas chromatography with flame ionization detection
LC	Liquid chromatography
MC 252	Mississippi Canyon 252 (Deepwater Horizon)
MDL	Method detection limit
MQO	Measurement quality objectives
MS/MSD	Matrix spike/matrix spike duplicate
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NRDA	Natural resource damage assessment
OPA	Oil Pollution Act
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic aromatic hydrocarbons
PIANO	Paraffins, isoparafins, aromatics, napthenes, olefins
QA	Quality assurance
QAP	Quality assurance plan
QC	Quality control
RM	Reference material
RPD	Relative percent difference
RSD	Relative standard deviation
SHC	Saturated hydrocarbons
SOP	Standard Operating Procedures
TEH	Total extractable hydrocarbons
TEM	Total extractable matter
TEO	Total extractable organics
TOC	Total organic carbon
USEPA	U.S. Environmental Protection Agency
VOC	Volatile organic compounds

INTRODUCTION

On April 20, 2010, a fatal explosion struck the Deepwater Horizon offshore oil platform approximately 50 miles off the Louisiana coast in the Gulf of Mexico, ultimately leading to the destruction of the platform and the connecting riser pipe to the seafloor a mile below the water surface, and the ongoing release of thousands of barrels of crude oil from the seafloor per day. The incident has been declared a Spill of National Significance by the U.S. Secretary of Homeland Security and a major spill response effort is in progress. The spill threatens a broad expanse of the U.S. Gulf Coast in addition to the natural resources in the path of the oil slick which has spread across thousands of square miles at sea. Federal and state natural resource trustees have begun collecting ephemeral data to support a natural resource damage assessment (NRDA). Currently, NOAA is the lead administrative trustee. Although a formal agreement has not yet been reached, BP America has indicated an interest in cooperating with the natural resource trustees in the damage assessment.

This Analytical Quality Assurance (QA) Plan describes the minimum requirements for the chemical analysis of the environmental samples that are collected in support of this NRDA. This plan does not address the actual field collection or generation of these samples. The scope of the laboratory work is twofold: (1) generate concentrations for key chemicals used in injury determinations for crude oil releases, and (2) produce more extensive chemical data to use in fingerprinting for source identification. The applicable chemicals, need and frequency of environmental sample analyses, quality control requirements, and data usage vary for these two purposes, although implementation of this plan enables both to be achieved. In recognition of these differences, sampling plans may reference the Analytical QA Plan and cite to specific tables of chemical analyses that are appropriate to the needs of the particular sampling effort.

The requirements specified in this plan are designed to: (1) monitor the performance of the measurement systems to maintain statistical control over the reported concentrations of target analytes and provide rapid feedback so that corrective measures can be taken before data quality is compromised and; (2) verify that reported data are sufficiently complete, comparable, representative, unbiased and precise so as to be suitable for their intended use.

The analytes of concern addressed in this QA Plan are polycyclic aromatic hydrocarbons (PAHs) including alkyl homologues, saturated hydrocarbons (SHC), total extractable hydrocarbons (TEH)[1], and volatile organic compounds (VOCs) and petroleum biomarkers. Additional analytes of concern are potentially toxic polar and non-polar components found within or formed from the dispersant agents utilized during the response to the incident, although the appropriate target analytes and methods are not yet established. A variety of matrices may be analyzed including water, filters, sediment/soil, tissues, vegetation, absorbent materials (e.g. Teflon nets, etc.), oils and oil debris. In addition to the primary analytes of concern, ancillary tests may include: percent moisture, total organic carbon (TOC) and grain size for sediment samples, and total extractable organics (TEO) for tissues. Additional tests not

[1] TEH is the total aromatic and aliphatic content as determined by GC-FID. If the sample extract is not "cleaned up" to remove biogenic material prior to the GC-FID analysis, then the result from the GC-FID analysis is termed Total Extractable Matter (TEM).

currently addressed in the QAP but may be of interest are: SARA (%Saturate, %Aromatic, %Resin, %Asphaltene) content in oil[2]; carbon, hydrogen, and nitrogen (CHN)[3] for sediments and particulate material in water. Performance criteria will be added to the QAP for additional tests when requested under the NRDA program.

The work plans and associated QA plans under which these samples were generated or collected are independent documents and not included or considered herein. This Analytical QA Plan describes the minimum requirements to be taken to provide for the chemical analyses (and associated physical normalizing parameters) of the previously generated or collected samples in a technically sound and legally defensible manner.

This Analytical QA Plan is consistent with the intent of NRDA regulations under OPA (33 U.S.C. §§ 2701 *et seq.)* and satisfies the requirements listed in the relevant EPA guidance for QA plans (USEPA 2002 and USEPA 2001) as far as the documents relate to analytical testing services. This QA plan will be revised as appropriate, as changes are made to the NRDA and the QA program.

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[2] SARA according to method published by Zumberge et al (2005) or equivalent. [Zumberge, J., J.A. Russell, and S.A. Reid . 2005. Charging of Elk Hills reservoirs as determined by oil geochemistry AAPG Bull. v. 89, pp. 1347-1371]

[3] CHN by micro elemental analyzer using the Dumas method of complete and instantaneous oxidation (flash dynamic combustion) at >1,000 °C following exposure of the sample to HCl fumes to remove inorganic carbon.

1.0 PROJECT DESCRIPTION

A number of laboratories will be analyzing samples associated with this NRDA. The intent of this plan is to present the minimum requirements for the performance criteria for the laboratories providing data in support of this investigation. The analytes of specific interest and brief descriptions of the analytical methods are as follows:

- PAHs including alkyl homologues by gas chromatography with low resolution mass spectrometry using selected ion monitoring (GC/MS-SIM). The analytical procedure is based on EPA Method 8270D with the GC and MS operating conditions optimized for separation and sensitivity of the target analytes. Alkyl PAH homologues are quantified using a response factor assigned from the parent PAH compound. Analytes, associated response factors and target detection limits are listed in **Table 1.1a.** The following references discuss the method options in further detail:

  Federal Register 40CFR300, Subchapter J, Part 300, Appendix C, 4-6-3 to 4-6-5 pp. 234-237.

  Murphy, Brian L. and Robert D. Morrison (Editors). 2007. *Introduction to Environmental Forensics*, 2nd Edition. Chapter 9, p. 389 – 402;

  Page, D.S., P.D. Boehm, G.S. Douglas, and A.E. Bence. 1995. Identification of hydrocarbon sources in the benthic sediments of Prince William Sound and the Gulf of Alaska following the *Exxon Valdez* oil spill. *In*: *Exxon Valdez Oil Spill: Fate and Effects in Alaskan Waters, ASTM STP 1219*, P.G. Wells, J.N. Bulter, and J.S. Hughes, Eds, American Society for Testing and Materials, Philadelphia. pp 44-83.

  Kimbrough, K.L., G.G. Lauenstein and W.E. Johnson (Editors). 2006. *Organic Contaminant Analytical methods of the National Status and Trends Program: Update 2000-2006*. NOAA Technical Memorandum NOS NCCOS 30. p. 25- 37.

  Sauer, T.C. and P.D. Boehm. 1995. *Hydrocarbon Chemistry Analytical Methods for Oil Spill Assessments*. MSRC Technical Report Series 95-032, Marine Spill Response Corporation, Washington, D.C. 114 p.

  USEPA. 2008. *Test Methods for Evaluating Solid Waste, Physical/Chemical Method* (SW846).

  Wang, Z. and S.A. Stout. 2007. Chemical fingerprinting of spilled or discharged petroleum – methods and factors affecting petroleum fingerprints in the environment. In: *Oil Spill Environmental Forensics: Fingerprinting and Source Identification*. Z. Wang and S.A. Stout, Eds, Elsevier Publishing Co., Boston, MA, pp. 1-53.

- Saturate hydrocarbons by gas chromatography with flame ionization detection (GC/FID) based on EPA Method 8015. Analytes and target detection limits are listed in **Table 1.1b**.

- Total Extractable Hydrocarbons (TEH[4]) representing the total aromatic and aliphatic hydrocarbon content of sample extracts after silica gel clean-up and analysis by GC/FID (**Table 1.1b**). The result is reported based on integration of the FID signal over the entire hydrocarbon range from *n*-C9 to n-C44 and calibrated against the average alkane hydrocarbon response factor.

  If the sample extract does not receive any clean-up then the result will be reported as Total Extractable Matter (TEM) because the extract may contain non-hydrocarbon compounds. . Either TEH or TEM may reported by the laboratory depending on the handling of the extract.

- Standard volatile organic compounds (VOC) by GC/MS based on EPA Method 8260B but for aromatics hydrocarbons only. Analytes and target detection limits are listed in **Table 1.1c.**

- Extended list of VOCs for a specialized fingerprinting analysis of paraffins, isoparaffins, aromatics, napthenes, and olefins (PIANO) by GC/MS. Analytes and target detection limits are provided in **Table 1.1d** for this source identification list.

- Petroleum biomarkers by GC/MS-SIM. Two methods for the analysis of petroleum biomarkers are contained herein, viz., quantitative and qualitative. The difference between these two analyses is that quantitative analysis produces absolute concentrations of target analytes whereas qualitative analysis produced pattern, or fingerprints, only. The proposed target analyte list for quantitative biomarkers is provided in **Table 1.1e.** This list may be expanded if warranted. This method is discussed in further detail in:

  Murphy, Brian L. and Robert D. Morrison (Editors). 2007. *Introduction to Environmental Forensics*, 2nd Edition. Chapter 9, p. 389 – 402;

  Wang, Z.. Stout, S.A., and Fingas, M. (2006) Forensic fingerprinting of biomarkers for oil spill characterization and source identification (Review). *Environ. Forensics* **7(2)**: 105-146.

- Qualitative biomarker patterns may also be acquired using GC/MS-SIM with monitoring of selected ions (m/z) as provided in **Table 1.1f**. Since no concentration data are generated by qualitative analysis the results are reported as hardcopy PDF files of each ion over the appropriate retention time(s) and scale and included in the hardcopy data package produced by the laboratory.

- Corexit indicator compounds can be identified and (semi-) quantified by conventional GC/MS-SIM. The indicator compounds presently identified include: 2-butoxyethanol, three closely-eluting glycol ether isomers (reported together as a single analyte), and

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[4] Note that the term TEH is being used for the total hydrocarbon analysis. The term "Total Petroleum Hydrocarbon" (TPH) may be used to refer to TEH, in some instances. For this QAP, the term TEH is used to avoid confusion with state-regulated gasoline or diesel determinations, rather TEH is used to refer to the sum of hydrocarbons from C_9 to C_{44}.

bis-(2-ethylhexyl)fumarate (the latter of which is a thermal degradation product of DOSS formed in the GC injection port). These indicator compounds can be identified in samples prepared for alkylated PAH analysis using conventional solvent extraction and preparation. These indicator compounds can be analyzed for concurrently with the alkylated PAHs during the same GC/MS acquisition by adding appropriate ions to the file. Suggested ions for monitoring are listed in **Table 1.1.g**. Indicator compound identifications are confirmed by analyzing a Corexit standard (i.e., a mixture of Corexit 9500 and 9527) under the same conditions as used for samples by comparing ion patterns and GC retention times. Semi-quantitative results for these indicator compounds can be based on a normalized response factor of 1 (without surrogate correction), and then the concentrations reported flagged by the laboratory as semi-quantitative.

- Corexit 9500/9527 dispersant (DISP) by liquid chromatography (LC)/MS for quantitative assessment, particularly dioctylsulfosuccinate sodium salt (DOSS). Proposed measurement performance criteria are presented in **Table 6.1g**. Because the method is under development the laboratory may develop appropriate performance criteria based on past method performance.

- GC/MS may have use for qualitative assessments of solvent package components (e.g. glycol ethers) or primary degradation products of DOSS (alkyl diesters), pending further method development. Standard methods are not available for either technique but provisional analytical criteria and detection limits are under development.

Analyses will include a number of different sample matrices. Matrices that will be analyzed will be determined in sampling plans and may not include all analyses for each matrix. The following table provides a summary of which analyses may be applicable to each matrix (analyses may be added or deleted as warranted over time).

Matrix	PAH	SHC/TEH	BIOMARK	DISP	VOC
Water	X	X	X	X	X
Filters	X	X	X		
Sediment/Soil	X	X	X	X	X
Tissue	X		X	X	
Vegetation	X	X	X	X	
Inert Sorbent Materials	X	X	X	X	X
Oil/Oily Debris	X	X	X	X	X

TABLE 1.1a
Extended PAH (Parent and Alkyl Homologs) and Related Compounds

	Compound	RF Source[5]
D0	cis/trans-Decalin	
D1	C1-Decalins	D0 or tD0[6]
D2	C2-Decalins	D0 or tD0
D3	C3-Decalins	D0 or tD0
D4	C4-Decalins	D0 or tD0
BT0	Benzothiophene	
BT1	C1-Benzo(b)thiophenes	BT0
BT2	C2-Benzo(b)thiophenes	BT0
BT3	C3-Benzo(b)thiophenes	BT0
BT4	C4-Benzo(b)thiophenes	BT0
N0	Naphthalene	
N1	C1-Naphthalenes	N0
N2	C2-Naphthalenes	N0
N3	C3-Naphthalenes	N0
N4	C4-Naphthalenes	N0
B	Biphenyl	
DF	Dibenzofuran	
AY	Acenaphthylene	
AE	Acenaphthene	
F0	Fluorene	
F1	C1-Fluorenes	F0
F2	C2-Fluorenes	F0
F3	C3-Fluorenes	F0
A0	Anthracene	
P0	Phenanthrene	
PA1	C1-Phenanthrenes/Anthracenes	P0
PA2	C2-Phenanthrenes/Anthracenes	P0
PA3	C3-Phenanthrenes/Anthracenes	P0

	Compound	RF Source
PA4	C4-Phenanthrenes/Anthracenes	P0
RET	Retene	RET or P0
DBT0	Dibenzothiophene	
DBT1	C1-Dibenzothiophenes	DBT0
DBT2	C2-Dibenzothiophenes	DBT0
DBT3	C3-Dibenzothiophenes	DBT0
DBT4	C4-Dibenzothiophenes	DBT0
BF	Benzo(b)fluorene	BF or FL0
FL0	Fluoranthene	
PY0	Pyrene	
FP1	C1-Fluoranthenes/Pyrenes	FL0 or PY0
FP2	C2-Fluoranthenes/Pyrenes	FL0 or PY0
FP3	C3-Fluoranthenes/Pyrenes	FL0 or PY0
FP4	C4-Fluoranthenes/Pyrenes	FL0 or PY0
NBT0	Naphthobenzothiophenes	
NBT1	C1-Naphthobenzothiophenes	NBT0
NBT2	C2-Naphthobenzothiophenes	NBT0
NBT3	C3-Naphthobenzothiophenes	NBT0
NBT4	C4-Naphthobenzothiophenes	NBT0
BA0	Benz[a]anthracene	
C0	Chrysene/Triphenylene	
BC1	C1-Chrysenes	C0
BC2	C2-Chrysenes	C0
BC3	C3-Chrysenes	C0
BC4	C4-Chrysenes	C0
BBF	Benzo[b]fluoranthene	
BJKF	Benzo[j,k]fluoranthene	BKF[8]
BAF	Benzo[a]fluoranthene	BKF or BAF

	Compound	RF Source
BEP	Benzo[e]pyrene	
BAP	Benzo[a]pyrene	
PER	Perylene	
IND	Indeno[1,2,3-cd]pyrene	
DA	Dibenz[a,h]anthracene	
GHI	Benzo[g,h,i]perylene	
4MDT	4-Methyldibenzothiophene	DBT0
2MDT	2/3-Methyldibenzothiophene	DBT0
1MDT	1-Methyldibenzothiophene	DBT0
3MP	3-Methylphenanthrene	P0
2MP	2/4-Methylphenanthrene	P0
2MA	2-Methylanthracene	P0
9MP	9-Methylphenanthrene	P0
1MP	1-Methylphenanthrene	P0
	2-Methylnaphthalene	
	1-Methylnaphthalene	
	2,6-Dimethylnaphthalene	
	1,6,7-Trimethylnaphthalene	
	Other	
	Carbazole	
	C30-Hopane[7]	

Target Method Detection Limit Range

Sediment/Soil = 0.1 – 0.5 ng/g dry weight
Tissue = 0.2 – 1.0 ng/g wet weight
Water = 1 – 5 ng/L

Target Reporting Limit

Oil = 2.0 mg/kg

[5] Response factor (RF) to be used for quantitation. If blank, compound is included in the calibration mix

[6] tD0 = transD0 (used if cis/trans in separate standards)

[7] Quantitative concentrations of C29-hopane and 18α-oleanane may be provided if laboratories are calibrated to do so; the C30-hopane is a minimum requirement.

[8] BKF = Benzo(k)fluoranthene. Benzo(j)fluoranthene and Benzo(k)fluoranthene coelute and will be reported as Benzo(j,k)fluoranthene (BJKF)

TABLE 1.1b
Saturated Hydrocarbons (Alkanes/Isoprenoids Compounds) and Total Extractable Hydrocarbons

Abbr.	Analyte
nC9	n-Nonane
nC10	n-Decane
nC11	n-Undecane
nC12	n-Dodecane
nC13	n-Tridecane
1380	2,6,10 Trimethyldodecane
nC14	n-Tetradecane
1470	2,6,10 Trimethyltridecane
nC15	n-Pentadecane
nC16	n-Hexadecane
nPr	Norpristane
nC17	n-Heptadecane
Pr	Pristane
nC18	n-Octadecane
Ph	Phytane
nC19	n-Nonadecane
nC20	n-Eicosane
nC21	n-Heneicosane
nC22	n-Docosane

Abbr.	Analyte
nC23	n-Tricosane
nC24	n-Tetracosane
nC25	n-Pentacosane
nC26	n-Hexacosane
nC27	n-Heptacosane
nC28	n-Octacosane
nC29	n-Nonacosane
nC30	n-Triacontane
nC31	n-Hentriacontane
nC32	n-Dotriacontane
nC33	n-Tritriacontane
nC34	n-Tetratriacontane
nC35	n-Pentatriacontane
nC36	n-Hexatriacontane
nC37	n-Heptatriacontane
nC38	n-Octatriacontane
nC39	n-Nonatriacontane
nC40	n-Tetracontane

TEH	$\Sigma(C_9\text{-}C_{44})$ Integration of the FID signal over the entire hydrocarbon range from n-C9 to n-C44 after silica gel cleanup.
TEM	$\Sigma(C_9\text{-}C_{44})$ Integration of the FID signal over the entire hydrocarbon range from n-C9 to n-C44 no silica gel cleanup.

	Target Method Detection Limit
Sediment (Alkanes) =	0.01 µg/g dry weight
Sediment (TEH) =	1 µg/g dry weight
Water (Alkanes) =	0.8 µg/L
	Target Reporting Limit
Oil (Alkanes) =	200 mg/kg
Oil (TEH) =	200 mg/kg
Water (TEH/TEM) =	200 µg/L

TEH = Total Extractable Hydrocarbons with silica gel "clean-up"
TEM = Total Extractable Matter with no extract "clean-up"

TABLE 1.1c
Standard Volatile Organic Compounds

Analyte
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene
4-Isopropyltoluene
Benzene
Ethylbenzene
Isopropylbenzene
m,p-Xylenes
Naphthalene[9]
n-Butylbenzene
n-Propylbenzene
o-Xylene
sec-Butylbenzene
Styrene
tert-Butylbenzene
Toluene

	Target Method Detection Limit Range
Sediment/Soil =	0.1 – 1 ng/g
Water =	0.05 – 0.5 µg/L
	Target Reporting Limit
Oil =	2 mg/kg

[9] Naphthalene is also included on the **Table 1.1a** target analyte list of PAH compounds. The PAH analysis is the preferred method, rather than this volatile method. Thus, if a sample location is analyzed for both PAH and VOC the result from the PAH analysis will be noted in the database as the preferred result.

TABLE 1.1d
C5-C13 Volatile Compounds for PIANO Forensic Assessment

Abbrev.	Analyte
IP	Isopentane
1P	1-Pentene
2M1B	2-Methyl-1-butene
C5	Pentane
T2P	2-Pentene (trans)
C2P	2-Pentene (cis)
TBA	Tertiary butanol
CYP	Cyclopentane
23DMB	2,3-Dimethylbutane
2MP	2-Methylpentane
MTBE	MTBE
3MP	3-Methylpentane
1HEX	1-Hexene
C6	Hexane
DIPE	Diisopropyl Ether (DIPE)
ETBE	Ethyl Tertiary Butyl Ether (ETBE)
22DMP	2,2-Dimethylpentane
MCYP	Methylcyclopentane
24DMP	2,4-Dimethylpentane
12DCA	1,2-Dichloroethane
CH	Cyclohexane
2MH	2-Methylhexane
B	Benzene
23DMP	2,3-Dimethylpentane
THIO	Thiophene
3MH	3-Methylhexane
TAME	TAME
1H	1-Heptene/1,2-DMCP (trans)
ISO	Isooctane
C7	Heptane

Abbrev.	Analyte
MCYH	Methylcyclohexane
25DMH	2,5-Dimethylhexane
24DMH	2,4-Dimethylhexane
223TMP	2,2,3-Trimethylpentane
234TMP	2,3,4-Trimethylpentane
233TMP	2,3,3-Trimethylpentane
23DMH	2,3-Dimethylhexane
3EH	3-Ethylhexane
2MHEP	2-Methylheptane
3MHEP	3-Methylheptane
T	Toluene
2MTHIO	2-Methylthiophene
3MTHIO	3-Methylthiophene
1O	1-Octene
C8	Octane
12DBE	1,2-Dibromoethane
EB	Ethylbenzene
2ETHIO	2-Ethylthiophene
MPX	p/m-Xylene
1N	1-Nonene
C9	Nonane[10]
STY	Styrene
OX	o-Xylene
IPB	Isopropylbenzene
PROPB	n-Propylbenzene
1M3EB	1-Methyl-3-ethylbenzene
1M4EB	1-Methyl-4-ethylbenzene
135TMB	1,3,5-Trimethylbenzene
1D	1-Decene
1M2EB	1-Methyl-3-isopropylbenzene

Abbrev.	Analyte
C10	Decane[10]
124TMB	1,2,4-Trimethylbenzene
SECBUT	sec-Butylbenzene
1M3IPB	1-Methyl-3-isopropylbenzene
1M4IPB	1-Methyl-4-isopropylbenzene
1M2IPB	1-Methyl-2-isopropylbenzene
IN	Indan
1M3PB	1-Methyl-3-propylbenzene
1M4PB	1-Methyl-4-propylbenzene
BUTB	n-Butylbenzene
12DM4EB	1,2-Dimethyl-4-ethylbenzene
12DEB	1,2-Diethylbenzene
1M2PB	1-Methyl-2-propylbenzene
14DM2EB	1,4-Dimethyl-2-ethylbenzene
C11	Undecane[10]
13DM4EB	1,3-Dimethyl-4-ethylbenzene
13DM5EB	1,3-Dimethyl-5-ethylbenzene
13DM2EB	1,3-Dimethyl-2-ethylbenzene
12DM3EB	1,2-Dimethyl-3-ethylbenzene
1245TMP	1,2,4,5-Tetramethylbenzene
PENTB	Pentylbenzene
C12	Dodecane[10]
N0	Naphthalene[11]
BT0	Benzothiophene[11]
MMT	MMT
C13	Tridecane[10]
2MN	2-Methylnaphthalene[11]
1MN	1-Methylnaphthalene[11]

Target Detection Limit

Sediment/Soil = 0.1 – 10 ng/g

Water = 0.2 - 2.0 µg/L

Target Reporting Limit

Oil = 2 mg/kg

[10] These compounds are also included on the **Table 1.1b** target analyte list of saturate hydrocarbons. Because of the extraction technique, the GC-FID method for hydrocarbons is the preferred method, rather than this volatile method. Thus, if a sample location is analyzed for both saturate hydrocarbons by GC-FID and VOC the result from the GC-FID analysis will be noted in the database as the preferred result.

[11] These compounds are also included on the **Table 1.1a** target analyte list of PAH compounds. Because of the extraction technique, the PAH analysis is the preferred method, rather than this volatile method. Thus, if a sample location is analyzed for both PAH and VOC the result from the PAH analysis will be noted in the database as the preferred result.

TABLE 1.1e
Petroleum Biomarkers for Quantitative Analysis

Compound *	Quant Ion m/z
C23 Tricyclic Terpane (T4)	191
C24 Tricyclic Terpane (T5)	191
C25 Tricyclic Terpane (T6)	191
C24 Tetracyclic Terpane (T6a)	191
C26 Tricyclic Terpane-22S (T6b)	191
C26 Tricyclic Terpane-22R (T6c)	191
C28 Tricyclic Terpane-22S (T7)	191
C28 Tricyclic Terpane-22R (T8)	191
C29 Tricyclic Terpane-22S (T9)	191
C29 Tricyclic Terpane-22R (T10)	191
18a-22,29,30-Trisnorneohopane-Ts (T11)	191
C30 Tricyclic Terpane-22S (T11a)	191
C30 Tricyclic Terpane-22R (T11b)	191
17a(H)-22,29,30-Trisnorhopane-Tm (T12)	191
17a/b,21b/a 28,30-Bisnorhopane (T14a)	191
17a(H),21b(H)-25-Norhopane (T14b)	191
30-Norhopane (T15)	191
18a(H)-30-Norneohopane-C29Ts (T16)	191
17a(H)-Diahopane (X)	191
30-Normoretane (T17)	191
18a(H)&18b(H)-Oleananes (T18)	191
Hopane (T19)	191
Moretane (T20)	191
30-Homohopane-22S (T21)	191
30-Homohopane-22R (T22)	191
T22a-Gammacerane/C32-diahopane	191
30,31-Bishomohopane-22S (T26)	191
30,31-Bishomohopane-22R (T27)	191
30,31-Trishomohopane-22S (T30)	191

Compound	Quant ion m/z
30,31-Trishomohopane-22R (T31)	191
Tetrakishomohopane-22S (T32)	191
Tetrakishomohopane-22R (T33)e	191
Pentakishomohopane-22S (T34)	191
Pentakishomohopane-22R (T35)	191
13b(H),17a(H)-20S-Diacholestane (S4)	217
13b(H),17a(H)-20R-Diacholestane (S5)	217
13b,17a-20S-Methyldiacholestane (S8)	217
14a(H),17a(H)-20S-Cholestane (S12)	217
14a(H),17a(H)-20R-Cholestane (S17)	217
13b,17a-20R-Ethyldiacholestane (S18)	217
13a,17b-20S-Ethyldiacholestane (S19)	217
14a,17a-20S-Methylcholestane (S20)	217
14a,17a-20R-Methylcholestane (S24)	217
14a(H),17a(H)-20S-Ethylcholestane (S25)	217
14a(H),17a(H)-20R-Ethylcholestane (S28)	217
14b(H),17b(H)-20R-Cholestane (S14)	217
14b(H),17b(H)-20S-Cholestane (S15)	217
14b,17b-20R-Methylcholestane (S22)	217
14b,17b-20S-Methylcholestane (S23)	217
14b(H),17b(H)-20R-Ethylcholestane (S26)	217
14b(H),17b(H)-20S-Ethylcholestane (S27)	217
C26,20R- +C27,20S- triaromatic steroid	231
C28,20S-triaromatic steroid	231
C27,20R-triaromatic steroid	231
C28,20R-triaromatic steroid	231

* Peak identification provided in parentheses.

Target Reporting Limit

Sediments/Soil = 2 ug/Kg dry weight
Waters = 10 ng/L

Target Reporting Limit

Oil = 2 mg/Kg

TABLE 1.1f
Suggested Hydrocarbon Groups and Petroleum Biomarkers for Qualitative Analysis

n-Alkycyclohexanes (m/z 83)
n-Alkanes (m/z 85)
Diamondoids (m/z 135, 187)
Sesquiterpanes (m/z 109, 123)
Isoprenoids (m/z 183)
Triterpanes (m/z 191)
Regular Steranes (m/z 217)
Rearranged β,β-steranes (m/z 218)
Methyl steranes (m/z 232, 245)
Methyl and triaromatic steroids (m/z 231)
Monoaromatic steroids (m/z 253)
Diasteranes (m/z 259)

TABLE 1.1g
Corexit Indicator Compounds for Qualitative Analysis in Water Only
(monitoring mass/charge ion)

2-Butoxyethanol (m/z 87, 75)
Glycol ether Isomers (m/z 59, 103)
Bis-(2-ethylhexyl) fumarate (m/z 112, 211)

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 Assessment Manager

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The Assessment Manager is the designated natural resource trustee representative who is responsible for the review and acceptance of specific work plans and associated QA plans.

2.2 Project Coordinator

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The Project Coordinator is responsible for administration of the contracts with the laboratory(ies). The Project Coordinator will oversee the proper scheduling and transmittal of the data from the time of sampling to data reporting.

2.3 Quality Assurance

Ann Bailey is the QA Coordinator reporting directly to the Assessment Manager. Ms. Bailey is responsible for the implementation of this Analytical QA Plan. She will receive assistance in the coordination and performance of laboratory technical audits and independent data validation from the QA Contractor (EcoChem). The QA Coordinator has the authority and responsibility to cease or temporarily halt activities not in keeping with this QA Plan. The QA Coordinator will work closely with laboratory representatives and the project team to assure that project and data quality objectives are met. The QA Coordinator may be reached at:

Ann Bailey
EcoChem, Inc.
710 Second Avenue Suite 660
Seattle, WA 98104
(206)233-9332 x106 FAX (206)233-0114
abailey@ecochem.net

Cheryl Randle is a QA Reviewer conducting data validation on behalf of BP America. Ms. Randle is responsible for working closely with the Assessment Manager's QA Coordinator to assure the validity of the final data in accordance with this Analytical QA Plan. The QA Reviewer will conduct spot

validation of up to 25 percent of the reported data, unless substantial problems are discovered in which case up to 100 percent validation may be performed. The QA Reviewer may be reached at:

Cheryl Randle
ENTRIX, Inc.
1000 Hart Road, Suite 130
Barrington, IL 60010
(847)277-2865 FAX (847)381-6679
crandle@entrix.com

2.4 Analytical Laboratories

The laboratories planned to be contracted at this time for analytical work in support of the NRDA are TDI-Brooks B&B Laboratories (B&B), Newfields/Alpha Analytical (Alpha), and Columbia Analytical Services (CAS). The laboratory project managers are responsible for assuring that all analyses performed meet project and measurement quality objectives. The Laboratory Project Managers are:

Juan Ramirez
TDI-Brooks B&B Laboratories
1902 Pinon
College Station, TX 77845-5816
(979)693-3446 FAX: (979)693-6389
juanramirez@TDI-BI.com

Liz Porta
Alpha Analytical
320 Forbes Boulevard
Mansfield, MA 02048
508-844-4114:
eporta@alphalab.com

Greg Salata, PhD.
Columbia Analytical Services (CAS)
1317 S. 13th Ave.
Kelso, WA 98626
(360)577-7222
gsalata@caslab.com

As additional analytical laboratories are brought under contract this QAP will be updated to include their names and project managers.

3.0 SAMPLE HANDLING AND CHAIN OF CUSTODY PROCEDURES

Chain of custody procedures will be used for all samples throughout the analytical process and for all data and data documentation, whether in hard copy or electronic format. Sampling procedures, including sample collection and documentation, are part of the work plans of the individual projects and as such, are not considered here.

3.1 Sample Preservation and Holding Times

Sample preservation and field treatment of samples for analyses should be described in relevant field work plans. Based on EPA guidance, "advisory" sample holding times prior to analysis and holding times for the extracts are presented below. These holding times may be extended or preservation guidance changed, as options are assessed.

Matrix	Storage for Samples	Holding Time to Extraction	Holding Time to Analysis
Water for PAH, SHC/TEH, Biomarkers	Refrigeration 4°C ±2°; Optional: Preserved with 1:1 HCl to pH<2	7 days if not acid preserved; 14 days if acid preserved	40 days from extraction[12]; except biomarkers no holding time
Water for VOC	Refrigeration 4°C ±2° with no headspace; Optional: Preserved with HCl in the field in VOA vial.	Not applicable	7 days if not acid preserved; 14 days if acid preserved
Sediment for VOC	Refrigeration 4°C ±2°	Not applicable	14 days
Filters for PAH, SHC/TEH, Biomarkers	Frozen	1 Year	40 days from extraction[12]; except biomarkers no holding time
Sediment/Soil for PAH, SHC/TEH, Biomarkers, total solids, grain size and TOC	Frozen, except Grain Size should not be frozen – store at at 4°C ±2°	1 Year, except not applicable for Grain Size, Total Solids, and TOC	40 days from extraction[12]; except biomarkers grain size and TOC no holding time.
Tissue for PAH, SHC/TEH, Biomarkers, and Total Extractable Organics (TEO, aka Lipids)	Frozen	1 Year	40 days from extraction[12]; except biomarkers and TEO no holding time.
Vegetation for PAH, SHC/TEH, Biomarkers	Frozen	1 Year	40 days from extraction[12]; except biomarkers no holding time
Inert Sorbent Material for PAH, SHC/TEH, Biomarkers	Frozen	1 Year	40 days from extraction[12]; except biomarkers no holding time
Oil/Oily Debris for PAH, SHC/TEH, Biomarkers, VOC	Refrigeration <6°C	No holding time	40 days from extraction[12]; except biomarkers no holding time
Water for DOSS	Frozen, 15mL plastic centrifuge tubes	Not established	Not established

[12] 40 days is an advisory extraction holding time. Extracts should be held at -20C in the dark, and may be analyzed past 40 days and results not qualified if surrogates are within criteria.

3.2 Chain of Custody

Chain of custody records will be completed in ink.

A sample is considered in "custody" if:

- it is in the custodian's actual possession or view, or
- it is retained in a secured place (under lock) with restricted access, or
- it is placed in a container and secured with an official seal(s) such that the sample cannot be reached without breaking the seal(s).

Samples are kept in the custody of designated sampling and/or field personnel until shipment.

3.4 Sample Shipping

Any transfer or movement of samples will use chain of custody procedures. The original signed and dated chain of custody record accompanies the sample(s); a copy is retained by the sample shipper. All shipments will comply with DOT regulations (*49CFR, Parts 172 and 173*).

3.5 Sample Receipt

Immediately upon receipt of samples, the recipient will review the shipment for consistency with the accompanying chain of custody record and sample condition, before signing and dating the chain of custody record. Sample condition(s) will be noted on the laboratory's sample receipt form and maintained with the chain of custody records. If there are any discrepancies between the chain of custody record and the sample shipment, the recipient will contact the sample shipper immediately in an attempt to reconcile these differences. Reconciliation of sample receipt differences will be maintained with the chain of custody records and discussed in the laboratory narrative which accompanies the data report.

3.6 Intra-Laboratory Sample Transfer

The laboratory sample custodian or designee will maintain a laboratory sample-tracking record, similar to the chain of custody record that will follow each sample through all stages of laboratory processing. The sample-tracking record will show the name or initials of responsible individuals, date of sample extraction or preparation, and sample analysis.

3.7 Inter-Laboratory Sample Transfer

Transfer of samples from one analytical laboratory to another, e.g. for grain size or TOC analysis, will follow chain of custody, sample shipping and receipt procedures described above. Transfer of samples between laboratories will be noted in the laboratory case narrative which accompanies the data report.

3.8 Sample Archival

All unanalyzed samples and unutilized sample aliquots or extracts will be held by the laboratory in a manner to preserve sample integrity at a secure location with chain of custody procedures for one (1) year after the QA Contractor has validated the data package for that particular set of samples. All archived materials will be accessible for review upon request. At the end of the archival period, the laboratory shall contact the QA Coordinator to obtain directions for handling remaining samples. The samples will not be disposed of by the laboratory unless provided with written approval from the Assessment Manager.

3.9 Data and Data Documentation

The laboratories will provide the QA Contractor with hardcopy data tables, QC documentation and instrument printouts suitable for QA assessment/data validation. Required laboratory deliverables are listed in **Table 7.1**. Data packages will include all related instrument print-outs ("raw data") and bench sheets. A copy of the data and data documentation developed by the laboratory for a given data package will be kept by the laboratory in a secure location using chain of custody procedures for five (5) years after the QA Contractor has validated that data package. All archived data and documentation will be accessible for review upon request. These materials will become the responsibility of the Assessment Manager upon termination of the archival period.

The original data will be transferred from the laboratory to the QA Contractor by means such that a signature is required at the time of document delivery. The QA Contractor will document receipt of packages and maintain a record of the method and date of data submittal with the complete data package. The QA Contractor will maintain the copy of the data packages and related validation documentation in a secure location for a period of one (1) year from the date of validation. These materials will become the responsibility of the Assessment Manager upon termination of the archival period.

4.0 LABORATORY OPERATIONS

All laboratories providing analytical support for the MC252 Damage Assessment must have the appropriate facilities to store and prepare samples, and appropriate instrumentation and staff to provide data of the required quality within the time period dictated. Laboratories are expected to conduct operations using good laboratory practices, including:

- Training and appropriate certification of personnel.
- A program of scheduled maintenance of analytical balances, laboratory equipment and instrumentation.
- Routine checking of analytical balances using a set of standard reference weights (ASTM class, NIST Class S-1, or equivalents).
- Recording all analytical data in secure electronic system with date and associated analyst identification, and/or logbooks with each entry signed and dated by the analyst.
- Monitoring and documenting the temperatures of cold storage areas and freezer units.

Laboratory operations may be evaluated by the QA Coordinator through technical systems audits, performance evaluation studies, and performance in a NIST-managed intercomparison program. Personnel in any laboratory performing analyses for this damage assessment should be well versed in good laboratory practices, including standard safety procedures. It is the responsibility of the laboratory manager and /or supervisor to ensure that safety training is mandatory for all laboratory personnel. The laboratory is responsible for maintaining a current safety manual in compliance with the Occupational Safety and Health Administration (OSHA) or equivalent state or local regulations. Proper procedures for safe storage, handling and disposal of chemicals should be followed at all times; each chemical should be treated as a potential health hazard and good laboratory practices should be implemented accordingly.

4.1 Quality Assurance Documentation

All laboratories must have the latest revision of the MC 252 NRDA Analytical QA Plan. In addition, the following documents and information must be current and available to all laboratory personnel participating in the processing of MC 252 samples:

- Laboratory Quality Assurance Management Plan
- Laboratory Standard Operating Procedures (SOPs) – Detailed instructions for performing routine laboratory procedures.
- Control charts or data tables – These must be developed and maintained throughout the project for appropriate analyses and measurements, including:
    - Alkyl PAH pattern book for MC252 reference oil.

4.2 Laboratory Systems Audits

Prior to or during sample analysis, QA systems audits will be performed. The laboratory audits will be conducted by the QA Coordinator or designee. The checklists used for the laboratory audits are based on requirements outlined in "Good Laboratory Practice Standards" (*40 CFR Part 792*) and audit procedures of the EPA National Enforcement Investigations Center, "NEIC Procedures Manual for the Contract Evidence Audit and Litigation Support for EPA Enforcement Case Development" (*EPA 330/9-89-002*). The Laboratory Project Managers will be informed of the findings and recommendations of the audit before the auditors leave the facility. A written report discussing the audits will be submitted to the Assessment Manager.

Additional laboratory audits may be performed at any time throughout the duration of the NRDA.

4.3 Participation in Intercomparison Exercises

Each analytical laboratory performing analysis will be required to participate in potential intercomparison exercises that may be organized by NS&T and/ or NIST during the duration of the laboratory's participation in this NRDA analytical program. A variety of samples including sample extracts and representative matrices (e.g., sediment or tissue samples) may be utilized in these exercises. Laboratories are required to analyze only those matrices or analytes that they are providing in like manner for the NRDA analytical program. When participating in the intercomparison exercise, the

laboratory should analyze the sample(s) in the same manner as routinely performed for this NRDA and as specified in this Analytical QA Plan. Laboratories which fail to achieve acceptable performance will be required to provide an explanation to the QA Coordinator and/or undertake appropriate corrective actions.

5.0 ASSESSMENT OF DATA QUALITY

The purpose of this Analytical QA Plan is to develop and document analytical data of known, acceptable, and defensible quality. The quality of the data is presented as a set of statements that describe in precise quantitative terms the level of uncertainty that can be associated with the data without compromising their intended use. These statements are referred to as Data Quality Objectives (DQOs) and are usually expressed in terms of precision, bias, sensitivity, completeness, and comparability.

5.1 Precision

Precision is the degree of mutual agreement among individual measurements of the same property under prescribed similar conditions, such as replicate measurements of the same sample. Precision is concerned with the "closeness" of the results. Where suitable reference materials (RMs) are available, precision will be expressed as the relative standard deviation (RSD) for the repeated measurements. This use of RMs allows for the long-term measurement of precision but does not include homogenization as a source of analytical variability.

In addition to the tracking precision of replicate RM analyses, precision will be expressed as the relative percent difference (RPD) between a pair of replicate data from environmental samples prepared and analyzed in duplicate.

5.2 Bias

Bias is the degree of agreement of a measurement with an accepted reference value and may be expressed as the difference between the two measured values or as a percentage of the reference value.

The primary evaluation of bias will be through the use of RMs. RMs with certified values (from NIST or a similar source) will be used if they are available. The laboratory will maintain control charts to track the RM performance. Spiked matrix samples will also be analyzed to assess bias for those analytes that are not available in suitable reference materials.

5.3 Comparability

Comparability expresses the confidence with which one data set can be evaluated in relationship to another data set. Comparability of the chemical analytical data is established through the use of:

- Program-defined general analytical methodology (e.g., low resolution MS), detection limits, bias and precision requirements and reporting formats;

- NIST-traceable calibration materials;
- Reference material with each sample batch;
- Analysis of a common "reference oil".

5.4 Completeness

Completeness is a measure of the proportion of data specified in the sampling plan which is determined to be valid. Completeness will be assessed by comparing the number of valid sample results to the total number of potential results planned to be generated. The DQO for completeness is 95%, i.e. no more than 5% of the analytical data missing or qualified as unreliable (rejected).

6.0 QUALITY CONTROL PROCEDURES

No particular analytical methods are specified for this project, but the QA/QC requirements will provide a common foundation for each laboratory's protocols. This "common foundation" includes: (1) the specification of the analytes to be identified and quantified and the minimum sensitivity of the analytical methods and (2) the use of NIST reference materials, and (3) the use of a common MC252 Reference Oil.

Prior to the analysis of samples, each laboratory must provide written protocols for the analytical methods to be used; calculate detection limits for each analyte in each matrix of interest and establish an initial calibration curve in the appropriate concentration range for each analyte. The laboratory must demonstrate its continued proficiency by participation in refereed intercomparison exercises (as available) and repeated analyses of reference materials, calibration checks, and laboratory method blanks. Laboratories will be expected to take corrective actions promptly if measurement quality objectives described in this plan are not met.

A laboratory may be audited at any time to determine and document that they have the capability to analyze the samples and can perform the analyses in compliance with the QA plan. Independent data validation will be undertaken promptly after analyses of each sample batch to verify that measurement quality objectives are met. The data validator will discuss any unacceptable findings with the laboratory as soon as possible, and assist the laboratory in developing a satisfactory solution to the problem.

6.1 Standard Operating Procedures for Analytical Methods

Prior to the analysis of field samples, each laboratory is required to submit to the QA Coordinator for review and approval, written Standard Operating Procedures (SOPs) detailing the procedures used in sample receipt and handling, sample preparation and analysis, data reduction and reporting. Once approved, the SOPs for each analytical method and from each analytical laboratory will be archived with this plan as part of the QA documentation.

6.2 Determination of Method Detection Limit, Quantitation Range, and Reporting Limits

The analytical laboratory will establish and report a method detection limit (MDL) for each analyte of interest in each matrix, with the exception of oil for which MDLs cannot be accurately determined. The target detection ranges or limits are specified in **Tables 1.1a – 1.1e**. The actual MDLs will be established by following the method in *40CFR part 136*. Results that are less than 5X the MDL or less than the lowest calibration standard will not be required to meet the measurement quality objectives (MQOs) for precision and bias, because these results may be outside the "quantitation range". Thus, these results may be flagged by the laboratory with a J, to indicate the results are possibly an estimate and have not been required to meet the MQOs. If the analyte is not detected in a sample, the result will be reported as non-detected at the MDL and flagged with a "U".

Reporting limits for the supporting analyses (percent moisture, percent total extractable organics [TEO], total organic carbon, and grain size) will be 0.01%. The reporting limit will be demonstrated by the laboratory to be greater than 5X the detection limit.

Target detection limits, as shown at the bottom of **Tables 1.1a through 1.1e**, may not be met due to required dilutions, interferences, and/or limited sample size. If a laboratory MDL does not meet the target detection limit, the reason for the elevated detection limits should be discussed in the laboratory case narrative.

6.3 Quality Control Criteria

MQOs and required minimum frequency of analysis for each QC element or sample type are summarized in **Tables 6.1a – 6.1g**. The analytical laboratory will determine when MQOs have not been met, and perform appropriate corrective actions before continuing the analyses or reporting of the data. If the "Corrective Action" in the Method Performance Criteria table states "Resolve before proceeding", the laboratory must perform an adjustment to the analytical process and subsequently demonstrate the criteria will be met before proceeding with analysis for project samples. In addition, if results associated with a non-compliant QC element have been obtained, the laboratory must repeat those analyses until acceptable QC results are obtained. If the laboratory determines the non-compliance does not affect the quality of the data, the laboratory will discuss the non-compliance and the rationale, used to conclude the data are not affected, in the case narrative which accompanies the data report. If the laboratory determines the non-compliance is due to interferences or circumstances outside the laboratory's control, the laboratory will discuss the reason for the non-compliance in the case narrative and the results reported.

At this time, no criteria for evaluating the target analyte concentrations in the MC252 Reference Oil have been established. Chromatographic resolution criteria for specific compound (peaks) are specified in **Tables 6.1a through 6.1e** and **Table 6.1g** below. When additional criteria are developed they will be added to this Analytical QAP.

TABLE 6.1a
Method Performance Criteria for Extended PAH (Parent and Alkyl Homologs) and Related Compounds

Element or Sample Type	Minimum Frequency	Measurement Quality Objective/ Acceptance Criteria	Corrective Action
Tuning	Prior to every sequence	Tune as specified in laboratory SOP	Resolve before proceeding.
Initial Calibration (All parent PAH and selected alkyl homologue PAH)	Prior to every sequence, or as needed based on continuing calibration/verification check.	5-point calibration curve over two orders of magnitude %RSD ≤ 20	Resolve before proceeding.
Continuing Calibration (CCAL)	Every 12 hours or every 12 field samples	%D ≤ 25 for 90% of analytes %D ≤ 35 for 10% of analytes	Perform instrument maintenance. Re-analyze affected samples.
Initial Calibration Verification (Second Source or can be met if CCAL is second source)	Per initial calibration	%R target analytes 80-120%	Resolve before proceeding.
Matrix SRM 1941b for sediment; SRM 1974b for tissue	One per batch/every 20 field samples	Within ±20% of NIST 95% uncertainty range for analytes within the quantitation range. 2 analytes may be greater than 20% outside, however average %D must be <35%	Resolve before proceeding.
Oil SRM 1582 (Oil and Water only)	One per batch of oil/every 20 field samples	Within ±20% of NIST 95% uncertainty range for analytes within the quantitation range. 2 analytes may be greater than 20% outside, however average %D must be <35%	Resolve before proceeding.
MC 252 Reference Oil	One per batch/every 20 field samples	Peak resolution >80% of 9-methylphenanthrene from 1-methylphenanthrene (m/z 192). Plus additional criteria to be developed.	Resolve before proceeding.
Matrix Spike/Matrix Spike Duplicate (Sediments, Soils, Tissues only)	One per batch/every 20 field samples	%R 50% - 125% for target analytes detected at >5X the spiked amount; RPD ≤30%, except biphenyl (40%-140%) and decalin (25%-125%)	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Blank Spike/Blank Spike Duplicate (Aqueous Samples)	One per batch/every 20 field samples	%R 50% - 125% for target analytes, RPD ≤30%, except biphenyl (40%-140%) and decalin (25%-125%)	Resolve before proceeding.
Procedural Blank	One per batch/every 20 field samples	No more than 2 analytes to exceed 5x target MDL unless analyte not detected in associated samples(s) or analyte concentration >10x blank value	Resolve before proceeding. QA coordinator may be contacted to resolve issues surrounding 'minor exceedance'.
Sample Duplicate (not required for water matrix)	One per batch/every 20 field samples	RPD ≤ 30% if analyte concentration is greater than QL	Evaluate impact to data, discuss with manager, and determine if corrective action is needed.
Mass Discrimination	Initial calibration and CCVs (mid-level)	Ratio for the concentration of Benzo[g,h,i]perylene to phenanthrene ≥0.70	Resolve before proceeding.
Internal Standard (IS)	Every sample	50% - 200% of the area of the IS in the associated calibration standard	Resolve before proceeding.
Surrogates	Every sample	%R 40-120% except d12-perylene which is 10-120%	Re-extract affected samples. Evaluate impact to data, discuss with manager, if corrective action is needed.

TABLE 6.1b
Method Performance Criteria for Alkanes/Isoprenoids Compounds and Total Extractable Hydrocarbons

Element or Sample Type	Minimum Frequency	Measurement Quality Objective/ Acceptance Criteria	Corrective Action
Initial Calibration (Standard solution - all target analytes, except phytane, and C_{31}, C_{33}, C_{35}, and C_{39} n-alkanes)	Prior to every sequence, or as needed based on continuing calibration/verification check.	5-point calibration curve %RSD ≤ 20	Resolve before proceeding.
Continuing Calibration (CCAL)	Every 12 hours or every 12 field samples	%D ≤ 15 for 90% of analytes %D ≤ 20 for 10% of analytes	Perform Instrument Maintenance. Re-analyze affected samples.
Initial Calibration Verification (Second Source or can be met if CCAL is second source)	Per initial calibration	%R target analytes 80-120%	Resolve before proceeding.
SRMs - no SRMs for SHC or TPH are available at this time			
MC 252 Reference Oil	One per batch/every 20 field samples	Peak resolution >80% of n-C17 from pristane; Add'l criteria to be developed.	Resolve before proceeding.
Matrix Spike/Matrix Spike Duplicate (Sediments, Soils, Tissues only)	One per batch/every 20 field samples	%R 50% - 125% for target analytes detected at >5X the spiked amount; RPD ≤30%.	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Blank Spike/Blank Spike Duplicate (Aqueous Samples)	One per batch/every 20 field samples	%R 50% - 125% for target analytes, RPD ≤30%.	Resolve before proceeding.
Procedural Blank	One per batch/every 20 field samples	No more than 2 analytes to exceed 5x target MDL unless analyte not detected in associated samples(s) or analyte concentration >10x blank value	Resolve before proceeding. QA coordinator may be contacted to resolve issues surrounding 'minor exceedances'.
Duplicate Sample Analysis (not required for water matrix)	One per batch/every 20 field samples	RPD ≤ 30% if analyte concentration is greater than QL	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Mass Discrimination	Initial calibration and CCVs (mid-level)	Ratio for the raw areas of n-C36 / n-C20 ≥0.70	Resolve before proceeding.
Surrogates	Every sample	%R 40-125%	Re-extract affected samples. Evaluate impact to data, discuss with manager, determine if corrective action is needed.

TABLE 6.1c
Method Performance Criteria for VOCs

Element or Sample Type	Minimum Frequency	Measurement Quality Objective/ Acceptance Criteria	Corrective Action
Tuning	Prior to every sequence	Per SW846 8260B	Resolve before proceeding
Initial Calibration (ICAL)	Prior to every sequence, or as needed based on continuing calibration/verification check.	Minimum of 5 concentration levels %RSD ≤ 25% for 90% of analytes %RSD ≤ 35% for all analytes >C6	Resolve before proceeding.
Continuing Calibration (CCAL)	Every 12 hours or every 12 field samples	%D ≤ 25% for 90% of analytes %D ≤ 35% for all analytes >C6 Except t-butanol <50%	Perform Instrument Maintenance. Re-analyze affected samples.
Initial Calibration Verification (Second Source or can be met if CCAL is second source)	Per initial calibration	%R target analytes 80-120%. Except 2 analytes can be at 60 - 140%	Resolve before proceeding.
SRMs – No SRMs are available at this time			
MC 252 Reference Oil	One per batch/every 20 field samples	To Be Determined	Resolve before proceeding.
Matrix Spike/Matrix Spike Duplicate (Sediments, Soils)	One per batch/every 20 field samples	%R 50% - 130% for target analytes detected at >5X the spiked amount; RPD ≤30%.	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Blank Spike/Blank Spike Duplicate (Aqueous Samples)	One per batch/every 20 field samples	%R 50% - 130% for target analytes, RPD ≤30%.	Resolve before proceeding.
Procedural Blank	One per batch/every 20 field samples	No more than 2 analytes to exceed 5x target MDL unless analyte not detected in associated samples(s) or analyte concentration >10x blank value	Resolve before proceeding. QA coordinator may be contacted to resolve issues surrounding 'minor exceedances'.
Sample Duplicate	One per batch/every 20 field samples	RPD ≤ 30% if analyte concentration is greater than QL	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Internal Standard (IS)	Every sample	50% - 200% of the area of the IS in the associated calibration standard	Resolve before proceeding.
Surrogates	Every sample	%R 70-130%	Re-extract or re-analyze affected samples. Evaluate impact to data, discuss with manager, determine if corrective action is needed.

TABLE 6.1d
Method Performance Criteria for Quantitative Biomarkers

Element or Sample Type	Minimum Frequency	Measurement Quality Objective/ Acceptance Criteria	Corrective Action
Tuning	Prior to every sequence	Tune as specified in laboratory SOP	Resolve before proceeding.
Initial Calibration	Prior to every sequence, or as needed based on continuing calibration/verification check.	5-point calibration curve over two orders of magnitude %RSD ≤ 20	Resolve before proceeding.
Continuing Calibration (CCAL)	Every 12 hours or every 12 field samples	%D ≤ 25 for 90% of analytes %D ≤ 35 for 10% of analytes	Perform instrument maintenance. Re-analyze affected samples.
Oil SRM 1582 (Oil and Water only)	One per batch of oil/every 20 field samples	Biomarker concentrations are not certified; Peak resolution (*m/z* 191) of: (a) oleanane (T18) from hopane (T19); (b) C26 Tricyclic Terpane stereoisomers 22R (T6b) from 22S (T6c) and from C24 Tetracyclic Terpane (T6a)	Resolve before proceeding.
MC 252 Reference Oil	One per batch/every 20 field samples	Peak resolution (*m/z* 191): 30-Norhopane (T15) from 30-Norneohopane (T16) from Diahopane (X). Add'l. criteria To Be Determined.	Resolve before proceeding.
Method Blank	One per batch/every 20 field samples	No more than 2 analytes to exceed 5x target MDL unless analyte not detected in associated samples(s) or analyte concentration >10x blank value	Resolve before proceeding. QA coordinator may be contacted to resolve issues surrounding 'minor exceedance'.
Sample Duplicate	One per batch/every 20 field samples	RPD ≤ 30% if analyte concentration is greater than QL	Evaluate impact to data, discuss with manager, and determine if corrective action is needed.
Internal Standard (IS)	Every sample	50% - 200% of the area of the IS in the associated calibration standard	Resolve before proceeding.
Surrogate	Every sample	%R 50-130%	Evaluate impact to data, discuss with manager, if corrective action is needed.

TABLE 6.1e
Method Performance Criteria for Qualitative Biomarkers

Element or Sample Type	Minimum Frequency	Measurement Quaiity Objective/ Acceptance Criteria	Corrective Action
Oil SRM 1582 (Oil and Water only)	One per batch of oil/every 20 field samples	Peak resolution (m/z 191) of: (a) oleanane (T18) from hopane (T19); (b) C26 Tricyclic Terpane stereoisomers 22R (T6b) from 22S (T6c) and from C24 Tetracyclic Terpane (T6a)	Resolve before proceeding.
MC 252 Reference Oil	One per batch/every 20 field samples	Peak resolution (*m/z* 191): 30-Norhopane (T15) from 30-Norneohopane (T16) from Diahopane (X). Add'l. criteria To Be Determined.	Resolve before proceeding.
Method Blank	One per batch/every 20 field samples	No interference with biomarker patterns	Resolve before proceeding. QA coordinator may be contacted to resolve issues surrounding 'minor exceedance'.
Sample Duplicate	One per batch/every 20 field samples	Qualitative comparison meets laboratory SOP	Evaluate impact to data, discuss with manager, and determine if corrective action is needed.

TABLE 6.1f
Method Performance Criteria for General/Conventional Chemistry

Conventional Sediment Parameters: Total Organic Carbon (TOC), Grain Size, Total Solids
Tissues: Total Extractable Organics (TEO)

QC Element or Sample Type	Minimum Frequency	Acceptance Criteria	Relevant Parameter(s) Reference Methods*
Initial Calibration	Prior to analysis (method and instrument specific procedures & number of standards)	For multipoint calibration, Correlation coefficient (r) >0.995	TOC
Continuing Calibration	Must start and end analytical sequence and every 10 samples	%R 90%-110%	TOC
Method Blanks	One per batch/every 20 field samples	Not to exceed QL	TOC, TEO
Blank Spike Samples	One per batch/every 20 field samples	%R 75% - 125%	TOC
Matrix Spike Samples	One per batch/every 20 field samples	%R 75% - 125% If MS/MSD analyzed, RPD ≤ 25%	TOC
Replicate Analyses[13]	Each sample must be analyzed at least in duplicate. The average of the replicates shall be reported.	RPD or %RSD < 20% for concentrations > QL	TOC
Sample Duplicates[14]	One per batch/every 20 field samples	RPD ≤ 25% for analyte concentrations greater than QL	TOC, Grain Size, TS, TEO
Reference Materials TOC NIST 1941B TEO NIST 1974B	One per batch/every 20 field samples	Values must be within ±20% of NIST uncertainty range	TOC, TEO

* Reference Methods

TOC	Plumb 1981/SW 846 Method 9060A
Grain Size	ASTM D422. If using sieve analysis only, report as percent gravel, coarse sand, medium sand, fine sand, very fine sand, and silt/clay. If using sieve and hydrometer, report as percent gravel, coarse sand, medium sand, fine sand, very fine sand, silt, and clay.
TS (percent)	EPA 160.3

Method 9000 series - analytical methods from SW-846 (U.S. EPA 1986) and updates
The SW-846 and updates are available from the web site at: http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm
Plumb (1981) - U.S. EPA/U.S. Army Corps of Engineers Technical Report EPA/CE-81-1 :
http://yosemite.epa.gov/r10/CLEANUP.NSF/ph/T4%20Technical%20Documents/$FILE/Plumb.pdf

[13] Method SW9060 requires quadruplicate analyses, however duplicate or triplicate analyses are acceptable.

[14] Method SW9060 requires a duplicate spike. A matrix spike and sample duplicate are acceptable in lieu of matrix spike/matrix spike duplicates. For grain size, RPD criteria only applied if fraction is greater than 5%.

TABLE 6.1g
Draft Method Performance Criteria for Analysis of Dioctylsulfosuccinate sodium salt (DOSS)

Element or Sample Type	Minimum Frequency	Measurement Quality Objective/ Acceptance Criteria	Corrective Action
Initial Calibration	Prior to every sequence, or as needed based on continuing calibration/verification check.	5-point calibration curve over two orders of magnitude %RSD ≤ 20	Resolve before proceeding.
Continuing Calibration (CCAL)	Every 12 hours	%D ≤ 30	Perform instrument maintenance. Re-analyze affected samples.
Initial Calibration Verification (Second Source or can be met if CCAL is second source)	Per initial calibration	%R target analytes 70-130%	Resolve before proceeding.
MC 252 Reference Oil	One per batch/every 20 field samples	Criteria to be developed	Resolve before proceeding.
Matrix Spike/Matrix Spike Duplicate (Sediments, Soils, Tissues only)	One per batch/every 20 field samples	%R 50% - 125% if sample concentration detected at >5X the spiked amount; RPD ≤30%	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Blank Spike/Blank Spike Duplicate (Aqueous Samples)	One per batch/every 20 field samples	%R 50% - 125; RPD ≤30%	Resolve before proceeding.
Method Blank	One per batch/every 20 field samples	Not to exceed 5x target MDL unless analyte not detected in associated samples(s) or analyte concentration >10x blank value	Resolve before proceeding.
Sample Duplicate (not required for water matrix)	One per batch/every 20 field samples	RPD ≤ 30% if analyte concentration is greater than QL	Evaluate impact to data, discuss with manager, and determine if corrective action is needed.
Internal Standard (IS)	Every sample	50% - 200% of the area of the IS in the associated calibration standard	Resolve before proceeding.
Surrogates	Every sample	%R 40-120%	Re-extract affected samples. Evaluate impact to data, discuss with manager, if corrective action is needed.

6.3.1 Initial Calibration

Acceptable calibration (initial and continuing) must be established and documented before sample analyses may begin. NIST-traceable calibration materials must be used where available in establishing calibration. Initial calibrations will be established according to the criteria in **Tables 6.1a – 6.1d , 6.1f and 6.1g**. A specific requirement for this project is to use methodology (and tune instrumentation) for low detection limits, therefore, samples with analytes above the calibration range will be diluted and reanalyzed. If samples require a dilution, results from the initial analytical run that were within the calibration range should be reported. Results from the diluted analyses should be reported for only those analytes which exceeded the calibration. .

6.3.2 Continuing Calibration Verification

Continuing calibration verification (CCV) standards will be run at the frequencies indicated in **Tables 6.1a – 6.1d, 6.1f and 6.1g**. If CCV results do not meet the specified criteria, then the instrument must be re-calibrated and all samples analyzed since the last acceptable CCV must be re-analyzed.

6.3.3 Reference Materials

Reference materials of a matrix appropriate to the samples being analyzed, will be analyzed every 20 samples throughout the analytical program, if available. The data resulting from the analysis of these samples will be reported in the same manner as that from the field samples. These data will be the prime materials used to determine and document the accuracy and precision of the associated field sample data. The reference materials to be used are listed in the criteria tables.

Accuracy is computed by comparing the laboratory's value for each analyte against either end of the range of values reported by the certifying agency. The laboratory's value must be within 20% of either the upper or lower end of NIST's 95% uncertainty range. For oil, water, filters, and inert sorbent materials analyses, the SRM is not extracted, but analyzed only on the instrument. The MC252 Reference Oil will be run with each batch of samples (e.g., GU2988-A0521-O9805 or equivalent as approved by the QA Coordinator). Chromatographic resolution criteria of selected peak pairs in the Reference Oil are indicated in **Tables 6.1a-6.1e**. After initial data sets are acquired, additional criteria for the Reference Oil will be determined.

6.3.4 Method Blanks

Method blanks are laboratory derived samples which have been subjected to the same preparation or extraction procedures and analytical protocols as project samples. A method blank will be analyzed with every 20 field samples analyzed. Acceptance criteria are provided in **Tables 6.1a – 6.1g**. Failure to meet acceptance criteria requires definitive corrective action to identify and eliminate the source(s) of contamination before the subsequent reanalysis and re-extraction of the blank and affected samples. Sample results will not be blank corrected.

6.3.5 Sample Duplicates

A duplicate sample aliquot from a representative matrix will be prepared and analyzed with every 20 field samples, except for water samples, filters, and inert sorbent materials for SHC/TEH and PAH. Water samples, filters and inert sorbent materials for SHC/TEH and PAH will not be analyzed in

duplicate because of the difficulty in subsampling representative aliquots. If duplicate VOA vials are collected, then volatile organic analyses may be performed in duplicate. Acceptance criteria the other matrices are provided in **Tables 6.1a – 6.1g**.

6.3.6 Matrix Spike/Matrix Spike Duplicates or Blank Spike/Blank Spike Duplicate

Matrix spike/matrix spike duplicates (MS/MSDs) will be analyzed every 20 samples, except for water samples, filters and inert sorbent materials. MS/MSDs will not be analyzed with the water sample batches because of the difficulty in subsampling representative aliquots from a sample container. Instead, blank spike/blank spike duplicates (BS/BSDs) will be analyzed with each batch of water samples. Samples will be spiked prior to extraction. Spike solution concentrations for the MS must be appropriate to the matrix and anticipated range of contaminants in the sample; that is 2 to 10 times analyte concentration. However, because it is not possible to know the concentration of contaminants prior to analysis, professional judgment may be exercised in choosing concentrations that are reasonable under the circumstances.

6.3.7 Internal Standards

All samples will be spiked with internal standards prior to analysis, when required by the analytical method. Control criteria for internal standard recovery are listed in **Tables 6.1a – 6.1d, and 6.1g**.

7.0 DATA REDUCTION, VALIDATION AND REPORTING

7.1 Data Reduction

Data reduction is the process whereby raw data (analytical measurements) are converted or reduced into meaningful results (analyte concentrations). This process may be either manual or electronic. Primary data reduction requires accounting for specific sample preparations, sample volume (or weight) analyzed, and any concentrations or dilutions required.

Primary data reduction is the responsibility of the analyst conducting the analytical measurement and is subject to further review by laboratory staff, the Laboratory Project Manager and finally, independent reviewers. All data reduction procedures will be described in the laboratory SOPs. Any deviations from the laboratory SOPs will be discussed in the laboratory case narratives.

- Concentrations will be reported as if three figures were significant.
- Data generated from the analysis of blank samples will not be utilized for correction of analyte data.
- Surrogate compounds, matrix spikes, and spike blanks will be evaluated as %R.
- Reference materials will be reported in units indicated on the certificate of analysis.
- Continuing calibration factors will be presented as %D
- Duplicate sample results will be expressed as RPD.

7.2 Data Review and Validation

Data review is an internal review process where data are reviewed and evaluated by personnel within the laboratory. Data validation is an independent review process conducted by personnel not associated with data collection and generation activities.

Data review is initiated at the bench level by the analyst, who is responsible for ensuring that the analytical data are correct and complete, the appropriate SOPs have been followed, and the QC results are within the acceptable limits. The Laboratory Project Manager has final review authority. It is the Laboratory Project Manager's responsibility to ensure that all analyses performed by that laboratory are correct, complete, and meet project data quality objectives.

External and independent data validation will be performed for all samples by the QA Contractor using a full data package containing sufficient information to allow the independent validation of the sample identity and integrity, the laboratory measurement system, and resulting quantitative and qualitative data. The required information with associated instrument print-outs are listed in **Table 7.1**.

TABLE 7.1 Laboratory Data Deliverables Per Sample Batch

Chain-of-Custody/ Sample Receipt Checklist	
Sample Data:	Result summaries including surrogate recoveries, percent total solids, dilutions, etc
Standards Data:	Target MDL data based on the method in *40 CFR, 136* Calibration summaries: Initial calibration data, standard curve equation, correlation coefficient or %RSD, continuing calibration %D.
Quality Control Data (Method Blanks, CRMs, Duplicates, Matrix Spikes, Spike Blanks):	Results summaries including surrogate recoveries, plus %R and RPD, as applicable.
Case Narrative:	Special handling or analysis conditions. Any circumstance that requires special explanation such as an exception to QA/QC conditions or control criteria, dilutions, reanalysis, etc. Corrective actions/procedure alterations
Chromatograms and Extracted Ion Profiles	Appropriately scaled (1) GC/FID chromatograms for samples and associated QC analyzed for extractable hydrocarbons; (2) GC/MS EIPs for samples and associated QC analyzed for qualitative biomarkers
Electronic Data Deliverable:	As specified in laboratory contract.

Three levels of data validation will be performed (see USEPA, *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use*. EPA-540-R-08-005. January 2009 for definitions): full (stage 4), summary (stage 2B), or cursory (stage 2A) validation. Full validation will consist of a review of the entire data package for compliance with documentation and quality control criteria for all the following items, plus recalculations of instrument calibration curves, sample and QC results. Summary validation will consist of a review of all the following items, but without recalculations. Cursory validation will consist of a review of only the starred (*) items:

- Package completeness*
- Holding times from extraction to analysis*
- Instrument calibration, initial and continuing
- Blank results*
- Instrument performance
- Spike recoveries*
- Standard reference material results*
- Laboratory duplicate results*
- Reported detection limits*
- Compound quantitation
- Compound identification
- Verification of electronic data deliverable (EDD) against hardcopy (10% verification)*

As the project proceeds and the quality of the data is verified and documented, the level of validation will decrease at the discretion of the QA Coordinator. At a minimum, cursory validation will be performed on all data packages, i.e., only the starred items will be reviewed.

Qualifiers (**Table 7.2**) may be assigned to individual data points by the QA Contractor. These validation qualifiers will not replace qualifiers or footnotes provided by the laboratory, but will be added to the data summary tables to inform the data user whether or not the data met all project quality objectives. Both sets of qualifiers will be maintained in the database.

TABLE 7.2 Data Validation Qualifier Codes

U	Analyte concentration is not significantly greater than the associated blank result. The result is judged to be the detection limit.
R	Unreliable result. Data should not be used.
N	The analysis indicates the present of an analyte for which there is presumptive evidence to make a "tentative identification".
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
J	Reported concentration is an estimate with potentially more bias, or less precision than an unqualified concentration, as judged by associated calibration and/or reference material results.
UJ	Not detected. Detection limit is an estimate with potentially more bias or less precision than an unqualified detection limit as judged by the associated quality control results
DNR	Do not report; A more appropriate result is reported from another analysis or dilution.
F	Found. Analyte detected at less than the MDL, however, peak height is greater than 3 times the noise level and ID criteria are met.

All discrepancies and requests for additional corrected data will be discussed with the laboratory prior to issuing the formal data validation report. Review procedures and findings during data validation will be documented on worksheets. A validation report will be prepared for each data group/data package summarizing QC results, qualifiers, and possible data limitations. Only validated data with appropriate qualifiers will be released for general use. Data are not considered final until QA Coordinator has performed assessment and accepted the data.

In addition, the validated data will be reviewed by the QA Reviewer on behalf of BP America. The following process shall be used should the independent validation of the laboratory data results in a material difference in how qualifiers have been assigned or in the actual value itself:

- The QA Coordinator and QA Reviewer will meet to determine the source of the difference, and resolve. No changes to validated results will be made if the differences are considered immaterial to both the QA Coordinator and QA Reviewer.
- If the validated data have already been released by the QA Coordinator, then the data will be updated in accordance with the resolution and reposted.
- Should there be no agreement on how to resolve the difference, the QA Coordinator and QA Reviewer shall request further assistance from the Assessment Managers and BP America, respectively.
- The basis for all material changes to validated results will be documented along with the resubmitted validated data.

8.0 CORRECTIVE ACTION AND PROCEDURE ALTERATION

The analytical laboratories are required to adhere to the SOPs submitted by them to the QA Coordinator for this project. When the data from the analyses of any quality control sample exceeds the project specified control limits or indicates that the analytical method is drifting out of control, it is the

immediate responsibility of the analyst to identify and correct the situation before continuing with sample analysis.

A narrative describing the problem noted, the steps taken to identify and correct the problem and the treatment of the relevant sample batches must be prepared and submitted with the relevant data package. If the action indicates a revision to the accepted SOP is warranted, the laboratory will revise the SOP and resubmit the SOP to the QA Coordinator within 30 working days after the problem was noted. Until the revised SOP is approved, any data sets reported with the revised method will have the any changes to the method noted in the laboratory's case narrative.

9.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Quality Assurance/Quality Control (QA/QC) reports will be submitted periodically to the Assessment Manager(s) by the QA Coordinator. These reports may be either formal or informal in response to the Assessment Manager's request. Upon termination of the analytical work for this damage assessment, a formal QA report will be submitted. This report will include:

- General compliance with QA objectives
- Summary of technical and performance evaluation audits
- Summary of data validation reports
- Summary of laboratory control charts

10.0 REFERENCES

Bence, A.E., K.A. Kvenvolden, and M.C. Kennicutt, II. 2006. Organic geochemistry applied to environmental assessments of Prince William Sound, Alaska, after the Exxon Valdez oil spill--a review. *Org. Geochem.* 24(1):7-42.

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USEPA, 2002. *Guidance for Quality Assurance Project Plans*, (EPA QA/G-5) EPA/240/R-02/009, December 2002. http://www.epa.gov/quality/qs-docs/r5-final.pdf

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Deepwater Horizon Oil Spill (DWHOS)

Water Column and Fish Technical Working Group
Bongo Net:
Description, Standard Operating Procedures, Sample Handling and Preservation

April 6, 2011

Bongo Net Deployment

The bongo net design and deployment protocol described herein are in accordance with those used by the Southeast Fisheries Science Center on Southeast Area Monitoring and Assessment Program (SEAMAP) surveys, as described in NMFS and GSMFC (2001). The 61 cm bongo net has twin 0.335 mm mesh nets and is fished in an oblique tow path to a maximum depth of 200 m or to 5 m off the bottom at depths less than 200 m (Figure 1). Typically, a monitored depth sensing device, such as an SBE-19 (referred to as "CTD profiler" in Figure 1), is attached to the mechanical wire slightly above the bongo net. A mechanical flowmeter is mounted off-center in the mouth of each bongo net to record the volume of water filtered.

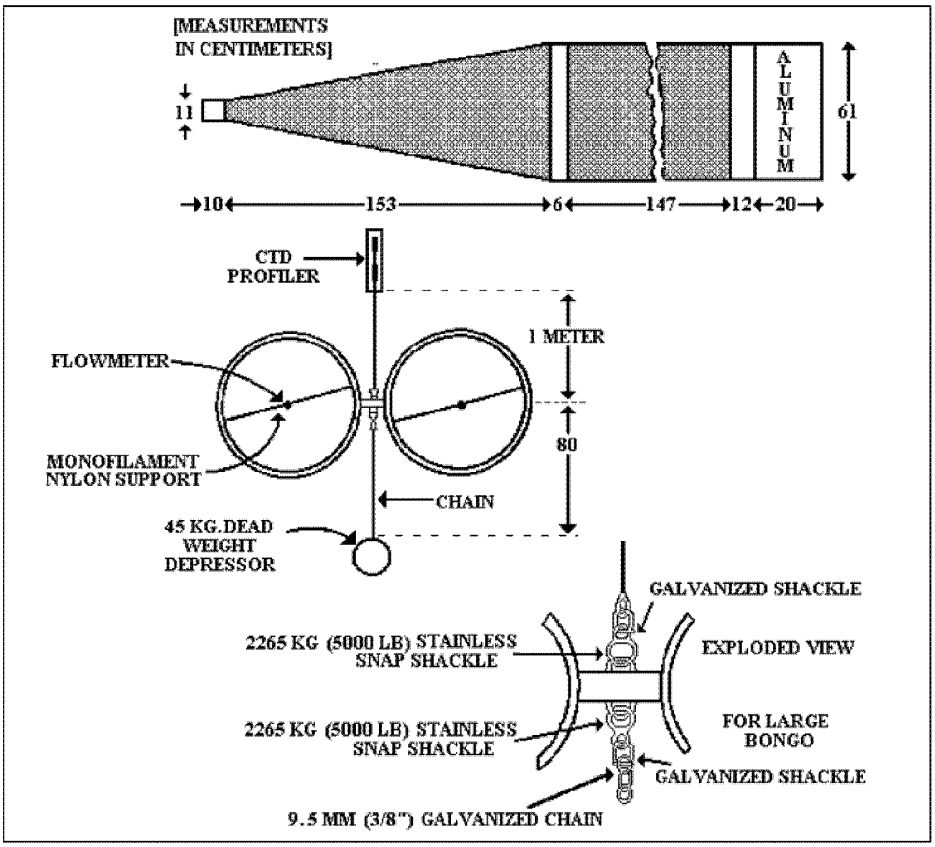

Figure 1. The standard SEAMAP bongo net assembly. From NOAA (2003)

A. Preparation

The direction in which the ship travels during the bongo net tow will be determined by weather conditions, primarily wind and swell direction. Navigational hazard information available to the captain, operations leads, and chief scientist should reviewed. When weather does not factor into the decision, it is preferable to tow towards the next station. The decision regarding which way to tow the bongo net will be the responsibility of the chief scientist, in discussion with the captain and operations leads.

Prior to deployment, ensure that the cod end of the bongo net is secure and that there are no rips or holes in the mesh. Ensure that there are no air bubbles in the flowmeters and that the flowmeter rotors spin freely and do not wobble. Perform repairs or make replacements as necessary. Record the start readings on the flowmeters.

If using a monitored depth sensing device such as an SBE-19, ensure that it is properly secured to the wire, connections are secure, the Tygon tube is filled with water, the magnetic switch is off, and all wires are in good condition. Measure the distance from the SBE-19 to the bottom of the bongo frame for use as a depth correction factor. Follow the **SBE-19 programming instructions** at the end of this protocol.

Based on the depth of the station, determine the target fishing depth. At stations in less than 200 m water depth, the optimum target fishing depth samples as much of the water column as possible. SEAMAP guidance is as follows: *In water depths less than 50 m, it is possible to sample within 1 to 2 m above the bottom. As depth increases, the target fishing depth should become more conservative because it is more likely that the bongo net may touch the bottom. The target fishing depth can be as much as 4 m above the bottom in 199 m of water depth. At stations that are beyond 200 m, the target fishing depth is 200 m*. However, on the side of safety, a conservative buffer of 5m as the maximum fishing depth off the bottom will be used in waters <205m deep.

B. Deployment

The initial tow speed for bongo net deployment is 1.5 - 2.0 knots through the water. Lower the bongo net to just above the water surface and ensure that the nets are streamed out straight behind the bongo frame. Take caution that high winds will cause the flowmeters to turn prior to submergence. Upon lowering the bongo net frame into the water and when the flowmeters begin to spin, record the tow start time. Pay out the appropriate amount of wire to reach the target fishing depth and adjust ship speed to maintain wire angle between 30° and 60° (preferably 45°). Handheld inclinometer should be used to record wire angle every few minutes during the entire deployment. Refer to Table 1 for the correct wire payout rates. Continue paying out wire to lower the bongo net to the target fishing depth by either monitoring the depth sensing device (take care to add the depth correction factor to the observed depth) or by following Table 2

(included at the end of this protocol) when a depth sensing device is not available. Employ particular caution in 50 to 200 m depths, because a small drop in the wire angle greatly increases the chance that the bongo nets will hit the bottom.

Table 1. Approximate rates of wire payout and retrieval for bongo nets. Actual rates will depend on winch capabilities. Once established, these rates must be held constant.

Target Fishing Depth (m)	Total Amount of Wire Out (m)	Wire Payout Rate	Wire Retrieval Rate
0 – 19	< 27	10 m / min	10 m / min
20 – 69	28 – 97	15 m / min	15 m / min
70 – 100	> 99	20 – 30 m / min	20 m / min
101 – 200	> 143	50 m / min	20 m / min

At the target fishing depth, stop payout of cable and immediately start retrieval of the bongo net; do not allow net to "settle". Record the time, angle of wire, and amount of wire out. Record the maximum net depth, either but referring to the monitored depth sensing device (take care to add the depth correction factor to the observed depth) or by calculation when a monitored depth sensing device is not used.

calculated maximum net depth = max wire out x cosine(wire angle)

C. Retrieval, Sample Handling, and Preservation

Sample handling protocols and preservation follow NRDA developed protocols.

Retrieve the bongo net at a rate commensurate with the amount of wire out, using Table 1 as a guide while maintaining a 45° wire angle. It is EXTREMELY IMPORTANT that the wire angle be as close to 45° as possible during retrieval. If the wire angle exceeds 55°, falls to 35° OR if combined variation exceeds 15°, the tow should be repeated (save the sample until a better tow is completed).

Record the time (gear out) when the net breaks the surface and the flowmeters stop turning, while an assistant or the winch operator immediately pulls the frame from the water. Do not let the bongo array continue to fish once it breaks the surface. Record the flowmeter reading as soon as practical.

If mud or sand is present in both bongo nets, the tow must be repeated. Save any marginal sample until a good tow is completed. If mud (no more than 2 tablespoons) is present in only one bongo net, it is not necessary to repeat the tow. Save both samples and record the presence of mud in the sample.

1. Wash down the bongo net with a low pressure seawater hose from the highest possible point, rinsing any specimens into the secured codend. When possible, rinse the bongo net while the net hangs over the side of the ship. In high winds, bring the net directly on board and rinse the plankton down to the codend on deck. If you place the bongo net on the deck, take care not to rest or scrape the frame against the net.
    - Large seaweed such as *Sargassum*, or other larger debris will be rinsed off (taking care to collect any rinsed plankton into net), quantified, recorded, photographed, and discarded. These items will not be kept due to storage capacity limitations. Detailed observations of larger debris should include abundance, wet weight, volume, and species.
    - Small fish and invertebrates that can easily fit into a sample jar should be preserved following the same preservation protocol as plankton.
2. Empty the codend of the net into a bucket with an icepack in the bottom. Rinse the codend and collar of the net thoroughly into the bucket.
3. Larger fish and invertebrates should be rinsed (taking care to retain any plankton in the bucket) and placed in plastic bags, labeled (cruise, station, and gear: put a label inside the bag and affix another label to the outside of the bag), and frozen.
4. If the sample contains a large volume of gelatinous zooplankton, the whole sample should be rinsed with sea water on a coarse sieve to separate out the larger jellies and ensure that the smaller organisms are retained in the bucket. Record the volume and species composition of sieved jellies using a calibrated large volume measuring device and photography.
5. Strain the plankton sample onto a sieve to remove excess water.
6. Rinse the plankton sample into a sample jar using 70% ethanol for the left bongo and seawater for the right bongo. Do not fill jars more than ½ full with sample. Divide large samples into multiple jars if necessary.
7. When the sample is ready for preservation, add the internal label.
8. Preserve the samples as follows:

    Left bongo: 70% ethanol
    - Fill any remaining sample jar head space with 70% ethanol and secure the lid.
    - 24 to 48 hours after initial preservation: strain the sample to remove the original ethanol solution (place the waste ethanol into the waste ethanol container) and refill the sample jar with fresh 70% ethanol.

    Right bongo: 10% buffered formalin
    - Ensure the sample jar has adequate space (1/3 volume) for the buffered formalin.
    - Measure 10 percent of the sample container volume of buffered formalin with a graduated cylinder and pour the buffered formalin into the sample jar.

        i.e. 500 mL sample jar – 50 mL buffered formalin

        1000 mL sample jar – 100mL buffered formalin
    - Fill any remaining sample jar head space with seawater and secure the jar lid.
9. Dry the outside of the sample jars and apply the external labels.

10. Once the jars have been labeled, wrap each jar entirely in clear tape to ensure that the label does not come off.

All samples will be held under NOAA NRDA chain of custody. All samples will be sent to Malinda Sutor's laboratory (or her designee) at Louisiana State University and stored in a secure facility.

Between stations, the bongo nets should be thoroughly cleaned and rinsed to remove any debris or fine phytoplankton that have clogged the mesh.

Safety measures

- Wear the proper personal protective gear (PPE), which includes a hard hat, steel toe boots, and a personal floatation device (PFD) such as a work vest when working on the deck.
- Wear gloves and goggles when handling chemicals.
- Work in a well-ventilated area (outside or in the fume hood) with proper lighting when handling chemicals such as ethanol, sodium borate, or formaldehyde.
- Watch for slips, trips, and falls when entering or exiting the science lab and while working on the deck.
- Make sure that the channels of communication are properly used and everybody is following the same procedures of collecting, analyzing, and preserving samples.
- If you are unsure about any procedures or have any safety concerns, ask the watch chief or chief scientist.

Chemical storage

Store unopened formalin and ethanol inside the fume hood or inside the flammable liquid storage cabinet that is outside of the wet lab.

Preparing 70% ethanol solution

70% ethanol solution is created by diluting the 95% non-denatured ethanol stock with sea water.

Preparing buffered formalin

Buffered formalin is created by adding sodium borate (Borax can also be used) to the stock 37% formaldehyde solution. Sodium borate should be added in small quantities until the formalin cannot hold any more and the borate begins to precipitate out of the solution. Test the buffered formalin with a pH strip to ensure that pH = 8. The buffered formalin is then ready to add to samples.

SBE-19 Programming Instructions:

DOS:
Type “cd SBE4213"
turn on deck box
at C:\SBE4213> Type "term19"
blue screen, press Enter
at S> type "DS", hit Enter or just hit F3 to display status
check vmain (should be greater than 12 to run)
at S> type "IL", hit Enter or just hit F8 to initialize logging
at S> type "QS", hit Enter, then press F10 to exit
at C:\SBE4213> type "SEASAVE", hit Enter
file (on right part of screen), enter station # as filename
press F10 to fill out header form
to leave header, press esc
Save header and continue, press Enter
Acquire and display realtime data, press Enter
At the message prompt, turn on the magnetic switch on the SBE-19
When data appears in the display, have the Deck Scientist and crew deploy the bongo.

Windows:
turn deck box on
double click on term19 icon
at S> type "DS", hit Enter or just hit F3 to display status
check vmain (should be greater than 12 to run)
at S> type "QS", hit Enter, then press F10 to exit
double click on SEASAVE icon
hit ok on the box that comes up
go to File on the menu bar and choose open Seasave configuration
(*.cfg)
choose the file that has been set up for that cruise
go to Realtime Data on the menu bar and choose Start Acquisition, hit Output data file button
Click on data folder and enter station number as the file name
Hit Green Start Acquire button - A header form will come up.
Fill it in.
Make sure the bridge and deck are ready to deploy before you hit ‘Ok’ at the bottom of the window because you will have only 60 seconds to turn on the magnetic switch after hitting ‘Ok’ or you will have to repeat the setup process.
When data appears in the display, have the Deck Scientist and
crew deploy the bongo.

Table 2. Wire out (m) to reach depths of 1-240 m at wire angles from 30° to 60°.

Target Fishing Depth (m)	Wire Angle						
	30°	35°	40°	45°	50°	55°	60°
1	1.15	1.22	1.31	1.41	1.56	1.74	2
2	2.31	2.44	2.61	2.83	3.11	3.49	4
3	3.46	3.66	3.92	4.24	4.67	5.23	6
4	4.62	4.88	5.22	5.66	6.22	6.97	8
5	**5.77**	**6.1**	**6.53**	**7.07**	**7.78**	**8.72**	**10**
6	6.93	7.32	7.83	8.49	9.33	10.46	12
7	8.08	8.55	9.14	9.9	10.89	12.2	14
8	9.24	9.77	10.44	11.31	12.45	13.95	16
9	10.39	10.99	11.75	12.73	14	15.69	18
10	**11.55**	**12.21**	**13.05**	**14.14**	**15.56**	**17.43**	**20**
11	12.7	13.43	14.36	15.56	17.11	19.18	22
12	13.86	14.65	15.66	16.97	18.67	20.92	24
13	15.01	15.87	16.97	18.38	20.22	22.66	26
14	16.17	17.09	18.28	19.8	21.78	24.41	28
15	**17.32**	**18.31**	**19.58**	**21.21**	**23.34**	**26.15**	**30**
16	18.48	19.53	20.89	22.63	24.89	27.9	32
17	19.63	20.75	22.19	24.04	26.45	29.64	34
18	20.78	21.97	23.5	25.46	28	31.38	36
19	21.94	23.19	24.8	26.87	29.56	33.13	38
20	**23.09**	**24.42**	**26.11**	**28.28**	**31.11**	**34.87**	**40**
21	24.25	25.64	27.41	29.7	32.67	36.61	42
22	25.4	26.86	28.72	31.11	34.23	38.36	44
23	26.56	28.08	30.02	32.53	35.78	40.1	46
24	27.71	29.3	31.33	33.94	37.34	41.84	48
25	**28.87**	**30.52**	**32.64**	**35.36**	**38.89**	**43.59**	**50**
26	30.02	31.74	33.94	36.77	40.45	45.33	52
27	31.18	32.96	35.25	38.18	42	47.07	54
28	32.33	34.18	36.55	39.6	43.56	48.82	56
29	33.49	35.4	37.86	41.01	45.12	50.56	58
30	**34.64**	**36.62**	**39.16**	**42.43**	**46.67**	**52.3**	**60**
31	35.8	37.84	40.47	43.84	48.23	54.05	62
32	36.95	39.06	41.77	45.25	49.78	55.79	64
33	38.11	40.29	43.08	46.67	51.34	57.53	66
34	39.26	41.51	44.38	48.08	52.89	59.28	68
35	**40.41**	**42.73**	**45.69**	**49.5**	**54.45**	**61.02**	**70**
36	41.57	43.95	46.99	50.91	56.01	62.76	72
37	42.72	45.17	48.3	52.33	57.56	64.51	74
38	43.88	46.39	49.61	53.74	59.12	66.25	76
39	45.03	47.61	50.91	55.15	60.67	67.99	78
40	**46.19**	**48.83**	**52.22**	**56.57**	**62.23**	**69.74**	**80**

Target Fishing Depth (m)	Wire Angle						
	30°	35°	40°	45°	50°	55°	60°
41	47.34	50.05	53.52	57.98	63.78	71.48	82
42	48.5	51.27	54.83	59.4	65.34	73.22	84
43	49.65	52.49	56.13	60.81	66.9	74.97	86
44	50.81	53.71	57.44	62.23	68.45	76.71	88
45	**51.96**	**54.93**	**58.74**	**63.64**	**70.01**	**78.46**	**90**
46	53.12	56.16	60.05	65.05	71.56	80.2	92
47	54.27	57.38	61.35	66.47	73.12	81.94	94
48	55.43	58.6	62.66	67.88	74.67	83.69	96
49	56.58	59.82	63.96	69.3	76.23	85.43	98
50	**57.74**	**61.04**	**65.27**	**70.71**	**77.79**	**87.17**	**100**
51	58.89	62.26	66.58	72.12	79.34	88.92	102
52	60.04	63.48	67.88	73.54	80.9	90.66	104
53	61.2	64.7	69.19	74.95	82.45	92.4	106
54	62.35	65.92	70.49	76.37	84.01	94.15	108
55	**63.51**	**67.14**	**71.8**	**77.78**	**85.56**	**95.89**	**110**
56	64.66	68.36	73.1	79.2	87.12	97.63	112
57	65.82	69.58	74.41	80.61	88.68	99.38	114
58	66.97	70.8	75.71	82.02	90.23	101.12	116
59	68.13	72.03	77.02	83.44	91.79	102.86	118
60	**69.28**	**73.25**	**78.32**	**84.85**	**93.34**	**104.61**	**120**
61	70.44	74.47	79.63	86.27	94.9	106.35	122
62	71.59	75.69	80.94	87.68	96.45	108.09	124
63	72.75	76.91	82.24	89.1	98.01	109.84	126
64	73.9	78.13	83.55	90.51	99.57	111.58	128
65	**75.06**	**79.35**	**84.85**	**91.92**	**101.12**	**113.32**	**130**
66	76.21	80.57	86.16	93.34	102.68	115.07	132
67	77.36	81.79	87.46	94.75	104.23	116.81	134
68	78.52	83.01	88.77	96.17	105.79	118.55	136
69	79.67	84.23	90.07	97.58	107.34	120.3	138
70	**80.83**	**85.45**	**91.38**	**98.99**	**108.9**	**122.04**	**140**
71	81.98	86.67	92.68	100.41	110.46	123.78	142
72	83.14	87.9	93.99	101.82	112.01	125.53	144
73	84.29	89.12	95.29	103.24	113.57	127.27	146
74	85.45	90.34	96.6	104.65	115.12	129.02	148
75	**86.6**	**91.56**	**97.91**	**106.07**	**116.68**	**130.76**	**150**
76	87.76	92.78	99.21	107.48	118.24	132.5	152
77	88.91	94	100.52	108.89	119.79	134.25	154
78	90.07	95.22	101.82	110.31	121.35	135.99	156
79	91.22	96.44	103.13	111.72	122.9	137.73	158
80	**92.38**	**97.66**	**104.43**	**113.14**	**124.46**	**139.48**	**160**
81	93.53	98.88	105.74	114.55	126.01	141.22	162

Target Fishing Depth (m)	Wire Angle						
	30°	35°	40°	45°	50°	55°	60°
82	94.69	100.1	107.04	115.97	127.57	142.96	164
83	95.84	101.32	108.35	117.38	129.13	144.71	166
84	96.99	102.55	109.65	118.79	130.68	146.45	168
85	**98.15**	**103.77**	**110.96**	**120.21**	**132.24**	**148.19**	**170**
86	99.3	104.99	112.27	121.62	133.79	149.94	172
87	100.46	106.21	113.57	123.04	135.35	151.68	174
88	101.61	107.43	114.88	124.45	136.9	153.42	176
89	102.77	108.65	116.18	125.87	138.46	155.17	178
90	**103.92**	**109.87**	**117.49**	**127.28**	**140.02**	**156.91**	**180**
91	105.08	111.09	118.79	128.69	141.57	158.65	182
92	106.23	112.31	120.1	130.11	143.13	160.4	184
93	107.39	113.53	121.4	131.52	144.68	162.14	186
94	108.54	114.75	122.71	132.94	146.24	163.88	188
95	**109.7**	**115.97**	**124.01**	**134.35**	**147.79**	**165.63**	**190**
96	110.85	117.19	125.32	135.76	149.35	167.37	192
97	112.01	118.42	126.62	137.18	150.91	169.11	194
98	113.16	119.64	127.93	138.59	152.46	170.86	196
99	114.32	120.86	129.24	140.01	154.02	172.6	198
100	**115.47**	**122.08**	**130.54**	**141.42**	**155.57**	**174.34**	**200**
101	116.62	123.3	131.85	142.84	157.13	176.09	202
102	117.78	124.52	133.15	144.25	158.68	177.83	204
103	118.93	125.74	134.46	145.66	160.24	179.58	206
104	120.09	126.96	135.76	147.08	161.8	181.32	208
105	**121.24**	**128.18**	**137.07**	**148.49**	**163.35**	**183.06**	**210**
106	122.4	129.4	138.37	149.91	164.91	184.81	212
107	123.55	130.62	139.68	151.32	166.46	186.55	214
108	124.71	131.84	140.98	152.74	168.02	188.29	216
109	125.86	133.06	142.29	154.15	169.57	190.04	218
110	**127.02**	**134.29**	**143.59**	**155.56**	**171.13**	**191.78**	**220**
111	128.17	135.51	144.9	156.98	172.69	193.52	222
112	129.33	136.73	146.21	158.39	174.24	195.27	224
113	130.48	137.95	147.51	159.81	175.8	197.01	226
114	131.64	139.17	148.82	161.22	177.35	198.75	228
115	**132.79**	**140.39**	**150.12**	**162.63**	**178.91**	**200.5**	**230**
116	133.95	141.61	151.43	164.05	180.46	202.24	232
117	135.1	142.83	152.73	165.46	182.02	203.98	234
118	136.25	144.05	154.04	166.88	183.58	205.73	236
119	137.41	145.27	155.34	168.29	185.13	207.47	238
120	**138.56**	**146.49**	**156.65**	**169.71**	**186.69**	**209.21**	**240**
121	139.72	147.71	157.95	171.12	188.24	210.96	242
122	140.87	148.93	159.26	172.53	189.8	212.7	244

Target Fishing Depth (m)	Wire Angle						
	30°	35°	40°	45°	50°	55°	60°
123	142.03	150.16	160.57	173.95	191.35	214.44	246
124	143.18	151.38	161.87	175.36	192.91	216.19	248
125	**144.34**	**152.6**	**163.18**	**176.78**	**194.47**	**217.93**	**250**
126	145.49	153.82	164.48	178.19	196.02	219.67	252
127	146.65	155.04	165.79	179.61	197.58	221.42	254
128	147.8	156.26	167.09	181.02	199.13	223.16	256
129	148.96	157.48	168.4	182.43	200.69	224.9	258
130	**150.11**	**158.7**	**169.7**	**183.85**	**202.24**	**226.65**	**260**
131	151.27	159.92	171.01	185.26	203.8	228.39	262
132	152.42	161.14	172.31	186.68	205.36	230.13	264
133	153.58	162.36	173.62	188.09	206.91	231.88	266
134	154.73	163.58	174.92	189.5	208.47	233.62	268
135	**155.88**	**164.8**	**176.23**	**190.92**	**210.02**	**235.37**	**270**
136	157.04	166.03	177.54	192.33	211.58	237.11	272
137	158.19	167.25	178.84	193.75	213.13	238.85	274
138	159.35	168.47	180.15	195.16	214.69	240.6	276
139	160.5	169.69	181.45	196.58	216.25	242.34	278
140	**161.66**	**170.91**	**182.76**	**197.99**	**217.8**	**244.08**	**280**
141	162.81	172.13	184.06	199.4	219.36	245.83	282
142	163.97	173.35	185.37	200.82	220.91	247.57	284
143	165.12	174.57	186.67	202.23	222.47	249.31	286
144	166.28	175.79	187.98	203.65	224.02	251.06	288
145	**167.43**	**177.01**	**189.28**	**205.06**	**225.58**	**252.8**	**290**
146	168.59	178.23	190.59	206.48	227.14	254.54	292
147	169.74	179.45	191.89	207.89	228.69	256.29	294
148	170.9	180.67	193.2	209.3	230.25	258.03	296
149	172.05	181.9	194.51	210.72	231.8	259.77	298
150	**173.21**	**183.12**	**195.81**	**212.13**	**233.36**	**261.52**	**300**
151	174.36	184.34	197.12	213.55	234.91	263.26	302
152	175.51	185.56	198.42	214.96	236.47	265	304
153	176.67	186.78	199.73	216.37	238.03	266.75	306
154	177.82	188	201.03	217.79	239.58	268.49	308
155	**178.98**	**189.22**	**202.34**	**219.2**	**241.14**	**270.23**	**310**
156	180.13	190.44	203.64	220.62	242.69	271.98	312
157	181.29	191.66	204.95	222.03	244.25	273.72	314
158	182.44	192.88	206.25	223.45	245.8	275.46	316
159	183.6	194.1	207.56	224.86	247.36	277.21	318
160	**184.75**	**195.32**	**208.87**	**226.27**	**248.92**	**278.95**	**320**
161	185.91	196.54	210.17	227.69	250.47	280.69	322
162	187.06	197.77	211.48	229.1	252.03	282.44	324
163	188.22	198.99	212.78	230.52	253.58	284.18	326

Target Fishing Depth (m)	Wire Angle						
	30°	35°	40°	45°	50°	55°	60°
164	189.37	200.21	214.09	231.93	255.14	285.93	328
165	**190.53**	**201.43**	**215.39**	**233.35**	**256.69**	**287.67**	**330**
166	191.68	202.65	216.7	234.76	258.25	289.41	332
167	192.83	203.87	218	236.17	259.81	291.16	334
168	193.99	205.09	219.31	237.59	261.36	292.9	336
169	195.14	206.31	220.61	239	262.92	294.64	338
170	**196.3**	**207.53**	**221.92**	**240.42**	**264.47**	**296.39**	**340**
171	197.45	208.75	223.22	241.83	266.03	298.13	342
172	198.61	209.97	224.53	243.24	267.58	299.87	344
173	199.76	211.19	225.84	244.66	269.14	301.62	346
174	200.92	212.41	227.14	246.07	270.7	303.36	348
175	**202.07**	**213.64**	**228.45**	**247.49**	**272.25**	**305.1**	**350**
176	203.23	214.86	229.75	248.9	273.81	306.85	352
177	204.38	216.08	231.06	250.32	275.36	308.59	354
178	205.54	217.3	232.36	251.73	276.92	310.33	356
179	206.69	218.52	233.67	253.14	278.47	312.08	358
180	**207.85**	**219.74**	**234.97**	**254.56**	**280.03**	**313.82**	**360**
181	209	220.96	236.28	255.97	281.59	315.56	362
182	210.16	222.18	237.58	257.39	283.14	317.31	364
183	211.31	223.4	238.89	258.8	284.7	319.05	366
184	212.46	224.62	240.19	260.22	286.25	320.79	368
185	**213.62**	**225.84**	**241.5**	**261.63**	**287.81**	**322.54**	**370**
186	214.77	227.06	242.81	263.04	289.36	324.28	372
187	215.93	228.28	244.11	264.46	290.92	326.02	374
188	217.08	229.51	245.42	265.87	292.48	327.77	376
189	218.24	230.73	246.72	267.29	294.03	329.51	378
190	**219.39**	**231.95**	**248.03**	**268.7**	**295.59**	**331.25**	**380**
191	220.55	233.17	249.33	270.11	297.14	333	382
192	221.7	234.39	250.64	271.53	298.7	334.74	384
193	222.86	235.61	251.94	272.94	300.25	336.49	386
194	224.01	236.83	253.25	274.36	301.81	338.23	388
195	**225.17**	**238.05**	**254.55**	**275.77**	**303.37**	**339.97**	**390**
196	226.32	239.27	255.86	277.19	304.92	341.72	392
197	227.48	240.49	257.17	278.6	306.48	343.46	394
198	228.63	241.71	258.47	280.01	308.03	345.2	396
199	229.79	242.93	259.78	281.43	309.59	346.95	398
200	**230.94**	**244.15**	**261.08**	**282.84**	**311.14**	**348.69**	**400**
201	232.09	245.38	262.39	284.26	312.7	350.43	402
202	233.25	246.6	263.69	285.67	314.26	352.18	404
203	234.4	247.82	265	287.09	315.81	353.92	406
204	235.56	249.04	266.3	288.5	317.37	355.66	408

Target Fishing Depth (m)	Wire Angle						
	30°	35°	40°	45°	50°	55°	60°
205	**236.71**	**250.26**	**267.61**	**289.91**	**318.92**	**357.41**	**410**
206	237.87	251.48	268.91	291.33	320.48	359.15	412
207	239.02	252.7	270.22	292.74	322.03	360.89	414
208	240.18	253.92	271.52	294.16	323.59	362.64	416
209	241.33	255.14	272.83	295.57	325.15	364.38	418
210	**242.49**	**256.36**	**274.14**	**296.98**	**326.7**	**366.12**	**420**
211	243.64	257.58	275.44	298.4	328.26	367.87	422
212	244.8	258.8	276.75	299.81	329.81	369.61	424
213	245.95	260.02	278.05	301.23	331.37	371.35	426
214	247.11	261.25	279.36	302.64	332.92	373.1	428
215	**248.26**	**262.47**	**280.66**	**304.06**	**334.48**	**374.84**	**430**
216	249.42	263.69	281.97	305.47	336.04	376.58	432
217	250.57	264.91	283.27	306.88	337.59	378.33	434
218	251.72	266.13	284.58	308.3	339.15	380.07	436
219	252.88	267.35	285.88	309.71	340.7	381.81	438
220	**254.03**	**268.57**	**287.19**	**311.13**	**342.26**	**383.56**	**440**
221	255.19	269.79	288.5	312.54	343.81	385.3	442
222	256.34	271.01	289.8	313.96	345.37	387.05	444
223	257.5	272.23	291.11	315.37	346.93	388.79	446
224	258.65	273.45	292.41	316.78	348.48	390.53	448
225	**259.81**	**274.67**	**293.72**	**318.2**	**350.04**	**392.28**	**450**
226	260.96	275.9	295.02	319.61	351.59	394.02	452
227	262.12	277.12	296.33	321.03	353.15	395.76	454
228	263.27	278.34	297.63	322.44	354.71	397.51	456
229	264.43	279.56	298.94	323.85	356.26	399.25	458
230	**265.58**	**280.78**	**300.24**	**325.27**	**357.82**	**400.99**	**460**
231	266.74	282	301.55	326.68	359.37	402.74	462
232	267.89	283.22	302.85	328.1	360.93	404.48	464
233	269.05	284.44	304.16	329.51	362.48	406.22	466
234	270.2	285.66	305.47	330.93	364.04	407.97	468
235	**271.35**	**286.88**	**306.77**	**332.34**	**365.6**	**409.71**	**470**
236	272.51	288.1	308.08	333.75	367.15	411.45	472
237	273.66	289.32	309.38	335.17	368.71	413.2	474
238	274.82	290.54	310.69	336.58	370.26	414.94	476
239	275.97	291.77	311.99	338	371.82	416.68	478
240	**277.13**	**292.99**	**313.3**	**339.41**	**373.37**	**418.43**	**480**

References

National Marine Fisheries Service (NMFS) and Gulf States Marine Fisheries Commission (GSMFC). 2001. SEAMAP Field Operations Manual for Collection of Data. October 2001 (Revision No. 4).

National Oceanic and Atmospheric Administration (NOAA). 2003. Northeast Regional Standard Operating Procedures for: Ecosystem Monitoring Program. Appendix 3 *in* NOAA Fisheries Protocols for Ichthyoplankton Surveys. NOAA Fisheries Alaska Fisheries Science Center. December 24, 2003.

Deepwater Horizon Oil Spill (DWHOS)

Water Column and Fish Technical Working Group
Neuston Net:
Description, Standard Operating Procedures, Sample Handling and Preservation

April 6, 2011

Neuston Net Deployment

The neuston net design and survey protocol described here are in accordance with those used by the Southeast Fisheries Science Center on Southeast Area Monitoring and Assessment Program (SEAMAP) surveys, as described in NMFS and GSMFC (2001). A single 2-m wide by 1-m deep pipe frame neuston net fitted with 0.950 mm mesh netting is towed from the side of the survey vessel at the surface of the water with the frame half submerged for 10 minutes (Figure 1).

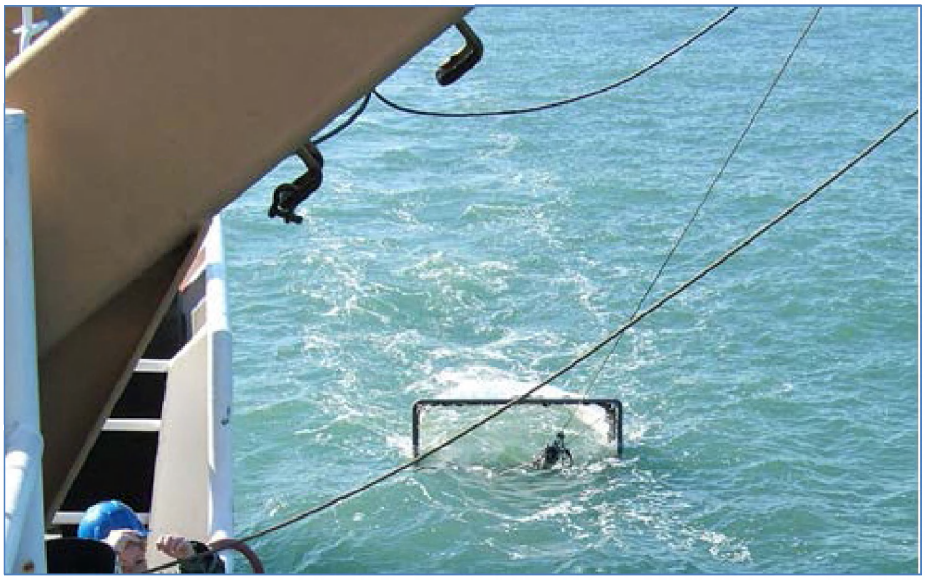

Figure 1. The standard SEAMAP single 1 m x 2 m neuston net being towed from NOAA RV GORDON GUNTER during a 2005 SEAMAP survey (NOAA 2011).

The direction in which the ship travels during the neuston net tow will be determined by weather conditions, primarily wind and swell direction. Navigational hazard information available to the captain, operations leads, and chief scientist should reviewed. When weather does not factor into the decision, it is preferable to tow towards the next station. The decision regarding which way to tow the neuston net will be the responsibility of the chief scientist, in discussion with the captain and operations leads.

Prior to deployment, ensure that the cod end of the neuston net is secure and that there are no rips or holes in the mesh. Perform repairs or make replacements as necessary.

The tow speed for net deployment is 1.5 - 2.0 knots through the water. Lower the neuston net so that it is half-submerged at the water surface. Record to the second the start time, which occurs when the gear is in the water, half-submerged, and fishing properly. The target duration for all neuston tows is 10 minutes, +/- 30 seconds. Record to the second the end time, which occurs when the net is out of the water. The duration of a neuston tow may be shortened to a minimum of five minutes when there are high concentrations of jellyfish, floating seaweed, or debris. It is very important to accurately record tow times, because tow duration is the only measure of fishing effort for neuston net sampling.

Neuston Net Sample Handling and Preservation

Sample handling protocols and preservation follow NRDA-developed protocols.

1. Wash down the neuston net with a low pressure seawater hose from the highest possible point, rinsing any specimens into the secured codend. If you place the neuston net on the deck, take care not to rest or scrape the frame against the net.
   - Large seaweed such as *Sargassum*, or other larger debris will be rinsed off (taking care to collect any rinsed plankton into net), quantified, recorded, photographed, and discarded. These items will not be kept due to storage capacity limitations. Detailed observations of larger debris should include abundance, wet weight, volume, and species.
   - Small fish and invertebrates that can easily fit into a sample jar should be preserved following the same preservation protocol as plankton.
2. Empty the codend of the net into a bucket with an icepack in the bottom. Rinse the codend and collar of the net thoroughly into the bucket.
3. Larger fish and invertebrates should be rinsed (taking care to retain any plankton in the bucket) and placed in plastic bags, labeled (cruise, station, and gear: put a label inside the bag and affix another label to the outside of the bag), and frozen.
4. If the sample contains a large volume of gelatinous zooplankton, the whole sample should be rinsed with sea water on a coarse sieve to separate out the larger jellies and ensure that the smaller organisms are retained in the bucket. Record the volume and species composition of sieved jellies using a calibrated large volume measuring device and photography.

5. Strain the plankton sample onto a sieve to remove excess water.
6. Rinse the plankton from the sieve into a sample jar using seawater. Do not fill jars more than ½ full with sample. Divide large samples into multiple jars.
7. When the sample is ready for preservation, add the internal label.
8. Preserve the samples in 10% buffered formalin as follows:
    - Ensure the sample jar has adequate space (1/3 volume) for the buffered formalin.
    - Measure 10 percent of the sample container volume of buffered formalin with a graduated cylinder and pour the buffered formalin into the sample jar.
        i.e. 500 mL sample jar – 50 mL buffered formalin
        1000 mL sample jar – 100mL buffered formalin
    - Fill any remaining sample jar head space with seawater and secure the jar lid.
9. Dry the outside of the sample jars and apply the external labels.
10. Once the jars have been labeled, wrap each jar entirely in clear tape to ensure that the label does not come off.

All samples will be held under NOAA NRDA chain of custody. All samples will be sent to Malinda Sutor's laboratory (or her designee) at Louisiana State University and stored in a secure facility.

Safety measures

- Wear the proper personal protective gear (PPE), which includes a hard hat, steel toe boots, and a personal floatation device (PFD) such as a work vest when working on the deck.
- Wear gloves and goggles when handling chemicals.
- Work in a well-ventilated area (outside or in the fume hood) with proper lighting when handling chemicals such as sodium borate, formaldehyde, or buffered formalin.
- Watch for slips, trips, and falls when entering or exiting the science lab and while working on the deck.
- Make sure that the channels of communication are properly used and everybody is following the same procedures of collecting, analyzing, and preserving samples.
- If you are unsure about any procedures or have any safety concerns, ask the watch chief or chief scientist.

Chemical storage

Store unopened formalin inside the fume hood or inside the flammable liquid storage cabinet that is outside of the wet lab.

Preparing buffered formalin

Buffered formalin is created by adding sodium borate (Borax can also be used) to the stock 37% formaldehyde solution. Sodium borate should be added in small quantities until the formalin

cannot hold any more and the borate begins to precipitate out of the solution. Test the buffered formalin with a pH strip to ensure that pH = 8. The buffered formalin is then ready to add to samples.

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National Marine Fisheries Service (NMFS) and Gulf States Marine Fisheries Commission (GSMFC). 2001. SEAMAP Field Operations Manual for Collection of Data. October 2001 (Revision No. 4).

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Deepwater Horizon Oil Spill (DWHOS)

Water Column and Fish Technical Working Group
Manta Neuston Net:
Description, Standard Operating Procedures, Sample Handling and Preservation

April 6, 2011

Manta Net Deployment

Plankton from the surface (neuston) layer of the water column will be collected using an 86 cm wide manta net that samples down to approximately 15.5 cm using 0.950 cm mesh (Figure 1). The manta net has been used by the California Cooperative Oceanic Fisheries Investigations (CalCOFI) plankton surveys since 1977. The manta net presents an improvement on the plankton sampling abilities of the standard SEAMAP neuston net (single or double 2 m x 1 m, 0.950 mm mesh). The manta net has moveable wings that act as floating hydroplanes, allowing the net frame to stay in close contact with the water surface during rough sea conditions and variable ship speeds, whereas the standard SEAMAP neuston net will bounce from the surface of the water (Brown and Cheng 1981, Jump *et al.* 2008). The asymmetrical bridles attached to the manta net cause it to tend away from the ship. Surface turbulence, especially from the bow wake of the ship, may disperse the neustonic plankton below the sampling range of the standard SEAMAP neuston net (Brown and Cheng 1981). In addition, a 45-kg weight attached to the towing cable in front of the manta net keeps the towing bridle away from the mouth of the net during sampling, which reduces avoidance of the net by faster moving zooplankton (Brown and Cheng 1981). Additional information on the manta net are available in: Ambrose *et al.* (2006), Brown and Cheng (1981), Jump *et al.* (2008), Moser *et al.* (2002), and NOAA (2003). Photos of the manta net assembly are available from CalCOFI (2011).

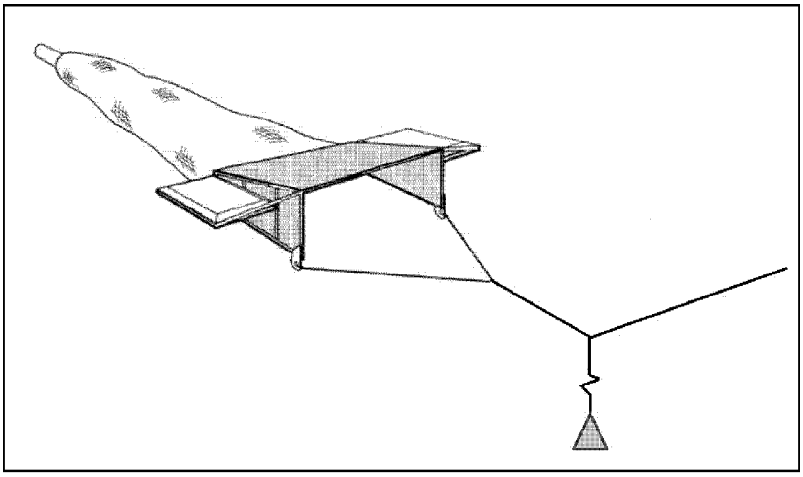

Figure 1. Schematic showing general manta net deployment.

The direction in which the ship travels during the manta net tow will be determined by weather conditions, primarily wind and swell direction. Navigational hazard information available to the captain, operations leads, and chief scientist should reviewed. When weather does not factor into the decision, it is preferable to tow towards the next station. The decision regarding which way to tow the manta net will be the responsibility of the chief scientist, in discussion with the captain and operations leads.

Prior to deployment, ensure that the cod end of the manta net is secure and that there are no rips or holes in the mesh. Ensure that there are no air bubbles in the flowmeter and that the flowmeter rotor spins freely and does not wobble. Perform repairs or make replacements as necessary. Record the start reading on the flowmeter.

The manta net is deployed off the side of the survey vessel. The target initial tow speed for manta net deployment is 1.5 - 2.0 knots through the water, although the final speed of the manta tow is determined by the angle of stray away from the ship. The manta net uses a 45-kg weight suspended on the mechanical wire. Lower the weight approximately 3 to 4 m below the water surface and connect the bridle clamp from the manta net to the mechanical wire. Lower the manta net frame to the surface of the water using the launching bridle or boat hook to assist in handling and keep the manta net frame from striking the ship's hull. Take caution that high winds will cause the flowmeter to turn prior to submergence. The net bag should be streamed out behind the frame. When the flowmeter begins spinning, record the tow start time. Let out the appropriate amount of mechanical wire (approximately 10 m or more), or if necessary, alter the ship's speed, to maintain the angle of wire stray from the ship between 15% and 25% during the tow. Carefully monitor the manta net during the tow to ensure that the towing bridle does not break the surface of the water. The book clamp that attaches the manta net towing line to the tow wire should remain approximately ½ m below the surface of the water. The ship's speed may need to be reduced below 1.5 knots.

Manta Net Retrieval

The target time for all manta net tows, from the time the flowmeter begins spinning until the time it stops, are 10 minutes. The duration of a manta tow may be shortened to a minimum of five minutes when there are very high concentrations of jellyfish, floating seaweed, or other debris- *i.e.* if a ten minute tow would result in the manta net being more than one half filled with debris. When retrieving the manta net, note the tow stop time when the manta net frame is lifted from the surface of the water and the flowmeter stops spinning. Using the launching bridle or boat hook to assist in handling, guide the manta net frame onto the deck. Take care to prevent the manta net frame from contacting the ship's hull and becoming caught during retrieval. Record the flowmeter reading as soon as practical. Place the frame and net on the deck (take care not to rest or scrape the frame against the net).

The manta tow should be repeated if the codend is lost or if it is over one half filled with large seaweed, jellyfish, or flotsam. Between stations, the manta net should be thoroughly cleaned to remove any debris or fine phytoplankton that have clogged the mesh.

Sample Collection and Preservation

Sample handling protocols and preservation follow NRDA developed protocols.

1. Wash down the manta net and frame with a low pressure seawater hose from the highest possible point, rinsing any specimens into the secured codend.
   - Large seaweed such as *Sargassum*, or other larger debris will be rinsed off (taking care to collect any rinsed plankton into net), quantified, recorded, photographed, and discarded. These items will not be kept due to storage capacity limitations. Detailed observations of larger debris should include abundance, wet weight, volume, and species.
   - Small fish and invertebrates that can easily fit into a sample jar should be preserved following the same preservation protocol as plankton.
2. Empty the codend of the net into a bucket with an icepack in the bottom. Rinse the codend and collar of the net thoroughly into the bucket.
3. Larger fish and invertebrates should be rinsed (taking care to retain any plankton in the bucket) and placed in plastic bags, labeled (cruise, station, and gear: put a label inside the bag and affix another label to the outside of the bag), and frozen.
4. If the sample contains a large volume of gelatinous zooplankton, the whole sample should be rinsed with sea water on a coarse sieve to separate out the larger jellies and ensure that the smaller organisms are retained in the bucket. Record the volume and species composition of sieved jellies using a calibrated large volume measuring device and photography.
5. Strain the plankton sample onto a sieve to remove excess water.
6. Rinse the plankton sample into a sample jar using seawater. Do not fill jars more than ½ full with sample. Divide large samples into multiple jars.
7. When the sample is ready for preservation, add the internal label.
8. Preserve the samples in 10% buffered formalin.
   - Ensure the sample jar has adequate space (1/3 volume) for the buffered formalin.
   - Measure 10 percent of the sample container volume of buffered formalin with a graduated cylinder and pour the buffered formalin into the sample jar.
     i.e. 500 mL sample jar – 50 mL buffered formalin
     1000 mL sample jar – 100mL buffered formalin
   - Fill any remaining sample jar head space with seawater and secure the jar lid.
9. Dry the outside of the sample jars and apply the external labels.
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- Wear gloves and goggles when handling chemicals.
- Work in a well-ventilated area (outside or in the fume hood) with proper lighting when handling chemicals such as ethanol, sodium borate, or formaldehyde.
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- Make sure that the channels of communication are properly used and everybody is following the same procedures of collecting, analyzing, and preserving samples.
- If you are unsure about any procedures or have any safety concerns, ask the watch chief or chief scientist.

Chemical storage

Store unopened formalin and ethanol inside the fume hood or inside the flammable liquid storage cabinet that is outside of the wet lab.

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Buffered formalin is created by adding sodium borate (Borax can also be used) to the stock 37% formaldehyde solution. Sodium borate should be added in small quantities until the formalin cannot hold any more and the borate begins to precipitate out of the solution. Test the buffered formalin with a pH strip to ensure that pH = 8. The buffered formalin is then ready to add to samples.

Manta Net and Frame Design

The design and dimensions of the CalCOFI manta net (Figure 2) were chosen for NRDA plankton sampling in the Gulf of Mexico. The CalCOFI manta net has 0.505 mm mesh. However, since the standard SEAMAP neuston net, which has been used to conduct previous plankton sampling in the Gulf of Mexico, has larger mesh (0.950 mm), NRDA manta net will also have 0.950 to be consistent with previous SEAMAP time-series data.

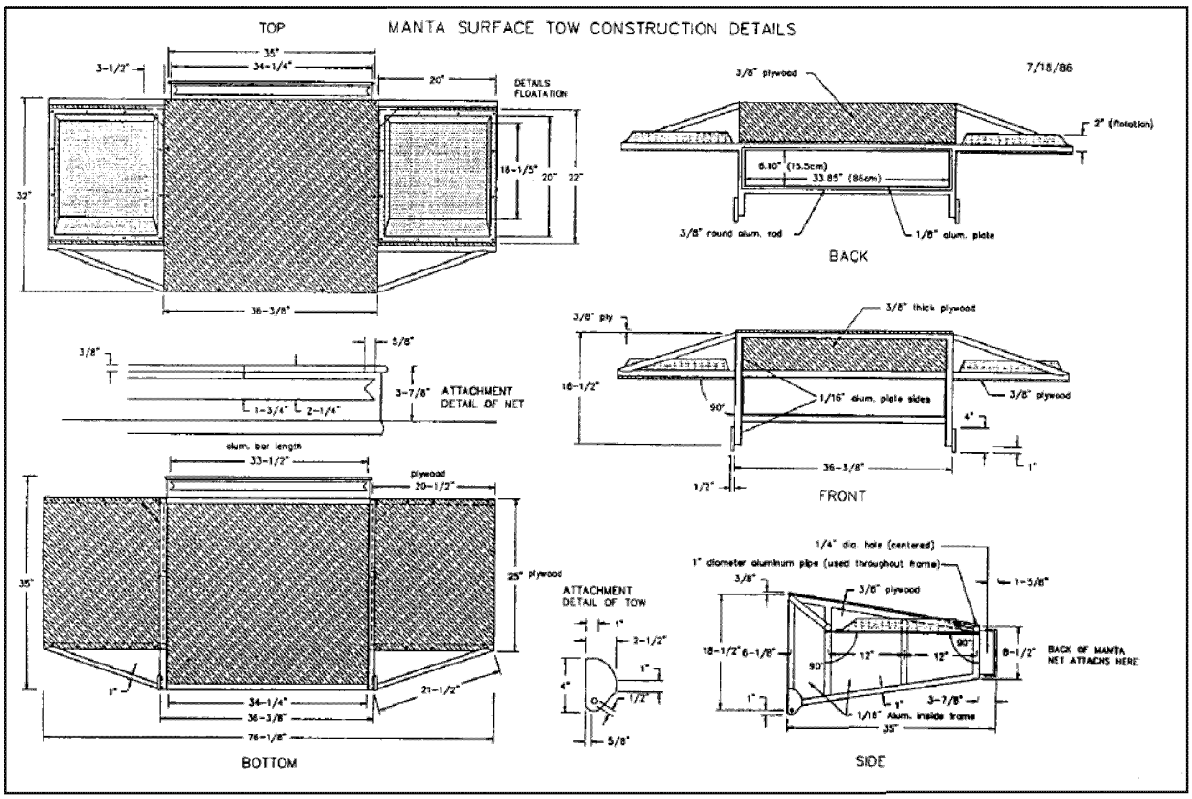

Figure 2. CalCOFI manta net specifications (NOAA 2003).

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