Flood and Stormwater Strategy

May 2022

MORNINGTON PENINSULA Shire

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Acknowledgement of Traditional Owners

Mornington Peninsula Shire acknowledges and pays respect to the elders, families and ancestors of the Bunurong/BoonWurrung people, who have been the custodians of this land for many thousands of years. We acknowledge that the land on which we operate is the place of age-old ceremonies, celebrations, initiation and renewal; and that the Bunurong/BoonWurrung peoples' living culture continues to have a unique role in the life of this region.

Waterways have cultural and spiritual value for the Bunurong/BoonWurrung people. Dreaming stories are associated with Port Phillip Bay (Nairm). Bunurong people once walked the land bridge between Wilsons Promontory and Tasmania. Locally, they hunted and camped across the lands that are now inundated beneath Port Phillip Bay. The wetlands, bays and creeks were important sources of food, such as waterfowl, tortoises, fish, rhizomes, bulbs and roots, and they were also significant camping sites (Bunurong Land Council 2020). Riparian and coastal areas across the Mornington Peninsula have many middens and may be significant for spiritual and ceremonial reasons. Aboriginal sites are protected under the Aboriginal Heritage Act 1972.

Executive summary

Flooding presents a significant risk to communities across our Shire. Flooding causes threats to human health, damage to properties, detrimental consequences to our natural environment, and social harm. Although flooding is a natural phenomenon, the probability of extreme events can be exacerbated by human influences such as climate change, urbanisation, the creation of impermeable surfaces, and drainage design. This Strategy proposes the use and development of various tools to quantify these risks to identify flood mitigation projects which resolve flooding and reduce the vulnerability of our communities.

This Strategy builds on the previous Flood Management Plans and Strategies created by the Shire. In 2009, the Shire produced the **Integrated Local Flood Management and Drainage Strategy (LIDS)** which began detailed flood modelling of the catchment. This work provided a detailed understanding of the risks associated with flooding and continues to inform decision making. Due to changing understanding of these flood processes it is important to maintain these models, to ensure that decisions are informed by high confidence representations of flooding, and a key objective of this Strategy is to work with stakeholders to keep these models current.

Melbourne Water has published **Flood Management Strategy for Port Phillip and Westernport 2021-2031**. This document provides a 10-year flood Strategy for the region. It provides the Shire with a framework and helps identify strategic objectives to achieve social and environmental goals. It also informs how flood risk is analysed in the catchment and provides advice regarding best practice guidance.

In 2019, the Shire declared a **Climate Change Emergency**. Climate change is likely to lead to significantly increased flood risk due to sea level rise and increased rainfall. It is important that the Strategy considers the changing climate both in identifying vulnerable communities and in the design for mitigation.

Another consequence of climate change is a reduction in total annual rainfall. This potentially has significant consequences for the quality of life in Mornington Peninsula Shire and is addressed as part of the **Integrated Water Management Plan - Our Water Future.** This plan considers stormwater as a resource, which can be stored and used. This means that flood mitigation should also consider retention of stormwater for the benefit of all.

The 2021 **Council and Wellbeing Plan** provides a range of strategic objectives for the Shire. Stormwater management is a key component of two of these strategic objectives, Strategic Objective 1.3.6, which aims to manage stormwater and build resilience to flooding and Strategic Objective 1.3.8 which aims to deliver strategies which minimise the impact of climate change on our built assets.

This Strategy will achieve these objectives, by aligning with the various other strategies to ensure a consistent approach to stormwater management; maintaining flood maps; developing tools to prioritise projects; assessing the condition of the existing assets; reviewing the level of service requirements to future proof our interventions; and working with other stakeholders to share information and provide optimum outcomes for residents with regards to flood risk.

Glossary[1]

Adaptation	Adjustment in response to actual and expected climate change and or effects, to reduce harm or take advantage of opportunities.
Annual average damage (AAD)	Represents the average yearly cost of flooding in a particular area. It is calculated by taking the total damage caused by all flooding over a period of time and dividing it by the number of years in that period.
Annual exceedance probability (AEP)	This is the likelihood of a flood of a given size happening in any one year. AEP is usually expressed as a percentage; for example, if a flood of a particular size (volume of water) has an AEP of 5%, that means there is a 5% (or 1 in 20) chance of a flood of that size happening in any given year.
Average Recurrence Interval (ARI)	The term previously used to express rain/flood events emphasizing on their likely frequency; for example, a 5% AEP event was referred as 1 in 20-year event which is very similar to 1 in 20 chance but it led to misconception that such events can happen only once in twenty years, which is not the case. As we are in a transitional phase, this term is used as a reference.
Catchment	A catchment is an area of land that drains to a particular point. All runoff within a given catchment will flow down to the same outlet.
Coastal and storm surge flooding	Very high ocean tides occurring during storms can cause flooding along coasts and the lower reaches of rivers, particularly when combined with high rainfall.
Flood map	Maps showing the geographic extent of possible flooding. Maps are informed by hydrologic and hydraulic modelling and can be produced to show the possible flooding that would arise from rainfall of a given intensity.
Hot spot	An area which has a history of repeat flooding of dwellings, properties, roads or crossings. Evidence of flood hot spots is usually provided through anecdotal information, advice from Council teams such as maintenance and customer complaints.
Intangible damages	Damages that are hard to quantify or measure in monetary terms. These include stress and anxiety, sadness due to loss of pets or items of personal and sentimental value, and the loss of feelings of safety and security in one's home. A particularly important aspect of intangible damages is the effect on people and families when loss of life or serious injury occurs during a flood.
Integrated water management (IWM)	A water management approach which considers all components of the water cycle as a whole to maximise social, environmental and economic outcomes. It achieves this through the coordinated management of drainage, flooding, waterways, water supply and sewerage services.

[1] FAQs and Glossary (ccmaknowledgebase.vic.gov.au)

Minimise	Taking measures to lessen the impact of a flood event.
Mitigate	Taking measures to reduce the likelihood or consequence of a flood event
Non-structural solutions	Any non-physical measure used to reduce the consequences of flooding. This includes community education programs, training, insurance, planning and development controls, warning and emergency planning and emergency response
Resilient	People or communities who have a strong understanding of their risks and take active steps to prevent or reduce the impact of floods. A resilient community is better able to withstand a crisis event and has an enhanced ability to recover from the impacts.
Riverine flooding	Occurs when runoff from storms exceeds the capacity of a river or creek and overflows onto surrounding land.
Stormwater flooding	Occurs when runoff from storms exceeds the capacity of our drains and pipes and overflows onto surrounding properties. Overland flooding can happen very quickly. Floods that rise very rapidly are often known as a ‘flash flood’. Stormwater flooding is sometimes referred to as ‘overland flooding’
Structural solutions	Physical measures used to minimise the likelihood and impacts of flooding. This includes channels, retarding basins and water storage, house raising, flood gates and more.
Tangible damage	The financial and practical impacts of flooding – things that have been affected or destroyed that can be measured in financial terms. This includes damage to property, cars and infrastructure, lost or interrupted utilities, income lost due to disruption, and public clean-up costs.

1 Introduction

Flooding is a natural phenomenon, although it is exacerbated by human influences. Flooding extent and depth is affected by the intensity, depth and duration of the rainfall, and environmental factors such as catchment topography and soil type. Human pressures include urbanisation, drainage design, and the conversion of permeable surfaces into to impermeable surfaces, which effects the quantity and the velocity of the runoff.

Mornington Peninsula Shire Council has responsibility for 70 drainage catchment and is responsible for a significant proportion of the drainage network, which includes various assets such as pits, pipes, culverts, open channels, creeks, retarding basins, wetlands, soakage pits, and flood ways. Melbourne Water also has significant responsibilities as they manage major outlets and regional drainage which includes major riverine outlets and main outfall drains. Responsible management of these assets and collaboration with Melbourne Water is required to ensure that we understand and reduce flood risk and support our communities.

In 2009, the Integrated Local Flood Management and Drainage Strategy (LIDS) provided objectives for flood management in the Shire. One of the major outcomes of this work was the flood mapping, which provided an excellent understanding of the risk across our catchments. This was followed by Mornington Peninsula Shire and Melbourne Water Flood Management Plan in 2017, with the support of the Victoria State Emergency Services (VICSES). The objective of the Flood Management Plan was to reduce the extents of flooding and its impact on people, infrastructure, and the environment.

In the Council and Wellbeing Plan 2021-2025, effective stormwater management and drainage contribute to two Strategic Objectives:

- 1.3.6 aims to manage stormwater and build resilience to flooding in our communities, our environment and infrastructure.
- 1.3.8 considers the climate change risk to drainage by aiming to deliver strategies which minimise the impact of climate change on our built assets.

This Strategy aims to assist in achieving those objectives and is the next stage in a continuous process to reduce flood risk in the Shire. The Strategy aims to quantify damages and to identify and prioritise areas in need of flood mitigation to reduce flood risk. It will be supported by other plans provided by the Council such as the Climate Change Emergency Plan *Ensuring Our Future* 2020 and the Integrated Water Management Plan '*Our Water Future*', 2021.

2 Objectives

The following provides a brief description of the main objectives from this Strategy. Further information can be found within the document:

1. Align with relevant internal and external strategies such as Integrated Water Management (IWM) Plan, Environmentally Sustainable Design (ESD) policy and the Flood Management Strategy Port Phillip and Westernport 2021 - 2031 by Melbourne Water. This will ensure a consistent and repeatable assessment of flooding and will increase confidence in the process of prioritising projects.
2. Develop an ongoing program to maintain flood models and floor level surveys, to determine land that is affected by flooding. This will keep models up to date and in line with best practice. Climate change predictions and scenarios will also be considered in line with best practice.
3. Complete a condition audit of the stormwater assets, for example Council's pipes, pits, pit lids, soak pits, open drains and culverts. This may be part of project prioritisation but will also assist asset management in identifying and replacing old and deteriorating assets.
4. Develop a project prioritisation tool, such as a multicriteria analysis to assess and identify priority projects. This may include weighted scores from Annual Average Damage, flooding hotspots, age of infrastructure, maintenance considerations, social consequences, and environmental consequences. This tool should also consider climate change to ensure that projects are designed to be future proofed.
5. Review and update the level of service requirements for various land users to be used for flood mitigation projects. The changing climate means that current level of service may not protect our communities for future scenarios.
6. Assist in the establishment of the Land Subject to Inundations Overlays (LSIO) and Special Building Overlay (SBO) through Planning Scheme Amendments.
7. Assist in the development of Flood Emergency Plans and collaborate in the delivery of the actions identified in the plans.
8. Identify funding options for infrastructure and non-structural flood plain control implementation.

3 Climate Change

On 13 August 2019, the Mornington Peninsula Shire Council unanimously declared a Climate Emergency, calling for immediate and urgent action to stop global warming. One year later, the Council unanimously adopted the **Climate Emergency Action Plan - *Ensuring our Future: Our Climate Emergency Response From 2020 to 2030***. The plan guides the Peninsula towards zero carbon emissions by 2040, through actions that unite our organisation, local business and the community to mitigate climate change and promote a resilient and thriving region.

Climate change has significant impact on rainfall and sea levels and is, therefore, a significant pressure on managing flood risk within our communities. It is expected that long-term climate change will result in greater climate variability with more intense extreme events than in the past, resulting in more severe flooding as well as an increase in sea level.[2] Climate change predictions are liable to change as our understanding of the mechanisms that cause climate change develops. Therefore, where possible up to date guidance will be used to ensure that we are designing to appropriate future design scenarios.

3.1 Rainfall Changes

The CSIRO projections for rainfall indicate that there will be reduced annual average rainfall, with periods of drought. This will increase pressure on our water resources, putting communities and our ecosystems under strain. There is an opportunity to develop flooding solutions which consider stormwater as a resource, which can be stored and used in periods of droughts or as an alternative to potable water supplies.

Extreme events are also likely to become more common and more intense resulting in more flooding in more flooding. By 2050, the IPCC predict that peak river flow for 1-2% AEP events will increase by 5-10%[3]. This is expected to result in greater damage to settlements, infrastructure and businesses.

3.2 Rising Sea Level and Storm Surges

The IPCC[4] report suggests that the Global Mean Sea Level is projected to increase by up to 1.1 metres by 2100 (relative to 1986-2005 levels). The IPCC report also warns that already stressed coastlines face bigger waves and storm surges as oceans warm and ice melts.

Much of our current drainage system relies on discharging stormwater to Port-Phillip or Westernport, and increased sea levels and storm surge will submerge outlets limiting the discharge capacity of drains. This will increase flooding further up the network, meaning properties above sea level may be flooded due to decreased efficiency of drainage networks.

[2] https://www.csiro.au/en/Research/Environment/Extreme-Events/Floods/Causes-and-impacts
[3] IPCC- Chapter 25- Australasia (2014)
[4] IPCC- Chapter 4- Sea Level Rise and Implications for Low Lying Islands Coasts and Communities (2014)

4 Integrated Water Management Plan

Integrated Water Management (IWM) is a collaborative approach to planning and managing all elements of the water cycle, including stormwater, wastewater, water supplies (surface water and groundwater) and waterways. It has the potential to provide greater community value by leveraging opportunities to achieve better economic, social and environmental outcomes that benefit our communities and ecosystems.

The Shire's IWM plan '*Our Water Future'* envisages working together in water planning and management for a liveable, resilient and thriving community and environment on the Mornington Peninsula. The delivery of the following outcomes is expected to help achieve this vision-

1. Safe, secure and affordable supplies in an uncertain future
2. Effective and affordable wastewater systems
3. Opportunities sought to manage existing and future flood risks and impacts
4. Healthy and valued waterways and marine environments
5. Healthy and valued urban and rural landscapes
6. Community values are reflected in place-based planning
7. Diverse jobs, economic benefits and innovation

The most critical objective for this Strategy is objective 3, *Existing and future flood risks are managed to maximise outcomes for the community.* This will be achieved within the IWM plan by reducing flooding impacts on communities and providing new surface runoff storage created through multi-functional assets

Mornington Peninsula Shire's IWM Plan sets out strategic direction and identifies existing and future opportunities for water management for our region. This Strategy will enhance liveability on the Peninsula and build water resilience through the whole water cycle, see Figure 1.

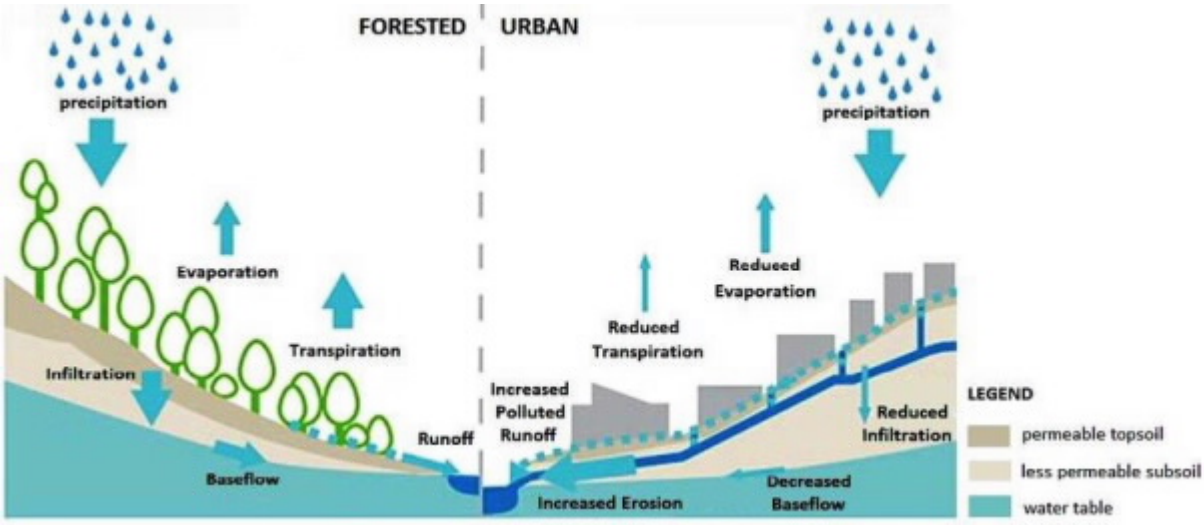

Figure 1: Natural and Urban Water Cycle (Source: Melbourne Water)

5 Responsibilities

There are a range of stakeholders which have responsibility for the management of drainage and stormwater in Mornington Peninsula. Below is a list of the major stakeholders with a brief list of their responsibilities:[5]

Mornington Peninsula Shire

- *Manage local municipal planning schemes and policies*
- *Manage local drainage systems*
- *Support local flood planning and coordinate local emergency planning*
- *Support development of local community resilience*
- *Support implementation of state policies and regional strategies through local flood management activities*
- *Develop local water management strategies and plans.*

Melbourne Water

- *Coordinates planning and delivery of flood management and drainage services across the region*
- *Undertakes catchment and coastal flood modelling and mapping*
- *Provides flood advice and conditions for new land use and development as a Referral Authority*
- *Contributes information to warning services*
- *Manages waterways*
- *Contributes to development and use of integrated water management (IWM) knowledge and tools*
- *Undertakes technical research.*

Retail water authorities

- *Manage urban water supply and sewage services*
- *Undertake technical research*
- *Develop and implement IWM infrastructure and tools with other stakeholders.*

Victorian State Government departments and agencies

- *Set policies, guidelines and standards for floodplain management, urban planning and development, and water resource management*
- *Support recovery from floods.*

Emergency services agencies

- *Lead emergency preparation and response*
- *Deliver community awareness and education programs.*

Federal Government organisations

- *Set national policies and guidelines for flood and emergency management*
- *Coordinate national research and data on a range of flooding, weather and climate change issues*
- *Contribute to delivery of warning services*
- *Contribute funding to flood prevention and recovery activities.*

Communities, individuals and businesses

- *Responsible for understanding personal and local risks, and being prepared for floods*
- *Can contribute to development of local flood management projects and plans.*

[5] Flood Management Strategy – Port Phillip and Westernport 2021-2031

5.1 Legislation

Under Part 10 of the Water Act 1989, Melbourne Water has drainage and flood management powers and functions and can declare flood levels, flood areas, building lines and control developments adjacent to waterways.

Under Section 198 of the Local Government Act, drains vested in the Council are under the management and control of the Council. This does not apply to drains vested in any public body.

The State Environmental Protection Policy (Waters) provides a framework to protect and improve the quality of Victoria's waters having regard to the principles of environment protection set out in the Environment Protection Act 1970. Clause 46 of this policy specifically requires Councils and water authorities to protect beneficial uses of water (optimum flow and quality) when managing their flood plains.

5.2 Collaboration

Melbourne Water actively engaged with other agencies and local governments, including Mornington Peninsula Shire in the development of the Flood Management Strategy Port Phillip and Westernport 2021- 2031 and Action Plan 2021-2026. The Strategy provides the direction towards flood management by clearly indicating key actions as well as roles and responsibilities for different stakeholders.

The Strategy provides three objectives to be achieved, in summary they are:

1. The right information is available at the right time to people who need it

2. Flood risks and opportunities are managed to reduce impacts and get the best social, economic and environmental outcomes

3. Land, water and emergency planning agencies work together to manage flooding effectively

The partnership between Melbourne Water and Local Government has been improved by:

a) Ongoing development of Shire Flood Management Plans
b) Engagement of Shire staff in the development of
    a. Flood Management Strategy Port Phillip and Westernport
    b. Healthy Waterways Strategy
c) Capacity building through training programs through Clearwater
d) Supporting funding of infrastructure projects under the Liveable Community Liveable Waterways incentive programs.

The Mornington Peninsula Shire Flood Management Plan was developed in 2017 with the intent to deliver the objectives identified in the regional Flood Management Strategy released in 2015. The plan breaks down the roles and responsibilities of Councils, Melbourne Water and SES Victoria to deliver local priorities and agreed flood management solutions. The current draft Strategy to be delivered in 2021 will guide ongoing flood management actions by relevant agencies.

5.3 Funding

Based on the cost estimates of some integrated projects, an annual budget commitment of $3 million is recommended over the next 8 years for the delivery of integrated projects that will minimise flood impacts and also improve flood resilience to the adverse climate conditions of the future.

Melbourne Water can seek property owner finance within its water management district under Section 196 of the Water Act. Under this section Melbourne Water may require owners to contribute to works carried out as part of its function. Flood mitigation works required under a Flood Management Plan would fall under Melbourne Water's functions as a Regional Authority.

Melbourne Water has an annual Waterways and Drainage Charge which is levied on all rateable properties on the Peninsula. Melbourne Water also collects developer charges to meet the cost of new regional drainage infrastructure required for areas where they have a defined drainage scheme.

The Shire has no power to obtain funding under the Water Act as it is not a Designated Authority. However, if a Water Management Scheme is prepared under Division 5 of the Water Act, Council may be nominated to construct, operate, control and manage the scheme.

Under the Local Government Act 1989 the Shire has the management and control of public drains within the Municipal district except for drains vested in other Authorities.

The Shire can prepare a special rate or charge scheme to recover expense for drainage works under section 163 of the Local Government Act. These provisions have generally been used to fund new infrastructure rather than upgrading or augmentation of existing infrastructure. The process is subject to appeal to the Victorian Civil and Administrative Tribunal (VCAT) and requires the comprehensive assessment and justification of 'Special Benefit' for property owners charged into the scheme as well as a broader assessment of community benefit. The process is extremely resource consuming, lengthy and subject to the uncertainties of decisions from VCAT. Drainage schemes are also particularly difficult for the community to associate the "Special Benefit" of the works being undertaken to their property when the works are likely to be remote from their property.

Under Section 162 of the Local Government Act the Council has the power to declare a service rate or annual service fee for any prescribed service.

Under the Planning and Environment Act a development contribution plan can be developed however this type of contribution levy is only applicable for new developments and is used where no or little existing development or drainage infrastructure is available. This contribution levy has been proven to be extremely complex and difficult to implement for drainage works especially in established or semi established areas as new growth is unpredictable in terms of timing and location. It also requires considerably more resources to implement and administer compared to a special charge/rate scheme.

The adoption of this Strategy will provide the framework for the Shire to seek grants from the Federal Government and State Government agencies both for catchment investigation and flood mapping as well as drainage upgrade and flood mitigation infrastructure.

The Housing Affordability Fund, Port Phillip Bay Fund, Living Heritage, Growing Suburbs are some of the grant's programs that might be available to Local Government infrastructure projects.

The Liveable Communities, Liveable Waterways Program which is now part of the new incentives program offered by Melbourne Water is another dependable stream applicable for works that address stormwater management and environment protection works.

6 Stormwater Drainage Network

The drainage network in the Shire includes a range of assets. These assets need to be upgraded, maintained and replaced, as required, to ensure continued drainage efficiency. The following provides a brief description of the different types of assets and the current pressures on capacity of the network.

6.1 Types of Assets

6.1.1 Conventional pits and pipes

A significant proportion of the managed drainage network is conventional pits and pipes. This is the drainage network that drains stormwater trough underground pipes and discharges to appropriate outfall locations, generally into bays or watercourses.

Due to the large network the Shire is undertaking desk top audits of drainage plans and the pipe network to understand the current state of our pipe network. Further survey work is required to confirm the drainage network and ensure we have sufficient understanding our assets. Without this investigation we may be making unreasonable assumptions in our models and therefore failing to appreciate the true flood risk.

The pipe network is dependent on regular maintenance as it can only function to its design capacity if it is free of blockages and the integrity of the pipe is preserved. The consequences of not maintaining the pipe network may lead to unpredictable flooding of properties and damage to infrastructure. Therefore, a comprehensive maintenance program is a key part of minimising flood risk.

6.1.2 Soak pits

The area between Rosebud and Point Nepean relies on soak pits for stormwater drainage. This is due to the undulating terrain which does not allow for overland drainage and would require an excessively deep pipe network. These areas do have high soil permeability which allows stormwater to be infiltrated into the soil and ultimately into the groundwater. Within these areas of the Peninsula there are approximately of 1200 soak pits and 160 Drainage Reserves, as well as several lagoons that receive stormwater.

The soak pit design continues to be improved and has had various iterations over the years. There is a current upgrade program which aims to replace the old soak pits, those with regular reports of failure, or limited capacity with newly designed efficient soak pits. Replacing obsolete assets is an important part of minimising flood risk.

6.1.3 Road infrastructure

Roads can transfer overland flows into street drains. During extreme rain events they can also function as a floodway, draining the excess flows to the nearby waterways, and can retain pit surcharges acting as a stormwater storage. Roads are, therefore, part of the drainage network.

The most common urban road design within the Mornington Peninsula is a sealed asphalt pavement. The road is sloped laterally to covey runoff to the kerbs, which are drained into pits and into the piped drainage network. Runoff generated from asphalt roads may contain water pollutants such as sediment, hydrocarbons and heavy metals, which may damage ecosystems if unmanaged.

There are also other road designs on the Peninsula which may pose a greater risk to water quality. Unsealed roads do not have an asphalt layer and are, therefore, liable to produce a significant quantity of sediment. A strategic action is required to provide serviceable roads which minimise these pollutants generated from unsealed roads.

6.1.4Water Sensitive Urban Design

Stormwater is potentially contaminated with various pollutants. When stormwater run-off is generated from surfaces, for example roads or roofs, it is likely to convey the contaminants such as litter, oil, nutrients and heavy metals which can all flow into the bays and natural waterways.

Water Sensitive Urban Design (WSUD) is an integrated approach to address the pollutants found in stormwater in an environmentally and economically sustainable manner. In new developments the approach begins at the planning stage to accommodate stormwater infiltration, biofiltration, onsite detention and retention, stormwater harvesting and flood flow. Additionally, retro fitting WSUD can also provide substantial benefits.

WSUD is currently being implemented through the planning requirements of the Planning Scheme and the Shire for new developments as well as being integrated into new projects as part of the Shire's Capital Works Program. WSUD is also a key activity as part of the Integrated Water Management Plan - Our Water Future.

6.1.5Drainage Easements and Reserves

Drainage Easements[6] is a defined area of land that gives the Council the legal right to use someone else's land for a specific purpose. They are needed because it allows the Council to access existing assets for inspection, maintenance, repair or replacement.

Drainage Reserves differ from easements as they are owned by Council. The Council owns approximately 450 Drainage Reserves. These are managed as part of the Strategic Land Program.

6.1.6Natural assets (Waterways and creeks)

The waterways and creeks form most of the floodway routes across the Peninsula and their environmental and hydraulic condition is an important aspect of the drainage system. Most waterways and creeks on the Peninsula are part of the Regional Drainage network under the control of Melbourne Water. We can help protect these natural assets by retaining pollutants in WSUD, and by retaining stormwater through storage or by reducing runoff volumes.

6.1.7Outfalls

Outfalls are the final component of a drainage network where the runoff is discharged into the receiving waters. Many of these outfalls discharge into the Port Phillip Bay and Westernport there are also a significant number which drain to other water bodies such as waterways and estuaries.

There have been two recent assessments of outfall quality, Melbourne Water completed an assessment in 2011 and the Shire completed an assessment in 2016. These studies presented assessment criteria to identify outfalls that requires improvements to improve their structural integrity, functionality, aesthetics, beach amenity, environmental protection and

[6] Drainage Easements - Rights and Responsibilities - Mornington Peninsula Shire (mornpen.vic.gov.au)

general health and safety. The outcome of the two investigation reports have provided lists of critical assets and appropriate measures to address them.

The outfalls are also affected by sea level rise and an increase in the intensity of storm surges caused by climate change. Sea level rise may submerge outfalls, so they are no longer operating to their optimal efficiency, potentially increasing flood risk in other parts of the catchment. Changes to the intensity of storms and the size of waves may also increase the rate of deterioration of outfalls. These factors may affect how outfalls will be designed and maintenance requirements and the rate of replacement these assets.

It is the recommendation of this Strategy to draft an outfall improvement program developed using the knowledge gathered in the reports, current status of the assets through site inspections, and feedback from Coastal Management and Infrastructure services teams. It is understood that several outfall improvement works will contribute towards flood mitigation in the local area.

6.2Design and Capacity

As communities have grown in Mornington Peninsula, so too has the drainage infrastructure which serves those communities. Although Mornington Peninsula Shire Council continues to improve the network some of these assets are over thirty years old.

Over time various factors effecting designs have changed. Historically some drains were designed to have a capacity for a 50%AEP (i.e., capacity would be exceeded approximately once in 2 years). Since then, runoff has increased due to a climate change and a higher proportion of impermeable surfaces, is putting pressure on the drainage networks. This means that the design capacity is reached more often today than when the asset was constructed. There are also potentially changing community expectations with regards to flooding and the expectation that flooding should be decreasing not increasing.

Another consequence of the age of assets is deterioration. Deterioration can significantly impact the efficiency of the asset. It can lead to cracks, which can increase roughness reducing velocities, and seeping low quality water into the environment. It can also result in catastrophic failure, such as the collapse of a pipes.

These factors mean there is a need to replace old and deteriorating infrastructure. This may have two approaches; an audit will identify old assets which can be systematically replaced; or this can be considered in the project prioritisation by assessing the age of the infrastructure.

7 Integrated Local Flooding Management and Drainage Strategy (LIDS) - Review

The Integrated Local Flooding Management and Drainage Strategy (LIDS) produced in 2009 and the subsequent Flood Management Plans produced in 2012 and 2017,were developed to enhance knowledge about the performance of the Peninsula's drainage infrastructure network and flood vulnerable areas. The knowledge gained from this Strategy has been fundamental in understanding the extent of flood impacts across the Shire and areas that require strategic mitigation.

7.1 Outcomes Achieved

7.1.1 Flood Modelling and Mapping

The detailed flood modelling provided the flood extents for all catchments during various event scenarios. Figure 2 presents the catchments used to build the various flood models. The flood maps assist in the identification of flood mitigation opportunities. The flood mapping has also supported the development of the Land Subject to Inundation Overlay as the Planning Scheme amendment throughout the Shire. This has been a significant achievement of previous strategies.

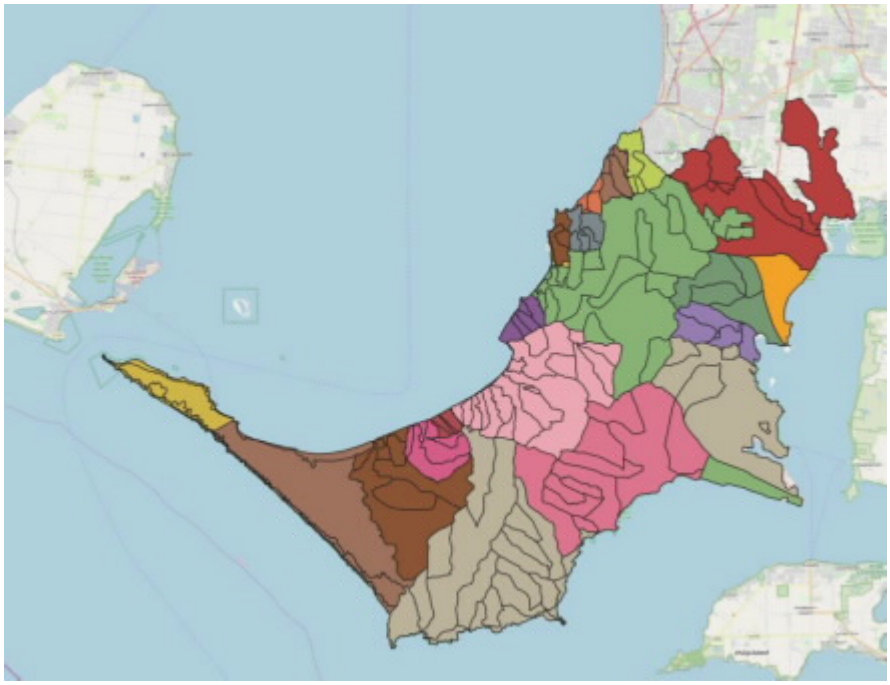

Figure 2: Flood model catchments

The catchment characteristics and flood model extents change in response to the understanding of flood mechanisms, as well as environmental and social changes. Additionally, the Australian Rainfall and Runoff was updated in 2019. This led to inconsistencies between models dependent on when they were created. While operation level information is expected to be less varied, the inconsistencies could cause potential differences in the size of flood extents between different catchments based on the year of modelling. Therefore, we will continue to work with Melbourne Water to maintain these models to ensure we base our decisions on the best available information.

7.1.2Floor Level Surveys

The floor level surveys were not part of the original Strategy, but they are critical in determining a properties flood risk. The goal was to survey the floor level of all the properties within the 1%AEP flood extent. While most catchments have been surveyed in the last 10 years, extensive redevelopments or changes in the predicted flood extent may mean that further floor level surveys are required to keep the dataset up to date.

Therefore, updating of floor levels of all properties subject to 1%AEP flooding continues to be a key action in this Strategy to enable understanding of the current catchment impact at different flood scenarios.

7.1.3Flood Risk Areas and Mitigation Options

The previous Strategy used assessment tools to identify potential flood mitigation projects. Some of these projects have been implemented. Other priority projects will be considered as part of this Strategy.

The prioritisation has not been consistent and as such doesn't allow for a fair comparison. This Strategy will begin a process of developing a useful and consistent method for assessing flood risk to identify priority projects.

7.1.4Planning Controls[7]

The Shire's flooding and inundation risk is mapped by the Floodway Overlay (FO) and Land Subject to Inundation Overlay (LSIO). The FO applies to land that's identified as carrying active flood flows associated with waterways and open drainage systems, whilst the LSIO applies to land affected by flooding associated with waterways and open drainage systems (otherwise known as floodplains).

Both overlays seek to ensure development maintains the free passage and temporary storage of floodwater, minimises flood damage and is compatible with flood hazard, local drainage conditions. The FO also aims to minimise soil erosion, sedimentation and silting, whilst the LSIO seeks to ensure inundation does not cause any significant rise in flood level or flow velocity. Only the LSIO contains a locally specific schedule, with permit exemptions for certain buildings and works.

Amendments to the Shire's flooding and inundation overlays is being progressively introduced, generally in accordance with the implementation of the Mornington Peninsula Shire Integrated Local Flood Management and Drainage Strategy (2009) and further relevant drainage modelling by Melbourne Water.

Amendment C216 enabled application of the LSIO to land identified by Melbourne Water as vulnerable due to hazards associated with coastal erosion, flooding, sea level rise and storm surge around Westernport. Further modelling for the balance of the Shire (i.e., Port Phillip side) has been undertaken as part of the Third Phase Coastal Hazard Assessment for Sea Level Rise and Inundation by DELWP and Melbourne Water.

It is noted that the planning scheme does not presently comprise the Special Building Overlay (SBO). The SBO is commonly used by municipalities to identify areas prone to overland flooding and set appropriate conditions and floor levels to address any flood risk to developments.

[7] Mornington Peninsula Planning Scheme Review No. 4 (19 November 2018)

In the absence of this overlay in the Mornington Peninsula Planning Scheme, permit applicants presently must apply (and pay an associated fee) for Council to confirm flood levels for individual sites via the Report and Consent mechanism under the Building Act 1993. That is, overland flooding risk is not being addressed at the planning stage, but rather the building permit stage. This can create issues for applicants who may have to amend development proposals if they did not seek a flooding report and consent before finalising development plans.

The Shire has recently completed mapping for overland flooding and temporary storage and is presently updating report and consent mapping. For clarity and transparency of flooding regulation, this data and associated requirements ought to be translated into SBO mapping. This will ensure overland flooding risks are captured in the scheme and appropriately managed at the planning stage.

7.2 Outstanding Actions

The following actions have not been achieved and should be considered as part of this Strategy.

7.2.1 Asset Responsibility Verification

Confirmation of asset ownership and maintenance responsibility has been a challenge in the last decade. DELWP has been leading a review of stakeholders' responsibility with regards to drainage. We will continue to collaborate with this review to seek clarification which will lead to clear understanding of ours, and our stakeholders' responsibilities.

7.2.2 Asset Condition Review

Over half of the Shire's drains are at least 30 years old. This means there is significant probability that there are drains which have been distressed and are no longer operating close to the optimum efficiency.

Current condition assessment and repair is driven by flooding complaints and blockage identification. A strategic stormwater drainage condition assessment is required and will be supported by this Strategy and assist in the delivery of the drainage capital works program to extend the life our existing drainage assets.

7.2.3 Flood Emergency Response Plans

The current Mornington Peninsula Shire Council Flood Emergency Plan was issued in 2013 and endorsed by the Mornington Peninsula Shire Council- Municipal Emergency Management Plan, last revised in May 2018.

Under Section 1.5, Responsibility for Planning, Review & Maintenance of this Plan, it is stated that the Municipal Flood Emergency Plan must be maintained in order to remain effective, the planning committee will meet at least once per year and that the plans should be reviewed:

- Following any new flood study

- Change in non-structural and/or structural flood mitigation measures

- After the occurrence of a significant flood event within the Municipality to review and where necessary amend arrangements and information contained in this Plan.

Though the review of this document hasn't occurred since 2013, the VICSES have been active in engaging the community with articles and flood awareness and preparedness materials.

VICSES's contribution at times of fire and flood emergencies are highly appreciated.

Flood warning systems have been discussed in the Mornington Peninsula Shire Integrated Local Flood Management and Drainage Strategy (2009) and in the Flood Emergency Plan. Though there are no systems currently available to the community to provide warning of an imminent flooding event, weather forecast in recent years has bridged the gap.

However, a forecast and flood modelling based automated system could offer highly precise warning to properties predicted to flood in various catchments. Further investigations will be undertaken supported by this Strategy to make this a reality.

8 Flood Mapping

Significant work has already been completed with regards to flood mapping. As technology and guidance changes, we need to ensure our flood models and maps are kept up to date to provide confidence to decision makers.

There are 70 Shire drainage catchments, each containing several sub catchments defined by key waterways, drains, reserves or localities. Flood modelling of these catchments started in 2008 with pilot studies at Rosebud and Dromana. Since then, all Shire catchments, as of 2021, have been modelled at least once.

The recent, post-2019, models comply with the current best practise framework and specification. Models built before 2019 are not as consistent as modelling requirements have varied over the years and therefore the flood extent and level cannot be confidently appreciated. The Shire is working with Melbourne Water to ensure that flood modelling and flood extents are up to date and provide high confidence to aid in flood mitigation identification and design. Another reason to ensure that all models are built to the same standard is to facilitate comparison between projects. Different methodologies may imply the need is greater in one area than in another when in practice that may not be the case.

The continued development and maintenance of the models is a key objective of this Strategy. The models are used by other stakeholders to make decisions relating to flooding. It also forms the foundation for project prioritisation as it can be used in assessing average annual damage and flooding hotpots.

9 Impact Assessment and Mitigation Themes

A key objective of this Strategy is to identify flood mitigation projects which provide value for money for our communities. This means taking a considered approach to assess projects and maximise benefits. The following describes the criteria which may be considered as part of that assessment.

9.1 Annual Average Damage (AAD)

Depending on its size (or severity), each flood will cause a different amount of damage to a flood prone area. The average annual damage is the average damage per year that would occur in a particular area from flooding over a very long period. In many years there may be no damage, in some years there will be minor damage (caused by small, relatively frequent flood events) and in some years there will be major damage (caused by large, rare flood events). Average annual damage provides the basis for comparing the economic effectiveness of different management measures against floods of all sizes, i.e., their ability to reduce the AAD. [8] Melbourne Water is now considering inclusion of tangible and intangible impacts (indirect, social impact, etc) in the calculation of the catchment AAD which is expected to have a variation with the current estimated AAD.

AAD is intended to be used as an indictive metric for the Shire's flood impact characteristics and it is also a critical Sub-Target under the Resilient and Adaptive Community summit of Shire's Climate Emergency Action Plan. As such, a key action of this Strategy is development of a dynamic spreadsheet program to estimate the AAD of each sub-catchments of the Shire, prioritise critical areas and evaluate efficiency of mitigation measures – assisting in development of project plans and business cases.

The annual average damage within Fisherman's Creek catchment has been undertaken as pilot project in 2020. The outcome of this project will inform the best practise model for estimation of AAD in other catchments which will help estimate the Shire wide AAD at an affordable cost.

9.2 Flood Hotspots

A flooding hotspot is a known flood problem area which has a history of repeat flooding of dwellings, properties, roads or crossings. These hotspots are identified through flooding reporting systems or through anecdotal evidence such as through Council maintenance teams. Ideally flood hotspots are caused by one mechanism, and although proximity of flooding locations may assist in identifying hotspots proximity does not necessarily imply that the cause is the same. For example, two neighbouring properties may flood, the mechanism of one may be fluvial flooding from a creek, and its neighbour may be due to overland flooding and ponding, mitigation would therefore require two separate projects, so the two flooding events should not be combined into one hotspot.

Melbourne Water is currently working with Councils to formalise the flooding hotspot identification methodology. We will use the agreed methodology to identify flood hotspots.

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[8] https://www.floodvictoria.vic.gov.au/learn-about-flooding/glossary-and-abbreviations/glossary-of-terms

9.3 Social Consequences

Flooding effects people and can have catastrophic impacts on the health and well-being of individuals, families, and communities. The social consequences may include public health issues due to exposure of individuals of contaminated flood waters. There are also risks to businesses, as access may be impeded for employees and trade, which leads to reduced economic output and loss of livelihoods. Regular floods may affect insurance premiums making flourishing communities unsustainable due to the economic burden of flooding. It also has emotional consequences as the stress of living with flooding can cause emotional damage, and flooding can destroy personal effects and keepsakes.

These are real and significant consequences of flooding. A challenge will be to appropriately account for this damage in any proposed flood mitigation prioritisation. Although there has been industry discussion regarding social consequences more work is required to have confidence that these consequences are properly accounted for. An objective of this Strategy will be to consider these damages and to include them in project prioritisation.

9.4 Environmental Consequences

In addition to property and social consequences posed by flood risk there are also environmental consequences which can influence the prioritisation of a project. Environmental risks include waterway pollution, siltation of riverbeds, coastal and riverine erosion, loss of aquatic habitat through riverbed siltation, prolonged stagnation of water leading to breeding of mosquitoes and bad odour.

The Strategy will aim to ensure that the beneficial flows in our waterways are protected when flood mitigation projects are evaluated and delivered. Previous Strategies have ben guided by the clauses in the State and Environment Protection Policy (SEPP) Waters, by as of July 2021 they have been mostly replaced by the Environment Protection Framework as part of the Environment Protection Regulations (2021).

9.5 Asset Condition

The condition of stormwater assets deteriorate over time. Although the priority for existing infrastructure is for it to be maintained, many of the structures are several decades old. Assets that are exposed extreme runoff, external influences road traffic, root intrusions, and sediment transport are expected to be renewed and upgraded at appropriate intervals. This Strategy acknowledges improvements in assets considering the future. As such, appropriate weightage will be applied in prioritising projects expected to involve upgrade of any critical assets as well as those that alleviate the stress on any critical assets.

9.6 Development Demand

Current Shire stormwater assets are either inherited from pre amalgamation or from new developments. As such, there are severe inconsistencies in the coverage of drainage assets. Though Shire's responsibility is limited to maintenance of existing infrastructure, it is understood that several isolated areas are heavily affected by lack of basic drainage infrastructure. In some instances, existing infrastructures are not fit for purpose to the current extent of developments and the predicted more intense rainfalls of the future. It is understood that an ongoing program is required to identify areas of insufficient and non-functional essential drainage infrastructure to support the growing community and changing climate.

9.7 Level of Service

The level of service for an asset provides a defined set of criteria for which the asset is required to achieve. The level of service drivers for Shire assets are generated by Community Needs and Expectations, legislative requirements, and future demand. For stormwater assets a critical level of service design criteria includes the probability of flooding, the design flows, and the vulnerability of the beneficiaries.

The required level of service may be different depending on the user, for example a carpark, a major road, or a residential home may all have different levels of service required to reduce their respective flood risk, as they have vastly different vulnerabilities. When proposing or designing a flood mitigation project a clearly stated level of service will ensure that protection is provided to an acceptable level and will mean there is consistency between projects.

As previously discussed, urbanisation and climate change are significantly increasing the likelihood and severity of events. This means that a level of service used to design today will not provide the same protection in the future, and the probability of flooding will increase. Therefore, flooding mitigation projects may quickly become obsolete unless the level of service is sufficient to provide continuing flood protection.

The current level of service will be reviewed to confirm whether the current practice is sufficient to provide continuing protection. Level of service guidance will provide specific requirements for various land users.

9.8 Mitigation Themes

The themes of resolving flooding problems, presented in Figure 3, are developed based on Shire's current operational practices and process identified in adaptation pathways [9]report developed in 2012. Ideally, these themes are considered in this order to determine the appropriate mitigation option.

Figure 3: Mitigation themes

9.8.1 React / Resolve

Basic maintenance and operation: A business as usual approach where areas that are affected by flooding will be investigated and underground drainage infrastructures, inlets and outlets checked for blockages and cleared to reinstate design flow. *E.g., street sweeping, jet cleaning of pipes, root cutting and pit cleaning.*

Upon condition assessment and analysis of trends in flood related enquiries such as repeated pit blockages, root intrusions, sand intrusions, proactive maintenance should be implemented to protect the community before the occurrence of floods. Ideally, areas with such repeated concerns should be investigated and resolved using a revised drainage design eliminating the causative factor. *E.g., Tree removal from an easement with drainage assets, sediment traps enforced at development areas, pit modification to prevent blockages.*

9.8.2 Reduce / Retain / Retrofit

Moderate Protection Pathway - resolving the impact of current flooding by reducing its localised extent via modest or small-scale engineering solutions. This pathway also includes behavioural and policy interventions to help reduce peak flows and avoid risks. *E.g., raingardens, smart tanks, underground retention storage, mounds and swales.*

9.8.3 Redesign / Retard

Major Protection Pathway – significantly reduces the risk of future flooding through large scale engineering solutions to allow continued use or development of the hazard zone over the longer term. *E.g., property floor raising, retarding basin, new pipe installation and pipe upgrades.*

It should be noted that retarding basins and large-scale stormwater retention/harvesting systems offers reduction in the flows but are expensive and require large amounts of space. The pits and pipe upgrades only divert the heavy flows through the immediate downstream

[9] Adapting to inundation in urbanised areas: supporting decision makers in a changing climate- AECOM (2012)

community, creating more discharge at the receiving waterways affecting the abutting properties and environment.

As such, in addition to the adaptation of the vulnerable downstream properties to the heavy flows from the catchment and the protection of the properties in the flood way, the least affected upper catchment must also include solutions to reduce the runoff volume and its discharge. This can be achieved by retrofitting the nature strip, carparks, kerbs and other urban elements into WSUDs in regions upstream of flood impacted areas. This also benefits the upstream catchment in water demand management, urban greening, reduction in heat as well as improved biodiversity and quality of discharge.

9.8.4Recover

Applies to areas where flooding cannot be prevented, so efforts are focussed on minimising impacts when it does occur. Adaptation options are focussed on those which can help communities and individuals prepare for, and recover from, flood events, including behavioural and policy interventions. *E.g., sand bagging, property reinstatement, emergency evacuation, etc.* Additionally, it is important to consider the clean-up from the event. Sewage can be a major public health issue during and after flood events, and decontamination may be required. Additionally, waste created during the flood and by the response such as sandbags will need to be recycled and reused if possible.

9.8.5Retreat

This adaptation pathway constitutes making informed decisions to retreat from flooding hazards. Where there is no effective solution to the problem and the impacts are too high to accept the risks, e*.g., carparks in the coastal inundation areas or flood pathways etc,* it may be appropriate to transition the land use into options with a lower flood hazard or acquire as a drainage reserve. It is considered a last resort, and where possible other options will be considered to maintain existing land-uses and protect existing assets.

10 Mitigation Prioritisation

The Annual Average Damage caused by flooding in the Mornington Peninsula catchments is estimated to be $26.75 million. Climate Change is expected to significantly increase the average annual damage. Overall, the aim of this Strategy is to reduce Annual Average Damage and reduce the economic burden on communities.

Various analysis methods are available to evaluate suitability and preferences of solutions, programs, policies, operations etc. Cost Benefit Analysis (CBA) is a useful tool to evaluate different options to assist government decision-making to achieve best value for money. Other tools such as Multi-Criteria Analysis (MCA) and Triple Bottom Line (TBL) assessments consider benefits and impacts to the environment and the society in addition to the economy. In the triple bottom line analysis, the criteria are fixed to the three factors whereas the Multi Criteria Analysis approach provides the opportunity to involve multi-disciplinary stakeholders and considers other significant factors such as public safety, governance, culture etc.

It is recommended to use MCA as a tool to assess different mitigation themes and individual projects. MCA can assess the criteria discussed in the Impact Assessment and Mitigation Themes. The weightings of the criteria can reflect best practice, as well as the expectations of the Shire, and the community of theses hazards and benefits. Projects can then be prioritised based on the ranking of the multicriteria analysis.

11 Conclusion

Flood risk has been shown to be a significant and increasing risk in the Shire. Aging infrastructure, and obsolete design standards mean that our assets are struggling to provide sufficient flood mitigation to meet the expectations of our residents. Future pressures such as urbanisation and climate change mean that the situation is likely to deteriorate.

The Council and Wellbeing Plan 2021-2025 sets out two strategic objectives which benefit from effective stormwater management.

This Strategy aims to support these strategic objectives. It has presented the need for consistent and detailed investigation to understand and appreciate the flood risk within our communities. A list of impact and mitigation themes have been identified which will ensure that the flood Strategy will satisfy the expectations of the community and reduce the flood risk across the Mornington Peninsula.