

## 5 Flood Damages Assessment

A flood damage assessment has been undertaken to identify flood affected property, to quantify the extent of damages in economic terms for existing flood conditions and to enable the assessment of the relative merit of potential flood mitigation options by means of benefit-cost analysis.

The general process for undertaking a flood damages assessment incorporates:

- Identifying properties subject to flooding;
- Determining depth of inundation above floor level for a range of design event magnitudes;
- Defining appropriate stage-damage relationships for various property types/uses;
- Estimating potential flood damage for each property; and
- Calculating the total flood damage for a range of design events.

### 5.1 Types of Flood Damage

The definitions and methodology used in estimating flood damage are summarised in the Floodplain Development Manual. Figure 5-1 summarises the "types" of flood damages as considered in this study. The two main categories are 'tangible' and 'intangible' damages. Tangible flood damages are those that can be more readily evaluated in monetary terms, while intangible damages relate to the social cost of flooding and therefore are much more difficult to quantify.

Tangible flood damages are further divided into direct and indirect damages. Direct flood damages relate to the loss, or loss in value, of an object or a piece of property caused by direct contact with floodwaters. Indirect flood damages relate to loss in production or revenue, loss of wages, additional accommodation and living expenses, and any extra outlays that occur because of the flood.

### 5.2 Basis of Flood Damage Calculations

Flood damages have been calculated using a database of potentially flood affected properties and a number of stage-damage curves derived for different types of property within the catchment. These curves relate the amount of flood damage that would potentially occur at different depths of inundation, for a particular property type. Residential damage curves are based on the OEH guideline stage-damage curves for residential property.

There is no existing property floor level survey available for Barellan. The floor levels for 244 dwellings located within the floodplain were estimated from the LiDAR DEM, with floor level above ground level estimated from a drive-by assessment. The results of this assessment were validated using information relating to the March 2012 flood event, during which approximately one third of properties are understood to have been inundated above floor.

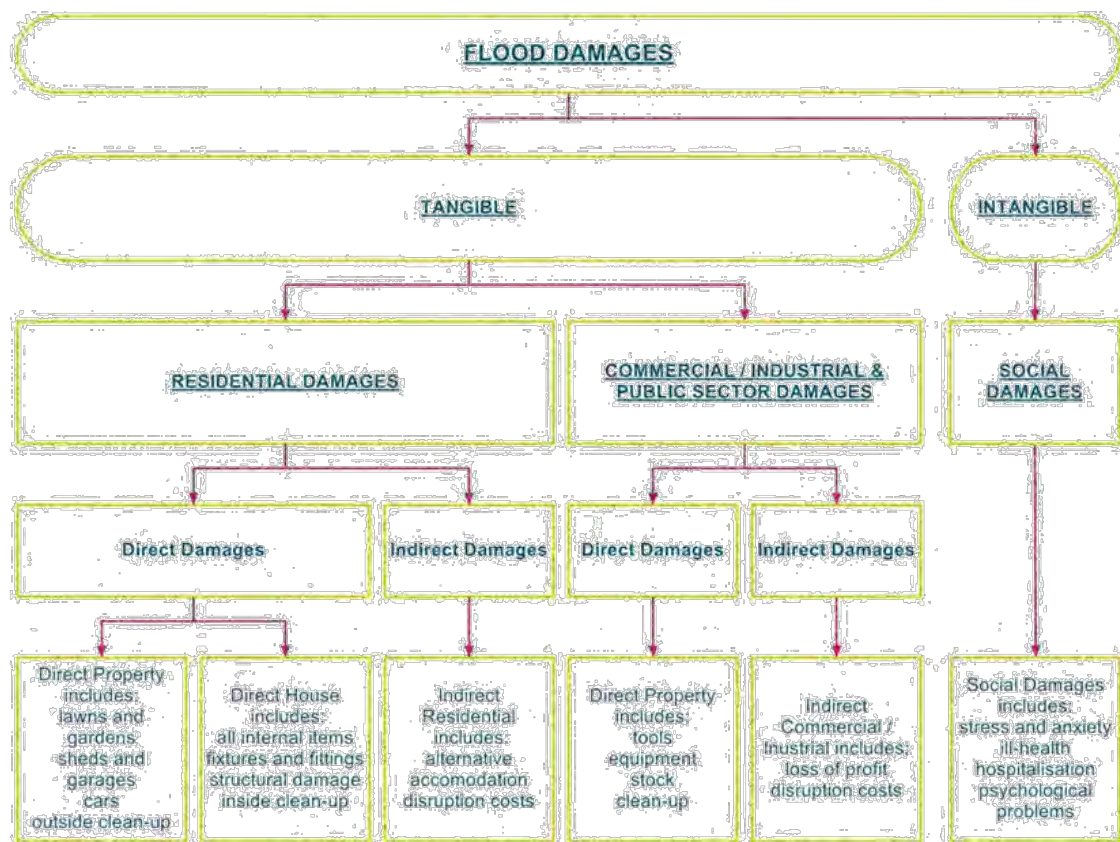


Figure 5-1 Types of Flood Damage

Different stage-damage curves for direct property damage have been derived for:

- Residential dwellings (categorised into small, typical or raised categories); and
- Commercial premises (categorised into low, medium or high damage categories).

Apart from the direct damages calculated from the derived stage-damage curves for each flood-affected property, other forms of flood damage include:

- Indirect residential, commercial and industrial damages, taken as a percentage of the direct damages;
- Infrastructure damage, based on a percentage of the total value of residential and business flood damage; and
- Intangible damages that relate to the social impact of flooding and include:
  - inconvenience,
  - isolation,
  - disruption of family and social activities,
  - anxiety, pain and suffering, trauma,
  - physical ill-health, and

- psychological ill-health.

The preliminary damage estimates derived in this study are for the tangible damages only. Whilst intangible losses may be significant, these effects have not been quantified, due to difficulties in assigning a meaningful dollar value.

## 5.3 Tangible Flood Damages

### 5.3.1 Assessment of Direct Damages

The peak depth of flooding was determined at each property for the 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP, 0.5% AEP and 0.2% AEP events and the Extreme Flood event. The associated direct flood damage cost to each property was then estimated from the stage-damage relationships. The flood damage curves include a flat \$11,725 cost of external damages for any level of flood inundation incurred below floor level. For instances where the property is not inundated above floor level and the external flood depth is below 0.3 m, this value is considered to be overly conservative. Therefore, a nominal \$5,000 value has been adopted for external flood damages for below floor flooding of less than 0.3 m. This value includes costs associated with septic system repair and disinfection – as this was a major impact of the March 2012 flood event. Total damages for each flood event were determined by summing the predicted damages for each individual property.

The Average Annual Damage (AAD) is the average damage in dollars per year that would occur in a designated area from flooding over a very long period of time. In many years there may be no flood damage, in some years there will be minor damage (caused by small, relatively frequent floods) and, in a few years, there will be major flood damage (caused by large, rare flood events). Estimation of the AAD provides a basis for comparing the effectiveness of different floodplain risk management measures (i.e. the reduction in the AAD), investigated in Section 7.

### 5.3.2 Estimation of Indirect Damages

The indirect damages are more difficult to determine and would vary for each flood event, particularly with the duration of the flood inundation. Previous studies detailing flood damages from actual events have found that the indirect damages for residential properties are typically in the order of 20% of the direct damages. Given the relative uncertainty associated with the indirect damages a value of 20% of the direct damages has also been adopted for this study.

The indirect damages associated with commercial properties are typically higher and a value of 40% of the calculated direct damages has been adopted.

## 5.4 Barellan Flood Damages

### 5.4.1 Residential Flood Damages

The assessment of the residential flood damages is presented in Table 5-1. From this data the AAD for residential properties was calculated as being \$79,000 in direct damages and \$19,000 in indirect damages, giving a total value of \$98,000.

**5.4.2 Commercial Flood Damages**

The assessment of the commercial flood damages is presented in Table 5-2. From this data the AAD for commercial properties was calculated as being \$4,000 in direct damages and \$1,000 in indirect damages, giving a total value of \$5,000.

**5.4.3 Infrastructure and Public Sector Flood Damages**

Public utilities and infrastructure include roads, railways, parklands and underground water, sewerage, power and telephone services and installations. The damages sustained by public utilities comprise the replacement or repair of assets damaged by floodwaters, the cost of clean-up of the installations, as well as the collection and disposal of clean-up material from private property.

Damage incurred to public utilities and infrastructure during a flood event was estimated as 30% of the combined tangible (direct and indirect) damages to residential and commercial properties.

**Table 5-1 Summary of Residential Flood Damages**

Design Event	Properties Flooded Above Floor (and Ground)	Direct Damages (\$)	Indirect Damages (\$)	Total Damages (\$)
20% AEP	0 (0)	\$0	\$0	\$0
10% AEP	0 (0)	\$0	\$0	\$0
5% AEP	0 (0)	\$0	\$0	\$0
2% AEP	22 (40)	\$461,000	\$110,000	\$571,000
1% AEP	69 (110)	\$2,559,000	\$602,000	\$3,162,000
0.5% AEP	118 (94)	\$5,250,000	\$1,230,000	\$6,480,000
0.2% AEP	163 (58)	\$7,820,000	\$1,801,000	\$9,622,000
Extreme Flood	208 (14)	\$11,331,000	\$2,614,000	\$13,945,000
<b>AAD</b>	<b>-</b>	<b>\$79,000</b>	<b>\$19,000</b>	<b>\$98,000</b>

**Table 5-2 Summary of Commercial Flood Damages**

Design Event	Properties Flooded Above Floor	Direct Damages (\$)	Indirect Damages (\$)	Total Damages (\$)
20% AEP	0	\$0	\$0	\$0
10% AEP	0	\$0	\$0	\$0
5% AEP	0	\$0	\$0	\$0
2% AEP	1	\$1,000	\$0	\$1,000
1% AEP	13	\$131,000	\$52,000	\$183,000
0.5% AEP	16	\$268,000	\$107,000	\$375,000
0.2% AEP	17	\$395,000	\$158,000	\$553,000
Extreme Flood	20	\$530,000	\$212,000	\$742,000
<b>AAD</b>	<b>-</b>	<b>\$4,000</b>	<b>\$1,000</b>	<b>\$5,000</b>

### 5.4.4 Total Tangible Flood Damages

The total tangible flood damages for residential properties, commercial properties and the public sector were combined, as presented in Table 5-3. From this data, the combined AAD was calculated as being \$134,000, comprised as follows:

- \$98,000 from residential properties;
- \$5,000 from commercial properties; and
- \$31,000 from infrastructure and public sector.

**Table 5-3 Summary of Total Tangible Flood Damages**

Design Event	Residential Flood Damages (\$)	Commercial Flood Damages (\$)	Infrastructure and Public Sector Damages (\$)	Total Tangible Flood Damages (\$)
20% AEP	\$0	\$0	\$0	\$0
10% AEP	\$0	\$0	\$0	\$0
5% AEP	\$0	\$0	\$0	\$0
2% AEP	\$571,000	\$1,000	\$171,000	\$743,000
1% AEP	\$3,162,000	\$183,000	\$1,003,000	\$4,348,000
0.5% AEP	\$6,480,000	\$375,000	\$2,057,000	\$8,912,000
0.2% AEP	\$9,622,000	\$553,000	\$3,052,000	\$13,227,000
Extreme Flood	\$13,945,000	\$742,000	\$4,406,000	\$19,093,000
<b>AAD</b>	<b>\$98,000</b>	<b>\$5,000</b>	<b>\$31,000</b>	<b>\$134,000</b>