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Interactive comment on “A flume experiment on the effect of constriction shape on the formation of forced pools” by D. M. Thompson and C. R. McCarrick

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Received and published: 30 April 2010

General comments

Good study on morphological adjustments as a result of a forced pool. Continues work such as Thompson (2002) that looks at the effect of different configurations of constrictions on pool and riffle geometry. The most relevant parameter seems to be the rate of constriction (change of width over streamwise distance) so that ‘blunt’ bodies, which are an instantaneous change in the width of channel produce wider and deeper pools, while those whose rate of constriction is lower produce shallower and narrower pools. Also interesting is the way that the circular form produces a pool that wraps around

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the constriction with a nearly symmetrical distribution of depths. Maybe there should be another way of quantifying this then like the second derivative of the constriction shape? It's not clear at this point of course, but it does seem like the data could be the basis for a more general understanding on the effect of width constrictions on pool scour. As it is the study is useful for understanding dynamics and habitat in forested streams and for designing potential restoration measures.

I do feel that more could be done with the data, specifically on the lateral adjustments of the form. For the moment the results present profiles along the channel centerline. However, there is no reason to suppose that the most interesting results will occur in this location. The upstream triangle, for example, clearly produces a bar that is connected with the channel side wall. It would be useful to develop metrics to characterize not just the streamwise location of the maximum and minimum depths, but also their lateral position and their extent. Some pools are quite narrow and leave a relatively unscoured bed on the opposite side of the channel while the blunt forms tend to have wider scour zones that nearly reach the opposite side. It would also be useful to measure the volume of scour and deposition relative to the initial bed as this is discussed but never calculated.

In the opposite direction it seems that the discussion goes too far when it tries to address the causes of these differences. If field and flume results have demonstrated anything, it is that the flow is complicated (MacVicar and Roy, 2007; Thompson and Wohl, 2009). There are a number of things happening with changing water surface slopes, convective acceleration and deceleration, generation of turbulence due to adverse pressure gradients including flow separation, lateral flow convergence and divergence. There are a number of interesting hydraulic questions that are raised by the morphological results from this study. However, they require further evidence to support some of the points raised in the discussion.

Specific comments

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Abstract

Final sentence is too long with a number of different ideas. The meaning is not clear, perhaps because of grammatical errors. There is also discussion of a number of items such as scour volume, helical flow development, and vortex shedding that were not evaluated in the current study.

Introduction

A background section might be useful here to take sections 1.1 to 1.3 to the side so that the introduction is more direct.

Methods

So the results are assumed to represent equilibrium dimensions of the runs?

Final paragraph is not clear “In particular, the distance from the upper edge, middle and lower edge of the point of full 40% degree constriction were analyzed.” I think a diagram showing exactly where the measurements were made for the different shapes would be helpful. The sentence that contains “an effort was conducted to determine if one of the various measures of distance from the constriction yielded a result of no significant differences for any of the obstruction shapes”, is also confusing.

Results

Paragraph 1 – very interesting observation of feedback between the morphology and the flow. It would be interesting to have more information about the evolving flow field during this period.

Paragraph 3 – “Statistical results described below indicate the location of the pool most directly related” – meaning unclear. What statistic are you referring to? If they are not described until later in the ms it seems that the results should be described at that time. I find it confusing trying to discern the chronology of events implied by ‘later’.

Paragraph 4 – location of riffle and pool max depth are not always on the channel cen-

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terline. It seems that the results should account for this. What is the water surface elevation? Could you add this to Figure 3? Also, do you show results for scoured volume? This would be interesting information and seems necessary for this discussion.

Paragraph 5 – confusing first sentence. Needs to be shorter. Confusing sentence – “The comparison of means indicate three distinct groups with pools formed by the square, rectangle, and triangle DS forming a discrete group, the semicircle producing pool centers with unique locations, and pool center locations associated with the trapezoid and triangle UP appearing distinct.” This could be written more concisely.

Discussion

Section 4.1 does not present much new information or understanding relative to the results section. I think one paragraph would be sufficient here to present the general discussion point that there is a difference between the blunt objects and the angled. Number of points that were not measured – turbulence, water surface elevations (back-water), position of eddy fence that are used in discussion. It would have been interesting to demonstrate the difference in these hydraulic patterns in order to strengthen the discussion.

Editorial comments (line numbers would have speeded this up!)

Abstract 2/ - rapidly narrow 2/- some of the differences .. 2/ and vortex shedding locations... 3/3 – forced-pool Section 3.1 should refer to 1.1 I believe 7/1 – no comma needed in first sentence 7/6 – ensure 7/6 – ‘A shallow depth of water was gradually added to the flume’ could be changed to ‘the flume was slowly filled’ 8/13 – ‘In particular..’ sentence is not clear 8/17 – sentence meaning is unclear 9/6 – ‘visually obvious’ seems unclear and the paragraph could be written more concisely.

References

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HESSD

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