PORT STEPHENS COUNCIL

STORMWATER BASIN RISK ASSESSMENT AND MITIGATION

TECHNICAL GUIDELINE

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Important Information

PLEASE NOTE

This Technical Guideline sets out the minimum requirements for the assessment and recommended implementation of risk mitigation treatments for stormwater basins.
Council has no responsibility to inform you of any matter relating to the accuracy of this Technical Guideline which is known to Council at the time of downloading or subsequently comes to the attention of Council.
This Technical Guideline is a Controlled Document. Before using this document check it is the latest version. Council may update this document at any time.

Document History and Status

ISSUE	DESCRIPTION OF REVISION	DATE	REVIEWED	AUTHORISED
Rev 0	Issued for use	Jan 2024	Civil Assets Manager	Assets Section Manager

For specific technical enquiries related to this Technical Guideline please contact Council.

DEFINITIONS

All definitions conform with AS-ISO 3100:2018 – Risk Management Guidelines.

PLEASE NOTE

A consequence can be certain or uncertain and can have positive or negative direct or indirect effects on objectives.

Consequences can be expressed qualitatively or quantitatively.

Any consequences can escalate through cascading and cumulative effects.

Consequence: The outcome of an event affecting objectives.

Event: An occurrence or change of a particular set of circumstances.

Notes:

1. An event can have one or more occurrences and have several causes and several consequences.
2. An event can also be something that is expected which does not happen, or something that is not expected which does happen.
3. An event can be a risk.

Risk: The effect of uncertainty on objectives.

Notes:

1. An effect is a deviation from the expected. It can be positive, negative or both, and can address, create, or result in opportunities and threats.
2. Objectives can have different aspects and categories and can be applied at different levels.

Risk Management: Coordinated activities to direct and control an organisation with regard to risk.

Risk Source: An element, which alone or in combination has the potential to give rise to risk.

Event: An occurrence or change of particular set of circumstances.

Notes:

1. An event can have one or more occurrences, and can have several causes and several consequences.
2. An event can also be something that is expected which does not happen, or something that is not expected which does happen.
3. An event can be a risk source.

Likelihood: The chance of something happening, a qualitative description of probability and frequency.

Notes:

1. In risk management terminology, the word “likelihood” is used to refer to the chance of something happening, whether defined, measured or determined objectively or subjectively, qualitatively, or quantitatively, and described using general terms or mathematically (such as probability or frequency over a given time period).
2. The English term “likelihood” does not have a direct equivalent in some languages; instead, the equivalent of the term “probability” is often used. However, in English, “probability” is often narrowly interpreted as a mathematical term. Therefore, in risk management terminology, “likelihood” is used with the intent that it should have the same broad interpretation as the term “probability” has many languages other than English.

Control: A measure that maintains and/or modifies risk.

Notes:

1. Controls include, but are not limited to, any process, policy, device, practice, or other conditions and/or actions, which maintain and/or modify risk.
2. Controls may not always exert the intended or assumed modifying effect.

Severity (of the hazard): How bad or the acuteness of the consequence.

Wet Basin: Earthen depression constructed with permanent long-term storage of stormwater.

Dry Basin: Earthen depression constructed for short-term storage (< 24 hours) of stormwater runoff during a storm event.

INTRODUCTION

Port Stephens Council (Council) currently maintains over 140 stormwater basins throughout the Local Government Area (LGA), which were constructed as a component of the existing development requirements for new subdivisions, or as improvements to the existing stormwater management system. These basins reduce the water velocity and volumes within the local stormwater networks and provide stormwater treatment improving water quality.

Stormwater basins are typically constructed in proximity of residential zones to supply supplementary water quantity and quality treatment. Dry stormwater basins are used to provide open space, and aesthetic appeal while often containing public amenities, such as barbeques, playgrounds and benches. This exposes Council to increased risk and therefore, case-by-case risk assessments shall be conducted to ensure the level of exposure to the community and Council is appropriately reduced to meet Council's Risk Matrix.

This guideline has been produced to ensure that a consistent approach is adopted when evaluating existing and new basins for hazards and the associated risk. The evaluation shall be used to implement risk mitigating measures to reduce the risk of injury to the public, and hence reduce Council's exposure to the possibility of a claim should an injury occur.

This guideline has been developed using differing approaches to separate existing and new stormwater basins. Council has developed an inspection, maintenance and upgrade program for all existing basins to effectively manage these assets and address any deficiencies on a risk-based approach within the available funding.

Figure 1: Typical "Wet" Stormwater Basin; Bagnall Beach Rd Stormwater Basin

ASSESSMENT

The aim of this guideline is to reduce or eliminate the risk of injury and/or death to the public should persons accidentally or deliberately enter any basin, and consequently reduce Council's exposure.

Objectives

- Provide a minimised risk for persons accessing a basin accidently or deliberately;
- Identify hazards and evaluate the severity through assessment via a consistent formal assessment guideline;
- Determine risks and an appropriate risk mitigating treatment.

Evaluation

To determine suitable risk mitigation treatments, basins are inspected and evaluated for identifiable hazards and the associated consequence and likelihood level. Physical and environmental characteristics of the basin are utilised in evaluation of the hazards and is used to produce a risk mitigation treatment solution.

Although basins may temporarily become "wet basins", and for the purpose of this document, basins are assessed on their predominant mode, categorised as either wet or dry, as the majority of the risk is associated with water levels, volumes and flow. Where basins are observed to have changed their predominant mode due to significant rainfall, a new risk assessment is required based on the new mode.

The International Infrastructure Management Manual (IIMM0215) has been used as the primary guide for the development of the structured approach to identifying, evaluation and managing risks.

Basin Properties

The latest version of Australian Rainfall and Runoff: A Guide to Flood Estimation (ARR) has been used to determine what type of physical conditions require mitigation treatments to reduce Council's exposure to risk, as identified below.

- Slopes 1V:6H or flatter are recommended for grassed lined channels.
- The maximum recommended slope of a basin should not be steeper than 1V:4H to permit safe egress in an emergency, prevent bank erosion, and facilitate maintenance and mowing.
- Where steep or vertical sides are unavoidable, due consideration should be given to safety aspects, such as the need for fencing or vegetation, both when the storage is full and empty.
- Balustrades (fences) must comply with the Building Code of Australia, while safety exclusion fences should comply with any legislated requirements for swimming pool fencing.
- Warning signs are recommended for installation.

Based on these conditions, this risk mitigation assessment shall examine the following physical characteristics to be determined as a hazard to the public:

- Batter slope;
- Height of drop from the top of batter to toe of batter;
- Depth of water;
- Proximity to and level of public use;
- Whether the predominate mode of the basin is wet or dry.

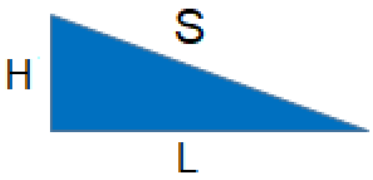
Table 1: Common Slope Descriptors

	Slope, as in 'x' in 1	Slope as horizontal run (H) to vertical rise (V)	Slope as percentage (%)	Slope as degrees from horizontal	Landscape (adapted from NSW Dept of Primary Industries, 2009)
	6 in 1	6H:1V	16%	9	Slight Slope
	4 in 1	4H:1V	25%	14	Moderate Slope
	3 in 1	3H:1V	33%	18	Steep Slope
	2 in 1	2H:1V	50%	26	Steep Slope
	1.5 in 1	1.5H:1V	66%	33	Very Steep Slope
	1 in 1	1H:1V	100%	45	Very Steep Slope
	0.5 in 1	0.5H:2V	200%	63	Extremely Steep Slope

If the slope cannot be determined through a review of the associated Work-as-Executed plan, the below process can be used to approximate the slope:

$$L(m) = \sqrt{S^2(m) - H^2\,(m)} \qquad (1)$$

$$Slope\ (degrees) \approx \tan^{-1}\left(\frac{H(m)}{L\,(m)}\right) \qquad (2)$$



Round to the steepest slope for a conservative option.

Water Depth and Velocity Vulnerability

In conjunction with egress within a basin, a hazard classification has been adopted from the Australian Disaster Resilience Handbook – Guideline 7-3. Section 4.1, which provides a combined set of thresholds for people stability within floodwater, as shown below in Figure 2.

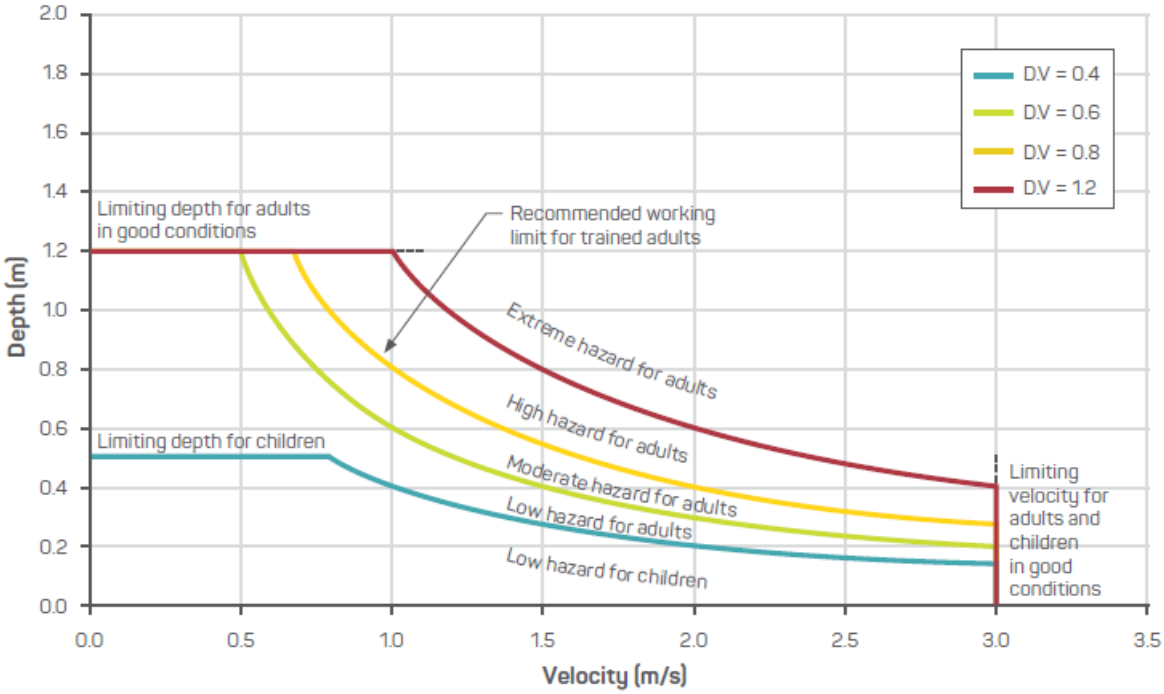


Figure 2: Thresholds for People Stability in Floods - ADR 7-3 Guideline, S4.1

These curves represent risk between water depth and velocity for people within floodwater, and can be utilised for detention basins risk assessments. For new and old basins, consideration to either designed or predicted velocities and flow volumes is required to ensure that in the event of a significant storm event or prolonged rainfall, basins do not introduce hazards which do not have the appropriate safety treatments.

Process of Evaluation – New Basins

It is recommended, and is Council's preference, that a batter slope of 6H:1V is adopted for all new stormwater basins (inclusive of batter slopes below the storage level) that are proposed to be dedicated to Council. This will lower the potential for hazards and minimise maintenance costs.

Council will require the design specification of minimum, average and maximum flow depths and velocities for proposed basins, and their associated treatments, which demonstrated the minimisation of risk.

As a minimum, all new basins shall adhere to the requirements outlined in the following:

- NSW Dams Safety Act 2015;
- Dams Safety Regulation 2019;
- The latest version of ARR;
- Council's Infrastructure Specifications;
- Ancillary items as outlined in this document.

If site constraints do not allow for the new basin to have batter slopes of 6H:1V or flatter, or the stability thresholds exceed the low hazard for adults, the hazard identification and risk assessment process as outlined in **Appendix A** shall be followed. Risk mitigation treatments shall be included as necessary to reduce the residual risk of the proposed basin to a level acceptable to Council. This process shall be document and submitted to Council for review prior to acceptance of the basin design.

RISK MITIGATION TREATMENTS

Council currently implements several risk mitigation treatment options to minimise the exposure of risk to members of the public. Risk mitigating treatments are selected and implemented on a case-by-case basis, and considers the practicality, efficiency, suitability, and cost for each treatment option. The following list highlights the common risk mitigating treatments for stormwater basins.

Exclusion / Security Fencing

Exclusion / security fencing is used as a method of excluding people (children and adults) from an area. In cases where safety risks exist for both adults and children, then the use of exclusion fencing may be required. Unfortunately, most fencing can be scaled, crossed, or damaged by a determined person, therefore, the type and height of fencing used is to be appropriate for the assessed likelihood and consequence level.

This mitigation treatment option shall be used if any of the following criteria are met:

- Consequence Level is assessed as C4 or greater.
- Safe egress cannot be designed into the basin.
- ALARP assessment categorises the risk as higher than Medium.
- Vertical batters resulting in a fall hazard.
- Flow depths and velocities are identified to fall equal or above the high hazard curve as per Figure 2.

All exclusion fencing shall comply with the latest version of AS1926: Fences and Gates for Private Swimming Pools.

If fencing is required within 1km of a saltwater body (river, ocean, beach etc.) then hot-dipped galvanised steel shall be used. All other fencing shall use powder coated mild steel complying with Council's colour selection.

Barrier Fencing / Dense Vegetation Deterrent

Barrier fencing is not primarily designed for excluding access by a person, rather, it is utilised as a method of visual warning for danger and as a means of preventing accidental access or falls. This treatment option is to be used in situations where a 'danger' is hidden or not reasonably obvious.

If the edge treatment of a stormwater basin allows a person to fall more than 1000mm (1.0m), then appropriate barrier fencing is required. All barrier fencing shall be designed in accordance with the imposed actions specified in AS1170.1: Minimum Design Loads on Structures, Dead and Live Loads.

In cases where there is no fall risk, or, when flow depths and volumes are assessed as below the high hazard curve, then the implementation of native dense deterrent

vegetation is encouraged to prevent access to basins where practical. Vegetation increases the aesthetic appeal of the area whilst reducing deliberate or accidental entry. At Councils discretion, either barrier fencing or vegetation deterrent can be chosen.

Vegetation shall only be used as a barrier treatment and shall not include materials that may be washed into the asset and affect either the serviceability or maintenance of the basin. No vegetation is to be installed within the basin structure as a method of access prevention, unless it has been included as a part of the stormwater treatment solution. Grass-lined basins may be used only if a maintenance program is provided, given the on-going maintenance required to prevent overgrowth and increased likelihood of encountering dangerous fauna.

The following native plants are recommended for use as deterrent vegetation.

Table 2: Recommended Native Plants for use as deterrent

Plant	Scientific Name	Description	Image
Blackthorn	*Bursaria spinosa*	Shrub or small to medium tree to 10 m high; branches usually spikey	
Dagger Hakea	*Hakea teretifolia*	Spreading shrub 1 – 3 m high, with rigid spreading branches	
Needlebush	*Hakea sericea*	Spreading bushy shrub 1 – 3 m high, with spiney stems	

Plant	Scientific Name	Description	Image
Prickly Beard-heath	*Leucopogon juniperinus*	Erect, densely branched shrub to 1 m high with spiney leaves.	
Prickly Tea-tree	*Leptospermum juniperinum*	Shrub 2 – 3 m high, with stems often with long fine appressed hairs	

The use of other native plants may be considered subject to Council approval.

In the event dense deterrent vegetation is used, an access route must be provided to allow for authorised personnel to access the basin. This may include, but is not limited to access fencing, boom gates or security fencing.

No trees are to be planted within the basin as this may lead to the accumulation of additional debris and increased maintenance requirements. Additionally, no trees are to be planted along the batter or basin wall as oversaturation of soil may increase the likelihood of fallen trees either within the basin, or outside of the basin.

Childproof Fencing

Childproof fencing is used to prevent access by children not considered old enough to properly assess the safety risks. The need for childproof fencing is to be assessed on a case-by-case basis based on the results of the risk assessment. Typically, this treatment option is to be used in public areas such as parks and shopping centres, where the likelihood of children accessing the basin either accidentally or deliberately is greater than L3, and a consequence level is less than or equal to C2.

Colour Selection

For constructed treatment options, colour selection is dependent on the proximity to coastal water bodies and the existing local amenity colour. Council requires the following colours to be utilised dependent on the setting:

Table 3: Colour options for fencing

Setting	Colour	
Coastal	Basalt	
Bushland	Monument	

All fencing, signage and ancillary items shall include Council's Logo.

ANCILLIARY ITEMS

Inlet and Outlet Screens

The use of inlet and outlet screens on stormwater pipes and culverts should **not** be a commonly utilised treatment option but should always be assessed on a case-by-case basis. Recommendation of this treatment option must consider both the beneficial and the adverse consequences of such screens and take into account the requirements of Council's Infrastructure Specification.

The following table outlines some of the potential beneficial and adverse consequences of inlet and outlet screens

Table 4: Benefit and Adverse Consequence lists

Benefits	Adverse Consequences
• Persons prevented from being swept into or through the structure / into the stormwater network • Person/s prevented from entering (exploring) the stormwater system (network) and becoming trapped in deep infiltration chambers, gross pollutant traps (GPTs) and the like • Prevents access to private land via access through the stormwater system	• Interference with terrestrial / aquatic movements • Safety risks to persons trapped against the screen via hydraulic pressure (inlet screens) • Person/s trapped within the stormwater system (network) and unable to escape (outlet screens) • Localised flooding due to debris build-up, and associated risks due to bypassing flow (inlet / outlet screens) • Increased maintenance requirements to remove debris

Outlet screens are generally not used in situations where upstream access is possible. In appropriate circumstances, consideration should be given to the placement of outlet screens on stormwater pipes of 600mm diameter or greater that contain accessible, enclosed, deepwater chambers (e.g. GPTs). Additionally, grates should only be installed on stormwater outlets on the condition that:

- Possible debris loadings from upstream catchment are adequately assessed.
- The consequences of system failure (e.g. property damages and safety hazards) resulting from debris blockage of the screen have been investigated and addressed to Council's satisfaction.
- All upstream inlets and access chambers are secured against unauthorised entry.

Inlet screens are not to be used in situations where the likelihood of persons becoming trapped against the inlet screen during a storm event is deemed

reasonably likely. The primary safety concern is the risk of a child being swept to, and held against, the screen in circumstances where the water level could rise above the child's head.

Inlet screens should only be installed on stormwater inlets on the condition that:

- The vertical downward component of water velocity at an inlet grade is minimised.
- Appropriate access must be provided to allow for maintenance.
- An appropriate process/procedure is developed for the cleaning of a fully blocked screen.
- Inlet screens/racks should have a removable feature to permit access for cleaning inside the pipe/culvert.
- Outlet screens should not be used in circumstances where a person could either enter, or be swept into, the upstream pipe network.
- Outlet screens on pipe/box units up to 1800 mm in width should be designed such that the full width of the outfall pipe/box can be accessed for periodic maintenance.
- All screens should be secured with tamper-proof bolts or a locking device.
- Outlet screens should be structurally designed to break away under the conditions of 50% blockage (or lower if needed to prevent undesirable backwater flooding) during the pipe's design storm event.

Council, at its discretion, can elect that no inlet and outlet screens are to be used within a designed system, and alternative treatment options must be used instead.

Signposting / Warning Signage

Council warning signage shall be installed using the most current design near access points around the basin. This signage is to give notification to the public of the risk associated with entering the basin and shall include all of the following:

- No Swimming
- Uneven Ground
- No Diving
- Snakes
- No Wading
- Drop off
- Suction Pipe

All signs are to include Council's logo and "In an emergency call 000".

A minimum of one (1) sign is required at each reasonable point of access to the basin (e.g. along a footpath, trail, low grade to access etc.).

Figure 3 - Council Warning Signage: Stormwater Pond

In addition to Councils “Warning Stormwater Pond” signage (Figure 3), any basins that will undergo a rapid increase in water levels shall also include “Warning Onsite Detention Area” signage (Figure 4).

Figure 4: Example of onsite detention area warning sign

The minimum dimensions of warning signage is 400 x 300 mm with reflective writing to provide additional visibility during the night.

Refer to Council's Infrastructure Specification 1192 SIGNPOSTING for further detailed requirements of signs and support structures.

Refuge Mounds

The provision of refuge mounds are to be considered in situations where the designed wet basin is greater than 1.2m in depth and rapid increases in storage levels have been modelled for events less than a 20% AEP event.

APPENDIX A

Hazard Identification and Risk Assessment

Hazards shall be examined to establish a consequence and likelihood level, and shall include any combination of the following components:

- Identification of the predominant mode of the basin (wet or dry);
- Identification of potential drops greater than or equal to 1 m;
- Safe Egress or Refuge Mound within basin structure;
- Proximity to childcare infrastructure or public amenities;
- Accidental or deliberate entry by person/s;
- Stormwater inlets and/or outlets of size greater than 300 mm.

A review of the relevant Work-as-Executed (WAE) documentation is required to confirm that the designed predominant mode of the basin is current. Any basin with a permanent storage depth of greater than or equal to 300mm is to be considered a wet basin. Basins which only hold water during a storm event and dissipates within 24 hours is to be considered a dry basin.

Larger storm events (greater than or equal to a 10% AEP event), or frequent rainfall may increase the water table level, and therefore temporarily change the predominant mode of a basin until the water levels drop below the floor of the basin. During inspections, it is to be noted whether a dry basin is holding water, and a measurement of the depth shall be conducted if safe to do so.

Batter Slope

With respect to this guideline, the following batter slopes have been adopted for consideration:

1. Vertical Face (Headwalls, drop offs etc.)
2. Stepped Face (Small Gabion Baskets, riprap, formed concrete etc.)
3. 1V:1H batter
4. 1V:2H batter
5. 1V:4H batter
6. 1V:6H batter of flatter

The measurement of the depth of the batter is dependent on the predominant mode of the basin. For a wet basin, the water depth is considered of greater risk than any batter slope less than or equal to a 1V:3H batter.

Table A1: Depth determination

Depth for Dry Basin (Diagram A.1)	=	depth from surrounding area to the base of the basin
Depth for Wet Basin 1V:3H batter or steeper (Diagram A.2)	=	depth from surrounding area to the base of the basin
Depth for Wet Basin flatter than 1V:3H batter (Diagram A.3)	=	depth of water from top of water to base of basin

Diagram A.1 - Dry Basin, all batter slopes

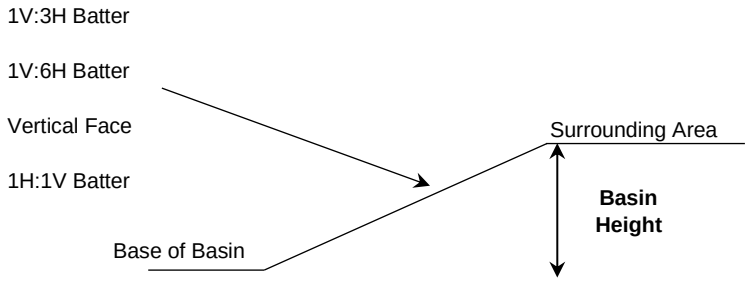


Diagram A.2 - Wet Basin, batter slopes of 1V:3H or steeper

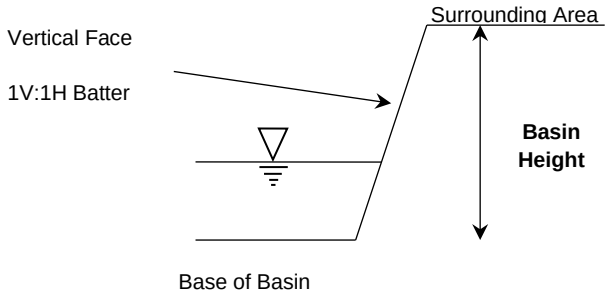
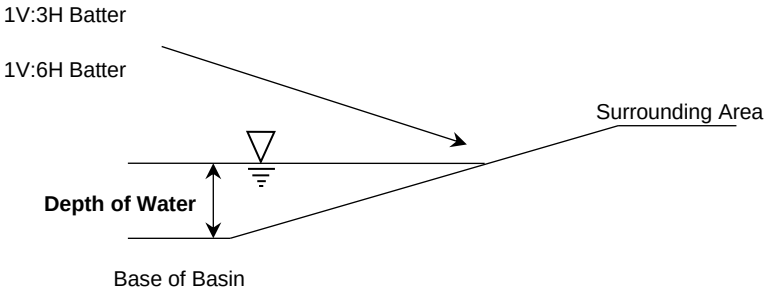


Diagram A.3 - Wet Basin, batter slopes flatter than 1V:3H



Water Depth, Flow and Velocity

With respect to this guideline, Figure 2 is to be utilised when considering water depth and velocities for basins. The measurement for potential depth and flow velocities are to be either:

a) Calculated during the design phase of a proposed basin and identified on the Works as Executed plans;
b) Approximated given the size of the catchments feeding into the basin, capacity of the basin, and the outlet capacity.

Consequence

The consequence level is the severity of an incident as a result a hazard. Using the table below, the consequence level can be determined from considering the depth of water/ height of drop and the batter slope for a wet or dry basin. When choosing the most appropriate batter slope, if an exact value cannot be established, then a conservative choice of the next steeper batter is to be used. Similarly, when selecting the most appropriate height of drop or depth of water, a more conservative option is to be used if an exact value cannot be determined.

Table A2: Consequence Level for Batter Slope with relation to Height of Drop & Depth of Water

		Batter Slope – Consequence Level									
		Vertical Face		Stepped		1V:1H		1V:3H		1V:6H	
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Height of Drop (or Permanent Depth of Water)	>1.2m	C4	C5	C3	C4	C3	C5	C3	C3	C3	C3
	1.2m	C3	C5	C3	C4	C3	C5	C3	C3	C3	C3
	0.9m	C3	C5	C2	C3	C2	C5	C2	C2	C2	C2
	0.6m	C2	C2	C1	C2	C2	C3	C1	C1	C1	C1
	≤ 0.3m	C1	C1	C1	C1	C1	C1	C1	C1	C1	C1

Table A3: Consequence Level Descriptors

Level	Descriptor	Description
C1	Insignificant	Local first aid may be required
C2	Minor	Minor injury that may require medical attention with no ongoing treatment
C3	Moderate	Injury requiring ongoing medical treatment and/or lost time
C4	Major	Extensive injuries that are life threatening; or multiple serious injuries and hospitalisation
C5	Severe	Any fatality or multiple permanent disability or ill health

Likelihood

The likelihood of an event occurring has been assumed to be proportional to the number or persons frequenting the basin. The greater the number of persons frequenting the hazard, the greater in probability that an incident will occur. As shown in the table below, likelihood will be assessed and described as:

Table A4: Likelihood Level Descriptors

Likelihood Level	A	B	C	D	E
Frequency visited	Rare	Less frequent	Frequent	Highly frequent	Most frequent
Persons per day	< 5	5 - 20	20-60	60-120	> 120

Additionally, the risk of an incident occurring is to a degree, affected by the types of activities conducted within the area of influence of the basin. For example, where a basin is within proximity to childcare facilities or pedestrian infrastructure the probability of accidental or deliberate entry increases with the result being an increased probability of incident. Whereas a basin relatively close to an existing natural water body, away from childcare facilities and pedestrian infrastructure, or with adequate restrictions to access will decrease the probability of access and incident.

A general estimate for access into a basin shall be conducted during inspections, with an adjustment to the likelihood level being completed as follows:

Increased Likelihood level: An increase of likelihood level by 1 if any of the following conditions are met:

1. Less than 100m from parks and open spaces where play equipment is present.
2. Less than 500m from childcare facilities, i.e., primary schools, preschools, day-care centre etc.
3. Less than 10m from a cycleway, shared pathway or footpath.
4. A basin which is partially obscured from sight.

In the event that a basin meets any of the conditions between 1 and 3, and is fully obscured from sight, the basin is to be treated as a high likelihood location.

Decreased Likelihood level: A decrease of likelihood level by 1 if any of the following conditions are met:

1. Less than 20m from an existing water body.
2. The basin is naturally not easily accessible.

The conditions identified above are not exhaustive. If other conditions existing which are considered to affect the level of use, then the level may be increased or decreased as required, with suitable evidence required.

Table A5: Likelihood Table

Level	Descriptor	Description	Frequency	Probability	Project/Program
L5	Almost Certain	Clear indication that the risk will materialise. Would be very surprised if it didn't	Annual	> 90%	Likely to occur in more than 1 in 2 projects of this kind.
L4	Likely	Risk is expected to occur. Would be quite surprised if it didn't	1 in 2-year event	50 – 90%	Likely to occur in 1 in 2 projects of this kind.
L3	Possible	Risk is not expected to occur, but would also not be surprised if it did	1 in 4-year event	20 – 50%	Likely to occur in between 1 in 4 projects of this kind.
L2	Unlikely	Risk is not expected to occur, would be quite surprised if it did	1 in 8-year event	5 – 20%	Likely to occur in less than 1 in 10 projects of this kind.
L1	Rare	Would be very surprised if the risk occurred	1 in 20-year event	< 5%	Unlikely to happen

Once the risk has been assessed, proposed methods of mitigation to control the risk are to be evaluated with consideration of likelihood and consequence to ensure the residual risk is As Low As Reasonably Possible (ALARP), and fit to Councils Risk Management Plan. All risk assessments must include a likelihood consequenec assessment to determined the ALARP level, as shown below in Figure A1.

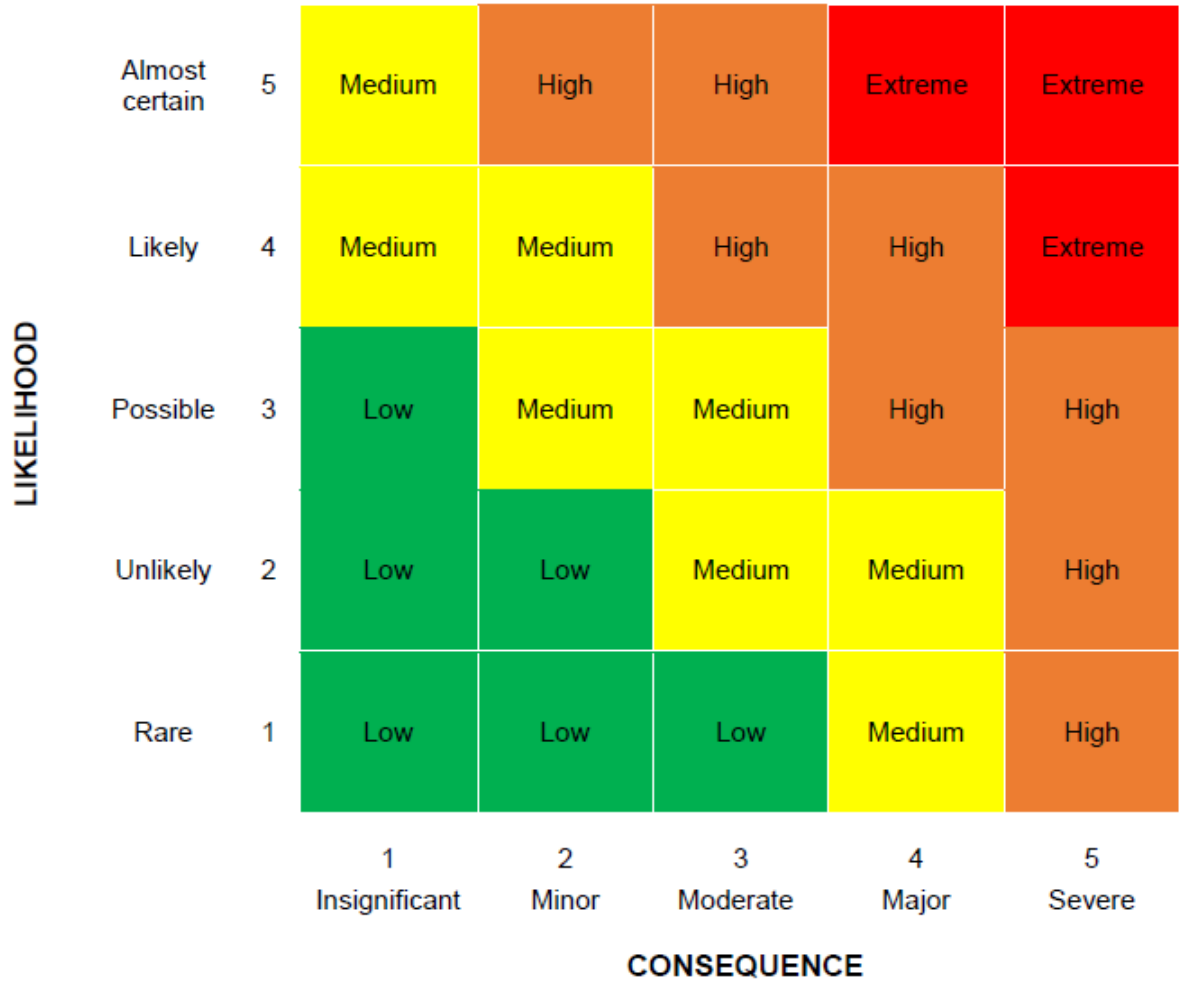


Figure A1: Risk 5x5 Matrix

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