Australian Industry

Flood Barrier Guideline

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1.0 Preface

Author Contribution Statement

The preparation of this guideline has been a collaborative effort involving skilled and experienced individuals from the industry, local government and private sectors.

Individuals who contributed to this guideline and their supporting organisations are listed below:

- **AWMA Water Control Solutions / FloodFree, Mathew Trigg and Kristy Gray**
- **Bluemont Pty Ltd, Justin Bear**
- **Central Coast Council, Parissa Ghanem**
- **Flooding Solutions, Keith Jackson and Con Vink**
- **FM, Jinghua Cao, Tom Nguyen and Steven Kuang**
- **Hydrology and Risk Consulting (HARC), Michael Cawood**
- **Molino Stewart, Steven Molino**
- **Rockhampton Regional Council, Monishaa Prasad**

2.0 Purpose of the Guideline

The Australian Flood Barrier Guideline have been developed as an industry initiative to educate and support public and private sectors on the concept of flood barriers as a means to effectively reduce flood risk.

The guideline is not a "how to" guide and is not intended as an advocate for barrier use in preference to effective land use planning or other measures. Additionally, this guideline is not intended as a promotion of one type of barrier over another, or of any particular barrier manufacturer or supplier.

Flood barriers have been used extensively throughout Europe and the USA for many decades to protect communities and properties from flood but the use of flood barriers in Australia is a relatively new concept.

It is considered preferable to eliminate the need for flood barriers through effective land use planning and policy. Unfortunately, historical land development strategies have resulted in a significant number of properties and assets being built in flood affected areas. Urbanisation, increased density, drainage limitations and a loss of permeable surfaces have

exacerbated the risk of overland flood events in our towns and cities. Changing weather patterns have also contributed to the increased flooding of our landscape with more severe weather events and global sea level rises.

There are many examples of similar legacy issues which make current flood planning levels and the principles of good urban planning and building design mutually incompatible. In these circumstances flood barriers offer a potential solution, subject to any statutory or mandated requirements applicable in a specific jurisdiction. Use of flood barriers to protect a facility can never be considered equivalent to the construction of buildings in areas outside the predicted flood extent. Flood barriers, like levees, reduce the likelihood of inundation but do not eliminate the risk. Flood protection schemes may fail due to inadequate design and construction, poor maintenance or other unanticipated reasons such as a flood larger than the design flood (i.e., a flood that achieves a peak level that is higher than the design flood level).

For these reasons it is critical for stakeholders of facilities in flood prone areas to understand what flood barriers are, how they are designed, constructed, installed and maintained. This understanding will assist in the effective reduction of flood risk for people, property and assets.

3.0 Flood Barrier Types

3.1 Temporary Flood Barriers

3.1.1 Mobile Flood Barriers

Temporary flood barriers are designed to be quickly deployed in pre-planned locations which do not have permanent defences. A mobile barrier is not permanently installed or affixed to a structure and requires some level of transportation and manual deployment.

Figure 1: Examples of mobile flood barriers

3.1.2 Demountable Flood Barriers

A demountable flood barrier involves both fixed and removable elements. These types of barriers are designed for installation to suit a specific location.

Figure 2: Examples of demountable flood barriers

3.2 Permanent Flood Barriers

3.2.1 Buoyant Flood Barriers

Buoyant flood barriers, also known as passive flood barriers, are actuated by utilising the principles of buoyancy with no other mechanical intervention.

Figure 3: Examples of buoyant (or passive) flood barriers

3.2.2 Actuated Flood Barriers

Actuated flood barriers are a permanent installation that automatically deploys when flood conditions are detected. Types of automatic barriers may include, but are not limited to, pneumatically, electrically or hydraulically actuated devices triggered by water sensors.

Figure 4: Examples of actuated flood barriers

3.2.3 Manual Flood Barriers

A manual flood barrier is permanently installed and affixed to a structure, then manually deployed requiring human intervention.

Figure 5: Examples of manually operated flood barriers

4.0 Safety and Risk Considerations

The intention of flood barriers is to protect people and property from the adverse impacts of floodwater.

Flood barriers are relied upon for a particular level of protection. It is therefore important that their deployment does not inadvertently create other risks to people or property. Losses caused by barrier failure or by barrier deployment and any unintended consequences may carry significant legal and financial liabilities. It is therefore important that the selection and design of flood barriers is undertaken by a qualified and experienced professional.

4.1 Flood Characteristics

The type of barrier must be appropriate for the type of flooding. The sources of water for which flood barriers can provide protection include:

- Lakes, rivers, streams, canals or other watercourses overtopping their banks.
- Sewers or stormwater drains overflowing.
- Low-lying coastal areas being inundated by extreme tides, storm surge or sea level rise.
- Roadways or other overland flow paths.

The characteristics of the flooding, which must be understood and taken into account during the design phase include:

- Flood levels and depths.
- Flow velocities and directions.
- Flow irregularities and surges.
- The rate of flood rise.
- The duration of flooding.
- Water quality and chemical composition.
- Likely debris content.

How the barrier changes flood behaviour must also be understood. It is important that the deployment of the barrier does not have unacceptable, adverse flood impacts on other parts of the premises or on neighbouring properties. Often this can only be determined by computer-based flood modelling.

4.2 Design Standards

Design requirements may be stipulated in a standard guideline, insurance specification, planning control or condition of approval. Alternatively, the designer may need to apply professional judgement in determining an appropriate safety margin in the barrier design.

An important consideration in determining an appropriate safety margin is the level of probability of the barrier being overtopped or failing in some other way and the potential consequences should either of these occurrences take place.

Design considerations include:

1. The type of flood from which protection is required: whether the protection is to exclude inundation from all events, only those up to a certain level, or of a specified probability of occurrence.
2. Assess what safety factors against barrier failure are required to be accounted for in the design.
3. Ascertain the depth of freeboard to be provided by the barrier to minimise the likelihood of overtopping. The depth of freeboard must also account for uncertainties associated with the calculated flood water level, irregularities in actual water surface compared to modelled water level and for surges or other phenomena.

4.3 Design Process

Subsequent to the selection of the design standard for the barrier, the following factors need to be accounted for:

Barrier Height

The barrier height is determined by the flood level plus freeboard (if required) for the specified design flood (i.e., all events, only those up to a certain level, or of a specified probability of occurrence).

Freeboard

The required depth of freeboard to be provided by the barrier needs to be included in the design.

Hydrostatic Forces

Hydrostatic forces on the barrier are determined by flood depths.

Hydrodynamic Forces

Flow velocity and direction determine the hydrodynamic forces on the barrier.

Debris Loads

Debris loads are determined by likely debris content together with flow velocity and direction.

Barrier Longevity

Longevity of the barrier is determined by the duration of the flooding as well as the water quality and chemical composition. For example, components exposed to seawater may corrode and those exposed to hydrocarbons may perish.

Speed of Deployment

The rate at which the barrier can be deployed must be faster than the rate of the rising floodwater.

Leakage

The acceptable leakage rate is derived from what rate and volume of leakage (past the barrier) the protected asset is able to accommodate and what measures are in place to manage that leakage.

Warning Signs and Systems

Warning systems, if fitted, are linked to barrier deployment. Warning signs and systems may alert selected personnel that the barrier needs to be deployed, or warn nearby personnel that the flood barrier is being deployed so they can stand clear or take other associated actions. Additionally, a warning system can advise personnel that the barrier has failed to deploy, either partially or fully.

Reliability of Deployment

If the barrier is to be automatically actuated the actuation mechanism must be assessed to determine whether it is sufficiently reliable

in the range of circumstances that may arise during a flood (e.g. loss of power, high debris loads, excess loads on top of the barrier such as a vehicle).

The assessment needs to investigate whether backup systems are required or whether alternative deployment methods such as manual operation can be initiated if the primary method fails.

Safety of Deployment

The deployment of the barrier should not place people or property in danger. For example, deployment of the barrier should not place personnel in a situation where they need to enter floodwaters or could be isolated by floodwaters. Nor should deployment cut off emergency accesses such as fire escapes.

False Triggers

Consideration must be given to events that could cause the flood barrier to deploy when it is not required and design features or other measures that could be incorporated to manage this possibility.

Post-Flood Clean Up

Consideration needs to be given to how easily the barrier can be cleaned after a flood has receded. This includes whether there are components that will need to be replaced and whether the replacement of such components requires specialist skills, tools or personnel. Also to be considered is how easily the components that need to be replaced can be disposed, particularly if they are contaminated by floodwater.

Barrier Storage

The flood barrier design should take into account how and where the barrier will be stored until it needs to be deployed.

Barrier Maintenance

The design should also consider how the barrier is to be maintained between and after deployments. This includes what measures can be put in place to ensure that it will be fit for purpose, i.e., that the barrier will deploy and work as intended after possible long periods of storage or non-operation.

Special Tools and Accessories

The requirement for any special equipment or accessories that are necessary to deploy or maintain the barrier must be considered.

Documentation and Training Requirements

What documentation and training is required for personnel responsible for the maintenance and deployment of the barrier?

5.0 Application Assessment

After identifying that a flood barrier solution is required and after being informed on the statutory and mandated requirements for flood barriers within the jurisdiction, several factors need to be considered when choosing the most suitable barrier type for a specific application.

These factors include:

- Whether the barrier is for a community, industrial, commercial, residential or multi-use application.
- Whether the installation is to form part of a new building project or is to be retrofitted into an existing site.
- What space and facilities are available to accommodate a flood barrier.
- The type of barrier required or preferred.
- The logistics of delivering the flood barrier to site.
- The logistics of installation and deployment/operation of the barrier; and
- Site and environmental constraints.

Generally, a flood barrier will form part of the building permit that provides the conditions under which approval is given for the proposed development to proceed. Conditions are dictated by the responsible authority (e.g. local council, water authority, floodplain manager).

Figure 7: Example of a temporary demountable flood barrier protecting a factory complex

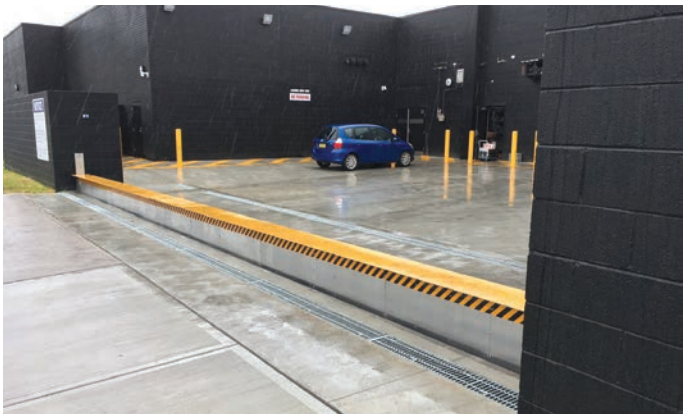

Figure 8: Example of a permanent buoyant pop-up flood barrier protecting a loading dock at a shopping centre

Figure 6: Example of a retractable flood barrier protecting community assets

Figure 9: Example of a temporary demountable flood barrier protecting critical infrastructure

Figure 10: Example of a permanent buoyant tilting flood barrier protecting basement car park

5.1 Asset Type

It is necessary to understand the types of assets that need to be protected. These can include community, commercial and residential properties.

5.1.1 Community

Community assets subject to flooding threat may include:

- Townships
- Medical facilities
- Power sources
- Parklands
- Schools
- Marine facilities

5.1.2 Commercial

- Carparks
- Shopping centres
- Retail outlets
- Factories
- Sporting complexes
- Airports
- Defence facilities
- Pump stations
- Public buildings

5.1.3 Residential

- Basements
- Dwellings
- Garages
- Sheds

5.2 Considerations

The following need to be considered reviewing flood protection solutions for a site:

Protection Solution

This includes whether the site or area needs to be fully protected (i.e., at site level) or whether only spot protection is required. That is, whether it is the building or an entire area that needs to be protected (some entrances or complete building).

Warning Lead Time

Warning of imminent flooding could be days, hours or only minutes. The amount of time available between the first warning of a flood and flood barrier deployment is critical. Consideration needs to be given to whether there is sufficient time for the flood barrier to be effectively deployed without risk to individuals or assets.

Flow of Water

Application Assessment Design decisions need to take into account the flow path, depth and velocity of the flood water as well as where is the flood water coming from and what is it likely to affect. How will the deployed flood barrier impact flood behaviour, locally at site, adjoining properties and more widely?

Availability of Resources

The availability of personnel and transportation when and where needed is a factor in the overall solution. Including, whether the resources that are required to deploy flood barriers (e.g. employees, contractors, volunteers, SES, fire, police, council, mechanical equipment) available at any time or only during certain times such as during normal work hours.

The ability to deploy the flood barrier at any given time during days, nights, weekends, public holidays and leave periods must also form a part of deciding which type of flood barrier is the appropriate solution for any site and application.

Surrounding Surface Materials

The decision process needs to include input as to whether the barrier needs to blend in with its surroundings. This includes whether there are architectural or interior/exterior design constraints, requests or considerations. For example, is there a requirement that parts of the flood barrier are to be colour coordinated with surrounding infrastructure (new or existing; buildings, levees, flooring, wall or architectural finishes)?

Structural Considerations

Consideration needs to be given as to what allowances are available around the space to be flood protected. Is the flooring of sufficient depth and design? Are lower floors of sufficient height to accommodate openings, cut-outs or recesses? Is the required below ground infrastructure suitable for tilt-up or pop-up flood barriers?

Additionally:

- When protecting building openings, the structural strength, stability and waterproofing capabilities of the adjoining walls, floors, windows and foundations up to a height of at least the design flood level plus freeboard should be reviewed.
- All other water intrusion points in the floors and walls must be sealed up to a height of at least the design flood level plus freeboard if the flood barrier is to be effective.
- A water collection system (drainage and sump) that includes a sufficient number of pumps with discharge points outside the protected areas. They must have sufficient capacity to effectively remove water from the sump(s) against a head equal to at least the flood level plus freeboard. The pump system must be capable of removing water from the protected area that may have leaked past the deployed flood barrier, entered as the flood barrier is being deployed or gathered post deployment (e.g. rain water).
- Consideration needs to be given to whether the flood barrier is required to withstand specific weather conditions such as impact loadings (e.g. high winds, cyclonic conditions, wave impacts), corrosive or otherwise aggressive site conditions (e.g. salt or contaminated water), or inhospitable site conditions (e.g. jet blasts).

Once a barrier type has been selected and the barrier design completed it will need to be accepted by the client's design team. Once accepted into the design, the overall package will be subject to the applicable council and referral authority (e.g. water authority, catchment/floodplain management authority) for review and permitting process.

6.0 Flood Barrier Operation

There are many different types of flood barriers and operating methodology. When choosing a flood barrier there are a number of matters to be considered (refer to Sections 4.3 and 5.2). Flood barrier manufacturers and suppliers should be able to provide the information needed to adequately address these and related or peripheral matters.

Every flood barrier product should be delivered with installation, operation and maintenance manual(s). Such manuals should:

- Contain the information required to enable an appropriate and/or capable person to understand how to deploy the flood barrier in anticipation of imminent flooding.
- Provide information on flood barrier components or operation and maintenance purposes.
- Specify detailed operational instructions including the time it takes to deploy (or be deployed).
- Provide detailed instructions on routine and post-flood maintenance activities and requirements; and
- Contain relevant contact and support details.

Manufacturers/suppliers should be able to provide examples of manuals prior to placement of a formal order so that an informed decision can be made on the appropriateness and acceptability of each available barrier type. That decision must have regard for any jurisdictional restrictions or requirements regarding flood barrier types and applications.

6.1 Temporary Flood Barriers

Temporary, or demountable, flood barriers are removable products that are deployed manually before or during a flood event and removed when water levels have receded. All or part of the flood barrier is usually stored away from the location where it is required to be deployed.

Temporary flood barriers require time and labour to deploy and, depending on the size, type and length of barrier to be deployed, can take minutes, hours, or days to install. They must be installed and removed in accordance with the manufacturer's guidance as provided in an installation

Figure 11: Example of a temporary demountable flood barrier

Figure 12: Example of a permanent manual flood barrier door

Figure 13: Example of a buoyant tilting flood barrier

manual and/or following formal training sessions.

When not in use, temporary flood barriers need to be appropriately stored and subject to routine maintenance, as per manufacturer's recommendations. They also need to be thoroughly cleaned and checked for damage or wear after each deployment or flood event to ensure that all parts are in good condition and working effectively.

Temporary flood barriers are generally made up of non-permanent and permanent sections that, when integrated together, form a solid barrier that protects against flood intrusion.

Mobile flood barriers are completely non-permanent and can be installed at any location.

A range of temporary flood barriers are available as an alternative to traditional sandbags for a relatively quick set up in preparation for a potential flooding event.

6.2 Permanent Flood Barriers

Permanent flood barriers are permanently installed at the point of deployment. Generally, once installed they will deploy and retract until end of service life with little or no human intervention.

These barriers usually require installation by the manufacturer or supplier. There are many permanent flood barrier options that are either buoyant (passive), actuated or manual.

Regular maintenance in accordance with the manufacturer's or supplier's recommendations described in the installation, operation and maintenance manual will be necessary to ensure that the barrier is ready for deployment when a flood does occur. The scope and frequency of maintenance activities will vary depending on the type and source of the barrier installed as well as frequency of use.

Buoyant flood barriers do not require any power, electricals or hydraulics to operate. They rely solely on the presence of floodwater to deploy them.

Actuated flood barriers require power and are typically activated and deactivated via a water sensor, BMS (Building Management System) or push button. These types of barriers usually include a trickle charged battery system so that they will deploy in the event of a mains power outage.

Deployment of permanent manual flood barriers such as flood doors and sliding gates will generally require some level of human intervention.

7.0 Design, Materials and Construction

The complex challenge of designing a flood barrier for a flood-affected site requires a well-prepared design process that has been developed through consultation with the building design team, flood consultants, councils and consent authorities.

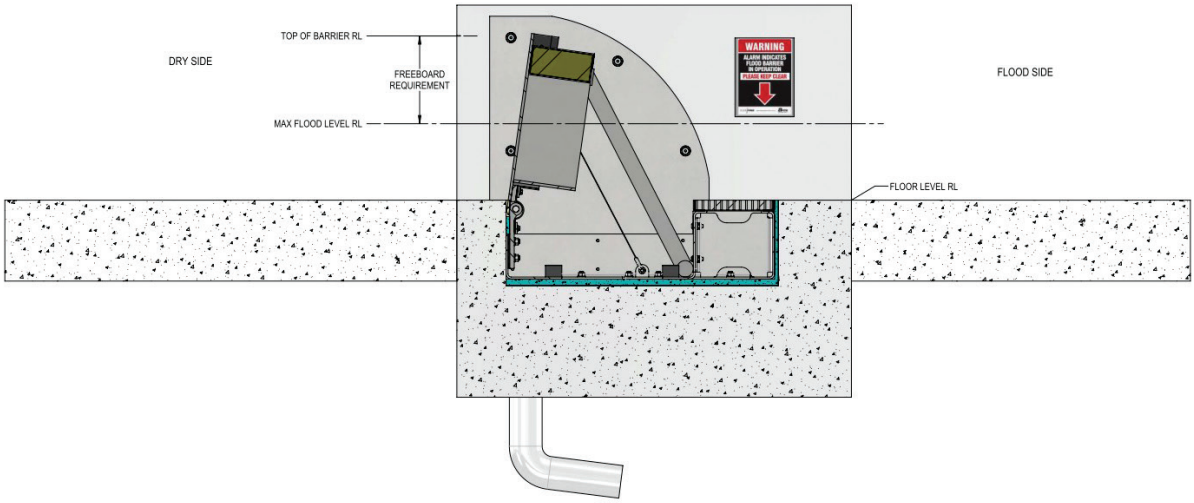

Figure 14: Example of a permanent buoyant tilting flood barrier section view drawing

The barrier design team may include planners, designers, architects and engineers. The team evaluates and refines a range of options prior to identifying the most appropriate solution for the particular application and subject site. Variables such as flood depths (including required freeboard), flood flow velocities and loadings, asset protection, accessibility, maintenance and other requirements are all considered.

As flood barriers and doors are purpose-built to specific sites, client and operational requirements, designs should be submitted for client design team approval prior to manufacture. Client requests and specifications typically include variables such as nominated flood levels and loading (e.g. pedestrian or heavy vehicle loadings).

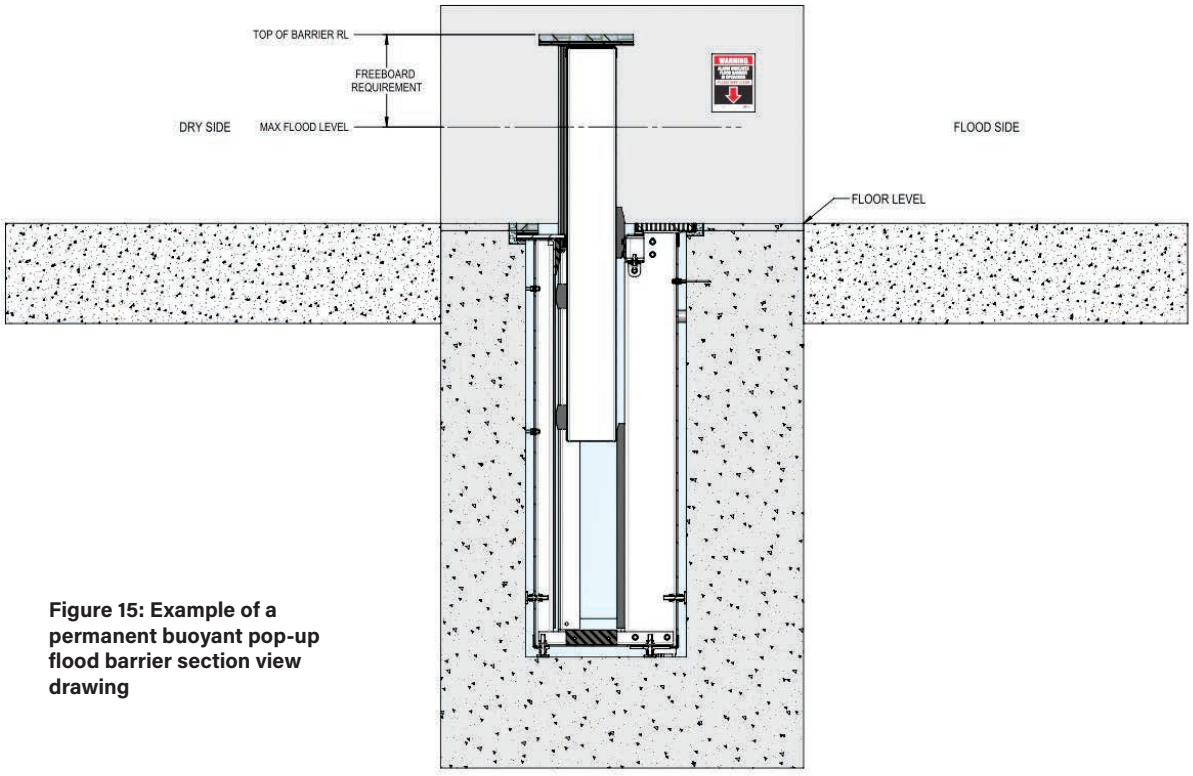

Figure 15: Example of a permanent buoyant pop-up flood barrier section view drawing

The design and engineering of flood barriers and doors should consider relevant Australian Standards. Typically, but depending on the type and application of the barrier, these include AS1170 Structural Design Actions, AS4586 Slip Resistance Classification of New Pedestrian Surface Materials, and AS 1428.1 Design for Access and Mobility.

While currently there is no Australian standard addressing flood barrier leakage rates, the British Standards Institution document PAS 1188 Flood Protection Products and the more recent BS51188 Flood Resistant Products provide guidance that is generally applicable to the Australian context.

Depending on the application and upon the flood barrier and door type, materials can vary from PVC, various types of metals and through to any other materials that are considered suitable for the application.

Design life and the warranty provided for each product type is as per manufacture's specification.

8.0 Testing, Installation, Training and Maintenance

Normal practice is for flood barrier manufacturers to provide complete instructions (i.e., installation manuals) to guide the correct and proper installation, deployment, operation and maintenance of a barrier. Generally, and as a minimum, the manuals include the following:

- Description of the parts and components needed for installation and operation or deployment of the barrier.
- Installation procedure and tolerances, including pre-installed and assembled components.
- Details of post-installation commissioning tests.
- Operation or deployment procedure.
- Required maintenance in order to keep the product functioning correctly.
- Correct storage of the barrier and components when not in use. This applies to temporary flood barriers in particular.
- Troubleshooting tips.
- Warranty terms and conditions; and
- Relevant contact and support details.

8.1 Testing (Pre-Installation)

Inspection and Test Plans (ITPs) are usually prepared in line with the project requirements and executed prior to installation. Site measurements should be undertaken prior to fabrication to confirm spatial requirements for the barriers including widths and levels at openings. As a minimum, they generally include a full dimensional check of all flood barrier components to the workshop drawings and a visual inspection of all seals and hardware as a part of functionality testing.

8.2 Installation

Installation of permanent flood barriers can include the installation of warning signals that activate to warn of imminent barrier closure. These can include visual strobe light(s) and audio warning siren(s). These features also require a control box complete with trickle charged battery and appropriate signage. The control box can be linked with the BMS or other smart processes that provide alerts to personnel who may be remote from where the barrier is located, or is to be deployed.

The persons undertaking the installation of a permanently installed flood barrier (i.e., not a temporary flood barrier) is expected to be competent and experienced in general mechanical installations. A set of site-specific drawings in addition to the manufacturer's installation manual, are usually used to guide the installation process. Incorrect installation can cause barrier malfunction, excessive leakage or operational issues. It is therefore critical that installation specifications and tolerances are documented within the manufacturer's installation manual, that they are met and that none of the barrier components are damaged during transport to site or during installation.

Failure to comply fully with the installation instructions can void the flood barrier manufacturer's warranty. Throughout the installation process, good practice requires the use of an installation inspection checklist.

The manufacturer is to provide certification of the flood barrier installation as confirmation that it has been installed correctly to the

manufacturer's specifications and that it performs as intended. Alternatively, the manufacturer may be required to certify the installation in cases where the manufacturer has not performed the installation but has provided onsite supervision during the installation process. In cases where the manufacturer has not been directly involved in the installation process, it is unlikely that they will certify that the barrier (or door) has been installed correctly, or that it will perform to the manufacturer's specification.

8.3 Training

As part of the installation process, manufacturers and suppliers are able to provide training to key personnel on how to operate or deploy as well as and maintain the flood barrier(s).

A formal Flood Emergency Response Plan (or Flood Risk Management Plan) can be developed to include:

- Details of the flood risk at site.
- Flood risk reduction measures implemented at site.
- Flood warning/detection methods and triggers implemented.
- Barrier deployment processes.
- Links to the flood barrier installation, operation and maintenance manual.

The preparation of such a Plan is often included as a development consent condition.

Figure 16: Example of a demountable flood barrier training session

Figure 17: Example of a permanent buoyant tilting flood barrier during a routine maintenance check

8.4 Maintenance

All flood barriers need to be maintained through a regular regime. Requirements are generally not onerous. As a general rule, all flood barrier components should be kept clean of rubbish, debris, mud and grime in order to prevent corrosion and reduce risk of failure.

A service and maintenance schedule needs to be undertaken regularly by qualified personnel as per the barrier manufacturer's recommendations detailed in the provided manual. Such personnel should have been appropriately authorised to undertake maintenance activities before commencing work.

Inappropriate or uninformed maintenance of the flood barrier or alterations to the barrier can cause damage, failure and risk to life and property. Such actions incur liability.

Good practice suggests that training on flood barrier matters, including maintenance, should be conducted annually (or more frequently) by authorised personnel. Such training can be provided by the flood barrier manufacturer or approved maintenance contractor.

Good practice dictates that a service report and inspection checklist should be provided by the person conducting the maintenance inspection and related activities. It is recommended that service and maintenance reports are kept on file.

The flood barrier industry recommends that all permanent and temporary flood barriers are dry tested or inspected at least every 6 to 12 months and after every flood event for which they are deployed. A wet test where possible is recommended. The flood barrier service duration will be nominated by the flood barrier manufacturer.

All flood barrier manufacturers generally hold parts in stock in the event that any flood barrier components need to be replaced.

Buoyant (Passive) Flood Barrier

Item	Action Required	Maintenance Schedule			Date Completed	Pass Y/N	Fail Y/N	Comments	Completed By
		Monthly	6 Mnths	12 Mnths					
Tilt Up Barrier	Check the condition of the side sealing plates and that they are free from damage and clean								
	Check that warning signs are in place, free from damage and securely fitted to the wall								
	Check the condition of the top plate for damage and that lifting points are clear								
	Check the condition of the grout around the frame and that it is intact								
	Check that the recess around the barrier top plate is clean and free of debris								
	Check that grate/ strip drain is in place, free from damage and debris								
	Check the condition of the alarm cabinet and beacon								
	Check the condition of debris brushes and seal on each side of the barrier								
	With the barrier deployed undertake a visual inspection.								
	Check the overall barrier and frame for structural integrity								
	Check the condition of the grout and anchors								
	Check the restraints for signs of deterioration								
	Check that restraints and safety mechanisms are secured to the barrier and frame								
	Clean and lubricate all seals where required								
	Wash the barrier with clean water								
	Check the bottom of the cavity for debris and remove if present								
	Check that the outlet drain is clear form debris to allow water to pass through in rain/flood event								
	Check the side wall inside measurements								
	Check the condition of the hinge for signs of wear and seal deterioration								
	Check that the barrier operates to full height								
	Check the side seals for signs of wear or deterioration								
	Check that side seals make contact with the side plates when fully open								
	Check that warning tape is fitted, visible and in good condition								
	Check the sump for debris and remove if present (where applicable)								
	Fill sump to 20mm and check that the pump operates (where applicable)								

Figure 18: Example of routine service and maintenance schedule for flood barriers. These should form part of a manufacturers operation and maintenance manual. This should be supplied product-specific at the time of purchase.

9.0 Definitions

Annual Exceedance Probability (AEP) - The likelihood of the occurrence of a flood of a given size or larger happening in any one year. AEP is usually expressed as a percentage, e.g., 1% AEP.

Australian Height Datum (AHD) - A common national surface level datum approximately corresponding to mean sea level.

Aperture - An opening within a wall, building or structure.

Average Recurrence Interval (ARI) - A statistical estimate of the average number of years between the occurrences of a flood of a given size or larger.

Australian Rainfall and Runoff (ARR) - ARR is a national guideline for the estimation of design flood characteristics in Australia published by Geoscience Australia and Engineers Australia.

Cladding - A covering of one material over another. In the case of a flood barrier this is usually tiles or pavers.

Coating - A covering of a substrate. In the case of a flood barrier this is usually for aesthetics, corrosion protection or as a textured nonslip surface.

Cross Fall / Grade - Angle of fall/ grade horizontally across a surface such as a driveway.

Deployment Time - The amount of time required for deployment and/or operation of a flood barrier.

Design Flood - The flood selected for design and planning purposes that is used to define the flood zone. For most types of development, this is the 1% AEP flood (or 100-year ARI flood).

Dry Side - The side of the flood barrier that is protected from flood waters.

Egress - The means of exiting a location.

Finished Floor Level (FFL) - The upper most surface of a floor once construction has been completed and after all finishes (e.g. tiles) have been applied.

Flood Level (FL) - Height reached by a body of water resulting from the overflow of sea level rise, stormwater flooding etc., beyond its normal limits.

Flood - The covering of normally dry land by water.

Flood Barrier - A device that is installed within an aperture or erected around equipment/buildings to prevent the ingress of floodwater.

Flood Management Report - An assessment of how likely it is that a property will suffer from flooding at some point in the future.

Floodplain Management Authorities - Catchment management authorities; councils; federal, state and territory government agencies; Floodplain Management Australia.

Floodplain Management Australia (FMA) - The national body for floodplain practitioners.

Flood Planning Level (FPL) - A height used to set floor levels for property development in flood prone areas and generally defined as the 1% AEP flood level plus freeboard.

Freeboard - The height above the design flood level. Freeboard compensates for a range of factors, including wave action and localized flow effects. It can also compensate for uncertainties in the accuracy of the 1% AEP flood level estimate.

Gradient / Grade - Increase or decrease in the slope of a surface.

Hydrostatic Force - The magnitude of water pressure acting on a surface.

Leakage - Any water that escapes past.

Leakage Rate - The rate at which water moves past or through a flood barrier from the wet side to the dry side, for example, at the seals.

Maximum Design Water Depth - Manufacturer's specified maximum water depth from which a flood product is designed.

Natural Ground Level (NGL) - The natural level of the site before any excavation or filling (in the past or as a part of any proposed development) has been carried out on the site.

Overtopping - The action of water flowing over the top a flood barrier.

Probable Maximum Flood (PMF) - The largest flood that could conceivably be expected to occur at a particular location, usually estimated from probable maximum precipitation.

Probable Maximum Precipitation (PMP) - Greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographical location at a certain time of year.

Reduced Level (RL) - Equating elevations of survey points with reference to a common assumed datum.

Seal - The location on a barrier where the product meets the ground, or the wall of a structure to prevent water from the wet side to the right side.

Structural Floor Level (SFL) - The floor level prior to the addition of finishing items such as screed, underlay and flooring.

Stage Hydrograph - A graph that shows how water level at a particular location changes with time during a flood. It must be referenced to a particular datum.

Top of the Barrier (TOB) - Height that the barrier needs to meet.

Velocity of Floodwater - The speed of floodwaters, measured in meters per second (m/s).

Warning Time - Site-specific feature to assist in the decision-making process for choosing an appropriate barrier, considering human resources available and the time needed to deploy/erect the barrier.

Wet Side - The side of the flood product that is subjected to flood waters.

10.0 References

- **Australian Building Codes Board 2019, National Construction Code** – Volumes 1, 2 and 3, in force from 1 April 2019.
- **Australian Building Codes Board (ABCB) 2019a**, ABCB Standard - Construction of Buildings in Flood Hazard Areas, February, Print version: 3.0 (2012.3).
- **Australian Building Codes Board (ABCB) 2019b**, Construction of Buildings in Flood Hazard Areas – Information Handbook, Version 2012.3.
- **Australian Institute of Disaster Resilience (AIDR) 2017, Flood Hazard** – Guideline 7-3: supporting document for the implementation of the AIDR Handbook 7 Managing the Floodplain: A guide to Best Practice in Flood Risk Management in Australia.
- **NSW Government 2005 Floodplain Development Manual** – the management of flood-liable land, Sydney.
- **NSW Legislation - Water Management Act - 2000- No 92** https://legislation.nsw.gov.au/view/html/inforce/current/act-2000-092#sec.271
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- **State Environmental Planning Policy (Infrastructure) 2007** - Division 4 - Exempt Development - Sections 20 and 20A
- **State Environmental Planning Policy (Infrastructure) 2007** - Division 5 - Complying Development - Sections 20 B and 20C, viewed 10 Oct 2020 https://www.legislation.nsw.gov.au/view/html/inforce/current/epi-2007-0641#pt.2-div.4
- **State Environmental Planning Policy (Infrastructure) 2007** - Division 1 - Clause 15 - Consultation with councils - development with impacts on flood liable land https://www.legislation.nsw.gov.au/view/html/inforce/current/epi-2007-0641#sec.15
- **State Environmental Planning Policy** (Infrastructure 2007-Division 7 Flood mitigation work, viewed 10 October 20, https://www.legislation.nsw.gov.au/view/html/inforce/current/epi-2007-0641#pt.3-div.7
- **International Infrastructure Management Manual (2015)**, pages 55, 79 and 180
- **Guidelines for Development in Flood Affected Areas, DELWP (2019**), https://www.water.vic.gov.au/__data/assets/pdf_file/0025/409570/Guidelines-for-Development-in-Flood_finalAA.pdf
- **AWMA / FloodFree**, https://www.awmawatercontrol.com.au/flood-barriers/ and https://www.floodfree.com.au/
- **Bluemont**, https://www.bluemont.com.au/flood-prevention/
- **Flooding Solutions**, https://www.floodingsolutions.com.au/
- **FM Global Data Sheet** – Flood, FM Global Loss Prevention Data Sheets – FM Global

Australian Standards:

- **AS 3700:2018** Masonry Structures.
- **AS/NZS 3500.3:2018** - Section 8- Pumped System which may be directly relevant to pumped system flood barriers.
- **AS1170.1 (2002)** Structural Design Actions - Permanent, Imposed and Other Actions. Deals with liquid pressure, groundwater and rain ponding.

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