HDD Monitoring Plan

Prepared for:
Monterey Bay Aquarium
Research Institute

1 INTRODUCTION

This plan has been prepared for the Monterey Bay Aquarium Research Institute (MBARI) project in Moss Landing, CA. Specifically, this plan will apply to the horizontal directional drilling (HDD), also known as directional boring, process that will take place at MBARI's site on Sandholt Road. MBARI will be installing one bore drilled out into the Pacific Ocean. The HDD operation will take place in a permit-specified staging area and will occur during daylight hours.

Horizontal directional drilling is recognized as the least environmentally disturbing construction technique available for installing marine fiber optic cable landings. The alternative to HDD would be open trenching in the surf zone.

The HDD contractor agrees that the measures presented in this plan are incorporated into their work plan. The equipment to be used in the HDD operation includes: HDD rig, power unit, control cab, mud pump, wire control system, backhoe, crane, and other miscellaneous support supplies and equipment.

2 PURPOSE OF THE PLAN

The purpose of this plan is to establish monitoring and response criteria that will minimize the environmental effects of the HDD operation. The HDD operation uses drilling fluid to facilitate the drilling of a bore hole and installation of the bore pipe (associated casings, if any, are typically placed in the first 100 to 200 feet of an alignment). The drilling fluid mixture usually consists of water and bentonite clay for fresh water mixtures and attapulgite clay for salt water mixtures. In some cases inert, non-toxic loss circulation materials (LCM's) are added to the mixture. These LCM's include cotton dust, cotton seed hulls, wood fiber, M-1 Mica and cedar fiber.

The drilling fluid is composed of naturally occurring clay and water. The clay is insoluble and made up of small particles that function as both a lubricant for the drill head and pipe and a sealant that fills the pore spaces surrounding the drill hole.

With the HDD operation proposed most or all of the drilling fluids will be absorbed by the formation. It is anticipated that some fluids may be lost in lateral and subterranean fractures within the formation. Although highly unlikely, due to bore depth, it is possible that drilling fluids may reach the surface by following a vertical fracture in the formation (e.g., the fracture comes close enough to the surface that pressure causes the release of drilling fluid aboveground). Any fluid that is released will be considerably diluted relative to the original mixture because the overlying sediments will act as a filter which retains the insoluble clay within the seabed, whereas the water that makes up the fluid will continue to diffuse upward. The boring process utilizes drilling fluid to run the drill motor or jetting tool, depending on the type of material encountered, to cut through the earth material, seal off fractures in the formation and lubricate the bore pipe during installation. Drilling fluid is pumped down the inside of the drill pipe and exits through the drill head. The fluid can then return to the drill site through the space between the outside of the drill pipe and the geologic formation being bored. The drill fluid returning to the bore site is called "returns". At the beginning of the bore, a large percentage of the drilling fluid returns to the drill site. As the bore progresses, more of the returns are absorbed by the earth or rock formation and do not return to the drill site. Eventually, drill fluid returns will be reduced significantly or gradually cease.

It is important to note that although there may be a reduction or loss of drill fluid returns, it is not necessarily an indication that drill fluids are being released to the marine environment. The loss of returns may occur because of lower pressures and volumes, thereby allowing gravity and friction to overtake the ability of the fluid to return to the bore site. As previously described above, drilling fluid is also expected to be absorbed by the formation or is drawn down into fractures within the formation.

On the other hand, a complete and sudden loss of returns is a signal that something more significant may be occurring and to watch closely for a possible surface release. This plan identifies the procedures that will be implemented in the event of the loss of returns or pressure.

A worst case for the loss of drilling fluid would be the loss of the entire volume of a bore hole, which would be roughly 3,000 gallons of water and 770 pounds of clay. The likelihood of this type of loss will be reduced by increasing the depth of the bore to nearly 60 feet below the sea floor. However, if a release of this type and volume of material occurs in the shallow waters off of the landing sites, no significant effects on water quality or marine organisms are likely due to the characteristics of the clay and the rapid dispersion by strong waves and currents of any clay suspension that does emerge at the surface of the seabed.

A key to controlling a loss of fluids, which may reach the surface and limit the release into State waters, including the ocean, is early detection and quick response by the contractor. This plan identifies the activities to be monitored and appropriate response actions to be taken to ensure that any release of clay or LCM's is minimized. The plan outlines a process of monitoring the drilling fluid in order to identify a loss-of-returns situation and to determine if there is a release to the surface. Specific measures to be taken to reduce the amount and likelihood of surfacing drilling fluid, and other actions, are included.

3 TRAINING

Prior to the commencement of construction, the Contractor and engineer's personnel will attend a training session on-site. The training session will be conducted by, SAIC. Local jurisdiction representatives or resource specialists may also attend as necessary to meet local requirements. Topics covered in the training session will include:

- the details of this plan,
- the need for environmental protection,
- environmental resources located at or near the site,
- specific permitting conditions and requirements,
- the need to monitor the HDD operation,
- lines of communication,
- lines of authority and responsibility,
- the information the contractor will need to provide to the HDD monitor and engineering site representative,
- contact names and phone numbers of the appropriate individuals and agencies, and
- events that need to be reported and to whom.

The contractor will provide an overview of the drilling operation in their work plan.

The training session will ensure that contractor personnel fully understand monitoring requirements and recognize the authority of the agency on-site representative to stop drilling if not they are in compliance with monitoring and permitting requirements.

4 Monitoring of HDD Operations

4.1 Overview of Release Monitoring Program

The objective of the Release Monitoring Program is to quickly detect any release of drilling fluids and determine the size, extent and location of the release. Multiple data acquisition techniques were considered to accomplish this objective; these are:

- Fluorometery: A fluorescent dye (Rhodamine WT) will be added to the drilling fluid mix once drilling reaches the point at which the drill head is directly beneath the high tide line. A standard flow-through fluorometer will then be used to detect the presence of dye diffusing off any bentonite drilling fluids released to the environment. Since dye can be detected in the parts per trillion range, very little is needed in order to mark the site of release; the natural ocean currents will spread the dye out into a plume which can easily be traced.
- Visual: If the dye is detected, suggesting the possibility of a release of drilling fluids, visual inspections will be conducted from shore, boat and by divers using an underwater video system to assess the presence of a release of bentonite drilling fluids on the seafloor.
- Sediment sampling: Grab samples will be taken in areas of suspected bentonite release on the seafloor, based on fluorometry results.
- Side Scan Sonar will be available to assist in the detection of a large release confirmed by the above measures, including fluorometry and visual confirmation of a release to surface waters.

The data acquisition method to be used will depend upon the work zone and drill head location. The three basic work zones which exist at the project sites are: (1) the land portion of the drill from the rig to the mean high water mark; (2) the surf zone portion of the drill which is the area from the mean high water mark to the outer (deeper) limit of breaking waves, a distance which depends on bottom topography and swell conditions; and finally (3) the open water portion from the outer edge of the surf zone out to the end of the bore, where vessel operation is not limited by water depth or typical surf conditions.

Drilling conditions and monitoring results will be reported continuously to the agency on-site monitor so that the agency monitor can provide notification to the agencies in compliance with their requirements. All incidents in which a release of dye or drilling materials (see below) have been detected shall be reported promptly to the agency on-site monitor, who will be responsible in turn for reporting all incidents to the agencies (CCC, CSLC, and SWRCB).

4.1.1 Monitoring "Decision Making Team" (DMT)

In order to increase communication on-site and facilitate proper decision making, a Decision Making Team (DMT) will be established. The Decision Making Team will be made up of the contractor's superintendent, MBARI's on-site representative, SAIC's on-site representative, and the agency on-site representative. The Team's purpose will be to make decisions concerning the continuation of drilling operations given certain conditions. The agency on-site representative will have the authority to determine if drilling operations may continue, based on the conditions set forth in Section 5 of this plan.

4.1.2 Monitoring Along the Land Portion of the Directional Drill

On the land portion of the drill, visual inspection of the drill route and beach will be used to look for evidence that drilling fluid has surfaced. The field team will keep track of the drill head position and will focus their visual inspection in this immediate area and in sensitive habitats such as the intertidal zone.

4.1.3 Monitoring in the Surf Zone

In the near shore surf zone, where boating may be precarious, the field team will continue to utilize a discrete-sampling fluorometer and grab water samples to determine if any drilling fluids have been released to the seafloor. By sampling down current of the drill route, the field team will be detecting dye transported from drilling fluids that have become entrained in the turbulent flow of the surf. Fluorometry will be in place so that sampling can begin as soon as the drill head is directly beneath the high tide line. For shoreline sampling, samples will be carried from the beach to the fluorometer, which will be kept in a van or portable shelter in the construction staging area.

4.1.4 Monitoring in the Open Waters

Boat monitoring is proposed to begin when the drill head is beyond the surf zone (typically 200 to 500 feet beyond the high tide line). This distance will depend on weather conditions and location. In the open waters, the monitoring equipment and manpower will consist of a monitoring platform (survey vessel capable of operating under moderate weather conditions, served by a dynamic electronic positioning system, DGPS), a first level detection system, consisting of remote sensing hardware (continuous flow fluorometer), and a second level inspection system consisting of scuba divers using an underwater video system.

This arrangement should provide the greatest operating range for the monitoring crew and the quickest method for detection. Additional description of the equipment and monitoring operation is provided in section 4.2 below.

The survey vessel and navigation system will operate in daylight hours, concurrent with the drilling operation, under all safe weather conditions, up to U.S. Coast Guard Small Craft Warnings, whenever drilling activities are on going. The first level of detection, remote sensing, will be operational within the same envelope. The second monitoring level, diver-controlled video has an operational envelope of up to about 3-foot seas. The diver-controlled video will be utilized, within the safety envelope, to confirm any anomalies detected by fluorometry and visual observations. Once visual confirmation of a spill is made by divers, remote sensing hardware (side scan sonar) will be deployed. It is important to note that the ship's captain has the final responsibility of determining the safe sea conditions.

4.2 Equipment

- Survey Vessel
- Fathometer
- Digital Recording Fluorometer
- Rhodamine WT Dye
- Diver-controlled underwater video camera
- Grab Sampler
- Side scan sonar

4.2.1 Survey Vessel, Positioning and Navigation

Data collection will be conducted aboard a survey vessel. Vessel positioning will be accomplished using a Differential GPS system interfaced with navigation computer software. The system will provide reliable, high-precision positioning and navigation for a wide variety of operations and environments.

During monitoring operations the survey vessel will be piloted along predetermined track lines, along and to either side of the drill route.

4.2.2 Fluorometry

To be able to detect the presence of bentonite drilling fluid released to the ocean, the drilling fluids will be marked with a soluble fluorescent dye tracer. Rhodamine WT, a biodegradable, fluorescent tracer that is extremely soluble in water and detectable in very small concentrations (less than 0.1 parts per billion), will be utilized for this project. The dye is supplied as a 20 percent aqueous solution. The dye will be mixed into the drilling fluid to approximately 5,000 ppb. The drilling crew and SAIC representative will visually monitor the dye concentration entering the borehole as well as returning to ensure it will be able to be detected by the remote sensing equipment. It has been shown in laboratory tests and in several prior drilling projects that the dye will solubilize from a drilling fluid mixture made according to driller specifications. The released dye will be detectable using fluormetric techniques. The dye is also visible to the eye.

Based on direct information from other bore sites in the State, the fluorescent tracer is highly visible when mixed into the drilling fluid. The dye turns the drilling fluid a light to medium pink color. However, it is not expected that the dye will be highly visible to the naked eye if it should surface in the ocean. The ocean turbulence will dilute the dye to the point where it is not easily seen, but will be detectable by the equipment.

Dye concentrations in the water column will be monitored using a fluorometer probe system linked to a laptop computer.

Since the fluorescence of dye varies with sample temperature, the water sample temperature will be recorded with the fluorescence data. These temperature data are used during real time processing to correct the dye concentration data for temperature variations.

The fluorometer system installed aboard the survey vessel will monitor for the presence of dye. Hourly sampling and testing will be conducted along the bore route, at varying depths.

The initial dye concentration of the fully mixed drilling fluids will be approximately 5000 ppb. Based on recent tests, it is expected that solubilized dye concentrations in the water just over released drilling fluids will be in the range of 10 to 50 ppb. Dye concentrations will be used to assist in location the release point prior to visual confirmation by following the dye concentration gradient to its maximum point.

Pre- and post-survey calibrations of the fluorometer will be conducted using standard solutions prepared with dye drawn from the same lot as used for the study. This will insure the maximum dynamic range of sensitivity for this project. Calibration solutions will be prepared employing Class A glassware as established by the National Bureau of Standards.

4.2.3 Diver-Controlled Underwater Video

In the event that drilling fluids are detected in the marine environment, underwater video imaging will be collected using a diver-controlled video camera appropriate for shallow-water documentation (e.g., to about 40 foot depths).

The video camera will provide real-time observations of the seabed and underwater environment that will be recorded on VHS videotapes. A time record on the videotape will allow direct comparison with navigational positions of the survey vessel, which will "live boat" at a safe distance from a surface buoy marking the diver positions.

The camera will be used to document the features of a suspected area of drilling fluid release.

The divers will descend to the bottom on the buoy down line and perform a circle search of approximately 25 feet. In addition to video documentation, the divers will collect seabed samples and assess bottom features.

4.2.4 Benthic Sampling

Sampling will be employed to confirm the fluorometry data by using a grab sampler. Bottom coring, employing a grab sampler deployed from the survey vessel or four-inch diameter plastic tubes operated by divers, will be used to collect samples of surficial sediments. Whichever the deployment methodology, the corer will be inserted into the bottom, a sample collected, and returned to the surface. Upon recovery, the samples will be measured, described and photographed, if bentonite is detected.

4.2.5 Side Scan Sonar

Once a spill is confirmed using the techniques described above (fluorometry, diver video, and grab samples), a side scan sonar will be deployed and towed over the affected area. Post-processing of the side scan data will be done offsite after the installation is complete. It must be noted that based on past installation experience in other areas off the west coast of California with similar bottom habitat and currents and anticipated sea conditions, side scan sonar was not used because it would not be successful at documenting spills because it is not expected that a release of bentonite on the bottom would accumulate to the point that it would be detectable by sonar.

5.0 RELEASE MONITORING AND OPERATING CONDITIONS

5.1 Overview of HDD Operating Conditions

Because the porosity and composition of the subsurface soils at the bore location, specific HDD technique and past experience indicates that there is a high possibility that loss of returns will occur, but a frac-out (release of drilling fluid to the ocean) is highly unlikely. In addition, the bore will be drilled at a depth of 60 feet below the sea floor to further reduce the likelihood of a frac-out. The bedding arrangement of this type of near shore zone typically has a high ability to absorb the bentonite drilling fluids into the existing formation, keeping the material underground and away from the surface. Previous HDD projects have shown that loss of returns is almost inevitable once the drill head advances beyond 450 to 550 feet from the start of the bore. This loss of returns does not mean that a release of drill fluid will occur. Rather, it indicates that the existing sediment formations are absorbing the material and that the drilling pressures being used are not strong enough to force the drilling fluid back to the drill site. The following general parameters will be incorporated during the drilling process.

1. Maintain adequate cover between the drill path and surface during the bore, except at entry and exit.
2. Adjust the viscosity of bentonite mixture to match the substrate conditions.
3. Closely monitor drilling pressures and penetration rates to optimize drill penetration into the formation.
4. When loss of circulation occurs, very little time will be spent trying to regain returns once under the sea floor. The HDD Contractor will proceed with the installation process even after loss of returns using increased penetration rates wherever possible. However, the ability of the formation to absorb the bentonite and still maintain drill performance is very good. Spending time trying to regain returns at a specific location could result in over pressurizing at a single point thus resulting in bentonite migration to the surface (i.e., frac-out).

The directional bore activities have been designed to avoid and otherwise minimize the potential for impact to sensitive areas. Additional protocols to be employed at the site include but are not limited to:

- Conducting on-site briefings for the work crew to identify the location of sensitive resources at the site.

- Ensuring that all field personnel understand their responsibility for timely reporting of frac-out releases.
- Maintaining necessary response equipment on-site, or at a readily available location, and in good working order.

5.2 Monitoring Conditions

The following table presents the operational measures and monitoring measures to be implemented given certain conditions and events.

Table 5.2 Operational and Monitoring Measures

Condition	Status of Drilling Returns	Dye Detected	Bentonite Release Detected	Operational Measures to be Implemented	Monitoring Operations
1	Normal expected drilling fluid returns`	No	No	Standard drilling procedures	- Spot visual inspection of bore path over land. - Beyond high tide mark, fluorometry readings will commence from shore. Beyond surf zone, offshore fluorometry readings by vessel will commence
2	Loss of normal expected drilling fluid returns`	No	No	The Contractor will take appropriate measures to attempt to restore retums. These may include: - Modifying drilling fluid properties Modifying pressure and volume[2] Advance or retreat pilot stem Introduce LCM's according to manufactures instructions `	- Spot visual inspection of bore path over land. - Between water line and 1000' off shore, fluorometry readings will commence from shore. Beyond surf zone, offshore fluorometry readings by vessel will commence
3	Normal expected drilling fluid returns`	**Yes**	No	The Contractor will attempt to determine if a drilling fluid release is occurring. If so, Condition 4 operational measures will be implemented. Additionally, the Contractor will take appropriate measures to attempt to prevent a possible drilling fluid release. These may include: - Modifying drilling fluid properties [1] Modifying pressure and volume[2] - Advance or retreat pilot stem Introduce LCM's according to manufactures instructions `	Fluorometer readings have detected a dye release. - Continue fluorometer readings from shore - Offshore fluorometry readings by vessel will continue beyond surf zone - Initiate grab sampling of ocean floor sediments. - Commence in-water survey including diver surveys and video - Conduct shoreline survey for wash-up of drilling fluid.

Condition	Status of Drilling Returns	Dye Detected	Bentonite Release Detected	Operational Measures to be Implemented	Monitoring Operations
4	Loss of normal drilling fluid retums. °	Yes	Yes	Work will temporarily cease to locate and quantify the release as described in the monitoring operation. The Contractor will take appropriate measures to attempt to reduce or eliminate the release. These may include: Modifying drilling fluid properties - Modifying pressure and volume[e] Advance or retreat pilot stem Introduce LCM's according to manufactures instructions°	Determine the location and extent of the drilling fluid release. Continue with monitoring method that detected the release and: - Continue fluorometer readings from shore - Offshore fluorometry readings by vessel will continue beyond surf zone. - Initiate grab sampling of ocean floor sediments. - Commence in-water survey including diver surveys - Conduct shoreline survey for wash-up of drilling fluid. Conduct side scan sonar survey of affected area.

General Notes:

- Dye will be injected for each pipe prior to the drill head reaching the mean high tide level
- Safety for boat operation based on Beaufort scale and sea state condition with decision to launch left to vessel captain.

Footnotes to Table:

1. Drilling fluid properties include viscosity and gel strength. The viscosity will typically range between 60 and 70 seconds viscosity. Adjustments may be to modify them to between 40 and 90 seconds viscosity.
2. Drilling fluid volume and pressures are typically reduced to minimize impacts.
3. The manufacturer of each LCM specifies the best methods of using the material. The Contractor will follow the manufacturers recommendations when using LCM's.
4. It is expected that a certain amount of drilling fluid will be lost into the formation and at a point, lost altogether. It is expected that all returns will be lost within 500 to 600 feet of each bore. When the loss of returns reaches 30% and when it reaches 100%, the agencies will be notified by the agencies' on-site representative.
5. Water samples from the shore will be obtained by wading into the water (if possible) or by casting sample container into the wash zone to collect the sample.

6.0 RELEASE MONITORING AND OPERATING SCENARIOS

6.1 Condition 1: Routine Monitoring

Routine monitoring will apply when the drilling operations are proceeding within expected parameters. The routine monitoring will be conducted by the monitoring team consisting of a monitor provided by SAIC and an agency on-site representative. The contractor and SAIC monitor will be responsible for supplying information to the agency's independent on-site representative. Using the information provided, the status of the drilling operation will be determined. The agency on-site representative will inform both the contractor and the field data collectors of the condition of the drilling operation. This information will also be recorded in logs.

6.1.1 Operational Measures To Be Implemented

The contractor shall supply the following information to the monitoring team at the completion of each joint of pipe:

- Position of the drilling head relative to the drilling point of entry.
- Recording of the total volume of drilling fluid that has been pumped during the drilling operation.
- Comparison of the current total volume of drilling fluid used and the estimated current total volume of returns.
- Equipment breakdowns and repairs.
- Any abnormal drilling fluid pressure at the time of occurrence.
- The type and quantity of drilling fluid components and dye being used.

6.1.2 Release Monitoring

During normal drilling conditions, the type of monitoring necessary will depend on the location of the drill head. Periodic visual inspection along the bore path of the terrestrial portion of the alignment will take place throughout the bore operation. As the bore head advances beyond the waterline a tracer dye will be added to the drilling fluid and, periodic fluorometry readings will commence. These readings will be taken by discrete water samples from the beach at a minimum rate of **once per hour** or more frequently if returns or pressure data warrant if a release of bentonite or dye is detected, then the monitoring operations for Condition 3 or 4 will apply. Offshore monitoring is done on a continuous (flow-through) basis with recordings of the results every 15 minutes.

6.2 Condition 2: Loss of Normal Expected Returns or Complete Loss of Returns Beyond 1000 Feet Off Shore

6.2.1 Operations Program

Loss of circulation or drilling fluid returns is expected. It is expected that the return of drilling fluid will end by the time the drill head reaches 450 to 550 feet downhole. Because a majority of the drilling operation will take place under Condition 2 status, the following sequence of operations will be put in place:

- The contractor will notify the DMT (Decision Making Team) of the loss of returns.
- Because it is expected that there will be a complete loss of circulation at a point in each bore, the contractor will spend very little time trying to regain returns once 450 feet to 550 feet of pipe has been installed.
- The Contractor, in consultation with the engineer and the DMT will determine the appropriate actions to be taken. The Contractor's rationale of implementing particular measures will be communicated to the DMT. The measures that may be used include the following:

    1) Modifying Drilling Fluid Properties. The Contractor may determine that modification of the drilling fluid properties will aid in restoring the circulation. These modifications can take place in the form of altering the viscosity or gel strength of the drilling fluid
        a) Viscosity: Viscosity of the drilling fluid may be adjusted up or down depending on the subsurface formation and materials encountered and other drilling conditions. Typical viscosity will range from 60 to 70 seconds viscosity as measured with a standard Marsh Funnel. Viscosity may be adjusted to ranges from 40 to 90 seconds viscosity in an effort to restore returns.
        b) Gel Strength: The gel strength of the drilling fluid refers to the shear strength of the fluid as is sets. This characteristic can be modified slightly up or down depending on the drilling conditions in an effort to restore returns.
    2) Introduce LCM's: LCM introduction into the drilling fluid may be desirable at this point. The possibility of success using LCM's to restore returns will depend on the drilling and subsurface conditions at the time. If used, the LCM's will be used according to the manufacturer's recommendations. The supplier of each LCM has determined the most appropriate implementation technique for the material. The contractor will carefully follow the supplier's recommendations to give the LCM's the best chance for success.

- If bentonite is detected as being released to the surface, Condition 4 operations will take effect.

6.2.2 Release Monitoring

Upon notification of loss of returns the monitoring team will elevate to Condition 2 status and prepare for fluid release monitoring. Normal monitoring using visual inspection and fluorometer from the shore will continue as described in Condition 1 until the drill head moves beyond the surf zone (typically 200-500 feet off shore). Beyond the surf zone, monitoring at Condition 2 status events will depend on sea and weather conditions.

Once the drill head moves beyond the surf zone, the monitoring team will activate the offshore survey team who will use the continuous flow fluorometer to sample near the location of the drill head.

If the tracer dye is detected by the remote sensing equipment, the status will be elevated to Condition 3. The DMT will be notified of the detection and the appropriate agency notifications will take place.

If the survey vessel is unsuccessful in locating or detecting the presence bentonite or dye and circulation has been re-established by the driller, the status will return to Condition 1.

If a loss of circulation continues and does not cause a detectable release of bentonite or dye, the survey vessel will widen its search to outside the drill head location. A pass will be made on each side of the drill alignment. A log of all monitoring and drilling operations shall be kept by the DMT and shall be available for review by regulatory agencies at all times. Estimated quantities of drilling fluid used when loss of circulation occurs shall be recorded

if a release of bentonite is detected, the status will be elevated to Condition 4.

6.3 Condition 3: Detection of Dye: No Bentonite Release Detected

This condition will apply when the tracer dye is detected by a fluorometer, but there is no immediate evidence or observation of a release of the bentonite. If a bentonite release is detected at the same time the dye is detected, the status will be elevated to Condition 4.

6.3.1 Operations Program

- The DMT will meet to discuss the likelihood of a drilling fluid release.
- Enhanced monitoring will commence (See section 6.3.2).
- Drilling will cease if ordered to do so by the agency on-site representative or when the contractor deems it advisable.
- The Contractor, in consultation with the DMT will determine the appropriate actions to be taken. The contractor's rationale of implementing the

particular measures will be communicated to the DMT. The measures that may be used include the following:

1) Modifying Drilling Fluid Properties. The Contractor may determine that modification of the drilling fluid properties will aid in restoring the circulation and help make sure no release of drilling fluid occurs. These modifications can take place in the form of altering the viscosity or gel strength of the drilling fluid
   a) Viscosity: Viscosity of the drilling fluid may be adjusted up or down depending on the subsurface formation and materials encountered and other drilling conditions. Typical viscosity will range from 60 to 70 seconds viscosity as measured with a standard Marsh Funnel. Viscosity may be adjusted to ranges from 40 to 90 seconds viscosity in an effort to restore returns.
   b) Gel Strength: The gel strength of the drilling fluid refers to the shear strength of the fluid as it sets. This characteristic can be modified slightly up or down depending on the drilling conditions in an effort to restore returns.
2) Introduce LCM's: LCM introduction into the drilling fluid may be desirable at this point. The possibility of success using LCM's to restore returns will depend on the drilling and subsurface conditions at the time. If used, the LCM's will be used according to the manufacturer's recommendations. The supplier of each LCM has determined the most appropriate implementation technique for the material. The contractor will carefully follow the supplier's recommendations to give the LCM's the best chance for success.

- During any drilling shut down period the contractor will be permitted to circulate drilling fluid on a two hour cycle for a period of approximately 15 minutes to prevent the drilling equipment and pipe from seizing.
- If the dye has been detected, but circulation has not been lost, and bentonite release is detected, drilling will continue.

6.3.2 Release Monitoring

Upon notification of the detection of the dye the monitoring team will elevate to Condition 3 status and prepare for fluid release monitoring. Normal monitoring using visual inspection and fluorometer will continue as described in Conditions I and 2.

6.3.2.1 Plan A Monitoring

Once the dye is detected, the monitoring team will activate the in-water survey team who will mark the location of the head of the drill with a surface buoy and begin using the remote sensing equipment. Fluorometry measurements will continue in order to track the concentration gradient of dye back to the areas of the source of the release on the bottom.

Bottom sediments in the area of suspected release will be sampled with a grab sampler deployed from the same vessel. Samples will be retrieved and inspected onboard the vessel to determine whether bentonite is present. Samples will continue to be taken in this manner until either the presence of bentonite in the sediments is confirmed, or dye is no longer detectable in the water column.

Divers will be deployed to search for a point of release on the seafloor, using an underwater video recording system to document each dive. If their initial search fails to detect a bentonite release, the divers will make subsequent searches as long as the dye continues to be detected.

The DMT will be notified of the detection and the appropriate agency notifications will take place.

If the survey vessel does not locate or detect the presence of dye or bentonite and the dye ceases to be detected, the status will return to Condition 1 or 2 as appropriate.

If the detection of the dye continues and there is no detectable release of drilling fluid, the survey vessel and or divers will widen their search to outside the drill head location. A pass will be made on each side of the drill alignment. A log of all monitoring and drilling operations shall be kept by the monitoring team and shall be available for review by regulatory agencies at all times. Estimated quantities of drilling fluid used when loss of circulation occurs shall be recorded.

If a release of bentonite is detected, the status will be elevated to Condition 4.

6.4 Surface Release of Drilling Fluid

This section applies in the case where the bentonite drilling fluid is detected on the ocean floor.

6.4.1 Operations Program

- Drilling will cease for a minimum of 2 hours to determine the actions need to be taken and to take those actions.
- The Contractor, in consultation with the DMT will determine the appropriate actions to be taken. The contractor's rationale of implementing the particular measures will be communicated to the DMT. The measures that may be used include the following:
  1) Modifying Drilling Fluid Properties. The Contractor may determine that modification of the drilling fluid properties aid in restoring the circulation. These modifications can take place in the form of altering the viscosity or gel strength of the drilling fluid

a) Viscosity: Viscosity of the drilling fluid may be adjusted up or down depending *on the subsurface formation and* materials encountered *and* other drilling *conditions.* Typical *viscosity* will *range from 60 to* 70 seconds viscosity as measured with a standard Marsh Funnel. Viscosity may be adjusted to ranges from 40 to 90 seconds viscosity in an effort to restore returns.

b) Gel Strength: The gel strength of the drilling fluid refers to the shear strength of the fluid as is sets. This characteristic can be modified slightly up or down depending on the drilling conditions in an effort to restore returns.

2) Introduce LCM's: LCM introduction into the drilling fluid may be desirable at this point. The possibility of success using LCM's to restore returns will depend on the drilling and subsurface conditions at the time. If used, the LCM's will be used according to the manufacturers recommendations. The supplier of each LCM has determined the most appropriate implementation technique for the material. The contractor will carefully follow the supplier's recommendations to give the LCM's the best chance for success.

- During any drilling shut down period the contractor will be permitted to circulate drilling fluid on a two hour cycle for a period of approximately 15 minutes to prevent the drilling equipment and pipe from seizing.
- Following consultation with the Agency's on-site representative, drilling will resume. If monitoring does not detect a bentonite release, drilling will continue.
- If the release has not stopped, drilling will cease again, the measures will be reapplied as necessary, and the steps above will be taken in consultation with the DMT.

6.4.2 Release Monitoring

Upon detection of the release of bentonite, the status will elevate to Condition 4. The monitoring method that detected the release will be continued.

Once the bentonite is detected, the monitoring team will activate the in-water survey team who will mark the location of the head of the drill with a surface buoy and begin using the remote sensing equipment. Fluorometry measurements will continue in order to track the concentration gradient of dye back to the areas of the source of the release on the bottom. Grab sampling of the bottom sediments and diver video survey will continue as initiated during Condition 3 to determine the location, extent, and dispersion of drilling fluid, and whether the release is continuing. This information will be used by the DMT to determine the appropriate course of action. If deemed necessary by the DMT, a side scan sonar unit will be deployed over the affected area.

All monitoring team members will be notified of the detection and the appropriate agency notifications will take place.

Monitoring of the release will continue in this manner until the release ceases or the DMT identifies an alternative course of action that is appropriate under the circumstances.

7.0 HDD DRILLING FLUID CLEAN-UP PLAN

7.1 Bore Operations Procedures

Before a directional drilling operation may begin, the Owner will ensure the drilling crew is properly informed of all aspects of this Spill Contingency Plan and of permit requirements, as described by the local agency(ies). The drilling crew will also be briefed on environmental monitoring procedures used to detect drilling fluid releases. In addition, the drilling crew will understand their obligation to immediately report bentonite releases and to follow the steps outlined in Section 6 of this plan at the first confirmation of the occurrence of a bentonite release.

7.2 Construction Setup

The following protocol applies to all pre-planned directional bores:

- The Owner in coordination with local agency(ies), will designate one or more Inspectors at those bore operations where such Inspectors are required;
- If required at the bore location, the Inspector(s) will participate in all construction meetings; and
- The Inspector will ensure that spill containment materials are available and in good working order.

7.3 Response Equipment

All equipment required to contain and clean up a bentonite release will either be available at the work site or readily available at an offsite location within one (1) hour of the bore site. The equipment includes the following:

- On-site-Heavy weight plastic gravel filled and sealed bags (at least 20 bags);
- On-site-Geotek filter bags 10x12-foot size or equivalent (at least 3 bags per segment);
- On-site-Several 5 gallon hard plastic pails;
- On-site-One wide heavy-duty push broom;
- On-site-Three flat blade shovels;
- On-site-Slit fence and T-posts or straw bales, as appropriate;
- On-site-Two bundles of absorbent pads to use with plastic sheeting for placement beneath motorized equipment while in operation in a riparian stream zone;
- On-site Plastic Pipe

- On-site-Portable pumps;
- Offsite-A minimum of 100 feet of hose; and
- Offsite-Vacuum trucks (800 or 3,000 gallon).

All primary containment equipment (i.e., all of the above items except the vacuum trucks and 100 feet of hose) will be kept on-site. Vacuum trucks and hose will be maintained on-site under the following circumstances: (1) the crossing contains sensitive species; or (2) the bore has experienced a previous bentonite release.

7.4 Field Response to Bentonite Release Occurrence

The response of the field crew to a bentonite release will be immediate and in accordance with procedures identified in this section. All appropriate emergency actions that do not pose additional threats to sensitive resources will be taken, as follows;

- Boring operations will continue or stop, as outlined in Section 6;
- The Inspector will be notified to ensure adequate response actions are taken and notifications are made;
- A dike/berm may be constructed around the site to entrap released drilling fluid;
- Any existing berms, barriers, or silt fence established and strengthened, as necessary, to contain drilling fluids; and
- Response equipment stored offsite in readily accessible locations (e.g., fully equipped 800 or 3,000 gallon vacuum trucks and 100 feet of hose) will be mobilized to recover larger releases when needed.

7.4.1 Cleanup Response

The clean up activity that can be undertaken will depend on the sea and weather conditions at the time.

Immediately following detection of a drilling fluid release the following actions will be taken:

- The cleanup crew will be notified and the dive team will be mobilized to the project site. Mobilization is expected to take less that four hours.
- Intensive monitoring of the release area by the survey vessel shall be implemented.

The following is a description of the work covered in this section and the materials and equipment to be utilized.

Divers equipped with specialized water lifts (pumps) and filter bags will be used to remove the discharged bentonite drilling fluid from the sea floor. The divers,

using remote hoses will vacuum up the material pumping it through extremely fine mesh filter bags that will trap the clay sized particles. Each bag will be recovered onto a diving support vessel, brought to shore and disposed of at an approved offsite location.

In the event a bentonite release occurs on land the release will immediately contained with silt fence or hay bales. The drilling fluid will be transferred manually or by pump back to the drill site for reuse or into a storage tank and removed from the site.

The divers shall maintain records of the quantity of drilling fluid removed, the transferal of the material to a disposal facility and the daily status of cleanup operations. The contractor shall be responsible for disposing of the vacuumed material and waste drilling fluids according to the local, state and federal regulations.

Records or manifests of the disposal shall be furnished to the agencies upon completion of the work.

7.5 Response Closeout Procedures

When the release has been contained and cleaned up, response closeout activities will be conducted at the direction of the Inspector (and with approval local agency(ies), as required), and may include the following:
The recovered drilling fluid will either be recycled on-site or hauled to an approved Class II facility for disposal by the Owner's Subcontractor specializing in the removal, transport and disposal of drilling fluids; All sites will be returned to pre-project contours - erosion control measures will be applied as needed to ensure protection of the waters. Sump pits at bore entry and exit locations will be filled and returned to natural grade; and all protective measures (fiber rolls, straw bale, silt fence, etc.) will be removed unless otherwise specified by the inspector.

No recovered drilling fluids will be discharged into the ocean, streams or storm drains.