Yorkshire Peat Partnership Technical Specification 1

Gully & Grip Blocking or Sediment Trapping techniques

1. Introduction

Peat as a land surface without a vegetative cover is unstable to the extent that the erosive forces of wind, water and livestock poaching easily facilitate the rapid stripping off of peat, often down to the subsoil/mineral/bedrock. Eroded peat is usually washed into watercourses along with silt from any mineral base material that has become exposed as the peat is removed. Peat is a very important carbon sink, once it is in solution in a water body the carbon becomes dissolved and may eventually be released into the atmosphere, probably contributing to the build-up of greenhouse gases in the atmosphere. Peat in upland watercourses also causes problems for water supply companies as large quantities of peat have to be removed from drinking water supplies at very great cost to them and ultimately the consumer. Silt getting into streams as a result of erosion is settling out in reservoirs and presenting serious problems for water companies as the siltation depths build up. There is also a widely held view that siltation of watercourses is damaging aquatic habitats for some species and is a major contributory factor when floods occur in areas downstream of the uplands.

Moorland drains (grips) have been dug across much of the Yorkshire upland peatlands. A number of these grips have become badly eroded to the extent that they can no longer be classed as grips and have become large gullies.

The impact of drainage combined with other factors (livestock poaching and overgrazing, vehicle damage, peat extraction for fuel use and the most widespread cause – fire) has also lead to the development of large eroding gullies in many areas.

The initial impact of these factors can lead to areas where the exposed edges of a peat block are continually eroded away due to the combined effects of freeze-thaw action, cantilever collapse of large blocks followed by desiccating wind erosion during drier periods. In many cases, these eroding edges are often either side of a flow of water (gullies – see Figure 1.1) where a grip has eroded, cracks in the peat have widened or sub-surface channels have collapsed followed by nick-point erosion upstream. Gullies and hags together with flatter areas of bare peat often combine to create extensive areas of heavily degraded eroding peatland.

The Yorkshire Peat Partnership is working to block grips and gullies to restore the water table to the peatlands and prevent further peat erosion.

This document sets out the techniques that the Yorkshire Peat Partnership use to block or reduce flows in drainage grips and gullies. These techniques are based on current available evidence and trial and error and may be subject to further refinement as further research is carried out. It is also likely that, in some circumstances, individual site conditions will require modifications or refinements to these standard techniques.

2. Grip and gully classification

Blocking techniques will vary depending on the condition of the grip or gully. It is essential, therefore that grips and gullies are surveyed prior to the production of a restoration plan. This survey can then be used to produce a detailed restoration plan.

Yorkshire Peat partnership have devised a survey protocol which provides all the information needed to develop a grip and gully restoration plan.

2.1.1.1. YPP now classifies grips & gullies based on 4 variables:

(i) Depth in metres in 5 categories (from top of sloping edge to base of grip or gully):
≤1m
>1m≤2m
>2m≤3m
>3m≤4m
>4m

(ii) Width in metres in 5 categories (from top of sloping edge on one side to top of sloping edge on other side).
≤1m
>1m≤2m
>2m≤3m
>3m≤4m
>4m

(iii) Angle of sloping side in 4 categories.

Vertical (V) = >75^{o}
Severe (Sv) = >45^{o}≤75^{o}
Moderate (M) = >33^{o}≤45^{o}
Stable (St) = ≤33^{o}

(iv) Base substrate in 6 categories.

Bare deep peat (≥0.3m)
Bare shallow peat (<0.3m)
Bare mineral
Vegetated deep peat (≥0.3m)
Vegetated shallow peat (<0.3m)
Vegetated mineral

The survey enables the grips and gullies to be categorised and then used to define treatment prescriptions (see Table 1).

Table1: Categorisation of grips and gullies from surveys and subsequent treatment prescriptions. Key: b = blocked, f = flowing, p = peat, m= mineral or peat <30cm), s = shallow, I = intermediate.

Survey data				**Prescription**		
Width (m)	**Depth (m)**	**Substrate**	**Code**	**Dam/sediment trap (see sections 3 & 4)**		**Side treatment (see Technical Specification 2)**
				Code	**treatment**	
≤1	**All**	**Vegetated Peat**	**1bp**	T1	Timber sediment traps (2m wide half or full height) (see section 3.3)	None
		Vegetated Mineral (or peat <30cm)	**1bm**	S1	Stone sediment traps (1 unit) (see section 3.4)	None
		Bare peat	**1fp**	P1	Peat dams (see section 3.2)	Reprofile
		Bare Mineral (or peat <30cm)	**1fm**	S1	stone sediment traps (1 unit) (see section 3.4)	None
>1≤2	**All**	**Vegetated Peat**	**2bp**	T2	Timber sediment traps (3m wide full height) (see section 3.3)	None
		Vegetated Mineral (or peat <30cm)	**2bm**	S2	Stone sediment traps (2 units) (see section 3.4)	None
		Bare peat	**2fp**	P2	Peat dams (see section 3.2)	None
		Bare Mineral (or peat <30cm)	**2fm**	S2	Stone sediment traps (2 units) (see section 3.4)	None
	<1	**Bare peat**		P1	Peat dams	Reprofile
>2≤3	**All**	**Vegetated Peat**	**3bp**	T3	Timber sediment traps (4m wide full height) (see section 3.3)	None
		Vegetated Mineral (or peat <30cm)	**3bm**	S3	Stone sediment traps (3 units) (see section 3.4)	None
		Bare peat	**3fp**	P3	Peat dams (see section 3.2)	None
		Bare Mineral (or peat <30cm)	**3fm**	S3	Stone sediment traps (3 units) (see section 3.4)	None
	<1	**Bare peat**		P1	Peat dams	Reprofile
>3≤4	**≤1**	**Peat**	**4sp**	TB3	Timber flow baffles (2m wide full height)	Reprofile to 45^0 (see

					(see section 4.2)	2.1.3 of Technical Spec 2) protect toe with stone, coir logs or bales and use geo-textile on slope. Revegetate (see 2.2. & 2.3 of Technical Spec 2).
		Bare Mineral (or peat <30cm)	**4sm**	SB3	Stone flow baffles (2 units) (see section 4.3)	Reprofile to 45^0 (see 2.1.3 of Technical Spec 2) protect toe with stone, coir logs or bales and use geo-textile on slope. Revegetate (see 2.2. & 2.3 of Technical Spec 2).
	>1	**Peat**	**4dp**	TB1	Timber flow baffles (2m widefull height) (see section 4.2)	None
		Bare Mineral (or peat <30cm)	**4dm**	SB1	Stone flow baffles (2 units) (see section 4.3)	None
>4	**≤1**	**Peat**	**5sp**	TB2	Timber flow baffles (2m wide full height) (see section 4.2)	Reprofile to 33^0 (see 2.1.3 of Technical Spec 2) Revegetate (see 2.3 of Technical Spec 2).
		Bare Mineral (or peat <30cm)	**5sm**	SB2	Stone flow baffles (2 units) (see section 4.3)	Reprofile to 33^0 (see 2.1.3 of Technical Spec 2) Revegetate (see 2.3 of Technical Spec 2).
	>1≤2	**Peat**	**5ip**	TB3	Timber flow baffles (2m wide full height) (see section 4.2)	Reprofile to 45^0 (see 2.1.3 of Technical Spec 2) protect toe with stone, coir logs or bales and

						use geo-textile on slope. Revegetate (see 2.2. & 2.3 of Technical Spec 2).
		Bare Mineral (or peat <30cm)	**5im**	SB3	Stone flow baffles (2 units) (see section 4.3)	Reprofile to 45^0 (see 2.1.3 of Technical Spec 2) protect toe with stone, coir logs or bales and use geo-textile on slope. Revegetate (see 2.2. & 2.3 of Technical Spec 2).
	>2	**Peat**	**5dp**	TB1	Timber flow baffles (2m wide full height) (see section 4.2)	None
		Bare Mineral (or peat <30cm)	**5dm**	SB1	Stone flow baffles (2 units) (see section 4.3)	None

3. Gully/grip blocking & sediment trapping

3.1. General considerations

3.1.1. All grips & gullies should be treated starting from the top working downslope.

3.1.2. Where there are confluences dams or sediment traps should be placed in the individual grips & gullies before they join together.

3.1.3. Where a grip or gully is blocked to it's full height (≤1m deep only) excess water should be dissipated across the moor. The water should be directed laterally across the moor away from the grip or gully by digging a small crescent shaped overspill channel (see Figure 1.2.) on the down slope side behind the dam or sediment trap.

3.1.4. The dam or sediment traps should be wider either side than the grip or gully and lower in the middle (or notched) to prevent erosion at the edges (see Figure 1.2).

3.1.5. Variation in the positioning of the dams or sediment traps is required in order to take advantage of the natural topography.

3.1.6. The locations of all dams, sediment traps must be recorded using sub-metre accuracy GPS.

3.2. Peat Dam construction (see Figure 1.3)

3.2.1. Average spacing of peat dams should be 7.5m but adjusted to take account of the gradient and vegetation conditions of the individual grip. On level ground the dams should be no more than 12m apart. On steeper slopes the dams should be no more than 5m apart. Peat dams are unlikely to be effective on slopes >6^{o}.

3.2.2. Full height peat dams should be higher than the surrounding ground level to compensate for shrinkage and so that impounded water overflows laterally away from the dam and soaks into the bog surface (see Figure 1.4).

3.2.3. Placement of the dams must be such that when the water backs up from the dam the grip is filled with water to a level above the base of the next dam up slope (see Figure 1.5).

3.2.4. The peat to be used must be well-humified so that it is sufficiently impermeable.

3.2.5. All peat dams must be constructed using a very low ground pressure 360^{o} excavators with wide ("bog") tracks (Figure 1.6). Even with bog tracks, however, the total machine weight should be less than 10 tonnes and portable "bog mats" will be needed to traverse areas of wet deep peat.

3.2.6. All machine operators must be able to demonstrate a high level of expertise in working in a bog environment.

3.2.7. With the machine sitting on the low side of the channel strip out the vegetation (to a depth sufficient to ensure the root zone stays intact) to a width of approximately 0.6m either side of the grip and 0.3m into the base for a length of 2.5m upstream of the dam site and place the stripped vegetation to the side of the grip for later use.

3.2.8. Initially using peat gathered from the grip to the upstream side of the dam site, turn peat over in the grip to create a wedge-shaped dam in the area stripped of vegetation 1.2m thick (see Figure 1.4).

3.2.9. Should additional un-oxidised peat be required to complete the dam, this should be gained from a borrow pit adjacent to the grip. The borrow pit must be located within 90º or 180º of the machine but within easy reach without moving the excavator. Strip the vegetation from the borrow pit in as large an unbroken turf as possible and store to one side for later use.

3.2.10. Excavate un-oxidised peat from the borrow pit and complete the dam making sure that it is keyed into both sides of the grip by 0.6m and the base by 0.3m.

3.2.11. The peat dam should be finished not less than 0.5m higher than the surrounding ground to allow for settlement and so that impounded water overflows laterally away from the dam and soaks into the bog surface (see Figure 1.4).

3.2.12. Make good the borrow pit by stretching the previously stored vegetation across it thus leaving a shallow depression. Use all other previously excavated vegetation to cover any bare peat.

3.2.13. Create a runoff via a crescent-shaped shallow overflow channel to the lower side of the grip upstream of the new dam, ensuring excess water can be dispersed onto moorland without causing subsequent surface erosion (see Figure 1.2).

3.2.14. To the upstream side of the dam re-profile the sides to approximately 33º and for a distance of approximately 1m to ensure there is no deep water hazard and to slow down flow (see Figure 1.7).

3.2.15. Revegetate all bare peat (including the top of the dam) using the vegetation previously set aside to prevent oxidation of the peat.

3.2.16. All grips and gullies ≤1 deep should be re-profiled between dams as follows unless otherwise specified or the grip is fully revegetated.

3.2.17. The vegetation either side of the grip or gully immediately upstream of the dam is removed and used to cover part of the dam. The newly exposed peat is then turned over to lift the base of the grip and the steep side slope is re-profiled to approximately 33º.

3.2.18. The peat from the sides and base are worked over and compacted to create a gentle undulating curve. Ensure that the downhill edge of the grip is slightly lower than the uphill edge to facilitate even overflow of collected water allowing even re-wetting and avoiding creation of secondary erosion channels.

3.2.19. Moving up the grip the next section of vegetation is removed and used to cover the previously exposed and now re-profiled peat. Repeat this process until along the length of the grip. At the top end of the grip section unbroken turves from adjacent to the grip may be needed.

3.2.20. Make good the area where the turves are taken from by teasing in the surrounding vegetation.

3.3. Timber sediment trap construction (see Figure 1.9)

3.3.1. Where construction of peat dams would cause unnecessary damage timber dams provide a less disruptive alternative for blocking small grips and gullies (<3m wide) with a deep peat base (>0.3m deep).

3.3.2. For deep gullies or grips it will not be possible to create full height sediment traps. The main effect of timber sediment traps is to reduce water flow to enable the trapping of sediment in the base and to prevent peat sides of the grips and gullies from drying out, cracking and collapsing. Timber sediment traps are likely to be temporary and may need two or more stages of activity to raise the level of the gully or grip base over time.

3.3.3. The locations for individual sediment traps will be drawn up prior to tendering. A location map will be provided in the Restoration Plan documentation for the Work Site(s).

3.3.4. Individual sediment trap locations will be marked out on the Works Site with the Nominated Officer prior to the works commencement date.

3.3.5. Timber sediment traps should be placed starting at the top of the grip or gully at pinch points, confluences or changes from mineral to peat based substrate at roughly 10m intervals.

3.3.6. Untreated timber planks should be used (suggested dimensions of 25cm wide, 3.75 cm thick). Ideally, these should be western red cedar, elm, oak, alder or larch from FSC certified sources.

3.3.7. Use up to four 25cm planks per trap to create a maximum 1m high trap except in shallower gullies and grips where half height traps (2 planks) would be used (see Figure 1.9). Dimensions of traps are given Table 2.

3.3.8. The planks should be embedded into the sides of the gully by 0.5m and should be driven straight down to avoid creating an erosion crack in the gully side.

3.3.9. The planks should be fastened to, and held in place by, supporting posts hammered into the gully at 1m intervals (recommended 1.5-2m long x 10cm thick for a full height trap).

3.3.10. The bottom two planks should fit closely together to retain water during all flow conditions. Gaps of approximately 1-2cm should then be left between the second board and the third board and between this board and the fourth board to

create a “weeping wall” which allows water to slowly leak away after high flow periods whilst retaining peaty sediment.

3.3.11. Planking sediment traps will require a spill plate placing down-stream to prevent turbulence erosion as water comes over the top (e.g. stone, timber, baled material, turves etc.).

3.3.12. A notch 15cm deep and 30cm wide should be cut into the middle of the trap to channel water in high flows through the middle of the trap to reduce edge erosion.

3.3.13. Where the dam is to the full height of the gully (ideal if this can be achieved) create a runoff via a shallow crescent shaped overflow channel to the lower side of the grip upstream of the new dam, ensuring excess water can be dispersed onto moorland without causing subsequent surface erosion (Figure 1.2).

Table 2. Dimensions of timber sediment traps

Prescription Code	Trap width (m)	Plank length (includes 0.5m embedded into gully/grip sides (m)
2	1	2
3	2	3
4	3	4

3.4. Stone sediment trap construction (See Figure 1.10)

3.4.1. Where grips and gullies have eroded down to a mineral base, peat dams and timber sediment traps won’t key in and water gets underneath causing scouring. In these circumstances it is necessary to use stone sediment traps.

3.4.2. The locations for individual traps will be drawn up prior to tendering. A location map will be provided in the Restoration Plan documentation for the Work Site(s).

3.4.3. Individual trap locations will be marked out on the Works Site with the Nominated Officer prior to the works commencement date.

3.4.4. Stone traps should be placed starting at the top of the grip or gully at pinch points, confluences or changes from mineral to peat based substrate at roughly 10m intervals.

3.4.5. Each stone sediment trap will be made up of 1, 2 or 3 units depending on the width of the gully with a single trap unit consisting of random gritstone (150 - 400mm) weighing approximately 750 - 800kg (see Figure 1.11)

3.4.6. 2 sediment trap units will be required for 2m wide gullies/grips and 3 units for 3m wide gullies/grips.

3.4.7. Stone sediment traps in gullies/grips are to be a minimum of 75cm high and at least 75cm in transverse width upstream to downstream and span the full width of the gully/grip.

3.4.8. Traps must be no taller than 1m in height for safety reasons.

3.4.9. Traps should have a steep face (approximately 60 degrees) on the upstream side and have a slope of approximately 45 degrees on the downstream face.

3.4.10. Traps should be higher at each side than in the middle to allow water to flow down the middle of the downstream face of the dam and prevent scouring around the sides of the trap.

3.4.11. There will be hand movement of the stone required to be carried out by the contractor after the trap unit has been initially dropped into place to ensure that the stone dam conforms to the right shape and size as set out above.

4. Slowing the flow in wider grips/gullies

4.1. General considerations

4.1.1. Where grips and gullies are >3m wide the amount of materials (peat, stone or timber) needed to block or trap sediment across the full width becomes prohibitive and there is also the danger of impounding a large volume of water which could lead to the catastrophic collapse of the dam or trap releasing a powerful erosive force which undermines the point of restoration.

4.1.2. However, combined with measures upstream it is possible to slow the flow of water in these larger grips and gullies using “baffles” to enable natural sedimentation and re-vegetation to take place. These baffles are made from stone or timber and are installed part way across the gully or grip in a staggered pattern down the gully and angled to 33^{o} from the side of the gully to push flows in all but the stormiest conditions into the centre of the watercourse (see Figure 1.12).

4.1.3. The effect is to create a meandering flow which, in calmer conditions, enables sediment deposition and re-vegetation with existing or introduced flora.

4.1.4. All grips & gullies should be treated starting from the top working downslope.

4.1.5. Where there are confluences baffles should be placed in the individual grips & gullies before they join together.

4.1.6. Variation in the positioning of the baffles is required in order to take advantage of the natural topography.

4.1.7. The locations of all baffles must be recorded using sub-metre accuracy GPS.

4.2. Timber baffle construction

4.2.1. The locations for individual baffles will be drawn up prior to tendering. A location map will be provided in the Restoration Plan documentation for the Work Site(s).

4.2.2. Individual baffle locations will be marked out on the Works Site with the Nominated Officer prior to the works commencement date.

4.2.3. Timber baffles should be placed starting at the top of the grip or gully at pinch points, confluences or changes from mineral to peat based substrate.

4.2.4. Untreated timber planks should be used (suggested dimensions of 25cm wide, 3.75 cm thick). Ideally, these should be western red cedar, elm, oak, alder or larch from FSC certified sources.

4.2.5. Use four 25cm planks per trap to create a 1m high baffle (Figure 1.13).

4.2.6. The baffle planks are 2.5m long embedded into the side of the gully by 0.5m and should be driven straight down to avoid creating an erosion crack in the gully side.

4.2.7. The planks should be fastened to, and held in place by, supporting posts hammered into the gully at 1m intervals (recommended 1.5-2m long x 10cm thick for a full height trap).

4.2.8. The bottom two planks should fit closely together to retain water during all flow conditions. Gaps of approximately 1-2cm should then be left between the second board and the third board and between this board and the fourth board to create a “weeping wall” which allows water to slowly leak away after high flow periods whilst retaining peaty sediment.

4.2.9. Planking baffles will require a spill plate placing down-stream to prevent turbulence erosion as water comes over the top (e.g. stone, timber, baled material, turves etc.)

4.3. Stone baffle construction

4.3.1. The locations for individual baffles will be drawn up prior to tendering. A location map will be provided in the Restoration Plan documentation for the Work Site(s).

4.3.2. Individual baffle locations will be marked out on the Works Site with the Nominated Officer prior to the works commencement date.

4.3.3. Baffles should be placed starting at the top of the grip or gully at pinch points, confluences or changes from mineral to peat based substrate.

4.3.4. Each stone baffle will be made up of 2 units with a unit consisting of random gritstone (150 - 400mm) weighing approximately 750 - 800kg (see Figure 1.14)

4.3.5. Stone baffles in gullies/grips are to be a minimum of 75cm high and at least 75cm in transverse width upstream to downstream and protrude into the gully/grip by 2m.

4.3.6. Baffles must be no taller than 1m in height for safety reasons.

4.3.7. Baffles should have a steep face (approximately 60 degrees) on the upstream side and have a slope of approximately 45 degrees on the downstream face.

4.3.8. There will be hand movement of the stone required to be carried out by the contractor after the baffle has been initially dropped into place to ensure that the stone dam conforms to the right shape and size as set out above.

TT October 2017

Figure 1.1 Photos of a hag and eroding gully sides

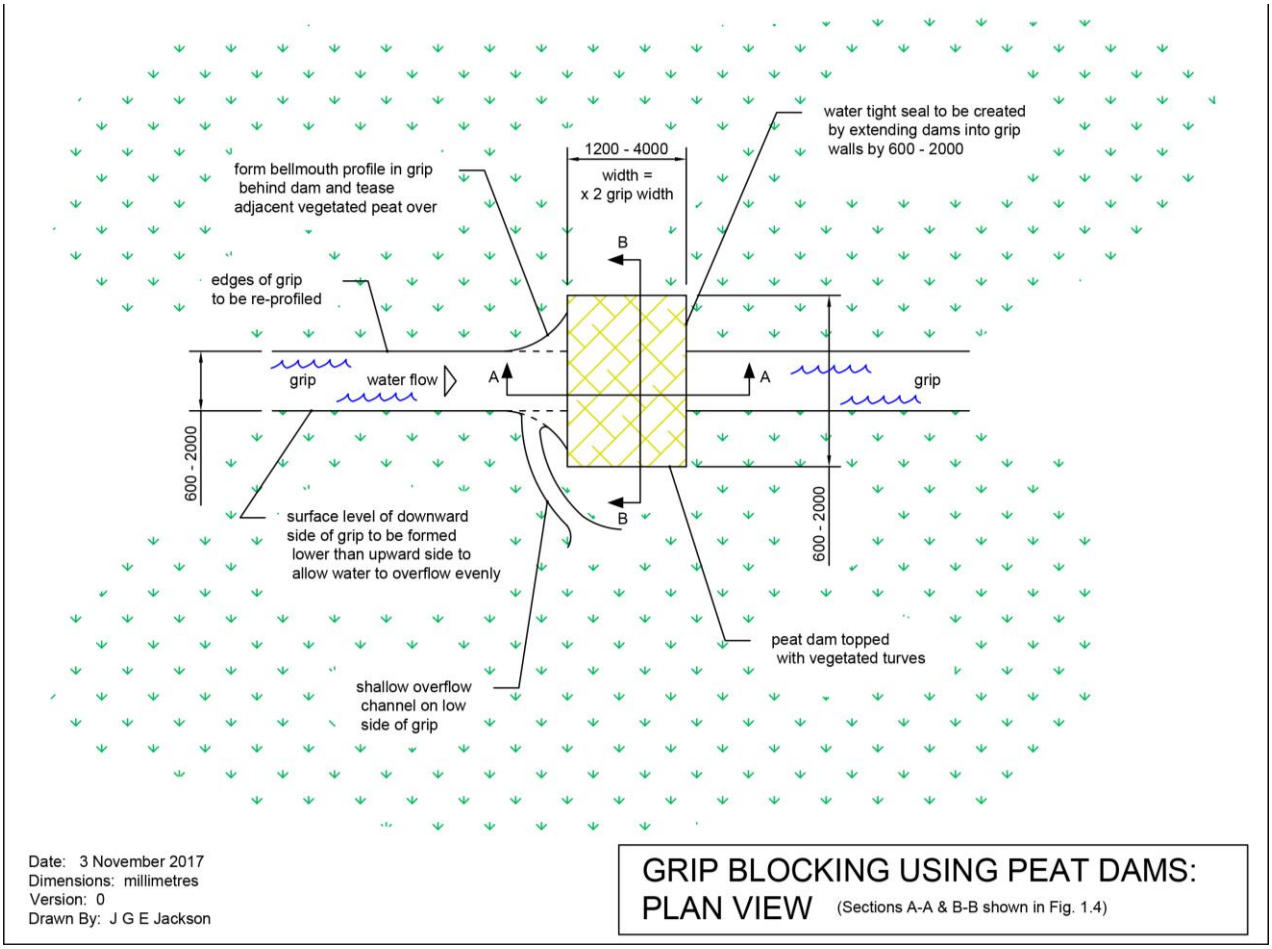

Figure 1.2 Grip/gully peat block diagram

Figure 1.3: Peat dams

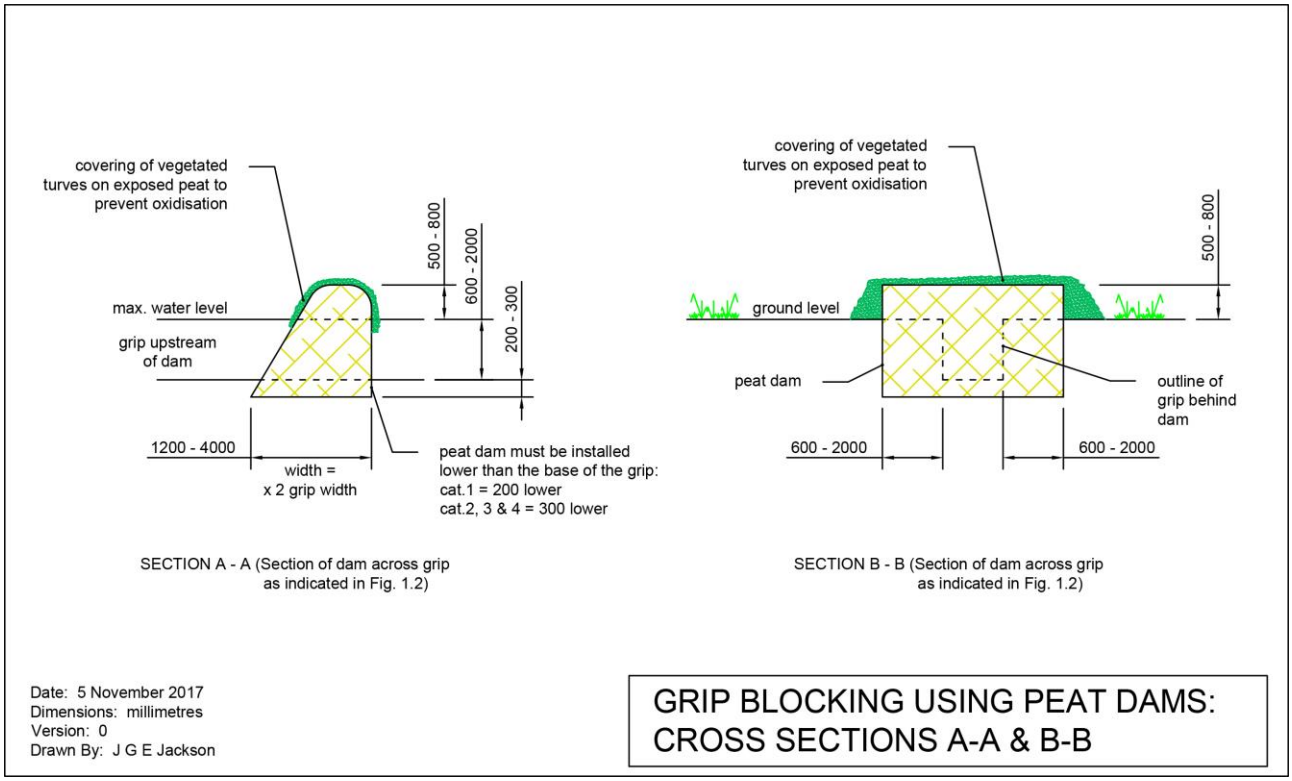

Figure 1.4 Peat dam specification

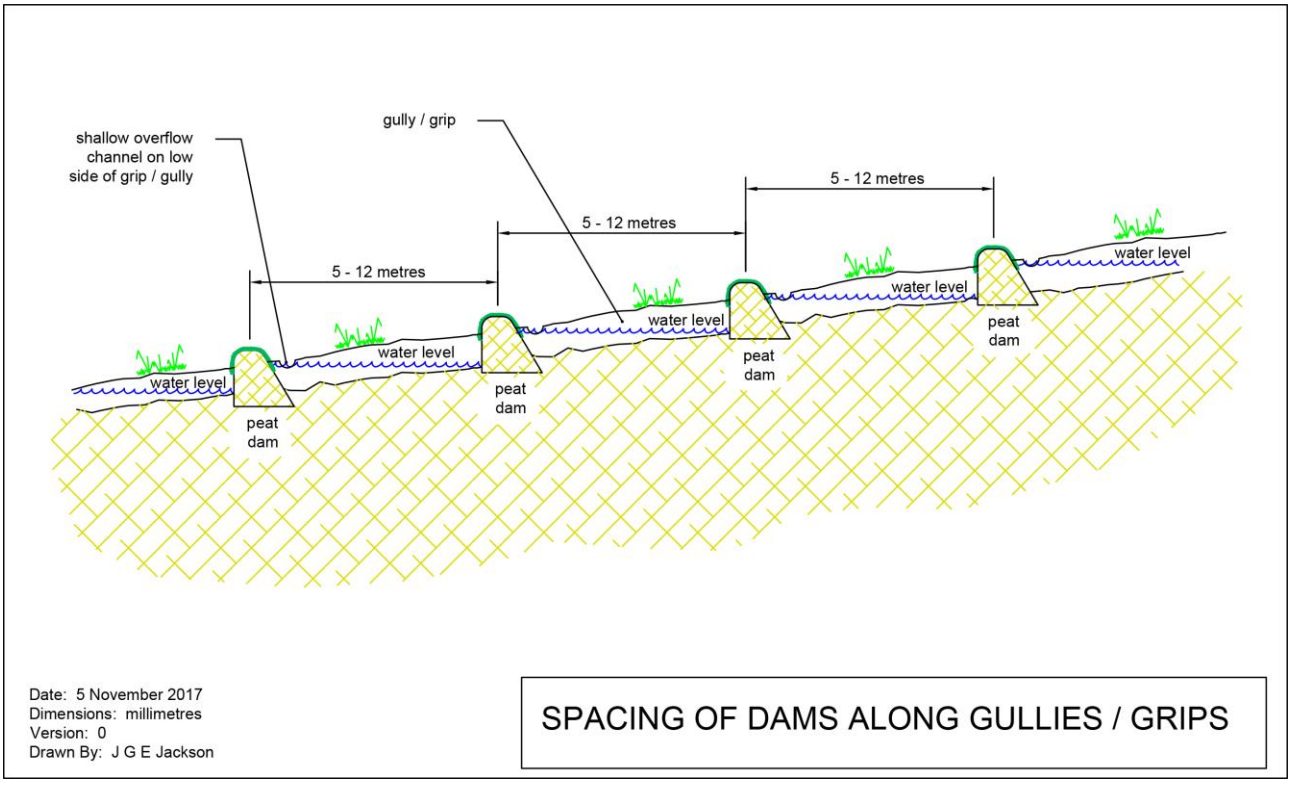

Figure 1.5: Spacing of grip/gully dams

Figure 1.6 Photo of LGP excavator

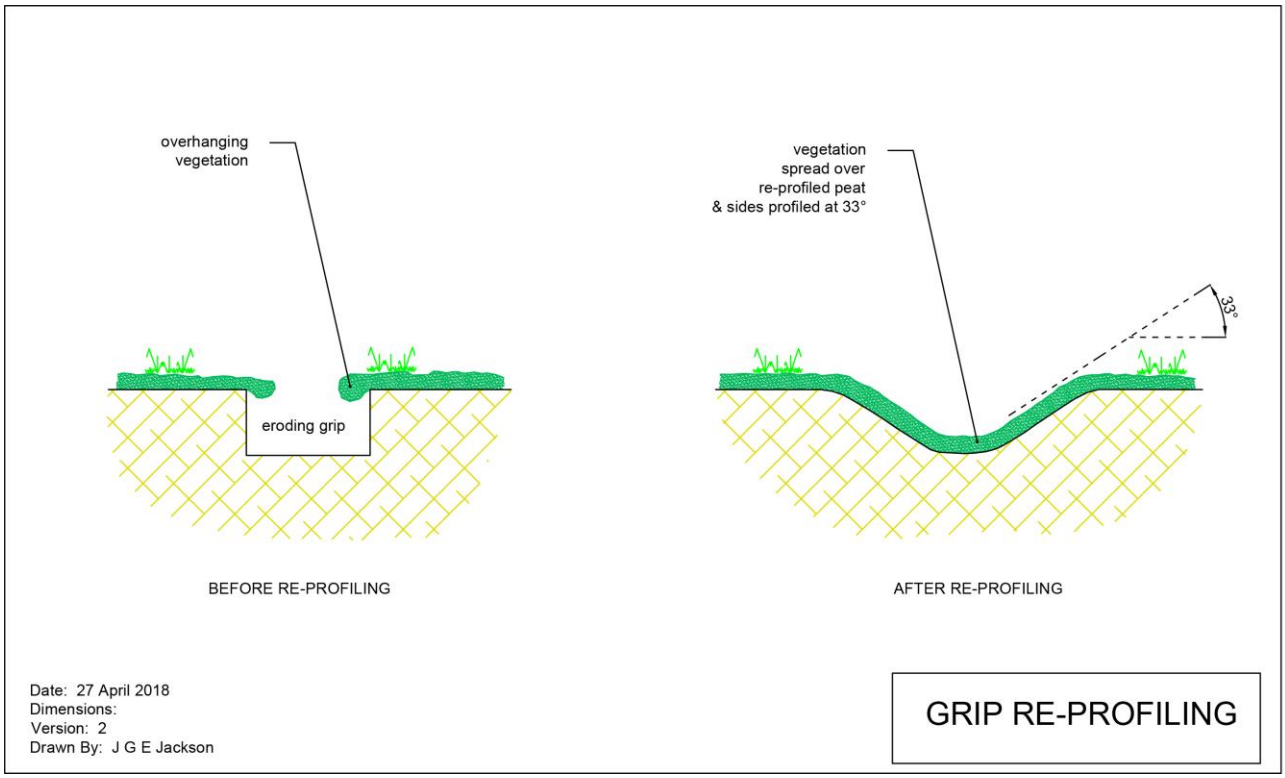

Figure 1.7: Grip reprofiling

Figure 1.7a: Photo of reprofiled grip.

Figure 1.8 Timber sediment trap

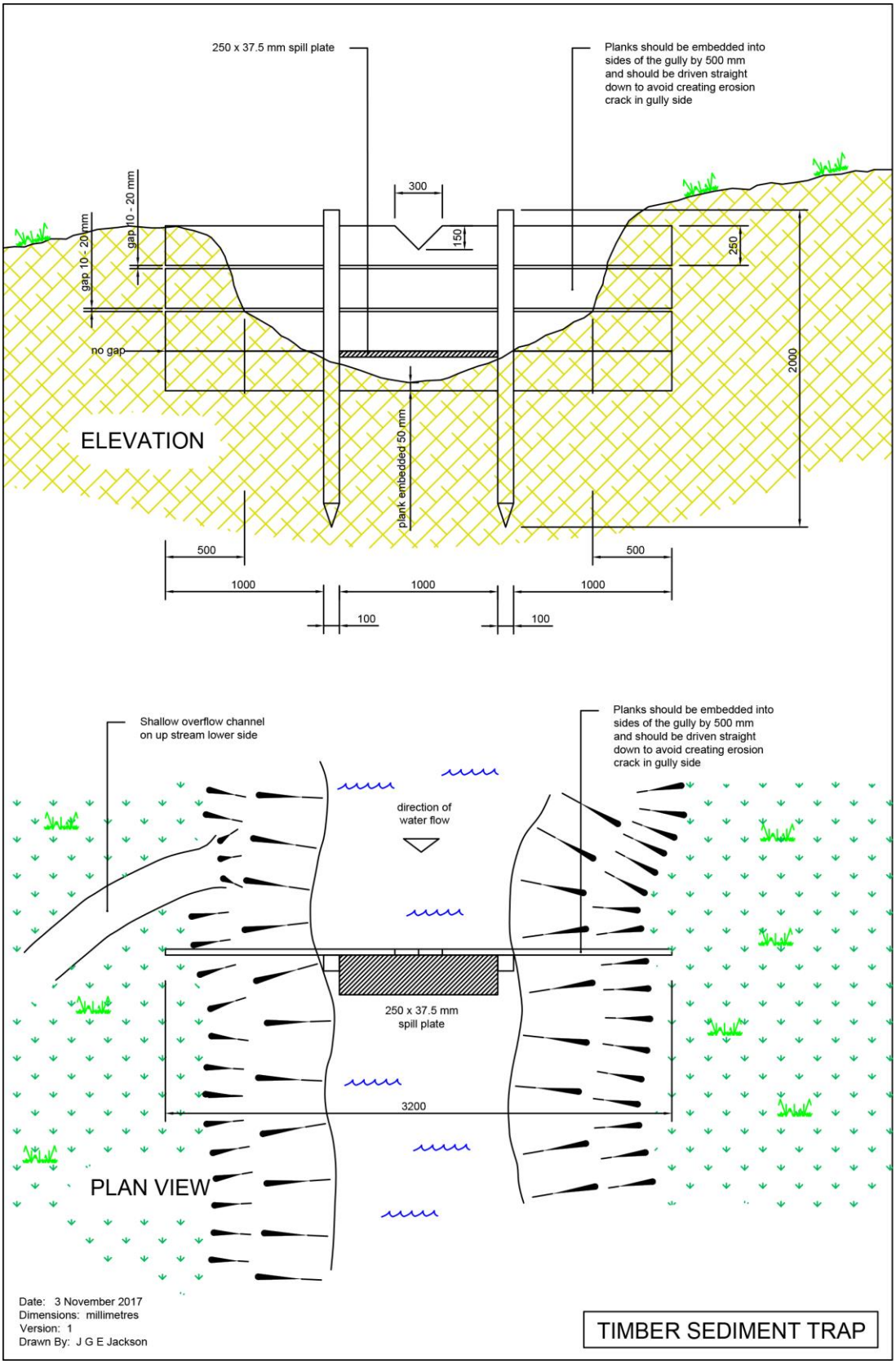

Figure 1.9 Timber sediment trap specification

Figure 1.10 Photograph of Stone sediment trap

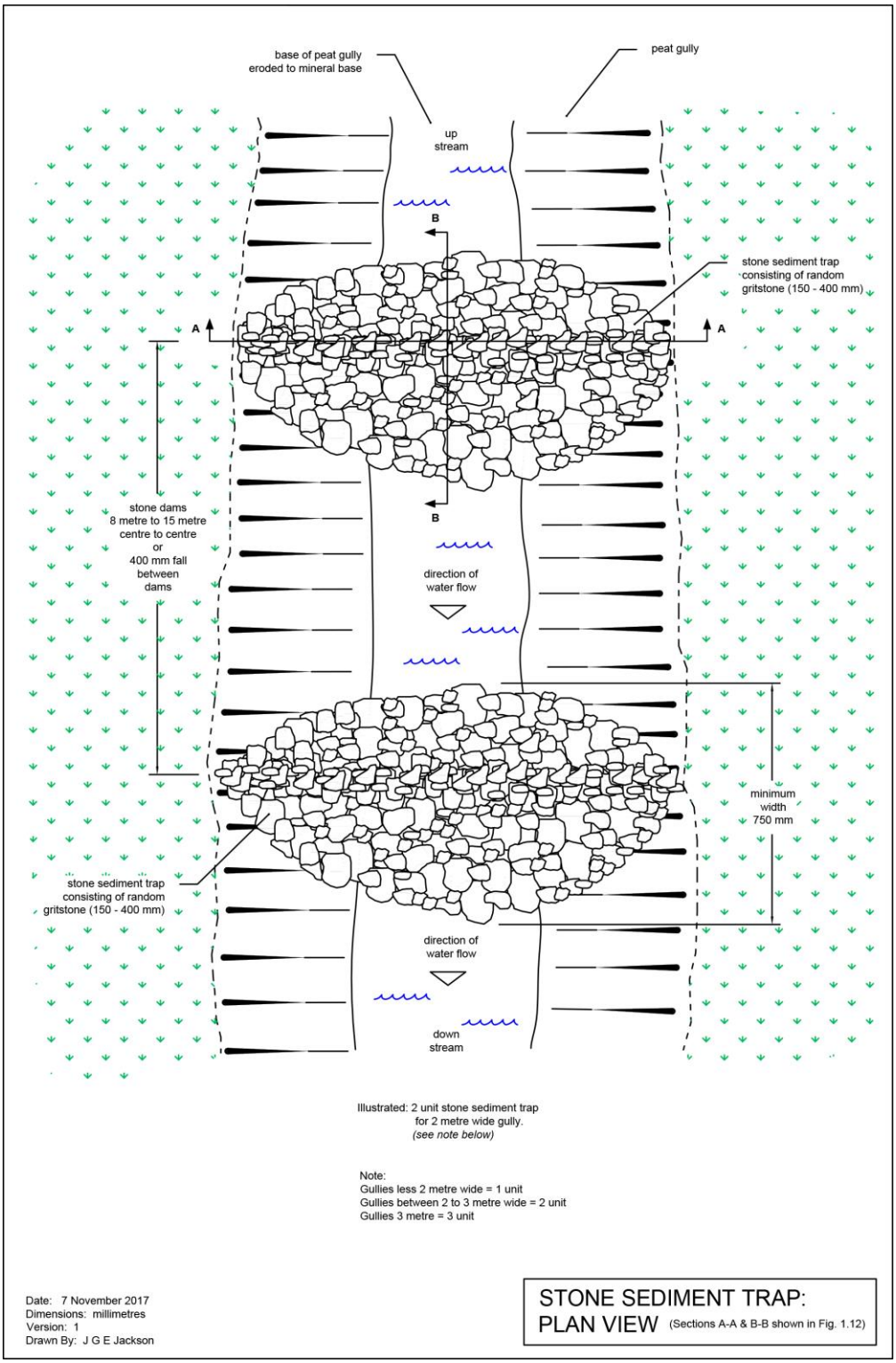

Figure 1.11 Stone sediment trap construction

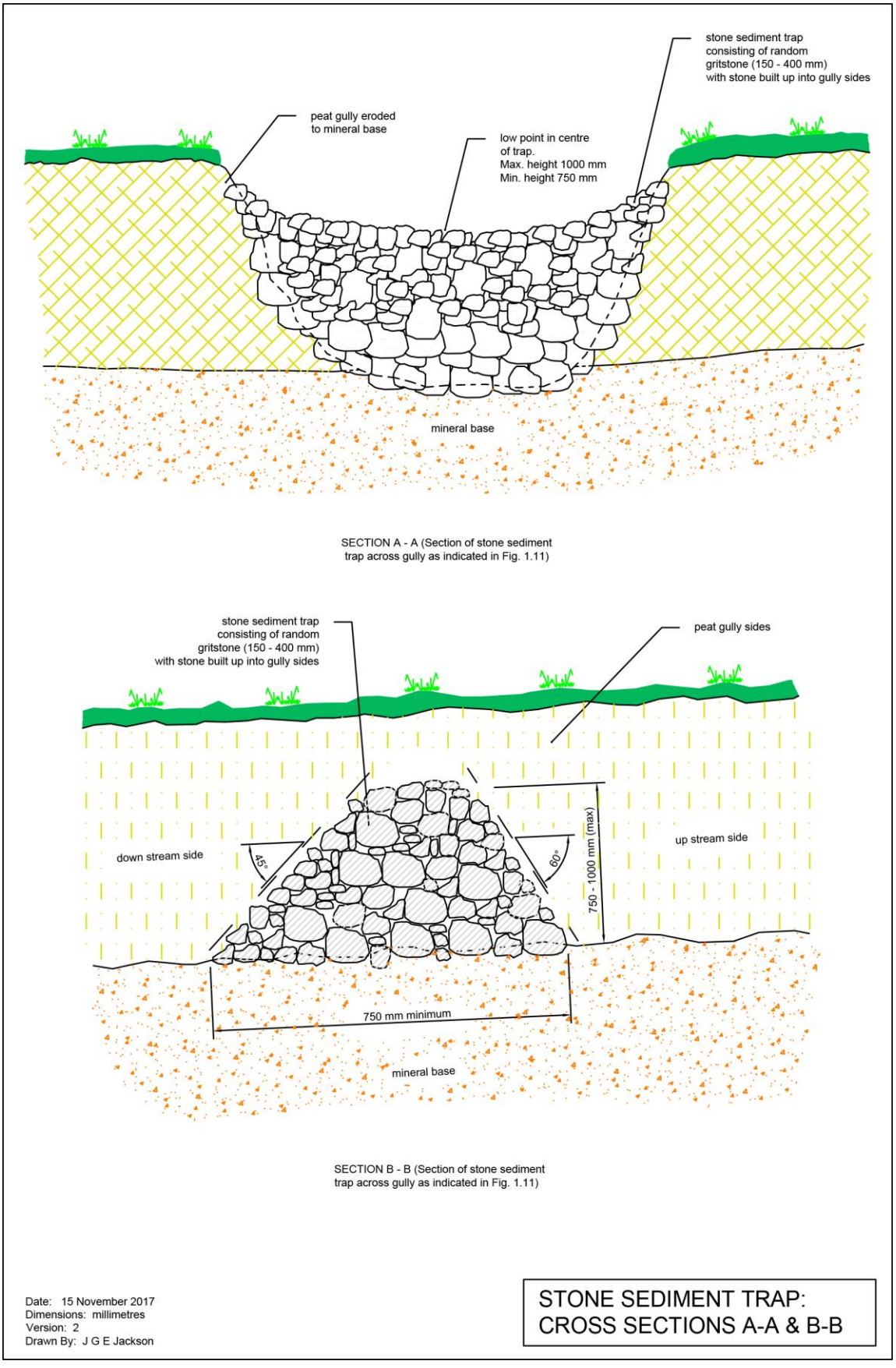

Figure 1.12 Sediment trap schematic

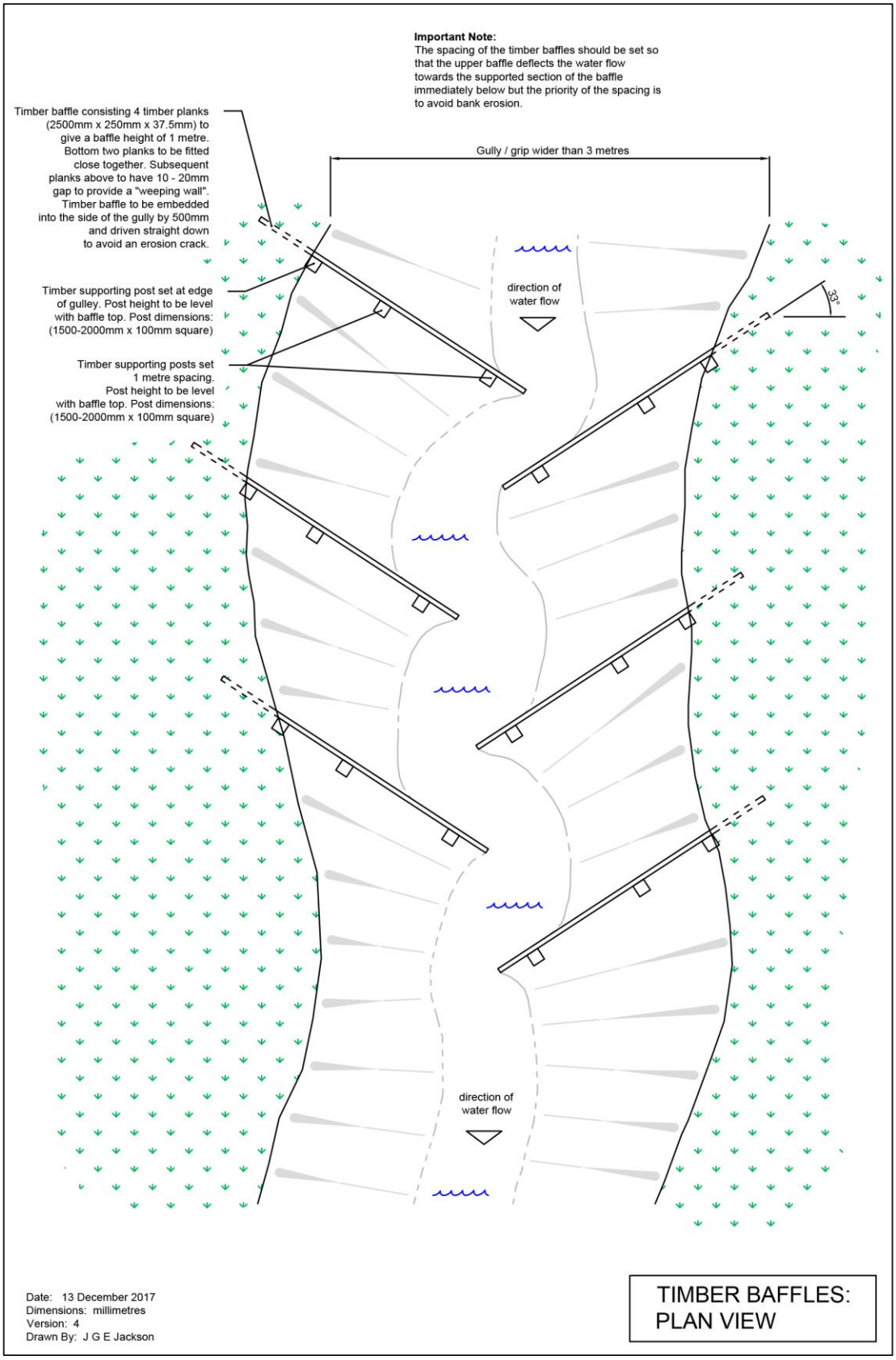

Figure 1.13 Timber slow-the-flow baffle specification

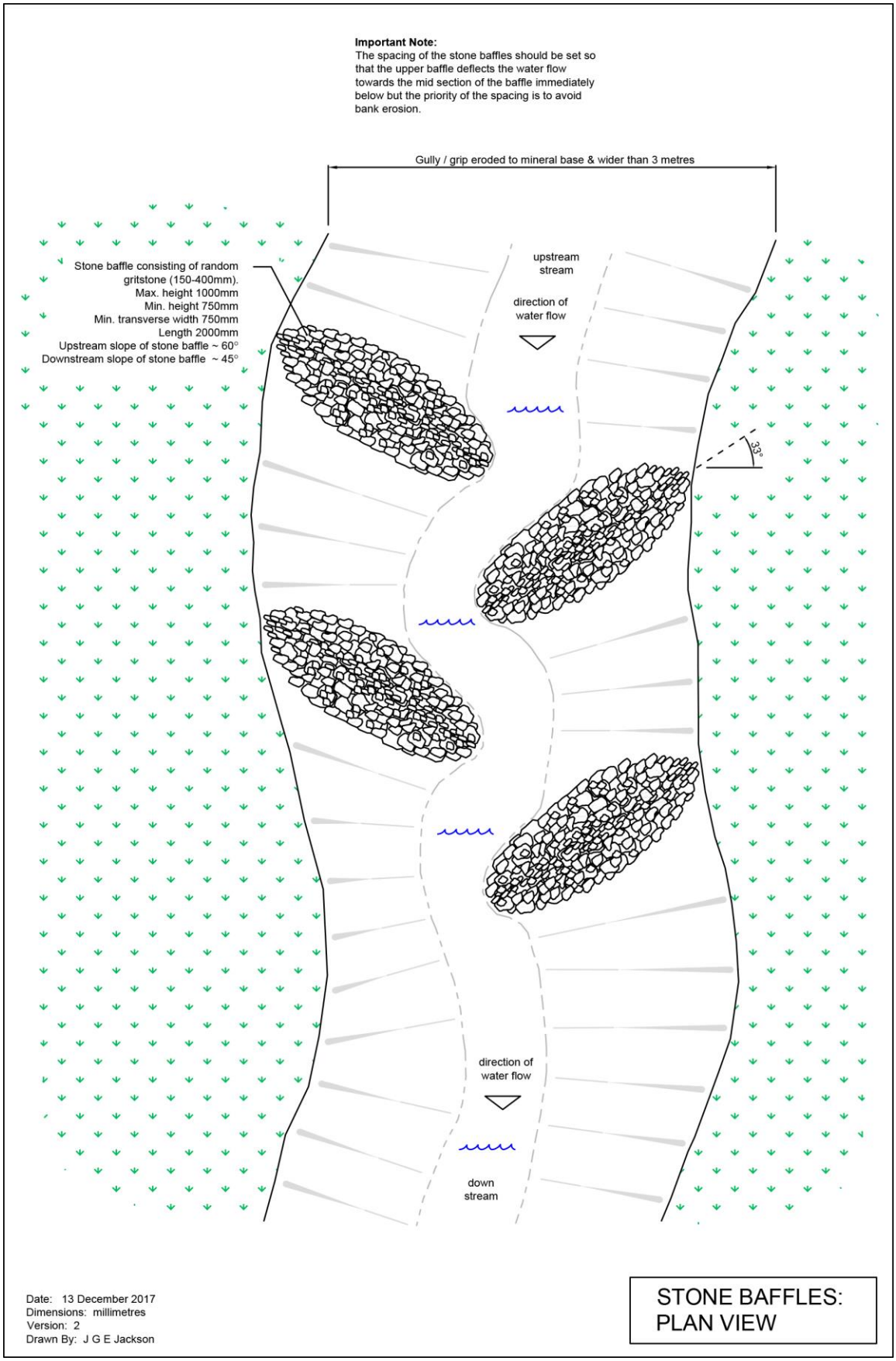

Figure 1.14 Stone slow-the-flow baffle specification