Going with the Flow
(A Proposed Method for Overland Flow Path Mapping)

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ABSTRACT

The Queensland Floods Commission of Inquiry (QFCI) has recommended that local governments should ñmap the overland flow paths of their urban areas.ò It is important that this information is presented in a way that effectively communicates the location of overland flow paths.

In response to the QFCI recommendations, the Sunshine Coast Council is currently undertaking to model its entire urban footprint. This project will map approximately 300km^2 using direct rainfall on a 2D hydrodynamic model.

Historically these flood maps have shown flood extents and depths. The goal of this paper is to present a method of mapping which clearly indicates flow path direction as it evolves with event severity. While flood extents and depths will continue to be an informative tool, it is believed that this new method of mapping will be of greater value by specifically outlining the path and direction of overland flow and understanding how it changes with increasing event severity. This will inform local government, developers and the community of the importance of overland flow paths and assist local government to identify, protect and enhance them.

KEYWORDS

Overland, Flow, Path, Mapping

REQUESTED PRESENTATION FORMAT

- Standard 15 minute Presentation and 5 minute Q&A

1 TRADITIONAL FLOOD MAPPING PRODUCTS

Regional (riverine) flood extent maps are generally the most common type of maps made available to the public by local governments. An indicative public flood map showing flood extent is shown in

Figure 1. Whilst flood maps generally shows areas that may be affected by flooding, it does not give an appreciation of the hazards associated with flooding (depth and velocity) or the direction of flow.

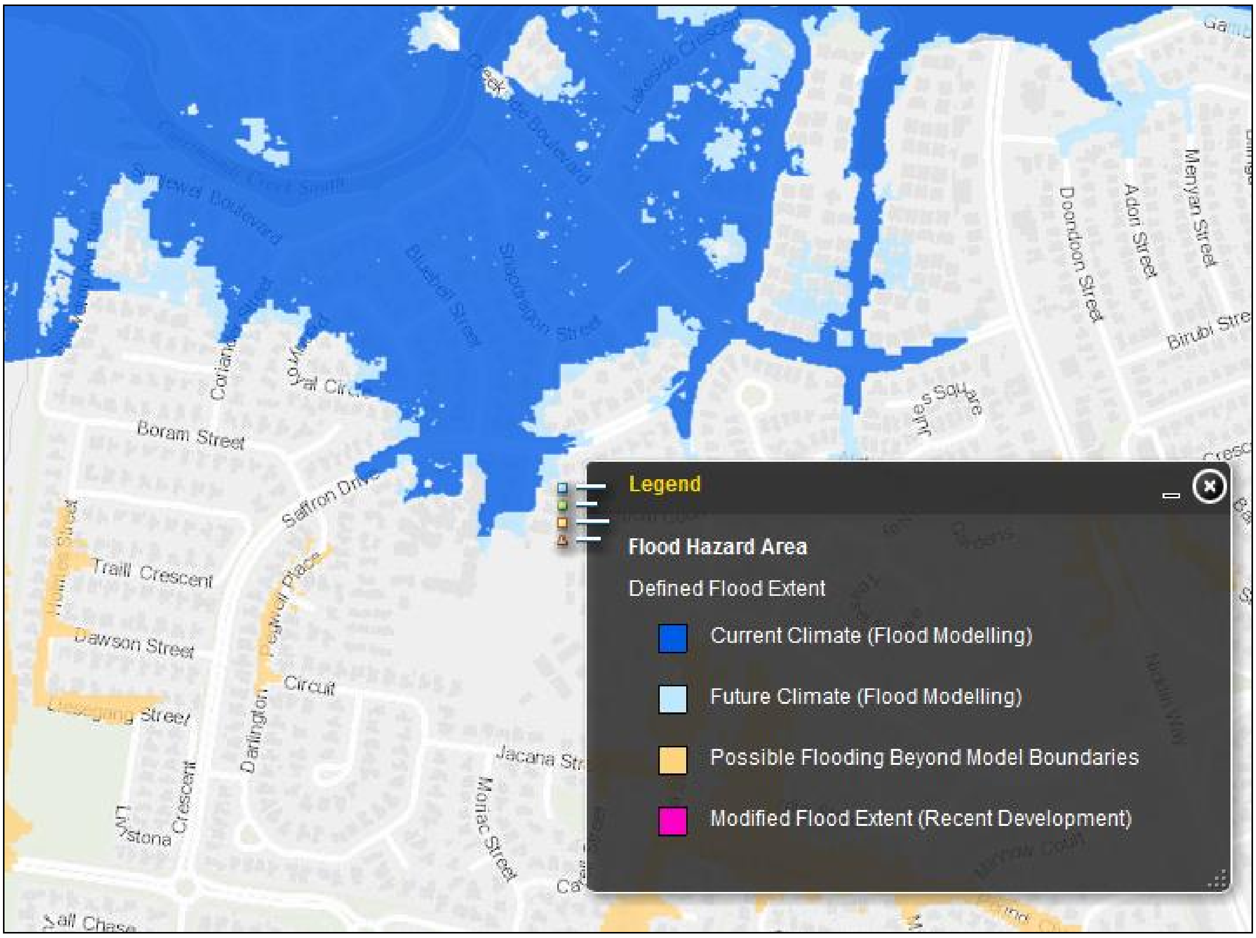

Figure 1 Flood Extent Map

The next level of detailed flood mapping that is often utilised is flood depth mapping. Figure 2 provides an example of a flood depth map derived from a regional flood model with depths clipped that are less than 150mm. This clipping of insignificant flood depths generally improves the perceived flood immunity of lots, relative to the flood extent mapping, as shown previously in Figure 1. This clipping also removes isolated depressions generated by the gridded terrain from the flood mapping.

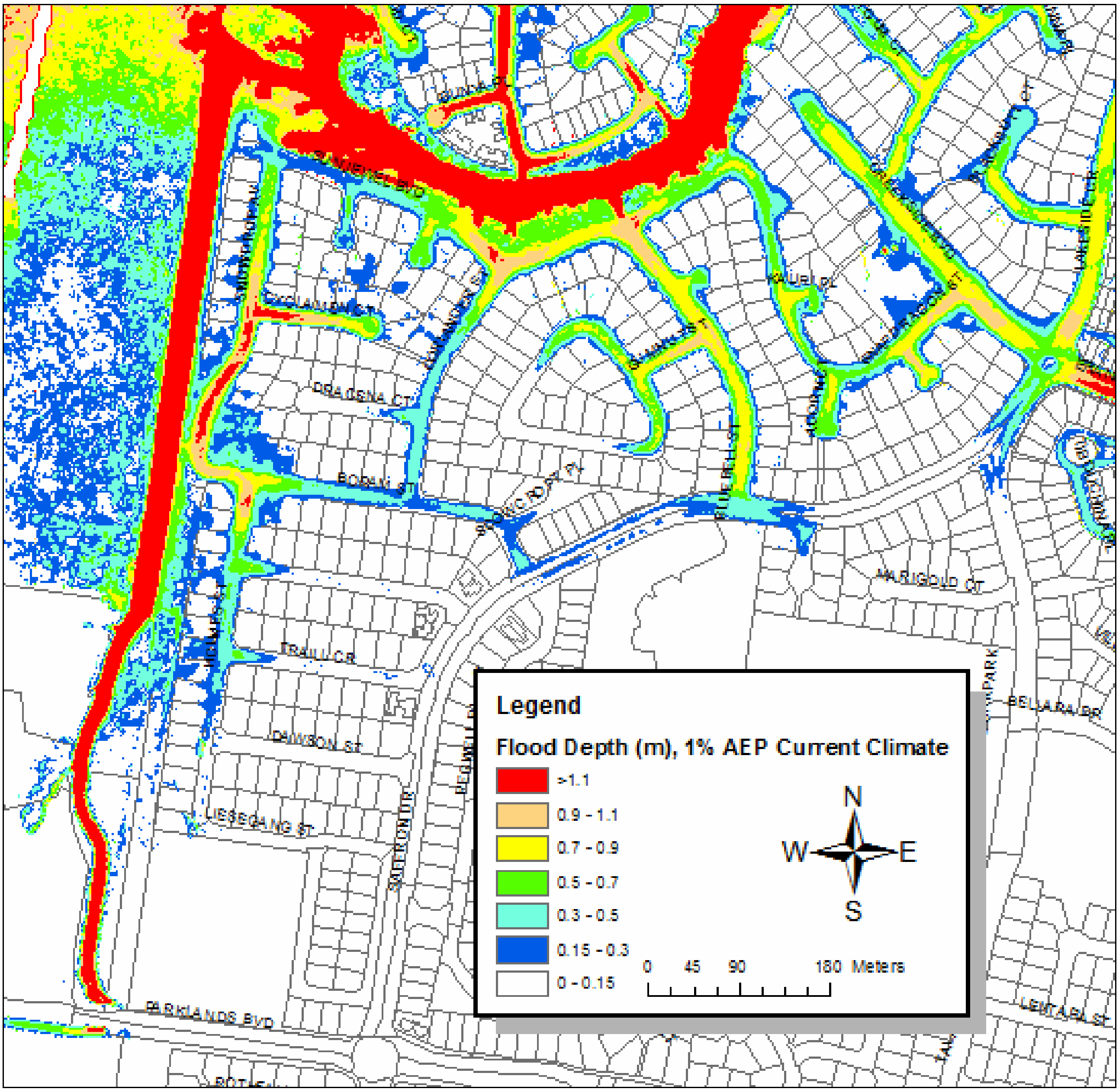

Figure 2 Flood Depth Map derived from a Regional Flood Model

Where flood depth mapping is derived from a regional flood model focused on riverine or creek flooding mechanisms the mapping product can at times be compromised by the limitations of source nodes in the underlying flood model, particularly in flat urban areas. Local area flood models that adopt 2D direct rainfall hydrodynamic modelling and utilise boundary conditions extracted from the regional model are considered an enhancement in these situations. Figure 3 provides an example of flood depth mapping that has been derived from a local area flood model utilising the direct rainfall methodology. It also has flood depths clipped to 150mm but shows a better spatial distribution of the flooding in the urban environment than the regional flood model, as any sensitivity to the location of the inflow source node is no longer a modelling consideration.

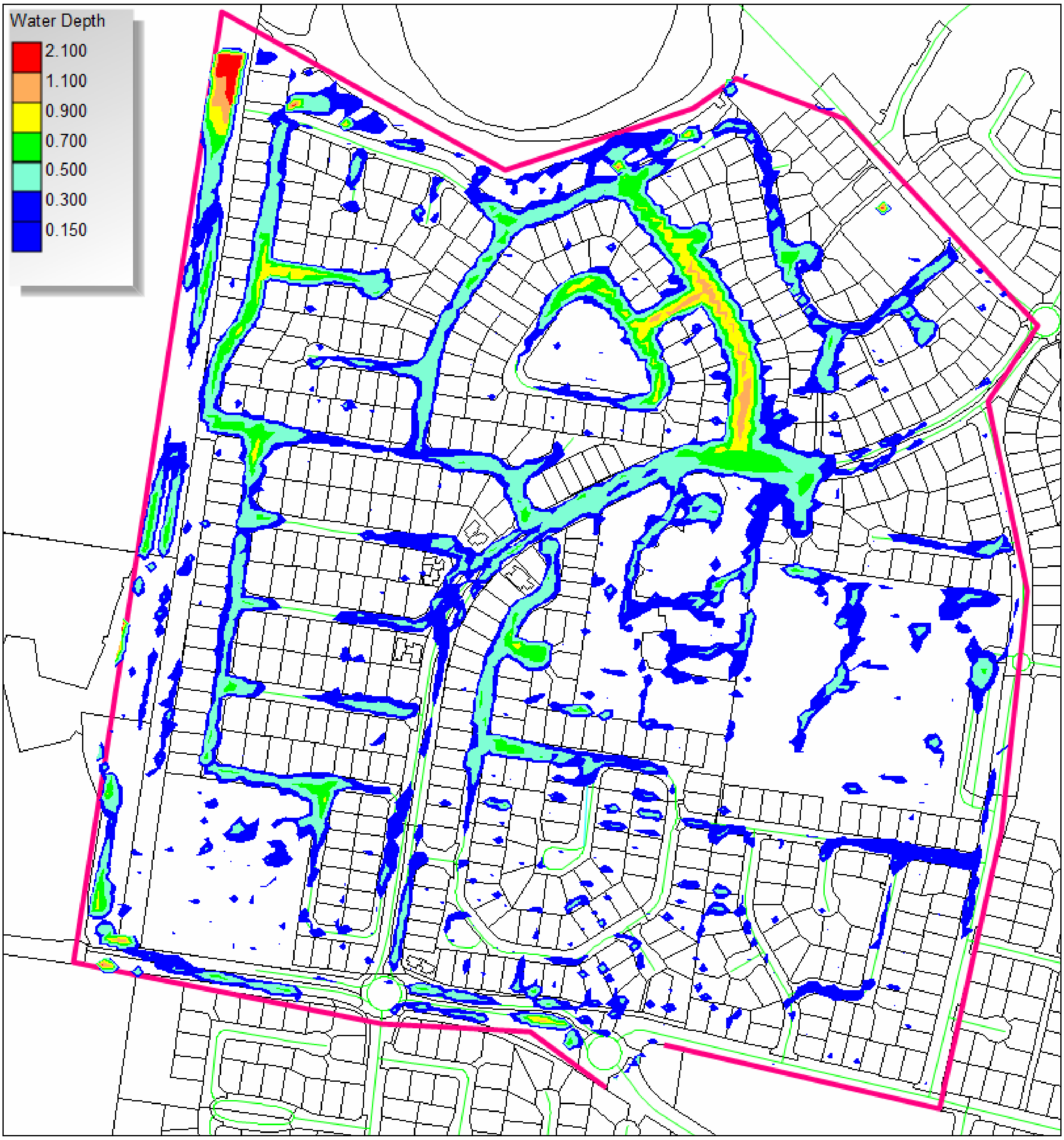

Figure 3 Local areas flood modelling using 2D direct rainfall methodology

The flood depth maps presented in Figures 2 and 3 are informative with regards to the hazards associated with the depth of flooding, but do not provide any guidance on the hazards associated with flow velocity or direction. These hazards may be present at a time during the event prior to the peak depth occurring. Another type of map is necessary to communicate information in relation to the flow velocity and direction.

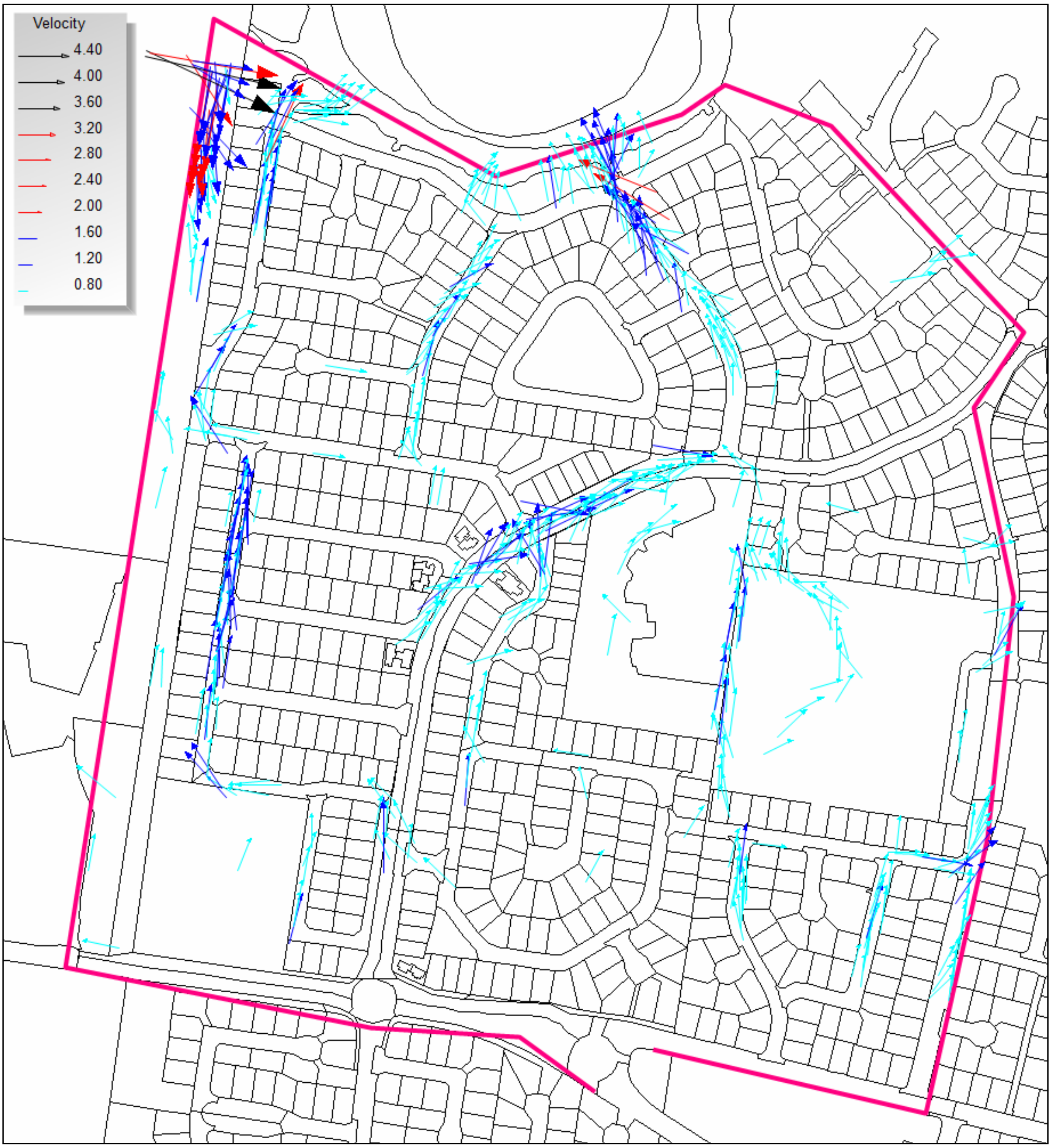

Figure 4 Velocity vector mapping

Figure 4 presents a velocity vector map. Whilst this map is demonstrating the concept in widely adopted industry modelling software (XP-SWMM), a similar mapping concept can produced by exporting velocity vector information to a GIS package. Clipping the lower velocities starts to identify clear flow paths. The example shown in Figure 4 clearly identifies the design intent for the streets to act as overland flow paths, but it also demonstrates that overland flow paths are also present on some of the larger lots. These are the paths that need to be identified, protected and where necessary enhanced.

Whilst it is apparent that the style of mapping product presented in Figure 4 can communicate the location of important overland flow paths, it only does this for a particular design event. One of the themes of the QFCI is that such investigation should consider a broad range of event severities. It is no longer considered appropriate that flood studies are limited only to the consideration of the 1% Annual Exceedance Probability (AEP) event, or lesser events. Considering each event as a single map is not ideal as it does not readily support an understanding of how overland flow paths may evolve as event severity increases. The proposal introduced in the next section details a methodology that is under review at Sunshine Coast Council.

2 PROPOSAL FOR AN OVERLAND FLOW PATH MAPPING PRODUCT

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2.1 Methodology

The proposed methodology produces a single map that shows the overland flow paths for a broad range of events. It involves a number of steps:

1. Analyse design events for the broad range of event severities using 2D direct rainfall hydrodynamic modelling. At Sunshine Coast Council these events include the 39% AEP (2yr ARI), 10% AEP, 1% AEP, 0.2% AEP and 0.05% AEP.
2. Clip the velocity information for each event to only velocities in excess of 1 m/s.
3. Extract the non-clipped velocity information for each design event, including the vectors.
4. Import this into a GIS, showing vector length as an indication of velocity magnitude.
5. Adopt a graduated colour symbology. The current consideration at Sunshine Coast Council is to adopt a dark blue colour for the least severe event (39% AEP) and a very light blue for the most severe event (0.05% AEP). The logic of this symbology is that the reader's eye will be drawn to the darker colours which will be the most active flow paths, although the flow paths that are activated only in the most severe events will also be evident in a lighter shade of blue.

The resultant mapping product is reflected in Figure 5. The single map is now communicating information about flow paths, directions and magnitudes (above 1 m/s), for a broad range of event severities, at a glance.

Figure 5 Proposed Style of Overland flow path mapping

3 CONCLUSIONS

The proposed overland flow path mapping presented in this paper is considered a worthwhile additional product of local area flood investigations. Whilst the traditional mapping products associated with such investigations (extents, depths and velocity vectors) will continue to be informative, it is believed that this new style of mapping will be of greater value by specifically identifying critical overland flow paths and how they evolve with event severity.

This is seen as particularly important in the context of the Queensland Floods Commission where there is a clear motivation that more mapping be made available, and at the same time be done in a such a way that considers the need for simple communication of key messaging. It is believed that this style of mapping can be used to inform all levels of government, developers and the community of the location of important overland flow paths and assist in their ongoing functional protection and enhancement.

4 RECOMMENDATIONS

It is recommended that other local governments consider the proposed style of overland flow path mapping presented in this paper. This includes a consideration of a requirement on development local area flood studies. The implementation of the proposed would impose minimal additional expense to such investigations. The information required to undertake the proposed mapping is generally already available from the 2D direct rainfall hydrodynamic modelling investigations that should be the basis of modern development assessment investigations.

4.1 List of References

State of Queensland, (2012), *Queensland Floods Commission of Inquiry – Final Report*, Department of Justice and Attorney-General, Brisbane

4.2 Author Biography

Gabriel Catalini is employed by Sunshine Coast Council as Graduate Engineer in the Flooding and Stormwater Management Team. He is a graduate of the University of Southern Queensland in 2011. He enjoys flood modelling and has been heavily involved with the overland flow path mapping at the Council. Gabriel is a native of Montreal, Canada and is appreciative of the warmer climate found in Queensland. Although he is a water engineer, he is known for dry humour.