

Directional Drilling Procedure

Overview

The installation of underground services by direction drilling is often faster and more economical than traditional open trenching techniques but it does come with some unique risks that must be addressed to work safely.

Due to the inevitable variety in ground conditions, drill heads, cutting head size and design, drill fluid mixtures, site set up, material existing services are made of etc, there is no one recipe for ensuring safety. As such this procedure looks at the risks posed in the various stages of the process and industry best practise to manage them to an acceptable level.

This procedure is intended for use by the directional drilling crew and project managers.

Definitions

Services

- **Known Service** – A service shown on the utility providers plans
- **Marked Service** – A Known Service that has had a location window marked on the ground service following location by electronic means (cable locator or ground penetrating radar)
- **Identified Service** – A service that has been physically exposed to confirm its exact position both laterally and vertically.
- **Unknown (Rogue) Service** – A service that is not shown on service plans and/or that was not identified by electronic means.

Pot Hole

- An excavation used to confirm the location of a service both laterally and vertically.

Drill Line

The intended line for installing the new service marked on ground.

Drill Plan

The intended path of the drill and cutting heads along the drill line i.e. includes planned depths. This is the directional drilling equivalent of a “Dig Corridor” used when open trenching.

Cutting Head

A cutter used to expand the initial bore hole out to a size that will allow the new service to be installed. Different designs are required in differing ground conditions.

Drill Fluid

The fluid pumped through the drill rods on the pull back that creates a stable bore hole and floats the new pipe into the hole. Different fluids are required in different ground conditions.

In Close Proximity

This is an imprecise / variable term. It is the minimum separation from a Confirmed Service that is considered in consultation with the Client by the Drill Forman to be safe. The In Close Proximity distance is at least the minimum clearance distance plus the outside diameter of the pipe being installed?

In determining what In Close Proximity means in each circumstance consideration needs to be given to variables like

- Ground conditions
- Cutting head size
- Flexibility of the drill rods
- Size and flexibility of the pipe to be installed
- Material of the existing services
- Potential consequences of hitting the service
- Minimum separation submitted by Client

Job Preparations

This procedure assumes that the following preparations have all been completed.

- All service plans are available for the area of interest
- The Corridor Access Request (CAR) has been submitted and approved by the Road Controlling Authority
- Appropriate Traffic Management is in place
- Staff have been inducted by the client and onto site by the Drill Forman
- A draft Drill Line has been discussed with the Client

Confirmation of Services

Before confirming a Drill Plan the exact location of the Known Services must be determined.

Step 1 – The Known Services shown on the service plans are located using a cable locator and ground penetrating radar (GPR, Cat and Genny) across the drill line. A window is marked on the ground where the service should be found. An additional sweep will then be conducted to potentially identify any unknown services.

Step 2 – The Drill Forman and Client representative checks the plans against the mark out to confirm all Known Services have been marked.

Step 3 – All Marked Services are Pot Holed on the draft Drill Line using hydro-excavation. The position and depth of the services is marked beside the potholes for use when confirming a Drill

Plan. The depths are also recorded on a “Location of Services” form in case the marks on the ground surface become illegible.

If a marked service has not been found in the marked window the following should occur

- Hydro-Excavate to 1.5m either side of the marked position perpendicular to the proposed drill line and at least 500mm below the proposed service installation depth
- Check under services that were found. Electronic location of services buried below other services by electronic means is not always possible
- If any marked services remain unfound discuss options with the client representative and utility owner

Step 4 - Once the exact location of the Known Services has been confirmed the Drill Line can be checked to ensure it is achievable. If the Drill Line needs to be modified the Pot Holes will need to redone on the newly proposed Drill Line.

Drill Plan

The Drill Plan is essentially the planned depths at certain locations along the confirmed Drill Line. Coming up with a Drill Plan requires the knowledge of, and processing of several variables.

From a safety perspective the most important part of the Drill Plan is the separation distance between a Confirmed Service and the service being installed. The separation required should be considered as shown below.

Cutting Head Diameter

The diameter of the Cutting Head is generally around 30% larger than the pipe being installed. The difference in diameters allows a volume of drill fluid to surround the pipe being installed which reduces the friction and effectively floats the pipe into the ground.

Safety Margin

The required safety margin varies depending on several variables.

- The service you are crossing –
 - The higher the potential consequences if a service is hit the larger the required safety margin
 - The more fragile the material
 - Of the service you are crossing the larger the required safety margin
 - The ground conditions (gravels or stones, clay or sand etc) o can influence the steering of the drill head as it is drilled out can increase the area affected as the Cutting Head is pulled back. Note - The stones may be native or potentially backfill in trench lines
 - The stress on the rods as changes in depth are made – the rods will always try to straighten themselves out. The diameter of the rods used alter this effect.
 - The experience and skill level of the Drill Locator

Other Considerations

Other factors that influence the Drill Plan

- Client dictated maximum installation depths
- Large diameter pipes and / or long drill shots require significant amounts of Drill Fluid. Limitations on the manufacture, storage and collection / disposal of drill fluid must be considered and may limit the length of drill shot
- If the pipe to be installed is supplied in straight lengths rather than coils an area to lay the pipe out while it is welded together that doesn't interfere with traffic flows or property access before being installed is required. This may limit the drill shot length
- The larger the pipe and the thicker it's wall the less flexible it is i.e. the smoother the changes in direction must be made
- Client dictated minimum clearance distances

Drilling Out

Note: Some clients use a “Permit to Excavate” or similar which is required prior to the use of mechanical excavators or directional drills.
If required have a permit issued before proceeding.
If the drill is fitted with an electrical strike safety system the earth stake must be driven into the ground and the system tested prior to drilling out.
The drill locator issues instructions to the Drill Operator to steer the drill head along the predetermined Drill Line at the proposed depths noted on the ground (the Drill Plan.)
Actual depths are marked on the ground at the end of each rod drilled out (use different colour paint to the Drill Plan)
When crossing services “In Close Proximity” to the drill head slowly proceed while maintaining a visual on the service.

Pull Back

When the drill head reaches the exit hole remove the drill head and attach the Cutting Head (if required) and connect the pipe.

Mixing Drill Fluid

The type of Drilling Fluid used is determined by considering several technical variables. The quantity required is determined by calculating the annulus area (Area of the Cutting Head – Pipe Area) multiplied by the length of the drill shot multiplied by a factor.

Pull Back

The pull back is started and the Drill Operator controls the speed of the pull back to ensure that there isn't too much tension of the drill rods and that the down hole pressure doesn't get too high which can lead to a Frack out (drill fluid migrating out of the drill hole).

Drill Fluid

Drilling fluid combined with native ground materials will flow back to the exit hole, or pressure relief hole if used. The fluid is sucked up by the hydro-excavator and removed to landfill disposal.

Service Strike Response

Electrical Strike If an electrical service strike occurs workers should not move. The voltage difference between plant and the ground or even between a person's feet can be sufficient to cause injury or death. Do not touch the drill, drill pipe, mud mixing system or anything connected to the drill.

The drill operator should reverse the direction of travel i.e. if drilling out pull back, if pulling back push out in an attempt to break the electrical connection.

Immediately contact

- The electrical utility company –
- Orion 03- 363-9898
- Main power 0508-60-70-80
- Client representative

Do not move until the supply company confirm that it is safe to do so.

Gas Strike

If a gas strike occurs do not attempt to move the drill as leaving it in position often helps to slow the gas release until the situation can be made safe. Turn the drill off.

Immediately move all staff to an up wind position. Take care not to create a source of ignition (cigarette lighters etc).

Immediately contact

- Fire Brigade on 111.
- Gas Supplier
- Contact Energy Emergency Contractor (Gas Engineering Services) 0800-501-101
- On Gas 0800-841-212
- Nova Energy 0800-668-236
- Utilities Infrastructure NZ LTD Project Manager
- Client representative

Note - LPG is heavier than air and in still conditions will settle to the ground and can potentially enter the storm water system and travel significant distances undetected to find a source of ignition. If safe to do so cover storm water grates.

Excavations may need to be ventilated to make them safe before entry following isolation of the leak, check with the repair crew.

Fibre Optic Strike

If a Fibre Optic strike occurs immediately stop drilling and call the utility owner.

- Fibre owner
- Telecom 120
- Vodafone 0800-555-500
- Enable 0800-434-273
- Trans power 0800-843-4743
- Utilities Infrastructure NZ LTD Project Manager
- Client representative

Do not look down the end of broken fibre optic cables as it can cause severe eye damage.

Communications, Sewer, Storm Water or Water Strike

If any communications, sewer, storm water, sewer or water strike occurs stop drilling and contact the utility owner.

Utility owner

- Telecom 120

- Vodafone 0800-555-500
- NZ Railways 0800-808-400
- Christchurch City Council 379-1660
- Waimakariri District Council 375-5009
- Selwyn District Council 347-2800

Anyone who comes into contact with sewerage should be disinfected.

Immediate Corrective Actions

Root Cause Analysis (Tick what you think was the main cause's keep asking why)		
<input type="checkbox"/> Plant/workplace design	<input type="checkbox"/> House keeping	<input type="checkbox"/> supervision
<input type="checkbox"/> Plant/ workplace modification	<input type="checkbox"/> Sub contactors	<input type="checkbox"/> Unsafe behaviour
<input type="checkbox"/> Ineffective guarding	<input type="checkbox"/> Alignment issues	<input type="checkbox"/> Operation procedures
<input type="checkbox"/> Maintenance	<input type="checkbox"/> Training	<input type="checkbox"/> Distractions
Comment on what was ticked: 		

Contract details	
Client:	Job description:
Sub contactors involve: • •	Photos Taken and Provided : Y/N
Whom Was notified:	When Was service fixed and by who:

Signed Client: _____ Date: _____

Signed UINZ Rep: _____ Date: _____

Signed UINZ Staff Involved: _____ Date: _____

Signed Sub Contractors Involved: _____ Date: _____