Report on Options to modify the Mill Weir on the March Burn, Riding Mill – Initial Draft for Comment – 7th June 2011

1. Background and Executive Summary

1.1 This report was commissioned by Riding Mill Parish Council to explore the options of lowering a section of the crest of the weir, and also the option of removing the entire weir.

1.2 These proposals have been developed following discussions to improve the passage of salmon and sea trout over the structure.

1.3 The primary concerns of Riding Mill Parish Council (who own the structure and both adjacent banks) are to ensure that alterations do not lead to increased flood risk to adjacent properties, and to ensure that public safety at the site is maintained. There is also a desire to avoid excessive and on-going cost at the site for maintenance and repairs.

1.4 The Appendix includes a number of emails outlining and agreeing the scope of the report.

1.5 In summary, this report confirms that alterations to the weir structure will not have a detrimental effect on flood levels in the village. The weir structure is in good condition, but the side masonry walls are undercut and need attention. The 'corner' of masonry at the right bank extending into the weir pool is severely undercut below water level, and should be fenced off as a matter of urgency before being taken down. Less urgent works are also required at the left bank. The best option at the weir is a 4m wide notch, up to 600mm deep. This presents the best solution in terms of fish passage, cost, erosion issues and the mobilisation of sand and gravel from upstream of the weir. The option of completely demolishing the weir would be expensive and mobilise a very large volume of this material. Machine access is difficult, but the work could be done by hand, possibly involving local volunteers.

2. The existing structure

2.1 The weir is a substantial masonry structure constructed many years ago to increase water head by a metre so support a mill. The remains of the old mill leat can be seen on the left bank (looking downstream).

2.2 It is not known whether the weir is a listed structure. If it was then clearly this would have significant implications for all of the options at the site. It is recommended that this aspect is investigated further with Northumberland County Council.

2.3 The main weir structure is in good condition considering its age. At some stage in the past, a concrete 'cap' has been poured to level the surface of the structure. This varies in thickness from 75mm at the left bank to a maximum of 400mm near the right bank. This concrete cap has had grooves formed into the surface to make it blend in with the stonework.

2.4 The weir forms a shallow arc when viewed from above, with the edges extending 800mm further downstream than the centre. The weir crest is 1200mm wide (1400mm at the right bank) and roughly level in the upstream to downstream direction. The weir is 8.5m wide, with a low point slightly off centre, 3m from the right bank. This low point is 50mm lower than the weir crest level at the banks.

2.5 On the 30th May, there was very little water going over the weir, with flow focused on the low point. The difference in water levels upstream to downstream was 1000mm. Although large salmon can leap higher than this in certain circumstances, the very shallow water on the wide weir crest would mean that the weir would be virtually un-passable. Further details on this aspect are considered later.

2.6 There is a very deep pool beneath the weir, with depths at the near vertical weir face of 1.3m on the day of survey. The depths 1m from the face of the weir were between 1.5m and 1.8m (near the flow concentration). Even at the sides of the weir pool, depths of 1.2m were observed. The deep water of the weir pool extends 7.5m from the face of the weir, where depths become shallow again as the stream extends downstream.

2.7 Upstream of the weir, in the middle of the channel, the water was 300mm deep near the middle, 500mm deep 4m from the crest, 700mm deep 10m from the crest and 800mm deep 20m from the crest. Beyond this, the long pool upstream of the weir gradually starts to get shallower. The stream is 7.7m wide upstream of the weir, with the bed formed from sandy gravel washed down during flood events.

3. Stonework at the left bank (looking downstream)

3.1 Repairs and additions to the masonry at the side of the weir have been made in the recent past in an attempt to stabilise the structure following flood damage and general erosion. A timber fence has also been erected set back from the edge to help ensure public safety.

3.2 The condition of the masonry at this bank is fairly poor, with evidence of sections being washed away and some undercutting of the structure. Although the side walls appear to be currently stable, further high flows will inevitably lead to further deterioration and failure could be expected in the next 5-10 years without further maintenance work.

3.3 A particular concern is an area near the water surface where sections of masonry have been lost, leading to under-cutting of the structure and further damage.

4. Stonework at the right bank

4.1 A ‘corner’ of masonry extends downstream into the weir pool at this bank. This corner is heavily undercut below the water surface, with a void extending under the masonry by up to 1m. ***This section could fail without warning if people were standing on it, resulting in people falling into the deep water below.***

4.2 There are a number of cracks in the masonry of the side wall at this bank, indicating movement and settlement. There is also evidence of flood flows spilling behind this side wall, leading to further erosion and instability.

4.3 Without further work, this side corner could be expected to fail in the next few years, probably during high flow conditions.

5. Flood conditions and levels

5.1 Very high flows have been seen on the March Burn at a number of times during the last decade (particularly in September 2008). There is a large catchment up stream of the weir, and levels are to be expected to rise quickly. There is no gauging station on the stream, and so flood flow estimates are unavailable.

5.2 Flood levels at a specific location are governed by features immediately downstream ('controls') such as bridges, narrow channel sections or other natural bed features such as gravel banks and bed rock in the base of the stream . At a 'broad crested weir' (such as the structure under consideration), the depth of water flowing over it can be calculated using standard flow formulas. Therefore in a given flood flow, the water level upstream of the weir will be dictated by the weir itself (using the formula), and the depth downstream by that dictated by channel conditions such as bed rock and gravel levels in the bed of the stream further downstream. In this case, levels downstream will be influenced by the footbridge, the section downstream where the river turns sharply left at the high cliff on the right bank, and the 'lips' of various stream bed features.

5.3 If the weir were to be lowered by the formation of a notch, (or even by removing the weir altogether), then the flood level upstream would be lower due to the 'control' of the weir itself being lower. Flood levels downstream of the weir would still be dictated by the same stream bed features, bridges or side conditions as before, and therefore flood levels would be the same as before. This is because the factors influencing the flood levels at points downstream in the village would not have changed. Altering the weir does not alter the flow rate coming down the stream; it would not 'release' a sudden quantity of water, nor would it take away any storage facility in the stream.

5.4 Although there is a perception that taking out a weir will 'release flood flows downstream' and make levels worse, in fact the levels downstream will still be dictated by the same stream bed features and will therefore still be the same.

5.5 This assessment is based on the assumption that lowering or removing the weir will not alter the bed level or other control features further downstream in the village. The existing weir has 'trapped' a considerable quantity of gravel over the years (the level of the bed immediately upstream of the weir is 2.2m higher than the bed in the weir pool – 1.5m deep pool+1m high weir, compared to 300mm deep just upstream of the weir). By altering the weir, some of this material (above the new crest level of the weir) will be mobilised downstream. Because the material is relatively small, high flows will move it downstream, but it will tend to settle out in the deeper pools rather than at control features, as these tend to have higher water velocities. In practice, it can be anticipated that the majority of this material currently upstream of the weir will end up in the very deep weir pool immediately downstream of the weir. Therefore, although a quantity of gravel will move downstream after the weir is altered (a large quantity if it is removed completely), it will not add to control features, and therefore will not increase flood water levels.

5.6 Therefore lowering or removing the weir will not increase flood levels downstream, (although it will actually lead to lower flood levels in the stretch upstream of the weir).

6. Option 1 – remove a section of the weir in the form of a wide notch

6.1 One suggested option has been to cut a notch in the weir structure roughly 300mm deep and 4m wide. Lowering the weir by this amount would make the structure more passable to large salmon and sea trout as the difference in water levels would then be 700mm in low flow conditions, roughly 500mm in higher flows (the difference in water levels decreases as the downstream level rises in increasing flows, relative to the depth of water going over the weir, until it eventually 'drowns out' in flood conditions).

6.2 Having a wide notch is preferable to a narrow one, as a strong 'jet' of water can be very high velocity, and hence still un-passable by fish.

6.3 A notch of the proportions suggested would mean the removal of 1.2m x 0.3m x 4m = 14.4 cubic metres of stone and concrete. It is questionable whether the concrete should be simply placed in the weir pool, although the cost of removal could be significant. It is however well weathered, and would not lead to any visual or pollution concerns. The stonework however, could be usefully placed at the sides to minimise further under-cutting of the side walls.

6.4 The position of the notch would ideally be somewhere near the centre so as to avoid directing high flows towards one of the banks. Having it slightly nearer the right bank (looking downstream) would help keep flow away from the eroding left bank near the footbridge. Gabions placed along this section of bank are currently in poor condition and showing signs of failure, partly due to the materials used and method of placing (the cobbles are rounded and mobile, and the wire mesh is relatively fine and flexible).

6.5 Lowering the weir by 300mm would not mobilise material from upstream as the bed is currently 300mm below the crest.

6.6 As part of the works, it would be advisable to also take down the corner of undercut masonry on the right bank before it collapses. As this is currently unstable, care would be needed to do this safely. The material could be left in the weir pool, although some of it could usefully be placed at the right bank to minimise further erosion. Silt management measures, such as straw bales would be required as part of this operation.

6.7 The area that would be left after removing the masonry would have to be sloped back and made safe. As flood flows have already spilled over this section, care would be needed to avoid future flood flows simply washing out this corner completely, resulting in the stream flowing around the side of the weir structure. This would lead to significant erosion and would mobilise large quantities of sand and gravel into the stream.

6.8 To avoid this scenario, some large pieces of the masonry removed from the weir and 'corner' could be placed on the right bank behind the side wall to 'armour' this section. This section could be stabilised further by the planting of alders and willows to hold the bank material together.

6.9 It would also be advisable to repair the wall and masonry at the left bank where this has become undercut. This would require masonry to be mortared into place near water level, and care would be required to avoid pollution. Although it would be best to lower the water level to do this work, the costs of this would be high, and therefore mortaring work could be limited to sections above water level. These repairs could extend the life of the side wall by a further 5-10 years, but some further work may be needed in the future as it deteriorates further.

7. Option 2 – remove all the weir and existing side walls

7.1 A further option to be considered is the complete demolition of the weir structure, together with the side walls. This would lead to significantly more work, but would have the advantages of removing the need for further work at the site, and would resolve the fish passage issue, even for small fish.

7.2 The option would involve taking down the concrete and masonry weir structure plus the masonry side walls. The weir itself is at least 2.3m high above the bed of the weir pool. However, there would be no advantage in demolishing the weir below the water level in the downstream weir pool, so it is assumed that this option means effectively taking down the 'visible structure' i.e. the 1m high weir that is visible from downstream.

7.3 The weir structure contains a considerable volume of material (roughly 10 cubic metres), but it could easily be placed in the weir pool and at the banks to minimise future erosion.

7.4 This option would realistically require a JCB or some form of mechanical excavator to do the work safely. Access to the site is very difficult, and is not possible from the left bank or from downstream or upstream. It may be possible to get a machine to site from the right bank, although this would require significant access works, and may also lead to the need to take out create and a safe access ramp at certain sections. This would clearly have a cost implication.

8. Discussion of Options – general aspects

8.1 If a machine is unable to access the site, then work to the weir structure will have to be completed using hand tools. This is possible, but obviously impacts on the choice of option due to the considerably different amounts of stone and concrete to be moved.

8.2 Measures will have to be taken to avoid silt being mobilised by the works as this can damage fish and invertebrates in the stream and their habitats. This can be minimised by securing straw bales into the stream to act as a filter. Taking down the weir to the downstream water level would mean that a significant quantity of material would be mobilised from upstream of the weir. This would be 700mm deep by 8m wide. Although the gradient upstream could be formed at roughly 1:10, in time it would erode to somewhere between 1:50 and 1:100. If 1:50 bed slope is assumed, then this option would mobilise a 'wedge' of gravel extending upstream 35m with a volume of 98 cubic metres. This in itself could fill the existing weir pool 1.5m deep (without allowing for the volume of concrete and masonry from the weir structure).

8.3 A proportion of this material would have to be excavated and placed into the weir pool as part of the exercise because otherwise it would create a source of sediment and siltation for many months as it gradually eroded. This excavation would lead to significant disturbance. Even with straw bales in place, there would be the likelihood of some material getting washed into the stream and probably out into the Tyne, where it may lead to concerns from anglers and members of the public.

8.4 The impact of the two options on the adjacent channel would be quite different. The notch option may lead to some localised movement of the bed material at the tail of the weir pool due to focused flow conditions, but would have a negligible effect on upstream or downstream erosion. However, taking the complete weir structure down would lead to localised erosion of the banks upstream. It could be expected to cause the banks immediately upstream to become unstable due to the bed level dropping by 0.7m. This could lead to the large tree on the left bank upstream of the weir falling in, possibly resulting in damage to the footbridge if this happened during flood flows. Erosion immediately downstream could be expected if the masonry from the weir and side walls was not used to armour the banks.

8.5 Removing the entire weir could have a significant impact on the gabions at the left bank near the footbridge. The weir removal would in essence return the stream to its original gradient, which is fairly steep. The flow would tend to focus on one bank as the channel readjusted, and if this was the left bank, then this could lead to increased velocities near the bridge, and hence the possibility of increased erosion and damage. (It should be noted however, that these gabions are currently in a state of failure, and have a very limited lifespan). The central pier of the footbridge is already under-cut at the upstream end by around 500mm. Although this does not mean that the structure is currently at risk, further increased velocities at this point caused by removing the weir could make this situation worse.

8.6 Works in the channel require Land Drainage Consent from the Environment Agency. As the March Burn is an 'Ordinary Watercourse' (as opposed to a Main River), this process should be fairly straightforward. The main issue that will require management is likely to be silt control, as discussed above, although there may also be some constraints on the timing of the works (due to fish movements). As one of the key aims is to improve fish passage, this aspect should be able to be satisfactorily agreed. The option of removing the whole weir would lead to large volumes of silt and gravel being mobilised, so this option would probably lead to more significant concerns and constraints being placed on timing or working methods.

8.7 The safety of people undertaking the work will need to be carefully considered, particularly if it is all to be by hand. There is very deep water, an unstable, under-cut section and heavy sections of concrete and masonry to be moved. Although there are no obvious cables or services at the site, this aspect should be checked ahead of the works being carried out. The Construction Design and Management Regulations (CDM) require all demolition works to be registered with the Health and Safety Executive, and a Safety Plan prepared. The Safety Plan associated with the full weir removal would clearly need to consider more issues and implications than the notch option.

9. Discussion of Options – flood implications

9.1 As discussed in a previous section, flood levels are dictated by 'controls' downstream, such as stream bed features, bridge footings or other channel features. Neither of the options would alter these downstream aspects, and therefore neither of the options would lead to different flood levels downstream. However, a theoretical issue could arise from the full weir removal option if a significant proportion of the gravel finally settled out at an existing control section further downstream (for example at the tail of a pool). If the material raised the bed level (and therefore the control) significantly then the flood water level would also rise. This is more a theoretical risk, as in practice most of the gravel and sediment would end up in the existing weir pool and in the bodies of pools downstream, where it would settle out due to the velocities being slower. The option of a notch would not have any implications on downstream flood levels; in practice nor theoretical.

9.2 Both options would lower upstream flood levels, although this would be a minor fairly localised effect in the case of a notch.

10. Consideration of options on future maintenance and repairs

10.1 There is an understandable desire to not have to keep undertaking costly repairs and maintenance at the weir site.

10.2 The option of a notch on its own leaves the issue of the masonry at both banks, which is in 'fair' condition (left bank) and 'poor' condition (right bank). It is recommended that the severely under-cut 'corner' of masonry at the right bank is addressed as part of the works, whichever option is taken. This would avoid the risk of it collapsing with someone standing on it or nearby. This section should be safely 'collapsed' into the weir pool, and the section stabilised and protected from erosion with reused masonry. This work should leave the resulting surface stable, and at a stable angle back to the river bank (eg 40 degrees).

10.3 At the left bank, there is a section of masonry wall that appears to be relatively new (the stone is not flat faced, as with the original masonry). This work may have been a previous attempt to improve safety at the site, before the introduction of the timber fence. Unfortunately this stonework is becoming under-cut as sections of masonry have been washed out in flood conditions. Although this area of erosion could be repaired and re-pointed, it may be more prudent to simply take down this side wall, as well as making good the erosion area near water level. This would avoid the risk of the wall becoming further undermined in the future, and it possibly collapsing with people leaning against it to watch salmon jumping.

10.4 In line with the main weir at the left bank is a large column of stone work. This is in good condition, and there is no need to take it down (if the option of weir removal was followed, then this edge section could be left standing together with an edge section of the weir).

11. Discussion of options with regards to fish passage

11.1 Clearly, removing the weir down to the existing downstream water level results in the best option for fish passage, as even small fish will be able to ascend. However, the work would have to done carefully to avoid sections of very shallow water or water cascading over piles of rocks without deep water at the base. It is likely that a JCB or excavator could leave the resulting channel in a relatively natural form, and no more of an obstruction to fish than the existing riffles downstream.

11.2 However, the option of a 300mm notch would still leave a difference in water levels of roughly 700mm in low flow conditions. This would still be a major obstacle to small sea trout and brown trout. The weir would still be impassable to coarse fish (particularly dace and eels). The ability for eels to pass obstructions is a major concern to the Environment Agency, as numbers of eels continue to decline rapidly. With the notch option, it is possible that a form of low cost eel pass could be incorporated at the right bank as part of modifications to the corner of unstable masonry.

11.3 A deeper notch would allow smaller fish to be able to get past the weir, with limited additional work. For example, this could be the deepening of the 300mm deep 4m wide notch by a further 300mm in the central 3m. This would mean that the difference in water levels would be only 400mm in low flow conditions; a difference that most small sea trout and brown trout could manage.

12. Discussion of options with regards to public safety

12.1 The Occupiers Liability Act requires the owner or occupier of a site to take measures to protect the public. Because Riding Mill Parish Council own both banks at the weir (and presumably also the weir itself), and have undertaken works at the site in the past, they would be considered an Occupier of the site. It is therefore important that the Parish Council takes reasonable steps to ensure the safety of people visiting the site.

12.2 The provision a timber fence set back from the left bank was a wise measure, and significantly reduces the risks to the public.

12.3 Because there is a footbridge immediately downstream, and evidence of children playing at the site (there is a rope swing nearby), a similar fence should be erected at the right bank as a matter of urgency. As it is not obvious that the corner of masonry is severely undercut and unstable, a warning sign may also be considered appropriate until works can be carried out to make this safe. This could read ‘Warning – this stonework and wall are unstable and may collapse. Very deep water’ The fence should also be erected alongside the sign, as children may simply ignore signs.

12.4 Work should take place to make the stonework at the right bank safe whichever option is chosen.

12.5 With the notch option, if the undercut stone work at the right bank is taken down, the section of new masonry at the left bank is taken down, the section of under-cutting at the left bank is repaired and re-pointed, the timber fence at the left bank is retained and kept in good repair, and the bank at the right bank is stabilised and made safe (possibly incorporating a low cost eel pass), then the safety of the public would appear to have been reasonably catered for. A fence and sign at the right bank would be prudent in the short term, but is unlikely to be required following works to the site.

12.6 With the weir removal option, if similar works at both banks are undertaken, then again the safety of the public will have been reasonably catered for.

12.7 The key thing is to avoid ‘unexpected’ risks to the public (for example the undercut corner at the right bank that people could stand on, or the undercut new masonry wall at the left bank that people may lean against). It is fairly obvious that the weir pool is deep, although just how deep would be a surprise to many, and therefore the fence is a wise precaution. After the work at the right bank is carried out, it may be decided to leave the fence in place, although the new stable side slopes into less deep water mean that this is less likely to be required.

13. Conclusions

13.1 There is significant damage and undercutting to the existing masonry at the weir side walls meaning that urgent works are required to ensure public safety. This is particularly the case at the right bank (looking downstream) where the ‘corner’ of masonry immediately downstream of the weir is undercut by 1m, and could collapse at any time.

13.2 Work is also required to make the left bank safe, although this is less urgent due to the presence of a set back safety fence.

13.3 The weir structure itself is in fairly good condition, and although there is some evidence of settlement and repairs in the past, it is unlikely to collapse on its own.

13.4 In my professional opinion (I am a Chartered Civil Engineer with 20 years of experience in river and flood engineering), removing or lowering the weir will not have a detrimental impact on flood levels in Riding Mill. Hydraulic modelling has not been completed to prove this, but this is assessed from the fact that the channel features that determine flood levels in the village downstream will not be altered by changes at the weir upstream. In a flood situation, the same flow (either with or without the weir) will be passing areas of concern leading to the same levels due to the effect of channel ‘controls’ downstream. It is these channel controls (for example bridge footings, bed rock or gravel shoals) that dictate the water levels upstream of them. The weir will be a control for water levels upstream of it, so lowering it or removing it, will reduce flood levels upstream of it.

13.5 There is a considerable volume of gravel, silt and sand held upstream of the weir. The upstream bed level is 2.2m above the downstream bed level. Complete removal of the weir structure needs to consider this material.

13.6 The weir pool is very deep (up to 1.8m, or 6 feet). It is also very deep at the edges (1.2-1.3m).

13.7 Access to the site with a JCB or excavator is extremely difficult. It is possible that access could be achieved from the right bank, although this could be costly and could lead to significant damage.

13.8 The weir currently presents a major difficulty to the upstream migration of fish. Some larger salmon and sea trout will be able to get over it in certain flow conditions, but these will be the exception. In low flow conditions, the weir will be basically impassable to fish.

13.9 Removing the weir will make the stretch of river passable to all fish, including small fish and eels.

13.10 Cutting a notch in the weir will make the weir passable to most fish (depending on the depth and width of the notch). A notch 600mm deep appears to present the best balance between fish passage, cost of the works and mobilised sediment from upstream.

13.11 Removing the weir down to the downstream water level (1m) will be significantly more expensive than cutting a notch in it, and will result in a large volume of gravel, silt and sand being mobilised.

13.12 Removing the weir down to the downstream water level will lead to the banks immediately upstream becoming unstable. This could lead to the loss of at least one mature tree. This option could also increase velocities at the footbridge and immediately downstream, probably leading to increased erosion and under-cutting.

14. Recommendations

14.1 Due to the increased cost, erosion and mobilised sediment associated with completely taking the weir down, it is recommended that the preferred option is to cut a notch in the weir.

14.2 The notch should be roughly 4m wide, but step down to a central section 3m wide and 600mm below the existing weir surface. This is a further 300mm beyond that originally proposed. The base of the notch should be 3m wide to avoid too much concentration of flow.

14.3 By taking the weir down by 600mm in a central notch, the structure will become passable by a far greater number of fish for very limited additional cost (compared to the shallower notch). The difference in cost may be roughly £500 in additional labour.

14.4 The location of the notch should be slightly off centre, towards the right bank (eg 2m from the right side wall to the notch, 2.5m from the left side wall, looking downstream). This will help direct flow away from the eroding left bank near the footbridge.

14.5 In practice, existing masonry layers of the structure should be used (for example, if the top of a layer of stone is 550mm down, then use that).

14.6 It may be found that the weir is formed from side walls with a ‘rubble core’. If this is the case, then the new top surface should be formed with mortared large sections masonry on a stable and well compacted base. This will require dewatering, over pumping and careful measures to avoid cement getting into the watercourse.

14.7 Cutting a deeper notch will result in some gravel and sediment upstream of the weir being mobilised. However, this will only be 300mm deep over 3m wide, and so is a far smaller quantity than for the complete weir removal (if 1:50 upstream gradient, then 6.75 cubic metres). The use of straw bales will be able to avoid damage to adjacent downstream stretches. The material excavated should be placed on the right bank behind the main river bank rather than in the weir pool. This will minimise the creation of sediment.

14.8 Masonry from the notch should be placed in the weir pool, preferably at the banks to reduce further erosion. Sections of the concrete cap to the weir could also be placed in the weir pool, but preferably in a way that buries them view.

14.9 In addition to taking out a notch in the weir, work should be undertaken at both banks to make safe sections of undercut masonry. At the right bank (looking downstream), the undercut 'corner' extending into the weir pool should be completely taken down to avoid the risk of it collapsing with people standing on it. The new section of masonry wall at the left bank should be taken down, and the section of under-cutting made good using pointed masonry.

14.10 *The undercut corner on the right bank is of concern regarding public safety, and it may be appropriate to erect a fence and warning sign until this work can be carried out.*

14.11 It may not be possible to get machine access to site to undertake these works. The works are still possible by hand (and indeed are likely to be cheaper). Either way, the work should be carefully planned to ensure that it can be carried out safely. The Construction, Design and Management (CDM) Regulations apply to all demolition work (although it could be argued that forming a notch is 'modifying', compared to the full option of taking down the weir). These place requirements on the Client (Riding Mill Parish Council), including to highlight specific risks or knowledge of the site to the contractor (eg undercut masonry, very deep water, very limited machine access), and to notify the Health and Safety Executive ahead of the works commencing.

14.12 This option appears to meet the requirements of the Parish Council in terms of;

- ensuring public safety at the site,
- avoiding the need for continuing repair and maintenance works,
- no impact on existing flood risks,
- acceptable mobilisation of sediments, (if suitably managed),
- low cost, and
- improved fish passage for most fish (a low cost eel pass could easily be incorporated into the works, taking the form of a shallow trough at the right bank with 'astro-turf' or similar on the base).

15. Permissions and licences required

15.1 The proposed work will require discussions with the Environment Agency, particularly fisheries staff, to ensure that they do not impact on migrating fish or downstream habitat. Land Drainage Consent will be required from the Environment Agency (this costs £50 and can usually be obtained in 8 weeks). Silt management measures will need to be discussed. Timing of the works could be an issue, but due to one of the outcomes being improved fish passage, this is likely to be able to be resolved.

15.2 Although the weir and adjacent banks are owned by the Parish Council, early discussions should take place with land owners immediately upstream and downstream to ensure that they are reassured that the proposals will not adversely impact their properties in terms of flooding or erosion.

15.3 Modifying the structure is unlikely to require planning permission due to the small scale of the changes, although it is recommended that this discussion takes place. This should also confirm that the weir is not a Listed Structure or of other historical importance.

15.4 A discussion should take place with the Health and Safety Executive regarding the CDM Regulations. If the work is classed as 'demolition', then a Safety Plan will be required and a CDM Co-ordinator will need to be appointed. These Regulations place roles and responsibilities on the Client for the works. However, it is likely that cutting a notch will be seen as 'modifying' rather than demolishing, although careful planning of the work will still be required, and the safety of contractor and members of the public ensured.

15.5 Although there are no obvious services at the site, such as buried electricity cables or gas mains, these aspects should be checked ahead of works taking place, particularly if an excavator is used.

15.6 Although not a statutory consultee, it would be useful to discuss the works with the Tyne Rivers Trust. This group may be able to provide volunteer support for the works, or even a financial contribution (for example if an eel pass is included).

16. Proposed next steps

16.1 It is recommended that this report is discussed at the 13th June2011 meeting of Riding Mill Parish Council so that a way forward can be agreed.

16.2 The safety of the public should be ensured by erecting a simple fence and laminated warning notice at the right bank. This should be set back roughly 3m from the under-cut corner of masonry.

16.3 Discussions should take place with landowners upstream and downstream, with the Environment Agency and with the Tyne Rivers Trust. The proposals should also be discussed with the Health and Safety Executive and Planning Department.

16.4 Land Drainage Consent should be applied for from the Environment Agency.

16.5 Costs should be sought from local contractors, together with details on how they will undertake the works safely. As an alternative to using contractors, it may be possible to deliver the works using local volunteers from angling clubs or the community (possibly with support from the Tyne Rivers Trust and the Environment Agency). If this were to be the case, it is possible that an application could be made to the Lottery 'Awards for All' to cover the costs of materials and equipment. (This fund is a relatively easy application for up to £10k of community led action).

16.6 The works should be able to be undertaken in September 2011, assuming that all of the discussions proceed according to plan, and flows in the March Burn remain low. With sufficient people on site, the works should be able to be completed in only 1 week.

16.7 The works would include (assuming no machine access):

- Place straw bales in the channel downstream to catch sediment. These should be secured in place.
- Safely take down the undercut corner at the right bank. This could be achieved by carefully digging down and using pinch bars and sledge hammers. Make area safe and 'batter back'.
- De-water the notch area using 'dumpy bags' filled with local gravel and sand.
- Cut the concrete cap using a 'stihl saw' or similar.

- Excavate the notch using the stihl saw plus hammers and bolsters. Large sections of masonry may need to be moved using a 'block and tackle' secured to a large tree.
- Form a sound, pointed surface to the notch, ensuring that the mortar does not come into contact with water. This may require a small pump.
- Take down the section of new masonry wall at the left bank and point and repair the section that is undercut (above water level).
- Install an eel pass at right bank (if required).
- Place large armour stones (preferably from the notch) at the right bank behind the masonry wall to reduce the risk of erosion in flood flows.
- Hand excavate gravel and sand upstream of the notch and place the material on the right bank away from areas where it could be washed back in during high flows.
- Place some large rocks at the upstream end of the footbridge central support to limit further under-cutting
- Reinstate the site. Note: it would be useful to plant a few alders and willows at the right bank, although this should take place early spring.

16.8 This would lead to a major improvement to the existing structure in terms of future repair and safety concerns, and also markedly improve fish passage this Autumn and Winter, opening up many kilometres of new spawning habitat.

Peter Kerr BEng (Hons) CEng CWEM MCIMEM
7th June 2011

Riding Mill Weir—30th March 2011

Figure 1 – Riding Mill Weir from the left bank

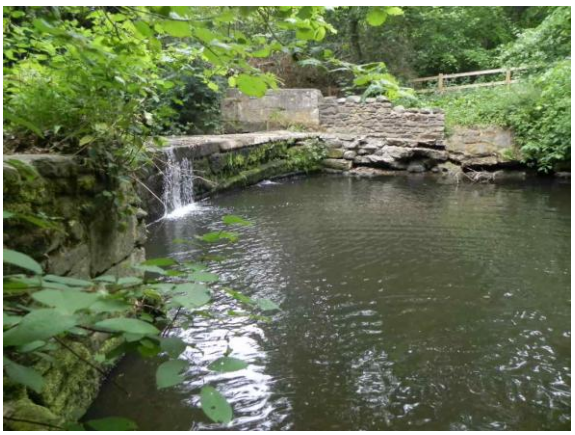

Figure 2 – The deep weir pool and area of erosion at the left bank.

Figure 3 – the concrete cap at the weir crest.

Figure 4 – the ‘corner’ to the left of the picture that is severely undercut below water level. The proposed notch would be roughly 2/3 of the weir height.

Figure 5 – safety fence at the left bank (to be replicated at the right bank until urgent works can be completed)

Figure 6 – section of new masonry at the left bank and area of erosion and undercutting.

Appendix 1
Email correspondence describing the commission

Peter

Following consultation with other councillors and my discussion with you, the Parish Council would like your assessment and report as set out in the first email below but without computer modelling. We would like your advice on the options so that we can consider in our 13th June meeting only those which in your professional opinion will not increase flood risk for other properties (and will preferably reduce it). The Parish Council owns the woodland on both sides of the Burn between the weir and the nearest footbridge.

I shall be leaving early in the morning, and if you have any queries over the net 2 weeks, please will you contact John Eakins (01434 682405) or another of the councillors (1st 3 names from the list above).

Regards,

Malcolm

From: Pete Kerr [mailto:p.kerr@tiscali.co.uk]
Sent: 18 May 2011 16:30
To: m reid
Subject: Re: hydrological modelling

Mike - thanks for the email. However, just to clarify, as I suggested, hydrological computer modelling could be carried out but would be expensive and wouldn't really give much more information than I can give in 'my professional opinion'. I can comment on control features and what the effect of the alterations are likely to be on flooding. If you are looking for modelling for the reach then the cost would be considerably greater. Welcome your views on this.

Happy to include views and advice on modifications to the weir as outlined in your email. I will also comment on the options, the 'logistics' of each, and how they will help achieve your objectives.

We discussed that it would be good to complete this work by 6th June to allow some circulation of the report ahead of your meeting.
Hope this is all OK, but welcome your views on the modelling aspect.

Kind regards

Pete Kerr BEng CEng CWEM MCIWEM

----- Original Message -----
From: m reid
To: p.kerr@tiscali.co.uk
Cc: 'Jill Mills' ; 'John Eakins - Parish Council' ; 'Andy Dunhill' ; 'Monica F Anderton' ; 'Peter & ChristineHowe' ; 'Malcolm Newson'
Sent: Tuesday, May 17, 2011 2:03 AM
Subject: hydrological modelling

Dear Peter,

Following our discussions, I have consulted with the majority of the councillors and also the Clerk, and the Broomhaugh and Riding Parish Council would be pleased if you would carry out a hydrological model and provide a written report in time for consideration of it at the June Parish Council meeting on Monday 13th June, for the agreed sum of £800 as follows:

to carry out hydrological modelling of the implications of the Parish Council having the March Burn Weir reduced in the following 2 ways:

(a) removing a rectangular notch of depth 30 cms and approximately 4 metres width from the top of the weir, including some advice on the most appropriate position and width of the notch (and comment on what effect the collapse of the side walls might have);
(b) taking away the whole weir in one go.

The Parish Council's main objective is to ensure that any action it takes to improve the stability and safety of the site will not increase the flood risk to any properties and will preferably reduce that risk. So we would be grateful if you would include comment on that aspect. Other goals are: to ease the passage of fish and other species, to preserve the attractiveness of the area, and to do these without incurring excessive or ongoing cost.

Regards,

Malcolm Reid, Ash Tree Cottage, Riding Mill, NE44 6DY