

IS YOUR FLOODPLAIN MANAGEMENT STRATEGY WORKING? INNOVATIVE SOCIAL RESEARCH IN THE WIMMERA

N Dufty¹, P Fennell², J Kremer¹, R O'Rourke¹, K Sanborn¹

¹ Molino Stewart Pty Ltd, Parramatta, NSW

² Wimmera Catchment Management Authority, Horsham, Victoria

Abstract

The success of the Wimmera Floodplain Management Strategy (WFMS) (Wimmera Catchment Management Authority, 2017) is largely dependent on community preparedness and response to flooding in the region, as flood study delivery across the catchment is complete. Regardless of the mitigation structures (e.g. levees) and non-structural mitigation methods (e.g. property modifications, land use planning) used, there will always be some residual risk for communities and emergency agencies to deal with in floods up to the Probable Maximum Flood (PMF).

To better understand the effectiveness of the WFMS implementation, an innovative research framework was developed to provide insight into the complex nexus between:

- contributing factors (e.g. flood experience, risk perception, demographics)
- indicators of community preparedness and response
- possible interventions (e.g. flood education and engagement, warning systems, insurance).

The research framework was used in a social research project covering six flood-prone communities in the Wimmera region. A community survey related to the research framework was developed and distributed to selected residences across five flood risk categories up to the PMF.

The social research provided intriguing insight into the psychological and sociological complexities and interrelationships in which the WFMS is bedded. It found low preparedness levels across the region, potential reasons for these low levels and possible interventions to help increase the levels. It identified aspects of community response which require attention including unwillingness to evacuate and willingness to drive through floodwaters. The high levels of social capital in the region auger well for community support mechanisms in future floods.

This methodology has universal appeal in helping to understand and improve community disaster preparedness and response.

Introduction

The Wimmera region is located in western Victoria, Australia. Flooding is a regular occurrence across the Wimmera region's 30,000 km² landscape. Floods severely disrupt communities by causing property damage, personal hardship, regional economic losses, and risks to people's safety.

The purpose of the Wimmera Floodplain Management Strategy (WFMS), developed in 2017, is to provide:

- a regional planning document for floodplain management
- a regional work program to assist with future investment priorities.

“The strategy delivers the relevant policies and actions of the Victorian Floodplain Management Strategy (Victorian FMS) that was informed by the Victorian Floods Review and the Victorian Parliament Environment and Natural Resources Committee Inquiry into Flood Management Infrastructure of the 2010-11 floods.” (Wimmera Catchment Management Authority 2017)

The success of the WFMS is largely dependent on community preparedness and response to flooding in the region. Two critical activities in the WFMS are:

1. Improving our understanding of floodplain risk
2. Education and engagement of the community.

One of the key evaluation questions in the WFMS Monitoring, Evaluation and Reporting (MER) Plan (Riverness, 2019) is, ‘To what extent has the Strategy contributed to changes in skills, knowledge and management practices of communities living on floodplains?’ This evaluation question will be measured in two ways:

1. Skills and knowledge change of community and flood-affected landholders
2. Change in positive floodplain practice, attitude, awareness and/or behaviour.

Floodplain and emergency professionals who developed the WFMS believe that residents may have a low level of understanding of flooding and floodplain management. To assess this theory, Wimmera Catchment Management Authority (Wimmera CMA) commissioned a project to undertake social research to establish the level of floodplain knowledge and behaviour of at-risk/flood affected landholders in the Wimmera region. This process will be used through future years to help assess the performance of the implementation of the WFMS through change in understanding within the community.

Wimmera CMA engaged consultants Molino Stewart to undertake the project.

The resultant social research project is innovative for three reasons:

1. There has been scant social research that has probed the complexities associated with the nexus between the psychological and sociological contributing factors of disaster preparedness and response, community preparedness and response levels, and flood risk management interventions (e.g. community education, early warning systems, insurance) that can influence those levels. A social research framework was developed to help analyse these complexities in relation to the WFMS (Dufty, 2021).
2. The social research draws on a holistic way of assessing and categorising flood risk. Wimmera CMA has identified and classified flood risk up to the PMF. The flood risk assessment method embodies the hydraulic conditions (depths and velocities) and the frequency of the flood events. As a result of this process (Figure 1) of relating flood hazard categories to the likelihood of a flood, five flood risk categories were identified by Wimmera CMA. Category A has the highest risk grading to Category E with the lowest risk.
3. A method of community surveying that was based on face-to-face engagement with potential respondents was planned. This type of community surveying is usually conducted using more impersonal methods such as online surveys and telephone interviews. However, due to the onset of COVID-19 restrictions in March 2020, the planned approach was modified to letter box drops to respect the need for social distancing (Molino Stewart, 2020).

This paper provides a summary of the methodology and results of the social research. It also discusses the implications for the WFMS and Wimmera communities.

First Flood	Hazard Category					
	H1	H2	H3	H4	H5	H6
1 in 100k / PMF	E	E	E	E	E	E
0.2% / 500y	D	D	D	C	C	C
0.5% / 200y (*)	D	D	D	C	B	B
1% / 100y	D	D	C	B	B	B
2% / 50y	D	C	B	B	A	A
5% / 20y	C	B	B	A	A	A
10% / 10y	B	A	A	A	A	A
20% / 5y (*)	B	A	A	A	A	A

Increasing Consequence →

Figure 1: Matrix for the identification of flood risk categories

Methodology

A social research framework (Figure 2) was constructed for the project following a workshop involving Wimmera CMA and Molino Stewart staff. The framework draws on the findings of relevant research related to the WFMS in three areas:

1. Contributing factors – the main psychological, sociological and demographic features potentially influencing community flood preparedness and response in the Wimmera region.
2. Preparedness and response levels – the common indicators used to measure these levels.
3. Interventions – the non-structural flood risk management measures used to influence preparedness and response levels.

A detailed coverage of the social research framework development is provided in Duffy (2021).

The social research framework was used to construct a community survey. The survey questions were trialled by Wimmera CMA staff and further refined prior to distribution. There were two options for survey response: through the post using a reply-paid envelope or online.

The social research was conducted in line with the principles in the National Statement on Ethical Conduct in Human Research (National Health and Medical Research Council, 2015).

Six towns were selected for survey distribution: Horsham, Halls Gap, Dimboola, Natimuk, Warracknabeal and Rupanyup. These towns were selected because of their known flooding history and varied demographics. It should be noted that no outlying rural properties were surveyed.

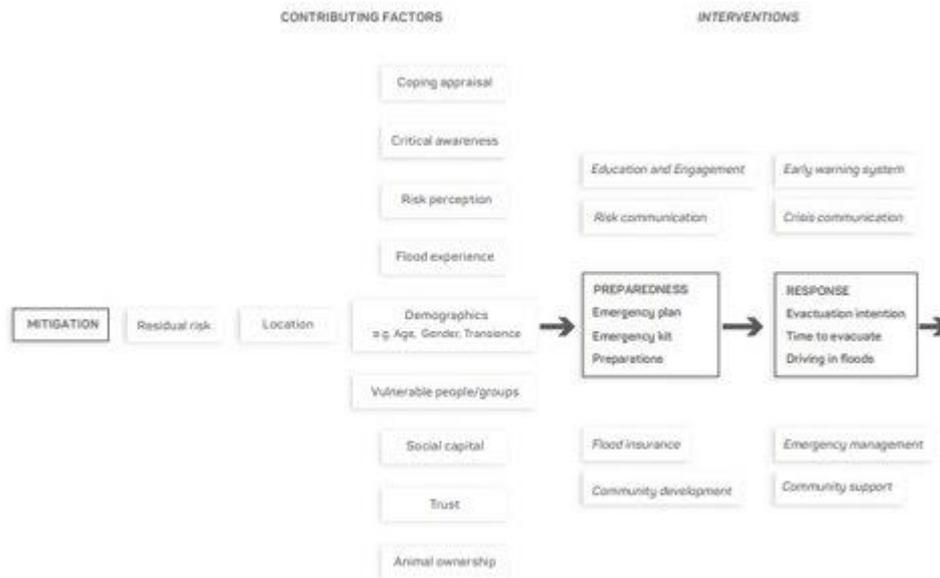


Figure 2: Research framework designed to examine community flood preparedness and response

The number of properties in each town in each flood risk category was calculated using GIS layers provided by Wimmera CMA. Of these, 38% of the properties in the A, B and C flood risk categories and 9% of properties in the D and E categories were selected using a stratified random sampling approach which involved selection of properties scattered across each category where possible.

To obtain a statistical confidence level of 95%, approximately 400 of the occupied land parcels needed to be surveyed across the six towns, noting that there is a statistical confidence interval of 5 (meaning that if 60% of respondents give a particular answer, there is confidence that the answer is between 55% and 65%). The planned survey method of face-to-face engagement with a 50% response rate meant that a total of 800 properties were selected for surveying.

However, due to the onset of the COVID-19 pandemic in March 2020 and related social distancing measures, the planned survey method of face-to-face engagement was impossible, and surveys were left in letterboxes and an online survey option was also offered. A total of 764 surveys were distributed in this way.

As a result of the altered method, a much lower survey response rate (21%) than planned was achieved, although this still provided a relatively high level of statistical confidence.

Furthermore, response rates across the five flood risk categories were relatively evenly divided, noting the bias towards higher risk categories in the survey distribution. Also, there was a good response from each of the six towns considering their proportionate populations and properties in flood risk categories.

Results

A summary of the main results from the social research is provided below.

Contributing factors

1. Flood experience. A longstanding hypothesis is that previous experience with a flood will make an individual more likely to perform protective behaviours (Bubeck et al., 2012). Whether people prepare or not for flooding in the future appears to be dependent on the severity of the experience and how that experience has been interpreted (Becker et al., 2017).

Approximately 60% of survey respondents experienced the 2011 flood event in the Wimmera region (approximately a 1% Annual Exceedance Probability event). For those that had not experienced a flood there was a propensity to either overestimate or underestimate flood risk because they have no benchmark for comparison.

There was a tendency for those that had experienced the 2011 flood to use this event as their only benchmark in preparedness and response decision-making. For example, when comparing previous flood experience to whether they would evacuate, they appear to rely on the decisions they made in the 2011 flood. This psychological condition is called the 'prison of experience' (Kates, 1962), where people expect the future to be like the past. It can cause major flood emergency issues (e.g. the need for multiple rescues) if people experience greater flood heights or different flood scenarios than previously.

2. Risk perception. Most respondents displayed 'optimism bias', underestimating their property flood risk against the actual risk. Of particular concern is the 71% of respondents in Category A (extreme risk) that did not perceive the flood risk to their property as 'high'.

The literature is ambivalent about the role of risk perception in preparedness and response behaviours (Scolobig et al., 2012). A direct relationship of risk awareness leading to risk perception to preparedness to warning response cannot be assumed as there are a variety of other factors at play such as flood experience, trust, self-efficacy, critical awareness, and social capital.

Demonstrating the lack of impact of risk perception on warning response behaviours is the finding that 80% of those respondents who perceived a high flood risk would not evacuate before a flood. On the other hand, there was a high correlation between those that perceived high risk and those who took precautions prior to a flood (e.g. sandbagging).

3. Trust. Trust in warning sources and emergency authorities has been found to be a major factor in an individual's preparedness and response actions such as evacuation (Lindell et al., 2013). As shown in Figure 3, the most trusted flood warning sources were emergency services (e.g. VICSES), emergency text messages and the VicEmergency website and app. The least trusted warning services were television and social media.
4. Social capital. Social capital has been defined as the 'networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit'

(Putnam, 1995). It consists of those bonds created by belonging to a group that instills trust, solidarity, and cooperation among members.

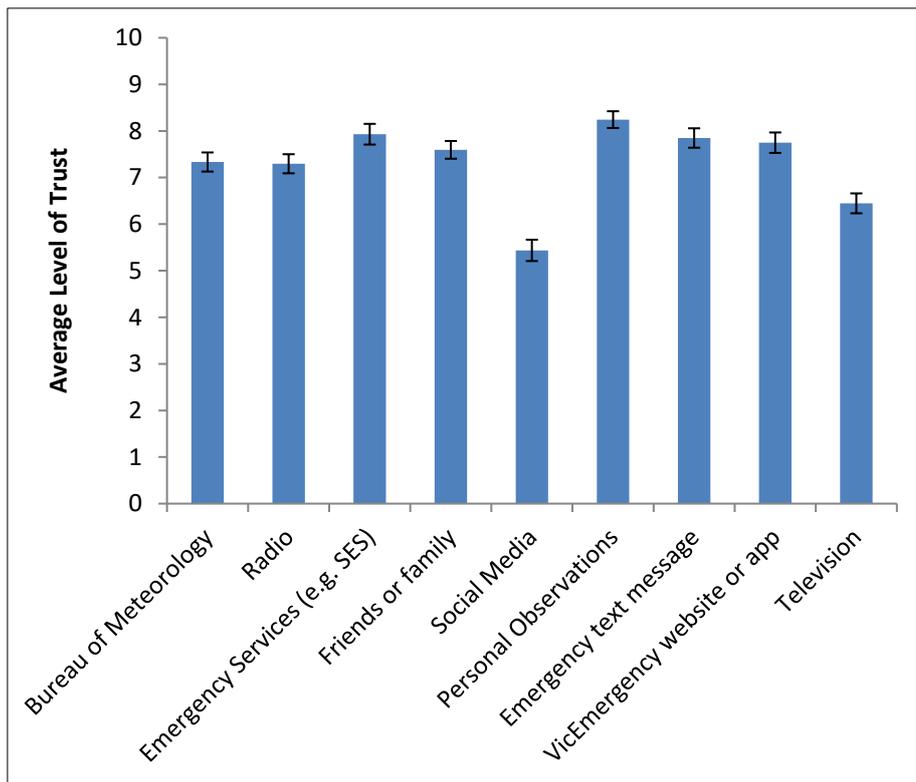


Figure 3: Trust in flood warning services, scale of 1-10 (where 1 equals very low level of trust, 10 equals very high level of trust)

Social capital has been found to be a key contributing factor to preparedness, response, and recovery (Aldrich, 2012).

The social research indicates a high level of social capital available in the study area with people learning about floods from others and being willing to help others in flood response. There was a tendency for social capital to be less strong in Horsham than the smaller towns in the study area. This finding is in concert with studies of social capital across the Wimmera region (Curtis & Mendham, 2017).

A high level of 'critical awareness' was displayed where respondents were talking to others about flooding through these social networks.

5. Vulnerable people and groups. There are numerous definitions of 'social vulnerability' (van der Veen et al., 2009). One well-supported definition of social vulnerability is 'the susceptibility of social groups to potential losses from hazard events or society's resistance and resilience to hazard' (Blaikie et al., 1994).

A person's gender, age, physical abilities, ethnicity, and sexuality, for instance, can lead to a higher risk of death or injury, longer recovery times, or greater risk of mental or physical trauma.

In each of the six towns, potential vulnerable people (e.g. those people with disabilities, older people) identified themselves. Approximately 19% of all respondents confirmed that they would need assistance in a flood. The main

reasons for requiring assistance were older age (over 80 years), poor vision and lack of mobility.

6. Other contributing factors. Other factors that contributed to flood preparedness and response were identified through the social research. These factors include location, age, and animal ownership.

There were significant differences in survey results across the six towns. For example, in Rupanyup, Halls Gap and Warracknabeal approximately half of the respondents had not experienced a flood, whilst in the other towns almost all had experienced a flood. The greater proportion of those that perceived no flood risk was in Halls Gap and Horsham.

As would be expected, the older respondents generally had the more flood experience and local knowledge. They also talked more with others about flooding. However, the older residents tended to be more unwilling to evacuate. They also tended to require assistance in a flood.

Half of the respondents said that they owned animals and of these about 90% said they were reticent to evacuate as a result. The ownership of animals can influence people's willingness to evacuate. Companion animals (pets) and livestock should be considered in household emergency planning.

Flood preparedness

The social research investigated several flood preparedness indicators including:

- Pre-flood mitigation actions
- Flood emergency plan
- Flood emergency kit.

Preparedness levels based on these indicators were generally very low. Only 28% of respondents said that they had conducted any action to reduce the damage to their property prior to flooding. Of greatest concern was the extremely low percentage (1%) that had written a flood emergency plan, even when emergency agencies had regularly promoted this action. Only 30% of respondents said they had a flood emergency kit.

Flood response

Several respondents said they had plenty of time to react to a warning and did not require prompting. Text messages and the VicEmergency app were the main warning triggers for action identified by respondents.

Most respondents appeared to have several protective actions to carry out if they knew a flood was imminent, such as sandbagging their property and lifting valuable belongings.

Although most of the towns have long flood warning lead times (> 24 hours), Natimuk and Halls Gap are prone to flash flooding (< 6 hours warning lead time). Of concern is the several respondents in these two towns that said they would take longer than 6 hours to evacuate.

Driving through floodwaters

VICSES strongly advocates that people do not drive through floodwaters, noting that a small car can float in 15 cm of water (VICSES, 2021).

The number of people willing to drive through floodwaters in the study area is comparable with that found in other studies in Australia (e.g. Rae et al., 2016).

Of particular concern are risk-takers that will drive through water greater than 20 cm and fast flowing water. These tended to be males over the age of 40 years.

Flood insurance

The uptake of flood insurance by at-risk property owners is based on several factors including flood experience, risk perception, socio-economic status and the effectiveness of insurance product promotion (Dufty, 2020).

Flood insurance coverage across at-risk Australian households is estimated to be over 93% (Insurance Council of Australia, 2016). From the social research, the flood insurance uptake across the six towns is significantly lower at 59%, although the large majority of respondents (88%) said they were aware of flood insurance products.

Discussion

Implications for the WFMS

The social research has unearthed several issues and concerns for future emergency management in the Wimmera region and the delivery/implementation of the WFMS. It confirms the hypothesis of floodplain and emergency professionals who developed the WFMS that residents have a low level of understanding of flooding and floodplain management.

From the social research, it appears that a large proportion of those living in flood-prone areas (including those in high risk categories) underestimate their flood risk, even though many experienced the 2011 flood in the region. They appear to be locked in a 'prison of experience' which limits their propensity for preparedness and their willingness to evacuate. Animal ownership appears to be an additional factor in evacuation willingness.

There are also newcomers to the Wimmera region and those living in low risk areas (little or no direct impact in the 2011 flood) that are either unaware of their flood risk or unable to gauge it accurately.

The willingness of particularly older males to drive through relatively deep and fast flowing water is of grave concern as over half of the flood deaths in Australia are attributable to people entering floodwaters (Haynes et al., 2017).

The low uptake of flood insurance and the relatively high level of people that require assistance should also be noted for attention.

On a positive note, the high levels of social capital, willingness to help others in a flood and interest in talking about local flooding are all attributes that can be harnessed to improve WFMS effectiveness through interventions such as flood education/engagement and community development.

Several specific interventions and activities were identified by Molino Stewart (2020) to influence the contributing factors and improve flood preparedness and response levels. These include:

- Check that vulnerable persons have a support network in a flood.
- Further build social capital related to flooding and include new residents in these networks.
- Notify residents in high flood risk categories that they are in this flood category and what they should do to prepare for and respond to a flood including the benefits of evacuation.
- Encourage all residents to learn about their flood risk and the benefits of flood insurance.
- Hold a ten-year anniversary of the 2011 flood to highlight flooding in the region and that it will occur again and most likely will be different.
- Continue to promote the virtues of preparedness actions through education and engagement.
- Communicate the message of not driving through floodwaters particularly to older males.

The social research also shows spatial differences across the Wimmera Region and therefore not only should there be these generic interventions, but also those related to specific issues in towns such as addressing the perception of the time required to evacuate in flash flood-prone Natimuk and Halls Gap.

Archetypes

The use of archetypes can help identify target groups in an at-risk community. Carl Jung instigated the popular use of archetypes in psychology. He viewed an archetype as a typical character to whom an observer might emotionally resonate (Jung, 1964).

Archetypes have been discussed in the international disaster literature based on local social context and community characteristics (e.g. Carroll & Paveglio, 2016). Strahan et al. (2018) identified seven self-evacuation archetypes for bushfires in Australia. 'These seven archetypes characterise the diverse attitudes and behaviour of typical groupings of householders faced with making a protective decision during a bushfire'.

From the survey data for this study there were no strong archetypes identified other than for flood evacuation behaviours and driving through floodwaters (see Figure 4).

Evacuation:

1. '**Early leavers**'. These tended to be younger people with little or no experience of flooding that would evacuate early.
2. '**Help needers**'. These tended to be older females that wanted to evacuate but required help.
3. '**Stay putters**'. These tended to be older males with previous flood experience that would not evacuate.

Driving through floodwaters:

1. '**No risk takers**'. Tended to be female and younger, and would not drive through floodwaters.
2. '**Slight risk takers**'. Would drive up to 20 cm slow water and tended to be males of all ages.
3. '**Big risk takers**'. Tended to be older males with previous flood experience who would drive through floodwaters greater than 20 cm depth.

Figure 4: Archetypes derived from the social research

From this analysis, older males should particularly be targeted in interventions as they are both unwilling to evacuate and willing to drive through floodwaters.

The social research framework

The social research framework developed for this project enabled the assessment not only of community flood preparedness and response levels, but also their underlying psycho-social contributing factors and possible interventions to influence these levels.

Figure 5 shows the complexity and interactions addressed by the framework (see Figure 2) that enabled an in-depth insight into some elements of the WFMS.

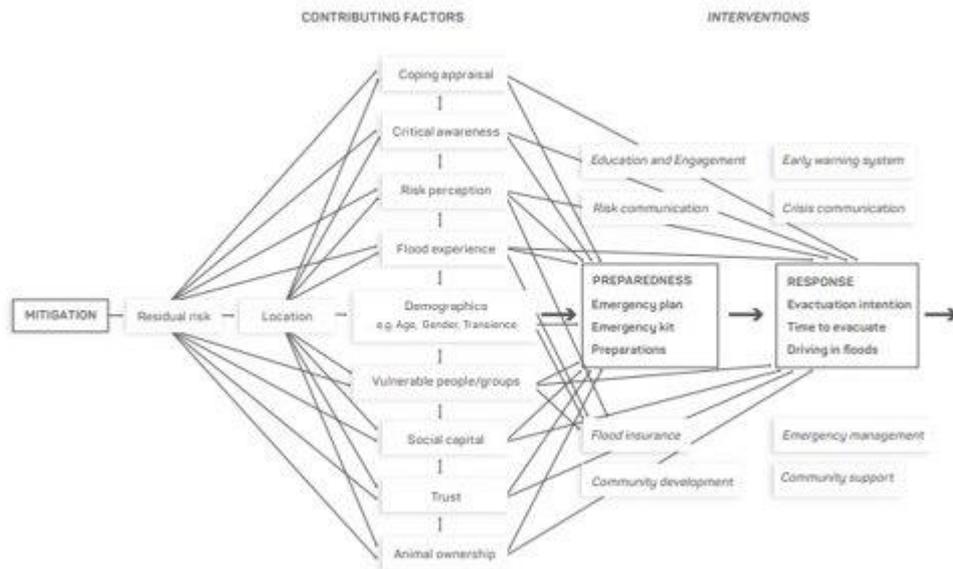


Figure 5: Use of the social research framework in the Wimmera project

It is the intention of the Wimmera CMA to conduct follow-up social research using the framework to see if recommended interventions have influenced flood preparedness and response levels and their contributing factors. Obviously, a major flood in the Wimmera region would strongly influence community flood behaviour and the impacts of this flood event should be monitored using the research framework.

The research framework has three limitations based on the Wimmera social research. First, at this stage, it does not weigh the contributing factors against each other but deals with them with the same level of importance. Second, the framework does not easily accommodate multiple causal factors where several factors may combine and have a cumulative effect. Lastly, there may be other important components of the research framework that have not been identified. Ongoing research is required to identify and include these components if warranted.

The research framework, built on the nexus of contributing factors and preparedness and response levels and interventions, has universal appeal in understanding and improving community disaster preparedness and response at the community, local, regional and national levels. The framework can be adapted to other hazards (bushfires, pandemics, heatwaves, tsunamis) and compounding hazard events (tropical cyclones where there is initial wind and storm surge followed by flooding). It can also be reconstructed for other parts of the 'disaster management cycle' (mitigation, recovery) and to assess overall community disaster resilience.

Conclusion

A research framework was developed to help understand and improve community flood preparedness and response across the Wimmera region of Victoria.

The framework was used as a basis for a social research project in the region, which found low preparedness levels, potential reasons for these levels and possible ways to increase the levels. It identified aspects of community response that require attention including unwillingness to evacuate and willingness to drive through floodwaters. The high levels of social capital in the region auger well for community support mechanisms in future floods.

The insight provided by the social research enables adjustments to the WFMS and identifies initiatives that can be developed and implemented to improve community flood preparedness and response in the Wimmera region.

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