



## **Appendix C: Flood Damages Assessment**

### **C.1. Quantification of Damages**

The quantification of flood damages is an important part of the floodplain risk management process. Flood damages can be defined as actual or potential where actual damage refers to the damage incurred during known flood events while potential damage is an estimation of the damage that could occur. Calculating potential flood damages gives a potential value of damage per property per design flood event and an overall average annual damages value which is the average cost to property owners per year owing to flood damages. By quantifying flood damage for a range of design events, appropriate cost effective management measures can be analysed in terms of their benefits (reduction in damages) versus the cost of implementation. The cost of damage and the degree of disruption to the community caused by flooding depends upon many factors including;

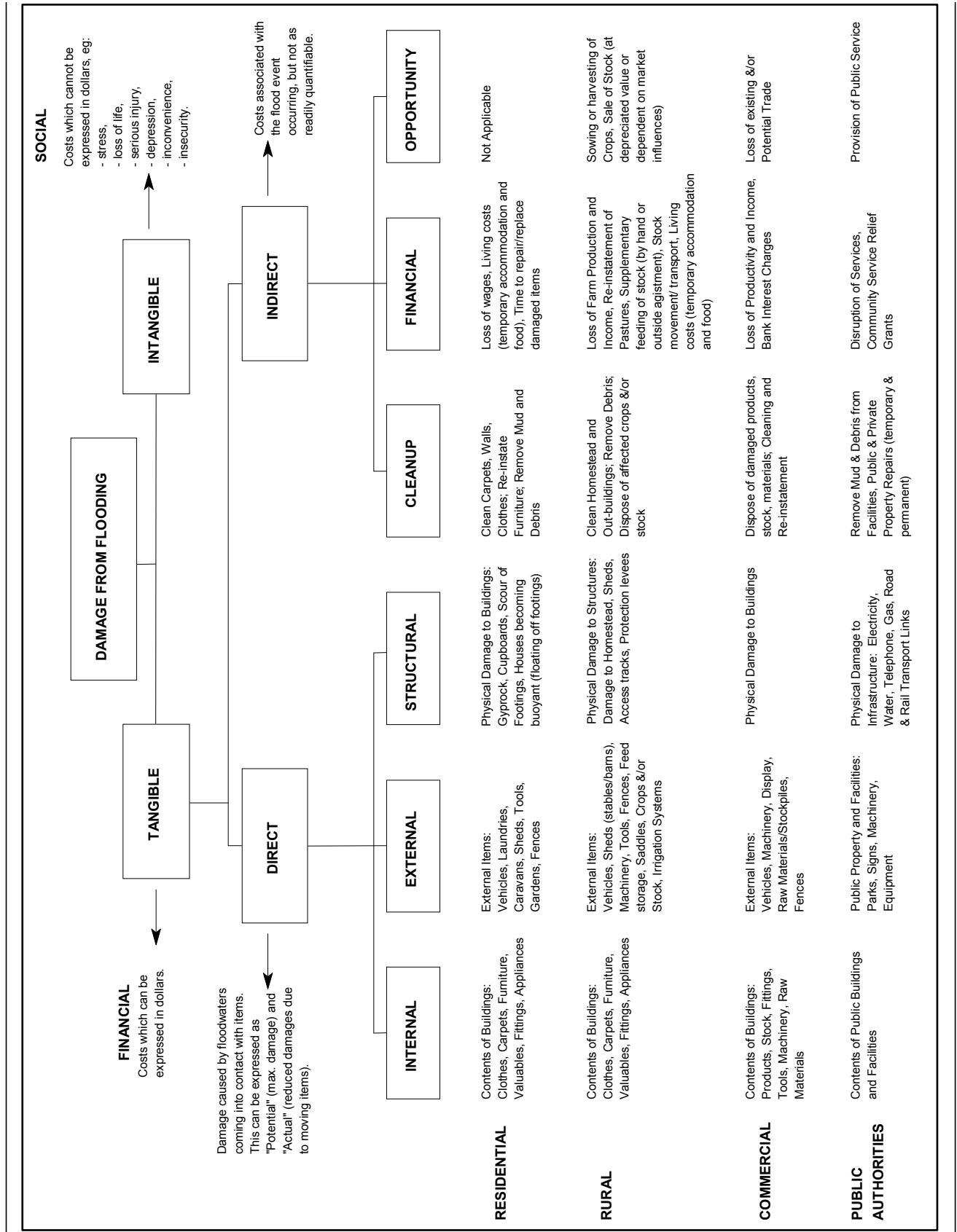
- The magnitude (depth, velocity and duration) of the flood;
- Land use and susceptibility to damages;
- Awareness of the community to flooding;
- Effective warning time;
- The availability of an evacuation plan or damage minimisation program;
- Physical factors such failure of services (sewerage), flood borne debris; and
- The types of asset and infrastructure affected.

The estimation of flood damages tends to focus on the physical impact of damages on the human environment and can be defined as being tangible or intangible. Tangible damages are those for which a monetary value can be easily assigned, while intangible damages are those to which a monetary value cannot easily be attributed. Types of flood damages are shown on Diagram C1 over.

To undertake the damages assessment floor level data is required. Flood levels were obtained for properties within the PMF extent from a variety of sources. Surveyed floor levels used in Reference 1 for the North Wagga area. Furthermore, WMAwater conducted a desktop flood level analysis for properties on the Murrumbidgee floodplain within the PMF extent. For properties within the Wagga Wagga Main City Level and average ground to floor estimate was applied using the results of the survey and desktop analysis. A total of 3,501 residential properties were examined in the damages assessment.

The non-residential damages are more complex than residential damages and have different damages associated with flooding. In Wagga Wagga 1,382 commercial properties were examined (public buildings such as toilet blocks, school, fire station were not included in the damages assessment). Damages for commercial properties have been assessed using separate damage curves to residential damages.

Diagram C1: Flood Damage Categories



## **C.2. Tangible Flood Damages**

Tangible flood damages are comprised of two basic categories; direct and indirect damages (Diagram C1). Direct damages are caused by floodwaters wetting goods and possessions thereby damaging them and resulting in either costs to replace or repair or in a reduction to their value. Direct damages are further classified as either internal (damage to the contents of a building including carpets, furniture), structural (referring to the structural fabric of a building such as foundations, walls, floors, windows) or external (damage to all items outside the building such as cars, garages). Indirect damages are the additional financial losses caused by the flood for example the cost of temporary accommodation, loss of wages by employees etc.

Given the variability of flooding and property and content values, the total likely damages figure in any given flood event is useful to get a feel for the magnitude of the flood problem, however it is of little value for absolute economic evaluation. However, considering damages estimates is useful when studying the economic effectiveness of proposed mitigation options. Understanding the total damages prevented over the life of the option in relation to current damages, or to an alternative option, can assist in the decision making process.

## **C.3. Expressing Flood Damages**

Average Annual Damages (AAD) is equal to the damage caused by all floods over a period of time divided by the number of years in that period and represents the equivalent average damages that would be experienced by the community on an annual basis. This means that the smaller floods, which occur more frequently, are given a greater weighting than the rare catastrophic floods total potential damage refers to the total damage estimated for a given flood event. Average damage per property is the Total damage estimated for a particular flood event divided by the number of properties flood affected in this event; either by flooding on the yard and/or above floor level of a building.

## **C.4. Calculating Tangible Flood Damages**

The flood damages assessment was undertaken for existing development in accordance with current OEH guidelines (Reference 3) and the Floodplain Development Manual (Reference **Error! Reference source not found.**). Potential flood damages were calculated with the use of a height-damage curves which relate the depth of water above the floor with tangible damages. The height-damage curves were established in accordance with OEH guidelines (Reference 3).

For residential damages the values used are based on the recommendations in the guidance with a post late 2001 adjustment factor was applied to increase damage values according to changes in Average Weekly Earnings (AWE) since 2001. Separate curves were established for commercial damages. The resultant curves are shown in Diagram C2 and C3.

Structural damages vary on whether the property is slab/low set or high set. For the purpose of this study, any property with a floor level of 0.5 m or more above ground level was assumed to be high set.

In calculating AAD, it was assumed that there would be no flood damages in events smaller than the 0.2EY event.

As it is usual that commercial and industrial damages are higher than residential damages a multiplier was applied to the total damage per property for each event by adjusting the typical building size value within the curve development calculations. Other factors including the clean-up costs and external damages were adjusted to reflect the differences between commercial and residential properties.

To adjust the residential damage curve to be applicable to commercial development, the average contents damages for a business was estimated to be \$150,000 and the clean-up cost have been estimated at \$4,000. This was done to take account the higher costs that businesses would incur compared to residential dwellings when flooded above floor level. The commercial damages curves were also amended to reduce the bench height based on the assumption that many commercial premises would have stock from floor level. External damage was set at \$1,250 as per residential properties.

Diagram C2: Flood Damages Curves – Residential Property

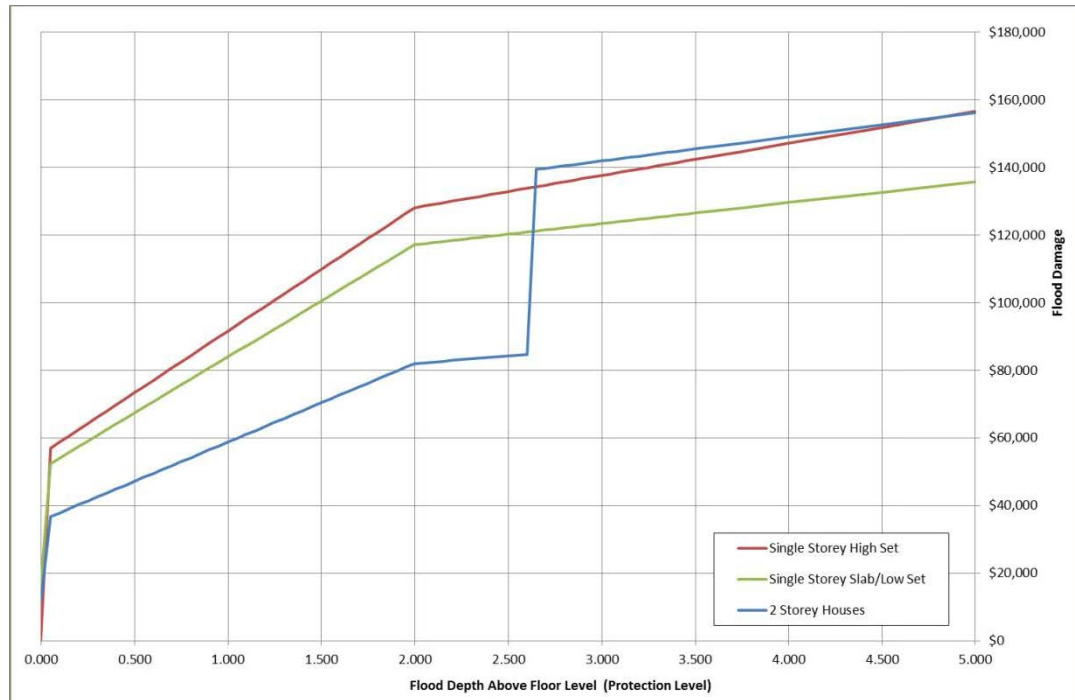
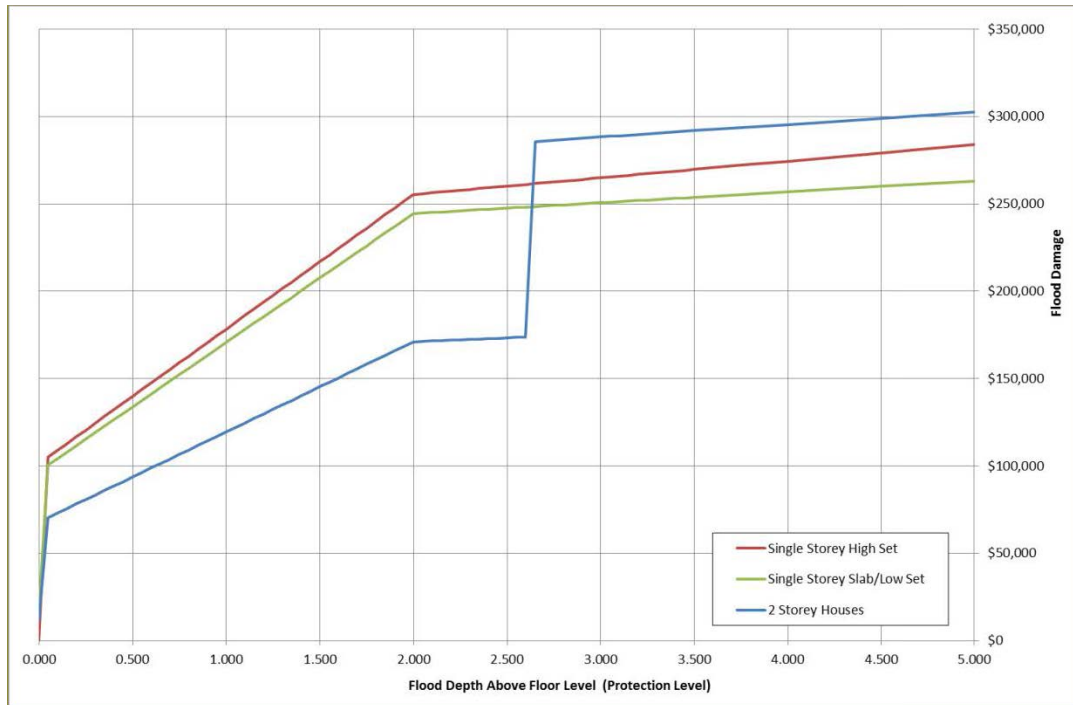


Diagram C3: Flood Damages Curves – Commercial Property



## APPENDIX C REFERENCES

1. NSW Government  
**Floodplain Development Manual**  
2005
2. WMAwater  
**Letter to NSW Public Works regarding North Wagga Damage Assessment**  
30 April 2015
3. Department of Environment and Climate Change  
**Floodplain Risk Management Guideline – Residential Flood Damages**  
NSW State Government, October 2007