Waterbody Management Guideline

Module 2

Development Assessment

VERSION 1 SEPTEMBER 2013

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Healthy Waterways is a not-for-profit, non-government organisation working to protect and improve waterway health in South East Queensland (SEQ). We facilitate careful planning and coordinated efforts among a network of member organisations from government, industry, research, and the community to achieve our shared vision for healthy waterways.
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Redland CITY COUNCIL

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2.1 INTRODUCTION

2.1.1 Purpose of module 2

The purpose of this module, *'Development Assessment',* is to assist local government officers and developers to assess and manage pre-existing waterbodies on a new development site. It does not provide detail on how to design new waterbodies proposed as part of a development or on private property for water supply. For further information on these components see the *Townsville Constructed Lakes Design Guideline* (DesignFlow, 2010) and *Planning Your Farm Dam* (DERM, 2011a).

2.1.2 How to use module 2

Module 2 is divided into four main sections. Figure 2.1 outlines how to use each section.

Figure 2.1 How to use module 2

Section 2.2	
Background to Waterbodies and Development Assessment	This section provides background on how waterbodies become a consideration in the development assessment process.
Section 2.3	
The Development Assessment Process for Waterbodies	This section outlines a process for assessing a pre-existing waterbody on a development site to ensure the most appropriate outcome is achieved for the waterbody post development.
Section 2.4	
Producing a Development Code for Waterbodies	This section provides advice on how to write planning scheme codes to achieve appropriate outcomes for waterbodies that exist on development sites prior to development.
Section 2.5	
Worked Example	This section uses a hypothetical example to demonstrate the processes documented in this module.

Determine if module 2 applies

Prior to commencing the process outlined in this module, be sure to check that the waterbody in question is within the scope of this guideline. Remember this guideline does not apply to riverine and marine wetlands and excludes waterbodies that have natural water flows, function as treatment systems (stormwater treatment systems, contaminant removal, sewage treatment ponds etc.) regional drinking water storages or are used for aquaculture or industrial purposes. Although the concepts presented in this module could be applied to the above waterbody types, it is not its primary purpose.

2.2 BACKGROUND TO WATERBODIES AND DEVELOPMENT ASSESSMENT

Unless appropriately managed, developing a site will degrade the condition of pre-existing waterbodies. Causes of this degradation include:

- poor sediment and erosion controls during development
- ongoing pressures such as increased pollution, altered hydrology and removal of riparian vegetation.

After development, most pre-existing waterbodies become the responsibility of local governments to manage, although some remain privately owned. If a development produces a poor waterbody outcome, this waterbody will become very difficult and expensive to manage. It is not sustainable for local governments to assume responsibility of poor quality waterbodies. Waterbodies must therefore be managed during development to ensure appropriate and sustainable outcomes are achieved.

The **goals** of development assessment are to ensure that on the development site pre-existing waterbodies with:

- high value are protected during development and values are retained post development
- low value and high risk are removed in a safe, low cost manner with minimal environmental impacts.

Most waterbodies located on sites prior to being developed are old farm dams. Before development, many of these are in poor condition (Figure 2.2). In some circumstances some waterbodies may become 'naturalised' to their surrounding landscape and be in good condition prior to development (Figure 2.3).

It is vital to determine if the pre-existing waterbody is part of or connected to a broader wetland as this will determine the options available for the system. It is also important to recognise the scope and limitations of the development assessment process and that seeking options that consider whole of catchment may require extra work beyond the scope of what development assessment can achieve. When determining the outcome for the waterbody it is important to recognise that protecting and retaining high value waterbodies during development will result in local government investing ongoing resources for long term, continued maintenance post development.

Figure 2.2 Farm dam in poor condition

Photo: Karen McNeale, Redland City Council

Figure 2.3 A naturalised waterbody

Photo: Julian Wakefield, Sunshine Coast Council

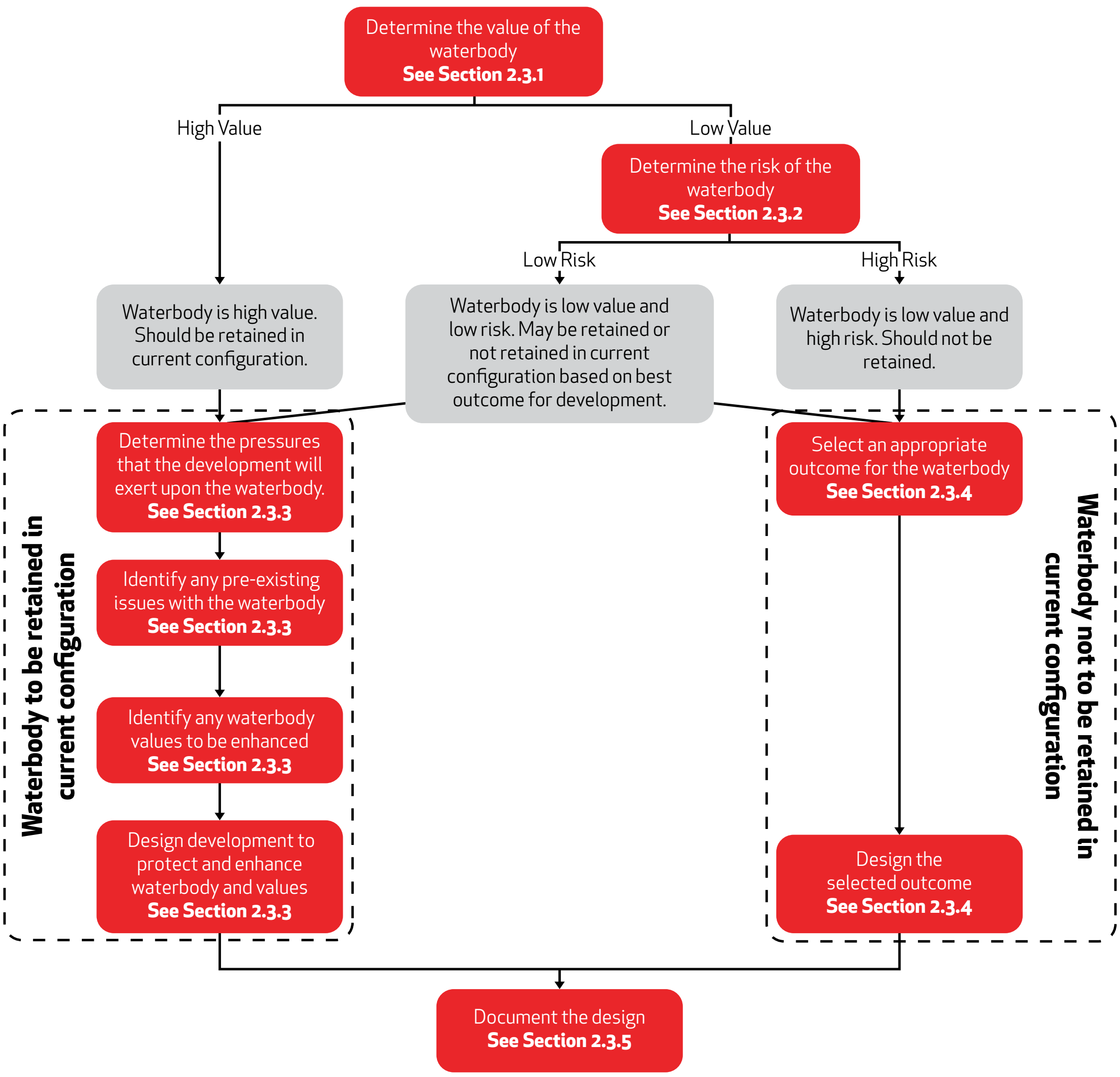
2.3 THE DEVELOPMENT ASSESSMENT PROCESS FOR WATERBODIES

This section provides guidance on achieving the requirements of a code for pre-existing waterbodies written in accordance with Section 2.4. Local governments can use this section as a source of information to write their own planning scheme policy for managing waterbodies. Simply reference this section within the appropriate planning scheme policy or use it to assess development applications. This section can also be used when preparing a development application to assist in achieving a well made application.

The Process

The first step is to determine the value of the waterbody through applying a value based scoring system (Section 2.3.1). The resulting value score is used to determine the options for the waterbody. If the scoring system shows that the waterbody has high value then it should be retained in its current configuration. If the scoring system shows that the waterbody is of low value, then a further assessment based on risk must be carried out to determine the level of risk retaining the waterbody in its current configuration will present (Section 2.3.2). If the result of this risk assessment shows that the waterbody presents a high risk then it is advisable not to retain the waterbody in its current configuration. If the result of the risk assessment shows that the waterbody is of low risk, then the development assessment officer must decide based on local conditions and the best outcome for the development whether or not to retain the waterbody. The final step of the development assessment process is to document the design for assessment and construction (Section 2.3.5). Figure 2.4 outlines this process.

Figure 2.4 The development assessment process for waterbodies



Retaining a waterbody in its current configuration

Retaining a waterbody in its current configuration means to keep the waterbody almost exactly as it is. It should only be altered to mitigate risks to its long term sustainability. Section 2.3.3 describes in detail the process for retaining waterbodies in their current configuration.

Not retaining a waterbody in its current configuration

Not retaining a waterbody in its current configuration means that it is considered too high risk to remain exactly as it is. Section 2.3.4 provides options for waterbodies not to be retained in their current condition.

2.3.1 Determine the value of the waterbody

Use the value based scoring system to determine the value of the waterbody (Table 2.1).The values are a subset of those discussed in Module 1, Section 1.3 and were chosen to be fit for purpose for development assessment needs.

Prior to completing the scoring system, read the following steps:

1. Understand the background, history and context of the waterbody. In particular, consider how the waterbody was formed and how the presence of the waterbody impacts the natural hydrology of the catchment.
2. Score the waterbody values in the interests of the broader community and not for individual needs.
3. Score the waterbody values for all attributes based on current status, not past or potential future status.
4. When scoring Recreation and Amenity values consider the value from the perspective of if the public had access to the waterbody.
5. Add up the individual scores to get the total score for the waterbody value.
6. If the total score is equal to or greater than 18, the waterbody is considered to be of high value and should be retained in its current configuration.
7. If the total score is less than 18 it is considered to be of low value and a risk assessment should be undertaken to determine what to do with these waterbodies of low value.

Table 2.1 Scoring system to determine the value of a waterbody for development approval purposes

Type of Value	Score	Criteria
Connectivity	7	The waterbody contributes significantly to ecological connectivity, provides a significant functional corridor for native wildlife and has the potential to link corridors.
	4	The waterbody provides some ecological connectivity and/or provides a functional corridor for native wildlife.
	1	The waterbody provides no ecological connectivity and does not provide a functional corridor for native wildlife.
Biodiversity	7	The waterbody provides both good quality aquatic and terrestrial habitat for native species.
	5	The waterbody provides either good quality aquatic or terrestrial habitat for native species.
	3	The waterbody provides some aquatic and/or terrestrial habitat for native species.
	1	The waterbody provides little or no aquatic or terrestrial habitat for native species.
Recreation	5	If the community were provided access to the waterbody in its current condition and configuration, it could be highly used for recreation. Factors to consider may include water quality, public health and safety, location, aesthetics etc.
	3	If the community were provided access to the waterbody in its current condition and configuration, it could be moderately used for recreation. Factors to consider may include water quality, public health and safety, location, aesthetics etc.
	1	If the community were provided access to the waterbody in its current condition and configuration, it would be unlikely to be used for recreation. Factors to consider may include water quality, public health and safety, location, aesthetics etc.
Amenity	5	If the community were provided access to the waterbody in its current condition and configuration, the waterbody could be highly used by the community for its amenity. Factors to consider may include water quality, location, aesthetics etc.
	3	If the community were provided access to the waterbody in its current condition and configuration, the waterbody could be moderately used by the community for its amenity. Factors to consider may include, water quality, location, aesthetics etc.
	1	If the community were provided access to the waterbody in its current condition and configuration, it would be unlikely for the community to use the waterbody for its amenity. Factors to consider may include water quality, location, aesthetics etc.
Cultural heritage	5	The waterbody is of high cultural and/or spiritual value to the community.
	3	The waterbody is of some cultural and/or spiritual value to the community
	1	The waterbody is of no cultural or spiritual value to the community.
Total Score	5 to 29	

If the results of the value assessment are:

Total score less than 18 → Waterbody is of low value → Further Assessment Required → Go to Section 2.3.2

Total score equal to or greater than 18 → Waterbody is valuable → Retain → Go to Section 2.3.3

2.3.2 Determine the risk of the waterbody

If the value assessment in Section 2.3.1 resulted in a score less than 18 then the waterbody is of low value and this section should be used to carry out a risk assessment to determine what to do with the low value waterbody.

Table 2.2 outlines a scoring system to determine the risk of a waterbody.

1. Use the criteria in Table 2.2 to assign a score to the waterbody for each of the six types of waterbody risks listed. The assessment should consider both existing risks, and the likelihood of the proposed development type (e.g. residential, commercial, industrial) to exacerbate or create risks.
2. Add the score for each type of waterbody risk to obtain a total score for the waterbody from 6 to 30.

Where a waterbody's total score is equal to or greater than 10, the waterbody is considered high risk and it is therefore advisable not to retain the waterbody in its current configuration. Proceed to Section 2.3.4 for further information on how to select an appropriate outcome for the waterbodies that are not to be retained.

Where a waterbody's total score is less than 10 it is considered to be of low risk. Low risk waterbodies may be either retained (Section 2.3.3) or not retained (Section 2.3.4) in their current configuration. The development assessment officer should work with the developer to decide the best outcome and design accordingly.

Table 2.2 Scoring system to determine the risk presented from retaining a waterbody

Type of Waterbody Risk	Score	Criteria
Structural integrity	5	Waterbody is not structurally sound. Human population (now or in the future) is at risk in the event of failure.
	3	Waterbody is certified as structurally sound. Human population located downstream (now or in the future) is at risk in the event of failure. OR Works will be undertaken as a part of development to ensure waterbody is structurally sound and can be certified as such. Human population located downstream (now or in the future) is at risk in the event of failure.
	1	Waterbody is certified as structurally sound. No human population (now or in the future) is at risk in the event of failure. OR Works will be undertaken as a part of development to ensure waterbody is structurally sound and can be certified as such. No human population (now or in the future) will be at risk in the event of failure.
Water quality	5	The waterbody has a history of poor water quality and the future development is industrial.
	3	The waterbody has a history of poor water quality and the future development is commercial or high density residential. OR The waterbody has no history of poor water quality and the future development is industrial.
	1	The waterbody has no history of poor water quality and the future development is low/medium density residential.

Type of Waterbody Risk	Score	Criteria
Safety	5	When assessed against the method outlined in Appendix A of *Rectifying Vegetated Stormwater Assets* (Water by Design, 2012b), a score of greater than 21 is achieved.
	4	When assessed against the method outlined in Appendix A of *Rectifying Vegetated Stormwater Assets* (Water by Design, 2012b), a score of 17 to 21 is achieved.
	3	When assessed against the method outlined in Appendix A of *Rectifying Vegetated Stormwater Assets* (Water by Design, 2012b), a score of 12 to 16 is achieved.
	2	When assessed against the method outlined in Appendix A of *Rectifying Vegetated Stormwater Assets* (Water by Design, 2012b), a score of 7 to 11 is achieved.
	1	When assessed against the method outlined in Appendix A of *Rectifying Vegetated Stormwater Assets* (Water by Design, 2012b), a score of less than 7 is achieved.
Maintenance access	5	Appropriate maintenance access is not, and will not, be provided.
	3	Appropriate maintenance access is (or will be) provided to between one and three (inclusive) of the following: the inlets, outlets, body of water and perimeter of the waterbody.
	1	Appropriate maintenance access is (or will be) provided to the inlets, outlets, body of water and perimeter of the waterbody.
Weeds and pests	5	The waterbody contains declared weeds and/or pests.
	3	The waterbody contains non-declared weeds and/or pests, or species which could become weeds and/or pests.
	1	The waterbody contains no species that could become weeds or pests.
Economics – removal*	5	Removing or repurposing the waterbody will have little effect on the cost of the development. It is much less expensive to remove or repurpose now rather than later. Removing or repurposing of the waterbody makes good economic sense.
	3	Removing or repurposing the waterbody will increase the cost of the development. It is moderately more expensive to remove or repurpose now rather than later. Removing or repurposing of the waterbody may make economic sense.
	1	Removing or repurposing the waterbody will have a large effect on the cost of the development. There is no advantage to remove or repurpose now rather than later. Removing or repurposing of the waterbody does not make good economic sense.
Total Score	6 to 30	

*Economic feasibility of repurposing or removing a waterbody is highlighted in this table to factor the cost and the risk of not taking an appropriate decision at a time where the cost is considered reasonable. A transparent and justifiable analysis must be provided to support the score.

If the results of the risk assessment are:

Total score greater than or equal to 10 → Waterbody is high risk → Do not retain → Go to Section 2.3.4

Total score less than 10 → Waterbody is low risk → Based on best development outcome decide whether waterbody should be retained (Section 2.3.3) or not retained (Section 2.3.4)

2.3.3 Retaining waterbodies in their current configuration

If a waterbody is of high value (value score equal to or greater than 18) or if a waterbody is of low value but also of low risk (risk score less than 10) and it is desirable to retain that waterbody in its current configuration then follow the process outlined in this section.

To retain a waterbody in its current configuration:

- determine the pressures that the development will exert upon the waterbody
- identify any pre-existing issues with the waterbody
- identify any waterbody values to be enhanced
- design development to protect and enhance waterbody and values.

Determine the pressures that the development will exert upon the waterbody

Development exerts pressures on waterbodies. These pressures can be indirect (occurring in the surrounding area of the waterbody) or direct (occurring directly to the waterbody). Table 2.3 describes the common pressures that development exerts upon a waterbody. This list of pressures has been derived from the State of the Environment Queensland Report, 2011. Use Table 2.3 as a guide to determine which pressures the development in question is likely to exert on the waterbody.

Table 2.3 Common pressures that development exerts upon a waterbody

	Pressure	Description
Indirect pressure	Catchment disturbance	Development results in landuse change, including vegetation clearing, which can result in erosion and sediment loading to the waterbody.
	Impacts on the fringing zone	Developing land adjacent to waterbodies creates edge effects such as weed ingress, degrading the waterbody.
	Loss of connectivity of the waterbody to the overall landscape	Developing land can cause fragmentation between habitats.
	Hydrological disturbances	Developing land alters hydrology by modifying catchment characteristics, typically increasing impervious land cover. This increases the magnitude and frequency of runoff events resulting in changes to waterbody inflows and waterbody detention time. This can cause erosion and alter ecological communities by changing the inundation or drying periods for vegetation and animals that live in the waterbody.
Direct pressure	Impacts on waterbody soils	Development can directly cause mechanical disturbance of waterbody soils which can lead to exposure and activation of acid sulfate soils (low pH and metal mobilisation).
	Impacts on waterbody flora and fauna	Development can directly remove habitat and encourage the introduction of pest flora and fauna.
	Impacts on water quality	Development can increase stormwater pollution delivered to waterbodies, impacting water quality.

Identify any pre-existing issues with the waterbody

Many valuable waterbodies will also contain pre-existing issues which if left untreated will develop into significant problems in the future. Table 2.4 describes common pre-existing issues with waterbodies.

Table 2.4 Common pre-existing issues with waterbodies

Issue	Description
Structural integrity	Some waterbodies may not be structurally sound. This may be because they were not designed or constructed to engineering standards, or because they have degraded over time.
Public health and safety e.g. steep batters	Some waterbodies will have health and safety issues such as steep sloping batters above and/or below the waterline. While these health and safety issues may not have been a concern prior to development when public access was restricted, they may become a significant safety issue if public access is provided post development.
Erosion	Many waterbodies will contain erosion around inlets and outlets.

Identify any waterbody values to be enhanced

In some instances, if a waterbody is to be retained, it may be beneficial to enhance some existing values. Any opportunities for this should be identified at this stage.

Design development to protect and enhance waterbody and values

The development should be designed to:

- mitigate any development pressures and pre-existing issues identified in Table 2.3 and Table 2.4
- enhance any identified waterbody values.

Table 2.5 and 2.6 describe how to investigate and mitigate any development pressures and pre-existing issues.

Table 2.5 How to investigate development pressures and design appropriate mitigation strategies

	Pressure	Investigation	Mitigation Strategy
Indirect Pressures	Catchment disturbance	If not carefully managed, clearing and developing land will deliver large sediment loads to the waterbody.	Implement best practice erosion and sediment control (e.g. IECA, 2008) on both the development site and any subsequent building sites.
	Impacts on the fringing zone	Use the proposed plan of development to assess the future development footprint relative to the waterbody.	A densely vegetated buffer of native plants comprised of trees, shrubs and groundcovers must be provided in accordance with the wetland perimeter planting in the *Water Sensitive Urban Design Technical Design Guidelines for South East Queensland* (Water by Design, 2006). Further information is provided in the *Townsville Constructed Lakes Design Guideline* (DesignFlow, 2010) and the *Queensland Wetland Buffer Planning Guideline* (DERM, 2011b).
	Loss of connectivity of the waterbody to the overall landscape	Any potential impact that development poses to the terrestrial or aquatic connectivity function provided by the waterbody should be identified and mitigated.	Further information is provided in the *Queensland Wetland Buffer Planning Guideline* (DERM, 2011b).
	Hydrological disturbance	Establish a water balance model for the waterbody and use it to compare the pre-development hydrology of the waterbody with the post development hydrology, particularly issues which cause stress to vegetation such as changes in depth, frequency and duration of inundation. Water level exceedance curves and spells analysis are a useful way of depicting this.	Mitigation strategies should focus on mimicking the pre-development hydrology, focusing on the depth, frequency and duration of inundation. Where the pre-developed hydrology cannot be perfectly mimicked, an aquatic ecologist or similar expert should be consulted to determine the impact of the change. No negative impact should be allowed. For further information on the effects of hydrology on aquatic vegetation in constructed wetlands see Hoban *et al.*, (2006). Mitigation strategies will need to be tested using the water balance model but may include: • bypassing a portion of flows around the waterbody • modifying outlet arrangements • minimise amount of impervious area to be developed.

	Pressure	Investigation	Mitigation Strategy
Direct Pressures	Impacts on waterbody soils	Check acid sulfate soils (ASS) mapping to assess if ASS or potential ASS are likely to be present.	Develop and implement an ASS management plan.
	Impacts on waterbody flora and fauna	Where habitat for highly valued species has been identified, use the proposed plan of development to assess to what extent the development may impact upon this habitat.	Develop a strategy to manage the potential impact. This may include developing a hierarchy to avoid, minimise or mitigate impacts on habitat.
	Impacts on water quality	Without treatment or other mitigation, stormwater from urban developments will negatively impact upon waterbodies.	As a minimum, treat stormwater to comply with stormwater pollutant load reduction targets (see DERM, 2010). Where a waterbody is sensitive to water quality, stormwater may be required to be treated beyond these standards. Untreated stormwater should not enter the waterbody.

Table 2.6 How to investigate pre-existing issues and design appropriate mitigation strategies

Pre-existing Issue	Investigation	Mitigation Strategy
Structural integrity	If as-constructed plans for the pre-existing waterbody are not available, undertake geotechnical investigations to determine the structural integrity of the waterbody, particularly all embankments.	The mitigation measure will depend on the waterbody design and condition. Consult a suitably qualified engineer. The community must not face any risk in the event of failure. All works must be certified by a suitably qualified engineer.
Public health and safety e.g. steep batters	Assess public access and safety concerns using the proposed plan of development against design advice for constructed wetlands and sediment ponds contained in the *Water Sensitive Urban Design Technical Design Guidelines for South East Queensland* (Water by Design, 2006) and *Rectifying Vegetated Stormwater Assets* (Water by Design, 2012b).	Undertake works to bring the waterbody into alignment with the guidance provided in the *Water Sensitive Urban Design Technical Design Guidelines for South East Queensland* (Water by Design, 2006) and *Rectifying Vegetated Stormwater Assets* (Water by Design, 2012b). Be sure not to compromise waterbody values in the process. Where the waterbody cannot be bought into alignment with the guidance, public access should be restricted using existing or enhanced dense vegetation.
Erosion	Investigate the potential for scour of inlets and outlets in accordance with local standards such as the *Queensland Urban Drainage Manual* (DEWS, 2013).	Inlet and outlet scour protection should be in accordance with local design standards such as the *Queensland Urban Drainage Manual* (DEWS, 2013).

2.3.4 Waterbodies not to be retained

If a waterbody is of low value (value score less than 18) and of high risk (risk score equal to or greater than 10) then it is advisable not to retain the waterbody in its current configuration. In these cases an appropriate outcome must be selected for the waterbody and designed accordingly. There are four main outcomes for low value, high risk waterbodies that are not to be retained in their current configuration (Table 2.7).

Table 2.7 Outcomes for waterbodies with low value

Outcome	Description
Remove waterbody	The waterbody is removed by either removing the embankment, or filling the waterbody and reinstating a natural channel.
Convert waterbody to a stormwater treatment system	The waterbody is converted to a stormwater treatment system such as a bioretention system or stormwater treatment wetland (Figure 2.5).
Redesign waterbody to a high ecological value wetland (not for stormwater treatment)	The waterbody is redesigned to a high ecological value wetland, rehabilitating or mimicking nearby native ecosystems
Convert waterbody to a flood mitigation system	The waterbody is converted to a flood mitigation system (e.g. a detention basin) (Figure 2.6).

Figure 2.5 A waterbody converted into a stormwater treatment wetland

Photo: Andrew O'Neill, Water by Design

Figure 2.6 A waterbody redesigned to incorporate a detention basin

Photo: Jack Mullaly, Water by Design

The following sections detail the standards for removing waterbodies and converting waterbodies into stormwater treatment systems and redesigning into high ecological value wetlands. If prior to development a waterbody provides a service (e.g. conveyance or flood mitigation) which is required after development, this service must be provided via an alternate means.

Removing a waterbody

Removing a waterbody can be undertaken in a variety of ways. Site assessment will help determine the most appropriate method for each particular waterbody. Methods may include:

- removing or modifying the wall or embankment and reinstating and stabilising a natural channel
- filling of the waterbody and reinstating and stabilising a natural channel.

Whether the waterbody is removed by breaking down the wall or embankment or by filling the waterbody is dependent on how the waterbody was constructed:

- a waterbody that was constructed by building a wall or embankment should be removed by breaking down or modifying the wall or embankment
- a waterbody that was constructed by digging a hole should be removed by filling the hole.

The reason for this is to avoid erosion or boggy areas through too steep or flat channel grade. If a waterbody constructed by building a wall or embankment is removed by filling, the grade of channel rehabilitated on the downstream end of the wall may be too steep to stabilise. If a waterbody constructed by digging a hole is removed by breaching a wall, the grade of the rehabilitated channel upstream of the waterbody will likely be too steep, or the length of channel may be excessively long to achieve an acceptable grade.

Regardless of the method used, the waterbody should be dewatered prior to being removed. Module 4, Section 4.4.2 provides information on methods for dewatering waterbodies. Relevant approvals to discharge water must be obtained prior to commencing work.

When removing a waterbody, consideration should be given to the quality of the sediment. Sediment in waterbodies will often be contaminated. The act of exposing (dewatering) or eroding sediments can mobilise this pollution. Waterbody sediments should be tested for contamination. If contamination is found, sediments must be either removed or capped with an impermeable clay liner. Note that if capping is undertaken, the design must be such that the impermeable clay liner will not erode to expose the sediments.

Where a waterbody is filled, clean fill must be used. The fill must be compacted to suit the future landuse.

Rehabilitation and reinstating of a waterway should be undertaken in accordance with the *Brisbane City Council Natural Channel Design Guidelines* (2003) or other relevant local standards or guidance.

Convert to a stormwater treatment system

Most developments with a pre-existing waterbody will also be required to achieve stormwater pollution targets. Converting the waterbody into a stormwater treatment system such as a constructed wetland or bioretention system is recommended as it saves space and money. This should be undertaken in accordance with the *Water Sensitive Urban Design Technical Design Guidelines for South East Queensland* (Water by Design, 2006) and the *Bioretention Technical Design Guideline* (Water by Design, 2012a).

Redesign waterbody to a high ecological value wetland

Redesigning the waterbody to a high ecological value wetland can take several forms. To guide the redesign of the waterbody refer to the *Water Sensitive Urban Design Technical Design Guidelines for South East Queensland* (Water by Design, 2006). Note that the *Technical Design Guideline* is tailored towards constructing wetlands to achieve stormwater pollution targets, or maximise pollution treatment. Where stormwater treatment is not the priority, design should focus on creating sustainable, easily maintained wetlands with appropriate ecologies. The result may be a permanently inundated or ephemeral wetland. Ephemeral wetlands can be safe and low maintenance and are therefore a recommended option (Figure 2.7). Designing ephemeral wetlands should also consider:

- creating an ephemeral wetland dominated by Melaleuca species to mimic natural Melaleuca wetlands as this is likely to be a low maintenance, sustainable solution
- creating a sustainable, biodiverse terrestrial ecosystem as described in Blanche (2010)
- modification of the outlet structure to achieve appropriate inundation duration (the existing outlet arrangement of the waterbody is likely to result in inundation for periods longer than is suitable for an ephemeral wetland)
- careful selection of outlet structure to prevent blockage.

Figure 2.7 Inside a detention basin redesigned as an ephemeral wetland

Photo: Jack Mullaly, Logan City Council

Convert to a flood mitigation system

All developments are required to comply with local flood management regulations. Detention basins are often constructed in new development to attenuate flooding. In many instances waterbodies can easily be converted into detention basins (see Figure 2.6).

Waterbody to detention basin conversions should be undertaken in accordance with local regulations and guidance, as well as the *Queensland Urban Drainage Manual* (DEWS, 2013), and *Australian Rainfall and Runoff* (Pilgrim, 1987).

In some instances it is possible to convert a waterbody into either a combined stormwater treatment system and detention basin or a combined wetland and detention basin. Where this occurs, the design should also be in accordance with guidance provided previously for stormwater treatment systems and wetlands.

2.3.5 Document the design

At the completion of the design it is appropriate to document the design, both for construction and development approvals. Three main design documents should be produced:

- design report
- design drawings
- specifications.

Design report

A design report documenting the analysis methods and assumptions made during the design process should be submitted to the approval authority, together with the design drawings.

The design report should include:

- details on location and nature of pre-existing waterbody issues (e.g. marked aerial photographs)
- details of development impacts on waterbody (e.g. marked aerial photographs)
- description of design intent
- supporting calculations or modelling results
- a summary of key design parameters
- detailed design drawings
- proposed construction and establishment methodology
- description of any maintenance requirements and evidence that the ultimate asset owner is satisfied with these requirements.

The report should refer to local standards for any other specific reporting requirements.

Design drawings

A set of engineering and landscape drawings suitable for design approval and construction tendering should be completed at the end of the design process. The drawings should clearly detail the design of the final outcome.

Specifications

Design specifications must be documented for assessment and construction. Typically this can be done by either including the specifications as notes on the detailed design drawings, producing a standalone specification document or a combination of both. The most important consideration is that anyone either assessing or constructing the system must be able to easily access the information contained within the specification. For this reason, even if a standalone specification document is produced, the detailed design drawings and design report must make mention of the specification document.

2.4 PRODUCING A DEVELOPMENT CODE FOR WATERBODIES

This section provides a brief background on planning schemes and planning scheme codes along with advice to local government on how to write a planning scheme code for pre-existing waterbodies on development sites to achieve the goals described in Section 2.2.

2.4.1 The Planning Scheme

A planning scheme is a statutory instrument made by a local government. It directs what land can and cannot be used for within a local government area. It guides how development may occur. Local governments can use their planning scheme to specify how a pre-existing waterbody is managed during development. This includes specifying the outcome to be achieved.

The key elements of a planning scheme are described in Table 2.8. For further information on these elements or planning schemes, consult the *Queensland Planning Provisions* (DSDIP, 2011).

Table 2.8 The key elements of a planning scheme

Planning Scheme Element	Description
Strategic framework	The strategic framework establishes at a high level the vision for future development within the local government area.
Priority infrastructure plan	The priority infrastructure plan identifies when and where infrastructure will be constructed. It facilitates new development to contribute to priority infrastructure.
Tables of assessment	Tables of assessment identify what assessment level applies to development in a particular area or subject to a particular hazard or feature.
Codes	Codes articulate the outcomes sought from development. The four types of code are zone codes, local plan codes, overlay codes and development codes.
Zone codes	Zone codes organise all the land to which a planning scheme applies into groups of related or compatible use. The zone indicates suitable future uses for this land.
Local plan codes	Local plan codes articulate development outcomes specific to a local area.
Overlay codes	Overlay codes identify areas of land which are sensitive to, present opportunities to or constrain development.
Development codes	Development codes articulate all remaining outcomes sought from development that are not included in zone codes, local plan codes and overlay codes.
Planning scheme policies	Planning scheme policies support development in achieving the outcomes of the strategic framework and codes. Planning scheme policies articulate technical standards for achieving the outcomes of the strategic framework and codes.

2.4.2 The Planning Scheme Code

A planning scheme code must clearly state the desired outcomes for pre-existing waterbodies on development sites. The Queensland Planning Provisions (DSDIP, 2011) states that all codes must contain:

- statements clearly stating the purpose of the code
- overall outcomes clearly identifying how the purpose of the code will be achieved
- assessment criteria including performance outcomes that meet the overall outcomes and purpose of the code.

Codes may also contain acceptable outcomes that meet the performance outcomes, the overall outcomes and purpose of the code. The performance outcomes and acceptable outcomes (if included) form the crux of a code.

Performance outcomes form a checklist of outcomes that development must adhere to. The development is assessed against and must achieve the performance outcomes.

Acceptable outcomes (if included in the code) are actions that could be taken by development to meet the adjacent performance outcome. If a development implements an acceptable outcome listed in a code it complies with the adjacent performance outcome.

2.4.3 Choosing the correct code

There are four possible codes; zone codes, local plan codes, overlay codes and development codes. Zone codes and local plan codes are not appropriate for pre-existing waterbodies because the outcomes sought (e.g. protecting values and reducing risk) are independent of the landuse type (zone codes) or location (local plan codes). Overlay or development codes should be used. The difference between an overlay code and a development code is mapping. A development code applies uniformly across the local government area. An overlay code uses mapping to clearly identify all the locations to which the overlay code applies and is therefore more targeted. Table 2.9 provides further information to help choose between overlay and development codes.

Table 2.9 Pros and cons of overlay codes and development codes for specifying pre-existing waterbody outcomes

Code Type	Benefits	Negatives
Overlay code	• clearly identifies waterbodies to which it applies • provides certainty to developers	• more resource intensive and time consuming to establish • waterbody must be mapped for code to apply
Development code	• easier to establish • applies to all waterbodies even if local government is unaware of a waterbody prior to development application	• a waterbody can be 'overlooked' at the development stage

2.4.4 What to say in the code

The crux of a code is the performance outcomes and acceptable outcomes. In order to achieve the goals of managing pre-existing waterbodies on the development site a waterbody code must specify two key points:

- Where a waterbody of low value exists on a development site prior to development, the development ensures that the waterbody does not present a safety, economic or environmental risk after development.
- Where a waterbody of high value exists on a development site prior to development, the development ensures that those values are protected during development and maintained post development.

The code must also specify what constitutes a value. It is recommended that the following values are included:

- connectivity
- biodiversity
- recreation
- amenity
- cultural heritage.

See Module 1 Section 1.3 for further description on the above waterbody values. It is optional to use acceptable outcomes and there are positives and negatives to doing so. The positive of acceptable outcomes is that they provide clarity for development by stipulating a possible method for complying with the adjacent performance outcome. The negative of acceptable outcomes is that they lack detail. Codes are succinct statements. Where achieving a performance outcome is complex or includes numerous considerations, an acceptable outcome does not provide enough detail to facilitate the correct decision. In the case of pre-existing waterbodies, there are many considerations that go into deciding the appropriate outcome. It is therefore recommended that only performance outcomes are provided.

An example code is provided in the worked example (see Section 2.5.3).

2.4.5 Creating a standalone code or combining with another code

The last step is to decide whether to include the performance outcomes regarding pre-existing waterbodies within its own code, or to incorporate it into another related code. Including it within another related code helps to keep the planning scheme succinct and simple. It also helps with grouping related activities. For example, waterbodies and stormwater quality and quantity management will often be addressed in tandem in a development application and hence grouping them in a single code is sensible. In other scenarios it may prove more appropriate to incorporate waterbodies with biodiversity (which includes wetlands) codes.

However, if the waterbodies to which the code applies are mapped, and thus an overlay code is to be used, it must be a standalone code. If mapping is not used, it is recommended that the waterbody code is combined with other related codes. The exact combination of codes will depend on how the local government chooses to structure the codes in its planning scheme as a whole.

2.5 WORKED EXAMPLE

This worked example demonstrates:

- how a hypothetical local government may go about establishing a planning scheme that ensures pre-existing waterbodies on developments sites are appropriately managed to improve safety, reduce cost, have no detrimental environmental impact and preserve any existing values of the waterbody.
- how to use the process outlined in Section 2.3 to determine the appropriate outcome for a pre-existing waterbody on a development site.

2.5.1 Setting

Sunnyside Council is a small to medium sized local government in South East Queensland. It contains several creek systems and one river. The lower reaches of these catchments are typically urban. The upstream reaches are a combination of rural, forest and conservation areas. There are a large number of waterbodies in Sunnyside Council. Approximately 70% are on private land, with the remaining 30% on Council land.

Sunnyside Council is experiencing a boom in urban development. As a result, many small parcels of land which were previously farms are being developed into urban housing, commercial and industrial sites. As a result, many old farm dams are becoming the subject of development applications. In some instances old farm dams have been left in place as lakes to 'beautify' the new development. Because of pressures such as stormwater pollution from this urban development, these lakes have deteriorated in condition causing Sunnyside Council to spend very large amounts of money rectifying them.

Sunnyside Council recently updated its planning scheme and included provisions to ensure pre-existing waterbodies are appropriately managed in new urban development.

2.5.2 Deciding the desired outcomes

The reason Sunnyside Council referred to pre-existing waterbodies in their planning scheme was to prevent inappropriate waterbody outcomes and minimise their economic risk. They also recognised that some pre-existing waterbodies were in good condition and could become valuable community assets if appropriately protected. Sunnyside Council chose to protect those waterbodies with the following values:

- connectivity
- biodiversity
- recreation
- amenity
- cultural heritage.

2.5.3 Writing the code

Initially Sunnyside Council considered mapping all the waterbodies in their local government area. However, after considering the expense and time to complete this task they decided to instead use a development code to list their requirements with respect to pre-existing waterbodies.

To help keep their planning scheme succinct, Sunnyside Council chose to include the pre-existing waterbody code within another larger, related code. They chose to include it within their Stormwater and Drainage Code which also included provisions for topics such as:

- stormwater drainage
- natural channel design
- stormwater quality.

Sunnyside Council drafted provisions regarding pre-existing waterbodies for inclusion in the Stormwater and Drainage Code (Table 2.10). No acceptable outcomes were provided as it was considered that too much detail was required, and thus an acceptable outcome was not an appropriate method of conveying how to achieve the performance outcomes.

Table 2.10 Sunnyside Council's pre-existing waterbody provisions for their Stormwater and Drainage Code

Performance Outcomes	Acceptable Outcomes
Pre existing waterbodies	
PO17 Development ensures that pre-existing waterbodies of high value continue to provide these values post development. *Note – The Stormwater and Drainage Code provides guidance on how to achieve the performance outcome*	*No acceptable outcome provided*
PO18 Development ensures that pre-existing waterbodies with low value are redesigned to avoid poor safety, economic and environmental outcomes post development *Note – The Stormwater and Drainage Code provides guidance on how to achieve the performance outcome*	*No acceptable outcome provided*

2.5.4 Writing the planning scheme policy

Sunnyside Council wished to adopt the technical information portrayed in this module. Therefore, for technical standards, methods and information to be provided to achieve their code, they incorporated a reference to Section 2.3 of this module in their Stormwater and Drainage Planning Scheme.

2.5.5 Determining the appropriate outcome for a pre-existing waterbody

This section of the worked example demonstrates how to use the process specified in Section 2.3 to determine the appropriate outcome for a pre-existing waterbody on a development site.

Project Overview

A six hectare, 70 lot residential development was proposed in Sunnyside Council. The land had previously been a small farm and contained a dam, approximately 1500 m^2 in size. Due to development of the neighbouring land, the site was surrounded on all sides by residential areas. Because of Sunnyside Council's recent amendments to its planning scheme, the development was required to produce an appropriate outcome for the waterbody using the process outlined in Section 2.3.

Determining the value of the waterbody

The first step of the development assessment process is to determine the value of the waterbody (Figure 2.8). This is achieved by carrying out a value based assessment using the criteria outlined in Table 2.1. The results Sunnyside Council's value assessment and the rationale for each score are provided in Table 2.11.

The waterbody scored a total of 11. Because it scored less than 18, it was deemed to be of low value. As a result, further risk assessment was required to determine the outcome for the waterbody.

Figure 2.8 Step 1 - Determine the value of the waterbody

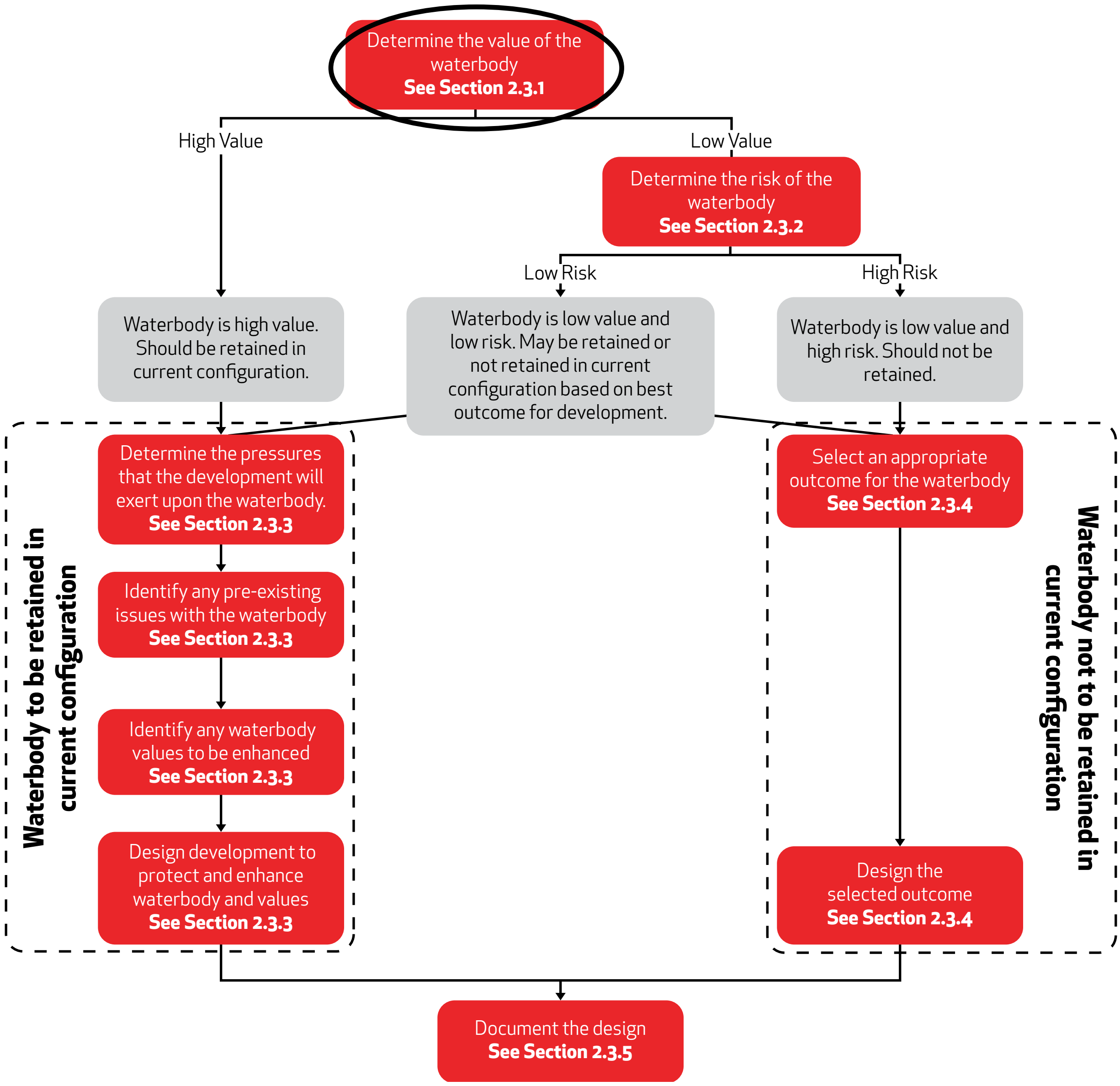


Table 2.11 Results of the value assessment

Type of Value	Score	Score Criteria	Rationale for Score
Connectivity	1	The waterbody provides no ecological connectivity and does not provide a functional corridor for native wildlife.	Previous urban development surrounding the site had isolated the waterbody and it no longer provides connectivity.
Biodiversity	5	The waterbody provides either good quality aquatic or terrestrial habitat for native species.	The waterbody contained good quality terrestrial vegetation providing habitat for native species.
Recreation	1	If the community were provided access to the waterbody in its current condition and configuration, it would be unlikely to be used for recreation. Factors to consider may include quality of access, water quality, public health and safety, location, aesthetics etc.	The waterbody was relatively small in size and located away from other recreation facilities such as parkland. It was considered unlikely that the community would use the waterbody for recreation.
Amenity	3	If the community were provided access to the waterbody in its current condition and configuration, the waterbody could be moderately used by the community for its amenity. Factors to consider may include quality of access, water quality, location, aesthetics etc.	The good quality terrestrial habitat and moderately good water quality within the waterbody made it an attractive landscape feature and thus likely to be used by some members of the community for amenity.
Cultural heritage	1	The waterbody is of no cultural or spiritual value to the community.	The waterbody was of no spiritual or cultural value to the community.
Total	11		

Determining the risk of the waterbody

Sunnyside Council's waterbody received a low value score. The next step for Sunnyside Council was to carry out a risk assessment outlined in Table 2.2 to determine what to do with the low value waterbody (Figure 2.9). If it was determined to be of high risk, the waterbody would not be retained in its current configuration. If it was determined not to be a risk, the development assessment officer would work with the developer to decide whether or not to retain the waterbody.

A risk assessment was undertaken to determine if the waterbody presented any risks. The results of this assessment and the rationale for each score are provided in Table 2.12.

The waterbody scored a total of 16 (Table 2.12). Because it scored greater than 10, it was deemed to be of high risk. Because the waterbody was determined to be of low value and high risk, it was inappropriate to retain the waterbody in its current configuration. As a result, an alternate outcome for the waterbody was required.

Figure 2.9 Step 2 - Determine the risk of the waterbody

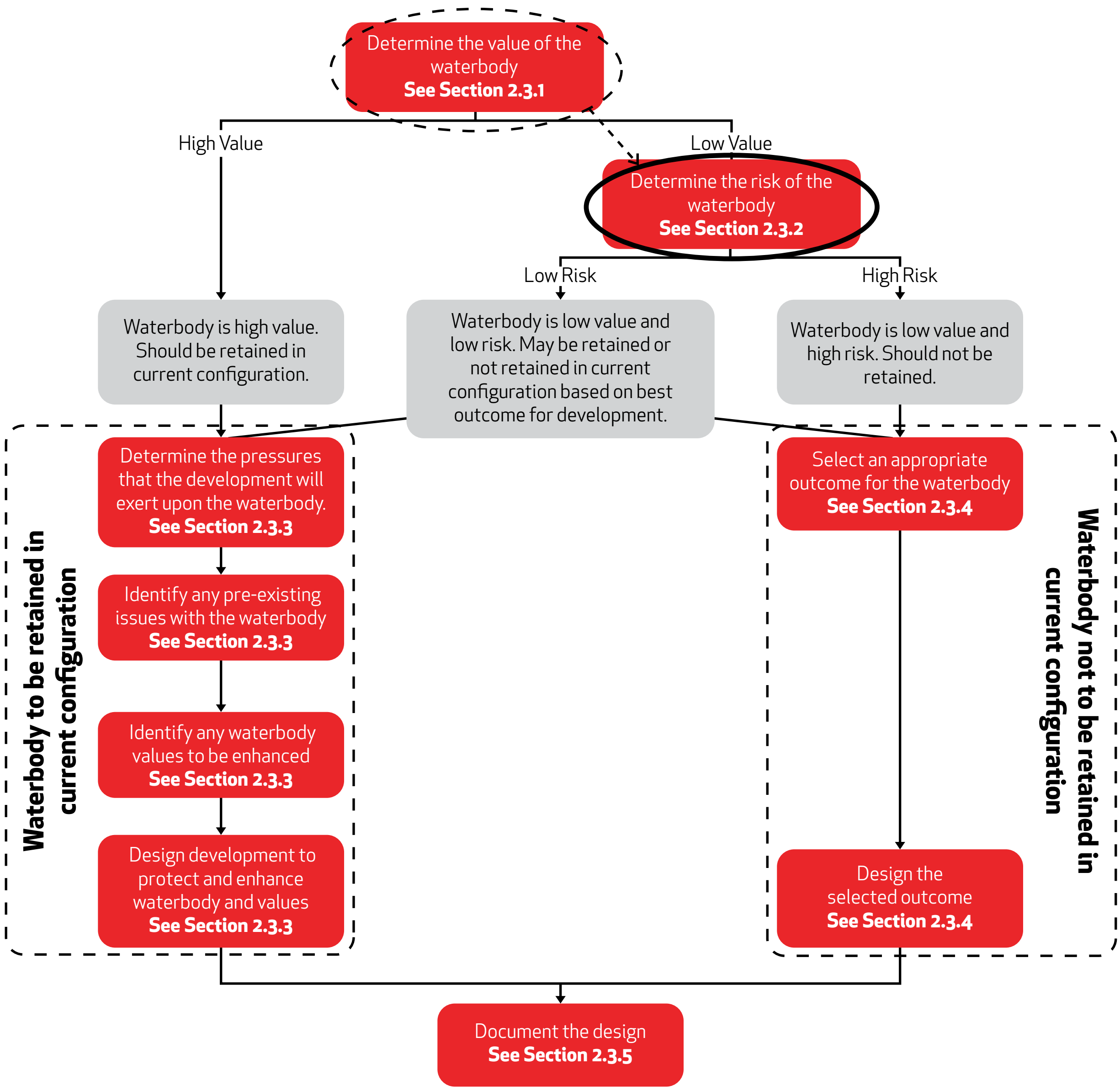


Table 2.12 Results of the risk assessment

Type of Value	Score	Score Criteria	Rationale for Score
Structural integrity	3	Works will be undertaken as a part of development to ensure waterbody is structurally sound and can be certified as such. Human population located downstream (now or in the future) is at risk in the event of failure.	The waterbody was structurally sound and will be certified as such. Due to surrounding urban development, a downstream human population is at risk in the event of the waterbody failing.
Water quality	1	The waterbody has no history of poor water quality and the future development is low/medium density residential.	The water quality was fair and the proposed development is for a residential subdivision.
Safety	5	When assessed against the method outlined in Appendix A of *Rectifying Vegetated Stormwater Assets* (Water by Design, 2012b), a score of greater than 21 is achieved.	When assessed against the method outlined in Appendix A of *Rectifying Vegetated Stormwater Assets* (Water by Design, 2012b), a score of 24 was achieved.
Maintenance access	3	Appropriate maintenance access is (or will be) provided to between one and three (inclusive) of the following: the inlets, outlets, body of water and perimeter of the waterbody.	No maintenance access existed, but will be provided as a component of the final design.
Weeds and pests	1	The waterbody contains no species that could become weeds or pests.	The waterbody was free of weeds and pests.
Economics – removal	3	Removing or repurposing the waterbody will increase the cost of the development. It is moderately more expensive to remove or repurpose now rather than later. Removing or repurposing of the waterbody may make economic sense.	Removing the waterbody was found to significantly increase the cost of the development.
Total	16		

Select an appropriate outcome for the waterbody

Sunnyside Council's next step was to select an appropriate outcome for their low value, high risk waterbody (Figure 2.10)

Four options were available for the waterbody (see Table 2.7):

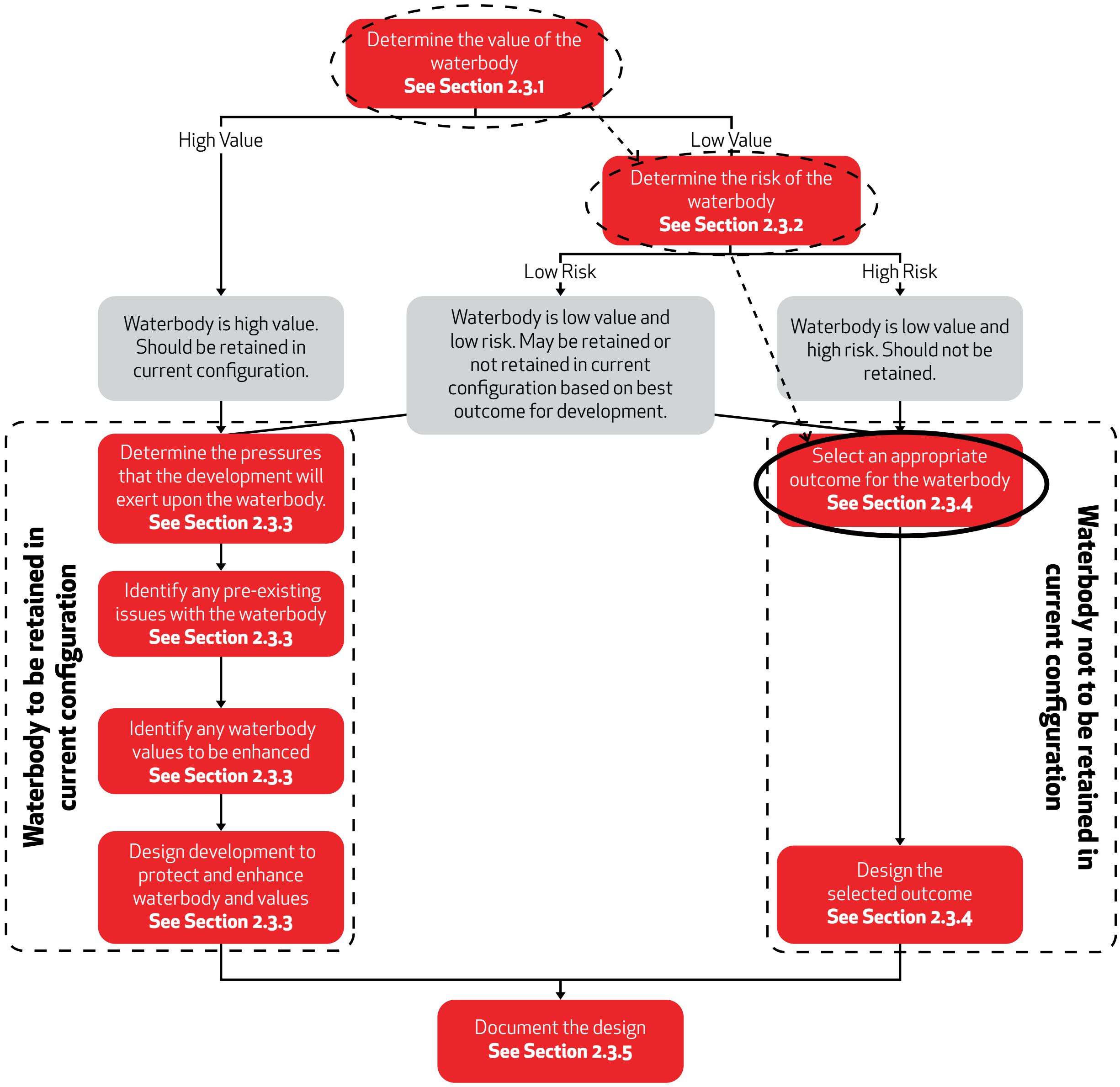
- Removing the waterbody
- Converting the waterbody to a stormwater treatment system
- Redesigning the waterbody to a high ecological value wetland (not for stormwater treatment)
- Converting the waterbody to a flood mitigation systems (e.g. a detention basin)

Removing the waterbody was deemed to be too expensive and was dismissed as an option.

Under the provisions of Sunnyside Council's planning scheme, the development was required to comply with stormwater quality objectives and flood mitigation objectives.

These requirements meant that regardless of the fate of the waterbody, a stormwater treatment system and a detention basin were planned. In order to save space, reduce cost, and comply with the requirements of the planning scheme for stormwater quality, flooding and the waterbody itself, it was decided to redesign the waterbody into a combined stormwater treatment system and detention basin.

Figure 2.10 Step 3 - Select an appropriate outcome for the waterbody



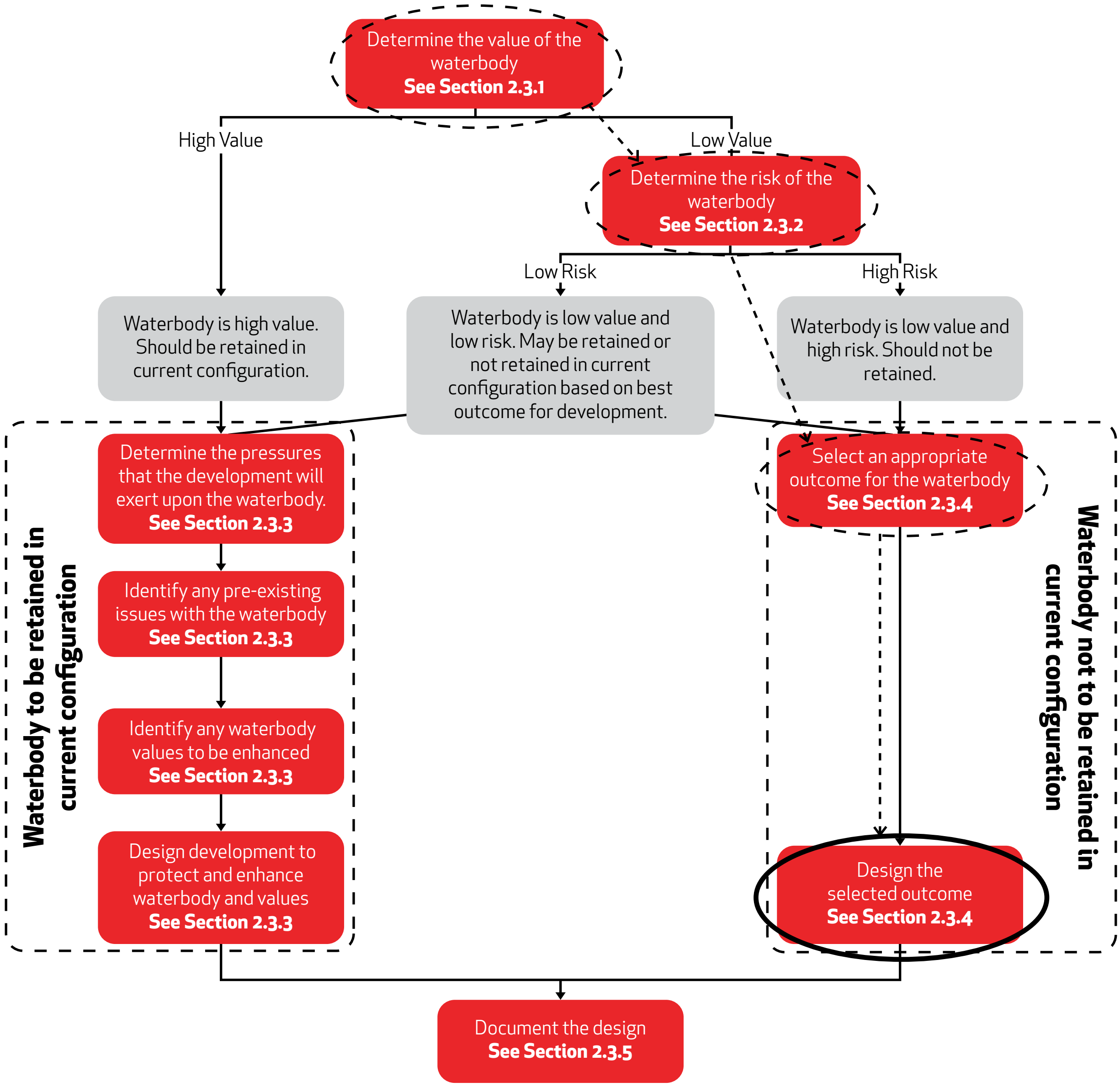
Design the selected outcome

The next step for Sunnyside Council was to plan and design their selected outcome (Figure 2.11).
The stormwater treatment system options considered for the development were either a bioretention system or a constructed wetland. Because of the size of the waterbody relative to the development, an appropriately sized constructed wetland could not be located within the waterbody. However, the waterbody was suitably sized to facilitate a bioretention system (which requires a smaller surface area in comparison to constructed wetlands) and also provide the flood mitigation requirements of the development. Therefore, a combined bioretention and detention basin was selected for the site.

The design was completed in accordance with:

- *The Bioretention Technical Design Guidelines* (Water by Design, 2012a)
- *The Queensland Urban Drainage Manual* (DEWS, 2013)
- *Australian Rainfall and Runoff* (Pilgrim, 1987).

Figure 2.11 Step 4 - Design the selected outcome for the waterbody

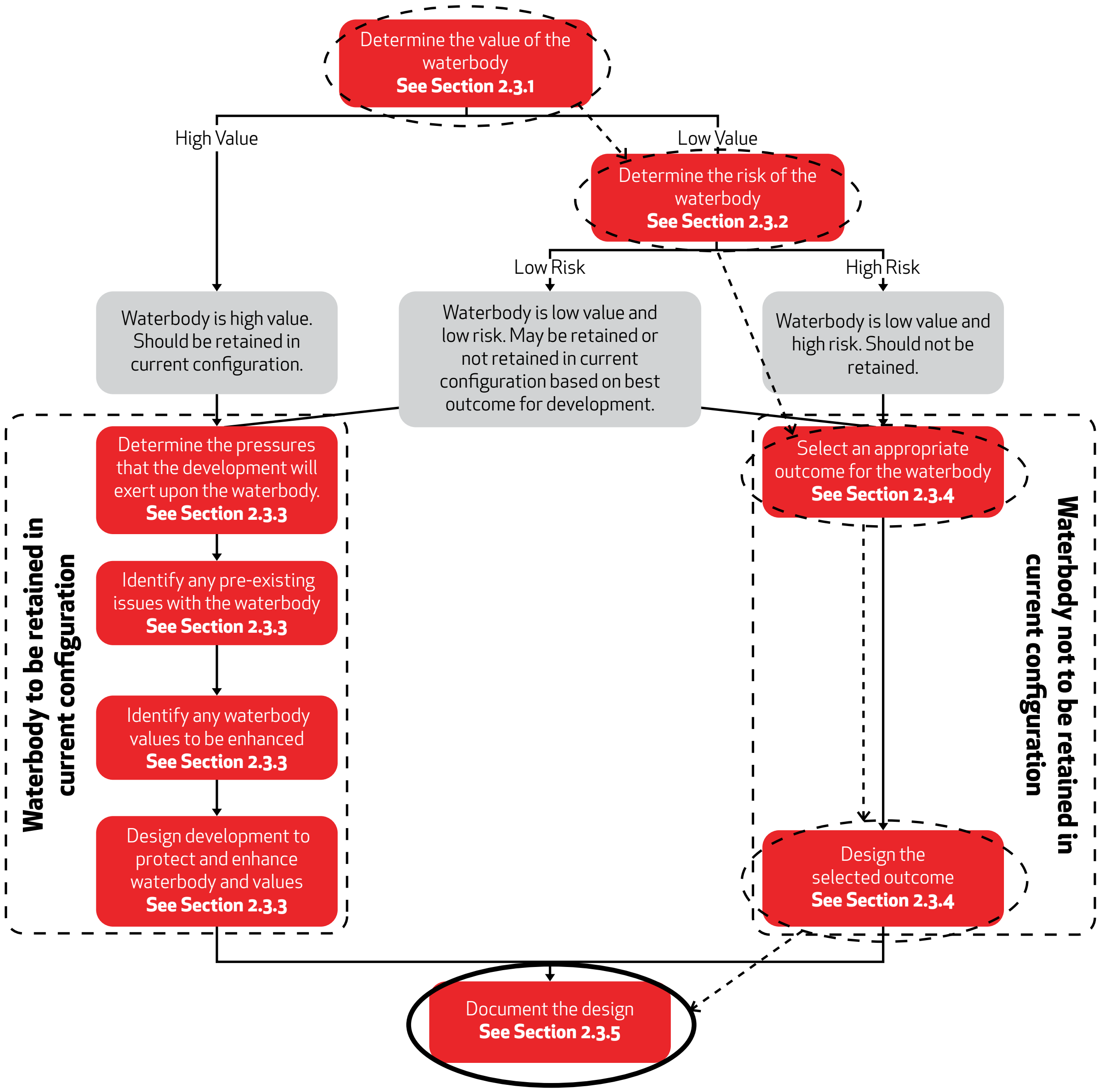


Document the design

The final step for Sunnyside Council was to document the design (Figure 2.12).

A design report and design drawings were produced for the site, including the conversion of the waterbody into a combined bioretention and detention basin. Specifications were included on the design drawings, and provided sufficient detail for assessment by Sunnyside Council, price estimation and construction by potential contractors.

Figure 2.12 Step 5 - Document the design



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