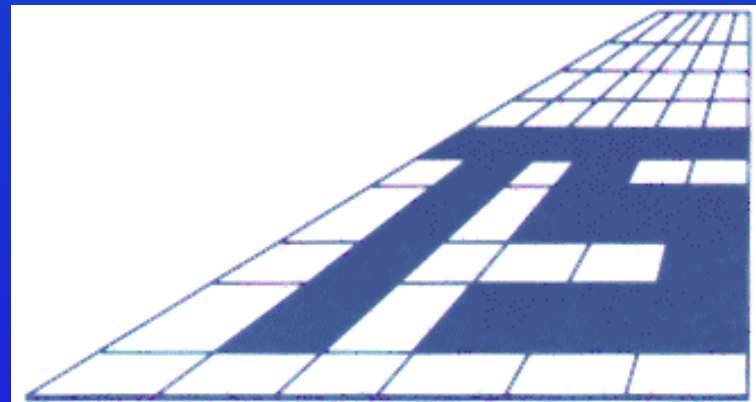


REVERSE CIRCULATION DRILLING INDUCTION - PROCEDURES IN THE FIELD



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How to use this presentation

- This presentation is a **guide** to RC Drill sampling developed over 27 years. It is meant to **act as a base plan for drilling procedures**. **However**, each drilling job is **unique** and therefore **variations** to this guide may be required.
- The presentation will run for about 30 min.
- Take your time and pay attention.
- If you do not understand certain information or you would like to have more information please refer to the General Field Operations and Safety Manual or ask the Field Manager.
- After the presentation you will complete a written test to demonstrate that you do understand all aspects of Terra Search's Reverse Circulation Drilling Induction.



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1. Introduction

Basically in a Reverse Circulation Drilling Program, the drill hammer breaks up the rock as the hole is drilled.

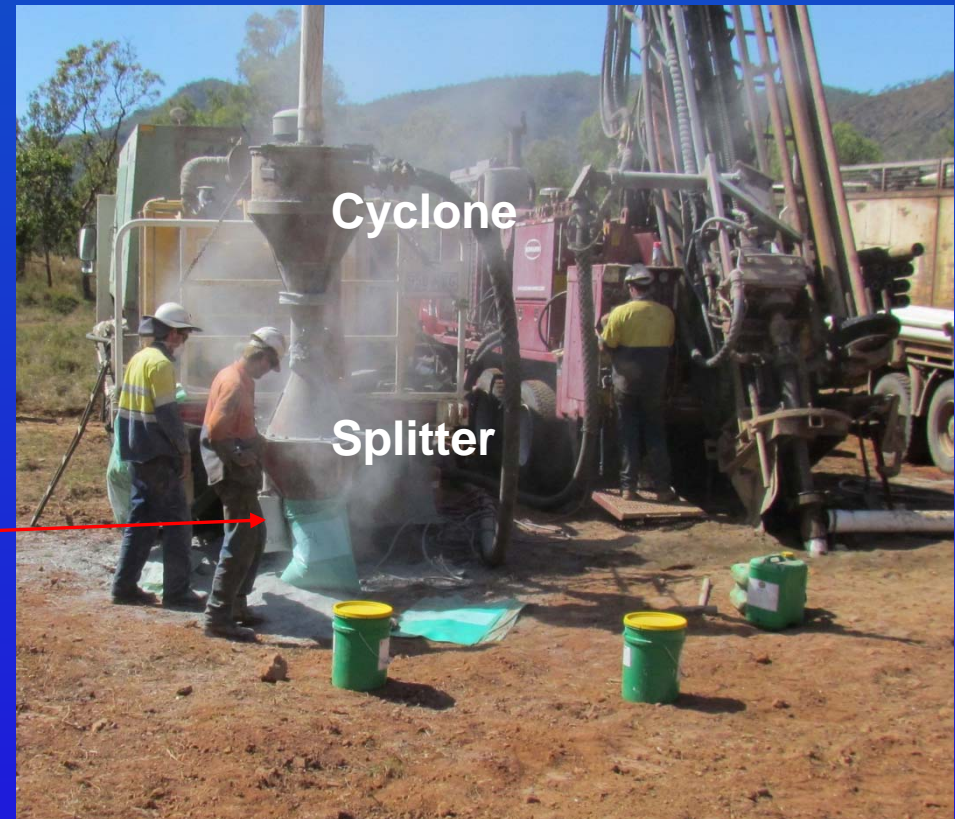
This produces gravel size rock chips, clay to sand sized sediments.

The rock chips are brought to the surface by compressed air.

These are then collected from the cyclone or splitter in calico bags and large bulk sampling bags.

The material in the large bulk bag is then speared to obtain a reference sample, XRF sample and a sieved rock chip sample.

The material in the calico bags are sent for assay.



2. Preparation

- Terra Search RC Drilling induction
- Job specific information – Native Title, Landholder Compensation Agreement and Environmental Sensitive Area
- **Geologist's role/responsibilities** – Job quoting, ongoing liaising with clients, contractors, landholders and native title. Establishing target and associated research plotting etc. Establishment of job specific techniques: drilling, sampling, labeling. Ongoing site management and supervision.
- **Field Assistant's role** – understanding and assisting in site specific sampling techniques, safety, general site duties, implement specific duties outlined by site supervisor or client
- Administration's role – sched in procedure, assistance with booking accommodation etc., landholder and tenure liaising and management and Field Manager support
- Safety - SOP's, JSA's, Tool Box, Checklists
- RC sampling – specific sampling techniques for each unique drilling job (commodity, company and location)
- Equipment preparation and mobilisation – following checklists, rechecking of equipment and vehicles



3. Equipment used to collect & label samples

Consumables

- ✓ Stapler and staples
- ✓ Rock chip tray – 20 compartment
- ✓ Scales
- ✓ Masking tape
- ✓ Zip ties
- ✓ Calico Bags
- ✓ Large green/white plastic bags
- ✓ Small green plastic bags
- ✓ Large poly-weave bags
- ✓ Permanent marker
- ✓ Home Brand sandwich bags (XRF)
- ✓ Small zip lock bags (XRF)
- ✓ Cardboard shoeboxes (XRF)

Sampling Equipment

- ✓ Spear
- ✓ Teaspoons (4)
- ✓ Sieve (2mm)
- ✓ Vege sieves (7)
- ✓ Sample number book
- ✓ Log book
- ✓ Field notebook
- ✓ Tubs (x 2) for water



4. Site Establishment & Inductions

- First onsite usually project Geologist and or Client – stake drill pad and drill hole location, sighting alignment of drill rig, determining location of samples and Terra Search sampling equipment and personnel
- Site management – checking slope of pad for drainage, design safe location for samplers and sample bags and vehicle access in and out of the site (ensuring turning circle of rig and continual daily access for drilling and sampling staff, access for rig booster/compressor, truck and water support truck, ensuring adequate distance between vehicles for high pressure pipes), agreement on casing depth
- Following rig mobilisation and site set up ensure all personnel are present for relevant rig and site inductions
- Ensure roles and responsibilities between drilling staff and sampling staff are emphasized
- Terra Search promotes maintaining a safe distance from the rig at all times where possible unless otherwise advised

For further information please refer to both the Drill Program Pre Start Checklist and Site Layout Checklist



5. Labeling Sample Bags

- Label bags before drilling commences where possible
- Use a permanent marker and ensure it does not rub off
- **Check the number sequence after marking**
- All sample numbers should be consecutive from the top of the Hole to the bottom of the hole
- Careful recording of the sample numbers and the holes and intervals they represent is required
- Calicos are to be marked clearly with a sample number obtained from sample book
- Sample numbers should be a numeric value and **not** a value that contains the Hole number



6. Contamination

- Drilling consumables and equipment – i.e. drilling grease, super foam, bits etc. (elemental anomalies can occur due to these materials and fluids/lubricants)
- Cyclone and Bull Hose– drill material can build up on the inside of the cyclone especially around the depth of the water table. This is cleared out by drillers as required
- Sampling Equipment – splitters are a major source of potential contamination if not adequately cleaned after each and every sample and in particular between holes. Further sources of contamination include: spears, sieves, spoons etc.
- Personal jewellery/clothing – remove all jewellery or cover appropriately with clothing at all times e.g. gloves to protect wedding rings
- Storage and removal of sample bags – ensure sample bags are kept away from sources of contamination e.g. bags too close to cyclone can mix with dust/water/weather. The process of removing samples can potentially involve contamination – ensure risks are minimized through correct fastening and labelling of bags
- Isolate high grade/anomalous material – high grade zones intersected down hole should be identified in chips/XRF and sample material in calicos adequately contained



7. Samples Collected on RC Drilling Program

Five samples are collected for each 1m interval:

- i. Bulk (20kg) from cyclone collected in a large green plastic
- ii. Calico bag sample (2-3 kg) collected from splitter which is submitted for assay
- iii. Representative sample (1kg) speared from large green plastic
- iv. Rock chips speared from large green plastic
- v. XRF sample (optional) taken from the 1kg representative sample

Plus:

Magnetic Susceptibility measurement for each interval



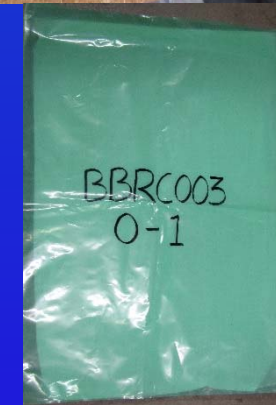
8. Sample Procedures

i. Bulk Sample from cyclone

- prior to drilling label large green plastics with **Hole ID** and the **depth interval** they represent as shown
- In preparation for drilling pre label large plastics bags in bundles of 50 or 100

Drillers are **responsible** for:

- Putting the large green plastic (pre-labelled by TS) on and off the splitter and
- Placing them in order on the edge of the drill pad with all bag **labelling facing in the same direction**
- a consistent sample size (approx 20 kg of drilled material)



ii. Calico assay sample (2-3kg)

- This sample is to be sent to the lab for assay. **All of the Hole should be assayed**
- **Field Assistant** is **responsible** for:
 - Placing pre labelled calico bag on rig splitter and collect 1m bag of drill material
 - Calico assay sample bags should have a **sample number** obtained from sample book
 - Sample size should be approximately **2-3kg** – anything over 3kg must be split
 - Some rigs will have a splitter that can be adjusted to get an accurate sample weight
 - Put 10 calicos per pre labelled poly-weave bag and zip tie
 - Label as follows:
 - **Client Name**
 - **To: Lab**
 - **From: Terra Search**
 - **Sample numbers from – to**
 - **Number of poly-weaves bags**



Splitting Samples

If sample size is over 3 kg or 2m composite samples are required the calico bag is split as shown below using a portable splitter.



The following two samples are taken from the bulk sample in large green plastics



iii. 1kg Representative sample

- A smaller sample for storing as a reference sample for the drill hole is speared from every 1m large green plastic bulk sample
- This sample is collected in small green plastic bags that are pre labelled with **depth interval** prior to drilling
- Once a sample is taken the small green plastics are to be folded and secured with 3 staples as shown
- Place 20 per poly-weave bag making sure it is not too heavy to lift and store
- Label poly-weave sacks with the **Hole ID** and **depth intervals** they contain
- ~~The purpose of these samples is to do metallurgical, petrological or other studies if required.~~



iv. **Rock Chip Sample**

Rock chip samples are for geological logging and kept indefinitely at the main office for future reference

- Spear rock chip sample from large green plastic bulk sample bag
- Place in 2mm sieve
- Once sieved to 2mm put sample into vege sieve for geologist
- Complete sieved samples 6 at a time



iv. Rock Chip Sample continued

Geologist:

- Collect all six sieves and wash sieved chips in water tubs
- Place rock chips into pre-labelled 20 compartment chip trays for geological logging
- Ensure the chip tray lids close easily i.e. the compartments are not too full
- Chips should be representative of the intervals down the drill hole
- Label chip trays on **four sides**: **top**, **front side** and **both ends** with corresponding **hole ID** and **depth intervals**
- Depth intervals should be marked on the **inside of chip tray lids**

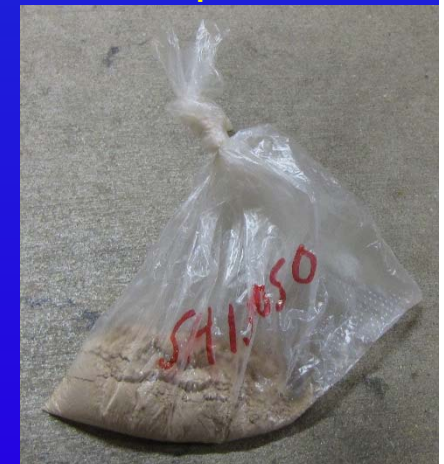


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v. XRF sample

- XRF analysis is used for determining the composition of the drill material and can be highly beneficial in a drilling program saving clients time and money
- XRF samples are taken from the 1kg representative sample already collected in small green plastic bags
- 1 tsp of drill material from the representative sample (small green plastic) is placed in a sandwich bag which is tied in a knot and put in a pre-labelled small zip lock bag
- **Home brand sandwich bags** are best as they are very thin. Be consistent with the brand of bags within a job
- The small zip lock bags should be **pre labelled** with **hole ID** and **depth interval**
- Place 20 small zip lock bags in a cardboard shoebox and **label** with **Client Name**, **hole ID** and **from and to depth interval**



vi. Magnetic Susceptibility Readings



- The measurement of susceptibility can be used after drilling has taken place to measure the drill material and so determine from what rock types and at what depths the observed magnetic responses have originated
- Mag sus readings are taken from the bulk samples in large green plastics using a portable, hand-held mag sus unit
- To take magnetic susceptibility readings clear the unit in the air, press onto sample and record results
- This can easily be carried out by two people at the end of each hole with one person taking the measurement and the other person recording results



vii. Rehabilitation

- At the conclusion of a drilling program and the receipt of these days it is normal for the larger 1m sample to be disposed of by either taking it to a dump site or placing it back down the hole.



9. Quality Assurance (QA) and Quality Control (QC) Samples

- The **QA** process with respect to chemical analysis of mineral exploration samples includes the addition of **blanks**, **standards** and **duplicates** to each batch sent for assay
- **Blanks**, **standards** and **duplicates** are used so checks can be done after the samples are analysed
- As part of the **QC** process TS checks the resultant assay data against known or previously determined assays to determine the quality of the analysed batch of samples
- An assessment is made on the data and a quality report is compiled
- **QA** is the feedback given to the lab on the quality of the assay data, which helps to prevent future errors
- **QA/QC** protocols conform to mineral industry standards and are compliant with the **JORC code** and **ASX reporting**



Blanks

- Terra Search **Certified Blank Sand** is normally placed at the start of each batch
- It is a pure quartz sand with very low levels of metals and gold, which requires crushing and therefore proceeds through the entire sample preparation phase
- This is important as a typical lab standard does not require crushing and therefore does not go through the entire phase
- Being the first sample in a batch the blank sand acts as a clean quartz wash for all lab equipment and also diminishes the risk of contamination between previous, potentially high grade samples



Standards

- Known internal standards can be useful in identifying sample number mix ups that may occur in sample preparation or elsewhere in the sample train. For example:
- **Terra Search Certified Internal Standard QCIG02** is a typical bulk percussion sample of Reverse Circulation percussion chips that contains a couple thousand ppm of Pb, Zn and Cu, and in the order of 33 ppm Ag
- It is **inserted** in the sample batch in the order of **every 50 samples** and weighs approximately 0.5 kg to 1 kg
- As with the blank sand this sample requires crushing and therefore proceeds through the whole sample preparation phase
- It is particularly useful to check for the accuracy of silver, copper, lead, zinc, sulphur, as well as low level bismuth and arsenic.



Standards continued

- Standards can also be used to check a range of elements. For example:
 - OREAS 95 High Cu, sulfide standard particularly checks for the accuracy of copper and sulfur analyses that are similar to the expected mineral target. Elements which can be checked with this standard include:

Ag, Bi, Co, Cu, Pb, S, Sb, Se, Sn, Zn

For further information on Standards refer to Standard Description Document: z drive Assay Labs and Standards QA/QC



10. Logging

- Logging of Holes should be in the Terra Search system at 1m intervals.
- 2 things need to come from the logging
 1. The first is a log of the factual geology – this includes colour, oxidation state (oxidized, partially oxidized or primary), grain size, texture and alteration and rock mineralogy.
 2. The second should be interpretive. This can usually be done at larger intervals. This information is usually plotted on sections and is usually what is used to correlate from Hole to Hole.

Please record the BOCO (Base of complete oxidation) and BOPO (Base of partial oxidation) for each Hole.



11. Drill hole Collar

- All Holes should be accurately located in the grid system after drilling.
- Important that the RL is measured accurately, best done using an automatic level and a known RL datum.
- Down hole surveys need to be completed for holes that are deeper than 50m.
- Down hole surveys are usually done at 48m intervals for a RC rod using 6m rods.
- Accurate recording of the collar azimuth and dip need to be completed.
- Collar azimuth and dip will comply with the proposed azimuth and collar but occasionally they may be slightly different.



12. Documentation

- A **full documentation** for **the Holes** is an **integral** part of any drilling program.
- It is necessary to keep a full record of the drilling operations.
 - ✓ Times drilling commenced
 - ✓ Times not operating and reasons
 - ✓ Times Holes were completed
 - ✓ Any drilling problems encountered
 - ✓ Times when drilling was slow (and fast)
 - ✓ Other notable features of the program
- Keep records in a hard bound note books for later reference
- **As a rule write it down whatever it is**



13. Personal Protective Equipment (PPE)

- Always use full safety gear around a drilling rig
 - ✓ Suitable clothing – long sleeved high visibility shirt and long pants, hand gloves
 - ✓ Head and face protection – hard hat, dust mask, safety glasses
 - ✓ Hearing protection – ear muffs
 - ✓ Suitable footwear – safety boots, steel capped boots
- Don't go near the rig unless you have to
- You are less likely to be injured if you keep your distance from the rig
- If you see a situation where someone may be putting themselves at risk, draw it to their attention.
- Stay hydrated, drink plenty of water and keep in the shade if possible.

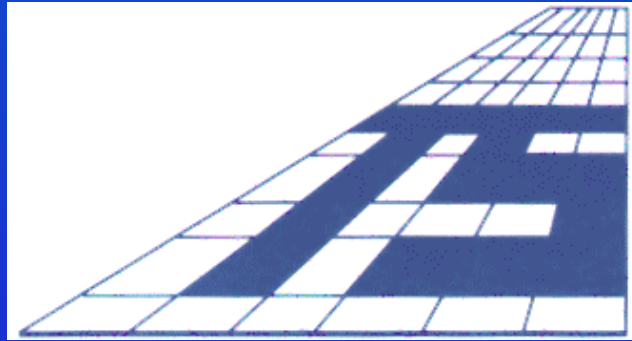


14. Lab Analysis

- Assay samples should be dispatched to ALS Chemex for assay for gold and a suite of elements
- These will be advised along with the Clients account number for the work



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