HOUSING DEVELOPMENT KILDALKEY ROAD, TRIM

METHOD STATEMENT FOR INSTALLATION OF 125MM RISING MAIN UNDER RIVER BOYNE

INSTALLATION OF 125mm UNDER BOYNE BY HDD

Method Statement

DUNNES DRILLING SERVICES LTD.

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INTRODUCTION

This document describes the methodology of construction, the material specifications and the means of managing the various specific risks associated with the scheme.

The scope of works associated with this project;

To install 125mm rising main under River Boyne through rock for housing development, Kildalkey Road Trim.

DRAWINGS

Drawings of the proposed drills will be included in the Workpack provided for the crossing for access by the project team.

Ensure the work is completed to the latest drawing revision prior to works being undertaken. A copy of the profile drawing will be available at each of the drill locations.

SITE PREPARATION

CLIENT INFORMATION

The Client shall provide unless otherwise agreed information including welfare requirements for inclusion into the project file. This shall be briefed to personnel as part of the site induction. If this is not the case, the site manager/supervisor shall either ensure arrangements are made or the whereabouts of local facilities are briefed to all personnel.

REVIEW OF GEOLOGICAL INFORMATION

Dunnes Drilling will utilise all the information in relation to any geological survey that may have been undertaken as part of the design phase of the contract. Where geological information has been provided or ascertained by borehole examination the information will be considered by the drilling manager before commencement for tooling and fluid management planning.

Ground conditions shall be inspected prior to activities being undertaken. This may include trial holes at various locations to establish the ground conditions. These will be conducted via the utilisation of insulated hand tools.

If there is a suspect of contamination, then work should cease immediately and be reported to the Client or his / her nominated representative.

REFERENCE DOCUMENTS

REFERENCE DOCUMENTS

A Work pack will be provided at each crossing location. This will include drawings, Rams, plant certification and service drawings. Drawings and service drawings to be provided by Client.

OTHER DOCUMENTS AND PROCEDURES

All works will be completed and monitored.

RISK ASSESSMENTS

Each team will be issued with Dunnes Drilling risk assessments which include control measures that maybe applied. These are complimented via the utilisation of a documented pre-start assessment with findings being brought to the attention of personnel that may be affected by our activities.

Any Client assessments that are completed will be assessed and brought to the attention of personnel prior to activities being undertaken. Signatures will be obtained from all attendees which includes employees, clients and visitors as a means to ensure compliance is understood.

PRE-COMMENCEMENT REQUIREMENTS

All personnel shall be inducted prior to activities being undertaken by the Principal Contractor as per their obligations under the Construction (Design & Management) Regulations 2015.

- The following stages shall be adhered to;
- All personnel attend the induction
- Ensure emergency procedures are understood which includes contact details
- Traffic routes and working times (including delivery times) are known.
- PPE checks are made and worn at all times.
- Daily checks of plant and equipment and site based risk assessments completed.
- Any restrictions including environmental risks and constraints identified and briefed to all involved in the project.
- All attendees must sign onto the applicable documentation i.e. Pre-start assessment, site log book, SPA's and any other applicable documentation associated with the project.
- Obtain permits associated with the working activities.
- Ensure safe access to the work area.
- Service drawings are checked, and the route checked via utilization of CAT and Genny where required.
- All services marked using the applicable marking applications i.e. paint, wooden stakes or marker flags.
- Excavations have the appropriate barriers in place to prevent unauthorized access or falls from height.
- Signage put in place to identify excavations.
- Good housekeeping is observed at all times.

RESOURCES – MATERIALS

MATERIALS

- Material will generally be stored in the client's site compound for removal by Dunnes Drilling employees or positioned on the site at a suitable location. Attention shall be paid to the manual handling techniques deemed applicable to this operation.
- Materials stored at the working area shall be stacked in a safe a sequential manner to prevent falling, mixing of materials and also to ensure maximum efficiency may be achieved.
- No materials shall be placed within 16 meters of any water course.
- All work areas shall be kept clean and be regularly inspected by designated personnel who are undertaking the works throughout the time of the project.
- Spill containment measures shall be in force for the duration of the project which includes; spill containment kits and absorption materials to use in an event. Site based personnel shall be trained in usage in case of an emergency.

Materials used are as follows;

No	Type
1	180mm and 125mm pipe
2	Bentonite
3	Soda Ash
4	Marker paint
5	
6	
7	
8	
9	Spill kits

PLANT AND EQUIPMENT

Plant and equipment used for the project. Certification with equipment or in project files. Additional copies available at Dunnes Drilling office.

No	Type	Usage / Notes
1		
2	Ditch With JT60AT	
3	Dupagro MPR7E Recycler	
4	Vehicles	
5	Generator	
6	Pumps	
7	Lorry mounted mixing system	
8	Falcon F5 tracker	
9	Digi Track	
10	welfare facilities	Provided.

CERTIFICATION

Thorough inspections, test inspection and certification will be included in Work pack. Copies will be available in Dunnes Drilling office and will be forwarded to respective personnel upon request.

When plant and equipment is hired, certification will be obtained at the point of delivery. This will be either left with the item or placed in the project file, available for inspection.

BARRIERS / FENCING AND SECURITY

The Client will be responsible for the placement of all the temporary fencing of the HDD excavations

TRAFFIC MANAGEMENT

The Client will be responsible for the provision of all necessary traffic management plans. All movement around the site will be in accordance with the Clients Construction Traffic Management Plan. This must be adhered to at all times by employees and also delivery drivers.

CONSTRAINTS / RESTRICTIONS & PERMITS

All licenses, permissions, consents and wayleaves requirements for the project works shall be obtained prior to commencement of the construction phase of the project. These shall be included in permit to

work documentation from t he Client and briefed to the works party prior to activities being undertaken.

A daily SPA will be completed and all site personnel will sign prior to commencement of works on each day. Client will provide site specific SPA.

PERSONNEL AND RESPONSIBILITIES

Roles and responsibilities associated with the project

Site Manager / Supervisor	• Ensure that the project is carried out in a safe and sequential manner. • Project documentation is completed as per the required standards. • Personnel are briefed on the requirements of the safe systems of works and checks on daily inspection documentation. • Daily Supervision of the project and personnel. • Liaise with Client to discuss progress as per the agreed programme • Ensure HDD completion packages are as per agreed specifications
Driller (Foreman)	• To undertake and complete pre- inspection documented checks. • Ensure profile is understood and established prior to activities being undertaken. • Constant monitoring during the HDD stages of the project.
Drillers Assistant	• Constant monitoring of the drilling activities whilst operational activities are being undertaken. • Ensure there is no unauthorised access to the exclusion zone whilst activities are underway • Work under the instruction of the driller. • Undertakes the role of Mud Engineer if required
Operatives	• Work under the instruction of the Supervisor. • Work in a safe manner and report any unsafe acts and activities immediately.

	• Conduct plant and equipment checks prior to utilisation and complete company documentation requirements

PPE

Personnel must ensure that applicable PPE is worn at all times. Below is a standard list of PPE that must be used. Any additional PPE will be identified prior and must be worn as per the site rules.

- Hard hat
- Hi vis protective trousers and top.
- Hi visibility jacket
- Eye protection.
- Safety footwear
- Wellingtons
- Gloves

SITE

SITE SET-UP

Prior to work commencing, all Dunnes Drilling personnel will attend a site safety induction by The Client. The Dunnes Drilling Project Manager will communicate the contents of method statements and risk assessments to the workforce and included any toolbox talks. The workforce will sign an attendance sheet.

The drilling equipment will arrive on site with horizontal Directional Drill Rig. Particular attention shall be made as to the observance of Root Protection Areas, Watercourse buffers and other 'No Work' zone. Public Footpaths in the works area and provision for closures.

The drilling rigs are approximately 9m in length and has a weight of around 12 - 15 tons. These will be transported to site by a heavy goods vehicle as per the traffic management plan.

The equipment will travel along the designated haul road to the work location as per the temporary works design. Access to be provided by client.

The rig is positioned at the agreed entry point and the remaining equipment is positioned around the rig to suit site conditions and connected in accordance with the manufacturer's requirement.

Once set up the drilling machine will be checked, and test run before operations commence. This process will be repeated daily prior to activities being undertaken.

The HDD equipment and excavated pits are to be fenced by 1.8m interlocking wire fencing provided by client.

The Site Manager/Supervisor shall ensure that the working area is established and briefed to personnel prior to deployment of plant, equipment and operational staff. The contents of the SPA shall be briefed to all personnel prior with signatures obtained as acknowledgement of compliance.

METHODOLOGY

The Site Manager will receive a permit to work from The Client which will also include any environmental considerations associated with the HDD location. This shall be issued to the Driller who will compile a point of work assessment with the finding's and control measures being brought to the attention of all parties and personnel who may be affected by Dunnes Drilling activities. This method is used for hazard awareness and it also considers variables which may not be identified within the contents of this document.

Stipulations established by 3rd party asset owners and The Client including environmental and ecological licenses and stipulations shall also be briefed. All documentation must be adhered to and understood.

All working areas will be demarcated using fencing/reflective boards, barriers and warning signs. Access to the working area will be restricted by placing Herras fencing and signage across the spread.

The proposed drilling works will not be allowed to impact on any members of the public, the work area will be contained by fencing and access through the works will be restricted. Attention will be given to ensuring a safe site, including safe access and egress for all persons who may be affected by the works, including: Employees, Workers, Visitors, and Emergency Services.

Particular attention to be paid to utility service records, CAT locating apparatus will be used to determine the position of underground services prior to any digging taking place. A site survey will take place prior to any drilling activities by The Client. Trial holes are to be hand dug directly above any known services in the area and all services must be located & recorded before ANY drilling takes place.

Location and recording of existing services will be untaken and provided by The Client.

Upon receipt of a permit to dig a trial holes may be required to prove any services have been correctly identified in depth and position.

FUELS, FLUIDS AND HAZARDOUS MATERIALS

DIESEL

Where possible all plant and equipment shall be refuelled, greased etc at the depot prior to departure. Care shall be taken when filling plant and equipment with fuels / liquids. Spill kits including absorption granules shall be placed at the point of refuelling only to be used in an emergency situation. Refuelling on site should not be required.

When refuelling onsite then this process shall be assessed with the safest means possible conducted to prevent any leach into the ground and watercourses. The assessment shall also take into consideration any ignition sources. In the event of an emergency situation then the spill kit should be used to contain the spillage at source. Spill containment is essential via the utilisation of the spill kits

and absorption materials. All material that has been affected by the accident / incident shall be treated as contaminated and placed in a suitable location to prevent cross contamination and suitably labelled. This shall be removed by a licensed waste removal company only with a consignment note obtained and retained for a minimum of three years.

HYDRAULIC FLUIDS

In an event of a spillage the same process applies as detailed in section 8.1. All materials shall be placed in suitable plant nappies when removed from company vehicles or store location.

OTHER FLUIDS AND MATERIALS

Fluids and materials that are used by Dunnes Drilling as part of their operational activities shall be stored in a bund to prevent any contamination.

All stationary plant will be bunded spill kits placed in close vicinity as means for rapid response in the case of an emergency.

Personnel should ensure that they have the applicable COSHH assessments and MSDS available so applicable requirements may be identified for the use and what actions must be taken in an event.

Containments, controls and reporting of all spillages of fluids and materials will comply with the Client's procedures.

DIRECTIONAL DRILLING METHODOLOGY

The equipment will travel along the designated route as briefed in the induction or included in the associated plans.

Plant shall be delivered via the hall road to the pre-constructed working pad. These items shall be delivered by a lorry low loader. All securing and release connections shall be made from ground level only. When the driver or plant operator traverses on to the flat bed to mount the plant he shall do so by ensuring he has either three points of contact at all times or crash mats shall be placed along his / her path.

Launch and reception pits shall be excavated as per pre-defined plans where provided otherwise decided on site to suit services and route. When lifting and excavating operations are being undertaken, exclusion zones will be established. These shall be outside of the slew on excavators at full reach and three meters from dumpers, telehandlers and site based transporting machines.

The rig is positioned at the agreed entry point and the remaining equipment located around the rig to suit site conditions and connected in accordance with the manufacturer's requirements ensuring field earths are fitted via the use of the stabilising augers.

Once set up is established the drilling machine will undertake a full function test which shall be completed before operations commence. Suitable escape prevention measures shall be applied to prevent drill fluid movement towards any watercourse. This shall be covered on the site- specific risk assessment.

The mixing of the drilling fluid is required, this shall be completed with the use of a mixing tank on the recycling system, positioned to suit site circumstances on level ground. These will be connected to the drilling rig using the 6 bar hoses.

Clean fresh water will be provided by the client.

The proposed drilling works will not be allowed to impact on any members of the public, the work area will be contained by fencing and access through the works will be restricted. Attention will be given to ensuring a safe site, including safe access and egress for all persons who may be affected by the works, including: Employees, Workers, Visitors, and Emergency Services.

NO MECHANICAL EXCAVATION IS TO TAKE PLACE WITHOUT A PERMIT.

The directional drill will maintain agreed clearances below all obstacles and services. Design profiles will be available to the drill operator and the profile will be used to establish the line and level of the drill. The client or shall where possible, mark the drill out on site every 10m along the line with wooden pegs or flags.

Once the machine has been secured in position the beacon or "sonde" transmitter is then checked for both battery life, calibration and inspection checks in accordance with the manufacturer's instructions and recorded on Form “HDD Quality Assurance Check". Once checked the "sonde" transmitter is then located at the front of the drill head. A visual check is carried out on the drilling rods prior to use.

A pilot bore is drilled through from the launch pit to the reception pit.

As the drilling proceeds the drill head is continually monitored using a signal from the "sonde" transmitter to the hand-held receiver allowing the drill head to be correctly steered. The information received by the tracking unit indicates the line of the bore, as well as depth and pitch angle. As the piloting head progressively moves forward the tracking operator walks slowly over the line of the bore enabling any steering adjustments to be made to achieve the line and level of the bore planned. All steering information is automatically relayed back to the drill operator on his steering console. The tracking operator records drill head details every drill rod in the drillers log.

The location equipment transmits information in real time as the drill progresses so steering adjustments can be made quickly to put the drill on the correct course. The drill position is constantly monitored for deviation from the intended path and adjusted as required.

Where it is unsafe or the trajectory is unobtainable on foot then tracking shall be undertaken by utilising the target steering method. The Target Steering locating method allows the receiver to be placed ahead of the drill head and used as a steering target. The Target Steering procedure requires correct placement of the receiver in front of the transmitter, on the bore path, with its back end (where the battery pack is inserted) facing the drill. Setting a target depth on the receiver activates target steering, and the Locate screen on the receiver now displays horizontal distance from transmitter to receiver. The remote display on the drill automatically changes to Target Steering mode. This method shall be adopted on the stream crossing.

Drilling compounds may be brought to site when required as a dry powder in 25 kg sacks loaded in to the back of the mixing system. The powder is stored on the purpose-built mixing lorry which has roof covering to ensure weatherproofing at all times. Additional materials may be stored in the compound to be brought to site as and when is required. This powder is then mixed slowly into a tank filled with fresh (non-saline) water via the mixing systems venture hopper. The Mud Engineer oversees the operation and takes periodic measurements of the drill fluid to ensure its suitability. The formation formula is as per manufactures instructions or the ground conditions.

Intermittently the water is tested with PH strips to test for the PH value. Soda Ash is added and the water tested again. Soda ash is added until a neutral PH is achieved. Record quantity of soda ash added and repeat for each tank fill. Retest PH weekly or if the water source has changed.

The drill fluid performs several functions:

- The drill fluid provides lubrication and cooling for drill head and string.
- The drill fluid fills and effectively seals small voids within the material being cut.
- The drill fluid suspends cuttings of the material being cut.
- The drill fluid carries the cuttings out of the hole.
- In soft soils, the drill fluid provides a hydrostatic pressure to the side walls of the hole.

The use of Bentonite / Easy Mud borehole stabiliser on the drill means that the ground formation will be held open and kept stable if sands, silts or gravels are encountered. If the mud engineer records a reduction of fluid returns, works shall cease and control measures as shall me implemented as per the "Lost Fluid Procedure" stated below;

- Stop drilling
- Stop all pumps and mud flows down the drill string.
- Carry out site survey for signs of a frac-out (drilling fluid to the surface).
- Check water courses in the immediate vicinity for signs of drilling fluid.
- Lift drain covers and manhole lids and check for drilling fluid increase.

If the loss of fluid is not noted in any of the above.

- Reverse the drill string until fluid flows return then recommence the bore whilst continuing to monitor the fluid returns.

If fluid loss occurs and no signs of loss to the surface or drainage systems.

- Add a fluid loss drilling additive to the drilling mud.

Once good flows are achieved again continue drilling monitoring fluid returns.

On completion of the pilot bore the drilling head will then be removed from the drill string and replaced by an appropriately sized back reamer. Any lifting of the drilling head and reamer will be by using the onsite excavator with exclusion zones established to prevent unauthorised access during operation. The newly installed pilot hole will then be incrementally increased in diameter using a rotational reaming system as per specifications. A second Selwood pump will be set up at the exit pit and connected to the

mud return line to the launch pit. The mud return line will be laid overground by pulling into place by winch.

Hole opening operations are carried out to enlarge the pilot hole to a size suitable for accepting the product string. Ground conditions and fluid flows will dictate the reaming process. Inspections shall be carried out on reamers to monitor excessive wear.

Throughout reaming operations, drilling fluid is pumped through the drill string. The fluids exit through nozzles in the reamer as this process directs the flow against the cutting face and flushes cuttings away. The drilling fluid and cuttings then flow through the annulus between the drill pipes and the borehole wall until reaching the surface.

The drill fluid is monitored in the recycling system for viscosity and bentonite added if required. It is also tested for sand content to ensure proper cleaning of bentonites. Change screens if sand content rises. Mud Density is also tested to ensure there is still carrying capacity in the bentonites. If mud density rises, dump mud and mix new batch.

The reaming operations are controlled by the driller. He liaises by radiophone with the pipe side coordinator. As with the pilot hole drilling, there will be continuous monitoring of the carriage loads, hydraulic pressures, mud pressures, mud mix, pump rate and drill progress.

Following completion of the hole-opening operations and prior to the pullback of the pipe, a cleaning run is conducted to flush any remaining debris from the drilled hole. The cleaning assembly consists of a barrel reamer which is threaded and attached to the drill string at the pipe site. This assembly is then pulled through the hole while rotating and pumping drill fluid through the string. The rate at which the tool is pulled through the hole is governed by the amount of resistance that is detected as it passes through the ground. Once the bore is opened to the required size the preparation for pulling the required ducting can be made.

The pulling head is connected to the drill string via a swivel connection which allows the drill string and barrel reamer to be rotated throughout the pullback without rotating the duct being towed through the hole. The pullback operation is controlled by the rig operator. The maximum pulling tonnage will be recorded on the HDD Quality Assurance and must not exceed the manufactures specifications.

Bentonite slurry will be dried and removed from site by The Client.

QUALITY

The Company will apply to any applicable contractual requirements and as per the scope of Dunnes Drilling quality management. The requirements of applicable plans shall be briefed to personnel to ensure the work may be carried out in safe and sequential manner. Defects shall be identified and reported via the agreed methods which shall be documented.

EMERGENCY AND FIRSTAID

EMERGENCY SITUATION AND CONTACTS

In the event of an emergency, attention must be made as to the requirements briefed at the induction. If this is not the case due to various factors which may include; the duration, the location and if Dunnes Drilling are the only contractor. Then the emergency response plan that is published within the project file and located at each drilling location should apply. Designated areas must be identified and emergency contact details, location of emergency facilities and contact details of emergency personnel shall be made available.

Emergency service	Location	Number / Eircode
First aid person		
Hospital		
Ambulance		999
Fire		999
Gardai		999

FIRST AID

First aid kits shall be located in each company vehicle. All accidents, however slight shall be entered into the accident book and reported to the applicable first aid trained person, supervisor. Additional first aid kits will be located in the mobile welfare facilities. If the severity of the accident is deemed that additional assistance is required i.e. needing professional medical treatment, attendance of the hospital. Dunnes Drilling will undertake a detailed investigation which will includes root cause analysis and contributory factors. This information will be used to prevent recurrence and may include changes to the procedural process.

ENVIRONMENTAL

ASSESSMENTS AND CONTROLS

All personnel shall be briefed of the environmental procedure requirements as per The Client's information received which includes constraints associated with the works. All works shall be conducted in accordance with Dunnes Drilling management systems, associated plans and guidance information.

An SPA shall be completed by the site supervisor, this will include environmental considerations. The findings of the assessment shall be brought to the attention of all personnel who may be affected by the operational processes.

Any mud, dirt or construction materials associated with Dunnes Drilling activities shall be cleaned up from the area at the earliest opportunity and the area returned to its previous condition.

If there is any suspect that the ground may be contaminated, then the work should cease immediately. The area shall be cordoned off and reported immediately to The Client.

Segregation techniques shall be established so material may either be recycled or removed to a licensed waste treatment facility.

Copies of waste carrier licenses shall be obtained, and consignment / transfer notes collected when waste materials are removed from the project area. The consignment / transfer notes shall be retained for designated timescales as per legislative requirements.

Spill kits to be positioned at the workface. All stationary plant will be bunded.

During the works, any nearby watercourse will be monitored for any changes in colour or signs of bentonite frack out. Should any pollution of any nature be identified the works will be stopped immediately and The Client will be notified.

FAILURE MODES AND FRAC OUT

INTRODUCTION

The purpose of this section is to establish procedures for addressing potential impacts associated with a "frac out" of drilling fluid during the horizontal directional drill (HDD) process. The term "frac out" is used to describe an inadvertent release of drilling fluid resulting from the fluid escaping from an underground HDD borehole and rising to the surface.

The HDD installation technique is susceptible to difficulties caused by subsurface ground conditions. This document establishes the criteria by which Dunnes Drilling will determine when a proposed HDD is unsuccessful.

Dunnes Drilling will provide on-site inspection during the HDD process to monitor the progress on the drill and to maintain daily progress reports.

HDD PROCESS

The HDD process generally includes three distinct phases beginning with the drilling of a pilot hole from the entry point on one side of the HDD along a designed profile to an exit point at the surface on the other side of the HDD. The second phase entails the reaming of the pilot hole to a diameter large enough to accept the cable ducts to be installed. Finally, the cable ducts are pulled into place within the enlarged hole.

DRILLING FLUID

The HDD process involves use of a drilling fluid (also referred to as drilling mud) made up primarily of water and bentonite (if required), with pH values between 8 and 10. Bentonite is a naturally occurring, non-toxic, inert substance and is frequently used for drilling potable water wells. Therefore, the environmental impacts of an inadvertent release of drilling fluid in a watercourse is a temporary increase in local turbidity until the drilling fluid dissipates with the current or is settled.

The primary purpose of drilling fluid is to remove the cuttings from the borehole, stabilize the borehole and act as a coolant and lubricant during the drilling process. The water and clay drilling fluid

consists of 1 to 5 percent active clays and from 0 to 40 percent inert solids with the rest being water. The primary active clay component is bentonite. The drilling fluid is first

prepared in the mixing tank with both new and clean recycled drilling fluid. The fluid is pumped at 40 to 100 gallon per minute rates through the center of the drill pipe to the cutters. Return flow is through the annulus created between the wall of the boring and the drill pipe.

The cuttings are then carried to either the entry or exit pit, depending on a combination of elevation difference and drilling/hole opening direction. A reduction or loss of drilling fluid returns does not necessarily indicate that these fluids are being released to the environment through fractures. The loss of returns may occur because of lower pressures and volumes, thereby allowing gravity and friction to overcome the ability of the fluid to return to the bore site. As previously described, drilling fluid will likely be absorbed by the formation or drawn down into fractures within the formation.

Within the boundaries of the worksites drill fluid would be controlled through the use of pits at the crossing entry and exit points and typical fluid handling equipment such as Selwood pumps. Drill fluid is released regularly on the drill rigs as part of normal operations when sections of drill pipe are separated. The worksite will be graded such that fluid released on the rig will flow into the fluid pit in front of the rig.

PILOT HOLE

The pilot hole is typically the most important phase of the HDD technique. It determines the final route and position of the cable ducts in the HDD hole.

Usually, a small-diameter (125mm) drill hole penetrates the ground at the designed entry point and at a predetermined angle. The pilot borehole will be reamed to enlarge the hole to accommodate the cable ducts. Generally, the reaming operation requires multiple reaming passes with increased diameters until the bore reaches the desired diameter. Once the drilled hole is enlarged, the cable ducts can be pulled into the reamed hole, which is filled with drilling fluid.

The pilot hole is drilled along a predetermined alignment and profile. The entry and exit points are located using traditional survey methods. After each section of the drill pipe has been drilled (3m to 4.5m), the tracking equipment is used to calculate the pilot hole location. These details are recorded in the drillers log.

The pilot hole process consists of drilling a small diameter hole along the pre- determined alignment and profile. The pilot hole is drilled using either a jetting assembly or a dual rod rock drilling system to a tri-cone rotary bit. Drilling fluid is pumped downhole via the string of drill pipe. The flow of drilling fluid powers the mud motor or jetting assembly that cuts the rock strata or soil. The fluid then flows back to the surface along the annular space between the drill pipe and the inside of the pilot hole. As it does so, the fluid also lubricates the drill stem, suspends and carries the drilled cuttings to the surface, and forms a wall cake to keep the hole open.

Data obtained during the pilot hole process will aid in planning the details of subsequent phases of the installation. These data include the rate of penetration and the friction forces acting upon the drill string.

PILOT HOLE FAILURE

Failure can occur during the drilling of the pilot hole when the hole collapses on the drill pipe string. This is typically caused by either not being able to maintain a good bentonite wall cake to keep the hole stable or an unfavourable drilling stratum containing glacial till, highly fractured rock, no cohesive alluvial material, or cobbles. If the hole collapses on the drill pipe and creates high friction on the drill pipe surface, the torque required to rotate the drill pipe will increase. The increased friction can become great enough to prevent the drill pipe from being moved. In an effort to free the drill pipe, torque and tension are applied to the drill pipe by the drill rig. Under the right conditions, the combined stress load exerted upon the drill pipe will exceed the strength of the drill pipe and will cause the drill pipe to either shear or twist into two pieces. Multiple changes in strata and long drill lengths contribute to the probability of this type of failure.

A second mode of pilot hole failure is a result of unfavourable ground conditions. Formations consisting of alternating strata of hard and soft rock, or soft clay containing large numbers of boulders can push the downhole assembly off course resulting in an unacceptable drill trajectory. In this event all or a portion of the pilot hole must be abandoned and re-drilled. This would be considered an unsuccessful pilot hole attempt.

REAMING PROCESS

Once the pilot hole is complete the borehole diameter must be increased to allow it to accommodate the pipeline. Typically, the final borehole diameter is approximately 1-1/2 times the pipe diameter. The final borehole diameter is dependent to a large degree on the length of the crossing and the types of geological formations through which the borehole passes. For this installation we will be reaming up to 550mm.

The borehole diameter is typically increased in several increments or passes. There are two types of downhole tools that are used: fly cutters, used for most soil formations, and rock hole opening tools, used for very dense soil or rock formations.

Typically, the fly cutter or hole opening tool is attached to the drill pipe string that drilled the pilot hole and is then rotated and pulled back towards the drill rig from the entry point. A second drill rig or a track hoe is typically used to handle the drill pipe at the exit point.

For each hole opening pass, as the fly cutter or hole opening tool progresses along the crossing profile, drill pipe is added to the string behind it while drill pipe is removed from the string ahead of it. Doing so maintains a continuous string of drill pipe in the borehole over its entire length. Depending on the stability of the hole a barrel reamer, typically several inches smaller than the outside diameter of the final hole opening tool, is pulled through the hole immediately prior to pullback. This is typically referred to as a swab pass. The purpose of the swab pass is to ensure the establishment of a good drilling fluid wall cake, a clean hole, and a hole full of drilling fluid with the proper density.

REAMING PROCESS FAILURE MODE

There are generally two modes of failure during the hole opening process. The first results from collapse of the borehole, the second from failure of the drill pipe string or other downhole components.

As in the pilot hole process, a severe borehole collapse can cause friction acting on the drill pipe string and downhole tools to increase to the point where attempts to move the string result in it breaking. This would be considered a failure.

The second mode of failure occurs when hole opening in hard rock or in formations containing large amounts of cobbles and boulders. In these instances, the downhole tools are subjected to severe amounts of wear and or impact loading. In extreme cases this can result in the hole opener breaking apart. Pieces of downhole tools lost in the borehole impede or halt further efforts at completing the installation.

It may be possible to recover pieces of downhole tools that have been lost in the borehole. Recovery efforts are generally very time consuming, are hampered by cobbles and boulders and are often fruitless. However, it is possible to push the offending piece out of the borehole and into a soft zone in the surrounding formation. In either scenario the hole opening process can resume.

PULLBACK PROCESS

The last step to complete a successful installation is the pullback of the prefabricated pipeline into the enlarged hole. A reinforced pull head is attached to the leading end of the pipe and to a swivel that is connected to a hole opener or fly cutter and the drill pipe. On the surface, the pipeline is supported with rollers as it is guided into the borehole. Once in the borehole the pipeline will be very buoyant in the drill fluid that occupies the borehole. The buoyancy will push the pipeline to the top of the borehole with considerable force. This will result in a significant increase in the friction between the side of the borehole and the pipe.

PULLBACK PROCESS FAILURE MODE

During the pullback process the drill rig must exert a pull load sufficient to overcome the friction forces acting on the pipeline as it is pulled into the borehole. If the friction forces rise to excessive levels, the pullback operation must be halted. At this point the direction of pull must be reversed and the pipeline pulled from the borehole. Once the pipeline is successfully withdrawn the portions of the hole opening and swabbing process are repeated to recondition the borehole and then the pullback process is repeated.

FRAC OUT OF DRILLING FLUID

Throughout the HDD process there is a loss of drilling fluid into the geologic formation through which the drill passes. In some cases, the drilling fluid may be forced to the surface resulting in what is commonly referred to as a frac out. Therefore, while the intent of the HDD method is to avoid surface disturbance, surface disturbance may occur when there is a frac out of drilling fluid.

It is extremely important to note that a loss of drilling fluid into the formation is not necessarily an indication that a frac out has occurred or is about to occur. It is normal to lose a significant amount of fluid into the formation without ever having a frac out. In fact, in very soft ground formations or in highly fractured formations it is normal to lose all of the drill fluid pumped into the borehole without a frac out occurring.

A frac out cannot occur unless drill fluid escapes from the borehole into the formation. Hence preventing and managing such escapes will in turn prevent and manage frac outs.

Drilling fluid releases are typically caused by pressurization of the drill hole beyond the containment capability of the overburden soil material. In some cases, a frac out of drilling fluid can be caused by existing conditions in the geologic materials (e.g., fractures) even if the down hole pressures are low.

Drill fluid pressures are generally the highest during the pilot hole process; hence it is this process that presents the greatest risk for a frac out. If a frac out occurs during the pilot hole process, it opens a path through the formation for drill fluid to escape during subsequent processes. For this reason, frac outs are likely at the same location during the hole opening and pullback process. Conversely, if the pilot hole process can be completed without a frac out, then it is likely that the entire installation can also be completed without a frac out.

Considerations for preventing and managing frac outs are described below.

FRAC OUT PREVENTION

The risk of a frac out in a sensitive area can be mitigated through profile design and through implementation of specific measures throughout the installation process. Dunnes Drilling operatives are responsible for execution of the HDD operation, including actions for detecting and controlling drilling fluid seepage. Dunnes Drilling will closely supervise the progress of the HDD with onsite inspections.

PROFILE DESIGN

The HDD profile is designed to minimize the potential for the release of drilling fluid in sensitive areas. The type of subsurface material and the depth of cover material are factors considered in developing the profile of an HDD crossing. Cohesive soils, such as clays, dense sands, and competent rock are considered ideal materials for containment of drill fluid.

In the vicinity of the entry and exit points of the crossing the depth of cover will be minimal. It is probable and expected that frac outs will occur in these segments of the crossing. The crossings are designed such that these segments will be in upland areas.

PREVENTATIVE MEASURES IMPLEMENTED DURING INSTALLATION

Key preventative measures implemented during installation are geared toward keeping the drill fluid contained in the borehole and preventing its escape to surrounding ground formations. This is accomplished through monitoring and management of drill fluid pressures and drill fluid volumes.

DRILL FLUID PRESSURE MONITORING AND MANAGEMENT

Drill fluid pressures are affected by several factors. A description of some of these factors and how they can be managed follows.

- Drill fluid density. Greater drill fluid densities result in greater downhole pressures. A large component of drill fluid density is the concentration of cuttings in the fluid. By controlling drilling and hole opening penetration rates and maximising the effectiveness of drill fluid recycling equipment drill fluid densities can be kept below acceptable limits.

- Drill fluid viscosity. Greater drill fluid viscosities result in greater downhole pressures. However, greater viscosities also help seal off fissures and other escape paths into the surrounding formation from the HDD borehole. Similarly increased viscosity improves the cuttings carrying capability of the drill fluid. Drill fluid viscosity must be carefully managed to obtain a balance between these conflicting requirements.

- Borehole cleanliness. Cuttings tend to settle out of the flow of drill fluid in the annular space around the drill pipe string. Accumulations of cuttings or cutting beds restrict the flow of drill fluid through the annular space. This results in an increase in the pressure required to maintain flow. Careful management of drill fluid properties and the regular use of borehole swabbing techniques will keep the borehole free of cuttings beds and their associated pressure increases.

- The drill fluid pressures in the borehole will vary throughout the installation processes. They will change with the depth of cover, the distance drilled, and the borehole diameter. However, changes in pressure should be gradual and can to a large extent be predicted. Rapid or unexpected changes in pressure are indicators of potential problems downhole. It is critical that drill fluid
  pressures be monitored and throughout the pilot hole process, when pressures are the highest.

- Measured pressure approximately equal to predicted pressure. This is an indication that conditions are normal and the driller will be allowed to proceed with the pilot hole drilling.

- Measured pressure greater than predicted pressure. This is an indication that the annular space behind the drill bit is becoming plugged with cuttings or that the concentration of cuttings in the drill fluid returns is too high resulting in excess drill fluid density. The driller will be required to implement measures to clean the annular space and or reduce the concentration of cuttings. This typically involves "swabbing" the borehole by slowly retracting the drilling assembly while pumping clean drill fluid into the bore to flush out cuttings and

replace the cuttings laden fluid with clean, less dense fluid. The composition of the drill fluid pumped into the bore may also be modified to improve its cuttings carrying capacity.

- Measured pressure less than predicted pressure. If the measured pressure is significantly less than the predicted pressure this is normally an indication that some of the drill fluid is escaping from the borehole. It is extremely important to note that having fluid escape from the borehole is not necessarily an indication that a frac out has occurred or is about to occur. It is quite normal to have a significant amount of fluid lost to the surrounding formation without a frac out occurring. Nevertheless, if the measured pressure is less than the predicted pressure, and in particular if this is the result of a sudden drop in pressure, Eco Drill will implement measures to reduce or eliminate the loss of drill fluid from the borehole. One measure that may be implemented is the use of Lost Circulation Materials (LCM) to plug a fissure in the formation. The use of additives to improve the sealing properties of the drill fluid is another measure.

DRILL FLUID VOLUME MONITORING AND MANAGEMENT

It is intuitive that if drill fluid is not allowed to escape from the borehole then the entire volume of fluid pumped downhole should return to the surface via the annular space. However, as described above, it is normal that a portion or all of the drill fluid will be lost to the surrounding formation and a program for monitoring and managing the volumes of drill fluid used will be available to identify any sudden increases in the volume of fluid lost which could signal a potential frac out.

Throughout the HDD processes the Dunnes Drilling will keep a running balance of the total volume of fluid pumped downhole and the total volume recovered from the return pits. The difference between these volumes will be the volume lost from the borehole.

If the rate of loss of fluid is greater than expected or if it suddenly increases this could be an indication of a problem downhole. Measures to reduce the loss of fluid from the borehole would be implemented as described in previous paragraphs.

FRAC OUT MANAGEMENT

Management of frac outs is key to minimizing the environmental impact of the HDD crossings and ensuring their successful completion. Managing frac outs requires that appropriate equipment is available, that the frac outs are detected in a timely manner, and that appropriate procedures are used to minimize the volume of fluid released and its environmental impact.

RESPONSE EQUIPMENT

Equipment for containing, controlling and cleaning up any drill fluid released during a frac out will be kept on site throughout the installation process. Heavy equipment not specifically designated for control and clean-up of drill fluid such as excavators and Vac Tanker will also be available on site.

Frac out containment machinery and equipment to be provided by client. The following list identifies some materials and equipment that will be maintained at the HDD site in sufficient quantities to help ensure containment of frac outs of drilling fluid:

- Excavator
- Shovels, brushes and buckets
- Silt fencing
- On-Call vacuum tanker and skips with an approved waste disposal site

MONITORING AND DETECTION

An obvious key to the timely detection of a frac out is monitoring of the surface above the HDD crossing for drill fluid. Dunnes Drilling will employ an operative to visually monitor the ground above the HDD crossing for frac outs. He will be supplemented by information from the rig operator as described above, namely pressure monitoring and volume monitoring.

The monitoring operative will survey the site along the HDD centreline. The monitor will be in constant radio contact with the rig operator who will keep them informed of the position of the downhole tool.

The rig operator will also keep the monitor informed of the drill fluid pressures and mud volume balance and will provide his professional opinion of level of risk of a frac out occurring at any given time. Armed with this information the monitor will be able to decide if monitoring a difficult area, such as a water course is warranted. It will also allow them to allocate their resources in the most effective manner.

The identification of a potential frac out prior to it occurring is dependent upon the skill and experience of the people involved. Similarly, the operatives who will supervise monitoring and mitigation efforts will also be experienced in this type of work.

CORRECTIVE ACTION FOR FRAC OUTS

If a frac out occurs, The Client will be immediately notified. Dunnes Drilling will suspend forward progress of the drilling operations if excessive loss of mud circulation is noted and conduct a detailed examination of the drill path and surrounding area for evidence of a release to the surface.

The HDD equipment may continue to operate during this period. It is important to initially maintain operations since soils such as sands, gravels, and some clays do not have the frictional characteristics necessary to maintain a void or hole from a drill. The weight or load from the soils has enough downward pressure to cause the hole to collapse. Shutting down the drilling operation further jeopardizes the success of the drill and it may not be possible to regain circulation. The weight of the settled soils may impede removal of the drill stem. The necessary torque to start the drill head rotating again, in the collapsed soils, may be more than the stress of the pipe can bear; in which case the drill stem and head will twist apart. The pieces may have to be abandoned in place and the process started again, without an assurance that the second attempt will have greater success. Once the clean-up response has started, the drilling activities will immediately resume. After the drilling fluid seepage has been contained. Dunnes Drilling will make every effort to determine why the seepage occurred. Once the cause of the seepage has been determined, measures will be enacted to control the factors causing the seepage and to minimize the chance of recurrence.

MINIMIZATION OF VOLUME RELEASED

The first action required when a frac out is detected is to minimize the volume of drill fluid that is released. This will be done by immediately halting pumping of drill fluid downhole. Pumping will not resume until the situation is assessed and, if possible, the fluid release is contained and controlled. As it is probable that the frac out will resume as soon as fluid pumping starts again containment and control measures will have to be able to contend with a further release of fluid. Normally the frac out stops of its own accord when the drilling assembly progresses a short distance ahead of the release point.

The risk of failure of the HDD installation increases dramatically as the duration over which pumping is halted increases. Hence, actions will be taken quickly in order that pumping may resume as quickly as possible.

CONTAINMENT AND CONTROL OF DRILL FLUID RELEASED

The types of measures implemented to contain the fluid released will depend on the type of area in which the release occurs.

Surface release

If an inadvertent release of drilling fluid is observed aboveground, the following measures will be implemented:

1. Immediately notify The Client.
2. Attempt to regain returns. Trip drill pipe and downhole tools back toward the direction of flow until returns through the drilled hole return to the entry/exit pit. Correct the bentonite properties, if necessary, and start drilling back in the same hole to see if the seepage continues. By swabbing the tool through the hole, this may remove any build-up of cuttings that created the inadvertent release. If the fracture is mitigated and controlled, resume HDD activities.
3. Evaluate the release to determine if containment structures are necessary. If containment structures are necessary. If the volume of the release is too small for containment measures to be practical, the area will be allowed to dry. This applies to surface releases only. The containment structures i.e. local excavation, subject to permit, will be made around the affected area to prevent flow of the drilling fluid.
4. If there is a threat to a sensitive resource or to public health and safety, HDD activities will be suspended immediately.

WATERCOURSE

The HDD profile is designed in order to minimize the potential for an inadvertent release into a watercourse. Frac outs in watercourses are rare due to the provision of adequate depth of cover. However, if an inadvertent release is observed in a watercourse, the following measures will be implemented

Temporarily suspend forward progress and immediately notify The Client. Dunnes Drilling operatives will monitor the extent of the drilling fluid plume and observe if the release results in distressed or dying fish.

Water samples may be required to be collected at both upstream and downstream locations from any plume associated with an inadvertent release of drilling fluid for any further

Attempt to regain returns. Trip drill pipe and downhole tools back toward the direction of flow until returns through the drilled hole return to the entry/exit pit. Correct the bentonite properties, if necessary, and start drilling back in the same hole to see if the seepage continues. By swabbing the tool through the hole, this may remove any build-up of cuttings that may have contributed to creating the inadvertent release. If the fracture is mitigated and controlled, resume HDD activities.

Implementation of containment and control measures is most difficult in watercourses.

The effectiveness of the measures implemented to limit the release of drill fluid will be closely monitored. If the measures are not effective and if the environmental impact of the release is deemed unacceptable the HDD installation will be abandoned. Another attempt using a modified profile or at an alternate location may be made.

ADDITIONAL CONTROL MEASURES

A determination will be made of the cause of the frac out. If it is determined that downhole pressures are excessive then measures to reduce them will be implemented. These measures are described above and include swabbing the hole and or modifying the drill fluid properties.

DRILL FLUID CLEAN UP

Measures to clean up drill fluid released by a frac out will be by use of suction tankers

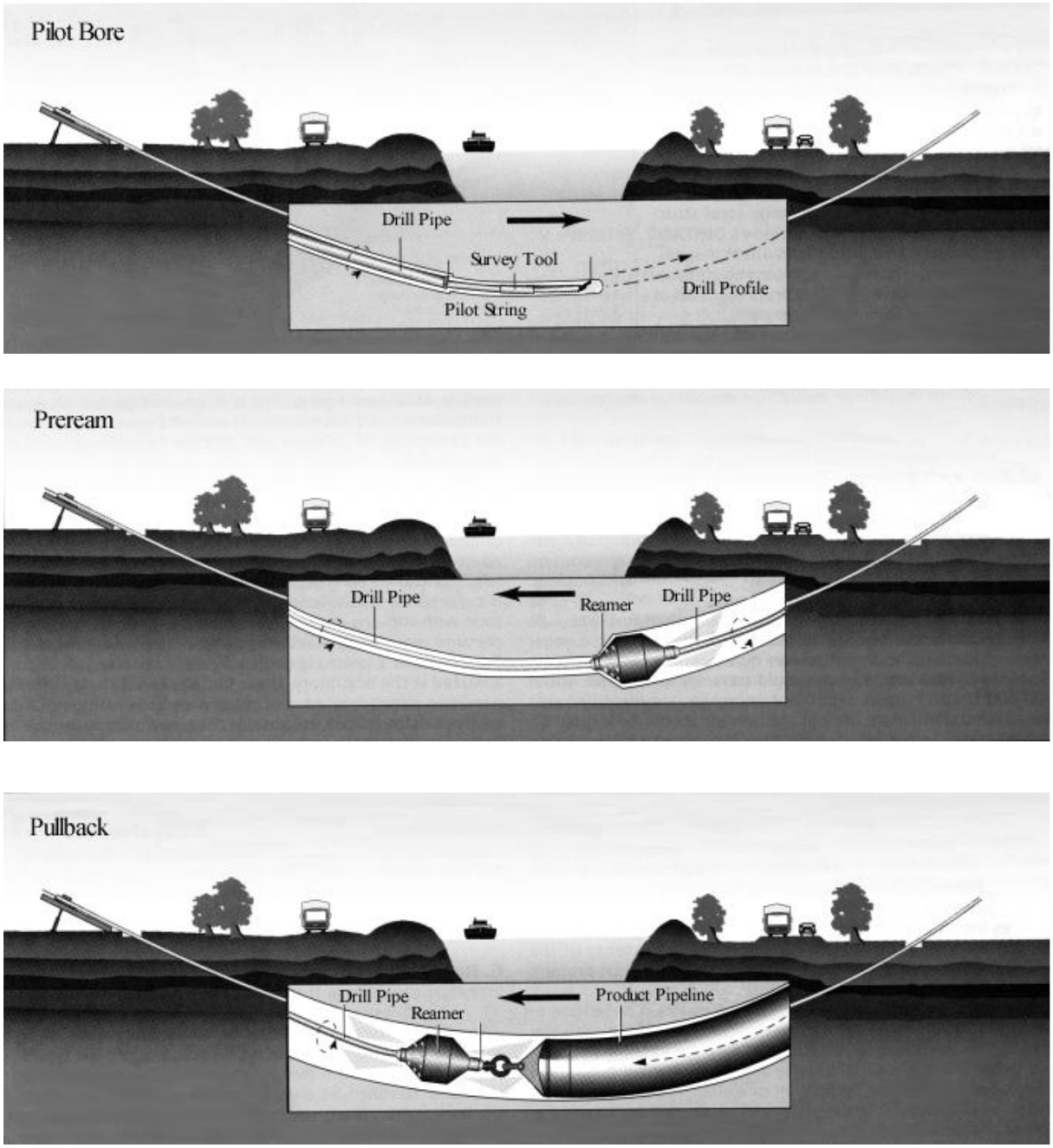


Figure 1: Stages of pipe installation using horizontal directional drilling

after installation.

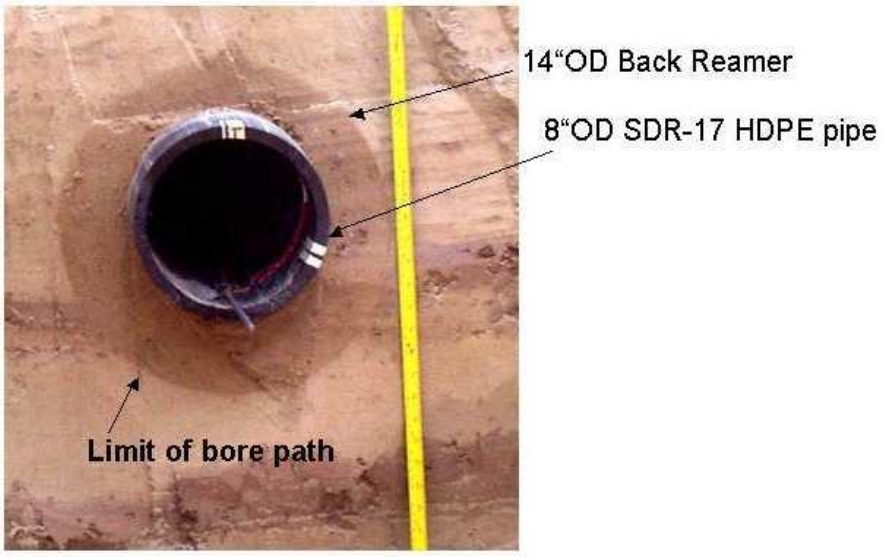
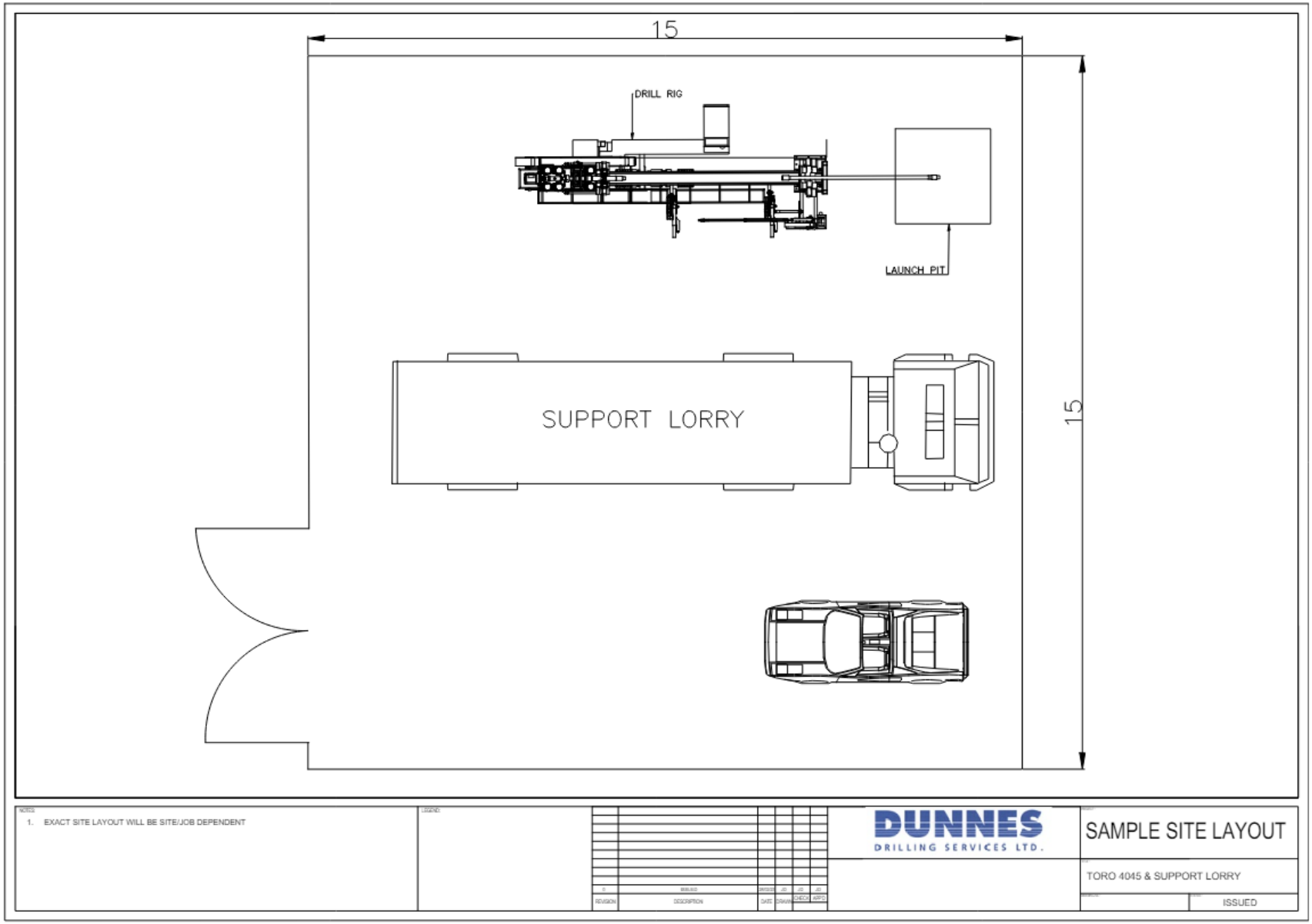
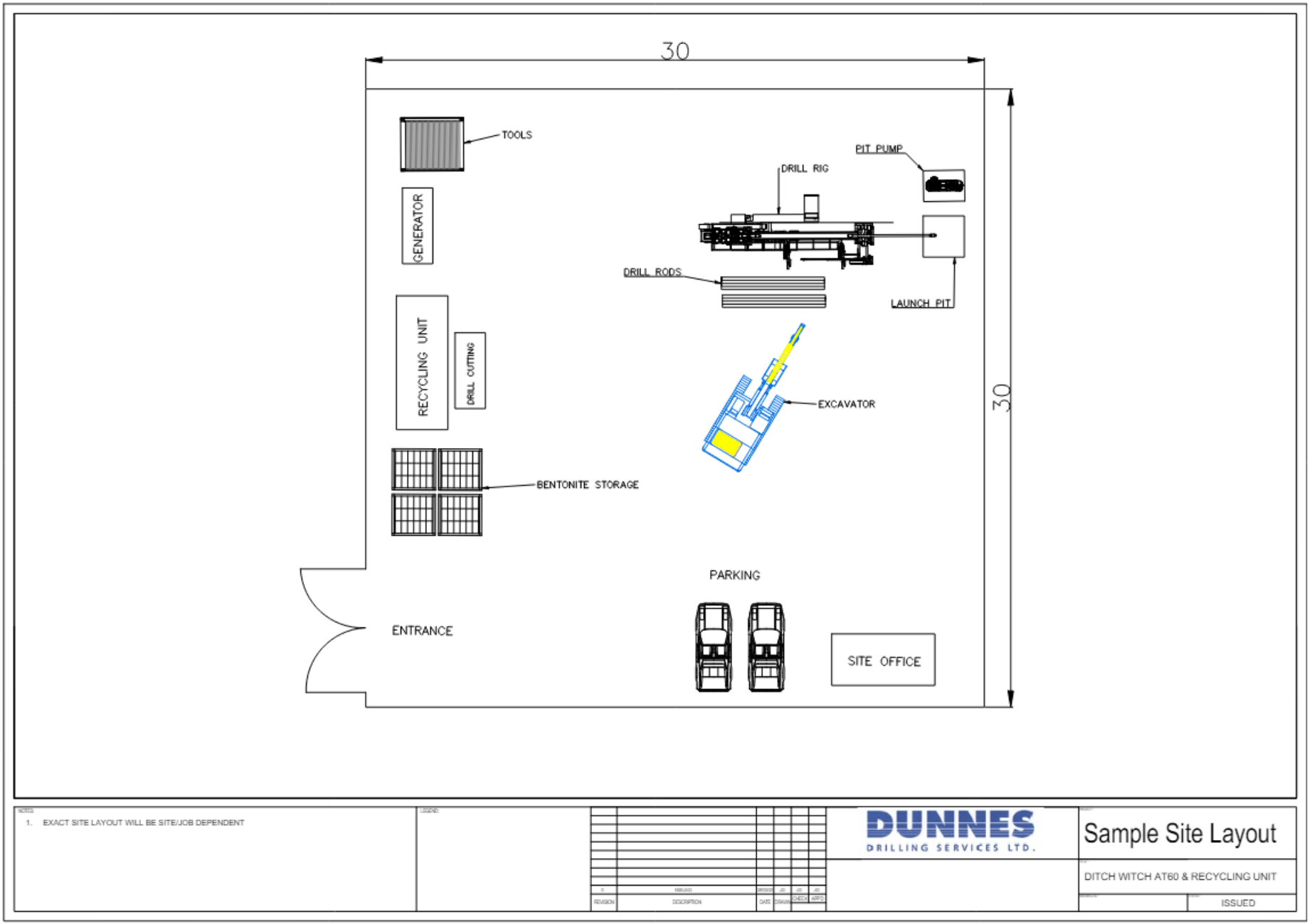


Figure 2: Cross section showing condition of well-designed drilling fluids and pipe location in a HDD bore approximately two years after installation

SAMPLE SITE LAYOUTS




30
TOOLS
PIT PUMP
DRILL RIG
GENERATOR
DRILL RODS
LAUNCH PIT
RECYCLING UNIT
DRILL CUTTING
EXCAVATOR
30
BENTONITE STORAGE
PARKING
ENTRANCE
SITE OFFICE
1. EXACT SITE LAYOUT WILL BE SITE/JOB DEPENDENT
DUNNES DRILLING SERVICES LTD.
Sample Site Layout
DITCH WITCH AT60 & RECYCLING UNIT
ISSUED

RISK ASSESSMENT

RISK MATRIX							
	CONSEQUENCES		LIKELIHOOD OR PROBABILITY				
			A	B	C	D	E
	PEOPLE	ENVIRONMENT	ALMOST CERTAIN *(expected)*	LIKELY *(will probably occur)*	POSSIBLE *(might occur - has happened)*	UNLIKELY *(could occur - known to happen)*	RARE *(practically impossible)*
INSIGNIFICANT	Non injury incident	Minor effect on biological or physical environment	MEDIUM	MEDIUM	LOW	LOW	LOW
MINOR	Injury / ill health requiring First Aid	Moderate short term effect but not effecting eco systems functions	HIGH	MEDIUM	MEDIUM	LOW	LOW
MODERATE	Injury / ill health requiring medical treatment	Medium term environmental impacts	HIGH	HIGH	MEDIUM	MEDIUM	LOW
MAJOR	Injury / ill health requiring hospital admission	Major impact to eco system functions	EXTREME	HIGH	HIGH	MEDIUM	MEDIUM
CATASTROPHIC	Fatal or permanent disabling injury	Serious Long Term impairment of ecosystem functions	EXTREME	EXTREME	HIGH	HIGH	MEDIUM

RISK RANKING	RISK DESCRIPTION	CONTROL APPLICATION
LOW	Tolerable. Monitor, manage and carryout activity in accordance with identified controls.	Any hazard assessed as presenting a low and/or medium risk level will be permitted to be controlled using a combination of controls as appropriate.
MEDIUM	Implement strict control measures reduce hazard to ALARP. **Management must determine appropriate level of supervision required.**	
HIGH	Implement strict control measures reduce hazard to ALARP. **Activity must not commence without Management approval and appropriate Supervision present.** Review process.	Any hazard assessed as presenting a high risk level will only be allowed to be controlled using a combination of at least one engineering control and lower level controls as appropriate.
EXTREME	Intolerable. **Activity must not commence.** Eliminated hazard or introduce further controls to reduce to ALARP.	Any hazard assessed as presenting an extreme risk level will only be allowed to be controlled using elimination and engineering as the primary source of controls.

NOTE: ALARP – As Low As Reasonably Possible

What High Risk Construction Work has been identified for this work activity?

HIGH RISK CONSTRUCTION WORK	WHAT ARE THE HAZARDS WITH THIS WORK	WHAT ARE THE CONTROL MEASURES
Work on or adjacent to roads (traffic)	Workers and others being struck by vehicles in adjacent road or traffic corridor. Motorists; pedestrians; riders entering work site. Excessive traffic speeds. Vehicle collision/lose control. Working on foot near moving plant. Working in impact zones, behind safety barriers. Trucks entering, exiting work site.	Dedicated, trained road traffic controller(s) to direct traffic entering and leaving site and control traffic (pedestrian and vehicle) on adjacent pedestrian footpath and roadways including using portable traffic signals and/or temporary safety barriers to direct/control traffic flow as required. High visibility clothing; day & night work. Correct size temp signs. Clear delineation of altered travel path/s. Keep impact zones clear behind safety barriers. Site Traffic Management will be planned and controlled either through site specific vehicle management or through the TCP – whichever is deemed preferable to the situation.
	Vehicles in adjacent road or traffic corridor being struck by falling objects	Plant delivery vehicles to be unloaded on-site (not from public roadway) Traffic Controller(s) to be utilized during plant movement to and from work zone.

	Plant movements which obstruct traffic &/or pedestrian flows.	Equipment left unattended at night, adjacent to a highway in normal use, or adjacent to construction areas where work is in progress, shall have appropriate lights or reflectors, or barricades equipped with appropriate lights or reflectors, to identify the location of the equipment
	Operator Competency	Operator Verification of Competency Assessment conducted. Operator to conduct Pre-Start inspection of plant/equipment prior to operating and ensure plant/equipment has been approved for use. Plan, coordinate & supervise tasks in close proximity to one another and/or plant, vehicles and equipment. Use Overhead Powerlines Awareness trained spotters. Do not approach operating plant without acknowledgement and approval of operator. Traffic Management operators; Select and correctly use signage; Co-ordinate Traffic; Modify activities depending on differing operational contingencies, risk situations and environment; Maintain Effective Communication; Promptly rectify and/or report any identified problems when controlling traffic in accordance with regulatory requirements and workplace procedures; Monitor work activities; Use correct PPE; Maintain Equipment.
Work in or near trench with excavated depth greater than 1.5m	Plant items driving into excavations. Unstable ground.	Barriers provided to prevent vehicles from driving / falling into excavations. Chocks / Spotters to be provided at least one metre from the edge for tipping/pouring into excavations. Note: Zone of influence distance from edge is same as depth of excavation. Filling / backfilling operation to be carried out by small plant.
Work where there is movement of powered mobile plant	Workers and others being struck by powered mobile plant including vehicles and load-shifting machinery	Prepare and implement workplace traffic management plan and make available to workers. Exclusion zone for mobile plant to be clearly identified (signage & barricades as per site plan) and controlled during vehicle loading/unloading operations. Powered mobile plant and materials are not to be operated or stored within 2 metres of an open trench.
	People being struck by a load during mechanical handling (for example when using a crane or fork-lift truck). This often leads to the victim falling or being crushed between the load and the vehicle; People being struck by a load falling from a vehicle or a load moving unexpectedly while on the vehicle; People being struck by vehicles, often during reversing; People being injured during manual handling operations (often when a load is too heavy or sharp or otherwise awkward); People injuring themselves when jumping off a vehicle.	The person who is responsible for the lifting operation and control of the lifting equipment must ensure that the lifting operation can be carried out safely before work starts; Select and use lifting equipment and lifting accessories (tackle) which are suitable for the task. In particular, do not exceed their safe working load; A safe exclusion zone should be established around the vehicle and lifting equipment, prior to commencing the operation; Drivers or anyone else attaching lifting accessories to material ('slinging') must be away from the load before it is lifted, preferably off the vehicle. Never stand on a load once it has been attached to lifting equipment; Do not use the banding wire or straps to lift the material; The load will often need to be loaded onto suitable skids so that there is enough clearance to get a sling or chains around and under it (or the forks of a fork-lift truck under it) when unloading; Workers operating the crane should have been trained in its safe use and safe Slinging techniques.
Work near pressured gas mains or piping	Potential gas mains strike affecting safety to public and the environment	Bord Gais present on site. Crews have identified, located and potholed underground utilities prior to excavation. Emergency Preparedness and Response Plan available on site.

Work near energized electrical installations or services	Workers coming in contact with and/or receiving electric shock from overhead electric lines.	The exclusion zones and approach distances to overhead electric lines at the location and distances specified on the Management Plan are to be clearly identifiable and enforced by site supervisor. Use Overhead Powerlines Awareness trained spotters when working in vicinity of Overhead Power. Where possible de energize electrical cables prior to works.
	Damage & Disruption to Power services	
	Damage to site plant & facilities	
	Possibility of a fire starting on site which could cause a major bush fire	
	Plant / equipment contacting overhead electric lines	
	Incorrect reading of service plans leading to missing existing utility and potentially striking utility at later stage.	Ensure full current set of service plans are on site, check plans are in date. Trained person only to read service plans.
		Check surrounding area for pits, cables, poles or signs of previous excavations that may not be shown on service plans. Where required get the asset owner on site to locate assets, such as high voltage power, fibre optic or high pressure gas.
		ADVISE PROJECT MANAGER IMMEDIATELY A LEAK/DAMAGE TO EXISTING UTILITIES HAVE BEEN DETECTED, WHO WILL IN TURN CONTACT THE UTILITY OWNER/MANAGER.
		Ensure all sediment controls are in place
		Prior to work, check 'works as executed' drawings for type and age of existing mains. Should there be an elevated risk of rupture or damage to the service the Supervisor shall engage supply authority Maintenance team as standby or coordinate isolation of the service.
	Damage to existing services from striking by hand tools Injury from electrocution from electrical cables or metallic pipes.	DO NOT ATTEMPT TO DIG AROUND DAMAGED PIPES / CONDUIT
		Where possible relocate the position of the excavation to avoid cables/pipes.
		Non destructive excavation to be used whenever possible
Risk of Fall more than 2 m	People falling on and from vehicles (including falls when climbing on and off);	The need for people to go up onto the load carrying platform of vehicles should be minimised. It is recognised that the elimination of the need for access onto the vehicle or trailer may only be possible in limited cases, for example when offloading goods that have been loaded on pallets; • Only those people who need access to the vehicle for unloading should be allowed onto it; • Wherever possible the physical unloading of the vehicle should take place without anybody being on the vehicle; • The Delivery Plan should aim to minimise the amount of time that anyone is on the vehicle or eliminate the need to climb on the vehicle or load by erection of a scaffold platform to access the pipes along the centreline and sling the pipe(s) without risk of fall from heights above 2 meters. Access to the load carrying platform will be allowed below 2 meters but care should be exercised for slips trips and falls. • Where people have to climb onto a vehicle or trailer, access should be via a well-constructed ladder fixed to the vehicle, or by steps. • No one should ever jump onto or off a vehicle; • The load carrying platform of the vehicle should always be inspected to ensure that it is safe to walk on, that there are no holes in it that may lead to tripping, and that it is not slippery (e.g. due to water, oil, grease or ice); • Fall restraint and fall arrest devices, airbags and other devices designed to reduce the risk of falls from vehicles should be considered to mitigate the Consequences of a fall. However it is recognised that such devices may not be applicable or practical on construction sites where there are a variety of off-loading locations.
Work in or near confined space	Unsafe Atmosphere Containment Poor Access/Egress Extremes of hot/cold	Gas detectors (Calibrated) used to detect poisonous gases present Confined space retrieval equipment Confined spaces entry permit system Confined space risk assessments and registers

	Unstable environment Unrestricted access to confined space Poorly ventilated workplace	Competency based training for persons accessing confined spaces Fall arrest training Safety system (inc harnesses, lifeline, rescue equipment) Emergency rescue procedures

Method Statement

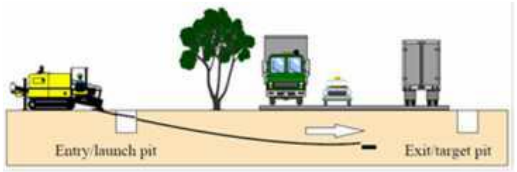
DUNNES DRILLING SERVICES LTD.

WORK SEQUENCE BASIC JOB STEPS		HAZARDS / ISSUE DESCRIPTION	INHERENT (BEFORE) RISK LEVEL	CONTROLS	RESIDUAL (AFTER) RISK LEVEL	WHO WILL DO THIS?
Break the job down into steps. Each step should accomplish some major task and be in a logical sequence		Identify the hazards associated with each step Examine each to find possibilities that could lead to an accident.	Refer to the Risk Matrix	- No of people to do the task - Occupations of people req'd - Licenses, Qual's, Permits - Training requirements - Approvals, Plans & Permits - Engineering Drawing/Ref's - Environmental controls - Lift Studies / Calculations - Plant & Equipment (static or mobile) - Safety Equipment - PPE - SDS/Hazsub/DG's	Refer to the Risk Matrix	List who specifically (by name) and when this needs to be done.
#	***Example*** *Transport 50kg reo bars to work area.*	*Heavy reo bars may cause back strain or sprain when they are being moved into position.*	**HIGH**	▪ *Two people required to transport 50 kg reo bars to work area with one person controlling the move. required* ▪ *Riggers gloves to be worn*	**LOW**	*John Smith & Joe Bloggs*
1	Pre start risk assessment meeting, Site setup of traffic control Process of works not known Causing injury to workers on or lead to an incident Traffic	Process of works not known – such as striking unidentified services Causing injury to workers on site. Workers being struck by moving plant	HIGH	• Attend daily prestart meeting on site • Determine length of drill shot/shots. By reviewing construction plans. (Start and finish of job, pit requirements. Use a measuring wheel. • Determine suitable entry and exit points. Drill rig and excavator access. • Dunnes Drilling working under Safety Management Plan & Direct Supervision of a CLIENT Site Supervisor • All personnel to attend project induction prior to works. • Approved SPA's to be communicated to the work crews and signed off prior to commencement. • CLIENT Management Plans to be communicated and understood by Dunnes Drilling Personnel. • CLIENT Procedures to be communicated and understood by Dunnes Drilling Personnel. • Plant Risk Assessments & inspections to be undertaken by Dunnes Drilling / Client prior to commencement on site. • Pre-work Brief to be discussed, signed and understood prior to commencement. • Slips, Trips & Falls – identified at Briefing and vigilance required by work crew members at all times.	LOW	Client & Dunnes Drilling
2	Preparation for drilling	Above ground level, search for obstacles such as parked plant or low hanging services or trees Don't block emergency evacuation route or amenities. Plan site set up – locate water point Working within the Rail Corridor	HIGH	• OVERHEAD: Overhead services (electrical & communication) are to be identified and located prior to establishment for height, and voltage • General awareness – look for signage • Working within Rail Corridor – Not entering the Danger Zone (3 meters from Track edge) Protection Officer Authorisation (Sign on to WPI)	LOW	HDD Crew

Method Statement

WORK SEQUENCE BASIC JOB STEPS		HAZARDS / ISSUE DESCRIPTION	INHERENT (BEFORE) RISK LEVEL	CONTROLS	RESIDUAL (AFTER) RISK LEVEL	WHO WILL DO THIS?
		Below ground level, search for obstacles, locate services Energised electrical installations or services Pressurised gas distribution mains and piping Service Damage	HIGH	• No excavation permit = no drilling or mechanical excavation • UNDERGROUND: Thorough service search & mark up using, visual indicators, pits, existing buildings, cable locator • Hand- dig trial holes or use non-destructive digging to expose each service • Customer service drawings, Drawings to be onsite and service searches conducted.	LOW	Dunnes Drilling
		Assessment of ground conditions (Fine/Coarse grained) Incorrect drill head selection	HIGH	• Turn a non-controllable condition into a controllable condition: Length > Pilot bore depending on the thrust force, Pullback depending on the pullback force • Diameter > Torque rating	LOW	HDD Crew
3	Environmental / Community	Soil and sediment run off, dirty water entering waterways Class 3 dangerous goods- Fuels, liquid explosive Damage the environment Other Work Crews working in the corridor	HIGH	• Set up containment barriers around entry point, ensure adequate silt bags are available. • All Stormwater, drainage pits, kerb side inlets and water way entry points have been identified and appropriate controls established. • Vacuum truck nearby. • Liaise with the other work crew's sign on to brief where required when working within their worksite.	LOW	Dunnes Drilling
4	Excavation (excavation of send and receive holes)	Damage to live electrical assets, causing fault. Electric shock, flash burn. Energised electrical installations or services Pressurised gas distribution mains and piping Service Damage Powered Mobile Plant	HIGH	• Excavations to be carried out by Sorensens.	MEDIUM	Sorensens.
5	Prepare Bore Plan	Unsuitable bore route Energised electrical installations or services Pressurised gas distribution mains and piping Service Damage	HIGH	• No bore plan = No drilling • Permit must be obtained before drilling • Maintain clearances from underground assets • Mark up bore plan, & excavation points, communicate bore plan with all site personnel • To avoid difficulties during the entire process it is recommended to drill in a smooth line from point A to point B. 	LOW	Crew Supervisor

Method Statement

WORK SEQUENCE BASIC JOB STEPS		HAZARDS / ISSUE DESCRIPTION	INHERENT (BEFORE) RISK LEVEL	CONTROLS	RESIDUAL (AFTER) RISK LEVEL	WHO WILL DO THIS?
6	Unloading the drilling rig	Unloading drill rig from back of truck Cause crush injury to workers Cause damage to property & equipment	HIGH	• Plan route before unloading • Ensure drill path is adhered to as per existing utility search previously completed.	LOW	HDD Crew
7	Set drill at send pit	Setting up drill rig tracking drill rig Plant striking underground electrical service Hose connection failures	HIGH	• Secure machine using stake down spikes • Calibrate drill head manually • Earth out drill rig, using earth stakes • Visually inspect and attach hoses, safety pins. 	LOW	HDD Crew
8	Mix drilling fluid	Incorrect levels used to mix drilling fluid (Bentonite) Cause illness to workers	HIGH	• Fill cleaned mixing system with water • Add bentonite bags through hopper add bentonite at a steady pace using correct PPE, refer to SDS. • Rule of thumb: Approximately 1 bag of bentonite per 1000litres of water. • Allow bentonite to hydrate for a minimum 20minutes. • Thixotropic behavior: Fluid when in motion, Solid when not in motion, cutting en-capsuling prevent clay balling.	LOW	HDD Crew
9	Refueling Mobile Plant	Exhaust Fumes Cause injury to workers from inhalation Ignition, fire	HIGH	• PPE • Ventilated area • No Smoking or mobile phones	LOW	Plant Operator
10	Commence drilling operations	Commencement of drill shot Zone of influence Service Damage Frac out on bore path Communication	HIGH	• Permit must be obtained before drilling. • Area around drill rig to be barricaded, eliminating access • No drilling to commence until all services to be crossed are all sighted. • Drilling within 300mm of any service inspection windows must be used to ensure drill head passes service with no damage. • Frac out on bore path, Vacuum truck to be used to control Frac. • Two-radio to be utilized during bore	LOW	HDD Crew

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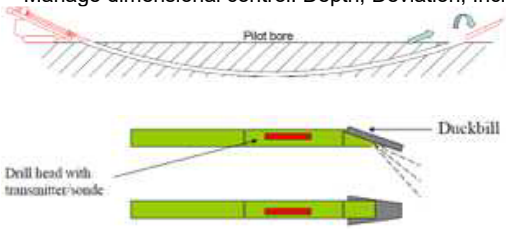
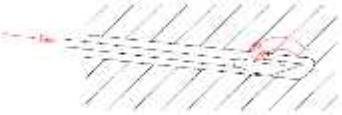
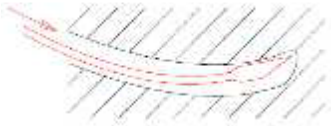
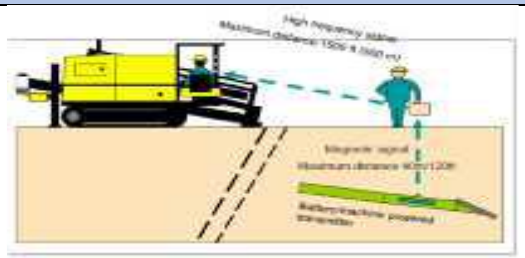
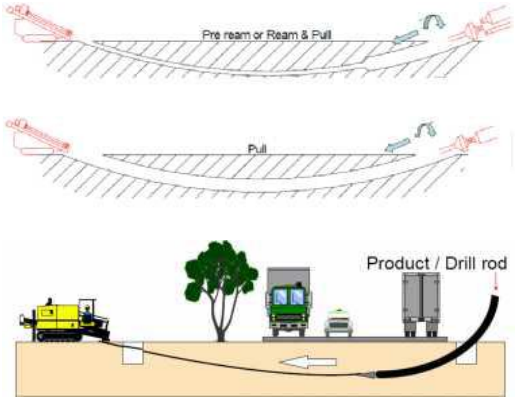
11	Pilot Bore	Pilot bore shot Energised electrical installations or services Pressurised gas distribution mains and piping Service Damage Powered Mobile Plant Frac out on bore path	HIGH	• Commence pilot shot, maintain depth • Drill head pushed and rotated from entry (machine) to exit (pipe) side, 100 – 150mm hole • Select required drill head, given ground conditions. Start with Tri Hawk. • Manage dimensional control: Depth, Deviation, Inclination, Direction, Distance 	LOW	HDD Crew
12	Steering Drill Head	Rotating rods, bending rods Communication Travel Path Service Damage Powered Mobile Plant Frac out on bore path	HIGH	• Steering drill head controls • Rotate & Push - No change in direction or inclination.  • Two way radios must be used at all times • Be aware of all plant in area when walking with locator. • Only push – Change in inclination and/or direction depending on the roll position of the drill head. Limited steering angle per drill rod allowed.  • For every 1 cubic m soil we need 3 cubic m bore fluid, small cuttings easy to transport • The drill head will always follow the easiest way • RULE: Returns (100%) = BOREFLUID (75%) + SOIL (25%)	LOW	HDD Drill Tracker & HDD Crew

WORK SEQUENCE BASIC JOB STEPS		HAZARDS / ISSUE DESCRIPTION	INHERENT (BEFORE) RISK LEVEL	CONTROLS	RESIDUAL (AFTER) RISK LEVEL	WHO WILL DO THIS?
13	Tracking Drill Head Navigation walkover	Loose signal of drill head Energised electrical installations or services Pressurised gas distribution mains and piping Service Damage Cause injury to worker	HIGH	 • Maintain constant communication with operator via 2-way radio • Navigation walkover, worker to walk along tracking the drill head with sonde, measuring & recording: □ Depth □ Inclination □ Direction □ Clock face □ Temperature □ Battery Status	LOW	HDD Drill Tracker
14	Receiving drill head at exit hole (detach drill head from drill rods)	Receiving drill head at exit point Cause injury to workers	HIGH	• No personnel to be inside exit point when receiving the drill head • Use remote lockout system on drill when changing reamers on opposite ends of the drill shot • Determine required pitch to exit at required depth in exit hole	LOW	HDD Crew

WORK SEQUENCE BASIC JOB STEPS		HAZARDS / ISSUE DESCRIPTION	INHERENT (BEFORE) RISK LEVEL	CONTROLS	RESIDUAL (AFTER) RISK LEVEL	WHO WILL DO THIS?
15	Attach reamer to drill rod and pull back bore pipe	Attach reamer to drill rod and pull back bore pipe Cause injury to workers	MEDIUM	 • Isolate drill rig, no uncontrolled movement of bore pipe tail • Securely attach, bore pipe to back cutter • Receiving pipe in entry put, cut bore pipe to length and disconnect pipe from pulling eye Hole size related to installation length Length / Overcut 0 > 50m/150ft — 20% 50m/150ft > 100m/300ft — 30% 100m/300ft > 300m/1000ft — 40% > 300m/1000ft — 50% Condition/product ROCK — 50% STEEL — 50% 	LOW	HDD crew

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16	Commence drilling	Pipe or rods breaking or getting stuck during drill. Breaking of rods, pipe, chains causing striking injury/fatality.	HIGH	1. Drilling Head breaks off from drill rods – Excavate down (Where possible) to find drill head and remove rods as per normal procedure. 2. Drill rods break – Excavate down (Where possible) to find broken rod, remove damaged rod and rejoin remaining rod string and remove rods as per normal procedure. 3. Pipe pulling head fails - Excavate down (Where possible) to find broken pullers, remove damaged pullers and replace, rejoin pipe and pulling head remove rods as per normal procedure. 4. Pipe breaks - Excavate down (Where possible) to find broken section, remove damaged section and replace, rejoin pipe and pulling head remove rods as per normal procedure. • If the pipe does get stuck during a pullback we would need to pull the pipe back out from the way it came, this is done using a pulling head on the other end of the pipe and attaching a cable winch to pull back the pipe in reverse, this allows the pipe to come back out from the way it has gone in and reduces the pressures of trying to pull onwards. When the pipe is removed the drill rods are put through again and the hole is reamed to a larger size and cleaned.	LOW	Project Manager Crew Supervisor& HDD Crew
17	Remove reamers/pullers	Injury to Work Crew – Potential injury from drill head moving parts while crew changing head/reamer.	MEDIUM	• Ensure rig is isolated before changing heads or reamers. Key to be removed from drill rig to ensure isolation. Use two way radio to check isolation is complete. • Use mechanical plant or team lift to lift drill heads and reamers. • Remove reamers, swivels and pullers as per operator's manuals and training.	LOW	HDD Crew
18	Shut down & secure drilling rig	Drill rig not secured Unauthorised use of drill rig	MEDIUM	• Shut down machine, track machine back to truck	LOW	HDD Crew
19	Backfilling of entry/exit points	Drilling Waste not removed from send/receive holes, and disposed of appropriately Ground Subsidence Causing fault in the asset	HIGH	• Backfill, compact and reinstate open points • Bore fluid removed by sucker truck & disposed at licensed waste facility. • Dockets taken from licensed facility when disposing of drill materials	MEDIUM	CLIENT
20	Temporary restoration	Ground subsidence Causing injury to workers, and public.	HIGH	• Temporary restoration must be level. • All open points that are not backfilled, must be securely fenced, maintaining • pedestrian access	MEDIUM	CLIENT

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21	Change Management	Hazards not identified within RAMS Procedures not implemented as per SWM	MEDIUM	Controls to be determined as per RAMS review by management.	LOW	CLIENT & Dunnes Drilling
22	Clean up work area	Injury to Public – Falling into open excavation, trip over protruding pipe. Damage to the Environment – Sediment entering stormwater system.	MEDIUM	• All excavations to be covered or fenced off securely. Fence off any protruding pipe • Maintain sediment controls	LOW	Site Supervisor

Method Statement

ACKNOWLEDGEMENT OF COMPLIANCE

1	I have been consulted in the RAMS	**3**	I understand the RAMS requirements
2	I have been given an opportunity to comment on the method of work	**4**	I understand what the hazards, risks and what the relevant controls are

Name of Worker	Signature	Date		Name of Worker	Signature	Date

Note: If necessary, attach additional signature pages.