2. BACKGROUND

2.1. THE NEED TO PLAN FOR FLOODING

Flooding is a natural phenomenon, but its consequences can be a disaster for the occupants of flood affected land. Flooding can be managed, but this requires some effort and sacrifice by communities and local governments. In essence, flood management involves making sound planning decisions based on a consideration of social, environmental and economic factors, as well as a consideration of flooding issues.

It is the interaction of people with the land that determines how much of a threat floods actually are. After heavy rain, the ability of catchment systems to contain water can be stretched to their limits. Large volumes of fast moving water must have somewhere to go, and its natural courses should not be obstructed. Flood management involves the implementation of physical and non-physical damage reduction measures.

Newcastle is a good example where townships were built close to rivers and creeks for ease of transport and access to water, with little or no understanding of the effects of this development on the natural flow of water. Rivers and streams are dynamic, changing systems, and all too often seem to ignore the natural boundaries set by their banks. Fast moving watercourses are formed by the channelling of floodwaters, not only by natural features, but also by man-made structures, for example along streets and between buildings. On the other hand, low lying open areas, including parks, can serve to contain and slow the damaging waters.

2.2. HISTORIC FLOODING

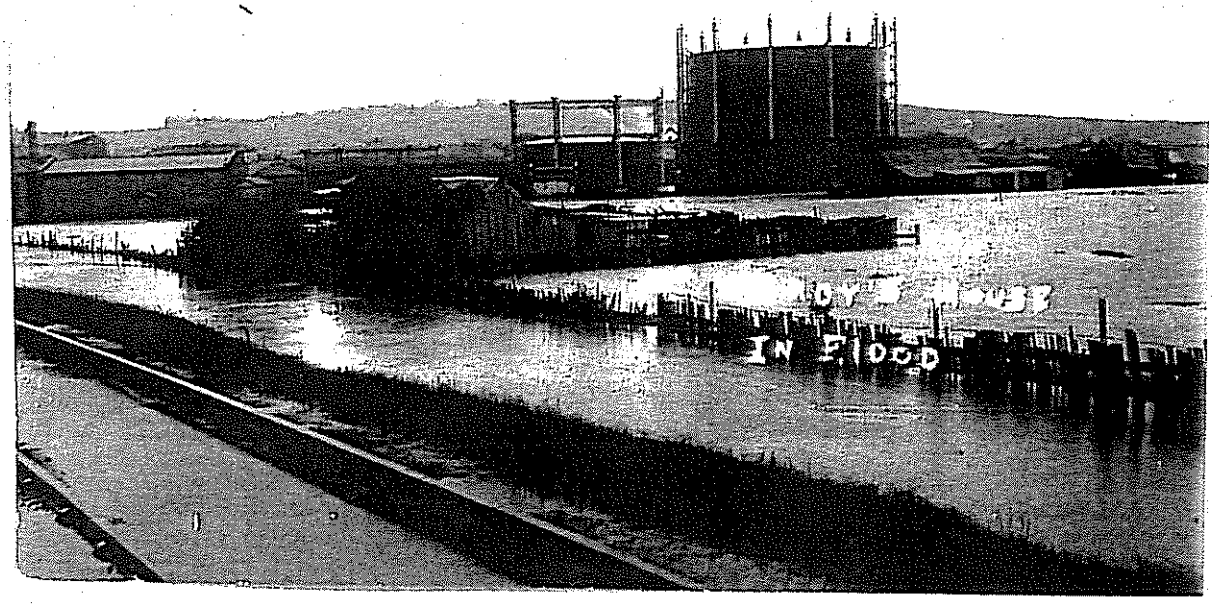
Prior to European settlement, flooding was a part of the natural environment that helped to shape the landform and ecology in the catchments that now pass through the Honeysuckle redevelopment. These catchments are now known as the Throsby, Cottage Ck. and Central Business District catchments and are shown in fig 1.

From the earliest times of European settlement in Honeysuckle's catchments, flooding was discovered to be an important part of nature that somehow had to be lived with. Early newspapers report for example:

> "Alderman Flemming said a letter had been received of there being too much water at Honeysuckle...He thought it would benefit ... to run a culvert into the sea to relieve the ward of a great mass of water." (The Newcastle Chronicle 15 June 1864)
>
> "Standing on the bridge which crosses the stormwater channel (now King Street), one looked on a raging rush of water, and the backyards of Hunter Street were all flooded. The Gas company's office was surrounded with water, and across the flats, the roofs of partially submerged houses stood out like little islands." (Newcastle Morning Herald 25 Feb 1908)
>
> "Cottage Creek channel was unable to cope... King Street west was like a lake... Water entered the back rows of the Theatre Royal and filled the orchestra well. Water entered Cameron's Family Hotel." (Newcastle Morning Herald 18 April 1927)
>
> "I tried to make my way to Steel Street along Hunter Street, but the water was too deep for me. ...People alighting from trains at Civic were unable to leave the station, and for nearly an hour stayed marooned at the entrance." (NS 11 Sept 1950)

Significant flood events since European settlement are known to have occurred in Honeysuckle's catchments in 1864, 1871, 1908, 1917, 1920, 1927, 1950, 1963,1984,1988, 1990, and 1992. Rescues by boat have been commonly reported.

Even before widespread development, the catchments that pass through Honeysuckle were capable of producing large volumes of runoff. Note the photos of historic flooding in Newcastle.



UPPER PHOTO: Flood Rescue Boat, Steel Street, early 1900's.
LOWER PHOTO: Looking across Marketown Shopping Centre from King Street, early 1900's.

Given the relatively short time since European settlement, it is unlikely that the historic record will have encountered the worst flooding that the catchments can generate.

The historic evidence and community expectations require the flood risks in the present and future urbanised catchment environments be understood and well managed. This is difficult in areas of the catchments because flood problems are "locked in" by earlier development. Developments would be built very differently if we were starting afresh in these catchments. However, despite the difficulties, today's standards and long term planning horizons can and should be incorporated into the new opportunities presented by Honeysuckle Redevelopment.

2.3. POTENTIAL FLOOD RISKS AND MECHANISMS

Flood risks emanate from mainstream flooding from Throsby Creek and Cottage Creek, and local flooding by local thunderstorms.

Mainstream flooding means inundation from rainfall over the total Throsby Creek or Cottage Creek catchments. Local flooding means any inundation from a storm event that does not mobilise the whole of the Throsby or Cottage Creek catchments, but which is capable of producing inundation at a location in the subdivision greater than mainstream, or where mainstream does not reach. For example, an intense storm centred over the Wickham / Maryville basin would need to be considered for overtopping Hannell Street.

Cottage Creek is a major flow path. However the limited capacity of the main channel results in flood waters breaking from the channel upstream of the Honeysuckle Development area. Some flow diverts along King Street and down National Park Street while the remaining flow passes along Steel Street through to Hunter street. In events greater than the 1% AEP, floodwaters will divert down Union Street if levels are sufficiently high. Steel Street flows will drain to the east and west along Hunter Street or through the railway to the north of Steel Street. The corridor through the railway yards is a major overland flow path. If this is closed off more flow is diverted down National Park and Union Streets. Flows that reach Hunter Street via National Park Street divert along Hannell Street and back to Cottage Creek or directly to the harbour. In larger events flood waters flow east along Hunter Street draining to the harbour through Merewether Street and Worth Place. Flow may also break over the catchment divide at Darby St. and drain east towards Queens Wharf. Flow diverted east along Hunter Street will drain through to Wharf Rd. at Queens Wharf and the Harbour Park Centre. Overland flow ponds at the low point on Wharf Road near the end of Merewether Street before spilling over the wharf and into the harbour.

While Throsby Creek initially overtops its bank as a relatively frequent event (5% AEP) at Islington Park, the flooding is contained locally until the low point in the ridge east of the park area along The Avenue overtops at a 0.2% AEP event. Flow then spills into the Maryville area and exits across the low point in Hannell St. at its intersection with Annie St. Throsby Creek also overtops its banks upstream of the Hannell St. Bridge (near Elizabeth St.) at a 0.2% AEP event inundating the northern end of Maryville. During very large floods, water ponding in the Maryville area breaks across Branch St. and flows into Wickham.

2.4. PREVIOUS STUDIES

Several studies have been undertaken on flooding behaviour relevant to the Honeysuckle Development area. These include:

- Throsby Creek TCM (ref 7) – this total catchment management study of the Throsby Creek Catchment in 1989 undertook simple investigations of the flooding behaviour of lower Throsby Creek.
- Lower Hunter River Flood Study (ref 3) – A flood study of the Hunter River undertook an analysis of recorded water levels appropriate to the foreshore areas.
- Newcastle/Honeysuckle Development Flood Strategy – Definition of Flooding Behaviour (ref 2) – A comprehensive investigation of broad-scale flooding impacts in the Throsby Creek and Cottage Creek catchments was undertaken, which was suitable to determine opportunities and constraints for the site.
- Honeysuckle Flooding and Drainage Study (ref 5) – This study looked at flooding behaviour in the Newcastle CBD area utilising a design-type modelling approach.
- Honeysuckle Development Trunk Drainage Concept Design Report (ref 6) – This study resulted in the design of floodways and view corridors through the Honeysuckle Development area.
- Honeysuckle Marina Environmental Impact Statement (ref 8) – This study reviewed tailwater conditions in lower Throsby Creek and Recommended elevated tailwater conditions.
- Cottage Creek Flood Study (ref 9) - A study of the upper reaches of Cottage Creek defined flooding behaviour upstream of the Honeysuckle development areas.
- Hannell Street Landscaping Investigations (ref 10) – Reviewed the impact of raised mounds, view corridors and flooding behaviour for the PMF event in the Wickham area.

The investigations showed that the flat nature of the terrain and the rapid response of the catchments leads to a diffuse flooding environment, with many cross-connections between flooding pathways.

3. STRATEGIC FRAMEWORK

3.1. STRATEGIC FRAMEWORK

The elements of the strategic framework for the flood management plan are;

- Compatibility with the future;
  - Future development in the catchments,
  - Future options to manage flooding,
  - Projected Greenhouse Impacts,

- Compatibility with the surrounding flooding environment;
  - Design the flood management system to have no or acceptable impacts on surrounding areas.

- Compatibility with the flood risks;
  - To life, eg high hazard floodways and underbuilding carparks,
  - To property, eg design habitable development generally above 1% AEP levels,
  - General, eg represent pre and post redevelopment conditions and reference to flood impact assessments.

3.2. FLOOD BEHAVIOUR AND HAZARD DEFINITION

The appropriate flood standards for Honeysuckle were determined to be based on a fully developed catchment scenario. This is different from a traditional flood study where the existing flood behaviour is accepted as the appropriate standard. This is because the Honeysuckle Redevelopment is a major feature at the most downstream point of three catchments, which when combined with the expected extended development period, may result in changes occurring in the catchment that could potentially result in larger flows.

By designing to a full development standard, Honeysuckle has seized the opportunity to satisfy both the design events required by NCC and also to exceed normal community standards.

Existing flow paths are generally defined by the street systems and open space areas. The high density of buildings along street frontages channels the flow through the road network until a break in the building line allows waters to spill into open spaces before reaching the harbour. The flood management plan utilises existing flow paths or provides for alternative routes where the existing flow path is closed.

Detailed hydraulic design was undertaken using the MIKE-11 numerical computer model developed for the original Honeysuckle Flooding and Drainage Study (ref.5). This model is suitable for this type of work because of its ability to simulate all the required processes, particularly the high velocity flows and flow controls that commonly occur in urban flooding situations. The model is further suited to the design of hydraulic channels and floodways because detailed culvert and pit information can be entered and checked.

Design flood hydrographs have been generated for the 1 % *AEP (annual exceedance probability)* event and for the PMF *(probable maximum flood)* event on the basis of potential fully developed catchments.

The capacity of the underground (or creek) drainage system is approximately 10% AEP. This means that for less frequent events, water will need to flow overland. For the Honeysuckle Redevelopment, designated overland flowpaths or floodways convey drainage water in excess of the capacity of the underground drainage system. The flood analysis is based on these designated floodways only, ie built finished level changes in other areas do not affect flood behaviour. The floodways are designed to accommodate flows with an acceptable management of risks.

The Greenhouse effect has been included in the analysis by using an elevated tailwater level in the predictive computer runs. The effect of high tides has also been considered. High tides which are often called 'King Tides' usually occur around late December. These tides can reach water levels of up to 1.2m above mean tide level in the Newcastle area. The Honeysuckle flood analysis has used a tide level of 1.3m above mean sea level for the analysis. This accounts for all possible high tide impacts.

Simulations for the 1% AEP and PMF ultimate case flows were completed for the developed and undeveloped conditions and the effects at key locations in and around the development site were determined. These flows, velocities and levels are the basis for the development of flood management plans for the area. The 1% AEP and PMF events are the appropriate flood scenarios for the setting of minimum property and minimum habitable floor levels (HFL).and underground carpark entrance levels as set out in the more detailed development guidelines in this Flood Management Plan. Refer to Appendix A for an explanation of HFL.

The 1%AEP effects presented in the various study reports have been prepared for broad-scale impacts. Where the contributing catchments are known to be very small and there is effectively no catchment wide 1%AEP effects, local catchment effects have been identified. The flood relief provided by the local drainage system has been ignored. The tabulated 1%AEP flood levels are the higher of the site specific average flood levels from mainstream flooding and local storm flooding. Local storm flooding has been determined by modelling a local storm over the immediate catchment of the development site. As a third criteria for setting floor levels, a minimum flood depth has been assumed at 0.15m deep, which corresponds to a condition where the surface drainage system, ie floodways and roads, may be flowing at gutter full, ie at 0.15m deep. This assumption is important when considering the entrances to local underground carparks.

The Flood Management Plans are based on this flood study. Significant outcomes from the flood study are;

- The Waterfront and Cottage Ck Precincts, when fully developed, will not adversely impact adjacent lands.
- There is little prospect of lowering flood risks and hazards on adjacent lands, since upstream controls dominate flooding behaviour.
- Future Flood Management Strategies in the wider catchments upstream of the Honeysuckle Redevelopment have not been inhibited by allowing sufficient corridors for future channel widenings, if the future community chooses to construct these.

It is likely that within the life of the Honeysuckle Redevelopment community standards and expectations will evolve and that scientific understanding of flood mechanisms will advance. Additionally infrastructure and development requirements may change. The Flood Management Plans may therefore require future revision to reflect those changes.

3.3. FLOOD MANAGEMENT PLAN DEVELOPMENT

The Honeysuckle Flood Management Plans incorporate practical methods to reduce the effect of flooding in the Honeysuckle areas, in particular;

- Sufficient flood conveyance capacity has been planned across the site through view corridors and public accessways (floodways) to facilitate the egress of flood waters into the harbour and thus reduce potential flood levels in the context of development objectives. Note, floodways have been designed as pathways reserved for water to travel in and through during large flood events. Floods of a larger magnitude can and will occur, with sudden water rise possible, so flooding may not be restricted to floodways and may extend into roads and public spaces.
- The floodway system permits development to be designed so that 1%AEP flooding does not affect any occupied areas.
- In designing the geometry and texture of the view corridors / floodways, consideration has been given to the public safety aspects of flood flows of large magnitudes.
- The flood conveyance capacity through the mouth of Cottage Creek to has been designed to accommodate a major (1% *AEP)* flood flow without affecting any proposed buildings. 1 % AEP flows have been accommodated from the local catchment through the CBD and Queen's Wharf areas. Under the existing

catchment and channel conditions, the 1 % AEP flow through Throsby Creek is contained within the existing channel.
- For floods in excess of 1 % AEP, flooding has been accepted of lower habitable floors of buildings. PMF refuges are required to be provided in the upper levels of new multi-storey buildings.
- Where possible, public refuge space is to be provided above the PMF flood level in all multi unit residential buildings.

3.4. DESIGN OF FLOODWAYS FOR THE WATERFRONT AND COTTAGE CK. PRECINCTS

Five floodways convey floodwaters across the Waterfront and Cottage Ck. Precincts. As of December, 1998, these floodways are in various stages of completion. Parameters to be taken into account in completing construction are;

General Requirements

- The grade along the floodways should be kept low where practical. This reduces hazard and scour problems.
- Grades across floodways should also have minimal grade to reduce flow concentration. Where access roads are not proposed, a suggested crossfall of 3 % from central invert to boundary or batter toe has been noted on the floodway plans.
- Due to elevated minimum property levels required for development lots adjacent to some floodways, a mowable batter slope of 1:6 has been specified as shown in appropriate floodway plans. Where property levels are elevated significantly above minimum property levels, retaining walls may be required to maintain an acceptable floodway profile.
- Subject to other NCC requirements, the use of floodways to provide vehicle access to developments is accepted. However, extended and overnight parking in the floodway should be avoided.
- Floodway spillway levels have been determined taking into account fixed floodway weir controls as well as recorded and predicted Port Newcastle water levels. Standing water levels of upto 1.36m AHD have been recorded in the harbour. A minimum spillway level of 1.6m AHD has been adopted with a preferred level in the order of 2.0m AHD where feasible.

Cottage Ck. Floodway

- As outlined in section 2.3, the capacity of the present channel is limited. The channel overflows upstream of the Honeysuckle Development area. The FMP caters for these overflows. Sufficient public space has also been provided within the Cottage Ck. floodway corridor to allow the floodway to convey the PMF. Future works to allow the floodway to accommodate PMF flows would include;
  - Works upstream of the Honeysuckle Development area to retain flow within the Cottage Ck. Channel.
  - Reformation of channel banks, including removal of present mounding, to provide a more suitable floodway profile.
  - Removal of the channel lid between Wharf Rd. and the harbour. Note the removal of this lid will also reduce the risk of flow obstruction during floods of lesser magnitudes.
  - Removal of toilet block at Hunter St
- Floodway warning signage is recommended upstream of Honeysuckle drive.

Steel St. and HWC Floodways

- As shown on the floodway plans, reconstruction is required downstream of Honeysuckle Drive.
- Currently the Steel St. and HWC floodways are likely to be utilised by flows greater than a 1%AEP event. However, proposals are being considered to extend Steel St. to Honeysuckle drive. This may allow floods of the order of 1% AEP to be relieved along this floodway.
- The HWC floodway would only operate in major floods, ie approaching the PMF.

Worth Place Floodway

- A major trunk drainage system has been constructed under this floodway.
- As shown on the floodway plans, reconstruction is required downstream of Honeysuckle Drive through the proposed Worth Place Park. A 1.6m AHD spillway crest level has been adopted to provide above ground flood relief while minimising the risk of wave spillage from the harbour.

Merewether St. Floodway

- This floodway has been designed to suit proposed developments along the waterfront.
- The tabulated flood levels for this floodway dominate flood heights between Merewether St. and the western end of lot HB5D.
- The critical feature of this floodway is the neck between the existing Perway Store and the proposed Merewether Wharf Hotel. Refer to the floodway plan for details.
- Floodway warning signage is recommended at this location.

3.4. FLOOD EMERGENCY RESPONSE PLAN

Flood Emergency Response Plans (FERPs) have been prepared for each area. They are primarily concerned with the protection of human life, with the control of flood debris and property damage being of secondary concern. The plans incorporates the following components:

- Hazard identification
- flood warning systems
- evacuation and evasion procedures
- evacuation routes and flood refuges
- flood monitoring and advisory provisions, and
- flood preparedness and awareness procedures for residents and visitors.

Since the Honeysuckle Development has been designed so that 1%AEP flooding does not affect any occupied areas, the flood response plans are designed for self-directed procedures for evacuation or evasion aimed at flood events that are larger, but less likely to occur. The FERPs also recognises that, where practical, persons should utilise the refuge provided in the upper levels of residential and commercial buildings in preference to evacuation. Where evacuation is required, the FERPs are simple and follows a format similar to fire evacuation procedures, where applicable. The FERPs are aimed at being self-directed to minimise the draw on limited State Emergency Services resources. Public refuges above PMF have been provided as shown on the hazard plans for each area. Well lit pathways and streets in all areas allow refuges to be identified and evacuation routes to be followed.

Provisional hazard and hazard zones have been determined based on the following hazard categories;

Hazard Category	Provisional Hazard (velocity X depth)	Effects
Low	less than 0.4	limit of car stability
Medium	0.4 to 0.8	Wading possible, evacuation possible by truck
High	0.8 to 1.0	Damage to light structures
Very High	1.0 to 2.0	Evacuation by trucks unsafe
Extreme	Greater than 2.0	Evacuation by land transport not possible. Significant damage to structures likely.

Hazard plans have been prepared for the 1% AEP flood and PMF events to allow areas of high risk to be identified and to assist in emergency response planning.

In the Waterfront and Cottage Ck. Precincts, where a range of development types are proposed, the FERP recommendations, as outlined in section 5 of this FMP, are likely to be utilised by individuals required to manage their own FERP and persons nominated under a corporate structure to manage an FERP for their development. It is recommended that appropriate means of allowing the FERP recommendations to be made available and be utilised be developed and implemented where feasible.

4. DEVELOPMENT CONDITIONS & GUIDELINES

4.1. GENERAL

Conditions and guidelines have been developed for the various types of development proposed taking into account the different site conditions and risks applying to the Precinct areas. These conditions and guidelines are based primarily on the Honeysuckle Flood Management Platform and are outlined in Appendix B. To facilitate the implementation of the relevant development conditions and guidelines applying to each Precinct area, plans and accompanying tables have been prepared for the relevant lots, floodways, roads and public areas.

For the Waterfront and Cottage Ck. Precinct, the proposed development is multi-storey commercial, mixed use and residential developments, with and without sub-basement carparking. The relevant plans and tables are included in Appendices C and D. In summary, the information provided incorporates;

Plan type	No. off	Comment
Site Plan	1	
Hazard Plans	2	
Roadway Plans & Table	1 set	Incorporates two plans
Open Space Plans & Tables	3 sets	
Floodway Plans & Tables	5 sets	
Lot Plans & Tables	26 sets	

Development requirements not included in the plans and tables include;

- Buildings and structures to be designed to remain structurally stable in any flood event.
- Building foundations to accommodate flood induced saturation.
- All construction below the 1% AEP flood level to be of flood compatible construction.
- Where feasible, all electrical installations to be above the 1% AEP flood level.
- Stairwells to incorporate sills above floor levels where appropriate to ensure flooding occurs from the lowest level upwards.
- No storage below the 1% AEP level within carparks unless the carpark barrier extends above the PMF level.
- The floor level of all commercial buildings and enclosed storages to be at least 300mm above the 1% AEP flood level.

4.2. USE AND APPLICATION OF THE FLOOD PLANS AND ASSOCIATED TABLES FOR WATERFRONT AND COTTAGE CK. PRECINCTS

As described in section 3.2, the flood modelling carried out predicted flood levels and hazard details for a number key locations within each Precinct. These locations were chosen to optimise the relevance of the information within the Precincts. The key locations are primarily within floodways and are recorded in the floodway tables. All level information is based on AHD datum. The primary flood level information recorded in the floodway tables is;

- 1% AEP Pre-Development Average Flood Level
- 1% AEP Post-Development Average Flood Level
- 1% AEP Design Flood Level
- PMF Pre-Development Average Flood Level
- PMF Post-Development Average Flood Level

- Additionally inundation at a 1% AEP local storm event was considered at roadway sag pits. As shown on the floodway tables, local storm inundation at sag pits is not a critical event when compared to the 1% AEP design flood events. Accordingly, this inundation condition has not been incorporated into the lot tables.

Note, as explained in sections 3 and 6, the information provided is based on modelling a number of flood scenarios and is consequently approximate. Although the modelled flood data is presented to two decimal places, it should not be assumed that the information is accurate to two significant figures. This is particularly significant for the PMF condition.

The above information has been applied to appropriate corners and intersections of lots, roads and public spaces as detailed in the relevant tables. The post-development flood level information is appropriate for design purposes. However, the pre-development flood level information may need to be referenced for a particular lot or area where isolated or staged developments are proposed. The pre-development condition is generally as existing at December,1998; ie floodways incomplete and lots undeveloped. The post-development condition would generally apply to a particular lot when construction of the relevant adjacent floodway(s) was completed and the property levels of the lot were built as required by this FMP.

For developments within the larger lots where levels differ significantly between corners, a linear interpolation between the recorded values for the flood events may be carried out . However, the effect of local conditions requires consideration of surface drainage features. This has been accommodated by including kerb levels in the applicable tables.

Accordingly, the minimum property & on-ground garaging level at a location can be based on the higher of;

- The post-development level of the top of the adjacent kerb (taken as 150mm above gutter level) and
- The 1% AEP design flood level derived as a linear interpolation of the recorded levels for the particular lot.

Additionally a height factor may need to be applied, depending on specific conditions. Where the minimum property level, derived in accordance with the above, varies across a lot and it is proposed to take advantage of this in the proposed development, care needs to be taken in positioning changes in the property level. The property must always be elevated sufficiently to be free of possible inundation at the 1% AEP event.

In a similar process, the minimum Habitable Floor Level (HFL) at a location can be based on the higher of;

- 100mm above the post-development level of the top of the adjacent kerb (taken as 150mm above gutter level) and
- 300mm above the 1% AEP design flood level derived as a linear interpolation from the recorded levels for the particular area.
- For residential developments only, 800mm below the post-development PMF level.

Additionally a height factor may need to be applied depending on specific conditions for the lot. Where the minimum HFL, derived in accordance with the above, varies across a lot and it is proposed to take advantage of this in the proposed development, care needs to be taken in positioning changes in the HFL. The HFL must always be elevated sufficiently to be a minimum of 300mm above the possible inundation level at the 1% AEP event and to be above 800mm below the PMF level.

An example of the use of the FMP to determine flood levels for a development is provided in Appendix F.

Developers seeking more precise flood information for individual lots may choose to commission additional flood analyses.

4.2.1 PLANS

Floodway Plans

Plans with long sections and typical cross sections have been prepared for each floodway. The floodway plans and sections show the typical centreline of the existing and proposed floodways between and downstream of development lots. However the floodway plans do not accurately detail the possible water course(s) across and around intersecting roadways, railways and medians. ISG coordinates and typical surface levels (generally gutters) are shown for key locations along the floodway centrelines.