Construction and Rehabilitation of Exploration Drill Sites

1. Introduction

This purpose of this Advisory Note is to assist exploration operators in the construction, rehabilitation and closure of drill sites to minimise the disturbance footprint and ensure the protection of the environment.

Drilling activities have the potential to impact on the environment in a variety of ways, including contamination of aquifers through the ingress of contaminants from the surface, interconnection between aquifers, contamination of surface water, loss of flora and fauna, soil contamination from hydrocarbons and drill fluids, and soil erosion. In addition, open holes pose a danger to people and wildlife and inhibit future exploration and pastoral vehicles traversing the area.

Likewise, bores used to access groundwater for exploration or mining activities can constitute a hazard to public health and safety, and can adversely affect the quality and flow of groundwater resources if abandoned without due concern. Therefore, it is imperative that drill sites are remediated and bores are adequately prepared for abandonment when they are no longer required.

2 Legislation

The purpose of the *Mining Management Act* is to ensure the protection of the environment on mining sites and for related purposes, including exploration. Under the *Mining Management Act,* every person has an obligation to take care of the environment and ensure the rehabilitation of areas impacted by their activities.

3 Requirements

Drill pads and benches are to be constructed with minimum disturbance to the environment and remediated in such a way as to reinstate the natural land surface, promote rapid revegetation and prevent the initiation of soil erosion. Prior planning is required, as this helps to minimise the cost of rehabilitation and to reduce negative impacts on the environment.

Drillholes and bores that are abandoned to restore, as close as possible, the controlling geological conditions that existed prior to drilling. In the Northern Territory exploration drillholes must be backfilled to the surface with a suitable medium (eg concrete or drill cuttings). At a minimum, drillholes are required to be plugged in the manner described in the diagrams below. It should be noted that the use of Octoplugs is not endorsed.

Special consideration for the protection of groundwater may be required where an exploration drillhole intersects an aquifer.

3.1 Construction of drill pads, benches and drillholes

- Prepare drill pads and benches with the minimum of disturbance and earthworks required. Drilling, excavation or clearing must not occur with 25m of a watercourse or 125m of a major road or railway.
- Minimise vegetation removal by avoiding large trees and leave rootstock in the ground to assist with stabilisation and natural regeneration.
- Clear and level the minimum area necessary for the work to be carried out safely.
- The dozing of earth and excavated material down steep slopes from which it cannot be readily recovered is to be avoided.
- The creation of hard bare rock areas which cannot support vegetation is to be avoided.
- If excavations are required, remove topsoil and stockpile for re-spreading on completion of the drilling program.
- Sumps are required to be situated away from the drip line of trees to avoid impacts on the root zone.
- Sumps require the construction of a slope to allow for fauna egress.
- The use of an excavator to assist in the construction of the pads is recommended on steep slopes to minimise earthworks and enable the storage of topsoil and subsoil for later rehabilitation operations.
- The use of tracked drill rigs is strongly recommended at sites on steep terrain.
- Drillholes that are likely to intersect artesian aquifers must be pre-collared and have a pressure cementing casing of adequate strength and to a sufficient depth, to enable bore control procedures to be carried out in the event of a blow-out.

3.2 Rehabilitation

3.2.1 Rehabilitation of drill pads and benches

- Dependent on site conditions and surrounding landscape, it may be necessary to conduct earthworks to stabilise and reshape the site. The site is required to be remediated to as near original condition as possible, following the completion of the drilling program.
- Ground which has become compacted by the use of heavy machinery and traffic is to be ripped along contour, not down slope, to loosen soil, promote water infiltration, aid revegetation and minimise soil erosion.
- Earth and overburden that was excavated from the pads and benches is required to be pushed, raked or pulled back over. The stockpiled topsoil and vegetation should be re-spread over the site.
- All sample bags, waste materials and contaminants must be removed from site and disposed of in an appropriate manner, following the completion of the drilling program.
- Drill cuttings that are acidic, radioactive or of a substantially different colour to the surface soil must be backfilled in the drillhole, sump or other excavation. All other cuttings are required to be dispersed around the site or raked over.
- Drill sumps must be backfilled with the excavated material and respread with stored topsoil.
- Permanent survey markers should be kept to a minimum and wooden pegs should be used in preference to steel pegs.
- Tracks constructed to access the drill site must be remediated as per the department's Advisory Note for the Clearing and Rehabilitation of Exploration Gridlines and Tracks.

3.2.2 Capping and plugging of drillholes intersecting a single unconfined aquifer

Collared holes

- PVC collars may be readily cut below ground level to a minimum depth of 0.4 metres using a powered brush cutter modified with a diamond masonry blade or an internal pipe cutter. The cut section of collar may be removed from the hole using chain tongs or an oil filter remover if necessary.
- A non-degradable plug, bridge (metal plate) or casing cap should be installed above the cut off casing at a minimum of 0.4 metres below ground level. The plug may be fitted with a length of wire rope and a tag as an indicator, if required.
- Alternately, drillholes may be either backfilled with drill cuttings, clean fill or cement, allowing for settlement.
- The soil backfill should be compacted and mounded over the hole to allow for subsidence and to limit the pooling of surface water.
- Please refer to **Figure 1**.

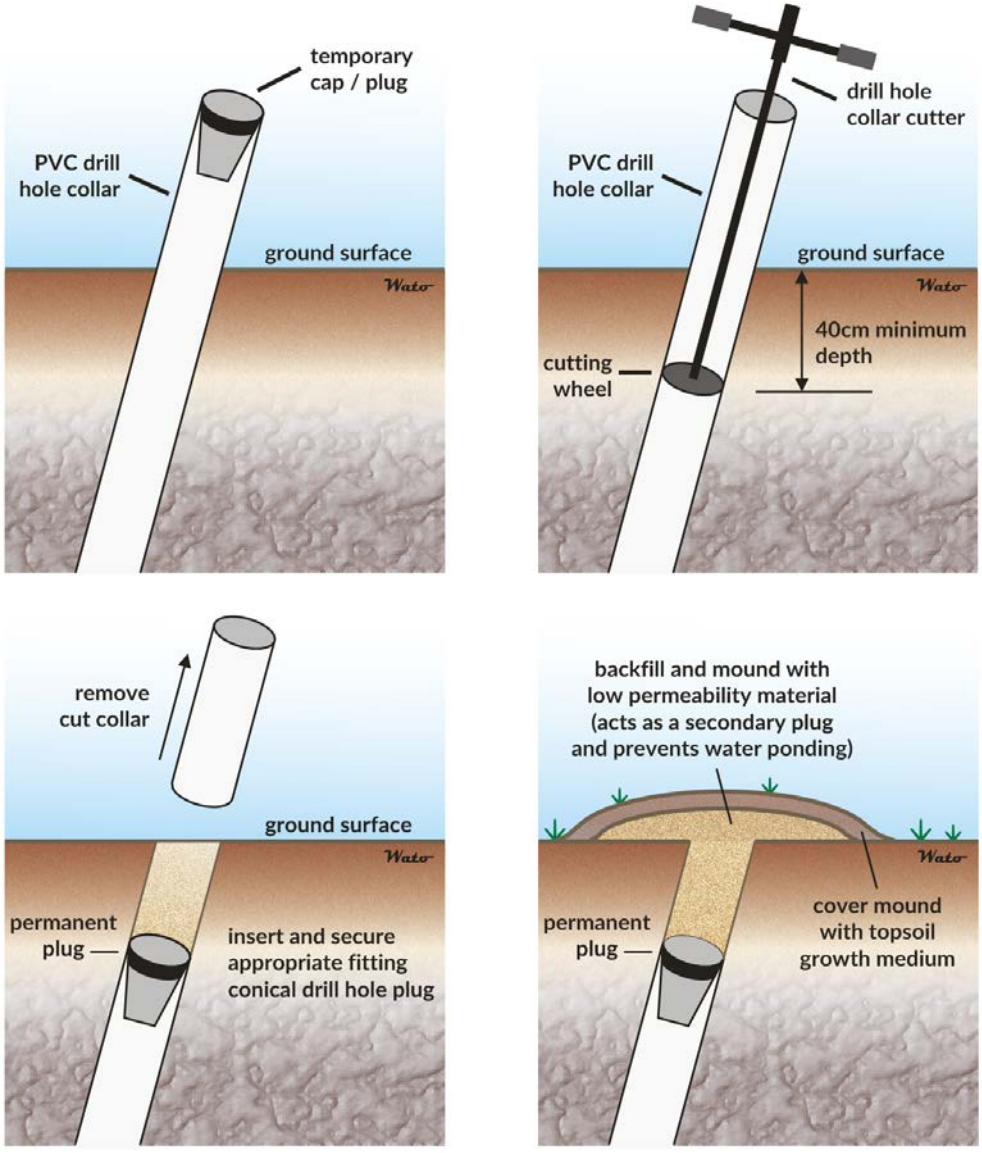

Figure 1: Capping and plugging of collared and uncollared drillholes.

Uncollared holes

- Drillholes should be plugged at least 1 metre below ground level with a non-degradable plug or bridge. The plug is to be at least 50 millimetres larger than the diameter of the drillhole, but depending on the nature of the ground, must be of sufficient size as to remain firmly in position.
- To enable the placement of the plug the drillhole may need to be reamed-out to 1 metre depth with hand tools or counter-bored by the drill rig with a larger drill bit.
- Alternately, holes may be either backfilled with drill cuttings, clean fill or cement, allowing for settlement.
- The soil backfill should be compacted and mounded over the hole to allow for subsidence and limit the pooling of surface water.
- The intention is that water shall not ingress the hole, causing erosion. Particular care is required to ensure the long term effectiveness of the plugging procedure.

3.2.3 Capping and plugging of drillholes intersecting a single confined aquifer

- The main objective in sealing drillholes in single confined aquifers is to contain water in the aquifer.
- Drillholes should be plugged across the aquifer confining bed interface for a thickness of about 4 metres (2 metres above the interface and 2 metres below); and then backfilled or plugged as outlined previously.
- Please refer to **Figure 2**.

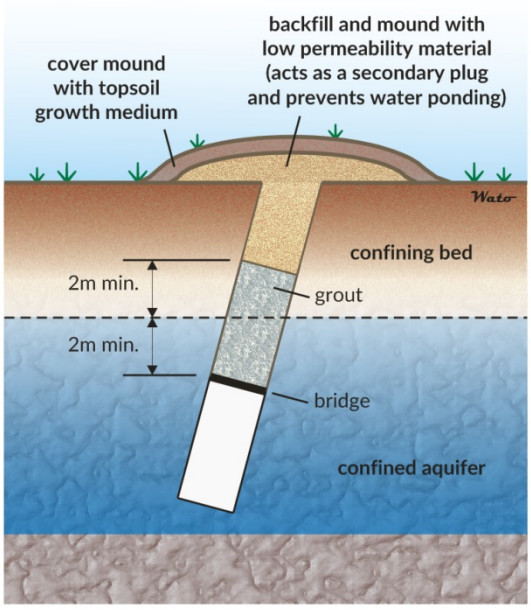

Figure 2: Capping and plugging of drillholes intersecting a single confined aquifer.

3.2.4 Capping and plugging of drillholes intersecting multiple aquifers

- Major aquifers should be sealed to prevent inter-aquifer flow.
- Grout plugs should be positioned at the interfaces between aquifers and the overlying confining beds. The grout should be at least 4 metres thick, with 2 metres above and 2 metres below the interface.
- Holes should then be backfilled or plugged as outlined previously, with compaction and mounding of backfilled material.
- Shallow drillholes can be backfilled from the base of the hole to the surface with grout.
- Please refer to **Figure 3.**

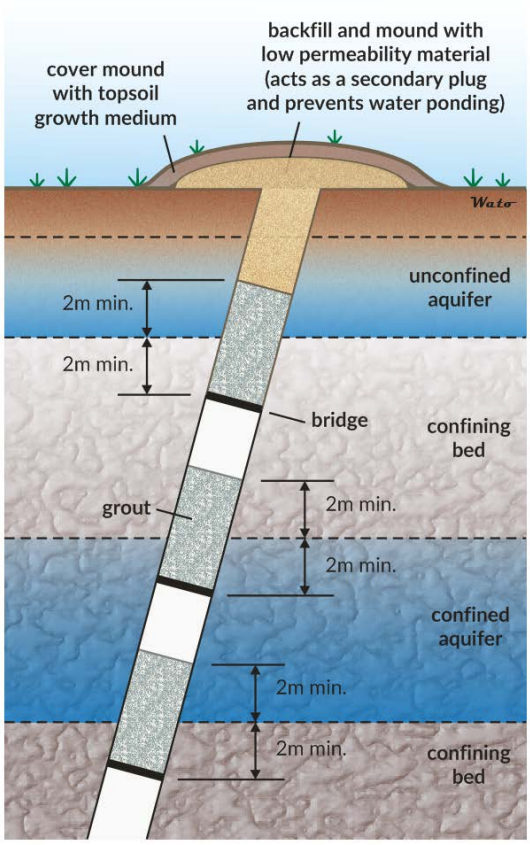

Figure 3: Capping and plugging of drillholes intersecting multiple aquifers.

3.2.5 Bore decommissioning

- If decommissioning a bore at a mine site, please contact the department's Environmental Monitoring Unit (08 8984 4234) or Mining Compliance (08 8999 6528) to ensure the department no longer requires the bore for monitoring.
- All bores that are to be permanently decommissioned must be sealed completely and filled in a manner that prevents vertical movement of water within the bore.
- The sealing material must not pose any potential human or environmental health risk and should be more impervious than the material through which the bore was drilled. Concrete, cement grout or bentonite grout should be used as the primary sealing material and should be placed from the base of the hole upwards.
- Fill material should consist of clean or disinfected sand, coarse stone, clay or drill cuttings.
- Bores with high flows and pressure should be sealed exclusively with cement grout to a depth of at least 20 metres (unless the flow originates from less than 20 metres).

- All bores should be sealed with an approved sealing material from a depth of 5 metres to around 30 centimetres below the ground surface. Topsoil should be placed above this to assist in full rehabilitation. Surface casings may be left in place if they have been pressure cemented or if they have been determined to be sound, in which case they must be bridged with cement grout.
- Grout bridges may be used where it is not practicable to grout a bore fully. A minimum of 10 metres is required for a bridge (20 metres for a flowing bore). These will be set in impermeable strata immediately above and below each aquifer formation in the bore.
- Records should be complete and accurate regarding the location of abandoned bores and the procedure used for decommissioning and rehabilitation.
- Please refer to **Figures 4 to 7**.

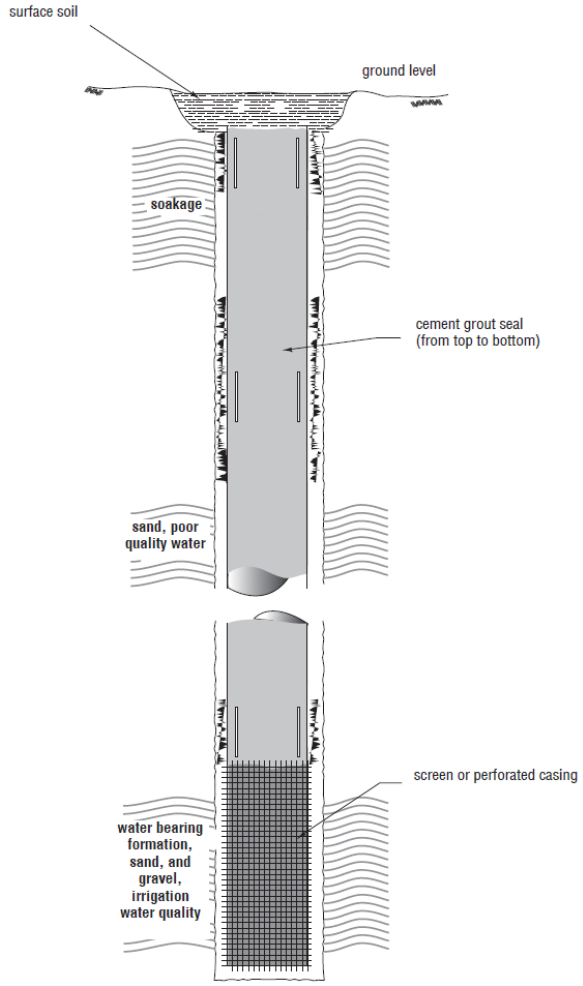

Figure 4: Requirements for decommissioning a non-flowing bore. Source: National Uniform Drillers Licensing Committee (NUDLC) 2012.

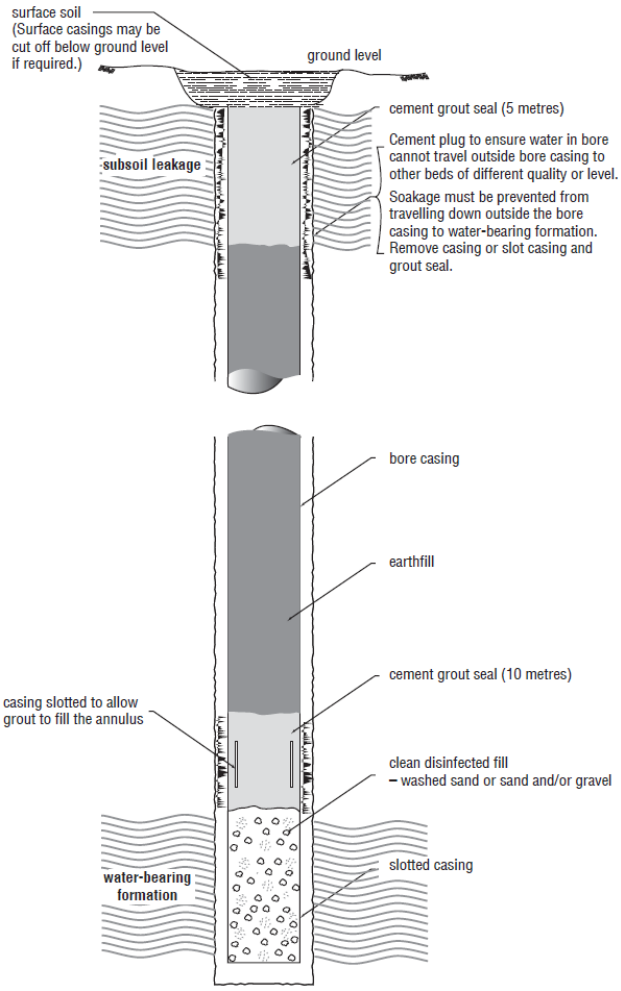

Figure 5: Requirements for decommissioning a single aquifer non-flowing bore. Source: NUDLC 2012.

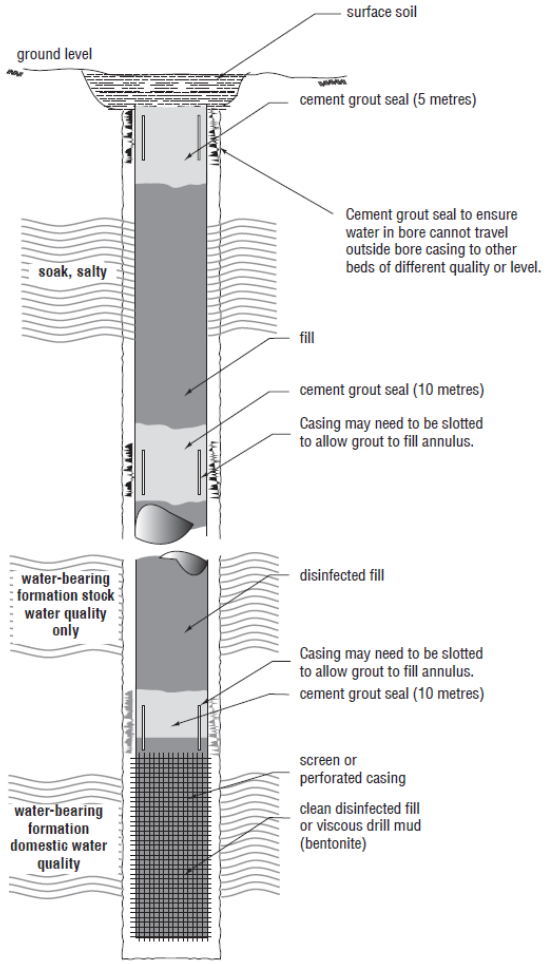

Figure 6: Requirements for decommissioning a multiple aquifer non-flowing bore. Source: NUDLC 2012.

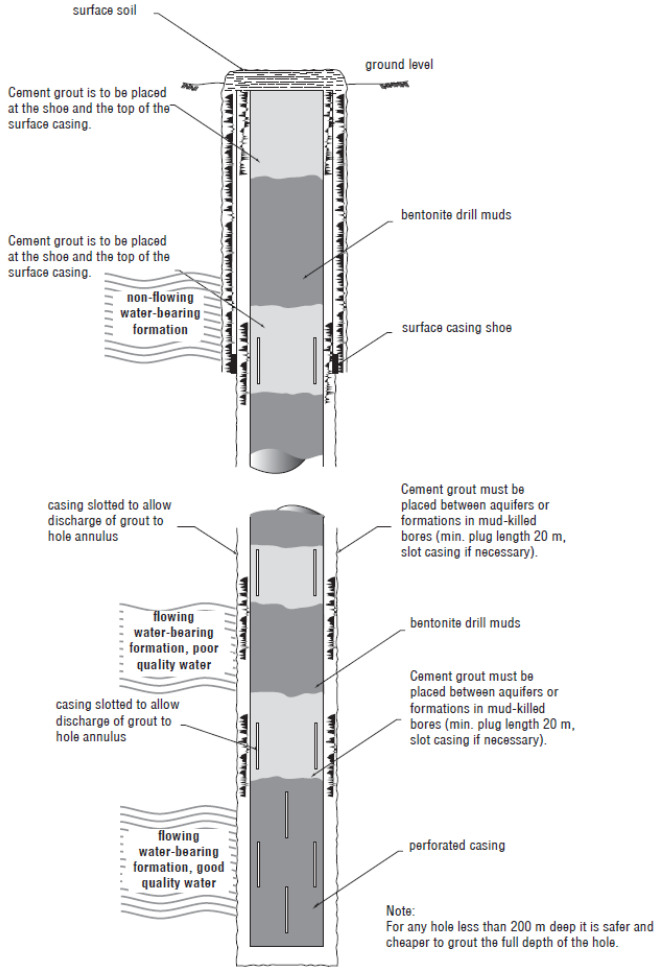

Figure 7: Requirements for decommissioning a flowing bore. Source: NUDLC 2012

4 Glossary of Terms

TERM	DESCRIPTION
Confined Aquifer	Confined aquifers are under pressure, have a confining layer of impervious strata above, and the water will rise above the level at which it is cut.
Environment	Means land, air, water, organisms and ecosystems on a site and includes: • the well-being of humans • structures made or modified by humans • the amenity values of the site • economic, cultural and social conditions.
Environmental Impacts	Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
Operator	Means the operator for a mining site referred to in Mining Management Act section 10.
Unconfined Aquifer	An aquifer in which the water is under atmospheric pressure, and generally the water remains at the level at which it was cut.

5 Further Information

National Uniform Drillers Licensing Committee, 2012. *Minimum Construction Requirements for Water Bores in Australia (Third edition).* http://aditc.com.au/wp-content/uploads/2014/06/Minimum-Construction-Req-Ed-3-2.8MB.pdf

Department of Primary Industry and Resources. *Mining Forms, Procedures and Guidelines* - www.minerals.nt.gov.au/mining

6 References

National Uniform Drillers Licensing Committee, 2012. *Minimum Construction Requirements for Water Bores in Australia (Third edition).* http://aditc.com.au/wp-content/uploads/2014/06/Minimum-Construction-Req-Ed-3-2.8MB.pdf [accessed September 2016].