Design of Debris Slash Traps:
Considerations for NZ Plantation Forestry Operating

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Enviro Link Contract

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1. Slash Traps - Overview

Slash traps are structures designed to intercept and trap slash in waterways to prevent their migration downstream. In a broader sense, they are referred to as 'debris traps'. In most natural waterways debris that become entrained in a flood flow will include rock/sediment as well as woody material. Any structure designed to retain woody debris, or more specifically slash for forest operations, will also retain sediment (Figure 1). Visa versa, traps designed to trap sediment will also capture woody debris.

Figure 1: Left, a basic railway iron and steel rope slash trap will retain slash, with sediment building up within and behind. Right, the more permanent debris control structure will retain sediment in the pond behind, with slash being trapped at the outlet by the pillars in the structure.

Rain-induced landslides and debris flows that recruit, transport and deposit woody debris or slash (i.e. 'slash events') are a significant global and national hazard. Even moderate entrainment of debris can exacerbate the hazard of a flood and potentially cause severe impacts for downstream infrastructure and communities. Flood flows with significant volumes of debris entrained are referred to as debris flows or debris torrents.

The scale of a flood flow in a given catchment can be estimated using rainfall-flood flow models (such as TM61 or Rational) and or interpolation/extrapolation of gauged catchments ('Regional methods'), whereby variability between estimates is considerable. Predicting the movement of debris associated with a given flood flow event is much more complex. In general, there is a relationship between the size of the flood event and the amount of debris mobilised. There is also a clear relationship with the availability of readily mobilised debris within a catchment (such as harvest residues, or recently disturbed soil from earthworks) and the volume of material moved. However, for any given event the total volume / amount of debris mobilised is highly variable. Once debris is entrained, especially near the top of a catchment, it will provide the force (/momentum) to dislodge greater volumes of debris in its passage down through the catchment. That is, while floodwater is very capable of dislodging debris, once debris is entrained the resulting damage can be an order of magnitude larger with debris flows often exceeding 50km/hr.

Figure 2 illustrates the complexity of the concept of debris flow estimates, linking flood flow to debris discharge from the catchment (from Rudolf-Miklau et al. 2015). Once flood flows exceed a 1 in 10 year probability (10% AEP, or 90% 'non-exceedance'), a 'Regime Transfer' can occur that changes the expected volume of debris from that delivered by 'Fluid Gravity Process' and moves to a 'Sediment Gravity Process' than can deliver material an order of magnitude greater for the same size flood event. Similarly, storms greater than a 1-in-200 year event (0.5% AEP) can trigger catastrophic effects (Regime III).

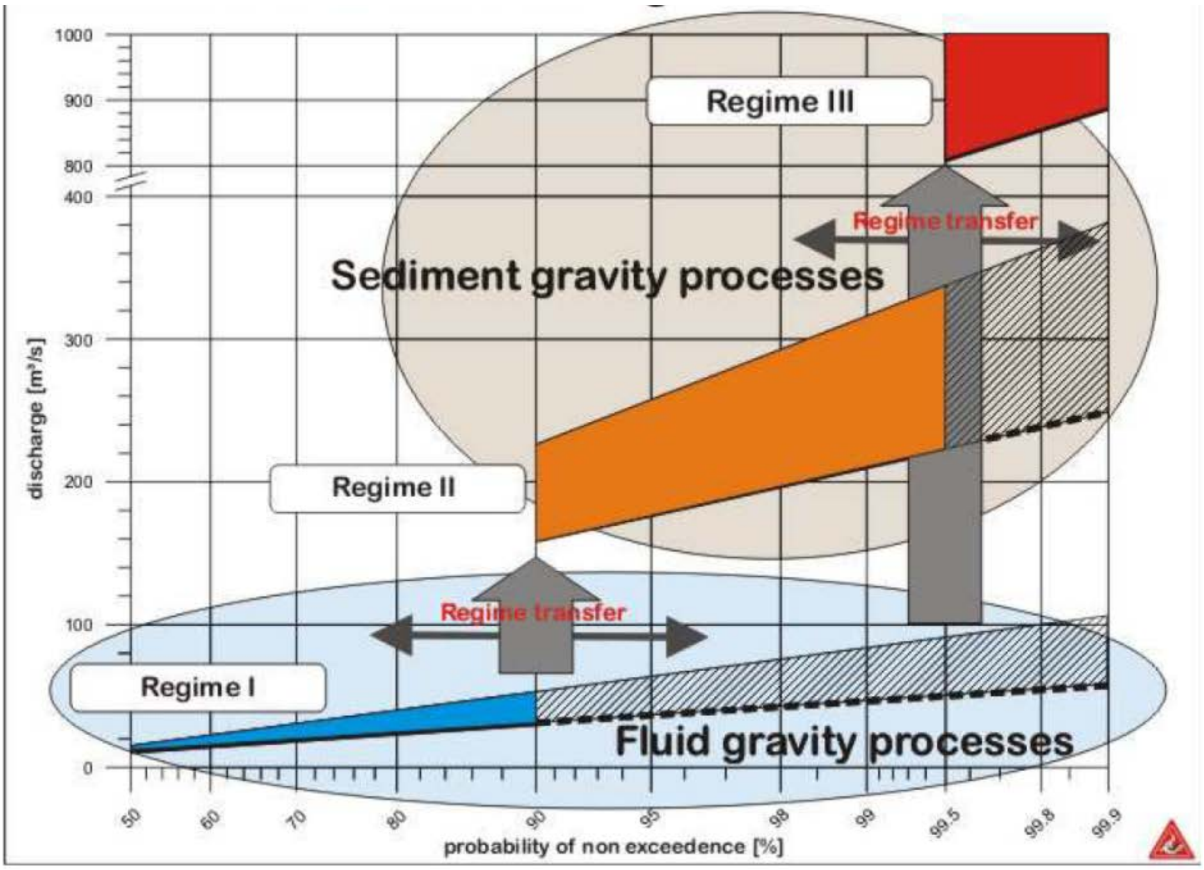

Figure2: Sketch of different torrential regimes (from Rudolf-Miklau, Hubl and Suda, 2015)

In regions such as the Alps in central Europe, managing debris from steep catchments is important enough to warrant its own academic discipline as well as unique State departments, and this is referred to ("Wildbach und Lawinenbau" (translated; 'Avalanche and Torrent Control'). Much of the technical knowledge in terms of debris flow and slash management, used in this report comes from this German/Austrian/Italy region. This is also because they have extensive experience in active forest management practices in their mountainous regions. There are many examples of large scale events from this region (Figure 3).

Figure 3: Mobilisation of woody debris is a worldwide problem; photo from Germany showing large-scale mobilisation by flood flow of whole trees from a catchment exposed to a major storm.

Larger scale clear-cuts are typically avoided in central Europe. These legal harvest restrictions have developed over time and have many reasons including aesthetic, wildlife, sustainability for local supply, but also to avoid changes to the hydrological response of the catchment that can exacerbate woody debris flow events. However, events such as larger forest fires and storms resulting in large scale wind-throw has resulted in significant debris flows formation and massive valley jams.

Approximately one-quarter of NZ’s plantation forests are on steepland highly susceptible to both erosion and catchment discharge of woody debris. There have been many well documented occurrences of large scale movement of woody debris originating from commercial forestry catchments. While there is a broad acceptance that NZ’s forest owners need to manage the risk of slash events, their ability predict the scale of such debris events is very limited. Managing this risk with confidence is limited by a critical lack of essential data and information to underpin hazard analysis (sources, extent, frequency) and risk management (ecological, social and economic impacts).

What is well established is that forestry debris can and will move in flood flow events, and that slash traps can be effective in retaining relatively large quantities of woody debris.

2. Design Principles of Slash Traps

The design of slash traps is complex and the following is intended to highlight some of the basic principles that are pertinent for consideration of slash traps in the NZ plantation forestry context.

Flow rate

Slash traps are most effective when the design reduces the velocity of the water approaching the structure. This is achieved by locating the slash trap in a lower reach of the catchment as the waterway emerges from the steepest part, or where a structure can be built to increase the depth of the waterway. Figure 4 illustrates this for a designed slash trap.

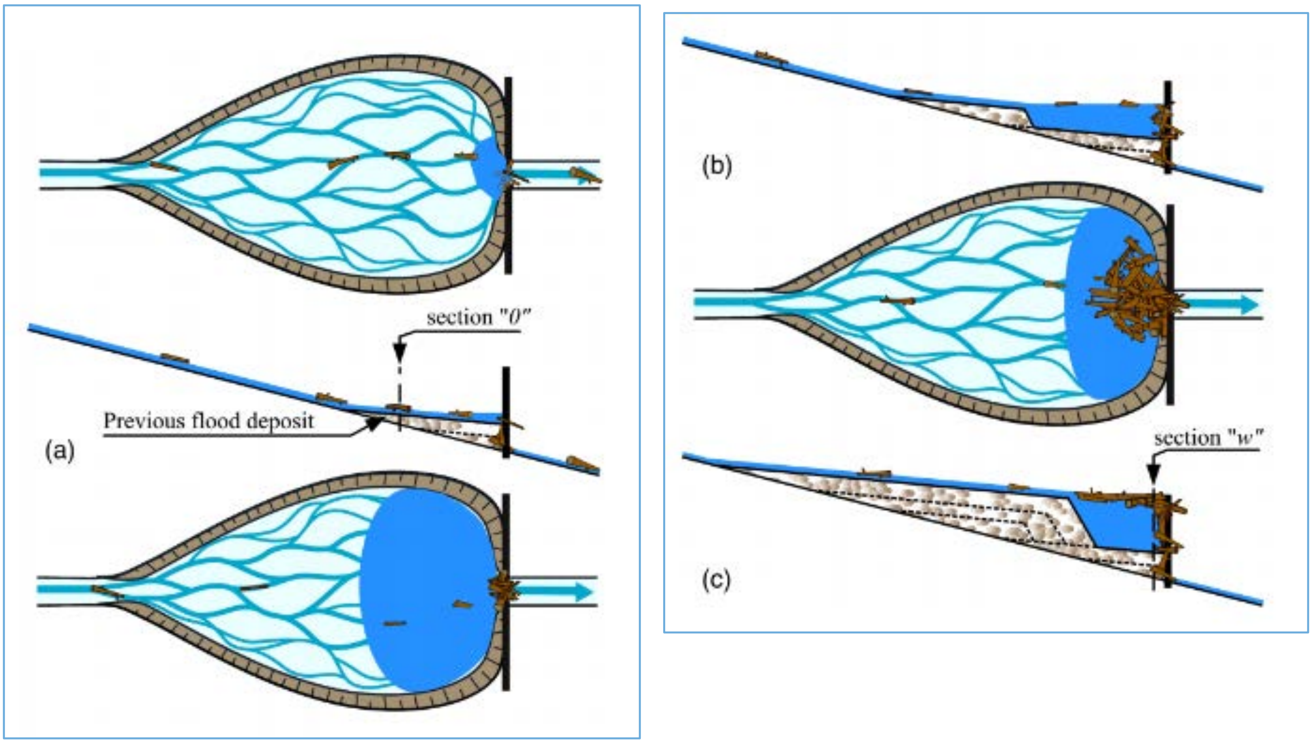

Figure4: The streambed is widened (a) to ensure water flow reduces in speed and provides the capacity for capturing sediment, which will typically drop out at the head of the enlargement as soon as water velocity slows (c). Woody debris will float to the restraining structure (b & c).

Figure 5 shows the change in energy state of water flowing down a steep waterway, from a rapid (‘critical’) flow, to a slower (‘subcritical’) and deeper flow as water is restrained by the slash trap – even without a change in streambed slope.

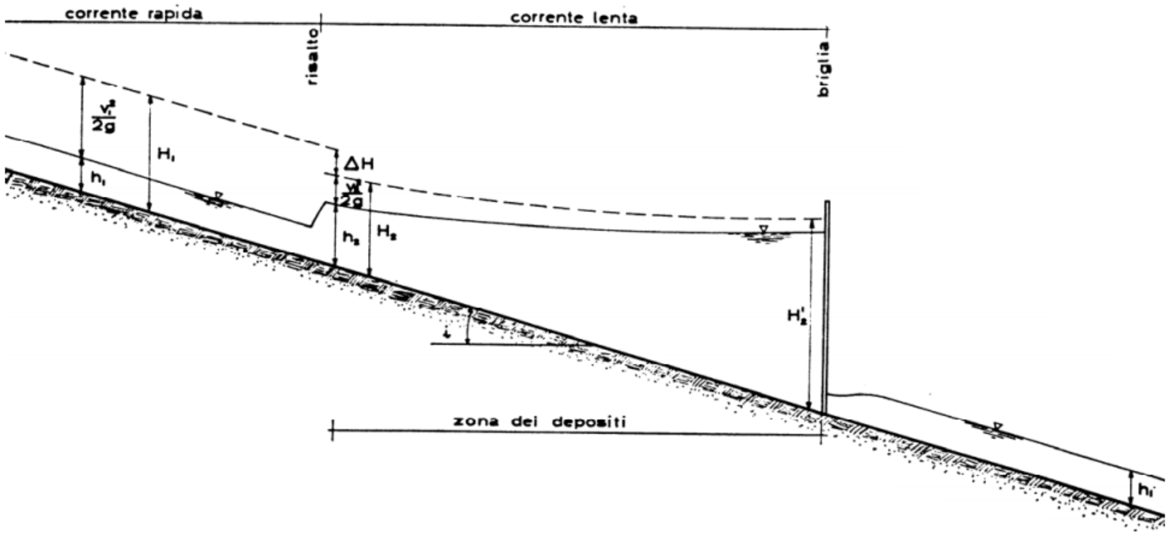

Figure5: Hydraulic profile of the debris dam design in a steep stream, whereby the dam slows the approaching water. Flow is shallow and fast approaching the structure, slows to subcritical that allows the debris to settle out, then is super-critical again.

While such structures can be built using the natural shape of the environment, the stream can also be modified using a series of structures. In Figure 6 below the streambed is changed to a lower slope, with a weir structure in place to dissipate the velocity/energy, and widened to reduce flow rate, prior to passing the structure. Again, the sediment would be expected to settle out immediately after the first structure where the water is slowed, and the woody debris captured by the second part of the structure. The stream banks are armoured to avoid collapsing the stream banks and endangering the integrity of the structure.

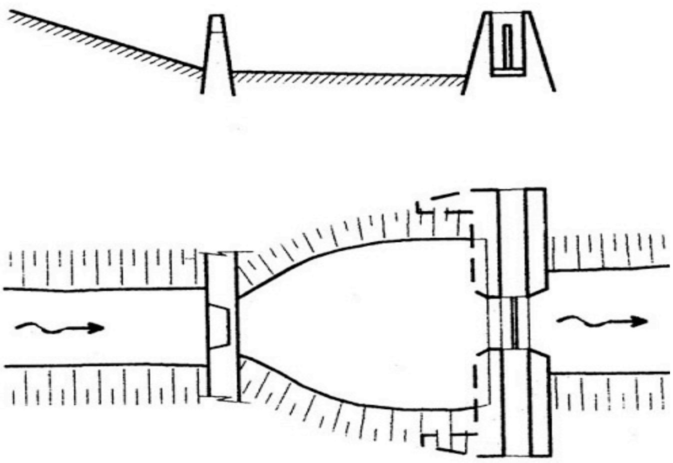

Figure 6: A basic debris trap design that deliberately changes the slope and shape of the streambed (top side view, bottom plan view).

More complex designs can also be considered that provide debris storage capacity for steep catchments where natural storage immediately above the stream may be limited. Figure 7 shows a design that has two interesting elements. The first is the double storage capability, meaning the individual structure elements (i.e. the damns themselves) need not be as substantial. The second aspect is that the smaller intake dams are designed to reduce the velocity of the water entering the storage area, but more importantly the first dam has a larger opening to capture only the larger debris (i.e. logs / trees), and the second damn includes cross-bars (approx. 1m spacing) to capture most of the remaining debris.

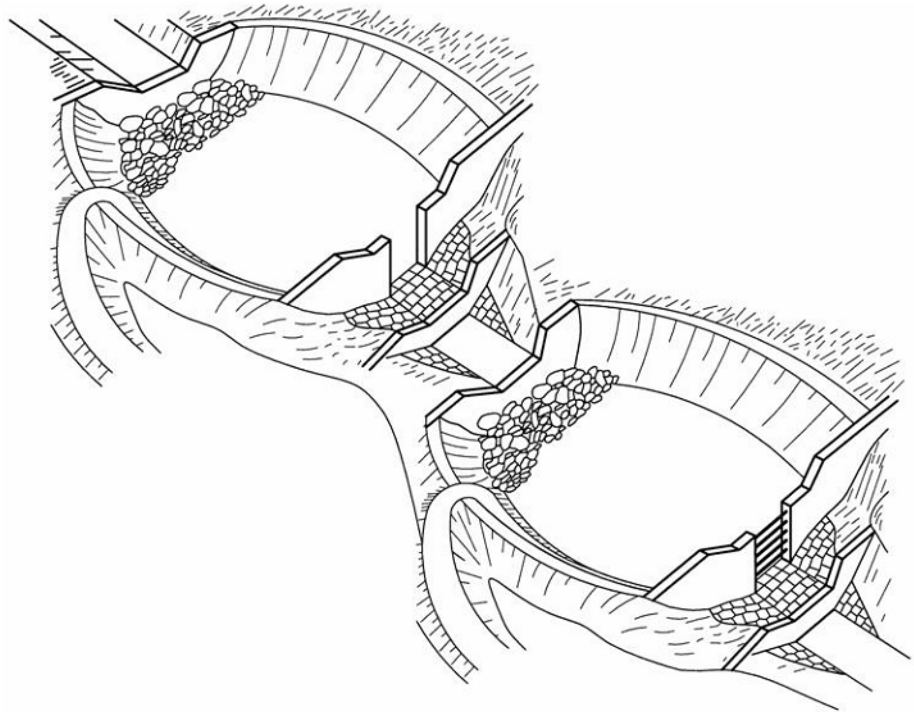

Figure 7: A more complex debris trap design: the upper catchment is primary for capturing sediment and larger debris, and the lower structure with the cross-members capturing the medium to small woody debris.

Structure aperture

All debris / slash traps are designed to pass the water / flood flow relatively unimpeded. Often they are also designed to allow some sediment / slash to pass to retain the natural character of the downstream waterway. That is, an absence of sediment (and slash) moving downstream will result in a channel devoid of habitat and aquatic life.

The two larger-scale permanent structures shown in Figure 8 are a similar design, with a vertical aperture that allows the stream at low-flow to pass unimpeded. Small floods that have blocked the gap can overtop in a controlled manner through the central weir-like opening and large floods might overtop the whole structure, but the velocity of the water is dissipated at a level that allows the debris to settle. While dam shown in the upper figure might be expected to retain larger woody debris, it will readily pass all medium and smaller sized debris. The lower image in the figure shows a similar dam design but one that includes horizontal elements that will retain medium sized woody debris.

Figure 8: Photos of two similar designs, whereby the lower structure design to retain more woody debris with horizontal elements to restrict passage of larger and medium-sized woody material,

Figure 9 shows a variation of the horizontal bars with the use of vertical columns. Literature suggests there is little difference in the efficacy of trapping debris between horizontal and vertical elements, it is the aperture that determines the volume trapped.

Figure 9: A debris trap design for catching a large range of woody debris with smaller apertures on the vertical columns.

Structure placement

In general, debris / slash traps are designed and placed with consideration to the physical downstream values that need to be protected. This may be simply neighbouring downstream land, but also infrastructure such as roads and residential areas (Figure 10).

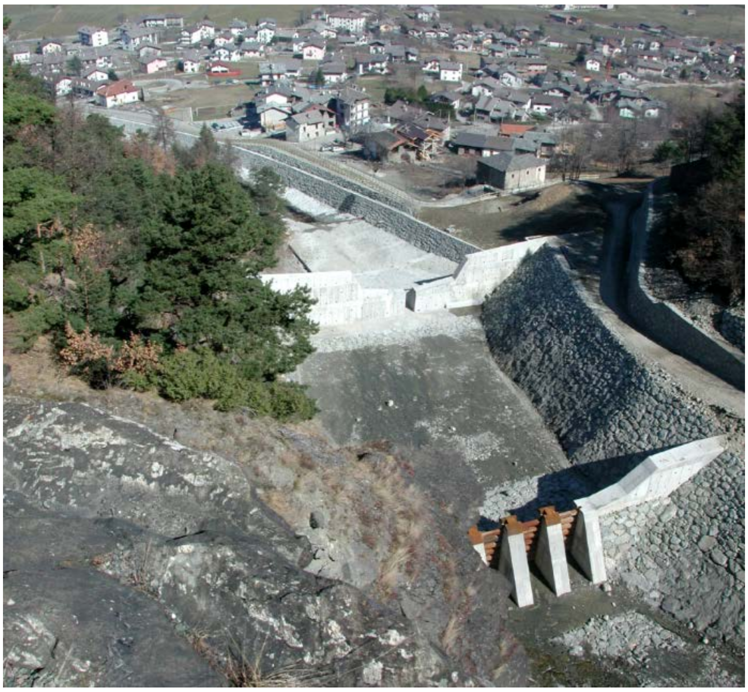

Figure 10: example of a substantial avalanche and torrent control structure, intend to trap both rock and woody debris from the catchment, but also showing the need to manage the risk with substantial residential developments in the valley below it.

Bridges are an example of infrastructure at risk from slash events, as the build-up of slash creates forces that it is not designed to withstand. As such debris traps are often planned so as to prevent debris from interacting with downstream infrastructure such as bridges. However there are examples of bridge designs that have integrated debris traps. While this adds elements of risk to the overall integrity of the bridge, it does provide for easy access in clearing debris after a flood flow event. As per Figure 11, it is only designed to trap the largest debris (i.e. tree size material) and does so in a location where the water will not have great velocity (i.e. relatively low slope river).

Figure 11: Debris control built into a bridge structure to avoid downstream impacts.

There are examples of debris catchers to work in conjunction with a culvert crossing, although he primary function of these 'debris traps' are to prevent the culvert from blocking up and risking the integrity of the road (Figure 12). In this situation the steel caging structure is coarse enough to allow the water to flow through and shaped so as to deflect the slash either up and or to the side. While moderate volumes of slash will be retained, in larger events the bulk of the debris is designed to overtop the structure.

Figures 12: Two examples where a culvert is designed to primarily deflect debris, but moderate volumes of debris will also be retained.

Storage capacity

Slash traps are designed for a given capacity. That is how much debris they can retain, and ensuring that the structure itself does not fail under that loading (Figure 13). All debris traps are designed to pass flood water, and they all need to have the debris removed at intervals or after major events. No structure is ever designed to catch all the debris (Figure 14).

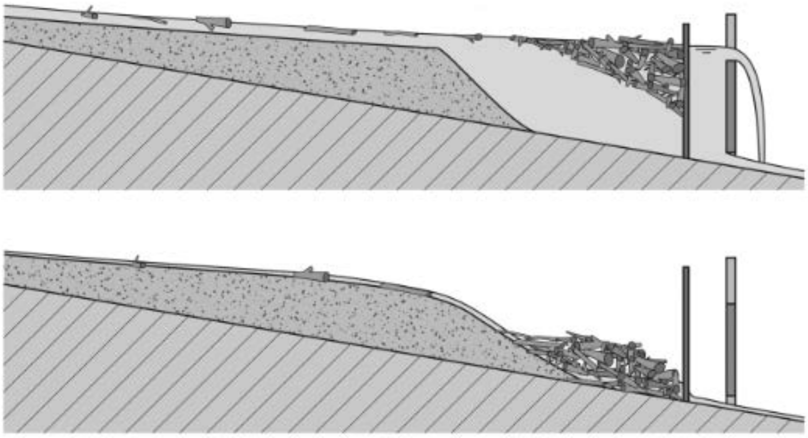

Figure 13: Separation of bed-load and large woody debris as a consequence of provoked backwater (from Bezzola et al. 2004). Both the sediment and woody debris must be removed to at intervals or after flood events to retain the efficacy of the structure.

Figure 14: The photo on the left shows a retaining structure, whereby on the right looking upstream shown the sediment retained within the channel. While effective, failure to clear out the accumulated sediment has drastically changed the watercourse.

Figure 15 shows a range of other slash trap structures. The image bottom left is a nice example of a relatively low-cost structure, top right is an example of a more carefully designed and costly slash trap. Top-left is interesting, being a series of anchored wire ropes across a span designed to catch slash during flood flow with no interference with the waterway at low flows. Bottom right is also a unique design for an outer bend of the river where the slash trap is designed parallel to the river, and slash, which is naturally driven to the outside, is caught behind a series of post secured in the embankment.

Figure 15: Different design options depending on placement of structure.

Structure design

A complete engineered design of a substantial debris dam structure is complex. However, a number of documents exist that help with design calculations for structure strength. For example the design guide developed by the US Department Hydraulic Engineering of Transportation Federal Highway Administration (Circular No. 9 FHWA-IF-04-016, 2005) entitled "Debris Control Structures Evaluation and Countermeasures" is very comprehensive and steps through various loading equations for structural design.

Part of the complexity of design arises from the build-up of woody debris that increases the loading on any vertical elements of a structure. Effectively, the woody debris mass provides a much larger surface for the water to push on. Figure 16 is from the NZ Transit Bridge Manual and shows engineers being provided with guidance as to the shape / size of the woody debris 'raft' that might realistically build, and the loading that is induced.

BRIDGE MANUAL
SECTION 3: DESIGN LOADING

Where a significant amount of driftwood is carried, water pressure shall also be allowed for on a driftwood raft lodged against the pier. The size of the raft is a matter of judgement, but as a guide, dimension A in Figure 3.4 should be half the water depth, but not greater than 3m. Dimension B should be half the sum of adjacent span lengths but not greater than 15m. Pressure shall be calculated using the formula in (a) above, with $K = 0.5$.

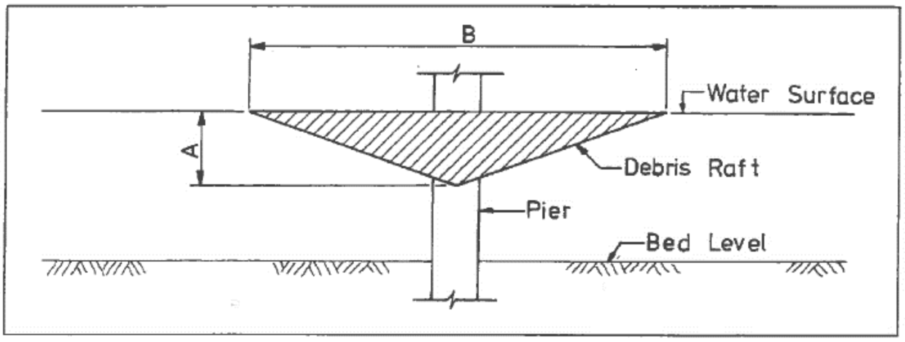

Figure 16: Transit NZ providing guidance as to calculating loading from debris accumulations on a pier (Figure 3.4 Debris raft for pier design from Transit NZ Bridge Manual).

3. Examples of Substantial / Engineered Debris Traps

This section provides examples of avalanche and debris control structures. Such structures are substantial, requiring extensive design, and reflect the risk of failure as well as the value of the downstream assets that require the protection. In Europe, structure are typically designed and built within the sphere of 'avalanche and torrent control'. While such structures are designed with the consideration of woody debris, typically they focus on rock movement as that remains the greatest risk. Most will have multiple design aspects that include the dam itself, but also major modification to the water and the embankments (Figure 17).

Figure 17: Substantial modification of the natural waterway to prevent debris from impacting communities downstream. Design elements include a series of dams, including the slash-catching component in the first structure, as well as embankments to prevent scour.

Figure 18 (left) is a classic debris trap design for a medium to large-sized catchment. It is a larger, permanent, and well design structure. It has a larger area behind to allow the rock/ sediment to settle out, but also central vertical pillars with cross-bars to trap the majority of woody debris. Another example of a debris trap design to retain a large percentage of the woody debris is shown on the right. Although the main dam has a large opening to allow the passage of flood-water, it has an extensive grating system to capture nearly all debris. For this design there is a clear overflow design (to the right) once the water level exceeds the height of the grate.

Figure 18: For this design in Italy, the calculated debris storage capacity was 12,000m3. The overflow weir is on the right.

Modern design will feature easy overtopping for large flood events to ensure the structure remains intact in all but the most extreme events. Figure 19 shows, that while the debris trap design is similar to previous examples, extra care is taken for the central pillars (with steel caps) and side walls (with rock) to have a sloping lead angle to deflect large debris.

Figure 19: Front and back of a modern debris trap design. In the lower figure the sloping lead of the central design elements are clearly visible. As such larger debris elements (i.e. whole trees) will be pushed up and over in larger floods to ensure the integrity of the structure is not compromised.

Given the population density and value of tourism in Europe, considerable effort is made to design debris dams with high aesthetic qualities (Figure 20). In general, all these substantial structures are designed and constructed by the regional torrent and avalanche control agency. They are expected to operate within a given budget, and as such undertake project according to need, although financial support can be obtained from the municipality that requires the protection.

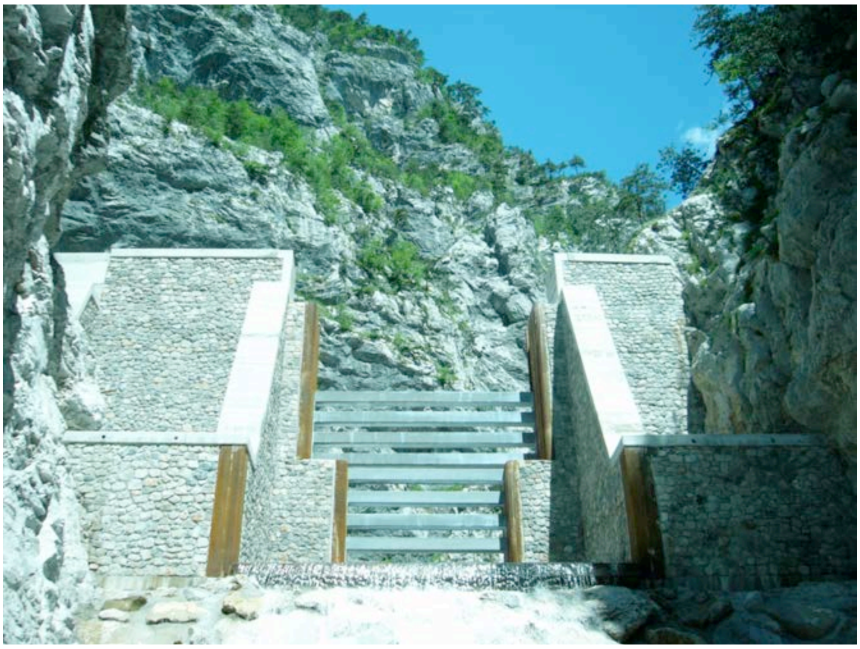

Figure 20: A design that is aesthetically pleasing, using stonemason type workmanship for the larger wall of the dam.

4. Slash Traps for NZ Forestry

Forest practices alter the physical landscape through built infrastructure, and its vegetation through active forest management practices (i.e. harvesting). This can influence the stability of steep slopes, risk of smaller landslides, but also the potential debris loading in waterways. It is not feasible to prevent all, or even a majority, of landslides that occur during large storm events. For example, the Oregon Department of Forestry regulates forest practices to manage landslide risk in order to protect the public's safety. Forest Practices Act rules for timber harvesting and constructing roads help minimize surface erosion and the potential for large scale woody debris movement.

Figure 21: Numerous significant woody debris flow events have occurred in the last decade. The large volume of harvest residues significantly exacerbates the impact. The impacts are not limited to the rural environment (above), but in many cases have impacted the coastal environment (below).

Three primary mechanisms for the off-site movement of woody debris have been identified for plantation forests: (a) harvesting residues left in gullies, waterways or flood zones than can be flushed out during higher rainfall events (Figure 22), (b) large accumulations of harvest residues, such as birdnests around landings, that can collapse under their own weight over time, and (c) harvest residues in the cut-over that are entrained during a landslide type event and mobilised by debris flows. It should be noted recent major slash events has resulted in many forestry companies drastically changing their approach to managing harvest residues, especially around landings.

Figure 22: Trees felled into a gully are difficult for cable yarder crews to extract. Broken tree-tops and slash typically also accumulate in such gullies when the timber is extracted across the gulley.

The use of slash traps provides a mitigation measure to limit the frequency, as well as the volume, of debris moving off-site. The Environmental Code of Practice (NZFOA 2009) talks about using slash traps downstream of areas where slash removal from harvesting is difficult. Little information is currently available on the efficacy of slash traps, although it is known that smaller slash traps are at higher risk of failure.

It should be noted that slash management traps need not be engineering designed structures. Effective streamside management zones can both intercept the harvest residues from entering the waterway system in the first place, but also retain larger volumes of residues if they are located where the catchment flattens out and the velocity of the water is reduced (Figure 23).

Figure 23: Streamside management zones that are well-vegetated can provide an effective trap for capturing mobilised residues.

The NES–PF provides the following guidance on slash traps:

- ***Design***: Allow water to flow freely through structure; Height of structure no more than 2m above stream bed.
- ***Placement***: For catchments > 20 ha, structure must be outside the bank full channel width; Machine must be able to access for clearing/maintenance
- ***Inspection and clearance*****:** Traps must be inspected within 5 days of a *significant rainfall event that is likely to mobilise debris.* Must be cleared of debris within 20 working days of a 1-in-20 year flood event. Must be maintained to avoid river bed erosion and to ensure soundness of the structure
- ***Reporting***: Written report to the Council within 20 working days of construction and an annual report detailing cleanout/maintenance, performance, and any adverse effects.
- ***Where to put the slash*****?** Somewhere stable, above the 1-in-20 year peak water level.

The NZ Forest owners have recently developed a series of guides to support the implementation of the NES-PF (Forest Practice Guide 6.4). It states:

- "Slash traps are generally constructed in the channel of a river. The aim is to catch larger pieces of slash that would otherwise be transported out of a catchment in flood flow conditions".
- "Slash traps are best made from rammed railway irons or steel beams threaded with wire rope and anchored solidly at each end. They have proven effective in catchments of several hundred hectares".

While full engineering designs for larger scale slash traps are available, most NZ designs are simple. For example railway irons linked and anchored by wire rope and this approach is promoted through the NZFOA Good Practice Guide (Figure 24). Other low cost materials include eucalyptus poles, steel grid, a debris dam itself, and a heavy duty fishing net.

Figure 24: Left - Slash trap in a headwater stream using crossed railway irons embedded in the stream bed. Wire rope is wrapped around the railway irons and secured. Right - slash trap installed using vertical railway irons with wire rope is threaded through the irons and secured either to mature trees or to deadmen anchors (buried logs).

However, the efficacy of such low-cost structures are a concern. While there is evidence they retain debris from smaller scale flood flow events, they can readily fail in larger events and then not only discharge the accumulated debris and sediment, but also the steel and rope. As such, published information for large woody debris specific traps are typically more substantial (Figure 25).

Figure 25: A substantial debris catcher ('Slash Rack') installed in a higher risk catchment (Photo retrieved from USDA NRCS)

The use of poles driven into the ground represents a very feasible and low cost option for retaining slash. The location of this option should be where the waterway emerges from the steepest part of the catchment, but still upstream of the road infrastructure, and at a diagonal to the waterway to guide the water over the structure for high flow but reduce the overall loading on the structure itself (Figure 26).

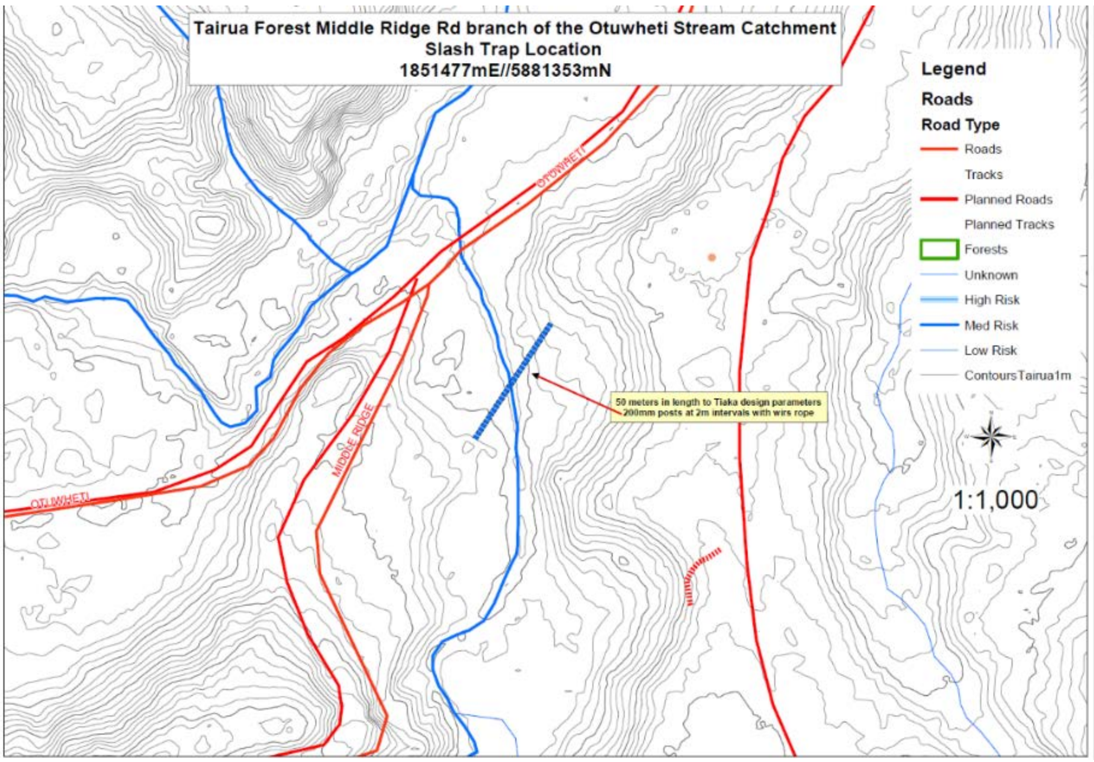

Figure 26: Photo and map showing the location and design of a driven pole slash trap. In this case as seen on the photo at top, the poles are secured using wire rope.

A design spreadsheet has been developed as part of this project to indicate the required depth and sizing of the poles. The spreadsheet shows the two main failure modes, (a) the poles being pushed over by the force of the water and debris, and (b) the poles breaking through bending. The design inputs relate to the desired spacing of the poles, the height above ground, the strength of the ground and the factor of safety. This spreadsheet can be obtained from Campbell Harvey (Campbell.Harvey@canterbury.ac.nz).

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6. Appendix: Good Practice Guide Slash Trap - NZFOA

Forest Practice Guide
Non-Regulatory

FOREST OWNERS ASSOCIATION

FICA FOREST INDUSTRY CONTRACTORS ASSOCIATION

NEW ZEALAND FARM FORESTRY ASSOCIATION

Harvest Slash
6.4 Slash Traps

What is a slash trap?

Slash traps are generally constructed in the channel of a *river*. The aim is to catch larger pieces of *slash* that would otherwise be transported out of a *catchment* in flood flow conditions.

Slash traps are best made from rammed railway irons or steel beams threaded with wire rope and anchored solidly at each end. They have proven effective in *catchments* of several hundred hectares.

Harvest Slash
6.4 Slash Traps

A Where and when to use

1. Use in high risk harvest and post-harvest *river* and *stream catchments*, where *slash* could be mobilised in flood events.
2. Use to limit *slash* movement downstream from the forest where it could cause problems for downstream property owners or infrastructure (e.g. roads, *culverts*)
3. Aim to install *slash* traps when road lining operations commence, where practicable.

B Where not to use

1. If the natural alignment of the *river* or *stream* channel will be altered.
2. If the *slash* trap will change the *river* gradient, by debris building up behind the structure and creating a weir.
3. If the *slash* trap will cause erosion of the banks and bed of a *river*.
4. If the *slash* trap will adversely affect downstream properties.

C Design

1. Design for:
   a. A minimum six year engineered life. *Slash* traps need to last long term.
   b. Free movement of water through the structure.
   c. Fish passage.
   d. Trapping the larger debris only, rather than trapping or damming all debris.
   e. Machine access to clean and maintain the structure.
   f. Ease of checking after storm events (near road access or good drone access).
2. Position at right angles to the *river* or *stream*. If there is a natural bench then slightly angle it downstream to aid *slash* being deposited onto it.
3. Construct the debris trap in a low gradient reach of the *river* to minimise the combined energy of water and weight of debris on the trap during peak flows. This helps to minimise the chance of structural failure.
4. A resource consent is needed to install *slash* traps in *catchments* larger than 20 ha, unless the *slash* trap is located on a terrace on one side of the *river* or on a low *river* terrace. The terrace(s) should allow the overflow of any excess material that may build up against the trap, to reduce pressure and risk of the structure failing.
5. Locating the *slash* trap adjacent to a large flat area above flood flow level is preferable, to provide storage for any debris that has been intercepted by the trap and needs to be removed. This will reduce the cost of maintaining the *slash* trap.
6. Document and take photos of location, design and construction.
7. Resource consent may be required, check prior to construction.
8. Consider whether a series of *slash* traps (two or more) would be a better solution than one *slash* trap.

Forest Practice Guide
Non-Regulatory

Harvest Slash
6.4 Slash Traps

D Construction

1. For maximum structural strength, use the largest railway iron gauge available or appropriately specified steel universal beams, such as I-beams or RSJ's.
2. Drive the irons/beams into the *river* bed.
3. Ensure the spaced iron/beam uprights are not too close to each other to avoid trapping too much material.
4. Support railway iron/beam uprights with a wire rope.
5. Anchor the wire rope to deadmen or large trees on either *river* bank to secure the *slash* trap.
6. Excavate, if necessary, a larger catch basin if space allows.

Slash captured by *slash* trap installed upstream of road and bridge. Accessible site allows removal of *slash* and maintenance of the *slash* trap.

E Maintenance

1. Prepare a routine maintenance plan including heavy rainfall response measures.
2. Maintain the debris trap to a maximum of two thirds storage capacity at all times.
3. Visit *slash* traps within five working days after a storm event that could have mobilised *slash* (5% *AEP* or greater).
4. Clear debris within 20 working days after a storm event.
5. Put cleared debris beyond the flood plain, or beyond where it could be mobilised by a flood event up to a 1 in 20-year event (5% *AEP*).

F Reporting

(to meet the National Environmental Standards for Plantation Forests)

1. Provide a written report to the regional council within 20 days of the construction of a *slash* trap.
2. Provide a written report to the regional council by 31 March each year that includes:
   a. Frequency of maintenance and clearing.
   b. *Slash* trap condition and performance.
   c. Any damage to downstream property, *stream* bed disturbance, fish passage blockages.

Forest Practice Guide
Non-Regulatory

FOREST OWNERS ASSOCIATION

Harvest Slash
6.4 Slash Traps

G Technical specification guidelines

1. Build the trap at least 0.5 to 1.0 m higher than the *river* banks.
2. The irons/beams should be up to 2 m above the *river* bed (if higher, a resource consent is required).
3. Drive irons/beams into the *river* bed to a depth of at least 1.5 m.
4. Space railway irons/beams 1.5 to 2 m apart and no closer than 1.5 m.
5. The irons should be no more than 2 m above the *river* bed (if higher, a resource consent is required).
6. Use a wire rope (minimum 22 mm diameter).
7. Ensure there are smooth-sided holes cut in the upper sections of the irons/beams (for threading the wire).
8. When anchoring the wire rope to the deadmen or large trees, insert a knot in the rope and supporting clamps, on either streambank to secure the *slash* trap.
9. Maximise tension in the rope.
10. Secure clamps to the wire rope immediately on either side of each railway irons/beams to create rigidity. Clamps stop the irons/beams from being forced out of alignment when under pressure.
11. Short logs or railway irons/beams can be driven into the terraces adjacent to the *slash* trap, to catch more material in high flows.
12. If it is likely that trapped debris could divert *stream* flow during a flood event, the bank should be armoured to prevent scouring.
13. Refer to Debris Flow Control Structures for Forest Engineering, D.F. VanDine, British Colombia Ministry of Forests 1996 and www.geobrugg.com/en/Debris-flow-barrier-UX-7949,7859.html.

National Environmental Standards for Plantation Forestry

Particular relevant provisions for managing *slash* are Regulations 83 – 92.

7. Appendix 1: NES-PF 'Slash Traps' (section 83 -)

Permitted activity

Territorial authority
Constructing, installing, using, maintaining, or removing a slash trap on land, including land within the riparian zone, is a permitted activity.

Regional council
Constructing, installing, using, maintaining, or removing a slash trap in the bed of a river or on land is a permitted activity if regulations 84 to 91 are complied with.

Conditions: design
The slash trap design must allow water to flow through freely and ensure that the slash trap does not dam the river.
The height of the slash trap must be no higher than 2 m above the bed of the river.

Conditions: placement
Where the catchment area upstream of the slash trap is greater than 20 ha, the slash trap must not be located within the bankfull channel width of the river.
The slash trap must be located in a position that allows machine access for clearing and maintenance.

Conditions: inspection and clearance
The slash trap must be—
(a) inspected within 5 working days of the date of any significant rainfall event in the upstream catchment that is likely to mobilise debris:
(b) cleared of debris at least within 20 working days following a 5% AEP flood event:
(c) maintained to avoid erosion of the river bed and maintained in a structurally sound and effective condition.
Slash cleared from the slash trap must be removed to a safe and stable location beyond river bed and land covered by the 5 % AEP flood event.

Permitted activity conditions: effect on other structures and users
A slash trap must not—
(a) alter the natural alignment or gradient of the river; or
(b) compromise the structural integrity or use of any other lawfully established infrastructure or activity in the bed of a river or lake; or
(c) cause flooding or ponding on any property under different ownership from that of the plantation forest; or
(d) cause or induce erosion of the river bed, or erosion or instability of the banks, of the river.

Conditions: passage of fish
The slash trap must be designed, located, and maintained so that it provides for the passage of fish.

Conditions: contaminant discharges and depositing organic matter

If a slash trap is being constructed, installed, removed, maintained, or cleared,—
(a) the activity must not release contaminants into water, other than sediment; and
(b) all practicable steps must be taken to—
(i) avoid depositing organic matter or discharging sediment into a water body or onto the bed of a river or land in circumstances that may result in it entering water; and
(ii) minimise the disturbance of the bed of the river; and
(c) all practicable steps must be taken to avoid wet concrete or concrete ingredients coming into contact with flowing or standing water; and
(d) elevated sediment levels in any river resulting from the construction, installation, maintenance, or removal of a slash trap must not occur for more than 8 consecutive hours; and
(e) all excess materials and equipment must be removed from the bed of the river within 24 hours of the completion of the construction, installation, maintenance, or removal of a slash trap.

Conditions: sediment
Sediment originating from slash traps must be managed to ensure that after reasonable mixing it does not give rise to any of the following effects in receiving waters:
(a) any conspicuous change in colour or visual clarity:
(b) the rendering of fresh water unsuitable for consumption by farm animals:
(c) any significant adverse effect on aquatic life.

Conditions: reporting requirements
A written report must be provided to the regional council within 20 working days of the slash trap's construction detailing location, design, and construction. Photographic evidence of the slash trap must form part of the report. A written report must be provided to the regional council annually by 31 March detailing the frequency of maintenance and clearance of the slash trap, and slash trap condition and performance, including any of the following adverse effects:
(a) damage to downstream infrastructure, property, or receiving environments:
(b) disturbance of the bed of the river:
(c) blockages to the passage of fish.

Restricted discretionary activity: regional council
Restricted discretionary activity
Constructing, installing, using, maintaining, or removing a slash trap in the bed of a river or on land is a restricted discretionary activity if any provision of regulations 84 to 91 is not complied with.

Matters to which discretion is restricted
Discretion is restricted to—
(a) slash trap design and construction:
(b) the location, timing, and duration of the slash trap:
(c) the effectiveness of mitigation measures to manage the effects of slash, debris mobilisation, and downstream deposition:
(d) alternative measures to manage slash and debris mobilisation:
(e) river bed and bank stability and erosion:
(f) the effects on ecosystems, including the passage of fish:
(g) water quality and flow:

(h) public use and public access to and along the river:
(i) the effects on upstream and downstream properties and infrastructure:
(j) the information and monitoring requirements.