HYDRAULIC CATEGORISATION

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Introduction

As floodplain risk managers either employed by the NSW Government, or as consultants to NSW Councils, our focus is assisting Councils to satisfy the primary objective of the NSW Government's Flood Prone Land Policy which is to reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods, using ecologically sustainable methods wherever possible.

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As such, our primary interest in hydraulic categories is to identify areas of the floodplain which will be sensitive to changes that impede the flow conveyance or flood storage functions of the floodplain. This understanding of flood behaviour and knowledge of these sensitive areas and the detrimental impacts of change can then be used as a tool to inform decisions. These decisions may relate to flood mitigation to reduce flood risk to the existing community and managing changing land use and development to manage growth in flood risk as the community expands.

What are hydraulic categories?

The Floodplain Development Manual: the management of flood liable land, NSW Government 2005, (FDM 2005) defines hydraulic categories of floodways, flood storage and flood fringe as follows:

> "Floodways are those areas of the floodplain where a significant discharge of water occurs during floods and are areas often aligned with obvious natural channels. They are areas that, even if only partially blocked, would cause a significant increase in flood levels and/or a significant redistribution of flood flow, which may in turn adversely affect other areas. They are often, but not necessarily, areas with deeper flow or areas where higher velocities occur."

> "Flood storage areas are those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. If the capacity of a flood storage area is substantially reduced by, for example, the construction of levees or by landfill, flood levels in nearby areas may rise and the peak discharge downstream may be increased. Substantial reduction of the capacity of a flood storage area can also cause a significant redistribution of flows."

"Flood fringe is the remaining area of land affected by flooding, after floodway and flood storage areas have been defined. Development in flood fringe areas would not have any significant effect on the pattern of flood flows and/or flood levels.

These are performance based definitions which are based on the function of these areas during floods and how changes in these different areas would impact on flood behaviour."

Managing the floodplain: a guide to best practice in flood risk management in Australia, Commonwealth of Australia 2013, discusses flood function in the following terms:

"Flow conveyance areas [Figure 5.1] are a fundamental element of the floodplain and are generally continuous. They flow from the upper reaches of the catchment [on the main waterway and its tributaries] to the catchment outlet and generally extend to at least the banks of the waterways. They may flow into larger waterbodies, such as lakes, and re-emerge to convey flows from the waterbody to the ultimate outlet. They are often, but are not necessarily, areas where flow is deeper or velocity is greater. Floodwaters are temporarily stored in flood storage areas [also shown in Figure 5.1] during the passage of a flood, which can reduce downstream flood flows and impacts. The remaining area of land inundated by the flood is generally known as the flood fringe, which can often be safely developed without significant adverse flood impacts if flood hazard [Section 5.3] can be managed effectively."

This is again a performance based consideration of the functions of various parts of the floodplain during the passage of a flood.

Why do we care?

Floodplain risk managers need to know the hydraulic categories or functions of various parts of the floodplain because, if buildings are built in floodways they will either be severely damaged or destroyed as shown in Plate 3 – Mount Pleasant Street, Maitland, 1955 in the FDM 2005 or result in the redirection of flows which may damage other buildings. Therefore defining floodways can ensure that the areas where these impacts occur are understood and that flow conveyance can be considered in decision making. For example, for new development this involves limiting the detrimental impacts any intensification of land use or development has on flow conveyance. This will generally involve excluding any intensification of land use or development from within floodways. Floodways, due to the combination of depth and velocity of waters, are also often areas where flood conditions are hazardous to people. Therefore limiting intensification of land use and development in these areas also has the added benefit of reducing the growth in flood fatalities by limiting the additional people exposed to these hazardous conditions.

If flood storage areas are "protected" by levees or filled then flood levels in nearby areas may rise and the peak discharge downstream may be increased both of which could damage development elsewhere. Therefore filling, intensification of land use or development in storage areas needs to consider the impacts of loss of storage of flood behaviour. Impacts are minimised by these changes being storage neutral.

In contrast if flood fringe areas are "protected" by levees or filled this will not lead to a significant change in flood behaviour and therefore they are more readily suited to an increase in the intensity of land use or development, with appropriate conditions to limit flood impacts on new development and its occupants.

How do we practically identify them?

Since we typically use numerical hydraulic models to inform our understanding of flood behaviour, the question then arises as to how modellers can derive reliable estimates of the function or hydraulic categorisation of different parts of the floodplain.

Traditionally, the most reliable method to establish the function or hydraulic categorisation of different parts of the floodplain which meet the performance criteria is to do an encroachment analysis where model parameters of parts of the model are adjusted to investigate how the model performs. This approach was developed for one-dimensional models and the transition of industry practice to two-dimensional models for complex flood situation means that the practicality of this approach is limited unless a reasonable preliminary estimate guides the initial parameter adjustments.

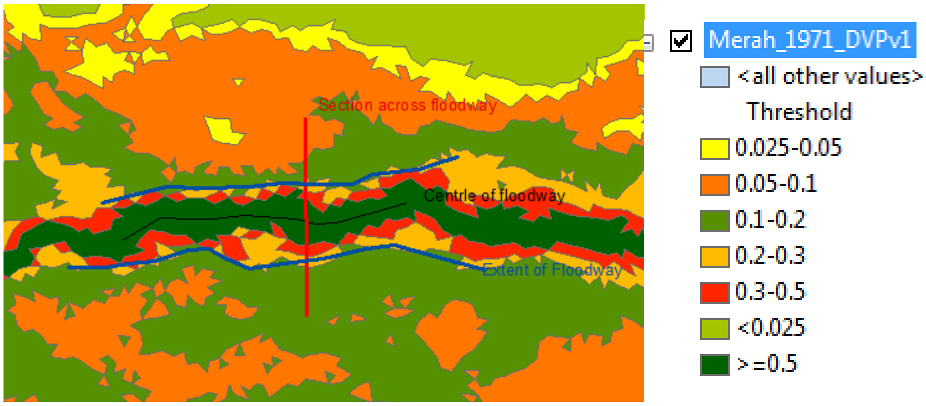
There have been a series of papers presented to this conference over the years such as Howells et al (2003) and "Thomas & Golaszewski (2012) which have tried to assign numerical values to model outputs which could be used to "define" the categories in a numerical sense. These approaches have had varying utility as first pass estimates and of themselves they can't actually tell us which areas meet the performance criteria.

The remainder of the paper therefore outlines approaches which have been developed for use with two-dimensional model platforms to derive reliable and repeatable?? first pass hydraulic categorisations which can then inform the model parameter adjustments applied to particular areas of the model in order to perform the encroachment analysis.

The first approach is being using in studies in rural areas of the the Murray Darling Basin characterised by broad slow moving floodplains???.

When establishing floodways it is necessary to identify the (main) flow path for continuity of flow and width for adequate capacity. With the use of 2D modelling and accurate depth velocity products (dvp), we are now able to identify the hydraulic centreline or areas of significant flow within flow paths. Establishing a width for the identified flow path can be problematic. Using a single dvp threshold to define and size large complicated floodplains has major disadvantages: floodways that do not meet the dvp threshold are not mapped, at the same time the size of other floodways are to conservatively mapped. Previous approaches have used a combination of dvp thresholds, flood imagery & local community knowledge to map flow widths and ensure continuity of flow. A more refined approach that could save analysis time is to proportion the flow width around the hydraulic centreline. A method which is being trialled at the moment is to set the width based on a dvp which is proportional to the maximum dvp for an identified flow path... This is a dynamic method and can be checked to ensure the proportion of the total flow (Q) that is contained within the identified floodway is adequate. An iterative process can then be followed to ensure the best dvp classification/division/category is selected for the characteristics of the particular floodplain. This will allow for an automated first pass assessment of delineating the floodway, however it does not totally admonish the need for further interpretation and refinement especially in complicated floodplains.

Figure x shows the delineation of the floodway based on a dvp of 0.2 m2/s less than the maximum of the centre (*I shall do a better map later*)



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