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Drain Blocking by Machine on Raised Bogs

National Parks and Wildlife Service
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The objectives of this report are to provide a specification on the most suitable machine to be used in the restoration of wet raised bogs, and the most efficient and cost effective procedure, under the Raised Bog Restoration Programme.

This is achieved by examining the following,

1. Planning the best route for the machine, which will depend on the following:

    1.1 The width of the drains.

    1.1 The orientation of the drains.

    1.3 The spacing between the drains.

    1.4 The nearest refuelling and access locations.

    1.5 The stability of the bog surface.

    1.6 The ownership of lands and turbury rights on or adjacent to the bog.

    1.7 The specification of the machine.

    1.8 The availability of suitable peat for dam construction.

2.0 Minimising the amount of skewing of the machine while on the bog surface.

3.0 Minimising the impact of tracking on the bog.

4.0 Programming maintenance trips.

5.0 Establishing the ideal specifications of the machine using the following criteria:

    5.1 Bearing pressure.

    5.2 Reach of the machine.

    5.3 Size of the bucket.

    5.4 No. and size of the bucket teeth.

6.0. The relevant experience of the operator in working on wet raised bog surfaces.

1.0

Planning the best route for the machine through the bog is the best way of reducing the impact of the machine on the bog surface, as it reduces the no. of times the machine has to skew, and the time spent tracking on the bog surface.

This route will depend on a no. of factors, the most obvious of these being the orientation of the drains and, the width of the drains. The majority of the bogs to date in the bog restoration programme, have the drains running in parallel, up the slope of the bog surface. This therefore provides two possible routes for the machine i.e.: tracking up one drain and down the other, blocking as it goes, or tracking across the drains, but this depends on the width of the drains, the intensity of the dams in that area, the gradient of the bog surface.

1.1 The width of the drains.

If the drains are two wide to cross with the machine then they may only be blocked with the machine tracking parallel to the direction of drain. Although it would be possible to build a temporary bridge at each crossing, this would not be practical, as each dam location would have temporary bridge, leading to less room for dam construction. Also the dam size would not allow it to act as a bridge. Also as will be discussed later the best position for the machine to work, is with the tracks perpendicular to the drain, as this gives the best reach, and provides for better stability for the machine while digging the peat and placing it in position. In order for the machine to get in this position after crossing the drain would require alot of skewing, tearing the bog surface and causing a depression, especially as it is so near the drain.

1.2 Orientation of the drain.

The majority of drains are running parallel to the slope of the bog surface, so therefore the machine has to travel up the slope of the drain and down the slope of the remaining run, as we are dealing with raised bogs i.e.. dome shaped. Unless the flow of water in the drain is very significant and the area around the dams immediately becomes wet after dam construction, it is possible to block up and down the slope.

Sometimes the flow of water in the drain is significant enough to make working conditions difficult for the machine, so therefore working up the slope of the bog is preferred to working down the slope, as it is the area behind the machine which is getting flooded.

Also as is in the case in Clara Bog, the drains often cross each other in a grid pattern. In this case the machine will be tracking parallel to one set of drains, and crossing the other set of drains running in the other direction. Here the best method is to select the largest drain network and track parallel to it, blocking at each junction making the dam large enough to cover the flow in both directions, and as most drains are spaced from 20 to 40 feet apart, blocking at each junction is sufficient to satisfy the intensity governed by the levels in that area.

1.3 The spacing between the drains.

This is very important in relation to ease of movement of the machine between the drains. When each dam is built there is peat extraction hole dug opposite it, making it difficult for the machine to gain re-access to the site should the dams require re-topping. So therefore the spacing between the drains should allow for the machine to dig a peat extraction hole, and still be able to travel back up by the drain should it be necessary.

1.4 Nearest refuelling and access locations.

The majority of drains in the bog restoration project have only one access point. This can cause some problems in relation to access for the driver and refuelling. If more than one access point is available, then it is preferable if the location is either at the start or at the end of the network to reduce the amount of tracking for refuelling. If the fuel capacity of the machine is not sufficient for it to run up one drain and down the other,returning to the fuel depot, then it is possible to carry a reserve fuel tank. This reduces the amount of tracking over the same areas.

Also the machine operator should be incourged to refrain from driving back for his lunch breaks, as opposed to walking back or having lunch where he last finished a dam. This practice should also be avoided when finishing up at the end of the day, i.e. the machine should be left at the last dam, but only if the bog surface is stable enough to support the machine over night or at the weekend. If this is not possible, it can be moved to a drier location, as is the case in Ballangare Bog, Co. Roscommon where the operator tracks to the nearest dry and stable spot.

Another point which is very important , is to avoid any spillage of diesel on the bog surface.This was overcome by Bord na Mona, who made a specially designed lockable tank with a proper seal on the cap, which could be transported by the machine easily. All seals on hydraulic, engine and brake oils should be checked regularly.

1.5 The stability of the bog surface.

It is very important to access the site for working conditions prior to moving a machine on to the bog. If the bog is too wet then there is the danger of sinking the machine, which not only involves expensive loss or damage and the cost of recovering it, but more importantly the damage caused while recovering it. This was the case in Garriskil Bog, Co Longford where a machine working on make shift mats slipped into the bog and the contractor involved had to use a heavier machine to haul it out of the bog causing alot of damage to the bog, not only from the visible hole left, but also the tracks left from pulling it out.

During the winter months the vegetation and surface can be frozen, and under these conditions it is preferred if work is not under taken, as the frozen plants break instead of bending under the weight of the machine, and the frozen surface does not recover as well as when the temperatures are above freezing. When the bog is wet it provides a cushion effect, which reduces the impact of the machine track on the surface and protects the roots of the vegetation.

1.6

The ownership of lands and turbury rights on or adjacent to the bog.

It is the case in many raised bog sites, that The National Parks and Wildlife Service do not own access to the bog, or land surrounding the bog through which access can be gained. In these circumstances, either an access area is purchased, or permission is received from local land owners to gain access to the site. Either way, it is important to notify the owners of lands adjacent to the works, the nature of the works to be carried out, and try to negotiate when access can be got, as this smooths out any problems which may occur later, if it comes to purchasing property or right of ways.

1.7

The specification of the machine.

This will be investigated later in the report and will cover such criteria as:

1. The bearing pressure of the machine.

2. The reach of the machine.

3. The size of the bucket.

4. The size and no. of teeth.

1.8

The availability of suitable peat for dam construction.

The ideal source of peat for dam construction will obviously be in the working radius of the machine its self. As is experienced, the spacing between the drains is sufficient to allow for a peat extraction hole and a route for the machine should access be needed again. It is important for the hole to be located as far from the dam as possible within the radius of the machine. In all the bogs so far, under the restoration programme, there has been sufficient peat located along side the drains, and no peat has had to be used from another part of the bog.

2.0

Minimising the amount of skewing of the machine on the bog.

As already discussed, the most suitable position for the machine while working on the drains is with the tracks perpendicular to the drains, due to stability and maximum reach. This position however requires alot of skewing i.e.. turning on the spot, and it was agreed that the best route would be parallel to the drains, where the only turning was at the end of a drain and was over a good radius.

As tracked machines can drive in both positions, there should be no need for turning on the spot, but if the circumstances dictate, then it should be done gradually, to reduce tearing of the vegetation, damage to the roots and localised depressions.

3.0

Minimising the impact of tracking on the bog.

This can be achieved by refraining from travelling over the same areas to often, as it does not give the vegetation a chance to recover. During the dry months, there is less moisture in some of the bogs under restoration, and the cushioning effect of the surface is reduced. The vegetation is drier and tends to break under the pressure of the machine. This was evident in Clara Bog, Co. Offaly, where constant driving over the same areas has damaged the vegetation, which is slow to recover. This could have been avoided by banning the used of the machine as transport back and forth from the hut to the dam sites, and selecting a different route each time for necessary trips such as maintenance and refuelling. Consistent travelling over the same tracks, might contain the damage to one location, but can cause the tracks to conduct water, defeating the purpose of the restoration works.

4.0

Programming maintenance and refuelling trips.

This can be achieved by timing the maintenance needs of the machine with the refuelling trips so as to minimise the impact of travelling over the same areas more than once. As has been experienced with the machine in Clara bog, various problems such as water in the diesel tank, or bent track extensions, can necessitate repairs, requiring the operator to track back to the main access point. At these times, refuelling and any other standard checks should be carried out, so the machine doesn't have to come back again.

5.0 The specification of the machine.

5.1 Bearing pressures.

The bearing pressure of the machine should be kept as low as possible to, minimise the impact of the machine on the bog surface while stationary or moving, to minimise the possibility of the machine sinking and to provide a sound base for the machine to work on. The bearing pressure is usually expressed in kg/cm2, but will be refereed to as Ib/"2 in accordance with Bord na Mona's figures.

Bord na Mona have previously used standard machinery such as bulldozers, hymacs etc. for working on the bog, but had to design a specialist machine for the contract work to be carried out on wet raised bogs with moisture contents of about 95%. This involved the purchase of an Hitachi EX60, by Bord na Mona, with a view to conversion of the under carriage, to reduce the bearing pressure of the machine. The centre section of the machine was widened by 200mm, the track frames extended by 300mm and the track pads widened from 600mm to1300mm. These overall adjustments brought the bearing pressure down from 3.3 Ib/"2 to 1.55 Ib/"2 while increasing the weight of the machine by 0.7 tonnes.

This machine has been working on Raheenmore, Clara and Sharavogue bogs and experience has found that the ideal bearing pressure should be no more than 1.6 Ib/"2. The same adjustments were also made to a Kubota KH 151, in use in Ballangare Bog, and this too is successful, although the movement of this machine is much slower than the Hitachi EX60.

5.2 The reach of the machine.

The arm reach of the machine is very important, as it allows the machine to keep back from the drain, and maintain a sufficient radius to keep the peat extraction hole back from the drains. If the machine has to work too close to the drain, then the stability is reduced, and as long a reach as possible is beneficial in the construction of dams in wider than normal channels such as those found in Ballangare Bog. In this case half the dam was built from one side, and the other half from the other side. This caused some problems, as the first half of the dam tended to slide into the drain while awaiting construction of the other half.

The reach of the Hitachi EX60 is 6m, where as it is 5.6 m in the case of the Kubota, making it more suitable for work on such channels, although it is not sure if the extra reach would allow the dams to be constructed from one side. Possibly the most efficient system would be to have two machines working in tandem from both sides of the dam.

5.3 The size of the bucket.

This will govern the width of the dams. The bucket should be deep enough, to enable the block of peat dug, to remain intact while placing in the drain, which was not the case in Garriskil Bog, Co Longford. Here, the peat block tended to break up upon placing in the drain, and was not allowed to form a seal. This was partially due to the operator dropping the block into position, instead of gently placing it in position, and the fact that the bucket did not have any holes in the side as in the Hitachi bucket, to allow any water taken up with the peat to seep out while slewing from the hole to the dam location.

5.4 The size and no. of teeth.

The usual buckets in most work on bogs do not contain any teeth, as the force of the bucket and the moisture content of the bog surface, allows the machine to dig with ease, and this is the case with raised bogs where the moisture content is even higher. However in relation to picking up the scraws for recapping the dam on completion, the teeth on the bucket are very important.

This is very evident in Garriskil bog, as the bucket used here did not contain any teeth, making it very difficult to lift the peat scraw and place it in position. The no of teeth on the standard bucket available with most machines is sufficient for the placing of the scraws on the dams, and as there is no wear and tear on the teeth, the size remains the same.

6.0 The relevant experience of the operator in working on raised bog surfaces

The majority of machine operators on contracts involving Bord na Mona, would have alot of experience of working on bogs and also have gained a certain amount of expertise of working on raised bogs with a m/c of 95% or more, such as Raheenmore, Clara and Ballangare bogs, and working under environmentally sensitive conditions where extra care in needed, and a high degree of expertise is required. This was not the caes in Garriskil bog, where the private contractor involved, used an operator who had little or no experience in working on raised bogs, and very little experience of working on peat surfaces whether developed or virgin.

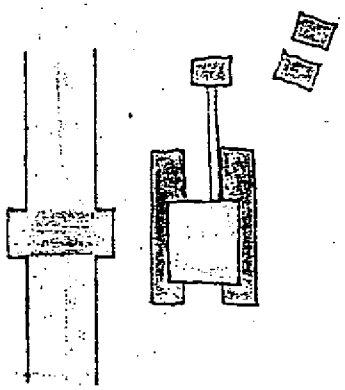
It is therefore very important that contractors, tendering for a contract under the Raised Bog Restoration Programme, not only have a machine with the correct specifications, and an understanding of the method and objectives of the dams, but have an operator who has the necessary experience. These requirements can be furthered, by arranging for demonstrations by the two operators and machines currently working in Ballangare and Raheenmore Bogs, as they have built up an expertise of working under these conditions.

Step 1.

Position the machine tracks parallel to the drain about 1m back, depending on the reach of the machine, and the width of the drain.

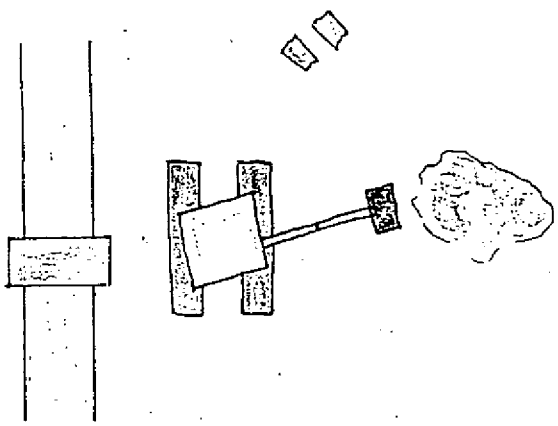
Step 2. (diag. 1)

Remove a scraw and peat from both sides of the drain to the depth of the bucket, and place to the right of the machine i.e.. 90 from the drain.



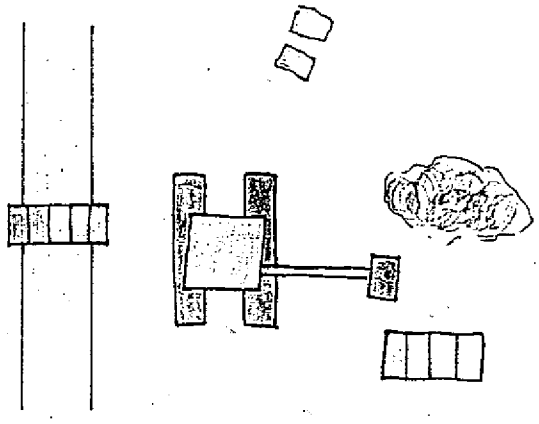
Step 3. (diag. 1)

Remove 0.5 m of peat from the bottom and sides of the drain and place behind the machine in a pile.



Step 4. (diag. 5)

Remove the scraw from an area of the same surface area of the top of the dam to be constructed, and place to the right of the hole, in such a way that it can be picked up by the bucket again.

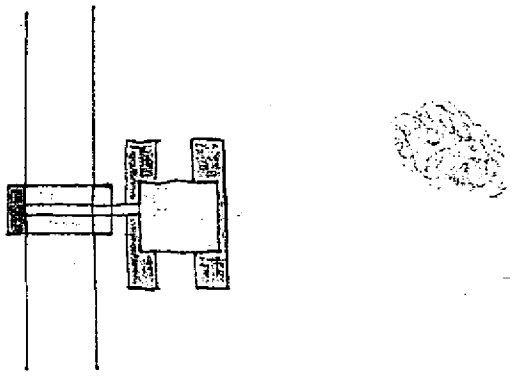


Step 5. (diag. 6)

Dig out the peat in layers with 3 to 4 buckets from each layer and place into the bottom of the drain, building up each layer and compacting it befoe laying the next layer to a height of about 0.5 m above the bog surface. It is very important here that should the drain need more peat than usual to build up to the required height, the peat extraction hole be widened and not deepened, as the best quality peat for the dams is nearer the surface, whereas the deeper it goes the wetter and harder it becomes to handle.

Step 6. (diag. 4)

Take the scraws dug in step 2, and place on the far and near side of the dam, compacting until firm.



Step 7. (diag. 4)

Fill up the area in between the replaced scraws with the ones taken from the surface of the peat extraction hole, lifting carefully so as not to damage them, and compacting until firm.

Step 8. (diag. 7)

Backfill the peat extraction hole with the peat taken out of the drain and press down into the hole with the bucket.

Step 9. (diag. 8)

Step 9. (diag. 8)

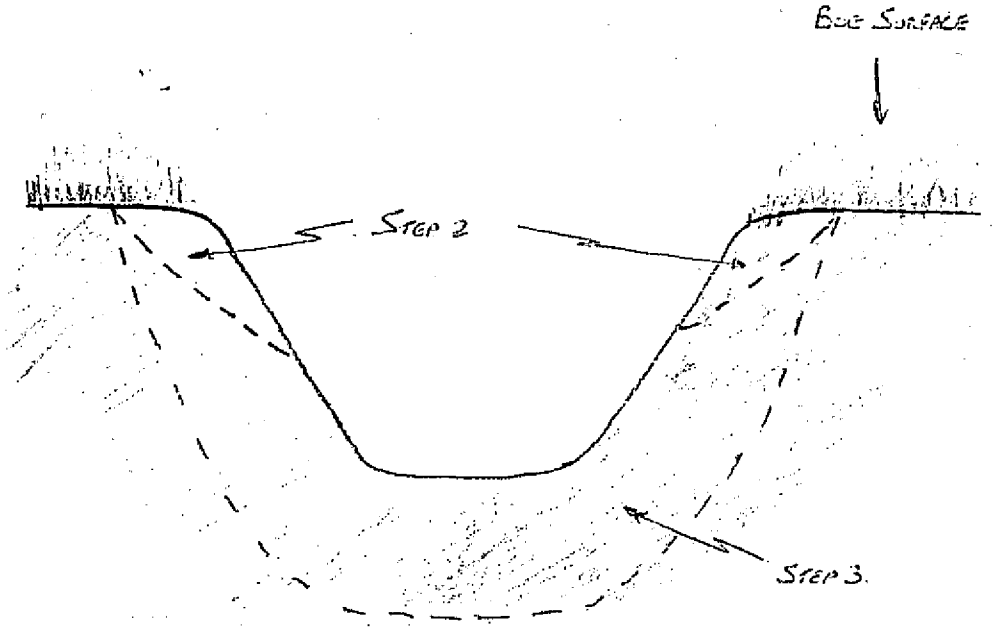
Press down on the sides of the peat extraction hole with the bucket to smooth the slope into the hole, causing a dish effect.

Step 10. (diag. 4)

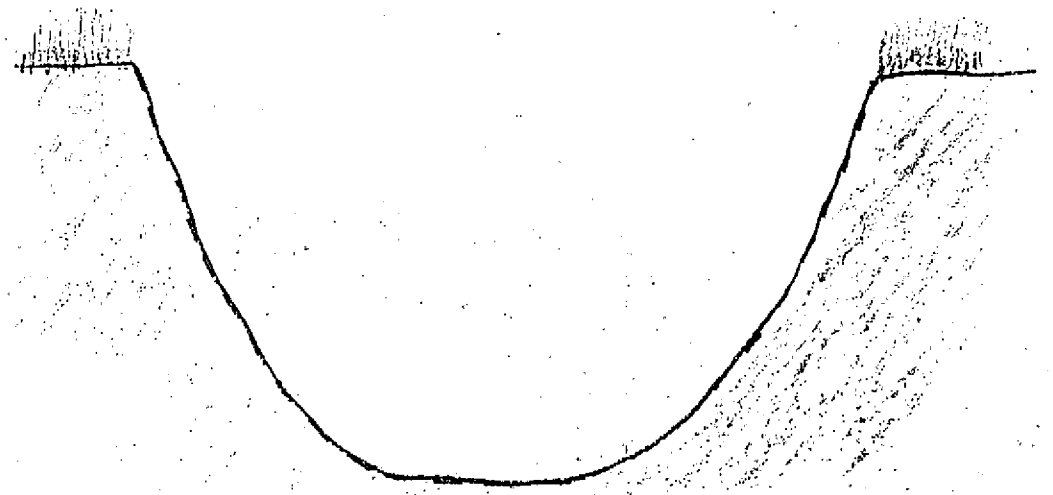
Slowly track upstream of the dam, and smooth of the side of the dam with the side of the bucket, and repeat the process down stream or in the direction of the next dam.

Step 11.

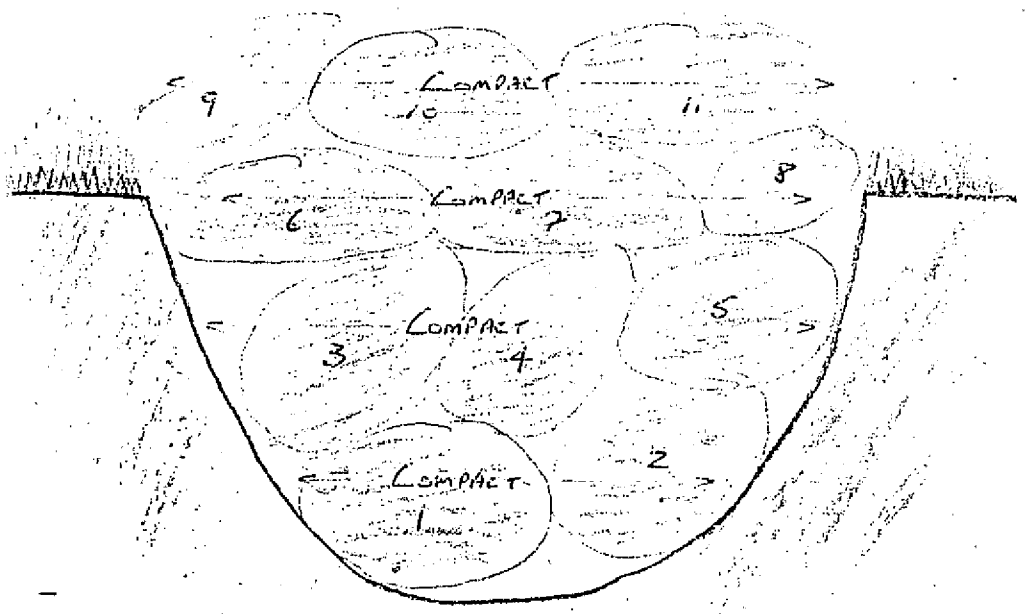
Remove the peg used to mark the location of the dam and keep all the pegs located in one stretch of drain, so as an accurate no. of dams for each drain may be calculated.



Profile of Drain Cross-section
Required for Dam Construction.



3. Step 5.



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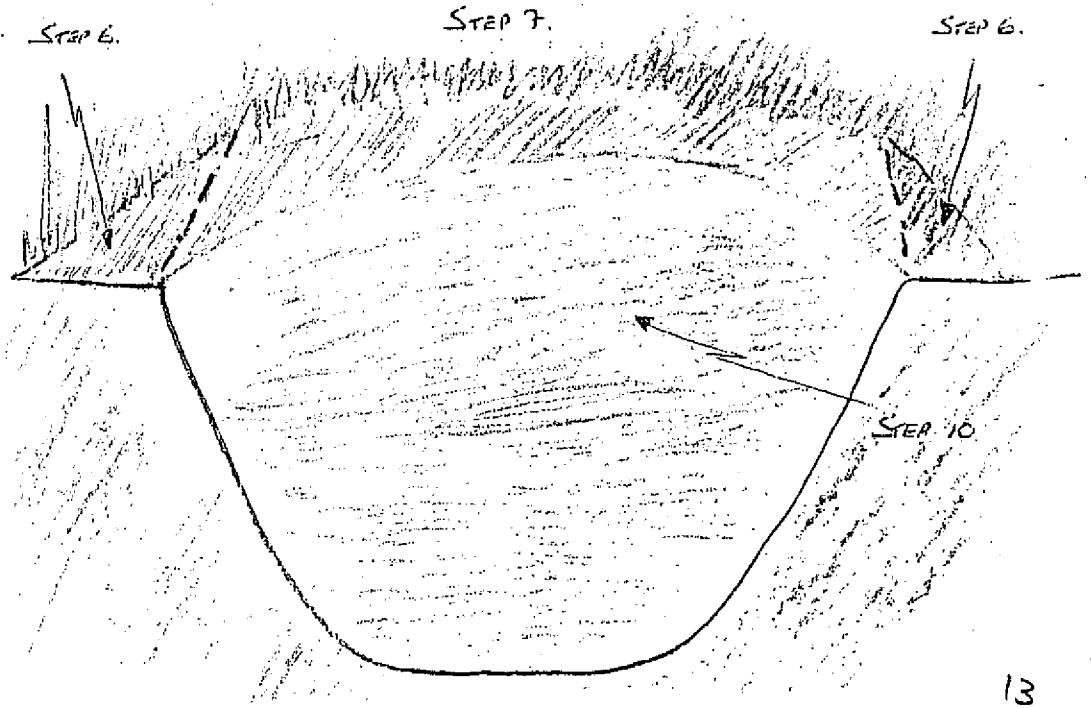
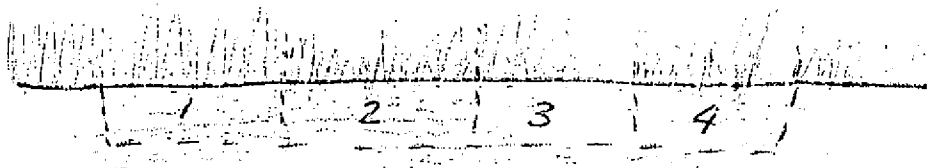
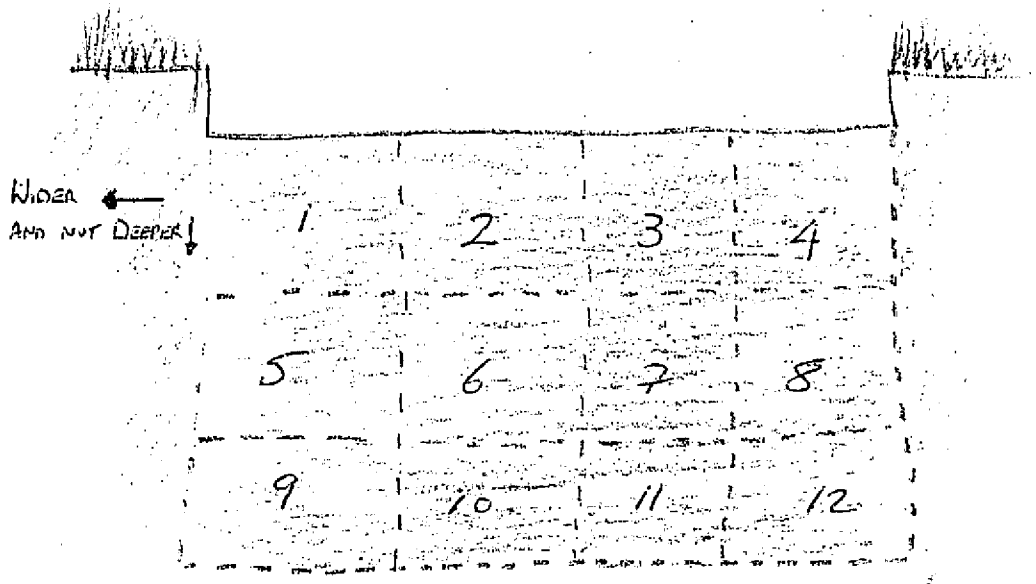


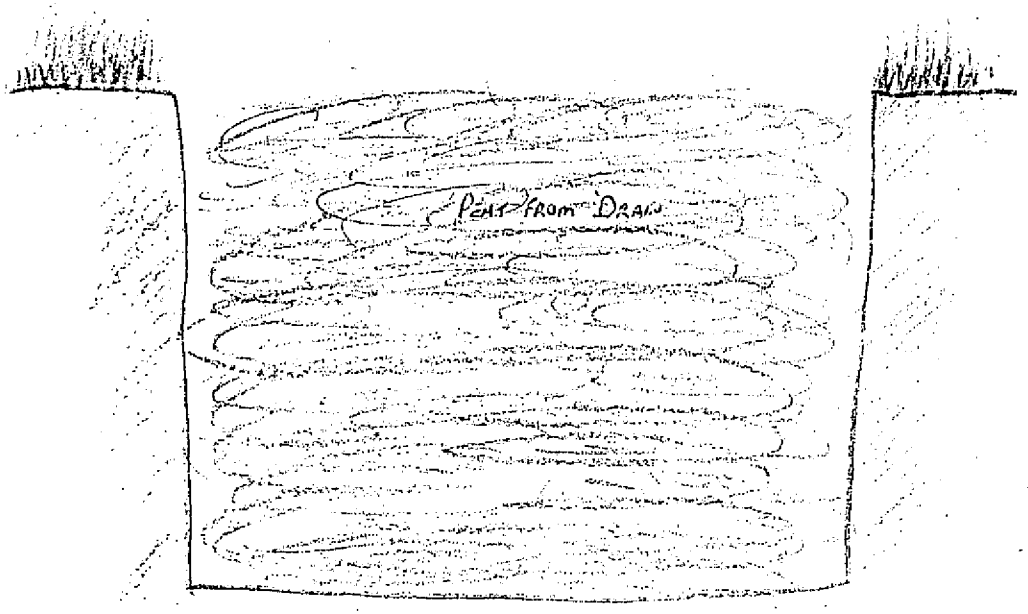
5. Step 4.



6. Step 5.



7. Step 8



8. Step 9.

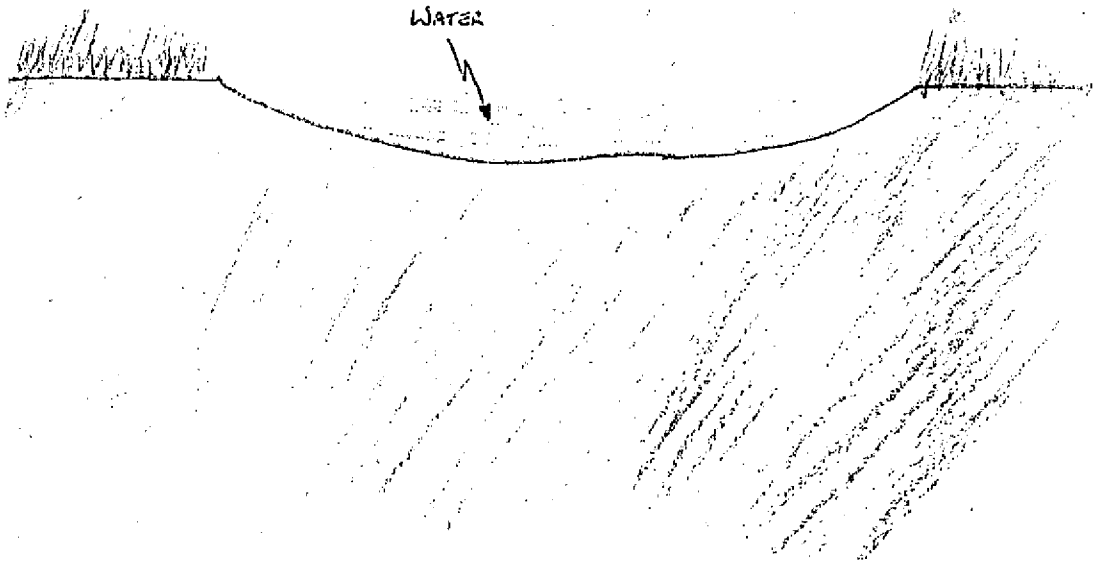


Plate 1. Damage to Clara south-east from over tracking. May 96'

Plate 2. Clara south-east. July 96'

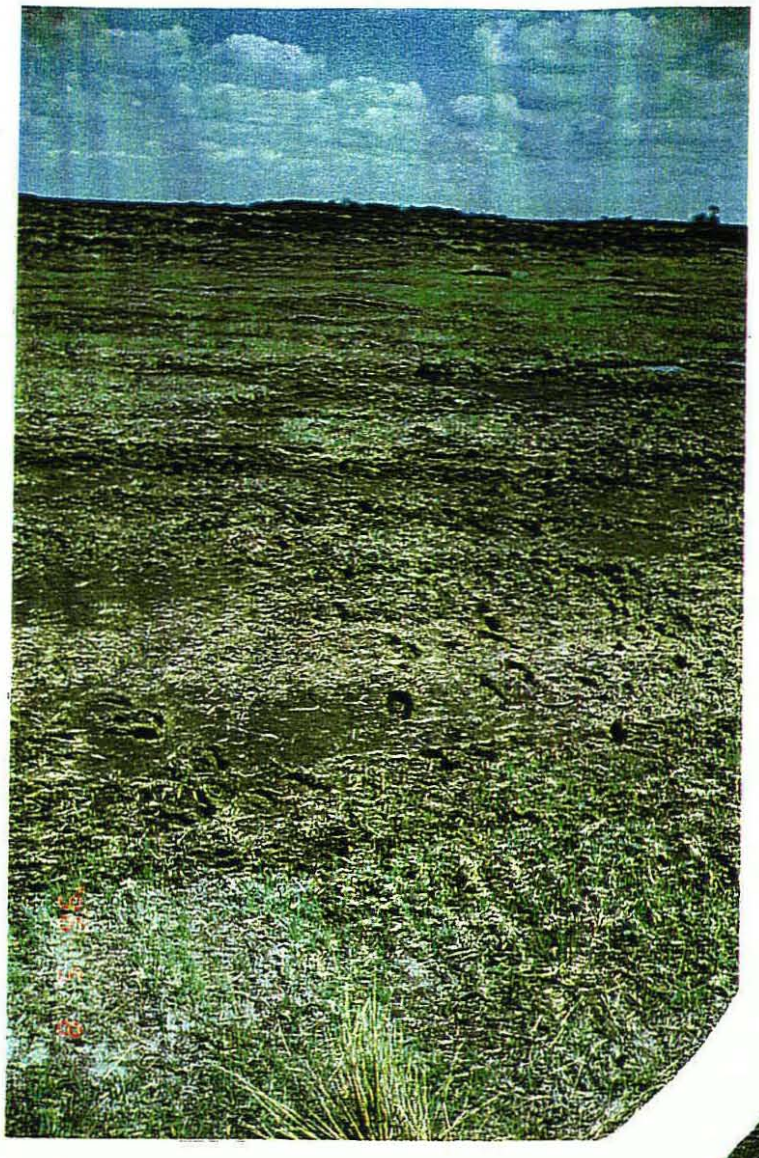


Plate 3. Damage to Clara east from over tracking. May 96'

Plate 4. Clara east. July 96'

Plate 5. Machine working on mats on Garriskil Bog. July 96'

Plate 6. Machine sank due to inadequate mats and very wet conditions. August 96'

Plate 7. Damage to bog surface from recovery of machine.

Plate 8. Poor quality dam construction due to unsuitable machine.

Plate 9. Peat extraction hole in Ballangare Bog.

Plate 10. Placing of peat in the drain.

Plate 11. Half of the dam built from one side of a wide channel in Ballangare Bog.

Plate 12. Finished dam prior to capping with a scraw of peat.

Plate 13. Filling of peat extraction hole.

Plate 14. Finished dam in Ballangare Bog.

Plate 15. Dam in Ballangare Bog requiring topping due to subsidence or settling.

Plate 16. Rising water levels behind a dam in Ballangare Bog.