DIRECT PUSH DRILLING.

CONCEPT.

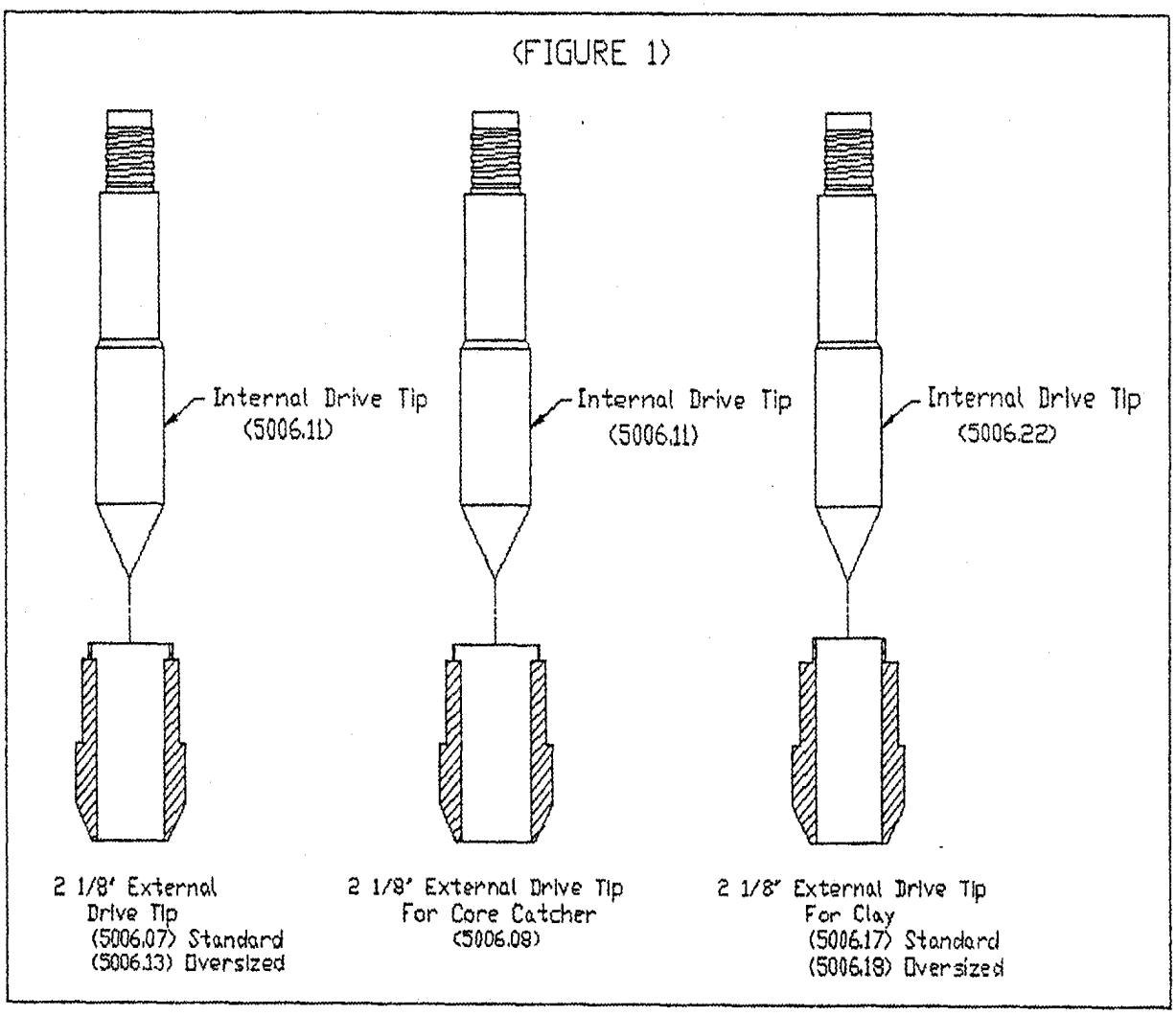
"Direct Push Drilling" is a method of drilling and sampling where the tools are "pushed" or driven into the ground. No rotation is involved so all the samples are uncontaminated and there is no drilling debris on the surface. The main application for this method is for drilling various soils, clays and sands both consolidated and unconsolidated. It allows the driller to take a core sample sealed inside a plastic tube so that no handling of the sample takes place.

Make up of Equipment.

The equipment consists of an outer rod called an Outer Extension measuring 4' x $2^{1}/_{8}$" to this a cutting shoe called an External Drive Tip is fitted. For sampling a plastic tube the same length as the outer extension and having an I.D. of 1½" is inserted into the extension, this fits into the back of the drive tip fitting snugly into special recesses cut into it. These recesses are cut according to the kind of sample that will be taken. Each drive tip is manufactured for different formations and uses. On the back of the Plastic Sample Tube a Plastic Grabber is fitted to hold the sample tube and to allow for smaller internal rods, Internal Extensions, to be added. Before driving the extensions into the ground a Thread Protector is screwed onto the Plastic Grabber or Inner Extension rod and a Drive Head Adaptor is then screwed onto the Outer Extension. This assembly is then placed under a hammer fitted onto the mast of the drill, pressure is then applied to the assembly pushing it into the ground assisted by the hammer which helps drive it into the ground. When the required depth is reached the Drive Head Adaptor and Thread Protector are removed and the Inner Extensions and Plastic Sample Tube are removed. Another tube is then inserted and an Outer Extension with Inner Extension is then added and the process is repeated until the required depth or refusal is reached.

Discrete Soil Sampling.

This is a process of probing to a specified depth and retrieving a sample. This is achieved by choosing the correct External Drive Tip and corresponding Internal Drive Tip for the prevailing soil conditions. There are five choices for discrete sampling. See **Figure 1** below.



<u>Standard External Drive Tip</u> - Used in soils that have good cohesive properties and will maintain a fixed shape.

Oversized External Drive Tip - The Oversized Drive Tip provides a greater displacement of the surrounding soil therefore reducing sidewall friction between the outer Extensions and the soil. In some soil conditions this may allow you to probe to deeper depths.

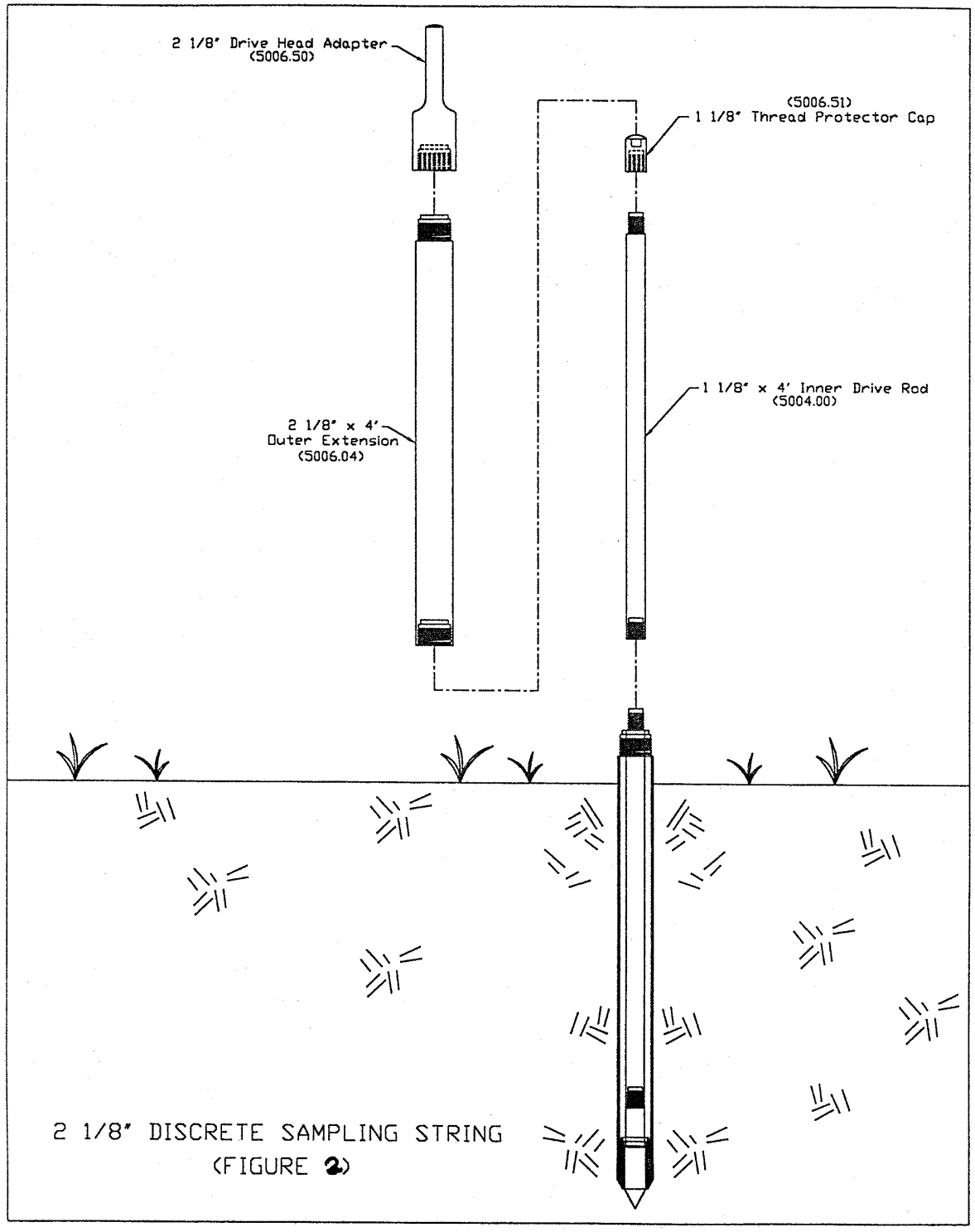
Core Catcher External Drive Tip - Used in soil conditions that do not have good cohesive properties and have a tendency to flow. The core catcher, used on the end of the liner allows soil to travel up in the liner but does not allow soil to escape as the liner is being retrieved. This tip is basically a Standard External Drive Tip that has been modified to accept a core catcher.

Clay External Drive tip - Used for heavy and expanding clay soils. The clay tip has a slightly smaller inner diameter. This smaller diameter enables the sample to carry up into the liner more effectively in expanding clay soils. The liner fits over the top of the Drive Tip rather than into the Drive tip. This prevents soil from entering the area between the Liner and the Outer Extension.

Oversized Clay External Drive tip - The Oversized Clay Drive Tip has an outsize diameter that is larger than the Standard Clay Tip, but the inside diameter is the same. The Oversized Clay Tip helps to reduce sidewall friction between the outer Extensions and the surrounding soil. In some conditions this may allow you to probe deeper.

Once you have made the choice of External Drive Tip and Internal drive tip, you then assemble the equipment first fitting a plastic liner to the External Drive tip and screwing it onto the Outer Extension, the Internal drive tip is then screwed onto the end of of an Inner Extension. The thread protector and Drive Head Adaptor are fitted and the equipment put into place under the hammer. This is then driven into the ground to it's full length and another Outer and Inner Extension are fitted, driven into the ground and repeated until you reach the desired depth. The thread protector and Drive Head Adaptor are removed and the Inner Extensions removed. The drive Head Adaptor is refitted and the

equipment driven into the ground. The equipment is then removed from the hole and the plastic sample liner removed and capped. See **Figure 2**.



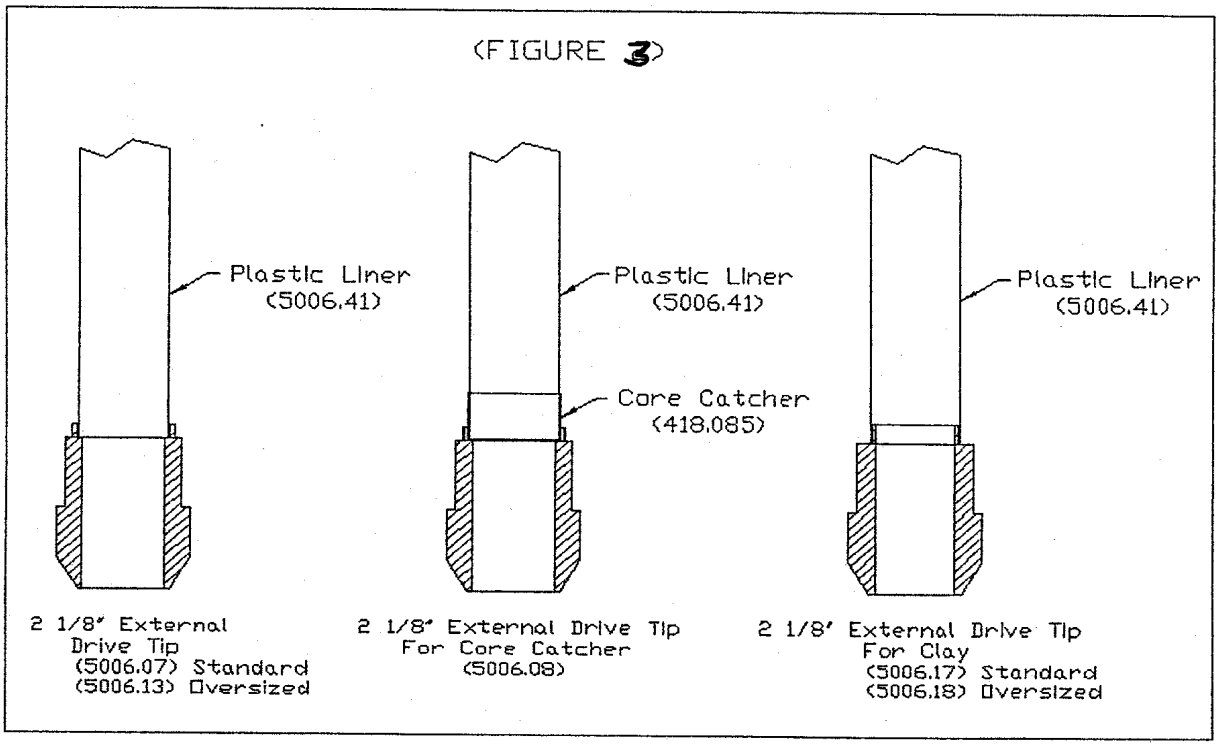
Continuous Soil Coring.

Continuous soil coring is the process of taking a continuous soil sample from ground level to a defined depth. Continuous soil coring is accomplished most effectively by the use of the Dual Tube System. This system leaves the outer extension in place, providing a cased hole through which to sample. This permits sampling in collapsing holes or through perched ground water and also prevents downward cross contamination while sampling is taking place.

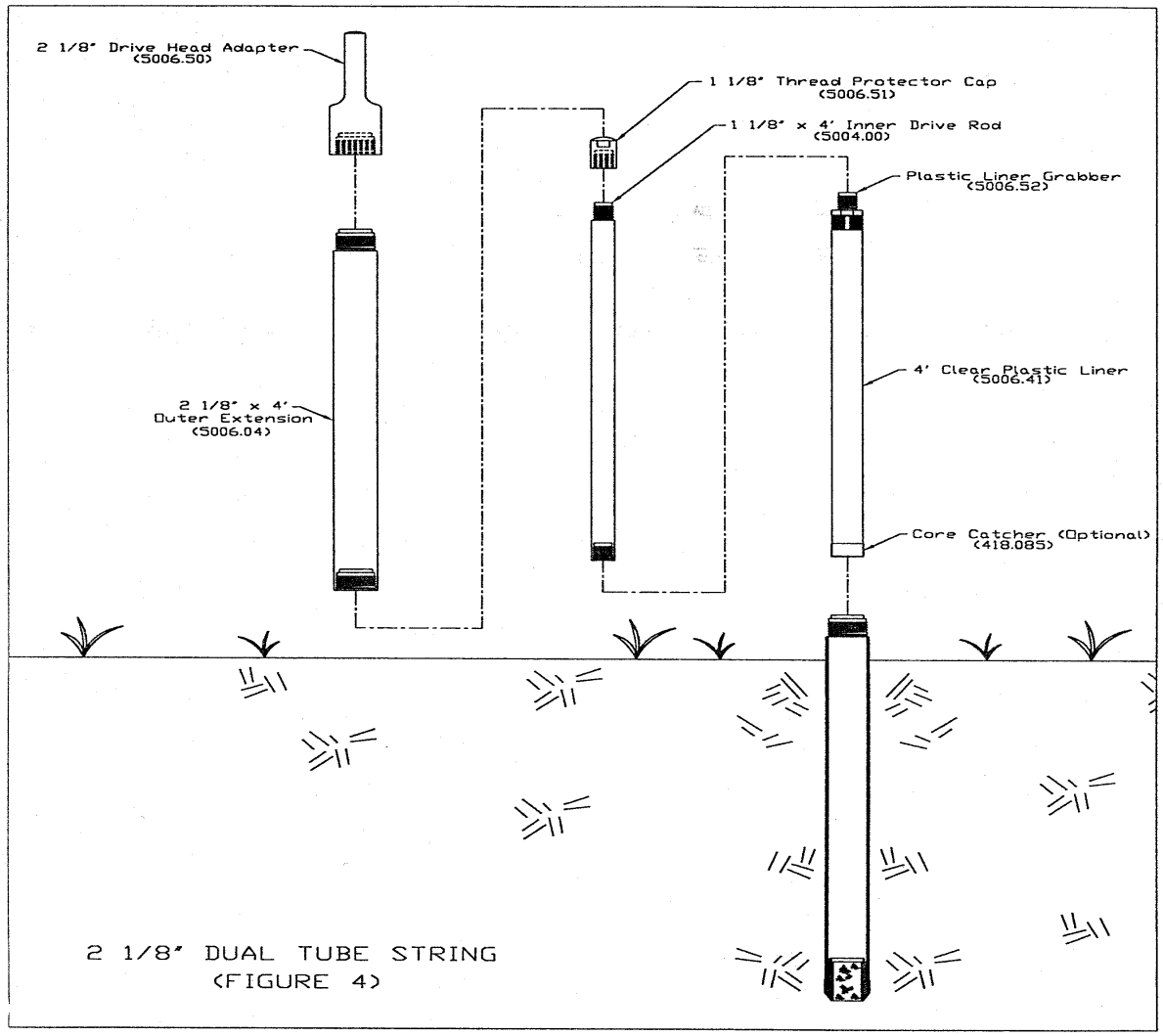
The External Drive Tips are the same as for discrete sampling. See **figure 1**.

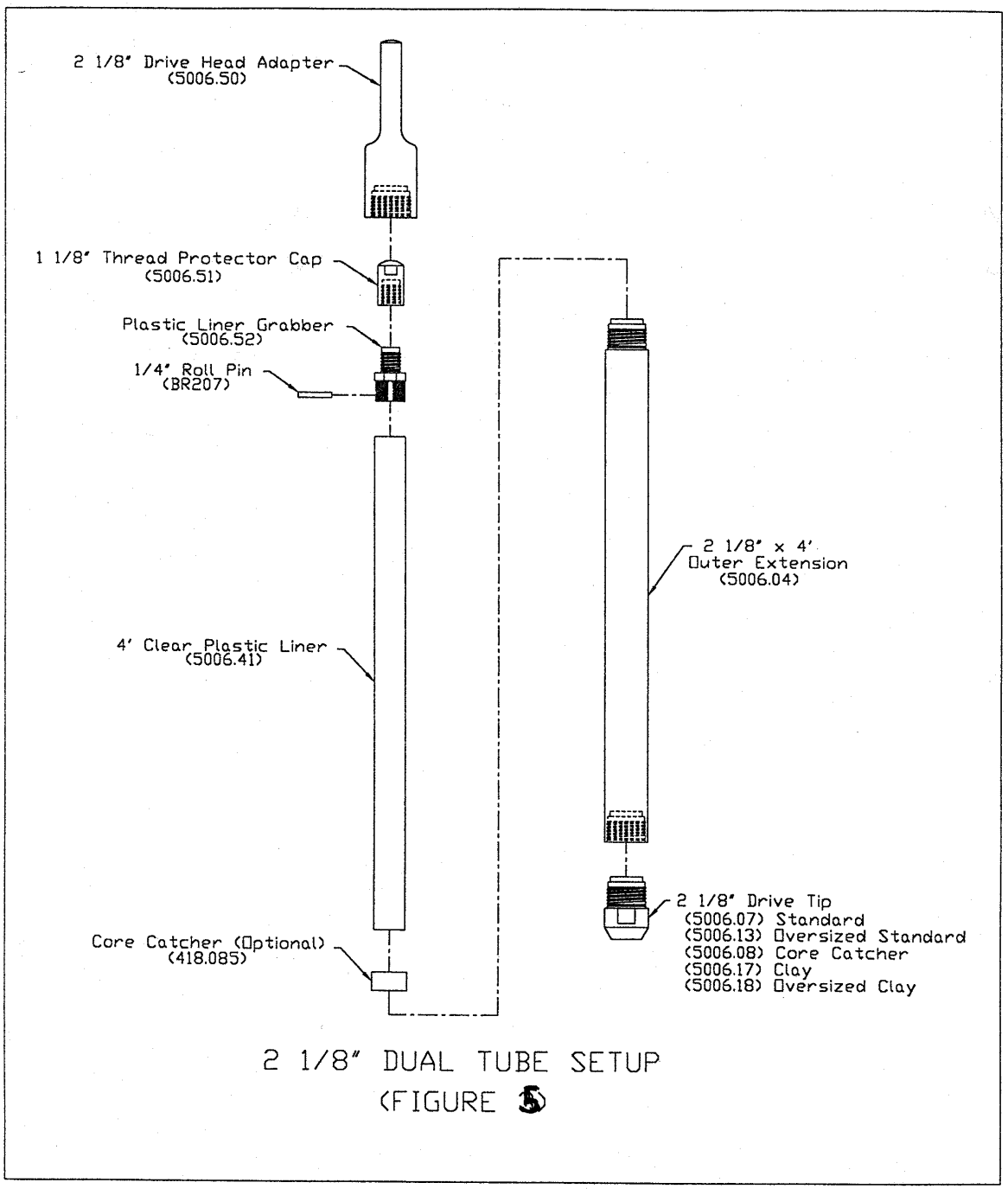
The operation is carried out as follows:

1. Thread the Plastic Line Grabber onto the Plastic sample liner. (If using a Core Catcher Drive tip, place the core catcher on the other end of the liner).
2. Thread the External Drive Tip of your choice into the first Outer Extension.
3. Insert the liner into the first extension and rotate it as you push down making certain the liner seats in the drive tip. See **figure 3**.



4. Thread the thread protector onto the line grabber and thread the drive head adaptor onto the outer extension.
5. Position the equipment beneath the hammer on the mast then drive the length of the liner.
6. Remove the drive head adaptor and place a spanner on the thread protector cap and rotate clockwise for ½ a turn before retrieving the liner. This shears the soil at the tip enabling you to retieve the sample without it falling back out of the liner.
7. Remove the line grabber and cap the liner after marking the depths on it
8. Replace the liner and add another outer extension and inner extension, replace the thread protector and drive head adaptor then repeat the process untill you are at the required depth or at refusal. See **figure 4&5**.





2 1/8" DUAL TUBE SETUP
(FIGURE 5)

Using Direct Push in Conjunction with Hollow Stem Augers.

There will be occasions when for one reason or another i.e. too much sidewall friction, when you cannot drive the direct push tools any further. In this event hollow stem augers can be used to drill down to the last depth reached and the direct push tools lowered through the centre of the augers and the sampling continued.

DIRECT PUSH DRILLING FOR SWIRLING SANDS

A new style piston sampler has been developed to allow us to be able to core "swirling sands". This has been successfully used at R.B.M. in Richards Bay and sand quarries at Pienaarspoort near Pretoria. I both cases there was a lot of water present just under the surface. We were able to continuously core the sand through the water until, in both cases, we hit ferrocrete.

The piston sampler is pushed down, as for the dual tube sampling system, to the desired depth where sampling is to begin. Once at the sampling depth the inner rod attached to the inner drive tip is removed and an additional 4 ft (1.22m) outer rod extension is added. At this point the rod is pushed and the sample is retrieved.

Additional sampling intervals at greater depths can be retrieved using the same drilling method. There is no chance of losing the centre rod and any caving/slumping that has occurred will not fill the piston sampler's liner. Any premature material that enters the sampler and liner is pushed out of and above the liner when the liner is filled from the desired sample interval.

The piston sampler is designed to collect discrete (interval specific) samples in difficult sampling conditions, such as flowing/heaving sands and swelling clays. The system also works well in soils below groundwater. Also the piston sampler is designed minimize or prevent liner failure during sample collection. Two "O" rings can be used on the bottom tip thus minimizing the chance of cross contamination from material entering the sampler prior to the desired sampling depth. The use of, either or both of, two core catcher options can minimize or eliminate the chance of loss of the core sample.